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Flood hazard mapping using fractal analysis in a semi-arid environment

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DESCRIPTION

Floods make up around one-third of all geophysical hazards in the globe and are the most damaging natural catastrophe on record. The loss of life and financial damage has been attributed to the floods. However, there are a number of effective strategies that can be used to manage and mitigate this phenomenon. Flood hazard mapping should be used in conjunction with other remedial measures rather than being used as a stand-alone strategy to decrease flood damages. There are a number of interventions that may be undertaken to alter the hydrological behavior of the catchments, including changes in flow velocity, soil erosion, and sedimentation. These interventions include water delivery, diversion, and check dam building. A major factor in sustainable development is the preservation and safeguarding of natural and cultural heritages. However, a number of human actions or natural calamities pose a hazard to cultural heritage sites. Floods are one of these catastrophes that harm historic sites. Today, managing flood risks is a significant concern for many cultural sites. With urbanisation, climate change, population expansion, and economic growth, this dilemma will only get worse. The evaluation of flood hazards is a critical first step in managing flood risks effectively. It also forms the foundation for applying precautionary conservation measures for risk reduction, which supports the sustainable development of World Heritage sites.

In recent decades, a number of studies have evaluated the effects of check dams on the hydrology and geomorphology of catchments. Using the WaTEM (Water and Tillage Erosion Model)/SEDEM model (Sediment Delivery model) and six land use scenarios, one can determine the effect of check dams' presence or absence on the sediment production of Spain's Rogativa basin. The findings suggested that the sediment load was reduced by 77% following the building of check dams. The SWAT model was used to quantify the impact of vegetation, check dams, and climate change on a watershed in southwest China's suspended sediment output. According to the findings, improved plant coveraccounted for 47.8% of sediment reduction, followed by climate change at 19.8%, check dams at 26.1% and simulation bias at 6.3%. The impact of check dams on the catchment's flood hydrograph's maximum flow.

The impact of check dams on the channel geometries, sediment patterns, and flora in Calabria's upstream area in southern Italy. By altering the gradient of the stream bed, check dams can stop debris flows, and a series of minor dams can stop drainage networks from being severed. A layer of wedge-shaped sedimentary deposits produced by sediment-filled check dams may be utilized for farming, producing a yield that is two to three times higher than that of terraced fields and six to ten times higher than that of hill slopes. To create these maps for catchments with built check dams, it is necessary to take into account the influence of check dams on flood hazard mapping by taking into account a number of evaluation indices. However, an appropriate modeling technique is made difficult by the linkages between indices and flood risk's complicated and non-linear behavior. To deal with this complexity, a number of systematic techniques have been developed, including the Analytic Hierarchy Process (AHP), Set Pair Analysis (SPA), Imprecise Shannon's Entropy, and Fuzzy Comprehensive Evaluation. Although these techniques have been successfully applied to evaluate flood risk, they have drawbacks.

When remote sensing data is combined with a Geographic Information System (GIS) environment, it opens up previously unprecedented possibilities for combining various extracted features and parameters for flood danger mapping. To create a flood danger map, independent characteristics were combined using the Frequency Ratio (FR) model using a weighted-based bivariate probability technique. 43 reference flood locations taken from a flood inventory were used to test the implemented technique, yielding 97.7% accuracy. Used seven factors to map flood danger zones in the city of Warangal, India in 2019: rainfall, surface roughness, soil type, distance from the main river, drainage density, and Land Use/Land Cover (LULC). To do this, the weights of each characteristic and parameter were determined using the Analytical Hierarchy Process (AHP), and a Flood Hazard Index (FHI) was created using a multi-criteria decision-making approach in a GIS context. The Soil and Water Assessment Tool (SWAT) was then used to evaluate the effectiveness of the suggested technique, indicating its great potential for mapping flood hazards.