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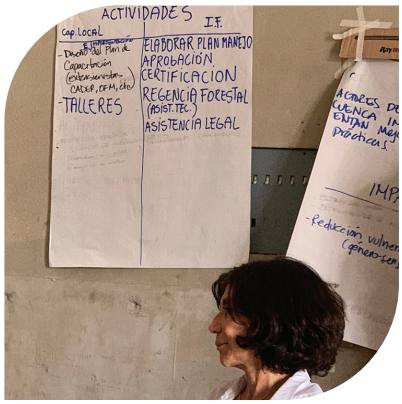
LEARNING-ORIENTED REAL-TIME IMPACT ASSESSMENT (LORTA) PROGRAMME

Synthesis Report - 2019 projects



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GREEN CLIMATE FUND
INDEPENDENT EVALUATION UNIT

Learning-Oriented Real-Time Impact Assessment (LORTA) Programme

SYNTHESIS REPORT – 2019 PROJECTS

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A photo-taking session during a LORTA country mission between the IEU, C4ED and local partners in Honduras, ©Solomon Asfaw
Viewing the landscape from the Nahualá mountains on the way to a LORTA country mission, Guatemala, ©Aemal Khan
A LORTA workshop to design a theory of change between the IEU, C4ED and local partners in Guatemala, ©Aemal Khan
The IEU LORTA team is helping the nationally accredited entity measure how GCF-funded green biogas stoves impact beneficiaries' lives in Gicumbi, Rwanda, ©Viktoriya Khan

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ABBREVIATIONS

AE	accredited entity
C4ED	Center for Evaluation and Development
CABEI	Central American Bank of Economic Integration
CADERs	Rural Development Learning Centers
CAF	community adaptation facility
CAMBio I	Central American Markets for Biodiversity
CAMBio II	Productive Investment Initiative for Adaptation to Climate Change (CAMBio II)
CARI	Consolidated Approach to Reporting Indicators of Food Security
CDRO	Association of Cooperation for the Rural Development of the Occident
CFF	Climate Finance Facility
CFU	Climate Finance Unit
CGIAR	Consultative Group in International Agricultural Research
CIFOR	Center for International Forestry Research
CO2	carbon dioxide
CRA	climate-resilient agriculture
CSA	climate-smart agriculture
DBSA	Development Bank of Southern Africa
DFI	development finance institution
DiD	difference-in-differences
DRC	Democratic Republic of Congo
EE	executing entity
EbA	ecosystem-based adaptation
EWS	early warning system
FAO	Food and Agriculture Organization of the United Nations
FCG	Foundation for Conservation in Guatemala
FFS	farmer field schools
FONERWA	Rwandan Green Fund
GCF	Green Climate Fund
GHG	greenhouse gas
GIS	geographic information systems
HDI	Human Development Index
IARNA	Institute of Agriculture, Natural Resources and Environment
ICC	intracluster correlation
IE	impact evaluation

IEU	Independent Evaluation Unit
IFI	intermediary financial institution
INAB	National Forest Institute
INSIVUMEH	National Institute of Seismology, Volcanology, Meteorology and Hydrology
IUCN	International Union for Conservation of Nature
kWh	kilowatt-hour
KOICA	Korea International Cooperation Agency
LORTA	Learning-Oriented Real-Time Impact Assessment
M&E	monitoring and evaluation
MAGA	Ministry of Agriculture, Livestock and Food, Guatemala
MARN	Ministry of Environment and Natural Resources, Guatemala
MDES	minimum detectable effect size
MFI	microfinance institution
MININFRA	Ministry of Infrastructure, Rwanda
MIS	monitoring and information system
MoE	Ministry of Environment, Rwanda
MoU	memorandum of understanding
MSME	micro, small and medium-sized enterprises
NDA	national designated authorities
OEU	Operations Evaluation Unit
PIC	Public Investment Corporation
PINPEP	National Forest Incentive Programme
PMU	Project Management Unit
PROBOSQUE	National Forest Incentive Programme
PSM	propensity score matching
RCT	randomized controlled trial
RE	renewable energy
RED	randomized encouragement design
RFP	request for proposals
ROAM	restoration opportunities assessment methodology
TASP	technical assistance support provider
ToC	theory of change
TUHF	Trust for Urban Housing Finance
UNDP	United Nations Development Programme
URL	Universidad Rafael Landívar

WCS	weather and climate services

A. THE LORTA PROGRAMME

1. IMPORTANT ELEMENTS OF THE IEU'S LORTA PROGRAMME

1. In 2018, the Independent Evaluation Unit (IEU) of the GCF started the multi-year Learning-Oriented Real-Time Impact Assessment (LORTA) Programme to keep track of the impact of GCF investments. The goal is to measure if GCF projects lead to lower greenhouse gas (GHG) emissions and enhanced resilience to climate change, and if so, by how much. This can be measured with the help of rigorous impact assessments. Empirical evidence on the impacts of climate-related projects is rather scarce, which adds to the importance of this programme.
2. The LORTA programme has two particular aims:
   - Embedding real-time impact evaluations into approved projects so that GCF project managers can quickly access accurate data on the quality of implementation and likelihood of impact
   - Building capacity within projects to design high-quality data sets, which aid the measurement of causal change and impact
3. The LORTA programme not only informs on the returns of GCF investments, it also helps GCF projects track implementation fidelity. To do so, LORTA incorporates state-of-the-art approaches for measuring results and informing effectiveness and efficiency into funded projects. It employs mixed-methods approaches that involve quantitative and qualitative data-collection methods and analysis. Theory-based counterfactual impact assessments are based on experimental or quasi-experimental research designs; real-time measurement systems and qualitative data help project teams measure progress in implementation and provide rapid lessons even during the early stages of the projects.
4. It is envisioned that GCF-funded projects will be enabled to increasingly use theory-based impact evaluations (IEs). The purpose of these evaluations is to measure the change in key result areas of the GCF that can be attributed to project activities. In sum, LORTA has the following objectives:
   - Measuring the overall change (outcome or impact) of GCF-funded projects and enhancing learning
   - Understanding and measuring results at different parts of theories of change (ToCs)
   - Measuring the GCF's overall contribution to catalysing a paradigm shift and achieving impacts at scale
5. The IEU contracted the Center for Evaluation and Development (C4ED) for consultancy services to develop IE designs for selected GCF projects and to provide relevant technical advice and quality assurance throughout the IE phases. This is always carried out as a collaborative effort between the IEU, C4ED, accredited entities (AEs), project teams and other stakeholders to provide other relevant technical advice and quality checks. Therefore, an important pillar of LORTA is the buy-in of AE and project staff into the overall idea of incorporating causal designs and theory-based IEs.

2. PHASES OF LORTA

6. LORTA is organized into three phases.
   - Phase I – formative engagement and design: The LORTA programme supports GCF-funded projects to build high-quality, theory-based IE designs. Formative work is conducted, which includes engagement with AEs and project teams, with the final output of this phase being a design for a theory-based IE for each project.

- Phase II – impact assessment: The second phase of LORTA involves the main impact assessment stage (2–5 years) and includes support to the project teams on collecting high-quality data to be used for the IE in the form of surveys, qualitative interviews, project monitoring tools and secondary data. The support from the LORTA programme specifically includes technical advice in setting up real-time implementation tracking and measurement systems, quality checks for data-collection and data analysis conducted by others, and data analysis of baseline, midline and endline data.
- Phase III – final data analysis and feedback: The final stage involves the final IE analysis (both qualitative and quantitative), discussing results and engaging with diverse stakeholders to share results and incorporate feedback as required.

7. The first Phase I period was completed in 2018, with eight projects undergoing formative research and the result being an IE design for each project. Of these eight initial projects, seven moved on to Phase II in 2019, during which necessary data for the IE are collected or compiled, project activities are implemented and the project teams are supported to ensure the highest quality of data, both in terms of measuring outcomes to be achieved and tracking the implementation of project activities.
8. In 2019, the LORTA team added six new projects into the LORTA portfolio, which will transition to Phase II in 2020.
9. In 2020, a third cohort of projects will enter LORTA and undergo Phase I. The seven projects from 2018 plus the six further projects from 2019 will continue in Phase II of LORTA.

B. PHASE I: FORMATIVE WORK

1. THE SELECTION PROCESS OF PROJECTS FOR LORTA IN 2019

The LORTA Design Workshop in Mannheim, Germany

10. The LORTA Design Workshop 2019 was organized by the IEU and C4ED. It took place from 15 to 17 April 2019, at the University of Mannheim, Germany. The workshop was attended by 97 participants, including representatives of 21 GCF-funded projects (from AEs, implementing partners and project staff present in the field). Further workshop participants came from different divisions within the GCF as well as IE specialists from C4ED and other international organizations.
11. The results of the workshop were manifold:
    - First, possibilities for collaboration were initiated between all groups of participants.
    - Second, project representatives were allowed to critically discuss viable IE designs for their respective project, under the guidance of experienced and qualified IE specialists.
    - Third, workshop participants were able to increase their knowledge about IEs and their importance, and learn from case studies, while being introduced to different IE methods.
    - Fourth, a shortlist of GCF-funded projects was identified from among those present for which IE designs could then be developed in the remaining 2019 inception and engagement phase of the LORTA programme.
12. The workshop provided participants engaged in project design and implementation with several opportunities:
    - Reflect upon the importance of including rigorous evidence in the project design process
    - Discuss case studies to learn from IE experiences in similar work areas

- Learn about methods of IE, with a focus on randomized evaluations as well as quasi-experimental designs using mixed methods
- Develop potential IE designs by working in groups involving evaluators and project implementers

Decision-making process

13. The 21 projects were assessed to determine their eligibility for LORTA by considering the following strategic criteria and guiding principles:
    - Buy-in from AE: Project selection takes into account the commitment of the AE to conduct a theory-based, rigorous IE. Support from the AE and the project team is essential during all phases of LORTA.
    - Budget: The project needs to be aware of the budget implications of an IE and be willing to make sufficient budget available to conduct a data-collection of a representative scope.
    - Focus on the private sector: The LORTA programme in 2019 especially encourages the inclusion of private sector projects.
    - Regional representation: The selected projects should be regionally representative of the GCF portfolio.
14. Directly after the LORTA Design Workshop in Mannheim, staff members of the IEU, C4ED and other IE experts, held a meeting to discuss the evaluability and emerging IE designs of the 21 projects. Discussions from these consultations were synthesized to inform the final deliberation of shortlisted projects.
15. The following nine projects were considered to be eligible for LORTA and hence taken to the next level – that is, to be subject to formative work in preparation of IEs:
    - FP045: Ground water recharge and solar micro irrigation to ensure food security and enhance resilience in vulnerable tribal areas of Odisha
    - FP073: Strengthening climate resilience of rural communities in Northern Rwanda
    - FP078: Acumen Resilient Agriculture Fund
    - FP084: Enhancing climate resilience of India's coastal communities
    - FP087: Building livelihood resilience to climate change in the upper basins of Guatemala's highlands
    - FP089: Upscaling climate resilience measures in the dry corridor agroecosystems of El Salvador (RECLIMA)
    - FP096: Democratic Republic of Congo (DRC) Green Mini-Grid Programme
    - FP097: Productive investment initiative for adaptation to climate change (CAMBio II)
    - FP098: Development Bank of Southern Africa (DBSA) Climate Finance Facility (CFF)
16. Following the workshop, the IEU consulted with relevant divisions of the GCF Secretariat to build consensus regarding the most appropriate and eligible projects for the LORTA programme against the criteria above. Each division brought invaluable insight into the projects' details and the broader dynamics within the GCF. Staff members of the GCF echoed the keen interest expressed by workshop participants and conveyed their continued support for the LORTA programme moving forward.
17. In the last step of the final selection process, the projects were contacted and asked to sign a memorandum of understanding (MoU) to become part of LORTA. The MoU lays out the intention

of the collaboration between the IEU and the AE and sets forth its objectives, scope and terms. While the IEU commits to provide technical and advisory services and quality control for the IE, the AE commits to actively engage, collaborate and work closely with the IEU throughout the evaluation, comply with timelines and quality standards, allocate the necessary budget for data-collection and give the right to access and use all data collected during the IE. Not all of the nine shortlisted projects were recommended by the GCF Secretariat or committed to this MoU, and one project (FP069) became part of the selection at a later stage. The final list of LORTA projects for 2019 is as follows:

1) FP069: Enhancing adaptive capacities of coastal communities, especially women, to cope with climate change induced salinity
2) FP073: Strengthening climate resilience of rural communities in Northern Rwanda
3) FP087: Building livelihood resilience to climate change in the upper basins of Guatemala's highlands
4) FP096: DRC Green Mini-Grid Programme (currently postponed to the second half of 2020)
5) FP097: CAMBio II
6) FP098: DBSA CFF

2. ENGAGEMENT WITH PROJECT TEAMS AND KEY STAKEHOLDERS

18. For each of the selected projects, an evaluation team was formed, usually consisting of two researchers from C4ED and one member of the IEU. Some projects were further supported by researchers from the Consultative Group on International Agricultural Research (CGIAR) network. The overarching task of these teams, referred to as “LORTA teams” in this report, was to develop an IE design for each project; to date, all teams have been on a field mission of one week. The timing for the field mission depended on the status of the project. Some projects (e.g. FP069 in Bangladesh and FP096 in DRC) were still in their very early stages in 2019, so their field missions were postponed to 2020 because a project team was not yet in place and therefore a mission would be more useful at a later stage.
19. A further task of the LORTA teams was to engage closely with key stakeholders of the selected GCF-funded projects before, during and after the field missions of Phase I. The principal stakeholders are the national designated authorities (NDAs), AEs, implementing agencies, GCF task managers and potential project end beneficiaries. Ensuring their interest, understanding and feeling of ownership for the planned theory-based impact assessments was one of the objectives of the close engagement. The strong cooperation of stakeholders, initiated and constantly supported by the IEU, was crucial for the following steps of the LORTA programme.
20. Benefiting from the close engagement between the LORTA teams and the key stakeholders/project teams, the next task was the elaboration of IE designs for each of the selected GCF-funded projects. The LORTA teams conducted context analyses, examined the existence of appropriate counterfactuals, assessed administrative and secondary data sources and discussed the ToCs. Some of this work was conducted during the field missions – that is, while the LORTA teams were in the field – although most of it was done remotely, either during the preparation or debriefing phases. The field mission schedule is presented in Table 1. A timeline of all LORTA activities of Phase I is presented in annex I.
21. Overall, key to the choice of an appropriate evaluation method was the design and implementation schedule of the selected GCF-funded projects. For example, outcome variables had to correspond to the project timing and mirror the time-horizon (e.g. short-term outcomes can be measured quickly

after implementation of a project, whereas long-term outcomes can only be measured a certain time after project finalization). Again, the importance of buy-in and ownership on the part of the implementation partners was taken into account, as was the need to respectfully strive for a balance between strong evaluation designs and requirements for implementation.

Table 1. Field mission schedule (2019–2020)

COUNTRY	LORTA TEAM	TIME PERIOD
Guatemala	Esther Heesemann (C4ED), Osana Bonilla-Findji (CCAFS) & Aemal Khan (GCF IEU)	26–30 August 2019
Central America	Esther Heesemann (C4ED), Jakob Gaertner (C4ED) & Solomon Asfaw (GCF IEU)	4–8 November 2019
Rwanda	Clémentine Sadania (C4ED), Ghida Karbala (C4ED), Mariana Vidal Merino (CIFOR) & Viktoriya Khan (GCF IEU)	11–16 November 2019
Southern Africa	Susan Steiner (C4ED), Natascha Haitz (C4ED) & Nathan Fiala (GCF IEU	18–22 November 2019
Bangladesh	Marc Gillaizeau (C4ED), Elisabeth Dorfmeister (C4ED), Babatunde Abidoye (UNDP) & Solomon Asfaw (GCF IEU)	17–¬20 February 2020

C. SUMMARIES OF EVALUATION QUESTIONS, DESIGNS AND TIMELINES

Guatemala

22. The project "Building livelihood resilience to climate change in the upper basins of Guatemala's highlands" (referred to below as "the watershed project") aims to improve the quality of watersheds while enhancing water and food security. The project consists of three project components that are implemented at the community and watershed levels. The first component addresses unsustainable land-use practices through extension worker training, financial incentives and the development of a micro watershed management plan, the second offers financing to community-based organizations present in the area to implement actions in response to climate change, and the third supports the generation of climate information to guide decision-making regarding watershed management practices for agriculture, forestry and conservation purposes to target users.
23. The AE for this project is the International Union for Conservation of Nature (IUCN). The project is implemented by a range of national and subnational entities, in particular the Ministry of Agriculture, Livestock and Food; the Ministry of Environmental and Natural Resources; the Rural Development Learning Centers; the National Forest Institute; and the Institute of Agriculture, Natural Resources and Environment. Important roles are also assigned to agricultural extension workers and municipal forestry offices/environment units.
24. The main research questions to be answered refer to the impact of the watershed project on the water security of farmers and whether farmers become more resilient and/or less vulnerable to extreme weather events. Further evaluation questions are as follows:
    - Did the intervention lead to better awareness and knowledge of climate-smart agriculture of farmers?

- Did the intervention lead to the implementation of activities related to climate-smart agriculture by farmers?
- Did the intervention lead to the diversification of crops by farmers?
- Did the intervention lead to an increase in forest coverage?

25. Three evaluation designs were developed for the watershed project. The most suitable one is a simple difference-in-differences (DiD) design with propensity score matching (PSM). The second design follows the same approach but additionally incorporates the financial incentives (forest incentive programmes). The third possible evaluation is a randomized encouragement design (RED) (not discussed during the LORTA mission). The idea would be to introduce a mobilization or encouragement campaign in some randomly assigned communities – for example, through extensive advertising of this incentive programme.
26. The baseline data-collection is scheduled for 2020/21. Exact dates depend on the final selection of the targeted project area (using the restoration opportunities assessment methodology (ROAM)). The endline data-collection could take place at the end of 2023.

Central America

27. The CAMBio II project aims to improve the resilience of micro, small and medium-sized enterprises (MSMEs) in Central America to the consequences of climate change. The Central American Bank of Economic Integration (CABEI), AE and implementing partner, will establish a credit line for intermediary financial institutions (IFIs) that finances credits for MSMEs' adaptation projects and provides funds for capacity-building of MSMEs and IFIs. The target population is MSMEs that are vulnerable to climate change in seven Central American countries: Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama and the Dominican Republic. The project consists of three interlinked components: (1) access to credits for MSMEs through selected IFIs; (2) provision of technical assistance, accompaniment and training of MSMEs and IFIs on green financing and adaptive measures; and (3) awards to IFIs and MSMEs for the successful implementation of investment projects.
28. The principal evaluation question is whether MSMEs are less vulnerable / better adapted to climate change events. Further (sub-)questions are as follows:
    - Do the MSMEs have a better knowledge of the effects of climate change?
    - Do the MSMEs have a better knowledge of adaptation measures?
    - Do the MSMEs implement more adaptation measures?
    - Will the effects be different between sectors (and gender)?
29. The proposed evaluation designs are a DiD design with PSM and a RED. The key challenge for the IE is finding a comparison group. Because the project is in theory not limited to any geographical area, MSME location cannot be used to identify the study population (5,000 credits distributed over seven countries and different sectors is too broad). Furthermore, the number of credits is small: 5,000 over five years in seven countries. Hence, if we drew a random sample of all MSMEs in the project area, it is highly unlikely that one of those would become a CAMBio II borrower. Working with applicants that were rejected by CABEI is also not possible, because (1) the country teams do not expect access demand[1] and (2) the application process is supposed to take only one month, hence there is not enough time to conduct a baseline data-collection before the treatment is in place.

[1] The country teams and IFIs speculate that this is due to a lack of knowledge of climate change adaptation practices and therefore interest in the product.

30. Instead, our sampling strategy exploits the fact that the IFIs will have to proactively promote the CAMBio II credits to distribute them. As intensive promotion is costly, it needs to be well targeted to eligible and potentially interested enterprises and producers to be cost-effective. We assume that even though the MSMEs have not yet applied for the credit, the IFIs are likely to know who the future CAMBio II borrowers will be. This population could then be used to sample treatment households for the DiD design or to randomize MSMEs into treatment and control for the RED.
31. CABEI will finish preparations for the project, hiring experts for the Project Management Unit (PMU), at the beginning of 2020. Baseline data-collection will, therefore, take place in early to mid-2020. The endline data-collection will start five years after project implementation (most likely in 2025).

Rwanda

32. The project "Strengthening climate resilience of rural communities in Northern Rwanda" (Gicumbi project) aims to increase the resilience of vulnerable communities to climate change. This will be achieved by restoring and enhancing the ecosystem services of subcatchment B of the Muvumba watershed, increasing the capacity of communities to renew and sustainably manage forest resources and supporting smallholders to adopt climate-resilient agriculture. The project will also invest in green settlements for vulnerable families currently living in high-risk areas. The project has four main components: (1) watershed protection and climate-resilient agriculture, (2) sustainable forest management and sustainable energy use, (3) climate-resilient settlements, and (4) knowledge transfer and mainstreaming.
33. The AE for this project is the Ministry of Environment (MoE) of Rwanda, and the executing entity (EE) is the Rwandan Green Fund (FONERWA).
34. The principal evaluation question aims to uncover to what extent the Gicumbi project contributes to incremental and transformational climate change adaptation and to the mitigation of GHG emissions. Further evaluation questions related to the main question are as follows:
    - Do adaptation interventions of components 1 and 2 lead to an increase in farmers' adoption of climate-resilient agriculture (CRA) practices?
    - Do adaptation activities of components 1 and 2 lead to an increase in food security and diversity?
    - Do component 1 and 2 activities lead to an increase in smallholder farmers' resilience? What dimensions of resilience are the most influenced by the project activities?
    - To what extent do mitigation activities of component 2 lead to the production and use of cleaner energy for cooking?
    - Do mitigation activities of components 1 and 2 lead to an increase in permanent vegetation cover and diversity of tree species of targeted areas?
    - Do the project activities of components 1 and 2 contribute to an increase in women's participation in economic life? Do the impacts of the project differ by the gender of the household head?
    - How do green settlements affect the resilience of vulnerable households and that of expropriated households? What are the factors that helped or hindered transformative change?
35. To evaluate the different project components, a mixed-method approach is suggested. The quantitative evaluation will focus on the activities of components 1 and 2 and be based on a quasi-experimental design. Specifically, DiD combined with PSM will be used. One limitation of the

suggested strategy is that we are not able to learn about the differential impact of specific project activities. The LORTA team recommends instead to explore the differential impact of various degrees of treatment intensity.

- Qualitative research methods will complement the quantitative evaluation by focusing on the beneficiaries' perception of the transformational change triggered particularly by component 3 of this project.
- The baseline data-collection is planned for the beginning of 2020, most likely in February. The endline data-collection will take place 5 years after the implementation of the project.

Southern Africa

36. The DBSA, AE for this project, has recently launched a new programme, the CFF. The CFF is a lending facility that aims to increase climate-related investment by the private sector in the Southern African region. The target countries of the CFF are South Africa, Namibia, Lesotho and eSwatini. Since the pipeline is expected to be dominated by projects in South Africa, the primary focus is on this country. The targeted sectors of the CFF are energy, water, waste and transport. The CFF plans to finance both mitigation projects (renewable energy), waste to energy, energy efficiency, low-emission transport) and adaptation projects (water efficiency, water treatment, new clean water).
37. Since a facility-wide IE would be difficult, if not impossible, the LORTA team decided together with the CFF team to reduce the scope to either the project level or the subsector (i.e. RE) level. The IE tries to answer different evaluation questions, related to the four high-priority goals of the CFF (reduced emissions of CO2, increased resilience against water shortage, job generation and increased commercial investment):
    - Is the climate-friendly technology for which CFF funding is provided installed and operational?
    - Do the end beneficiaries use the technology?
    - Do investments by the private sector, which are funded by the CFF, lead to reduced usage of on-grid electricity? Do they lead to changes in the usage of total (i.e. on-grid and other) electricity?
    - Do the investments lead to reduced usage of water?
    - Does the climate-friendly technology for which CFF funding is provided lead to higher reliability of energy provision?
38. The suggested evaluation method follows the method of an event study: an intervention may be given at different times for different locations. The date of the intervention (i.e. the point in time when a technology becomes operational) is coded as time 0 and called the "event". The outcome of interest can then be coded as an outcome at or some amount of time before or after the event. Even though a comparison group, which never experiences an event, is not needed in an event study, being able to include a comparison sample is helpful to better illustrate any changes in outcomes after the event. However, unlike other IE designs in which it is required that the comparison group is not treated during the evaluation period, this is not a necessary condition here. This purely quantitative analysis is planned to rely entirely on administrative information from the project developers. It may be complemented by qualitative information to obtain additional insights on what end beneficiaries think about climate-friendly technology. Evaluation results can be expected by the end of 2023.

Bangladesh

39. The field mission took place and an initial IE design has been agreed upon. The final IE design is currently still under review and the IE design report will be made publicly available at a later stage.

    Figure 1 in annex I shows a timeline of the overall activities of Phase I 2019/2020. The full reports for Guatemala, Central America, Rwanda and Southern Africa are presented in annex II.

Table 2. Summary of impact evaluation designs of projects started in 2019

PROJECT N°	PROJECT NAME	COUNTRY	AE	EVALUATION DESIGN	EVALUATION QUESTIONS
FP087	Building livelihood resilience to climate change in the upper basins of Guatemala's highlands	Guatemala	IUCN	DiD with PSM	Does the project increase the water security of farmers? Do farmers become more resilient and/or less vulnerable to extreme weather events?
FP097	Productive investment initiative for adaptation to climate change	Central America (7 countries)	CABEI	DiD with PSM	Are MSMEs less vulnerable / better adapted to events of climate change due to the adaptation of climate-smart agriculture?
FP073	Productive investment initiative for adaptation to climate change	Rwanda	MoE	DiD with PSM	Does the project contribute to incremental and transformational climate change adaptation and to the mitigation of GHG emissions?
FP073	DBSA Climate Finance Facility	Southern Africa (4 countries)	DBSA	Event study	Is the climate-friendly technology for which CFF funding is provided installed and operational? Do the end beneficiaries use the technology? Do investments by the private sector, which are funded by the CFF, lead to reduced usage of on-grid electricity?
FP073	Enhancing adaptive capacities of coastal communities, especially women, to cope with climate change induced salinity	Bangladesh	UNDP	*Not yet available as the final evaluation design is currently still under review.*	

D. LESSONS LEARNED AND RECOMMENDATIONS

LORTA Design Workshop

40. As in 2018, the LORTA Design Workshop in 2019 was a success in terms of introducing the workshop participants to the main ideas and concepts of IE. With the help of inspiring keynote speeches and productive group work sessions, the representatives of GCF-funded projects were taken through the basic steps of developing an IE design. Since the workshop took place in Mannheim, Germany, it was possible to have one IE specialist from C4ED accompany each one of the 11 groups during the group work sessions, which helped immensely to structure these sessions along a common approach. The IE specialists had been assigned to their groups well ahead of time and were thus able to prepare for the sessions.
41. With 21 projects being represented at the workshop, the final session, in which all projects presented the results of their group work, was quite dense and might require either a compression of information or more time in the next workshop. Not all of the projects were able to come up with a preliminary evaluation design. For some projects, it became clear during the group work sessions that their implementation plans precluded a rigorous evaluation design (for example, because project activities had national coverage). Representatives of these projects nevertheless benefited from their workshop attendance as they built up capacity in IE. If, however, there were severe resource constraints in the future, it might become advisable to single out these two types of projects before the next workshop.

Formative work (Phase I)

42. Only four out of six field missions were completed in 2019. The remaining two are still outstanding and are planned for 2020. In the case of the DRC project, this delay is because it is a private sector project, which depends on the successful identification, procurement and onboarding of a project developer before implementation can begin. The bidding process for the developer is still ongoing and will not be finalized before mid-2020; hence, a field mission to DRC before then was not deemed useful. In the case of the Bangladesh project, the delay is caused by the replacement of another project with this project as part of LORTA. While exceptions to the rule are difficult to avoid, it would be desirable to select projects into LORTA for which the field mission is feasible within the same year as the workshop; an alternative would be to accept them into LORTA only the following year.
43. The four field missions completed in 2019 were invariably successful. As in 2018, it proved crucial to incorporate field visits in the field missions, as it enabled the LORTA teams to observe project activities on the ground and have conversations with project beneficiaries.
44. In 2019, the LORTA teams comprised one or two staff members of C4ED, one staff member of the IEU and – in two cases (Guatemala and Rwanda) – one staff member of the CGIAR network. The presence of IEU staff was perceived as very useful because GCF- and IEU-specific questions, which often centred on GCF-specific reporting requirements and budgets for IE, could be immediately addressed. The presence of CGIAR researchers in selected projects also turned out to be beneficial because the expertise of these researchers on adaptation to climate change complemented the expertise of C4ED staff on IE methodology. Their input was most helpful in the development of a ToC, the formulation of evaluation questions and the definition of indicators. They also referred the LORTA teams to relevant literature and consulted on the operationalization of indicators. This collaboration will not end after the formative research phase within LORTA. Instead, it is planned

that the CGIAR researchers will remain part of the LORTA teams and support the IEs in the later phases as well. It is expected that they will contribute to technical advice for setting up data collections and working out implementation tracking tools as well as to the interpretation of results once data analysis is completed.

45. It has become routine in 2019 that IE design reports are reviewed by one IEU staff member before they are shared with the project teams. C4ED staff greatly appreciated the feedback obtained from the IEU and incorporated the comments and questions received.

Annex 1. LORTA PHASE I ACTIVITIES

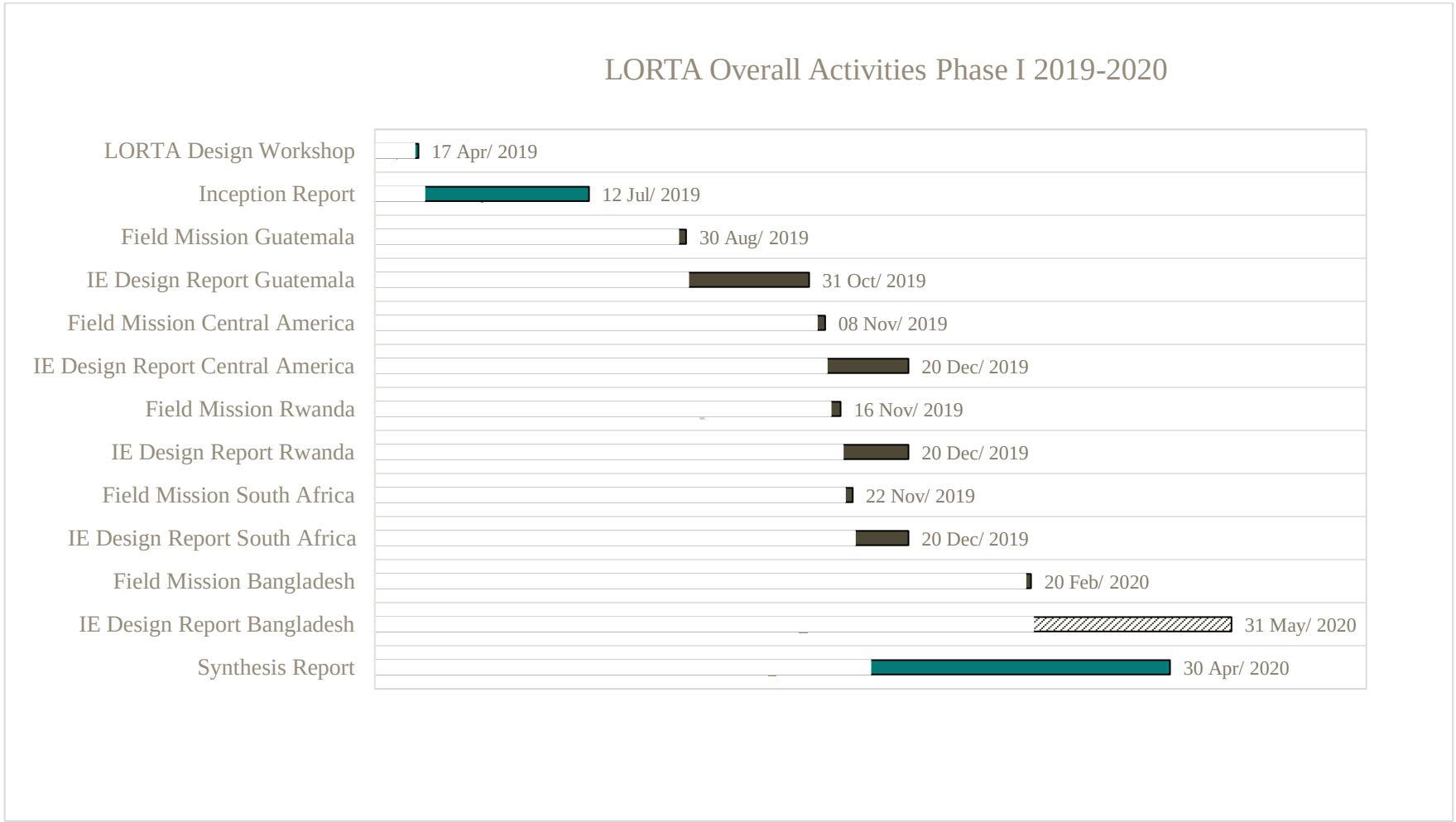

Figure 1. Timeline of LORTA overall activities Phase I 2019–2020

Annex 2. IMPACT EVALUATION DESIGN REPORTS

IMPACT EVALUATION DESIGN REPORT 1: GUATEMALA

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A. INTRODUCTION

1. THE LORTA PROGRAMME

1. Evaluating the impact of development projects and programmes has gained importance in recent years. IE not only allows for increased transparency by measuring the effects of investments, it also provides the opportunity to design and implement development projects more effectively. To contribute to this progression, the IEU of the GCF has started the LORTA programme to be able to keep track of GCF projects in terms of performance and results, and to enhance learning within the GCF.
2. The LORTA programme has the following aims:
   - Embed real-time IEs into funded projects so GCF project task managers can quickly access accurate data on a project's quality of implementation and likelihood of impact
   - Build capacity within projects to design high-quality data sets for overall impact measurement
3. The purpose of the IEs is to measure the change in GCF key result areas that can be attributed to project activities. The LORTA programme will inform on returns on GCF investments and help GCF projects track implementation fidelity. LORTA has the following objectives:
   - Measuring the overall change (outcome or impact) of GCF-funded projects and enhancing learning
   - Understanding and measuring results at different parts of ToCs
   - Measuring the overall contribution of the GCF to catalysing a paradigm shift and achieving impacts at scale
4. Currently, the LORTA programme is in its second year. In the first year (2018), the IEU supported eight GCF-funded projects to build high-quality, theory-based IE designs at inception. Seven of these projects moved on from the formative research phase to the main impact assessment phase. In the second year of LORTA (2019), six additional GCF-funded projects and programmes were selected to enter the LORTA programme. They are currently undergoing formative work, which includes engagement with AEs, project teams and GCF staff and developing designs for theory-based IEs.

2. THE GUATEMALA PROJECT

a. Country background

5. The project "Building livelihood resilience to climate change in the upper basins of Guatemala's highlands" (referred to below as "the watershed project") is one of the six projects selected to be part of the inception stage (Phase I) of the LORTA programme in 2019. The overall goal of this project is to improve the quality of watersheds in Guatemala's highlands through climate-smart agriculture (CSA), community grants and an early warning system.

   Guatemala is an upper middle income country, bordering Mexico in the north, Belize in the east, and El Salvador and Honduras in the south. Despite its small but constant economic growth in the past decades, the country still suffers from high rates of poverty and malnutrition, especially in rural areas (Table 3).

Table 3. Development indicators

INDICATOR	FIGURE
HDI and rank[a]	0.650/127 (2018)
Poverty rate (total)[b]	59.3% (2014)
Poverty rate (rural)[c]	76.1% (2014)
GDP per capita annual growth 1995–2015[d]	1.4%
GINI coefficient[e]	48.3 (2014)
Percentage of children under 5 years of age who are stunted (malnutrition)[f]	46.5% (2015)

Source: [a] UNDP, http://hdr.undp.org/en/composite/HDI; [b] World Bank, Poverty headcount ratio at national poverty lines (% of population); [c] World Bank, Rural poverty headcount ratio at national poverty lines (% of rural population); [d] World Bank, World Development Indicators; [e] World Bank, GINI Index (World Bank estimate); [f] FAO, Suite of Food Security Indicators, http://www.fao.org/faostat/en/#data/FS.

6. Lying in an isthmus between the Pacific and the Atlantic Ocean, Guatemala will be affected by climate change in several ways. In the short-term, the incidence of extreme natural hydro-meteorological events (e.g. floods, droughts, storms) is expected to increase. In the long term, increases in annual average temperatures (2.5°C to 4°C in total until 2050), as well as more variability in rainfall paired with an overall 10 per cent decrease in precipitation, are expected. Higher temperatures lead to higher levels of evapotranspiration and therefore a loss in water. Consequently, more water will be needed to maintain the same levels of agricultural production. Simultaneously, stronger but less frequent rainfall paired with more droughts will also affect the quality of the soil, as its ability to absorb water will worsen and thereby the soil will recharge at a slower rate. This not only increases soil erosion, the risk of landslides and sediment exports, but deteriorates the water quality downstream as well. The process described is particularly dangerous for lands with a steep slope, as is the case in the Guatemalan highlands.
7. A further problem caused by the changing climate conditions is a more frequent occurrence of pests and diseases. Higher temperatures along with periods of increased humidity, due to stronger rainfalls, create the conditions for outbreaks of pests and diseases. A good example is the coffee rust fungus that has already affected regions that were considered not at risk some years ago.[2]
8. The project area for the watershed project, the highlands of Guatemala, is located in the "Dry Corridor", a region in the southern part of Guatemala. Individuals residing in the highlands are mainly small-scale agricultural subsistence farmers (average size of farms: 1.75 hectares[3]) relying on natural resources for their livelihoods. About three-quarters of the households in the western highlands are estimated to be poor.[4] The vulnerability of these families is intensified by unsustainable agricultural practices, such as deforestation, land degradation, slash-and-burn subsistence agriculture and overexploitation of water resources. Such agricultural practices decrease soil fertility until the soil becomes infertile and uncultivatable, requiring the acquisition of new land, which often requires deforestation. A further threat to forests is the increase in palm oil plantations.

[2] Internal documents (Funding proposal FP087)
[3] Internal documents (Feasibility study)
[4] IARNA and IICA, "Perfil del agro y la ruralidad de Guatemala 2014: situación actual y tendencias" (Guatemala, URL, Editorial Cara Parens, IICA, 2015). Available at *https://www.url.edu.gt/publicacionesurl/FileCS.ashx?Id=40392*

Since average yields of palm oil trees in Guatemala are quite high, as is the demand for palm oil, more trees and forests are destroyed to make way for palm oil farms.[5]

b. Project details

9. The watershed project in Guatemala aims to improve the quality of watersheds while enhancing water and food security. The project consists of three project components that are implemented on the community and watershed levels. The first component addresses unsustainable land-use practices through extension worker training, financial incentives and the development of a micro watershed management plan; the second offers financing to community-based organizations present in the area to implement actions in response to climate change; and the third supports the generation of climate information to guide decision-making regarding watershed management practices for agriculture, forestry and conservation purposes to target users.
10. The AE for this project is the IUCN, whose regional and national offices design and monitor the project activities. A range of additional national and subnational entities are involved in the planning and implementation of the watershed project, varying between the activities. The first component builds on existing institutional structures from the Ministry of Agriculture, Livestock and Food (MAGA), Rural Development Learning Centers (CADERs) and agricultural extension workers, municipal forestry offices/environment units, the environmental education decentralized services of the MoE and Natural Resources (MARN), and the local forestry extension support of the National Forest Institute (INAB). The second component channels money from the GCF and the Korea International Cooperation Agency (KOICA) directly to the community-based organizations. The third component is realized in collaboration with the Institute of Agriculture, Natural Resources and Environment (IARNA), which is part of the Universidad Rafael Landívar (URL).
11. The project is in line with several ongoing Guatemalan government strategies, such as K'atun, Our Guatemala 2032. This national development plan from the Government of Guatemala recognizes the importance of tackling climate threats for future sustainable economic and social development. The watershed project further aligns with the national action plan on climate change, in which the government sets mitigation and adaptation priority actions, the nationally determined contributions that aim to reduce total GHG emissions by 11.2 per cent by 2030, and the forest policy strengthening the sustainable management of forests.

i. Project components

12. **Component 1** is divided into two subcomponents: (1) local capacity-building for climate action and watershed management and (2) support of the government forestry and agroforestry incentive programmes.
13. The first subcomponent (C1.1) aims to mainstream climate-smart agricultural practices into farmers' land management. Therefore, extension workers from several governmental and non-governmental organizations (e.g. the CADERs, MARN and INAB) are trained in ecosystem-based adaptation (EbA). Which network the project finally collaborates with depends on the locally available structures. Furthermore, in this subcomponent the elaboration of an integrated water resource management model will be supported, encompassing the creation and/or strengthening of microbasin committees.

