The Estimated Assessment of Sediment of MiyanehShaharchayBasin Using EPM and Fournier Models in GIS Environment

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Extended Abstract

Introduction

Erosion, especially soil erosion is a serious threat to soil and water resources, because the soil consists of a combination of small-scale materials, non-organic and organic materials, also is a natural, dynamic environment that the growth of plants depends on it. Nowadays, soil erosion is one of the issues and problems that causes serious damages in Iran. Every year, nearly 75 billion tons of fertile soil and billions of tons of other agricultural land soil erode. The present research aims at investigating the EPM and Fournier models, validating the aforementioned models with the observed data of hydrometric station of Kouhsalar located at MiyanehShaharchay, and introducing Fournier model if validated instead of the costly and time-consuming models to estimate the sediment.

Materials and Methods

Shaharchai basin with an approximate area of 1510 square kilometers is located in the Eastern Azarbaijan Province and in the northwest part of the city of Mianeh and is one of the main branches of the GezelUzan River.

In the present research to achieve the desired goal, the following materials were used including: topographic map, geological map of the region, satellite images of Landsat 8 in 2014, and 1:20,000 aerial photos, for the preparation of the current state of the erosion and land cover, as well as the use of soil science studies of identification-justification stage report of hydrometric areas of Shaharchai basin in 2007, the data of precipitation and evaporation Survey stations on a monthly basis for use in the models and data of Kouhsalar hydrometric station in order to estimate sediment of the basin.

The software Arc GIS was used for preparing thematic maps, including maps of isotemperature and isoprecipitation lines, maps of land use - land cover and the formation of the database, the software ENVI5 was used for extracting data related to the land use - land cover in the area.

The models used in this research are EPM and Fournier by using GIS to estimate the sediment.

In the present investigation after obtaining the amount of sediment estimates for each of the sub-basins, the data of 40 years (1972-2012) of hydrometric station of first grade of Kouhsalar were used for validation of the results of the models. One of the common methods for calculating the production of suspended sediment is to use the method of sediment rating curve-daily stream discharge. The required data for drawing the sediment rating curve and calculating estimated relationship, flow and sediment discharge are corresponding. Then, to compare the results of observation and estimation, percentage of relative error (RE) was used.

Discussion and Results

The necessary data for the estimation of erosion and sedimentation of the region after the weighting and calculating was obtained for each of the sub-basins. The intensity and the

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percentage of erosion area of the basin is shown in a table. Map of the intensity of erosion reflects the severity of the erosion of the area under study in three classes of Very Low, Low, and Medium. Although the severity of the erosion of the Medium class has a dramatically considerable percentage of the area, the highest percentage is related to the intensity of the Low class of erosion. The Medium class of erosion is about 26%. In this class of the erosion, separation and movement of soil particles is to the extent that the implementation of soil and water conservation programs is required. Most of these areas are located on rangelands, and effective factors in these areas include high slope, poor coverage, and sensitive structures to erosion. In these areas, mechanical operations should be carried out more carefully and with caution. Preservation of pasture plants, biological operations, and preventing animals' grazing are strictly recommended.

Conclusions

In the present research, the models of erosion with the aim of determining the best model for the estimation of the sedimentation of the catchment area of ShaharchaiMianeh basin were applied. Because of the simplicity and low cost of Fournier model, it was investigated. But because of its being too simple and not taking into account the parameters influencing the erosion, the Fournier model cannot be a good alternative to costly and time-consuming models such as EMPSIAC or EPM. In the validation of EPM model, using the observed data, relative coincidence with 9.9% difference fits fairly well. Considering the absolute value of the difference in EPM with the observed data, the amount of sediment reached 200,454 tons per year. This amount of sediment is due to the large area of Medium class of erosion. In this class, erosion, separation, and movement of soil particles is to the extent that soil and water conservation programs are necessary.

Keywords: Soil Erosion, EPM Model, Fournier Model, MiyanehShaharchay, Geographical Information System.

References

1. Ahmadi, H., Mohammadi, A. S. (2010). Evaluation of sediment estimation using MPSIAC and EPM with effect of geomorphology factors (case study: Dehnamakcachment), desert and range research of Iran, Vol. 17, PP: 340-352.

2. Arabkhedri, M., Zargar, A. (1995). Estimation of sediment yield in north of Alborz using of regression model, research and reconstruction, Vol. 29, pp: 22-29.

3. Anton, V.,G.M. Sterk, S. de Jong, 2010. Satellite- based estimation of rainfall erosivity for Africa. Journal of Hydrology. pp 235-241.

4. Ahmadi, H., Javadi, M.R, Salavati, Atigh (2014). Zonation of Erosionable Using Fournier and some Interpolation methods (Case Study: Province of Gazvin), Natural Ecosystems of Iran, Vol. 5, No. 2, PP 1-14.

