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Assesment of Local Water Resource in Kuljuktov Mountain System

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Abstract

Since most of the territory of the Republic of Uzbekistan is located in the arid zone, water issues for drinking and irrigation purposes are crucial in order to solve the challenges in these areas. One way to alleviate this problem is the efficient use of local water resources. The low mountains that exist on the plains of the country are a source of local water resources. There are more than a dozen low-mountain ranges in the plain part of Kizilkum desert such as Bukantov, Tomditov, Kuljuktov. The paper is devoted to assess water resources by applying geographic information systems in the southern slope of the Kuljutov Range.

Keywords: *water resources, low mountain, charts, Kuljuktov, geographical information systems, model SWAT, ArcGIS*

I. INTRODUCTION

Quantitative assessment of water resources suitable for drinking and irrigated agriculture is very important in Uzbekistan. Over 70% of the territory of the country is located in the desert and semi-desert zones. There are not enough water resources. Therefore, the issue of identifying the local water resources of such areas is very important. In addition, given the country's population growth, it is obvious that in the future, the demand water for drinking and irrigation purposes is expecting to increase. There are several mountains in the plain part of

Uzbekistan, such as Kuljuktov, Bukantov, Yetimtov, Kazaktov, Beltov, Ovminzatov, Sultonvais. These mountains are relatively well-studied in terms of geographical, geological, geomorphological etc. However, hydrographic networks of these low-mountain ranges have not investigated much. [Hydrologicheskayaizuchennost, 1967, p. 20].

II. STUDY AREA

The Kuljuktov mountain range is located in the central part of the Kyzylkum Desert, administratively on the border between Bukhara and Navoi regions. The total area of the mountain ridge is 2735 km2. The average elevation of the range is ___ m and the highest elevation is 785 meter. Gold, marble, granite, okra deposits and mineral springs rich in various useful elements have been identified in the system. Due to the active exploration mining work at the Kuljuktov ridge, it is clear that the demand for water will also increase as a result of construction of industrial facilities and settlements in the future. In addition, there are currently 4 settlements on the slopes of the Kuljuktov Range that we are studying. Water needs remain relevant to the needs of their residents.

III. CATCHMENT DESCRIPTION

One way to mitigate this problem is to effectively use seasonal atmospheric precipitation in the areas where there is no permanent water source. Low-altitude mountains located in the desert regions of Uzbekistan, are also capable of accumulating seasonal atmospheric precipitation. The Kuljuktov Range, which is located in the central part of the Kyzylkum desert, or more precisely in the area adjacent to Bukhara and Navoi regions, is of special importance.

On the southern slopes of this ridge, more than 40 streams are formed, which form a temporary flow of spring seasonal atmospheric precipitation [Halimova, Zaitov, 2018, p. 205–209]. These temporal streams are not yet fully understood in hydrological terms and are virtually discaounted in the literature on the nature and inland waters of Uzbekistan. With this in mind, in the present study, we tried to create as much information as possible on these streams, using GIS technologies.

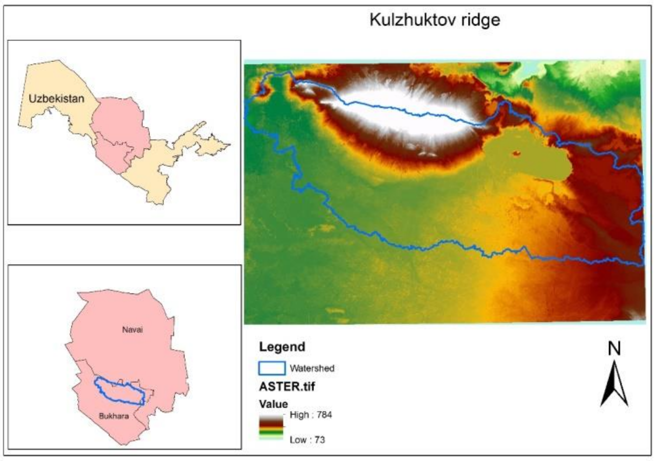

Figure 1. Location of Kuljuktov Catchment

To do this, the temporary stream water basin on the southern slopes of the Kuljuktov Range was modeled using the Soil and Water Assessment Tool (SWAT) model introduced in the Geographic Information System. For this purpose, used extension of ArcSWAT from ArcGIS 10.3 software.

IV. SWAT DESCRIPTION

The SWAT hydrological model is a model that provides daily and monthly analysis results [Safarov and others, 2012, p.148]. In order to adequately model hydrological processes, basins are subdivided into lower reservoirs, through which streams are routed.

SWAT is a watershed-scale, physically based distributed hydrological model developed to predict the impact of land management practices on hydrologic and water quality response of complex watersheds with heterogeneous soils and land use conditions [Arnold J and others, 1998, p.73-89].

The computational components of SWAT can be placed into eight major divisions: hydrology, weather, sedimentation, soil temperature, crop growth, nutrients, pesticides and agricultural management.

Lower reservoir units are known as hydrological units (HRU), a unique combination of soil properties, land use and rainfall, and are considered to be hydrologically homogeneous. Both the lower pond and the HRU have been identified by the users, allowing the model users to control the decision considered in the SWAT model. Model calculations are performed on the HRU base and variable flow quality and water quality are transferred from the HRU to the lower ponds and then to the pond. The SWAT model simulates hydrology as a two-component system consisting of surface hydrology and channel hydrology.

The surface of the hydrological plane is based on the equilibrium of the water mass. Groundwater balance is the main focus for the model in each HRU shown in the figure [Arnold J and others, 1998, p.73-89].

