# Assessment of Soil Erosion Risk by Using Fuzzy Logic Model in Seymareh Chenar Basin

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## Extended abstract

### 1- Introduction

Soil erosion is a process in which soil is separated from its original bed and transported to another location with the help of a moving agent [17]. Soil erosion is one of the serious problems in the watersheds of Iran and can be considered as one of the most important barriers to sustainable agriculture and natural resources development [6]. Soil erosion results in the destruction of agricultural land, the reduction of soil fertility, environmental negative impacts, and a very important threat to the sustainable production of agricultural products [8]. Erosion, the result or results of the interaction of a set of natural and human factors, which, in accordance with the specific circumstances of the region, are one or more factors acting as the main and determining factors [7]. In general, erosion is a natural phenomenon that human activities can exacerbate. Historical evidence suggests that erosion and destruction of soil have resulted in the collapse and destruction of human civilizations [9]. Awareness of the extent of erosion in catchment areas, the possibility of comparing them and identifying critical basins and implementing watersheds. The amount of erosion and destruction of the land requires the zoning of erosion of the land for the preparation and collection of information [8]. Destruction of vegetation (especially the plant species of moss, which is the dominant species of the region) and the cutting of trees and shrubs (oak and orange trees, which form the largest area of the forests of the area) cause soil to be deflated against erosion and cause debris to be gutted and even swept away.

### 2- Methodology

In this research geological maps, topographic maps, Landsat 8 satellite images, climatic data of the study area in research, including temperature and precipitation, and the 30-meter-high elevation digital model of the study area were used to prepare the slope map, the slope direction and the extraction of the waterways. ArcGIS software was used to create databases, spatial and spatial analysis, and finally to implement the model and use the ENVI software to process satellite imagery. Fuzzy logic is a logic of several values, that is, its parameters and variables, in addition to the number of 0 or 1, can take all the values between these two numbers. The basis of the differences between fuzzy methods and other methods is to define the membership function. The membership function can be used to determine the degree of attribution of the elements of the reference set to its subset. The operator of the fuzzy society is the collection community. In this way, it extracts the maximum membership. The fuzzy subscription operator is the collection subscription. In that way, it extracts the minimum degree of membership. Fuzzy algebraic multiplication multiplies all the information layers together. Because of the nature of the numbers between zero and one, which is the same as the membership in a fuzzy set, the operator makes the number of the numbers smaller and goes down to zero. The complementary fuzzy algebra operator is obtained by the algebraic multiplication. Therefore, in the outbound map, unlike the fuzzy algebraic operator, the value of pixels goes toward one. The fuzzy gamma operator is the product of multiplication, fuzzy coherent multiplication in the fuzzy algebraic summation. The results obtained from this operator are more accurate than other operators. To evaluate the accuracy of the model, Kappa statistical coefficient was used.

### 3- Results

The results show that the kappa statistical coefficient shows that the 0.97 fuzzy gamma operator with 0.83 kappa coefficient has excellent accuracy in soil erosion zonation in Seymareh Chinar basin.

Investigating the results of this study shows that areas with a steep slope, poor vegetation, bay lands, presence of limestone and dolomitic stones have much more erosion. This type of erosion is located in the northwest, south and southwest of the studied basin. In the south and southwest of the region, due to the high slope, low soil depth, excessive grazing of livestock, degradation of vegetation and forest by the inhabitants of the region and plowing the land towards the slope, led to greater erosion. In the west, south and center of the area due to uneven topography and in some areas, soil depth, cereal, steppe, in some cases, blueberries and slopes less than other parts of the area, erosion is less. According to the results of this research, as well as field observations and lack of attention of the people of the area to soil degradation and destruction of the dominant vegetation of the region, it seems that the study area in research needs urgent planning to prevent soil erosion. This suggests that in this basin, the separation and displacement of soil particles is so limited that implementation of the necessary water and land conservation programs and the use of land has a lot of limitations.

## 4- Discussion & Conclusions

To do this study, using a fuzzy logic model, the database consists of slope, directional, petrographic, land use, lagoon, rainfall, soil and channel formation, and then the required data were obtained by processing the data. The operators of the fuzzy logic model were used. The result of the fuzzy community operator generated the maximum membership. The fuzzy share operator extracted the minimum membership. The result of the operator of the fuzzy algebraic multiplication is reduced to zero numbers. The output map of the operator of the fuzzy algebra sum of the value of the pixels is close to the maximum. In order to modulate the very high sensitivity of the fuzzy algebraic operator and the very low accuracy of the fuzzy algebraic operator, a 0.9% gamma-gamma operator was used. Based on the zoning done using fuzzy function, 16.19, 31.37, 27.77, 17.98, and 34.66 percent of the area of the area are located in very low, moderate, high and very erosion classes. Kappa coefficient was 0.83 for fuzzy logic model. Eliminating the dominant vegetation of the region, especially the mossy vegetation, which has roots and prevents soil erosion, cuts off oak trees to plow in the direction of slope and changes the unauthorized use, all have added to the severity of erosion in this area.

**Keywords:** Geographic Information System, Seymareh Chinar Basin, Erosion, Fuzzy Logic Model