African Environmental Engineering (Technology focus)

Methodological Evaluation of Power-Distribution Equipment Systems in Uganda Using Multilevel Regression Analysis for Reliability Measurement

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Abstract

Power distribution equipment systems (PDES) play a crucial role in ensuring reliable electricity supply to households and industries in Uganda. However, these systems often suffer from frequent breakdowns and inefficiencies. A multilevel regression model was employed to analyse data from various power distribution points (PDP) across Uganda's districts. The model accounts for both fixed effects (e.g., infrastructure quality, maintenance practices) and random effects (district-specific variability). The analysis revealed that district-level factors significantly influence PDE reliability, with a regression coefficient of -0.53 indicating a negative relationship between district characteristics and system failure rates. This study provides empirical evidence on the determinants affecting power distribution equipment reliability in Uganda, offering insights for policy makers to enhance grid resilience. Policy recommendations include prioritising infrastructure investments in high-risk districts, implementing standardised maintenance protocols, and fostering public-private partnerships for continuous improvement. Power Distribution Equipment Systems, Multilevel Regression Analysis, Reliability Measurement, Uganda The maintenance outcome was modelled as $Y\{\}=beta0+beta1X\{\}+ui+varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Sub-Saharan, Multilevel, Regression, Evaluation, Infrastructure, Reliability, Modelling*