Power-Distribution Equipment Reliability Analysis in Rural Kenya Using Multilevel Regression Analysis

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Abstract

Power-distribution equipment (PDE) reliability is crucial for rural electrification in Kenya. However, existing studies often lack a comprehensive analysis of PDE systems across different geographical and socioeconomic settings. A multilevel logistic regression model was employed to analyse data collected from 20 villages across four counties. The model accounts for hierarchical structure (village-level and county-level) to assess the impact of socio-economic factors on PDE reliability. The analysis revealed that rural electrification coverage significantly improved PDE system reliability in villages with higher educational attainment levels, contributing to a 25% reduction in failure rates compared to less educated areas. This study demonstrates the effectiveness of multilevel regression analysis in understanding and improving the reliability of power distribution equipment systems in Kenya's rural settings. Policy makers should prioritise investments in electrification programmes that target communities with higher levels of education, thereby enhancing PDE reliability and overall service quality. The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Kenya, Multilevel Regression, Power-Distribution Equipment, Reliability Analysis, Rural Electrification, Geographic Information Systems, Methodological Evaluation*

ABSTRACT-ONLY PUBLICATION

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