4.4 Improving on-farm water management through irrigation information for climate-smart agriculture in sub-Saharan Africa[25]

In sub-Saharan Africa (SSA), irrigation is promoted for intensified production and increased resilience to climate variability. In Ethiopia specifically, most agricultural land is under low input-low output rainfed cultivation and is highly susceptible to rainfall variability (Haileslassie *et al*., 2016). Investment in sustainable water solutions has the potential to boost crop yields and household revenues and reduce risks associated with climate variability and change (Giordano *et al.*, 2012).

Sustainable development of irrigation requires sound use of natural resources at plot, scheme and watershed level. Timely and accurate water management can mitigate production and income risks associated with hydrologic variability, as well as soil and water degradation associated with inefficient water use both on-farm and downstream of irrigation hotspots (Gedfew *et al.*, 2017). This requires guiding farmers to more efficient on-farm water management – how much and when to irrigate – with tools that are robust in the field and easy for farmers to use.

The wetting front detector (WFD) and related tools were field tested with farmers in Ethiopia by the International Water Management Institute (IWMI) and partners between 2013 and 2017 to assess the effect of access to irrigation scheduling information on crop yields and income. The study included various scenarios of water lifting and irrigation technologies in different regions, agro-ecological zones and soil conditions, with more than 200 farmers irrigating cereals or vegetables. Measurements were taken on irrigation depth, and crop and water productivity (Schmitter *et al.*, 2016). Results were compared with a control group using well established irrigation methods.

Results from field testing are positive and show potential. The WFD is a feasible approach to supporting farmers in adapting to and mitigating climate variability. In most sites, use of the WFD reduced water consumption while improving or maintaining yield levels. In cases under manual water lifting and application, the WFD helped newly irrigating farmers to double their yields with just a 30 percent increase in irrigation (Tesema *et al.*, 2016). For smallholder farmers using motorized pumps or in a gravitational scheme, water use decreased and yields increased, depending on crop and soil. The average change in water use for farmers using the WFD as a source of information for irrigation, compared with the control group, is presented in **TABLE 17**.

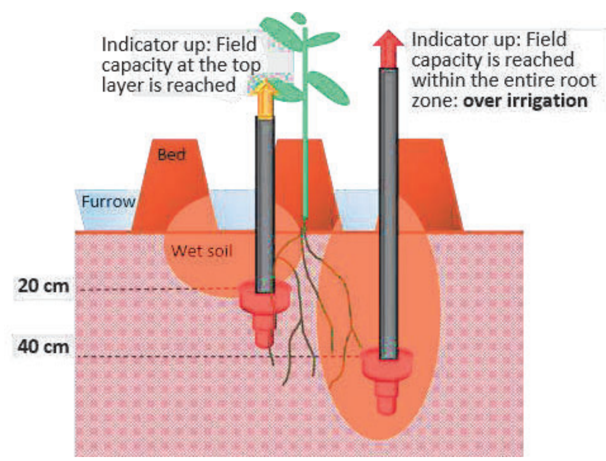

FIGURE 37: Top: Woman farmer in Ethiopia learning to use irrigation scheduling tools. Bottom: Diagram of the wetting front detector in use

Photo credit: IWMI

Source: Schmitter et al, 2017

[25] Case study Petra Schmitter, Nicole Lefore, Jennie Barron and Meredith Giordano (IWMI).

The more efficient water use following the introduction of the WFD also led to yield increases in most crops, though these were highly dependent on agronomic practices and crops. Yield improvements observed for farmers using wetting front detectors as a source of information for irrigation, compared with the control group, are presented in **TABLE 17**. Moreover, 80 percent of farmers preferred the produce from the WFD plots because of improved quality.

TABLE 17: Decrease in water use and increase in yield obtained for farmers using motorized pumps or within an irrigation scheme

Farmers using irrigation scheduling information provided by the WFD were compared against a control group with no irrigation scheduling information (depicted in % difference).

