

Flood Hazard Zonation and Risk Assessment Using QGIS: A Case Study of Vijayawada Region

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Abstract - Floods are one of the most common natural disasters and cause serious damage to people, buildings, roads, and other infrastructure. Vijayawada, which is located on the banks of the Krishna River, experiences floods frequently due to heavy rainfall, release of water from upstream reservoirs, and rapid urban growth. This study aims to identify flood-prone areas in Vijayawada using Geographic Information System (GIS) and QGIS software. Important factors such as Digital Elevation Model (DEM), slope, rainfall, land use and land cover (LULC), drainage density, and distance from river channels were used for the analysis. Each factor was given a suitable weight based on its importance in causing floods. A weighted overlay analysis was carried out in QGIS to prepare a flood risk map. The study area was classified into four flood risk zones: **Very High, High, Moderate, and Low**. The results show that low-lying areas near the Krishna River, densely built-up urban regions, and places with poor drainage are more likely to experience flooding. The flood risk map can help urban planners, disaster management authorities, and civil engineers in planning flood control measures, improving land use planning, and developing safer infrastructure in Vijayawada.

Key Words: Flood Risk Assessment, DEM, Slope, Rainfall, LULC, Weighted Overlay Analysis, soil Investigation.

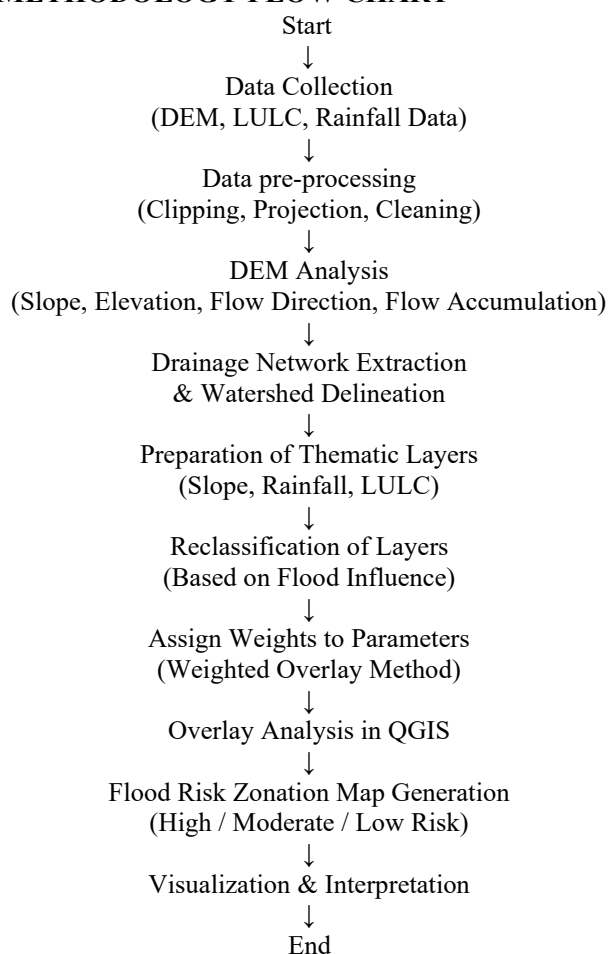
1. INTRODUCTION

Floods are one of the most common natural disasters, causing damage to people, property, and infrastructure. Vijayawada is prone to flooding due to heavy rainfall, the Krishna River, low-lying areas, and rapid urbanization. GIS and QGIS provide an effective way to identify flood-prone areas by analyzing factors such as elevation, slope, rainfall, land use, and drainage. This study uses weighted overlay analysis to prepare a flood risk map for Vijayawada.

2. OBJECTIVE OF THE STUDY

The present study integrates advanced geospatial technologies and computational tools to perform a comprehensive flood risk assessment. Geographic Information System (GIS) serves as the primary platform for spatial data analysis, visualization, and mapping. Software such as QGIS is utilized to process and analyze spatial datasets, generate thematic maps, and perform overlay analysis.