[5] Sofia Menchu, "Guatemalan farms shift to palm oil, fueling family migration", Reuters, 6 January 2019. Available at *https://www.reuters.com/article/us-usa-immigration-border-guatemala/guatemalan-farms-shift-to-palm-oil-fueling-family-migration-idUSKCN1P00IU*

14. The second subcomponent (C1.2) refers to two already existing forest incentive programmes of INAB: PROBOSQUE (Programa de Incentivos para el Establecimiento, Recuperación, Restauración, Manejo, Producción y Protección de Bosques en Guatemala) and PINPEP (Programa de Incentivos Forestales para Posedores de Pequeñas Extensions de Tierra de Vocación Forestall o Agroforestal). The programmes provide grants for sustainable forest management – for example, by reducing deforestation on income-generating forested land or reforestation of areas currently without forest. PROBOSQUE and PINPEP follow the same overall objective but are differentiated by the target population: PROBOSQUE requires a minimum land size of 0.5 hectares but has no upper limit on land ownership. PINPEP on the other hand can only be accessed by applicants with less than 15 hectares of land. PROBOSQUE thereby excludes many smallholder farmers if they are applying individually. However, the incentives are not only for individuals; farmers' groups, associations and even municipalities are also allowed to apply. Further criteria for participating include developing a forest management plan and pursuing the objectives of the programmes.
15. The watershed project offers technical assistance for farmers/organizations in the application process (e.g. preparation of management plans) as well as during the implementation of EbA measures after they have received money from one of the two incentive programmes (e.g. instalment of agroforestry systems). The technical assistance will be provided through INAB personnel and municipal forestry office/environmental units that were also trained under C1.1.
16. **Component 2** promotes watershed management systems through grant facilities. Two types of grants are offered: a minimum of 17 medium-sized grants (USD 100,000–400,000) for community-based organizations and a minimum of 52 small-sized grants (USD 10,000–45,000) for small farmer organizations. The grants will be given out in three rounds, spread over the full project timeline. This means that in each round, on average six medium-sized grants and 17 small-sized grants will be disbursed. Supported organizations are financed to strengthen investments and interventions that reduce climate impact on the hydrological cycle in target watersheds. The possible activities implemented from the grant receivers can vary substantially, as long as they belong to EbA measures such as agroforestry or the restoration and protection of forests and degraded land.
17. For **component 3**, an early warning system (EWS) will be designed and implemented, which will provide climate and weather information to local communities. The collection, interpretation and dissemination of information are expected to lead to higher and better adaptation of agricultural, agroforestry and forestry practices as well as enhanced water resource management. Different activities contribute to reaching this objective. First, meteorological and hydrological information systems are strengthened through investment in equipment for data-collection, modelling, forecasting and archiving. This not only includes equipment of existing hydro-meteorological stations, but also the establishment of new stations. Second, official climate information collected by the hydro-meteorological stations is made accessible for the population in the target communities. That way farmers and watershed managers can make informed sowing and harvesting decisions and improve planning. The mode of information delivery will differ by community, making use of local radio and TV channels, involving local leaders and "preachers", and posting in highly frequented public places (e.g. schools). Finally, the last activity encompasses capacity-building for relevant actors at communal, municipal and national levels for operation and maintenance of equipment, data interpretation, modelling and forecasting

ii. Project area and beneficiaries

18. The project targets communities, and mainly farmers, living in the area of 20 micro watersheds that belong to four upper watersheds: Samalá, Chixoy, Motagua and Coyolate. The four watersheds lie in

the highlands of Guatemala (see highlighted area in the left square of Figure 2) and stretch over the departments of Chimaltenango, Quetzaltenango, Quiché, Totonicapán and Sololá.

19. The upper watersheds were selected based on different climate indicators: projections of climate change in the area of influence of the project, potential erosion and an index of the catchment and hydrological regulation. The combination of these indicators leads to the region with the highest potential vulnerability (see highlighted area in the right square of Figure 2).

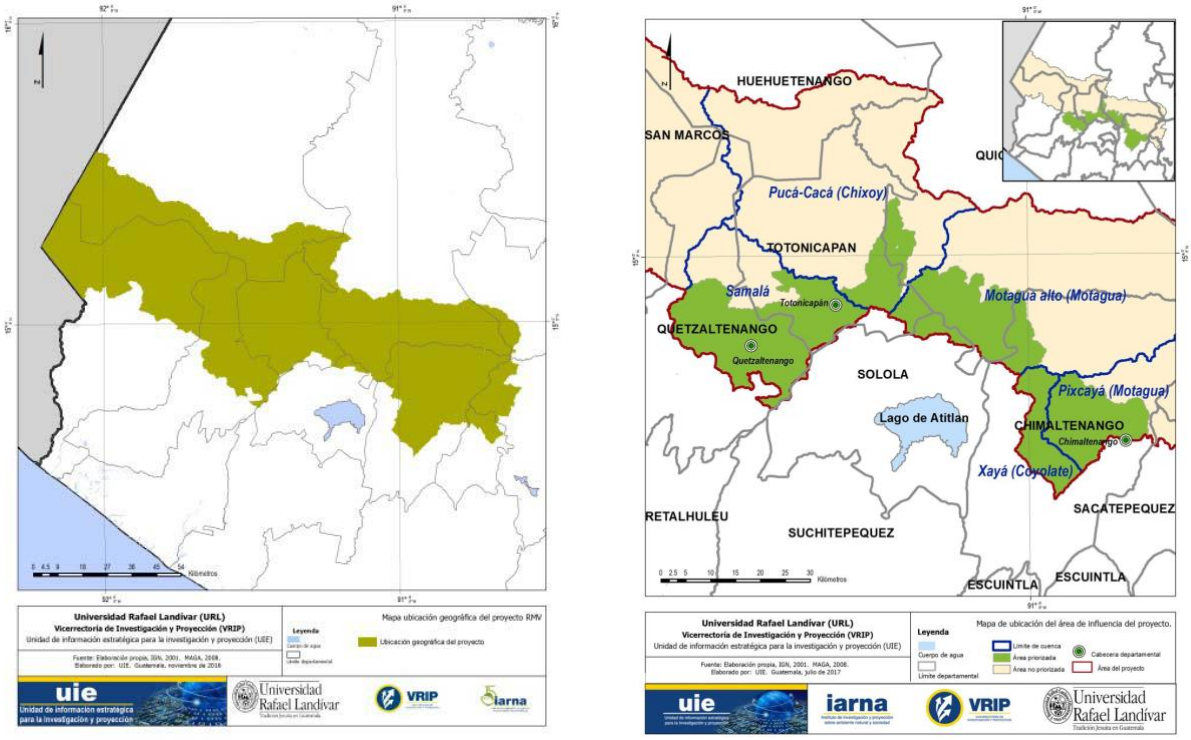


Figure 2. Project area in Guatemalan highlands

Source: Internal documents (feasibility study)

20. The four watersheds are further divided into five basins (Samalá, Pucá-Cacá, Motagua alto, Pixcayá and Xayá) and 35 micro watersheds. Of these 35 micro watersheds, 20 will be "prioritized" – that is, they will benefit from the watershed project, whereas the remaining 15 micro watersheds will not. The 20 micro watersheds will be selected purposively by the end of 2020 using ROAM. This methodology was developed by the IUCN and the World Resource Institute and is intended to provide a framework to identify priority areas for forest landscape restoration.[6] Although the assessment combines stakeholder engagement ("best knowledge") and analysis of documented data ("best science"), it mostly consists of collaborative qualitative engagement with important stakeholders. One micro watershed comprises on average 20 communities, summing up to roughly

[6] IUCN, "Restoration Opportunities Assessment Methodology (ROAM)", n.d. Available at *https://www.iucn.org/theme/forests/our-work/forest-landscape-restoration/restoration-opportunities-assessment-methodology-roam*

700 communities (400 in project communities and 300 in non-project communities). One community encompasses 310 households, on average.[7]

21. Given the complexity and multiple layers of the watershed project, the beneficiary population is not straightforward to define. From the activities targeting the community (C1.1: micro watershed management & training of extension workers, and C3: the EWS & diffusion of climate information), theoretically everyone living in the 20 micro watersheds can benefit. This is because improved micro watershed management eventually increases the quality and availability of water to all those living in the area of the micro watershed, and the information from the EWS and the extension workers is accessible and useful for all farming households.[8]
22. The activities related to the forest incentives (C1.2) and the grant component (C2) have more limited outreach. Only those who are interested in applying for the incentives programme and meet the qualification criteria will benefit from the support provided by the project. While this could be an entire municipality or agricultural association, individual farmers can also apply, in particular for PINPEP. The beneficiaries from component 2 are restricted to those living in the influence area of the grant-receiving organizations. As the grants are awarded through open calls, spread over the full project period, the beneficiary population of component 2 cannot be determined beforehand.

B. GUATEMALA FIELD MISSION

1. GENERAL REMARKS

23. An evaluation team, consisting of one consultant from C4ED, one consultant from the IEU and a climate resilience expert from the Climate Change, Agriculture and Food Security Program of the CGIAR (referred to below as the LORTA team), was formed to lead the field mission from 26 to 30 August 2019. The task of the team was to engage closely with key stakeholders of the project - namely, the NDA, AE, implementing agencies, project staff and potential end beneficiaries - to ensure their interest in and understanding and sense of ownership of the planned theory-based IE.
24. During the field mission, the LORTA team held meetings and capacity-building workshops with the key stakeholders (IUCN; URL IARNA; KOICA; Foundation for Conservation in Guatemala (FCG); Association of Cooperation for the Rural Development of the Occident (CDRO); INAB; and the National Institute of Seismology, Volcanology, Meteorology and Hydrology (INSIVUMEH)). In group meetings and individual talks, the stakeholders' views about the project's implementation, expected impact, challenges and possible solutions were discussed. The meetings not only informed the LORTA team about the project but also aimed to foster collaboration and trust between the team and on-site involved parties.
25. Under the guidance of the LORTA team, several potential IE designs were worked out for the Guatemala project. It should be noted that the operational manuals for the project activities have not yet been developed, as the actual roll out of the project is only foreseen for the end of 2020 or the start of 2021. Therefore, many details about the implementation are yet to be defined. The following are the particularly pressing open questions for the IE design:

    - Which 20 micro-watersheds will be treated?

[7] According to the Guatemalan National Population Census 2018, the country has a population of 14,901,286 and the number of households is 3,275,931, resulting in an average household size of 4.55. We then compute the average number of households in each community using the inhabitants of the prioritized area (Source: Feasibility Study), the average number of communities and the average household size: 989,016 inhabitants / 700 communities / 4.55 individuals per household = 310 households per community.
[8] The project will be most relevant for farmers as the information and trainings are tailored to their needs.

- How will the EbA training be implemented in the project area: simultaneously in different locations or in a phased-in manner? Which organizations will take part in the EbA training of trainers?
- Through which channels will the information of the EWS be disseminated? Who will be involved in this process?

26. The IE designs developed at this stage are therefore only preliminary and will need to be revised during 2020.

2. THE MISSION AGENDA

27. The LORTA team received prompt support in organizing the mission from the IUCN Guatemala and the regional office. The agenda - shown in appendix I of this design report - was developed to facilitate the joint attendance of all key stakeholders at the LORTA workshop and to allow for a field visit.
28. The mission comprised a three-day stakeholder workshop and two days of field visits. The first two days of the workshop took place at the URL in Guatemala City. The first day started with a presentation of the watershed project by the country team, followed by an introduction to IE and a capacity-building session on the construction of a ToC by the LORTA team. After the theoretical part, the workshop participants split into three groups and developed separate ToCs, including indicators and risks, for one project component each. On the second day, experimental and non-experimental IE methods were presented, followed by the development of appropriate IE designs for the watershed project. At the end of the day, the LORTA team gave a presentation on power calculations explaining why a large sample is needed to discover statistically significant project impacts.
29. On days 3 and 4, a team of IARNA, IUCN, INAB and the CADERs together with the LORTA team went for field visits in the upper watersheds of R√≠o Salam√° in Totonicap√°n and project areas in Quetzaltenango. The teams met with the local INAB officials and visited a small meteorological station and a training centre of the NGO CADERs. The visits helped substantially in gaining a clear understanding of the agricultural practices of the target population, the geographical and cultural heterogeneity and the challenges the farmers face.
30. For the last day, the LORTA team met the IUCN staff and researchers from IARNA in the IUCN country office. In the first session, the IUCN monitoring and evaluation (M&E) specialist introduced the LORTA team to the IUCN's general guidelines for project M&E. Afterward, IARNA presented their experience with data collections in Guatemala's highlands and presented a detailed budget from a former IE on food security for USAID. This helpful exercise informed the LORTA and project teams of possible costs of the IE in this context.
31. The workshop benefited the key stakeholders and the LORTA team. On one hand, the presentations and interactive discussions on ToCs and project implementation brought all the key stakeholders together on the same page concerning the project objectives, ownership and evaluation needs. On the other hand, the LORTA team was able to gather a rich set of information on the project area, implementation goals and data-collection costs and get to know the relevant stakeholders of the project.
32. Appendix II of this design report lists all the people engaged with at the workshop and during field visits throughout the LORTA mission.

3. RESULTS

33. The watershed programme is complex in its activities and targets multiple levels of the project area. One of the goals of the design workshop was to determine the scope of the evaluation, based on the technical and financial feasibility. As already described, subcomponent C1.1 and component 3 have the potential to affect all households in the project area, in particular those with farming activities. The number of beneficiaries is hence large and predictable. Furthermore, the activities under these (sub-) components will be fairly homogeneous across the communities, which makes it possible to identify key evaluation outcomes.
34. In contrast, the number of direct beneficiaries of component 2 is small (about six medium-size grants and 17 small-size grants in each wave) and will only be fully known after the last grants have been awarded. The same is true for the activities and, hence, outcome measures, as they depend fully on the proposals of the grant-receiving organizations. The number of direct beneficiaries of the application support under C1.2 is expected to be substantially larger but can also not be identified a priori as farmers and organizations can apply on a rolling basis.
35. In conclusion, subcomponent C1.1 and component C3 have a much more clearly defined scope and a large enough and more predictable target population. Therefore, they are better suited for a rigorous IE. The following sections of this report will, therefore, focus on C1.1: micro watershed management and EbA training and C3: the EWS & diffusion of climate information.[9]

a. Theory of change

36. The ToC associated with the watershed project is laid out below for the first and the third project components. It relies on several assumptions that were extensively discussed during the workshop in Guatemala and are also presented below.

i. Component 1: Integrated climate-smart watershed management

37. Inputs

    While the budget is provided by IUCN through GCF funding, the input in terms of human and technical resources is provided by different Guatemalan agencies and organizations (INAB, MAGA, NGOs, etc.). Information is provided by different databases.

38. Activities

    The actions at the core of this component are the training of extension agents (training of trainers) and the technical and legal assistance to elaborate management plans of micro watersheds in line with climate change. Also, information about the incentive programmes will be disseminated, and extension agents will provide technical assistance for the application process as well as support for the implementation of EbA measures after farmers have received money.

39. Outputs

    Through the inputs and activities of the component, extension workers are trained in practices of CSA, micro watershed management plans are designed and more farmers have access to the incentives.

40. Outcomes

[9] However, since C1.1 and C1.2 are closely related, the ToCs are presented for both subcomponents. The ToC for component 2 is reported in appendix III.

The first results are enhanced knowledge in and application of practices of CSA, improved governance of integrated watershed management and the participation of farmers in the incentive programme. This will lead to a diversification of crops, higher yields and increased forest cover.

41. Goals

The main goals behind this component are higher hydrological security of the communities, and in particular farmers, as well as improved resilience against climate change.

These five stages are summarized in Figure 3. The assumptions for the ToC to hold are as follows, listed for each activity.

- EbA training
  - Extension workers are interested in the trainings and participate fully.
  - The farmers are capable of implementing the new agricultural practices (suitable soil and land characteristics, knowledge).
  - The farmers are interested in new practices.
  - The farmers have enough financial means to implement new practices.
- Incentives
  - The farmers are aware of the incentive schemes.
  - The farmers fulfil the selection criteria to enter the incentives programme.
  - The farmers have the technical and financial means to meet the objectives set by the incentives programme.
- Management of micro watersheds
  - The communities are interested in micro watershed management.
  - There are institutional and organizational capacities in the communities to execute the micro watershed management plans.

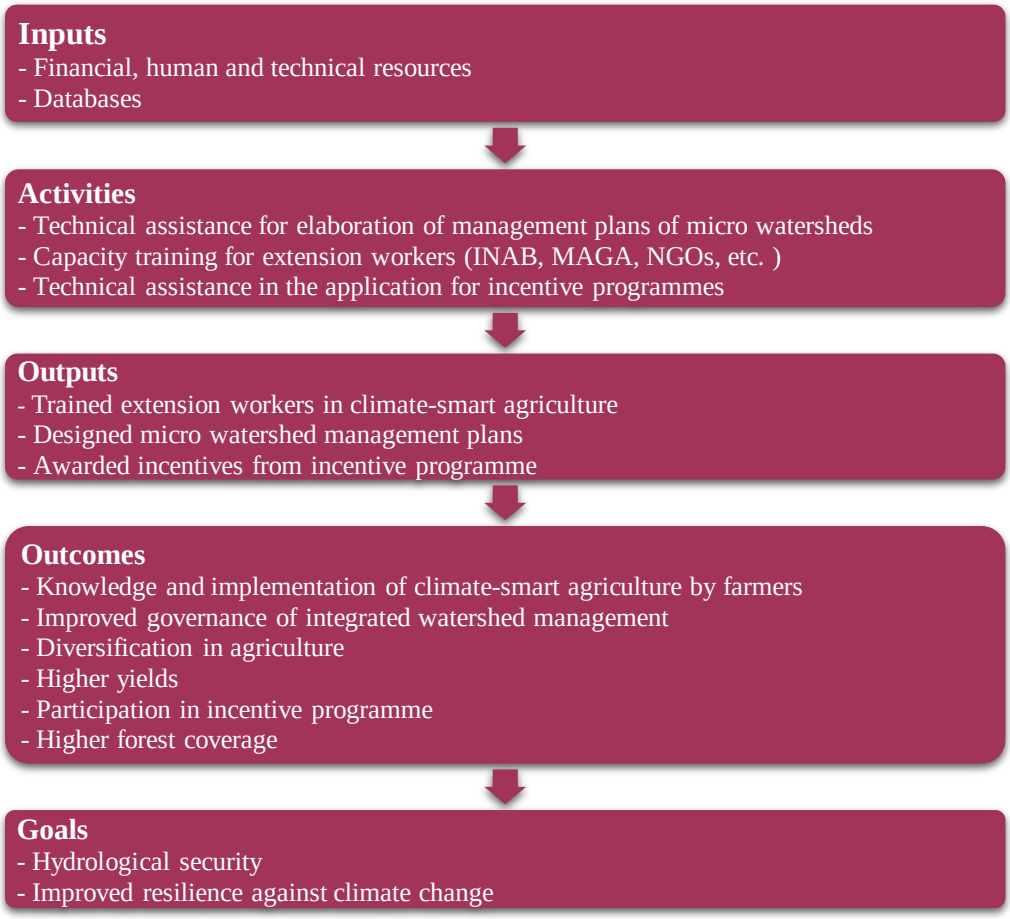


Figure 3. Theory of change for component 1

ii. Component 3: Climate-related information provided to farmers and other target stakeholders for watershed management

42. Inputs

While the budget is provided by IUCN through GCF funding, the input in terms of human and technical resources comes from INSIVUMEH and URL IARNA. Databases from different institutions provide information.

43. Activities

The activities all refer to the dissemination of climate information. Five existing weather stations will be complemented with the right equipment to ensure precise climate information. Also, 10 new hydrological and meteorological stations will be established. A comprehensive EWS for the highlands will be designed, including the distribution methodology of the information and recommendations of actions.

44. Outputs

Through the inputs and activities of this component, the EWS is in place and the information and recommendations are distributed to the communities.

45. Outcomes

If the target group benefits from the elements described in the output stage, more producers/farmers will be informed on weather-related events and coping strategies. This will

trigger the implementation and adaptation of climate-smart agricultural practices and higher and less volatile yields.

46. Goals

    The main goal behind this component and programme is the improved resilience against climate change.

47. These five stages are summarized in Figure 4. The assumptions for the ToC to hold are presented in the following.

- Extensive networks for communication and information dissemination exist in the communities.
- Information/recommendations are culturally adapted and in adequate language.
- The information/recommendations transmitted are of high-quality and useful to the target area.
- Information arrives at the necessary moment (timing).
- The communities/producers have the agency to implement the recommendations.
- Farmers are interested in implementing new practices and recommendations.
- Local leaders support the implementation of the new practices and spread of information.

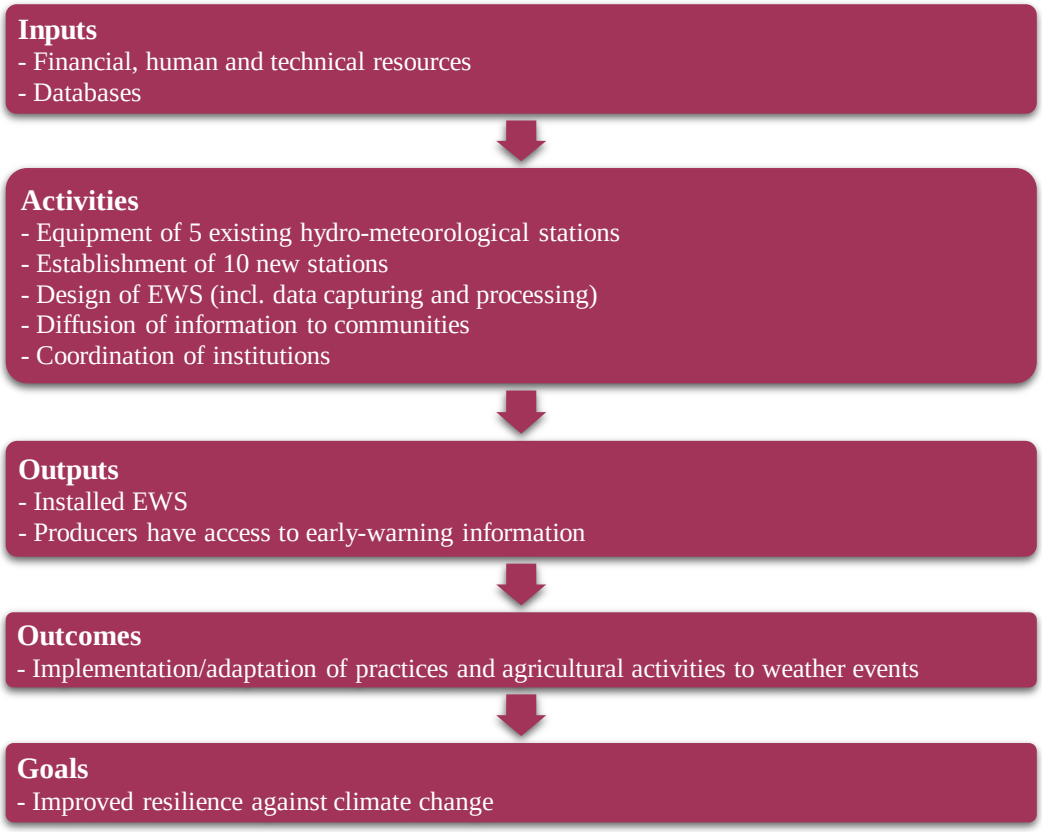


Figure 4. Theory of change for component 3

b. Evaluation questions and impact indicators

48. The main research questions to be answered by this IE, derived from the ToC, are listed below together with the corresponding impact indicators and the level of measurement in brackets.

Impact level

- EQ1: What is the impact of the watershed project on the water security of farmers?
  - Access to water in the dry period (household-level)
  - Loss in crops due to lack of water (household-level)
  - Water quality (micro watershed level)
  - Stability in water flow (micro watershed level)
- EQ2: Are the farmers in the intervention area more resilient / less vulnerable to extreme weather events?
  - Loss in crop due to extreme weather events
  - Stability in farm income
  - Food security indices
  - Utilization of sustainable coping mechanism in response to extreme weather shocks

Outcome level

- EQ3.1: Did the intervention lead to better awareness and knowledge of CSA of farmers?
  - Indicators to be defined depending on the content of the EbA curriculum
- EQ3.2: Did the intervention lead to the implementation of activities related to CSA by farmers?
  - Indicators to be defined depending on the content of the EbA curriculum
- EQ3.3: Did the intervention lead to the diversification of crops by farmers?
  - Number of crops
- EQ3.4: Did the intervention lead to an increase in forest coverage?
  - Number of trees on the land
  - Area of land covered by forest

c. Evaluation design

49. A DiD design with matching was identified as the most suitable IE design for the watershed project.
50. During the workshop, it became clear that the randomization of micro watersheds into a treatment and control group was not desired. Such randomization would have ensured that on average the two groups were balanced concerning observable and unobservable characteristics. As a consequence, differences in outcomes between the two groups after project implementation could have been attributed to the treatment, provided that the randomization has not been compromised. However, randomization was not an option for the country team as the intention of the project is to target the most vulnerable micro watersheds. Thus, due to the non-random selection of the treated communities, only quasi-experimental methods can be used. In the absence of a clear cut-off that selects entire micro watersheds into the treatment, either matching or DiD methods remain on the table. Taking advantage of the fact that implementation has not yet started, the LORTA team suggests a combination of both – that is, DiD with matching as the most robust method to evaluate the impact of the watershed project.
51. The DiD technique enables the estimation of treatment effects via the comparison of changes in outcomes over time between a treated and a control group. In other words, the DiD technique gives a causal treatment effect if the two groups – in the absence of the programme – would have developed similarly over time (known as the “parallel trends” assumption). This is an untestable assumption; however, suggestive evidence can be provided on pre-programme trends on relevant outcomes/impacts in treatment and control groups – conditional on the availability of such data.

Importantly, time-varying differences are not controlled for and, if present, would undermine the unbiased estimation of the treatment effects. Examples of such uncontrolled differences are the construction of infrastructure or agricultural interventions in the same 20 treatment or the 15 control micro watersheds during the period of the programme. Matching micro watersheds and/or farmers in the treatment group with micro watersheds and/or farmers in the control group based on observable baseline (i.e. before project implementation) characteristics strengthens the design even further.

52. For the design of the IE, it needs to be considered that according to the current state of planning all components and subcomponents will be implemented around the same time in the entire project area (the 20 micro watersheds). Furthermore, nobody in a treatment community can be excluded from receiving climate information and support by the extension workers trained in EbA. The same is true for the benefits of the micro watershed management plans. It will hence not be possible to distinguish between the potential treatment effect of these elements (referred to below as the "3-element package").
53. Below we present two potential evaluation designs that were also discussed during the LORTA mission, and we suggest one additional scenario.

i. Evaluation design for the package of extension worker training, micro watershed management plans and early warning information

54. A suitable control group for the evaluation of the 3-element package needs to be located outside the 20 treated micro watersheds. A natural choice for a control group are communities in the 15 remaining micro watersheds that form part of the same four watersheds that define the project area. The spatial proximity strengthens the parallel trend's assumption as the communities face similar geographical, cultural and institutional set-ups. The vulnerability assessment that identifies the 20 micro watersheds in the first place, on the other hand, goes against it. To foster the comparability of the two groups, the sampled farmers should not participate in the incentives programme. This is because the incentives programme is likely to differ between treatment and control area: in the project area, individuals receive support in the application process and the incentives might be linked to EbA related conditions. To solely measure the impact of the three elements, it will be important to focus on farmers that are not enrolled in PROBOSQUE or PINPEP.
55. It should be noted that parts of the treatment group may be affected by the grants awarded through component 2. This complicates the attributability of the impact solely to the above-mentioned elements, as the grant financed activities will only be implemented in the region of the treatment group but not of the control group. To which extent the grant activities will affect the study sample can, however, only be determined after the completion of the project, when the geographical scope of all grants is clear.
56. **Treatment group**: Farmers living in the area of the 20 prioritized micro watersheds
57. **Control group**: Farmers living in the area of the 15 non-prioritized micro watersheds

    Assumption: Parallel trends in outcomes for farmers in the 20 prioritized and the 15 non-prioritized micro watersheds, in the absence of treatment.

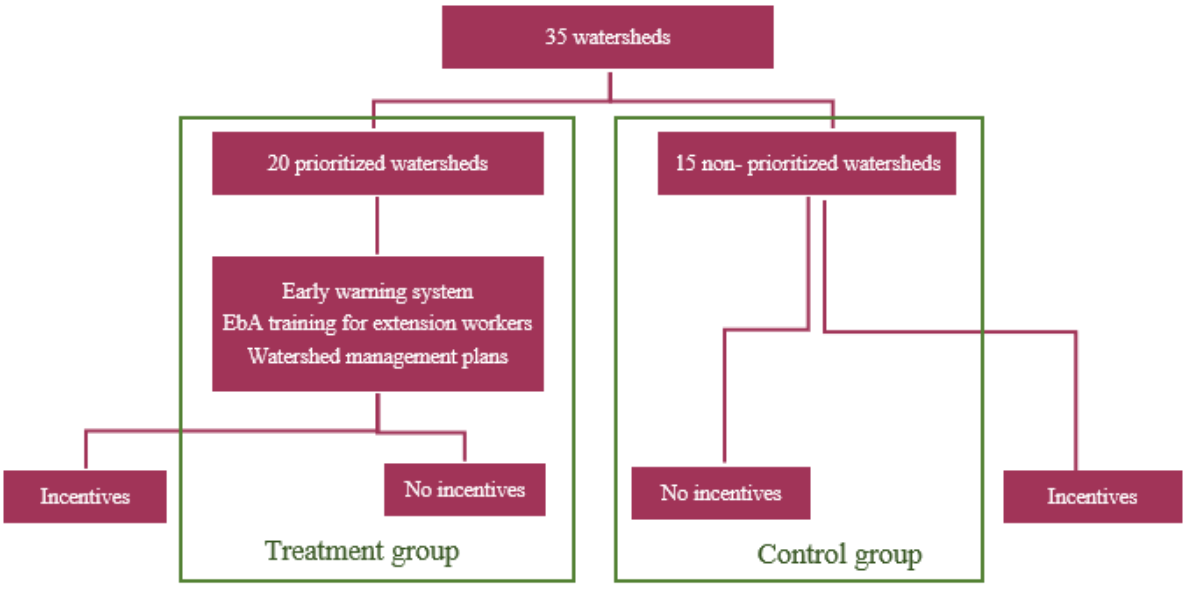


Figure 5. Impact evaluation design for 3-elements package

ii. Evaluation design for incentive programmes in the treatment area

58. During the workshop, the participants showed a strong interest in evaluating the impact of the incentive programmes. In the context of the watershed programme, this effectively means to measure the impact of the participation in the incentive programme with technical assistance in the application and EbA implementation process. The latter are important to acknowledge, as these are different from what is offered in the rest of the country.
59. A possible evaluation strategy for this "advanced" incentive programme is again a DiD design with non-incentivized farmers as a control group. As there are incentivized and non-incentivized farmers inside the 20 micro watersheds, farmers in the non-prioritized micro watersheds can be disregarded in the evaluation of the incentive programme. The study sample for this part of the evaluation would add a subsample of incentivized farmers to the evaluation.
60. **Treatment group 2**: Farmers living in the area of the 20 prioritized micro watersheds and participating in the incentive programme
61. **Control group 2**: Farmers living in the area of the 20 prioritized micro watersheds and not participating in the incentive programme
62. **Assumption**: Farmers participating and not participating in the incentive programmes would show the same trend in outcomes in the absence of the incentive design.
63. Figure 6 displays the evaluation design.
64. There are, however, several challenges to the implementation of such an evaluation. First of all, to collect baseline data of a treatment and control group, it must be possible to identify farmers who will participate in the incentives programme in the future but do not yet do so at baseline. A potential sampling frame for this group could be a list of applicants provided by the PROBOSQUE or PINPEP administration, assuming that there is a large enough number of applicants at the time of the baseline in the treatment area.
65. Second, there is the risk that farmers of the control group – the non-incentivized farmers – will enter the incentives programme after baseline. We judge this risk as low, as INAB reported overall low take-up rates of the programmes. This will need to be checked again in follow-up discussions.

66. Another concern relates to the common trends assumption of incentivized and non-incentivized farmers. Incentivized farmers are likely to be either better informed and more motivated or have more means to implement the demands of the incentive programmes. They thereby set themselves apart from the non-incentivized farmers. A common trend in, for example, yields or adjustment to climate change might, therefore, be difficult to justify. Ideally, the control would thus consist of farmers who applied for PROBOSQUE or PINPEP but who have not been selected for participating. That way it can be expected that they are similarly motivated and aware of the programmes. The feasibility of this approach needs to be further discussed with INAB and IUCN.

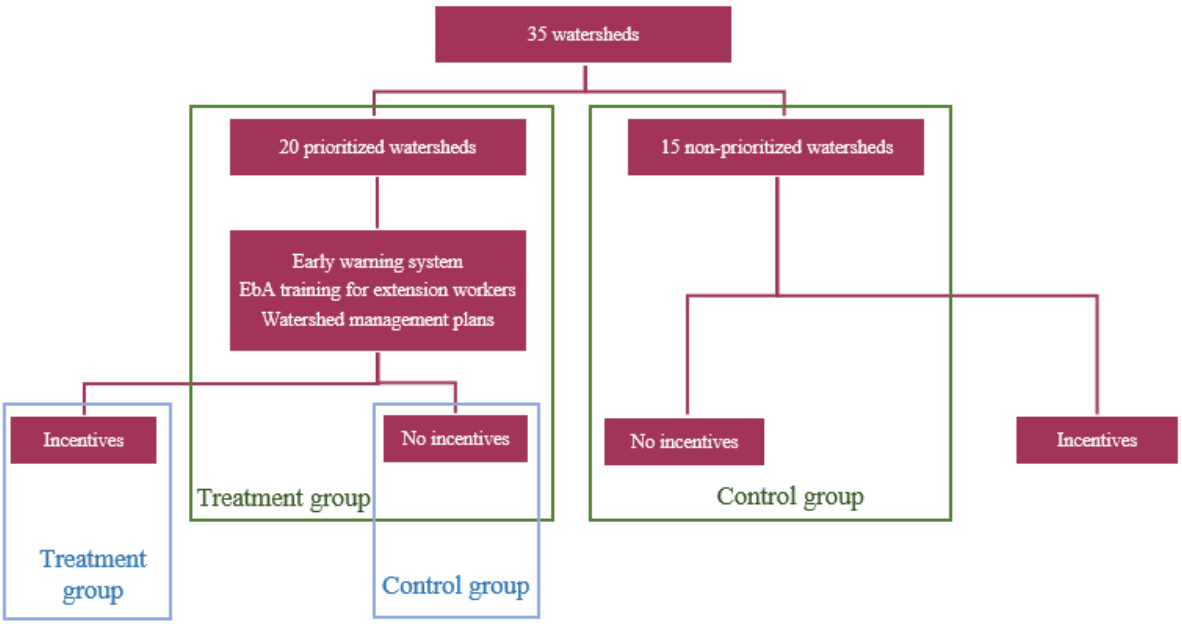


Figure 6. Combination of the two evaluation designs

iii. Suggestion: Encouragement design

67. Within the third and last scenario, we suggest an encouragement randomized controlled trial (RCT). The idea would be to introduce a mobilization or encouragement campaign in some randomly assigned communities – for example, through extensively advertising the incentive programme. The research question would then be defined as the evaluation of the promotion campaign impact. This design was not discussed during the design workshop because it only came up in C4ED internal discussion. Whether or not the country team is interested in such a design will be determined in follow-up talks.

iv. Power calculations

68. Power calculations enable us to determine the minimum sample size needed to detect the impact of the watershed project. We suggest applying a clustered design – that is, randomly sampling communities ("clusters") and then randomly selecting households.[10] Such a clustered design is necessary because the activities are implemented on the community level, hence the outcomes for farmers within one community will be correlated. Another advantage of a two-stage sampling method is that we can control the number of communities visited and thereby the costs of data-collection. Through the random sampling at the first and second stages, the final sample will still be representative of the full universe of communities in the 20 micro watersheds. The downside of this

[10] Results for a simple random sampling process are presented in appendix IV.

approach is that a slightly larger sample size is needed because observations within clusters are more similar than observations between clusters.

69. We use the following power formula that relates the sample size to the minimum detectable effect size (MDES) – that is, the difference in mean outcomes between the treatment and control groups that can be detected with a statistically significant level of alpha:

$$MDES = (t_{1-\kappa} + t_{\alpha})\sqrt{1 + \rho(m-1)}\sqrt{\frac{\sigma^2}{N}}\sqrt{1 - R^2}$$

where $t_{1-\kappa}$) and t_{α} are t-statistics representing the required power and level of statistical significance (by convention, we seek a power of 80 per cent and a statistical significance of 95 per cent), ρ is the intracluster correlation (ICC), m is the number of individuals per cluster, σ^2 is the variance, N is the total sample size. Finally, R^2 represents the extent to which baseline characteristics predict the endline yields. The better the baseline characteristics predict the outcome measure, the lower the MDES.

70. The above formula allows for a comparison between the two groups. To our knowledge, no investigations are evaluating the effect of such a treatment package that combines EbA training, seasonal weather forecast and the elaboration of micro watershed management plans. Thus, the power calculations realized below are based on different studies assessing the effect of CSA and forecast information on yield. We consider the following comparison:
    - Households in the treatment area, who receive the 3-element package (treatment group T)
    - Households in the control area, who do not receive the treatment package (control group C)
71. The optimal sample allocation ratio for a study with one treatment arm and a control arm is 50:50. As an outcome of interest, we consider yields of maize; however, the results are equally applicable for any other outcome variable with a similar distribution.

Impact on yields

72. Data on agricultural land and the production quantity for the three major crops (maize, beans and rice) produced in Guatemala are available from the National Agricultural Survey of Basic Grains 2017–2018.[11] Because the predominant land-use in the Guatemalan highlands is growing maize (covering two-thirds of the agricultural area[12]), we will focus the power calculations on maize yields. The figures from the survey can be used to compute the mean yield (metric tons per hectares, t/ha): 4.85 t/ha.
73. Unfortunately, the survey report does not include information on the standard deviation, which is essential for the power calculations. We will, therefore, build our power calculations on assumptions based on standard deviations found in other countries and studies focusing on agricultural production. The – arguably strong – assumption is that agricultural productions vary to a similar extent over different crops in different countries. Komarek et al. performed a study on maize yields in Malawi and found an average maize yield of 1.8 t/ha with a standard deviation of 1.17 t/ha, which relates to 65 per cent of the mean value.[13] We assume the same relation of the standard deviation to the mean for maize production in Guatemala. We, therefore, estimate the standard deviation to be at 3.1525 t/ha, which is 65 per cent of the mean value of 4.85 t/ha.

[11] Instituto Nacional de Estadística (INE), "Encuesta Nacional Agropecuaria de Granos Básicos (Maíz, Frijol y Arroz), Año Agrícola 2017–2018" (Guatemala, 2018). Available at *https://www.ine.gob.gt/sistema/uploads/2019/01/29/20190129112819t0K8vdPBkGZYjIhvSXRqTgPE0PsoxC9R.pdf*
[12] Internal documents (Feasibility study)
[13] Adam M. Komarek and others, "Agricultural household effects of fertilizer price changes for smallholder farmers in central Malawi", *Agricultural Systems,* No. 154 (2017), pp. 168–178.

- The mean yield for maize is 4.85 t/ha.
- The standard deviation is 3.1525 t/ha.

74. When it comes to the expected effect size, we rely on different studies, conducted outside Guatemala, evaluating the different project components individually.

75. Patt et al. found yields for farmers in Zimbabwe to increase by 19 per cent when applying forecast information.[14] Their effect was compared to farmers not benefiting from the provided training and improved climate information. After several years, the effect was still a 9 per cent increase.

76. According to an investigation realized by Arslan,[15] CSA in the form of intercropping can lead to an increase in yields of at least 20 per cent. However, they did not find significant results for other forms of CSA (e.g. crop rotation). Nevertheless, we suppose a positive impact of CSA on yields.

77. We consider an MDES of 10 per cent for the following power calculations, which is a conservative estimate. A higher MDES would require a lower sample size to detect a statistically significant treatment effect. Table 4 shows the results for the MDES at different values of R2 including clusters. The indicator is always maize yield in t/ha, the mean value is set to 4.85 t/ha and the standard deviation to 3.1525 t/ha. In all cases, we are trying to achieve the minimum detectable per cent change of 10 per cent.

78. The first two rows use the optimal sample size from the power calculations without clusters (900) (see appendix IV). The MDES, displayed in the last row, is substantially higher in the clustered design than in the simple design. Consequently, we have to increase the sample size to attain the target value of 10 per cent. Assuming an ICC of 0.1, the optimal sample size rises to 1,700 (see rows 3 and 4). Rows 5 to 8 use different ICCs and sample sizes demonstrating the important implication of the power calculation: an increase in the ICC (the higher correlation of outcomes in one cluster) must be accompanied by an increase in the sample size to detect a 10 per cent change. In rows 5 and 6, for an ICC of 0.2, we need a sample size of 2,600. This halves for an ICC of 0.05 (rows 7 and 8).

