Estimates of Maximum Flood Discharge, Transfer Capacity and Sedimentation of Sonqor Watershed Using the GIUH and WinTR-55 Models

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1-Introduction

In the catchment areas without statistics or incomplete statistics, the extraction of flood characteristics and the provision of water resources and sediment transport analysis are appropriate using empirical methods or models based on the watershed characteristics. One of these methods is the use of the capabilities and capabilities of hydrological models in simulating the hydrological processes (Valderz et al., 1979). Rainfall-runoff models, most notably the GIUH hydrograph model and the WinTR-55 hydrologic model, are suitable tools for the study and estimation of maximum hydrograph discharge using geomorphologic parameters of the region (Ghorbani et al., 2015). The purpose of this study was to estimate maximum flood discharge, transfer capacity, and sediment yield of the Kermanshah River using the GIUH and WinTR-55 models.

2-Methodology

Sanqor basin, with an area of 6317 hectares and minimum and maximum heights of 1500 and 3300 m, respectively, is located in the northeast of Kermanshah province and part of Karkheh watershed. Average values of annual rainfall and temperature are 586.9 mm and 12.9 °C. The WinTR-55 model uses parameters, such as main channel length (flow length), channel gradient (flow gradient), manning roughness coefficient, width of waterway floor, and the slope of margins to determine the effects of flow type and velocity on the discharge peak output and water and sediment transport capacity in the basin. To this end, the area was divided into eight hydrological sub-basins after registration of the basin situation. After estimating the geomorphologic and hydraulic parameters of the canal, the discharge was estimated with different return periods using the WinTR-55 and GIUH models. Geomorphologic proportions include length ratio, branching ratio, area ratio, drainage network, and ranking of riverbeds in the basin (Valderz et al., 1979).

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3-Results and Discussion

The estimation results of velocity types in each sub-basin with the WinTR-55 model indicate that the laminar flow in the flood basin were on the surface and not inside the channel, but flow frequency was low with high water content. However, centralized and channelized flows were flooded and concentrated, flowing through the canal or small or large drains .Peak discharge values estimated by the GIUH model were, on average, 6.52% higher than those estimated by the WinTR-55 model. The S3 and S4 sub-basins with low gradients and high roughness coefficients had low flow velocities. In S2, S6, and S8 sub-basins, on the other hand, the discharge and flow rate increased due to a high slope. Estimated peak discharge values by the GIUH model showed increases in all sub-basins other than S1 sub-basin and in the outlet relative to the peaks calculated using the WinTR-55 model. Discharge changes obtained from the GIUH increased on average by 76.1% and 7.1% in the outlet and in the S1 sub-basin, respectively, compared to that calculated by the WinTR-55 model. In the S2, S3, S4, S5, S6, S7, and S8 sub-basins, average increases were 7.31, 5.13, 5.98, 6.3, 6.9, 5.8, and 6.67 percent, respectively. The model calibration d and the sensitivity analysis of the flow parameter were done using the canal slope and the results were investigated at the basin output. The results of the model for a change in the slope of the waterway showed a low effect of the slope on the outlet flow variations. The evaluation results of GIUH and WinTR-55 models in peak discharge estimation with observational data by correlation coefficient (R) and root mean square error (RMSE) indicate good efficiency of both models. R values of 0.90 and 0.97 were obtained between observational and calculated data by the GIUH model by the WinTR-55 model, respectively. The RMSE values were very insignificant in the estimation of observed discharge and those estimated by the WinTR-55 model and the geomorphologic hydrograph unit method.

4- Conclusion

In this study, the efficiency of WinTR-55 and GIUH models was investigated in peak discharge estimation. The results showed that there was a high flow rate in S1, S2, S6, and S8 sub-basins due to the high mountainous nature, along increased erosion and sediment transport capacity. In S3, S4, S5, and S7 sub-basins, transfer capacity and sedimentation dropped due to low slope and slower flow rate. The estimated discharge values of S8 and S6 sub-basins by the GIUH method increased by 8.31 and 6.67 percent, respectively, compared to those estimated by the WinTR-55 model, which is due to the increased gradient and its role in discharges calculated by both models. The discharge rate in the area outlet estimated by the GIUH method increased by 1.76% compared to that obtained by the WinTR-55 model, indicating the effect of geomorphologic parameters on the calculation of peak discharge in the basin.

Assessments of R2 and RMSE showed that the efficiency of the WinTR-55 model was high at maximum average discharge rate for all return periods, with average RMSE values of 0.66 and 0.32 for the GIUH and WinTR-55 models, respectively. The results showed a high correlation between observational and calculated data obtained from both models. Additionally, the calculated RMSE values showed that the GIUH and WinTR-55 models had high and acceptable performance in peak discharge estimation and could well analyze the erosion and sedimentation conditions.

Keywords: Hydrograph, Erosion and Deposition, Flow Velocity, Manning Roughness Coefficient, Sonqor Watershed

5-References

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