STDF/PG/577

Improving Capacity Building and Knowledge Sharing to Support Management of Cadmium Levels in Cocoa in Latin America and The Caribbean for Export to the EU

STDF/PG/681

Improving the institutional capacity of Colombia and Ecuador to mitigate trade barriers due to high cadmium levels in cacao

JOINT - END OF PROJECT ASSESSMENT REPORT

30th September 2025

RJB International Consult - Roxane Burstow

Independence of evaluation and conflict of interest statement

This report was produced by Roxane Burstow, an independent consultant and Director of RJB International Consult Ltd. It was commissioned as an independent evaluation by STDF but the opinions and recommendations expressed within are the author's own. The author has no conflicts of interest to declare with regards to this study.

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LIST OF ABBREVIATIONS

AGROSAVIA – Corporación Colombiana de Investigación Agropecuaria (Colombian Agricultural Research Corporation)
ARCSA – Agencia Nacional de Regulación, Control y Vigilancia Sanitaria (Ecuador)
Cd – Cadmium
CIAT – International Center for Tropical Agriculture
CILABsalud – Centro de Investigación y Laboratorios en Salud Colectiva (Universidad Andina Simón Bolívar, Colombia)
CRC – Cocoa Research Centre (Trinidad & Tobago)
DAC – Development Assistance Committee (OECD evaluation criteria)
DECAB – Departamento de Ciencia de Alimentos y Biotecnología (Escuela Politécnica Nacional, Ecuador)
ECA - European Cocoa Association
ESPOL – Escuela Politécnica del Litoral (Ecuador)
EU – European Union
FAO – Food and Agriculture Organization of the United Nations
FEDECACAO – Federación Nacional de Cacaoteros (Colombian Cocoa Growers Federation)
GAP – Good Agricultural Practices
GQM – Grupo Químico Marcos C. Ltda (Colombia)
ICCO – International Cocoa Organization
IICA – Inter-American Institute for Cooperation on Agriculture
INIAP – Instituto Nacional de Investigaciones Agropecuarias (Ecuador)
INM – Instituto Nacional de Metrología (Colombia)
KII – Key Informant Interview
KU Leuven – Katholieke Universiteit Leuven (Belgium)
LAC – Latin America and the Caribbean
MAG – Ministerio de Agricultura y Ganadería (Ecuador)
MADR – Ministerio de Agricultura y Desarrollo Rural (Colombia)
MALF – Ministry of Agriculture, Land and Fisheries (Trinidad & Tobago)
MIDAGRI – Ministerio de Desarrollo Agrario y Riego (Peru, current name)
MINAGRI – Ministerio de Agricultura y Riego (Peru, former name)
ML – Maximum Level (for cadmium in chocolate/cocoa products, EU regulation)
MOCCA – Maximizing Opportunities in Coffee and Cacao in the Americas
NPIA – National Project Implementing Agency
PG – Project Grant (STDF)
PMU – Project Management Unit
PPG – Project Preparation Grant (STDF)
PTA – Project Technical Assistance
QA/QC – Quality Assurance / Quality Control
SENASA – Servicio Nacional de Sanidad Agraria (Peru)
SPS – Sanitary and Phytosanitary (measures)
STDF – Standards and Trade Development Facility
USA – United States of America
WSS EC – World Survey Services Ecuador
WUR – Wageningen University & Research (Netherlands)
XRF – X-Ray Fluorescence (portable analyzer for cadmium testing)

LIST OF TABLES AND FIGURES

PROJECT INFORMATION - 1

STDF/PG/ 577
Title Improving Capacity Building and Knowledge Sharing to Support Management of Cadmium Levels in Cocoa in Latin America and The Caribbean for Export to the EU
Implementing agency The Inter-American Institute for Cooperation on Agriculture (IICA)
Partners Cocoa Research Centre (CRC), Colombian Agricultural Research Corporation (AGROSAVIA), The Ministry of Agriculture and Irrigation (MINAGRI), currently The Ministry of Agricultural Development and Irrigation (MIDAGRI), Instituto Nacional de Investigaciones Agropecuarias (INIAP)
Start date 01/02/2022
End date 30/09/2025, *extension dates: 31/01/2024 to 30/09/2025*
Beneficiaries Colombia, Ecuador, Peru and Trinidad and Tobago
Budget Project Total Value: Contract USD 550,948 | Actual total project value USD 814,119 STDF contribution: USD 381,946 Other contribution: Total in-kind contribution – Contract USD 103,748 | Actual USD 368,743 Total co-financing from EU – Contract USD 65,254 | Actual USD 63,430

PROJECT INFORMATION - 2

STDF/PG/ 681
Title Improving the institutional capacity of Colombia and Ecuador to mitigate trade barriers due to the high cadmium levels in cacao
Implementing agency KU Leuven
Partners International Center for Tropical Agriculture (CIAT), Escuela Politécnica del Litoral (ESPOL), Department of Environmental Sciences Wageningen University & Research (WUR), Corporación Colombiana de Investigación Agropecuaria (AGROSAVIA) (originally planned but eventually dropped out), Federación Nacional de Cacaoteros (FEDECACAO)
Start date 01/09/2020
End date 31/08/2023, *extended to: 31/12/2024*
Beneficiaries Colombia, Ecuador
Budget Project Total Value: US$ 617,999 STDF contribution: US$ 516,989 Other contribution: total in-kind US$ 101,010

1 EXECUTIVE SUMMARY

Project aims and objectives

At the time of project design, new SPS regulations (EU Regulation 488/2014 and California's Proposition 65) posed a major threat to cocoa exports from Latin America and the Caribbean (LAC), due to naturally high cadmium (Cd) levels in Andean soils. Weak institutional capacity, fragmented testing protocols, lack of mitigation strategies, and limited farmer outreach risked market access and rural livelihoods.

Cadmium in cocoa is also a major food safety concern, as elevated levels pose health risks and are subject to strict international regulations. For Colombia, Ecuador, Peru, and Trinidad & Tobago, the resulting trade challenge is ensuring compliance with EU limits on cadmium in cocoa and chocolate products to maintain export competitiveness.

In response, two complementary projects were launched:

- *STDF/PG/577* (2022–2025) (hereafter referenced by PG/577) took a regional approach across Colombia, Ecuador, Peru, and Trinidad & Tobago[1] to build coordination, standardize the Cd testing protocols used across leading research institutions in Latin America and the Caribbean, identify the main drivers of Cd contamination in hotspots, update or create cadmium hotspot maps, and train extension providers through Master Trainers.
- *STDF/PG/681* (2020–2024) (hereafter referenced by PG/681) targeted Colombia and Ecuador, strengthening institutional and laboratory capacity, expanding mapping, and testing context-specific practices to reduce cadmium uptake.

Together, they provided a strategic response to safeguard exports, promote compliance with international standards, and support the competitiveness of the LAC cocoa sector.

Partners and beneficiaries

- PG/577 was implemented by The Inter-American Institute for Cooperation on Agriculture (IICA) through National Project Implementing Agencies (NPIAs) including Cocoa Research Centre (CRC – Trinidad & Tobago), Colombian Agricultural Research Corporation (AGROSAVIA), The Ministry of Agricultural Development and Irrigation (MIDAGRI - Peru), Instituto Nacional de Investigaciones Agropecuarias (INIAP - Ecuador).
- PG/681 was implemented by KU Leuven with International Center for Tropical Agriculture (CIAT), Escuela Politécnica del Litoral (ESPOL), Department of Environmental Sciences Wageningen University & Research (WUR), Corporación Colombiana de Investigación Agropecuaria (AGROSAVIA) (originally planned but eventually dropped out) and Federación Nacional de Cacaoteros (FEDECACAO).
- Beneficiaries included national agricultural and research agencies, laboratories, and extension providers. Indirect beneficiaries were cacao farmers, cooperatives, exporters, and consumers, with cocoa playing a strategic role in rural development, alternative livelihoods, and premium markets across the region.

Governance

[1] Trinidad & Tobago's participation was funded via a separate EU-funded SPS programme, as it is not eligible for STDF support.

Both projects established Project Steering Committees (PSCs):

- Project PG/577's PSC included IICA and FEDECACAO, MALF, MIDAGRI, INIAP supported by country-level coordination mechanisms. The STDF Secretariat, International Cocoa Organization and the European Union, as a co-financier for Trinidad & Tobago were invited to participate in PSC meetings at the Inception, Midterm and End of Project Workshops. The PMU, managed by IICA, oversaw operations, finances, and reporting.

Project PG/681's PSC convened key partners (KU Leuven, CIAT, ESPOL, WUR, FEDECACAO), though the original requesting ministries disengaged early. National institutions such as INM (Colombia) and AGROSAVIA were associated at different points but later withdrew. The STDF Secretariat also participated in some meetings of the PSC.

Methodology

The joint end-of-project assessment was conducted from June to September 2025 through document review, key informant interviews (KIIs), and field missions in Ecuador and Colombia, with additional virtual consultations in Peru and Trinidad & Tobago. Interviews were carried out in English and Spanish, with notes validated by participants. While lessons were drawn jointly, findings were analyzed separately by project.

Findings – PG/577

Relevance (PG/577)

Project PG/577 was highly relevant to national and regional SPS strategies and STDF's goal of safe trade, directly addressing cadmium as a barrier to market access and smallholder livelihoods. Designed through broad stakeholder consultation, it aligned with NPIA priorities in Colombia, Ecuador, Peru, and Trinidad & Tobago, and provided transferable lessons across the region. Activities such as Master Trainer programmes built in practical farmer training, though private sector engagement not factored into project design and the inherited framework from the PPG and early PG development reduced flexibility in some contexts (notably where stakeholders were not involved in early discussions given institutional and staff turnover). The continued importance of cadmium, reinforced by new findings on fertilizer contamination, underlines the lasting relevance of project inputs.

Coherence (PG/577)

The project was coherent with STDF's mandate, addressing a clear SPS trade barrier and aligning with national and regional initiatives on cadmium in cocoa. It complemented parallel efforts such as Clima-LoCa and PG/681, engaging many of the same institutions and experts to support knowledge sharing. Outputs from PG/681, including ring tests (aka inter-laboratory proficiency tests) where multiple labs measure the same blind samples of a matrix (e.g., cocoa, soil, fertilizer, water) for cadmium and compare results to check accuracy, precision, and comparability, and QA protocols, were leveraged by PG/577. This was used to produce harmonized SOPs for cadmium analysis in soils and cocoa bean samples, training materials, and equipment validation. While synergies were strong, coordination between the two projects was largely informal, and some stakeholders noted that a formal mechanism could have further improved integration.

Effectiveness (PG/577)

Output 1 (Regional platform) created a space for NPIAs to share knowledge, catalogued research, and advanced consensus on regional QA standards. Output 2 (Laboratory capacity) produced SOPs, curricula, and training, strengthening national capacity and building on PG/681 results. Output 3 (Mapping) delivered hotspot maps in several countries and revealed fertilizer contamination as a key cadmium source, a planned study on cadmium uptake from cycling of plant material was not implemented. Output 4 (Awareness) proved highly effective, with Master Trainer programs and the “Cd Talks” series raising awareness, improving practices, and enabling regional knowledge sharing.

Efficiency (PG/577)

The project is expected to reach full utilization of the budget, with adjustments made to respond to political changes and technical needs across countries. Management by IICA and NPIAs was generally effective, supported by regular coordination and reporting, though some beneficiaries noted delays in disbursement. Collaboration with PG/681 generated efficiencies, such as savings reallocated to expand technical training, though the lack of a formal joint management framework led to some overlaps. The project delivered a wide range of outputs, including manuals, bulletins, videos, and webinars.

Impact (PG/577)

The project helped reduce cadmium-related trade risks and supported continued market access, with evidence of fewer export rejections in Peru and Ecuador and continued effective risk management in Colombia and Trinidad & Tobago. It strengthened laboratory capacity, with Peru and Trinidad & Tobago achieving accreditation and acquiring XRF and E-Max equipment, which proved to be a significant and impactful innovative technology, reducing reliance on foreign testing. Producers reported improved practices through the Master Trainer program, and recommendations were integrated into national cocoa plans. Trinidad & Tobago developed a farm categorization system which could offer a model for the region. Fertilizer was identified as a major source of cadmium contamination, catalyzing international policy discussions through ICCO and Codex. The project also raised global awareness through “Cd Talks” and contributed to knowledge sharing across the sector.

Sustainability (PG/577)

Sustainability was built into the project, with recommendations intended for integration into national cocoa plans and extension systems. Peru has incorporated results into its sector strategy, while Ecuador and Trinidad & Tobago continue to use protocols, guides, and hotspot maps. In Colombia, stakeholders are institutionalizing practices, and recommendations are expected to be included in the next cocoa plan update. Training materials remain in use by producers, though refresher training is needed. At the regional level, “Cd Talks,” manuals, and mapping tools continue to be disseminated, and IICA is leveraging the project to scaled approaches to other Caribbean countries. Engagement with the EU and follow-on initiatives indicate momentum for continued support.

Unexpected results (PG/577)

The project identified fertilizer as a major source of cadmium contamination, expanding relevance beyond LAC cocoa. Reallocated resources enabled more training and testing, and the approach is now being prepared for replication in the Caribbean.

Findings - PG/681

Relevance (PG/681)

The project was highly relevant, directly addressing a critical SPS gap in Colombia and Ecuador: the lack of reliable laboratory testing for cadmium. It was endorsed at design by ministries and producer federations, reflecting recognition of sector-wide challenges, including weak QA systems, incomplete zoning, and limited knowledge on cadmium risks. While originally considering farm-level mitigation, the project refocused on laboratory QA and mapping, complementing Clima-LoCa's work. Institutional leadership was stronger in Ecuador than Colombia, and practical outputs e.g QA protocols, manuals, and hotspot maps were valued by laboratories and exporters. The introduction of innovative XRF machines further increased relevance by providing affordable, rapid testing capacity, though some components, such as predictive modeling, had limited immediate applicability.

Coherence (PG/681)

The project was coherent with STDF's mandate, focusing on laboratory capacity and testing protocols as a technical complement to PG/577's broader regional scope. Outputs such as ring tests, SOPs for cadmium analysis, and XRF trials addressed a critical SPS gap and were later leveraged by PG/577. Strong collaboration with Clima-LoCa and VLIR was essential, particularly for mapping and field trials that exceeded PG/681's budget, and Clima-LoCa funding enabled purchase of XRF machines now used by national institutions.

Effectiveness (PG/681)

Output 1 (Laboratory QA/QC) established a baseline through ring tests with 25 labs, delivered training and guidelines, and built an initial base for accreditation, though further progress was needed. Output 2 (Mapping) delivered cadmium maps for Colombia and Ecuador, valued by policymakers and companies for sourcing and blending. Output 3 (Mitigation guidelines) was not implemented, as a universal handbook was deemed unfeasible. Output 4 (XRF testing) was a significant result, piloting portable devices that were rapidly adopted and scaled through Clima-LoCa and PG/577. Output 5 (Predictive modeling) expanded the Wiersma model with new soil data, though complexity and late delivery limited direct application.

Efficiency (PG/681)

The project faced early delays due to partner changes and COVID-19 but, with a no-cost extension to 2024, completed activities within budget. Cost savings were achieved by leveraging Clima-LoCa and VLIR field trials and mapping. Tested XRF devices were later purchased under Clima-LoCa. Coordination among partners was efficient, though the absence of an overarching mechanism with PG/577 and Clima-LoCa limited wider gains. Adaptive management such as reallocating funds from the handbook to XRF and modeling led to efficiencies, and outputs were shared with PG/577 to extend reach.

Impact (PG/681)

The project strengthened national SPS laboratory capacity in Colombia and Ecuador, reducing reliance on overseas testing and supporting safer trade. Ring tests and tailored QA support improved laboratory performance, with manuals and SOPs still in use providing a strong foundation for accreditation. National partner labs consolidated roles as reference institutions. Adoption of XRF technology was a significant impact, enabling faster, cheaper, and field-based cadmium testing. Mapping and modeling outputs informed sourcing and blending strategies for private sector actors.

Sustainability (PG/681)

Project results have been embedded in national and private laboratories, with SOPs, QA protocols, and mapping tools still applied. However, disengagement of ministries during implementation limited government ownership. A second ring test was not factored into design; these tests should be government-led and regularly conducted to measure progress (reliance on external funding for this affects ownership and continuity). Dissemination through Clima-LoCa has extended the reach of PG/681 outputs.

Unexpected results (PG/681)

The re-scoping of Output 3 led to major advances through testing XRF technology, regarded as among the project's strongest results. Manuals, guidelines, and mapping tools were shared with industry platforms like CAOBISCO and are feeding into sector reference materials, with dissemination now extending to FAO and a planned 2025 regional event.

Cross-cutting

Neither project systematically integrated gender into design nor monitoring, though participation data was tracked. In PG/681, women represented around 60% of project staff and 61% of laboratory training participants but had lower representation in decision-making roles and digital mapping training. In PG/577, women accounted for 25–31% of training participants in Ecuador and Peru and 48% in Trinidad & Tobago (no data for Colombia). Environmental integration was stronger in PG/577, which promoted soil management practices and sustainable event organization, while PG/681 did not explicitly address environmental issues.

