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MASOFADAN ZONDLASH MA'LUMOTLARI ASOSIDA SUV FONDI YERLARI DINAMIKASINI BAHOLASH

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Annotatsiya. *Ushbu tadqiqotda masofadan zondlash ma'lumotlari va geografik axborot tizimlari (GAT) texnologiyalari asosida suv fondi yerlarining dinamik holatini baholash o'rganilgan. Tadqiqot hududiga Qashqadaryo viloyatidagi suv obyektlari, xususan, Sechankul va Achinkul ko'llari kiradi. Suv obyektlaridagi fazoviy va mavsumiy o'zgarishlarni Normallashtirilgan farqli suv indeksi (NDWI) asosida baholashda Sentinel-2 sun'iy yo'ldosh tasvirlaridan foydalanildi. NDWI qiymatlarini hisoblash va fazoviy tahlil ArcGIS dasturining ArcMap platformasida Raster Calculator va Classify vositalari yordamida amalga oshirildi. Natijalar masofadan zondlash ma'lumotlari va NDWI indeksidan foydalanish suv fondi yerlari holatini monitoring qilish, suv obyektlari maydonidagi o'zgarishlarni aniqlash va ularning fazoviy dinamikasini baholashda samarali ekanini ko'rsatdi. Tadqiqot xulosalari suv resurslarini monitoring qilish va muhofaza qilish hamda hududiy boshqaruv jarayonlarini takomillashtirish uchun amaliy ahamiyatga ega.*

Kalit so'zlar: *masofadan zondlash, suv fondi yerlari, suv resurslari, Sentinel-2, NDWI, geografik axborot tizimlari, GAT, ArcGIS, suv obyektlari, suv yuzasi maydoni, dinamik monitoring, spektral indeks, Sechankul, Achinkul.*

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ОЦЕНКА ДИНАМИКИ ЗЕМЕЛЬ ВОДНОГО ФОНДА НА ОСНОВЕ ДАННЫХ ДИСТАНЦИОННОГО ЗОНДИРОВАНИЯ

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Аннотация. В исследовании рассматривается оценка динамического состояния земель водного фонда на основе данных дистанционного зондирования и технологий геоинформационных систем (ГИС). Район исследования включает водные объекты Кашкадарьинской области, в частности озёра Сечанкуль и Ачинкуль. Для оценки пространственных и сезонных изменений водных объектов на основе нормализованного разностного водного индекса (NDWI) использовались спутниковые снимки Sentinel-2. Расчёт значений NDWI и пространственный анализ выполнены в среде ArcMap программного комплекса ArcGIS с помощью инструментов Raster Calculator и Classify. Результаты показали, что использование данных дистанционного зондирования и индекса NDWI эффективно для мониторинга состояния земель водного фонда, выявления изменений площади водных объектов и оценки их пространственной динамики. Полученные выводы имеют практическое значение для мониторинга и охраны водных ресурсов и совершенствования процессов территориального управления.

Ключевые слова: дистанционное зондирование, земли водного фонда, водные ресурсы, Sentinel-2, NDWI, геоинформационные системы, ГИС,

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ArcGIS, водные объекты, площадь водной поверхности, динамический мониторинг, спектральный индекс, Сечанкуль, Ачинкуль.

ASSESSMENT OF THE DYNAMICS OF WATER FUND LANDS BASED ON REMOTE SENSING DATA

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Abstract. This study investigates the assessment of the dynamic condition of water fund lands based on remote sensing data and geographic information system (GIS) technologies. The study area includes water bodies in Kashkadarya Region, particularly Sechankul and Achinkul lakes. Sentinel-2 satellite imagery was used to assess the spatial and seasonal changes in water bodies based on the Normalized Difference Water Index (NDWI). The calculation and spatial analysis of NDWI values were performed in the ArcMap platform of ArcGIS using the Raster Calculator and Classify tools. The results demonstrated that the use of remote sensing data and the NDWI index is effective for monitoring the condition of water fund lands, identifying changes in the area of water bodies, and assessing their spatial dynamics. The findings have practical significance for monitoring and protecting water resources and improving territorial management processes.

Keywords: remote sensing, water fund lands, water resources, Sentinel-2, NDWI, geographic information systems, GIS, ArcGIS, water bodies, water surface area, dynamic monitoring, spectral index, Sechankul, Achinkul.