Table 4. Power calculations for two study arms and outcome maize yields, cluster

	MEAN	BASELINE STD. DEVIATION	ICC	SAMPLE SIZE (TOTAL)	R2	SIZE OF GROUP	SAMPLE SIZE IN C	SAMPLE SIZE IN T	MDES (IN T/HA)	% CHANGE
1	4.85	3.1525	0.1	900	30%	10	450	450	0.68	14.01%
2	4.85	3.1525	0.1	900	0%	10	450	450	0.812	16.75%
3	4.85	3.1525	0.1	1,700	30%	10	850	850	0.495	10.20%
4	4.85	3.1525	0.1	1,700	0%	10	850	850	0.591	12.19%
5	4.85	3.1525	0.2	2,600	30%	10	1300	1300	0.485	10.01%
6	4.85	3.1525	0.2	2,600	0%	10	1300	1300	0.580	11.96%
7	4.85	3.1525	0.05	1,300	30%	10	650	650	0.157	10.19%
8	4.85	3.1525	0.05	1,300	0%	10	650	650	0.187	12.18%

79. We argue that an overall sample size of 1,700 households is ideal when we assume an ICC of 0.1 and 1,300 for an ICC of 0.05. In both cases, it is reasonable to assume that we will be able to capture

[14] Anthony Patt, Pablo Suarez and Chiedza Gwata, "Effects of seasonal climate forecasts and participatory workshops among subsistence farmers in Zimbabwe", *PNAS*, vol. 102, No. 35 (August 2005), pp. 12623–12628.
[15] Aslihan Arslan and others, "Climate smart agriculture? Assessing the adaptation implications in Zambia", *Journal of Agricultural Economics*, vol. 66, No. 3 (March 2015), pp. 753–780.

some of the variation in yields through baseline covariates (R_2 of 30 per cent). Both ICCs are rather conservative estimates and are obtained from Geyer et al.[16] and Winters et al.,[17] respectively.

v. Possible risks for impact evaluation

80. A key limitation of the IE design is that the selection of the priority micro watersheds will be determined purposively, based on climate vulnerability criteria, and will thus be non-random. The selected quasi-experimental method, the DiD technique, relies on the satisfaction of the **parallel trends assumption**, which cannot be tested. In principle, secondary data from the pre-intervention period could be used to at least compare the past trends in outcome variables. Showing a parallel trend in the past supports the assumption that the same trend would have persisted without the watershed project. While several data sources provide interesting information on agricultural production, it is not clear whether these data can be (dis)aggregated at the micro watershed level, which is the defining unit for the treatment and control group. Furthermore, the past trends of the two groups can only be compared once the groups are defined – that is, when the prioritization is completed, which is late 2020 according to the current timeline.
81. Furthermore, any time-varying factor differentially affecting treatment and control areas would undermine the unbiased estimation of the treatment effect. The estimation of the effect is particularly vulnerable to the confounding effect of overlapping development or policy interventions as well as weather-related shocks that may differentially affect the areas. A violation of the parallel trends assumption invalidates the evaluation strategy, and the observed differences in treatment and control groups can no longer be attributed to the intervention.
82. Another threat to the evaluation is posed by the risk of **spillovers** from treated to control micro watersheds, particularly likely in case of CSA knowledge and early warning messages. We cannot rule out that personal relations between community members or extension workers across treatment and control areas lead to information-sharing and behavioural adaptation of farmers. Moreover, IARNA commented in the workshop that the design of the EWS in the treatment area is part of a national plan to improve the meteorological services countrywide. For a few years, the investments might, therefore, affect the control group as well. Such spillover might positively affect the outcomes in the control group over time, which will lead to an underestimation of the treatment effect.
83. During the workshop, the country team recurrently pointed out the **heterogeneity** of the study population in terms of ethnicity, social structures, agricultural practices and soil fertility. For this reason, the content of the EbA training, the networks engaged and dissemination channels for the early warning messages will differ across communities. These differences in beneficiary characteristics and implementation are likely to produce heterogeneous treatment effects. While the estimated average treatment effect will remain unbiased, it will be less precisely estimated at a given sample size, which has implications for the power calculation. A way to deal with the heterogeneity issue is to plan from the beginning with subsample analysis, in this case, for example, by the main crop or implementing agency. This, however, requires a substantially higher sample size, as every single subsample needs to have enough power to detect statistically significant impacts.

[16] Judy Geyer, Mikal Davis and Tulika Narayan, "Intracluster correlation coefficients of household economic and agricultural outcomes in Mozambique", *Evaluation Review*, vol. 40, No. 6 (August 2016), pp. 526–545.
[17] Paul Winters, Lina Salazar and Alessandro Maffioli, "Designing impact evaluations for agricultural projects", Impact-Evaluation Guidelines, Technical Notes No. IDB-TN-198 (Inter-American Development Bank (IDB), 2010). Available at *https://publications.iadb.org/publications/english/document/Designing-Impact-Evaluations-for-Agricultural-Projects.pdf*

d. Budget

84. The original financial planning for the watershed project does not contain a budget for IE. The AE is, however, planning to reallocate funds within the project to finance the data-collection and analysis. Whether this is possible is not yet clear.

85. The funds required for data-collection depend on the number of treatment arms, sample size per treatment arm and the indicators to be measured. The proposed main evaluation design is a DiD approach with two subsamples: non-incentivized households outside the treatment area and non-incentivized households within the treatment area. A minimum of two waves of data need to be collected to calculate the changes in outcome variables within each group. Our power calculation for clustered two-stage sampling suggests that a sample of 850 households in each group will be sufficient to find an economically relevant treatment effect. Assuming an attrition rate between the waves of 15 per cent, a total of roughly 1,000 households per group or 2,000 households in total need to be interviewed at baseline. If the design for the incentives programme is also deemed feasible, an additional sample of 1,000 households (incentivized households within the treatment area) needs to be added to the evaluation.

86. To calculate the costs of data-collection, we take the cost example of a similar household survey from IARNA[18] as a basis. Assuming a questionnaire of roughly 50 pages with which three households can be interviewed per enumerator per day, the unit costs of data-collection are approximately USD 50 per interview. Hence, two waves of data-collection with N=2,000 would cost USD 200,000, and a sample with N=3,000 would cost USD 300,000. This does, however, not yet account for the preparation costs (questionnaire design, sampling, data quality checks, etc.) and data analysis costs for the project team or the assigned data-collection company.

e. Timeline of evaluation

87. The LORTA team is coordinating with the IUCN and other stakeholders involved in the project to ensure effective implementation of the project and evaluation activities, to be in line with the IE design. Since the workplan of the project is not yet finalized, the dates for the activities in the timeline are only tentative.

Table 5. Tentative timeline of the project evaluation

TIME	ACTIVITY
Q3 2019	LORTA Design Workshop
Q1 2020–Q1 2021	Using ROAM, the project stakeholders will finalize the selection of 20 micro watersheds for project implementation
Q2 2020	Finalization of operational manuals
Q3 2020	Baseline data-collection (farmer survey)
Q3, Q4 2020	Start of capacity training of extension workers (INAB, MAGA, etc.) Design of EWS Development of micro watershed development plans First call for proposals for grants
Q1 2021	First farmers receive capacity training Early warning information is transferred to the communities

[18] Internal documents (Final evaluation report: “Evaluación final del Proyecto Cadenas de Valor Rurales (PCVR)”)

TIME	ACTIVITY
Q3 2023	Endline data-collection (farmer survey)

f. Secondary data sets

88. The evaluation can benefit from integrating the primary data collected with a multiplicity of secondary data sources, both at the baseline and later stages.

89. One data set that will be consulted by the LORTA team is the most current version of the Guatemala household survey "Encuesta Nacional de Condiciones de Vida", capturing data from 2014. This is a national survey conducted by the National Statistics Institute, a decentralized governmental organism, investigating the population's living conditions, as well as determining the existing poverty levels and their determinants in Guatemala. The institute also possesses other data that might be relevant such as agricultural data on the principal crops: maize, beans and rice.

90. Additionally, IARNA conducted a household survey for the evaluation of the "Proyecto Cadenas de Valor Rurales". The survey costs of this assignment were used to give a preliminary cost estimate for the data collections for the IE of the watershed project. We could also use the data to calculate standard deviation, ICC and R^2 for the power calculation. In the best-case scenario, this data set would even contain several representative communities for the micro watersheds in our study sample. In that case, we could use these data to compare treated and control communities and draw conclusions on the comparability of the two.

91. Finally, secondary data, such as on soil quality (e.g. Harmonized World Soil Database[19]), food insecurity and rainfall patterns (e.g. Centro Clima,[20] Regional Platform of Climate Information), may benefit the evaluation in controlling for observed external factors in the econometric analysis.

C. WAY FORWARD

92. Overall, we consider that the LORTA mission in Guatemala was well received and that it produced promising results. The success of the LORTA mission is particularly due to the attentive collaboration and high motivation of the project stakeholders. Before the planning of the IE can continue, the LORTA team will need feedback from the IUCN regarding the financial feasibility of the evaluation. Furthermore, the design of the projects needs to be finalized. C4ED will wait for the final selection of project locations before assessing options for suitable control areas. Furthermore, once the operational manuals are finalized, C4ED will review them and discuss the new information with the country team regarding the evaluation design and outcome measures. To assess the feasibility of the evaluation of the incentives programme, C4ED will get in touch with INAB to gain a further understanding of the application process and requirements. With the help of IARNA, we will be able to give more precise power calculations and thereby have a better idea of the evaluation costs. After we know these details, we will update this report. This will also determine the next steps of the evaluation.

93. The future success of this project in the LORTA framework is highly conditional upon a continuous responsive collaboration from the IUCN and other involved key stakeholders.

[19] See *http://www.fao.org/soils-portal/soil-survey/soil-maps-and-databases/harmonized-world-soil-database-v12/en/*
[20] See *http://centroclima.org/*

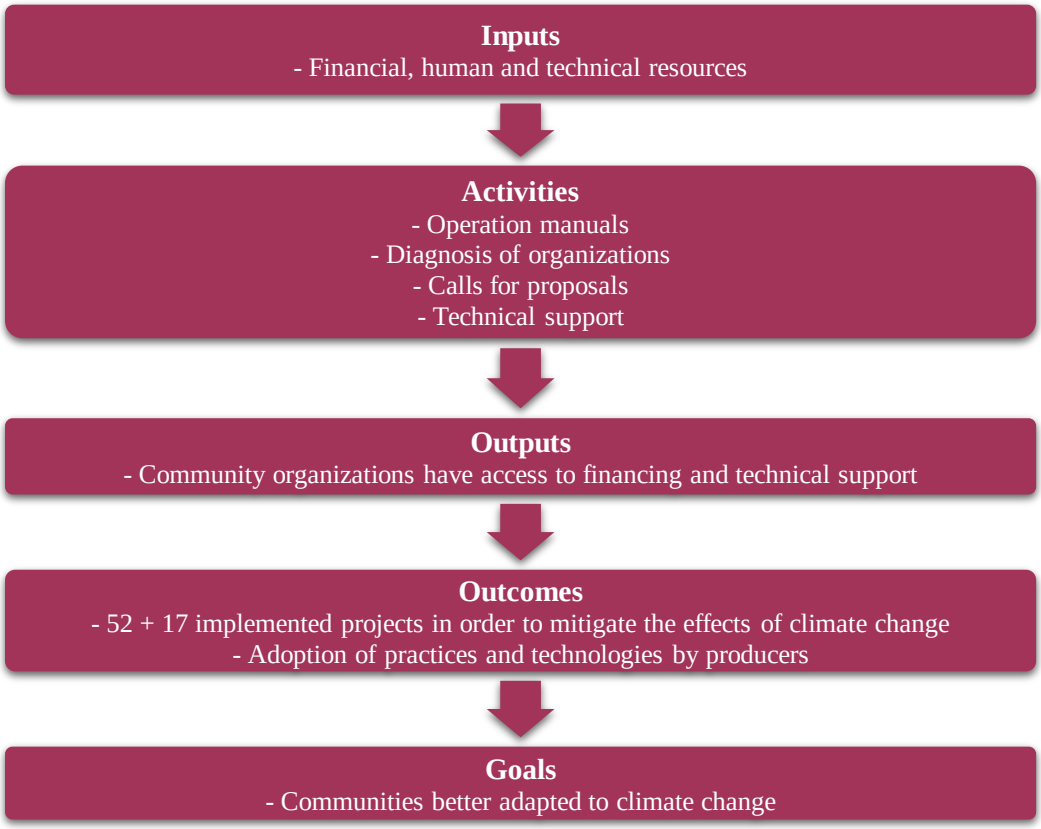
Appendix 1. AGENDA OF GUATEMALA LORTA FIELD MISSION

DAY	PROPOSED ACTIVITIES
Day 0: Sunday, August 25	Arrival of team
Day 1: Monday, August 26 From 8:00	Welcome, presentation of participants, workshop objectives, project presentation
	Presentation "What is an impact evaluation?" – Understand the challenges
	Presentation Theory of change – concept and application of project components
Afternoon From 14:00	Presentation Theory of change, cont.
	Review proposed methodology and the technical proposal provided by the consultant firm selected for IE work and discuss survey methodology, sample size, etc.
Day 2: Tuesday, August 27 From 8:00	Presentation Methods for IEs
	Presentation Definition and design of the project's IE
Afternoon From 13:00	Workshop Power calculations and application with available data
	Preparation of field visit
Day 3: Wednesday, August 28 Morning	Travel to Totonicapán
Afternoon	Visit of project areas Watershed "Río Salamá" EWS, CDRO
	Travel to Quetzaltenango
Day 4: Thursday, August 29 Morning	Visit of project areas Watershed "Río Salamá" Exchange with key stakeholders from PROBOSQUE
Afternoon	Travel back to Guatemala City
Day 5: Friday, August 30 8:00	Presentation Monitoring instruments and systems within IUCN
	Presentation Costs and financing of IE
Afternoon From 13:30	Discussions, summary and following steps

Appendix 2. List of stakeholders engaged with during Guatemala LORTA mission

LORTA WORKSHOP		
Name	Position	Institution
Ursula Parrilla	National Coordinator Guatemala	IUCN Guatemala
Tania Ammour	Regional Program Coordinator	IUCN ORMACC
Jesus Cisneros	M&E Specialist	IUCN ORMACC
Osana Bonilla-Findji	Environmental Expert	CGIAR
Esther Heesemann	Impact Evaluation Specialist	C4ED
Aemal Khan	Evaluation Assistant Consultant	GCF IEU
Ottoniel Monterroso	Director	URL IARNA
Enju Kim		KOICA
Lissette Castro	Program Coordinator	KOICA
Pedro Pineda	Researcher	URL IARNA
Hector Tuy	Director	URL IARNA
Yvonne Ramirez	Executive Director	FCG
José Saturnino Ordoñez	Supervisor	INSIVUMEH
Silvia Anaité Lopez	Head of Conservation of Strategic Forest Ecosystems	INAB
Lourdes Perez	Social Representative of Communal and Municipal Strengthening	INAB
Antonio Guoron	Head of Climate Change	INAB
Rodrigo Rodas	Head of Institutional Monitoring & Evaluation	INAB
Luciano Silvestre	Analyst	INAB
Herles Martinez	Coordinator of PROBOSQUE	INAB
Edgar Rodriguez	Coordinator of PINPEP	INAB
Rosa Elena Medina	Representative of Forest, Municipal and Communal Strengthening	INAB
Jairo Morales Lemus	Forest Technician	INAB
Williams Chuc		CDRO
Antonia Xuruc	Organizer of the Environmental Community System SAC/CDRO	CDRO
Alejandro Meda		FCG
Orsibal Ramírez		IUCN GUATEMALA

Appendix 3. THEORY OF CHANGE FOR COMPONENT 2



Appendix 4. POWER CALCULATIONS FOR TWO STUDY ARMS AND OUTCOME MAIZE YIELDS, SIMPLE RANDOM SAMPLING

	MEAN	BASELINE STD. DEVIATION	SAMPLE SIZE (TOTAL)	R_2	SAMPLE SIZE IN C	SAMPLE SIZE IN T	MDES (IN T/HA)	% CHANGE
1	4.85	3.1525	1,000	30%	500	500	0.468	9.65%
2	4.85	3.1525	1,000	0%	500	500	0.559	11.53%
3	4.85	3.1525	1,300	30%	650	650	0.41	8.46%
4	4.85	3.1525	1,300	0%	650	650	0.49	10.11%
5	4.85	3.1525	900	30%	450	450	0.493	10.17%
6	4.85	3.1525	900	0%	450	450	0.589	12.15%

We argue that an overall sample size of 900 households is ideal, split into 450 households in T and C (50:50). It is reasonable to assume that we will be able to capture some of the variation in yields through baseline covariates (R^2 of 30 per cent).

Formula for power calculations of simple random sampling

$$MDES = (t_{1-\kappa} + t_{\alpha}) \sqrt{\frac{1}{P(1-P)}} \sqrt{\frac{\sigma^2}{N}} \sqrt{1 - R^2}$$

where $t_{1-\kappa}$ and t_{α} are t-statistics representing the required power and level of statistical significance (by convention, we seek a power of 80 per cent and a statistical significance of 5 per cent), P represents the proportion of the sample in one of the two compared groups (allocation ratio), σ_2 is the variance, N is the total sample size, and R_2 represents the extent to which baseline characteristics predict the endline outcome variable.

IMPACT EVALUATION DESIGN REPORT 2: CENTRAL AMERICA

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BOXES

A. INTRODUCTION

1. THE LORTA PROGRAMME

1. Evaluating the impact of development projects and programmes has gained importance in recent years. IE not only allows for increased transparency by measuring the effects of investments, it also provides the opportunity to design and implement development projects more effectively. To contribute to this progression, the IEU of the GCF has started the LORTA programme to be able to keep track of GCF projects in terms of performance and results, and to enhance learning within the GCF.
2. The LORTA programme has the following aims:
   - Embed real-time IEs into funded projects so GCF project task managers can quickly access accurate data on a project's quality of implementation and likelihood of impact
   - Build capacity within projects to design high-quality data sets for overall impact measurement
3. The purpose of the IEs is to measure the change in GCF key result areas that can be attributed to project activities. The LORTA programme will inform on returns on GCF investments and help GCF projects track implementation fidelity. LORTA has the following objectives:
   - Measuring the overall change (outcome or impact) of GCF-funded projects and enhancing learning
   - Understanding and measuring results at different parts of ToCs
   - Measuring the overall contribution of the GCF to catalysing a paradigm shift and achieving impacts at scale
4. Currently, the LORTA programme is in its second year. In the first year (2018), the IEU supported eight GCF-funded projects to build high-quality, theory-based IE designs at inception. Seven of these projects moved on from the formative research phase to the main impact assessment phase. In the second year of LORTA (2019), six additional GCF-funded projects and programmes were selected to enter the LORTA programme. They are currently undergoing formative work, which includes engagement with AEs, project teams and GCF staff and developing designs for theory-based IEs.

2. THE CAMBIO II PROJECT

5. The project "Productive Investment Initiative for Adaptation to Climate Change" (CAMBio II) is one of the six projects selected to be part of the inception stage (Phase I) of the LORTA programme in 2019. The AE for this project is the CABEI, with its headquarters in Honduras and regional offices in Guatemala, El Salvador, Nicaragua, Panama and Costa Rica. The overall goal of this project is to improve the resilience of MSMEs in Central America against the consequences of climate change. Therefore, CABEI will establish a credit line for IFIs that finances credits for MSMEs' adaptation projects and provides funds for capacity-building of MSMEs and IFIs. The target population is MSMEs that are vulnerable to climate change in seven Central American countries: Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama and the Dominican Republic.

a. Regional background

6. Central America, lying in an isthmus between the Pacific and Atlantic oceans, is strongly affected by climate change. The wide range of consequences includes changes in temperature and sea level,

delay of the rainy season, and greater irregularity and intensity of the precipitation. Extreme weather events such as hurricanes, floods and droughts already hit this region more frequently and more severely than in earlier decades. Figure 7, picturing a world map with the Climate Risk Index[21] Ranking 1998–2017 (developed by German Watch), shows that Central America is one of the most affected regions in terms of extreme weather events. Particularly vulnerable to these threats are the countries in the north of Central America: Guatemala, El Salvador, Honduras, Nicaragua and the Dominican Republic. They are ranked among the 20 countries most exposed to climate risks.

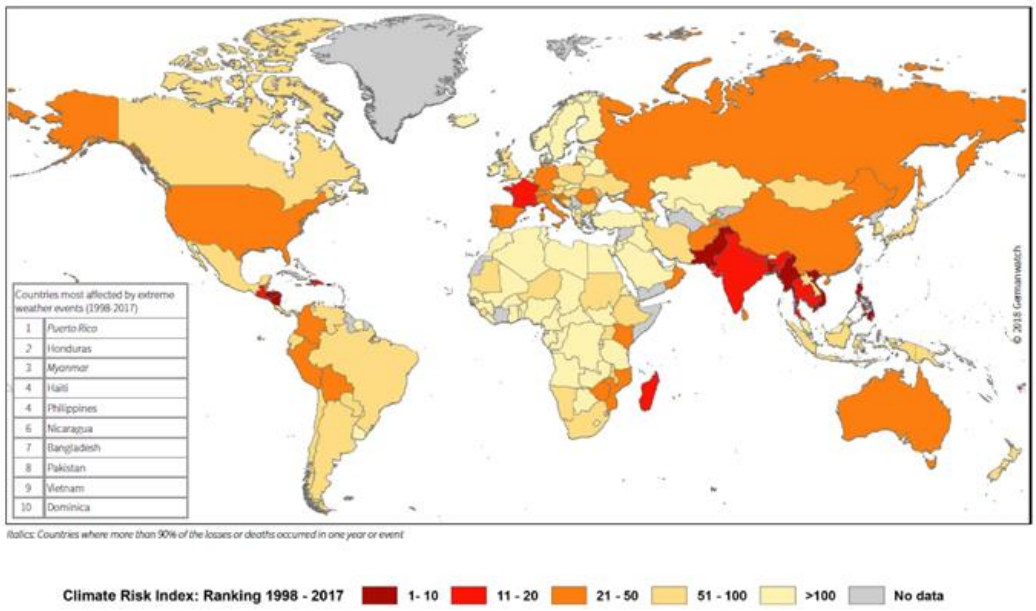


Figure 7. Countries most affected by extreme weather events

Source: Germanwatch e.V.

7. The vulnerability of Guatemala, El Salvador, Honduras and Nicaragua is exacerbated by socioeconomic conditions. As depicted in Table 6, all four countries were until 2018 categorized as Lower Middle Income countries by the World Bank[22] and have the lowest Human Development Index (HDI) of the region (column 2). Not surprisingly, they also show the highest poverty headcount ratios in the region (column 3), above all in rural regions, with ratios between 52 per cent and 66 per cent (column 4). Costa Rica, Panama and the Dominican Republic are markedly better off, with rural poverty rates between 21 per cent and 35.5 per cent. The combination of restricted financial means and the elevated exposure to weather shocks sets in motion a vicious circle: a more frequent occurrence of climate shocks results in more costs for coping mechanisms leading to serious deterioration of these countries' economic situation.

[21] A lower rank means the country or region is more highly affected. Germanwatch e.V., "Global Climate Risk Index 2019". Available at https://germanwatch.org/en/16046.
[22] Guatemala with a gross national income per capita of USD 4,410 has been only narrowly above the threshold of USD 3,895 since 2019.

Table 6. Characteristics of Project Countries

Indicator Country	Country Income classifica-tiona	HDI and rankb 2018	Poverty headcount ratio (total)c	Poverty headcount ratio (rural)d	Employment in agriculture (% of total employment), 2019e	GDP per capita annual growth 1995–2015f
Guatemala	Upper Middle Income	0.650/127	50.5% (2014)	65.8% (2014)	31.5%	1.4%
El Salvador	Lower Middle Income	0.674/121	37.8% (2017)	52.2% (2017)	16.3%	1.5%
Honduras	Lower Middle Income	0.617/133	53.2% (2016)	64.0% (2016)	30.3%	1.5%
Nicaragua	Lower Middle Income	0.658/124	46.3% (2014)	59.8% (2014)	30.7%	2.7%
Costa Rica	Upper Middle Income	0.794/63	15.1% (2017)	20.8% (2017)	12.1%	2.5%
Panama	High-Income	0.789/66	16.7% (2017)	35.5% (2017)	14.0%	4%
Dominican Republic	Upper Middle Income	0.736/94	27.4% (2016)	34.9% (2016)	9.0%	3.8%

Source: a World Bank; b UNDP, http://hdr.undp.org/en/composite/HDI; c CEPALSTAT, Pobreza nacional y Pobreza Total del área rural; d World Bank, Rural poverty headcount ratio at national poverty lines (% of rural population); e World Bank, World Development Indicators; f World Bank, World Development Indicators.

8. The majority of MSMEs that will benefit from the project are expected to operate in the agricultural sector. As presented in Table 6, this sector accounts for around 30 per cent of the total employment in Guatemala, Honduras and Nicaragua. Agricultural production is highly vulnerable to climate change. Loss in harvest due to increased occurrence of pests and diseases or changing weather patterns (rain and dry periods) is only one example of its adverse consequences. Farmers or agricultural businesses, organized in MSMEs, do not possess the financial and/or technical knowledge to adapt to climate change.[23] Financial and non-financial institutions often perceive MSMEs as high-risk, and hence only 3 per cent of total credits are offered to the whole agricultural sector (by the regulated financial system).[24] CAMBio II aims to remove these financial barriers by promoting credits for MSMEs to increase adaptation measures against climate change.

b. Project details

9. CAMBio II consists of three interlinked components:

[23] Lisa Dougherty-Choux and others (2015). "Adapting from the ground up: Enabling small businesses in developing countries to adapt to climate change" (Washington, D.C., World Resource Institute; UNDP; 2015).
[24] Internal document (Feasibility study)

1) Access to credits for MSMEs through selected IFIs
2) The provision of technical assistance, accompaniment and training of MSMEs and IFIs on green financing and adaptive measures
3) Award to IFI and MSME for successful implementation of investment projects

10. CAMBio II is a follow-up project to CAMBio I, which aimed at fostering and mainstreaming biodiversity conservation within MSMEs through green financing (see Box 1).

11. The implementation of CAMBio II relies heavily on the interplay between CABEI and local IFIs, which will apply for the CAMBio II credit line from the bank. IFIs can be public or private banks, finance companies, non-banking financial institutions and cooperatives. Per country, two to three IFIs are expected to participate in the CAMBio II project and will be purposefully selected by CABEI. The selected IFIs need to have a dense network of clients in the sectors and areas particularly vulnerable to climate change.

Box 1 CAMBio I: Central American Markets for Biodiversity

CAMBio I provided in total USD 55 million to financial institutions lending to biodiversity-friendly MSMEs, more than double the amount available for CAMBio II (CAMBio I was a revolving credit line). CAMBio I distributed more than 12,000 credits. The project countries were Costa Rica, Guatemala, Honduras, El Salvador and Nicaragua. CAMBio I did not provide technical assistance / capacity building (component 2).

12. MSMEs can apply to the IFI for credits for adaptation projects according to their enterprise size: medium enterprises for up to USD 1 million, small enterprises for up to USD 400,000 and microenterprises for up to USD 100,000. Their application will be forwarded from the IFI to CABEI, which will then decide on the success of the application.

13. Both IFIs and MSMEs receive start-up training on climate change issues and adaptation projects. The start-up workshop for the MSMEs will be delivered through regional group sessions or online training. While the start-up workshops are compulsory, IFI and MSMEs can also apply for technical assistance and coaching at the PMU. The technical assistance will be provided by technical assistance support providers (TASPs) in the relevant areas. It is the role of the PMU to identify suitable TASPs. Once the application for assistance is approved by CABEI, the PMU will match TASPs to IFIs or MSMEs, based on expertise and need. There is a limited budget available for assistance services: USD 812,000 is earmarked for MSME pre-investment support, USD 276,250 for technical assistance during investments and another USD 189,000 for capacity-building of the IFIs. This would translate to USD 162 for pre-investment and USD 55 post-investment for each credit. In fact, in the M&E plan, only 385 MSMEs are targeted to participate in voluntary training. During the design workshop, CABEI mentioned that the funds for assistance are likely to be exhausted in the first implementation years.

14. When the adaptation project has been successfully implemented, the IFI–MSME pair can apply to the PMU for an award in the form of a grant. Only IFIs and clients of IFIs that are non-bank financial institutions, cooperatives and microfinance institutions are eligible for the awards. The grant will cover 8–15 per cent of the loan size for the MSME and 4–5 per cent for the IFI, depending on the gender of the applicant (Figure 8) and with a ceiling of USD 10,000. The award will be granted if specific progress indicators defined by the IFI and overall eligibility criteria set by CABEI are met. The CABEI eligibility criteria include (1) fulfilment of payment obligations, (2) records on baseline and endline indicators, and (3) that no award has been granted already. Applications for

awards below USD 7,500 will be assessed by the PMU and larger grants by a technical committee within CABEI. In the M&E plan, a target is set of 1,340 MSMEs receiving awards.

15. The three project components are hence strongly interlinked: every enterprise that received the credit has the opportunity to apply for a range of coaching services and technical assistance and is also eligible for the awards upon compliance with the progress indicators.

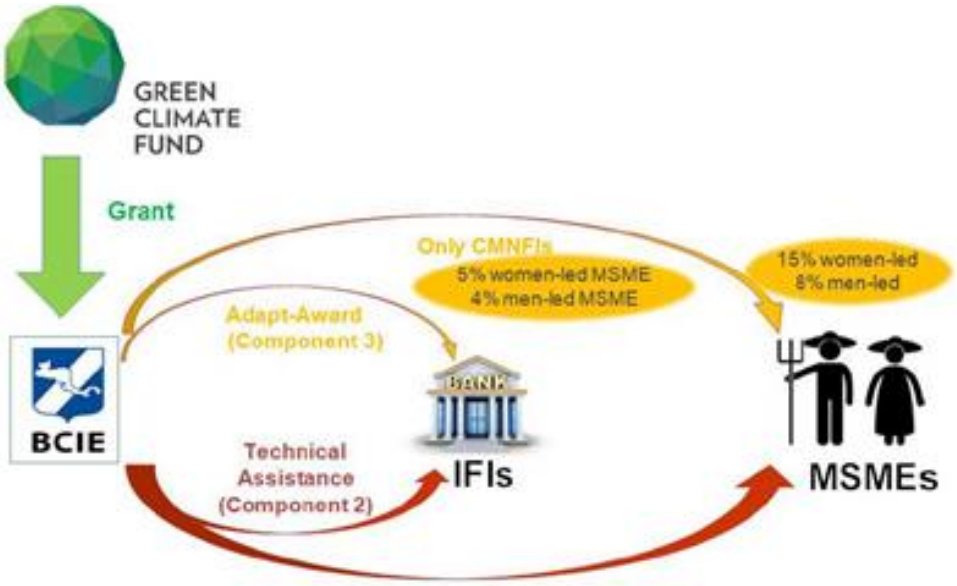


Figure 8. Component 2 and 3 implementation

Source: Funding proposal.

c. Project area and beneficiaries

16. The project will be implemented in seven Central American countries: Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama and the Dominican Republic. The loan recipients need to fulfil the following conditions:
    1) Firm size: micro (up to five employees), small (up to 50 employees) or medium (up to 100 employees)
    2) Sector: Agroforestry and agroecological farming; Silvopastoral systems; Sustainable tourism; Private/community protected areas; Sustainable forest management; and Fisheries and sustainable aquaculture
    3) MSME or activity is exposed to climate risks
    4) Low environmental or social impact
    5) Participation in a start-up workshop
17. As all Central America is vulnerable to climate change, the beneficiaries of CAMBio II can be located almost anywhere within the seven countries. Even though CABEI identified 14 broad subnational areas where they expect the highest take-up, project activities will not be limited geographically.

d. Project timeline

18. The project is in an advanced preparatory state. The operation manuals are written, and the first payment from the GCF is expected on 16 January 2020. Once the funds are received, a PMU will be set up and staff will be hired. The workshop participants expect the recruitment to be finalized by April 2020. Once the PMU is in place, the selection and identification of IFIs will begin. According to the country team, the first year will be spent mainly on start-up activities and only 2 per cent of the reimbursable funds will be invested (Table 7). From year 2 to year 4 the share of the reimbursable funds invested will slowly increase from 16 per cent to 32 per cent. This projection implies that the 5,000 credits will be disbursed more or less evenly across the years, from the second year onwards. The corresponding number of credits range from 900 in years 1 and 2 to 1,600 in year 4. It should be noted that this projection is based on the experience with other credit lines, among them CAMBio I. The actual distribution of funds across the years will be driven by the demand of MSMEs and the readiness of the IFIs.

Table 7. Expected disbursement schedule of component 1

	Year 1	Year 2	Year 3	Year 4	Year 5
Amount of reimbursable funds for component 1 (USD)	500,000	4,000,000	6,500,000	8,000,000	6,000,000
Share of total amount	2%	16%	26%	32%	24%
Average number of loans	100	800	1,300	1,600	1,200

B. Honduras field mission

1. General remarks

19. An evaluation team, consisting of two consultants from C4ED and one consultant from the IEU (referred to below as the LORTA team), was formed to lead the field mission from 4 to 8 November 2019. The task of the team was to engage closely with key stakeholders of the project – namely, the AE, implementing agencies, project staff and potential end beneficiaries – to ensure their interest in and understanding and sense of ownership of the planned theory-based IE.

20. During the field mission, the LORTA team held meetings and capacity-building workshops with the key stakeholders from the CABEI headquarters and country offices. The stakeholders' views about the project's implementation, expected impact, challenges and possible solutions were discussed. Furthermore, a field visit to a current IFI (ODEF Financiera SA) was conducted to learn from their experience and meet smallholder coffee producers. The meetings not only informed the LORTA team about the project but also aimed at fostering collaboration and trust between the team and on-site involved parties.

2. The mission agenda

21. The LORTA team received prompt support from CABEI in organizing the mission. The agenda – shown in appendix I of this design report – was developed to facilitate the joint attendance of all key stakeholders at the LORTA workshop and to allow for a field visit.

22. The mission comprised three and a half days of stakeholder workshops and one day of field visits. The workshop took place in CABEI's headquarters in Tegucigalpa, Honduras.

23. The first day started with the introduction of participants and the presentation of CABEI and its financial intermediation scheme by the country team, followed by an introduction to LORTA and the benefits of IEs by the LORTA team. After the first break, the country team described the CAMBio II programme including the implementation plans and other available documents. In the afternoon, CABEI's evaluation office presented their experience with IEs. The day was concluded with a capacity-building workshop comprising interactive discussions and the elaboration of a ToC and the indicators and risks for components 1 and 2.
24. The second day started with the presentation of the details of the programme's implementation, the progress made so far and the plans for the short, medium and long-term. The LORTA team continued with an interactive workshop during which experimental and non-experimental IE methods were presented, followed by the analysis and development of appropriate IE designs for CAMBio II.
25. The third day included further discussions about the appropriate IE design, a presentation about the required sample size, general guidelines regarding project M&E of CABEI, as well as discussions on budget lines.
26. On the fourth day, a team of CABEI together with the LORTA team took a field visit to San Pedro Sula to visit ODEF Financiera SA, a microfinance institution (MFI). They invited four of their clients to share with the team their stories of taking a "green credit" (e.g. taking a credit to plant trees). Three out of the four smallholder farmers were coffee producers that experienced a loss in harvest due to climate-related hazards. The visit helped substantially in gaining a clear understanding of the challenges faced by the target population (due to climate change), how farmers coped with this risk after the grant of the credit, and how IFIs (in this case an MFI) apply for the Global Credit Line, do their promotion and outreach, and function. Visiting the Fundación HonduCafe,[25] a possible service provider for the project, concluded this field visit. The foundation presented their work with the coffee farms and thereby gave an insight into the livelihood conditions of a potentially important target population of CAMBio II.
27. For the last half-day, the LORTA team presented a summary of the main results of the workshop.
28. The workshop benefited the key stakeholders and the LORTA team. On the one hand, the presentations and interactive discussions on the ToC and project implementation brought all the key stakeholders together on the same page concerning the project objectives, ownership and evaluation needs. On the other hand, the LORTA team was able to gather a rich set of information on the project area, implementation goals and data-collection costs, and to get to know the relevant stakeholders of the project.
29. Appendix II of this design report lists all the people engaged with at the workshop and during field visits throughout the LORTA mission.

3. RESULTS

30. The design workshop confirmed the feasibility of an IE of the CAMBio II project. As all borrowers can apply for technical assistance as long as funds are available, and can qualify for the award, the proposed evaluation strategy will evaluate the full project rather than focusing on individual components. A focus is, however, on the first and second component, as the third can be seen rather as an enforcing mechanism that motivates the beneficiaries to reach the desired outcomes. The impact of the project will hence need to be attributable to all three components.

[25] See *https://fundacioncohonducafe.org/*

a. Theory of change

31. The ToC associated with CAMBio II is laid out below for the first and the second project components.

i. Component 1: Access to credits to MSMEs through selected IFIs

32. Inputs

    The inputs encompass the refundable funds from CABEI and the GCF, the human capital of the implementation team (e.g. PMU) and the network of IFIs that CABEI has in place in each of the project countries.

33. Activities

    The actions at the core of this component are the promotion of the Global Credit Line for adaptation projects to IFIs and the selection of MSMEs based on the evaluation of their application for the credit.

34. Outputs

    Through the inputs and activities of the component, as well as the IFIs that grant credits, MSMEs have access to credits to implement adaptation projects against the consequences of climate change.

35. Outcomes

    As a result, MSMEs use the loan to implement different adaptation measures, depending on the sector. This would lead to higher yields and higher income, further translating into faster successful repayment of the loan and better credit history.

36. Goals

    The main goal behind this component is lower vulnerability and therefore an increase in the resilience of MSMEs to climate change.

37. These five stages are summarized in Figure 9. The assumptions for the ToC to hold are presented at the end of the section.

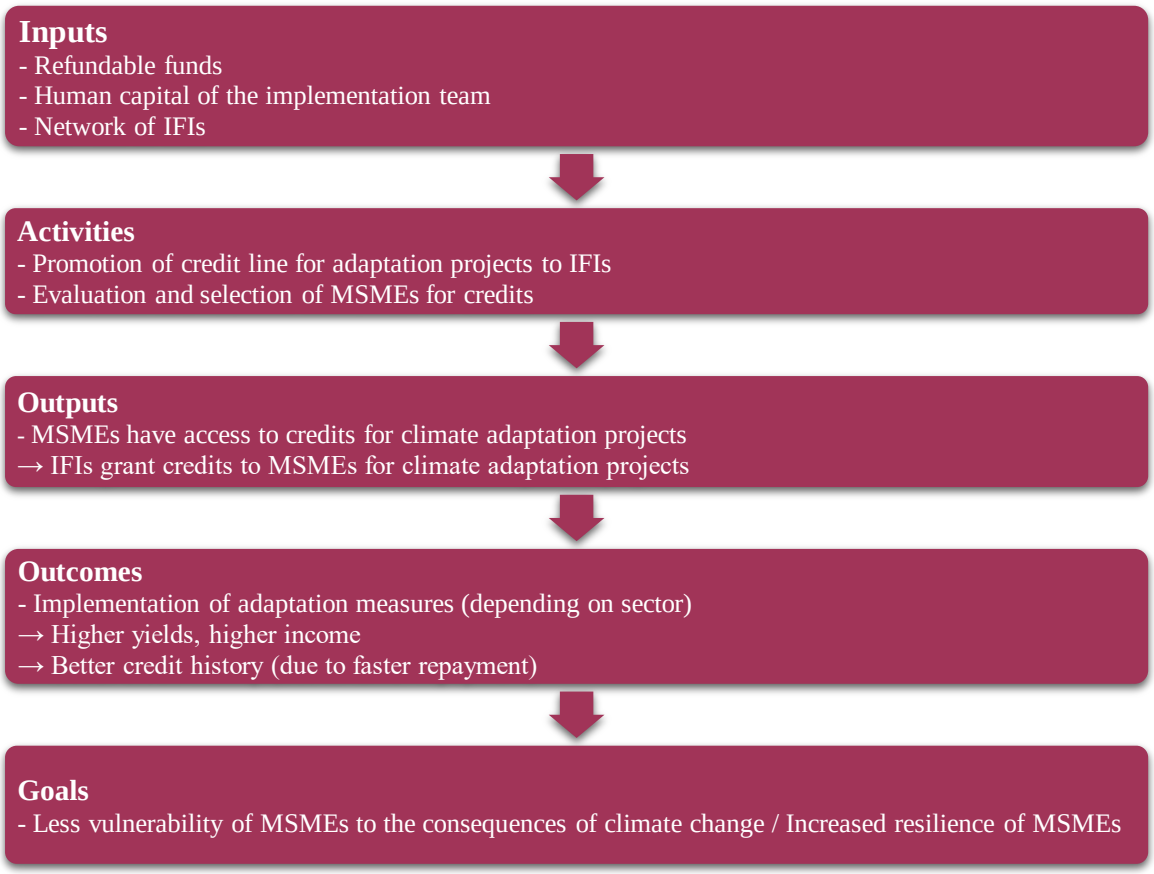


Figure 9. Theory of change for component 1

ii. Component 2

38. Inputs

    The inputs encompass non-refundable funds from CABEI and the GCF, the human capital of the implementation team (e.g. PMU) and the network of IFIs that CABEI has in place in each of the project countries.