Joint Lessons Learnt (PG/577 & PG/681)

- Institutional anchoring is essential, but political turnover undermined ownership.
- On-farm countermeasures were ineffective; hotspot mapping and XRF use showed stronger results.
- Private sector engagement was limited; dedicated liaison roles proved more effective.
- North–South and South–South cooperation built credibility and regional ownership.
- Train-the-trainer approaches scaled knowledge transfer and adoption.
- Regional platforms accelerated harmonization and dissemination of practices.
- Adaptive management increased project relevance.

Joint Project Conclusions & recommendations (PG/577 & PG/681)

PG/577 and PG/681 strengthened SPS capacity in LAC to address cadmium risks in cacao and delivered complementary results. Both projects contributed to reduced cadmium-related trade risks, greater producer and laboratory capacity, and stronger alignment with international standards. However, constraints such as political instability, weak institutional anchoring (notably in PG/681), and limited private sector participation constrained their sustainability and reach.

- Integrate PG/577 recommendations into national cocoa plans.
- Redirect investment to hotspot mapping, blending, and early tool deployment (XRF).
- Require private sector engagement strategies, with liaison roles.
- Sustain regional platforms and expand cooperation (North–South, South–South).
- Scale train-the-trainer models via extension services and producer associations.
- Develop sustainability plans and financing for laboratories.
- Establish cross-project coordination mechanisms.

2 INTRODUCTION

2.1 Purpose and context (PG/577 & PG/681)

2.1.1 Summary of the SPS challenge and solution implemented

1. At the time of the projects' design, the enforcement of new international sanitary and phytosanitary (SPS) regulations - notably the EU's 2019 Regulation 488/2014 and California's Proposition 65 - posed a threat to cacao exports from Latin America and the Caribbean (LAC), due to maximum limits (MLs) on cadmium (Cd) in chocolate products.[2] Countries like Colombia, Ecuador, and Peru faced particular vulnerability due to the natural presence of cadmium in Andean soils.

2. This situation exposed key deficiencies in the region, including limited institutional capacity, non-harmonized sampling and testing protocols, lack of coordinated mitigation strategies, and weak dissemination of best practices to farmers. These gaps threatened not only market access to the EU and U.S., but also the livelihoods of smallholder cacao producers, especially in regions where cacao served as a substitute for illicit crops and a driver of rural development.

3. In response, two complementary Project Grant (PG) applications were submitted to the Standards and Trade Development Facility (STDF):

    - PG/577: initially conceived under a Project Preparation Grant (PPG) took a regional approach, targeting Colombia, Ecuador, and Peru, with Trinidad & Tobago[3] included for its strong research capacity. It focused on building regional coordination, developing harmonized testing protocols, conducting cadmium hotspot mapping, and training extension services through a network of Master Trainers.
    - PG/681: focused on Colombia and Ecuador, aiming to strengthen institutional capacity, improve surveillance and laboratory systems, advance mapping and zoning, and develop context-relevant Good Agricultural Practices (GAPs) to reduce cadmium uptake in cacao.

4. Together, these projects emerged as strategic responses to a growing SPS threat, designed to safeguard market access, promote compliance with international standards, and ensure the sustainability and competitiveness of the LAC cacao sector.

5. The two project Logical Frameworks including objectives, main outcomes/ outputs, and activities are included below.[4] These were agreed for each respective project with the relevant participating countries and reviewed during implementation. Progress for each at the Output/ Activity levels is described in Sections: Effectiveness (PG/577) and Effectiveness (PG/681), progress at the Outcome level is largely addressed in Sections: Impact (PG/577) and Impact (PG/681). A full list of activities including status of completion as of project end is included in Annex B.

[2] Set threshold limits ranging from 0.10 to 0.80 mg Cd kg^{-1} dry matter, depending on the percentage of raw cacao present in the final product (The European Commission, 2014). There are no limits on Cd in cacao beans but thresholds of 0.6 and 0.8 mg Cd kg^{-1} have been used as values that allow the manufacturing of cacao products meeting the EU Cd limits (Arévalo-Gardini et al., 2017; Barraza et al., 2017; Chavez et al., 2015; Gramlich et al., 2018).

[3] Trinidad & Tobago's participation was funded via a separate EU-funded SPS programme, as it is not eligible for STDF support.

[4] Some of the original logframes' text has been condensed/ paraphrased for presentation purposes.

Figure 1 - Project Logic PG/577

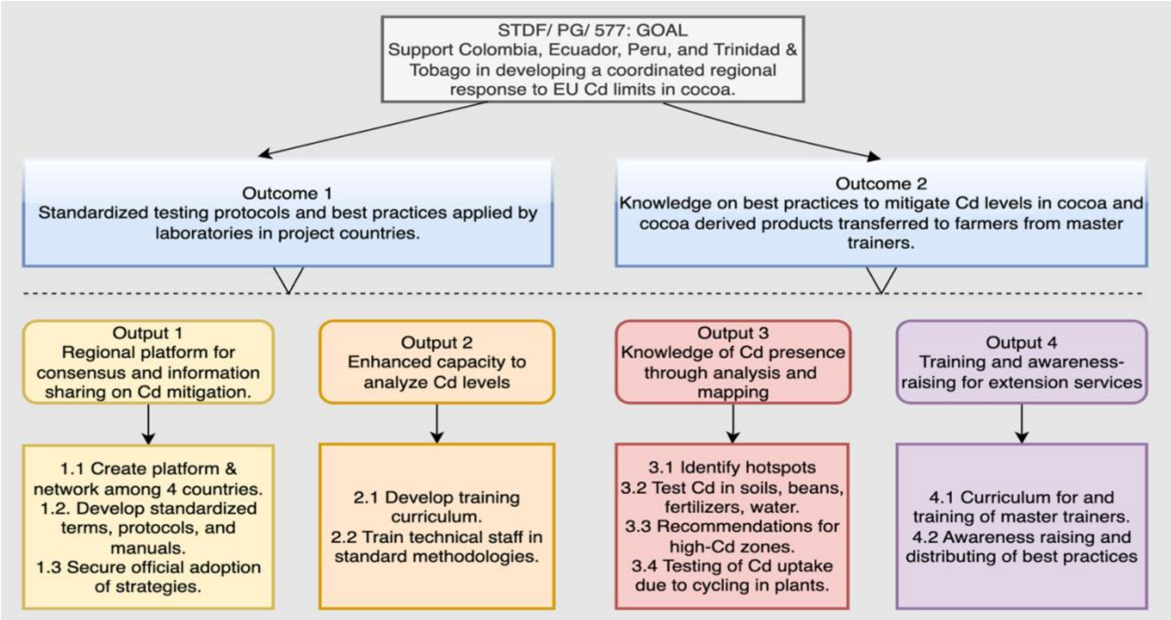
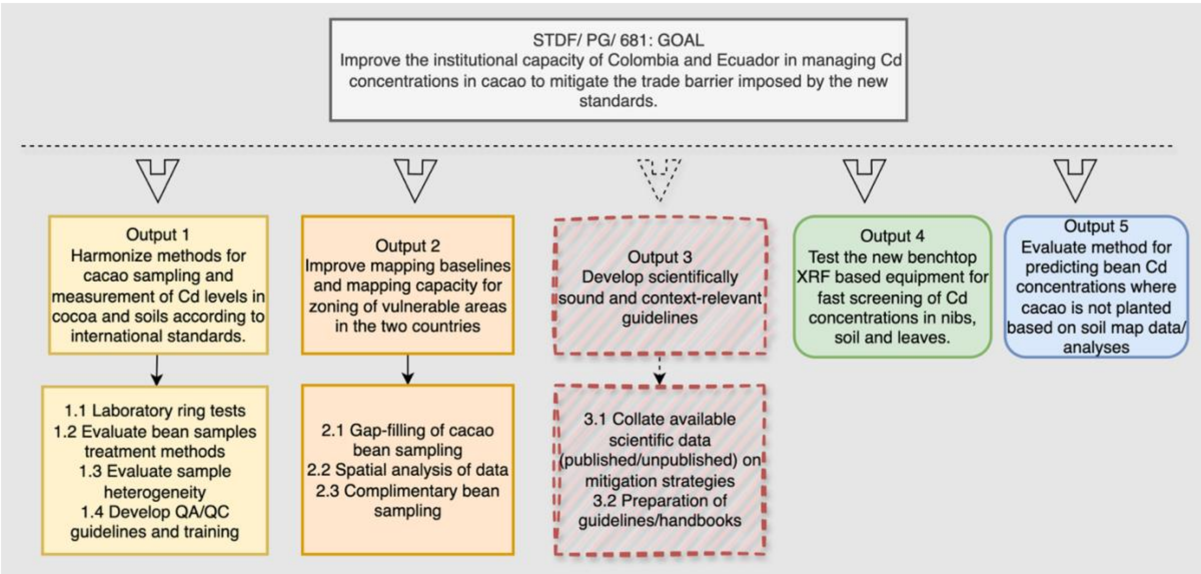


Figure 2 - Project Logic PG/681[5]



2.1.2 Implementation context and alignment with similar national, regional and international priorities and initiatives.

6. The LAC region supplies nearly one fifth of the world's cocoa and is a major producer supplying over 80% the world's fine flavor and organic cocoa with key markets in the EU and USA (PG Application, PG/577). Across the Andean region, around 260,000 farmers cultivate more than 950,000 hectares and produce over 548,000 tons annually (Briefing Note No. 4, Clima-LoCa). In Colombia, 92.6% is consumed domestically, making it both a dietary staple and an industrial driver. In Ecuador, it serves as a major

[5] Output 3 has been shaded out as it was replaced by Outputs 4 and 5. See relevant effectiveness section for details.

export and revenue source. In Colombia and Peru, cocoa plays a role in alternative development and crop substitution. In Trinidad & Tobago, cocoa is important as a source of fine-flavor beans for premium markets.

7. Multi-elemental fingerprinting analysis showed that Cd concentrations in cacao beans from South America were nearly three times higher than those from Central America and East Africa, and ten times higher than West Africa (Bertoldi et al., 2016).[6] Surveys in Peru, Ecuador, and Honduras confirmed that cadmium thresholds were exceeded in localized areas, meaning that upcoming EU regulations would affect a large share of regional cocoa production,[7] with the effects of the regulations on cocoa varying between and within countries due to differences in markets and value chains.[8]

8. At the time of project design and as per the PPG/STDF/577 application document, Ecuador, Peru, Trinidad & Tobago, and Colombia had already launched policies linking cocoa production with rural development, economic diversification, and sustainable livelihoods. These efforts aligned with international food safety standards and positioned cocoa as a driver of poverty reduction, green growth, and alternatives to illicit crops.

9. In Peru, the Family Farming Law and a multisectoral agenda integrated cocoa into strategies for food security, biodiversity, and heavy metal mitigation, complemented by a technical working group of producers, academia, and authorities. Ecuador pursued initiatives through the Plan for Good Living, the Gran Minga Agropecuaria, and a cadmium agenda, while training was promoted as a preventive measure to protect household incomes and market access. Trinidad & Tobago declared cocoa a strategic crop through its "Agriculture Now" strategy, while in Colombia, cocoa featured in the National Development Plan and the Cacaotero Development Plan. Together, these actions underscored cocoa's strategic importance and laid the foundation for coordinated Cd remediation and policy harmonization across the region.

10. In parallel, regional and international collaboration had been growing to support knowledge exchange and collective action. Since 2016, a series of technical forums and symposia had been convened, including the International Cocoa Organization's first Symposium on Cocoa Research in Peru (2017), which showcased findings from Ecuador, Colombia, Peru, and Trinidad & Tobago, and highlighted the urgent need for field-level testing of mitigation strategies. In 2018, the CacaoCdFREE workshop in Colombia and a regional meeting convened by the Swiss Embassy brought together public and private actors from Latin America, Europe, and the USA to define interdisciplinary research plans, harmonize laboratory methods, and explore strategies to mitigate the economic impact of incoming Cd

[6] This regional disparity is linked to underlying soil geochemistry, volcanic activity, and agricultural practices, which make Latin American beans more likely to exceed EU maximum permissible levels than other regions such as Africa or Asia. Consequently, producers and exporters in the region face greater risks of rejected shipments and reduced competitiveness in European markets. Addressing these challenges requires both on-farm interventions (such as soil management, fertilizer use, and shade tree selection) and institutional support for monitoring, training, and market diversification. Vázquez- deCastro, J. L., Chávez, E., Espinel, R., Hendrix, S., Smolders, E., & Maertens, M. (2023). The economic costs of cadmium non- tariff measures for smallholder cocoa farmers in Ecuador. The World Economy, 00, 1–20. https://doi.org/10.1111/twec.13488

[8] Overall impacts have been minor, but localized effects in high-Cd areas can be severe. Farmgate prices remain stable in major production zones, while farmers in Piura, Peru, and Sucumbíos, Ecuador, reported Cd-related price reductions of 31% and 20%. Exporters and cooperatives face operational cost increases of up to 20% for Cd mapping, bean blending, traceability, marketing, and testing. They also face lower prices and foregone incomes from client changes, which is particularly critical for specialized cooperatives in high-Cd areas (Briefing Note No. 4, Clima-LoCa).

regulations. These platforms emphasized the importance of regional cooperation, standardized approaches, and training and extension for farmers.

2.2 Implementing partners and beneficiaries

Project	STDF/PG/577	STDF/PG/681
Implementer	Inter-American Institute for Cooperation on Agriculture (IICA)	KU Leuven
Partners	- Cocoa Research Centre (CRC) - Colombian Agricultural Research Corporation (AGROSAVIA) - The Ministry of Agriculture and Irrigation (MINAGRI), currently The Ministry of Agricultural Development and Irrigation (MIDAGRI) - Instituto Nacional de Investigaciones Agropecuarias (INIAP)	- International Center for Tropical Agriculture (CIAT) Escuela Politécnica del Litoral (ESPOL) - Department of Environmental Sciences Wageningen University & Research (WUR) - Corporación Colombiana de Investigación Agropecuaria (AGROSAVIA) (originally planned but eventually dropped out) - Federación Nacional de Cacaoteros (FEDECACAO)
Target Beneficiaries[9]	Immediate beneficiaries: - Cocoa public sector agencies (e.g. lab facilities that conduct tests for cadmium in cocoa) - Research institutions in project countries - Providers of Extension services to farmers Ultimate beneficiaries: - Cocoa growers and traders of all scales	- Participating national soil chemical laboratories - Ministries of Agriculture of Ecuador and Colombia - Cacao farmers - Cocoa exporters, cacao national and international industry - Chocolate manufactures and consumers

2.3 Governance (PG/577 & PG/681)

Both projects established Project Steering Committees (PSC) to oversee implementation and progress.

Project PG/577: the PSC included representatives from the implementing organization (IICA), FEDECACAO, MALF, MIDAGRI, INIAP, and other stakeholders. It convened regularly, primarily virtually, and occasionally in conjunction with project workshops or related events. The STDF Secretariat, International Cocoa Organization and the European Union, as a co-financier for Trinidad & Tobago were invited to participate in PSC meetings at the Inception, Midterm and End of Project Workshops. Additional stakeholders, such as research organizations linked to parallel initiatives (e.g., PG/681), were invited as observers when beneficial to enhance synergies.

At the national level, country-level steering/coordination mechanisms were set up in Colombia, Ecuador, Peru, and Trinidad and Tobago, involving government agencies and private-sector actors. These included: FEDECACAO and AGROSAVIA in Colombia; INIAP in Ecuador; MIDAGRI in Peru; CRC in Trinidad and Tobago. These bodies were responsible for implementation at the national level, aligning project activities with national priorities, and providing technical oversight.

[9] As per each project PG application.

The Project Management Unit (PMU), managed by IICA, coordinated day-to-day operations, oversaw finances, and ensured timely reporting. Local IICA offices managed stakeholder relationships in-country/ region. Weekly coordination calls and quarterly reporting cycles (to both STDF and the EU) supported monitoring.

Project PG/681: the PSC brought together key stakeholders, specifically representatives from the requesting organizations - the Ministerio de Agricultura y Desarrollo Rural (MADR) of Colombia and the Ministerio de Agricultura y Ganadería (MAG) of Ecuador - as well as representatives of the implementing agencies (KU Leuven, CIAT, ESPOL, Wageningen University & Research). However, the initial requesting organizations MADR and MAG disengaged from the project early on.[10] STDF was also invited to some of the PSC meetings.

The Steering Committee convened regularly, virtually and in person, alongside project meetings and technical workshops. Additional stakeholders were associated at different points of the project. The Federación Nacional de Cacaoteros (FEDECACAO) joined as a project partner after initially being listed as an associate partner. The Instituto Nacional de Metrología (INM) of Colombia also joined as an associate partner, though later withdrew due to internal restructuring and timing constraints. AGROSAVIA, initially included as a partner, did not sign the consortium agreement and withdrew early in the project given sensitivities around sharing sampling data.

