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COMPARATIVE STUDY

Comparative Cost-Effectiveness of Municipal Infrastructure Asset Management Systems in Rwanda

A Randomised Field Trial Evaluation

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ABSTRACT

{ "background": "Municipal infrastructure asset management systems are critical for sustainable development, yet evidence on their comparative cost-effectiveness in low-resource settings remains sparse. This gap hinders evidence-based policy and investment decisions in the engineering sector.", "purpose and objectives": "This study aimed to rigorously evaluate and compare the cost-effectiveness of two prevalent municipal infrastructure asset management systems implemented in the country: a centralised digital platform and a decentralised, paper-based system.", "methodology": "A randomised field trial was conducted across 24 municipalities. Municipalities were randomly assigned to implement one of the two systems for managing road and water drainage assets. Cost data were collected systematically, and effectiveness was measured via a composite performance index. Cost-effectiveness was analysed using a generalised linear model: $CEi = \beta0 + \beta1\,Ti + \beta2\,\xi + \epsiloni$, where CEi is the cost-effectiveness ratio, Ti is the treatment assignment, and ξ is a vector of covariates. Robust standard errors were clustered at the municipal level.", "findings": "The centralised digital system demonstrated superior cost-effectiveness, with a mean ratio 1.47 times higher than the decentralised system (95% CI: 1.21 to 1.73). This was primarily driven by a 22% reduction in administrative costs and more consistent asset condition reporting.", "conclusion": "The centralised digital asset management system represents a more cost-effective approach for municipal engineering infrastructure management in the studied context.", "recommendations": "Policy makers should prioritise investment in and scaling of integrated digital asset management platforms, supported by targeted capacity-building for municipal engineers. Future research should examine long-term lifecycle cost implications.", "key words": "asset management, cost-effectiveness analysis, randomised controlled trial, infrastructure, municipalities, engineering management", "contribution statement": "This paper provides the first experimental evidence from a field trial comparing infrastructure management systems in the region, introducing a novel application

Keywords: *Municipal infrastructure, Asset management, Cost-effectiveness analysis, Randomised controlled trial, Sub-Saharan Africa*

Article Highlights

- A randomised trial across 24 Rwandan municipalities

Methodological Note

Cost-effectiveness was analysed using a generalised linear

provides robust comparative evidence. • Centralised digital systems reduced administrative costs by 22% versus decentralised methods. • Superior cost-effectiveness was driven by more consistent asset condition reporting. • Findings support prioritising digital platforms for municipal infrastructure management.	model with robust standard errors clustered at the municipal level. *This study offers the first experimental comparison of municipal asset management systems in the region.*