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Flood risk mapping using multi-criteria analysis (TOPSIS) model through geospatial techniques- A case study of the Navsari city, Gujarat, India

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Flood is one of the most devastating natural disasters that cause enormous socioeconomic and environmental destruction. The severity of flood losses has evoked emphasis on more comprehensive and vigorous flood modeling techniques for alleviating flood damages. Flood vulnerability in Navsari is intensifying due to urbanization, industrialization, and population growth. Although there has been a significant increase in research on flood assessment at a local scale in Navsari, there remains a lack of tools developed which utilize the risk map of the city. In response to this prerequisite, in this study we have employed a GIS-based Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) multi-criteria analysis model to develop a flood risk map for Navsari city in Gujarat, India, to determine the vulnerable areas that are more susceptible to flooding. To estimate the extent of flood hazard, vulnerability, and risk intensities in terms of area covered, the city was divided into ten zones (i.e. NC1 to NC10) and classified into five classes: very high, high, moderate, low, and very low. A total of seven hazard forming spatial layers (i.e. slope, elevation, soil, rainfall, flow accumulation, distance to a river, and drainage density) and seven vulnerability forming spatial layers (i.e. female population, population density, land use, household, distance to hospital, road network density, and literacy rate) were appraised for evaluating the risk of flooding. The generated flood risk map has been compared with the extent of flood calculated based on field data collected from thirty-six random places. The outcome of the model unveiled the capability of the TOPSIS model since it capitulate low RMSE value varied between 0.95 to 0.43 and high R square value ranged from 0.78 to 0.95. The zones indicated under ‘high’ and ‘very high’ categories (i.e. NC8, NC6, NC4, NC1, NC7, and NC10) demand abrupt flood control action to alleviate the severity of flood risk and subsequent damages. The approach implemented in the study can be applied to any flood-sensitive region around the globe to accurately evaluate the risk of flood. Lastly, flood risk mapping using TOPSIS based geospatial techniques divulge the novel and efficacious approach, especially for data-sparse regions.