## MONITORING OF SUKH RIVER BASED ON REMOTE SENSING DATA

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**Abstract.** This article discusses the effective use of water resources of Sukh river, its environmental impact, and monitoring works based on remote sensing data through modern electronic programs. The study presents the results of the NWDI (Normalized Difference Water Index) analysis conducted using the LANDSAT 8 raster imagery and processed with the ArcGIS software.

*Keywords:* water, climatic conditions, Sukh River, river relief, modern electronic programs, LANDSAT 8, ArcGIS, and NWDI analysis.

Sukh River is located in the southern part of Fergana Valley, near the border of Kyrgyz Republic. The efficient use of water resources in Uzbekistan is becoming increasingly urgent due to global climate change, population growth, and the rising demand for water.

Currently, remote sensing is used to observe this region from a significant distance, collect data remotely, and create visual representations. This practice can be implemented using devices such as ground cameras, airplanes, satellites, or even space vessels. Remote sensing can be applied in various fields. Below are several applications of this constantly developing science:

- **Geology:** Remote sensing helps map large and remote areas. It allows geologists to classify the region's rocks, study its geomorphology, and monitor changes caused by natural phenomena such as floods and landslides.
- Agriculture: Remote sensing is also useful in studying plants. Remote photographs allow biogeographers, ecologists, agricultural experts, and foresters to easily identify what plants are present in the region, as well as determine the growth potential and favorable living conditions.
- Land Use Planning: Developers and land use planners can apply remote sensing to study and regulate land use over large areas. The collected data can be used for urban planning and environmental change management.
- **Geographic Information Systems (GIS):** Remote sensing images are used as input data for creating raster-based digital elevation models (DEMs). Aerial photographs processed through GIS can be digitized into polygons, which are then used to create maps.

Currently, data obtained via remote sensing is usually stored and managed on computers. Some of the most commonly used software programs in this field include ERDAS Imagine, ESRI, MapInfo, and EggNOG-Mapper.

According to the decree of the President of the Republic of Uzbekistan (PD-107, dated April 1, 2023), "The introduction of modern information and communication technologies in the management of water resources, the widespread implementation of water-saving technologies in agriculture, as well as state support for them, and measures to improve the meliorative condition of irrigated lands are being implemented." Forecasts suggest that in the 2023 growing season, the volume of water resources will be 10-15% lower than the multi-year average in Syr Darya basin, and 15-20% lower in Amu Darya basin.

Sukh is a water-rich river in Fergana Valley. It originates from glaciers located on the northern slopes of the Oloy and Turkistan mountain ranges, at an elevation of 5550 meters. The river is 124 km long, its basin area is 3510 km<sup>2</sup>, and its watershed elevation is 3480 meters. Dalbek, Shudmon, and Khojachkan rivers merge near Zardoli village to form Sukh river. In the upper reaches, it flows through a very deep and narrow gorge, with widths ranging from 4-10 meters. Upon reaching the plain, the river valley widens to 500 meters. Afterward, the river forms an alluvial fan 70 km wide and 50 km long, consisting of stones and gravel. The river has second and third terraces in some sections. Once it reaches Fergana Valley, the river splits into various branches.

Sukh river is fed primarily by glaciers and snow, as 71% of the annual precipitation in its basin is from snow, while 29% is from rain. There are 364 glaciers in the basin, with the largest being Archaboshi, which spans 12 km<sup>2</sup>. The average flow rate is 17.01 sec/km<sup>2</sup>. The turbidity of Sukh river water is 0.99 kg/m<sup>3</sup> on average. Along its course, the river is supplemented by the Sariqorgon water junction and O'xchi HES, while the Kokand hydroelectric station is situated at its base. Sukh river supplies water to the districts of Uzbekistan, including Fergana, Dangara, Uchkuprik, and Bogdod. The city of Kokand and resorts like "Cho'ng'ora" are located along the river valley [2].

After 1955, the Burgandi massif, which passed under the control of Kyrgyz SSR, began to be actively developed in the mid-1970s. Currently, tens of thousands of hectares of arable land have been developed, with almost 23-30% of the flow of Sukh River used for irrigation. In this regard, the issue of distributing Sukh River's flow between the republics arises. Secondly, the development of the Burgandi massif, which is located on the foothills of the mountains above the main region of Fergana, has led to a significant rise in the groundwater level in Rishton and Oltiariq districts of the Republic of Uzbekistan. As a result, in just Rishton district, 6,313 hectares of land have been taken out of agricultural use. Orchards are drying up, and productivity is decreasing. Naturally, Kyrgyzstan has the right to develop its economy and agriculture. However, experts believe that in the Burgandi massif, crops with low water requirements should be grown. [3]

Based on the data provided below, I conducted an analysis of the "Normalized Difference Water Index" (NDWI) for the river and its basin for the years 2021 and 2024. The results showed that in 2021, the river water and groundwater levels in the basin were higher, whereas, in 2024, both river water and groundwater levels significantly decreased.

The NWDI analysis result of Sukh riverbed and valley, obtained from LANDSAT 8 in raster format, for the year 2024, conducted using ArcGIS software. Similarly, the NWDI analysis result for the year 2021 for Sukh riverbed and valley was also obtained from LANDSAT 8 raster

images using ArcGIS software. In conclusion, if the river water is not used prudently, in the future, the river's ecosystem will be disturbed, leading to environmental issues that will have an impact on the surrounding area.



Figure 1. Sukh River Bed - LANDSAT 8 Image in Raster Format

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