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Multilevel Regression Analysis to Evaluate and Enhance Industrial Machinery Fleet Efficiency in Tanzanian Industries

Balala Miti[1], **Simiyu Chituwo**[2], **Ilima Maganga**[2,3], **Kamanda Muteka**[1,4]

[1] State University of Zanzibar (SUZA)

[2] Sokoine University of Agriculture (SUA), Morogoro

[3] Department of Mechanical Engineering, Nelson Mandela African Institution of Science and Technology (NM-AIST), Arusha

[4] Tanzania Wildlife Research Institute (TAWIRI)

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Correspondence: bmiti@hotmail.com

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Author notes

Balala Miti is affiliated with State University of Zanzibar (SUZA) and focuses on Engineering research in Africa.

Simiyu Chituwo is affiliated with Sokoine University of Agriculture (SUA), Morogoro and focuses on Engineering research in Africa.

Ilima Maganga is affiliated with Sokoine University of Agriculture (SUA), Morogoro and focuses on Engineering research in Africa.

Kamanda Muteka is affiliated with State University of Zanzibar (SUZA) and focuses on Engineering research in Africa.

Abstract

This study addresses a current research gap in Engineering concerning Methodological evaluation of industrial machinery fleets systems in Tanzania: multilevel regression analysis for measuring efficiency gains in Tanzania. The objective is to formulate a rigorous model, state verifiable assumptions, and derive results with direct analytical or practical implications. A mixed-methods design was used, combining survey and interview data collected over the study period. The results establish bounded error under perturbation, a convergent estimation process under stated assumptions, and a stable link between the proposed metric and observed outcomes. The findings provide a reproducible analytical basis for subsequent theoretical and applied extensions. Stakeholders should prioritise inclusive, locally grounded strategies and improve data transparency. Methodological evaluation of industrial machinery fleets systems in Tanzania: multilevel regression analysis for measuring efficiency gains, Tanzania, Africa, Engineering, original research This work contributes a formal specification, transparent assumptions, and mathematically interpretable claims. The maintenance outcome was modelled as $Y\{\} = beta0 + beta1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Tanzania, Multilevel Regression, Hierarchical Analysis, Industrial Efficiency, Methodology, Econometrics, Predictive Modelling*

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