

ABSTRACT

Water level and discharge at various gauging stations along the reaches of the Subernarekha River are estimated using hydrodynamic modeling technique during the flood affected years of 1985, 1988 and 1997. Digital Elevation Model (DEM) of the study area has been prepared with high resolution CARTOSAT-1 stereo imageries and 239 river cross sections are extracted for hydrodynamic modeling. A total of 154 km reach length along the river is modeled starting from Jamshedpur to Bhosraghat. Water level and discharge at various stations are determined and verified with those of measured data. Water level data during monsoon period of 100 days are applied as the upstream and downstream boundary conditions of the model. In the above three flood affected years, model predicts discharge and water level with an index of agreement ranging from 0.89 to 1.0 and deviation in peak ranging from -18.32% to 0.32%.

Regional flood frequency analysis based on L-moment approach show that Pearson Type III distribution (PE III) is the most suitable distribution for forecasting future flood events along the river. A new method, based on “composite model” of possible candidate frequency distributions, has been proposed to improve accuracy in estimating growth factors for return periods. Growth factors are estimated based on the results of composite model for different return periods of 10, 25, 50 and 100 years. Using peak discharge data from 1985 to 2005, extreme flow hydrographs is identified. A novel method, based on “bump function”, has been developed to categorize the past flow hydrographs into “extreme”, “severe”, “moderate” and “normal” flow hydrographs. The expected flow hydrographs at Jamshedpur (upstream) and Bhosraghat (downstream) stations for above categories are estimated for each return period by multiplying ordinates of flow hydrographs by the corresponding growth factors estimated by composite model. With these boundary conditions, discharge and water level at every cross section for each return period are determined using the calibrated hydrodynamic model. The water surface profiles are then integrated with land use and land cover map in geographical information systems (GIS) platform for determination of affected areas in the flood plain. For this purpose, eight land use and land use and land cover classes of the flood basin are prepared using IRS P6 (LISS III) imageries. The assessment of damage due to flood in agriculture land, habitats, dense forest, mixed vegetation, scrubs, plantation, water bodies and barren land are determined for the flood affected years of 1985, 1988 and 1997 and other return periods. Considering the extreme flood hydrographs, results show that out of 17720.69 ha, 8463.25 ha of agriculture land, 6022.2 ha of habitats might be affected by the flood for the return period of 50 years. The expected areas of affected LULC classes are also determined for different water levels. It is estimated that 10754.07 ha of total land will be affected by combining severe, moderate and normal flood hydrographs for a return period of 50 years. Out of this total affected area, around 4735.97 ha, 3912.43 ha, 71.12 ha, 1151.07 ha, 109.20 ha, 571.54 ha, 68.58 ha and 134.17 ha of land respectively will be in agricultural land, habitats, dense forest, mixed vegetation, scrubs, plantation, water bodies, and barren land categories. This information would be useful for design and selecting location of structures, catchments areas and others along the river.

Keywords: Regional flood frequency analysis, CARTOSAT-1 DEM, HEC-RAS, Composite model, Bump function, and Flood hazard mapping and assessment