

IRRIGATION TO ENHANCE YIELDS AND CLIMATE-RESILIENCE EFFECTS ON YIELD

The Climate Investment Fund's (CIF) Pilot Program for Climate Resilience (PPCR) is a program for developing countries and regions to build adaptation and resilience to the impacts of climate change. The program supports the Sustainable Land & Water Resources Management Project (SLWRMP) in Mozambique, implemented by the African Development Bank and focusing on addressing pressing development challenges affecting agriculture-dependent communities in Mozambique: rural poverty, food insecurity, and land degradation.

As part of its role as a pioneering climate fund and learning laboratory on frontier climate-finance instruments, alongside regular monitoring and research the CIF deploys targeted impact evaluations to deliver rigorous findings that aid in course correction and in understanding which approaches are most effective. The SLWRMP project was selected for such an evaluation, currently being conducted by the World Bank Group's Development Impact Evaluation Group (DIME). The following brief looks at one of the primary research questions within the evaluation: to what degree does the deployment of irrigation increase yields and incomes of farmers in climate-vulnerable contexts?

60 to 80 percent of annual precipitation in Mozambique falls during a single rainy season, meaning that rain-fed agriculture can only be practiced in a fraction of the year. 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. In response, the SLWRMP has focused on expanding the irrigation access of smallholder farmers 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, the ongoing impact evaluation attempts to understand to what degree, and how, irrigation affects yield growth. The evaluation team conducted a baseline survey, several monitoring visits, a mid-line survey in October/November of 2018, and end-line data collection in November 2019 to assess, among other factors, how kit usage affects crop-choices and the related changes in yearly yields and incomes. This brief outlines the primary findings.



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)

A CHALLENGING ENVIRONMENT FOR AGRICULTURE IN CENTRAL MOZAMBIQUE

A baseline survey of farmers who had not yet received support from the SLWRMP highlighted the challenging economic conditions for farmers: 72% were only cultivating subsistence crops. 80% of rainfall happen within just a few months,



therefore without irrigation nearly all cultivation must happen in this short rainy season. In fact, in the pre-intervention survey of farmers, only 23% cultivated any crops in the dry season. The baseline year was marked by a severe drought in Southern Mozambique, leading to widespread crop failure in which 52% of farmers within the evaluation's dataset lost their harvest entirely. With droughts expected to worsen and increase in prevalence due to climate change, irrigation may provide a key mitigation strategy. This brief describes how the SLWRMP expanded access to irrigation, and the advantages farmers have when they are able to access irrigation.

ACCESS TO IRRIGATION BY SLWRMP

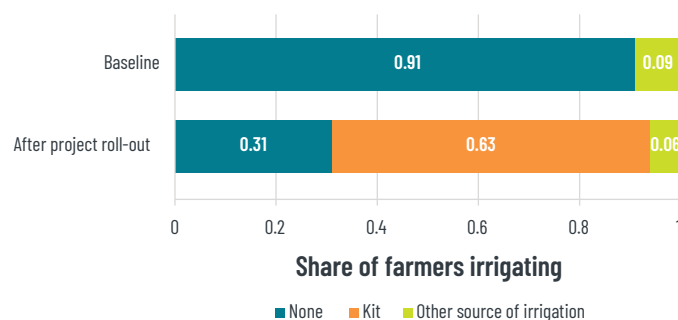
The US\$ 15.75M SLWRM project is implemented by the African Development Bank and covers several focus areas: land reforestation; livelihood support; and fire and drought control. Of these, the current DIME evaluation focuses on the irrigation component which provides beneficiary communities with small-scale irrigation kits, each comprising a combination of pumps and sprinklers that deliver water from a river to cover an area of (initially) 10-20 individual plots, that make up a total area of 5-10 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. 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. The project's interventions represent a significant expansion in access to irrigation for these farmers.

Figure 1 shows the increase in access to irrigation because of the project's investments: 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 November 2019, 70% of these farmers were using irrigation. In total, this represents an expansion of over 100 Ha under irrigation by end-line.

EXPANDING THE AGRICULTURAL SEASON: IRRIGATION AND DRY SEASON CULTIVATION

As expected, the data shows that almost all farmers, regardless of access to irrigation, cultivate in the rainy season. The huge potential of irrigation becomes apparent when looking at dry season cultivation. One of the avenues through which irrigation can increase farmers' annual production is by expanding the period over which they can cultivate. At baseline, only 21% of farmers without access to irrigation cultivated in the dry season, and farmers with access to irrigation were more than twice as likely to cultivate in the dry season. After project roll-out, a still larger share of farmers with access to irrigation were cultivating in the dry season, with no substantial shifts observed for farmers without access to irrigation.

