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Comparative Field Trial of Water Treatment Systems in Ghana

Methodological Evaluation and Adoption Metrics (2000–2026)

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ABSTRACT

Background: Universal access to potable water remains a critical challenge in sub-Saharan Africa. While numerous water treatment technologies have been deployed, systematic comparative data on long-term adoption and performance under real-world conditions is scarce, hindering evidence-based policy and engineering design.

Purpose and objectives: This study aimed to methodologically evaluate and compare the sustained adoption rates and operational efficacy of three prevalent community-scale water treatment systems—biosand filters, ceramic pot filters, and chlorination dispensers—through a longitudinal randomised field trial.

Keywords: *Water treatment technologies, Sub-Saharan Africa, Randomised field trial, Adoption metrics, Methodological evaluation, Ghana*

Article Highlights

- Ceramic filters showed superior long-term adoption (68%) versus biosand (52%) and chlorination (41%).
- Adoption odds ratio for ceramic filters versus chlorination was 3.05 ($p<0.001$).
- Maintenance accessibility and perceived taste were key determinants of sustained use.
- Study employed mixed-effects logistic regression across 120 rural communities.

Methodological Note

Cluster-randomised controlled trial with adoption modelled via: $\text{logit}(p_{ij}) = \beta_0 + \beta_1 T_{ij} + \beta_2 X_{ij} + u_j$, where p_{ij} is adoption probability.

This trial provides longitudinal evidence for technology selection in rural water interventions.