



Methodological Evaluation of Water Treatment Systems in South Africa Using Quasi-Experimental Design for System Reliability Assessment

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Abstract

Water treatment systems in South Africa face challenges related to reliability due to varying environmental conditions and infrastructure quality. The study employed a quasi-experimental design, including data collection from 20 randomly selected water treatment plants across South Africa. A statistical model was used to analyse the impact of climate variability and maintenance practices on system reliability. A significant proportion (35%) of systems showed reduced efficiency due to unpredictable climatic conditions, particularly during drought periods. The quasi-experimental design provided insights into how environmental factors influence water treatment facility performance, highlighting the need for adaptive management strategies. Investment in climate-resilient infrastructure and regular maintenance programmes is recommended to enhance system reliability in South African water treatment systems. Quasi-Experimental Design, Water Treatment Systems, System Reliability, Climate Variability, Maintenance Practices The maintenance outcome was modelled as $Y = \beta_0 + \beta_1 X + u_i + \epsilon_i$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Sub-Saharan, reliability assessment, quasi-experimental, water supply, treatment systems, infrastructure quality, environmental variability*

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