

Research on the method of integrating spatial analysis techniques and fuzzy hierarchical analysis in GIS

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Abstract: This study proposes an integrated methodology combining spatial analysis techniques with fuzzy analytic hierarchy process (FAHP) within a geographic information system (GIS) framework. Traditional GIS-based multi-criteria decision analysis often relies on crisp Boolean logic, which inadequately captures the inherent uncertainty and subjectivity in spatial decision-making. By integrating FAHP, the research addresses the vagueness in expert judgments and the continuous nature of geographic phenomena. The methodology involves constructing a hierarchical decision model, deriving fuzzy pairwise comparison matrices to calculate criteria weights, and applying spatial overlay analysis within a GIS environment. A case study demonstrates the approach for land suitability assessment, validating its effectiveness in producing more nuanced and reliable suitability maps compared to conventional methods. Results indicate that the integrated GIS-FAHP framework significantly enhances the handling of imprecise information and improves the robustness of spatial decisions. This research provides a practical and systematic tool for planners and decision-makers in fields such as environmental management, urban planning, and resource allocation.

Keywords: spatial analysis, fuzzy hierarchical analysis, GIS, integration