African Food Engineering (Food Science/Technology)

Methodological Evaluation of Industrial Machinery Fleet Systems in Tanzania Using Panel Data for Reliability Analysis

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Abstract

Industrial machinery fleets play a crucial role in various sectors of Tanzania's economy, particularly in manufacturing and agriculture. However, their reliability is often underutilized due to limited data-driven insights. A mixed-methods approach incorporating econometric techniques was employed. Panel data from the National Industrial Machinery Registry were analysed, employing a fixed effects model with robust standard errors to account for potential endogeneity. The panel data revealed that maintenance frequency and operational conditions significantly influence reliability outcomes. Specifically, machinery operating above its optimal capacity by more than 30% experienced a degradation rate of 15% in system reliability over one year. This study provides robust evidence on the impact of operational parameters on industrial machinery reliability, offering actionable insights for policymakers and industry stakeholders. Based on findings, it is recommended that regular maintenance schedules are implemented to maintain optimal capacity levels. Additionally, targeted training programmes should be developed to enhance operator proficiency in managing machinery stress. The maintenance outcome was modelled as $Y\{\} = beta0 + beta1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Pan-African, Geographic Information Systems (GIS), Time-series analysis, Econometrics, Stochastic models, Panel data, Monte Carlo simulation*

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