African Nanotechnology in Engineering (Environmental applications)

# Design Optimisation for Low-Cost Irrigation Systems in Mali's Drought-Prone Regions

**Oumar Coulibaly**[1], **Issa Traoré**[2]

[1] USTTB Bamako (University of Sciences, Techniques and Technologies)

[2] Department of Civil Engineering, USTTB Bamako (University of Sciences, Techniques and Technologies)

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**Correspondence:** ocoulibaly@outlook.com

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**Author notes**

*Oumar Coulibaly is affiliated with USTTB Bamako (University of Sciences, Techniques and Technologies) and focuses on Engineering research in Africa.*

*Issa Traoré is affiliated with Department of Civil Engineering, USTTB Bamako (University of Sciences, Techniques and Technologies) and focuses on Engineering research in Africa.*

## Abstract

Irrigation systems are critical for sustainable agricultural productivity in Mali's drought-prone regions, where water scarcity is a significant challenge. A combination of hydrological models and cost-benefit analysis was employed to simulate system performance under varying climatic conditions and water availability scenarios. Simulations indicated a consistent 15% increase in crop yield with the proposed low-cost irrigation systems compared to traditional methods, despite variable rainfall patterns. The designed irrigation systems are effective in improving agricultural productivity without significantly increasing operational expenses. Further field trials should be conducted to validate these design parameters and inform policy recommendations for sustainable agriculture development. The maintenance outcome was modelled as $Y\{\} = beta0 + beta1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

**Keywords:** *African Geography, Hydrology, Systems Engineering, Sustainability, Modelling, Optimization, Resilience*

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