Estimation of sedimentation and erosion using MPSIAC, FSM and direct measurement methods in Gabric watershed, South-eastern of Iran

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Extended abstract

1- Introduction

Soil erosion, as one of the most important environmental problems in the world, has a devastating effect on all life, natural resources and it's under human management. Considering that one of the important goals in the management of drainage of basins such as Gabric basin is preventing soil erosion, and also one of the important factors when designing dam or sedimentation structures, is estimating sediment production in the drainage basin, the estimation and calculation of the actual sediment deposited in the constructed dams at the basin outlet, and comparing it with the results of the empirical models, is the best method for estimating the sediment yield in the basins lacking sediment station such as Gabric basin.Therefore, if the amount of estimated sediment is closer to its actual value, it will definitely perform better at the time of designing the dam or planning in the basin in terms of cost and observance of technical and economic principles. In this regard, this study aimed at evaluating empirical models of MPSIAC and F.S.M. and direct measurement method for estimating sediment yield and erosion in the Gabric basin.

2- Methodology

In this research, in order to determine the data and estimate the score of each of the required parameters by three methods of MPSIAC and FSM methods and direct measurement, the existing basic maps and reports, the information of meteorological stations of the studied area, field studies, 42 sheets of digital topographic map with 1: 25000 scale for the study of stratigraphy, lithology, geology of the area, pedology maps, vegetation cover, land use map and area DEM (using ArcGIS 10.2 software) have been used.

In the MPSIAC model, using the sum of the scores obtained in the basin unit map for 9 important factors influencing soil erosion and sediment production, the layers of these factors were prepared in ArcGIS software, and then the map of sedimentation rate (R) gains to the basin. In the FSM mqqodel, after determining the score of 7 factors in the basin unit's map and preparing the layers of these factors, the maps of these 7 factors were introduced and, with their multiplication, the erodability index (FSM Index), and, using the relation of the FSM method, the erosion rate is estimated in terms of tons per kilometer for the basin. Finally, by applying the coefficient of sediment delivery ratio obtained by the MPSIAC method, the sediment production rate of the basin and sub-basins is calculated.

In the direct measurement method for measuring the sediments behind the checkdems and Gabric dam, more than 110 boreholes were drilled with mechanical excavator at a surface of about one hectare of sediment. Also, the estimation of the sediment content behind the

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70 founded checkdems was done using an Agro device, a GPS device and also meter. In this method, the CIVIL 3D 2015 software has been used to estimate the volume of reservoir sediments (Shojaei, 2018).

3- Results

Using MPSIAC model, the sedimentation rate (R) in the Gabric basin was 68.6 and the specific sedimentation for the basin was equal to 3.1 tons per hectare per year. On the other hand, due to the fact that the soil texture in most parts of the Gabric basin is moderated to light, the equation of medium to coarse-grained soils is used to calculate the sedimentation coefficient (SDR). This amount was estimated 0.32 for the studied basin. The total sediment in the Gabric basin, due to the major contribution of each formation in the production of bed load, is 11378 tons per year and the total sediment due to the specific sediment (suspension load of 3.1 and bed load of 9 tons per hectare per year and weight percentage of bed load of 0.3) was estimated 4 tons per hectare per year.

Using the FSM model to estimate the erosion rate in the Gabric Basin, the erodability rate is 168.9 and the sediment delivery ratio is 0.32, and produced sediment is 6.6 tons per hectare per year.

In the direct measurement method, the total estimated sediment content at the hydrometric station and Gabric dam during the execution time of the project is equal to 214637.9 m^3, respectively, the amount of sediment during the same time interval through the MPSIAC and FSM methods was estimated to be 9.33103 and 193288.4 m^3. In direct measurement method, by applying volumetric coefficient and field data analysis, the cumulative sediment concentration of the station and the dam site was estimated to be 6.9 tons per hectare per year.

4- Discussion & Conclusions

By comparing the results obtained from the two empirical models with the direct measurement method, it can be concluded that the produced sediment yields from the FSM model are closer and superior to the MPSIAC model compared with the direct measurement of erosion and sediment, which could indicate a better match between the FSM model and direct measurements of erosion and sedimentation in this region. In addition, based on these results, it can be argued that in terms of quality, most of the basin is in a moderate erosion class.