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Processes of Mirishkor channel using GIS technologies

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Processes of Mirishkor channel using GIS technologies

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Abstract. In this article, were studied sediments in the Mirishkor main canal. Were identified erosion processes resulting from water movement in the main canal with using GIS. Sediment layers in the canal water flow were identified as factors influencing the flow of the sediment through the ArcGIS 9.3 program. One of the main obstacles in the main canals is the analysis of the results of the deposition of suspended particles in the water at the bottom of the canals using geoinformation systems. The dependence of suspended particles in canals on water discharge and canal topography has been partially analysed. In the Mirishkor main canal area sediment washing core equal to an average of 9.2 tons per year, i.e. a potential erosion process is happening in this channel. As a result, the contribution of sediment flow in the canal water increases and causes a number of complications. According to the results, the particles in the upper part of the main channel move depending on the water discharge.

1. Introduction

Due to the fact that agriculture in the desert region is based on direct irrigation, the efficiency of the irrigation system plays an important role in the development of such regions. One of the main obstacles to the efficiency of the irrigation system is the burying of canals as a result of the deposition of suspended particles in the water at the bottom of the canal (Arifjanov, Rakhimov, et al., 2019). There is also a reclamation significance of the flow of suspended particles in the canals, which can increase soil fertility due to the deposition of various minerals as a result of irrigation. The characteristics of the solid flow in the canals depend on the ground condition at the source where the canal receives water and in the areas where it flows. In some cases, in suspended particles in the Kyzyldaria irrigation system of the Arabian Peninsula account for a large proportion of fine particles brought to the surface of the open water as a result of sediment from the environment (Sattar, Jasak and Skuric, 2017). As a Amudarya River which situated in Central Asia begins from the slopes, and the share of suspended sediments in the river is 70-80% (Arifjanov, Samiev, et al., 2019). Suspended sediments in the river pass from the river to the canals and accumulates in the canal. If some suspended sediments in water were deliveres in agricultural field and deposites, they can increase soil fertility (Gu et al., 2019).

2. Methods

In Central Asia when estimating river water resources for irrigation purposes, primarily studies suspended particles in their water. Therefore, many studies have been conducted in this area (Arifjanov, Akmalov, et al., 2019; Chandler and Evans, 2019). In particular, studied the irrigation

significance of suspended particles in water by Klyukanova and Kovda, Zakharina on the example of the Amudarya (Arifjanov, Akmalov, et al., 2019).

Many negative changes are taking place in nature under the influence of water flow. It is important to identify these changes in a timely manner and to identify measures to prevent them. Because the magnitude and extent of changes are unstable, they require study speedly and with high accuracy, create scientifically based conclusions, and develop useful interventions (Jurík et al., 2019).

It is not enough to study only one component of nature and make a decision according to it. Because different influences in nature are reflectes in all components of it. For example, changes amount of water or changes of sediments composition affect not only the underwater flora, but also indirectly the vegetation and fauna. Therefore, the main problem of the environment is to study these changes on a large scale and in detail. This studies takes a lot of resources and a long time. This problem was partially solved by the advent of remote sensing (RS) in the world in the early twentieth century. Because this branch has provided opportunities for large-scale detailed research in nature (Deng et al., 2019; Fatxulloev and Gafarova, 2019; Jurík et al., 2019).

Most of the irrigation systems in the country are natural canals with soil bed, which are constantly washed and muddy. The main reason for this is due to the amount of turbid runoff in rivers and irrigation networks, which affects the formation of streams and, consequently, makes it impossible to estimate water discharge in stationary conditions. At the same time, there are still cases of declining Useful Volume of systems (Syvitsky et al., 2019). At present, the capacity to determine the current water discharge is limited, and therefore the accuracy of the results is not high. In accurately estimating water discharge in irrigation systems, requires constant information on irrigation networks and flow rates is clearly evident. Even done many scientific works in this direction, there still need to the availability of up-to-date information on the hydraulic and operational parameters in the basins of irrigation systems remains the main problem of the industry. It is necessary to use the capabilities of GIS technologies in identifying modern solutions to the above problems (LIU and SHEN, 2008; Lu et al., 2019; Arifjanov and Fatkhullaev, 2020).

To date, one of the important conditions for the sustainable exploitation of irrigation canals is the prediction of the process of flooding in units of time. The capabilities of the modern GIS in the digital representation of geographical existence and the rapprochement of relations to the real situation will accelerate the achievement of new results in this area.

As object of research were allocated the main part of the Mirishkor canal in Kashkadarya region (Figure 1.2). The region is located in a subtropical climate zone with a rainfall of around 130 mm. Evaporation is 25 times higher than rainfall. Temperatures are hot in summer and dry air rises to +45 C, winters are warm.

