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Agricultural Development through Evidence:

Lessons from a Decade of IDB Impact Evaluations in Latin America and the Caribbean (2014–2025)

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Abstract:

This study reviews a decade of rigorously evaluated IDB-supported agricultural interventions in Latin America and the Caribbean. The evidence base encompasses five major intervention categories: input and technology transfers, rural infrastructure, land regularization and administration, extension services and capacity-building, and animal and plant health. Five key findings emerge. First, productivity impacts are inherently dynamic and often require medium- and long-term data to fully capture the transformation of productive systems. Second, agricultural programs can generate substantial welfare gains, including improvements in food security, resilience, and inclusion, even in the absence of immediate increases in productivity or income. Third, heterogeneous impacts across gender and other population groups are highly relevant but remain insufficiently explored. Fourth, the measurement of spillover effects provides valuable insights into the broader development effectiveness of agricultural interventions beyond direct beneficiaries. Finally, combining survey data with remote sensing offers a powerful complementary approach that expands the scope of impact measurement and helps overcome many of the limitations of traditional field-based data collection. The study concludes with practical recommendations to strengthen the design, implementation, and evaluation of future agricultural development programs.

JEL Codes: O13, Q16, Q18, C93 O22

Keywords: Agricultural Policies, Impact Evaluation, Agricultural Productivity, Rural Development, Latin America and the Caribbean

1. Introduction

Over the last 15 years, the Inter-American Development Bank (IDB) has significantly expanded its portfolio of impact evaluations to assess and improve the development effectiveness of its interventions. This commitment has produced a robust body of evidence across multiple sectors, with the agricultural sector experiencing a particularly significant increase in empirical analyses. This study synthesizes the knowledge generated between 2014 and 2025, offering an overview of the main findings from this recent evidence. The goal is to provide policymakers with actionable insights for designing interventions that boost agricultural productivity and income while simultaneously strengthening food security, rural welfare, and climate resilience.

To promote evidence-based interventions, the IDB complements its operational portfolio with robust knowledge generation efforts. These efforts have evolved over time, particularly following the introduction of an updated institutional framework for development effectiveness in the late 2000s, which strengthened the systematic use of rigorous empirical evidence throughout the project cycle.

This study presents a narrative review of quantitative evaluations of IDB agricultural projects. Several of the evaluations reviewed have been published as IDB knowledge products and were therefore subject to the Bank's rigorous internal peer review process, which often begins at the program design stage. Others have been published in peer-reviewed academic journals and therefore, reviewed through external scholarly processes.

Given the heterogeneity of the evidence base and the narrative nature of this review, this study does not intend to draw universal conclusions regarding the absolute effectiveness of specific intervention types. Rather, it identifies cross-cutting themes within the IDB's agricultural portfolio, highlighting systemic lessons from the application of evidence-based policy. The focus remains on understanding how evaluation insights can inform context-specific program design across the sector.

The analysis draws on 25 impact evaluations of IDB-supported agricultural projects implemented between 2010 and 2024. These evaluations rely on counterfactual methods—experimental or quasi-experimental—to compare treatment and control groups and identify the causal impacts of agricultural interventions. Although the evaluated projects do not constitute a statistically representative sample of the Bank's agricultural portfolio, they encompass the principal intervention areas in which the IDB invests, including sustainable agricultural development, technology adoption, agricultural health and food safety, infrastructure, research and innovation, irrigation, agribusiness, and land administration. These investment areas also constitute the core of the Bank's current agricultural portfolio, which comprises approximately US$1.81 billion in active lending. Moreover, because the evaluations cover agricultural operations implemented between 2010 and 2024 across the Bank's principal lines of intervention, the evidence synthesized in this review provides a robust and policy-relevant basis for informing the design, implementation, and evaluation of ongoing and future agricultural operations.

In sum, several key lessons emerge from the evidence of these 25 impact evaluations:

1. **Productivity impacts are dynamic**, and effects may emerge over different time horizons; consequently, medium- and long-term evaluations are critical for accurate measurement.
2. **Welfare impacts can be achieved** through agricultural programs even in the absence of immediate or expected changes in productivity or income.
3. **Impact heterogeneity by gender can result from strategic program design**, though evidence remains scarce despite clear links to household food security.
4. **Accounting for spillover effects** in program and evaluation design provides critical insights into the broader reach of development effectiveness.
5. **Integrating remote sensing with survey data** offers a powerful complementary strategy for overcoming the traditional challenges and costs of field data collection.

The remainder of this study is structured as follows. Section 2 summarizes the analytical framework, including an overview of the IDB's role in implementing and evaluating agricultural interventions. Section 3 presents a literature review describing key characteristics of each of the 25 studies considered in this study. Section 4 highlights and describes the lessons learned from ten years of IDB impact evaluations. Finally, Section 5 summarizes actionable guidance for policymakers and development practitioners seeking to advance food security and sustainable growth in the region.

This study aims to create a bridge between operational experience and academic evidence by reviewing a decade of rigorously evaluated IDB-supported agricultural interventions.

2. Analytical Framework

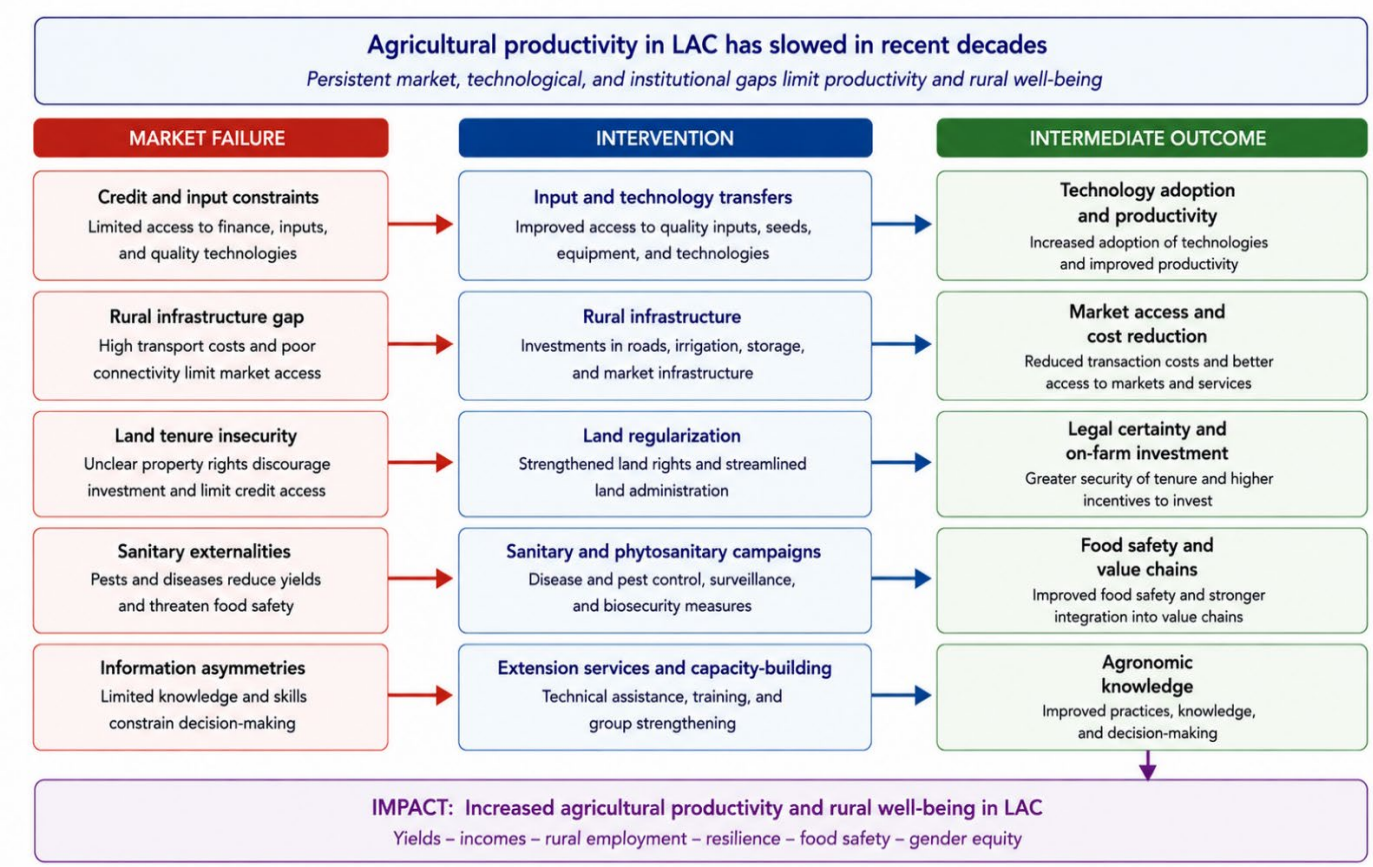
The IDB has been a key partner to Latin American and the Caribbean (LAC) in the design and implementation of agricultural interventions that aim to improve farmers' productivity, output, and incomes. Between 2010 and 2025, the IDB financed 105 agricultural and rural development projects, representing a total investment of US$7,203 million. In parallel, between 2014 and 2025, the IDB published 25 analytical papers evaluating IDB-financed agricultural operations that address a broad spectrum of challenges and opportunities across the region.

To facilitate a systemic review, this analysis groups the interventions identified in these 25 publications into the following five categories:

1. **Input and technology transfers:** Interventions that provide producers with inputs or technologies, typically accompanied by technical assistance. Transfers may occur either through (i) the direct distribution of inputs; (ii) vouchers that can be used to purchase inputs from pre-approved vendors; or (iii) credit/loans that can be used to make input purchases or capital investments.
2. **Rural infrastructure:** Interventions that construct, rehabilitate, improve, or expand rural infrastructure (i.e., irrigation, roads, electrification).
3. **Land regularization and administration:** Interventions that aim to increase access to land titling, characterize agricultural land use, redistribute land assets, or otherwise strengthen land administration systems.
4. **Animal and plant health:** Interventions that strengthen the provision of sanitary and phytosanitary services across agricultural value chain actors (i.e., pest eradication programs, animal vaccination campaigns, etc.).
5. **Extension services and capacity-building:** Interventions that aim to overcome information and capacity barriers through knowledge dissemination regarding the technical or business aspects of agricultural production.

As shown in Figure 1, these five categories are grounded in a cohesive Theory of Change (ToC) framework designed to address systemic market failures that hamper agricultural growth in LAC. Input and technology transfers alleviate credit constraints and risk aversion among smallholders, while extension services tackle information asymmetries regarding modern farming practices or technologies. Investments in rural infrastructure and land regularization provide the public goods and secure property rights required for long-term private investment. Animal and plant health interventions, in turn, aim to prevent and mitigate the negative effects of disease outbreaks that can destabilize entire value chains. Together, these create a synergistic effect: improved access to resources and reduced risk environments translate into higher productivity, which in turn fosters increased household income, enhanced food security, gender equity and climate resilience across the region.

Figure 1: Theory of Change framework



Source: Authors' own elaboration.

This study summarizes the IDB's experience by identifying patterns across categories based on rigorous counterfactual methodologies. The selection of these 25 papers ensures that the lessons derived are rooted in causal evidence. Furthermore, the framework accounts for the geographical diversity of LAC landscape, drawing lessons on various contexts, ranging from the large agricultural sectors from the Southern Cone to the specific of Small Island Developing States (SIDS) in the Caribbean.