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INTRODUCTION. Today, the rational use of water resources, regular monitoring of their quantitative and qualitative condition, and identification of spatial and temporal changes occurring in water fund lands are among the important scientific and practical issues [4, 5]. Climate change, increasing anthropogenic pressure, expansion of irrigated agricultural areas, intensification of water use, and changes in natural hydrological processes directly affect the dynamics of water body areas and water levels.

Regular assessment of these processes based solely on traditional field observations requires considerable time and material resources. Therefore, the use of remote sensing data and geographic information systems (GIS) is increasingly considered an effective tool for monitoring water fund lands. Satellite imagery makes it possible to assess the spatial boundaries of water bodies, water surface areas, temporal changes, and spatial dynamics with high accuracy [3].

The use of spectral indices is particularly important for identifying surface water bodies and assessing their dynamics. In particular, the Normalized Difference Water Index (NDWI) makes it possible to distinguish water-covered areas from other land-cover types, identify changes in the area of water bodies, and assess their temporal dynamics. This index was initially proposed by McFeeters in 1996 and is based on the use of the green (Green) and near-infrared (NIR) spectral bands.

The main objective of this study is to determine the changes in the area of water fund lands in Kashkadarya Region, particularly the Sechankul and Achinkul water bodies, during 2020–2024 using Sentinel-2 satellite imagery and the NDWI spectral index, and to conduct a spatial assessment of these changes using GIS technologies [4, 7].

MAIN PART (DISCUSSION AND RESULTS). Sentinel-2 satellite imagery was used as the primary remote sensing data in the study. Sentinel-2 data provide spatial resolution of up to 10 m, enabling the monitoring of water bodies, vegetation, agricultural lands, and other land-cover types.

For the study, satellite images corresponding to July and October of 2020 and 2024 were selected. The selection of these periods considered the condition of the vegetation season, the intensity of irrigation processes, and the possibility of comparing seasonal changes occurring in water bodies.

Radiometric and geometric corrections were applied during the processing of the satellite imagery. Radiometric processing was used to improve the accuracy of spectral values in the images, reduce inconsistencies caused by different image acquisition conditions, and prepare the data for subsequent spectral analysis. Geometric correction was used to align the images with the geographic coordinate system and enable accurate comparison of images acquired during different periods.

The Normalized Difference Water Index (NDWI) was used to identify water bodies. For Sentinel-2 imagery, NDWI was calculated using the following formula:

$$\mathbf{NDWI = (B03 - B08) / (B03 + B08)\ (1)}$$

where:

– B03 (Green) — green spectral band;

– B08 (NIR) — near-infrared spectral band.

NDWI values generally range from −1 to +1. Increasing positive values indicate a higher probability of water-covered areas, whereas negative values

generally correspond to land, vegetation cover, and other non-water surface features.

In the study, water bodies were extracted by classifying NDWI values. A threshold of 0.1 and above was used to identify water-covered areas. At the same time, interpretation was not limited to mathematical thresholding of NDWI values. Their spatial distribution was additionally verified through visual interpretation using high-resolution satellite imagery and Google Earth data.

NDWI analysis was performed in the ArcMap platform of ArcGIS [1]. The Raster Calculator tool was used to calculate the NDWI value for each pixel based on the B03 and B08 bands. The resulting NDWI raster data were subsequently classified using the Classify function. Classes corresponding to water bodies were extracted, and their areas were calculated.

The areas of water bodies were expressed in hectares and square kilometers. By comparing the results for different years, the absolute and relative changes in water surface area were determined.

The study methodology also considered factors that could affect the accuracy of the NDWI index. In particular, snow and glaciers in mountainous areas, irrigated agricultural crops, and cloud cover may in some cases result in the incorrect classification of water bodies. Therefore, the results of the spectral index analysis were additionally verified through visual interpretation.

The study determined the spatial dynamics of water bodies in Kashkadarya Region during 2020–2024 based on Sentinel-2 satellite imagery. The NDWI analysis showed that the maximum index value reached 0.9. High NDWI values were found to correspond primarily to open water surfaces.

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Comparative analysis of NDWI data for July and October 2020 and 2024 revealed both seasonal and interannual changes in the areas of water bodies. Changes in water surface area were particularly evident in Sechankul and Achinkul lakes.

According to the data obtained, the water surface area of Sechankul in July was 59.18 km² in 2020, whereas in 2024 this indicator increased to 62.78 km². Thus, an increase of 3.60 km² was recorded. In the October comparison, however, the lake area decreased from 61.76 km² to 59.52 km², indicating a reduction of 2.24 km².

