IMPACT EVALUATION EARLY EVIDENCE SERIES | MAY 2019

BRIEF

CIF CLIMATE INVESTMENT FUNDS

Overview: Leveraging Irrigation to Boost Agricultural Production and Improve Livelihoods

OBJECTIVE

The Climate Investment Funds (CIF) are committed to their mandate to deliver urgent and innovative climate-smart investments at scale. Given the ever-accelerating demands on limited resources, there is a pressing need to ensure that initiatives chosen for investment are positioned to generate the greatest impact. To this end, the CIF deploys a variety of monitoring and evaluation tools to test project effectiveness and efficiency. Impact evaluations have proven highly effective in delivering rigorous findings that aid in course correction and in understanding which approaches are most effective.

CIF's support to Mozambique via the African Development Bank's Sustainable Land & Water Resources Management Project (SLWRMP) includes such an impact evaluation, currently being implemented by the World Bank Group's Development Impact Evaluation Group (DIME). The project is supported by CIF's Pilot Program for Climate Resilience (PPCR), a funding window for developing countries and regions to build adaptation and resilience to the impacts of climate change. Alongside furthering PPCR's objective to mitigate climate vulnerability, the project also seeks to address pressing development challenges affecting agriculture-dependent communities in Mozambique: rural poverty, food insecurity, and land degradation.

Sixty to eighty percent of annual precipitation in Mozambique falls during a single rainy season, meaning that rainfed agriculture can only be practiced in a fraction of the year.[1] Moreover, the country faces frequent floods and droughts, making yields highly volatile. Within this context, irrigation has the potential to dramatically improve yields through three channels: it can increase farmers' incomes by allowing expansion of cultivation to the dry season (double cropping calendar); allows

1. World Bank, 2007

COUNTRY Mozambique

PROJECT Sustainable Land & Water Resources Management Project (SLWRMP)

CIF FUNDING $15.75M from PPCR

MDB African Development Bank

PRODUCT TYPE Development Impact Evaluation (DIME)

cultivation of water-sensitive crops; and improves resilience to droughts. Unfortunately, only 8% of all farmers in the country currently have access to irrigation, and only 2-8% of cultivated land is irrigated.[2] In response, the SLWRMP has focused on expanding the access of smallholder farmers (those with less than 2 ha of land) via the provision and promotion of irrigation equipment. Moreover, despite its huge potential there is surprisingly little rigorous evidence of the impacts of irrigation. Within this frame, DIME's ongoing impact evaluation attempts to answer several key questions:

- What is the impact of irrigation infrastructure on water availability, crop choices, yields and variability of yield?
- Does rule-based targeting lead to a more equitable distribution of benefits and greater inclusion of smallholder farmers than does decentralized community?
- How does the group composition affect their ability to maintain the irrigation infrastructure and increase yields?

INTENDED USES AND USERS

This evaluation is intended to inform policymakers and practitioners in the fields of agriculture and resource-management, including those who implement, plan, or monitor agriculture and/or irrigation programs. The findings are particularly important for climate vulnerable countries like Mozambique where the sole rainy season is becoming both less predictable and too sparse to generate agricultural yields that provide a stable and adequate income to farmers.

PROJECT OVERVIEW

The SLWRMP is a US$ 15.75M project implemented by the African Development Bank in the areas of land reforestation; livelihood support; and fire and drought control. The current evaluation looks at the irrigation component which provides beneficiary communities with small-scale irrigation kits, each comprising a combination of pumps and sprinklers that deliver water from a river to a plot of land of either 5 or 10 ha. Communities were chosen based on their proximity to a waterway with year-round throughflow; geographic vulnerability to droughts; and a lack of irrigation access. Given landholding patterns in Mozambique, the kits had to be shared among farming communities, and 56 kits were installed in target areas between June 2016 and October 2017. Each kit serves an average of 13 households, irrigates an average area of 4.85 ha, and costs an average of USD 35K per unit.

SMALLHOLDERS VS. LARGE LANDHOLDERS: IS THERE AN EFFICIENCY TRADE-OFF?

The evaluation tests the differences in kit usage, kit maintenance and agricultural output between smallholders and larger landholders. With the intent to deliver the greatest possible outcomes to the poorest populations and to allow for greater income equity, it is assumed that smallholders are more likely to be within lower income brackets. Because targeting smallholders means that a larger number of smaller plots can be irrigated by each kit, this approach also allowed for reaching a greater number of households, i.e. targeting smallholders results in the project reaching more and poorer households and alongside, the assumption of diminishing marginal returns, provides the possibility of greater net outcomes than if targeting larger landholders. However, focusing on a larger number of users per kit also risks collective action problems in equipment maintenance and fuel purchasing. Moreover, larger landholders are generally more likely to have greater sophistication in production methods, either via experience in using irrigation methods or in the usage of other modern inputs such as fertilizer.

FINDINGS: Neither kit maintenance nor fuel usage was more efficient among larger landowners, debunking the theory of collective action failure in this context. Kits provided to smallholders were no more likely to fail and were in fact less likely to face fuel shortages. The inclusion of more smallholders was shown to have a large and statistically signifi-

2. FAO, 2016; World Bank, 2018

cant impact on the average quantity of fuel used, with smallholders better able to coordinate on fuel purchases needed to keep pumps running. The results may also suggest small-holders putting in relatively more effort and resources to kit-access plots in comparison to larger landholders who may already have other irrigated plots and therefore did not prioritize kit-access plots. This finding illustrates that the SL-WRMP, and similar projects, may not need to worry about a trade-off between smallholder targeting and program efficiency. Further data collection will shed light on this question.

