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Flood Estimation by GIS Based GIUH Approach for Ajay Basin upto Sarath Gauging Site of South Bihar

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ABSTRACT

The linearity principle of unit hydrograph theory has been widely applied for the simulation of rainfall-runoff process, particularly for small and medium sized catchments. Derivation of unit hydrograph has been extensively investigated by many researchers since Sherman gave the principle of unit graph in 1932. For the gauged catchments the unit hydrographs can be derived by analysing the historical rainfall-runoff records. However, for ungauged catchments some indirect approaches have been used for the derivation of the unit hydrographs. Due to scarcity of data, particularly for small and medium sized catchments, computational and the other constraints, physically based models are very difficult to be implemented. Greater emphasis is now being given to the concept of models based on geomorphological characteristics. Geomorphological instantaneous unit hydrograph (GIUH) is one among the various approaches available for the simulation of flood events, for the ungauged catchments. Many investigators have tried to relate the parameters of the conceptual models to the geomorphological characteristics of the catchments.

In this study, the mathematical model developed at the National Institute of Hydrology for estimation of the Clark model parameters using the geomorphological characteristics of an ungauged basin has been applied for simulation of the direct surface runoff (DSRO) hydrographs of the Ajay basin upto Sarath gauging site of South Bihar. The geomorphological parameters of the Ajay basin have been evaluated using the GIS package, Integrated Land and Water Information System (ILWIS). The direct surface runoff hydrographs estimated by the GIUH approach have been compared with the observed direct surface runoff hydrographs as well as with the DSRO hydrographs estimated by the Nash model and the HEC-1 package. The performance of the GIUH model has also been evaluated by employing some of the error functions viz. (i) efficiency, (ii) absolute average error, (iii) root mean square error, (iv) average error in volume, (v) percentage error in peak and (vi) percentage error in time to peak computed based on the observed and the

simulated DSRO hydrographs. It is observed that the DSRO hydrographs are computed quite accurately by the GIUH based Clark model approach, which simulates the DSRO hydrographs of the basin considering it to be ungauged. Sensitivity analysis of the GIUH based Clark model shows that the peaks of the DSRO hydrographs of the various events increase with increase in the velocity parameter of the model. As estimation of the velocity parameter emerges to be one of the most important factors in this methodology of the GIUH derivation; hence, scope of the further work to be carried out for improving the excess-rainfall intensity and velocity relationship and the concept of determination of regional velocity has also been focussed.