

Advanced GIS-Based Flood Hazard Mapping Using Multi-Source Remote Sensing Data

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ABSTRACT

The increasing frequency and severity of flood events worldwide have amplified the necessity for advanced spatial analysis tools to predict, monitor, and mitigate flood-related hazards. Geographic Information Systems (GIS) integrated with multi-source remote sensing data present a robust framework for generating accurate flood hazard maps. This study develops a GIS-based flood risk mapping approach utilizing high-resolution satellite imagery, digital elevation models (DEMs), land use/land cover (LULC) data, and hydrological parameters. The methodology integrates remote sensing data with hydrological modeling to delineate flood-prone zones and assess vulnerability indices. The resulting flood hazard map identifies critical zones susceptible to inundation, enabling proactive disaster preparedness and informed urban planning. The findings underscore the potential of integrating UAV-based imagery, Sentinel-2 data, and LiDAR-derived elevation models to enhance spatial accuracy and decision-making in flood risk assessment.

Keywords: *Flood risk mapping, GIS, remote sensing, DEM, hydrological modeling, UAV, Sentinel-2, LiDAR*

INTRODUCTION

Floods are among the most devastating natural disasters, causing significant socio-economic losses and environmental damage globally. The integration of Geographic Information Systems (GIS) and remote sensing provides a reliable platform for identifying flood-prone areas and predicting potential inundation zones. High-resolution remote sensing data, combined with hydrological and topographical datasets, can be processed to create accurate risk maps that support early warning systems and sustainable land-use planning.

METHODOLOGY

Data Acquisition

Data were collected from multiple sources, including Sentinel-2 satellite imagery for land cover classification, UAV imagery for high-resolution terrain mapping, and LiDAR data for generating precise DEMs. Hydrological parameters, such as rainfall intensity and river discharge data, were obtained from meteorological and hydrological departments.

Data Processing

The acquired datasets were pre-processed using atmospheric correction and geometric rectification. LULC classification was performed using supervised classification techniques in GIS. DEMs were processed to extract slope, flow accumulation, and watershed boundaries.

Flood Risk Mapping

Flood hazard zones were delineated by integrating hydrological models with spatial data layers, including slope, elevation, soil type, and drainage density. Weighted overlay analysis was employed to produce a composite flood risk map.

Data Sources And Specifications

Data Type	Source	Resolution/Accuracy
Sentinel-2 Imagery	ESA Copernicus	10 m
UAV Imagery	Field Survey	5 cm
LiDAR DEM	National Survey Agency	0.5 m

RESULTS AND DISCUSSION

The flood hazard map generated through the GIS-based approach revealed that approximately 35% of the study area is at high risk of flooding, with critical zones located near riverbanks and low-lying regions. The integration of UAV and LiDAR data significantly enhanced spatial precision compared to traditional satellite imagery alone. These findings demonstrate the effectiveness of multi-source data fusion in improving flood risk prediction accuracy.

CONCLUSION

The study successfully demonstrated that the integration of GIS with multi-source remote sensing data offers a robust and accurate method for flood risk mapping. The produced hazard maps can guide authorities in strategic planning, early warning systems, and emergency response measures. Future research should explore real-time data integration from IoT sensors to further enhance flood prediction capabilities.

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