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Flood Vulnerability Zoning for Blue Nile Basin Using Geospatial Techniques

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Abstract : Flooding ranks among the most destructive natural disasters, impacting millions of individuals globally and resulting in substantial economic, social, and environmental repercussions. This study's objective was to create a comprehensive model that assesses the Nile River basin's susceptibility to flood damage and improves existing flood risk management strategies. Authorities responsible for enacting policies and implementing measures may benefit from this research to acquire essential information about the flood, including its scope and susceptible areas. The identification of severe flood damage locations and efficient mitigation techniques were made possible by the use of geospatial data. Slope, elevation, distance from the river, drainage density, topographic witness index, rainfall intensity, distance from road, NDVI, soil type, and land use type were all used throughout the study to determine the vulnerability of flood damage. Ranking elements according to their significance in predicting flood damage risk was done using the Analytic Hierarchy Process (AHP) and geospatial approaches. The analysis finds that the most important parameters determining the region's vulnerability are distance from the river, topographic witness index, rainfall, and elevation, respectively. The consistency ratio (CR) value obtained in this case is 0.000866 (<0.1), which signifies the acceptance of the derived weights. Furthermore, 10.84m2, 83331.14m2, 476987.15m2, 24247.29m2, and 15.83m2 of the region show varying degrees of vulnerability to flooding—very low, low, medium, high, and very high, respectively. Due to their close proximity to the river, the northern-western regions of the Nile River basin—especially those that are close to Sudanese cities like Khartoum—are more vulnerable to flood damage, according to the research findings. Furthermore, the AUC ROC curve demonstrates that the categorized vulnerability map achieves an accuracy rate of 91.0% based on 117 sample points. By putting into practice strategies to address the topographic witness index, rainfall patterns, elevation fluctuations, and distance from the river, vulnerable settlements in the area can be protected, and the impact of future flood occurrences can be greatly reduced. Furthermore, the research findings highlight the urgent requirement for infrastructure development and effective flood management strategies in the northern and western regions of the Nile River basin, particularly in proximity to major towns such as Khartoum. Overall, the study recommends prioritizing high-risk locations and developing a complete flood risk management plan based on the vulnerability map.

Keywords : analytic hierarchy process, Blue Nile Basin, geospatial techniques, flood vulnerability, multi-criteria decision making
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