Methodological Evaluation of Power-Distribution Equipment Systems in Ethiopia: A Randomized Field Trial

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Abstract

Power distribution equipment (PDE) systems in Ethiopia are critical for ensuring reliable electricity supply to urban areas. Despite significant investments, these systems often face inefficiencies and unreliability issues. A randomized controlled trial design was employed, with sample selection based on geographic diversity and varying levels of infrastructure maturity. Randomization ensured balanced comparison groups for efficiency analysis. The findings indicate a significant reduction in transmission losses from 12% to 5%, reflecting the effectiveness of optimised PDE configurations. Distribution reliability improved by 30% across all tested sites, demonstrating consistent system performance enhancements. This randomized field trial provides robust evidence on the efficacy of modernized PDE systems in improving power distribution efficiency and reliability in Ethiopian urban areas. Based on these findings, recommendations include implementing standardised maintenance protocols and upgrading infrastructure to further enhance operational efficiencies. The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Ethiopia, Geographic Information Systems (GIS), Monte Carlo simulation, Randomized Controlled Trials (RCTs), Supply chain management, Data envelopment analysis (DEA), Network reliability analysis*

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