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EXTENDED ABSTRACT

Investigation of Flood Effects on Morphological Changes in Bazoft River

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1. Introduction

Investigating changes in the behavior of rivers is of particular importance in the protection of hydraulic structures and the determination of the boundaries of the river bed, as well as the reduction of possible damages. Dams are among the structures that have the greatest impact on river morphology. Therefore, it is very important to study the morphology of rivers flowing to large dams in planning and ease of strategic decision making on the construction of engineering structures along the river. In recent years, due to the unique characteristics of remote sensing and satellite imagery, many studies have been done to investigate river morphological changes (Baki and Ga, 2012; Fisher, 2016). In this research, the study uses 26 Landsat satellite images to investigate the morphological changes of the Bazoft River between 1985-2015. In this regard, the present study investigates morphological changes of the Basoft River, one of the northern Karun sub-basins, which finally enters the Karun 4 dam. In this study, using 26 satellite images of Landsat ETM$^+$ and OLI, the displacement pattern of the main river channel, along with the variations in width and sinousity due to sedimentation and erosion processes in long and short periods up to the year 2015 and caused by large floods in this period were investigated.

2. Methodology

In order to evaluate the morphology of the river and the impact of the floods, morphological parameters such as river boundary displacement, area variation, latitude variation and river sinusoidal changes due to the erosion and sedimentation of the river bank in the long and short periods were investigated. It should be noted that the long-term periods were 10 years and short periods of 1 year. To determine morphological values, 26 frames of Landsat satellite images were used in ENVI and GIS software (Fawcett, 2006). In this research, the difference between the main channel of the river on the left and right shore on the cross-section in two years was considered as the main channel movement in that time interval. Negative and positive values were considered as sedimentation and erosion (land degradation), respectively.

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3. Results and discussion

3.1. Boundary displacement

The results show that the average displacement led to erosion in the ten year period for the left and right banks is 5.5 meters per year. The average sedimentation rate on the right bank was 5.6 meters and on the left bank was 4.50 meters per year. According to the average width of the river, which is about 37.88 m, the main channel displacement led to erosion (precipitation) for the right and left banks, is 14 (15) and 14 (14) percent of the mean river length, respectively .

3.2. Area variations

The results show that there is no significant difference between the average accretion and erosion in the right bank, and the accretion area is about 8% more than the erosion in this bank. However, on the left bank, erosion is about 1% more than the amount of accretion. The results also showed that the highest amount of eroded area occurred in 2004-2005, equal to 4.9 hectares, and the maximum accretion occurred in 2005-2006 and 44.18 hectares. However, the minimum amount of accretion in 2008-2009 and the minimum amount of eroded area in 2010-2011 were 10.17 and 7.09 hectares, respectively.

3.3. Effect of floods on morphological parameters

Fig. 1 shows the results of the main channel displacement for the flood in 2010 and the long-term average of 30 years (1985-2015). As is evident from the figure, due to the flood events, the erosion is more than sedimentation on both banks, but in the 30 year period on the left bank the sediment is deposited and the amount of erosion on the right bank is slightly higher than the sedimentation. In each period, the right bank is more prone to erosion.

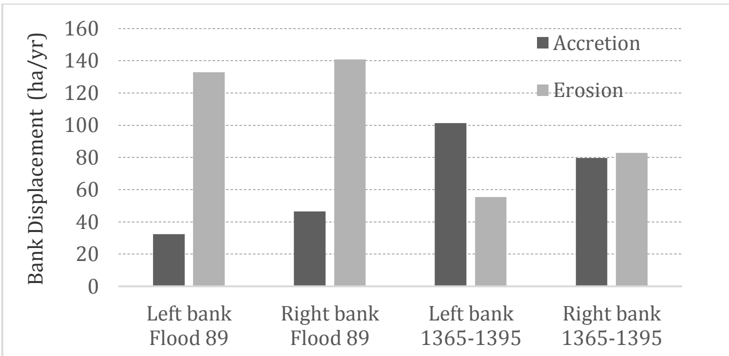

Fig. 1. shows the changes on the left and the right bank of the year 89 and the 30 year period

In the flood of 2009, the net rate of changes along the river is about 195 hectares of eroded area, with the share of the right bank of 95 and the left bank of about 100 hectares. However, in the long run, the trend of change is reversed. So that the net rate of change from the sediment is 46 hectares, that is, about 43 hectares of sediment on the right bank and 3 hectares of erosion on the left bank (it should be noted that the net rate of difference between the average erosion rate of the average rate accretion was determined).

3.4. River width variations

The average width of the river in four intervals was 33.8, 44.7, 40.2, and 38.6, respectively. The minimum width of the river is related to the initial period, which seems reasonable considering the mountainous conditions and conditions of the region. Figure 2 shows the variations in river width before and after the 2009 flood and the average of 10 years. As it is known, the width of the river during the years 2005 to 2015, as well as before the flood in 2009, has not changed much and its value has not exceeded 40 meters. But after the flood, the river's width has suddenly increased and these changes seem obvious.