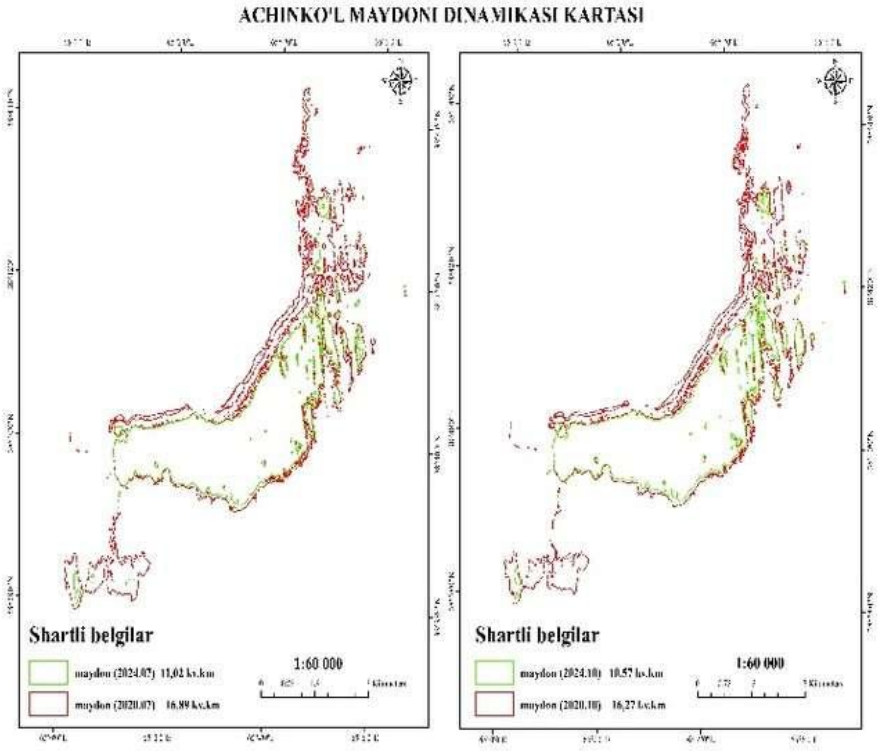


Figure 1. Assessment of changes in the area of lakes located within the study area during 2020–2024 using Sentinel-2 satellite imagery

The results for Achinkul showed a significant decrease in water surface area. In July, the lake area decreased from 16.89 km² in 2020 to 11.02 km² in 2024,

representing an absolute reduction of 5.87 km². In October, the corresponding value decreased from 16.27 km² to 10.57 km², resulting in a reduction of 5.70 km².

Based on the obtained results, it was established that the water surfaces of Sechankul and Achinkul exhibited different dynamics across years and seasons. While an expansion of the water surface area was recorded in Sechankul during certain periods, a persistent decreasing trend was observed in Achinkul throughout the study period.

The results of the study demonstrated that the use of remote sensing data and the NDWI index is an effective methodological approach for assessing the spatial dynamics of water fund lands. The spatial resolution of Sentinel-2 imagery makes it possible to accurately delineate water body boundaries and map relatively small changes in their areas.

The changes identified for Sechankul can be interpreted in relation to the natural and hydrological conditions of the area. In particular, hydrogeological processes in the southern collector area and fluctuations in groundwater levels may be among the factors affecting water availability. However, additional hydrological and hydrogeological observations are required to fully confirm this causal relationship.

The observed reduction of 5.70–5.87 km² in Achinkul indicates a substantial decrease in water surface area. These changes may be associated with variations in the water balance, evaporation, intensity of water use, precipitation levels, and other natural and anthropogenic factors. However, it is not possible to conclusively determine which of these factors is the primary cause based solely on NDWI data.

Several limitations of the NDWI index were also identified during the study. In particular, snow and ice cover may sometimes produce high index values and

consequently be incorrectly classified as water bodies. Similarly, moisture in irrigated agricultural fields may increase NDWI values. Therefore, it is advisable to verify spectral index results using high-resolution imagery or other independent data sources [8].

Selecting images acquired on different dates and conducting comparative analyses to minimize the effects of cloud cover can improve the reliability of the results. At the same time, for long-term monitoring, the use of imagery acquired during the same season and under similar meteorological conditions ensures methodological consistency in interannual comparisons.