39. Activities

    The actions at the core of this component are the identification of TASPs for IFIs and MSMEs, depending on the application for technical assistance, the approval and matching of TASPs with MSMEs or IFIs and the promotion of forums for experience exchange between IFIs and MSMEs.

40. Outputs

    Through the inputs and activities, MSMEs and IFIs have access to capacity training, consultation and technical assistance. Thus, IFIs and MSMEs obtain technical assistance, capacity training and consultation related to adaptation measures and their implementation.

41. Outcomes

    As a result, MSMEs and IFIs have more and better knowledge in technical aspects of adaptation projects as well as climate change effects. This acquired knowledge facilitates the appropriate implementation of adaptation projects (by sector) and results in more adaptation projects financed by IFIs.

42. Goals

The main goal behind this component equals the goal of the other components: increased resilience of MSMEs against climate change.

43. These five stages are summarized in Figure 10.

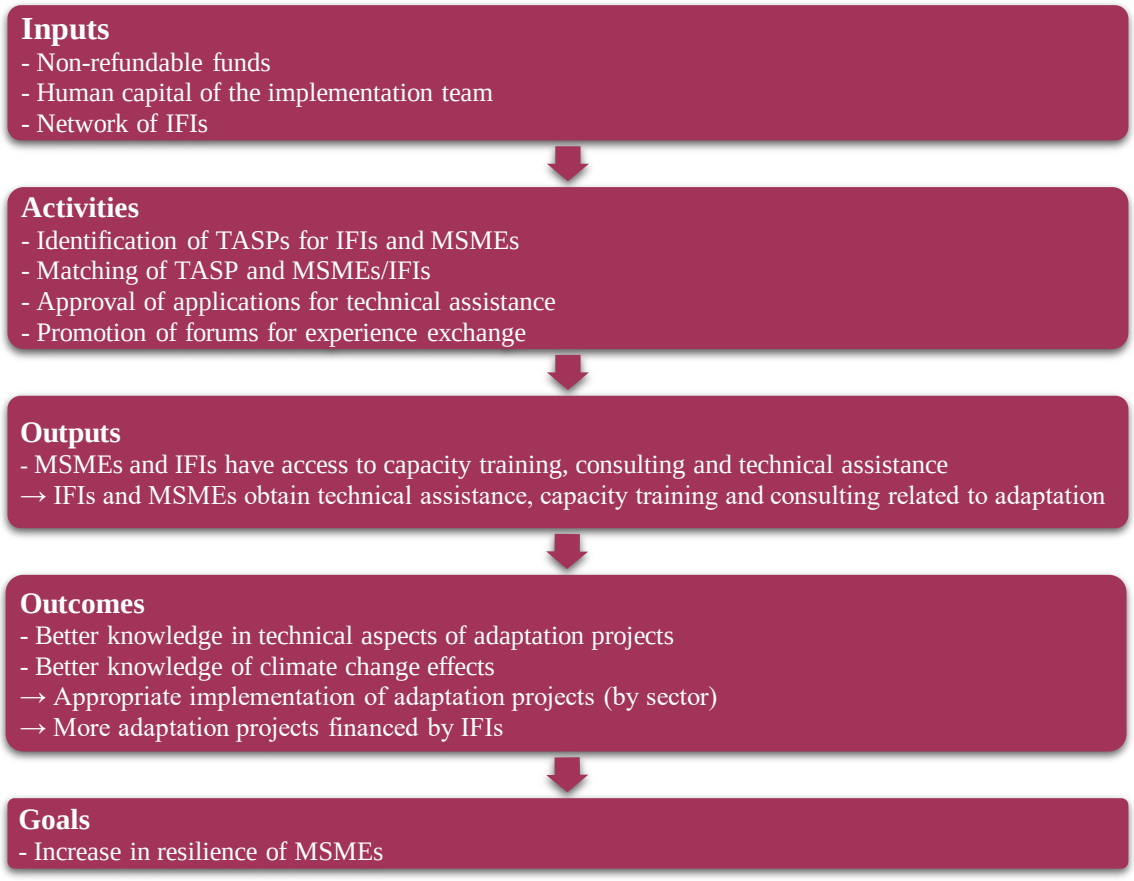


Figure 10 Theory of change for component 2

44. The success of the CAMBio II project in achieving these goals, outcomes and outputs relies on several assumptions:

- IFIs are interested in the new credit line and request funds from CABEI
- IFIs and CABEI are successful in promoting the new credit line and generate awareness among the MSMEs
- MSMEs are interested in the CAMBio II credits
- The IFIs and MSMEs must be matched with suitable, highly qualified TASPs to enrich their capabilities and knowledge on adaptive measures
- MSMEs have sufficient knowledge and understanding of climate change and the adaptive measures to select the appropriate measure for their enterprise

b. Evaluation questions and impact indicators

45. We derived the main research questions to be answered by this IE from the ToC. As the final beneficiaries of the project are the MSMEs and the goal is formulated at the MSME level, the evaluation questions will also concern the MSMEs rather than the IFIs. This does not mean that the IFIs need to be fully excluded from the evaluation. Key informant interviews can be conducted at different levels of the IFIs to learn more about expectations and experiences with CAMBio II.

46. The impact indicators, listed below each evaluation question, will be mainly measured on the enterprise level. Only when the enterprise is a single-household business, can we also consider household-level outcomes.

- EQ1: Are the MSMEs less vulnerable / better adapted to events of climate change?

Indicators:

  - Profits and profit stability of MSMEs
  - For MSMEs in the agribusiness: yields and loss of harvest (due to weather-related shocks)
  - In the case of single-household enterprises: food security

- EQ2: Do the MSMEs have a better knowledge of the effects of climate change?

Indicators (depending on technical assistance content):

  - # of effects known to the applicant

- EQ3: Do the MSMEs have a better knowledge of adaptation measures?

Indicators (sector dependent):

  - # of adaptive practices known by the applicant

- EQ4: Do the MSMEs implement more adaptation measures?

Indicators (sector dependent):

  - # of adaptive practices applied by MSME
  - # of bad practices applied MSME

- EQ5: Will the effects be different between sectors (and gender)?

We cannot yet define the impact indicators in greater detail as the knowledge questions in particular need to relate to the content of the workshops and technical assistance. Moreover, which exact adaptive practices the MSMEs should apply will depend on the sector of the MSME.

c. Evaluation design

47. During the inception workshop, the LORTA team identified two potentially feasible IE designs for CAMBio II: a DiD design with matching and a RED.

48. The challenge of both designs is to identify the study population before the MSMEs receive the credits, so the DiD can collect baseline data and the RED can act as a randomization frame. As the project is in theory not limited to any geographical area, MSME location cannot be used to identify the study population. Furthermore, the number of credits is small: 5,000 over five years in seven countries. Hence, if we drew a random sample of all MSMEs in the project area, it is highly unlikely that one of those becomes a CAMBio II borrower. Working with applicants that were rejected by CABEI is also not possible, because (1) the country teams do not expect access demand and (2) the application process is supposed to take only one month, so there is not enough time to conduct a baseline data-collection before the treatment is in place.

49. Instead, our sampling strategy exploits the fact that the IFIs will have to proactively promote the CAMBio II credits to distribute them. As intensive promotion is costly, it needs to be well targeted to eligible and potentially interested enterprises and producers to be cost-effective. The IFI we visited during the mission explained that the local credit agencies advertise the credit via home visits to potential clients, with an impressive success rate of about 90 per cent. The country office of Guatemala reported that the largest IFI in her country follows similar schemes when addressing smallholders. We, therefore, assume that even though the MSMEs have not yet applied for the credit, the IFIs are likely to know who the future CAMBio II borrowers will be. This population

could then be used to sample treatment households for the DiD design or to randomize MSMEs into treatment and control groups for the RED. The comparison group for the DiD is expected to be composed of clients who would, on paper, also qualify for the credits, but who will not be directly targeted by the IFIs. This could be due to an overall lack of interest in climate adaptation measures or missing demand for additional financial products. Another reason for not applying could be a lack of awareness of the credit line. However, as CABEI and the IFIs are planning large and extensive promotion campaigns involving farmer associations and other national agricultural bodies, all the clients of the respective IFIs should, in theory, be informed about the new offer. Figure 11 illustrates the different types of clients and their categorization into treatment and comparison group.

i. The difference-in-difference design

50. The DiD technique enables the estimation of treatment effects via the comparison of changes in outcomes over time between a treated and a comparison group. In other words, the DiD technique gives a causal treatment effect if the two groups – in the absence of the project – would have developed similarly over time (known as the "parallel trends assumption"). This is an untestable assumption; however, suggestive evidence can be taken from pre-project trends on relevant outcomes/impacts in treatment and comparison groups – conditional on the availability of such data. Importantly, time-varying differences are not controlled for and, if present, would undermine the unbiased estimation of the treatment effects.
51. For this IE, the treatment group will consist of CAMBio II borrowers and the comparison group of other IFI clients that have not taken up the credit (see Figure 11). The two groups are hence endogenously defined and are likely to be different from each other even before the project starts. Due to this initial difference, a simple comparison of endline means will not be enough to determine the unbiased treatment effect of CAMBio II. Instead, the differences between the two groups at baseline need to be calculated and subtracted from the difference at endline. This will give the causal impact of CAMBio II if the parallel trend assumption is satisfied.

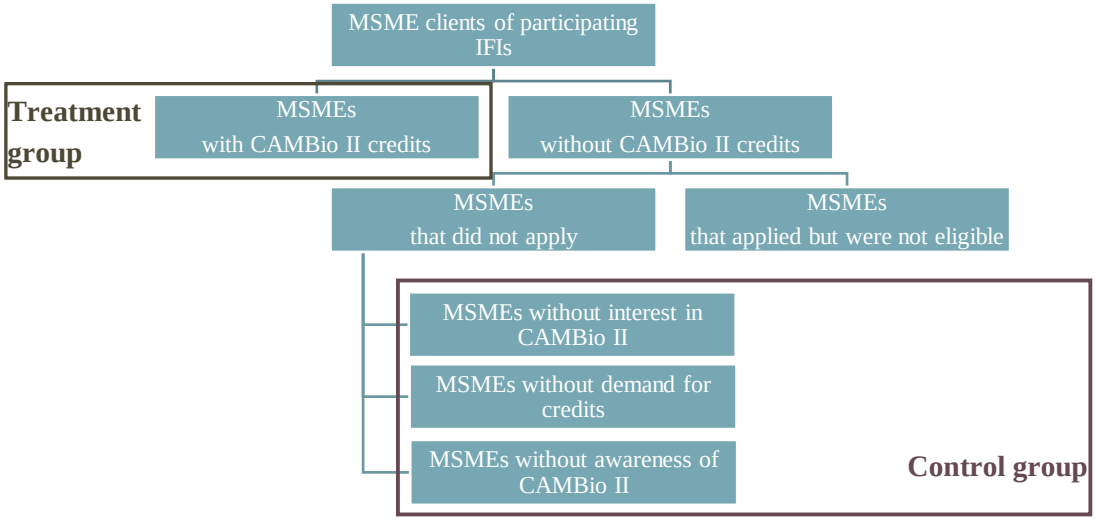


Figure 11. Difference-in-difference evaluation design

52. For the parallel trends assumption to be satisfied, outcome variables such as yields would need to evolve similarly in the treatment and comparison groups in the absence of the project. Whether this is indeed the case cannot be verified in reality. One way to gain more confidence about parallel trends, and hence the validity of the DiD approach, is to compare pre-trends – that is, the change of

yields in the treatment and control groups over time before the project starts. Furthermore, to improve the comparability of the treatment and control groups, a matching procedure should be applied. Matching assigns to each "treated" client a client without treatment, hence without credit, based on a propensity score. The propensity scores reflect the likelihood of receiving treatment, irrespective of the actual take-up, based on baseline characteristics that influence treatment.

53. For both pre-trends and matching, the availability of high-quality baseline information is crucial. As we are planning to work only with existing clients of the IFIs, it is a matter of access rather than availability for the LORTA team to make use of these data. In addition to data probably collected by the IFIs for credit eligibility, CABEI requests from all borrowers in their credit lines a filled "Resource Justification Form", also known as an "F1". The F1 asks for a comprehensive set of socioeconomic parameters, such as education, housing quality and business characteristics (e.g. the number of employees, sales, economic activity). Important matching variables could be the geographical location of the enterprise and the economic activity, which are closely related to the vulnerability to climate change. Also, the size of an enterprise, and thereby its access to alternative financial products, could be used to match MSMEs. The matching should be conducted even before the baseline survey. The usual oversampling of the control group to ensure good matches can, therefore, be avoided, which saves costs and time.

ii. The randomized encouragement design

54. If the local IFIs agreed to a randomization of the intensive promotion at least in the first years of the programme, a RED could be conducted. The RED is similar to an RCT with partial or imperfect compliance. Instead of randomizing units into treatment, the RED only randomizes units into a level of encouragement – for example, financial incentives, nudges or promotion. It is a useful design when nobody can be excluded from participation, for practical or moral reasons. The analysis of a RED follows essentially the instrumental variable approach, where take-up is instrumented with the nudge in a 2-stage-least-square estimation. This gives us the local average treatment effect estimator – that is, the treatment effect for the compliers who take the treatment when nudged and who would not otherwise.

55. For the CAMBio II IE, the nudge is the intensive promotion administered by the IFIs to potential borrowers. The randomization of potential future borrowers into encouragement or not would improve the validity of the IE (compared to DiD) because the randomization ensures the similarity of treatment and control group, on average. If the RED was accepted, the IFIs would share with the LORTA team or the CABEI a list of all potential future borrowers that they would like to contact for the CAMBio II credits. The clients from this list would then be randomly assigned into an "encouraged" and a "not encouraged" group (Figure 12). Hence, while all MSMEs can still apply for a CAMBio II credit, the probability of take-up is higher for the encouraged MSMEs than non-encouraged MSMEs.[26] If the IFIs commit to only targeting MSMEs in the "encouraged" group with their personal promotion, and if the promotion is sufficiently effective, the causal impact of the programme is the difference in outcomes between the two groups at endline. The longer the list of potentially eligible clients, the more likely we expect the IFI to agree to the RED because not all clients can be targeted anyway for logistical reasons. There is, however, also a minimum number of clients that are required to make the RED approach work. This minimum number can be calculated in power calculations, as soon as it is clear how many IFIs and subagencies ("clusters") will participate in the study.

[26] From a logistical point of view, it can be easier to randomize on the sub-unit level (e.g. field agency, village) than on the client level.

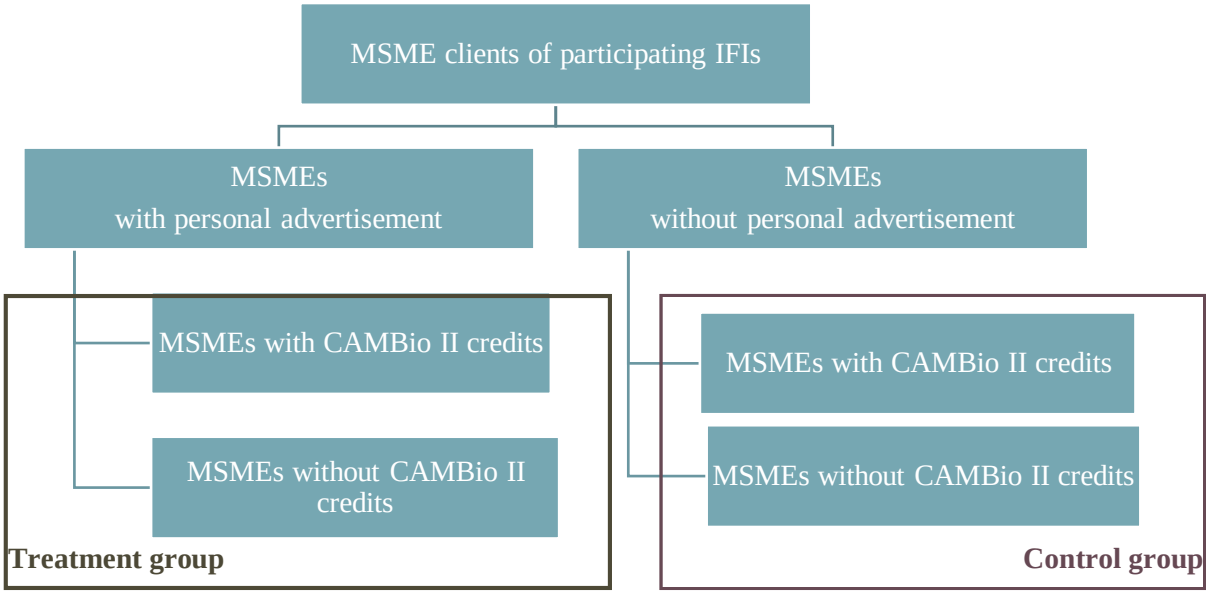


Figure 12. Encouragement evaluation design

iii. Possible risks for impact evaluation

56. Several risks and assumptions underlie the above-presented evaluation designs.
57. Both designs rely on the assumption that IFIs know a priori who in their client stock is eligible and likely to take the credit. This knowledge is crucial so that we can define beforehand the treatment and control groups and collect baseline data. A large advantage when working with existing clients is that certain information on the MSMEs is available before baseline. Depending on the depth of this information, these data can be used to narrow down the eligible MSME universe.
58. Second, we assume that the IFIs will proactively promote the credits to specific clients, which in turn will increase the likelihood of take-up for the target groups. In the DiD, the treatment group would be endogenously defined by the targeting plans of the IFIs. The non-targeted but theoretically eligible clients can then be used as a comparison group. For the RED, the LORTA team will randomly select the target group from the group of eligible clients. Reliable buy-in and commitment from a sufficient number of IFIs or IFI branches are therefore crucial for the feasibility of the design.
59. If the IFIs are not able or willing to share information on potentially treated and untreated clients, we could work with the participants of the Start-up Workshop. Every MSME that is interested in receiving the CAMBio II credits is obliged to participate in such a workshop. If there are enough MSMEs that decide against the credit after the workshop, these “dropouts” could form the control group for data-collection in a DiD design. Whether the number of dropouts will provide a sufficient sample size for an IE is, however, difficult to assess beforehand. In addition to the dropout rate per workshop, the number of start-up workshops conducted within a short period will matter for the feasibility of this design, as well as the possibility of collecting baseline data before the credit disbursement.
60. Extensive contamination of treatment and control groups is a risk for the RED. Contamination, or rather imperfect compliance of the treatment group, refers to the fact that clients who were offered the credit did not take it. For the control group, we talk about contamination if clients who were not individually targeted nevertheless applied for and received the credit. The risk of contamination of the control would be particularly high if the IFI decided to change their targeting strategy in later

years. While imperfect compliance is part of the design of the RED, the design can be invalidated if take-up in the treatment and control groups is too similar, despite the unequal levels of promotion. The risk for contamination will be assessed in discussion with collaborating IFIs before the baseline data-collection.

61. In the DiD design, contamination is not a concern because we define treatment and control groups retrospectively by their take-up. The prior classification from the IFIs is rather a means to plan the data-collection, as we aim at having equally sized treatment and control groups. Hence, to reach this goal, we recommend increasing the sample size at baseline of the group for which misclassification is most likely.
62. A large enough sample size is needed to detect a statistically significant impact of the programme. The number of credits given out is small, however. When selecting the IFIs for the IE, in addition to their collaboration, the number of clients and roll out capacities should also be considered (see the following section "Scope of the impact evaluation"). Alternatively, several rounds of baseline and endline data-collection could be conducted covering multiple cohorts of loan recipients. As several rounds of face-to-face interviews might be too costly, phone interviews should be considered. The data can then be pooled and analysed jointly. This approach is non-traditional, however, and not without caveats. To enhance comparability across the studies, the gap between baseline and endline and the season of the data-collection needs to be the same for each cohort. Furthermore, when working with different cohorts, the institutional learning of the IFIs needs to be taken into account. Clients applying for credit in year 5 will work with more experienced staff, which might improve the effectiveness of the credits. On the other hand, the funds for technical assistance might have run out already, which is likely to negatively affect the impact of the credit.

iv. Scope of the impact evaluation

63. The number of credits distributed per country and sector is not sufficient to conduct a rigorous IE for each country nor each sector separately. Pooling the data for separate counties and economic sectors is possible but not very informative, as it will only generate average effect sizes. For this reason, during the design workshop we discussed narrowing down the scope of the evaluation such that a more meaningful interpretation of the findings will be possible.
64. We propose to focus the IE on those fields with the largest number of beneficiaries. The potential sample size will thereby be as large as possible, and we would evaluate the GCF investment for the largest possible population of beneficiaries. At a second level, to facilitate the logistics of the data-collection, it would further be possible to identify particular "hotspots" in some countries and focus the study on those.
65. To get a better idea of the distribution of beneficiaries, we take a closer look at the CAMBio I project. The Final Evaluation Report of CAMBio I reports that the vast majority of loans were given out to beneficiaries working in subsistence agriculture, in particular the production of coffee (10,823 out of 12,100 loans). The main lenders in this field are two microfinance institutions: the Guatemalan microfinance institution Genesis Empresarial and Financiera Fondo de Desarrollo local, a microfinance institution in Nicaragua. Genesis Empresarial targets rural clients in the whole of Guatemala and provided loans to 9,529 CAMBio I clients (mostly subsistence farmers growing coffee, cardamom and basic grains and living in poverty). Financiera Fondo de Desarrollo local, operating in the western part of the country (Pacific Coast) and the highlands in the northwest, reached 1,140 clients in CAMBio I. They focus on small farmers working in silvopastoral, agroforestry and sustainable agriculture systems. A third IFI worth mentioning is Banco Hipotecario

del Salvador in El Salvador, since they have a strong lending history in agriculture and gave out 85 per cent of the loan placements in El Salvador (231 loans).

66. Thus, we suggest collaborating with these three above-mentioned IFIs for the following reasons. First, they are active in the nationally important agricultural sector; second, they have a broad and large network of clients served through many local branches; third, they already have experience with this kind of credit line and are likely to participate again; and fourth, coffee production is highly vulnerable to climate change (see Table 8 for climatic projections of Guatemala, El Salvador and Nicaragua).

Table 8. Climatic projections for suggested evaluation countries

INDICATOR COUNTRY	INCREASE IN TEMPERATURE (BY YEAR)	EXTREME WEATHER EVENTS	FURTHER RISKS
Guatemalaa	2.5°C–4°C (2050)	Increased incidence and intensity of extreme rainfall events, droughts and floods	More frequent and prolonged heatwaves, droughts and canículas
El Salvadorb	1.4C°–2°C (2050)	Increased incidence of extreme weather, including droughts, tropical storms and floods	Sea level rise of 18 cm by 2050
Nicaraguac	0.6°C–2.7°C (2060)	Increased frequency and severity of natural disasters, particularly hurricanes and floods	Decreased overall rainfall and increased unpredictability of rainfall patterns

Source: a USAID, Climate Change Risk in Guatemala: Country Climate Risk Profile (April 2017); b USAID, Climate Change Risk in El Salvador: Country Risk Profile (April 2017); c b USAID, Climate Change Risk in Nicaragua: Country Risk Profile (January 2017).

67. Given the type of IFIs and that the majority of loans were given out in Guatemala (85 per cent), followed by Nicaragua (10 per cent) and El Salvador (4.3 per cent), it is useful from a logistical perspective to limit the scope of the impact assessment to certain regions or hotspots in those countries. To identify those hotspots, we compare the geo-data of MSMEs identified for previous evaluations: the CABEI internal evaluation of their intermediate credit programmes including CAMBio I (Figure 13) and the evaluation of CAMBio I by EcoAgriculture Partners (see Figure 14).[27] It should be noted, however, that georeferenced data were only available for less than half of the CAMBio I recipients. Comparing the two maps reveals that MSMEs are indeed clearly clustered around two hotspots: the highlands in the northwest of Nicaragua and the highlands in the north of El Salvador. In Guatemala, no clear concentration can be identified as the hotspots differ between the two maps: in Figure 13, the hotspot is in the west of Guatemala, in Figure 14 in the northwest. Interestingly, the hotspots in Nicaragua and El Salvador match closely with the hotspots of coffee production in Central America (see appendix III). Coffee in Guatemala is mainly produced in the west, which partially coincided with the clients of CABEI's client mapping.

[27] A non-profit organization dedicated to supporting innovators from the agriculture, conservation and rural development sectors to strengthen and scale up integrated landscape management; Lee Gross, Sebastian Castro-Tanzi and Sara Scherr, "Connecting farm to landscape for biodiversity conservation: The CAMBio project in Central America", EcoAgriculture Discussion Paper No. 15 (EcoAgriculture Partners, 2016).

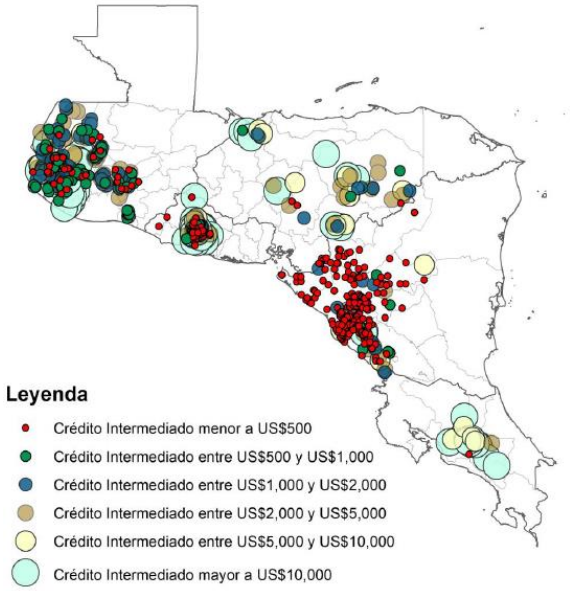


Figure 13. Map of MSMEs within intermediation programmes, Evaluation Office CABEI

Source: Evaluation Office CABEI.

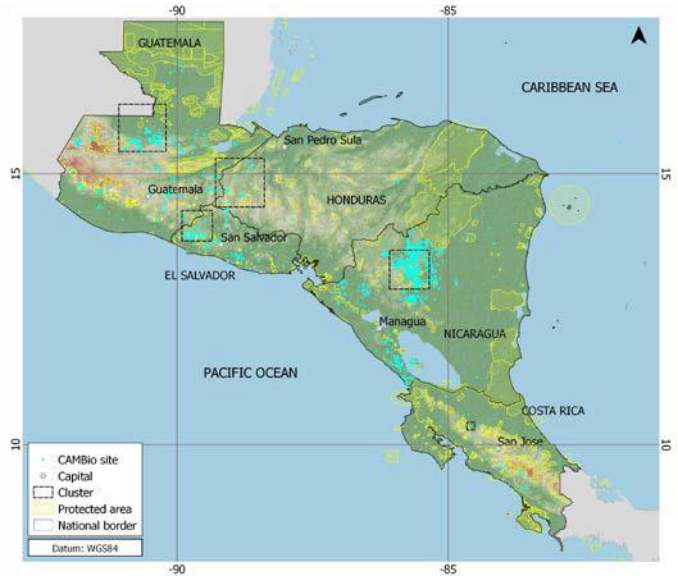


Figure 14. Map of MSMEs, subsample of CAMBio I

Source: EcoAgriculture Partners.

v. Power calculations

68. Power calculations enable us to determine the minimum sample size needed to detect the impact of CAMBio II. To do that, we use the following power formula, which relates the sample size to the MDES – that is, the difference in mean outcomes between the treatment and control groups:

$$\text{MDES} = (t_{1-\kappa} + t_{\alpha}) \sqrt{\frac{1}{P(1-P)}} \sqrt{\frac{\sigma^2}{N}} \sqrt{1-R^2}$$

where $t_{1-\kappa}$ and t_{α} are t-statistics representing the required power and level of statistical significance (by convention, we seek a power of 80 per cent and a statistical significance of 5 per cent), P represents the proportion of the sample in one of the two compared groups (allocation ratio), σ_2 is

the variance, N is the total sample size, and R_2 represents the extent to which baseline characteristics predict the endline outcome variable.

69. The above formula allows for a comparison between the two groups. To our knowledge, there are barely any studies evaluating the general effect of implemented adaptive measures on crop yields and/or profits of MSMEs. As described above, we suggest limiting the scope of the evaluation to El Salvador, Guatemala and Nicaragua, where the most important crop is coffee (in economic terms). The adaptation measure closely linked to coffee is agroforestry, above all the planting of shade trees.
70. Thus, the power calculations realized in the following section are based on studies assessing the effect of shade trees on crop yields. We consider the following comparison:
    - MSMEs who receive credits to implement adaptation measures (treatment group T)
    - MSMEs who do not receive credits (control group C).
71. The optimal sample allocation ratio for a study with one treatment arm and a control arm is 50:50. As an outcome of interest we consider yields of coffee; the result is, however, equally applicable for any other outcome variable with a similar distribution.

Impact on yields

72. Since we focus on the coffee sector, we use the mean coffee yield averaged over El Salvador, Guatemala and Nicaragua for the baseline mean: 688.17 kg/ha (kilogram per hectares).[28] Unfortunately, no information is available on the baseline standard deviation that is essential for the power calculations. We will, therefore, build our power calculations on assumptions based on standard deviations found from a study on smallholder coffee producers in Nicaragua by Jena et al.[29] They report the standard deviation of coffee yields to be 75 per cent of the mean value. We assume the same relation of the standard deviation to the mean for El Salvador, Guatemala and Nicaragua. We, therefore, estimate the standard deviation to be at 516.12 kg/ha, which is 75 per cent of the mean value of 688.17 t/ha. Additionally, for demonstrational purposes, we realize the calculations with a standard deviation of 50 per cent (344.08kg/ha).
73. When it comes to the expected effect size, we rely on different studies, conducted outside El Salvador, Guatemala and Nicaragua, evaluating the effect of agroforestry on coffee yields.
74. Rahn et al. found coffee yields for farmers in two East African sites to increase by at least 10 per cent, depending on the location, altitude and climatic conditions, when the shade tree cover is optimal.[30] The key to a successful implementation of a shade tree system is extensive knowledge of MSMEs/farmers.[31] Technical assistance (component 2) is ensuring that this knowledge is transmitted to the agricultural producers. Importantly, planting of shade trees or agroforestry, in general, may also have a long-term positive impact on yields due to fertile and sustainable soil.
75. Thus, we consider an MDES of 10 per cent for the following power calculations, which is a reasonable but also conservative estimate. A higher MDES would require a lower sample size to detect a statistically significant treatment effect. Table 9 shows the results for the MDES at different values of R_2. The indicator is always coffee yield in kg/ha; the mean value is set to 688.17 kg/ha. In all cases, we are trying to achieve the minimum detectable per cent change of 10 per cent.

[28] FAOSTAT, Coffee yield 2018
[29] Pradyot Ranjan Jena, Till Stellmacher and Ulrike Grote, "Can coffee certification schemes increase incomes of smallholder farmers? Evidence from Jinotega, Nicaragua", *Environment, Development and Sustainability*, vol. 19, No. 1 (November 2017).
[30] Eric Rahn and others, "Exploring adaptation strategies of coffee production to climate change using a process-based model", *Ecological Modelling*, No. 371 (March 2018), pp. 76–89.
[31] C. R. Cerdán and others, "Local knowledge of impact of tree cover on ecosystem services in smallholder coffee production systems" *Agricultural Systems*, vol. 110 (July 2012), pp. 119–130.

76. In the first three rows, we perform the power calculations with the baseline standard deviation of 50 per cent, 344.08 kg/ha. There, the optimal sample size is 500 if we assume an R_2 of 30 per cent. As soon as we suppose an R_2 of 0 per cent, the sample size needs to rise to 700 to attain the target value of 10 per cent.
77. Rows 4 to 6 use the 75 per cent standard deviation. When we assume an R_2 of 30 per cent, the optimal sample size is 1,200, more than double the size of the 50 per cent standard deviation. A decrease of R_2 to 0 per cent is accompanied by a required sample size of 1,600.

Table 9. Power calculations

	MEAN	BASELINE SD	SAMPLE SIZE (TOTAL)	R2	SAMPLE SIZE IN C	SAMPLE SIZE IN T	MDES (IN T/HA)	% CHANGE
1	688.17	344.08	500	30%	250	250	72.21	10.5%
2	688.17	344.08	500	0%	250	250	86.31	12.5%
3	688.17	344.08	700	0%	350	350	72.94	10.6%
4	688.17	447.31	1,200	30%	600	600	69.92	10.2%
5	688.17	447.31	1,200	0%	600	600	83.57	12.1%
6	688.17	447.31	1,600	0%	800	800	72.37	10.5%

78. We argue that an overall sample size of at least 1,200 households is ideal when we assume that we will be able to capture some of the variation in yields through baseline covariates (R_2 of 30 per cent) and a baseline standard deviation of 75 per cent. This is reasonable since coffee harvest is subject to high volatility, particularly depending on climatic conditions (e.g. rain, sun, diseases).[32]

d. Budget

79. Based on the evaluation design and power calculation, a sample size of at least 1,200 observations is needed to detect a statistically significant impact of the project. We estimate attrition to be low, due to their commitment to the IFIs. Nevertheless, non-response and contamination of control and treatment groups is a risk, which we account for by oversampling 20 per cent. This results in a total sample size per wave of 1,440 observations. Previous multi-country data collections from the CABEI evaluation office had unit costs of approximately USD 50 per respondent. Assuming the same costs for this evaluation, the total cost of two waves of data-collection in face-to-face interviews is USD 144,400.
80. There are no funds explicitly assigned for the IE in the CAMBio II budget. However, CABEI has a strong M&E unit, which is independently financed by the institution. Several internal M&E specialists joined the design workshop and showed high capacities and interest in conducting a rigorous IE for this LORTA project. Their past experience in the collection of MSME level data in different Central American countries will simplify the organization of baseline and endline data-collection considerably and lower the costs for external consultants.

[32] Jeremy Haggar and Kathleen Schepp, “Coffee and climate change: Impact and options for adaption in Brazil, Guatemala, Tanzania and Vietnam”, NRI Working Paper Series: Climate Change, Agriculture and Natural Resources No. 4 (Natural Resources Institute, 2012). Available at https://www.nri.org/publications/working-paper-series/4-coffee-and-climate-change/file.

e. Timeline of evaluation

81. CAMBio II is already in an advanced stage of planning, and the implementation date is certain for 2020. Nevertheless, before the first credits can be disbursed, the IFIs need to be identified and trained, and the new credit line needs to be promoted among the MSMEs. In the first year, only a small number of disbursed credits are expected. Due to the sample size requirements for the IE, the IE will most likely focus on borrowers from year 2 onwards. A baseline data-collection is hence planned earlier, in Q4 2020. To give the investment projects enough time to materialize, we plan an endline data-collection for 2024, in the same season as the baseline data-collection was conducted. The exact timing of this data-collection will depend on the final scope of the evaluation and the timeline of the selected IFIs that the LORTA team will collaborate with for the IE.

Table 10. Timeline of the evaluation

TIME	ACTIVITY
Q4 2019	Impact Evaluation Design Workshop
Q1 2020	Finalization of IE design
Q3 2020	Start of programme for IFIs and MSME: inception workshops, start-up workshops
Q3 2020	Preparation of data collections: collecting of sampling frame, design of instruments, recruitment of data collectors
Q4 2020	Baseline data-collection
Q4 2024	Endline data-collection
Q1 2025	Data analysis

f. Secondary data sets

82. As mentioned earlier, CABEI has a rich database of all of the clients that receive credits from a CABEI credit line, which is collected through the F1 form. In addition to the socioeconomic and credit-specific information, adaptation indicators will be included for the CAMBio II clients (see appendix IV for an example). These data can be used to either cross-check the baseline data collected for the IE or to complement it. If DiD with matching is implemented, the data collected in the F1 can be used for the matching procedure.

83. To gain a better understanding of the context of the study and the study population, secondary data sources on national levels can be consulted once the scope of the data-collection is set. The Statistics Department of the Economic Commission for Latin America and the Caribbean has a large, accessible database (CEPALSTAT) on a broad selection of topics, ranging from demographics to economic and environmental information. They also capture agricultural data such as production and (surface) area harvested of the main crops. Additionally, each year the National Institute of Statistics of Honduras conducts household surveys (e.g. Encuesta Permanente de Hogares de Própositos Múltiples) containing considerable information about 7,200 households.

g. Plans for M&E / implementation tracking and real-time measurement system

84. The project has a detailed M&E plan following a logical framework approach. The monitoring activities are realized by two parties: PMU/CABEI M&E and IFIs.

- An M&E specialist within CABEI, working closely together with the PMU, will oversee the general progress of CAMBio II. They are responsible for developing tools that will simplify the monitoring of projects on the ground and for training IFIs on them. The M&E expert will further perform field visits to randomly selected MSMEs in each country at least once per year. They will collect qualitative data in the form of focus group discussions and in-depth interviews with key stakeholders. The PMU will regularly visit IFIs to monitor the overall progress, including operations and the adaptation solutions on the ground.
- IFIs are responsible for visiting MSMEs regularly and for sending monitoring reports on a six-month basis that are filled out together with the MSMEs. Moreover, they check on the project investment progress and effectiveness of the implementation of adaptation measures. These activities are complemented by qualitative data-collection – for example, in the form of MSMEs' self-reporting of their progress and in-depth interviews with MSME owners.
- Lastly, CABEI, as AE, will also perform supervisory missions to different selected countries and MSMEs on the field.

C. WAY FORWARD

85. Overall, we consider that the LORTA mission in Honduras was well received and that it produced promising results. The success of the LORTA mission has been particularly achieved thanks to the attentive collaboration and high motivation of CABEI.

86. The main task for the first months in 2020 is to reach an agreement among all stakeholders on the scope of the study, in terms of country and sector coverage. With this information CABEI can identify suitable IFIs for the evaluation, being those that serve the target population and that are interested in participating in the study. It then needs to be verified whether the IFIs are willing and able to share lists of clients and to accept the randomization plans or not. At the same time, the promotion scheme of the IFIs needs to be understood to judge whether it will be possible to pre-identify potential beneficiaries and non-beneficiaries who will then either directly form the treatment and control groups or be subject to randomization. Identifying participating IFIs will also help to refine the project roll out timetable. This will be important to mark the moment of the baseline data-collection. For now, we assume that there will not be enough MSMEs in year 1 to include them in the IE. It might, however, be the case that the selected IFIs are better prepared to start the credit line than expected, and hence a large number of credits will already be disbursed in year 1. This would pose a threat to our evaluation design if the baseline data-collection is not shifted accordingly.

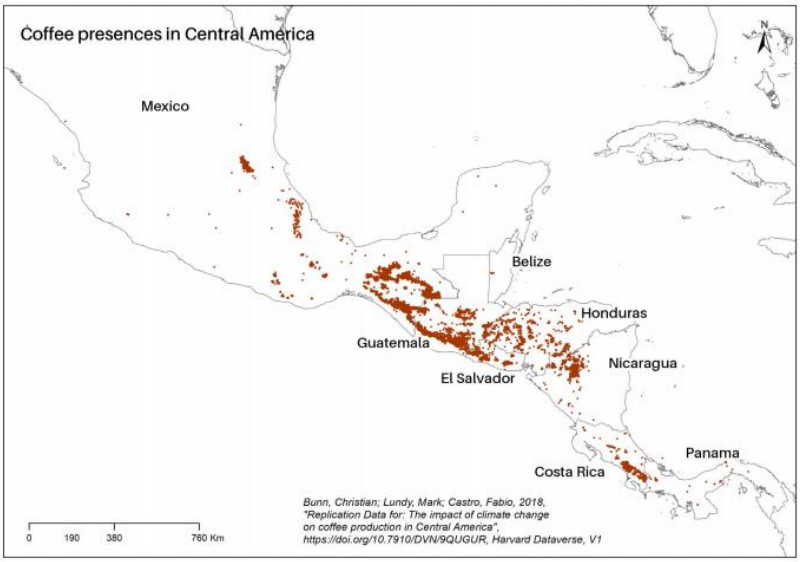
Appendix 1. AGENDA OF LORTA FIELD MISSION

DAY	PROPOSED ACTIVITIES
Day 0: Sunday, November 3	Arrival of team
Day 1: Monday, November 4 From 9:00	Welcome, introduction of participants, workshop objectives
	Presentation of CABEI and its Financial Intermediation Scheme
	Introduction to LORTA, benefits of IE
	Description of the programme, implementation plans and available programme documents, ToC
Afternoon From 14:00	Presentation of CABEI IE experiences
	Capacity-building workshop, interactive discussion and elaboration of the ToC
Day 2: Tuesday, November 5 From 9:00	Discussion of key documents, field visits, identification of targeted beneficiaries
Afternoon From 14:00	Presentation about IE methods
	Workshop and discussion about IE designs feasible for CAMBio II
Day 3: Wednesday, November 6 From 9:00	Stocktaking of planned data-collection, tracking activities (M&E)
Afternoon From 14:00	Discussion on budget lines, survey methodology, sample size and timeline (incl. procurement options for baseline data)
Day 4: Thursday, November 7	Travel to San Pedro Sula
	Visit IFI (MFI ODEF Financiera SA). Experience exchange with beneficiaries of "green credit" programmes Visit of Fundación HonduCafe
	Travel back to Tegucigalpa
Day 5: Friday, November 8 From 9:00	Final presentation of principal mission results incl. next steps

Appendix 2. LIST OF STAKEHOLDERS ENGAGED WITH DURING LORTA MISSION

LORTA WORKSHOP, TEGUCIGALPA		
Name	Position	Institution
Rubén Avila	Green Finance Analyst	CABEI
Fanny Ramos	Project Manager Guatemala, Department of Financial Institutions and Strategic Programs	CABEI
José Deras	Head of the Evaluation Office	CABEI
Sergio Avilés	Coordinator	CABEI
Luisa Noyola	Evaluation Analyst	CABEI
Shirley Yadira Orellana Garcia	Evaluation Analyst	CABEI
Solomon Asfaw	Principal Evaluation Officer	IEU
Esther Heesemann	Impact Evaluation Specialist	C4ED
Jakob Gärtner	Junior Research Manager	C4ED

Appendix 3. COFFEE PRESENCES IN CENTRAL AMERICA



Source: Christian Bunn, Mark Lundy and Fabio Castro-Llanos, "Climate change impacts on coffee production in Mexico and Central America" (International Center for Tropical Agriculture (CIAT), 2019).

