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5. Ochilov I. Financial account. T.: - "Finance" 2008. 6. Sotivoldiyev A.S. Modern accounting. T.: - 2002.[5]
6. Mustafoyev Odiljon Murod o‘g‘li, & Nortoshev Elyor Zayirovich (2024). Baxmal tumanida olma yetishtiruvchi tomorqa xo‘jaliklari faoliyatiga ta’sir qiluvchi omillar ta’sirini iqtisodiy tahlili. Science and innovation, 3 (Special Issue 20), 169-179 [6]
7. Mustafoyev O.M. (2023). Respublika qishloq xo‘jaligida yetishtiriladigan mahsulotlar o‘rni va ahamiyati. Academic research in educational sciences, 4 (SamTSAU Conference 1), 709-714. [7]
8. Nortoshev Elyor Zayirovich, Mustafoyev Odiljon Murod o‘g‘li, & Ismatullayev Jo‘rabek Ismatulla o‘g‘li (2024). Gulchilik marketingiga ta’sir etuvchi omillar tahlili hamda “FLOWER INFO MOCKUP” ma’lumotlar maketining afzallik ko‘rsatgichlari. Science and innovation, 3 (Special Issue 36), 461-467. [8]

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ESTIMATION OF SALT-ACCUMULATED SOILS BASED ON SATELLITE IMAGE ANALYSIS IN MINGBULAK DISTRICT OF UZBEKISTAN.

Abstract. *Soil salinization poses a significant environmental challenge in arid and semi-arid regions, particularly in irrigated areas. This study aims to develop a cost-effective and efficient method for assessing soil salinity in the Mingbulak district of Namangan, Uzbekistan. Traditional soil salinity measurement methods are time-consuming, costly, and labor-intensive. We utilized Landsat 8 OLI and Sentinel-2A satellite imagery to derive salinity indices, estimate soil electrical conductivity (EC), and quantify the concentrations of salinity-related cations and anions. Our findings indicate that the Normalized Difference Salinity Index (NDSI) from Landsat 8 outperforms other indices, with an R^2 of 0.715 for the 0-30 cm soil layer. The study successfully validated a model to create salinity maps, revealing similar patterns to government maps, and demonstrating that satellite-based methods are a viable alternative to traditional approaches.*

Keywords. *Soil salinization, remote sensing, Landsat 8, Sentinel-2A, soil electrical conductivity, salinity indices, soil mapping, Mingbulak, Uzbekistan, NDSI, GIS.*

Introduction. Soil salinization is a major environmental threat in irrigated areas, particularly in arid and semi-arid regions. In Uzbekistan, nearly half of the country's 4.3 million hectares of irrigated land is salinized to varying degrees. In Soil salinity is measured in the laboratory using a variety traditional method in Uzbekistan. Traditional methods for mapping and monitoring geographical and temporal changes of soil salinity are slow, expensive, and labour intensive. Remote sensing (RS) methods have grown in popularity in recent years, particularly for soil analysis using satellite imagery. RS methods are less expensive, faster, and enough accurate.

Research objectives. The objective of this study was to develop an efficient and cost-effective method for assessing soil salinity in the Mingbulak district of Namangan, Uzbekistan. The objective was to compare and validate the accuracy of the indices derived from Landsat 8 OLI and Sentinel-2A satellite data, to determine the most effective salinity index, to estimate soil electrical conductivity values (EC), to quantify the concentrations of salinity-related cations and anions, and to produce an EC and salinity map showing the distribution of anions responsible for soil salinity. Compare the results of the satellite-based approach with the salinity maps produced by relevant institutions in Uzbekistan.

Materials and Methods.

Study area. The study was conducted in Mingbulak district of Namangan region in Uzbekistan. The region is critical for agriculture, with cotton, wheat, rice, and corn being the main crops. Most of the irrigated soils are gleysols or solanchaks.