Beyond these primary categories, the analysis also assesses the integration of cross-cutting themes across impact evaluations, including gender, food security, and climate resilience, and examines methodological synergies between traditional survey data and remote sensing. Reviewing this evidence base is essential for ensuring accountability, identifying sub-regional disparities, and informing future strategic investments in the agricultural sector across the region.

While this review provides a comprehensive synthesis of evidence generated through IDB supported impact evaluations, its scope is defined by certain methodological considerations. Unlike formal meta-analyses, this approach emphasizes qualitative synthesis rather than the statistical aggregation of impact estimates and, therefore, does not provide a single weighted estimate of impact estimates for each intervention category. Furthermore, the findings are highly context-specific. While patterns emerge across the portfolio, the diversity of institutional and agro-ecological conditions across LAC means that results from one country or sub-region may not be directly transferable to another. Finally, the analysis is limited to the 25 impact evaluations included in the IDB's published evidence base. While these evaluations cover a broad range of interventions and contexts, they represent only a subset of the Bank's broader agricultural portfolio and, therefore, may not capture the full spectrum of operational experiences and outcomes across the region.

3. Review of IDB impact evaluations (2014–2025)

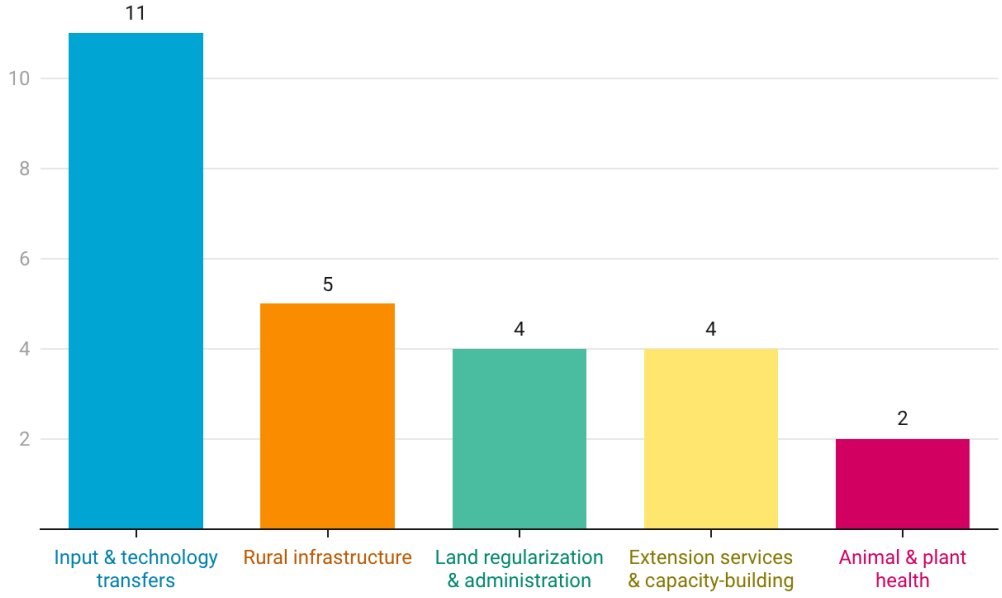
This section provides a narrative literature review of the 25 impact evaluations of IDB interventions implemented between 2014 and 2025. The available studies and key findings are described for each intervention category. Table 2 and Figure 2 provide an overview of the number of relevant studies by category, as well as the countries in which the evaluations were developed. A detailed table outlining each study's intervention category, methodology, and key findings is included in **Appendix 1**.

TABLE 1: SUMMARY OF INTERVENTION CATEGORIES AND COUNTRIES STUDIED

Intervention category	Number of studies[1]	Countries studied
Input and technology transfers	11	Argentina (3), Bolivia (2), Dominican Republic (2), Guatemala (1), Haiti (1), Nicaragua (2)
Rural infrastructure	5	Argentina (2), Bolivia (1), Ecuador (2)
Land regularization and administration	4	Bolivia (1), Ecuador (2), Peru (1)
Extension services and capacity-building	4	Costa Rica (1), Haiti (1), Peru (1), Uruguay (1)
Animal and plant health	2	Peru (2)

Source: Authors' own elaboration.

Figure 2: Number of impact evaluations by intervention category



Source: Authors' own data.
Note: Some studies evaluate more than one intervention category. As a result, the number of studies per intervention category reflected in the figure exceeds the total number of studies included in this review.

[1] Gibbons et al. (2016) evaluate the complementary effects of two intervention types (rural infrastructure and input and technology transfers), which results in a total count of 26 studies in this table.

3.1 Input and technology transfers

The most frequently studied intervention category was input and technology transfers, analyzed across 11 studies. Of these, two studies evaluated direct input transfers to farmers (Salazar et al., 2018a; Mullally et al., 2019); eight evaluated technology adoption transfers via vouchers (Aramburu et al., 2019; Salazar et al., 2015; Salazar et al., 2018b; Schling & Pazos, 2022b; Salazar et al., 2021; Gibbons et al., 2016; Salazar et al. 2025; González Flores & Le Pommellec, 2019). Finally, one study[2] evaluated a transfer program that established a revolving credit fund that could be used for variable input purchases or capital investments (Schling et al., 2025a). Together, these evaluations constitute one of the strongest bodies of causal evidence within the IDB's agricultural portfolio and contribute to closing the existing literature gap in the region.

Several of the gaps identified in the broader impact evaluation literature have been explicitly addressed through the IDB's evaluation agenda (Salazar et al., 2025). First, IDB-supported impact evaluations have significantly expanded the geographical coverage of rigorous empirical evidence in Latin America and the Caribbean. While most studies on agricultural technology and input support programs are concentrated in the Southern Cone—particularly in Brazil—the IDB's evaluations span all four subregions of LAC. This broader coverage substantially increases the representation of underrepresented contexts.

Second, IDB-supported evaluations have helped strengthen the methodological rigor of the evidence base. All impact evaluations in this intervention category employ robust causal inference approaches, relying on experimental or quasi-experimental designs to identify program effects. This represents a significant methodological contribution relative to the broader literature, where rigorous causal evaluations remain relatively scarce and much of the evidence continues to rely on descriptive analyses or non-experimental approaches. By expanding both the geographical reach and methodological quality of the available evidence, the IDB has contributed to a more comprehensive understanding of what works, for whom, and under what conditions across the diverse agricultural systems of LAC.

i. Livestock Transfer Programs

Within the IDB's impact evaluation portfolio, two studies evaluate direct transfer of livestock assets on productive and welfare outcomes, reflecting a broader approach to measuring program impacts that extend beyond agricultural performance to household welfare and nutrition.

Livestock Assets and Technical Assistance in Nicaragua

In Nicaragua, Salazar et al. (2018a) evaluate the Agrifood Support Program (APAGRO, due to its Spanish initials), which provided poor rural households with livestock assets (cows, pigs, sheep, and chickens), alongside technical assistance in management and commercialization. Using a difference-in-differences (DiD) design combined with propensity score matching (PSM), the authors find large and robust impacts on both productive and welfare outcomes:

- **Productive outcomes:** Agricultural output increased by approximately **60%**, and income from livestock sales more than tripled.
- **Welfare Gains:** Household consumption rose by **18%**, protein intake by **12%**, and overall food consumption by **11%**.
- **Gender Empowerment:** The study documented a **15 percentage-point (p.p.)** reduction in women's disempowerment and an **18 p.p.** decline in intra-household gender imbalance due to program participation.

[2] While this study was conducted by IDB specialists, it evaluates a non-IDB funded intervention. It is included in this review due to its thematic relevance and the methodological contribution of the evaluation to the IDB's agricultural evidence base.

These findings underscore that combining direct input provision with technical assistance can simultaneously bolster productivity, improve living standards, and strengthen women's roles in productive decision-making.

Poultry Assets and Child Nutrition in Guatemala

In contrast, an evaluation in Guatemala examined a program that provided farmers with locally adapted poultry breeds in exchange for completing a training course. Using randomized phase-in, Mullally et al. (2019) analyzed both productive outcomes and child anthropometric indicators,

- **Productive outcomes:** The study found **no statistically significant effects** on production or sales.
- **Welfare gains:** Despite the lack of productive gains, the intervention generated substantial welfare impacts. Specifically, **stunting among girls declined by 23.5 p.p.** and **severe stunting by 14 p.p.**

ii. Agricultural technologies and input transfers

Eight studies evaluated non-reimbursable voucher-based input and technology transfer programs. While the primary objective of these interventions was to improve medium- and long-term outcomes such as agricultural productivity, production value, income, and household welfare, most evaluations also examined technology adoption as a key short-term milestone. This reflects the underlying theory of change of these programs, whereby the adoption of improved technologies constitutes an intermediate step through which longer-term productive and welfare impacts are expected to materialize. As a result, the evaluations typically assessed both immediate behavioral changes—such as the uptake of subsidized technologies—and subsequent effects on productivity, income, food security, and other development outcomes.

Technological packages and technical assistance in Nicaragua

In Nicaragua, the Environmental Program for Disaster Risk and Climate Change Management (PAGRICC, due to its Spanish initials) provided subsidized technology packages and technical assistance across multiple value chains with the objective of improving agricultural productivity while enhancing environmental resilience through the adoption of agroecological production systems. Using a DiD approach combined with PSM, González Flores and Le Pommellec (2019) found positive impacts on both productive and environmental outcomes:

- **Productive outcomes:** The value of agricultural production increased by **US$195 per hectare**.
- **Environmental benefits:** relative to the control, the amount of **captured rainwater** increased by **204 m³ per year** among treated households, **tree cover increased** by about **3 hectares** (equivalent to 22 plants) among treated households compared to the control group, and plants managed using **agroforestry practices** increased, on average, by **1,045 plants** relative to the control group.

Vouchers for technology adoption in Bolivia

In Bolivia, the Direct Support for the Creation of Rural Agrifood Initiatives (CRIAR, due to its Spanish initials) Program provided vouchers covering up to 90% of the cost of an agricultural technology selected by beneficiary producers. Using an Instrumental Variable (IV) approach that exploited variation in producers' distance to technology fairs where voucher distribution events were held, Salazar et al. (2015) found large and statistically significant positive impacts on both productive outcomes and food security. The results suggest that facilitating adoption to productive technologies can generate benefits that extend beyond agricultural performance, contributing to improved household well-being and food security.

- **Productive outcomes**: Annual **value of production** per hectare **increased by 92%** and net agricultural household **income rose by 36%.**
- **Food security**: The probability of being food secure **increased by 32%.**

A subsequent evaluation of the second phase of CRIAR was based on a two-phase randomized controlled trial (RCT) with explicit objectives to capture spillover effects. The analysis found positive and significant direct and spillover effects on household income, value of production, and technology adoption (Salazar et al., 2025).

In the Dominican Republic, a two-stage randomized experiment was conducted to examine the Program for the Support of Innovation in Agricultural Technology (PATCA II, by its Spanish acronym), which provided non-reimbursable vouchers covering 33–59% of the cost of agricultural technologies (irrigation or electric fencing) selected by beneficiary farmers, complemented with technical assistance. The evaluation found heterogeneous effects by value chain on agricultural productivity while technology adoption strengthened (Aramburu et al., 2019).