In addition to NDWI, the use of indices such as the Normalized Difference Moisture Index (NDMI) can expand the analytical capabilities. While NDWI uses the GREEN–NIR combination to distinguish surface water bodies, NDMI primarily uses the NIR–SWIR spectral ranges to assess moisture in vegetation and soil. Therefore, the combined application of these indices may allow better differentiation between water bodies and moist agricultural areas.

Overall, calculating the NDWI index, performing classification, automatically calculating areas, and conducting comparative analyses of multi-year data within the ArcGIS environment enable the digitization of water fund land monitoring. This approach facilitates the rapid identification of changes in the area of water bodies, the development of cartographic models, and the creation of an information base required for the spatial management of water resources [2, 5, 6].

CONCLUSION. The results of the study demonstrated that the integrated use of Sentinel-2 satellite imagery, the NDWI spectral index, and GIS technologies is an effective approach for assessing the dynamics of water fund lands. The comparative analysis of data for July and October 2020 and 2024 in Kashkadarya

Region revealed significant temporal and spatial changes in the areas of water bodies.

The area of Sechankul increased by 3.60 km² in July 2024 compared with the same period in 2020, while in October it decreased by 2.24 km². In contrast, the area of Achinkul decreased by 5.87 km² in July and 5.70 km² in October. These results demonstrate the need for regular remote monitoring of the dynamic condition of water bodies.

The findings also indicate the necessity of considering factors such as snow and ice cover, irrigated agricultural fields, and cloud cover when applying the NDWI index. Therefore, integrating NDWI-based results with high-resolution satellite imagery, field observations, and hydrological data can further improve the accuracy of monitoring water fund lands.

In the future, for a more comprehensive assessment of the dynamics of water fund lands, it is advisable to use NDMI, MNDWI, and other spectral indices in addition to NDWI, develop long-term time series, and implement an automated GIS-based monitoring system. Such an approach will expand the possibilities for regularly monitoring changes in the area of water bodies, ensuring rational use and protection of water resources, and making scientifically sound management decisions.

REFERENCES

1. Ibragimov L.T. Creation of a cartographic model of a water cadastre based on geoinformation technologies // International Journal of Culture and Modernity ISSN: 2697-2131, Volume 9, Issue 7, July., 2022 Pp. 73–75

2. Ibragimov L.T. Theoretical basis of creating a water inventory map // Web of scientist: International scientific research journal ISSN: 2776-0979 (Volume 2, Issue 10, Oct., 2021 Pp. 104–107

3. Ibragimov L.T., Babaxanova D.Y., Narzullayeva Sh.N. Cartographic study of water resources using high resolution satellite images // J. Central asian journal of arts and design ISSN: 2660-6844 Volume: 02 Issue: 10 2021 Pp. 17–19

4. Ibragimov L.T., Gafurov A. The role of geographical information systems in support of state water cadastre on the example of Kashkadarya region, Uzbekistan // International Journal of AdvancedResearch in Science, Engineering and Technology ISSN: 2350-0328 Volume–7, Issue 7, July., 2020 Pp. 14495–14500

5. Ibragimov L.T., Raximov U.A., Yarkulov Z.R., Ortiqov J.U. Improvement of the State Water Cadastre's Management System // International journal on human computing studies e-ISSN: 2615-8159 -ISSN: 2615-1898 Volume: 04 Issue: 12 | December 2022 Pp. 101–103

6. Ibragimov L.T. Creation of a water cadastre geoportal for the Kashkadarya region based on GIS technologies // Electronic journal of actual problems of modern science, education and training ISSN 2181-9750, №3. March, 2025 Pp.54–58

7. Ibragimov L.T. Geoinnovatsion yondashuvlar asosida Qashqadaryo viloyati yer usti suv obyektlarini monitoring qilish va muhofaza zonalarini belgilash // "Geodeziya kartografiya va kadastr muammolari" ilmiy jurnali ISSN: 3030-3826 Toshkent., №1. Aprel, 2025. 123–130 bet.

8. Ibragimov L.T., Umarov N.Sh. Uchuvchisiz uchish apparatlari (UUA) yordamida suv resurslari kadastrini yuritish // "Atrof-muhitni asrash va "yashil"

iqtisodiyot ilmiy asoslari" mavzusidagi xalqaro ilmiy-amaliy konferensiya materiallari. Toshkent davlat agrar universiteti, Toshkent., 2025. – B. 830–835.