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Investigation of Drainage Network of Ramhormoz Basin Using Tokunaga Model and Fractal Dimension Correlation

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1-Introduction

Genesis and evolution river systems, it is a gradual and complex phenomenon that depends on various natural and human factors and its processes affect each other during short-term and long-term periods (Bartolini, 2012, 460). Meanwhile, Investigation of changes in form and morphology of drainage networks and parameters affecting them, are widely used as useful tools to better understand the evolutionary process of the river (Carke et al., 2015, 14). In addition to Morphology features such as the order of streams, drainage density, slope drainage network, Roughness, overland flow Length, stream frequency, River shape, and other aspects of the morphology of the basins are important for identification and identifying, and calculating them must be analyzed in an appropriate way (Golekar et al., 2013, 351). Therefore, after the concept is introduced geometry Fractal By Mandelbort (1982) As a mathematical framework for the study of geometries Complex and erratic with similar patterns on different scales (Buzsaki et al, 2013, 58); In recent years, many researchers using fractal geometry, fractal dimension And fractal analysis cells by the river, They used it and showed it That distribution cells by river Is fractal (Yang & Shi, 2017, 168), For this reason, in this study, investigates the bifurcations of drainage networks of the Ramhormoz basin using Tokunaga model and fractal dimension correlation, has been done.

2-Methodology

Ramhormoz River is one of the sub-basins of Jarahi basin located in the southwest of the country. This river originates from 50 km southeast of Izeh and flows to the southwest. Before reaching the city of Ramhormoz, this river is called the Zard River and 22 km south of Ramhormoz, it flows into "Jarahi". In this method, the Ramhormoz basin is divided into eastern and western parts and then fractal dimension calculations are drawn using the Tokunaga method, irregular network, and curve of Ramhormoz river in regular,

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geometric and tree form, and the basin bifurcation ratio is calculated from the Horton bifurcation ratio equation. To calculate the Tokunaga method; Initially, using the Horton-Strahler method, all streams to which the lower orders is not connected are recognized as first order, and from the connection of two first order to each other, one streams form the second order. The second order stream is formed from the junction of the two orders of the first order and extends down to the point where this stream. The second stream should be connected with another second- order streams and a third order streams should be created. The increase in order in the tributaries of the river occurs only when the two tributaries of the river join each other with equal order (Torket, 2007, 307).

The correlation dimension is one of the common methods for determining the chaotic of the time series system as well as the chaotic dimension and the absorber dimension of the system (Rezaei and Jabbari Qarabagh, 1396, 243). In this study, river networks were extracted from Arc GIS software, and then input data were entered into the software to calculate two-dimensional fractal numbers using correlation function (Donadio et al., 2014, 1979). The correlation function of the number of pairs with distance | X_i-X_j | Counts that are smaller than (R), this is done by considering a point as the center and analyzing the distribution of other points relative to it. The number of pairs created using hybrid algebra is equal to 2 [n (n-1)] ^ (- 1).). (1).

(1)
$$C(R) = 2[n(n-1)]^{-1}\sum_{i=1}^{n}\sum_{j=1}^{n}\Theta\left(R-\left|X_i-X_j\right|\right)$$

3- Results and Discussion

3-1 Tokunaga Results

By Equation (2), the bifurcation ratio was calculated by the Horton method. Because the bifurcation ratio is used to express the extent of development of streams with different orders, relative to each other, and can be a good indicator to determine the effect of river network tributaries on flood hydrograph or the hydrological behavior of the basin in general. And is one of the effective factors in the form of the hydrograph (Rahmati et al., 2015). Next, according to Equation (3) and Horton (1945), the ratio of streams length can be defined by the ratio of the average length of the streams of the desired order to the average length of the stream less later and the important relationship with the surface flow and discharge Has been calculated. River networks in the basin are responsible for draining runoff. The more developed the river network of a basin; the Runoff discharge from that basin is better and easier (Rahimzadegan and Marshpour, 2016) according to (Tables 1 and 2) the eastern part in the Tokunaga drawing method in the order (3) and the western part in the order (4) are located and eventually both parts of the basin flow into the Jarahi River. According to the length of the streams, the fractal dimension was calculated for both parts of the Ramhormoz basin, the fractal dimension is Ramhormoz basin (1.39) and the Kupal basin (1.57). The calculated fractal dimension represents the average bifurcation ratio and the short time to reach a constant flow. Next, according to the Tokunaga method, fractal trees have lateral streams. The value of the fractal dimension Due to the relationship between the streams with order (j) and the streams of the order (j), a high triangular matrix is created. According to Equation (5), we create the matrix in Equation (8).

