CIF CLIMATE INVESTMENT FUNDS

IMPACT EVALUATION EARLY EVIDENCE SERIES

IRRIGATION TO ENHANCE YIELDS AND CLIMATE-RESILIENCE OVERVIEW

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 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.

60 to 80 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 cultivation of water-sensitive crops; and improves resilience to droughts. 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 to irrigation via the provision and promotion of irrigation equipment.

Despite its huge potential, there is surprisingly little rigorous evidence of the impacts of irrigation. Within this frame, DIME has developed an ambitious agenda aimed at assessing impacts while also analyzing challenges of adoption and sustainability.

1 World Bank, 2007

2 FAO, 2016; World Bank 2018

QUICK FACTS

DATE
May 2020

COUNTRY
Mozambique

PROJECT
Sustainable Land & Water Resources Management Program (SLWRMP)

CIF FUNDING
$15.75M for PPCR

MDB
African Development Bank

PRODUCT TYPE
Development Impact Evaluation (DIME)

The impact evaluation embedded in the SLWRMP project attempts to answer several of these key questions:

1 **What is the impact of irrigation infrastructure on water availability, crop choices, yields and variability of yield?**

2 **Does group composition affect water user associations' abilities 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. 53 kits were installed in target areas between June 2016 and October 2017. The kits are shared among smallholder farmers, and 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.

EXPANSION IN IRRIGATION ACCESS

The primary purpose of providing irrigation kits was to extend the growing season. Of the communities where irrigation kits have been installed, at least half were using them every month. Among the farmers who at any point used or were identified as planned users of the irrigation kits during the project's lifetime, only 9% had any access to irrigation before the project interventions. By the time of the end-line survey in January 2020, 70% of these farmers were using irrigation. As would be expected, irrigation usage was at its minimum during the rainy season and peaked over the July and August dry season.

ACCESS TO IRRIGATION AND DRY SEASON CULTIVATION

Within the target communities, the area cultivated in the dry season increased with access to irrigation, although still lagging well behind the capacity to cultivate in the rainy season. In terms of crop choice, while staple food crops grown heavily during the rainy season, such as maize and pumpkin, remained relatively high also in the dry season, the cultivation of higher value crops such as tomatoes, onions, and butter beans showed significant increases on irrigated plots cultivated in the dry season. This provides that access to irrigation in the dry season allowed for farmers' revenue-to-area optimization in crop selection. However, despite a large value differential, 34% of kit area was still used to cultivate maize, a low-value, base starch in the diet, possibly signifying either that a large share of cultivation was being utilized for own-household consumption rather than for sale at markets, and/or that higher value produce, or cash-crops, may have posed greater risks or challenges in being cultivated. In sum, analyses of crop choice and area show that:

- Irrigation leads farmers to cultivate more in the dry season and plant more high value crops, and
- Irrigation has the potential to help farmers adapt to climate variability and increase overall yields.

INCOME GENERATION: DID USAGE BOOST PRODUCTIVITY?

FINDINGS: Yes. The project resulted in a large expansion in access to irrigation, and therefore also increased cultivation, resulting in increased yields and income. End-line data found that:

- → The average area irrigated are per household rose from 0.20 ha to 0.45 Ha;
- → Irrigated agriculture was much more productive: from baseline till end-line, irrigated plots produced 4-times more than rainfed plots;
- → At end-line, irrigated plots had an average yield of 17,930 Meticais[3] per Ha (~ US$ 267), compared to

3 Meticais are the national currency of Mozambique, officially termed the Mozambique New Meticial, and equivalent to about USD 66.8 at the time of writing in April 2020

4,385 Meticais (US$ 65) for rainfed plots—a 4-fold difference; and compared to 4,937 (US$ 74) Meticais for households without irrigation—a 3.6-fold difference.

This rise in yields in irrigated plots is driven by both the expansion of the growing period into the dry season and the shift to higher value crops like tomato and butter beans.

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

To address these questions, two alternate targeting 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:

- **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 0.5ha with the kit.
- **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 .8 ha more land ownership among beneficiaries than those chosen via PMT.

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

Besides evaluating the overall impact of the project, the team sought to unpack questions related to targeting and group composition and its impacts on overall returns and sustainability. The underlying question is whether trying to maximize the productive potential of irrigation investments and prioritizing the inclusion of the most vulnerable farmers are competing objectives. On the one hand, targeting smallholders means that a larger number of smaller plots can be irrigated by each kit, increasing the number of beneficiaries. Based on the assumption of diminishing marginal returns, it is possible that these smaller farmers in fact may obtain greater net increase in production. However, allocating a larger number of users per kit also risks creating 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. Moreover, per hectare production in the kit area was not different between the two groups. The results may also suggest that smallholders put in relatively more effort and resources toward kit-access plots in comparison to larger landholders. The latter may already have other irrigated plots and therefore may not have prioritized kit-access plots. This finding illustrates that the SLWRMP, 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.

CHALLENGES

Sustainability is a concern. Monitoring data has shown that both the durability of the equipment and the purchasing power for fuel are constraining factors to continued use. Less than three years after the first kits were installed more than 15% were no longer functional and half had broken parts. Access to fuel is another limitation. In more than 45% 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?

The impact evaluation has just completed end-line data collection, and final results are currently being analyzed. 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. Maintaining and operating a fuel powered pump and irrigation kit is challenging. The known challenges regarding both operations and maintenance raise the question of whether there is a trade-off inherent in trying to include the most vulnerable farmers possible or focusing first on the farmers who have already shown signs of commercial potential in order to maximize efficiency. The DIME impact evaluation helped the project rigorously test these trade-offs to inform both the SLWRMP and other projects in Mozambique and beyond, finding that while communities initially indicate a preference for including wealthier farmers, concerted efforts to involve smallholders in targeting did not undermine the sustainability of the kits. If anything, including

smallholders may have led to slighter better operations and maintenance. These findings are discussed in more detail in a complimentary brief titled “Beneficiary Targeting.”

Maximizing income growth. Realizing the full potential of irrigation means encouraging farmers to adopt the crops which yield the highest returns. The evaluation found that in the rainy season, a large share of farmers use irrigated kits to produce maize, a staple crop with a commercial value that is limited by the degree to which it is able to recover the full investment cost of the kit. This evaluation and other DIME evaluations have found that households also face constraints in accessing the labor they need to cultivate what are inherently labor-intensive horticultural crops, highlighting the need for projects to address constraints on multiple fronts in order to maximize the returns and deliver climate protections to the most vulnerable farmers.

Measuring Profitability. To quantify the impact of the project, the on-going analysis includes measuring the profitability of the irrigation and whether these smallholders earn higher returns than other farmers. If confirmed, the findings could help make the case for replicating and scaling up the similar targeting 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.