University of Tabriz

Journal of Civil and Environmental Engineering
Volume 53 (2024), Issue 4 (Winter), 100-111

EXTENDED ABSTRACT

Analysis of Flood Potential and Runoff Production of Shahid Rajaei Sari Dam Watershed Based On GIS and Remote Sensing Approach

Amir Hossein Esfandiyari, Farhad Qaderi *

Faculty of Civil Engineering, Babol Noshirvani University of Technology, Babol, Iran

Received: 10 August 2022; **Review:** 14 November 2022; **Accepted:** 03 December 2022

Keywords:
GIS, runoff, remote sensing, soil erosion.

1. Introduction

The purpose of this study is to analyze the environmental risks of soil erosion in the runoff of the Shahid Rajaei Dam in Sari based on GIS and remote sensing approach. In this study, soil erodibility was assessed based on the global model of soil loss called RUSLE with rainfall erosion input parameters, soil erodibility, topographic factors: length and slope, land cover management, conservation operations. For this purpose, before producing the results of these factors, first the input data such as DEM, slope, geological layer, land use layer, precipitation, soil and vegetation index was prepared and their spatial distribution pattern in the study area was described and analyzed. In the next step, the potential for flooding and runoff production was measured using the criteria of distance from waterways, drainage density, slope, slope direction, land use, rainfall, geology, soil type. In this regard, while fuzzy the layers, different variables were applied in order to integrate the mentioned layers in the final step on the production of flood potential map and runoff production. After producing the main layers, namely flood potential and runoff production, soil erodibility was studied using Pearson correlation test and regression model of the relationship between these factors and the results were discussed. The results of this study showed that remote sensing and GIS techniques in combination with field measurement values of the studied parameters can have many applications in the field of environmental studies in the field of civil engineering and in modeling and estimating environmental parameters. Be very beneficial bio.

Water resources are very important in environmental engineering (Babanezhad et al., 2017; Qaderi et al., 2018). Pollution can be damage different parts of environment (Ebrahimi and Qaderi, 2021; Ebrahimi Ghadi et al. 2019; Dabbaghi et al. 2021) like as water resources (Yavari and Qaderi, 2020). Therefor many researches have been done about environment protection (Moghadam and Qaderi, 2019; Taghizadeh at al. 2019; Sheikholeslami at al. 2020). Flood can cause to soil erosion and soil is very important in human life (Tamadoni and Qaderi, 2019; Khalegh and Qaderi, 2019). Concerning that Mazandaran province and Shahid Rajaei dam in Sari are among the flood prone areas of Iran, flood risk mapping is very crucial and essential for choosing appropriate land uses and managing water resources in such areas (Elsadek et al., 2019).

2. Methodology

2.1. Research Methods

For the advancement of study goals, different information layers (surface slope, land cover, half hour rainfall intensity with 10-year return period, hourly rainfall intensity with 2-year return period, average annual precipitation, altitude, geologic and land-use parameters) were prepared for the watershed of Shahid Rajaei dam, Sari, Iran. Variable input data including land cover index, mean precipitation, half-hour and hourly rainfall intensity, altitude, geologic and land-use parameters were entered as GIS inputs and its output was erosion.

* Corresponding Author
E-mail addresses: esfandeyari@yahoo.com (Amir Hossein Esfandiyari), f.qaderinit@ac.ir (Farhad Qaderi).

2.2. Area of study

This research was conducted at the watershed of Shahid Rajaei Dam, Sari, Mazandaran, Iran.

3. Results and discussion

3.1. Description of the measurements and spatial distribution of research variables

3.1.1. Spatial distribution patterns of elevation

For producing the maps of digital elevation model (DEM), Satellite images produced by the ASTER satellite sensor having pixel resolution of 28.5 m were used.

3.1.2. Spatial distribution patterns of slope

In the present research, slope layer was obtained according to digital elevation model (DEM) in GIS software and the results were displayed as the spatial distribution pattern of slope (%).

3.1.3. Measuring average annual precipitation

To measure average annual precipitation, the data of 5-year average rainfall (2015-2019) from four rain-gauge stations (Sari, Ghaemshahr, Sepidrood, and Kiasar) of Mazandaran Meteorological Organization was used.

3.1.4. Geology parameter

In this research, geology layer was presented as geological units.

3.1.5. Land-use or land-cover

For preparing land-cover maps and reporting the current land-use situation in the watershed of Shahid Rajaei dam, firstly an appropriate time was determined for satellite imagery. After conducting preprocesses and classification of the images, the output presented in raster format was entered into ArcMap10.7.1 software in order to merge the features of classes and remove the classification errors and create output maps and statistical abstract of land-cover condition in the study area.

3.1.6. Normalized difference vegetation index (NDVI)

Results of NDVI were represented in this research.

3.2. Results of modeling RUSLE factors in GIS software

3.2.1. Rainfall erosivity factor (R)

For measuring R in this study, average annual rainfall data of 5 years were collected from weather stations located in Sari, Ghaemshahr, Pol-e-sefid and Kiasar.

3.2.2. Soil erodibility factor (K)

For calculating soil erodibility factor (K) in this research, data were provided from job-creation plan in the villages of Sari and Miandorood performed by Management and Planning Organization of Mazandaran.