3 METHODOLOGY OF THE ASSESSMENT

11. The PG/577 & PG/681 project assessments took place from June 2025 to September 2025. Given the overlapping remits of the two projects, it was decided that the project assessments would be conducted jointly. However, given the distinct approaches and stakeholders, the analysis has been presented separately for a number of evaluation criteria (including for relevance, effectiveness, efficiency, impact & sustainability). Joint project lessons learnt and recommendations have been made and some sections cross-reference both projects.

12. Evidence collection included: a document review; Key Informant Interviews (KIIs) conducted in person and virtually. The evaluation framework developed by the Evaluator provided questions to guide semi-structured interviews with stakeholders which were shared ahead of each interview. Findings were logged in an evaluation matrix against the evaluation questions.

13. The document review and interviews were carried out in both English and Spanish by the Evaluator. The assessment report was drafted in English as per contracting requirements. However, meeting notes shared with project partners and beneficiaries were produced in both English and Spanish as relevant.

14. Ecuador was selected for the field mission based on discussions with the implementing parties. As logistics allowed it, in-person meetings were also held in Bogota, Colombia.

Document Review:

15. A review of all relevant documentation was completed. This included applications and progress reports (e.g. PPG, PG, inception reports, bi-annual progress reports), as well as technical deliverables. Data on

[10] Despite attempts by the implementing agency and STDF to reestablish engagement throughout implementation.

cocoa exports was provided by government authorities in Ecuador and Peru and is included in Annex E. A full list of documents is provided in Annex C.

Key Informant Interviews (KIIs):

16. 13 KIIs were carried out per project (a total of 26 interviews - including 4 women and 9 men for PG/577; and 5 women and 8 men for PG/681) with government authorities, cocoa producers, public and private research laboratories, and private sector representatives (e.g. cocoa warehouses). This included 3 in-person interviews covering both projects (with AGROSAVIA, FEDECACAO and STDF representatives).

17. To attempt to mitigate any bias, the project evaluator highlighted to each interviewee the importance of providing unbiased and independent responses and confirmed the anonymity of information shared. Interview notes were also shared with beneficiaries to confirm they represented an accurate representation of what was discussed and request clarifications where relevant.

18. KIIs took place in person in Colombia (Bogota) and Ecuador (Quito, Guayaquil, Quevedo and a site visit to a cocoa producer in Ventanas) on the week of the 4th – 8th August 2025. Additionally, the Evaluator attended the opening event of La Cumbre de Cacao 2025 which coincided with the Evaluator's visit to Guayaquil.

19. Further interviews took place virtually with the implementing parties (IICA and KU Leuven), project partners (representing WUR and CIAT), as well as NPIAs in Peru and Trinidad & Tobago (MIDAGRI and CRC). A full list of consulted stakeholders is provided in Annex D.

Data Limitations:

20. The joint nature of the assessment involved undertaking two project reviews concurrently, and required careful consideration to distinguish results attributable to each project as well as consolidate joint lessons, which increased the overall workload.

21. The assessment was carried out in a short time window, which condensed research time and restricted the number of stakeholders reached. The timing of the assessment over the summer break affected availability of some stakeholders.

22. KII limitations:

    - Some government officials interviewed in Ecuador and Peru were not involved in the original design of PG/577 due to the long gap between design and implementation and subsequent institutional changes in both countries. Given Ministry (e.g. MADR and MAG) disengagement in the PG/681 project, interviews were not possible with these stakeholders.
    - Private sector perspectives were limited in both projects. The evidence base was therefore weighted more heavily toward public sector sources. For PG/577, private sector KIIs were not carried out as the stakeholder list prioritized participating public sector agencies (who were the key beneficiaries). Under PG/681, two cocoa warehouses were interviewed, though their role in the project was limited.

- For PG/577 producer perspectives were largely restricted to Ecuador, with only two Master Trainer participants available for KII. No producers were consulted in the other participating countries, as the field mission focused on an Ecuadorian farm.
- For PG/681 two sample laboratories participating in the ring test were suggested in Ecuador (outside of project partners), with one unavailable for interview given staff turnover since the ring test completion. However, the Evaluator was able to visit and interview other laboratories that were part of public/ research institutions heavily engaged in the projects (e.g AGROSAVIA, INIAP, ESPOL).

23. Short project implementation cycles limited observation of long-term outcomes, especially for a permanent crop such as cacao. Although data was shared around number of rejections related to cadmium and trade data for cacao exports any positive correlation was difficult to attribute to the project given other contributing factors (e.g. increased demand for cocoa products in LAC given African supply issues).

4 FINDINGS AND ANALYSIS

4.1 Findings (PG/577)

The terms of reference for this assessment set out a relatively long list of evaluation questions. For ease of presentation here, findings are set out by DAC criteria instead of by question. Key findings are summarized for each criterion, followed by a fuller discussion.

4.1.1 Relevance (PG/577)

Project PG/577 was highly relevant to national and regional SPS strategies and STDF's goal of safe trade, directly addressing cadmium as a barrier to market access and smallholder livelihoods. Designed through broad stakeholder consultation, it aligned with NPIA priorities in Colombia, Ecuador, Peru, and Trinidad & Tobago, and provided transferable lessons across the region. Activities such as Master Trainer programmes built in practical farmer training, though private sector engagement (which was not a direct beneficiary) was limited and the inherited framework reduced flexibility in some contexts. The continued importance of cadmium, reinforced by new findings on fertilizer contamination, underlines the lasting relevance of project inputs.

24. Overall, the project's objectives and activities were well aligned with national and regional SPS strategies, as well as the stated priorities of NPIAs in all four countries. Each NPIA identified cadmium contamination in cocoa as a barrier to market access, with potential impacts on smallholder livelihoods and export competitiveness. For cocoa-exporting countries in the Andean region and parts of the Caribbean, the regulation posed clear commercial risks. From the perspective of STDF, this was an SPS issue with direct trade implications, making it a priority.

25. The initiative addressed this priority through a regional approach. It sought to raise awareness by strengthening collaboration and information sharing between the research community and cocoa extension service providers, while also convening stakeholders to agree on a regional testing protocol

and common terminology for determining cadmium levels in cocoa beans destined for the EU market. This approach could be replicated in other fine-flavor cocoa-producing countries in LAC.

26. As per the project documentation, the project was designed in consultation with a broad range of stakeholders through the PPG[11] and resulting PG. The International Cocoa Organization (ICCO) initially led the design to develop a regional strategy covering countries affected by naturally high cadmium in soils.[12] Colombia, Ecuador, and Peru were ultimately selected for their research and management capacity on heavy metal issues in cocoa, while Trinidad & Tobago was included for its strong research base, suitability for pilot interventions, and the CRC's germplasm collection. Together, the countries offered both technical expertise and opportunities to generate lessons transferable across the region.

27. Logframes and budgets were developed per country. There was some adaptation in terms of activities (for example, Ecuador had pre-existing hotspot mapping and was not engaged in this activity). Steering Committees were composed of senior decision-makers from the national cocoa sectors of each project country, and research institutions were heavily engaged. Given the key role of NPIAs in leading the technical delivery of the projects, implementation adaptations were directly proposed by each agency and therefore closely aligned with national needs.

28. The project engaged directly with NPIAs, with project recommendations intentionally developed to feed into national cocoa strategies and sector plans. Early letters of commitment were provided by NPIAs to this effect. However, the long lag between the PPG and PG phases,[13] coupled with political, institutional, and personnel changes at country level, led to delayed start-up and affected ownership for some beneficiaries. This was most evident in Ecuador and, to a lesser extent, Peru which both experienced political changes and institutional restructuring.

29. The PMU platform helped sustain engagement during the start-up period, enabling stakeholders to exchange information, advance technical discussions, and start building consensus in the interim.

30. The Master Trainer activities were seen as particularly relevant across all four NPIAs given the need for practical training for small-scale producers. In Colombia, FEDECACAO, representing 38,000 producer families, approximately 70% of all producers (Abbot et al., Cacao for Peace, 2018), specifically highlighted the need for practical, farmer-oriented training and awareness. This was also confirmed by producer KIIs in Ecuador. While they had not yet faced confirmed rejections, awareness of the risk was high, and training was viewed as important to safeguard market access and household incomes, with cocoa as their main cash crop.

31. Engagement with the private sector was comparatively limited and not systematically built into project design or governance structures. However, some industry participation was achieved through the platform, which contributed inputs through the "Cd Talks" series (e.g. Casa Luker a major cocoa player

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[11] To develop this project proposal, a gap analysis was completed which reviewed the research carried out on cocoa and cadmium in the LAC region. Extensive consultations were held including a workshop in Lima, Peru (July 2017) at which stakeholders presented the current state of knowledge and research capabilities in the field of heavy metal contamination, breeding and biotechnology of cocoa.

[12] This initially focused on three countries for which presence of Cadmium in cocoa had been identified in some areas: Ecuador, Trinidad and Tobago and Peru. In addition, the situation in the Dominican Republic, Nicaragua and Venezuela was reviewed for possible inclusion (Application, PPG/ STDF/ 577).

[13] Linked both to ICCO's internal governance processes and the COVID-19 pandemic.

in Colombia). This brought private sector perspectives to the project, though broader and more consistent engagement with industry players would have enhanced relevance.

32. While the project remained relevant during implementation, some respondents noted that the inherited framework from the PPG restricted flexibility. For instance, respondents in Ecuador stated that local realities, such as security problems in some cocoa areas and variations in institutional capacity, were not fully considered in the initial plans and impacted implementation.

33. Some project adaptations were made to realign with project realities during delivery, for instance when an impasse was reached on creating one standardized regional protocol under the Platform, the project pivoted to country-appropriate protocols, using available evidence and existing work. Separately, activity 3.3 testing of cadmium uptake due to cycling of plant material was deemed unfeasible and funds reallocated.

34. The cadmium issue remains active and highly relevant. New findings, such as fertilizer contamination, confirmed the ongoing need for work in this space and lasting relevance of project inputs.

4.1.2 Coherence (PG/577)

The project was coherent with STDF's mandate, addressing a clear SPS trade barrier and aligning with national and regional initiatives on cadmium in cocoa. It complemented parallel efforts such as Clima-LoCa and PG/681, engaging many of the same institutions and experts to support knowledge sharing. Outputs from PG/681, including ring tests and QA protocols, were leveraged by PG/577 to produce harmonized SOPs, training materials, and equipment validation. While synergies were strong, coordination between the two projects was largely informal, and some stakeholders noted that a formal mechanism could have further improved integration.

35. Project PG/577 was coherent and well aligned with STDF's mandate and theory of change. It addressed a clear SPS trade barrier with direct market implications, adopted a regional and collaborative approach, and generated technical outputs (e.g., SOPs, training curricula, mitigation guidelines). The evidence also suggests strong alignment with other initiatives targeting cacao in cadmium. This is true both in terms of other national and regional initiatives, as well as externally funded projects.

36. In terms of external initiatives, PG/577 was implemented in parallel with and/ or built on several other efforts in the region, such as Clima-LoCa (EU DeSIRA), Cacao for Peace (USAID, Colombia), VLIR (Flemish Association for Development Cooperation and Technical Assistance (VVOB), the Maximising opportunities in coffee and cacao in the Americas (MOCCA) project, as well as the parallel STDF PG/681 project. The PMU was mindful to avoid duplication with these initiatives.[14] Nevertheless, coherence was achieved as many of the same institutions and experts were engaged across several initiatives, allowing for knowledge sharing.

37. The two STDF projects PG/577 and PG/681 were closely linked in practice. Both operated in Colombia and Ecuador. Project PG/577 was conceived first as a broader regional initiative, but delays in approval

[14] For instance, Clima-LoCA had a different thematic focus on climate resilience and agroforestry systems, whereas Project PG/577 concentrated on cadmium mitigation rather than climate-smart practices, resulting in limited overlap. Some interaction occurred through Project PG/681, which was linked to Clima-LoCA, but Project PG/577 itself had limited engagement. Coordination with Cacao for Peace, also avoided duplication, as this project emphasized production-level interventions and promoting cocoa as a substitute crop, without SPS or cadmium-related components.

affected kick-off. In parallel, KU Leuven, already active in cadmium-focused research through partnerships like VLIR, submitted a proposal for Project PG/681. This narrower intervention targeted a technical gap in terms of laboratory capacity building and the standardization of testing protocols, giving countries a way to move forward on laboratory work ahead of PG/577 project start. STDF approved Project PG/681 based on its technical relevance and readiness, on the condition that it coordinate with PG/577 to ensure alignment and avoid overlap.

38. Project PG/681 conducted laboratory ring tests and developed QA protocols. Project PG/577 subsequently leveraged these outputs to create harmonized SOPs, training curricula, and manuals tailored for laboratory technicians. While the projects maintained complementarity, their approaches differed: PG/681 produced more general laboratory guidelines, whereas PG/577 aimed to develop stakeholder-specific guidance. The manuals referenced each other but remained distinct.[15] Project PG/681 also shared reference samples of cocoa liquor with consensus values of cadmium, processed the data of the laboratories involved in PG/577, and provided the NPIAs with a comparable training given to the participating PG/681 laboratories. Participants in the proficiency tests of both projects received additional reference samples to support continued QA.

39. Collaboration also took place on equipment validation (E-Max machine trials). Under PG/577, Colombia, through AGROSAVIA, was the first to trial the E-Max analyzer for cadmium. Tests comparing E-Max with AAS and ICP machines showed over 95% correlation with standard methods, providing a strong case for adoption of this innovative technology.

40. Despite these synergies, coordination between PG/577 and PG/681 remained largely informal, with no overarching governance structure established between the two projects. Some respondents felt that formal mechanisms could have improved integration of lessons from PG/681 into PG/577.

4.1.3 Effectiveness (PG/577)

> Output 1 (Regional platform) created a space for NPIAs to share knowledge, catalogued research, and advanced consensus on QA standards. Output 2 (Laboratory capacity) produced SOPs, curricula, and training, strengthening national capacity and building on PG/681 results. Output 3 (Mapping) delivered hotspot maps in several countries and revealed fertilizer contamination as a key cadmium source, a planned study on cadmium uptake from cycling of plant material was not implemented. Output 4 (Awareness) proved highly effective, with Master Trainer programs and the "Cd Talks" series raising awareness, improving practices, and enabling regional knowledge sharing.

See activity table Annex B for progress.

Output 1.1 Regional platform established on standardized testing protocols by lead research agencies from Colombia, Ecuador, Peru and Trinidad and Tobago (largely achieved).

41. *Activity 1.1 Platform to share knowledge and methodologies across the region and relevant knowledge systematized****.*** A regional platform was created to bring together NPIAs, with literature on cadmium

[15] According to KIIs an introductory chapter was added to both manuals clarifying their differences and specifying which laboratories would benefit most from each.

mitigation catalogued and organized into a KOHA database containing 140 entries.[16] The platform provided a space for multi-stakeholder dialogue and knowledge sharing, fostering early engagement despite delays in Ecuador and Peru formally joining.[17] The value of the platform was in allowing NPIAs to build consensus on regional SOPs for cadmium analysis, share sensitive information, as well as supporting the development and dissemination of key project deliverables. KIIs indicate that a single regional testing protocol was ultimately not adopted, but convergence was reached on QA standards. In addition, five seminars took place on different topics of interest bringing in industry perspectives.

Output 1.2: Technical staff trained in agreed standardized protocols to analyze cadmium Levels in cocoa and cocoa products (achieved leveraging PG/681 results).

42. *Activity 1.2 Standardized terminology and methodologies for measurement and management of cadmium in cocoa.* A standardized glossary of cadmium-related terminology was created and included in the training manual.

43. *Activity 1.3 User appropriate manual and official endorsement of updated national strategies.* Consensus was achieved on nine national cadmium mitigation strategies for integration into national cocoa plans. Governments provided formal letters of response, demonstrating political buy-in, although the degree of formal adoption varied (see Sustainability (PG/577)). Research on mitigation strategies for managing cadmium in beans is still ongoing.

44. ***Output 2 Enhanced and standardized Capacity to Analyze Cadmium Levels (achieved).***

45. *Activity 2.1 – Curriculum and Technical manual with agreed standards and reference materials for sampling and analysis methodologies.* An SOP manual and training curriculum was developed for cadmium analysis in soils and cocoa beans, drawing directly on QA protocols from Project PG/681. These were adapted to fit different laboratory setups, ensuring flexibility across national contexts.

Activity 2.2 – Training technical staff within and between project partners in use of standard methodologies. This activity planned to train eight technicians on standard methodologies but was revised once consensus emerged to adopt NPIA laboratory methodologies that met or exceeded the QA benchmarks established under PG/681. This enabled scaling up to approximately 80 technicians (26 women; 54 men).[18] KIIs confirmed that use of the technology by trained technicians is ongoing in the laboratories that have acquired the E-max.

Output 3 Improved Knowledge of Cadmium Presence in Cocoa Growing Areas Through Analysis and Mapping (partially achieved).

