

Comparative Performance and Sustainability of Low-Cost Drip and Solar-Pump Irrigation Systems in the Sahel, 2000–2024

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ABSTRACT

Background: Persistent drought and water scarcity in the Sahel necessitate innovative, low-cost irrigation solutions to enhance agricultural resilience. While various small-scale systems have been promoted, a comprehensive engineering comparison of their long-term performance and sustainability in this harsh environment is lacking.

Purpose and objectives: This study comparatively evaluates the technical performance, durability, and water-use efficiency of two prevalent low-cost irrigation technologies—manual drip kits and photovoltaic pump-fed systems—deployed in the Sahelian region.

Keywords: *Sub-Saharan Africa, Appropriate Technology, Water-Use Efficiency, Smallholder Irrigation, Sustainable Agriculture, Comparative Analysis*

Article Highlights

- Solar systems showed 32% higher incidence of major component failure than drip kits.
- Cost-benefit for solar pumps favourable only at scales above 0.5 hectares.
- Optimal technology is contingent on plot scale and local technical capacity.
- Neither system proved universally superior; each presents a distinct compromise.

Methodological Note

Longitudinal field study employing mixed methods: technical monitoring, life-cycle cost analysis, and farmer interviews. Performance modelled using GLMM to account for site-specific random effects.

A nuanced engineering analysis of appropriate irrigation technology for smallholder resilience.

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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