

**MODERN CARTOGRAPHIC ASSESSMENT OF IRRIGATED LAND
EROSION IN CENTRAL FERGANA**

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Annotation:

In this article, the state of soil erosion of irrigated lands in the territory of Central Fergana was assessed based on modern cartographic technologies. Based on satellite images of Landsat 8 and Sentinel-2, digital terrain models (DEM), and NDVI indices, erosion risk zones were identified and modeled in a GIS environment. Using the RUSLE model, the values of soil loss were calculated and the location of high-risk zones was mapped. The results are important in the development of effective agrotechnical measures against land degradation and provide a scientific basis for decision-making on territorial planning and resource management.

Keywords: irrigated lands, soil erosion, GIS, remote sensing, NDVI, DEM, RUSLE, Central Fergana, cartographic assessment

Irrigated lands of the Republic of Uzbekistan constitute the main part of the country's agricultural potential. At the same time, one of the most important ecological problems limiting the effective use of these lands is soil erosion. Soil erosion is the erosion, migration, and degradation of the fertile soil layer under the influence of natural and anthropogenic factors. Erosion of irrigated lands is developing rapidly, especially in foothill slopes and as a result of improper agrotechnical measures. The territory of Central Fergana - Kuva, Tashlak, and Fergana districts - in this respect has unique geobotanical and morpho-geographical conditions, where erosion processes are quite active.

In recent years, along with classical field observations, cartographic approaches based on modern geoinformation systems (GIS), remote sensing (RS), digital terrain models (DEM), and vegetation indices (e.g., NDVI) have been widely used to identify and assess erosion risk. These methods are of great importance in determining the spread of soil erosion, identifying risk zones, organizing repeated monitoring, and planning preventive measures. In particular, using multispectral images obtained from satellites such as Landsat 8 OLI and Sentinel-

2, it is possible to determine the density of vegetation cover, identify open lands without vegetation, and assess their level of protection against erosion [1-5].

In this study, a NDVI (Normalized Difference Vegetation Index) map was compiled for the irrigated lands of Central Fergana using Landsat 8 and Sentinel-2 images. NDVI values are an indicator of vegetation status: values below 0.2 - vegetation is practically absent, the range of 0.4-0.6 indicates moderate coverage, and above 0.6 - dense vegetation. According to the research results, zones with NDVI values below 0.2 in the Kuva and Fergana districts were assessed as areas most susceptible to erosion.

In addition, the LS-factor (slope length and steepness) was calculated based on digital terrain models (USGS DEM). The angle of inclination plays a key role in soil erosion processes. Lands with slopes above 5 degrees are quickly eroded, especially under the influence of irrigation. Zones with LS-factor values above 1.2 were designated as hazardous zones. Based on this methodology, a map of erosion hazard zones was created and analyzed in the GIS environment (ArcGIS Pro).

In the study, the RUSLE (Revised Universal Soil Loss Equation) model was used to assess the amount of erosion. According to this model, the average annual soil loss for each district was determined as follows: Kuva district - 9.7 t/ha/year, Fergana district - 7.3 t/ha/year, Tashlak district - 6.1 t/ha/year. The main coefficients taken into account are the intensity of precipitation (R), the solubility coefficient (K), which depends on the physicochemical state of the soil, the slope and length of the soil surface (LS), the degree of influence of vegetation cover (C), as well as the effectiveness of land cultivation and agrotechnical measures (P).

The obtained mapping results show that in the territory of Central Fergana, the risk of erosion is mainly high in open areas located near the foothills, not covered with vegetation, especially in areas with improper irrigation or intensive cultivation. It was established that there is an inverse relationship between the risk of erosion and the density of vegetation: if the NDVI is low - the risk of erosion is high.

Based on these results, it is recommended, firstly, to restore cover based on biodiversity in high-risk zones (through agroforestry or sustainable crop rotation), and secondly, to introduce mulching, contour planting, and drip irrigation technologies. The map of erosion zones is an important tool for local authorities,

agricultural departments, and farms for the effective use of resources, reduction of erosion, and improvement of the monitoring system [6-10].

