GIS-Based Comparative Analysis of Landslide Susceptibility Using Shannon Entropy, Weight of Evidence, and Information Value: A Case Study of Solan District

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Abstract

Landslide Susceptibility Assessment (LSA) is crucial for understanding and mitigating landslide risks, especially in vulnerable regions like Solan District, Himachal Pradesh, where complex topography, diverse geological formations, and significant precipitation contribute to instability. This study integrates geospatial analysis with statistical modelling techniques to evaluate the influence of various landslide conditioning factors (LCFs), including slope, elevation, aspect, and lithology, on landslide occurrence. Using a landslide inventory of 845 recorded events and GIS-derived thematic layers were used to apply three statistical models: Information Value (IV), Shannon Entropy (SE), and Weight of Evidence (WoE). Among them, the Information Value (IV) model demonstrated the highest predictive accuracy (AUC = 0.737), followed by Shannon Entropy (SE) (AUC = 0.719), while Weight of Evidence (WoE) showed the lowest performance (AUC = 0.632), suggesting limited capability in capturing complex spatial relationships. The resulting susceptibility map categorizes the district into distinct risk zones, aiding in hazard mitigation and land-use planning. Model validation through AUC-ROC analysis and success prediction rate curves confirmed the reliability and predictive accuracy of the applied techniques. This comparative study helps in underscores the importance of combining statistical models with geospatial tools for disaster risk management and infrastructure planning in Solan district.

Keywords

Landslide susceptibility, Solan district, GIS, Information Value (IV), Shannon Entropy (SE), Weight of Evidence, AUC-ROC analysis.