

Rainfall Variations and Land-use Pattern Change the Floods in MahaOya River Basin, Sri Lanka

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Flood behavior and possible driving factors (land use and rainfall) responsible for flood hazards of the Maha Oya were studied. Discharge data over the last 28 years were collected and analyzed to identify disaster management precautions and the driving factors affected flooding in Maha Oya. Previous studies suggest that the river basin had been subjected to serious erosion due to increased soil digging, clay mining, and high flood vulnerability over the last three decades. HEC-HMS rainfall-runoff modeling techniques were employed to develop previous (1992-1995) and present (2016-2019) conditions of the Maha Oya basin to compare the changes in discharge with respect to the variations in land-use and rainfall. These two periods were selected to represent the 28 years of duration. Land-use variations of the river basin for the relevant period were obtained from a supervised classification using Landsat images. Classified land-use maps were subjected to an accuracy assessment by calculating Kappa Coefficient. Delineated maps for the year 1990 and 2019 were validated with an overall accuracy of 92.5% & 96% and Kappa estimate value of 0.90 & 0.95, respectively. Two models were calibrated and validated with observed data until the Nash Sutcliffe function reach the acceptable range. Model-01 was calibrated for the period of 1992-1994 with a 0.60 Nash value and validated for the period of 1994-1995 with a Nash value of 0.507. Model-02 was calibrated for the period from 2016 to 2018 with a Nash value of 0.613 and validated for the period from 2018 to 2019 with a 0.553 Nash count. Developed models were used to run the controlled simulation by changing the rainfall data of the two models. Hydrographs of Model 01 & Model 02 and two controlled simulation hydrographs (Controlled Simulation 01 & Controlled Simulation 02) were derived and compared to assess the impact of land-use change and the rainfall variation on the river discharge. The comparison revealed that the river discharge level has depleted over the period of 1992 – 2019 due to the land-use variation. The rainfall variation has reduced the flood frequency during 1992-1995. And old river basin condition generates peak discharge of 200cms excess volume than the present condition. The base-flow of the Maha Oya basin has reduced over the study period, affecting the river discharge during dry months which was the major influence on the river discharge depletion. Land-use classification indicates changes in river channel over the study period augment by sand mining over the riverbank which may be the major influence on the base-flow depletion. The discharge level depletion is affected by other minor alterations and agricultural expansions in the sub-basins of the Maha Oya River basin.

Keywords: HEC-HMS, Land-use variation, Arc GIS, Rainfall variation, Baseflow, River discharge