Investigation of Channel Change of Aras River by Using Transect Method from 1987 to 2014 and the Effects of Built Structures on the Modification of River Route (Case Study: From Aslandoz to Parsabad)

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1. Introduction

Rivers through production, movement and storage of sediments are one of the most important factors that modify the earth's surface. Historically, some rivers have been selected as the boundary lines between the countries and have acquired additional importance. River channels, particularly alluvial bed rivers are continuously changing and this can cause many problems. In this study, lateral movement of the Aras River, 15 km away from west of Aslanduz city to exit of the river in Iran's border, are investigated in three time periods, 1987, 2000 and 2014. This river has a great importance in relation to water supply in the northwestern parts of the country . Moreover, in the large distances, it forms Iran boundary line with the countries of Armenia and Azerbaijan. Therefore, research on the lateral changes of river becomes necessary.

2. Material and Methods

Topographic maps with scale of 1: 50,000, digital elevation model (DEM) with 27 m resolution, and satellite imagery (Landsat 7 ETM+ satellite sensor& Landsat 8 OLI satellite sensor) are most important materials in this research. Studied channel reach of the Aras River for three time periods, 1987, 2000 and 2014 were extracted by processing satellite images. Then, channel based on morphology and changes trend was divided into 17 transects, and quantitative indicators were calculated for each transect.

3. Results and Discussion

The Aras river planform in the study is mainly meandering. According to the studies, meanders of the river channel are active, and the formation of new meanders, meanders

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migration as a result of erosion and creation of cutoff frequently occurs with a relatively high rate. Study of lateral migration of the Aras River have shown high change in late 26 years. Even lateral migration in some parts of the third reach has been 1.7 km. The average of channel migration rate in the study reach of the Aras River is about 8 meters per year, which is a significant value. By comparing the mean values of the central angle and rate of channel migration can be said, in transects that planform is the developed meandering river, the rate of channel migration is higher. But in a few transects where the river tends to be a straight pattern, in other words the central angle and sinuosity coefficient values are smaller, the amounts of movement was lower. In the study area, according to the past changes trend, channel changes have occurred due to three major reasons: (1) channel migration in the floodplain due to the erosion of concave banks of meander loops, (2) occur cutoffs through development and near the base of meanders, which its effects can be seen as an abandoned channel, and (3) occur avulsion in the parts of the river channel. In fact, large quantities and unusual migration rate in some transects were related to the avulsion. Most likely, the avulsion caused by the river flooding, especially in the spring and disturbances are due to the confluences. In some cases, the combination of these factors associated with intervening variables such as the effects of confluences have caused the channel movement to be very significant and unusual.

4. Conclusion

The modification of the Aras River route in the study area (From Aslandoz to Parsabad) in 11 different reach has been done in Ardabil regional water authority. These actions in reaches: old dyke, Muhammad Rezalvo reach, Ghara Daghlou reach, Salamn Kandi reach, Alireza Abad reach, Topraq Kandy reach, West Sarband reach, Haj Hassan Kandy reach, Ozone Tape Reach, 1/53 reach, Maghsoudlou reach which trigger the release of more than 420 hectares of coastal land in Iran and have a very important role in the modification of the Aras River route and prevent lateral movement of the Aras river during the past years.

Key words: Morphology, Channel, Lateral migration, Meander, Avulsion, The Aras River

References (in Persian)

Rezaei Moghaddam, M., & Piruzinezhad, N. (2014). The investigation of channel changes and erosion in the Gamasyab River between 1956-2011 years. *Journal of Planning Geography, 18*(47), 109-132.

Rezaei Moghaddam, M., Rajabi, M., Daneshfaraz, R., & Kheirizadeh, M. (2016). Zonation and investigating the morphological effects of flooding on the Zarrineh-Roud River (From Sariqamish to Noruzlu Dam). *Journal of Geography and Environmental Hazards, 17*, 1-19.

Rezaei Moghaddam, M., Servati, M., & Serkansrod, A. (2013). The investigation of geometric pattern of changes of Qezel Ozan River by using analytical geometry fractal. *Journal of Planning Geography, 16*(40), 109-132.

Sharifikia, M., & Malamiri, N. (2013). Detecting the spatial pattern of changes and morphological analysis on the Hirmand river. *Journal of Geomorphology Quantitative, 4*, 149-160.

Yamani, M., Rahim, M., & Veysi, A. (2015). Morphometric and compare lateral change in Aras River in Past three decades (case study: Downstream Mil Moghan dam*).* *Journal of Geomorphology Quantitative, 4*, 74-89.

Yasi, M. (2009). *Guide the design, construction and maintenance of river dike*. Publication number 516 Ministry of Energy.

Yekom Consulting Engineers. (1994). *Studies organized the first stage of the Aras River*, Ardebil regional water Authority.

References (in English)

Abate, M., Nyssen, J., Steenhuis, T. S., Moges, M. M., Tilahun, S. A., Enku, T., & Adgo, E. (2015). Morphological changes of Gumara River channel over 50 years, upper Blue Nile basin, Ethiopia. *Journal of Hydrology, 525*, 152-164.

Giardino, J. R., & Lee, A. A. (2011). *Rates of channel migration on the Brazos river*. Submitted to the Texas Water Development Board. Department of Geology & Geophysics, Texas A & M University.

Heo, J., Duc, T. A., Cho, H. S., & Choi, S. U. (2009). Characterization and prediction of meandering channel migration in the GIS environment: A case study of the Sabine River in the USA. *Environmental Monitoring and Assessment, 152*(1-4), 155-165.

Hossain, M. A., Gan, T. Y., & Baki, A. B. M. (2013). Assessing morphological changes of the Ganges River using satellite images. *Quaternary international, 304*, 142-155.

Lauer, J. Wesley. (2006). NCED Stream Restoration Toolbox, Channel plan form Statistics. National center for earth-surface dynamics.

Lewin, J., Macklin, M. G., & Newson, M. D. (1988). Regime theory and environmental change irreconcilable concepts? In W. R. White (Ed.), *Proceedings of the International Conference on River Regime* (pp. 431-445). New York: Wiley.

Magdaleno, F., Yuste, Jose A. Fernandez. (2011). Meander dynamics in a changing river corridor. *Geomorphology, 130*, 197-207.

Pires-Luiz, C. H., & Maillard, P. (2010). *Inferring fluctuations of the aquifer by monitoring the area of small lakes in a Brazilian savanna region using a temporal sequence of 50 Landsat images*. ISPRS TC VII Symposium – 100 Years ISPRS, Vienna, Austria, July 5–7, 2010, IAPRS, Vol. XXXVIII, Part 7B. pp. 463-468.

Rapp, R. G. Cygnia and Abbe, Timothy B. (2003*). A framework for delineating channel migration zones*. Ecology final draft publication.

Rozo, M. G., Nogueira, A. C., & Castro, C. S. (2014). Remote sensing-based analysis of the planform changes in the Upper Amazon River over the period 1986–2006. *Journal of South American Earth Sciences, 51,* 28-44.

Shields, F., Douglas., Simon, Andrew., Steffen, Lyle, J. (2000). Reservoir effects on downstream river channel migration. *Environmental Conservation, 27*(1), 54–66.

Xu, H. (2006). Modification of normalized difference water index (NDWI) to enhance open water features in remotely sensed imagery. *International Journal of Remote Sensing, 27*(14), 3025–3033.

Xu, H. (2007). Extraction of urban built-up land features from Landsat imagery using a thematic-oriented index combination technique. *Photogrammetric Engineering & Remote Sensing, 73*(12), 1381-1391.