FORECASTING AND MONITORING OF FLOOD OF RIVER MAYURAKSHI AT TILPARA BARRAGE SECTION, SURI, WEST BENGAL, INDIA

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Abstract:

Human civilization evolves over the ages by the side of the river, channel and streams. Rivers and water resources not only supply plenty amount of water for daily purposes but also help grow civilization in other forms like navigation, irrigation, agriculture, fishing and aquaculture, entertainment and recreation etc. But living in flood plain, man also has to face flood disaster. Flood is the deadliest among the natural disasters counting innumerable losses. The main cause of flooding is the incessant and continuous rain in a stipulated time over any watershed. The heavy downpour generates a considerable amount of runoff water that river course cannot accommodate, resulting disastrous flood along its bank and adjoining area. Flooding is also catered by human induced causes which are drainage congestion, constriction of river channel due to deposition of silt and sand, uncontrolled release of dam or barrage water, not proper dredging of river course , water logging and over saturation of river plain etc. Like many other river basins of the world, the Indian rivers are no exception from this dreadful extreme phenomenon. In every monsoon season, the country suffers from severe flood situation. River Mayurakshi, one of the tributaries of Bhagirathi (Branch River of the Ganges) is a well known name in the flood scenario of South Bengal. In the years 1978, 1995, 1997 and 2000, Mayurakshi river basin suffered from massive floods. Several community blocks were washed away and a large number of villages were marooned which accounted forheavy loss of life and property. So, proper flood model and management program need to be adopted to mitigate the ill effects of the same. The current study has been undertaken in an attempt to forecast and monitor flooding phenomena of the Mayurakshi river at the Tilpara barrage section and its downstream area. The present research work focuses on the control section Tilpara barrage situated downstream of Massanjore dam near Suri, the district headquarter of Birbhum. In the research work, the forecasting and monitoring processes as a part of non-structural flood management measure has been carried out in three relevant sections. In the first section of the work, an attempt has been made to establish statistical relationship between the flood causative factors like rainfall, inflow, upstream water level and total canal discharge by using ordinary least square regression (OLSR) model. Out of the five statistical hypotheses that have been postulated, two hypotheses got rejected and it is found that the final statistical modelis linked in such a way that rainfall affects inflow, affecting total canal discharge alongside upstream

water level. Standardized beta between rainfall and inflow has been found to be 0.128, with probability of significance of 0.00%. The same between inflow and total canal discharge is 0.511. The relative importance of upstream water level and inflow is 27% and 73% (approximately) for influencing total canal discharge, which is the crucial parameter inducing flood in the neighborhood area. The stability of the final model also has been analyzed over twenty year's data set (1996-2016). The present work includes determination of descriptive statistics like maxima, minima, standard deviation, skewness and kurtosis for the entire data set of twenty five years (1992-2016). Along with this, Pearson correlation coefficient has been found out considering rainfall as independent variable and keeping other variables as dependent. These outcomes of the first section of the research work help to control and monitor the flow of the Mayurakshi river over the barrage section. In the second section of the work, an artificial neural network (ANN) model is used to forecast total canal discharge using rainfall, inflow, upstream water level as input variables. Twenty five year's river data (1992-2016) has been used. ANN module has been executed through *MATLAB* software. As a result, it produces two graphs: one graph showing data point distribution of actual discharge vs. predicted discharge and the other graph shows squared error vs. epoch corresponding to model's training, testing and validation line. From the result, it can be found that the outlier points of discharge data points having values 10,000-15,000 cusecs or more indicate the flood situation of the area of interest. Moreover, a trend analysis of the above four variables along with time as an independent variable has been operated through OLSR model and the stability of the model has been checked over the time period. Firstly, considering 'time' as an independent variable and 'upstream water level' as the dependent variable, the OLSR model has been operated, and F statistics values are found to be much higher with a probability value of significantly less than 5 %, which suggests a good fit. When 'inflow' is considered a dependent variable and „time" as an independent variable, the F value is statistically significant (less than 5%), except for the time period 2002-2006. Again, considering 'rainfall' as the dependent variable and 'time' as an independent variable, F statistics are found at a significant level (5%) only in periods 1997-2001 and 2006-2011. Finally, considering 'total canal discharge' as the dependent variable and 'time' as an independent variable, the F value is significant for 1997-2001, 2002-2006, and 2011 to 2016. B value in this duration is positive, and it indicates the rate of drainage of total canal discharge increases with each unit of time. In the third section of the study, the

freely available software HEC-RAS from US Army Corp's along with its HEC-GeoRAS extension has been used. The research work attempts hydrodynamic modeling of the Mayurakshi river basin (MRB), particularly in the downstream reaches of the Tilpara barrage section. SRTM DEM is used for terrain generation. It has further created a 2D flow area and is attributed with properly filled hydraulic table. It has finally generated a flood inundation extent of 9th August of 2015 using DEM, Land Use Land Cover and other inputs. The flood map is prepared by using QGIS software. It is able to indicate maximum inundation near the Kandi and Bharatpur blocks in the downstream area of the Tilpara barrage. Maximum inundation of 3 meters or more has been found in some places of the basin. Due to the lack of field data downstream of the barrage section, the flood inundation extent map is verified by the available satellite imageries from MODIS, Landsat 8 and Sentinel-1.

Thus it can be inferred that, the research work can forecast canal discharge using river parameters, establish statistical relationships among them, and finally generate a flood inundation extent of the river basin, making a comprehensive early decision support system for the flood and inundation scenario over the basin, particularly atthe downstream of Tilpara barrage section. All of the above outcomes of the research work are vital ingredients in modeling basin's early warning and flood management program and helps planners devising flood abatement strategies. The present research work suggests a comprehensive approach towards flood management in the MRB to be adopted by the local administration.