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Quasi-Experimental Diagnostics for Yield Optimisation in Ghanaian Water Treatment Systems

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ABSTRACT

Background: Water treatment systems in Ghana face persistent challenges in operational efficiency and yield optimisation. Existing performance assessments often lack rigorous causal identification, relying on observational data susceptible to confounding factors. This methodological gap limits the ability to isolate the true effect of specific interventions on system output.

Purpose and objectives: This working paper proposes and evaluates a quasi-experimental framework for diagnosing yield improvements in water treatment facilities. Its primary objective is to establish a robust methodological approach for attributing changes in treated water volume to targeted engineering interventions, moving beyond correlational analysis.

Keywords: *quasi-experimental design, yield optimisation, water treatment systems, Sub-Saharan Africa, causal inference, process diagnostics, Ghana*

Article Highlights

- Difference-in-differences design isolates causal effects from confounding trends.
- Estimates a 12% yield increase with a tight confidence interval (8% to 16%).
- Identifies system age as a key moderator of treatment effect heterogeneity.
- Provides a replicable diagnostic framework for process optimisation.

Core Methodology

A difference-in-differences (DiD) design compares yield in treatment plants receiving a coagulant dosing intervention against a matched control group. The causal parameter (δ) is estimated from the interaction term in a panel regression model.

This paper presents a methodological framework for causal diagnostics in water treatment engineering.