Investigation of Duiraj River meandering pattern, Using Curvature and Center Angle Coefficients

Ali Asghari[1], Maryam Mousavi Bideli[2], Saeed Shojaei[3,*], Khadijeh Rahimi Balkanlou[4]

[1]Department of Agricultural, Payame Nour University, Iran
[2]M.S. Student of Department of Environmental Pollution, Yazd University, Iran
[3*]Ph.D. Student Department of Management the Arid and Desert Regions, Yazd University, Iran
[4]Ph.D. Student of Desertification at University of Kashan, Department of Desert Engineering, Faculty of Natural Resources and Geo Sciences, University of Kashan, Kashan, Iran
Shojaeisaeeds@Gmail.Com

Abstract: Meandering is one of the most important river engineering issues that affects human activities in the riverside boundary, so studying these areas is necessary in order to obtain accurate knowledge and to investigate possible problems and risks for optimum conservation and optimal utilization of natural resources. The purpose of this research is to investigate the quantitative characteristics and patterns of the paths studied in the Duirj River, thereby identifying the characteristics and characteristics of the studied area. The study of curling in this river indicates that the curling is low and the degree of side and middle erosion is also low. Investigating the variations of the central angle showed that the variation of the range is limited, which indicates rocks of approximately the same length along the river's path. The development of meanders usually increases the length of the canal and at the same time reduces the steepness of the river. The river in question is too developed Meander, and the rate of rifting is sinusoidal.

[Asghari A, Mousavi Bideli M, Shojaei S, Rahimi Balkanlou KH. **Investigation of Duiraj River meandering pattern, Using Curvature and Center Angle Coefficients.** *Stem Cell* 2018;9(1):28-31]. ISSN: 1945-4570 (print); ISSN: 1945-4732 (online). http://www.sciencepub.net/stem. 5. doi:10.7537/marsscj090118.05.

Key words: Meandering, Central Angle, Sinuosity, Duiraj watershed.

1. Introduction

River geomorphology is a term used in geology to study the shape and system of the river. The riverbed as a small part of the ripples of the earth is influenced by geological, climatological and hydrological factors that create the river's shape (Schumm, 1980). Many researchers have studied river geomorphological patterns. Rezaee Moghaddam et al (2015) In their research on the quantitative analysis of Aji Chai rivers, found that river morphology changes are more influenced by natural factors such as decreasing flow power due to decreasing annual mean water flow, sediment flow, sediment accumulation and flimsy lithology. Yamani and Hosseinzadeh (2004), in their studies on the Talar river, concluded that 60.4% of the river follows the pattern of developed Meanders and 25.5% of the river is very developed. Mirzavand et al (2015) Reviewed meander rivers pattern of Babol Rood and Sajjad Rood, and found that according to the curvature coefficients, 71.76% of the river has a developed meander river. The coefficients obtained through these models require the need for medium and short term bed fixation through management and structural engineering methods. Dallal Oghli (1992) analyzed the curvature coefficient of the river in the Ahar plain. By performing granulometry from the river bed, it was concluded that in meanders rivers the grain size is smaller, but the size of the grains is larger in the arterial rivers. Nohegar et al (2001) Examined the geomorphological status of the Minab River and it was found that Meander's bolts are slowly moving downward over time and Any change in sediment load causes loading, increase or change of gradient, and ultimately spiralization of the river. Brooks (2003) explored the displacement of the Red River Canal in Manitoba, Canada and found that the displacement of the Meanders was at a gradient of 0.7 to 2 percent. Bayti Khatibi (2008) studied the effect of tectonic activity and dam's construction on the change in the sinuosity of the flow path and found that human manipulation and creation of dams are the main causes of movement of the stream and meander creation in the rivers. Zamolyi et al (2010) studied the role of Neotectonic in river sinusoidal control and duct pattern in the western margin the Little Hungarian Plain and concluded that the Sinuosity Index is a very important tool for demonstrating Neotectonic activity. Millar and Quik (1993) examined the longitudinal slope and river sinuosity criteria they found that sinuosity depends on the slope, and the rivers with low slope have more sinuosity than rivers with high slope.

In this research, tried to identify and quantitative investigation of the characteristics of Duiraj meander river and development of meanders according to the region's morphology.

2. Materials and Methods

Duiraj River originates from Sarab Abdanan, 38 km north of Dehloran and Golgol and Derakhshor rivers also join it. After reaching 18 km from the city of Dehloran, the river enters the Mussan section. In this region known as Nahr-e- Anbar. Another branch of the Mormori River, called Jykhab, also joins it. The river Doiraj, which flows from north to south, flows through Iraqi territory, passing through Mussian to the Tigris. The length from origin to this point is 188 km and its local names are Abdanan and Talezi River. A dam has been built on this river.

