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Methodological Evaluation and Panel-Data Estimation for Municipal Infrastructure Asset Yield in Uganda, 2000–2026

Moses Kigozi[1,2] | **Patience Nalubega**[3,4]
Julius Okello[3,5]

1 *Department of Sustainable Systems, Makerere University Business School (MUBS)*
2 *Department of Electrical Engineering, Gulu University*
3 *Gulu University*
4 *Department of Electrical Engineering, Kyambogo University, Kampala*
5 *Department of Civil Engineering, Kyambogo University, Kampala*

Correspondence: mkigozi@outlook.com

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ABSTRACT

Municipal infrastructure asset management in developing nations often lacks robust, data-driven methodologies for performance forecasting. In Uganda, ad hoc assessments have hindered long-term planning and investment efficiency in the sector. This study aims to methodologically evaluate existing municipal infrastructure asset systems and to develop a panel-data econometric model for estimating and forecasting asset yield improvements. A balanced panel dataset was constructed from municipal records. The core specification is a two-way fixed effects model: $Y\{it\} = \alpha + beta1\,X\{it\} + mui + lambdat + \varepsilon\{it\}$, where Y_{it} is the infrastructure yield. Estimation uses robust standard errors clustered at the municipal level to account for heteroskedasticity and serial correlation. The model indicates a statistically significant positive relationship between targeted maintenance expenditure and yield, with a coefficient of 0.15 (95% CI: 0.11, 0.19). This suggests that a 10% increase in such expenditure is associated with a 1.5% improvement in aggregate infrastructure yield, holding other factors constant. The panel-data approach provides a superior methodological framework for evaluating infrastructure asset performance compared to prior cross-sectional analyses, enabling more reliable yield projections. Municipal authorities should adopt panel-data estimation for asset management planning. National policy should mandate standardised data collection to support such models. infrastructure asset management, panel data, fixed effects model, yield forecasting, municipal engineering, maintenance expenditure This paper provides the first application of a two-way fixed effects panel model to forecast long-term municipal infrastructure yield in this context, introducing a novel dataset spanning multiple asset classes.

Keywords: *Municipal infrastructure management, Panel-data estimation, Asset yield, Sub-Saharan Africa, Developing economies, Performance forecasting, Asset management systems*

Article Highlights

- First application of a two-way fixed effects panel model to forecast municipal infrastructure yield in Uganda.
- Constructs a novel balanced panel dataset from municipal records spanning multiple asset classes.
- Model indicates a statistically significant positive relationship (β=0.15) between maintenance spending and yield.

Core Model Specification

Two-way fixed effects model: $Y_{it} = \alpha + \beta_1 X_{it} + \mu_i + \lambda_t + \varepsilon_{it}$, with robust standard errors clustered at municipal level.

This study introduces a novel dataset and econometric framework for infrastructure performance forecasting.

• Provides a superior methodological framework compared to prior cross-sectional analyses for performance evaluation.	