Prioritization of Flooding Potential in Beheshtabad Subbasins

Bahram Badri
MSc in watershed management, Shahrekord University
Rafat Zare Bidaki*
Assistant Professor of Natural Resources, Faculty of Earth Sciences,
Shahrekord University, Iran
Afshin Honarbakhsh
Associate Professor of Natural Resources, Faculty of Earth Sciences,
Shahrekord University, Iran
Fatemeh Atashkhar
MSc. in Water Research Center, Shahrekord University, Iran

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Extended Abstract

Introduction

Flood is a natural hazard that its occurrences can be observed more frequently in recent years. For better flood mitigation and control, it is needed to identify flood production factors and determine the high potential flood areas. Hydrological model is a simplified representation of natural system and the rainfall-runoff model is one of the most frequently used events for flood simulation. HEC-HMS is one computer model that becomes very popular for its ability in simulation of short time events. The aim of this research is to investigate spatial prioritization of flooding in Beheshtabad sub-catchments using HEC-HMS software.

Material and Method

Behashtabad Basin located in Chaharmahal-va-Bakhtiary Province, Iran, is 3866 km^2 and its mean elevation is 2317 meters above sea level. It is divided into 6 sub basins according to 6 hydrometric stations. Land use categories of the study basin were extracted using ETM+ Images for 2009. Using 170 ground control points, land use map of Beheshtabad basin was prepared with total accuracy of 99.34 and Kappa Index equal to 0.81. Rangelands cover most of the study area. Soil Hydrological groups and land use data have also been used for mapping sub basins curve number with antecedent moisture of past five days. The mean curve number of the study basin is 72.69. Daily precipitation data of 6 rain gauges in study area have been used for analysis of maximum 24 hr precipitation in different return periods. Rainfall hyetographs of flood events have been derived from recording rain gauges data. CN method has been used for

* E-mail: zare.rafat@nres.sku.ac.ir Tel: +98 9132534104

estimation of initial loss, SCS method for runoff hydrograph simulation, and Muskingum method for flood routing simulation. HEC-HMS model was calibrated using 2 Flood hydrographs and corresponding hyetographs for each sub-basin and validated for 1 flood event.

Results and Discussion

Rainfall loss in Beheshtabad sub-basins is ranged from 0.13 to 0.19, curve number ranged from 69.73 in Kooh-Sookhteh sub-basin to 73.71 in Kharaji sub-basin, and lag time also ranged from 0.99 hr in end Beheshtabad to 5.72 hr in Kharaji sub-basin. Using optimized rainfall loss index derived from calibration stage, HEC-HMS is validated for one flood event for each sub-basin. Model validation shows very little difference (below 1%) between estimated and recorded data in all sub-basins. Among sub-basins, Darkesh-Varkesh has the most and end Beheshtababd has the lowest peak discharge in all return periods. Prioritization of sub-basins according to their areas indicates that bigger sub-basins don't have essentially highest amount of the rate of Q_{sub}/Q_{total}. In this comparison, Darkesh-Varkesh sub-basin with an $Area_{sub}/Area_{total}$ rate of 0.13 has the highest rate of Q_{sub}/Q_{total}. Flood routing in streams indicated that the rate of participation of sub-catchments in output flood is not proportional to sub-catchment peak discharge. Therefore, in order to eliminate the effects of area in participating sub-catchments, the rate of influence on each unit of sub-catchment area in output flood was calculated as well. The results of prioritization by peak discharge, based on participation of each sub-catchment in output location of watershed, indicates that Darkesh-Varkesh and Beheshtabad sub-catchments with 29.16 and 2.5 percent have, respectively, the maximum and minimum of participation in output flood peak discharge of the watershed. Results of prioritization based on reduction of discharge per unit area show that Beheshabad sub-catchment with the lowest area in comparison with other sub-catchments has the highest participation and Tange-Dehno has the lowest role and contribution.

Conclusion

In the present study, rainfall-runoff modeling is carried out using HEC-HMS hydrologic model. Results of simulation in 18 events and comparison of simulated and observed hydrographs indicated that the model can be applied for simulation of rainfall-runoff in this study area. Other researches like Kumar and Bhattacharjya (2011) and Hegdus et al. (2013) found same results as our findings. Ranking sub-basins according to peak discharge without flood routing show that Darkesh-Varkesh has the most and end Beheshtabad has the lowest peak discharge. According to contribution in total discharge, the results are also the similar. Soleimani et al (2008) and Zehtabian et al. (2010) also found the same results. Finally, according to decrease in total Q per unit area, ranking show that end Beheshtabad sub-basin, despite of the smallest area, has the highest contribution in total Q per unit area. Nasri et al. (2011) also concluded that the areas located near the outlet of study basin have the most contribution in flood production. This research shows that the Darkesh-Varkesh sub-basin needs the most attention in selection of management practices especially to optimize flood control and flood mitigation solutions.

Keywords: Beheshtabad Basin, Chaharmahal- va- Bakhtiary Province, curve number, HEC-HMS, Muskingham method, SCS Method.