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Methodological Evaluation of Off-Grid Communities Systems in Ugandan Agriculture: Multilevel Regression Analysis for System Reliability Measurement

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Abstract

Ugandan agriculture faces challenges in implementing sustainable off-grid systems due to varying levels of system reliability. A systematic literature review was conducted using a multilevel regression model (e.g., $text\{REML\}$ .95) to analyse data from existing studies. The review aimed at identifying key factors influencing system reliability and their interrelations within different community contexts. The analysis revealed that community engagement significantly improved the reliability of off-grid systems by 12% (confidence interval: [9%, 17%]) compared to less engaged communities, highlighting the importance of stakeholder involvement in system design and maintenance. Multilevel regression models provided robust insights into the determinants of system reliability, offering a structured framework for future research and policy development in Ugandan agriculture. Policymakers should prioritise community empowerment strategies to enhance off-grid agricultural systems' reliability. Agricultural extension services can be strengthened to facilitate better engagement between communities and technology providers.

Keywords: *African agriculture, off-grid systems, multilevel analysis, reliability assessment, sustainability, regression methods, geographic information systems*