- **Technology adoption:** The likelihood of adopting technology increased by **68 percentage points** for farmers enrolled in the **improved pastures** (livestock) program, and **62 percentage points** for farmers enrolled in the **irrigation** (crops) program.
- **Productive outcomes:** Limited short-term effects on the value of production per hectare.
- **Crop portfolio:** Irrigation technologies encouraged a shift from temporary to permanent crops.

In Haiti, the Technology Transfer to Small Farmers Program (PTTA by its French acronym) offered smart subsidies through vouchers for agricultural inputs and agroforestry technology packages. Combining RCTs with matching-based methods, Salazar et al. (2018b) found heterogeneous impacts across value chains.

- **Productive outcomes in rice, horticulture, peanuts**: No significant effects on productivity or the value of agricultural production.
- **Productive outcomes in agroforestry:** Profits increased by 63%, while the value of agricultural production increased by 38%, highlighting the potential of agroforestry interventions to generate substantial economic returns.

<u>Voucher programs and geospatial data in Argentina and Dominican Republic</u>

Two impact studies of programs that provided vouchers to promote adoption, combined survey data with geospatial analysis to capture the dynamic, multi-year effects of technology adoption. By using satellite-based observations to complement traditional surveys, the authors measured changes in vegetation indexes overtime using a Normalized Difference Vegetation Index (NDVI), a measure of photosynthetic activity or 'greenness', to track crop health from space., finding that voucher programs had dynamic effects over time.

In the evaluation of the Family Agriculture Development Program (PRODAF, due to its Spanish initials) in Argentina, Schling & Pazos (2022b) employed an Inverse Probability Weighting (IPW) approach to address potential selection bias and ensure a robust counterfactual. The study found that:

- **Technology adoption** by 21 p.p. and credit access by 47 p.p.
- **Productive impacts varied by value chain**: positive, statistically significant productivity effects were detected in the citrus value chain, with the largest effects materializing two to three years after exposure to the program.

Similarly, in the Dominican Republic, the Support Program for the Competitive Agrifood Transition (PATCA II, due to its Spanish initials) program provided a non-reimbursable voucher that financed up to 60% of the total cost of the agricultural technology selected by the Farmer. The evaluation of the program

by Salazar et al., (2021), demonstrated a dynamic effect on productivity resulting from the adoption of irrigation technologies.

- **Vegetation indices:** Increases as of the third year after treatment, and differences between the treatment and control groups dissipated over time, possibly due to spillover effects.

In Argentina, an evaluation of the Provincial Agricultural Services Program (PROSAP, by its Spanish acronym) and the Program for Small Producers of the Wine Industry in Argentina (PROVIAR, by its Spanish acronym) programs estimated a DiD model to assess the effect of providing input vouchers for viticulturists to purchase winemaking inputs. Gibbons et al., (2016) find:

- **PROVIAR:** Beneficiaries increased production by **9.4%** and productivity by **7.7%**.
- **PROSAP:** Beneficiaries increased production by **4.2%** and productivity by **4.6%.**
- When the **programs were combined**: production and productivity rose by **16.6%** and **14.7%**, respectively

Notably, farmers exposed to both interventions achieved larger yield increases than the sum of each intervention separately.

Together, these findings illustrate that technology transfer programs may produce highly heterogeneous impacts depending on the technology promoted, the production system, and the time horizon over which outcomes are measured. While adoption effects are often immediate, productivity gains may take longer to materialize and can vary considerably across value chains.

iii. Input Transfer via a Revolving Loan Fund

Finally, one impact evaluation examined the effect of input transfers delivered through a revolving loan fund for smallholder dairy producers in Argentina, using a DiD approach (Schling et al., 2025a). Administered by smallholder dairy associations, the revolving loan fund provided short-term credit for the purchase of variable inputs, such as pasture fertilizers and hired labor, and longer-term credit for capital investments, including farm infrastructure and equipment). The evaluation revealed heterogenous impacts across different types of credit.

- **Productive outcomes:** Short-term credits used for variable inputs had **no statistically significant effect on dairy production**. In contrast, **long-term credit used for capital investments increased output** by 17.2% one year after the credit was received.
- **Persistence of impacts: Larger investment loans were associated with more sustained productivity** gains. Producers who received investment loans above the median continued to experience significant increases in production up to three years after receiving credit.

TABLE 2: IMPACT EVALUATIONS ON INPUT AND TECHNOLOGY TRANSFERS

Authors	Country	Period	Method	Sample size	Key Findings
Aramburu et al. (2019)	Dominican Republic	2011-2014	RCT	2,146 farmers (447 direct beneficiaries-effectively treated (DB-ET); 463 indirect beneficiaries; 583 controls; 335 social network nodes)	• Income: 627% income increase from improved pastures; 14% increase per month of exposure; short-run negative irrigation effects. • Adoption: 62–68% • Limited spillover effects.

Gibbons et al. (2016)	Argentina	2002-2013	DiD	27,625 vineyards (7,180 PROSAP, 1,439 PROVIAR, 884 PROSAP & PROVIAR, 18,122 control)	• PROVIAR: +9.4% production increase; +7.7% productivity growth. • PROSAP: +4.2% production increase; +4.6% productivity growth. • Combined: +16.6% production increase; +14.7% productivity growth.
González Flores & Le Pommellec (2019)	Nicaragua	2012-2016	DiD and PSM	1,033 households (519 treated, 514 control)	• Productivity: +US$195/ha increase • Environment: +10% rainwater harvesting (to 44%, +204 m³); increased tree cover (+22 plants and +3 ha); eco-forestry adoption (+1,045 additional plants managed, equivalent to ~0.25-0.33 ha); increase in productive practices (+2 practices adopted on average).
Mullally et al. (2019)	Guatemala	2014-2017	RCT	791 households (391 treated; 400 control)	• Productivity: No significant impact on egg production or sales. • Gender: 23.5 pp reduction in girls' stunting; 14 pp reduction in severe stunting.
Salazar et al. (2015)	Bolivia	2013-2014	IV model	1,287 households (817 treated; 470 control)	• Productivity: +92% • Net agricultural income: +36% • Household food security: +32%
Salazar et al. (2018a)	Nicaragua	2011-2014	DiD and PSM	1,081 producers (570 treated; 511 control)	• Production: +60% • Income: >200% increase in livestock income. • Welfare: +18% household consumption; +12% protein and +11% food intake. • Gender: 15% reduction in women's disempowerment; 18% reduction in gender imbalance.
Salazar et al. (2018b)	Haiti	2011-2017	RCTs and PSMs	290 households (100 treated; 190 control)	• Production: +63% profit increase; +38% crop production value. • Food Security: No significant effects observed.
Salazar et al. (2021)	Dominican Republic	2011-2020	DiD and event study	377 plots (129 treated; 248 control)	• Productivity: +2.4–2.7% increase in vegetation indices, with impacts emerging 3 years after adoption and converging in later years. • Spillovers: Small but positive effects in neighboring communities (NDVI +0.0135)
Salazar et al. (2025)	Bolivia	2021-2022	Two-phase RCTs and IV	1,684 small producers (879	• Production: +US$946 direct and +US$466 indirect (spillover) production value.

				direct beneficiaries, 395 indirect beneficiaries, 410 control households)	• Income: +US$1,691 direct and +US$528 indirect (spillover) household income. • Adoption: +64 pp direct and +14 pp indirect (spillover) technology adoption; increased crop diversification.
Schling & Pazos (2022b)	Argentina	2019-2020	IPW	898 farmers (534 treated; 364 control)	• Productivity: Yield gains in citrus only; peaks 2–3 years post-adoption. • Adoption: +21 pp increase. • Finance: +47 pp credit access; decreased labor costs (dairy).
Schling et al. (2025a)	Argentina	2010-2017	Synthetic DiD	854 producers (288 treated; 566 control)	• Production: +17.2% from capital investment (year 1); +11–17.4% increase sustained for 3 years.

Source: Authors' own elaboration.
Note: (*) This program also includes complementary rural irrigation, which is discussed under the rural infrastructure intervention category.

3.2 Rural Infrastructure

The category of rural infrastructure included one impact evaluation of a rural road improvement program (Corral & Zane, 2021) and four studies of irrigation infrastructure programs (Gibbons et al., 2016; Corral & Zane, 2020; Salazar & López, 2017; Schling et al., 2025b).

Placing these evaluations in the context of the broader literature highlights both similarities and differences in the IDB's evidence base. Consistent with the findings of Salazar et al. (2025), most impact evaluations of rural infrastructure focus on irrigation investments, with relatively few studies examining rural roads. The IDB's portfolio follows a similar pattern, with four evaluations assessing irrigation projects and one evaluating rural roads.

At the same time, the IDB evidence differs from the broader literature in important ways. While previous studies have been concentrated in the Southern Cone, particularly Brazil, the IDB's evaluations are more heavily represented in the Andean region. Nevertheless, both the IDB portfolio and the broader literature exhibit a notable lack of evidence from Caribbean countries. Finally, the IDB's evaluations contribute to strengthening the methodological rigor of the evidence base: whereas few studies in the broader literature employ causal inference methods, all IDB evaluations in this category rely on quasi-experimental designs.

Overall, the IDB evidence on rural infrastructure is largely consistent with the broader literature in terms of the types of interventions evaluated, predominantly irrigation projects, while contributing to a more geographically diverse and methodologically rigorous evidence base.

i. Rural Roads Improvements

In Ecuador, the Chimborazo Rural Investment Project evaluated the impact of upgrading a rural road on productive and household welfare outcomes using a DiD approach combined with PSM (Corral & Zane, 2021). The evaluation found no significant effects on productive outcomes but identified significant improvements in household welfare.

- **Productive outcomes:** No significant impacts on crop production or household income.
- **Household welfare:** Road improvements significantly reduced travel times and transportation costs contributing to higher secondary school enrollment for adolescents and improved health outcomes.

ii. Irrigation Systems Rehabilitation

Rehabilitation of irrigation systems in Ecuador and Bolivia

In Ecuador, the Chimborazo Rural Investment Project focused on rehabilitating small-scale irrigation systems in Indigenous highland communities while supporting the strengthening of water-user associations. USing a DiD approach, Corral and Zane (2020) found positive and significant effects on both productive outcomes and household welfare.

- **Productive outcomes: Crop yields increased by about 33%**, although **crop sales decreased.**
- **Household welfare:** The probability of facing a **food insecurity shock decreased** by 1.9 pp[3].

In Bolivia, an impact evaluation of the National Irrigation Program (PRONAREC, by its Spanish acronym) employed PSM and found a mixed pattern of impacts (Salazar & López, 2017):

- **Technology adoption:** Irrigation investments more than doubled, while adoption of complementary technologies increased substantially, including improved seeds (80%) and agricultural machinery (11%).

- **Productive outcomes:** The value alue of agricultural production increased by 60–70% and household agricultural income rose by 35–45%. However, no statistically significant effects were found on crop yields.

The authors attribute the absence of yield effects to the learning curve associated with the transition from rainfed to irrigated agriculture, suggesting that producers are likely still in the process of adapting to the new technology.

Irrigation Rehabilitation in Argentina

Two studies evaluated irrigation investments under Argentina's Provincial Agricultural Services Program (PROSAP) in the wine-producing region of San Juan.

Using a 12-year panel dataset and a long-term DiD design, Gibbons et al. (2016) found that irrigation expansion generated significant gains in both production and productivity.

