African Heritage and Conservation

Off-grid Community Systems in Tanzania: Methodological Evaluation and Panel Data Estimation of System Reliability

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Published: 17 December 2009 | **Received:** 05 October 2009 | **Accepted:** 01 December 2009

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DOI: 10.5281/zenodo.18895648

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Abstract

Off-grid communities in Tanzania are increasingly relying on solar-powered water pumping systems for domestic and agricultural use. The study employed a mixed-method approach, combining quantitative analysis with qualitative insights to assess system reliability over time. Panel data analysis revealed that solar efficiency varied by up to 15% across different seasons, with higher variance in the dry season compared to the wet season. The findings suggest a need for seasonal adjustments and improved system maintenance strategies to enhance overall reliability. Communities should be encouraged to adopt adaptive management practices based on local climate conditions. Off-grid systems, solar-powered water pumping, panel data analysis, reliability, Tanzania The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p\, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Tanzania, Off-grid, Solar-Powered, Panel Data, Reliability, Methodology, Sustainability*

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