Appendix 4. TRANSLATED INSTRUCTED JUSTIFICATION SHEET

Source: BCIE (2019) Instructivo de la Ficha de Justificación (F1)

Translated by the LORTA team

Programme of operation: green MSMEs

Facilities: Micro, small and medium enterprises with a focus on energy efficiency

1. Loan identification number.
2. Client identification number.
3. Type of client.
4. Name of client.
5. Amount of yearly sales of clients (currency).
7. Loan number for client
8. Other financial services for client.
9. Education of client.
10. Department / Province.
11. Geographic location.
12. Number of male employees.
13. Number of female employees.
14. Basic facilities: Electricity.
15. Basic facilities: Water.
16. Basic facilities: Phone.
17. Status of house of client.
18. Date of loan.
19. Date of initial payment.
20. Date of expiration of loan.
21. Annual interest rate.
22. Amount (currency).
24. Collateral
25. Economic activity.
26. Use.
27. Form of payment.
28. Amount of taxes paid (currency).
30. Amount of utilities
32. Address.
33. Phone number.
34. Type of energy project.
36. Expected monthly saving (in USD)
37. CO2 tons saved per year.
38. Porcentaje de Ahorro esperado en Facturación Mensual Promedio

IMPACT EVALUATION DESIGN REPORT 3: RWANDA

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A. INTRODUCTION

1. THE LORTA PROGRAMME

1. Evaluating the impact of development projects and programmes has gained importance in recent years. IE not only allows for increased transparency by measuring the effects of investments, it also provides the opportunity to design and implement development projects more effectively. To contribute to this progression, the IEU of the GCF has started the LORTA programme to be able to keep track of GCF projects in terms of performance and results, and to enhance learning within the GCF.
2. The LORTA programme has the following aims:
   - Embed real-time IEs into funded projects so GCF project task managers can quickly access accurate data on a project's quality of implementation and likelihood of impact
   - Build capacity within projects to design high-quality data sets for overall impact measurement
3. The purpose of the IEs is to measure the change in key result areas of the GCF that can be attributed to project activities. The LORTA programme will inform on returns on GCF investments and help GCF projects track implementation fidelity. LORTA has the following objectives:
   - Measuring the overall change (outcome or impact) of GCF-funded projects and enhancing learning
   - Understanding and measuring results at different parts of ToCs
   - Measuring the overall contribution of the GCF to catalysing a paradigm shift and achieving impacts at scale
4. Currently, the LORTA programme is in its second year. In the first year (2018), the IEU supported eight GCF-funded projects to build high-quality, theory-based IE designs at inception. Seven of these projects moved on from the formative research phase to the main impact assessment phase. In the second year of LORTA (2019), six additional GCF-funded projects and programmes were selected to enter the LORTA programme. They are currently undergoing formative work, which includes engagement with AEs, project teams and GCF staff and developing designs for theory-based IEs.

B. THE RWANDA PROJECT

5. The project “Strengthening climate resilience of rural communities in Northern Rwanda” is one of the six projects selected to be part of the inception stage (Phase I) of the LORTA programme in 2019. This project is also referred to as the Gicumbi project, as it is taking place in the district of the same name (Figure 15). The AE for this project is the MoE of Rwanda, and the EE is Rwandan Green Fund (FONERWA).
6. The sensitivity of Rwanda to climate change is assessed as being high, while its adaptive capacity is low. In recent years Rwanda has witnessed a series of climate-related hazards – such as floods, landslides and droughts – that have left devastating effects, particularly on those with low adaptive capacity and resilience to climate change. The high dependency on rain-fed agriculture, the hilly topography, low access to climate information and the depletion of forest stocks have been identified as some of the factors exacerbating the vulnerability of Rwanda to such hazards. Data from the national survey on the assessment of climate change in Rwanda (2018) show that in the Northern Province, the Gicumbi district ranks highest in exposure to climate hazards and second-

highest in sensitivity to climate-related impact. The two indicators give Gicumbi the highest rank for the potential impact caused by climate hazards. According to the report, the high vulnerability of the Gicumbi district to climate change is based on (1) an increase in temperature, (2) frequent and longer heatwaves, (3) intensive rainfall and frequent floods, and (4) severe droughts. Moreover, the Gicumbi district has one of the highest rates of households experiencing crop loss, food insecurity, animal disease and fluctuations in livelihood due to weather hazards.

7. To give a visual idea of the geographical spread of hazards across Gicumbi, Figure 16 shows the 2017 Gicumbi regional maps for flood, soil erosion exposure and landscape vulnerability spots defined by overlaying the following four criteria: low tree cover, high erosion rate, landslide vulnerability and flood risk.
8. The Gicumbi project targets 9 of the 21 sectors in Gicumbi (Figure 15). The sectors covered are Rubaya, Cyumba, Kaniga, Mukarange, Rushaki, Shangasha, Manyagiro, Byumba and Bwisige. According to the project proposal submitted by the Rwanda team, around 248,907 people, or 63 per cent of the district's population, live in the targeted areas. The nine sectors fall within subcatchment B of the Muvumba River and comprise around 252 villages. The local population in the targeted areas are highly dependent on agriculture as a source of food and income, which makes them highly vulnerable to the degradation processes occurring within the catchment.

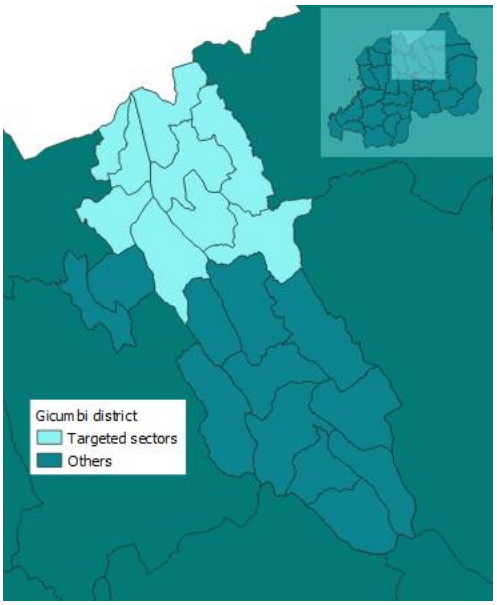

Figure 15. Project intervention area
Source: Authors.

9. Particularly at risk are tea and coffee farmers, because both crops are highly sensitive to climate change and adverse losses in production are already evident. For example, the estimated annual loss of production from climate variability at the Mulindi tea plantation (2,300 ha) in Gicumbi over the last six years ranges from 2.0 million to 3.3 million metric ton of green leaf per year, with an equivalent market loss of USD 2.5 million to USD 4.1 million. Such losses directly affect the incomes of smallholders. During the LORTA team's field visit to the Mulindi Tea Factory, the tea farmers highlighted a loss equivalent to 1,000 hectares of tea plantations due to 2018's flooding. However, the degradation of the watershed is accelerated not only by climate change but also by poor land management and the steep topography and shallow soils of the surrounding sectors.
10. The Gicumbi project aims to increase the resilience of vulnerable communities to climate change. This will be achieved by restoring and enhancing the ecosystem services of subcatchment B of the Muvumba watershed, increasing the capacity of communities to renew and sustainably manage forest resources, and supporting smallholders to adopt CRA. The project will also invest in green settlements for vulnerable families currently living in high-risk areas. The project has four main components:
    - Watershed protection and CRA
    - Sustainable forest management and sustainable energy use
    - Climate-resilient settlements
    - Knowledge transfer and mainstreaming

11. Each of the above-listed components consists of an extensive list of activities. Communities within each of the nine targeted sectors will receive assistance in prioritizing activities based on needs assessments. For each community, this exercise will lead to the development of a local adaptation plan describing the package of interventions that the community will receive.

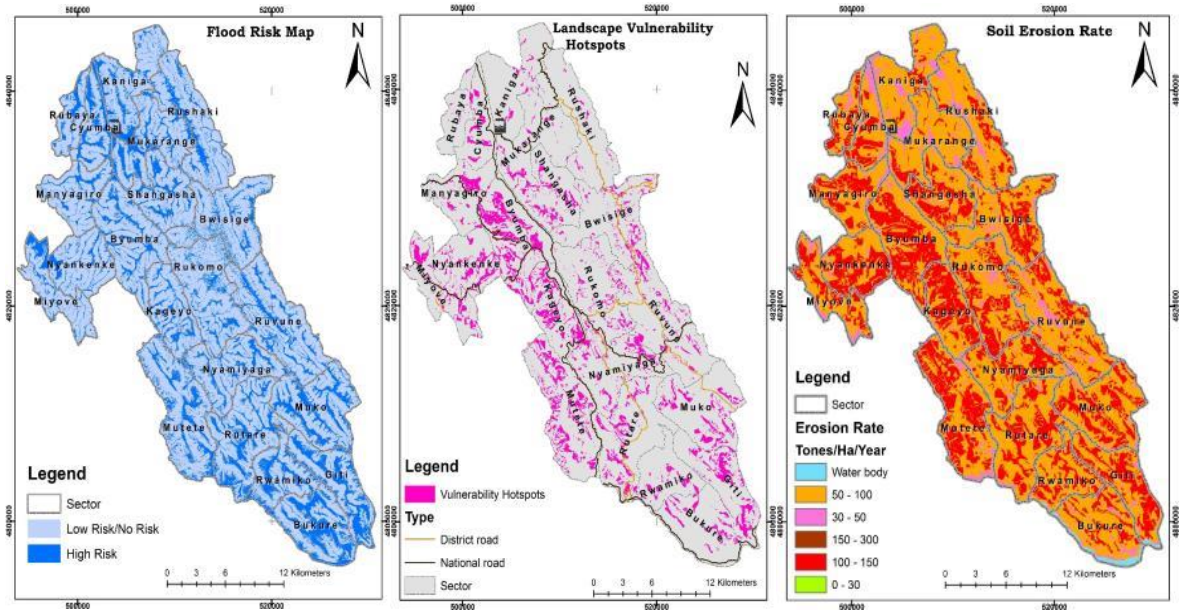

Figure 16. Geographical distribution of hazards in the Gicumbi district

Source: IUCN, Watershed Protection Plan (2017).

C. RWANDA FIELD MISSION

1. GENERAL REMARKS

12. An evaluation team, consisting of two consultants from C4ED, a consultant from the Center for International Forestry Research (CIFOR) and one IEU staff member (referred to below as the LORTA team), was formed to lead the field mission from 11 to 16 November 2019. The task of the evaluation team was to engage closely with key stakeholders of the project – namely, the AEs, the implementing agency, technical advisers, project staff and potential end beneficiaries – to ensure their interest, understanding and feeling of ownership for the planned, scientifically sound IE.

13. During the field mission, the LORTA team held meetings and capacity-building workshops with the key stakeholders. Besides conveying technical knowledge, this workshop aimed to emphasize the benefits of theory-based counterfactual approaches and real-time learning and measurement. Active interactions during these workshops showed that the project team and key stakeholders were accepting of the new concepts and eager to contribute to the discussion. These exchanges were crucial for the project team to gain ownership of the IE. Also, discussions following group exercises were used to acquire in-depth and more detailed information about the GCF-funded project. Stakeholders shared their views and insights about the project's implementation and monitoring strategies, expected impact, challenges and possible solutions. The presence of multiple stakeholders with various roles and backgrounds brought in key perspectives. These discussions were supplemented by expert interviews and presentations by the project team. All these exchanges not only informed the LORTA team about the project but fostered collaboration and trust between the team and on-site involved parties.

14. Under the guidance of the LORTA team, an IE design was elaborated for the Gicumbi project. In collaboration with the project team, the LORTA team conducted context analyses, examined the existence of appropriate counterfactuals (i.e. comparable treatment and control groups), elaborated a ToC, assessed the availability of baseline administrative and secondary data sources, and acquired budget information. The results of this undertaking are presented in the following sections.

2. THE MISSION AGENDA

15. The agenda – shown in appendix I – was developed to facilitate the joint attendance of all key stakeholders to the LORTA workshop, and to organize field visits by the LORTA team. It should be noted that at the time of the workshop the hiring process of the project team, including the M&E expert, was still ongoing. However, key stakeholders were present, including the project lead, the technical adviser, M&E experts from FONERWA and MoE representatives.
16. The LORTA capacity-building workshop was condensed into two days. It contained all the elements that needed to be introduced to the key stakeholders: LORTA's objectives, the roles and responsibilities of the LORTA team members, and key IE concepts. Also, thorough discussions on the ToC and indicator development took place on the second day of the workshop. During the ToC session, the implementation details were discussed for different components of the project, after which separate ToCs were developed for each of those components.
17. The workshop was successful in that it benefited the key stakeholders and the LORTA team. The presentations and interactive discussions on the ToC and implementation brought all the key stakeholders onto the same page concerning their ownership of the evaluation of the project and understanding their contribution within the project – starting from the objectives, through to the evaluation needs and implementation strategies. Simultaneously, the LORTA team benefited by being able to gather, in a short time, a rich set of crucial information to design the IE.
18. Following the capacity-building workshop, the LORTA team engaged in further discussions with the team leader, technical adviser and MoE representatives. During these meetings, the LORTA team was able to identify the research questions that were of high interest to the project team and discuss the feasibility of adjusting implementation plans to account for the IE design.

3. RESULTS

a. Discussion of implementation

19. The project is mainly an adaptation project focusing on reducing vulnerability to climate change by enhancing the adaptive capacity of the targeted groups as well as reducing their exposure to climate risks. A key focus of the project is to transform existing practices into highly resilient practices embedded within communities and thus enable the communities to continue adapting to future climate variability and change beyond the lifetime of the project. In addition to the Gicumbi project's main adaptation focus, it includes a mitigation component entailing activities that encourage the use of alternative forms of energy, such as biogas and efficient cookstoves, as well as sustainable forest management, to mitigate the emission of GHGs. Finally, the project is planned around a gender-sensitive implementation plan that ensures women's access to the intervention activities (e.g. training, employment opportunities, knowledge) and aims at reaching gender parity in benefits. Furthermore, some of the project activities specifically target or give priority to women or women-headed households (e.g. resettlements), thereby increasing women's chances of directly benefiting from the intervention by circumventing obstacles that may have otherwise hindered their

participation. The gender aspect of the project is highlighted through gender-sensitive indicators and the disaggregation of expected results by gender.

20. As mentioned earlier, the implementation of the project activities in each of the targeted communities is determined by a needs assessment, based on which an adaptation plan is developed for every community. According to the project team, the needs assessment is planned to be completed by March 2020 and implementation of the activities will follow in March–April 2020.
21. The project consists of 133 activities grouped into 27 subcomponents and four main components. The description of each component is presented below. The proposed IE will focus on the first three components to assess the ability of the project to contribute to transformational adaptation and mitigation of GHG emissions.

i. Component 1: Watershed protection and climate-resilient agriculture

22. This component focuses on reducing soil erosion and land degradation in cultivated areas, including tea and coffee plantations, as well as in buffer areas around the catchment and other public areas such as rivers and roadsides. This intervention aims to identify sites of high-risk in all nine sectors targeted by the project, including the Mulindi tea estate, which is particularly vulnerable to flooding and landslides. The reduction in soil erosion is planned to be achieved by (1) implementing mechanical soil stabilization techniques such as the establishment of radical and progressive terraces, and (2) replanting steep slopes with perennial grasses and shrubs, wattling and brush layering, and replanting protective forests along roads and riversides. Activities will be supervised and implemented by local entities (not yet selected), who will train and hire community members. This approach is therefore expected to generate employment for community members. In addition to targeting public areas, this component targets smallholder farmers. As a complement to the soil erosion reduction measures, which benefit all farmers, the project also foresees measures to increase the adaptive capacity of smallholder farmers by promoting CRA and agroforestry technologies. The project differentiates between three types of beneficiaries: crop-livestock farmers (1,800), tea (4,900) and coffee (1,000) growers, and other smallholder farmers with private land along the watershed.

    1) **Crop-livestock farmers** will receive training and advice on CRA. They will also be provided with disease- and drought-resilient forage species and animal inputs. The training of farmers takes place through 300 promoters or lead farmers who will first be trained across all the nine sectors. Lead farmers in their turn will train other farmers in the village at existing farmer field schools (FFS) and through community demonstration sites.
    2) **Tea and coffee farmers** will receive support in adopting climate-resilient farming practices to reduce exposure risk to future climate change. Such practices include improved water management, belt plantations, intercropping trees, grass-strip plantings and shade trees. Tea and coffee farmers will receive technical assistance in implementing climate-resilient agricultural practices via existing FFS. This activity targets 4,900 tea farmers in Mulindi state through the existing 50 tea farmer schools and 2,500 coffee farmers out of the total 11,783 farmers in Gicumbi. Finally, farmers will be provided with weather and climate information in addition to developing surveillance and monitoring systems for climate-sensitive pests and diseases for both crops. This intervention is expected to start in March-April 2020.
    3) **Farmers with private land along the watershed** will receive support in implementing different agroforestry technologies, including contour hedgerows on terraces, boundary planting, trees scattered in crops, home gardens and fodder banks. Note that those may also include tea and coffee farmers. Farmers will be remunerated for highly labour-intensive work

to introduce the appropriate agroforestry technology on private and public lands around the watershed. Moreover, the species selection for agroforestry systems will benefit the livelihoods of households surrounding the targeted land. Such measures are expected to be implemented during the rainy season - that is, September 2020.

23. Finally, the project aims to support the expansion of existing tea and coffee areas on elevated land plots uphill via a community adaptation facility (CAF), which is a revolving fund.

ii. Component 2: Sustainable forest management and sustainable energy

24. This component will assist forest owners and users to improve forest productivity and reduce deforestation. This is done via enhanced forest management techniques and reduced dependency on biomass. This component provides high-quality seeds and plant material by implementing trial sites and assessments to match targeted sites with appropriate species. Following demonstration sites and technical capacity-building, a roll out of renewal forests will take place over 2,261 hectares of the watershed. Moreover, capacity-building training on forest management and maintenance is organized and aims to target different groups including district staff, technicians, MoE and Rwanda Water and Forest Authority staff. Capacity-building also targets private forest owners and beekeeping associations, cooperatives and contractors, who are trained via the use of demonstration nurseries and forest and agroforestry plots. The training ensures skills and management competence, raises awareness and introduces new practices, techniques and species to support and improve the livelihoods of communities.
25. In terms of private landowners, the project will cover the cost of improved woodlot management to facilitate the adoption of best management practices. The project will support the development of nurseries in communities, and the development of cooperatives for small woodlot owners. In total, the intervention will train 3,960 individuals over five years and 1,080 people over 18 months.
26. Finally, in addition to improving forest management, this component aims at mitigating GHG emissions by encouraging the use of biogas and efficient cookstoves. This activity will target institutions (including the Mulindi Tea Factory) and dairy households involved in the production of dairy products, by raising awareness on the use of alternative energy and encouraging investment in biogas. This also includes promoting and subsidizing cleaner cookstoves.

iii. Component 3: Climate-resilient settlements

27. Component 3 aims to reduce the exposure of households living in high-risk areas to flooding and landslides by building climate-resilient settlements in Kabeza (100 households) and Kaniga (100 households). The settlements will be offered to households living in high-risk areas and described as vulnerable according to community members, in line with criteria specified by the project team. The selection of beneficiaries follows a ranking system developed by communities. In addition to receiving new houses, beneficiaries will benefit from several other services and inputs such as cows, roads, home water-harvesting tanks, cowsheds and kitchen gardens.
28. This component includes investments in improved surface water management to reduce the risk of climate-related disasters and increase the capacity of communities to capture and store rainwater to address high levels of climate variability and emerging climate change. Sites for the construction of drains, dams, ditches, contour bunds and other structures to manage water run-off from households will be identified. Those structures will benefit farmers with lands in downstream low-lying areas.
29. Communities in upland areas will receive underground cisterns and ponds, and households will receive subsidized tanks. Water storage will enable households to diversify crop production,

safeguard against drought and increase income. Beneficiaries will be selected from targeted areas based on social categories and poverty status.

iv. Component 4: Knowledge transfer and mainstreaming

30. Based on lessons learned from the above components and activities, component 4 aims at ensuring that results are mainstreamed and that knowledge is disseminated. This component aims to produce a range of knowledge products, including policy briefs and case studies.

b. Theory of change

31. Each of the Gicumbi project's three components of interest to the IE (components 1, 2 and 3) seeks to address different core problems faced by vulnerable communities. Component 1 is concerned with the low adaptative capacity at the community and landscape scales. Component 2 is focused on the degradation and unsustainable management of forests. Component 3 aims to provide solutions for rural populations living in houses and areas susceptible to landslides and flooding, and with limited access to water and other essential services. Three ToCs have been developed to identify how each of these components aims to resolve these problems. These ToCs are presented separately in the following subsections.

i. Theory of change of component 1: Watershed protection and climate-resilient agriculture

32. Inputs

    The GCF grant and funds from FONERWA, Gicumbi district and the Wood Foundation will be allocated to the hiring of service providers, technical experts and the purchase of inputs. Communities will also contribute to the project through labouring work.

33. Activities

    Component 1 activities will consist of both adaptation and mitigation measures. Adaptation activities include public awareness campaigns, several sessions of training, provision of inputs and continuous technical assistance to smallholder farmers on CRA and the construction of terraces. These activities will be tailored to the needs of communities documented in the form of local adaptation plans. The adoption of CRA practices will be supported by the development of a CAF, a revolving fund to which households or groups can apply. Coffee and tea farmers will additionally benefit from the development of weather and climate services (WCS) specific to these two crops. Replanting of steep slopes, the Mulindi tea estate and roadsides will contribute to climate change adaptation and mitigation efforts. Terraces and replanting activities will involve high-intensity labour-force methods, with service providers hiring the local labour force. The good conduct of these activities will be measured by collecting information on the number of campaigns and training sessions conducted, the purchase of inputs, contracts with service providers and the availability of the CAF.

34. Outputs

    Awareness and training activities are expected to result in an enhanced capacity of sector and district technicians in CRA and in the dissemination of risk reduction and adaptation practices. Component 1 activities should also result in smallholder farmers receiving inputs and technical assistance, access to the CAF, jobs (mostly temporary employment) and WCS. Furthermore, it is expected that soil conservation and water management measures will be implemented and agroforestry systems will be established in targeted areas. The successful completion of the output stage will be measured in terms of the number of district technicians participating in the training sessions; the number of

farmers receiving inputs and assistance; feedback on the clarity of the material presented; knowledge of risk reduction and adaptation strategies; the number of households benefiting from the CAF and amounts received; the number of terraces built and hectares covered by terraces; hectares of land under protective forest cover, under agroforestry or planted with Napier grass; hectares of land of higher elevations planted with tea/coffee; and the number of farmers who receive WCS.

35. Outcomes

District technicians are expected to train farmer promoters and lead farmers who will, in turn, train smallholder farmers through repeated training sessions and demonstration plots. Also, if the target group benefits from the elements described in the output stage, we expect a certain number of farmers to adopt these new risk reduction and adaptation practices.

Risk reduction and adaptation practices include, among others, resilient tea and coffee seedlings, agroforestry, shade trees, grass strips, fodder banks, better pest management, expansion of coffee and tea production upland, and building and maintenance of radical and progressive terraces.

These intermediate outcomes will, in turn, lead to a reduction in the overall exposure of the watershed to soil erosion by increasing infiltration and reducing run-off, thereby decreasing the risk of flooding.

It is also expected that farm households will increase their adaptive capital by improving their agricultural and animal production and productivity and by diversifying their sources of livelihoods resulting in higher income, to which job creation also contributes.

36. Goals

Component 1 activities aim to contribute to the restoration of the watershed and to strengthen the resilience of landscapes and communities to climate-related hazards.

37. These five stages are summarized in Figure 17.

ii. Theory of change of component 2: Sustainable forestry and energy use

38. Inputs

The GCF grant and funds from FONERWA, Gicumbi district and the Wood Foundation will be allocated to the hiring of service providers, technical experts and the purchase of inputs. Communities will also contribute to the project through labouring work.

39. Activities

Component 2 activities will consist of both mitigation and adaptation measures, through promoting the use of cleaner energy and sustainable forest management. These activities include awareness campaigns; farmer training; providing inputs, technical assistance, cleaner cookstoves and fuels; establishing community tree nurseries; and supporting the establishment of woodlot cooperatives. Additionally, the Mulindi Tea Factory Company will receive financial support and technical assistance for energy efficiency improvements. These activities will be tracked by collecting information on the purchase of inputs and equipment and the hiring of relevant staff.

40. Outputs

Component 2 activities are expected to result in farmers' enhanced knowledge of clean energy and sustainable and climate-resilient forestry; the receipt of inputs, cleaner cookstoves and technical assistance; the establishment of tree nurseries; and job creation. The successful completion of component 2 activities will be measured by the number of farmers trained; knowledge of clean energy and sustainable and climate-resilient forestry; the number of farmers that receive inputs,

cookstoves and fuels and technical assistance; the number of tree nurseries; and the number of jobs created.

41. Outcomes

Component 2 activities should lead to the production and use of cleaner energy, in the form of the production and use of biogas, cleaner cookstoves and a reduction in the use of firewood by households and the Mulindi Tea Factory, contributing to reduced tree cutting. The latter is also expected to be affected by more sustainable management of woodlots, resulting in an increase in tree production and diversity and a reduction in soil erosion of woodlots. Training also aims to support the adoption of additional sources of livelihoods from forestry products, contributing along with job creation to an increase in income. The benefits of using cleaner sources of energy are also expected to be observed in terms of improved health.

42. Goals

Like component 1, component 2 aims to strengthen the resilience of landscapes and communities to climate-related hazards; it also aims to reduce GHG emissions.

43. These five stages are summarized in Figure 18.

iii. Theory of change of component 3: Climate-resilient settlements

44. Inputs

The GCF grant and funds from FONERWA and Gicumbi district will be allocated to the hiring of service providers and technical experts, and the purchase of inputs and land.

45. Activities

Component 3 activities consist of establishing green social housing in two villages to resettle vulnerable households living in high-risk zones prone to flooding and landslides. In addition to dwelling units and kitchen gardens, the new settlement will have murram roads, water management infrastructure and infrastructure to produce biogas. Households will be trained in how to use and maintain small-scale infrastructure, while an operation and maintenance structure will be set up for the maintenance of larger-scale infrastructure. To support households' livelihood, newly resettled households will receive two cows and benefit from cow sheds and water ponds. Progress on these activities will be measured by the purchase of inputs and equipment and the number of contracts with service providers.

46. Outputs

As outputs of the above-mentioned activities, target households will be resettled in the newly built green social housing and receive cows, and roads and water infrastructure will be installed. Households' knowledge of water management and management of small-scale green infrastructure will be enhanced, and the operation and maintenance structure will be in place. Finally, service providers will hire the local labour force, resulting in job creation.

47. Outcomes

By resettling households highly vulnerable to flooding and landslides, the immediate outcome of component 3 is a reduction in their exposure to these climate-related hazards. The latter is reinforced by improved water management of the new settlements. The integrated approach of component 3 is also expected to increase the adaptative capital of farm households in general, by providing better access to services, including water and roads (and thereby markets, schools and health centres); an increase in dairy products and vegetable production, leading to an improved dietary and food diversification; and the use of cleaner energy, contributing to a reduction in tree cutting and improved health outcomes.

48. Goals

    Like component 2, component 3 aims to reduce GHG emissions and to strengthen the resilience of vulnerable farm households to climate-related hazards.

49. These five stages are summarized in Figure 19.

c. Evaluation questions

50. The proposed evaluation focuses on household-level outcomes and aims to inform the following overarching research question: To what extent does the Gicumbi project contribute to incremental and transformational climate change adaptation and the mitigation of GHG emissions?

51. Incremental adaptation is defined in the context of this project as changes in the socio-ecological system to improve its resiliency to climate change. Incremental adaptation may entail strategies that do not change the system completely but that re-arrange and improve it to preserve its benefits. In contrast, transformational adaptation involves strategies that shift the socio-ecological system away from unsustainable or undesirable trajectories by greatly changing its fundamental attributes.[33]

52. To answer the above question, the LORTA and project teams jointly elaborated key evaluation questions derived from the underlying hypotheses behind the ToC. Questions EQ1 to EQ6 will be answered using quantitative methods and focus on the impacts of components 1 and 2 activities. Question EQ7 will focus on component 3 activities and be assessed by a qualitative approach.

    - EQ1: Do adaptation interventions of components 1 and 2 lead to an increase in farmers' adoption of CRA practices?
    - EQ2: Do adaptation activities of components 1 and 2 lead to an increase in food security and diversity?
    - EQ3: Do components 1 and 2 activities lead to an increase in smallholder farmers' resilience? What dimensions of resilience are the most influenced by the project activities?
    - EQ4: To what extent do mitigation activities of component 2 lead to the production and use of cleaner energy for cooking?
    - EQ5: Do mitigation activities of components 1 and 2 lead to an increase in permanent vegetation cover and diversity of tree species of targeted areas?
    - EQ6: Do the project activities of components 1 and 2 contribute to an increase in women's participation in economic life? Do the impacts of the project differ by the gender of the household head?
    - EQ7: How do green settlements affect the resilience of vulnerable households? What are the factors that helped or hindered transformative change?

53. EQ3 and EQ7 will inform on the ability of the project to contribute to its first long-term goal, which is strengthening the resilience of landscapes and households to climate change. EQ1 and EQ2 aim to identify key steps towards achieving this goal and provide further insights into the processes leading to the observed changes in resilience. EQ7 also contributes to shedding light on underlying processes leading to strengthened resilience. This evaluation question focuses on component 3 activities and seeks to uncover the enabling factors for transformative change to better inform governmental initiatives in resettling highly vulnerable households. EQ4 and EQ5 intend to capture

[33] Robert W. Kates, William R. Travis and Thomas J. Wilbanks, "Transformational adaptation when incremental adaptations to climate change are insufficient", *PNAS*, vol. 109, No. 19 (May 2012), pp. 7156–7161; Netra Chhetri, Michelle Stuhlmacher and Asif Ishtiaque, "Nested pathways to adaptation", *Environmental Research Communications*, vol. 1, No. 1 (February 2019), pp. 015001; Giacomo Fedele and others, "Transformative adaptation to climate change for sustainable social-ecological systems", *Environmental Science and Policy*, No. 101 (2019), pp. 116–125.

essential steps towards the second long-term goal of the project, which is a reduction in GHG emissions. Because women represent a primary target group of the Gicumbi project, EQ6 will help in assessing the gender responsiveness of component 1 and 2 activities.

54. The proposed evaluation questions also aim to inform on the co-benefits of the project. EQ1, EQ4, EQ5 and EQ7 will shed light on the environmental co-benefits of the project. The impact assessment of the project on access to services (EQ3 and EQ7), improved livelihoods (EQ3 and EQ7) and nutrition (EQ2) contribute to the assessment of the social co-benefits of the Gicumbi project. Furthermore, by exploring the gendered impacts of the project, EQ6 will measure the direct contribution of the project to gender-related co-benefits, which are also part of the social co-benefits. By looking at the impacts of project activities on improved livelihoods, EQ3 and EQ7 will provide information on the economic benefits of the project (direct job creation, income generation, and diversification and agricultural productivity). Economic benefits will be further informed by EQ4 in the form of improved energy independence. The contribution of the proposed study to the assessment of the project's contribution to these co-benefits is summarized in Table 11.

Table 11. Assessment of the project's contribution to co-benefits

Co-benefits		Sub-categories	Indicators	Research questions
Environment	Air	Producing/using compost	Use of cleaner energy for cooking	EQ4, EQ7
	Land	Producing/using compost	Use of compost	EQ1
		Producing/using manure or other soil nutrients	Use of manure or other soil nutrients	EQ1
		Irrigation	Use of irrigation	EQ1
		Preventing soil erosion	Adoption of soil conservation measures	EQ1
		Minimum tillage	Mode of preparation of land	EQ1
	Water	Improving management/control of wastewater	Infrastructure related to wastewater	EQ7
		Saving/conserving water	Infrastructure to collect/store/save water, usage	EQ1, EQ7
		Improving reliability/accessibility of water supply	Access to water	EQ3, EQ7
		Improving the ecological state of water bodies		
		Other means to improve water supply		
	Natural resources	Protecting/enhancing plant life	Hectares of trees/shrubs planted	EQ5
		Protection/enhancing species diversity	Number of species planted/cultivated	EQ1, EQ5
		Protecting/enhancing forests	Vegetation cover	EQ5
Social	Jobs	New long-term jobs	Types and number of sources of livelihoods	EQ3, EQ7

Co-benefits	Sub-categories	Indicators	Research questions
	New short-term jobs	Types and number of sources of livelihoods	EQ3, EQ7
	New sources of income generation	Types and number of sources of livelihoods	EQ3, EQ7
Health and safety	Access to food	Food security and diversity	EQ2
	Reducing health-damaging indoor air pollution	Use of cleaner energy for cooking	EQ4, EQ7
	Enhancing health services	Access to health centres	EQ3, EQ7
Education	Job-related training	Reception of training	EQ1, EQ7
	Enhanced educational services	Access to schools	EQ3, EQ7

d. Impact indicators

55. The above-mentioned evaluation questions will be primarily answered by measuring changes in the following indicators:

- EQ1: number of farmers that adopt CRA practices; number and type of CRA practices adopted by farmers
- EQ2: Coping Strategies Index;[34] the number of days members of the household did not eat three meals a day; Household Dietary Diversity Score[35]
- EQ3: production of agricultural, animal and forest products; agricultural, animal and forest productivity; income; the number of sources of livelihoods; share of the agricultural production not for household consumption; climate resilience index
- EQ4: production of biogas; the quantity of firewood used for cooking (bundles/day)
- EQ5: permanent vegetation cover, type and location (measured by satellite images)
- EQ6: above-mentioned indicators disaggregated by gender; women's access to CAF

56. Additional indicators (secondary indicators) will also be collected to better inform the mechanisms at play.

e. Climate resilience index

57. The Intergovernmental Panel on Climate Change defines resilience as "the ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a potentially hazardous event in a timely and efficient manner, including through ensuring the preservation,

[34] This index is based on a series of questions (to be adapted to the local context) related to how households manage to cope with a food shortage, measuring both the frequency of coping behaviours and their severity. For more information on how to build this index, see Daniel Maxwell and Richard Caldwell, *The Coping Strategies Index: Field Methods Manual*, 2nd ed. (CARE, 2008).
[35] This tool aims to capture the economic ability of a household to access a variety of foods in a simple and practical manner. For more information, see FAO, "Guidelines for measuring household and individual dietary diversity" (2013). Available at *http://www.fao.org/3/a-i1983e.pdf*

restoration or improvement of its essential basic structures and functions."[36] There is no single measure of resilience to climate change. The LORTA team suggests adapting the resilience tool proposed by the Food and Agriculture Organization (FAO) of the United Nations, the Resilience Capacity Index (RCI, FAO, 2016).[37] This index is organized around five pillars: (1) Access to Basic Services; (2) Assets; (3) Social Safety Nets; (4) Sensitivity; and (5) Adaptive Capacity.

58. The LORTA team defined a list of components to be part of the resultant climate resilience index (see Table 12). For ease of implementation and interpretation, the index can be computed as a simple average of its different components.

Table 12. Components of a climate resilience index

PILLARS	INDICATORS
Access to Basic Services	Distance to the closest all-weather road
	Distance to the closest market
	Distance to the closest primary school
	Distance to the closest health centre
	Distance to the closest drinkable water
Assets	Household assets ownership
	Livestock
	Landholding
	Tree area
Social Safety Nets	Reception of social safety net
	Group membership
	Reception of remittances
Sensitivity	Losses in agricultural, animal and forest products following climate hazards
Adaptive Capacity	Education level
	Dependency ratio
	Knowledge of climate-resilient practices
	Income
	Income diversification
	Off-farm employment
	Reception of WCS

[36] Allen Lavell and others, "Climate change: New dimensions in disaster risk, exposure, vulnerability, and resilience", in *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change, C.B. Field and others, eds. (Cambridge, UK, and New York, NY, Cambridge University Press, 2012)

[37] *http://www.fao.org/3/a-i5665e.pdf*. This indicator needs to answer the project's stakeholders needs and interest and can be modified accordingly. An alternative possible would be to refer to the vulnerability index used in the National Framework for Vulnerability Assessment.

