



Methodological Evaluation of Municipal Water Systems in Senegal: A Randomized Field Trial for Cost-Effectiveness Assessment

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Abstract

The effectiveness of municipal water systems in Senegal is crucial for rural development and environmental sustainability. A randomized controlled trial was conducted to measure KPIs such as water supply reliability, distribution efficiency, and user satisfaction. Data collection included monthly surveys and technical inspections. Water supply reliability in the intervention group improved by 30% compared to the control group ($p < 0.05$). User satisfaction scores increased 12 percentage points from baseline (95% CI: 6-18%). The randomized trial demonstrated significant cost-effectiveness gains, with a marginal cost-benefit ratio of 1.7 in favour of the intervention. Municipal water systems should prioritise infrastructure upgrades and robust maintenance schedules to enhance reliability and user satisfaction. The empirical specification follows $Y = \beta_{0+\beta} p X + \text{varepsilon}$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *African geography, Methodology, Randomized trials, Water resource management, Sustainability assessment, Economic evaluation, Rural development*

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