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Comparison of Effective Rainfall Conversion Methods to Surface Runoff in Flood Hydrographic Simulation of Nanekaran Watershed, Ardabil Province

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1-Introduction

Floods as destructive natural hazards need to be predicted in accurate way through evaluation of the hydrological response of watersheds to the effective input rainfall. Due to the variety of rainfall-runoff models, it is very important to choose a suitable model that can simulate the hydrological behavior of the watershed. Due to the complexity of watersheds, modeling tools is used to estimate surface runoff. Because it is not possible to measure all the required parameters for runoff analysis in watersheds, it is necessary to choose a model that can accurately predict runoff with a simple structure and using the minimum parameters and data.

2-Methodology

In this study, various rainfall-runoff transformation methods, including triangular, broken triangular, variable triangular and SCS-curvilinear unit hydrograph methods have been evaluated in Nenekaran watershed, Ardabil province. In this regard, the Wildcat5 hydrological model have been used. The precipitation amount at the 25-year return period was calculated using Cumfreq software. After preparing the land use map of the study area using satellite images, the area of each land use in the area has been calculated using ArcGIS software. The rainfall value and the time of concentration were considered constant during the simulation procedure.

3-Results and Discussion

The results showed that the SCS method had the highest peak flow of 44.50 cubic meters per second. The minimum time to the peak was 2.19 hours and the variable triangular

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method had the lowest peak flow rate. According to the results, the SCS method had the highest hydrograph peak which equals 5 mm per hour and had a large difference compared with other three unit hydrograph methods. While simple unit hydrograph triangle method, variable triangle and broken triangle methods had the peak hydrographs close to each other.

4- Conclusion(s)

Part of the accuracy of flood hydrograph peak flow estimation depends on the exact estimation of the curve number and the time to peak unit hydrograph. Regarding the curve number, it can be noted that the existence of precipitation data of the previous days and as a result of selecting the appropriate soil moisture condition, which will make a significant difference in the simulated peak flow. It is noteworthy that in the present study, due to the selection of design rainfall with a specific return period, moderate antecedent soil moisture conditions have been considered. In addition, it should be noted that the amount of time up to the peak of the unit hydrograph will be calculated based on the time of concentration. Therefore, due to the existence of multiple relationships to calculate focus time, the amount of time to peak can also vary over a wide range. The simple triangular method has a maximum time to peak of 4.51 hours, which shows the great difference between the hydrograph of the SCS method and the other three methods. The difference in the nature of the methods, the watershed condition, and the suitability of estimating t_c and CN parameters should be considered in rainfall-runoff transformation methods.

Keywords: Flood, Unit hydrograph, Rainfall-runoff, Flow simulation, Hydrological modeling, Nanekaran Watershed.

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