Technological Workflow for Modern Cartographic Assessment of Irrigated Land Erosion

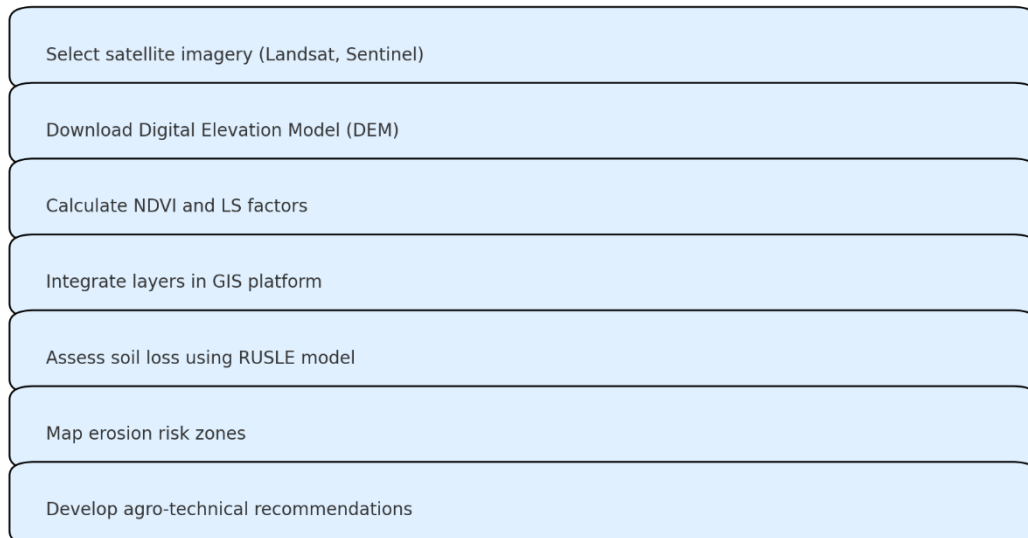


Figure 1. Technological Workflow for Modern Cartographic Assessment of Irrigated Land Erosion

Compared to international experience, the use of NDVI, LS, DEM, and RUSLE models, as well as the practice of identifying and forecasting erosion zones based on them, is widespread in such countries as the USA, India, and Turkey. Although such approaches are only now reaching the level of scientific and practical application in the conditions of Uzbekistan, their potential is very high. Also, the recommendations of FAO, UNEP, and other international organizations on the development of modern digital mapping technologies served as the theoretical basis for this work.

Assessment of erosion of irrigated lands in Central Fergana based on modern cartographic technologies is of strategic importance not only for identifying environmental problems, but also for sustainable land resource management. The research results show that systemic approaches based on digital cartography, satellite monitoring, and GIS should be mandatory for reducing soil degradation [11-14].

Conclusion

The results of the conducted research showed that the problem of soil erosion of irrigated lands in the territory of Central Fergana is a pressing ecological and agrarian issue, which limits the sustainable and efficient use of land resources. Using remote sensing technologies, digital terrain models, and the NDVI index, erosion-prone zones were identified, and their spatial distribution was cartographically assessed. As a result of modeling carried out in the GIS environment, zones of high and medium risk were clearly identified, and the factors of relief, vegetation, and anthropogenic pressure characteristic of these zones were analyzed. Based on the RUSLE model, the amount of annual soil loss was calculated, and based on these results, a scientific basis for planning agrotechnical and landscape-based anti-erosion measures was created.

According to the research results, areas with low vegetation density and high slopes have the greatest risk of erosion. Based on these results, the recommended measures are the restoration of cover based on biodiversity, contour planting, mulching, drip irrigation, and the introduction of erosion-resistant technologies. Maps developed on the basis of these approaches can serve as a practical tool for planning environmentally sustainable land use for local authorities, agricultural departments, and farms.

In conclusion, the use of modern cartographic analysis methods and GIS technologies allows for a prompt, accurate, and systematic assessment of the erosion state of irrigated lands and creates an important scientific and practical basis for sustainable land resource management.

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