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Integrating GIS, MCDM, and Spatial Analysis for Comprehensive Flood Risk Assessment and Mapping in Uttarakhand, India

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ABSTRACT

This study presents a comprehensive approach to flood risk assessment and mapping in the Uttarakhand region, India, by integrating geographic information system (GIS) and multi-criteria decision-making (MCDM). The methodology involves using digital elevation models (DEMs) to categorise elevation into five classes, slope analysis to evaluate the role of terrain steepness and drainage density assessment to identify areas less susceptible to flooding. Average annual rainfall data, classified from meteorological stations, land use/land cover patterns and distances from rivers and roads, were analysed within a GIS framework to assess flood susceptibility. The analytic hierarchy process (AHP) was employed to assign weights to these criteria and generate a flood risk index (FRI) map. Key findings indicate that extensive moderate-to-high-risk zones are present, particularly in the lower regions of Uttarakhand. The weighted overlay analysis using GIS and AHP effectively identified areas at greater risk of flooding. The results offer valuable insights for flood risk management, land-use planning and disaster preparedness, highlighting the need for targeted interventions to enhance flood resilience in the region.

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The authors declare no conflicts of interest.