

Technical guidelines for improving water use efficiency in irrigation areas in Africa

In Sub-Saharan Africa, rice consumption has consistently outpaced domestic production, leading to a critical reliance on imports. Therefore, it is essential to increase productivity within irrigation schemes. However, there are some cases where the actual irrigated area falls short of the planned command area due to the functional deterioration of water facilities and inefficient water management. These guidelines were developed to expand technical options by proposing new countermeasures that contribute to efficient water utilization.

In the Lower Moshi area, leakage in earth canals was measured at 43 mm h^{-1} after the commencement of farming (Fig. 1). By implementing countermeasures to mitigate leakage (Fig. 2C, D), water loss is reduced, enabling the supply of additional water to downstream areas. Furthermore, concrete canal surfaces become increasingly rough over time, impairing water flow. A resin-based coating method (Fig. 2B) can significantly improve water flow by 36% to 46% (Fig. 3). In the same cross section as that used in the field trial, this resulted in a flow rate increase of 56% to 84% (at a water depth of 0.6 m). Implementing plot leakage countermeasures—such as towing a Cambridge roller (Fig. 2E) and removing the topsoil to directly compact the hardpan—resulted in a 5 mm reduction in water requirement per day (WRPD) (Fig. 4). These guidelines describe several other methods to increase the irrigated area through efficient water utilization, including: upgrading diversion works, improving field drainage using cut drains, powering pump irrigation with small-scale hydropower using the flow within irrigation canals, installing recirculation subsurface irrigation powered by solar energy (Fig. 2F–I), adopting water-saving cultivation via the alternate wetting and drying (AWD) method, and implementing appropriate water allocation to improve water use efficiency (Fig. 5).

By applying these technologies to the 2019 conditions of the Lower Moshi District, there is potential to expand the irrigated area to 2,273 ha (152% of the original planned command area of 1,500 ha) (Fig. 6). These guidelines are available in English, Japanese, and Swahili on the JIRCAS website.

Successful implementation requires addressing financial and social factors. Since many of these technologies involve initial costs, the development of agricultural credit systems is recommended. While these methods are designed for broad application by farmers and engineers, pilot testing is advised to adapt them to local soil and climatic conditions. Crucially, as these improvements benefit the entire irrigation block rather than just individual plots, fostering community consensus and collective agreement among water users is vital for the sustainable management of improved water resources.

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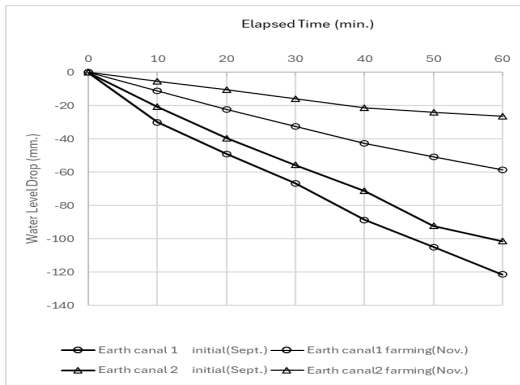


Fig. 1. Results of earth canal infiltration test

Infiltration rate from earth canals (Lower Moshi area): Average 111.5 mm h⁻¹ before and 43 mm h⁻¹ after the start of farming

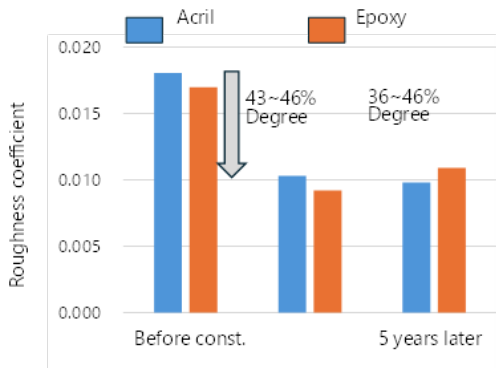


Fig. 3. Effect of surface coating

Epoxy- and acrylic-resin-coated concrete canals resulted in a 43–46% reduction in roughness half a year after application, and a 36–46% reduction after five years.

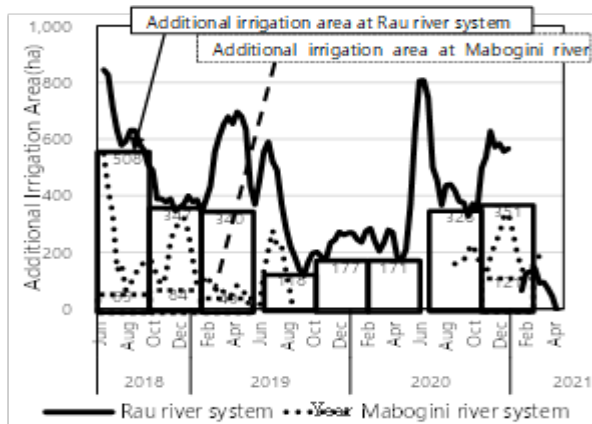


Fig. 5. Additional irrigable area

Calculated by subtracting the required irrigation volume from the monthly irrigation water volume by river system



Fig. 2. Measures described in the guidelines

Resin coating (A: before, B: after), earth canal leakage measures (C: polyethylene sheet, D: PVC pipe), E: plot leakage measure, F: sub-surface irrigation, G: shallow sub-surface drainage, H: small hydropower, I: division box renewal

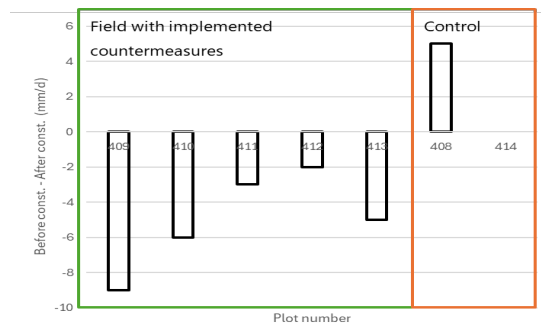


Fig. 4. WRPD in plots treated with the crushing and compaction method

Average WRPD of the plots where the crush and compaction method were implemented (Plots 409–413) decreased by 5.0 mm (29%).

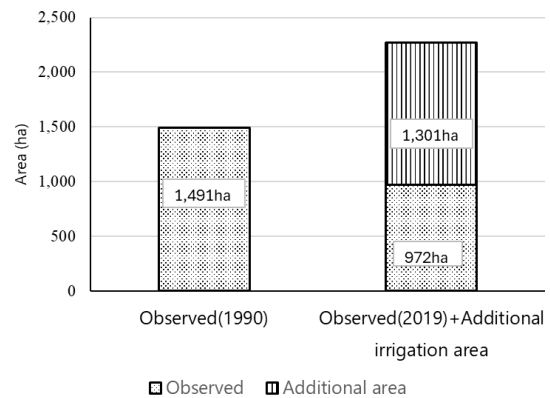


Fig. 6. Potential additional irrigation area by measure implementation

Actual irrigated area: 1,491 ha (in 1990), 972 ha (in 2019). Estimated expandable area: 1,301 ha

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