- **Productive outcomes:** Irrigation expansion increased grape production by 4.2% and yields by 4.6%. The combination of irrigation with input vouchers increased production by 16.6%.

Schling et al. (2025b) evaluated a subsequent phase of the program (PROSAP III), which focused on the rehabilitation of irrigation canals. Combining survey and remote sensing data within a DiD-PSM framework, the study found sustained impacts on technology adoption and productivity.

- **Technology adoption:** The program increased the area under effective irrigation and reduced the likelihood of irrigation-related losses.

[3] Food insecurity was measured through a survey module based on the Food and Agriculture Organization's (FAO) Food Insecurity Experience Scale Survey Module, in which the person responsible for preparing meals in the household is asked a series of questions regarding their family's exposure to food insecurity episodes, such as having to skip meals.

- **Productive outcomes**: Grape production increased by 31.4–53%, while yields increased by 0.9–1%. Evidence from NDVI indicators suggests that productivity gains strengthened over time.

Overall, these evaluations indicate that irrigation investments can generate substantial gains in production, income, and household welfare. However, impacts on yields may take longer to materialize, particularly when producers face learning and adaptation constraints.

Table 3: Impact Evaluations on Rural Infrastructure

Authors	Country	Period	Method	Sample Size	Key Findings
Corral & Zane (2020)	Ecuador	2015-2019	DiD	636 households (234 treated; 402 control)	• Productivity: +33% crop yields • Income: No significant income effects, decreased sales (higher self-consumption). • Food security: decreased probability of facing food insecurity events by 1.9 pp • Irrigation: +10 pp irrigated plots
Corral & Zane (2021)	Ecuador	2015-2019	DiD and PSM	564 households (301 treated, 263 control)	• Productivity: no significant impacts • Income: no significant impacts • Food security: no significant impact • Employment: 22pp higher probability of being employed • Access to services: Lower travel time and costs to education and health services; improved health outcomes.
Gibbons et al. (2016)	Argentina	2002-2013	DiD	25,302 (7,180 PROSAP-treated; 18,122 control; PROVIAR-only and combined groups excluded)	• Production: Irrigation expansion alone increased viniculture production by 4.2%. • Productivity: Irrigation expansion alone increased viniculture yields by 4.6%.
Salazar & López (2017)	Bolivia	2014-2015	PSM	1,591 households (543 treated, 1,048 controls)	• Production: +60–70% • Income: +35–45% household income • Productivity: no significant yield effects. • Investment: +100–160% irrigation spending; +80–90% certified seed use; machinery/tractor: +11-20% • Market access: +20–30%
Schling et al. (2025b)	Argentina	2022-2023	DiD, PSM and IPW	299 producers (180 treated; 119 control)	• Production: +31.4–53.2% grape production • Productivity: +0.93–1% yields; impacts increased over time. • Irrigation: Expanded effective area; reduced irrigation-related losses.

Source: Authors' own elaboration.

3.3 Land Regularization and Administration

Evidence on the effectiveness of land regularization and administration interventions remains relatively limited within the broader agricultural productivity literature. Moreover, rigorous impact evaluations employing experimental or quasi-experimental approaches are scarce (Salazar et al., 2025). In response to this gap, the IDB has supported four studies that examined the impact of land regularization and administration programs in the Andean region (Schling et al., 2024; Corral et al., 2024; Schling et al., 2023; Schling & Pazos, 2022a).

These studies make an important contribution to the evidence base in two aspects. First, by employing quasi-experimental methods, they address the lack of rigorous causal evidence identified in the broader literature. Second, by focusing on three Andean countries, these studies expand the geographical coverage of rigorous evidence on land regularization and administration interventions. As a result, the IDB's evaluation portfolio not only strengthens the methodological quality of the available evidence but also improves its relevance for informing policy in underrepresented contexts across LAC.

i. Land Regularization and Administration

Land regularization in Bolivia, Ecuador and Peru

A multi-country evaluation examined a series of land administration programs implemented in Bolivia, Ecuador, and Peru that provided formal land titles in rural areas Schling et al. (2024). Combining PSM and a bias-corrected stochastic production frontier (SPF), the study found that land regularization significantly improved technical efficiency.

- **Productive outcomes:** Farmers holding formal land titles are, on average, 38.6% more technically efficient than comparable non-beneficiaries.

While the magnitude of the effects varied across countries, the analysis identified two principal mechanisms through which land titling enhanced productivity: improved access to credit and increased productive investments. These findings underscore the importance of secure land tenure as a catalyst for agricultural productivity.

ii. Land Regularization and Women's Empowerment, and Household Welfare

In addition to productive outcomes, two evaluations studied the link between land tenure, women's empowerment, and household welfare.

Cadastral Mapping in Ecuador

In Ecuador, Schling et al. (2023) evaluated the SigTierras program using a DiD approach combined with IPW . The study found positive impacts on women's economic participation and overall household welfare.

- **Household welfare:** Households receiving jointly titled cadastral maps were 5.8p.p. more likely to be food secure, and increased crop diversity toward more marketable and nutritious products.
- **Gender impact:** Female beneficiaries increased their access to credit by 3.8 percentage points and became more engaged in off-farm economic activities.

Informal Land Ownership and Women's Welfare in Peru

In Peru, Schling and Pazos (2022a) analyzed the effects of self-declared informal land ownership on women's empowerment and household welfare using an IV approach based on land inheritance. The study finds:

- **Household welfare:** Household food security improved by 20 p.p.
- **Gender impact:** Women's land ownership increased crop diversity and reduced time spent on farm work.

These evaluations demonstrate that land tenure interventions can generate benefits that extend well beyond agricultural productivity. While evidence on direct productivity effects remains limited, the findings consistently show positive impacts on women's economic empowerment, food security, productive investment, and agricultural efficiency. More broadly, they highlight land tenure security as a critical enabling condition for inclusive rural development and long-term agricultural transformation.

Table 4: Impact Evaluations on Land Regularization and Administration

Authors	Country	Period	Method	Sample Size	Key Findings
Corral et al. (2024)	Ecuador	2014-2018	DiD and IPW	5,200 households (2,627 treated, 2,573 control)	• Productivity: No significant effects on yields. • Socio-economic: Higher household income / wages; improved food security; no effect on tenure perception / conflicts.
Schling & Pazos (2022a)	Peru	2019	IV	1,048 households (Women own plots: 230; Women own none: 818)	• Food Security: +20 pp household food security; improved fruit crop sales and pest knowledge. • Gender: increased crop diversity and reduced on-farm work time.
Schling et al. (2023)	Ecuador	2014-2018	DiD and IPW	1,450 households (683 treated, 767 control)	• Food Security: +20 pp; 30% higher crop diversity • Gender: Higher women's off-farm wages / business investment; more non-agricultural activity time; increased access to credit • Food Security: +5.8 pp food secure; shift toward higher-value crops. Gender: +3.8 pp increased access to credit, higher women's off-farm income, and greater time allocated to non-farm activities.
Schling et al. (2024)	Bolivia, Ecuador, Peru	Bolivia (2023); Ecuador (2014–2018); Peru (2019)	PSM and SPF	5,288 households (Peru: 1,591; Ecuador: 2,353; Bolivia: 1,344)	• Technical efficiency: +38.6% (effects vary by country). • Socio-economic: Higher household income / wages; no significant effects on tenure perception, conflicts, or input use.

Source: Authors' own elaboration.

3.4 Animal and Plant Health

Animal and plant health interventions remain underrrepresented in the broader agricultural productivity literature in LAC (Salazar et al., 2025). Existing studies are concentrated in few countries with methodological limitations to establish causal relations between animal and plant health interventions and agricultural outcomes. The IDB's evaluations help address both geographical and methodological gaps to some extent.

i. Fruit Fly Eradication in Peru

Short-Term impacts

Salazar et al. (2016) evaluated a fruit fly eradication program implemented by National Agrarian Health Service of Peru (SENASA) in the coastal region. The study employed a geographical regression discontinuity design (RDD) that exploited the staggered spatial rollout of the program and the administrative boundaries used for the implementation. Under the assumption that producers located near the intervention boundary were comparable, the evaluation identified substantial improvements in agricultural practices, productivity, and market outcomes.

- **Technology adoption:** The probability of adopting good practices to prevent fruit fly incidence increased by 35% and farmers' knowledge about fruit fly prevention and control improved by 10%.

- **Productive outcomes:** Fruit productivity increased by more than 15%, production volumes rose by approximately 65%, and value of fruit sales more than tripled.

Long-term impacts

A follow-up study by Salazar et al. (2023) examined the long-term impacts of the same program over a ten-year period. The evaluation combined the original RDD approach with remotely sensed vegetation data, using the Normalized Difference Vegetation Index (NDVI) as a proxy for productivity. The findings indicate that productivity gains not only persisted but strengthened over time.

- **Productive outcomes:** Estimated impacts using the NDVI ranged from 12% in the short term to as much as 49% in the long term, suggesting sustained improvements in agricultural productivity.

- **Heterogenous impacts:** Quantile regression results revealed that productivity gains were concentrated among more productive farmers. This finding points to heterogeneous treatment effects and suggest that complementary interventions may be needed to ensure that less productive farmers benefit in the same extent.

These studies demonstrate that phytosanitary interventions can generate substantial and long-lasting productivity gains. They also illustrate the value of combining traditional survey data with remote sensing technologies to capture long-term impacts that would be difficult to observe through conventional evaluation approaches alone.

Table 5: Impact Evaluations on Animal and Plant Health

Authors	Country	Period	Method	Sample Size	Key Findings
Salazar et al. (2016)	Peru	2011-2014	Geographical regression discontinuity	431 households (246 treated; 185 control)	• Productivity: +15% • Production: +65% in production, +370% in sales • Adoption: +35% • Knowledge: +10%
Salazar et al. (2023)	Peru	2010-2020	Regression discontinuity	305 producers (155 treated; 150 control)	• Productivity: +12–49% gains (rising over time); largest increases in top-performing farmers.

Source: Authors' own elaboration.

3.5 Extension Services and Associativity.

Extension services and technical assistance are among the most frequently evaluated interventions in LAC, whereas producer remains one of the least studied categories (Salazar et al., 2025). The IDB's s impact evaluations contribute to the literature by expanding the geographical scope of rigorous evidence and applying counterfactual methods to assess causal effects.

i. Extension Services

Livestock Extension Services in Uruguay

In Uruguay, Mullally and Maffioli (2014) analyzed the Uruguayan Livestock Program that consisted in improve and finance business plans of cattle breeder's, strengthen livestock traceability system, and establishing silvopastoral systems. Using an IPW approach, the evaluation focused on assessing productive outcomes finding positive improvements in calf production and livestock sales.

- **Productive outcomes:** Calf production increased by 11.36–15.3 calves and net calf sales increased by 4.35 calves on average.

Extension Services for Mango Producer Groups in Haiti

In Haiti, Arráiz et al. (2015) assessed an extension program that promoted associativity and trained producer business groups (PBGs) in the production and commercialization of mangoes. The program promoted the adoption of Francique mango trees, a highly commercial variety in the US market with high quality characteristics and compliance with export requirements. Additionally, the program connected smallholder producers to exporters via PBGs, with the aim of increasing incomes by facilitating access to export markets. Using a DiD combined with PSM approach the study finds positive effects on adoption of improved varieties and productive outcomes.

