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Derivation of Rule Curve for Flood Risk Zone A Case Study: Baranduz-Chay River

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Abstract

1- Introduction

Mainly the flood is caused by the surface runoff resulted from the properties of precipitation and river basin. The reduction of flooding by the effect of vegetation and soil in a small basin is less than a basin with a large area. Hence, to have a flood zoning map, the first step is studying economic flood management and flood control projects. This paper focuses on Baranduz-chay River as a case study, located in the Urmia lake basin. The river reach having 3 km long, was studied between two hydrology stations namely Bibakran at the upstream and Dizaj at the downstream. The annual peak discharge data of Baranduz-chay has surveyed during the years from 1974 to 2013, where the appropriate Manning roughness coefficient, *n*, by averaging 0.0325 as an upstream coefficient and 0.0301 as a downstream coefficient were both implemented in the HEC-RAS software and its result including floodplain zones elevation extraction by the Muskingum-Cunge method, based on the floods with different return periods obtained. After converting these zones to their corresponding risk for each return period time, it has been delineated in Arc-Map software through HEC-geo-RAS extension, floodplain zones were then defined. The maximum inundated

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area is 97.34 Hectares and belongs to 1000 years return period which has the most risk as 63.58% within 3 years of useful periods. The Rule Curve is obtained by inundated areas with both different return and useful periods from the risk formula in which the general Area-Period-Risk formula was extracted.

Basically, the magnitude of the floods and their repetition over time is subject to rainfall intensity, permeability, and topographic conditions in the area. The occurrence of floods as one of the natural disasters that cause many financial losses in many parts of the world. The first step in economic studies of flood management or flood control is flood zoning. Flood zoning means the extent to which the flood covers the area. Today, via modern science and technology, human beings are trying to optimize designs and to reduce these costs. Therefore, it seems that flood zoning study in the permanent and seasonal rivers path appears to be of great importance by conducting case studies in vulnerable areas. ShahiriParsa et al. (2016: 55-62) used the integration of the HEC-RAS one-dimensional model and the two-dimensional CCHE2D model on the Sungai Maka river in the state of Kelanten, Malaysia. They concluded that in this case, some important factors are: Manning's flow resistance coefficient, *n*, the geometric profile of the river section and the choice of the most suitable flood return period. The mentioned parameters have a major role in providing flood zoning outcome, which has caused the most changes in the geometric shape of the river section. Their results showed that the greatest difference between the models was 6% in the location of the meandering rivers. The results of both models were also consistent in most of the transverse sections, and, due to the difference in the shape of the rivers, the greatest difference was the difference between the two models. Sung et al. (2011: 1-12) used the Maskingum method to process unqualified basins by analyzing the HEC-HMS hydrologic model and the HEC-geo-HMS geo-hydrologic model, the extraction of sub-basins and characteristics of the basin was extracted. The results showed that the percentage of flood events proportional to the maximum discharge errors of a moment of less than 20% and a runoff volume of less than 10% to reaches 100%.

2- Methodology

Baranduz-chay river as the main river and permanent water catchment area of the study area. It originates from the highlands of Iran and Turkey border. The catchment area of this riverside in Saatlu is about 666 square kilometers and in Babarood is 1012 square kilometers. This research was associated with a similar risk due to the risk relationship with different return periods for the restricted areas around the river, based on different return periods. To determine risk areas or certain return periods, peak discharges were fitted with the best statistical distribution and through that, peak discharges were then calculated with different return periods and each of them was determined along the river and its expansion area.

3- Results and discussion

Fig. 3, shows the risk versus area (A, RISK), the risk with a downward trend, which means that the area risk is decreasing with the area covered by the risk area. By fitting a variety of exponential, linear, logarithmic, polynomial and power statistical functions, among those functions as shown in Fig. 3, risks with different useful lives are plotted simultaneously and from among functions, the power function was selected as a suitable fit function in order to obtain the general probabilistic distribution function and its parameters based on different useful life.

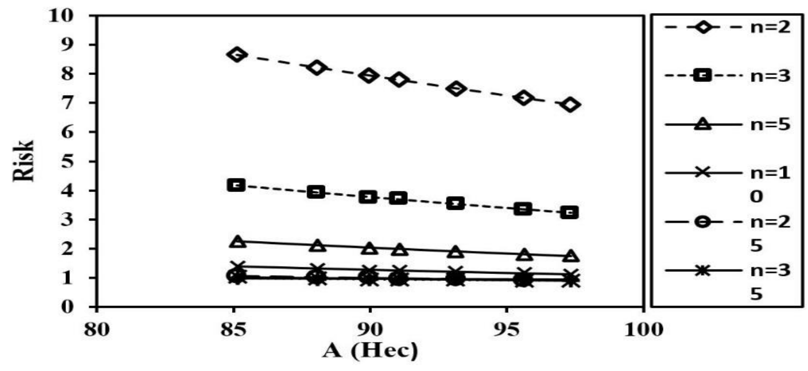

Fig. (3) Risk diagram versus area (Rule Curve) with a different useful life

4- Conclusions

For the Manning roughness coefficient, *n*, in the hydraulic model, the Manning's *n* for the upstream and downstream stations were computed. The roughness coefficients, *n*, were then obtained for the upstream and downstream stations as 0.0325 and 0.0301, respectively. In order to obtain the corresponding risks for the areas covered by a flood of 3 km long from the Baranduz-chay between the upstream Bibakaran station and the lower reaches of the Hoerl's model, which is a type of power function. The risk-space-period curve for the specified periods is 2, 3, 5, 10, 25, 35 and 75 years (for more details, see Mohammadi, 2016).

Keywords: Rule Curve, Iso-Risk Curves, Muskingum-Cunge Method, and Baranduz-chay.

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