Soil sampling and laboratory analysis. Soil samples were collected 76 points in a 52580-hectare research area between October 10 and 20, 2019. EC was measured using EC meter after samples were collected at depths of 0-30, 30-60, and 60-90 cm. The soil samples were analyzed using various methods to quantify the anions and cations of water-soluble salts. In this study, different combination sets of 58 out of 74 samples were utilized to create the model, while the remaining 16 samples were preserved to validate it.

Seattleite images. Landsat8 OLI and Sentinel-2A MSI data were used for this study. The Landsat 8 OLI L1 image was downloaded on October 15, 2019, and the Sentinel-2A image was downloaded on October 19, 2019. In this study, we examined the blue, green, red, NIR, SWIR1, SWIR2 bands and 16 salinity indices to select the one with the best correlation with the EC values.

The study used regression analysis to develop models explaining soil EC from salinity index data from two satellites. The models were validated using samples, and the coefficient of determination was used to compare predictions. Spearman's correlation was used to establish the relationship between soluble ion species and soil salinization.

Results and discussion.

***Laboratory results*.** The soil samples taken from the three layers for modeling had EC values ranging from 0.59 to 15.95 dS/m^{-1} (0-30 cm), 0.59 to 19.73 dS/m^{-1} (30-60 cm), and 0.58 to 18.43 dS/m^{-1} (60-90 cm). Soil samples taken for validation ranged from 0.53 to 15.74 dS m^{-1}, with the 0–30 cm depth having the highest EC. Ca^{+2} and SO_4^{2-} ions was found to be significantly more abundant at depths 0-30, 30-60, and 60-90 cm, compared to other anions.

***Regression analysis and validation results*.** The results revealed that SI12 and the NDSI from Landsat 8 were superior to the others (R^2=0.715) for 0-30 cm (Fig.1). The accuracy of the single band B2 and that of salinity indices SI1 and SI8 of Landsat 8 and Sentinel-2A were higher in the deeper layers than in the upper. NDSI was used to model the relationship between soil salinity (EC) and the prominent salt ion. The model was

validated successfully R^2=0.67 and R^2=0.70 respectively, and a soil salinity map was created. According to the findings, the NDSI provided more accurate information on soil salinity than the other salinity indices, and the blue band was successful in depicting sublayers and the overall salinity of the region. The comparison between the Salinity Maps developed by our study and the Government institution of Uzbekistan in 2017 reveals similar salinity patterns across the district, with the north being mostly non-saline and the south exhibiting moderate to strong salinity levels.

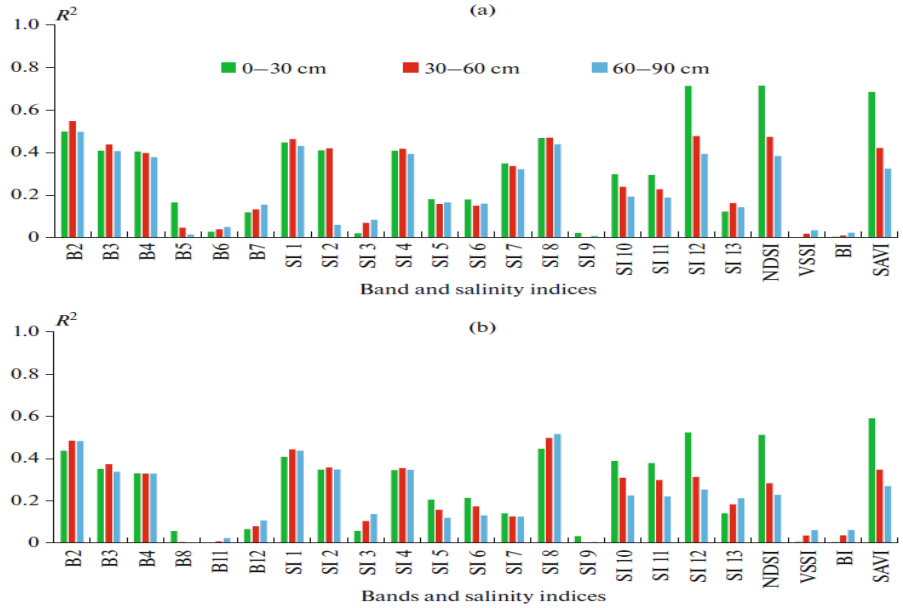

Fig. 1. Results of linear regression EC in soil layers of 0–30, 30–60, and 60–90 cm with the selected (a) Landsat 8 and (b) Sentinel-2A bands and indices.

