



# Climate-Resilient Design for Urban Drainage Systems in Coastal Ghana: A Case Study

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### Abstract

Urban drainage systems in coastal regions of Ghana are increasingly challenged by climate variability, particularly with regard to increased frequency and intensity of heavy rainfall events. Coastal areas face unique hydrological challenges due to their proximity to sea level rise and tidal influences. A combination of hydrological modelling and stakeholder consultations was employed to develop a resilient drainage solution. The approach included sensitivity analysis using Monte Carlo simulations to evaluate the impact of climate change on rainfall patterns and runoff volumes. The model predicted that a 20% increase in annual precipitation could lead to a 35% rise in peak flood levels, necessitating adaptive design modifications to ensure system resilience. Stakeholder feedback emphasised the need for integrated drainage solutions that also address stormwater management and sanitation needs. The study underscores the importance of climate-resilient infrastructure planning for coastal urban areas facing increasing hydrological stresses. The findings suggest a direction towards incorporating predictive modelling in design processes to enhance system performance under future climatic scenarios. Urban planners should prioritise climate change adaptation measures in their drainage designs, aligning with international guidelines and best practices. Stakeholder collaboration is essential for comprehensive planning that considers both technical and social aspects of urban development. Climate Change, Urban Drainage Systems, Coastal Ghana, Hydrological Modelling, Resilience Design The maintenance outcome was modelled as  $Y = \beta_0 + \beta_1 X + u + v + \epsilon$ , with robustness checked using heteroskedasticity-consistent errors.

**Keywords:** *Geographical Information Systems (GIS), Climate Change Adaptation, Hydrology, Urban Planning, Water Management, Sustainable Infrastructure Design, Coastal Engineering*

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