- **Technology adoption:** The program increased planting of Francique mango trees and improved the adoption of good production practices by producers.
- **Productive outcomes:** No significant effects on yields or sales are found at the time of evaluation likely caused by the short period of analysis (16 months).

ii. Trade Facilitation

The IDB-supported impact evaluations have also documented the effects of interventions designed to facilitate trade and investment. Carballo, Rodríguez, and Volpe (2018) evaluate the digital platform of ConnectAmericas, a business to business (B2B) digital platform that provides information, networking opportunities and market connections to entrepreneurs, including firms in the agrifood sector. Likewise, Carballo, et al., (2026) assessed the effects of the digitalization of trade procedures in Costa Rica through the Single Window for Trade system.

- **ConnectAmericas**: Facilitated cross-border business linkages and improved export performance, particularly among agrifood firms.

- **Costa Rica's Single Window for Trade:** Increased agricultural exports, with particularly strong effects among small firms and producers located outside the country's central region.

These findings suggest that trade facilitation and digitalization can complement traditional agricultural development interventions by reducing transaction costs, expanding market access, improving compliance with quality standards, and accelerating the diffusion of knowledge and technology.

Table 6: Impact Evaluations on Extension Services and Capacity Building

Authors	Country	Period	Method	Sample Size	Key Findings
Arraíz et al. (2015)	Haiti	2012-2013	DiD and PSM	461 households (205 treated, 256 control)	• Adoption: Increased planting of export trees (Francique); adoption of improved practices (fencing/pruning). • Market Organization: Reduced reliance on middlemen; 54% higher likelihood of participating in PBGs; 43% higher probability of receiving credit from PBGs
Carballo et al. (2018)	Peru	2010-2018	DiD	Approximately 6,300 exporting firms	• Exports: Platform use generated additional exports • Market access: Increased visibility to foreign buyers; improved business opportunities.
Carballo et al. (*forthcoming*)	Costa Rica		Staggered DiD	Forthcoming	• Exports: Digitalization increased exports along both intensive and extensive margins. • Firm Impact: More pronounced for smaller firms in non-central regions and ESW destinations.
Mullally & Maffioli (2014)	Uruguay	2003-2010	IPW	23,214 observations (413 beneficiaries, 22,801 non-beneficiaries)	• Production: +11.36–15.3 calves produced; net sales increased by 4.35 calves. • Economic Return: Increased net calf sales (4.35 on average); IRR analysis indicates modest effects.

Source: Authors' own elaboration

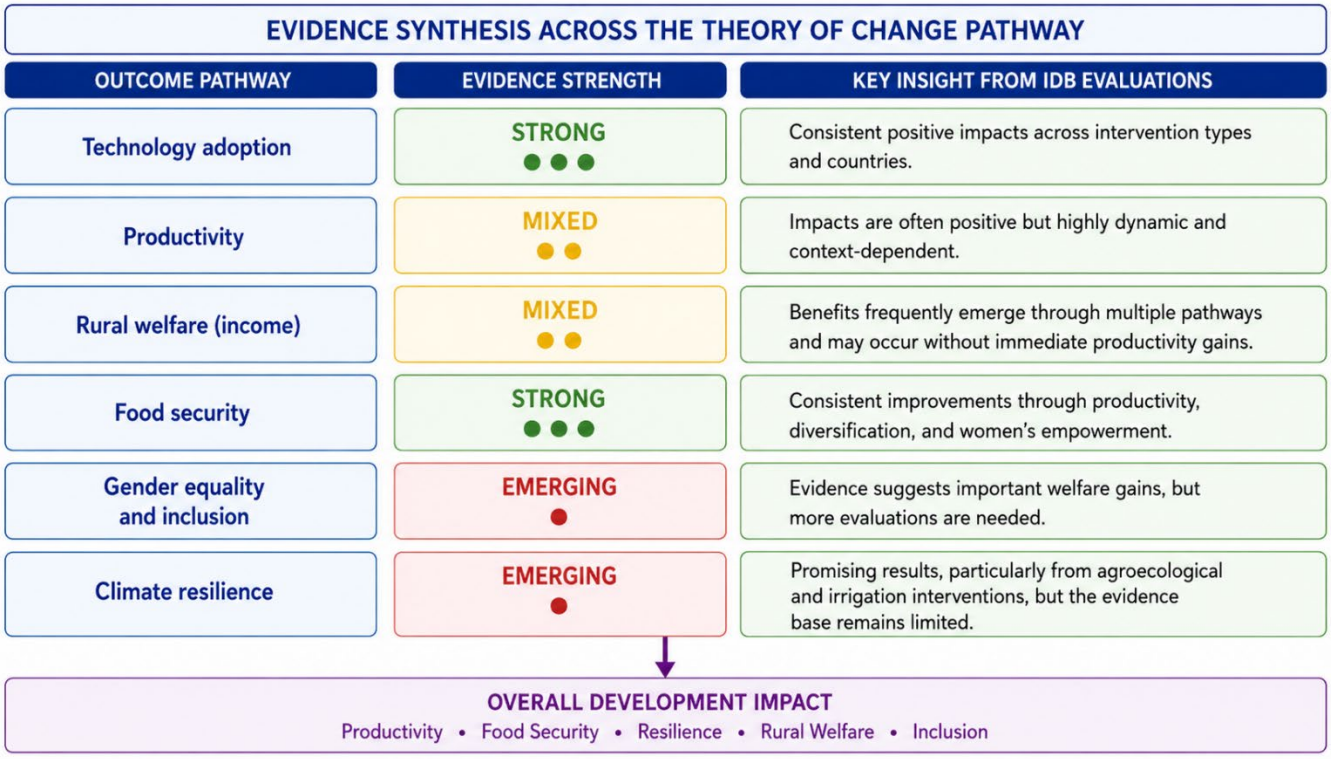
4. Cross-Cutting Insights from the IDB-supported Evidence Base

Building on the review of IDB-supported impact evaluations, this section synthesizes key cross-cutting insights that emerge across intervention categories and country contexts. Rather than seeking to derive universal conclusions, it identifies key lessons on the conditions under which agricultural programs are likely to be most effective, the timing and persistence of impacts, and the breadth of outcomes assessed. These insights provide a foundation for more context-sensitive, evidence-informed program design and contribute to strengthening the effectiveness of future agricultural investments in Latin America and the Caribbean.

Figure 3 summarizes the strength of evidence across the main pathways of the Theory of Change presented in Figure 1. The review finds strong evidence of positive impacts on technology adoption and food security, mixed evidence on productivity and income-related outcomes due to their dynamic and context-dependent nature, and more limited evidence on gender equality, inclusion, and climate

resilience. Together, these findings suggest that agricultural interventions generate benefits that extend well beyond productivity growth and contribute to broader development objectives, including food security, resilience, and rural welfare

Figure 3. Findings from IDB evaluations



Source: Authors' elaboration

4.1 Addressing methodological, geographic, and equity gaps in the broader literature

The IDB's evidence base complements the broader regional literature on agricultural productivity interventions, as documented in the most recent systematic map of agricultural productivity studies in LAC (Salazar et al., 2026). IDB-supported evaluations address important gaps related to methodological rigor, geographic coverage, and the assessment of heterogeneous impacts across vulnerable populations.

The broader empirical literature examining public agricultural interventions in LAC is characterized by a notable scarcity of studies employing rigorous causal inference methods. Among a representative sample of 82 studies published between 2014 and 2024, only one employed experimental design and seven used quasi-experimental approaches, highlighting a significant gap in causal evidence. Among a representative sample of 82 studies published between 2014 and 2024, only one employed experimental design and seven used quasi-experimental approaches, indicating a significant gap in causal evidence. In contrast, as shown in Figure 4, quasi-experimental approaches are common in the IDB's impact evaluations, and experimental designs are used more broadly.

Figure 4: Number of impact evaluations by methodology

Method type	Times used
Differences-in-differences (DiD)	11
Synthetic Differences-in-differences (DiD)	2
Propensity Score Matching (PSM)	8
Inverse Probability Weighting (IPW)	5
Regression Discontinuity (RD)	2
Instrumental Variable (IV)	2
Event study methodology	1
Randomized Controlled Trial (RCT)	**4**
Stochastic Production Frontier Analysis (SPF)	1

Source: Authors' own data.
Note: Some studies employ more than one methodology. As a result, the sum of the numbers in the figure exceeds the total number of studies included in the review.

Beyond methodological rigor, the IDB's evaluations also expand the geographical scope of the evidence base by generating rigorous evidence in countries that have been largely underrepresented in the broader literature, particularly in the Andean and the Caribbean regions. The systematic map reveals a pronounced spatial concentration of evidence, with 36 of the 82 studies focusing on interventions in Brazil. By contrast, most other countries are represented by only a handful of studies, and no studies are found for the Caribbean. The geographical distribution of IDB impact evaluations, presented in Figure 4, is considerably more balance reflecting the deliberate effort to generate evidence across a wider range of contexts. As a result, the IDB's evaluation portfolio contributes to a more representative understanding of the effectiveness of agricultural interventions across LAC.

Figure 3: Number of impact evaluations by country

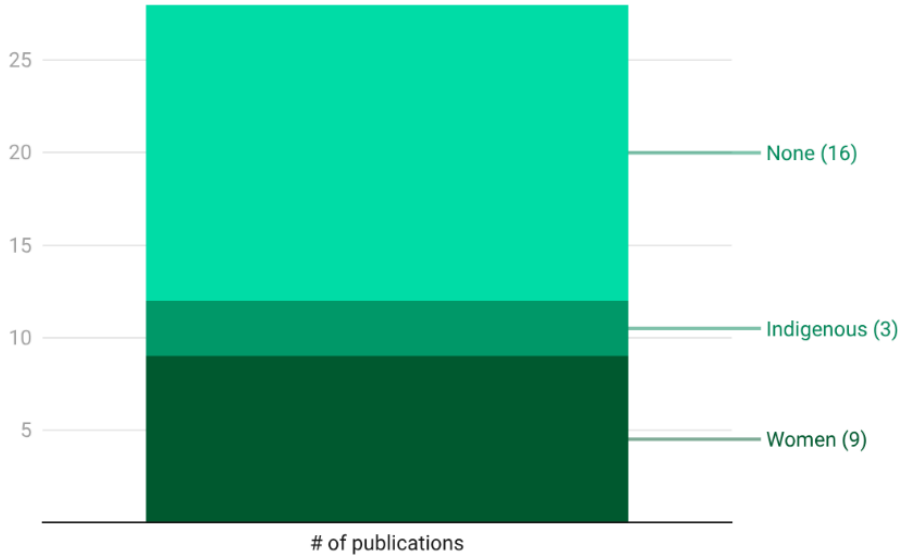
Source: Authors' own data.
Note: Some studies evaluate more than one country. As a result, the number of studies per country reflected in the map exceeds the total number of studies included in this review.

Figure 5 presents the number of impact evaluations that incorporate analysis of heterogenous effects across vulnerable groups, particularly women and indigenous or Afro-descendant producers. A study was classified as contributing to the evidence on vulnerable populations if the intervention was explicitly targeting this population or when it included heterogeneity analysis by gender or ethnic identity.