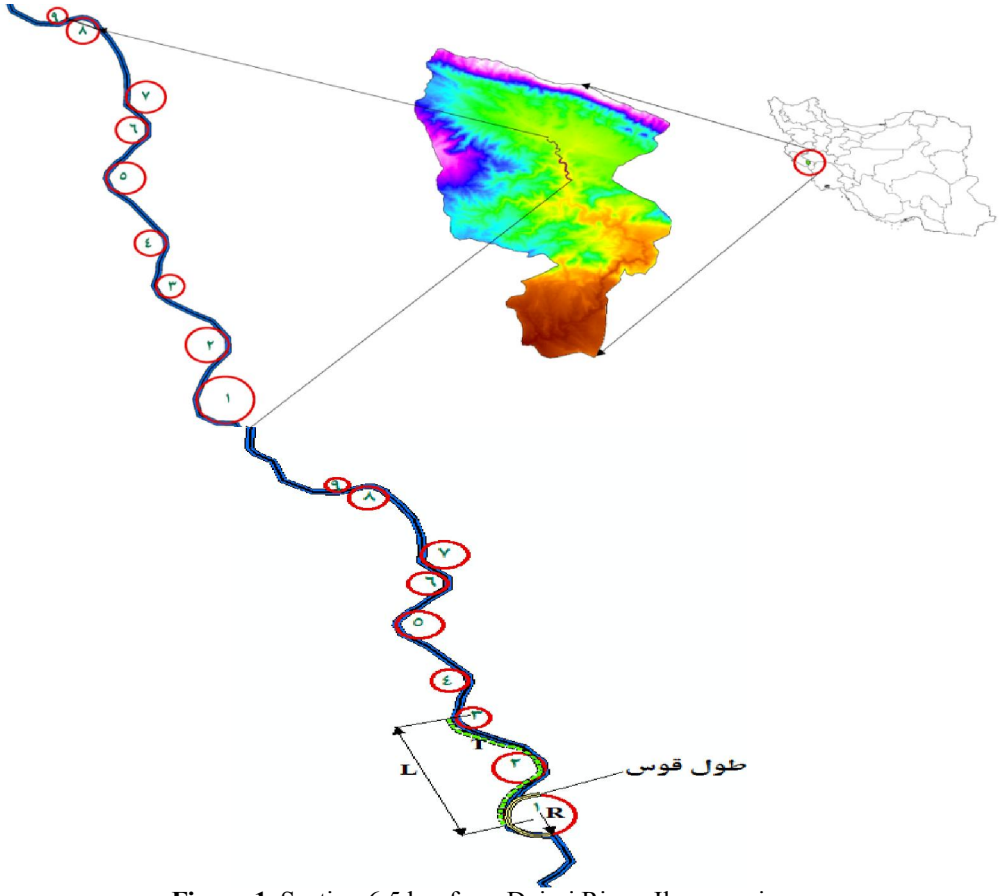

Figure 1. Section 6.5 km from Duiraj River, Ilam province

In order to investigate the mean discharges, the characteristics of Meanders are also used. For discharge estimating, meander length is measured from the Google Earth and Using the following equation, the mean discharge of each arc is calculated.

Qmean =0.0009(L/2)1.8
Qmean: Mean discharge
L: Meander length
$A = \frac{180L}{R\pi}$
A: Central angle
L: Arc length
R: Hydraulic radius

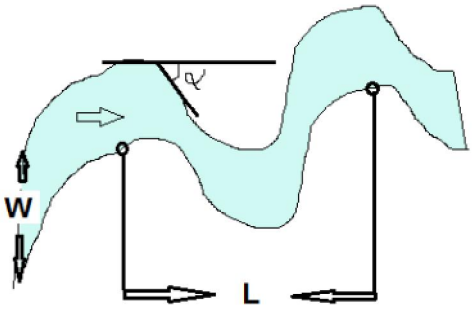

Table 1. Average Flow Rate

Arc	Q_{mean}
1	0.00075
2	0.00054
3	0.00024
4	0.00042

Table 2. The values of the central angle, the length of the arc, the radius of the river arch

Arc	Central angle	Arc length (A)	Arc radius (R)
1	175	0.95	0.31
2	174	0.7	0.23
3	183	0.48	0.15
4	178	0.53	0.17
5	180	0.66	0.21
6	177	0.54	0.17
7	179	0.67	0.21
8	180	0.55	0.17
9	182	0.33	0.1

Development of meanders is determined using Kornise method.

Table 3. Types of meanders in river based on the central angle (Kornish, 1980)

Shape of canal	Direct	Semi meander	Undeveloped meander	Developed meander	More developed meander like river	River ox-bow (serpentine arc)
Central angle	-	0-41	41-85	85-158	158-296	Up to 296

Calculate the sinuosity rate of the Duiraj River

The amount of river twists in the flow path can be determined by the amount of sinuosity. The amount of sinuosity in the Duiraj River during different parts is calculated according to Fig. 3 and using the relation 1:

S=T/L

S: Sinusoidal rate

T: Sinusoidal length

L: Longitudinal distance of straight line

Table 4. Sinuosity and sinusoidal length

Arc	T	L
1	2.22	1.82
2	1.72	1.52
3	1.26	0.98
4	1.62	1.32

Table 5. Obtained sinusoidal values

Arc	Sinuosity	Sinusoidal value
1	1.21	Low
2	1.13	Low
3	1.28	Low
4	1.22	Low

In this study, the curvature of the river course has been calculated using sinuosity index (S). It is possible to determine meandering of rivers according to the following thresholds.