46. *Activity 3.1 Updating maps of cadmium contamination in identified hotspots.* This activity produced the first cadmium hotspot map in Colombia, identified new hotspots in Peru and Trinidad & Tobago updated their national maps. Ecuador did not participate given its existing mapping

[16] As per reporting, this database is currently restricted for internal use allowing project members to openly share published and unpublished research and grey literature to support consensus-building.

[17] Webinars and seminars were organized to build a shared understanding across scientific, industry, and public sectors, while research papers and data formed the evidence base for SOP development. A dedicated Koha database was created, cataloguing over 140 research entries, which provided a consolidated reference source for regional stakeholders.

[18] Individuals were trained in standardized cadmium testing techniques in standardized cadmium testing protocols for cocoa soils, plant tissues, and final products using the ICP-MS and/ or the E-max.

work under other projects (however KIIs suggested that revisiting the maps/ collecting new sampling data could have been beneficial). Results from these efforts were also published in peer-reviewed literature.

47. *Activity 3.2 – Implement a programme of coordinated testing for cadmium in cocoa, soils, fertilizers and water to complete the mapping.* Coordinated testing for cadmium in cocoa, soils, fertilizers, and water testing broadened the scope of understanding cadmium drivers and demonstrated the global relevance of fertilizer as an important source of cadmium contamination, beyond natural or geological origins. This finding was considered one of the most significant project contributions.

48. *Activity 3.3 – Devise appropriate mitigation recommendations for high cadmium areas (hotspots)* Recommendations were developed and applied in some countries. For example, Trinidad & Tobago used mapping results to develop a farm categorization approach, providing a basis for policy and management decisions at the national level.

49. *Activity 3.4 - Testing of cadmium uptake due to cycling of plant material.* This activity, proposed by Peru, was not implemented. An internal review determined that the experimental design was flawed and could not adequately answer the research questions. The resources were instead redirected to Activity 4 and to additional testing, showing adaptability in project management.

50. ***Output 4 Awareness on Cadmium Issues Among Stakeholders in the Cocoa Supply Chain (achieved).***

51. *Activity 4.1 Curriculum developed and trained Master Trainers from cocoa extension providers*

	Total Trained/ Reached	Men	Women
Master Trainers	30		
Extensionists	173	132	41
Farmers/Producers	2309	*1539**	*769**
*Estimated figures as evidence suggests men outnumbering women by at least 2:1			

Table 1 - Master Trainer Results

52. This activity was consistently highlighted in KIIs as one of the project's most effective components. A total of 30 Master Trainers were trained using a comprehensive curriculum and manual developed by NPIAs in Ecuador,[19] specifically designed for accessibility across LAC.[20] Evidence from Ecuador confirmed that Master Trainers effectively transferred knowledge to farmers, with strong uptake of recommended practices, demonstrating long-term impacts at the producer level. The training guide developed by INIAP was adapted to develop a national curriculum in Trinidad & Tobago resulting in regional knowledge sharing.

53. *Activity 4.2 Awareness-raising and distributing of best practices* The "Cd Talks" webinar series included 5 webinars and 2 expert-led presentations and reached 217

[19] The tools were developed by Ecuador through INIAP. Technical guides for farmers were adapted into practical tools for Master Trainers, covering: use of low-cadmium cocoa clones; application of lime to raise PH and immobilize cadmium; management of shade trees to influence soil chemistry; avoidance of fertilizers with high cadmium content; proper management of leaf litter and compost. Following their development, a direct evaluation was conducted with lead trainers and farmers, testing their practical use in Santo Domingo and the Amazon region.

[20] Selected sections were later translated into French for use in Haiti.

(105 females and 112 males) participants from 32 countries, with high engagement, and remains accessible online on the IICA repository. It was effective in engaging regional and international representatives, including from the private sector, to share industry best practice in cadmium management.

54. Activities related to 5.1 -5.3 Workshops & Results Dissemination; 6.1-6.2 Project Coordination, Monitoring & Evaluation are addressed in the efficiency section as they closely relate to PMU functions.

4.1.4 Efficiency (PG/577)

> The project is expected to reach full utilization of the budget, with adjustments made to respond to political changes and technical needs across countries. Management by IICA and NPIAs was generally effective, supported by regular coordination and reporting, though some beneficiaries noted delays in disbursement. Collaboration with PG/681 generated efficiencies, such as savings reallocated to scale technical training, though the lack of a formal joint management framework led to some overlaps. The project delivered a wide range of outputs, including manuals, bulletins, videos, and webinars.

55. Project PG/577 was implemented between February 2022 and September 2025, with a no-cost extension granted from January to September 2025. As of February 2025, $305,941.29 (80%) of the implementation budget and $32,871.68 (95%) of overhead costs were expended, totaling $338,813.1 or 89% of the overall budget. These figures are currently being reconciled with outstanding invoices to be received from AGROSAVIA and the other IICA Delegations representing the NPIAs. It is expected that at least 99.5% of the budget will be utilized.

56. Adjustments to activities and budget allocations were made throughout the implementation period in response to changes in country contexts and technical requirements. For instance, in Colombia, resources were redirected to cover additional sample analyses under Activity 2. In Ecuador, delays linked to political turnover and late mobilization of the NPIA led to a reallocation from Activity 1 to Activity 3. In Peru, adjustments within Activities 3 and 4 supported training of master trainers.

57. Project management was carried out by IICA as regional coordinator, in collaboration with NPIAs which oversaw individual country workplans from a technical perspective. Weekly coordination meetings and quarterly reporting to STDF (and the EU for Trinidad & Tobago) were used for monitoring and adjustments. Institutional changes in Ecuador and Peru, such as the replacement of MAG with INIAP, were addressed through reallocation of responsibilities.

58. Evidence indicated that project management was generally viewed positively, although some beneficiaries expressed concerns about low budget allocations and uneven distribution between countries. Reporting requirements were noted by one respondent as onerous, citing monthly frequency. For field activities, it was noted by a beneficiary that delays in budget approvals and disbursements had affected implementation.

59. Collaboration with project PG/681 led to efficiencies as highlighted under sections related to coherence & effectiveness. For instance, savings under Activity 2.2 allowed the project to reallocate funds to significantly expand technical training. As per KIIs, the absence of an overarching management

framework and formal joint workplan between the two projects led to some overlaps in engagement with the same stakeholder groups for STDF.

60. In terms of Workshops and Results Dissemination, eight Bulletins, two Manuals, one peer review publication, six videos and five webinars with video summaries and Q&A were produced.

4.1.5 Impact (PG/577)

The project helped reduce cadmium-related trade risks and supported continued market access, with evidence of fewer export rejections in Peru and Ecuador and continued effective risk management in Colombia and Trinidad & Tobago. It strengthened laboratory capacity, with Peru and Trinidad & Tobago achieving accreditation and acquiring XRF and E-Max equipment, reducing reliance on foreign testing. Producers reported improved practices through the Master Trainer program, and recommendations were integrated into national cocoa plans. Trinidad & Tobago developed a farm categorization system which could offer a model for the region. Fertilizer contamination was identified as a major source of cadmium contamination, catalyzing international policy discussions through ICCO and Codex. The project also raised global awareness through "Cd Talks" and contributed to knowledge sharing across the sector.

61. Both interviews and reports suggest that the project has helped maintain market access by reducing cadmium-related risks. While further quantification of trade outcomes is necessary (for instance, to measure the costs derived from mitigation strategies and laboratory controls)[21] the combined evidence suggests the project has produced tangible impacts including: positive correlation of applied measures to low export rejections, strengthened laboratory and institutional capacity, improved farming practices, and catalyzed international regulatory discussions.

62. In terms of reduced export rejections, the evidence was positive, with some stakeholders noting that project interventions likely contributed to this outcome.

- In Peru, stakeholders noted that prior to the project there had been 2–3 recorded container rejections related to cadmium since EU regulations came into force, whereas no new cases have been reported since. This was perceived to be the result of greater control in lot selection and improved monitoring practices, and a positive link was made with project outputs.
- In Ecuador, one export rejection has been recorded since project start,[22] as potential issues are detected during sample analysis. KIIs suggested the project could have contributed to this outcome through awareness-raising, training, and the development of practical guidance.

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[21] KIIs revealed that a cost estimation study, carried out by MAG technicians in Ecuador in 5 collection centers and 5 companies, measured the additional costs derived from mitigation strategies and laboratory controls. The analysis was based on 1,600 validated surveys (from an initial total of 1,900). This collected baseline data has not been published due to political changes and lack of financing. The original plan, developed under VLIR, was to compare "before" and "after" costs; however, the follow-up phase was not completed when the Ministry closed programs. Even so, the baseline data remains valuable and, with financing, could serve as the basis for a continuation study.

[22] This corresponds to Notification 2023-3177, communicated through Official Letter No. MPCEIP-SN-2023-0272-O, dated May 16, 2023, and addressed jointly with the National Agency for Regulation, Control and Sanitary Surveillance (ARCSA). The notification reports the following: Operator: Asociación Agroartesanal de Producción de Bienes Agrícolas, Pecuarios y Piscícolas de Napo – KALLARI. Product: Dark fine chocolate Sacha 85%. Contaminant identified: Cadmium. Detected concentration: 1.48 mg/kg (ppm). Sampling date: March 29, 2023.

- In Colombia, only one case of Cadmium related export rejection was reported by respondents (in 2024), it is otherwise effectively managing risk.
- In Trinidad and Tobago, exporters manage risk through targeted sourcing and blending from non-affected areas, and no rejections have occurred to date, however this could be attributed to pre-existing practices.

63. Data on cacao production was shared by Ecuador and Peru (Annex E). This shows an increase in exports however this is difficult to attribute as a project outcome given contributing factors (e.g. supply problems in Africa cocoa market increasing demand in LAC, and global price increase making the crop more attractive to regional producers).

64. Nine recommendations were developed in discussion with NIAPs in Colombia, Ecuador, Peru and Trinidad and Tobago to be included in national cocoa sector plans (see Annex F for full recommendations). Several NPIAs have formally integrated cadmium monitoring into their cocoa sector plans drawing on the project recommendations (see section Sustainability (PG/577)) representing a lasting impact.

65. KIIs revealed that expanded hotspot mapping led to approx. 100 additional farms sampled in Trinidad & Tobago. Reporting confirmed that a farm categorization system was developed linking environmental factors to cadmium levels in beans. This framework supported an intervention matrix linking contamination severity with targeted strategies, offering a model (and potential regional manual) that could inform mitigation in Andean smallholder contexts.

66. Producers in Ecuador reported improvements in practices following capacity building through the Master Trainer program. These included cessation of burning waste, avoiding drying beans on asphalt, improved soil management (organic matter, fungi, microorganisms), and the use of organic and mineral fertilizers that contributed to cadmium reduction. One producer indicated that his farm had already shifted away from chemical inputs toward organic production prior to the project, which helped improve yields (from approx. 30 to 50 quintals per hectare annually) and enhance soil biotic health. The training in 2023 built on this foundation, providing additional tools and knowledge specifically focused on reducing cadmium risks.

67. There was also active knowledge sharing. For example, another Ecuadorian producer highlighted poor local post-harvest practices and questioned buyers who continued to accept such practices following the training. Producers also noted awareness that future regulations may extend beyond cadmium to metals such as aluminum and nickel. Farmers expressed commitment to preventive action and openness to applying similar mitigation methods. In Peru KIIs indicated that personnel from NGOs (e.g. Solidaridad) had been included as part of the Master Trainer program and had transferred knowledge to producers via their ongoing field activities.

68. The project resulted in consensus on SOPs for cadmium analysis in soils and cocoa bean samples and valuable outputs (e.g. standardized glossary and adapted manuals). We note that this outcome heavily leveraged results from PG/681. At the laboratory level, notable gains were observed for Peru and Trinidad & Tobago (countries common to PG/577 and PG/681 will be covered in Section Impact (PG/681)). KIIs suggest the SENASA and INIA laboratories in Peru achieved INACAL accreditation

(including for cadmium analysis) following the project, which strengthened their credibility. This certification has reduced the need to send samples to international laboratories, which in turn has reduced costs for producers and exporters using their services.

69. National laboratories in both countries have also acquired XRF technology. In Trinidad & Tobago, the installation of the E-MAX analyzer, purchased by MALF as a result of project recommendations, has increased the national laboratory's capacity, with faster turnaround and reduced testing costs. [23] In Peru, NPIAs purchased the E-Max through Clima-LoCa funds.

70. The fertilizer results show that cadmium levels in inputs are a significant concern across all four countries, though with varying severity. In Colombia, fertilizers often contained more Cd than the soils themselves, pointing to a major source of bean contamination. In Ecuador, over 13% of samples exceeded the national limit, underscoring the urgent need for tighter monitoring and regulation. Peru showed the most extreme cases, with some fertilizers containing up to 75.9 mg/kg Cd—among the highest levels recorded—posing a serious contamination risk. While Trinidad & Tobago had lower values than the Andean countries, fertilizers there still contribute to Cd build-up in soils and beans. (see Annex G for full per country results). [24]

71. The findings around fertilizers as a source of contamination catalyzed wider international action. The PMU was invited to share findings on cadmium contamination levels in fertilizers at the ICCO's FSWG meeting in June 2024, which was attended by the Codex Working Group on Contaminants.[25] The full project results were subsequently shared with ICCO, and findings are now documented in the public domain. Fertilizer findings may have relevance beyond cocoa, since contamination affects multiple crops.

72. The "Cd Talks" webinar series had a global impact, raising awareness among stakeholders and informing policy discussions. KIIs revealed that the learnings have since been leveraged and shared in non-related projects on farmer training and extension by a previous project expert.

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[23] We note that national labs in Colombia and Ecuador also acquired the XRF technology, but this is more directly attributable to the PG/681 project recommendations supported by Clima-LoCa funding and will be covered in PG/681 impact section.

[24] The findings on the assessment of fertilizers in Colombia was published online in the peer reviewed journal Food Additives and Contaminants Part A: 42(9) https://doi.org/10.1080/19440049.2025.2537872

[25] As per the PPG application, project results were "expected to serve as useful inputs to two Codex electronic working groups: (i) the establishment of maximum levels for cadmium in remaining categories of chocolates and cocoa-derived products, and (ii) the development of the Code of Practice for cadmium reduction in cocoa beans." However, confirmation from ICCO would be needed regarding the participation of the two specific Codex electronic working groups.

4.1.6 Sustainability (PG/577)

Sustainability was built into the project, with recommendations intended for integration into national cocoa plans and extension systems. Peru has incorporated results into its sector strategy, while Ecuador and Trinidad & Tobago continue to use protocols, guides, and hotspot maps. In Colombia, stakeholders are institutionalizing practices, and recommendations are expected to be included in the next cocoa plan update. Training materials remain in use by producers, though refresher training is needed. At the regional level, "Cd Talks," manuals, and mapping tools continue to be disseminated, and IICA is leveraging the project to scale approaches to other Caribbean countries. Engagement with the EU and follow-on initiatives indicate momentum for continued support.

73. Sustainability was embedded in PG/577's design, with recommendations intended for integration in national cocoa plans and extension systems. All NPIAs provided formal letters in response to the project's recommendations:

74. In Colombia, PG/577's recommendations were not included in its National Cocoa Plan due to timing constraints as this was released ahead of the recommendations being issued. However, the Unidad de Planificación Rural Agropecuaria (UPRA) has committed to incorporating them in the next update. FEDECACAO has taken steps to institutionalize practices, applying standardized protocols and increasing its laboratory testing capacity.

75. Ecuador's National Cocoa Agenda already contained similar elements, which limited direct incorporation of PG/577 recommendations however, the relevance of the recommendations was noted. Importantly, KIIs revealed the project's findings on fertilizer contamination have proved valuable and are now part of national roundtable discussions.[26] Additionally, standardized methodologies and farmer guides developed under the project remain in use by INIAP (as confirmed in the Ventanas farm visit). These guides have been integrated into INIAP's regular extension materials and training for farmers, ensuring continued dissemination.

76. In Peru, KIIs confirmed that project results have been integrated into the national cocoa sector strategic plan, and a further update of the plan will take place end of 2025. Protocols and guides are in active use by technicians and producers, and hotspot maps guide planting decisions and help redirect production to alternative markets (e.g., Asia, Malaysia).

77. In Trinidad & Tobago, the updated plan is under governmental review. However, hotspot maps developed under PG/577 continue to support traceability, planting decisions, and sourcing. An E-Max analyzer was also acquired based on the project recommendations, and technicians trained in its use.

78. At the producer level, farmers in Ecuador confirmed continued use of training materials such as guides on soil and pH management. A soil testing kit distributed under the project remains in circulation and is sometimes shared among farms. Demonstration plots and producer networks established during implementation continue to be used, though producers stressed the importance of regular refresher

[26] These are formal multi-stakeholder technical roundtables convened under the Cocoa Agenda with participation from MAG, INIAP, producer associations, and exporters. These spaces provide a platform to integrate research findings into sector strategies and policy processes.

trainings, the last of which took place in 2023. External challenges, including climate change, political instability, and youth moving to cities were cited by producers as risks to long-term sustainability. In Peru, KIIs suggest a follow up exercise on the impact of farm field work is planned at the end of 2025.