The systematic map of agricultural interventions in LAC found limited attention to vulnerable populations in the broader literature. Of the 82 studies reviewed, only three explicitly focus on vulnerable groups (two on women and one on indigenous populations) (Salazar et al., 2026). The IDB evaluations place a greater emphasis on understanding differential impacts across population groups. Among the 25 evaluations reviewed, more than one-third include gender-disaggregated or gender-focused analyses (n=9), while three assess impacts on Indigenous producers (n=3). No studies specifically examined impacts on Afro-descendant producers.

Although most evaluations in the IDB portfolio (n=16) do not explicitly focus on vulnerable populations, the evidence base demonstrates substantially greater attention to heterogeneous impacts than in the broad literature. By incorporating gender and ethnic dimensions into impact evaluation design and analysis, these studies provide valuable insights into who benefits from agricultural interventions thereby contributing to more inclusive and equitable agricultural development policies.

Figure 4: Number of impact evaluations that focus on women or other vulnerable groups



Source: Authors' own data.
Note: Some studies focus on more than one vulnerable group (for example, studies conducting heterogeneity analysis by gender and indigenous identity). As a result, the totals in the figure exceed the total number of studies included in the review. Studies were categorized as focusing on a vulnerable group if (i) the intervention itself targeted a vulnerable group such as women or indigenous producers, or (ii) the study included heterogeneity analysis by gender or ethnic identity.

4.2 Timing and sustainability of agricultural interventions

The timing of an evaluation is a critical factor in determining whether program impacts can be accurately detected. Several studies suggest that assessments conducted too early in the intervention cycle may underestimate program effectiveness. In Haiti, an extension program for mango producers showed no significant effects on production or sales 16 months after implementation. However, the intervention significantly increased the adoption of improved varieties and recommended agronomic practices, leading the authors to conclude that the evaluation was conducted before productivity gains could reasonably be expected to materialize (Arráiz et al., 2015). Similarly, in Bolivia, the absence of statistically significant yield effects from a national irrigation program may reflect producers remaining in a learning-by-doing phase as they adapted to the new technology (Salazar & López, 2017). These findings underscore the importance of aligning evaluation timelines with the expected pace of technology adoption and behavioral change.

Several evaluations also demonstrate that productivity gains may emerge only after an extended period of exposure to a specific intervention. Productivity impacts are inherently dynamic and may materialize over different time horizons, making medium and long-term evaluations essential for accurately assessing program effectiveness. Across the evidence base, impacts on agricultural productivity varied not only in magnitude but also in their timing and persistence, with some effects emerging gradually, others strengthening over time, and some fading after initial gains.

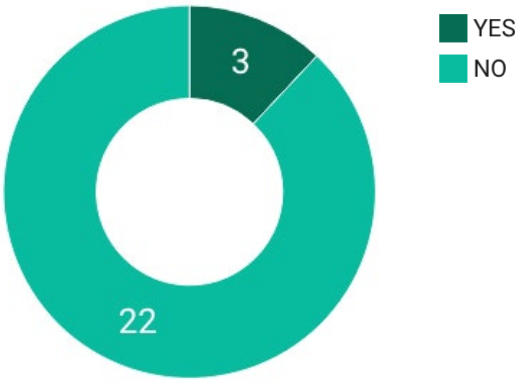
For example, in the Dominican Republic, an evaluation of a technology adoption program found that while some irrigation technologies initially reduced farmers' income, each additional month of exposure was associated with a 14% increase in income (Aramburu et al., 2019). Similarly, evaluations of voucher-based technology transfer programs in Argentina and the Dominican Republic show that productivity gains became visible only two to three years after program exposure (Salazar et al., 2021; Schling & Pazos, 2022b). Long-term evaluations of a fruit fly eradication program in Peru and an irrigation

rehabilitation program in Argentina further confirm that impacts can strengthen over time, with gains in productive outcomes materializing several years after implementation (Salazar et al., 2023; Schling et al., 2025b).

The sustainability of impacts overtime is also fundamental for impact assessments. Some studies from the IDB-supported evidence report positive impacts that later diminish in magnitude or lose statistical significance (Salazar et al., 2021; Schling & Pazos, 2022b; Schling et al., 2025a). However, the attenuation of estimated treatment effects should not be interpreted as evidence of declining program effectiveness as it may reflect broader knowledge diffusion processes, whereby non-beneficiaries gradually adopt technologies or practices introduced by the intervention. In the Dominican Republic, for example, Salazar et al. (2021) present evidence consistent with spillover effects that reduced observable differences between treatment and control groups over time.

Taken together, these findings suggest that agricultural interventions often require extended time horizon to fully materialize their impact, particularly when involving learning processes or shifts in production decisions and crop portfolio (Aramburu et al., 2019; Arráiz et al., 2015; Salazar & López, 2017). Figure 6 summarizes the subset of impact evaluations that include long-term analyses (defined as 8 years or more after the intervention is implemented). Overall, across the evidence base, impacts on agricultural productivity varied not only in magnitude but also in their timing and persistence, with some effects emerging gradually, others strengthening over time, and some fading after initial gains.

Figure 5: Number of impact evaluations that conduct long-term analyses (8+years)



Source: Authors' own data.

4.4 Welfare effects beyond productivity and income

Agricultural programs can generate welfare gains beyond productivity or income. While theories of change in agricultural development often assume a linear pathway from increased yields to improved incomes and welfare outcomes (such as food security), the evidence reviewed suggests a more complex and heterogeneous set of relationships between productive, economic, and social indicators.

Several studies in the IDB-supported evidence base find positive impacts in welfare outcomes for interventions with no detectable effects on yields or agricultural income. For example, some interventions show positive effects on health outcomes (Corral & Zane, 2021) and girls' anthropometric indicators

(Mullally et al., 2019) despite limited or no changes in productivity. In Bolivia, a national irrigation program increased food security and incomes without measurable gains in yields (Salazar et al., 2015). Conversely, in Ecuador, an irrigation infrastructure program targeting indigenous communities reduced food insecurity and increased yields despite no detectable impact on income and reduction in sales (Corral & Zane, 2020).

Other studies highlight alternative transmission channels through which welfare gains materialize. In Ecuador, the SigTierras land administration program did not affect input use or agricultural income, but it significantly increased agricultural wages and overall household income (Corral et al., 2024). The authors suggest that, in contexts where customary land tenure norms are important, program-induced improvements in perceived tenure security may encourage households to allocate more labor to off-farm activities.

These findings suggest a more complex theory of change to agricultural interventions with multiple and sometimes non-linear pathways to welfare outcomes. They suggest that improvements in welfare can occur without corresponding increases in productivity or income, and that increases in yields do not automatically translate into expected social or economic gains. Local market conditions, intrahousehold decision-making, and institutional context play a central role in shaping these impact pathways.

4.4 Gender analysis through women's empowerment

The IDB's impact evaluations also provide valuable evidence on the role of agricultural interventions in promoting women's empowerment. Beyond their productive objectives, agricultural programs can serve as important catalysts for strengthening women's agency, economic participation, and decision-making power within households and agricultural production systems.

Three IDB-supported evaluations explicitly assess impacts on women's empowerment indicators (Salazar et al., 2018a; Schling et al., 2023; Schling & Pazos, 2022a). Although the evidence base remains limited, studies incorporating gender analysis consistently find positive associations between women's empowerment and improvements in household welfare, particularly food security. In Ecuador and Peru, greater land tenure security among women led to improvements in household food security and increased crop diversification (Schling et al., 2023; Schling & Pazos, 2022a). Similarly, in Nicaragua, participation in a technology transfer program reduced the incidence of women's disempowerment while simultaneously improving household food security (Salazar et al., 2018a).

Overall, these findings highlight women's empowerment as an important yet underexplored pathway through which agricultural interventions can generate broader welfare impacts. They also underscore the value of incorporating gender-sensitive indicators into impact evaluations to better understand how agricultural programs contribute to food security, social inclusion, and gender equality.

4.5 Spillover effects and project effectiveness

Understanding how spillover effects shape the overall effectiveness of agricultural interventions is critical for impact assessment. Ignoring these effects may lead to an underestimation of program impacts and, in some cases, misleading conclusions regarding intervention effectiveness. Within the IDB-supported evidence base, three evaluations of technology transfer programs explicitly examine spillover effects on indirect beneficiaries (Aramburu et al., 2019; Salazar et al., 2021; Salazar et al., 2025). Overall, these studies provide consistent evidence that agricultural interventions can generate important positive spillover effects beyond direct beneficiaries, although the timing and magnitude of these effects vary considerably across contexts and technologies.

In Bolivia, a technology adoption program generated substantial indirect benefits, with non-participating producers in treated communities experiencing higher agricultural production values, household incomes, and technology adoption rates than producers in pure control areas (Salazar et al., 2025). In the Dominican Republic, evidence suggests that spillover effects emerged more gradually. An initial evaluation of a technology transfer program found limited spillover effects in the short term (Aramburu et al., 2019), whereas a subsequent follow-up study of the same intervention documented longer-term spillovers that reduced observable differences between treatment and control groups over time (Salazar et al., 2021). The authors suggest that the diffusion of knowledge and technologies may depend on the complexity of the technologies being promoted and the time required for adoption among non-beneficiaries.

Overall, these findings suggest that focusing exclusively on direct treatment effects may underestimate the full impact of agricultural interventions and, consequently, their social returns and cost-effectiveness.

4.7 Remote sensing data as a complement to survey data

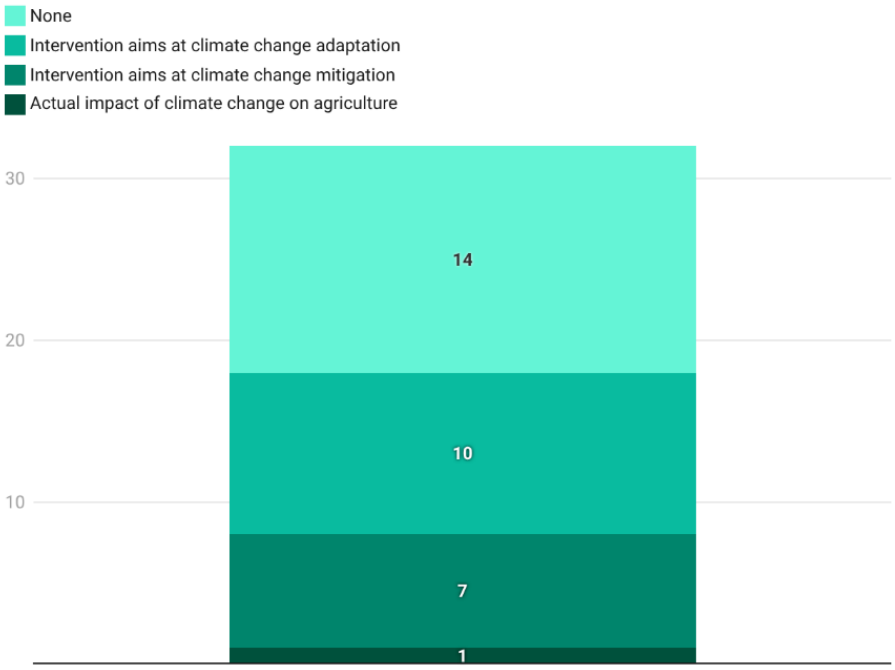
Remote sensing has emerged as a powerful tool to help overcome some of the challenges of field data collection. The IDB has advanced a set of impact evaluations that integrate household surveys with satellite-based measures to assess agricultural program outcomes. One-fifth of the studies (5 out of 25) incorporate such data into their analysis.

