Research Paper

Hydrogeomorphology, Vol. 10, No. 34, Spring 2023, pp (26-28)

Received: 2023.01.30
Accepted: 2023.04.08

Effect of Vegetation and Soil Erosion on the Hydro-geochemical Quality of Surface Waters
Case Study: Qolyan River Catchment Area, Qalikuh Region, Lorestan

Amirsaeid Hosseini [1], Saeid Hakimi Asiaber *[2] , Mojgan Salavati [3]

1-PhD student, Department of Geology, Lahijan Branch, Islamic Azad University, Lahijan, Iran
2-Assisstant Professor, Department of Geology, Lahijan Branch, Islamic Azad University, Lahijan, Iran
3-Assistant Professor, Department of Geology, Lahijan Branch, Islamic Azad University, Lahijan, Iran

1-Introduction

The Qalikuh region is the most important region with scattered oil shales in Iran. It contains seasonal and permanent waterways, which are fed from the surrounding rivers. The permanent waterways of Gashun and Pirbadush, flowing into the Qolyan River, are situated over the path of oil shales. Aligudarz River, one of the main branches of the Bakhtiari River, feeds from the Qolyan River. Bakhtiari River, together with the Sezar River, constitutes one of the main branches of the Dez River. Dez, Karun, and Karkheh Rivers are the most important rivers of southwestern Iran, which flow into the Persian Gulf. Therefore, it is very important to investigate the causes of qualitative changes in water and effective management to optimally use water in the region for different types of consumption.

2-Methology

Following the initial studies in the Qalikuh region and using Google Earth images, as well as specialized geological maps, it was determined that not only oil shales had expanded (in Garau and Sargelu formations), permanent waterways were streaming in the Gashun (G) and Pirbadush (P) sections of Qolyan River. Then, by locating the stations, sampling from the central part of the river was performed based on the 1985 ISO-Standards, and also by registering water temperature. The samples were poured into polyethylene containers, previously rinsed with 10% nitric acid and distilled water, and were transferred to a laboratory less than 24 hours away from direct sunlight and heat. In the laboratory, the main parameters, including cations (NH_4^+, K^+, Ca^{2+}) and anions (Cl^-, NO_3, NO_2^-, PO_4^{3-}), physical parameters such as electrical conductivity (Ec), pH, turbidity, and chemical parameters, such as total dissolved solids (TDS) were measured by ASTM, St. Method, and MMS methods.

* Corresponding Author, **Email:**saeid.h.asiabar@gmail.com

This study used WHO-2011 and NSI (1053) standards for comparison. During the sampling procedure, data were recorded by measuring water temperature, slope, and altitude, and calculating vegetation. In August and at the time of sampling water samples, the approximate distance of plants (shrubs) from the highlands down to the lowlands was calculated using the Transect Method and the following equation, with the percentage of vegetation at each station calculated.

Percentage of vegetation cover = (100 - length of land without vegetation cover/100) × 100

This study calculated the level of rainfall based on the geographical altitude and from the following equation for various areas.

$P=0.1183\times h\ (0.9.62)$

Where P is rainfall (mm), and h is the height from sea levels (m).

The following is also an equation for the relationship between vegetation and soil erosion.

$E_r = e^{-b\times C}$

Where C is the percentage of vegetation and b is a fixed number ranging from 0.0235 to 0.0816, depending on the type of vegetation. In this region, vegetation is pasture and grassland. To evaluate the level of erosion, the following equation is used:

$E_r = e^{-0.0694\times C}\ (e=2.71)$

3-Results and Discussion

According to laboratory results and statistical calculations (The Pearson Correlation Test, Principal Component Analysis (PCA), and Cluster Analysis (CA)), factors affecting soil erosion and vegetation on the water quality of the region were examined.

According to laboratory data and based on water ions (calcium, potassium, and nitrate), and the water physiochemical properties (electrical conductivity and total dissolved solids), water quality had dropped from high altitudes to low-altitude regions, as the P_1 station water saw the highest quality, while the G_7 had the worst quality. As illustrated by diagrams, there was a reverse relationship between vegetation and erosion factors, total dissolved solids, electrical conductivity, and water calcium content.

The chlorine-to-nitrate ratio in the regional water was higher in many of the stations (especially G_7 and G_8 stations). Water nitrate can result from organic wastage, such as animal manure in livestock grazing. This region is far away from urban industrial and agricultural activities and is thus affected by geological factors such as oil shales (P_1 and P_2) and Quaternary deposits (G_6). At the G_6 station, both geo-genic factors and environmental factors such as reduced vegetation and increased dissolution and weathering cause the concurrent increase of nitrate ions, chlorine, total dissolved solids, and turbidity. According to objective evidence, the only human agent in the region is excessive livestock grazing, which increases nitrate ions (P_6 and P_7).

According to the Pearson correlation coefficient, there is a negative relationship between erosion and vegetation, rainfall, slope, geographical altitude, and the alkaline pH of water. According to the Pearson correlation coefficient, vegetation was negatively correlated with calcium, potassium, electrical conductivity, total dissolved solids, water temperature, and turbidity. The Principal Component Analysis (PCA) on studied indices led to identifying 3 main factors, the first of which (the most important factor) was that there was a negative relationship between erosion and potassium, calcium, total dissolved solids, electrical conductivity, and water temperature. However, there was a positive relationship between vegetation and slope, geographical altitude, rainfall, and the alkaline pH of water. These relationships confirm the correlation coefficient and suggest that the first factor had the most pivotal role in the regional vegetation density. The second factor had a negatively significant relation with nitrate anion (NO_3^-). The third factor, which has the least significant role among the studied indices, suggested there was a positive and significant relationship between turbidity and total dissolved solids. According to the correlation coefficient and the principal component analysis, cluster analysis (CA) is less capable of determining the factors, and whose results cannot be trusted.

4-Conclusions

This study found that excluding nitrate in some regions, environmental and geo-genic factors affected water quality. The most important environmental and geo-genic factors were:

- Decreased vegetation density and increased erosion and expanded Quaternary deposits (G_6)
- Oil shale outcrop (P_1 and P_2)

The most important anthropogenic factor was:

- Excessive grazing in regional pastures (P_6 and P_7)

Keywords: vegetation, Quaternary sediments, oil shales, erosion, Qalikuh Lorestan.