3-2-Correlation dimension results

Fractal dimension and sensitivity to initial conditions are the main features of a chaotic system. In the correlation dimension method, the fractal dimension of the system is estimated to identify the chaotic behavior of the system (Zakir Mushfeq and Anis Hosseini, 2013). The fractal dimension of the correlation between the Ramhormoz basin and its eastern and western parts has been calculated between (1.42 to 1.68) with a high correlation coefficient, which indicates a relatively high turbulent behavior of the basin and its parts. The dimensions of fractal trees for the eastern and western parts are as follows:

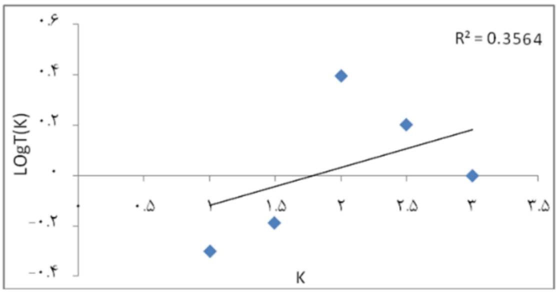

Fig (1): Dependence of T (K) with constant values of a = 0.5 and c = 3.5 in the eastern part of Ramhormoz basin

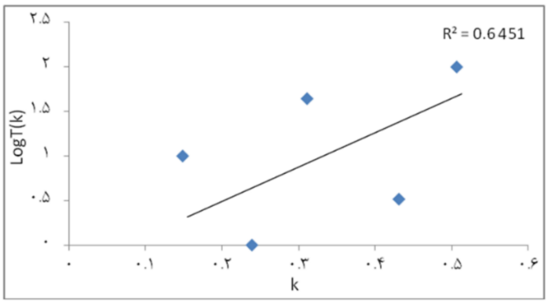

Fig (2): Dependence of T (K) with constant values of a = 1.161 and c = 47.257 in the western part of Ramhormoz basin

4-Conclusions

The number of tributaries of streams in the eastern and western part of the Ramhormoz basin, which is in orders (1) and (2), is more than in other orders. It is; however, they gradually deviate from the order of flow by colliding with different angles of slope and tectonic activity. In parts of the basin where the slope increases, the streams are parallel to each other. The greater the number of streams, the higher the bifurcation ratio, drainage density, and fractal dimension. The fractal dimension of the eastern part of Ramhormoz basin is equal to (1.39) with (28) streams and Horton bifurcation ratio (2.87), western part of Ramhormoz basin with fractal dimension (1.57) with (54) number of streams and ratio Horton bifurcation (3.40) indicates that the average bifurcation ratio increases with increasing number of orders. Due to the fractal correlation dimension, one of the characteristics of the tributaries of Ramhormoz basin and the eastern and western parts is very sensitive to first-order streams so that the slightest change in the first-order streams causes There is a change in the bifurcations of the basins and they create the phenomenon of chaos and threshold. East The main order changes from 33 to 22 and in the western part from the main order 44 to 33, which is consistent with the findings (Elmizadeh et al. 1393; Anwar et al., 2018). Also, according to the results, Ramhormoz Basin is associated with a lot of sensitivity and chaos.

Keywords: Fractal correlation dimension, Tokunaga model, Drainage networks, Ramhormoz Basin, Southwest of Iran.

5-References

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