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Methodological Evaluation and Yield Improvement of Municipal Infrastructure Asset Systems in Senegal

A Quasi-Experimental Design

Aminata Diop[1]
Council for the Development of Social Science Research in Africa (CODESRIA), Dakar
Correspondence: adiop@gmail.com

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ABSTRACT

Municipal infrastructure asset management in West Africa faces systemic challenges in data collection and performance measurement, leading to suboptimal resource allocation and service delivery. Existing evaluation frameworks often lack empirical rigour suitable for the region's specific operational contexts. This study aimed to develop and apply a robust methodological framework for evaluating municipal infrastructure asset systems, with the specific objective of quantifying yield improvements in maintenance and capital works programmes. A quasi-experimental difference-in-differences design was implemented across a sample of matched municipal councils. The core impact was estimated using a fixed-effects panel model: $Y\{it\} = beta0 + beta1\,(Treati \times Postt) + alphai + gammat + \varepsilon\{it\}$, where robust standard errors were clustered at the municipal level. Primary data on asset condition, expenditure, and service output were collected via structured audits. The intervention group demonstrated a statistically significant 18.7% improvement in aggregate asset yield (95% CI: 14.2% to 23.2%) relative to the control group. The enhancement was primarily driven by improved prioritisation of reactive maintenance and more efficient procurement cycles. The applied quasi-experimental design provides a valid and reliable method for isolating the causal effect of systematic asset management interventions within a municipal engineering context. Municipal authorities should adopt structured, data-driven audit protocols and integrate quasi-experimental evaluation designs into the planning cycle for infrastructure programmes to rigorously measure performance gains. asset management, infrastructure, quasi-experimental, municipal engineering, difference-in-differences, yield This paper presents a novel application of a quasi-experimental design to isolate the causal impact of a systematic asset management framework on infrastructure yield in a Sub-Saharan African municipal context.

Keywords: *Municipal infrastructure, Asset management, Sub-Saharan Africa, Quasi-experimental design, Performance measurement, Yield improvement, Service delivery*

Article Highlights

- Applies a quasi-experimental difference-in-differences design to municipal infrastructure evaluation.
- Quantifies a significant 18.7% improvement in asset yield from systematic management.
- Highlights improved maintenance prioritisation and procurement efficiency as key drivers.
- Advocates for integrating structured audit protocols into municipal planning cycles.

Core Methodological Contribution

This study validates the application of a quasi-experimental design with a fixed-effects panel model to rigorously isolate causal effects in municipal asset management, providing a replicable framework for the region.

This article presents a novel empirical framework for evaluating infrastructure management in Sub-Saharan Africa.