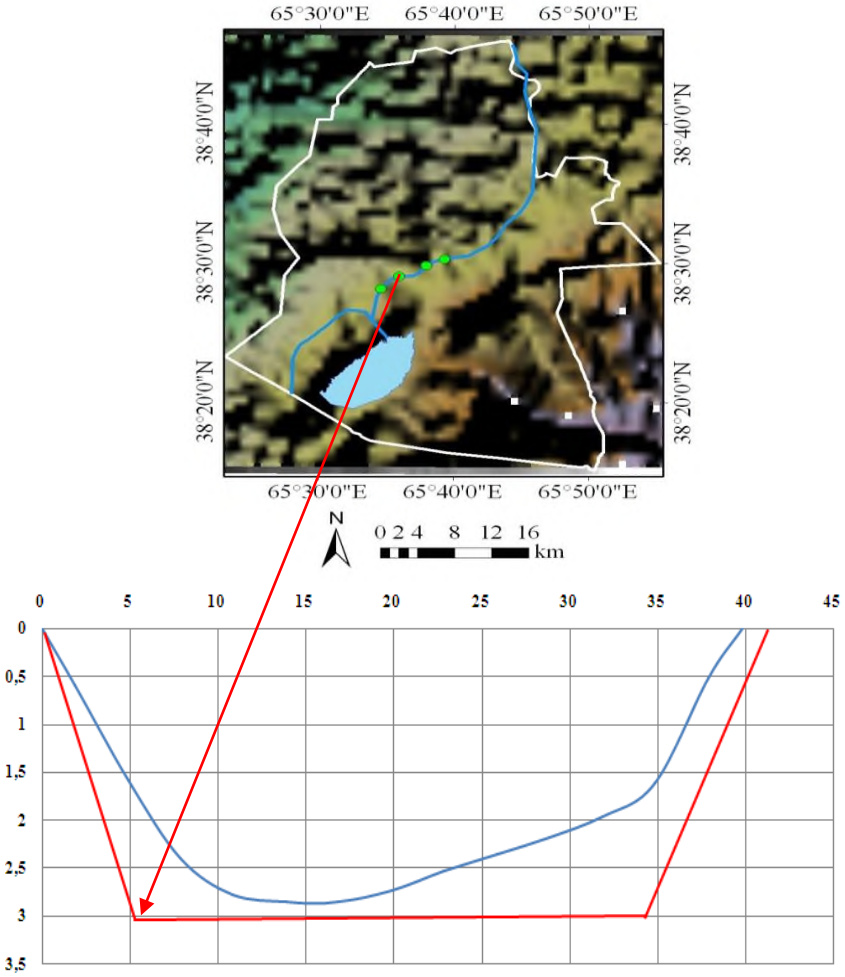

Figure 1. Mirishkor channel and cross section of the channel in PK-245-00 of the Mirishkor main canal.

3. Results

The following method was developed to study the dependence of solid flow in the main channel on the erosion process. The suspended particles in the channel were studied as a result of seasonal sampling in a flow medium and analysis under laboratory conditions. The potential erosion condition of the area was modeled using GIS. To do this, a digital relief model of the area was formed using SRTM satellite radar (Figure 2).

The erosion process develops as a result of the following factors (Zhang et al., 2016): climatic elements (temperature, precipitation, wind), soil type, surface cover (vegetation, open ground), economic activities of people affecting the soil layer (Management practices for estemating soil) and the expression would be correct as follows (Deng et al., 2019):

$$ER_{soil} = R * SL * CP * K \quad t/ha/year$$

there: R- rainfall erosion component; SL- surface slope factor of earth; C- surface cover factor; CP- surface layer erosion factor; K- soil erosion rate.

The erosion factor (R) of the precipitation is based on the formation of a flow from the precipitation and the absorption of this flow by the ground layer within a maximum of 30 minutes. In our calculation, R=38,5+0,1*P.

Surface slope factor (SL) was determined in two different ways. First, the slope directions of the surface are the azimuthal position and the slope of the surface relative to the horizontal line.

Earth surface cover (SR) was determined as a result of classification based on the GEOKOVER data of the Landsat satellite, and the soil erosion factor (K) was formed based on the literature review.

The above empirical model was calculated in the ArcGIS 9.3 program as a raster calculator action tool.

According to the results obtained, the surface of the canal is tilted southwest at a short distance near the canal core. The slope is 30-40º near the Talimarjan reservoir. Depending on the erosion properties of the soil layer, it can be said that the potential erosion process in these areas will be strong. However, even under laboratory conditions, it can be seen from the data obtained from the samples that a certain amount of suspended sediments in the water corresponds to the proportion of the river.

