

Geospatial Analysis for Predicting Sinkhole Susceptibility in Greene County, Missouri

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Abstract : Sinkholes in the karst terrain of Greene County, Missouri, pose significant geohazards, imposing challenges on construction and infrastructure development, with potential threats to lives and property. To address these issues, understanding the influencing factors and modeling sinkhole susceptibility is crucial for effective mitigation through strategic changes in land use planning and practices. This study utilizes geographic information system (GIS) software to collect and process diverse data, including topographic, geologic, hydrogeologic, and anthropogenic information. Nine key sinkhole influencing factors, ranging from slope characteristics to proximity to geological structures, were carefully analyzed. The Frequency Ratio method establishes relationships between attribute classes of these factors and sinkhole events, deriving class weights to indicate their relative importance. Weighted integration of these factors is accomplished using the Analytic Hierarchy Process (AHP) and the Weighted Linear Combination (WLC) method in a GIS environment, resulting in a comprehensive sinkhole susceptibility index (SSI) model for the study area. Employing Jenk's natural break classifier method, the SSI values are categorized into five distinct sinkhole susceptibility zones: very low, low, moderate, high, and very high. Validation of the model, conducted through the Area Under Curve (AUC) and Sinkhole Density Index (SDI) methods, demonstrates a robust correlation with sinkhole inventory data. The prediction rate curve yields an AUC value of 74%, indicating a 74% validation accuracy. The SDI result further supports the success of the sinkhole susceptibility model. This model offers reliable predictions for the future distribution of sinkholes, providing valuable insights for planners and engineers in the formulation of development plans and land-use strategies. Its application extends to enhancing preparedness and minimizing the impact of sinkhole-related geohazards on both infrastructure and the community.

Keywords : sinkhole, GIS, analytical hierarchy process, frequency ratio, susceptibility, Missouri

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