African Food Process Engineering

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

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Abstract

Irrigation systems are essential for sustainable agriculture in Mali's drought-prone areas, where water scarcity limits crop productivity and farmer income. A combination of hydrological analysis and cost-benefit modelling was employed to identify appropriate irrigation techniques suitable for Mali's climate conditions. Field trials were conducted to validate the proposed systems' performance under local environmental constraints. Field tests indicated that a gravity-fed drip irrigation system, with an average water usage reduction of 30% compared to traditional flood irrigation methods, was the most cost-effective and resilient option for smallholder farmers in Mali's arid regions. The developed low-cost irrigation systems are tailored to withstand climate variability and ensure sustainable agricultural productivity without compromising environmental integrity. Implementing these designs could potentially increase crop yields by up to 20% and reduce water usage by approximately 35%, thereby improving the livelihoods of farmers in Mali's drought-prone areas. The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Geographic, Sub-Saharan, Hydrology, Systematics, Sustainability, Precision, Optimization*

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