79. "Cd Talks" organized under PG/577 remain in use and continue to serve as a channel for disseminating project outputs. These, along with manuals, guidelines, and mapping tools, have been incorporated into sectoral platforms such as the Association of Chocolate, Biscuits and Confectionery Industries of Europe (CAOBISCO), supporting broader visibility and uptake.[27]

80. An added value of the project has been its catalytic role in scaling work across the region, with approaches and standards developed under PG/577 proving replicable beyond direct project partners and beneficiaries. IICA, as a permanent regional institution, has maintained its role in technical and policy engagement, linking PG/577 outputs with wider networks and seeking funding to scale SOPs and mitigation measures. Interest has also been expressed in replicating the PG/577 approach in other countries, including Grenada, Jamaica, Dominica, and St. Lucia.

81. Engagements with the European Union have been initiated to explore the possibility of further technical and financial support to build on the results of this initiative. Support has also been secured for Trinidad & Tobago's participation in a follow-on project submitted to STDF.

4.1.7 Other unexpected results (PG/577)

> The project identified fertilizer as a major source of cadmium contamination, expanding relevance beyond LAC cocoa. Reallocated resources enabled more training and testing, and the approach is now being prepared for replication in the Caribbean.

82. A major scientific finding was that fertilizer is a source of cadmium contamination, extending the project's relevance beyond LAC to global cocoa supply chains.

83. Reallocated resources allowed expansion of training (e.g. to 80 technicians). Resources freed by dropping the plant material cycling study were redirected to additional testing and Output 4 training, ensuring broader impact and sustained visibility.

84. Follow on work replicating the PG/577 approach in the Caribbean region is currently being planned.

[27] KIIs noted that while scientific papers and project stories should continue to be published through partner platforms and other open channels, sensitive findings should be communicated with some caution across borders to avoid creating undue concern about cocoa from the LAC region.

4.2 Findings (PG/681)

4.2.1 Relevance (PG/681)

The project was highly relevant, directly addressing a critical SPS gap in Colombia and Ecuador: the lack of reliable laboratory testing for cadmium. It was endorsed at design by ministries and producer federations, reflecting recognition of sector-wide challenges, including weak QA systems, incomplete zoning, and limited knowledge on cadmium risks. While originally considering farm-level mitigation, the project refocused on laboratory QA and mapping, complementing Clima-LoCa's work. Institutional leadership was stronger in Ecuador than Colombia, and practical outputs e.g QA protocols, manuals, and hotspot maps were valued by laboratories and exporters. The introduction of XRF machines further increased relevance by providing affordable, rapid testing capacity, though some components, such as predictive modeling, had limited immediate applicability.

85. As per the PG application project PG/681 directly addressed a critical SPS gap in the cocoa sectors of Colombia and Ecuador: the lack of reliable laboratory testing for cadmium. As noted under Section Coherence (PG/577) it was proposed by KU Leuven to STDF to target a technical gap in terms of laboratory capacity building and the standardization of testing protocols, giving countries a way to move forward on laboratory work ahead of the parallel PG/577 project start.

86. The proposal was initially endorsed by the Ministries of Agriculture in Colombia and Ecuador, as well as by private cocoa producer federations such as FEDECACAO through letters of support. This endorsement reflected broad recognition of sector-wide technical and organizational challenges, including *(i) lack of harmonization and quality control in surveillance programs and laboratory procedures; (ii) incomplete zoning of vulnerable areas due to data gaps or restrictions on data sharing; (iii) limited knowledge on Cd risks for identifying suitable land for cocoa expansion; and (iv) absence of coherent, scientifically validated, and context-relevant agricultural practices to lower Cd in cocoa*. These priorities were confirmed in the 2018 International Workshop on Cadmium Reduction in the Andean Zone (CacaoCdFREE), as well as in follow-up stakeholder meetings in Bogotá and Lima. While Peru was initially considered, it did not join the project.

87. Institutional differences were noted between the two participating countries. Ecuador had already established clearer SPS leadership on cadmium through AGROCALIDAD and the Reactivation of Coffee and Cacao Project, working with the private sector and universities such as ESPOL. In Colombia, institutional leadership on cadmium was less consolidated, even though stakeholders widely recognized the potential impact of the new EU regulation. Generally, the design was similar for the two countries however a different sampling strategy was adopted in Ecuador, and more field sites were visited in Colombia. Data collection efforts on cadmium had largely been initiated by the private sector in both countries, but much of this information was not systematically shared or integrated into national systems given its sensitive nature.

88. While the project originally considered cadmium mitigation at the farm-level, this component was dropped in favor of a stronger focus on laboratory QA and monitoring, as a parallel initiative Clima-

LoCa was already working in this space. This shift was also consistent with the more immediate need for harmonized lab protocols and reliable cadmium mapping.

89. The project was formally endorsed by the Ministries of Agriculture (MADR and MAG) of both countries at the outset, ultimately, these institutions discontinued their collaboration with PG/681 due to changes in personnel and structure.[28] The Colombian partner AGROSAVIA also dropped out as given sensitivities around sharing soil sampling coordinates. Relevance was nonetheless reinforced by buy-in from participating public and private laboratories, as well as cocoa exporters (involved in the early project stages), who valued the practical outputs, such as laboratory manuals, QA protocols, and hotspot maps, which supported sourcing, blending, and compliance strategies.

90. The introduction of XRF machines, which occurred in the latter stages of implementation (following reallocation of funds initially earmarked for Output 3 to develop guidelines on good agricultural practices which proved inconclusive), responded to a major constraint identified by stakeholders i.e. the lack of affordable and timely testing capacity in-country. KIIs revealed this reduced the number of samples sent to European laboratories, creating costly delays.

91. Relevance of some components (for instance Output 5 predicting bean Cd concentrations) was limited due to late implementation, complexity and need for further research.

4.2.2 Coherence (PG/681)

The project was coherent with STDF's mandate, focusing on laboratory capacity and testing protocols as a technical complement to PG/577's broader regional scope. Outputs such as ring tests, SOPs, and XRF trials addressed a critical SPS gap and were later leveraged by PG/577. Strong collaboration with Clima-LoCa and VLIR was essential, particularly for mapping and field trials that exceeded PG/681's budget, and Clima-LoCa funding enabled purchase of XRF machines now used by national institutions.

92. STDF PG/681 was conceived as a technical intervention focused on laboratory capacity building and the standardization of cadmium testing protocols in cocoa. It aligned strongly with STDF's mandate and theory of change (albeit in a narrower, technical dimension compared to PG/577's broader regional and policy scope). Its outputs, including ring test, SOPs, and testing of XRF technology addressed a critical SPS gap (subsequently leveraged by PG/577 to develop harmonized SOPs and training materials for laboratories). It aligned well with national, regional and international efforts to address cadmium levels in cocoa.

93. The project benefitted from particularly strong collaboration with Clima-LoCa (on both the ring test and hotspot mapping), with stakeholders emphasizing that field trials for the mapping component could not have been conducted without leveraging complementary initiatives. While the PG/681 project budget summarized trial results to provide recommendations for cadmium mitigation, much of the underlying evidence was drawn from Clima-LoCa and VLIR field trial activities. This collaboration

[28] This shift was attributed to political changes during implementation. KIIs suggested it may have also been due to existing involvement in the parallel PG/577 design, as well as sensitivities around sharing cadmium data in Colombia.

proved essential, as the actual costs of mapping and field trials were significantly higher than the financial scope of the PG/681 project.

94. The four E-max machines, initially rented under Project PG/681 to pilot the technology, were later purchased with Clima-LoCa funding. They are now in active use by national institutions (e.g. ESPOL in Ecuador, and FEDECACAO and Agrosavia in Colombia) and have significantly strengthened the capacity of local laboratories to conduct cadmium analysis on cocoa samples.

95. See section: Coherence (PG/577) for further details on collaboration with project PG/577.

4.2.3 Effectiveness (PG/681)

Output 1 (Laboratory QA/QC) established a baseline through ring tests with 25 labs, delivered training and guidelines, and built an initial base for accreditation, though further progress was needed. Output 2 (Mapping) delivered cadmium maps for Colombia and Ecuador, valued by policymakers and companies for sourcing and blending. Output 3 (Mitigation guidelines) was not implemented, as a universal handbook was deemed unfeasible. Output 4 (XRF testing) was a significant result, piloting portable devices that were rapidly adopted and scaled through Clima-LoCa and PG/577. Output 5 (Predictive modeling) expanded the Wiersma model with new soil data, though complexity and late delivery limited direct application.

See activity table Annex B for progress.

Output 1 Harmonize methods for cacao sampling and measurement of Cd levels in cocoa and soils according to international standards, thereby preparing the countries for adequate inspection and potential certification/accreditation programs (partially achieved).

96. *Activity 1.1 - Laboratory ring tests*
Local laboratories participated in a regional ring test that established a baseline of capacity. Participation was high as it was free and connected to training and potential certification. Twenty-three laboratories in Latin America (Ecuador, Colombia, and Peru) and two European laboratories participated between May and July of 2021.[29] Five cacao liquor (pure solid cacao mass) samples were collected from local cacao producers in Ecuador and Colombia. One commercial cacao powder was included in the proficiency test as a sixth sample. A proficiency test was also set up on soil Cd concentrations. The soil test included twenty-four participants, of which nine were new compared to the cacao ring test).

97. Results revealed significant variability across labs, highlighting limitations in accuracy and consistency. Personalized feedback, training sessions, and guidelines were delivered to individual laboratories to improve this. KIIs revealed that some laboratories had applied recommendations emerging from the ring test, including the acquisition of CMR for quality control and upgrading of equipment reported in one instance, and increased ability to develop analytical capacity on ISO standards in another. A follow-up ring test to measure progress was not conducted as it was outside of project scope/ budget.

98. *Activity 1.2 – Evaluate bean sample treatment methods*
The project tested different ways of preparing bean samples to see how this affected the consistency

[29] KIIs did however reveal that, despite progress, the capacity building support imparted by national laboratory partners provided was at times challenging given competition between laboratories providing similar testing services.

of cadmium results. Two approaches were compared: grinding 10 beans after mixing from 20 bags and grinding 60 beans from the same number of bags. The smaller sample produced highly variable results, while the larger sample reduced variability to within acceptable limits.

99. *Activity 1.3 – Evaluate sample heterogeneity* The project examined how much natural variation exists in Cd concentrations within and between bean samples. Three sources of variability were identified: analytical error, differences among individual beans within a bag, and differences among bags within a pallet. Results showed that bean-to-bean and bag-to-bag variation contribute about equally to overall variability.

100. *Activity 1.4 – Develop QA/QC guidelines and training* Training was provided, and detailed guidelines were developed to help laboratories avoid common mistakes (e.g., incorrect calibration), apply practical methods for sample preparation, and verify the quality of results using appropriate QA/QC procedures. These guidelines, informed by questionnaires and supported by personal reports, gave laboratories the tools to assess and improve their setups. Equipment-specific protocols were not developed, as machines differ and manufacturer instructions already exist, and generalized guidance could be misleading.

101. Many laboratories were motivated to learn and improve toward certification, with strong engagement during training and evidence that QA guidelines are still in use in some of the interviewed labs. However, follow-up KIIs indicated that, despite the progress, other private sector labs preferred to maintain their own systems rather than adopt standardized protocols, suggesting a need for continued support. KIIs also noted that without an institutional framework for sustained follow-up (e.g., regular government-led ring tests), the long-term impact may be limited.

Output 2 Improve mapping baselines and mapping capacity for zoning of vulnerable areas in the two countries, based on harmonized methods and data on Cd levels in cacao beans (achieved).

102. *Activity 2.1 – Gap-filling of cacao bean sampling* Additional sampling was planned to strengthen coverage in Colombia and Ecuador, complementing existing Clima-LoCa data. While this helped fill some data gaps, challenges such as security and weather delays restricted full coverage in certain regions (e.g., Arauca, Santander, Pacific). Nonetheless, the effort improved the representativeness of baseline data and provided a stronger foundation for spatial analysis.

103. *Activity 2.2 – Spatial analysis of data* Spatial analysis was conducted using nearly 200 combined samples (Ecuador, Colombia, and earlier work). This produced cadmium hotspot maps to allow policymakers and companies to identify areas of higher risk. While point predictions remain uncertain at fine scales, the maps were deemed sufficiently reliable for decision-making, roughly equivalent to soil analysis at ~30×30 km resolution. Work is ongoing under Clima-LoCa to optimize the models, and integration with Clima-LoCa data will allow for multi-country (Colombia–Ecuador–Peru) approach, improving regional relevance.

104. *Activity 2.3 – Complementary bean sampling* Complementary sampling supported the creation of second-generation maps, which built on and improved the accuracy of initial versions. Cocoa warehouses interviewed reported using these maps

internally to guide blending strategies, mixing beans from high- and low-cadmium areas to reduce reliance on laboratory testing.

Output 3 Develop scientifically sound and context-relevant guidelines (not implemented, re-scoped).

105. *Activity 3.1 Collate available scientific data (published/unpublished) on mitigation strategies; Activity 3.2 Preparation of guidelines/handbooks* KU Leuven judged that a simple, universal handbook would oversimplify a complex issue and pose undue risk, so the activity was dropped and replaced by Outputs 4 and 5. A short communication on field reduction options was issued under Clima-LoCa. The re-scoping was discussed with and approved by STDF.

Output 4 Test the new benchtop XRF based equipment for fast screening of Cd concentrations in nibs, soil and leaves (achieved).

106. This output was consistently highlighted as one of the most significant project results. Low-cost, portable XRF devices (emerging circa 2022) were tested and adopted. Beneficiaries in Ecuador (e.g. ESPOL) and Colombia (e.g FEDECACAO) eventually obtained units through Clima-LoCa funding. Devices are field-portable and cost effective (vs the ICP-MS (Inductively Coupled Plasma Mass Spectrometry)), detect other elements (e.g., Nickel), showed strong correlation with laboratory methods, and have low per-sample cost with simpler training requirements. PG/681 funds were used to rent the equipment, with Clima-LoCa eventually purchasing four machines for long-term use. XRF uptake extended beyond the original scope to Clima-LoCa and PG/577 beneficiaries (e.g., in Peru and Trinidad & Tobago), a positive spillover.

Output 5 Evaluate the best method for predicting bean Cd concentrations in areas where cacao is not yet planted based on soil map data or on soil analyses (achieved - but limited application).

107. The project expanded the Wiersma model from 35 to approx. 200 soils (adding 75 Ecuadorian and 79 Colombian samples), deepening understanding of Cd speciation and how clay and organic matter govern availability and cacao uptake.[30] While it produced valuable scientific insights into the conditions affecting soil amendment effectiveness, its direct practical applications for stakeholders remain limited due to complexity and its late implementation in the project, highlighting the need for further research to translate these insights into field-level applications.

4.2.4 Efficiency (PG/681)

> The project faced early delays due to partner changes and COVID-19 but, with a no-cost extension to 2024, completed activities within budget. Cost savings were achieved by leveraging Clima-LoCa and VLIR field trials and mapping. Tested XRF devices were later purchased under Clima-LoCa. Coordination among partners was efficient, though the absence of an overarching mechanism with PG/577 and Clima-LoCa limited wider gains. Adaptive management such as reallocating funds from the handbook to XRF and modeling led to efficiencies, and outputs were shared with PG/577 to extend reach.

108. Project PG/681 was initially planned for the period September 2020 to August 2023. The project started off-track with regards to the original timeframe. This is attributed to the change of partners

[30] The model examined detailed cadmium speciation in soils, considering interactions with clay particles and organic matter fractions, to better understand cadmium availability and uptake by cacao plants.

and covid-19 (resulting in closing of multiple laboratories). A no-cost extension was granted until December 2024. This extension enabled the project to complete outstanding activities without additional funding, with budget reallocations made to reflect the longer duration and cover new activities.

109. The total project value amounted to US$617,999, of which STDF contributed US$516,989 (83.66%) and in-kind partners provided US$101,010 (16.34%). The project delivered cost savings by deliberately leveraging other initiatives, particularly Clima-LoCa and VLIR, which covered the most resource-intensive components (field trials and cadmium mapping). As a result, PG/681 concentrated STDF funds on synthesizing trial results into actionable recommendations. The decision to rent XRF devices under PG/681, later purchased under Clima-LoCa, ensured continuity. Plans were adjusted where necessary, with demonstration farms reduced from 14 to 10 to fit available resources.

110. Coordination was reportedly positive within PG/681, with active participation from ESPOL and FEDECACAO in implementation and sharing of results. Collaboration between project partners KU Leuven and CIAR/ WUR (also involved in Clim-LoCa) proved effective, particularly in laboratory work and validation. However, the absence of an overarching coordination mechanism across related projects (Clima-LoCa and PG/577) limited further efficiency gains that joint planning could have delivered.