Conclusion. The study shows Landsat 8 satellite images are more accurate for assessing soil salinity in Mingbulak than Sentinel-2A images. The NDSI index outperforms other indices, particularly the blue band, which effectively represents sublayers and overall salinity. The study validates a simple approach for quantifying salinity-causing salt ions using the NDSI index. Despite using limited soil samples, our model remains resource and time-saving compared to the existing traditional extensive data collection.

References

Allbed, A., & Kumar, L. (2013). Soil Salinity Mapping and Monitoring in Arid and Semi-Arid Regions Using Remote Sensing Technology: A Review. *Advances in Remote Sensing*, *02*(04), 373–385. https://doi.org/10.4236/ars.2013.24040

Asfaw, E., Suryabhagavan, K. V., & Argaw, M. (2018). Soil salinity modeling and mapping using remote sensing and GIS: The case of Wonji sugar cane irrigation farm, Ethiopia. *Journal of the Saudi Society of Agricultural Sciences*, *17*(3), 250–258. https://doi.org/10.1016/j.jssas.2016.05.003

Bannari, A., Guedon, A. M., El-Harti, A., Cherkaoui, F. Z., & El-Ghmari, A. (2008). Characterization of slightly and moderately saline and sodic soils in irrigated agricultural land using simulated data of advanced land imaging (EO-1) sensor. *Communications in Soil Science and Plant Analysis*, *39*(19–20), 2795–2811. https://doi.org/10.1080/00103620802432717

Delavar, M. A., Naderi, A., Ghorbani, Y., Mehrpouyan, A., & Bakhshi, A. (2020). Soil salinity mapping by remote sensing south of Urmia Lake, Iran. *Geoderma Regional*, *22*, e00317. https://doi.org/10.1016/j.geodrs.2020.e00317

Gorji, T., Yildirim, A., Hamzehpour, N., Tanik, A., & Sertel, E. (2020). Soil salinity analysis of Urmia Lake Basin using Landsat-8 OLI and Sentinel-2A based spectral indices and electrical conductivity measurements. *Ecological Indicators*, *112*(October 2019), 106173. https://doi.org/10.1016/j.ecolind.2020.106173

Hardie, M., & Doyle, R. (2012). Measuring soil salinity. *Methods in Molecular Biology*, *913*, 415–425. https://doi.org/10.1007/978-1-61779-986-0_28

He, Y., Zhang, Z., Xiang, R., Ding, B., Du, R., Yin, H., Chen, Y., & Ba, Y. (2023). Monitoring salinity in bare soil based on Sentinel-1/2 image fusion and machine learning. *Infrared Physics & Technology*, *131*, 104656. https://doi.org/10.1016/j.infrared.2023.104656

Khan, S. (n.d.). *Using Remote Sensing Techniques for Appraisal of Irrigated Soil Salinity*.

Lamqadem, A. A., Afrasinei, G. M., & Saber, H. (2019). Analysis of Landsat-derived multitemporal vegetation cover to understand drivers of oasis agroecosystems change. *Journal of Applied Remote Sensing*, *13*(01), 1. https://doi.org/10.1117/1.jrs.13.014517

Liu, J., Zhang, L., Dong, T., Wang, J., Fan, Y., Wu, H., Geng, Q., Yang, Q., & Zhang, Z. (2021). The applicability of remote sensing models of soil salinization based on feature space. *Sustainability (Switzerland)*, *13*(24). https://doi.org/10.3390/su132413711

Lutz, W., Goujon, A., Stonawski, M., & Stilianakis, N. (n.d.). *Demographic and human capital scenarios for the 21st century 2018 assessment for 201 countries*.