TARGETING LOWER-INCOME BENEFICIERIES: WHAT IS AN EFFECTIVE STRATEGY?

Within the design choice to target smallholder farmers, two alternate strategies were deployed. A set irrigation area was demarcated in each community. Each community was assigned one of two selection models to select beneficiaries within this demarcated area:

A. **Approach 1:** Priority, score-based targeting, where the project team applied a fixed selection criterion to constrain beneficiary selection to favor the inclusion of smallholders. Each farmer was intended to irrigate 0.5-1 ha with the kit.

B. **Approach 2:** Decentralized, community-driven targeting, where community leaders had the freedom to determine who would have access to the irrigation kits.

FINDINGS: The baseline showed that using score-based targeting with a proxy means test (PMT or poverty scorecard) was more effective at targeting smallholders than the use of decentralized, community-driven targeting. In the latter there seemed to be some amount of elite-capture, wherein large landholders were more easily able to direct program benefits to themselves. Community leaders tended to choose slightly wealthier households, with the decentralized approach resulting in an average of .7 ha more land ownership among beneficiaries than those chosen via PMT.

UPTAKE: WAS THERE DEMAND?

FINDINGS: Yes. As of the mid-line survey in Oct/Nov 2018, 52 of the 56 project communities had installed irrigation kits and 47 communities were regularly using them. Its primary purpose was in extending the growing season. Of the communities where irrigation kits have been installed, at least half were using them every month. As would be expected, kit usage was at its minimum during the rainy season and peaked over the July and August dry season.

INCOME GENERATION: DID USAGE BOOST PRODUCTIVITY?

FINDINGS: Per non-experimental[3] findings, yes. Baseline[4] and midline[5] data from households with access to at least one irrigated plot indicate that, over the ~3-year period:

- Households' average production value rose from ~US$29 (1,836 meticais) to ~US$369 (23,655 meticais), a 1,188% increase.
- The share of households using irrigation rose from 10% to 86%
- The average area irrigated per household rose from 0.20 ha to 0.45 ha

The findings related to changes in productivity due to kit-use are non-experimental, as the evaluation has not conducted an assessment of the counterfactual (or control group). For example, some proportion of the shift in production values may have been influenced by other external factors—the two periods prior to the project were marked by droughts in the region.

There was also a significant difference in household production values when comparing kit-access plots that did and did not utilize irrigation: non-irrigating households saw production values increase by ~US$ 134 (745% or 8,467 meticais) whereas irrigating households saw production values increase by ~US$ 374 (1,222% or 23,633 meticais). However, it must be

3. Findings are non-experimental as there is no comparison to a counterfactual. The sample is restricted to households that were surveyed at both the midline and baseline and had at least one plot inside the midline kit area. Observations are at household level.
4. June-Sept 2015
5. Oct/Nov 2018

noted that households that did not utilize the kits may have been constrained by other resource deficiencies that themselves contribute to lower production. For example, households may have been unable to meet kit repair and fuel needs due to insufficient finances, a factor which could stand also to reinforce other adverse effects on farming potential (lack of access to seeds, fertilizer, hours of labor, etc.).

In comparing irrigating households inside and outside the kit-access area, both groups are seen to boost production value, and there is no significant difference between kit-based irrigation and other sources of irrigation. This suggests that at least a substantial part of the general yield gains that new kit users experience is likely due to the provision of irrigation.

CHALLENGES

Sustainability is a concern. Monitoring data has shown that both the durability of the equipment and the purchasing power for fuel are mitigants of continued use. Less than three years after the first kits were installed, more than 30% are no longer fully functioning, with pump and tube failure the most recurrent problems. Access to fuel is another limitation. In more than 40% of communities where kits were installed, users reported that at some point during the previous year, they were unable to purchase sufficient fuel to use the kits as planned.

WHAT'S NEXT?

Both the project and the impact evaluation are still ongoing, and final results have yet to be determined. Key take-aways and course correction options, however, are already available.

Replication and scaling-up. The impact evaluation provides a level of confidence, previously unestablished, that including smallholders does not necessitate a trade-off in terms of usage and maintenance of the kits. Over the next months the evaluation will seek to understand the drivers and incentives of the emerging findings, aiding replication and scaling in the design of future projects as well as shedding further light on yield implications. In tandem, also replicable are the innovative tools tested for effectively identifying, targeting and including smallholders in projects of this type.

Ensuring sustainability. Given the issues with both equipment failure and fuel availability, the project team will begin to look at corrective measures, such as the use of solar batteries in place of fuel, to ensure that the irrigation equipment continues to function in as sustainable a manner as possible.

Measuring Profitability. To quantify the impact of the project, the on-going analysis will measure the profitability of the irrigation and whether these smallholders earn higher returns than other farmers. While increments in production value have been shown, the empirical validation is still in process. If confirmed, it is possible that the findings will help make the case for replicating and scaling up the approaches, both within Mozambique as well as in countries experiencing similar challenges. This is particularly valuable for lower-income countries trying to balance pressing income and social protection needs (food security, nutrition, etc.) in tandem with climate vulnerability.

The impact evaluation is expected to be finalized in 2020 with a full array of lessons shared by 2021.

The World Bank's Development Impact Evaluation (DIME) group generates high-quality and operationally-relevant data and research to transform development policy, help reduce extreme poverty, and secure shared prosperity. It develops customized data and evidence ecosystems to produce actionable information and recommend specific policy pathways to maximize impact.

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