

Integrating Flood Inundation Analysis and Susceptibility Modeling for Comprehensive Flood Hazard Assessment: A Case Study of Kota Belud, Sabah, Malaysia

ABSTRACT

Flood Hazard Assessment (FHAs) plays a vital role in enhancing the effectiveness of disaster preparedness and mitigation strategies. This study presents a comprehensive approach to FHAs by combining flood inundation analysis and flood susceptibility modelling. For this purpose, one of the flood-prone areas of Sabah, namely Kota Belud district, was selected as the study area. Leveraging a hydrodynamic methodology, the HEC-RAS model was employed to generate Flood Inundation Maps (FIM), considering diverse return periods. Concurrently, the Flood Susceptibility Index (FSi) was derived through statistical bivariate analysis, utilizing the Frequency Ratio model and heuristic analysis employing the Analytic Hierarchy Process (AHP) model. Creating a comprehensive flood inventory map for the study area involved integrating field surveys and official reports from local authorities. Statistical analysis utilized a dataset comprising 100 flood locations that experienced inundation in 2017 for training purposes, with an additional 54 flood locations from the 2016 flood report forming the validation dataset. The flood susceptibility modelling process considered six key parameters: drainage density, drainage proximity, land use, topographic elevation, topographic wetness index, and lithology. Validation of the flood susceptibility models was carried out through Area Under the Curve (AUC) analysis, revealing the Frequency Ratio model to exhibit higher accuracy with a success rate AUC of 0.89 and a prediction rate AUC of 0.82 compared to the AHP model. Consequently, the Frequency Ratio model was selected to be integrated with the Flood Inundation Maps (FIM) for generating the Flood Hazard Assessment (FHAs) map. The outcomes of this study underscore the significance of robust flood susceptibility modelling in tandem with accurate flood inundation mapping for effective flood hazard assessment. The amalgamation of the validated FSi (Frequency Ratio model) and FIM results in a robust FHAs map, serving as a vital tool for informed decision-making in flood risk management and disaster mitigation strategies.