Zonation of the Intensity of Carbonaceous Rocks in Southern Zagros (Case Study: Seif Abad-e-Laghar Basin)

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Introduction

The Iran has vast areas of karst landforms due to the relatively high carbonaceous rocks deposited during different geologic eras. Karst landforms are noteworthy for investigation from many aspects. The primary importance of these regions is the considerable amount of underground water stored in karst formations. These reserves are favorable, both in quality and quantity, as natural resource for human. In addition to the studies performed to identify karstic regions of Iran, studying the geomorphologic aspect of karstic areas could be a noticeable contribution tothe studies related to underground water resources. In a total review, necessary and effective factors for karst formation and development are divided into chemical, physical and hydrological groups. Usually seven elements act together to form karstic landforms: precipitation, elevation, lithology, carbonate rock thickness, Carbon Dioxide pressure, temperature and Tectonics. Although all these elements would act as an independent factor, the dissolution of karst in the real world is mainly affected by two major factors: precipitation and temperature. It should be mentioned that when temperature is low, precipitation variation has little effect on karst dissolution rates, but, when temperature rises to 16–20°C, karst dissolution rates rise quickly as precipitation increases. Since the carbonate rocks are solvent to acids, and since the temperature and precipitation cause the formation of Carbonic Acid by solving CO^2 into precipitation water, the two mentioned factors highly control the karst Process. Furthermore, the karst dissolution is a function of water and temperatureand any factor that could increase the contact between karstic lands and water- such as drainage network, faults,

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and etc- may also increase karst dissolution. Therefore, in this research, the authors have tried to make a zonation of the mentioned basin for karst dissolution suitability using Fuzzy Gamma coefficient.

Materials and Methods

A) Study area

The study area of the research is Seif Abad-e-Laghar which is located between northern latitudes of 27°50' and 28°06 and eastern longitudes of 52°51 and 53°16. Seif Abad is a sub-basin of the Mond great basin located in the Kazeroun County. The area has an area of 1244.82 square kilometers and a perimeter of 192.2 kilometers. The average precipitation of the basin is 298.5 millimeters and the average temperature is 22.7 C° degrees. There are 12 wells to measure the quality and quantity of underground water in the study area.

B) Materials

In order to perform the study, after reviewing previous studies, 9 parameters were selected as final variables: precipitation, temperature, sinkhole density, distance from sinkholes, drainage network density, distance from streams, faults density, distance from faults, and slope. To achieve these variables, data were gathered from different sources: climatic data were obtained from Iran meteorology organization, hydrology data were obtained from Iran Water Company and Fars Province's regional water. Physiological data were also extracted from the Digital Elevation Model (DEM) of the region. Then, data were entered into ArcGIS 9.3 to produce the variables using spatial analysis functions and ArcHydro tools.

In order to combine the variables, the Fuzzy Gamma was employed. Based on Fuzzy sets theory, a fuzzy set is a set in which the amount of membership for each factor is between zero and one. The membership degree is determined using experts' ideas. Then, the fuzzy combination functions are used. Five functions of fuzzy subscription, fuzzy community, fuzzy multiplication, and fuzzy sum are used to combine the factor sets. In this research, various Gamma coefficients were used to make zonation of the intensity of karst dissolution. To choose the most appropriate gamma coefficient for such mean, a correlation coefficient between each layer derived from gamma estimation and interpolated Calcium ion layer (as a factor of dissolved carbonate). The coefficients showed that the highest correlation exists between gamma 0.4 and the calcium ion interpolated layer. Hence, the gamma 0.4 was employed to calculate the final zonation map.

Results and Discussion

After converting the factors into fuzzy layers and applying the gamma 0.4 and combining the data, the final map was calculated and drawn. Then, the final map was divided into 5 classes of very low, low, moderate, high, and very high. It was based on standard deviation. The results showed that the basin is in a low dissolution rate. The spatial distribution of karst dissolution is also heterogeneous. According to the relative homogeneity of precipitation, temperature, drainage density and distance from streams in the basin, these factors do not seem to be as much effective as other factors. Elaborately, regions with high karst dissolution are mainly coincident with the areas with high sinkhole and fault density, and low slope. Generally, the main direction of regions with high and low dissolution is fubction of the general elevation and topography in

northwestern- southeastern direction. In a geological view, the area with maximum dissolution rate is located on the terrace deposits. A part of the second erosion area is also located on the terrace deposits and the other part is located on the Bangestan. Studying the area of each dissolution class shows that more than 80 percent of the basin's area is in very low and low classes and only 2.82 and 3.93 percent of the basin is in very high and high dissolution classes, respectively. Therefore, it could be concluded that the basin has a low dissolution of carbonate rocks. Thismight be due to the low precipitation rate over the basin.

Conclusion

The dissolution of carbonate rocks seems to be significantly dependent upon precipitation rate and temperature. However, it is also affected by some other variables such as the purity, thickness, and the age of the carbonate rocks, which are not studied in this paper. In this research, it was revealed that the gamma 0.4 coefficient works the best in predicting and interpolating the carbonate rocks dissolution rate.The minimum and maximum dissolution areas are located respectively in north and southwest of the basin. Besides, the maximum dissolution in non-carbonaceous and carbonaceous rocks occurs in terrace deposits and Bangestan group, respectively. Furthermore, the minimum dissolution rate was estimated in Bakhtiari Conglomerate (non-carbonaceous) and Asmari and Jahrum Formations (carbonaceous).

Keywords: fuzzy Gamma, karst dissolution, limestone, Seif Abad-e- Laghar Basin.