5. Beyer Portner, N. (1998). Erosion des basins versant alpinsscusses par ruissellementde surface. Ph.D Thesis, Laboratoire de Constructions Hydrauliques-LCH, No. 1815, laussanne, Switzerland.

6. Eltaif, N. I., Gharaibeh, M. A., Al-Zaitawi, F., Alhamad, M. N. (2010). Approximation of rainfall erosivity factors in North Jordan. Pedosphere, 20(6), 711-717..

7. Gavrilovic, z. (1988). The use of empirical method (erosion potential method) for calculating sediment production and transportation in stadied or torrential streams, International Conference on Rriver Regime – Joh, Wiley and sons, Paper 12, pp:411-422.

8. Hosseini, S. S., Ghorbani, M. (2005). Soil erosion economy, Mashhad,Ferdowsi University of Mashhad Press.

9. Hashemi, S. A. A., Arabkhedri, M. (2007). Evaluation of EPM model through of small dams sedimentation tanks measuring, agriculture and natural resources sciences and technologies, No. 42, pp: 345-355.

10. Identification and justification of ShaharChay basin. (2007). Natural resources and watershed management office of Azarbayjan-e-sharghi province.

11. Lafen, J.M., Roose, E.J. (1997). Methodologies for assessment of soil degradation due to water erosion. In Lal, R., Blum, W. H., Valentine, c., Stewart, B. A (Eds), Methods for assessment of degradation, Londaon New York Washington, D.C., CRC press, Bo Ca Raton. 576 p.

12. Mohseni, B., Ghodosi J., Ahmadi, H., Tahmasbi, R. (2011). Evaluate the accuracy and effectiveness of the EPM, MPSIAC, models in the estimation of erosion and sediment, geography and development, No. 22, pp: 107-122.

13. Moghli, M., Khalilzadeh, M., Abi, Y. (2012). Investigation on geomorphological features and erosion zoning on Varband catchment (Larestan), natural geography, No. 15, pp: 9-20.

14. Moghimi, E., Negahban, S. (2012). Study of erosion on Shorghodami river catchment (Fars province) using of entropy model, Journal of natural geography researches, No. 81, pp: 1-16.

15. Ownegh, M. (2003). Land Use planning and integrated management of natural hazard in Golestan, In: seminar on flood hazard prevention and mitigation, 15-16 janurary, Gorgan, Abstract, P9.

16. Oduro K., 1999. Rainfall erosivity map for Ghana.Department of physicalUniversity of Ghana.ELSEVIERJournal.pp 161-166.

17. Pimentel, D., Harvey, C., Resosudarmo, P., Sinclair, K., Kurz, D., McNair, M., Blair, R. (1995). Environmental and economic costs of soil erosion and conservation benefits. Science, 267(5201), 1117-1123.

18. Refahi, H. (2000). Water Erosion and its Control, Tehran, Samt Press.

19. Rangraz, K., Zasvandi, A. R., Hydari, A. (1998). Comparing the basin EPM and MPSIAC models to estimate erosion and sedimentation in Peghah Sorkh Gotvand catchment using RS and GIS techniques, Geography Researches, Vol. 64, pp: 123-136.

20. Rompaey, A., Govers, G. (2002). Data quality and model complexity for regional scale soil erosion prediction, Geographical Information Scince, Vol. 16(7), pp: 663-680.

21. Sadeghi, H. R. (1993). Comparison of Some predict erosion and sedimentation in OzonDarehcachment, Proceedings of the national Symposium on policy and procedures for optimal utilization of land, Tehran.

22. Sadeghi, S.H.R.; Tavangar, S. (2015). Development of stational models for estimation of rainfall erosivity factor in different timescales. Journal of Natural Hazards. 77, 429-443.

23. Toy, T. J., Foster, G. R., Renard, K. G. (2002). Soil erosion processes, prediction, measurement and control, John weily and sons ,Inc, new York.

24. Tangestani, M.H. (2006). Comparison of EPM and PSIAC models in GIS for erosion and sediment yield assessment in a semi-arid environment: Afzar Catchment, Fars Province, Iran, Journal of Asian Earth Sciences, Vol. 27, pp: 585-597.

25. Ziyaei, H. (2001). Principles of Watershed Management Engineering, First Edition, Mashhad, Astan Quds Press.

26. Ufoegbune, G.C.; Bello, N.J.; Ojekunle, Z.O.; Orunkoye, A.R.; Eruola, A.O.; Amori, A.A. (2011). Rainfall Erosivity Pattern of Ogun River Basin Area (Nigeria) using Modified Fournier Index. European Water Journal, 35: 23-29.