Building More or Managing Right?

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The previous case study focused on the economics of irrigation impacts and the role of market failures: incomplete land and labor markets contribute to the agriculture productivity gap by hindering technology adoption. This case study shifts focus from market explanations for gaps in agricultural productivity (despite irrigation investments) to the behavior of farmers.

Common Perceptions

Irrigation systems are a resource commonly shared by farmers. Therefore, when farmers fail to internalize the cost of their water use on others, the allocation of water within an irrigation scheme may not only be inefficient, but also affect water availability for others. Collective action over the management of a scheme is therefore necessary to ensure the sustainability of irrigation supply.

Decentralized models of governance have evolved to formalize the delivery of water resources (Ostrom 1990; Ostrom and Schlager 1992). For example, with only 8 percent of farmers in Mozambique having access to irrigation (FAO 2016), the government of Mozambique acknowledged that action was needed. To improve agriculture growth and rural development, the government spent US$2.3 billion in 2008 (World Bank 2010). To help drive this goal, the World Bank invested US$70 million through the Sustainable Irrigation Development Project (PROIRRI) to support the rehabilitation and development of over 3,000 Ha of irrigated farmland—benefitting 6,000 people across 42 schemes in three central regions of Mozambique: the Manica, Sofala, and Zambézia provinces.

However, local institutions, like water user associations, may not achieve efficient resource sharing if the main constraint users face is limited attention to water management (Meinzen-Dick 2007; Plusquellec 2002).

Questions We Should Be Asking

To assess how effectively farmers with irrigation access were managing water, DIME's technical partners (Hydrosolutions Ltd.) created a user-based water monitoring system. This system covered 148 households cultivating 222 plots across three irrigation schemes.

The first year of monitoring data revealed that issues around water access went beyond poor accessibility to irrigation equipment and infrastructure: there was enough water in the scheme to meet everyone's requirements, but at the plot level there was scarcity. Aside from the rainiest weeks, many farmers were not allocated enough water to meet crop recommendations. Water scarcity was, therefore, purely a problem of allocation.

Our evidence offers three stylized facts:

- Water allocations are inefficient;
- Water scarcity arises from basing water needs on fixed quantities rather than dynamic crop requirements; and
- There is substantial variation in planting times. Therefore, some farmers have crops in early growth stages while others have crops in late growth stages.

If farmers could be persuaded to use less water in the first and second growth stages, when water requirements are lower, more water would be available to farmers in the third and fourth growth stages when requirements are higher.

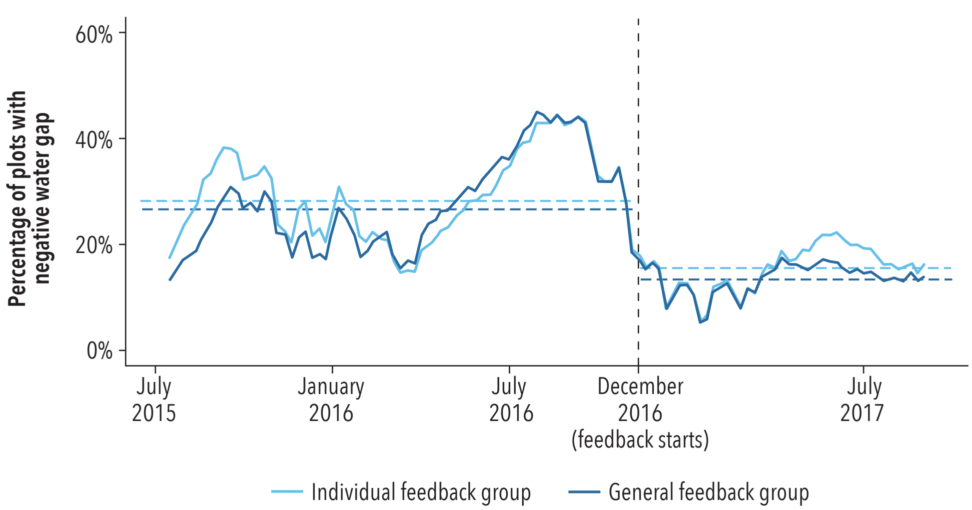
If allocations were more closely matched to crop water requirements given their growth stages, water scarcity could be eliminated without making any other changes to cultivation practices. With this in mind, researchers at DIME, Arizona State University, the International Food Policy Research Institute, and engineers from Hydrosolutions Ltd. designed a randomized controlled trial comparing the impact of providing information about water recommendations on water allocation (see figure 1.3). Farmers from 147 households were randomly assigned to one of two groups, and surveyed seven times (once every four months) between August 2015 and July 2017. One group received information that provided general watering recommendations across crop growth stages. The second group received individualized information that compared water requirements to each farmer's water use in the same season of the previous year.

Using surveys, we collected information on the watering patterns on all plots farmed by households, and monitored water supplies and weekly precipitation data (mm/week) from the NOAA's Climate Prediction Centre CMORPH product (Climate Prediction Center 2015). Farmers were provided with information about water use by interviewers before they completed each survey.

We found that:

- Providing farmers with guidelines for the water requirements of their primary crops may be a low-cost way to remedy water scarcity.
- Reminding farmers of the water requirements over their primary crop's growth cycle significantly reduced the number of conflicts over water use and the proportion of farmers who self-reported having insufficient water.
- In contrast, administering user-based water monitoring systems to provide individualized feedback on water use does not appear to merit its costs.

Figure 1.3 The Impact of the Mozambique Irrigation Information Campaign



Note: The figure shows the eight-week moving averages of plot-crop-week observations. The solid lines show the proportion of plots (on the y-axis) in a given week (on the x-axis) where the water available in canals adjacent to monitored plots is less than the amount required. This is also known as a "negative water gap." The two sets of horizontal dashed lines show the averages of plots associated with each feedback modality before and after the feedback period. The vertical dashed line indicates the week in December 2016 when all farmers received feedback.

Policy Implications

Effective monitoring can be a cost-effective water management strategy. In this context, we learned that communication through text messages was ineffective: while the messages can be simple, they must be delivered in person. These findings informed plans to build capacity for both monitoring water usage and establishing water user associations to support the effective expansion of irrigation infrastructure. Finally, assuming all irrigated areas are similar to the PROIRRI project, potential savings would represent 9.4 percent of water withdrawal from all sources in Mozambique.

This case study is based on an impact evaluation conducted within DIME's Economic Transformation and Growth research program. See: Christian, Paul, Florence Kondylis,* Valerie Mueller, Astrid Zwager,* and Tobias Siegfried. 2018. "Water When It Counts: Reducing Scarcity Through Water Monitoring in Central Mozambique." Policy Research Working Paper 8345, World Bank, Washington, DC. See also: Christian, Paul,* Florence Kondylis,* Valerie Mueller, Astrid Zwager,* and Tobias Siegfried. 2021. "Monitoring Water for Conservation: A Proof of Concept from Mozambique." American Journal of Agricultural Economics 104 (1): 92–110.*

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