This approach has proven versatile across countries and intervention types, particularly for tracking outcomes over long time horizons. For example, studies combine survey data with vegetation indices such as NDVI to evaluate input and technology transfers in Argentina and the Dominican Republic (Salazar et al., 2021; Schling & Pazos, 2022b), irrigation expansion in Argentina (Schling et al., 2025), and fruit fly eradication in Peru (Salazar et al., 2023). These integrations enable a more detailed understanding of the evolution of productivity changes in the short, medium, and long term. Overall, the evidence suggests that remote sensing is a valuable complement to survey-based approaches, strengthening the robustness of impact measurement while helping to address some of the logistical and cost constraints associated with traditional field data collection.

Despite these advances, applications remain relatively narrow. Existing studies primarily use satellite data to proxy agricultural productivity (e.g., crop yields) through vegetative index, with limited attention to environmental and climatic dimensions. Expanding the use of remote sensing could diversify the types of analysis conducted in impact evaluations, particularly with respect to climate and environmental outcomes.

As shown in Figure 7, many impact evaluations analyzed in the IDB's-supported evidence base focus on assessing the dynamics between agricultural projects and climate variability, with a focus on both adaptation (n=10) and mitigation (n=7) interventions. However, there is a notable lack of studies that quantitatively assess the effects of climate change on agricultural outcomes (n=1), and none that evaluate the environmental impacts of agriculture interventions (n=0). Incorporating satellite-derived data on variables such as precipitation, temperature, vegetation cover, and water availability could help address these gaps. Strengthening the integration of such data would enhance the analytical scope of IDB evaluations, particularly as climate-related risks to agriculture become more pronounced.

Figure 7: Number of studies by climate perspective



Source: Authors' own data.
Note: Some studies employ more than one climate perspective (for example, a single study may include an adaptation intervention and a mitigation intervention). As a result, the totals in the figure exceed the total number of studies included in this review.

5. Conclusion and policy recommendations

This review confirms that agricultural interventions are a powerful development tool with the potential not only to increase productivity, but also to strengthen resilience, improve food security, promote social inclusion, and generate valuable learning through rigorous evaluation. From a portfolio perspective, the review suggests that the Bank's largest areas of investment, particularly sustainable agricultural development and technology adoption, are also among those for which the evidence demonstrates consistent improvements in productivity, income, and food security when interventions are complemented by technical assistance and adapted to local conditions.

Drawing on 25 impact evaluations of IDB-financed agricultural projects implemented across Latin America and the Caribbean between 2014 and 2025, this study identifies important lessons across intervention types, contexts, and methodological approaches. The findings underscore the importance of accounting for heterogeneity in program impacts, adopting longer evaluation horizons, and recognizing that welfare gains may emerge through multiple and often non-linear pathways. They also highlight the relevance of spillover effects and the growing potential of remote sensing technologies to strengthen impact measurement. These insights point to the need for more context-sensitive, methodologically robust, and forward-looking approaches to agricultural program design and evaluation.

Overall, the following strategic lessons unfold from this review:

1. **Agricultural projects generate benefits beyond productivity.** While increasing productivity remains an important objective, the evidence shows that agricultural programs can improve

food security through multiple pathways, including higher incomes, production diversification, women's empowerment, and reduced vulnerability to shocks. Evaluations should therefore measure a broader set of welfare outcomes alongside traditional productivity indicators.

2. **What works depends on context.** Agricultural interventions do not affect all producers equally. The evidence reviewed shows substantial heterogeneity in impacts across regions, value chains, genders, ethnic groups, and productivity levels. These findings underscore the importance of tailoring interventions to local conditions and systematically measuring heterogeneous effects to better understand what works, for whom, and under what circumstances. Such analysis is essential for improving targeting, maximizing impact, and ensuring that agricultural investments contribute to inclusive development.
3. **Productivity impacts are dynamic and require a long-term perspective.** Evaluation timelines should be aligned with agricultural cycles and the time required for impacts to materialize. Programs should incorporate short-, medium-, and long-term follow-up periods, as well as intermediate indicators that allow testing theories of change and supporting adaptive implementation. Long-term evaluations, including the use of satellite data, are essential for capturing the full range and sustainability of program impacts.
4. **Spillover effects are program impacts.** The evidence shows that agricultural interventions can generate benefits beyond direct beneficiaries, although the timing and magnitude of these effects vary across contexts. Evaluations that focus exclusively on direct treatment effects may underestimate total program impacts and cost-effectiveness. Future evaluations should therefore be designed to identify and measure spillover effects whenever feasible.
5. **Emerging technologies can transform impact evaluation.** Combining remote sensing with traditional survey data can expand the scope, scale, and robustness of agricultural impact evaluations. Beyond productivity measurement, future applications should increasingly incorporate environmental and climate-related indicators, enabling more comprehensive assessments of resilience, sustainability, and long-term development outcomes.

Although the evidence base remains limited for some subsectors, the evaluations indicate that combining complementary investments tends to generate more robust and sustained impacts than isolated interventions. These findings support a portfolio strategy that emphasizes integrated, context-specific interventions while embedding a more systematic learning agenda across the agricultural portfolio. Such an approach would prioritize rigorous impact evaluations in under-studied investment areas, helping to ensure that future operational decisions are informed by a more balanced and comprehensive evidence base.

Moving forward, the successful implementation of these recommendations will require sustained coordination among evaluators, implementers, and local stakeholders. Embracing more granular data, longer-term perspectives, and innovative technologies such as remote sensing will better equip policymakers with the evidence needed to design effective interventions that sustainably increase productivity, strengthen resilience, improve rural livelihoods, and enhance food security. These insights should be integrated directly into the design of targeted, evidence-based policies capable of addressing the multiple challenges facing agrifood systems across Latin America and the Caribbean. By prioritizing adaptive learning and the rigorous measurement of both direct and indirect effects, as well as short- and long-term impacts, the IDB can continue to strengthen the effectiveness, scalability, sustainability, and inclusiveness of agricultural development interventions across the region.

6. References

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Appendix 1

Table A1. Summary of Studies included in the Synthetic Review

Publication	Category	Country	Methodology	Program name and description	Key findings	Publication title	Additionally published in a peer review Journal
Salazar et al. (2018a)	Input and technology transfers—direct transfer	Nicaragua	DiD + PSM	Agrifood Support Program (APAGRO): Producers received different combinations of cows, pigs, sheep, and chickens, and technical assistance on livestock management and commercialization.	**Productivity:** Agricultural output: 60% increase; income from livestock sales: more than 200% increase. **Others:** Household consumption: 18% increase; probability of women's disempowerment: 15p.p. decreased; probability of gender imbalance: 18p.p. decrease; protein intake: 12% increase; food consumption: 11% increase.	Agrifood Support Program (APAGRO).	

Mullally et al. (2019)	Input and technology transfers—direct transfer	Guatemala	RCT (phase-in design)	Recovery of the Natural Capital of the Dry Corridor Region Program: Provision of naked-neck chicken varieties in exchange for completing a poultry extension program.	**Productivity:** No significant effects on egg production or egg sales. **Others:** No detectable effect on household food consumption indicators; significant positive impacts on girls' anthropometric indicators—reduced stunting by 23.5 p.p. and severe stunting by 14 p.p.	All they're cracked up to be?: The impact of chicken transfers in Guatemala.	
Aramburu et al. (2019)	Input and technology transfers—voucher	Dominican Republic	RCT (two-stage random assignment)	PATCA II: Non-reimbursable vouchers to finance a portion (33%–59%) of an agricultural technology chosen by the farmer, including technical assistance. Technologies evaluated: (i) improved pasture technologies and (ii) modern irrigation technologies.	**Productivity/production:** Improved pastures increased agricultural income by 627% over time (only 10% significance); one additional month of exposure associated with 14% increase in income; irrigation had initial negative effects on agricultural income. **Others:** increased technology adoption (by 62%–68%); irrigation associated with a shift in crop portfolios (temporary to permanent crops); limited spillover effects.	Direct and spillover effects of agricultural technology adoption programs: Experimental evidence from the Dominican Republic (PATCA II).	

Salazar et al. (2015)	Input and technology transfers—voucher	Bolivia	IV model using distance to voucher distribution events	CRIAR: Non-reimbursable vouchers covering 90% of the cost of producer-chosen technologies and technical assistance.	**Productivity:** Annual value of production per hectare: 92% increase; net annual agricultural household income: 36% increase. **Others:** Probability of a household being food secure: 32% increase; distance from events strongly reduces likelihood of participation.	Food security and productivity: impacts of technology adoption in small subsistence farmers in Bolivia.	Salazar et al. (2016). "Sowing for food security: A case study of smallholder farmers in Bolivia." **Food Policy**, 65: 32-52.

Salazar et al. (2018b)	Input and technology transfers—voucher	Haiti	Multiple evaluations; RCTs and PSMs	PTTA: Smart subsidies to give farmers vouchers for various inputs (seeds, seedlings, fertilizer, labor tasks) and technological packages for agroforestry.	**Productivity:** Agroforestry technical package subsidies increased the total value of crop production by 38% and profits by 63%; smart vouchers for rice, horticulture, and peanut production had no significant difference on productivity variables or a significant negative impact, which the authors attribute to factors such as climate shocks, implementation challenges, and information gaps that influenced investment decisions. **Others:** No significant difference in food security.	Technology Transfer to Small Farmers Program (PTTA) in Haiti: Implementation, evaluation, and lessons learned.	

González Flores & Le Pommellec (2019)	Input and technology transfers—voucher	Nicaragua	DiD + PSM	PAGRICC: Vouchers to subsidize technological packages and technical assistance to establish agroecology systems.	**Productivity:** Value of production per hectare: increased by US$195 ha. **Others:** Tree coverage increased (22 plants and 3 hectares); number of plants managed with ecoforestry practices increased (1,045 plants); rainwater harvesters increased (from 34% to 44%); volume of water collected increased (204 m^3); number of productive practices adopted increased.	Evaluación de impacto del componente 1 del programa ambiental de gestión de riesgos de desastres y cambio climático (PAGRICC)	
Schling & Pazos (2022b)	Input and technology transfers—voucher	Argentina	IPW and NDVI	PRODAF: Smart subsidies and technical assistance for the adoption of sustainable technologies (PRODAF).	**Productivity:** Positive and statistically significant impacts on yields only for the citrus value chain, with largest effects at 2–3 years; effects on other value chains not statistically significant in most estimations. **Others:** Technology adoption: 21 p.p. increase; credit access: 47 p.p. increase; labor costs for dairy producers: decrease.	The impact of smart subsidies on agricultural production: Innovative evidence from Argentina using survey and remote sensing data	

Salazar et al. (2021)	Input and technology transfers— Voucher	Dominican Republic	DiD + event study methodology ; NDVI + OSAVI	PATCA II: Voucher to purchase modern irrigation technology.	**Productivity:** Dynamic effects on productivity, with increased vegetation indices beginning in year 3 (NDVI and OSAVI used as proxies for productivity); differences between treatment and control dissipate in later years, possibly due to spillovers. **Others:** Evidence suggests spillover effects into neighboring communities.	Using satellite images to measure crop productivity: long-term impact assessment of a randomized technology adoption program in the Dominican Republic.	
Schling et al. (2025b)	Input and technology transfers—credit	Argentina	Synthetic DiD	Revolving loan fund for smallholder dairy farmer associations. The fund provides short-term credit lines to cover input purchases (feed, veterinary products, etc.) and long-term credit lines for capital investments (equipment, infrastructure, etc.).	**Productivity:** Effects not reported; credits for variable inputs showed no significant effect on dairy production; credits used for capital investment increased production by 17.2% the year after the credit was received; larger investment loans had positive production impacts for 3 years after the credit was received (between 11%–17.4%). **Others:** N/A	Evaluación de fondos rotatorios de crédito: Evidencia de la cadena lechera argentina.	

