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Flood Analysis of Subbasins Using WASPAS Model

Case Study: Aland Chai Basin, Northwest of Iran

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1- Introduction

Floods are one of the major natural hazards that annually cause extensive damage worldwide. There are numerous floods in the northwest of the country with the beginning of spring and the start of spring rains, which in most cases results in heavy damages. Aland chai catchment suffers from destructive floods every year since the beginning of spring. The purpose of this study was to examine and analyze the role of hydrogeomorphic indices in flood sensitivity in this basin. Hydrogeomorphic parameters of sub-basins were studied from three aspects of drainage network characteristics (including order of stream, number of streams, length of streams, frequency of stream, bifurcation ratio, length of overland flow, drainage density, drainage texture, texture ratio, infiltration number, constant of channel maintenance, and Rho coefficient), shape characteristics (Including basin area, compactness coefficient, circulatory ratio, elongation ratio, form factor, and shape factor) and relief properties (relief, relief ratio, ruggedness number, and gradient).

2- Methodology

With an area of 1,147.30 km^2, Aland Chai basin is located in the Northwest of Iran and in the Western Azerbaijan province. This basin is located between 38°- 30′-14″ and 38°- 48′-22″ N and between 44°- 15′- 13″ and 45°- 01′-02″ E. The minimum elevation of the area is 1093 meters and the maximum elevation is 3638 meters. This basin is one of the sub-basins of the Aras basin, which flows into the Aras River after joining the grand Qotour River. SWARA multi-criteria decision analysis model was used to weight the parameters. The Step-wise weight assessment ratio analysis (SWARA) model was developed by Keršuliene et al (2010). WASPAS multi-criteria decision-making model was used to prioritize sub-basins in terms of flood sensitivity. The weighted aggregated

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sum product assessment (WASPAS) method was proposed by Zavadskas et al in 2012. The WASPAS method consists of two aggregated parts, namely (1) The weighted sum model (WSM) and, (2) The weighted product model (WPM).

3- Results and Discussion

Hydrogeomorphic analysis is significantly involved in the analysis of hydrological behavior of the basins. In the present study, 22 hydrogeomorphic parameters were analyzed from three aspects of drainage network characteristics, shape parameters and relief properties with the purpose of examining the effect of these parameters on the flood sensitivity of the Aland Chai basin. In the first step, the study area was divided into 15 sub-basins based on topographic and drainage characteristics using a digital elevation model (DEM) with a 12.5m spatial resolution. In the next step, the information of each sub-basin was provided based on 22 hydrogeomorphic parameters using the geomorphological laws of Horton, Schumm, and Strahler in ArcGIS software. According to the comparison among 22 parameters using the SWARA method, drainage texture, texture ratio, and drainage density (weighted as 0.273, 0.273 and 0.156) had the highest impacts on the occurrence of floods in study area respectively. On the contrary, Rho coefficient, constant of channel maintenance, infiltration number, and length of overland flow exhibited the lowest weights respectively.

4-Conclusion

The purpose of the current study was to examine and evaluate the role of hydrogeomorphic indices in flood sensitivity of Aland Chai basin, for which SWARA and WASPAS multi-criteria decision-making models were employed. The results of prioritization of sub-basins using WASPAS model indicated that sub-basin 1 with a coefficient of 0.907, sub-basin 3 with a coefficient of 0.858 and sub-basin 2 with a coefficient of 0.818 had respectively the highest sensitivity to flooding. The results also revealed that sub-basins 4, 7, 11 and 15 in are placed in the high level category, sub-basins 8 and 9 are categorized in moderate-level category class, sub-basins 5, 10, 12 and 14 are classified in the low-level class and sub-basins 6 and 13 are situated in the very low level category in terms of flood sensitivity. The total area of sub-basins in the high and very high class of flood sensitivity is 656.72 km^2, which comprises 57.24% of the total Aland Chai basin. Therefore, according to the findings of the study, which indicate that the study area has high flooding, it is necessary to adopt protective measures such as watershed planning and dam construction in highly sensitive sub-basins to prevent flooding and mitigate potential damages in cases of severe flooding.

Keywords: Flood, Hydrogeomorphic Indices, GIS, WASPAS Model, Aland Chai Basin

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