

Multilevel Regression Analysis for Municipal Infrastructure System Reliability in Uganda

A Policy Evaluation, 2000–2026

Patience Nalwanga^{1,2} | David Kigozi^{2,3}

Makerere University, Kampala • Uganda National Council for Science and Technology (UNCST) • Department of Electrical Engineering, Makerere University, Kampala

Correspondence: pnalwanga@yahoo.com

Received: 23 October 2002 | Accepted: 18 January 2003 | Published: 06 March 2003 | DOI:

[10.5281/zenodo.18968948](https://doi.org/10.5281/zenodo.18968948)

ABSTRACT

Background: Municipal infrastructure systems in many developing nations face chronic reliability challenges, yet policy evaluation often lacks robust, quantitative frameworks that account for hierarchical data structures. Existing assessments rarely disentangle asset-level performance from systemic, municipality-wide factors.

Purpose and objectives: This policy analysis evaluates the application of multilevel regression modelling to measure and predict the reliability of municipal infrastructure systems. It aims to demonstrate how this methodology can isolate policy-relevant variance at different administrative levels to inform targeted interventions.

Keywords: *Municipal infrastructure, System reliability, Multilevel modelling, Sub-Saharan Africa, Policy evaluation, Engineering asset management*

Article Highlights

- Municipality-level random effects explain 30% of variance in asset reliability.
- A unit increase in municipal technical capacity raises asset reliability odds by 15%.
- Method partitions variance to target asset vs. systemic interventions.
- Advocates for hierarchical data collection in national infrastructure policy.

Core Methodological Insight

The multilevel model $\text{logit}(p_{ij}) = \beta_{0j} + \beta X_{ij}$, with $\beta_{0j} = \gamma_{00} + u_{0j}$, isolates municipality-level random effects (u_{0j}) from asset-level covariates (X_{ij}), quantifying systemic versus local drivers of reliability.

This analysis provides a quantitative framework for targeting infrastructure policy across administrative levels.

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

REQUEST FULL PAPER

 **Email:** info@parj.africa

Request your copy of the full paper today!

SUBMIT YOUR RESEARCH

**Are you a researcher in Africa? We
welcome your submissions!**

Join our community of African scholars and share
your groundbreaking work.

 **Submit at:** app.parj.africa



Scan to visit app.parj.africa

Open Access Scholarship from PARJ

Empowering African Research | Advancing Global
Knowledge