3. METHODOLOGY FLOW CHART



4. RESULTS AND DISCUSSIONS

The flood risk assessment for the Vijayawada region was carried out using a multi-criteria spatial analysis approach, with the Weighted Overlay Method serving as the core technique. Various thematic layers such as slope, elevation (DEM), rainfall, and drainage density were integrated by assigning appropriate weights based on their influence on flood occurrence. The resulting Flood Risk Index (FRI) map clearly highlights the spatial variation in flood susceptibility across the study area. Low-lying regions with gentle slopes and high rainfall intensity were identified as the most vulnerable zones, while elevated areas with steeper slopes showed comparatively lower flood risk.

Table 1 Connected Streams

S.No.	Parameter	Description	Method/Source	Units	Relevance to Flood Risk
1.	Stream Order	Hierarchical classification of streams derived from major river	Strahler Method	Dimensionless	Identifies drainage hierarchy and flow structure
2.	Tributary Density	Number of streams originating from the main river per unit area	GIS-based Extraction (DEM)	No./km ²	Indicates runoff concentration and flood potential
3.	Stream Length	Total length of tributaries connected to the major river	Spatial Analysis (GIS)	km	Reflects flow accumulation and drainage extent
4.	Proximity to Main River	Distance of streams from the primary river channel	Buffer Analysis	km	Determines flood vulnerability zones

Figure 1 Land Use and Land Cover

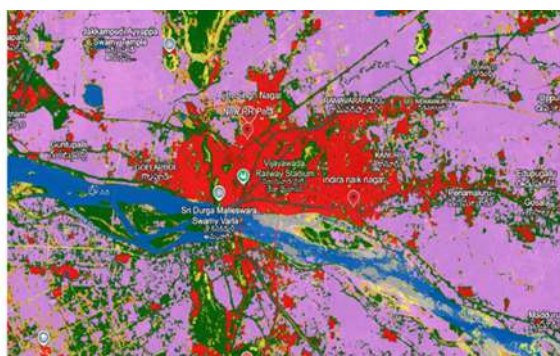
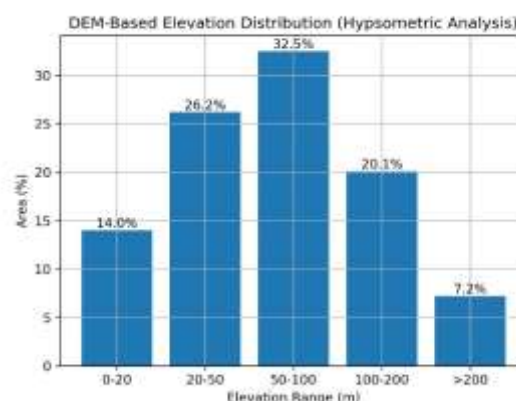


Figure 2 Connected Streams



Chart 1 Hypsometric analysis



5.CONCLUSIONS

1. The study successfully used GIS and QGIS to analyze flood-prone areas by integrating factors such as DEM, slope, rainfall, drainage, land use/land cover (LULC), and river flow.
2. The analysis showed that elevation and slope strongly influence flood occurrence. Low-lying and gentle slope areas are more prone to water accumulation and flooding.
3. The drainage network plays an important role in flood behavior. Areas with poor drainage or high drainage congestion are more vulnerable during heavy rainfall.
4. The flood risk map identified that regions near the Krishna River and downstream areas have a higher flood risk, while higher elevation areas are comparatively safer.
5. River flow analysis indicated that during heavy rainfall, some river sections may exceed their carrying capacity, leading to overflow and flooding in nearby areas.
6. The study concludes that GIS-based flood risk assessment is an effective tool for identifying vulnerable areas and supports urban planning, disaster management, flood mitigation, and sustainable infrastructure development.

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