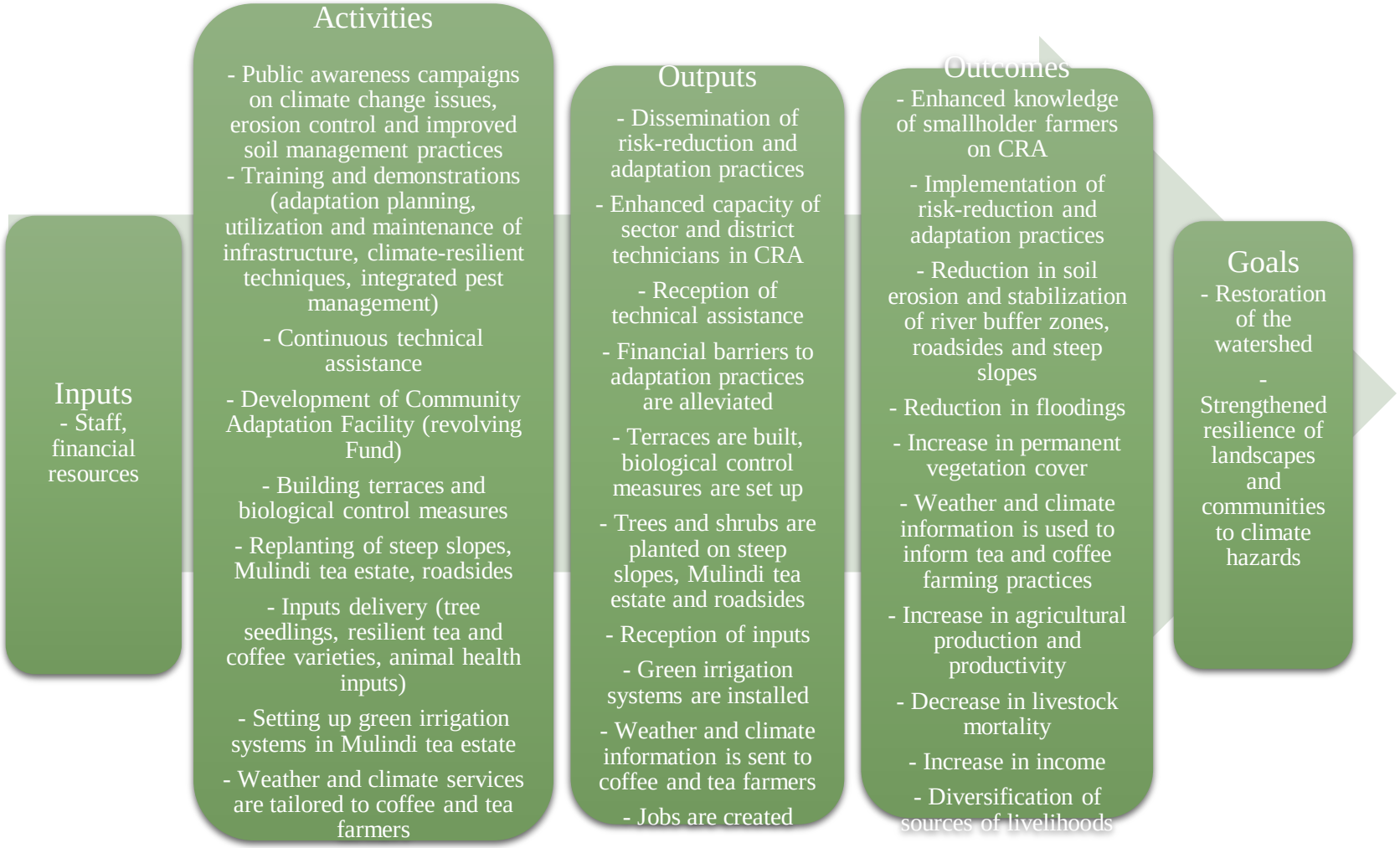

Figure 17. Theory of change component 1 - Watershed Protection and Climate Resilient Agriculture

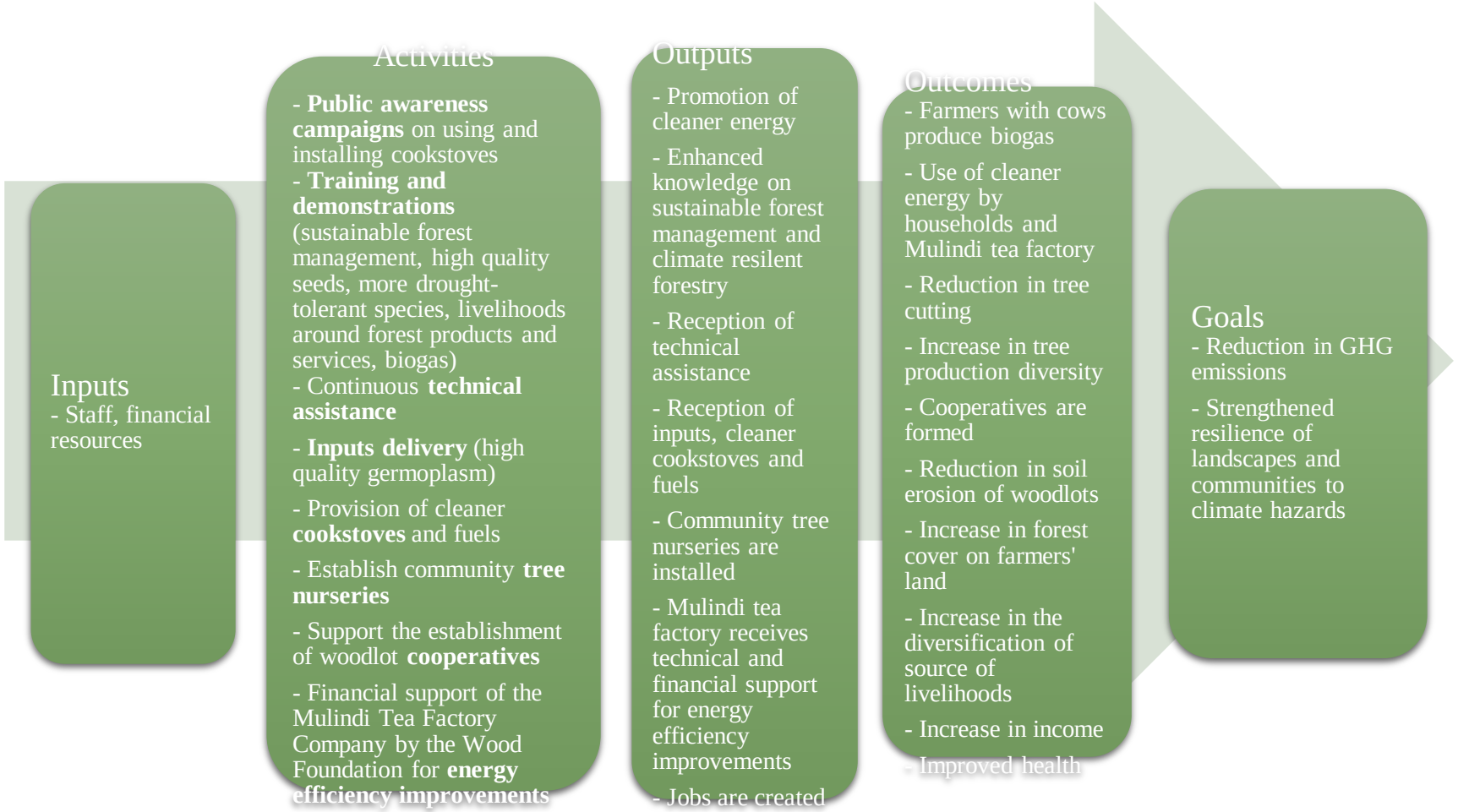

Figure 18. Theory of change of component 2 – Sustainable forest management and sustainable energy

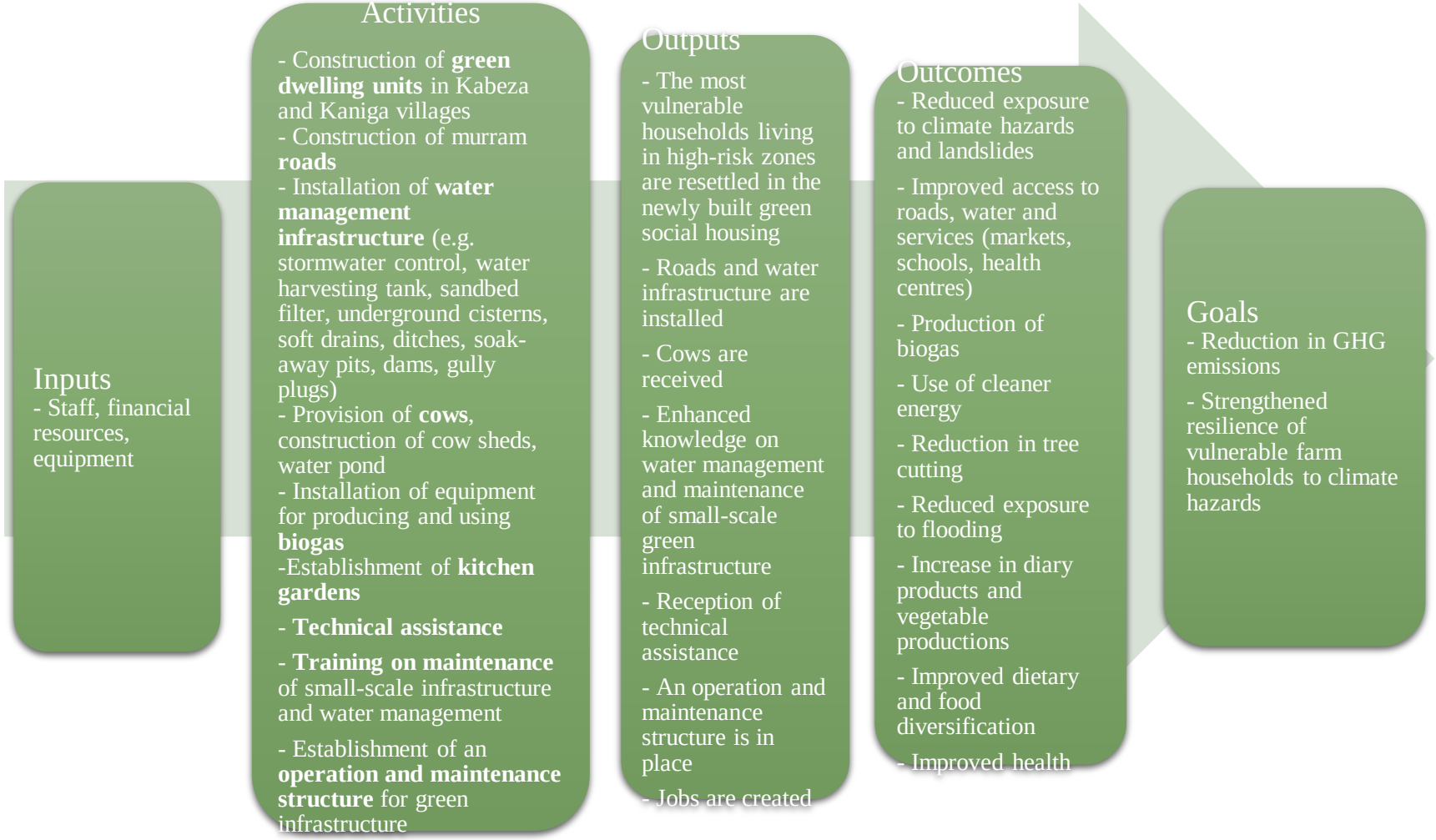

Figure 19. Theory of change of component 3 – Climate-resilient settlements

f. Plans for evaluation

i. Methodology

59. The proposed methodology follows a mixed-method approach that combines quantitative and qualitative data analysis. Quantitative and qualitative methods have been selected according to the nature of the information sought and will be used concurrently to answer different evaluation questions. Both approaches will bring different insights into the overarching research question to provide a complete picture of the ability of the project to contribute to climate change adaptation and mitigation of GHG emissions. The quantitative evaluation will focus on components 1 and 2 activities and be based on a quasi-experimental design. Specifically, DiD combined with matching will be used. Two primary units of analysis will be considered: farmers and private woodlots. Hence, this approach will lead to the precise measurement of changes in farmers' outcomes of interest and private woodlots' vegetation cover that can be solely attributed to project activities.

60. Qualitative research methods will complement the quantitative evaluation by focusing on the beneficiaries' perception of the transformational change triggered particularly by component 3 of this project (EQ7). The qualitative approach will aim at understanding the underlying drivers leading to strengthening the resilience of vulnerable households as a result of resettlements. The number of targeted beneficiaries being relatively low, this component is not suitable for a quantitative IE. Furthermore, given the interest of the project team in better understanding the underlying processes of this component in contributing to enhancing the resilience of the targeted group, the LORTA team suggests examining this component using a qualitative approach. The corresponding research question will be answered through in-depth interviews with project beneficiaries. Also, a comparative case study could be added to the qualitative research approach, including non-project beneficiaries in the green settlement of Kabeza and in other settlements in Kaniga (if applicable). Note that for this purpose further information will be required on non-beneficiaries, beneficiaries of previous similar interventions and the type of services they have benefited from, to assess whether these two groups can effectively be compared.

ii. Impact evaluation design

61. The LORTA team recommends the adoption of a quasi-experimental design for the quantitative assessment of evaluation questions 1 to 6, which focuses on the impacts of components 1 and 2 activities.

62. During the LORTA mission, the different stakeholders of the project expressed their interest in learning about the overall impact of the project. Due to the complementary nature of project activities and the necessity to tailor activities to the characteristics and needs of each community, the LORTA team suggests evaluating the overall Gicumbi project interventions rather than distinguishing between specific activities. As a result of the diversity of activities and implementing partners, and the sequential nature of a subset of activities, a phase-in of beneficiary communities appears as unpractical. Hence, a DiD approach combined with matching has been identified as the most suitable evaluation design to inform on the overall impact of component 1 and 2 activities.

63. The DiD approach estimates programme effects through the comparison of changes in outcomes over time between beneficiaries and a comparison group. As every community of the intervention area will ultimately receive the interventions, this comparison group will be composed of farmers in communities outside of the nine sectors targeted by the project. Due to the non-random selection of communities and direct beneficiaries, we expect that beneficiaries and the comparison group differ at baseline. Therefore, a pure ex-post comparison of both groups does not allow us to recover the

effects of the project. Instead, we will compare changes in outcomes between the two groups, acknowledging potential initial differences.

64. A DiD design accounts for initial observable and unobservable differences between beneficiaries and the comparison group. As long as initial differences having an impact on the outcomes of interest would have been constant over time in the absence of the intervention, this method enables the causal identification of the impacts of the project. This approach is also robust to external shocks, as long as these shocks affect both groups similarly. Thus, the crucial assumption of this technique is that the change in outcomes of beneficiaries and the comparison group would have been the same without the intervention. This is called the "parallel trends assumption".

65. The parallel trends assumption is illustrated in Figure 20. In this fictitious example, we can see that the resilience of beneficiaries and that of the comparison group evolved similarly before the implementation of the project and would have continued to develop in the same way in the absence of the project. This is illustrated by the counterfactual (dotted green line), which represents the change in the resilience of beneficiaries in the absence of the project. Based on this assumption, the change in trend observed for the beneficiaries after the project can be uniquely attributed to the project. The effect of the project on resilience is then estimated by computing the difference between d2 and d1, where d2 is the difference in outcome between beneficiaries and the comparison group after the project and d1 is the difference in outcome between the same groups at the beginning of the project. Hence, the impact of the project corresponds to the DiD interval (orange arrows).

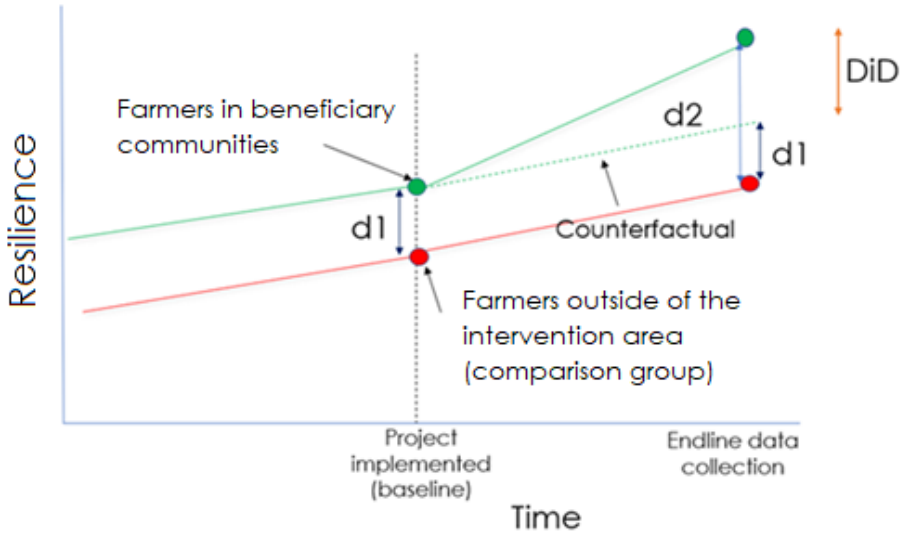

Figure 20. The parallel trends assumption

66. The validity of the parallel trends assumption is reinforced by a greater similarity between the groups at the beginning of the project. Therefore, the LORTA team suggests complementing this approach with matching at two levels: the community (village) and the household.

67. Matching consists in using statistical techniques to construct an artificial comparison group. The idea is to select, for every treated unit – for instance, a beneficiary community – a non-treated unit that has the most similar observable characteristics. To enhance the quality of the matches and thus of the comparability between beneficiaries and the comparison group, the LORTA team recommends as a first step to select comparison communities using matching, to lower the data required at the household-level. Matching will be based on geographic and demographic

characteristics obtained from secondary source data, notably agroecological zones; hazard risks; distance to a river, water bodies and road; poverty level; and population density. More information on the availability of secondary source data will be exposed in the subsection "Secondary data sets".

68. After discussions with the project team, the southern part of the Gicumbi district, situated around the Nyabugogo catchment, was determined to be particularly suitable to serve as a comparison area because it shares more similar agroecological characteristics than the upper part of the Muvumba catchment, located in eastern neighbouring districts (Nyagatare and Gatsibo) of the project intervention area. Nonetheless, the suitability of comparison villages close to the eastern Gicumbi border will also be explored. Identifying comparison villages in both areas would reduce the threat to the IE strategy represented by external shocks only affecting the northern (beneficiary villages) or the southern part of Gicumbi.
69. In a second step, beneficiary households will be matched to non-beneficiary households in selected comparison communities based on characteristics collected at baseline, notably sociodemographic characteristics and baseline outcomes. Several project activities require the active participation of eligible farmers. Therefore, differences in the perceived benefits of adaptation and mitigation activities may affect the probability of an eligible farmer to effectively take part in project activities. To account for this, information on baseline knowledge on the consequences of climate change and potential ways to adapt to them or mitigate them will be collected from beneficiaries and the comparison group.
70. This two-step approach aims to reduce the initial differences between these two groups. Any remaining time-invariant differences will be accounted for by the DiD approach.
71. One limitation of the suggested strategy is that we are not able to learn about the differential impact of specific project activities. The LORTA team recommends instead to explore the differential impact of various degrees of treatment intensity. Differences in treatment intensity can be measured in two ways, by using the number of activities from which a village effectively benefited and by using the number of visits of project-related staff in the village. This information could be collected during the monitoring of the project. Also, the relative importance of different activities could be explored qualitatively by querying farmers during the midline and endline household surveys about their satisfaction with and their perceptions of the respective roles of activities they benefited from.
72. The LORTA team recommends a similar quasi-experimental approach to evaluate the impact of project activities on permanent vegetation cover. The main analyses will be based on satellite imagery following a DiD approach using changes in forest cover as the main outcome of interest, as presented in Arriagada et al.[38] Project activities are expected to affect the decision-making process of programme participants owning woodlots regarding the management of these woodlots; private woodlots constitute the relevant unit of analysis.[39] Following a similar approach to that for the estimation of programme impacts on household-level outcomes, the validity of the parallel trends assumption will be reinforced by using weighting strategies to balance covariates to match beneficiary private woodlots owners with non-beneficiary private woodlots owners. Depending on the quality of available data, in terms of resolution and cloud cover, yearly panels may be used.

[38] Rodrigo A. Arriagada and others, "Do payments for environmental services affect forest cover? A farm-level evaluation from Costa Rica", *Land Economics*, vol. 88, No. 2 (May 2012), pp. 382–399
[39] Allen Blackman, "Evaluating forest conservation policies in developing countries using remote sensing data: An introduction and practical guide", *Forest Policy and Economics*, vol. 34 (September 2013), pp. 1–16.

g. Sampling

73. The evaluation of the Gicumbi project rests on two units of analysis: farmers and private woodlots. Regarding farmers, one challenge is that the direct beneficiaries of the Gicumbi project will not be known at baseline. To address this limitation, the LORTA team suggests identifying farmers to be interviewed based on a list of key common selection criteria for main project activities, to be drawn up in consultation with the project team. An appropriate sampling frame – that is, the list of farmers meeting these criteria – could be developed by consulting community leaders, upon the condition than the latter possess the relevant information on community members. Community leaders would be first asked to list all adults residing in the village, if such a list is not readily available, and to identify from this list individuals meeting the criteria of interest. The final lists of farmers eligible for the survey will then be shared with or collected by the data-collection team. A random sample of farmers will be drawn from these lists to be interviewed. Women will be oversampled to allow for the exploration of differential impacts by gender (EQ6), such that the final sample contains 50 per cent female farmers.
74. However, this strategy does not guarantee that the potential beneficiaries interviewed at baseline will ultimately directly benefit from the programme. Therefore, the LORTA team recommends oversampling potential beneficiaries at baseline to guarantee sufficient observations on direct beneficiaries. The latter could be identified by collecting information on individual beneficiaries during the monitoring of the programme, which would be followed up in consecutive household surveys.[40]
75. To enhance the quality of the comparison group and therefore the strength of the identification strategy of the impacts of project activities, oversampling the comparison group at baseline is also recommended. Once direct beneficiaries have been identified, these could be matched to a subgroup of comparison farmers. Based on the baseline data, potential differences in observable characteristics between the two groups will be identified. These variables will enable us to predict the probability of receiving project activities, this probability is referred to as “propensity scores”. Then, each farmer will be compared to farmers having the most similar probability of participation. Matching from a larger pool of farmers increases the likelihood of finding comparison farmers who are similar to direct beneficiaries. Alternatively, if budget constraints prevent the team from interviewing a larger group of comparison farmers at baseline, weighting strategies to balance covariates can be used to match beneficiaries with non-beneficiaries. This approach consists, for each beneficiary farmer, in giving more weight to comparison farmers whose propensity score is the closest to his or her own, and a lower weight to comparison farmers whose propensity score is more dissimilar.
76. Private woodlots represent a potential second unit of analysis of interest. Tracking the changes in vegetation cover requires recording the GPS coordinates of the plots that we want to monitor. The LORTA team suggests collecting this information during the baseline household survey from private woodlot owners that are part of the sample. This approach would enable the evaluation team to cross information collected in the survey with observed changes in vegetation cover for this subgroup.

[40] To guarantee the correct identification of direct beneficiaries of project activities within the sample of farmers interviewed at baseline, monitoring data should record the list of direct beneficiaries using similar identifier codes to those used in the baseline data set.

h. Power calculations: Optimal Scenario

77. Power calculations enable us to determine the minimum sample size needed to detect the impact of a given intervention. Considering an equal allocation ratio between these three groups, the LORTA team recommends a sample of 1,950 farmers at baseline and 1,500 farmers at midline and endline.

78. Power calculations were performed using the following power formula that relates the sample size to the MDES between the mean outcomes of two groups:

$$MDES = (t_{1-\kappa} + t_{\alpha}) \sqrt{\frac{1}{P(1-P)}} \sqrt{1 + \rho(m-1)} \sqrt{\frac{\sigma^2}{N}} \sqrt{1 - R^2}$$

where $\mathbf{t_{1-\kappa}}$ and $\mathbf{t_{\alpha}}$ are t-statistics representing the required power and level of statistical significance, $\boldsymbol{P}$ represents the proportion in one of the two compared groups (allocation ratio), $\boldsymbol{\rho}$ is the ICC, $\boldsymbol{m}$ is the number of individuals per cluster, $\boldsymbol{\sigma^2}$ is the variance of the outcome of interest within our population, $\boldsymbol{N}$ is the total sample size and $\boldsymbol{R^2}$ represents the extent to which baseline characteristics predict the endline outcome.

79. The MDES was estimated for a power of 80 per cent and a level of statistical significance of 5 per cent. Because the project interventions differ by community, we have to account for the similarity of members within the same community. Hence, we consider a clustered design in which a cluster corresponds to a village. The similarity between farmers residing in similar villages is measured by the ICC, which compares the variance in outcomes within villages and between villages. When the similarity in outcomes within villages increases, and at the same time there is heterogeneity across villages, the variability of the responses of farmers to the interventions reduces. As a result, the sample size required to detect a significant difference between beneficiaries and the comparison group increases. Because there are no available data at the village level, following the literature we considered four different values of ICC: 0.05, 0.10, 0.15 and 0.20.

80. Figure 21 plots the standardized MDES versus the number of clusters, considering an ICC of 0.05 as a lower bound and of 0.20 as an upper bound. Because the MDES decreases faster with the number of clusters than with average cluster size, we selected a number of observations of 10 farmers per cluster. From Figure 21, we see that after a level of 0.2, the MDES weakly improves as the number of clusters increases, suggesting a number between around 120 and 210 villages. The LORTA team recommends 150 villages, enabling us to detect a standardized MDES of 0.2 when the ICC is equal to 0.10.

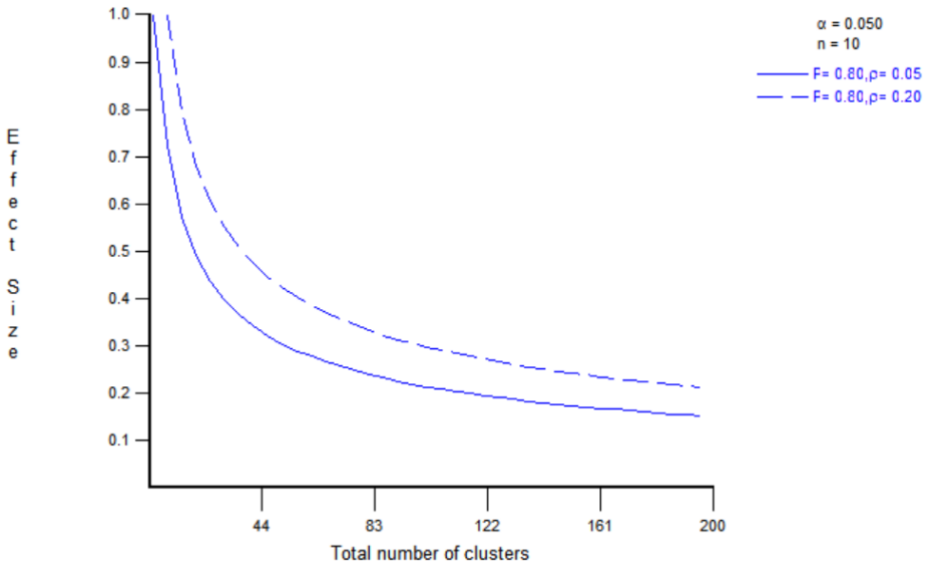

Figure 21. Minimum detectable effect size versus number of clusters

81. The actual MDES depends on the baseline value of the outcome of interest and its variance within the sample. As a result, different sample sizes may be required for different outcomes of interest. The suggested sample size represents an average estimation, taking into account our primary indicators. As an illustration, we computed the MDES that would be obtained with this sample size for two indicators of interest: food security and main cooking fuel. These are presented in Table 13 and Table 14 for different values of ICC.
82. Baseline values on these indicators were obtained from the comprehensive food security and vulnerability survey, a nationally representative survey conducted in 2015 and 2018. The 2018 database is not yet publicly available but the corresponding report contains information at the district level on a food security index based on information on households' food consumption and coping capacities, following the Consolidated Approach to Reporting Indicators of Food Security (CARI) developed by the World Food Programme[41]. According to this survey, the weighted percentage of households being classified as food secure in the Gicumbi district is equal to 37.9%. Table 13 indicates that with a sample of 1500 farmers, we would be able to detect any increase in the number of farmers being food secure that is between 26.4% to 40.2%. This corresponds to a standardized MDES ranging from 0.206 to 0.343. A systematic review of agricultural input innovations on African smallholder farmers' food security has identified improvements in standardized indicators of food security from 0.23 to 1.24.[42] Hence, the minimum effect size we would be able to detect can be seen as a reasonable lower bound of the expected impacts of the programme on food security.
83. As an alternative indicator of interest, we looked at the percentage of households using firewood as the main cooking fuel, equal to 91.1 per cent in the Gicumbi district. In this case, the computed sample size would enable us to detect a decrease in the number of farmers using firewood as their main cooking fuel of between 4.6 per cent and 7.6 per cent (Table 14).

[41] World Food Program. 2018. Randa: Comprehensive Food Security Analysis 2018 (Data collected in March-April 2018).
[42] Ruth Stewart and others, "The effects of training, innovation and new technology on African smallholder farmers' wealth and food security: A systematic review", Campbell Systematic Reviews, 19 (3ie, 2015). Available at *https://www.3ieimpact.org/sites/default/files/2019-01/sr19-africa-smallholder-farming-review.pdf*

Table 13. Power calculations on food security

ICC	NUMBER OF VILLAGES	TOTAL SAMPLE	R2	SIZE OF CLUSTERS	MDES (IN % POINTS)	% CHANGE IN FOOD SECURITY
20%	150	**1,500**	30%	10	0.096	28.5%
20%	150	**1,500**	0%	10	0.114	34.1%
15%	150	**1,500**	30%	10	0.088	26.1%
15%	150	**1,500**	0%	10	0.105	31.2%
10%	150	**1,500**	30%	10	0.079	23.5%
10%	150	**1,500**	0%	10	0.094	28.1%
5%	150	**1,500**	30%	10	0.069	20.5%
5%	150	**1,500**	0%	10	0.082	24.5%

Table 14. Power calculations on percentage of households using firewood as the main cooking

ICC	NUMBER OF VILLAGES	TOTAL SAMPLE	R2	SIZE OF CLUSTERS	MDES (IN % POINTS)	% CHANGE IN FOOD SECURITY
20%	150	1,500	30%	10	0.058	6.3%
20%	150	1,500	0%	10	0.069	7.6%
15%	150	1,500	30%	10	0.053	5.8%
15%	150	1,500	0%	10	0.063	6.9%
10%	150	1,500	30%	10	0.048	5.2%
10%	150	1,500	0%	10	0.057	6.2%
5%	150	1,500	30%	10	0.042	4.6%
5%	150	1,500	0%	10	0.050	5.5%

84. Assuming an equal sample size of female and male farmers and a total sample of 1,500 farmers, a subgroup analysis of the impact of the Gicumbi project by gender would enable us to detect standardized MDES ranging from 0.21 to 0.34.

85. As previously mentioned, the LORTA team suggests a greater sample at baseline to increase the likelihood of having direct beneficiaries in the study sample and to enhance matching quality at the household-level. Oversampling at baseline will also enable us to account for potential attrition in follow-up surveys. Therefore, the LORTA team recommends an increase in the baseline sample size of 30 per cent (450 additional observations). Following this sampling strategy, once the direct beneficiaries of the project are identified, baseline data can be used to shed light on the ability of the project to effectively reach its target population.

86. Note that due to a limited budget, the LORTA team has shared with the project team an additional three conservative sample scenarios. Following revision by the project team the chosen scenario consists of a total sample size of 1200 households instead of 1500. Moreover, while this scenario preserves the collection of midline data, it compromises the above suggestion to oversample the comparison group.

87. Similar to before, the baseline value on food security was obtained from the comprehensive food security and vulnerability survey conducted in 2018. Also, the baseline value on vulnerability was taken from the Rwanda Climate Change Vulnerability Assessment and Index, a report prepared by the Rwanda Environmental Management Authority in 2019 and based on data collected in 2019. According to this report, the average value of the vulnerability index in Gicumbi is equal to 0.472.

Table 15. Power calculations on food security

ICC	NUMBER OF VILLAGES	TOTAL SAMPLE	R2	SIZE OF CLUSTERS	MDES (IN % POINTS)	% CHANGE IN FOOD SECURITY
20%	120	1200	30%	10	0.110	29.0%
20%	120	1200	0%	10	0.131	34.7%
15%	120	1200	30%	10	0.101	26.6%
15%	120	1200	0%	10	0.120	31.8%
10%	120	1200	30%	10	0.091	23.9%
10%	120	1200	0%	10	0.108	28.6%
5%	120	1200	30%	10	0.079	20.9%
5%	120	1200	0%	10	0.095	25.0%

Table 16. Power calculations on vulnerability index

ICC	NUMBER OF VILLAGES	TOTAL SAMPLE	R2	SIZE OF CLUSTERS	MDES (IN % POINTS)	% CHANGE IN VULNER-ABILITY
20%	120	1200	30%	10	0.359	24.0%
20%	120	1200	0%	10	0.337	28.7%
15%	120	1200	30%	10	0.368	22.0%
15%	120	1200	0%	10	0.348	26.3%
10%	120	1200	30%	10	0.379	19.7%
10%	120	1200	0%	10	0.361	23.6%
5%	120	1200	30%	10	0.391	17.3%
5%	120	1200	0%	10	0.375	20.6%

88. By reducing the sample size, the standardized MDES for food security varies between 0.16 and 0.27 depending on the degree of correlation in outcomes within households of the same village. A systematic review of agricultural input innovations on African smallholder farmer's food security (Stewart et al., 2015)[43] has identified improvements in standardized indicators of food security from 0.23 to 1.24, which suggests that in a worst-case scenario, the study may not be able to detect changes in food security. However, this risk is mitigated by collecting information on the determinants of food security and including them in the regression, bringing down the standardized MDES between 0.16 and 0.23.[44]

[43] Stewart, R., Langer, L., Da Silva, N. R., Muchiri, E., Zaranyika, H., Erasmus, Y., Randall, N., Rafferty, S., Korth, M. & Madinga, N. 2015. The Effects of Training, Innovation and New Technology on African Smallholder Farmers' Wealth and Food Security: A Systematic Review. *Campbell Systematic Reviews, 11*.
[44] These numbers assume that the included variables are able to explain 30% of variation in food security.

89. With this sample size, we can detect changes in vulnerability between 17% and 29%. To our knowledge, there is no available information on rigorous estimations of the effect size of similar interventions on vulnerability or resilience indexes. We nevertheless refer to an evaluation conducted by the United Nations Environment Programme of adaptation interventions of the Gishwati ecosystem in Rwanda, who report a change in vulnerability to climate change of 35% after four years of project activities.[45] As part of this change may not be attributed to the project, we may expect a lower effect, which would be permitted by the suggested sample size.
90. It should be noted that by not oversampling the comparison group, there is a risk of a lower matching quality, which may induce some bias in the estimation of the project impacts.

i. Possible risks for impact evaluation

91. Potential risks for the suggested IE design relate to the quality of matching, the possibility of spillovers, shocks separately affecting beneficiaries and the comparison group, and other interventions in comparison areas.
92. The reliability of the two-step matching approach depends on the effective access to secondary data representative at the village level. The extent of information collected during the project's feasibility studies lowers this concern for villages located in the Gicumbi district. For comparison villages outside of the Gicumbi district, the availability of detailed geographic information system (GIS) data still needs to be assessed.
93. Capacity-building of local authorities and district technicians, as well as knowledge transfer, may not only strengthen the adaptive capacity of targeted communities but also that of non-targeted communities chosen as a comparison area. The existence of positive spillovers would undermine the estimation of the impacts of the Gicumbi project. However, these activities represent a minor subset of all interventions proposed by the programme and do not address all barriers that smallholder farmers are facing to effectively implement adaptation and mitigation strategies. As a result, effects due to spillovers are expected to be small. Communities closer to beneficiary villages could be more likely to be exposed to project interventions and, thus, to learn from these new disseminated practices. To explore this possibility, we will test whether estimated impacts differ by distance to beneficiary villages. Also, a partial assessment of the existence and extent of spillovers could be obtained during the planned key informant interview with a district local official.
94. Another option would be to include comparison villages outside of the Gicumbi district, which would reduce concerns regarding spillovers. However, it is important to note that the inclusion of comparison villages outside of Gicumbi strongly depends on the comparability of these areas to the beneficiary villages and the presence of targeted farmer groups in these communities. These criteria will be verified at the sampling stage, during which both beneficiary and comparison villages will be selected to be part of the study sample using matching.
95. The parallel trends assumption behind the DiD approach would fail if an external shock only affected one of the two groups being compared (i.e. beneficiary or comparison communities). The inclusion of comparison villages outside of Gicumbi would reduce this risk by increasing the geographic dispersal of the comparison area.
96. Finally, another potential threat to the IE design relates to the intervention of other actors in the beneficiary and comparison areas. The existence of similar interventions to those offered by the project would undermine the estimation of the impacts of the Gicumbi project, requiring good

[45] United Nations Environment Programme. 2015. Terminal Evaluation of the Project: "Reducing vulnerability to climate change by establishing early warning and disaster preparedness systems and support for integrated watershed management in flood prone areas (Rwanda LDCF)".

documentation of ongoing activities in comparison areas during the monitoring of the programme. Before implementing a project, requests have to be filed at the relevant ministry to avoid duplications. It is therefore unlikely that a similar project will take place in the same area of intervention as the Gicumbi project. However, this problem may occur in comparison villages.

j. Qualitative assessments

97. As mentioned earlier a qualitative approach will be followed to address the role of resettlement (subcomponents 3.3 and 3.4)[46] in enhancing the resilience of households living in vulnerable areas. The qualitative research design will consider the literature on the impact of relocation projects and the three fundamental phases identified when addressing transformational change: first, building resilience (stability); second, enhancing transition (incremental social change and the exercise of existing rights); and, finally, transformation (new rights claims).[47] This will enable the evaluation team to understand the resilience–transition–transformation process potentially encouraged by the project and identify possible lessons learned and best practices resulting from the latter.
98. The LORTA team suggests that the qualitative study allows for enough of a time gap following the implementation of this activity to be able to apprehend the transformation process at a rather advanced stage. Table 17 presented below gives an overview of the main evaluation questions suggested and potential indicators and sources of information.

[46] The sub-components 3.3 and 3.4 correspond to the construction of green social housing development in Kabeza and in Kaniga respectively.
[47] Mark Pelling, *Adaptation to climate change: From resilience to transformation* (Routledge, 2010).

Table 17. Qualitative evaluation questions

MAIN RESEARCH QUESTIONS	SUBQUESTIONS AND RATIONALE	EXAMPLES OF INDICATORS	SOURCE OF INFORMATION
EQ7. How do green settlements affect the livelihoods of beneficiary households?	7.1. To which extent does the project reach out to the most vulnerable populations? 7.2. To which extent does the project contribute to social cohesion/conflict, especially in Kabeza, where project beneficiaries share the settlement with non-project beneficiaries? Inclusion is paramount to create transformational changes. As marginalization magnifies the vulnerability of populations and the risks they face, projects aiming at transformational change will not meet their objectives if they do not reach out to the most vulnerable groups.[48]	• Selection of beneficiaries • Actual profile of beneficiaries interviewed • Perceived inclusivity of the project • Beneficiaries' needs (m/f/c) taken into consideration (according to respondents' perception) • Cohabitation quality with non-project beneficiaries	Primary data • Project beneficiaries • Key informants Secondary data (project documentation)
	7.3. To which extent does the project help its beneficiaries to build resilience? • How did the beneficiaries adopt adaptation practices leading to changes in their professional activity and private life? • To which extent does the project help beneficiaries to prepare for and recover from climate-related shocks? • How does the project enhance the beneficiaries' skills and knowledge of climate-related information? Transformational change results from an increase in knowledge, which encourages people to make informed decisions and therefore challenges inherited ways of thinking, e.g. access to and use of climate information.60 • What are the factors that helped or hindered transformative change? • To which extent does the use of a community hall,	• Perceived quality of relocation (selection process, moving process, quality of infrastructure provided) • Perceived capacity to cope with shocks (which occurred following project implementation) and perceived capacity to recover from shocks • Perceived changes (before/after) related to the access to: • The new low-carbon house • Inputs (e.g. cows) • The water control system • Water waste biogas treatment • Cooking facilities • Home water-harvesting tank • Communal rainwater collection • Terracing soil	Primary data • Project beneficiaries • Key informants Secondary data (project documentation)

[48] Uma Pal, Aditya V. Bahadur, Jesse McConnell, Prutha Vaze, Pankaj Kumar and Sunil Acharya, "Unpacking transformation: A framework and insights from adaptation mainstreaming", Action on Climate Today Learning Paper (Oxford Policy Management, 2019). Available at *https://reliefweb.int/sites/reliefweb.int/files/resources/ACT-Transformation-paper_final_web-res.pdf*

MAIN RESEARCH QUESTIONS	SUBQUESTIONS AND RATIONALE	EXAMPLES OF INDICATORS	SOURCE OF INFORMATION
	youth centre, health post and pharmacy, early childhood centre increase the beneficiaries' resilience?	• Most appreciated (according to beneficiaries' perception) service or package of services • Increase knowledge on climate resilience perceived by the beneficiaries after relocation • Training topics • Frequency of training • Participants' needs addressed (according to respondent's perception) • Lessons learned • Best practices	

99. The research methodology will include a content review of primary and secondary data (programme documentation and policy papers) combined with primary data to be collected during the field visit. The diversification of sources will enable researchers to triangulate the evidence from different sources of information to identify the findings. Regarding the data-collection, we suggest that the research questions are answered through in-depth interviews with project beneficiaries and interviews with key informants, such as district and sector officials, as well as FONERWA staff members responsible for the project implementation. Following the interest of the project team in a comparison between project beneficiaries and non-project beneficiaries or beneficiaries of different resettlement interventions, a qualitative comparative analysis can also be conducted. This could, however, only be considered if access to information on potential comparison groups (non-project beneficiaries living in the settlements in Kabeza, for example) is facilitated by the project team to assess whether such groups can effectively be compared. A common ground needs to be ensured across the two groups for such an analysis to lead to meaningful comparisons. Information such as (1) the profile of non-project beneficiaries, (2) the type of services they have and had access to, and (3) when they were relocated would be needed to ensure a high-quality research design. Such a method would involve the inclusion of non-project beneficiaries into the sources of information identified in Table 18.

100. As the GCF priority is to foster the participation and empowerment of women, young people from 18 to 30, elderly persons and people with disabilities,[49] the sample will contain beneficiaries (and potentially non-beneficiaries) meeting GCF priority criteria, aiming to ensure a 50 per cent representation of women and youth, and the presence of beneficiaries with disability across all categories. In close cooperation with the project officers and the M&E specialist, the sampling strategy will be based on the information available in the monitoring and information system (MIS). Information on the heads of the household (female/male/child), their age and the potential presence

[49] The Gicumbi Project Implementation Plan (2017)

of a disability will be extremely valuable for the research team to develop an inclusive and representative sample frame.

101. The qualitative analysis in each sector will consider the concept of saturation (the point at which additional data-collection no longer generates new understanding). However, the sample should be large enough to be able to address all research questions, capture the heterogeneity of the beneficiaries' profiles and cover the two green settlements in Kaniga and Kabeza sectors. Based on C4ED's experience in leading qualitative evaluations, we therefore suggest interviewing the number of respondents identified in Table 18. We purposively assigned less weight to children-headed households, assuming that they might be less numerous than adult-headed ones. This number can, however, be adapted to the reality reflected by the MIS.

Table 18. Number of interviews suggested

TYPE OF RESPONDENT	ADMINISTRATIVE UNIT		
	KABEZA	KANIGA	Total
Male-headed households	8	8	16
Female-headed households	8	8	16
Children-headed households (girls)	4	4	8
Children-headed households (boys)	4	4	8
Non-project beneficiaries?	Optional	Optional	Optional
Key informant interviews with project officers (GCF)	2	2	4
Key informant interviews with district or sector officers	2	2	4
TOTAL (without non-beneficiaries)	28	28	56

102. For each type of the above respondents, standardized open-ended interview grids will be designed based on the research questions suggested and key indicators. Note that the establishment of indicators is crucial because they provide the hypotheses around which the interview grids are to be designed.