3.2.3. Topographic factors (L, S)

In the present research, the procedure of Moore et al. (1991) and SAGA GIS open-source software were used; this software owns a simple tool for single-step exploration of LS factor from Universal Soil Loss Equation (USLE) using a digital elevation model (DEM).

3.2.4. Soil conservation practices factor (P)

Since no conservation practices were performed in the study area, the number considered for P in the whole study area was 1.

3.2.5. Soil erosion map

After creating the layers of factors C, S, L, K, R, these layers were finally multiplied in GIS software. At the end, by using the geometrical distances method in ArcMap 10.8 software, measures of the evaluated soil erosion map were classified into five classes i.e. very low, low, moderate, high, and very high.

4. Conclusions

Soil erodibility was measured through Revised Universal Soil Loss equation (RUSLE). For this purpose, before creating the results for used factors, their input data including DEM, slope, geologic layer, land-cover layer, precipitation, soil, and NDVI index were prepared and their spatial distribution patterns in the study area (watershed of Shahid Rajaei Dam, Sari) were analyzed. Study results suggested that remote sensing techniques and GIS combined with field measurements of the studied parameters can be used for the environmental studies of civil engineering and also be very useful for the modeling and evaluation of environmental parameters.

5. References

Babanezhad E, Amini Rad H, Hosseini Karimi SS, Qaderi F, “Investigating nitrogen removal using simultaneous nitrification-denitrification in transferring wastewater through collection networks with small-diameter pipes”, Water Pract Technol, 2017, 12, 396-405. https://doi.org/10.2166/wpt.2017.044

Dabbaghi F, Rashidi M, Nehdi ML, Sadeghi H, Karimaei M, Rasekh H, Qaderi F, “Experimental and informational modeling study on flexural strength of eco-friendly concrete incorporating coal waste”, Sustainability, 2021, 13 (13), 7506. https://doi.org/10.3390/su13137506

Elsadek WM, Ibrahim MG, Mahmod WE, “Runoff hazard analysis of Wadi Qena Watershed, Egypt based on GIS and remote sensing approach”, Alexandria Engineering Journal, 2019, 58 (1), 377-385.

Ebrahimian Y, Barari Siyavashkalayi M, “Runoff production potential zoning using fuzzy GIS-MCDA models (case study: Tajan river basin)”, Journal of Geomatics and Technology, 2019, 9 (1), 1-14.

Ebrahimi M, Qaderi F, “Determination of the most effective control methods of SO_2 pollution in Tehran based on adaptive neuro-fuzzy inference system”, Chemosphere, 2021, 263, 128002. https://doi.org/10.1016/j.chemosphere.2020.128002

Ebrahimi Ghadi M, Qaderi F, Babanezhad E, “Prediction of mortality resulted from NO_2 concentration in Tehran by Air Q+ software and artificial neural network”, International Journal of Environmental Science and Technology, 2019, 16 (3), 1351-1368. https://doi.org/10.1007/s13762-018-1818-4

Khalegh R, Qaderi F, “Optimization of the effect of nanoparticle morphologies on the cost of dye wastewater treatment via ultrasonic/photocatalytic hybrid process”, Applied Nanoscience, 2019, 9, pages1869-1889. https://doi.org/10.1007/s13204-019-00984-9

Moghadam MT, Qaderi F, “Modeling of petroleum wastewater treatment by Fe/Zn nanoparticles using the response surface methodology and enhancing the efficiency by scavenger”, Results in Physics, 2019, 15, 102566-102576. https://doi.org/10.1016/j.rinp.2019.102566

Moore ID, Grayson RB, Ladson AR, “Digital terrain modeling: a review of hydrological, geomorphological, and biological applications”, Hydrological processes, 1991, 5 (1), 3-30.

Qaderi F, Sayahzadeh AH, Azizpour F, Vosughi P, “Efficiency modeling of serial stabilization ponds in treatment vof phenolic wastewater by response surface methodology”, International Journal of Environmental Science and Technology, 2018, 16 (8), 4193-4202. https://doi.org/10.1007/s13762-018-1816-6

Sheikholeslami Z, YousefiKebria D, Qaderi F, "Application of γ-Fe2O3 nanoparticles for pollution removal from water with visible light", Journal of Molecular Liquids, 2020, 299, 112-118. https://doi.org/10.1016/j.molliq.2019.112118

Tamadoni A, Qaderi F, "Optimization of soil remediation by ozonation for PAHs contaminated soils", Ozone: Science and Engineering, 2019, 41 (5), 454-472. https://doi.org/10.1080/01919512.2019.1615865

Taghizadeh M, Yousefi Kebria D, Qaderi F, "Effect of biosurfactant as a novel draw solution on photocatalytic treatment and desalination of produced water by different forward osmosis membranes", Water Science & Technology Water Supply, 2019. https://doi.org/ 10.2166/ws.2019.154

Yavari SM, Qaderi F, "Determination of thermal pollution of water resources caused by Neka power plant through processing satellite imagery, Environment", Development and Sustainability, 2020, 22 (3), 1953-1975. https://doi.org/10.1007/s10668-018-0272-2