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Power-Distribution Equipment Reliability in Tanzanian Mines: A Multilevel Regression Analysis

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Abstract

This study examines the reliability of power-distribution equipment (PDE) in Tanzanian mines, focusing on identifying factors that influence system performance and maintenance needs. A multilevel regression model was employed to analyse data collected from multiple mines over two years, accounting for both fixed effects (mine-specific characteristics) and random effects (variation within mines). The analysis revealed a significant interaction effect between temperature and humidity on PDE failure rates, with higher failure rates observed in environments exceeding 30% relative humidity. The multilevel regression model provides insights into the factors affecting PDE reliability, offering targeted recommendations for maintenance scheduling to enhance equipment longevity. Based on findings, a proactive maintenance strategy should be implemented, with scheduled inspections during high-risk periods identified by environmental conditions. The maintenance outcome was modelled as $Y\{\} = beta0 + beta1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Tanzania, reliability engineering, multilevel analysis, power distribution systems, maintenance needs, geographic information systems, statistical methods*

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