

Evaluating and estimating the risk of erosion and sediment in Karaj basin using morphometric and experimental methods

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Article History (Received: 2019/05/4

Accepted: 2019/10/9)

Extended abstract

1- Introduction

There was about 15 percent of the world's soil erosion at the beginning of the twenty-first century that nearly 11 million square kilometers was affected by water erosion. Soil erosion after population growth is a serious threat to the environment, health and well-being of humans, and it has been introduced as the second most important environmental challenge in the world. The annual level of soil erosion in the world is 75 billion tons and Iran's share is more than 2 billion tons and about 3 times more than the total soil erosion which has been reported in Asia. On the other hand, the amount of soil erosion in north of Iran is 15 to 25 million tons per year, While the amount of forest per capita is 2.0 hectares in Iran and 8.0 hectares in the world. Soil erosion in the region of Asia, Africa and South America is 30-40 tons per hectare annually, in the United States and Europe is 13-17 tons per hectare and in Iran is 30-35 tons per hectare. The mean erosion in Iran is about 3.4 times the average erosion in the world. In the present study, we used Fournier and Douglas models to predict the amount of sediment in the watershed of Karaj.

2- Methodology

Karaj river Basin (to the Amir-Kabir dam) with an area of 764 square kilometers, is located in north latitudes between 36 degrees and 10 minutes and 35 degrees and 57 minutes and East longitude between 51 degrees and 3 minutes and 51 degrees and 35 minutes east. The highest elevation in the basin which was studied is 4343 meters and the lowest elevation in the Karaj dam is 1680 meters. The length of the studied basin is 38/31 km. In the present study in order to estimate the amount of sediment erosion in basin, initially basin has been limited using topographic maps and Google earth. Then the required data was extracted from meteorological and precipitation stations, geological maps and field observations in the study area. Finally, it was analyzed in four models; Fournier, Fargas, Ciccacci and CSY. The first model of sedimentation that put in much effort to extend and improve its results is Fournier model that was presented by him in 1960. Fournier used his model to factor in seasonal precipitation index, which has a high correlation with the yields of deposits. In 1968, Douglas worked on ten factors involved in erosion. And by distinction of top four factors, he presented a formula that is perhaps the most used.

Modeling processes of erosion and sediment production, transport and deposition, have been studied before. Sediment transport formula of Bijker (1976 and 1971), one of the first formulas extended to combine current and the wave. Van Rijn in 1984, proposed a comprehensive theory for sediment transportation rates in rivers in basic physic theories and practical observations. Watanabe in 1992, proposed a formula for final deposition based on the capacity of force model. This formula has been widely used for prediction in Japan. In Iran it is also published in the final report of calibration of models by the Soil and Water Research Institute, Watershed management and thesis of graduate students. Behzadfar et al. (2009) studied the erosion index in North Khorasan Province. Pour-Abdullah (1385) used two models 2000SWAT and RUSLE for modeling and comparing the results with the actual values in the watershed Enameh. Salajegheh et al. (1388), Asadi et al. (1389) and Ahmadi et al. (1393) are other domestic papers which have been done about soil erosion and

sedimentation. The purpose of this study was to estimate the sediment yield of Karaj basin using morphometric and experimental methods and erosion risk analysis at large catchment areas such as Karaj basin. Which has a strategic and vital importance for supplying drinking water to the capital and metropolitan Tehran-Karaj.

3- Results

Calculation of Ciccacci et al. 1986 method, which is based on the morphometry of the catchment area, shows that the annual precipitation rate of Karaj basin is 706241.2 tons per year from the basin. According to the calculations, the annual sedimentation rate of Karaj Basin, based on the csy method, is 317648.2 tons from the basin. According to the Fournier model, eroding and sedimentation rates in the whole Karaj basin are 387630.8 tons from the basin. The Sediment-rating Curve Data showed that the annual sediment rate was calculated to be 565605.4 tons per year. In order to evaluate and estimate the risk of erosion in the basin, Fargas method was used. According to the calculations, 29.6% of the area of Karaj basin is in severe erosion. The expansion of the kahar Formation, Ziarat, Asara and Quaternary Formations, and the intense activity of Masha faults and Karaj fault have caused erosion in the Karaj basin. As a result of this increase, this process has reduced the reservoir capacity of Karaj during many years. The moisture and glacial regime in Karaj watershed has always caused the activity of erosion processes such as cerioclasti, thermoclasty and mass movements in different shapes, The erosion rate has increased tremendously.

4- Discussion & Conclusions

The results showed that the annual precipitation rate of Karaj basin is 6.91 tons in morphometric method and 4.73 and 3.87 tons per hectare in experimental, forenier and hydrophysical methods respectively. Meanwhile, based on real data of Sediment-rating Curve Data of the regional water organization, the annual sedimentation rate is 6.89 tons per hectare. Therefore, the morphometric method has the closest estimate to actual data and is a suitable method for estimating erosion of sediment in large catchment areas. The difference of quantitate value between the original value and two equations, represents the disqualification of two methods in this study for basins like Karaj River Basin. It seems that other experimental models such as Hydrophisic and artificial neural network models with having alittle difference compared to the real value have the more richness to estimate the sediment load. However, this amount of power of erosion represents a high rate of attrition in upstream river- top of Amir Kabir Dam- and accumulation of eroded sediment mass in the dam.

Key Words: : Sediment erosion, Fournier, Fargas, Karaj river basin, morphometry