103. The LORTA team will provide technical advice throughout the above phases as well as after data-collection.

k. Timeline of evaluation

104. Figure 22 illustrates the planned timeline of the evaluation of the Gicumbi project. With household-level project activities expected to start in March 2020, baseline data should be collected in February 2020, leaving January to plan these activities. Before moving to baseline data analysis, the data need to be cleaned for remaining entry errors and inconsistencies and the data set to be prepared for analysis (e.g. codification of open questions, creation of variables to use for the analysis). Therefore, a **minimum** of two months is recommended between the end of the data-collection and the finalization of the baseline report. The project ends in 2025; the LORTA team, therefore, suggests that the midterm data-collection takes place in February 2023, thus allowing some time for expected changes to prevail. Endline data-collection would then take place in February 2025. The two data collections will provide crucial insights into the evolution of the effects of the project interventions three and five years after the start of the programme. We suggest that the satellite data analysis on private woodlots is performed in parallel to the midline and endline household data analysis.

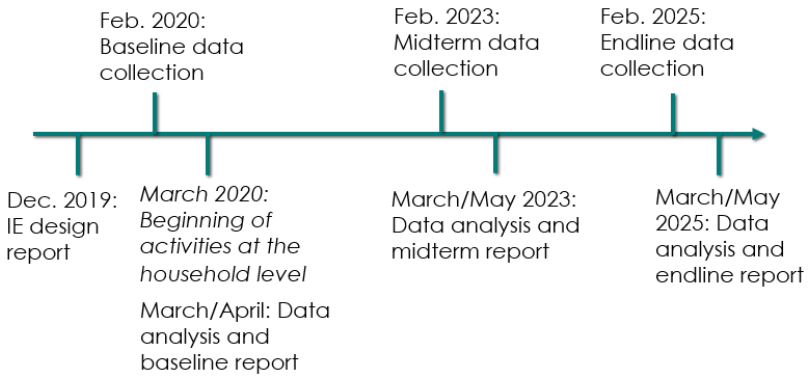

Figure 22. Timeline of household surveys

105. In parallel to the IE, monitoring data will be collected by the project team during the whole timespan of the project. The team will report regularly on implementation progress through quarterly reports and annual progress reviews.
106. To be able to apprehend the transformation process at a rather advanced stage, the research team recommends conducting qualitative fieldwork activities towards the end of the project timespan – for instance, at the same time as the endline quantitative data-collection.

l. Secondary data sets

107. The evaluation can benefit from the integration of primary data collected with several secondary data sources – both at the baseline and later stages.
108. As the IE design aims at a two-stage matching (community and household-level), GIS data including information on climate, topography, land-use, hazard mapping and deforestation of targeted communities will be required. Also, administrative data including poverty levels (and ubudehe categories),[50] population density and other socioeconomic characteristics will be considered. Additional data including surveys and assessments that will be used to identify sites or beneficiaries are also of high importance.
109. Additionally, the following sources are considered. This list is not exhaustive and other sources may be added later:
    - Available hazard maps and disaster databases
    - Available national data on community and household-level vulnerability assessments
    - Feasibility studies on future climate risks
    - Integrated Household Living Survey
    - Seasonal Agriculture Survey
    - Preparatory studies and surveys conducted to identify targeted sites
    - Previous government programmes such as those of the Ministry of Infrastructure, Rwanda (MININFRA) and the Energy, Water and Sanitation Authority / Energy Development Company Limited, upon which some components of this intervention build[51]

[50] Ubudehe categories were created by the Local Administrative Entities Development Agency in 2014 and define the social-economic status of households. The categorization process of households in four possible groups is based on a participatory process involving local leaders and a representative from each household. See the Government of Rwanda website, *http://www.gov.rw/news_detail/?tx_ttnews%5Btt_news%5D=1054&cHash=a315a8b0054e76f9c699f05ce24d3eb8*
[51] MININFRA, "Survey of institutional cook stoves and biogas technology" (July 2010)

- Site surveys that categorize land units (by slope, soil type, soil depth, etc.)
- Watershed protection plan 2016 and GIS analysis
- Tea (and Coffee) Resilience study and climate change assessment

m. Plans for M&E / implementation tracking and real-time measurement system

110. At the time of the inception visit, the project team was in the process of hiring an M&E expert for the project, and hence developing the M&E plan. The project will adapt FONERWA's established M&E procedures that have been used for other development funds. The M&E team will consist of two specialists: an experienced M&E expert who will design and develop the detailed operational guidelines of the M&E system, and an M&E officer who will undertake data-collection and quality assurance. Moreover, implementing partners will be responsible for reporting on the set of outcomes and output indicators specified in the M&E plan. In addition to tracking the implementation of activities across time and space, collected data should provide information on the direct beneficiaries of these activities. Furthermore, information on the type and location of planted species can shed light on the effects of the project on biodiversity. Quarterly and annual progress reports will be developed and assessed against the work plan and the indicators and targets presented in the project log frame. In addition to data compiled from the implementing partners' management information systems, baseline and independent midterm and end-term evaluations are planned by the project team. According to the project team, an independent midterm evaluation will be conducted at the end of year 3 to assess project performance and to determine whether the goals of the project are being achieved. An independent final evaluation will be conducted three months before project closure.
111. As the project team is still in the process of developing its M&E plan, we recommend attaching a detailed communication plan with a clear assignment of responsibilities and roles. Other tools that help to better define the monitoring activities include an indicator plan, monitoring tool lists and a programme work plan.
112. It is recommended to prepare a communication plan describing the staffing and management structure for M&E in the programme. This document should describe reporting lines and explain relationships and responsibilities across and within partner organizations. An indicator plan provides a detailed description of the indicators that will be monitored along with their definition, how they will be measured, how often and by whom. The monitoring tool lists explain all monitoring tools that will be used at each stage of the project and for each of its activities. These lists describe the tools, their purpose, format, sample targeted, data collector and the frequency. Finally, a programme analysis plan draws on the developed log frame and indicator plan to describe the activities required for implementing the project, their designated time period and the required resources. The work plan shared was comprehensive and included an exhaustive list of all activities covering all subcomponents. At the time of the inception visit, the project team had developed a workplan of the project that, according to the project team, will be updated to account for delays in the preparations and the implementation of activities.
113. During the inception visit, the project team raised concerns regarding the management of monitoring data. The project team confirmed that data are collected using paper questionnaires, which requires a lot of time and human resources to ensure data entry in a well-designed information management system. Given the importance of monitoring data in general, and for the IE exercise in particular, we recommend developing a clear diagram showing the flow of data from point of collection to points of analysis and reporting. Moreover, we recommend that data are collected electronically by M&E

officers using tablets or smartphones. Electronic data-collection saves time spent on data entry, in addition to enabling the M&E expert to directly receive the data in the format specified and thus to immediately examine their quality and their correspondence to the work plan. Those tools also allow for the immediate visualization of results. Several software programs exist for electronic data-collection: SurveyCTO, CSPro, SurveySolutions, Magpi, Fulcrum, Ona, Kobo and others.[52] Depending on the software chosen there might be additional costs associated with the development of basic programming knowledge and registration fees.

114. The LORTA team offers to review the plan on M&E and other associated tools such that the IE strategy can benefit at most from a real-time assessment of the project activities.

n. Data-collection and budget

115. The final budget required for the impact evaluation design suggested is determined by the number of data-collection rounds, sample size and the cost of conducting one interview per household.

116. The below budget takes into account the cost of collecting household-level baseline, midline, and endline data for farmers in beneficiary villages as well as in comparison areas as described under subsection “Power calculations: Alternative scenario”.

117. This implies that household-level data is collected before the roll out of the intervention in each of the study villages. Collecting baseline data allows obtaining information on the characteristics of the targeted and treated groups before introducing the project activities. Also, baseline data is required to perform the difference-in-difference analysis at midterm and end-term, and to match farmers on baseline values of outcome variables of interest, hence ensuring better comparability of the beneficiaries and the comparison group. As mentioned in the section “Sampling”, there is a need to oversample households in the treated and control communities at baseline to ensure the availability of enough participants that are targeted by the program. The need to oversample is particularly triggered by the fact that targeted participants cannot be identified well before the activities of the project are implemented. As a result, the LORTA team suggests collecting information on 1380 farmers at baseline in 60 selected beneficiary villages and 60 matched comparison villages. From this pool, 1200 farmers will be re-interviewed at midline and endline.

118. A midline household survey has been included to align with the project team’s initial plan and offers the benefit of providing information on initial impacts after three years. These results may then be used to adjust the implementation strategy of the program. However, this survey round is not required for the validity of the impact evaluation strategy of the project and can be considered as optional.

119. In addition to costs associated with quantitative data-collection, the below budget accounts for qualitative data collected to address the research question (EQ7) on the role of resettlement in enhancing the resilience of households living in vulnerable areas.

120. The budget below amounts to a total of 280,000 $. This figure is estimated based on a cost of 70$ for a two-hour quantitative interview conducted per household and a cost of 275$ for a qualitative in-depth interview. As a result, the final estimates may change if the costs of qualitative and quantitative interviews suggested in Table 19 change following updates by the project team. Moreover, the data collected for the impact evaluation exercise can be integrated with the baseline, and independent midterm and endline evaluations planned by the project team as part of the M&E plan. The integration of the two exercises reduces the cost of the impact evaluation substantially as

[52] CSPro and SurveySolutions are free software, whereas the use of SurveyCTO may include additional costs depending on the number of users.

additional costs will be only associated with data collected from households residing in comparison areas.

121. An external survey firm will be hired by the project team to conduct quantitative and qualitative data-collection. The work of the firm will be supervised by the project team and the LORTA team will provide guidance where requested. Technical advice will be provided on defining the terms of reference with the survey firm, the development of survey tools, sampling of villages and farmers, replacement strategy, training of enumerators and conducting high-frequency quality checks during data-collection.

Table 19. Budget for impact evaluation primary data-collection

QUANTITATIVE DATA COLLECTION (COMPONENTS 1 AND 2)			
Difference-in-difference combined with matching	Sample size	Cost per household (USD)	Total (USD)
Baseline	1380	70 $	96,600 $
Midline (optional)	1200	70 $	84,000 $
Endline	1200	70 $	84,000 $
Total			264,600 $

QUALITATIVE DATA COLLECTION (COMPONENT 3)			
Household-level			
In-depth interviews	Sample size	Cost per household (USD)	Total (USD
	56	275	15,400

D. WAY FORWARD

122. Overall, we consider that the LORTA mission in Rwanda was well received. Project stakeholders demonstrated a genuine interest and engagement in the workshop activities. They seemed convinced of the need for a rigorous IE and of the benefits of this collaboration. The next steps include a final agreement between the IEU, the AE and the project team on the evaluation strategy of the Gicumbi project and related costs.

123. Conditional on moving to Phase 2 of LORTA, January will be dedicated to preparing the baseline household data-collection. During this period, the LORTA team can provide support to the project team in the form of identifying comparison villages using matching, as well as technical advice on defining the terms of reference with the survey firm to be contracted by the project team, the development of survey tools, sampling of farmers, the replacement strategy, training of enumerators and conducting high-frequency quality checks during data-collection. Further guidance will be provided for the project team to analyse and report on the collected information.

124. Another important coming step consists of the finalization of the M&E strategy. The LORTA team offers to review the plan on M&E and other associated tools. Upon agreement between the IEU and the project team, the LORTA team could provide guidance in setting up an electronic data-collection system for implementation tracking. The extent of support provided by the LORTA team will be decided collaboratively between IEU, the AE and the project team, based on assessed needs and priorities.

Appendix 1. AGENDA OF THE LORTA MISSION

Mission Dates: 10–15 November 2019

LORTA mission staff: Dr. Clémentine Sadania, C4ED M&E Specialist (PhD), email: sadania@c4ed.org; Dr. Ghida Karbala, C4ED M&E Specialist (PhD), email: karbala@c4ed.org; Dr. Mariana Vidal Merino, representative for CIFOR, email: marianavidal@gmx.de; Viktoriya Khan, representative for the GCF, email: vkhan@gcfund.org.

Location: Meetings and workshops will be organized at FONERWA office and at Lemigo Hotel.

DAY	TIME	PROPOSED ACTIVITIES	TYPE OF PARTICIPATION	DESCRIPTION	LOCATION AND PARTICIPANTS
Day 0: Sunday, 10 November 2019		Arrival of team	LORTA team	*The LORTA team arrives in the country, debriefs and prepares for the week.*	
Day 1: Monday, 11 November 2019	9:00–9:15	Opening of the LORTA mission	Especially AE representatives, FONERWA team, Gicumbi district representative, project Team Leader and Project Technical adviser. Preferable but not necessary participation. The Wood Foundation, WASAC, and steering committee members	Introduction of key members: AE representatives, M&E experts, project leader and team members, FONERWA, implementing agencies and LORTA team	Lemigo Hotel 20 participants: 2 MoE, 2 Gicumbi district, 6 FONERWA, 5 from technical committee and Wood Foundation.
	9:15–9:45	Overview and discussion of objectives		*Lead by LORTA team* Overview of the LORTA mission objectives	
	Tea break: 15 min				
	10:00–11:00	The benefits of IE	Participants are MoE representatives, project leader and team members, technical committee members and particularly the implementation teams (FONERWA, etc.)	*Lead by LORTA team* Introduction to impact evaluation: What does IE do? Why is it important? What can we learn?	Lemigo Hotel 20 participants: 2 MoE, 2 Gicumbi district, 6 FONERWA, 5 from technical committee and Wood Foundation.
	11:00–12:30	Capacity-building workshop.	Participants are MoE representatives,	*Lead by LORTA team*	Lemigo Hotel 20 participants: 2 MoE, 2 Gicumbi

DAY	TIME	PROPOSED ACTIVITIES	TYPE OF PARTICIPATION	DESCRIPTION	LOCATION AND PARTICIPANTS
			project leader and team members, technical committee members and particularly the implementation teams (FONERWA, etc.)	What are the methods used? This contains some more technical discussion on implementation, comparison groups, sample selection etc. Interactive workshop and discussions	district, 6 FONERWA, 5 from technical committee and Wood Foundation.
	Lunch break: 12:30-13:30				
	13:30–15:30	Capacity-building workshop continued	Participants are MoE representatives, project leader and team members, technical committee members and particularly the implementation teams (FONERWA, etc.)		Lemigo Hotel 20 participants: 2 MoE, 2 Gicumbi district, 6 FONERWA, 5 from technical committee and Wood Foundation.
	13:30–15:30	Capacity-building workshop continued	Participants are MoE representatives, project leader and team members, technical committee members and particularly the implementation teams (FONERWA, etc.)		Lemigo Hotel 20 participants: 2 MoE, 2 Gicumbi district, 6 FONERWA, 5 from technical committee and Wood Foundation.
	16:15–17:00	Discussion and closing remarks	AE (MoE), FONERWA Implementing agencies (IA), (NDA, country-specific), key representatives, project management team and other relevant stakeholders	Discuss key details that are relevant for designing an IE in the context of Rwanda	Lemigo Hotel 20 participants: 2 MoE, 2 Gicumbi district, 6 FONERWA, 5 from technical committee and Wood Foundation.
Day 2: Tuesday, 12 November 2019	9:00–10:30	Presentation of the project by the country PMU	Theory of change discussion Invite all stakeholders, especially those who oversee high-level decisions.	Collaborative exercise Presentation of the key elements of the ToC to better inform the IE design, group work re-constructing	Lemigo Hotel 20 participants: 2 MoE, 2 Gicumbi district, 6 FONERWA, 5 from technical committee and

DAY	TIME	PROPOSED ACTIVITIES	TYPE OF PARTICIPATION	DESCRIPTION	LOCATION AND PARTICIPANTS
			AE (MoE), FONERWA IA, (NDA, country-specific), key representatives, project management team and other relevant stakeholders	the ToC of the project, and discussing relevant indicators (based on the project team's presentation)	Wood Foundation.
	Tea Break: 15 min				
	10:40–12:30		*Lead by Project Team* Presentation of project, its activities and details of its components, timelines, budget and M&E (logical framework) and overall project budget		
	Lunch break: 12:30-13:30				
	13:30-17:00 (with break)	Discussions with the project team	LORTA team, AE representatives, FONERWA project team, advisers etc	Group discussion Group discussions on project and implementation details.	Lemigo Hotel 20 participants: 2 MoE, 2 Gicumbi district, 6 FONERWA, 5 from technical committee and Wood Foundation.
Day 3: Wednesday, 13 November 2019	9:00-12:30	Project activities plans, stocktaking of documents	LORTA team, AE representatives, FONERWA project team, advisers etc.	Group discussion Reviewing existing key documents, plans and secondary data Discussion of anticipated bottlenecks in the project's ToC.	FONERWA Office
	Tea Break: 15 min				
	13:30-16:30 (with break)	Discussion with M&E specialist and project finance officer	LORTA team, AE representatives, FONERWA, M&E specialist and finance specialist	Group discussion Stocktaking of planned data-collection and MIS activities and monitoring and tracking activities Discussion on budget lines, needs	FONERWA Office

DAY	TIME	PROPOSED ACTIVITIES	TYPE OF PARTICIPATION	DESCRIPTION	LOCATION AND PARTICIPANTS
				for sample size, discussion on procurement options for baseline data	
	16:30-17:00	Discussion and closing remarks			
Day 4: Thursday, 14 November 2019	Full day, flexible as per the location and distance	Field visit to project sites	Project team members & C4ED	Visit relevant sites and conduct scoping interviews with potential beneficiaries	Gicumbi project sites
Day 5: Friday, 15 November 2019	9:30-13:00	Debriefing	FONERWA, AE representatives and other experts, project leader and team members	Final presentation to the project team	FONERWA Office

IMPACT EVALUATION DESIGN REPORT 4: SOUTH AFRICA

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A. INTRODUCTION

1. THE LORTA PROGRAMME

1. Evaluating the impact of development projects and programmes has gained importance in recent years. IE not only allows for increased transparency by measuring the effects of investments, it also provides the opportunity to design and implement development projects more effectively. To contribute to this progression, the IEU of the GCF has started the LORTA programme to be able to keep track of GCF projects in terms of performance and results, and to enhance learning within the GCF.
2. The LORTA programme has the following aims:
   - Embed real-time IEs into funded projects so GCF project task managers can quickly access accurate data on a project's quality of implementation and likelihood of impact
   - Build capacity within projects to design high-quality data sets for overall impact measurement
3. The purpose of the IEs is to measure the change in key result areas of the GCF that can be attributed to project activities. The LORTA programme will inform on returns on GCF investments and help GCF projects track implementation fidelity. LORTA has the following objectives:
   - Measuring the overall change (outcome or impact) of GCF-funded projects and enhancing learning
   - Understanding and measuring results at different parts of ToCs
   - Measuring the overall contribution of the GCF to catalysing a paradigm shift and achieving impacts at scale
4. Currently, the LORTA programme is in its second year. In the first year (2018), the IEU supported eight GCF-funded projects to build high-quality, theory-based IE designs at inception. Seven of these projects moved on from the formative research phase to the main impact assessment phase. In the second year of LORTA (2019), six additional GCF-funded projects and programmes were selected to enter the LORTA programme. They are currently undergoing formative work, which includes engagement with AEs, project teams and GCF staff and developing designs for theory-based IEs.

2. THE CLIMATE FINANCE FACILITY

5. The CFF is one of the six projects selected to be part of the inception stage (Phase I) of the LORTA programme in 2019. The AE for this project is the DBSA. The DBSA is a development finance institution (DFI), whose mandate is to support the financing of infrastructure in the water, energy, transport, and information and communication technologies sectors in sub-Saharan Africa. The DBSA has recently launched the CFF.
6. The CFF is a lending facility that aims at increasing climate-related investment in the Southern African region. The target countries of the CFF are South Africa, Namibia, Lesotho and eSwatini. Since the pipeline is expected to be dominated by projects in South Africa, the primary focus is on this country. The targeted sectors of the CFF are energy, water, waste and transport. The CFF plans to finance both mitigation projects (RE, waste to energy, energy efficiency, low-emission transport) and adaptation projects (water efficiency, water treatment, new clean water).
7. The CFF identified the key barriers to investment in climate-related projects. First, private investors are not familiar with the requirements of climate-related investments. For this reason, climate-

related investments are perceived to be risky, resulting in high interest rates and a general reluctance to invest in climate-related projects. The biggest barriers are regulatory constraints, such as Basel III, which impacts all four target countries. As a result, commercial banks across all the CFF target countries cannot provide tenors (i.e. credit periods) longer than seven to eight years.

8. To overcome these constraints and to crowd in investment from financial intermediaries,[53] the lending facility offers credit enhancement such as subordinated debt or first loss and tenor extension. The CFF aims to use these instruments to de-risk and increase the bankability of climate investment and to contextualize the Green Bank model in countries outside high-income countries. As governments in the Southern African region face challenges in tackling climate change, the CFF will aim to fill market gaps and crowd in financial intermediaries' investment. As a result, the CFF is targeting commercially viable technologies that currently cannot attract market-rate capital. With its blended finance approach, the CFF can offer loans at below the market lending rate. The prime lending rate in South Africa is currently 10.5 per cent,[54] while the CFF will offer loans at 9 per cent. The planned structure of the CFF is displayed in Figure 23. Currently, the total budget of the CFF is USD 110 million, split equally between contributions from the GCF and the DBSA. In the future, the CFF plans to receive additional funding of ZAR 700 million from the Public Investment Corporation (PIC) and/or other DFIs. Each project funded by the CFF will have to be co-financed by a local bank, with an expected mobilization of USD 850 million. The CFF aims at an overall portfolio leverage ratio of 1:5[55] – that is, for every rand that the CFF puts into a project, it will be looking for approximately five rand of private investment. Project-specific leverage ratios will vary.

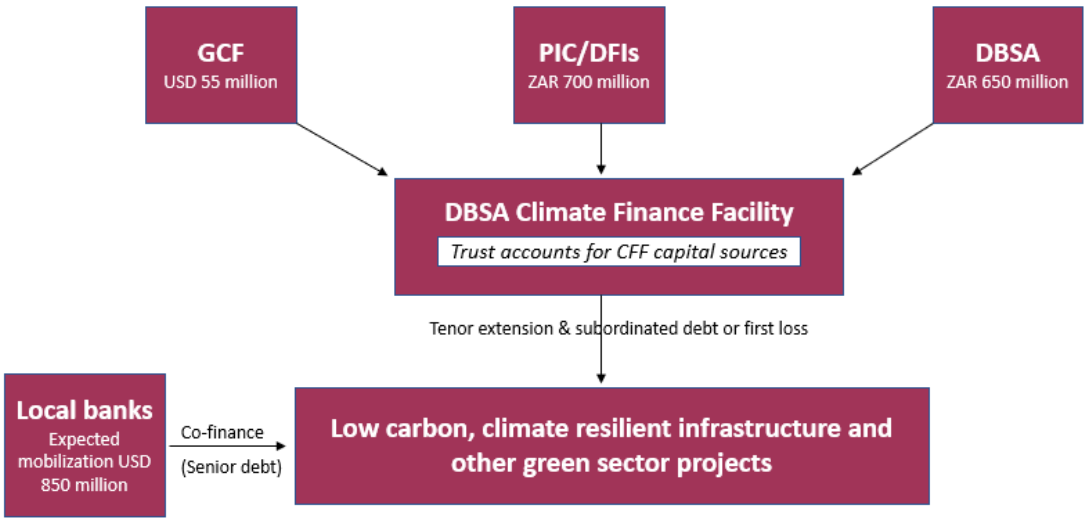

Figure 23. CFF structure

Source: DBSA, CFF Operations Manual (18 September 2018).

[53] This mainly refers to commercial banks but can also include other financial intermediaries such as insurance companies and investment banks. In this design report, the term "financial intermediaries" will be used to cover all types of financial intermediaries.
[54] The prime lending rate in Lesotho and eSwatini is slightly higher (12 per cent and 11.7 per cent), the rate in Namibia is slightly lower (10.25 per cent).
[55] The target of 1:5 is stated in the CFF Operations Manual. During the workshop, the CFF team mentioned that a realistic leverage ratio might be closer to 1:3.

9. As the additionality aspect is key, projects that could solely be funded by other financial intermediaries will not receive CFF loans. When applying to the CFF, projects are required to demonstrate that they are focused on economically and technically feasible transactions and that they involve financial participation by one or more private sector financial parties The majority (70 per cent) of the financed projects are planned to be in the mitigation sector, and the remaining 30 per cent in the adaptation sector. After demonstrating initial success, the CFF will seek to grow its funding base and corresponding portfolio. The implementation period of the CFF is 5 years, while the tenor of the Funded Activity Agreement with the GCF is 20 years.

B. Field mission to South Africa

1. General remarks

10. An evaluation team, consisting of two staff members from C4ED and one IEU consultant (referred to below as the LORTA team), was formed to lead the field mission from 18 to 22 November 2019. The task of the team was to engage closely with key stakeholders of the project - namely, representatives from different divisions within the DBSA as well as two projects that will likely receive CFF funding - to ensure their interest, understanding and feeling of ownership for the planned theory-based IE.
11. During the field mission, the LORTA team held meetings and a capacity-building workshop with the key stakeholders. Meetings, in the form of expert interviews, were used to acquire the maximum possible information about the CFF and the two example projects. Stakeholders were interviewed regarding the CFF's implementation and monitoring strategies, expected impact, potential challenges and possible solutions. The meetings not only informed the LORTA team about the programme but also fostered collaboration and trust between the team and on-site involved parties. Also, a capacity-building workshop on IE was held, targeted at the mentioned key stakeholders. Besides conveying technical knowledge, this workshop aimed to emphasize the benefit of theory-based counterfactual approaches and real-time learning and measurement.
12. Under the guidance of the LORTA team, an IE design was worked out for the CFF. The LORTA team conducted context analyses, examined the existence of appropriate counterfactuals (i.e. suitable treatment and comparison groups), elaborated a ToC, assessed the availability of baseline administrative and secondary data sources and acquired budget information. The results of this undertaking are presented in the following sections.

2. The mission agenda

13. Ahead of the mission, the LORTA team received prompt support from the CFF team, which consists of representatives from the DBSA's Operations Evaluation Unit (OEU), the Climate Finance Unit (CFU) and the Product Innovation Unit. The agenda - shown in appendix I - was developed to facilitate the joint attendance of all key stakeholders to the LORTA workshop and to accommodate site visits.
14. The LORTA field mission was conducted over five days. On day one, the LORTA team informed the key stakeholders about the LORTA objectives, introduced the main concepts of an IE, developed a detailed ToC and discussed CFF implementation details with the DBSA representatives.
15. On the second day, the LORTA team introduced the key stakeholders to IE methods and discussed potential designs for an IE of the CFF and its different components. On day three and day four, the

LORTA team and the key stakeholders visited the sites of a sample of projects that will potentially be financed by the CFF. These site visits helped substantially in gaining a clearer understanding of the implementation of the projects to be financed by the CFF and on the data requirements for an IE.

16. On day three, the LORTA team visited the Fedgroup. The Fedgroup was established in 1990 and is one of the leading independent financial service providers in South Africa. In 2016, the Fedgroup created Fedgroup Impact Investing 154 (Pty) Ltd as a special purpose vehicle[56] to raise institutional funding to invest in impact initiatives. The funds will be mainly used to finance upcoming RE projects and to refinance a portion of the current RE portfolio in South Africa. To be more specific, the Fedgroup finances solar panels on rooftops of different kinds of commercial and industrial properties, such as shopping malls, industrial buildings and parking lots. The CFF supports the Fedgroup with a subordinated loan of Rand 200 million, while commercial banks contribute Rand 470 million senior debt and the Fedgroup itself Rand 330 million equity. The loan from the CFF is essentially targeted at scaling up these RE investments. The Fedgroup currently offers property owners three different financing options for the solar panels: a Power Purchase Rooftop rental agreement, variable lease to own and fixed lease to own. The Fedgroup also maintains the solar panels. During the site visit, the LORTA team observed the rich set of data the Fedgroup collects on a daily (or even more frequent) basis: hours of sunshine, the energy production of the solar panels, on-grid use of electricity, the share of energy used via solar and via on-grid electricity, and whether any solar panels need repairs, among others.
17. On day four, the LORTA team visited Trust for Urban Housing Finance (TUHF). TUHF is an impact-focused lender with a track record of successfully financing the purchase, conversion and refurbishment as well as a new build of inner-city buildings in South Africa. To be eligible for TUHF loans, the final purpose of a building has to be low-income rental housing. The Luhlaza Fund is a new credit line within TUHF, to be supported by the CFF with ZAR 100 million and a further ZAR 300 million from the capital markets. The Luhlaza Fund follows the principal TUHF business model but requires the installation of resource-efficient technology (such as centralized heat pumps, solar panels, low-flow showerheads and dual-flush toilets) within the buildings to achieve substantial energy, water and carbon savings. TUHF does not take care of the maintenance of the installed technology but requires the property owners to do so. The Luhlaza Fund is expected to benefit TUHF (as the lender), the borrowers (property developers, owners and investors) and the tenants (end users). The advantage for TUHF is that environmentally sustainable buildings operate at lower lifecycle costs and can mitigate tariff hikes. Therefore, the cash flow volatility is lower, resulting in better credit quality. Landlords, in turn, may experience higher demand for units that offer similar comfort levels at a lower total cost of accommodation.
18. On day five, the LORTA team and the key stakeholders met for a debrief session to decide on the potential designs for an IE and to determine the way forward in this endeavour.
19. The mission benefited the CFF team and the LORTA team. On one hand, the presentations and interactive discussions on a ToC and programme implementation brought all the key stakeholders onto the same page concerning plans for implementation of the CFF, the evaluation needs and possible evaluation designs. On the other hand, the LORTA team benefited from gathering, in such a short time, a rich set of crucial information to design the IE. The LORTA team also benefited from gaining an understanding of the key DBSA representatives and their willingness to collaborate in accommodating the evaluation design.

[56] A special purpose vehicle is a subsidiary created by a parent company to isolate financial risk. The special purpose vehicle has its own balance sheet. Its legal status as a separate company makes its obligations secure even if the parent company goes bankrupt.

20. Appendix II lists all the people engaged with during the mission, including during the site visits.

C. RESULTS

1. DISCUSSION OF IMPLEMENTATION

21. Throughout the week of the mission, the LORTA team discussed the details of the implementation of the CFF with the project team. The CFF team currently expects to fund 12 to 20 projects in total, of which approximately 60 per cent are expected to be in the RE sector. The CFF plans to disburse all funds by the end of 2021, and about one-quarter of the money will most likely be committed to the first four projects around March/April 2020.
22. At the moment, proposals for the financing of projects are accepted on a running basis, and suitable projects are financed on a first-come, first-served basis. Queries for funding are always channelled through financial intermediaries, and project developers cannot directly request funding from the CFF. The CFF's selection process of projects is as follows. As a first step, financial intermediaries approach the CFF with a request for funding for a certain project. At this stage, the project has already gone through the due diligence process of the financial intermediary. The CFF approval process starts with the CFF steering committee assessment. The steering committee is composed of representatives from the DBSA and other CFF co-financiers and first assesses the expected climate impact of the proposed project. In a next step, the Early Results Review deal screening is conducted. Then, the project has to go through the DBSA's due diligence process,[57] which is guided by the usual DBSA credit appraisal procedures. Resulting from these steps, a loan submission (similar to a score) is prepared. Based on the loan submission and the steering committee's recommendation, the DBSA's High-Impact Investment Committee will make the final decision to approve or reject the proposed project.
23. Since the screening process for the CFF is highly resource-intensive, the CFF currently only funds projects with a CFF contribution of more than ZAR 50 million. However, it has to be noted that this is not a firm cut-off but rather a deal-by-deal decision.
24. So far, the marketing activities of the CFF have been limited to a press release and a roadshow to which the CFF invited financial intermediaries, DFIs and potential project developers. At the beginning of 2020, the CFF team plans to publish a request for proposals (RFP) and expects to receive a substantial number of loan applications afterward. It is still unclear how funding decisions will be taken when the CFF reaches oversubscription. The CFF aims to diversify its portfolio, so rejections will likely not only be based on merit but also aim to achieve representativeness of projects in the four countries, in the adaptation versus mitigation scope, and across sectors. The CFF does not yet have clear rejection criteria in the case of multiple eligible projects in the same country and sector.
25. According to the CFF team, the DBSA keeps track of projects that do not receive funding from the CFF, to see whether they could get funding from another lender at some point.

2. THEORY OF CHANGE

26. The ToC for the CFF is presented in Figure 24. With the launch of the CFF, the DBSA grants loans, co-financed by commercial banks or other financial intermediaries, to private sector entities. These

[57] During the LORTA mission, the CFF team mentioned that the reason for having yet another due diligence process is that the DBSA has in-house sector experts who can assess the risks and the characteristics of the projects, while financial intermediaries might not have this kind of expertise.

loans are used for investment in climate-friendly technology (i.e. technology that facilitates the adaptation to climate change or mitigates CO2 emissions). After installation of this technology, it becomes operational and is used by the end beneficiaries, which can be firms, entrepreneurs, households or other units.

27. One of CFF's long-term goals is to reduce emissions of CO2. This is to be achieved by replacing on-grid electricity (which is almost entirely produced in coal-fired power plants) with RE sources (such as solar and wind power) and by investing in climate-friendly technology that either directly reduces CO2 emissions or reduces the consumption of on-grid electricity. The second long-term goal is to increase resilience against water shortages by investing in technologies that allow for reduced usage of water. A third important goal, especially in the South African context, is job generation through the created investments. Finally, by demonstrating that loans for climate-friendly technology are not as risky as currently perceived and by successfully contributing to adaptation to or mitigation of climate change, the DBSA aims to attract increasing investment by commercial financial intermediaries in climate-related projects.

28. This ToC relies on several crucial assumptions being fulfilled. These assumptions are marked by the numbers 1 to 7 in the figure and are listed below.

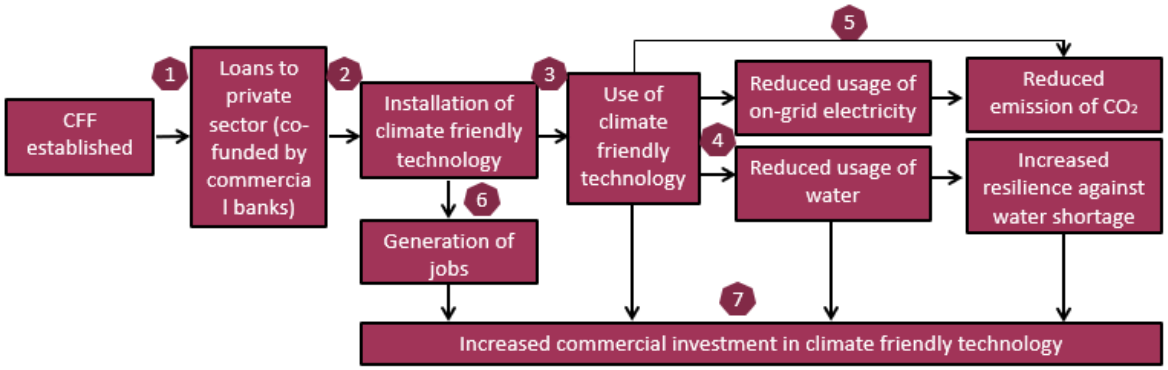

Figure 24. Theory of change

a. Assumptions in the theory of change

1. There is sufficient interest among private sector companies to apply for loans from the CFF.

   There are private sector companies with projects that suit the climate rationale in line with GCF investment criteria.

   Financial intermediaries are willing to co-fund the CFF loans.

   There is a need for additionality: private sector companies cannot obtain loans from financial intermediaries directly.

   CFF can rely on a well-functioning credit screening process.

   Private sector companies that applied sign the final loan contract.

2. Private sector companies have the capacity in-house or hire relevant firms to install the technology.

   There are no legal restrictions on installation.

   The price of the technology is stable and does not increase significantly after a CFF loan was granted.

3. The technology is suitable for use in the Southern African context.

There are no legal restrictions on the use of the installed technology.

The people who are expected to use the technology do not refuse to do so. They do not uninstall it.

The people who are expected to use the technology know how to use it. If they do not know, they learn how to use it.

The technology is well maintained.

4. The technology, if used appropriately, is efficient – that is, it needs less energy or water to get to the same output.

   People do not substantially increase their usage of on-grid energy or water after the new technology becomes operational. In other words, they use a relatively constant level of energy or water regardless of the technology.

   There is no change in the use or occupancy of the buildings.

5. The climate-friendly technology emits less CO2.
6. The installation of the technology cannot be done with existing firms and/or existing staff levels at these firms.

   Some people have the knowledge and the capacity to work in installation (and maintenance).

7. The climate-friendly technology can be shown to have an impact on adaptation or mitigation.

   Financial intermediaries no longer perceive investment in this kind of technology to be risky.

   Investing in climate-friendly technology is profitable.

b. Evaluation questions

29. During the LORTA field mission, it became clear that all four goals of the CFF (reduced emissions of CO2, increased resilience against water shortage, job generation and increased commercial investment) are of high-priority for the CFF team. However, to keep the evaluation focused, it seemed reasonable to formulate only a limited set of evaluation questions, which focus on resource savings.
30. In practice, the DBSA and the project developers applying for CFF funding usually set CO2 emissions avoided by the installation of RE facilities or other technologies equal to the installed capacity - that is, the output of a facility. Equivalently, water savings are directly calculated from the potential efficiency of the new climate-friendly technology. However, this approach might be misleading, as it ignores both technical factors and human behaviour. We, therefore, identified the following evaluation questions:
    1. Do investments by the private sector, which are funded by the CFF, lead to reduced usage of on-grid electricity? Do they lead to changes in the usage of total (i.e. on-grid and other) electricity?
    2. Do the investments lead to reduced usage of water?
    3. Is the climate-friendly technology for which CFF funding is provided installed and operational?
    4. Is the technology used by the end beneficiaries?
31. The first two evaluation questions analyse whether investments by the private sector, which are funded by the CFF, lead to reduced usage of on-grid electricity and water. There are several reasons why this might not be the case. The installed capacity of a facility is not always equal to the actual electricity output of the facility. The ratio between these two measures is called the "capacity

factor".[58] There are several possible explanations for why the capacity factor of a facility is not at 100 per cent. For example, for RE sources, such as solar power, the main reason for reduced capacity is the availability of the energy source. Solar panels are highly dependent on sunshine to produce energy; therefore, energy production can vary for different locations and weather conditions (e.g. cloud cover, seasonal changes, daily rotation of the earth). Technical constraints, such as missing maintenance or the quality of the technology, are other influencing factors. Also, electricity from RE sources cannot always be stored, which is why the timing of energy production becomes important. In this case, a back-up capacity is needed in addition to the RE source.[59] Therefore, despite the installation of climate-friendly technology, on-grid electricity might still be used if the new technology is not working (i.e. low capacity factor) or not suitable to the context (i.e. bad timing of energy production).

32. The analysis of changes in electricity and water consumption must take potential rebound effects into account - for example, whether people increase their usage of energy and/or water after the installation of the climate-friendly technology. This so-called rebound effect occurs when some of the savings from energy efficiency are cancelled out by changes in people's behaviour. For example, as a reaction to the lower costs for energy by installing solar panels, consumers might increase their electricity consumption. Water savings from more efficient low-flow showers can make people shower longer.
33. The third and fourth evaluation questions address whether the climate-friendly technology for which CFF funding is provided is installed and used. For example, people living in buildings with climate-friendly technology (for example, energy-saving lamps) might not like the technology and decide not to use it or might replace it with the old technology (regular bulbs). Furthermore, maintenance of climate-friendly technology is key, and people might fall back to using old technology when maintenance is not ensured.

c. Impact indicators

1. Do investments by the private sector, which are funded by the CFF, lead to reduced usage of on-grid electricity? Do they lead to changes in the usage of total (i.e. on-grid and other) electricity?
    a. Monthly consumption of on-grid electricity (kilowatt-hour (kWh)), per square metre
    b. Monthly consumption of total electricity (kWh), per square metre
2. Do the investments lead to reduced usage of water?
    a. Monthly consumption of cold water (litres), per square metre
    b. Monthly consumption of hot water (litres), per square metre
3. Is the climate-friendly technology for which CFF funding is provided installed and operational?
    a. Installation of technology completed (yes/no)
    b. Installed capacity (kW peak)
    c. De-installation of technology (yes/no)
    d. Technology in order after 1 year (2, 3, 4 … years) of installation (yes/no)
4. Is the technology used by the end beneficiaries?

