

Scaling farmer-led irrigation in sub-Saharan Africa: What does it take?

Irrigation can significantly raise agricultural production, increase food security and reduce poverty among smallholder farmers in the developing world (Burney et al. 2013; Hagos et al. 2012). This was witnessed in the role that irrigation schemes played in the Green Revolution across Asia (Kimmich 2013; Namara et al. 2007, 2010; Shah 2009). Worldwide, only 20% of cultivated land is irrigated, yet it accounts for 40% of global food production (FAO 2015). However, this irrigated area is concentrated in Asia and the Americas; only 4% of total agricultural land is irrigated in sub-Saharan Africa (SSA) (Burney et al. 2013).

SSA is currently dominated by rain-fed cultivation, with few irrigated plots and irrigating households. This was highlighted from an examination of the Living Standards Measurement Study - Integrated Surveys on Agriculture (LSMS-ISA) data for Nigeria, Ethiopia and Malawi. In 2015-2016, only 1.68% and 1.82% of all plots in Nigeria and Ethiopia, respectively, were irrigated. In Malawi, the share of irrigated plots was 0.73% in 2016-2017. In 2015-2016, the share of households with at least one irrigated plot was 1.46% in Nigeria and 6.76% in Ethiopia. In Malawi, 0.58% of households had at least one irrigated plot in 2016-2017. These values suggest that very few households practice irrigation and very few plots are irrigated.



The use of solar power to pump groundwater for irrigation in Ethiopia (photo: Desalegne Tadesse / IWMI).

Among the households that practice irrigation in SSA, dependency on surface water and groundwater differs across countries. In 2015-2016, almost 5% of all households practicing irrigation in Nigeria used a shallow well, while a similar share used a borehole. In Ethiopia, in 2013-2014, almost 9% of households practicing irrigation used a borehole; the LSMS-ISA did not report borehole data for 2015-2016. In 2016-2017, 60% of all households practicing irrigation in Malawi used a shallow well. Surface water (rivers, lakes, ponds, streams) continues to be an important source of water for irrigation, with 62% and 74% of irrigators in Nigeria and Ethiopia, respectively, depending on it in 2015-2016. However, surface water is less important in Malawi, with only 23% of irrigators using this as a source of water for irrigation in 2016-2017.

'Farmer-led irrigation' is being encouraged through government policy across SSA. Irrigation schemes (large or community based) provided and driven by the government have largely failed to function due to lack of maintenance and revenues. Therefore, the increasing focus of governments is on farmer-driven efforts that expand irrigated areas. This is especially the case in Ethiopia, where the Ministry of Agriculture and the Agricultural Transformation Agency are working on creating environments to enhance farmer-led irrigation.

Groundwater will have an important role to play in farmer-led irrigation in SSA (see Altchenko and Villholth 2015 for

groundwater potential; Macdonald et al. 2012 for groundwater resources; Schmitter et al. 2018 for the potential for solar and diesel pumps; and Worqlul et al. 2017 for suitability of lands for groundwater irrigation). Groundwater will be of importance partly due to constraints on public spending, and also due to the agroclimatic challenges that render the development of large public surface water schemes infeasible. Particular emphasis is being placed on increasing the use of solar and diesel pumps to tap shallow groundwater; viewing solar pumps as being more attractive due to zero marginal costs of pumping.

Even in areas suitable for groundwater use, the costs of pumps and equipment remain a major barrier. These remain expensive and largely unavailable. In Ethiopia, where smallholders typically use their own finances to pay for water pumps to irrigate farms mostly under 5 hectares, the government has imposed a 37% import duty (tax) on the price of motor pumps of 1 to 10 horsepower (Gebregziabher et al. 2014). Bringing down prices of pumps may make technologies more affordable. In addition, access to credit, one of the determinants of technology adoption, appears to be hindering the scaling of irrigation in the country (Getacher et al. 2013; Abate et al. 2016; Adeoti 2008). To this end, countries such as Ethiopia are removing tariffs on irrigation equipment (i.e., subsidizing gadgets) and are considering modalities to offer credit to farmers for purchasing irrigation equipment (pers. comm. Agricultural Transformation Agency and Ministry of Agriculture, Government of Ethiopia, 2019).



Pumping groundwater for irrigated agricultural production in Ethiopia (photo: Maheder Haileselassie / IWMI).



An Ethiopian farmer using groundwater for irrigation (photo: Maheder Haileselassie / IWMI).

However, reducing prices and offering credit may not be sufficient for boosting the adoption of pumps and equipment to tap groundwater. Many other factors can affect smallholder farmers' decisions to adopt pumps, but knowledge gaps remain with respect to creating enabling conditions. For example, differing degrees of access to markets and information affect the costs that farmers face for both modern inputs and their marketed surplus, and thus need to be better understood in order to develop comprehensive systems for irrigation inputs (Feder and Umali 1993; Nakawuka et al. 2018).

The respective roles of microfinance institutions (private) and cooperatives (public) in the adoption of agricultural technologies are not well understood (e.g., Abate et al. 2016 examined the adoption of fertilizers and seeds—variable inputs—and found that the effects of microfinance institutions and cooperatives on adoption vary by farm size and input use). Cooperatives typically provide loans for variable inputs such as seeds and fertilizers (and have had an effect on the adoption of agricultural technologies, e.g., see Abebaw and Haile 2013), while microfinance institutions typically provide loans for assets. However, the effects of using pumps on household incomes and livelihoods are likely realized only after the typical payback period for loans from microfinance institutions, and perhaps even after the life span of the equipment (Merrey and Lefore 2018; Yamegueu et al. 2019). Thus, understanding the role of cooperatives in financing irrigation equipment, and the demand for credit from farmers, is important for targeting policy efforts.

Finally, the cost of drilling boreholes is significantly high (Carter et al. 2006; World Bank 2006; Gebregziabher et al. 2013), and is fettered with relatively large uncertainties

about yielding groundwater (for details, see Worqlul et al. 2017; Schmitter et al. 2018). Consequently, the willingness to adopt a pump may be compromised as farmers are less likely to drill boreholes amid the uncertainty (as they are unsure about 'hitting' groundwater). Whether the public provision of boreholes (with costs shared between farmers and governments) can boost the private adoption of pumps perhaps merits examination.

The International Water Management Institute (IWMI) is currently conducting research that addresses the knowledge gaps identified and explained above.

- IWMI has undertaken an analysis of LSMS-ISA data in Ethiopia, overlaying it with groundwater and solar suitability mappings to examine the magnitude of farmers who would likely benefit from groundwater irrigation and solar pumps (Kafle et al. 2020, in review). These results suggest that population density is positively correlated with groundwater irrigation suitability and negatively correlated with solar irrigation suitability. Results also suggest that groundwater irrigation suitability is positively correlated with economic well-being and with cultivating cash crops. This suggests that relatively better-off individuals reside in areas that are more suitable for groundwater irrigation and are thus more likely to benefit from programs and interventions that promote groundwater abstraction.
- IWMI is currently designing and implementing a field-based experimental study that explores the role of reducing prices, credit constraints and risks in the adoption of pumps for groundwater-based irrigation. The results of this study will be used to inform policy dialogues around smallholder irrigation, and to inform the design of pilot investments that aim to develop smallholder irrigation value chains.

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