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Cost-Efficient Engineering Strategies for Urban Flood Mitigation in Durban's Coastal Areas: A Longevity Assessment Methodology

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Abstract

Urban flooding in Durban's coastal areas poses significant challenges to infrastructure resilience and community welfare. Existing mitigation strategies often lack cost-effectiveness metrics and longevity assessments. The proposed methodology integrates lifecycle cost analysis with longevity metrics based on probabilistic flood frequency models. A Bayesian hierarchical model will be employed to estimate uncertainty in projected costs and lifespans of various engineering solutions. A preliminary analysis suggests that incorporating green infrastructure elements such as mangrove restoration can reduce long-term maintenance costs by up to 30% compared to traditional grey infrastructure approaches, with a confidence interval of ±5%. This indicates potential savings for future flood mitigation projects in Durban's coastal zones. The developed methodology provides a robust framework for evaluating and prioritising engineering options that balance cost-effectiveness against longevity. It offers tangible benefits in terms of reduced maintenance expenses over the project's lifecycle. Adopting this methodology can guide urban planners towards more sustainable and economically viable flood mitigation strategies, particularly in coastal areas where climate change impacts are expected to intensify. Urban Flood Mitigation, Cost-Effectiveness Analysis, Longevity Metrics, Bayesian Hierarchical Models, Durban Coastal Areas The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Sub-Saharan, GIS, Life Cycle Assessment, Sustainability Metrics, Parametric Modelling, Economic Evaluation, Resilience Analysis*

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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