Table 6. Division of rivers based on sinuosity coefficient

Sinuosity coefficient	1-1.06	1.06-1.25	1.25- 2	2≤S
Type of the river	Straight	Sinuous	Meandering	Sever meandering

Table 7. Sinuosity rate in the river Arcs

Arc	Sinuosity	River Route Type
1	1.21	Sinuous
2	1.13	Sinuous
3	1.28	Sinuous
4	1.22	Sinuous

According to the table 7, in the marked arcs; pathway type is sinusoidal.

3. Results and discussion

Meanders are usually characterized by sinuosity. Activity rate and its intensity characterized by the amount of spatial and temporal displacements (Hook, 2007). Study of sinuosity in this river according to table 5 showed that the sinuosity is low. Survey of river sinuosity can be used to identify active areas in terms of tectonics, areas affected by human manipulation and also active areas of erosion (Field et al, 2014). As a result, it can be stated that the amount of lateral and middle erosion is also low. The study of central angle variations showed that changes in this index are limited and this represents roughly similar arcs along the river's course. The values of the central angle and the curvature coefficient show that central angle changes (Except low proportion in mountainous regions) in all the examined intervals has a limited range. This indicates the presence of roughly similar arch along the river course, thus meander rivers on the Fractal Geometry scale are quite similar. In the other words, in the long curve paths sinuosity coefficient is higher than short curve paths (Brice, 1984). Increasing river power in the flow direction, is one of the important factors in the development of meanders in different areas. Meanders development usually increases the length of the channel. At the same time, the slope of the flow path is reduced (Withanage et al, 2014). According to the Kornise index, desired river is in sever meandering category and the rate of meandering in this river is sinusoidal.

Corresponding Author:
Saeed Shojaei
Ph.D. Student Department of Management the Arid and Desert Regions, Yazd University, Iran
E-mail: Shojaeisaeeds@Gmail.Com

References

1. Bayati Khatibi, M. 2008. Investigating of meander rivers in arid regions (case study: Flood plains in the southeast slopes of Sahand mountains). Geographical Research Journal, 27(3).
2. Brice, J. C. 1984. "Planform Properties of Meandering Rivers," River Meandering: Proceedings of the Conference Rivers '83, New Orleans, LA, October 24-26, 1983, Charles M. Elliott, ed., American Society of Civil Engineers, New York, pp 1-15.
3. Brooks, G.R. 2003. Holocene lateral channel migration and incision of the Red River, Manitoba, Canada Geomorphology. 54:197-215.
4. Dallal Oghli, A. 1992. Ahar plain geomorphology. M.Sc. Thesis. Faculty of Humanities and Social Sciences, University of Tabriz.
5. Field, J., Tambunan, B. and Floch, P. 2014. Pyanj River Morphology and Flood Protection. Publication Stock No. WPS146649, Philippines.
6. Hooke, J.M. 2007. Complexity, self-organization and variation in behavior in meandering rivers Geomorphology 91, 236–258.
7. Nohegar, A. and Yamani, M. 2001. Geomorphological study of meander rivers and its role in the bed and sides of the Minab River. Geographic Research, 15: 58-65.
8. Millar, R.G. and M.c. Quik. 1993. Effect of bank stability on geometry of gravel rivers, Journal of Hydraulic Engineering-asce.119: 1343-1363.
9. Mirzavand, M., Ghasemieh, H., Nazari Samani, A.A., Vali, A.A. and Sadatinezhad, J. 2015. Examining meandering pattern of river, using the indexes of curvature coefficient and central angle (case study: Babolrud and Sajjadrud Rivers). Journal of Watershed Management Research, 6(11): 152-160.
10. Rezaee Moghaddam, M.H., Mohammadi Fard, A and Valizadeh, K. 2015. Quantitative investigation of Ajichay river meanders. Journal of Geography and Planning, 17(44): 161-178.
11. Kornish, M.R.S. 1980. Meander Travel in Alluvial Streams, in Proceeding of the International Work Ship on Alluvial River Problems. India. Sarita Prakashan Meerut, New Delhi. 4: 35-82
12. Withanage, N.S., Dayawansa, N.D.K. and De Silva, R.P. 2014. Morphometric Analysis of the Gal Oya River Basin Using Spatial Data Derived from GIS. Tropical Agricultural Research, 26, 175-188.
13. Yamani, M. and Hoseinzadeh, M.M. 2004. Examining meandering pattern of Talar River, using the indexes of curvature coefficient and central angle. Geographical Research, 19(43):144-154.
14. Zámolyi A. B. Székely, E. Draganits, G. Timár. 2010. Neotectonic control on river sinuosity at the western margin of the Little Hungarian Plain, Geomorphology 122, (3-4) pp231-243.

2/10/2018