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## ***Investigation of Changes in the Meandering Pattern of Darbadam River, Quchan city***

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### **1-Introduction**

It is necessary to study the creation of different landscapes by rivers over time and because of their interaction with human life. The morphological characteristics of the river are constantly changing due to its dynamic characteristics, and these changes can cause a large number of agricultural lands, residential areas and construction facilities to be destroyed and destroyed every year due to erosion of the river bank. Therefore, any hydraulic analysis on the river requires access to accurate morphological characteristics, especially the channel platform. It is necessary to study the pattern of rivers to understand the current situation and the potential for their possible changes in the future and only in this way, their natural reaction to natural or human changes, the rate of displacement, changes in their dimensions and pattern can be detected (Chorley et al., 1397). In this study, the Darbadam River is selected to investigate changes in the channel platform. The study area of this research is a subsystem of a larger whole called Darongar catchment area which has changed over time and space due to various geomorphic factors. Therefore, the purpose of this study was to detect these changes to determine the curvature coefficients (Sinuosity) and central angles of the river.

### **2-Methodology**

Darbadam catchment area is one of the important catchments of Drongar River, located in the north of Khorasan Razavi province in the northwest-southeast direction. The basin is located at 37 degrees 29 minutes 52 seconds to 38 degrees 28 minutes 13 seconds north latitude and 58 degrees 26 minutes to 58 degrees 27 minutes 87 seconds east longitude. The two topographic units of mountain and plain in the basin are separable and the average height of the basin reaches 2073 meters above sea level. Darbadam village is limited to Bajgiran border town from the north, Quchan county from the south, Dargaz town from the east and Shirvan county from the west. In this study, Landsat satellite images in 2010 and 2021 were used to study the temporal and spatial changes of the river.

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The geometric coefficients of the river, including the values of the central angle index and the curvature coefficient, have been extracted and compared over an eleven-year period. The central angle (Equation 1) and the curvature coefficient (Equation 2) were used to quantify the extent of development and progression of torsion in rivers.

$$1) \quad \theta = 180 \, c / R\pi$$

In this relation  $\theta$  is the central angle,  $c$  is the meander curvature,  $R$  is the radius of the hypothetical circle and  $\pi$  is the number pi

$$2) \quad p = \frac{Lc}{Lv} = \frac{Sv}{Sc}$$

Where  $Lc$  is equal to the length of the channel,  $Lv$  is equal to the length of the valley,  $Sv$  is equal to the slope of the valley and  $Sc$  is also equal to the slope of the channel .

The study of river pattern changes was studied in three parts including the first part (right sub-basin), the second part (left sub-basin) and the third part (end part). In each section, according to the river arches in two time periods, a circle was drawn, which was based on the analysis of the central angle index and the curvature coefficient.

### 3- Results and Discussion

As mentioned, the Darbadam River consists of two main tributaries that are connected at the end of the basin and form the Darbadam River. According to the results obtained for the central angle, in the first part between 2010 and 2021, the Meandri River pattern was developed and there was no change in the pattern class, but in the second and third parts in 2010, the river pattern is not developed meandering, which in 2021 has become the developed meandering river pattern.

The values of curvature coefficient obtained for 2010 were 1.67 in the first part, 1.68 in the second part and 1.39 in the third part. These values have increased in 2021, in the first part: 1.68, in the second part: 1.74 and in the third part: 1.53. All values obtained represent the meandering pattern

### 4-Conclusions

Based on the average curvature coefficients in all three sections studied, the Darbadam River has a meandering pattern. Due to the characteristics of the region, such as the presence of resistant rock layers, the high slope of the region and also the mountainous



topography, has led to low transverse displacement of meander in the region. However, in some parts of the river, due to human activities, including land use change, vegetation degradation and overgrazing, there has been a change in the river pattern.

**Keywords:** Meandering pattern, Curvature coefficient, Central angle, Darbadam River, Northeast Iran.