ArcSWAT is a complementary tool for the ArcGIS software, which is used mainly for the evaluation of natural water resources - the use of rivers and streams and the quality of water [Abbaspour and others, 2015, p.733-752]. The SWAT calculates the peak runoff rate with a modified rational method [RokhsareRostamian and others, p. 4]

V. DATA COLLECTION

Initially, the Digital Elevation Model (DEM) height

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image of the study area is downloaded from https://earthexplorer.usgs.gov/. The downloaded image is the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER), with a celestial resolution of 30 meters per pixel. This is three times better than the previous height image (the previous image was 90 meters in the Shuttle Radar Topography Mission). These images allow us to build up model which is deriving watershed basin and it's subbasins contours. Respectively, flow direction, flow accumulation and stream network, number of streams and lengths for those watershed areas.

Table 1. The list of relief images from NASA for the study area:

№	Denomination
1	ASTGTM2_N40E062_dem.tif
2	ASTGTM2_N40E063_dem.tif
3	ASTGTM2_N40E064_dem.tif
4	ASTGTM2_N40E065_dem.tif
5	ASTGTM2_N41E062_dem.tif
6	ASTGTM2_N41E063_dem.tif
7	ASTGTM2_N41E064_dem.tif
8	ASTGTM2_N41E065_dem.tif

VI. METHODOLOGY

The Flow chart below shows the basin boundary and its hydrological faults, their boundaries, and the stages of formation of the catchment points.

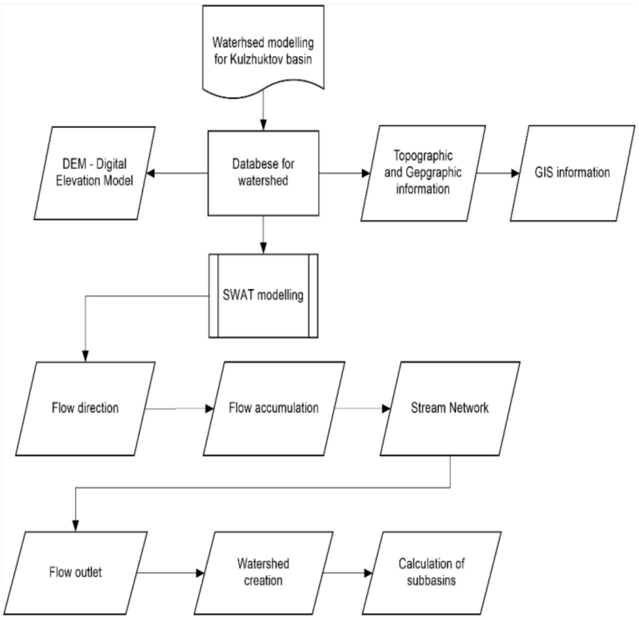

Figure 2. Image Methodology for the creation of a temporary stream basin model on the southern slopes of the ridge

These downloaded images of relief are combined with images using ArcGIS 10.3 software. For this purpose, we used the analysis and process window of the program's raster files.

Once the images are merged, they must be converted from the World Geodetic System (WGS) coordinate system to the Universal Transverse Mercator (UTM) meter, to be uploaded to the ArcSWAT model. Because ArcSWAT is programmed to work with this system.

After the ArcSWAT tool is activated in ArcGIS 10.3, the basin modeling process will start.

After that, open the watershed delineator - the basin separator window, then go to the next main window by opening the pool auto-function. Mathematical operations and calculations are done automatically.

The basin boundary was calculated using an algorithm from the downloaded height image. Further, ArcSWAT is the basin's basin flow and flow direction, which calculates the position of the stream and its tributaries as a point.

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VII. RESULTS AND DISCUSSION

The ArcSWAT algorithm calculates the boundary of the study pool and the range of subbasins contained in it. To do this, we identified the inflow points of each stream and its tributaries and included it in the program as a factor that allowed us to find subbasins. The ArcSWAT program then calculated the boundary of each stream. The boundaries of the resulting inflow points are automatically removed.

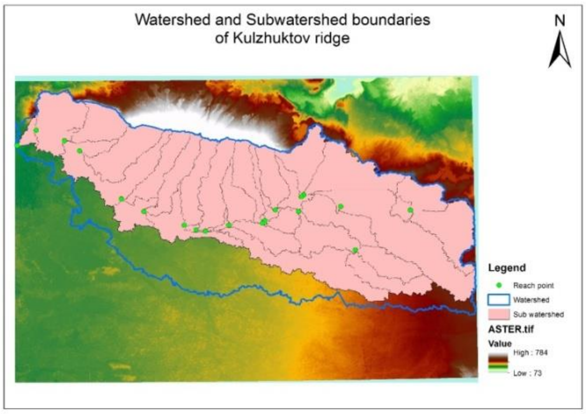

Figure 3. Watershed of Kuljuktov basin

For the first time, an electronic map was created based on the data collected during fieldwork in the Kuljuktov Range and the geographic information system of the temporary basin streams on the southern slopes of the ridge, with a scale of 1: 100000. As a result, a temporary basin of rivers was discovered on the southern slopes of Kuljuktov ridge.

VIII. CONCLUSION

Research on the local water resources assessment of the system using the electronic map of this research facility is ongoing. In the future, the methodology which applied in Kuljuktov range can be used for other the low mountain ranges of Uzbekistan such as Bukantov, Etimtov, Kazaktov, Beltov, Ovminzatov, Sultanuvays

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