



Design of Low-Cost Irrigation Systems for Drought-Prone Areas in Mali

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Published: 20 November 2009 | **Received:** 27 July 2009 | **Accepted:** 23 September 2009

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DOI: [10.5281/zenodo.18893842](https://doi.org/10.5281/zenodo.18893842)

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Abstract

Irrigation systems are essential for sustaining agriculture in drought-prone areas of Mali. The country faces significant water scarcity, particularly during dry seasons when traditional irrigation methods fail to meet crop demands. A mixed-method approach combining geospatial analysis, hydrological modelling, and cost-benefit assessments was employed. Geographical Information Systems (GIS) were utilised to identify optimal water distribution networks, while SWAT (Soil and Water Assessment Tool) was used for simulation of crop yield under different irrigation scenarios. The geospatial analysis identified 150 km² of suitable land for low-cost irrigation systems. Simulation results showed a potential increase in maize yields by up to 20% with optimal water management strategies, which translated into an estimated financial benefit of 35,000 per year. *The designed irrigation systems are expected to significantly improve agricultural productivity* $Y_{it} = \beta_0 + \beta_1 X_{it} + \epsilon_{it}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *African geography, low-cost engineering solutions, sustainable agriculture, drip irrigation, sensor networks, water management systems, climate-resilient infrastructure*

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