[58] See *https://www.nrc.gov/reading-rm/basic-ref/glossary/capacity-factor-net.html*
[59] Atse Louwen, Wilfried G. J. H. M. van Sark, André P. C. Faaij and Ruud E. I. Schropp, "Re-assessment of net energy production and greenhouse gas emissions avoidance after 40 years of photovoltaics development", *Nature Communications* vol. 7, No. 13728 (2016). Available at https://www.nature.com/articles/ncomms13728.

a. Use of technology (yes/no)
b. Enthusiasm for the technology (like/do not like)

3. PLANS FOR EVALUATION

a. Impact evaluation design

34. Given that the CFF will provide loans to several sectors (energy, waste, water and transport) and possibly also to different kinds of projects within one sector (such as RE and energy efficiency within the energy sector as well as water efficiency, water treatment and new clean water within the water sector), it became clear that a facility-wide IE would be difficult, if not impossible. The LORTA team and the CFF team, therefore, decided that the scope of the evaluation would best be reduced to either the project level or the subsector level. Evaluation designs for both options were developed together with the CFF team.
35. In principle, a subsector-level evaluation is more interesting for the DBSA, not least because it has more external validity than a project-level evaluation. However, the subsector-level approach contains more risks and may turn out to be unfeasible, which would become clear in 2020, as further explained below.
36. The method of analysis proposed for the below evaluation scenarios is referred to as an event study. In an event study, an intervention may be given at different times for different locations. The date of the intervention (i.e. the point in time when a technology becomes operational) is coded as time 0 and called the "Event". The outcome of interest can then be coded as an outcome at or some amount of time before or after the event. Even though a comparison group, which never experiences an event, is not needed in an event study, being able to include a comparison sample is helpful to better illustrate any changes in outcomes after the event. Yet, unlike other IE designs in which it is required that the comparison group is not treated during the evaluation period, this is not a necessary condition here. If comparison units eventually become treatment units, an event study is still feasible.
37. Note that an event study does not require randomization of the event. However, to measure causal effects, it relies on random – or at least unexpected – timing of the event. It is a strong improvement over matching methods in IE as we will be able to make use of a significant amount of pre-intervention data.
38. The estimation model for analysing the causal effect in an event study is a simple ordinary least squares model of the following form:

$$Y_{it} = \tilde{\alpha}_i + \tilde{\beta}_t + \sum_{k=-\infty}^{\infty} \tilde{\gamma}_k \mathbf{1}\{K_{it} = k\} + \tilde{\varepsilon}_{it}.$$

where i=1,…,N indicates the units in which the outcome Y_{it} is observed for t=1,…,T time periods.[60] Every unit receives treatment in some period E_i and stays treated forever. $K_{it} = t\text{-}E_i$ denotes the number of time periods relative to the event. γ_k for k<0 correspond to pre-trends, and for k≥0 to dynamic effects k periods relative to the event. γ_k for k≥0 thus shows the effect of the intervention.

Figure 25 presents a classic example of an event study. Dates (here, years) before the event are coded as negative time before the event (-6 to -1 in the example) and dates after are coded as

[60] Kirill Borusyak and Xavier Jaravel, "Revisiting event study designs, with an application to the estimation of the marginal propensity to consume", Working Paper (2017): Available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2826228.

positive time (1 to 5). The figure shows a positive impact of wind energy installation on total revenue of between USD 1,500 and USD 1,600 several years out. The point estimates are close to zero and statistically insignificant before wind energy installation.

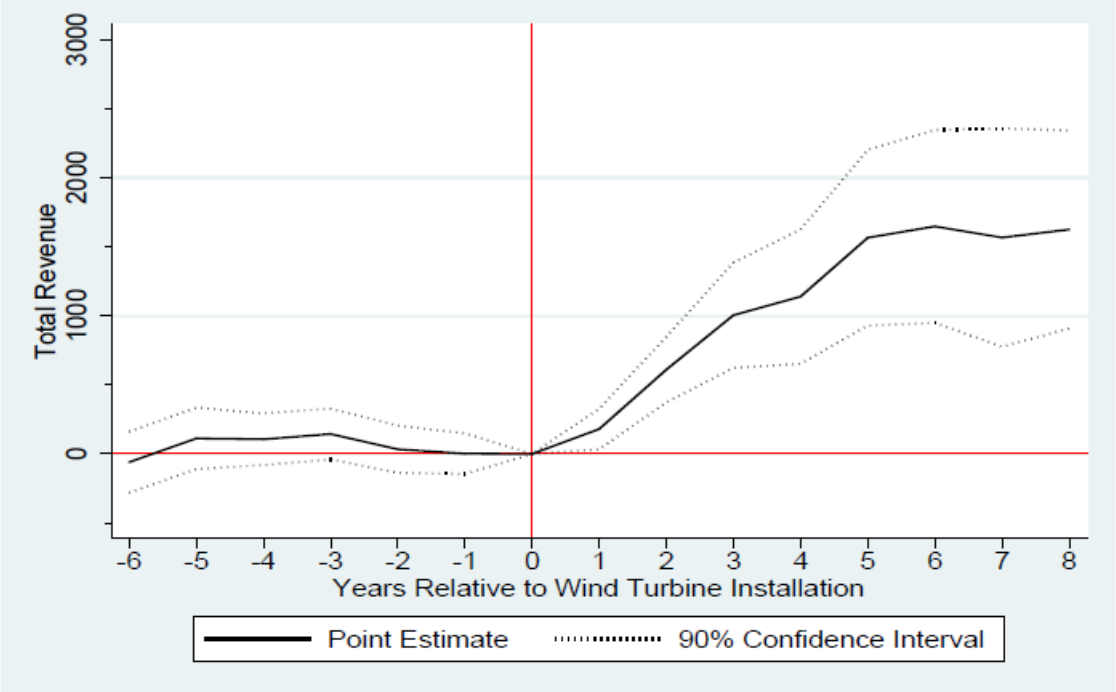

Figure 25. Example of an event study analysis

Source: Eric Brunner, Ben Hoen and Joshua Hyman, "School district revenue shocks, resource allocations, and student achievement: Evidence from the universe of US wind energy installations", Working Paper (2019).

39. Importantly, the unit of analysis in the below IE scenarios is not the project to be funded by the CFF but the sites of a project. In most projects, interventions are implemented in several sites (such as the commercial and industrial buildings in the case of the Fedgroup project below). By coding and displaying the usage of on-grid electricity, total electricity or water using an event study method for each of these sites, we can see whether there was a common trend in electricity or water usage across treatment and comparison groups over time before the intervention and whether there is a divergence between treatment and comparison groups after.

i. Scenario 1: Project-level impact evaluation

40. Both potential projects that were visited during the LORTA mission (Fedgroup and TUHF) proved to be suitable for a project-level IE. It is possible other projects can be evaluated, but there was only limited information for those projects that had already submitted loan applications to DBSA and no information for those that were yet to do so. The feasibility of project-level evaluation for other or additional projects, therefore, has to be assessed at a suitable time in the future.

a) The Fedgroup renewable energy project

41. With a loan from the CFF, the Fedgroup plans to install and maintain solar panels on the rooftops of commercial and industrial buildings. The energy generated from these solar panels is to be used within the buildings. Solar panels are attractive in the South African context, not only from a climate perspective but also from a commercial point of view, because they reduce dependence on the

national electricity grid. Electricity generation in South Africa relies heavily on coal, with 89 per cent of electricity generation coming from that source.[61] Generating about 90 per cent of the electricity used in South Africa and 40 per cent of the electricity used in Africa as a whole, Eskom, a public utility, is the primary electricity supplier in the region. Electricity prices in South Africa have increased steadily in recent years and have approximately doubled since 2010.[62] Electricity provision is not reliable, and power cuts and load shedding are common constraints for businesses and the population.[63]

42. An IE of the Fedgroup's RE project could answer the following project-specific evaluation questions:
    1. Does investment in solar rooftops, funded by the CFF, lead to reduced usage of on-grid electricity by commercial and industrial buildings?
    2. Does the investment lead to changes in the usage of total electricity?
    3. Are solar rooftops for which CFF funding is provided installed on commercial and industrial buildings? Are they operational?
    4. Are the solar rooftops used by commercial and industrial buildings?
43. According to the CFF team, more than 14 new sites will be funded with CFF funding. These solar panels were funded by the special purpose vehicle mentioned above as well as through app-based crowdfunding.[64] The requested CFF loan is an attempt to scale up the previous activities because there is a high demand for solar panels among property owners but no opportunity to obtain loans from financial intermediaries, according to the Fedgroup stakeholders. One of the main obstacles seems to be that financial intermediaries are not allowed to provide long enough tenor, whereas the time period to refinance an investment in solar rooftops is 10 years (with a lifecycle of the solar rooftop of 20 years).
44. We expect that a CFF loan will fund about the same number of solar rooftops as have already been constructed since 2016. Properties with CFF-funded solar panels would then be the treatment group for the IE. Those otherwise funded could also be included to increase the number of sites in the analysis, even though they are not strictly the CFF treatment group. In any case, we would analyse monthly on-grid and total electricity usage in an event study. Data on on-grid, solar and, hence, total electricity usage in treatment properties is collected in real time and can be accessed through Emergent Energy, the Fedgroup's partner company that installs and maintains the solar rooftops. Data on the installation and maintenance of solar rooftops can be obtained from the administrative records of the Fedgroup.
45. If a comparison group were to be included in the analysis, the Fedgroup stakeholders suggested using the commercial and industrial buildings that they own and that do not have solar panels installed (Figure 26). The Fedgroup currently owns approximately 50 buildings, of which only four have solar panels installed. From among those without solar panels, suitable comparison group buildings would have to be identified through a matching design, which could be based on a simple matching of pre-intervention electricity usage or PSM. The advantage of using Fedgroup's property as a comparison group is that data on energy usage are readily available and do not have to be compiled from a wide range of property owners.

61 IEA, "Electricity Information 2019" (2019). Available at *https://webstore.iea.org/electricity-information-2019*
62 Republic of South Africa, Department of Energy, "Energy Price Report" (2018). Available at *http://www.energy.gov.za/files/media/explained/Energy-Price-Report-2018.pdf*
63 GIIN, "The landscape for impact investing in Southern Africa" (2016). Available at *https://thegiin.org/research/publication/southern-africa-report*
64 Fedgroup developed the app Fedgroup Impact Farming, which can be downloaded from the Google Play Store.

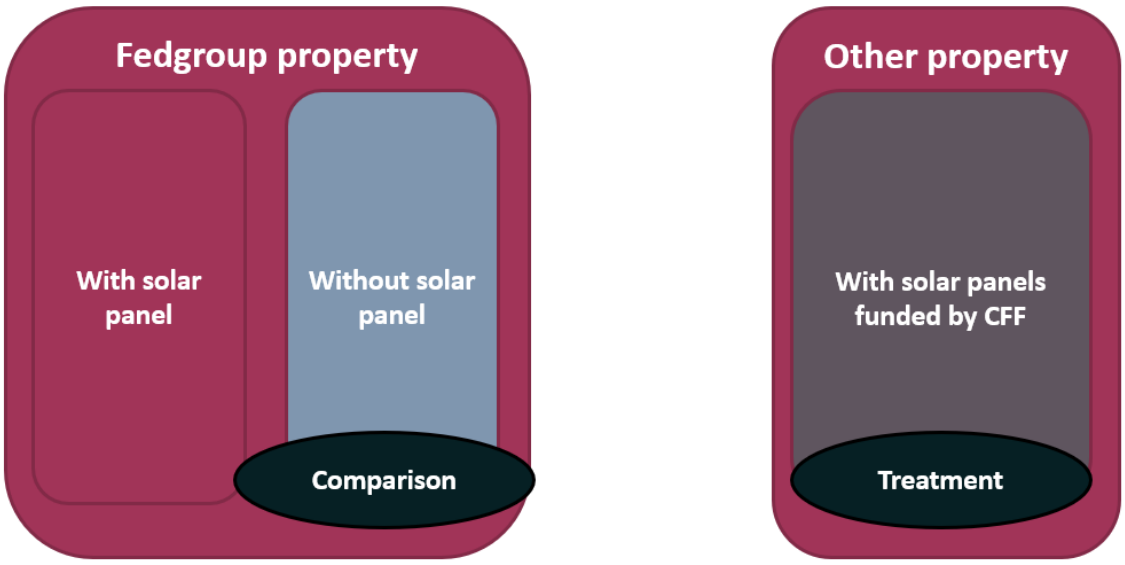

Figure 26. Potential treatment and comparison group for the Fedgroup project

b) The TUHF project: Luhlaza Fund

46. As briefly explained above, the TUHF's Luhlaza Fund, to be supported by the CFF, requires the installation of resource-efficient technology within residential buildings. More precisely, Luhlaza Fund buildings must achieve at least 25 per cent savings in energy and carbon and at least 30 per cent savings in water. These savings are to be achieved in comparison with the situation before the technology is installed or with a hypothetical situation if no suitable baseline data are available (for example, if the buildings were not previously used for residential purposes). In the latter case, the TUHF has developed a utility calculator, which calculates a theoretical baseline by using key building parameters such as occupancy levels and floor space.
47. An IE of the Luhlaza Fund would answer the following project-specific evaluation questions:
    1. Do investments in resource-efficient technology in residential buildings, funded by the CFF, lead to the envisioned savings in energy and water?
    2. Are resource-efficient technologies for which CFF funding is provided installed in the buildings and residential units?
    3. Do landlords and tenants make use of the resource-efficient technology?
48. So far, the TUHF has provided loans to 350 borrowers, thereby funding 40,000 residential units in 608 buildings. TUHF has always promoted the installation of resource-efficient technology, which is why many borrowers installed some form of such technology in the financed buildings, either at the building level (such as heat pumps) or at the residential unit level (such as low-flow showers). In some cases, the installed technology may even meet the resource savings threshold of the Luhlaza Fund. TUHF is aiming to include at least 80 per cent of the portfolio of buildings to be financed between now and the end of 2025 in the Luhlaza Fund.
49. For the IE of the Luhlaza Fund, buildings that will receive a loan from the Fund are the treatment group. As in the case of the Fedgroup, the TUHF representatives confirmed that buildings that have already received or will receive TUHF funding but do not meet the minimum resource savings threshold of the Luhlaza Fund can serve as the comparison group. Again, suitable comparison buildings have to be identified through matching.

50. Data on water and energy usage will be readily available for the treatment group because it is a requirement that Luhlaza Fund properties install smart meters. The generated information will be transmitted to TUHF for tracking resource savings for the life of the loan. One caveat will be that this information is not necessarily available for the period before the technology is installed, especially because many of the properties are vacant before they are refurbished. The feasibility of an event study for this project should, therefore, be re-assessed when more details on data become available.
51. Unlike the Fedgroup case, information on resource usage might be more difficult to compile for the comparison group because these properties are not owned by TUHF. Nevertheless, the TUHF representatives were optimistic about collating this information from at least a sample of all funded buildings. They even considered the installation of smart meters in some of these buildings. Data on the installation of technologies can be readily obtained from the administrative records of TUHF.

ii. Scenario 2: Subsector-level impact evaluation

52. Of the subsectors, the RE subsector lends itself to be analysed in an IE because the CFF team currently expects that 60 per cent of all CFF funding will go to RE projects.[65] With 12–20 projects to be funded by the CFF in total, 60 per cent would result in 7–12 projects in RE. According to the CFF Operations Manual, the RFP to be issued in early 2020 (possibly with a deadline in the third quarter of 2020) will focus on off-grid solar projects, microgrid solar and wind projects, and industrial and commercial solar projects, as far as the RE subsector is concerned. If similar projects to that of the Fedgroup are funded (with or without a project-specific comparison group), they could be added to the Fedgroup-level IE to produce evidence on a higher level than just for one project.
53. Alternatively, if the RFP results in a substantial number of suitable loan applications, the DBSA will likely have to reject projects that are eligible for CFF funding (see Figure 27). As mentioned above, it is currently unclear how exactly the DBSA will deal with oversubscription. A few alternatives were discussed during the LORTA mission.
54. First, it was suggested by the LORTA team to randomize all eligible loan applications into a treatment group (which will receive CFF funding) and a comparison group (which will not receive CFF funding). The CFF team indicated that such randomization would be possible in principle but would have to happen after the steering committee assesses the loan applications and before applications are passed on to Early Results Review. It was made clear that randomization would be impossible at the final stage of the screening process – that is, when the High-Impact Investment Committee takes the final approval decision – because this committee follows the usual DBSA credit appraisal procedures, which cannot be changed. Second, it was pointed out by the LORTA team that those loan applications with the highest credit scores could be funded right away and only the remaining eligible projects could be randomly assigned to treatment and comparison groups and consequently be used for the IE. This alternative presumes that there are enough such remaining projects. Third, since the CFF team did not formally commit to randomization, another possibility is that loans will be approved purely based on credit scores. All three alternatives could additionally include a stratification of CFF funding by target country, mitigation versus adaptation, and sector. Depending on the final alternative chosen and whether stratification is applied, it still needs to be decided whether an IE would have to be restricted to RE projects in South Africa only or could consider projects in the other three countries as well.

[65] This estimation of 60 per cent, which was made by CFF representatives during our LORTA mission, notably contradicts an estimation of 31 per cent stated in the CFF Operations Manual. This contradiction might stem from the fact that the numbers from the Operations Manual are based on a market study, while the estimation in the workshop is based on the pipeline of suitable applications.

1. In all scenarios, an IE can be performed to answer the following questions:
2. Do investments in renewable energy generation, funded by the CFF, lead to changes in the usage of on-grid and total electricity by the end beneficiaries?
3. Is the technology for renewable energy generation for which CFF funding is provided installed and operational?
4. Is the technology used by the end beneficiaries?

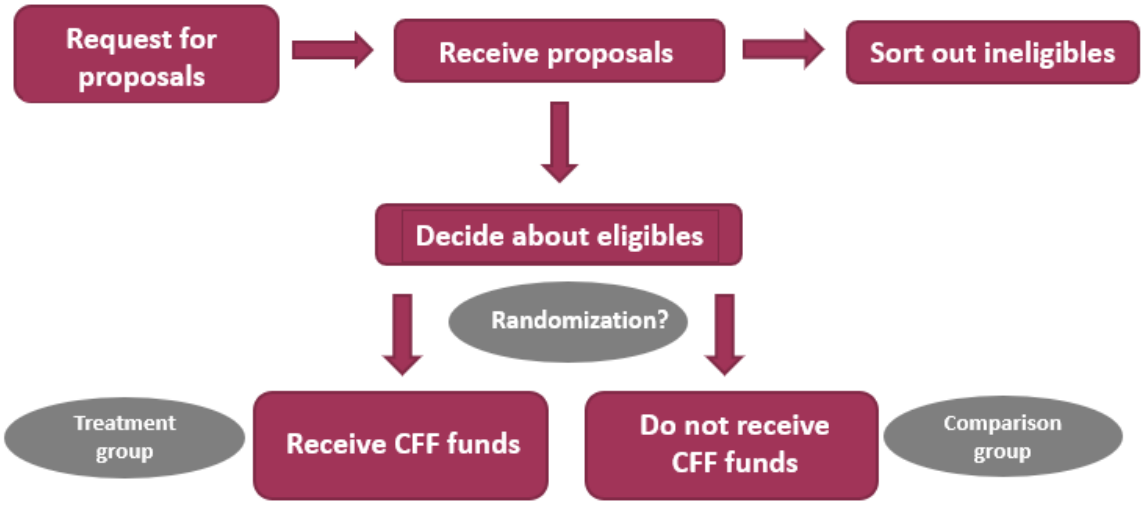

Figure 27. Possible selection of projects following RFP

55. If CFF receives many more loan applications than can be funded after publishing the RFP and the DBSA randomly assigns projects to treatment and comparison, we would expect that treatment and comparison sites are identical, on average. We could then analyse the impact of the technology on electricity usage with the standard ordinary least squares model of analysis for RCTs or combine such analysis with an event study approach to further ensure there is a common trend before the intervention is conducted. If the DBSA is not able to randomize projects into treatment and comparison, the subsector-level IE in the form of an event study could either work with treatment sites only or add comparison sites from the set of rejected projects. As above, treatment and comparison sites would have to be matched to each other. If a comparison group is to be used, data from the respective sites must be collected from rejected projects, which may not be straightforward. However, given that the required data are no more than energy usage over a certain period, we think it is possible to compile these data with the help of a consultant.

b. Power calculations

56. Power calculations for an event study require a significant amount of information that we do not currently have. We have requested information from CFF on the electricity usage of facilities that the Fedgroup owns or has funded as well as information on electricity and water usage from residential properties funded by TUHF. When we obtain this information, most likely only after the projects have been approved by the DBSA High-Impact Investment Committee, we can determine the mean and standard deviation of electricity (and water) usage of the respective buildings, the (auto)correlation of usage across months and the size of the buildings so we can create a standardized measure of these values. This information will enable us to conduct a formal power calculation.

57. However, given that our main variable of interest is the usage of on-grid energy, total energy and water, which is available monthly for both treatment and comparison groups, the sample size (of sites) needed is not as large as in other IE studies. Event studies like the one envisioned here can be done with a small number of sites, given highly frequent – monthly – data-collection. In event studies, 20 to 30 sites have been used in the literature.[66] We expect that a sufficient number of observations will be available for all the above IE design scenarios.

c. Data requirements

58. Data on installations (such as the type of buildings or the area of the installation) and energy and water consumption can be obtained from administrative databases of the projects. Table 20 lists the precise data requirements for a project-level evaluation (either Fedgroup Impact Investing or Luhlaza Fund) and the subsector-level evaluation.

Table 20. Data requirements for different evaluation scenarios

PROJECT-LEVEL EVALUATION: FEDGROUP IMPACT INVESTING (ROOFTOP SOLAR ON COMMERCIAL AND INDUSTRIAL BUILDINGS)	
Treatment group: Properties with rooftop solar	***Comparison group***: Properties without rooftop solar
• Exact location (address or GPS coordinates) • Type of building (carport, supermarket, office building, etc.) • Date when solar cells were installed • Area (m2) • Monthly consumption of on-grid energy, for each month, for one year before the rooftop solar was installed and the entire time period since then • Monthly consumption of solar-based energy, for each month, for the entire time period since installation	• Exact location (address or GPS coordinates) • Type of building (carport, supermarket, office building, etc.) • Area (m2) • At least two (better: five) years monthly consumption of on-grid energy, for each month
PROJECT-LEVEL EVALUATION: LUHLAZA FUND (ENERGY AND WATER EFFICIENT TECHNOLOGY AS WELL AS ROOFTOP SOLAR)	
Treatment group: Properties funded by TUHF that qualify for Luhlaza funding	***Comparison group***: Properties funded by TUHF that do not pass the Luhlaza threshold
• Exact location (address or GPS coordinates) • Type of residential property (student dormitory, apartment complex, etc.) • Number of residential units • Area per residential unit (m2) • Technology features planned and installed at property and unit levels (heat pump, rooftop solar, low-flow shower, etc.) • Date when these were installed	• Exact location (address or GPS coordinates) • Type of residential property (student dormitory, apartment complex, etc.) • Number of residential units • Area per residential unit (m2) • Technology features planned and installed at property and unit levels (heat pump, rooftop solar, low-flow shower, etc.) • Date when these were installed

[66] For example, see Nicholas Bloom, Benn Eifert, Aprajit Mahajan, David McKenzie and John Roberts, "Does management matter? Evidence from India", *Quarterly Journal of Economics*, vol. 128, No. 1 (February 2013), pp. 1–51.

PROJECT-LEVEL EVALUATION: FEDGROUP IMPACT INVESTING (ROOFTOP SOLAR ON COMMERCIAL AND INDUSTRIAL BUILDINGS)	
• Last two years monthly consumption of on-grid energy at the unit level, *for each month* • Last two years monthly consumption of solar-based energy at the unit level (if properties have solar panels), *for each month* • Last two years monthly consumption of water at the unit level, *for each month*	• Last two years monthly consumption of on-grid energy at the unit level, *for each month* • Last two years monthly consumption of solar-based energy at the unit level (if properties have solar panels), *for each month* • Last two years monthly consumption of water at the unit level, *for each month*
SUBSECTOR-LEVEL IMPACT EVALUATION	
Treatment group: Properties with solar cells	***Comparison group***: Properties without solar cells
• Exact location (address or GPS coordinates) • Type of building • Area (m2) • Monthly consumption of on-grid energy, *for each month* • Monthly consumption of solar-based energy, *for each month*	• Exact location (address or GPS coordinates) • Type of building • Area (m2) • Monthly consumption of on-grid energy, *for each month*

d. Qualitative assessments

59. An IE of the CFF, regardless of whether it is at the project or subsector level, lends itself to a mixed-methods approach. As explained above, the IE will rely on administrative data alone, which will generally be restricted to the main outcome variables of usage of on-grid and total energy and water. Qualitative information can be used to complement this purely quantitative analysis and to focus on the respective last evaluation question. Whether or not property owners and tenants like and use the installed technology and whether they are aware of it at all can be studied with the help of in-depth interviews and focus group discussions. Of course, these qualitative assessments would be done for a limited sample of project sites only, but they would add valuable insights to the purely quantitative event studies. Our preference is to collect qualitative data after the analysis of the quantitative data, so that interview and discussion grids can be specifically formulated to help the interpretation of the quantitative findings.

e. Possible risks for impact evaluation

60. Several assumptions underlie the above-presented evaluation designs, which – if not fulfilled – can present serious risks to the IE and the validity of the findings.

61. The project-level evaluation relies on the assumption that we receive data for energy and/or water usage for both the treatment group and the comparison group. Cooperation from the projects is crucial for the success of the evaluation. Another risk for the project-level evaluation is that the comparison group does not allow for good matches – that is, that comparison sites are not similar enough to the treatment sites in terms of pre-intervention resource usage and potentially other characteristics.

62. Equally, the subsector evaluation relies on the cooperation of the respective projects that will be evaluated. Furthermore, the subsector-level evaluation heavily relies on oversubscription. One risk is that there might not be enough interest in the CFF resources, and the RFP does not lead to

oversubscription. At this point, it is entirely unknown how many and which kind of funding proposals will reach the DBSA in the coming two years.[67] The loan proposals received could be in subsectors other than RE and in widely varying types of projects. However, this risk could be mitigated by targeted promotion for projects in the RE sector.

63. For the selection of treatment and comparison projects, it would be helpful to set an application deadline in the RFP. At the time of writing it is not confirmed whether the DBSA is willing to have such a deadline in the RFP. Moreover, it is still unclear at which stage of the selection process the randomization could be done.

64. It is also worth noting that the timing of the selection process might be difficult to set, as some proposals might be in good shape and can be assessed quickly, whereas others might need several rounds of requests for additional information and documentation.

65. Another risk is a low conversion rate – that is, that only a small percentage of projects take up the approved CFF funding. This could occur, for example, because of the long duration of the loan approval process. According to the CFF team, the conversion rate within the DBSA is 24 per cent. However, this number refers to typical DBSA projects. In the case of the CFF, the LORTA team expects the conversion rate to be higher, as the projects are not supposed to get other funding and thus might be more willing to wait for the CFF to take a decision.

66. In the end, whether a subsector-level evaluation is possible will only become clear after the RFP has been published and loan applications received.

f. Timeline of evaluation

Table 21. Envisioned timeline of impact evaluation

	PROJECT-LEVEL EVALUATION	SUBSECTOR-LEVEL EVALUATION
Q4 2019	IE design developed	IE design developed
Q1 2020	Loan agreement signed	RFP published, deadline in Q3 2020
Q2 2020	Project implementation	
Q3 2020	Project implementation	Assessment of proposals
Q4 2020	Project implementation	Re-assessment of the feasibility of sector-level evaluation (following steps only if confirmed) Selection of proposals to be funded
Q1 2021	Project implementation	Loan agreements signed with successful proposals
Q2 2021	Project implementation	Project implementation
Q3 2021	Project implementation	Project implementation
Q4 2021	Project implementation	Project implementation
Q1 2022	Project implementation	Project implementation
Q2 2022	Project implementation	Project implementation
Q3 2022	Project implementation	Project implementation

[67] The projects that are in the current pipeline of the CFF have been attracted through roadshows where the CFF has invited financial intermediaries and through a press release. It is unclear how many more suitable projects exist and what kind of projects these are.

	PROJECT-LEVEL EVALUATION	SUBSECTOR-LEVEL EVALUATION
Q4 2022	Project implementation	Project implementation
Q1 2023	Project implementation	Project implementation
Q2 2023	Data analysis	Compilation and analysis of quantitative data
Q3 2023	Qualitative data-collection and analysis	Qualitative data-collection and analysis
Q4 2023	Final IE report	Final IE report

g. Budget estimation

67. Reliance on administrative data for most of the analysis foreseen allows for a low-cost IE. The below data-collection costs refer to qualitative assessments, such as in-depth interviews and focus group discussions, as well as to compiling data on energy usage from rejected projects. The qualitative data-collection costs comprise the collection of the data as well as the transcription of interviews and focus group discussions. If data analysis cannot be conducted by OEU, respective costs would have to be added.

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69. The indicated costs are rough estimates because we do not know unit costs. We expect that compiling data from rejected firms, which is not a standard survey, can be done by a consultant for USD 50 per day. For a maximum of 40 rejected projects, each with 20 locations, and data-collection for two days per location, the maximum cost is USD 80,000. An update of the below cost estimation should be made once unit costs are available.

Table 22. Estimated data-collection costs

KIND OF EVALUATION	DATA-COLLECTION METHOD	TOTAL COST (USD)
Project-level evaluation	In-depth interviews	2,500
	Focus group discussions	2,500
	In-depth interviews	2,500
	Focus group discussions	2,500
	Compilation of energy use	80,000

h. Secondary data sets

70. As mentioned earlier, the projects to be evaluated have a rich database with information on energy consumption, maintenance, and so forth. To complement these data, secondary data sources can be consulted once the scope of the evaluation is set. Helpful secondary data could include data on weather conditions (e.g. sunshine and wind), electricity tariffs and the characteristics of the neighbourhoods of treatment and comparison buildings.

i. Plans for M&E of the CFF

71. As part of its development mandate, the DBSA is required to provide accountability for its different lending activities. Therefore, the DBSA has an effective M&E system in place, with two fundamental components: the M&E policy and the Development Results Reporting Framework. The M&E activities of the CFF should align with the DBSA M&E policy and the requirements of the GCF.
72. The broad monitoring and reporting requirements for the CFF are split into project level and facility-level. Monitoring at the project level follows the project-specific log frame that will be compiled for each project funded by the CFF. Based on this project log frame, the funded projects will be required to report to the CFF biannually.
73. Using the individual project-level reports, the CFF team will compile the information into the annual performance report that is submitted to the GCF at the end of the calendar year. Relevant portfolio disaggregation will be provided to reflect metrics such as type of projects, reporting on indicators by type of investment, and reporting on indicators per project.
74. Therefore, reporting at the project level is crucial for facility level reporting. Every project that has been in implementation for a minimum of six months must ensure that monitoring is conducted diligently across the whole implementation period of the project. To this end, the projects will be required to use the CFF project monitoring report template (see appendix III). On project completion, a close-out monitoring report must be submitted.

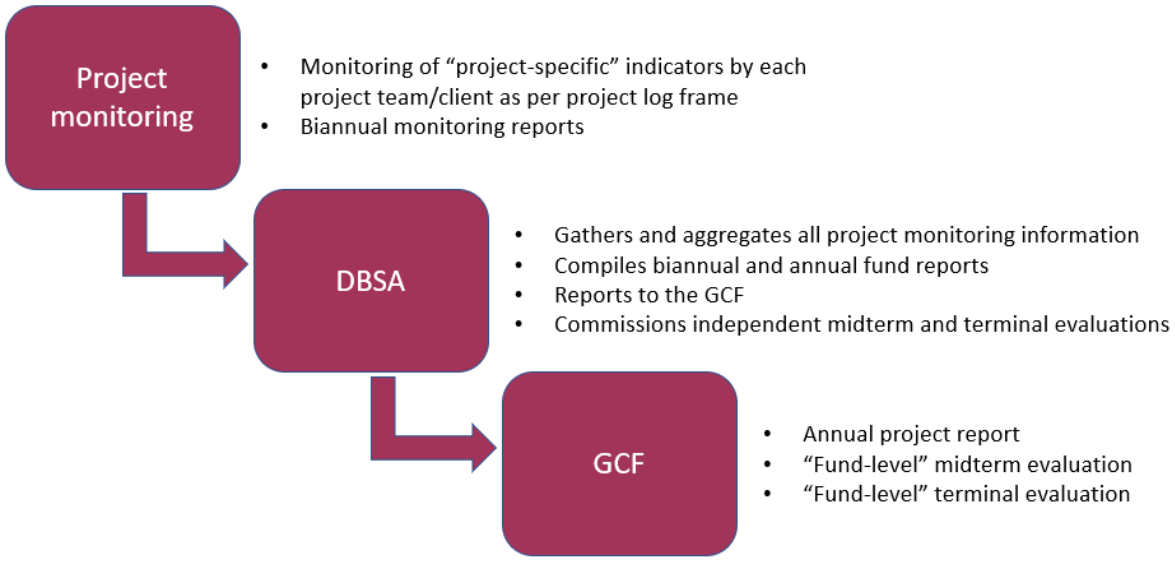

Figure 28. Monitoring and evaluation requirements at different levels

Source: CFF Operations Manual, DBSA

75. The CFF also foresees a project-level evaluation (i.e. a midterm evaluation presenting preliminary findings and a final evaluation measuring the overall impact, effectiveness, efficiency, sustainability, replicability and lessons learned of a project). These evaluations are supposed to be undertaken by an independent evaluator. It is important to note that both the midterm and the final evaluation refer to performance or process evaluations, not to IEs.

76. In line with this, an interim and a terminal evaluation of the whole CFF will be undertaken by an independent consultant. These evaluations will assess the indicators that have previously been identified in the CFF log frame.
77. The project-level monitoring could inform the IE on the current state of the project implementation (i.e. installation of technology completed) and indicators such as installed capacity. Therefore, suitable reporting requirements can facilitate access to the data required for the IE. The LORTA team will work with the CFF team to specify the indicators and the kind of information that should be collected from each project, in particular for those projects that will be part of the IE.

D. WAY FORWARD

78. Overall, we consider that the LORTA mission in South Africa was well received and that it produced promising results. During the mission, the LORTA team was able to establish a tight collaboration with the CFF team and the key stakeholders of the potential CFF-financed projects. This enabled us to quickly understand the implementation of the CFF and to promptly develop a potential evaluation design.
79. The success of the LORTA mission has been particularly achieved thanks to the attentive collaboration of the head of the OEU, Saphira Patel, and the CFU Specialist, Muhammed Sayed. Their support was crucial in arranging the meetings and making sure all the key informants and decision-making representatives could be consulted. Furthermore, they managed the operational and implementation discussions with the project stakeholders.
80. The future success of this programme in the LORTA framework is highly conditional upon a continuous, responsive collaboration from the CFF team and the stakeholders from the funded projects. The LORTA team has requested access to (a sample of) data from the Fedgroup and TUHF to be able to perform power calculations. No data access has been provided yet, and the CFF team has indicated that it will be difficult to obtain data before the final loan decision has been taken. However, as the envisioned IE primarily relies on administrative data, it is important to assess the quality and quantity of these data as soon as possible and identify any data gaps that may need to be filled. We will, therefore, work with the CFF team on specifying the information that is relevant for the IE and that should be collected from each CFF-funded project to be evaluated. Furthermore, we will keep track of the progress of the CFF and any incoming loan applications, especially after the RFP is published.

Appendix 1. AGENDA OF FIELD MISSION

DAY	TIME	PROPOSED ACTIVITIES	PARTICIPATION	DESCRIPTION	NOTES
Day 0: Sunday 17 November 2019					
	Arrival of LORTA team		The LORTA team arrives in the country, debriefs and prepares for the week.	Protea Hotel Midrand	
Day 1: Monday 18 November 2019					
Day 1: DBSA -VA	9:00–9:45	Opening of the LORTA mission	Participants are: • DBSA key representatives • project management team • other relevant stakeholders	Welcome by OEU: • Introduction of LORTA Team and DBSA Team • Key objectives of the five days by project leaders and DBSA • What does DBSA hope to get out of the five days?	DBSA – Vulindlela Academy
	9:45–10.30	What are the key objectives of the CFF project? Presentation of LORTA	Participants are: • DBSA key representatives • project management team • other relevant stakeholders	By DBSA team: • Presentation of CFF • By LORTA team: • Overview of the LORTA mission and outline of LORTA programme	
	Break: 15 min				
	10:45–11:30	Why do IE?	Participants are: • key representatives, project management team and other relevant stakeholders • OEU • investment support specialists	By LORTA team: • Introduction to IE • 20-minute presentation on rationale of IE • Exercise on IEs	DBSA – Vulindlela Academy

DAY	TIME	PROPOSED ACTIVITIES	PARTICIPATION	DESCRIPTION	NOTES
	11:30–12:30	Key elements of the CFF Building a good theory of change	Participants are: • key representatives, project management team and other relevant stakeholders • OEU • investment support specialists	By DBSA team: • What are the elements of the CFF project? What is the timeline? Who are the key actors? By LORTA team: • What does a good theory of change require? • Warm-up exercise on the theory of change	
	Lunch break: 12:30–13:15				
	13:15-15:15	The CFF theory of change	Participants are: • DBSA/ AE GCF team • OEU • Investment support specialists	By DBSA team: • Presentation on key outcomes, key limitations, implementation plans By LORTA team: • Group work session on theory of change	DBSA – Vulindlela Academy
	Break: 15 min				
	15:30–16:30	Presentation session on group work outcome	Participants are: • DBSA/ AE GCF team • OEU • Investment support specialists	Presentation to each other: • What are the different implementation plans? • What are the key linkages/assumptions?	DBSA – Vulindlela Academy
	16:30–17:00	Discussion and closing remarks	Participants are: • DBSA/ AE GCF team • OEU • Investment support specialists		
Day 2: 19 November 2019					
Day 2:	9:00–9:30	Recap of Day 1	Participants are:	Recap of Day 1	

DAY	TIME	PROPOSED ACTIVITIES	PARTICIPATION	DESCRIPTION	NOTES
DBSA -VA			• DBSA key representatives • project management team • other relevant stakeholders		DBSA – Vulindlela Academy
	9:30–11:00 (with break)	Randomization why and how	Participants are: • DBSA key representatives • project management team • other relevant stakeholders	By LORTA team: Exercise with DBSA team using previous day's work	
	11:15–12:30	Mimicking randomization	Participants are: • DBSA key representatives • project management team • other relevant stakeholders	By LORTA team: Exercise with DBSA team using previous day's work	
	Lunch break: 12:30–13:30				
	13:30–15:00	Sources of data	Participants are: • CFF steercom • key representatives, as required	LORTA and DBSA teams jointly: Discussion on reporting requirements for the funded projects, also on budget lines, needs for sample size, procurement options for baseline data	DBSA – Vulindlela Academy
	Break: 15 min				
	15:15–16:30	• Presentation by the finance officer • Discussion of other IE designs	Participants are: • CFF steercom • key representatives, as required	LORTA and DBSA teams jointly: Discussion on reporting requirements for the funded projects, also on budget lines, needs for sample size, procurement options for baseline data	DBSA – Vulindlela Academy
Day 3: 20 November 2019					
Day 3: Site Visit	9:00–17:00	Full day, flexible as per the location and distance	Project team members & LORTA team	Field visit to project sites	Site
Day 4: 21 November 2019					

DAY	TIME	PROPOSED ACTIVITIES	PARTICIPATION	DESCRIPTION	NOTES
Day 4: Site Visit and DBSA VA	9:00–12:30	Half-day, flexible as per the location and distance	Project team members & LORTA team	Field visit to project sites	Site
	Lunch break: 12:30–13:30				
	13:30–17:00	Main elements of IE design	Participants are: Key representatives, as required	LORTA and DBSA teams jointly: • Discuss options for an evaluation design based on the insights from the mission • Sample size and other follow-up work	DBSA – Vulindlela Academy
Day 5: 22 November 2019					
Day 5: DBSA Wrap Up	9:30–10:30	Recap of mission objectives and debrief	Participants are: • DBSA key representatives • Project management team • Other relevant stakeholders	By LORTA team: • Final presentation • Key elements of design and timeline of IE for CFF	DBSA – Vulindlela Academy
	Break: 10:30–10:45				
	10:45–12:30	Discussion and way forward	Participants are: • DBSA key representatives • Project management team • Other relevant stakeholders	LORTA and DBSA teams jointly	DBSA – Vulindlela Academy
	Closure – Depart				

Appendix 2. List of stakeholders engaged with during LORTA mission

Organization	Name	Position
DBSA	Saphira Patel	Head of OEU
	Fatima Mathivha	Specialist
	Olympus Manthata	Head of CFU
	Mookho Mathaba	Specialist/CFF deal processing coordinator
	Muhammed Sayed	Specialist
	Harold Mogale	Specialist
	Spiwe Sibanda	Head of Product Innovation Unit
	Jonathan First	Lead Specialist
	Willie Myburgh	Specialist
	Jonathan Barnes	PhD student
Fedgroup	Nicole Verwey	Financial Manager
	Sheldon Friedericksen	Group CFO
	Suraj Lallchand	Director – Fedgroup Ventures
TUHF	Paul Jackson	CEO
	Sqiniseko Mbatha	Development Impact Accountant

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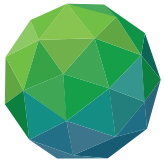

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