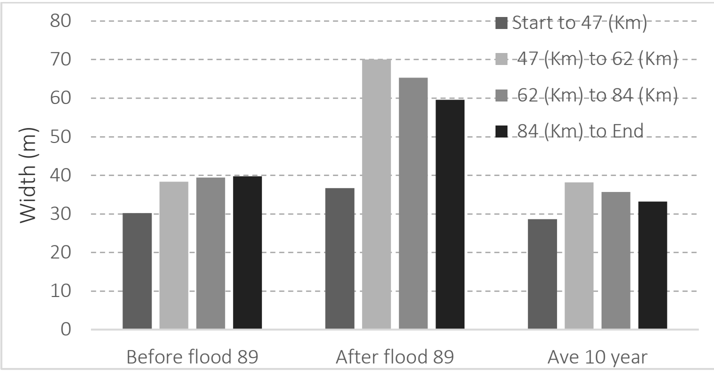

Fig. 2. River width variations before and after flood and the average 10 years

3.5. Change the Sinousity River

In this study, sinuosity variations were obtained at different times and in four desired intervals, the results of which can be seen in Fig. 3-a Based on the of Fig. 3-a, it is clear that in the second and third intervals the sinuosity is greater than in the two intervals. In the first period, sinuosity has a steady trend, due to the topography and geologic conditions of the river bed in this region. Given that the sinuosity shows the dynamism of the river system, it can be said that the river is more dynamic in the second and third intervals. In other words, morphological changes in these two periods are higher. In the third to fourth intervals, sinuosity values have been declining. The damping effects of the Karun 4 Dam are evident, especially in the last years in the fourth period.

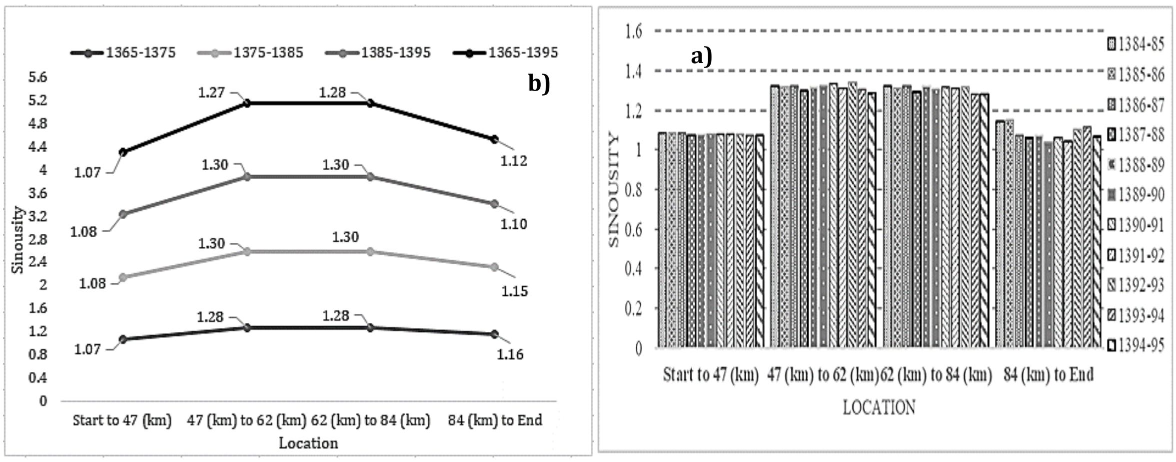

Fig. 3. Changes of sinuosity along the Bazoft River between 2005 to 2015, and between 10 and 30 years

Refer to Fig. 3-b, in each of the four studied periods, the sinuosity has increased in the first to second intervals. In the second and third intervals, the sinuosity values are approximately the same and the line slope is constant. At the end of the interval, the slope of the trend line is also decreasing in each period of time and the amount of, sinuosity has decreased. In the long-term vision of 30 years, the variation in, sinuosity is less than in the 10 year period.

4. Conclusions

Considering the mountainous nature of this river and the occurrence of large floods and subsequent high sediment loads, it was observed that the average displacement of the main river duct due to erosion over a ten-year period for both shores is about 14% of the river's width. Also, the study of some flood events showed that this value, due to the flood, reached 47 and 50% of the river's width for the left and right banks, respectively. The assessment of the net rate of changes in the area of sedimentation and erosion zones along the river showed that this rate in the floods reaches about 194 hectares of the eroded area. Therefore, it can be stated that morphological changes with high sedimentation volume can affect the performance and presentation of Bazoft river management strategies.

By examining the variations in the width of the river, it was found that the trend had been declining from the beginning to the end of the given period. However, the river is facing a widening after the flood. The results showed that the amount of sinuosity was higher in the two intermediate intervals. In the first period, sinuosity changes are fixed, because of the topographic conditions of the region. At the end of the river, the amount of sinuosity shows a decreasing trend compared to the previous period. This study shows that by analyzing satellite images, morphological changes in rivers can be investigated, and the sedimentation coefficient of rivers before any construction operations is evaluated for dam or bridge design and considered in design criteria.

5. References

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