Crop	Decrease in water use	Yield increase
Onion	16 – 26%	4 – 21%
Potato	19 – 43%	5 – 17%
Tomato	21%	14%
Pepper	22 – 28%	14 – 75%
Wheat	44%	-3%
Cabbage	5%	13%

With the WFD, farmer incomes improved as a result of yield gains coupled with a reduced number of irrigation events, which in turn reduced input costs for labour, fuel and fertilizer. **FIGURE 38** shows the trend in increased profit when smallholder farmers used the WFD as they irrigated less, translating directly to reduced irrigation costs and improved yields. **FIGURE 39** shows the variability in profit for three different irrigation information groups: Control (no information access), Time Domain Reflectometry (TDR for information on soil moisture), and WFD. The variability in profit is strongly correlated to the effect of the irrigation quantity on yield, and is proportional to the associated irrigation labour.

The study found that use of WFDs by water user associations in an irrigation scheme saved a volume of water sufficient to increase irrigated area by 33 percent in the case of onions, and 75 percent for potatoes – equivalent to 2 to 5 percent of the entire irrigated land and 1 to 5 percent of the

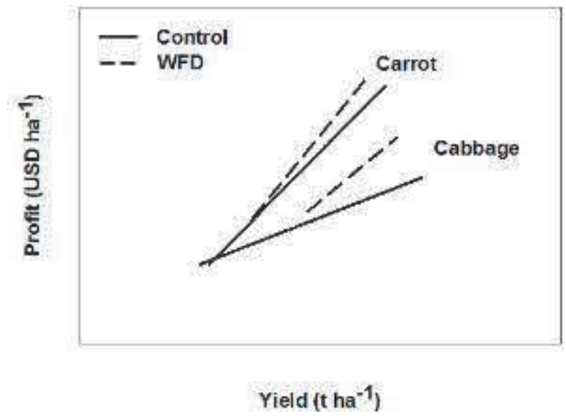

FIGURE 38: Trend in profit and yield for different levels of farmer information on irrigation on farms using manual water lifting technologies

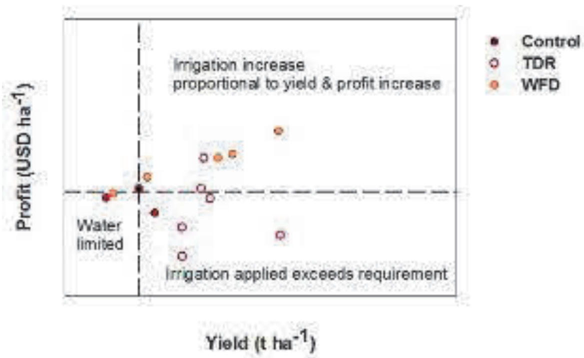

FIGURE 39: Variability in profit for different levels of farmer information on irrigation on farms using manual water lifting technologies

designed command area in the scheme (Banteamlak *et al.*, 2017).

Farmers benefit from the improved productivity and incomes, as well as from strengthened information about water use. The tools complement and extend existing indigenous understanding about on-farm water management. The efficient use of irrigation water further improved in the second year, as farmers learned more about irrigation and using the tools. The improved access to information on crop water application and sharing of irrigation information within irrigation systems can improve water resources management at community level and larger scales. For these reasons, the tools can make a positive contribution to overall natural resources management – leading to more climate-smart and resilient agricultural systems.

Scaling use of simple tools for irrigation management could improve efficiency with substantial gains for economic and

environmental sustainability. Smallholder irrigation is developing quickly in sub-Saharan Africa, creating a need for increased water efficiency. Motorized pumps in SSA could benefit 185 million people, extend irrigated area to nearly 30 million ha and generate revenues of USD 22 billion a year (Xie *et al.*, 2014), but this will require climate-smart management of water in farmers' fields. The introduction of the WFD and similar tools could reduce fuel costs by USD 1.5 to 4.4 billion, and save 3 to 29 billion m^3 of water per year (Schmitter *et al.*, 2017).

The promotion of climate-smart agricultural techniques, such as water lifting and related agricultural water management technologies should include appropriate tools and technical advice on irrigation scheduling. The inclusion of on-farm water management support can help to better manage overall water demand and support sustainability of natural resources. Becoming more climate-smart and resilient requires targeting not only the technologies, but also the supporting management tools appropriate to the agro-ecological context. As this study suggests, the extent of benefits gained from irrigation scheduling tools depends on water availability, method of water lifting and application, crop and soil type, and land size. For larger scale impact, we will need to identify ways to link technologies to ICT/SMS services and bigger data apps to transfer knowledge, outreach and advice, so as to effectively scale resilience through climate-smart agriculture.

Acknowledgement

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