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Gis Based Flash Flood Runoff Simulation Model of Upper Teesta River Besin - Using Aster Dem and Meteorological Data

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Abstract : Flash flood is one of the catastrophic natural hazards in the mountainous region of India. The recent flood in the Mandakini River in Kedarnath (14-17th June, 2013) is a classic example of flash floods that devastated Uttarakhand by killing thousands of people.The disaster was an integrated effect of high intensityrainfall, sudden breach of Chorabari Lake and very steep topography. Every year in Himalayan Region flash flood occur due to intense rainfall over a short period of time, cloud burst, glacial lake outburst and collapse of artificial check dam that cause high flow of river water. In Sikkim-Derjeeling Himalaya one of the probable flash flood occurrence zone is Teesta Watershed. The Teesta River is a right tributary of the Brahmaputra with draining mountain area of approximately 8600 Sq. km. It originates in the Pauhunri massif (7127 m). The total length of the mountain section of the river amounts to 182 km. The Teesta is characterized by a complex hydrological regime. The river is fed not only by precipitation, but also by melting glaciers and snow as well as groundwater. The present study describes an attempt to model surface runoff in upper Teesta basin, which is directly related to catastrophic flood events, by creating a system based on GIS technology. The main object was to construct a direct unit hydrograph for an excess rainfall by estimating the stream flow response at the outlet of a watershed. Specifically, the methodology was based on the creation of a spatial database in GIS environment and on data editing. Moreover, rainfall time-series data collected from Indian Meteorological Department and they were processed in order to calculate flow time and the runoff volume. Apart from the meteorological data, background data such as topography, drainage network, land cover and geological data were also collected. Clipping the watershed from the entire area and the streamline generation for Teesta watershed were done and cross-sectional profiles plotted across the river at various locations from Aster DEM data using the ERDAS IMAGINE 9.0 and Arc GIS 10.0 software. The analysis of different hydraulic model to detect flash flood probability ware done using HEC-RAS, Flow-2D, HEC-HMS Software, which were of great importance in order to achieve the final result. With an input rainfall intensity above 400 mm per day for three days the flood runoff simulation models shows outbursts of lakes and check dam individually or in combination with run-off causing severe damage to the downstream settlements. Model output shows that 313 Sq. km area were found to be most vulnerable to flash flood includes Melli, Jourthang, Chungthang, and Lachung and 655sq. km. as moderately vulnerable includes Rangpo,Yathang, Dambung,Bardang, Singtam, Teesta Bazarand Thangu Valley. The model was validated by inserting the rain fall data of a flood event took place in August 1968, and 78% of the actual area flooded reflected in the output of the model. Lastly preventive and curative measures were suggested to reduce the losses by probable flash flood event.

Keywords : flash flood, GIS, runoff, simulation model, Teesta river basin
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