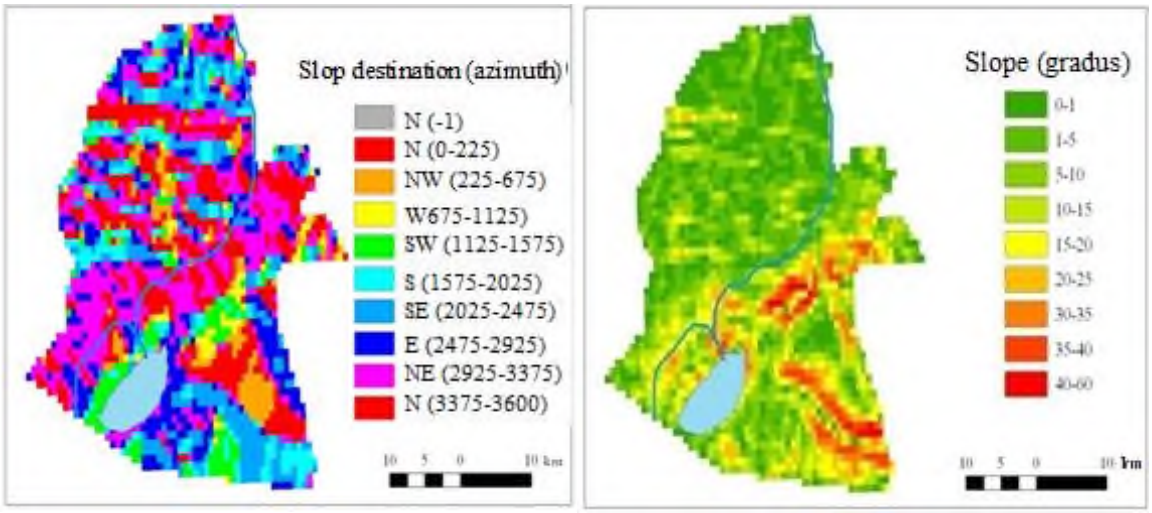

Figure 3. The relief elements formed on the basis of SRTM data of the research object represent the processes of erosion development.

The relief components, the external effects of denudation and erosion, which affect the erosion process of the soil surface, together cause erosion at different rates in the area. Potential erosion does not spread evenly across the geographical surface.

A study of the picket data from four samples proved the correctness of this process. The correlation between the erosion process and the slope was 0.68, and the presence of different soil surfaces resulted in less correlation.

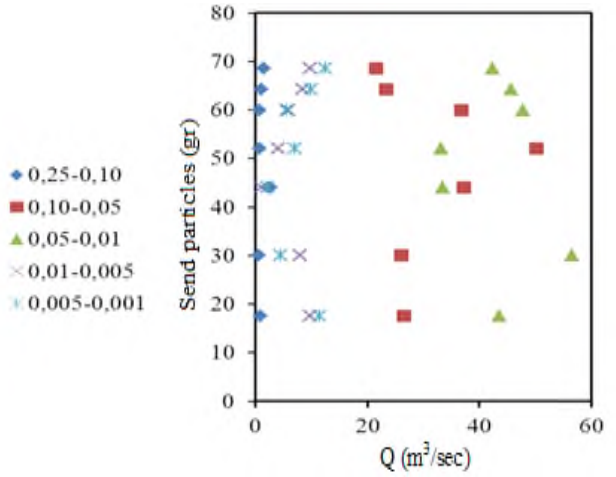

Figure 4. Relation of water discharge and suspended particles in research part of channel.

When studying the dependence of particles of different mechanical composition on the water discharge in the initial part of the main channel, it was found that the coefficient is low (Figure 4). Follows with suspended particles do not exist on the basis of a single law. Their ability to be in canal

water is not entirely depends on water discharge. Because, taking into account that the Amudarya River, located mainly in the territory of the Republic, begins in the mountains, most of the canals receive water from this river. This river is one of the rivers rich in suspended sediments.

4. Conclusion

Based on the above GIS analysis, detected erosion of the soil surface of the bed of main canal and the presence of suspended particles in the river water. Given that the object of study receives water from the Amudarya, the minerals in sediments of this river can be used as a mineral fertilizer for irrigated agricultural lands. According to the obtained results, an average 9.2 tons of canal self-erosion can be observed in an allotted area per km2 per year, i.e., a potential erosion process. As a result, the contribution of sediment flow in the canal water increases and leads to a number of complications. This process requires more and depth researches. According to the results, the particles in the upper part of the main channel move depending on the water discharge.

Were analyzed the possibilities of geoinformation technologies in the assessment of erosion and accumulation processes in the valley. The analysis was based on the use of RS data, the use of high-resolution WorldView2 images to assess the technical and operational condition of irrigation systems, the ability to determine and calculate the water capacity of irrigation networks based on the assessment of erosion and accumulation processes in the river using GIS technologies based on WorldView2 images.

In the field studies, attention of research was given to conduct to determine the hydraulic and hydrological characteristics of the Mirishkor canal. Based on the results of the obtained data, were analyzed the processes occurring in the channels of the canal (Mirishkor).

Based on the application of RS data from GIS technologies, the use of ultra-high-resolution WorldView2 images, and data obtained in natural field conditions, were created GIS maps of individual parts of the Mirishkor channel.

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