111. Project management demonstrated adaptability in response to risks. For example, when a legal complication delayed AGROSAVIA's sharing of sample origins, responsibilities were quickly shifted to FEDECACAO, minimizing disruption. Similarly, the team re-prioritized away from the handbook (Output 3) before major expenditures were committed, redirecting resources toward XRF adoption and predicting bean Cd concentrations (Output 4 and 5), which better aligned with stakeholder needs.

112. Efficiency gains were also achieved through synergies with other projects. Shared training events (notably KU Leuven participation and dissemination of project results through the PG/577 Platform), ring tests, and laboratory samples reduced duplication with other projects, notably PG/577. Knowledge and materials from PG/681 (e.g., training modules, lab protocols) later supported PG/577 improving their reach and increasing efficiencies. Clima-LoCa's sampling further reduced the need for PG/681 to finance large-scale fieldwork.

4.2.5 Impact (PG/681)

> The project strengthened national SPS laboratory capacity in Colombia and Ecuador, reducing reliance on overseas testing and supporting safer trade. Ring tests and tailored QA support improved laboratory performance, with manuals and SOPs still in use providing a strong foundation for accreditation. National partner labs consolidated roles as reference institutions. Adoption of XRF technology was a significant impact, enabling faster, cheaper, and field-based cadmium testing. Mapping and modeling outputs informed sourcing and blending strategies for private sector actors.

113. Interviews and document reviews show that the project strengthened national laboratory SPS capacity, reducing reliance on international testing. Key outcomes backed up by KII data include

improved laboratory performance, adoption of XRF technology, and mapping tools that continue to inform sourcing decisions. While further quantification of trade outcomes is needed (e.g., avoided costs from reduced overseas testing), the evidence indicates contributions toward STDF goals of safer trade and stronger SPS capacity.

114. Evidence from both PG/577 and PG/681 indicates a positive correlation between mitigation strategies and low cadmium-related rejection rates in common project countries (see Section Impact (PG/577)). Improved laboratory capacity, testing protocols, and informed blending decisions helped to contribute to this outcome.

115. The ring test revealed calibration and representativeness gaps across participating laboratories. These were addressed through tailored recommendations, internal reference samples, and QC training. Ring test results allowed one laboratory to detect a systematic ~10% bias in moisture content during drying process. The project allowed this to be corrected - improving testing consistency. More appropriate sampling protocols were also developed and adopted. KIIs reveal that participating laboratories continue to use PG/681 laboratory manuals and SOPs, in some cases where limited previous capacity existed in cadmium testing which is a notable achievement.[31]

116. In Ecuador, ESPOL, and in Colombia, FEDECACAO, have consolidated their roles as national reference institutions for cadmium research and mitigation (with KIIs reporting increased capability on ISO standards, scientific publications through PG/681, and use of the E-Max). While no new cadmium-related accreditation has been recorded in participating laboratories (the achievement of which was in any case outside project scope), these advances provide a foundation for future accreditation.

117. Adoption of XRF technology was one of the most impactful outcomes. Beneficiaries - including ESPOL, FEDECACAO - purchased E-Max units, improving cadmium testing, reducing reliance on overseas laboratories, cutting turnaround times and costs, and strengthening sourcing decisions. Given their portability, testing can be done directly in the field.[32] The technology was later purchased through Clima-LoCa funds to ensure at least one national unit, with benefits extending to Clima-LoCa (and PG/577 participating countries.

118. KIIs suggested that geochemical modeling (led by WUR under Output 5) provided new insights into cadmium behavior in soil systems and enabled the move from trial-and-error interventions to more targeted, evidence-based recommendations. However further research to translate these insights into field-level applications was required.

119. From a private-sector perspective, a cocoa warehousing company in Ecuador reported that cadmium hotspot mapping and improved testing enabled them to retain suppliers through blending strategies rather than exclusion. Their understanding of cadmium sources, seasonal variations, and mitigation measures was reportedly enhanced through collaboration and scientific publications provided by the

[31] Documentation (from the parallel PG/577 project) noted a shortcoming of the ring test: that no commercial EU labs participated in ring tests, as the remit of project PG/681 was limited to research institutions which limited the project findings aligning with EU market-access requirements for producers.

[32] A case study from Clima-LoCa documented the benefits, where real-time evaluation of cadmium levels in cacao allowed the biggest cooperative in Piura, Peru to sell its stock in full compliance with EU regulations. This resulted in the cooperative paying a better price for cacao, directly benefiting 800 associated farmers in the north and 3,600 indirectly across Peru https://hdl.handle.net/10568/141769.

project. Findings such as the role of zinc fertilization in reducing cadmium uptake and improving productivity on acidic soils were integrated into their sustainability programs and disseminated through technical packages to farmers in their supply chain.

120. XRF's applicability beyond cadmium was also noted (e.g. for other metals like aluminum, nickel, lead) and for other commodities representing a broader impact beyond the project.

4.2.6 Sustainability (PG/681)

Project results have been embedded in national and private laboratories, with SOPs, QA protocols, and mapping tools still applied. However, disengagement of ministries during implementation limited government ownership. A second ring test was not factored into design; these tests should be government-led and regularly conducted to measure progress (reliance on external funding for this affects ownership and continuity). Dissemination through Clima-LoCa has extended the reach of PG/681 outputs.

121. Sustainability was considered at the design stage, with the request coming through participating Ministries expected to take results forward, and cadmium mitigation approaches, harmonized testing protocols, and laboratory SOPs developed under PG/681 embedded in national laboratories and research institutions. These outputs were intended for incorporation into sectoral planning; however the participating ministries disengaged during implementation despite efforts by KU Leuven and STDF to reestablish their participation. This ultimately affected country ownership and sustainability. Nevertheless, while formal government participation and endorsement were not secured, elements of PG/681 have since been referenced in recommendations 4 and 5 of PG/577 aimed to inform national cocoa plans in the participating countries.

122. KIIs with laboratories confirmed that PG/681's SOPs and quality control protocols are still being maintained and applied for cadmium testing (with an estimated 150,000 analyses conducted annually in Ecuador). Harmonized cadmium testing protocols remain operational in both public and private laboratories, and mapping tools developed under PG/681 continue to guide sourcing, blending, and planting decisions. In Colombia, FEDECACAO has adopted the standardized protocols and established a new chemical analysis unit in San Vicente de Chucurí equipped with an XRF machine.

123. As mentioned, a second ring test was outside of project budget and scope for PG/681. A follow up ring test was expected to be organized under Clima-LoCa with many of the same laboratories that had participated in PG/681, to provide continuity, benchmark progress, and validate that capacities remain in use. However, it was delayed due to problems with the shipment of reference materials from Belgium. The second ring test is expected to be completed soon, following the hiring of a consultant engaged under PG/681 by Clima-LoCa. For long term sustainability, such exercises should be led by government institutions (ideally every two years) but limited national capacity and continued reliance on external funding constrain this.

124. Government cuts to cocoa programs in Ecuador have reduced laboratory staff in some cases. In INIAP, cadmium-related work currently depends on a single staff member, creating continuity challenges if that person becomes unavailable. For some laboratories, capacity building has not extended beyond

the initial ring test. Without broader staffing and regular follow-up training, there is a risk that long-term sustainability of gains will be affected.

125. Dissemination and follow-up of PG/681 outputs are ongoing, supporting sustainability and extending reach. Clima-LoCa, which runs until 2026 and includes a strong communication component, has scaled dissemination and research on cadmium mitigation, embedding PG/681 findings in wider networks.[33]

4.2.7 Other unexpected results (PG/681)

The re-scoping of Output 3 led to major advances through testing XRF technology, regarded as among the project's strongest results. Manuals, guidelines, and mapping tools were shared with industry platforms like CAOBISCO and are feeding into sector reference materials, with dissemination now extending to FAO and a planned 2025 regional event.

126. An unexpected result was the re-scoping of Output 3. Instead, the work was redirected to new outputs such as testing portable XRF devices (Output 4). This shift delivered some of the project's strongest contributions. The benefits of XRF devices were successfully validated and quickly adopted, including in countries beyond the project (Peru, Trinidad & Tobago). At the same time, soil modeling expanded from 35 to nearly 200 soils, generating new insights on Cadmium speciation and uptake. This work created a valuable scientific base for future research.

127. KIIs revealed that manuals, guidelines, and mapping tools developed under the project have been shared with industry platforms such as CAOBISCO and the European Cocoa Association (ECA) via Clima-LoCa. This group meets every six months and invites researchers to present learnings. These are used to update industry and national-level manuals/ guides. Project results are therefore feeding into reference materials for the sector. Discussions are underway with the FAO to develop joint dissemination products to create coherent recommendations, and a regional event will take place with policy makers across LAC countries.

128. Stakeholders noted that no major new large-scale projects or partnerships have emerged or are considered necessary as key improvements in laboratory systems have largely been put in place to address cadmium in cacao as a result of the various cadmium-related interventions, including PG/681. Smaller, more specific follow-up projects are now required (for instance around genetic mitigation approaches). Collaboration with Clima-LoCa on this issue is ongoing but funding for this work will end next year.

5 CROSS-CUTTING (PG/577 & PG/681)

5.1 Gender

129. Gender considerations were acknowledged in both projects, but were not systematically integrated into the design, logframes, or monitoring frameworks. Project documents referred to women's roles

[33] For instance, an event in Medellin (October 2025), organized by the EU delegation in Colombia will showcase findings from PG/681 and Clima-LoCa.

in cocoa production, especially in post-harvest handling and processing, but no gender-specific targets or indicators were developed.

130. A gender and environmental analysis was conducted during the PPG phase of Project PG/577, with recommendations provided. This was not carried out for Project PG/681.

131. Both projects recognized the risk of gender bias and committed to gender balance in participation. Project PG/681 reported participation data: women made up approx. 60% of wider project personnel and 61% of laboratory training participants, though representation was lower among partners in decision-making roles (33%) and digital soil-mapping training (15–23%). Project PG/577 also reported gender-disaggregated figures in training, with women accounting for 31% of participants in the Training of Trainers course and 25% in the replication workshops delivered to producers in Peru, 30.8% of the participants trained in Ecuador, and 48% in Trinidad and Tobago. Data was not available for Colombia. While these figures show some attention to balance in participation, neither project can be said to have fully mainstreamed gender in design or implementation.

5.2 Environment, Biodiversity and Climate change

132. With regards to environment, Project PG/577 applied the PPG recommendations and integrated mitigation measures, such as promoting soil-management practices (e.g. liming, organic matter use, tailored fertilization) and sustainable event organization. Project PG/681 did not address environmental issues explicitly either during design (PG Application) or in the end-of-project report.

6 JOINT PROJECT LESSONS LEARNT (PG/577 & PG/681)

133. **Alignment with national institutions** was an important factor in shaping outcomes but institutional instability undermined implementation. Project PG/577, by working through NPIAs, benefitted from stronger government engagement and continuity, however political instability led to significant delays onboarding some countries (e.g. Ecuador and Peru). PG/681 lacked comparable anchoring early on in implementation, reducing ownership at the national level.

134. **On-farm countermeasures proved ineffective** in Project PG/681. Trials confirmed that fertilization, liming, compost, manure application, and biochar did not consistently reduce cadmium levels in cacao beans. This evidence demonstrated that such interventions could not be relied on to mitigate contamination.

135. **Private sector engagement was weak** in both projects, limiting their sector-wide influence. In Project PG/577, industry participation was mostly restricted to presentations in the Platform. In PG/681, cocoa warehouses contributed samples for ring tests, but broader collaboration was limited. In contrast, Clima-LoCa maintained a dedicated liaison point for private sector relations, which kept the private sector engaged.

136. **North–South and South–South cooperation** strengthened both technical credibility and local ownership. Collaboration with KU Leuven and WUR under PG/681 improved laboratory standards and provided a framework for eventual adoption of regional SOPs, but ownership increased when regional laboratories were directly involved in protocol development. At the same time, South–South

exchanges across Latin American countries facilitated sharing of training materials, and mitigation practices (e.g. Ecuador developed farm guidelines which were adopted by other countries under PG/577).

137. **The train-the-trainer model was effective** in scaling reach and influencing farmer practices. PG/577 introduced practical, on-farm training with soil testing, and used training methods that encouraged adoption and raised awareness, even among producers not yet directly affected by regulations. A model whereby a lead trainer is selected to work directly with producer associations was recommended to further scale up the approach.

138. **Regional platforms accelerated knowledge sharing** by providing a safe space for engagement on a sensitive topic by NPIAs.[34] This enabled the rapid dissemination of SOPs, mitigation protocols, and XRF use. It also allowed sharing of major findings e.g. related to fertilizers. Both projects benefitted from the platform established under PG/577, which sped up adoption of guidelines and practices.

139. **Adaptive management increased relevance**, leading to some of the most notable achievements in both projects. Project PG/577 adapted its outputs reallocating funds to increase training outcomes, while Project PG/681 replaced a universal handbook on cadmium mitigation deemed impractical with testing of innovative XRF machines.

140. **Cross-project collaboration delivered benefits** - especially between PG/681 and Clima-LoCa, and between PG/577 and PG/681 - by leveraging Clima-LoCa funds and dissemination channels, and applying PG/681's laboratory work within PG/577. Institutions engaged across projects also supported cross-learning. However, the absence of a formal coordination mechanism meant PG/577 and PG/681 often operated in parallel; linkages among laboratory actors, farmers, and policy stakeholders were not systematically made, creating overlap and reducing efficiency. Formal coordination would likely have amplified synergies. Separately, challenges also stemmed from the fact that many science-based mitigation solutions for cadmium were still lacking, making harmonization across projects difficult.

141. **Project timelines were too short** to match the realities of a permanent crop. Both projects operated on three-year cycles, which were insufficient to measure impacts across full cacao production cycles. As a result, KIIs indicated that the durability of interventions could not be adequately assessed.

7 JOINT PROJECT CONCLUSIONS (PG/577 & PG/681)

142. Together, STDF/PG/PG/577 and STDF/PG/PG/681 strengthened SPS capacity in LAC to address cadmium risks in cacao. The projects delivered complementary results: PG/577 advanced regional coordination, farmer training, and integration of cadmium mitigation into national cocoa plans, while PG/681 built laboratory QA, introduced cost-effective XRF technology, and improved cadmium mapping.

[34] It was noted that international standards created local challenges when applied without contextual adaptation. Thresholds for cadmium were seen as unfairly penalizing producers in areas with naturally high soil concentrations. There was reluctance from stakeholders to share sensitive data, notably under PG/681.

143. Although not all outputs were fully achieved and institutional instability limited ownership in some cases, both projects contributed to reduced cadmium-related trade risks, greater producer and laboratory capacity, and stronger alignment with international standards. Collectively, they supported the STDF programme goal of safe trade by safeguarding market access for cacao exports and fostering sustainable SPS systems in the region.

7.1 Joint Project Recommendations:

144. **Institutional support should be strengthened** by working through agencies such as geological services, accreditation bodies, or technical institutes, which are generally more stable and less prone to high staff turnover, to reduce risk related to political changes.

145. **Resources (including international, public and private resources aimed at mitigating cadmium) should be redirected from ineffective farm-level countermeasures** towards strategies with stronger evidence of impact, including hotspot mapping, cacao blending, and purchasing of XRF technology.

146. **Private sector participation should be embedded systematically** from the design stage and maintained throughout implementation. Dedicated liaison roles, as demonstrated in other initiatives such as Clima-LoCa, can ensure regular feedback, increase co-financing opportunities, and align interventions with market realities.

147. **North–South and South–South cooperation should be leveraged jointly** partnerships with European reference laboratories should continue to provide external quality assurance, while peer-to-peer exchanges within the region should be encouraged to strengthen regional capacity.

148. **Regional laboratories should be directly embedded in protocol development** to strengthen ownership and ensure sustainability. Engagement of both public and private laboratories, as seen in Project PG/681, should be encouraged and potential reference laboratories strengthened at a national level to increase capacity and reduce the need for external testing.

149. **The train-the-trainer model should be scaled up** as an effective knowledge transfer method. The Master Trainer approach, working through associations or farmer groups, would ensure wider coverage and encourage adoption.

150. **Regional platforms should be maintained and scaled** to harmonize standards, disseminate findings effectively, and ensure lessons learnt with related initiatives. Their role in accelerating uptake makes them a useful investment.

151. **Practical tools should be introduced early** in project cycles to maximize their utility. New tools (such as XRF and similar technologies) should be researched and deployed from the outset where possible to maximize their value, allowing projects to generate evidence throughout implementation. XRF technology, unknown when the projects were developed, proved to be innovative and highly effective. Given their portable nature XRF machines, could be used at field and at port-level.

152. **Formal cross-project coordination mechanisms should be established** to connect diverse stakeholder groups (including laboratory, policy, and farmer-level work) and share lessons systematically. The lack of such mechanisms in PG/577 and PG/681 could have undermined further opportunities for synergy.

