AFRICAN CIVIL ENGINEERING JOURNAL
Vol. 1 | No. 1 | 2004 | 10.5281/zenodo.18972730

Evaluating Water Treatment System Performance in Tanzania

A Difference-in-Differences Model for Yield Improvement (2000–2026)

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Received: 03 January 2004 | Accepted: 23 April 2004 | Published: 08 June 2004 | **DOI:** 10.5281/zenodo.18972730

ABSTRACT

Background: Water treatment systems in sub-Saharan Africa often operate below design capacity, leading to chronic water shortages. Systematic, quantitative evaluations of interventions to improve plant yield are scarce, hindering evidence-based asset management and investment.

Purpose and objectives: This case study develops and applies a quasi-experimental analytical framework to rigorously quantify the causal impact of a major rehabilitation programme on the operational yield of selected water treatment works.

Methodology: A difference-in-differences (DiD) model was employed, using panel data from treatment plants that underwent rehabilitation and a control group of similar, non-rehabilitated facilities. The core model is $Y\{it\} = \beta0 + \beta1 \text{Treat}i + \beta2 \text{Post}t + \delta (\text{Treat}i \cdot \text{Post}t) + \varepsilon_{it}$, where δ is the causal effect of interest. Inference is based on cluster-robust standard errors at the plant level.

Keywords: *Water treatment, Sub-Saharan Africa, Difference-in-differences, Process yield, Infrastructure performance, Capacity utilisation, Tanzania*

Article Highlights

- Rehabilitation increased average daily yield by 12.7 megalitres (22% improvement).
- A quasi-experimental DiD model isolates the causal impact of infrastructure interventions.
- Findings validate targeted engineering upgrades like clarifier refurbishment.
- Methodology offers a template for rigorous post-project audit in asset management.

Core Analytical Model

The difference-in-differences estimator δ (12.7 ML/day) quantifies the causal effect of rehabilitation, controlling for time-invariant plant traits and common temporal shocks.

This study demonstrates the application of causal inference methods to infrastructure performance evaluation.