

Integrating Probabilistic Rainfall Projections and Hydraulic Modelling for Climate-Resilient Urban Drainage Design in Coastal Ghana

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ABSTRACT

Background: Urban drainage infrastructure in coastal West Africa faces increasing failure risks due to more intense precipitation events driven by climate change. Existing design standards often rely on historical rainfall data, which inadequately represent future climate uncertainty, leading to systems vulnerable to surcharge and flooding.

Purpose and objectives: This study aimed to develop and demonstrate a probabilistic framework for designing climate-resilient urban drainage systems. The objective was to integrate future rainfall projections with one-dimensional hydraulic modelling to quantify and mitigate flood risks under changing climatic conditions.

Keywords: *Climate-resilient infrastructure, Urban drainage design, Probabilistic rainfall modelling, Hydraulic modelling, Coastal West Africa*

Article Highlights

- Probabilistic analysis projects an 18–32% increase in 10-year design storm intensity by mid-century.
- A coupled stochastic rainfall and hydraulic modelling framework quantifies future system failure risks.
- The study demonstrates the insufficiency of historical data-based design for coastal West Africa.
- Findings advocate for integrating climate projection ensembles into national drainage guidelines.

Methodological Insight

The framework couples a stochastic rainfall model, forced with downscaled RCM projections, with 1D hydraulic modelling to assess system performance via a logit model of surcharge probability.

This study provides a practical framework for transitioning to climate-informed drainage design.



ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.



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