

# Methodological Evaluation and Panel-Data Estimation for Municipal Infrastructure Risk Reduction in Senegal (2000–2026)

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## ABSTRACT

**Background:** Municipal infrastructure systems in many developing nations face significant, yet poorly quantified, risks from environmental and socio-economic pressures. A lack of robust, longitudinal methodologies for asset-level risk assessment hinders effective capital planning and resilience investment.

**Purpose and objectives:** This working paper aims to develop and evaluate a panel-data econometric methodology for quantifying risk reduction in civil engineering assets. The objective is to provide municipal engineers with a replicable framework for prioritising infrastructure interventions based on empirical risk trajectories.

**Keywords:** *Municipal infrastructure, Sub-Saharan Africa, Panel-data analysis, Risk reduction, Asset management, Developing countries, Longitudinal data*

### Article Highlights

- Panel-data methodology successfully isolates effects of targeted interventions from unobserved heterogeneity.
- Structured maintenance programmes associated with significant reduction in composite risk scores.
- Provides municipal engineers with a replicable framework for prioritising infrastructure interventions.
- Moves infrastructure risk assessment beyond cross-sectional snapshots to longitudinal analysis.

### Core Methodology

Two-way fixed effects model with cluster-robust standard errors, integrating engineering inventories, environmental exposure, and maintenance records.

*This paper presents a novel econometric framework for longitudinal infrastructure risk assessment.*

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