Salazar, et al. (2025)	Input and technology transfers—voucher	Bolivia	Two-phase RCT with randomization at the geographic and community levels with spillover measurement	CRIAR II: Nonreimbursable financial support to cover the cost of an agricultural technology chosen by the producer, and technical assistance.	**Productivity:** Increased value of production for direct beneficiaries (US$946) and indirect beneficiaries (US$466. Spillover effect). **Others:** Increased household income for direct beneficiaries (US$1,691) and indirect beneficiaries (US$528); increased likelihood of technology adoption for direct beneficiaries (+64 p.p.) and indirect beneficiaries (+14 p.p.); increased crop diversification among direct beneficiaries.	CRIAR II: Creation of Agrifood Initiatives (Phase II).	
Gibbons et al. (2016)	Rural infrastructure—irrigation	Argentina	DiD (long term: 12 years)	PROSAP: Construction of irrigation canals	**Productivity:** PROVIAR: production: 9.4% increase;	Programa de Apoyo a Pequeños	

	Input and technology transfer—voucher			PROVIAR: Distribution of vouchers for viticulturists to purchase winemaking inputs such as hail-resistant nets, wood, and wire. Some producers received both PROVIAR and PROSAP.	productivity: 7.7% increase. PROSAP: production: 4.2% increase; productivity: 4.6% increase. PROVIAR+PROSAP: total production: 16.6% increase; productivity: 16% increase. **Others:** N/A.	Productores Vitivinícolas en Argentina (PROVIAR) y Programa de Servicios Agrícolas Provinciales (PROSAP).	
Corral & Zane (2021)	Rural infrastructure—rural roads	Ecuador	DiD and PSM	Chimborazo Rural Investment Project: Rural road improvement.	**Productivity:** No statistically significant effect on agricultural productivity, income, or investments. **Others:** Reduced travel time and costs; improved health outcomes; increased secondary education enrollment at crucial transition ages (13 and 18).	Chimborazo Rural Investment Project: Rural roads component impact evaluation.	
Gibbons et al. (2016)	Rural infrastructure—irrigation Input and technology transfers—voucher	Argentina	DiD (long term: 12 years)	PROSAP: Construction of irrigation canals PROVIAR: Distribution of vouchers for viticulturists to purchase	**Productivity:** PROVIAR: production: 9.4% increase; productivity: 7.7% increase. PROSAP: production: 4.2% increase;	Programa de Apoyo a Pequeños Productores Vitivinícolas en Argentina (PROVIAR) y Programa de Servicios	

				winemaking inputs such as hail-resistant nets, wood, and wire. Some producers received both PROVIAR and PROSAP.	productivity: 4.6% increase. PROVIAR+PROSAP: total production: 16.6% increase; productivity: 16% increase. Others: N/A.	Agrícolas Provinciales (PROSAP).	
Corral & Zane (2020)	Rural infrastructure — Irrigation	Ecuador	DiD	Chimborazo Rural Investment Project: Rehabilitation of irrigation systems in Indigenous highland communities; creation of water-use associations; technical assistance focused on water management.	**Productivity:** Overall crop yields: approximately 33% increase; agricultural income effects were positive but not statistically significant. **Others**: Share of irrigated plots: 10 p.p.; decreased crop sales (suggesting increased self-consumption); reduced food insecurity.	Chimborazo Rural Investment Project: irrigation component impact evaluation.	
Salazar & López (2017)	Rural infrastructure —irrigation	Bolivia	PSM	PRONAREC: Public irrigation infrastructure for use by water-use associations; technical assistance.	**Productivity:** No statistically significant effect on yields; agricultural production value: 60%–70% increase; total household income: 35%–45% increase. **Others:**	PRONAREC Bolivia: National Irrigation Program with a Watershed Approach.	

					Spending on irrigation equipment: 100%–160% increase; use of certified seeds: 80%–90% increase; market access: 20%–30% improvement.		
Schling et al. (2025a)	Rural infrastructure —irrigation	Argentina	Synthetic DiD, PSM, and IPW on NDVI (long-term impact evaluation)	PROSAP III: Rehabilitation of irrigation channels (public infrastructure) in Argentina's wine-producing San Juan province.	**Productivity:** Positive impact on production volume of grapes: 31.4%–53.2% increase; yields: 0.93%–1% increase, with impacts becoming stronger over time- **Others:** Reduced probability of farmers reporting irrigation-related losses; increased area under effective irrigation.	Infraestructura de riego y productividad de los viñedos: evidencia mediante teledetección y diferencias en diferencias sintéticas en Argentina (PROSAP III).	
Schling et al. (2024)	Land regularization and administration	Bolivia, Ecuador, Peru	PSM and SPF analysis	Three national-level land tenure security programs that provided formal land titling for smallholder farmers. Bolivia: Land Management Program for Sustainable Rural Development	**Productivity**: Technical efficiency levels of farmers with legal titles were 38.6% higher than those without titles (effects varied based on country). **Others:** Increased access to credit; increased productive investments.	Land regularization and technical efficiency: an empirical study in Andean countries.	Schling, M., Somarriba, M. S., de Dios Mattos, J., & Huaita, R. C. (2026). Land regularization and technical efficiency in agricultural production: An empirical study in Andean Countries. **Journal of**

				Ecuador: SigTierras Program (in Ecuador) Peru: PTRT			**Rural Studies**, 121, 103912.
Corral et al. (2024)	Land regularization and administration	Ecuador	Double robust estimation (DiD and IPW)	SigTierras: Cadastral mapping to improve land tenure security in Ecuador.	**Productivity:** No statistically significant effects on crop or livestock income. **Others:** Increase in total household income; increase in agricultural wages; no effect on tenure security perception; no effect on land conflicts; no effect on input use.	Effects of land administration: evaluation of Ecuador's Rural Land Administration Program (SigTierras).	
Schling et al. (2023)	Land regularization and administration	Ecuador	Double robust estimation (DiD and IPW)	SigTierras: Cadastral mapping under rural land administration program in Ecuador (including joint titling).	**Productivity:** N/A **Others:** Jointly titled cadastral maps led to increased food security and shifts in production portfolios toward higher-value/higher-nutrition value chains; increased women's off-farm wages and time spent on nonagricultural activities; increased investment in women's business.	The effects of tenure security on women's empowerment and food security: evidence from a land regularization program in Ecuador.	Schling et al. (2025). "The effects of increasing tenure security on women's empowerment and food security: Evidence from Ecuador." **Land Use Policy**, 158: 107695.

Schling & Pazos (2022a)	Land regularization and administration	Peru	IV	PTRT: Effective (self-declared) land ownership by women.	**Productivity:** N/A **Others:** Women's informal land ownership increased crop diversity, reduced time in farm work, and improved household food security by 20 p.p.	Effective land ownership, female empowerment, and food security: evidence from Peru.	Schling & Pazos (2024). "Effective land ownership, female empowerment, and food security: Evidence from Peru." **World Development**, 181: 106680.
Mullally & Maffioli (2014)	Extension services and capacity-building—extension	Uruguay	IPW (long term—8 years)	ULP: Extension program to improve cattle management practices.	**Productivity:** Increased calf production (11.36 and 15.3 calves) and net sales (4.35 calves). **Others:** Net calf sales increased by 4.35 on average; IRR analysis suggests modest effects.	The impact of agricultural extension for improved management practices: An evaluation of the Uruguayan Livestock Program.	Mullally, C. & Maffioli, M. (2016). "Extension and matching grants for improved management: An evaluation of the Uruguayan livestock program." **American Journal of Agricultural Economics** 98(1): 333-350.
Arráiz et al. (2015)	Extension services and capacity-building—associativity	Haiti	DiD + PSM	Haiti Hope Project: creation of producer business groups for mango production, training in mango production and commercializatio n, promotion of Francique mango	**Productivity:** No significant change in production or sales. **Others:** Increased number of Francique trees (export variety) planted; increased adoption of several improved	Planting the seeds: The impact of training on mango producers in Haiti.	

				variety (export variety).	practices (e.g., fencing plot, pruning trees); decreased use of intermediaries; increased participation in producer business groups; authors note short timeframe.		
Carballo et al. (2018)	Extension services and capacity-building	Peru	DiD	ConnectAmericas: online B2B platform that has been explicitly established to foster cross-country trade.	**Productivity:** The use of the platform resulted in additional exports. **Others:** Increased visibility of firms to foreign buyers and holds even if they do not actively look for business opportunities in the platform.	Online Business Platforms and International Trade	Carballo, J., Chatruc, M. R., Santa, C. S., & Martincus, C. V. (2022). Online business platforms and international trade. **Journal of International Economics**, *13 7*, 103599.
Carballo et al. (forthcoming)	Extension services and capacity-building	Costa Rica	Staggered DiD	Digitalization of trade documents (ESW)*: online application and issuance of trade-related permits and certificates through a single website.	**Productivity:** Digitalization increased exports at the implementation level along both the firm intensive and extensive margins. **Others:** Firms using the digitalized procedures exported more and at a higher frequency than non-treated firms. More pronounced effect for smaller firms located in	Trade Policy Meets Digital Technologies: How Digitalization of Trade Procedures Affects Firms' Exports	

					non-central regions and in destinations that also have operative ESWs.		
Salazar et al. (2017)	Animal and plant health	Peru	Geographical regression discontinuity	Fruit Fly Eradication Program: Multipronged program that includes technical assistance on pest eradication, installation of fruit fly traps, application of fruit fly pesticides, release of male sterile flies to prevent reproduction, and implementation of quarantine centers.	**Productivity:** Increased fruit crop productivity and sales. **Others:** Improved farmers' knowledge of pests and adoption of prevention practices.	Estimating the impacts of a fruit fly eradication program in Peru: A geographical regression discontinuity approach.	Salazar et al. (2017). "Sweeping the flies away: evidence from a fruit fly eradication program." **European Review of Agricultural Economics** 47, no. 5 (2020): 1920-1962.
Salazar et al. (2023)	Animal and plant health	Peru	Regression discontinuity and NDVI over 10 years, quantile regression	Fruit Fly Eradication Program: Multipronged program that includes technical assistance on pest eradication, installation of fruit fly traps, application of fruit fly pesticides, release of male sterile flies to prevent	**Productivity:** 12%–49% increase with productivity gains increasing over time. **Others:** Most productive farmers experienced largest productivity increases.	Estimating the long-term effects of a fruit fly eradication program using satellite imagery.	

				reproduction, and implementation of quarantine centers.			

Notes: RCT = randomized controlled trial; DiD = difference-in-differences; PSM = propensity score matching; IV = instrumental variables; IPW = inverse probability weighting; NDVI = normalized difference vegetation index; OSAVI = optimized soil-adjusted vegetation index; SPF = stochastic production frontier.