7.2 Joint Project Actions (PG/577 & PG/681)

#	Action	Timing	Responsible party	Linked project
1	Continue to integrate PG/577 recommendations into national cocoa plans to ensure continuity and sector-wide uptake	Within 12 months/ next policy update cycle	NPIAs	PG/577
2	Scale regional Platform as ongoing space for consensus-building and knowledge sharing	Within 12 months	IICA, NPIAs, intergovernmental organisations (e.g ICCO)	PG/577
3	Support follow-on work in other heavy metals, and replicate the PG/577 approach in the Caribbean region	Within 24 months	STDF, donors, IICA	Both (PG/577/PG/681)
4	Integrate and scale the train-the-trainer model in extension systems, using lead trainers to work with producer associations	Within 12 months	NPIAs	PG/577
5	Create partnerships and channel funds through technical institutions (e.g., geological services, accreditation bodies, technical institutes) to reduce disruption from political turnover	At project inception	Donors, implementing agencies, national authorities	Both (PG/577/PG/681)
6	Co-finance portable XRF machines and training for use at ports and field-level	Within 24 months	Private sector, governments	Both (PG/577/PG/681)
7	Share recommendations from follow up ring test and support sustainability planning for laboratories (e.g., ring test follow up, continued capacity building)	Within 12 months	Clima-LoCa representatives, national authorities	Both (PG/577/PG/681)
8	Embed private sector engagement strategies in new projects, with dedicated liaison roles	At design stage	STDF, donors	Both (PG/577/PG/681)
9	Review farm categorization system (developed by Trinidad & Tobago) as a potential model for regional cadmium mitigation	Within 12 months	CRC, IICA, NPIAs	PG/577

8 ANNEXES

ANNEX A: PROJECT EVALUATION MATRIX (INCL. EVALUATION QUESTIONS)

EQ no.	Criteria	Evaluation Questions	Indicators	Desk Review	KIIs	Sources of documentary verification
EQ1	Relevance	To what extent did the objectives and design of the projects respond to the SPS-related needs, policies and priorities of the beneficiaries and region, as well as other stakeholders involved (public and/or private sector, regional, international partners, etc.)?	Evidence of alignment between project objectives and national SPS/cocoa policy priorities; references to project goals in national or regional strategies; stakeholder validation of design relevance.	X	X	Project applications and logframes; national SPS and cocoa strategies; KIIs with public/ private sector.
EQ2	Relevance	How were differing local and regional contexts, ownership, processes and stakeholders taken into account in the design and implementation of the projects?	Evidence of national consultations held during design; degree of country-specific activities and/ or contextual activity adaptation in work plans; stakeholder perceptions of ownership and contextual responsiveness.	X	X	PPG/ PG workshop reports/ applications; country-level inception reports; steering committee reports; KIIs with stakeholders including NPIAs.
EQ3	Relevance	To what extent did the projects remain relevant, even if the circumstances changed over the course of implementation?	Number of design or implementation adaptations made in response to evolving national priorities; stakeholder confirmation of ongoing relevance during implementation.	X	X	Progress and final reports; Steering Committee meeting minutes; project adaptation documents (e.g. updated logframes); KIIs with stakeholders including NPIAs.
EQ4	Coherence	How well did the projects align with STDF's mandate, vision, and theory of change, as well as with the objectives and SPS-related initiatives of other regional institutions?	Project-level results framework aligns with STDF theory of change and 2025-30 Strategy; Documentary evidence of country-level project/ donor mapping (in PPG/ PG/ inception report)	X	X	STDF strategy documents; project proposals and theory of change; final reports; KIIs with STDF.
EQ5	Coherence	How well did STDF/PG/ 577 & 681 align with each other in terms of objectives, activities, and approaches, and to what extent were they complementary or conflicting in their implementation and outcomes?	Number of shared tools, methods, or training approaches; documented coordination meetings or joint planning sessions; evidence of shared outcomes or learnings.	X	X	Joint planning meeting notes; training materials; progress and final reports from both projects; KIIs with implementing agencies and common beneficiaries.

EQ no.	Criteria	Evaluation Questions	Indicators	Desk Review	KIIs	Sources of documentary verification
EQ6	Coherence	How well did the projects align with other interventions (including policies) in the specific context (e.g., country, region, sector), and to what extent were they complementary or conflicting?	Number of other SPS or sectoral initiatives aligned or engaged with during the project; stakeholder views on complementarity or duplication; evidence of cross project synergies (e.g. #of workshops/ trainings jointly delivered etc)	X	X	Mapping of SPS interventions (national and regional); final reports and workshop documentation; KIIs with partners and other project representatives.
EQ7	Effectiveness	To what extent were the projects' objectives achieved or are likely to be achieved (based on the indicators for expected outputs and outcomes identified in the project's logframe) including any differential results across groups?	% of logframe output and outcome indicators achieved; number of trained beneficiaries by gender and country; lab or training reports showing increased knowledge or capacity; documented evidence of outcomes across groups.	X	X	Project MEL data; updated logframes (including achievement summary); training evaluations and attendance records; KIIs with PMU and national coordinators.
EQ8	Effectiveness	What were the major factors that influenced the achievement or non-achievement of the projects' objectives, outcomes, and outputs in each country, and how well did the projects adapt to risks and changing conditions?	Documented barriers or enabling factors; evidence of adaptations, including contract amendments; adaptation evident in risk logs.	X	X	Final reports; changes to logframes; KIIs with PMU and national coordinators.
EQ9	Effectiveness	Were there any unexpected results achieved and/or spillovers at national/regional levels?	Number and type of unintended outcomes or positive spillovers (e.g., uptake in non-target regions or with other contaminants); stakeholder references to unplanned benefits or challenges.	X	X	Progress and final reports; changes to logframes; KIIs with PMU.
EQ10	Effectiveness	To what extent were horizontal issues (particularly related to gender and environment) adequately addressed by the projects?	Gender-disaggregated participation data; environmental safeguards or sustainability measures integrated into project activities; references to cross-cutting issues in reports.	X	X	Training reports; gender analysis (if any); review of training materials and project documentation.
EQ11	Efficiency	To what extent did the projects deliver results in an economic and timely way, and were they cost-effective in addressing the needs of the beneficiary countries?	% of activities completed on schedule and within budget; cost per training or technical output; partner ratings of cost-effectiveness.	X	X	Workplans and budgets; financial reports; KIIs with PMU.
EQ12	Efficiency	How well were the projects managed?	Quality of reporting; evidence of timely decision-making and problem resolution.	X	X	Final reports; KIIs with PMU.

EQ no.	Criteria	Evaluation Questions	Indicators	Desk Review	KIIs	Sources of documentary verification
EQ13	Efficiency	What changes and risks, if any, occurred during implementation, and how efficiently did the projects use resources and manage timelines in adapting to these changes and risks?	Number of risks recorded and managed; evidence of reallocation of resources or modified timelines in response to risk.	X	X	Updated workplans or budgets; contract amendments; final report sections on risk and mitigation; KIIs with PMU.
EQ14	Efficiency	Were there any positive synergies with other related projects/programmes, ensuring better utilization of funds?	Number of joint initiatives, or shared resources with other programs.	X	X	Progress and final reports; financial reports; KIIs with partners.
EQ15	Impact	To what extent did the projects generate, or are expected to generate, significant positive or negative, intended or unintended, higher-level effects? (These may cover sustain or increase of the export volumes of cacao beans in the beneficiary countries, reduction of rejections thanks to improved practices to manage Cadmium contamination, satisfactory measurements by participating laboratories, etc.)	Changes in the capacity of SPS institutions, the SPS situation, market access, needs and other relevant indicators since project start baseline (e.g. reduction in cadmium levels in tested cocoa samples; evidence of increased compliance with international SPS standards; number of Cd-related rejections averted or reduced).	X	X	Lab testing data; Rejections databases from importing countries UNIDO Standards Compliance Analytics (SCA) platform; Monitoring of cadmium in cocoa beans carried out in-country; Published information on cadmium levels in products; KIIs with key stakeholders.
EQ16	Impact	To what extent and how did the projects catalyze other actions or changes, such as the development of Codex standards and innovative approaches to address Cadmium contamination in cocoa and cocoa-derived products, or mobilizing additional resources for SPS capacity development?	Evidence of new Codex or regional standards influenced; resources mobilized through partnerships or follow-up projects; innovations piloted as a result.	X	X	Codex documentation; reports and new working groups from regional organizations and/ or ICCO; evidence of new SPS initiatives or follow-on projects.
EQ17	Impact	How did the projects catalyse any other action or change, for instance adaptation and replication of SPS approaches developed by each project to benefit non project beneficiaries (e.g. other actors in the cocoa value chains in different countries in the region)?	Number of institutions or countries demonstrating interest and/ or adopting tools developed by the projects; references to project tools or approaches in external policies or plans.	X	X	Interest documented in non-project countries; communication materials; regional strategy documents.
EQ18	Sustainability	To what extent are the benefits of the projects continuing, or are likely to continue over the longer term, after the end of STDF funding?	Official endorsement of national strategies for mitigating cadmium in cacao in project countries; # of tests conducted by laboratories in project countries using standardized protocol; evidence of continued	X	X	Country national cocoa plans; follow-up KIIs/ surveys with stakeholders including labs, cacao growers and NPIAs.

EQ no.	Criteria	Evaluation Questions	Indicators	Desk Review	KIIs	Sources of documentary verification
			training uptake by labs and growers.			
EQ19	Sustainability	To what extent was sustainability addressed at the design stage and during implementation, and what are the major factors (including risks) influencing sustainability?	Sustainability in PG approval evident; evidence of sustainability monitoring and reporting.	X	X	Project design documents; progress reports; end of project reports, KIIs with PMU and NPIAs.
EQ20	Sustainability	Are the necessary capacities and systems (financial, social, institutional, etc.) in place to sustain the projects' results over time?	Official endorsement of national strategies for mitigating cadmium in cocoa in project countries; evidence of institutions adopting project tools or SOPs; % of trained personnel retained in their roles post-project; effects of coordination and cooperation across government institutions in different countries/regions, and with the private sector.	X	X	National cacao action plans; KIIs with key stakeholders including NPIAs; final project reports.
EQ21	Sustainability	What actions have been taken by beneficiaries or other stakeholders to disseminate, learn from, and follow up on the project outcomes, and what additional follow-up activities are planned or needed to sustain these results over time	Number of follow-up activities initiated; documented learning and dissemination actions by national partners; implementation of recommendations from national cacao plans; resources or partnerships secured for post-project continuation.	X	X	Communication materials/ learning event reports; learning briefs; media coverage; final project reports; KIIs with key stakeholders including NPIAs.
EQ22	Lessons Learned	What lessons can be learned from the projects regarding their processes of design and implementation in beneficiary countries (including attention to public-private partnerships, North-South and South-South cooperation, leveraging expertise and knowledge)?	Documented good practices and challenges identified; feedback from implementing partners and stakeholders.	X	X	Lessons learned sections in final reports; communication/ learning materials; scientific publications; ICCO communications; KIIs with key stakeholders.
EQ23	Lessons Learned	What lessons can be drawn from implementing the two projects with different approaches to addressing the issue of cadmium in cacao?	Comparative insights between PG/577 and PG/681; feedback from shared actors.	X	X	KIIs with key implementing partners and shared project stakeholders.
EQ24	Lessons Learned	What other lessons can be learned from the two projects, which may be of importance to the broader SPS community, and	Feedback from stakeholders on scaling up the approach regionally, including for other metals/ contaminants	X	X	Lessons learned sections in final reports; communication/ learning materials;

EQ no.	Criteria	Evaluation Questions	Indicators	Desk Review	KIIs	Sources of documentary verification
		which should be disseminated more widely?	Documentary evidence of scale up potential.			scientific publications; ICCO communications; KIIs with key stakeholders.

Annex B: Updated Project Logframe with Results

STDF/ PG/ 577		
GOAL	**To help Colombia, Ecuador, Peru, and Trinidad and Tobago establish a coordinated regional approach to meet international regulations (especially EU) on maximum residue levels (MRLs) for cadmium in cocoa and cocoa products.**	
Outcomes	(1) standardized testing protocols and best practices applied by laboratories in project countries; (2) knowledge on best practices to mitigate Cadmium levels in cocoa and cocoa derived products transferred to farmers from master trainers.	
Output/ Activity	**Project Activity**	**Completed**
Output 1	**Platform for Consensus building and Information Sharing on Best Practices for cadmium Mitigation and Remediation**	**Largely achieved**[35]
Activity 1.1	Platform/network formed for consensus building among research agencies in 4 countries with relevant research literature catalogued and organized	Y
Output 1.2	**Technical staff trained in agreed standardized protocols to analyze cadmium Levels in cocoa and cocoa products**	**Achieved leveraging PG/681 results**
Activity 1.2	Standardized terminologies, testing protocols and best practices developed to manage cadmium issues in cocoa and cocoa products from LAC towards meeting regulatory requirements	Y
Activity 1.3	User appropriate manuals and updated national country strategies signed by Officials for mitigating cadmium levels in cocoa and cocoa products from 4 countries	Y
Output 2	**Enhanced and standardized Capacity to Analyze Cadmium Levels**	**Achieved**
Activity 2.1	Curriculum for standardized methodologies for measurement and management of cadmium in cocoa	Y
Activity 2.2	Capacity building/training within and between project partners in use of standard methodologies	Y
Output 3	**Improved Knowledge of Cadmium Presence in Cocoa Growing Areas Through Analysis and Mapping**	**Partially achieved**
Activity 3.1	Reviewing of the scale of contamination and identification of hotspots	Y
Activity 3.2	Implement a programme of coordinated testing for cadmium in cocoa, soils, fertilizers and water to complete the mapping	Y
Activity 3.3	Devise recommendations for high cadmium areas (hotspots)	Y
Activity 3.4	Testing of cadmium uptake due to cycling of plant material	N (rescoped)
Output 4	**Awareness on Cadmium Issues Among Stakeholders in the Cocoa Supply Chain**	**Achieved**
Activity 4.1	Curriculum for and Training of Master Trainers	Y
Activity 4.2	Awareness-raising and distributing of best practices	Y

[35] This output achieved meaningful deliverables, however, one of the objectives of the platform was to develop a single regional testing protocol. Given it was not deemed practical, this was ultimately not developed or adopted although convergence was reached on QA standards.

Ouptput 5 (5.1 - 5.3)	Workshops and Results Dissemination	Y
Ouptput 6 (6.1 - 6.2)	Project Coordination, Monitoring and Evaluation	Y

STDF/ PG/ 681		
GOAL	**To improve the institutional capacity of Colombia and Ecuador in managing cadmium concentrations in cacao to mitigate the trade barrier imposed by the new standards, using a regional approach.**	
Output/ Activity	**Project Activity**	Completed
Output 1	**Harmonize methods for cacao sampling and measurement of Cd levels in cocoa and soils according to international standards, thereby preparing the countries for adequate inspection and potential certification/accreditation programs**	**Achieved**
Activity 1.1	Laboratory ring tests	Y
Activity 1.2	Evaluate bean samples treatment methods	Y
Activity 1.3	Evaluate sample heterogeneity	Y
Activity 1.4	Develop QA/QC guidelines and training	Y
Output 2	**Improve mapping baselines and mapping capacity for zoning of vulnerable areas in the two countries, based on harmonized methods and data on Cd levels in cacao beans**	**Achieved**
Activity 2.1	Gap-filling of cacao bean sampling	Y
Activity 2.2	Spatial analysis of data	Y
Activity 2.3	Complimentary bean sampling	Y
Output 3	**Develop scientifically sound and context-relevant guidelines**	**Not Implemented/ Rescoped**
Activity 3.1	Collate available scientific data (published/unpublished) on mitigation strategies	N
Activity 3.2	Preparation of guidelines/handbooks	N
Output 4	**Test the new benchtop XRF based equipment for fast screening of Cd concentrations in nibs, soil and leaves.**	**Achieved**
Output 5	**Evaluate the best method for predicting bean Cd concentrations in areas where cacao is not yet planted based on soil map data or on soil analyses**	**Achieved**