Figure 1.
USE OF IRRIGATION, BASELINE VS. ENDLINE

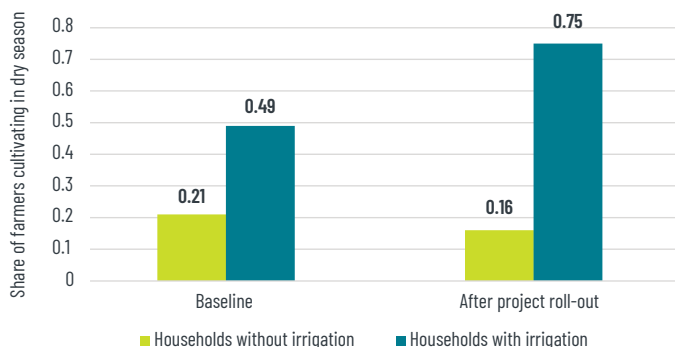


Sample is restricted to households assigned to kit at baseline or using kit at midline or endline. (N=1,120)

ACCESS TO IRRIGATION AND THE TRANSITION TO HIGH-VALUE CROPS

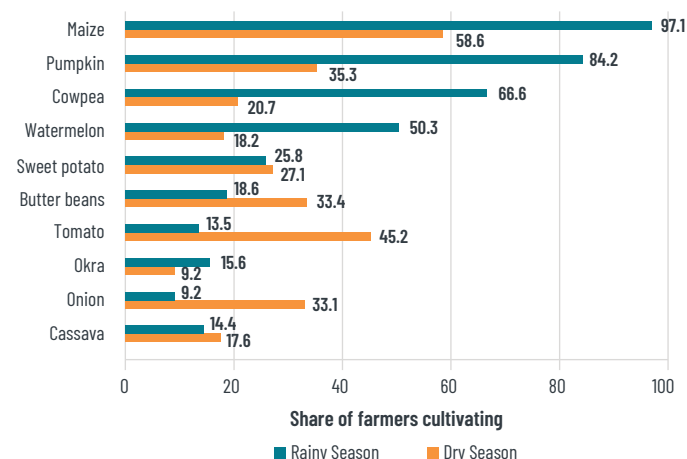
A second channel through which irrigation improves annual production value is by enabling the transition to higher value crops. Figure 3 shows the percentage of farmers with access to irrigation who were cultivating different crops at end-line. Overall, irrigation allows many more farmers to cultivate higher value commercial crops. Marketable crops like tomatoes and butter beans are among the most commonly cultivated crops, especially during the dry season, a period which was almost entirely unproductive for these farmers before the project helped expand their use of irrigation.

Figure 2.
DRY SEASON CULTIVATION, BASELINE VS. ENDLINE: WITH ACCESS TO IRRIGATION VS. WITHOUT



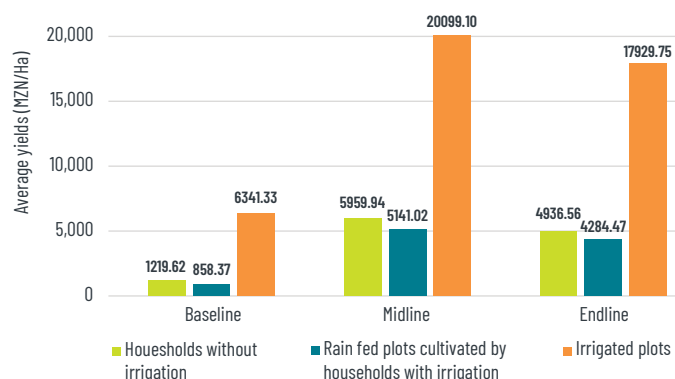
Sample is restricted to households assigned to kit at baseline or using kit at midline or endline. (N=1,120)

Figure 3.
CULTIVATED CROP VARIETIES, RAINY SEASON VS. DRY SEASON



Sample is restricted to households assigned to kit at baseline or using kit at midline or endline. (N=1,120)

Figure 4.
HOUSEHOLD LEVEL PRODUCTION VALUE



Sample is restricted to households assigned to kit at baseline or using kit at midline or endline. (N=1,120) Yields are winsorized at 99th percentile.

YIELD RESULTS

Simple comparisons of yields obtained from irrigated land versus yields from rainfed cultivation show the productive potential of irrigation. After the project expanded access to irrigation, at mid-line and end-line data collection, irrigated plots were more than 4-5 time more productive in terms of Meticaïs¹ per Ha than non-irrigated plots. Assuming that in the absence of irrigation, irrigated plots would have produced the same revenue earned on unirrigated plots, access to irrigation may have produced additional value of more than 13,000 Meticaïs for each irrigated hectare per year, equivalent to US\$ 193/Ha, a difference of 263%.



1 Meticaïs are the national currency of Mozambique, officially termed the Mozambique New Metical, and equivalent to about USD 66.8 at the time of writing in April 2020

CHALLENGES AND NEXT STEPS

Irrigation clearly offers tremendous potential for farmers in central Mozambique who are vulnerable to droughts and other disasters and have limited opportunities for accessing inputs or participating in profitable investments. The SLWRMP expanded irrigation access, increasing the share of farmers who were able to cultivate in the dry season and grow high value crops. Comparing yields on irrigated plots and unirrigated plots shows that this expansion may be creating large additional value for farmers.

However, challenges remain. Maintaining and operating fuel powered pumps and irrigation kits has proven difficult. Less than three years after the first kits were installed more than 15% were no longer functional, highlighting the challenge these farmers face in accessing parts, making repairs, and operating the kits. The known challenges of operations and maintenance raise the question of whether there is a trade-off inherent in trying to include the most vulnerable farmers versus 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 irrigation kits to produce maize, a staple crop with a low commercial value, making it difficult 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 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.

