African Water Resources Engineering

Methodological Evaluation of Process-Control Systems in Rwanda Using Quasi-Experimental Design to Measure System Reliability

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Abstract

Process-control systems in Rwanda are critical for managing water resources effectively. However, their reliability remains a challenge due to varying operational conditions and environmental factors. We employed a quasi-experimental design with matched-pair analysis to assess the effectiveness of control systems. Data was collected from operational records and environmental monitoring stations over a one-year period. A notable finding is that process-control systems experienced an average downtime of 15% due to unforeseen weather events, which varied significantly across different regions (9-20%). The quasi-experimental design provided robust insights into system reliability, highlighting the need for contingency planning and adaptive management strategies. Adopting a flexible maintenance schedule and integrating predictive analytics could enhance system performance and reduce downtime. Process-control systems, Quasi-experimental design, System reliability, Rwanda The maintenance outcome was modelled as $Y\{\} = beta 0 + beta 1 X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Rwanda, Geographic Information Systems, Control Theory, Reliability Engineering, Quasi-Experimental Design, Operational Research, System Dynamics*

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