Annex C: List of Documents Consulted

Documentation – STDF/PG/ 577
Document Title
STDF PPG 577 - Improving Capacity Building and Knowledge Sharing to Support Management of Cadmium Levels in Latin America and the Caribbean Project Preparation Grant (PPG) Application Form
STDF PG 577 - Improving Capacity Building and Knowledge Sharing to Support Management of Cadmium Levels in Latin America and the Caribbean Project Grant (PG) Application Form
STDF PG 577 - Improving Capacity Building and Knowledge Sharing to Support Management of Cadmium Levels in Latin America and the Caribbean Inception report
STDF PG 577 Midterm Workshop Reports
STDF PG 577 Progress Reports Improving Capacity Building and Knowledge Sharing to Support Management of Cadmium Levels in Latin America and the Caribbean
STDF/PG/577 End of Project Report - Improving Capacity Building and Knowledge Sharing to Support Management of Cadmium Levels in Latin America and the Caribbean
Annex 1: National Cocoa Sector Plans to Mitigate Cd Levels in LAC Cocoa Value Chain – Document PTA-1-112023: 9 Recommendations to Implement in National Cocoa Sector Plans
Annex 2: Letters of endorsement from Colombia, Ecuador, and Peru for the implementation of PTA-1-112023 and its initiation in Trinidad and Tobago
Annex 3: Report on E-max Training Session at MALF Centeno on 09 April 2025
Annex 4: Updated Logical Framework with Actual Results Achieved for Each Project Indicator
Annex 5: List of key documents produced under the project (e.g., training manuals, codes of good practice, etc.) - Cocoa Jargon in Latin America and the Caribbean - ISBN digital: 978-92-9273-158-8; ISBN print: 978-92-9273-159-5 - Glosario del Cacao en América Latina y el Caribe - ISBN digital: 978-92-9273-160-1; ISBN print: 978-92-9273-161-8. - Latin America and the Caribbean Standard Operating Procedure for the Analysis of Cadmium in Cocoa – ISBN digital and print: 978-92-9273-152-6 - Manual de procedimiento operativo estándar en América Latina y el Caribe para el análisis de cadmio en el cacao – ISBN digital and print: 978-92-9273-151-9 - Herramientas de aprendizaje para la prevención y mitigación de la presencia de cadmio en cacao. Guía de Aprendizaje Nro.17 Instituto Nacional de Investigaciones Agropecuarias (INIAP) – ISBN print: 978-9942-22-605-1 - Learning tools for the prevention and mitigation of cadmium in cacao. Facilitators' guide No. 17 Instituto Nacional de Investigaciones Agropecuarias (INIAP) – ISBN print English: 978-9942- 22-605-1 - Bravo D., Araujo-Carrillo G., Carvalho F., Chaali N., León-Moreno C., Quiroga-Mateus R., Lopez-Zuleta S., Domínguez O., Arenas P., Avella E. 2024. First national mapping of cadmium in cacao beans in Colombia. Science of the Total Environment. Volume 954, 1 December 2024, 176398. https://doi.org/10.1016/j.scitotenv.2024.176398
Annex 6: List of key training workshops, outreach events, study tours, etc. organized under the project including dates, location, number of persons (M/F)
Annex 7: Project Team Directory and List of Project Partners
AGROSAVIA. (2024, September). *Monthly technical and financial report – September 2024. Improving capacity building and knowledge sharing to support management of cadmium levels in cocoa in Latin America and the Caribbean for export to the EU (ANNEX III).* Corporación Colombiana de Investigación Agropecuaria – AGROSAVIA.
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Documentation – STDF/PG/ 577
Document Title
Bravo, D., Quiroga-Mateus, R., López-Casallas, M., Torres, S., Contreras, R., Mendez Otero, A. C., Araujo-Carrillo, G. A., & González-Orozco, C. E. (2024). Assessing the cadmium content of cacao crops in Arauca, Colombia. *Environmental Monitoring and Assessment, 196,* 387. https://doi.org/10.1007/s10661-024-12539-9
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MOCCA. (2021, March 22). *MOCCA Newsletter 4*
MOCCA. (2021–2023). *MOCCA newsletters (#2, #3, #6, EN edition)*
WJ-GR. (n.d.). *Cadmium Cocoa Haiti Bulletin*

Documentation – STDF/PG/ PG/681
Document Title
STDF PG 681 - Project Grant (PG) Application Form Improving the institutional capacity of Colombia and Ecuador to mitigate trade barriers due to the high cadmium levels in cacao
STDF PG 681 - Inception report Improving the institutional capacity of Colombia and Ecuador to mitigate trade barriers due to the high cadmium levels in cacao
P1 - STDF PG 681 Progress Report 01.09.2020–28.02.2021
P2 - STDF PG 681 Progress Report 01.03.2021–31.08.2021
P3 - STDF PG 681 Progress Report 01.09.2022–28.02.2022
P4 - STDF PG 681 Progress Report 01.03.2022–31.08.2023
P5 - STDF PG 681 Progress Report 01.09.2022–30.06.2023
P6 - STDF PG 681 Progress Report 30.06.202331.12.2023
P7 - STDF PG 681 Progress Report 01.01.2024–30.06.2024
STDF/PG/681 - End of Project Report: Improving the institutional capacity of Colombia and Ecuador to mitigate trade barriers due to the high cadmium levels in cacao
Annex 1: Final report cacao proficiency test
Annex 2: Final report soil proficiency test
Annex 3: Example of certificate of participation proficiency test
Annex 4: Example of individual laboratory report proficiency test
Annex 5: Scientific publication on sampling and laboratory variability
Annex 6: Geospatial covariates used in digital soil mapping
Annex 7: Scientific publication on XRF equipment
Annex 8: dissemination of sampling and laboratory variability results
Annex 9: List of participants in laboratory training sessions + pictures
Annex 10: Invitation for laboratory training sessions
Annex 11: Laboratory guidelines for good lab practices and quality control
Annex 12: Digital soil mapping training report
Annex 13: Impact story XRF equipment https://cgspace.cgiar.org/items/3eabca74-647b-4735-9db9-b6d1f8f4e6a4
Annex 14: Updated logical framework matrix
Annex 15: Final signed financial report
STDF/PG/681 - Final workshop report
STDF/PG/681 - Proficiency Test on the Determination of Total Cd Concentration in Cacao Samples: Individual Lab Reports: - Agrilab Laboratorios SAS

Documentation – STDF/PG/ PG/681
Document Title
- Agrocalidad – Agencia de Regulación y Control Fito y Zoosanitario - AGROSAVIA – Corporación Colombiana de Investigación Agropecuaria - Biotrends Laboratorios - ARCSA Guayaquil – Agencia Nacional de Regulación, Control y Vigilancia Sanitaria - Compañía Nacional de Chocolates SAS / Laboratorio de Análisis Instrumental - Bureau Veritas Ecuador - DECAB – Escuela Politécnica Nacional, Departamento de Ciencia de Alimentos y Biotecnología - CILABsalud – Centro de Investigación y Laboratorios en Salud Colectiva - Ecotox Environmental Services Limited - INIAP – Instituto Nacional de Investigaciones Agropecuarias - GQM – Grupo Químico Marcos C. Ltda - Terralab – Hacienda La Tentación SAS / Laboratorio Terra-Lab - SENASA – Servicio Nacional de Sanidad Agraria del Perú - Universidad Industrial de Santander – Laboratorio Químico de Consultas Industriales - Universidad de Bogotá Jorge Tadeo Lozano – Centro de Bio-Sistemas Alberto Lozano Simonelli - Universidad Tecnológica de Pereira – Laboratorio de Análisis de Agua y Alimentos - Universidad San Francisco de Quito – Laboratorio de Ingeniería Ambiental - University of Nottingham – Agricultural & Environmental Sciences, School of Biosciences - World Survey Services Ecuador (WSS EC)
Communication materials: - Sampling training session by CIAT: video, - Facebook post+pictures. - The digital soil mapping training: Facebook post and LinkedIn post.

ANNEX D: LIST OF STAKEHOLDERS INTERVIEWED

Full stakeholder lists as provided by the implementing agencies are included below with stakeholders interviewed for KIIs shaded in grey.

STAKEHOLDERS PG/577			
Name	Country	Organization	Email
Deisy Toloza	Colombia	AGROSAVIA Colombia	
Ruth Quiroga	Colombia	AGROSAVIA Colombia	
Clara Franco	Colombia	AGROSAVIA Colombia	
Daniel Bravo	*Colombia*	*AGROSAVIA Lead*	*dbravo@agrosavia.co*
Mala Partap	Trinidad & Tobago	CEO, Cocoa Development Company of Trinidad and Tobago	
Pathmanathan Umaharan	Trinidad & Tobago	CRC	
Gideon Ramtahal	*Trinidad & Tobago*	*CRC - Lead*	*gideonramtahal@gmail.com*
Amel Baksh	Trinidad & Tobago	Deputy Research Director, Ministry of Agriculture, Land and Fisheries	
H.E. Peter Cavendish	Trinidad & Tobago	EU Embassy Trinidad & Tobago	
Jose Bernando Restrepo	Colombia	FEDECACAO	
Wilfredo Gonzalez	Colombia	FEDECACAO	
NELSON Jaimes	Colombia	FEDECACAO	
Juan Alberto Rangel	Colombia	FEDECACAO	
Victor Arguello	Colombia	FEDECACAO	
NELSON Leon	Colombia	FEDECACAO	
Jhon Jairo Rueda Canizales	Colombia	FEDECACAO	
Erney Patino Quitian	Colombia	FEDECACAO	
Luis Enrique Tellez Delgadillo	Colombia	FEDECACAO	
Emarson Pereira	Colombia	FEDECACAO	
Ediar Baron	Colombia	FEDECACAO	
Leonardo Morales	Colombia	FEDECACAO	
Oscar Mancipe	Colombia	FEDECACAO	
Omar Salamanca	Colombia	FEDECACAO	
Jerson Lancheros	Colombia	FEDECACAO	
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Annex E: Cocoa Production Data

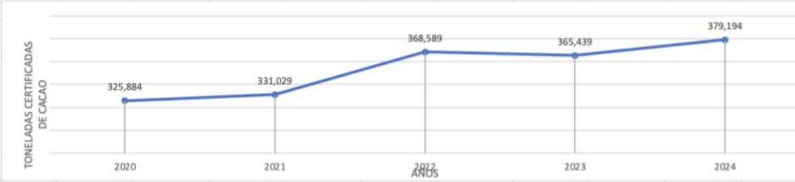
ECUADOR

1. Cuadro de toneladas de cacao en grano certificadas por año.

AÑO	TONELADAS CERTIFICADAS (Miles)	NÚMERO DE INSPECCIONES (Fitosanitaria y calidad)
2020	325,884	3703
2021	331,029	3567
2022	368,589	3948
2023	365,439	3821
2024	379,194	4280
2025*	307,545	

FUENTE: Bases de datos de Certificación de Cacao AGROCALIDAD.

*Nota: año 2025 parcial hasta julio.



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PERU

PERU: Producción de cacao

				2020				2021				2022 p				2023 p			
Dpto	COSECHA (ha)	Rendimiento	Precio chacra	PRODUCCION	COSECHA (ha)	Rendimiento	Precio chacra	PRODUCCION	COSECHA (ha)	Rendimiento	Precio chacra	PRODUCCION	COSECHA (ha)	Rendimiento	Precio chacra	PRODUCCION (t)	COSECHA (ha)	Rendimiento (kg/ha	Precio chacra (S/ / kg
NACIONAL	**170,017**	**834**	**6.28**	**158,944**	**177,674**	**895**	**6.86**	**160,522**	**182,186**	**881**	**7.66**	**172,058**	**190,688**	**902**	**7.57**	**166,709**	**198,307**	**841**	**8.78**
Amazonas	7,873	649	5.88	5,052	8,023	630	6.06	5,214	8,247	632	6.50	6,607	8,247	801	6.61	5,501	8,185	672	7.70
Ayacucho	8,216	730	6.29	5,634	7,855	717	6.27	6,857	7,592	903	7.48	6,633	7,589	874	7.07	3,155	7,172	440	8.53
Cajamarca	1,330	843	5.87	1,137	1,328	857	6.97	1,234	1,381	894	7.69	1,226	1,437	853	7.50	1,218	1,437	848	8.51
Cusco	18,323	541	5.90	7,476	18,381	407	6.41	7,702	18,381	419	7.25	8,042	18,336	439	7.98	10,222	20,427	500	8.62
Huánuco	22,095	607	6.55	14,395	23,671	608	7.17	15,958	24,731	645	8.09	16,602	24,770	670	7.97	16,948	25,015	678	9.84
Junín	20,924	1,222	6.61	27,536	22,568	1,220	7.19	29,774	24,272	1,227	8.03	31,860	26,605	1,198	7.37	33,542	28,426	1,180	8.76
La Libertad	26	1,180	3.60	33	28	1,197	3.61	30	24	1,283	4.15	33	22	1,546	4.02	31	22	1,454	4.52
Lambayeque	78	2,173	5.56	99	78	1,263	6.56	61	54	1,137	6.24	38	40	950	6.40	21	31	674	8.19
Loreto	665	1,352	2.74	930	806	1,153	2.73	991	821	1,207	2.74	1,097	854	1,284	2.75	1,257	892	1,409	2.75
Madre de Dios	1,416	828	5.39	1,235	1,492	828	5.98	1,497	1,509	992	6.19	1,485	1,536	967	6.30	1,984	1,995	994	6.50
Pasco	5,373	820	5.80	4,033	5,503	733	6.38	4,707	6,173	762	7.70	4,858	6,400	759	7.69	5,105	6,813	749	9.15
Piura	1,559	922	4.59	1,385	1,570	882	4.52	1,486	1,569	947	5.80	2,177	1,502	1,449	5.64	1,789	1,445	1,238	6.36
Puno	818	834	7.11	675	821	822	7.24	750	971	773	7.60	726	951	763	8.46	726	951	763	8.30
San Martín	59,928	904	6.42	66,786	60,782	1,099	7.14	63,396	64,516	983	7.89	66,413	65,488	1,014	7.83	65,252	70,273	929	9.00
Tumbes	657	1,002	7.94	832	661	1,259	6.89	819	664	1,233	7.27	1,539	655	2,351	7.19	1,072	578	1,853	7.64
Ucayali	20,739	821	5.90	21,705	24,107	900	6.33	20,046	21,283	942	7.06	22,724	26,258	865	7.52	18,887	24,646	766	8.38

Fuente: Gerencias y Direcciones Regionales Agrarias

p: Provisional

ANNEX F: RECOMMENDATIONS TO IMPLEMENT IN NATIONAL COCOA SECTOR PLANS TO MITIGATE CD LEVELS IN LAC COCOA VALUE CHAIN

Document PTA-1-112023 – 9 Recommendations to Implement in National Cocoa Sector Plans to Mitigate Cd Levels in LAC Cocoa Value Chain

1. Recommendation: Revise and update national policies for Cadmium (Cd), Lead (Pb), Arsenic (As), Aluminum (Al) and other heavy metal contaminants in imported materials for manufacture of fertilizers and other agricultural inputs to meet the prevailing regulations to protect human health, reduce environmental impact and maintain market access for the Cocoa Sector.

2. Recommendation: Consider the use of government incentive programs to encourage compliance with updated policies for minimizing heavy metal contaminants in importation and manufacture of fertilizer and agricultural inputs.

3. Recommendation: All manufacturers of fertilizers and suppliers of agricultural inputs used by the Cocoa sector are subject to routine testing by Laboratories designated by National Cocoa Sector Authorities for Cd, Pb, As, Al and other heavy metal contaminants in raw materials and finished products to minimize risk of increasing bioavailability to cacao trees. Results from these tests will be published and transparent to the public.

4. Recommendation: Use of consensus protocols in the most appropriate technologies for cost effective and rapid measurement of Cd, heavy metal contaminants and micronutrient requirements in cocoa production systems for decision-making and enhanced granularity in Cd hotspots maps. Currently, the optimized X-Ray Fluorescence (XRF) technologies in the E-MAX analyzer is the most promising.

5. Recommendation: Give priority to capacity-building initiatives aimed at improving the proficiency of laboratories in cadmium analysis, addressing both equipment limitation and infrastructure challenges.

6. Recommendation: To achieve the market-preferred levels of 0.8 mg/Kg of Cd in Cocoa bean lots, buyers of cocoa beans must implement blending of well- fermented and dried beans from areas with high Cd content in the beans with those from areas with low Cd content in cocoa beans.

7. Recommendation: Implement appropriate National Cocoa Traceability systems to facilitate blending of well-fermented and dried cocoa beans that meet market requirements for heavy metal contaminants as well as maintain flavor attributes which attract premium prices for producers of Fine and Flavour Cocoa.

8. Recommendation: Implement Training of Trainers strategies for extension agents and technicians from the public and private sectors to develop training processes for cocoa producers focused on the prevention and mitigation of cadmium contamination in cocoa based on science and evidence-based research.

9. Recommendation: Create more knowledge products on the significance of high cadmium and heavy metals in soils, plants and beans and disseminate same through media such as videos (YouTube, tiktok), animation, bulletins and infomercials to reach producers and target stakeholder.

Annex G: Fertilizer Cadmium Findings by Country

Country	Fertilizer Cd Levels Found	Exceeding National/Regulatory Limits	Key Findings / Implications
Colombia	Up to **40 mg/kg** Cd in organic & synthetic fertilizers	No explicit national limit cited, but levels far above safe thresholds	Fertilizers (esp. in Santander) often had **higher Cd than soils**, making them a **major source of bean contamination**.
Ecuador	Some up to **34.6 mg/kg**	**13.7% exceeded** Ecuador's max allowable level of **1.5 mg/kg**	Urgent need for **fertilizer monitoring and regulation**; significant risk from certain products.
Peru	**0.01 – 75.9 mg/kg**	**Samples exceeded 2.5 mg/kg** threshold: • **38.4 mg/kg** (organic, San Martín) • **75.9 mg/kg** (phosphate rock, Huánuco)	Identified as **serious contamination risks**; fertilizer Cd levels some of the **highest recorded**.
Trinidad & Tobago	**0.105 – 8.75 mg/kg**	No national threshold cited; values moderate compared to Andean countries	Fertilizers still contribute to **soil and bean Cd build-up**, even if not as extreme as Colombia/Peru.