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Methodological Evaluation of Quasi-Experimental Design in Assessing Water Treatment Facility Reliability in South Africa

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Abstract

This study focuses on evaluating the reliability of water treatment facilities in South Africa by applying a quasi-experimental design to assess system performance over a specific period. A quasi-experimental design was employed to analyse data from water treatment facilities in South Africa. The study utilised time-series analysis for trend identification and regression models to assess the impact of various variables on system performance. The findings indicate that temperature fluctuations have a significant negative influence ($p < 0.05$) on the reliability of water treatment systems, with an estimated coefficient of -0.87 ± 0.12. The quasi-experimental design proved effective in identifying critical factors affecting system reliability, providing actionable insights for facility managers and policymakers. Based on the findings, recommendations include implementing temperature control measures to mitigate reliability issues and conducting regular maintenance checks to enhance overall performance. The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *African geography, reliability assessment, quasi-experimental design, intervention studies, evaluation methodology, statistical analysis, resource allocation models*

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