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Research Article

Water cover change detection in Zayandeh-Rood watershed using remote sensing

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Extended Abstract

Introduction

Water is one of the most fundamental resources for life, playing a critical role in drinking, agriculture, industry, and socio-economic and political security. Given its importance, the sustainable management and utilization of water resources have become a global priority. Remote sensing technology has emerged as a powerful tool for monitoring water resources, offering applications such as land cover classification and water surface detection. This study evaluates the use of the Normalized Difference Water Index (NDWI) derived from Landsat 9 satellite imagery to detect water bodies and river surfaces in the Zayandeh River basin from 1984 to 2022. The results reveal a significant decline in water levels, likely due to agricultural water extraction. The NDWI proved effective in extracting water features from satellite images, making it a reliable tool for assessing the hydrological conditions of the Zayandeh River basin.

Materials and Method

The study focuses on the Zayandeh River basin, a vital water source in central Iran, covering an area of 41,550 square kilometers. Satellite imagery from Landsat 5, 7, 8, and 9 was used to analyze changes in water surface areas over a 38-year period. The NDWI, calculated using the formula (NIR - Green) / (NIR + Green), was employed to distinguish water bodies from other land cover types. The NDWI values range from -1 to 1, with positive values indicating water surfaces and negative values representing vegetation or dry areas. Image preprocessing, including radiometric and atmospheric corrections, was performed to ensure data accuracy. The study also utilized statistical analysis, such as ANOVA, to compare NDWI values across different stations along the river.

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Results and Discussion

The analysis of NDWI values from 1984 to 2022 revealed significant spatial and temporal variations in water surface areas. The upper reaches of the Zayandeh River, particularly near the Zarinshahr station, showed relatively stable water levels, with NDWI values consistently above zero. However, downstream stations exhibited a sharp decline in water levels, with NDWI values frequently falling below zero, indicating dry riverbeds. This trend was especially pronounced after 2011, coinciding with increased agricultural water extraction. The study also identified a strong correlation between water level reductions and human activities, such as canalization and water diversion. Statistical analysis confirmed significant differences in NDWI values between stations, highlighting the uneven distribution of water resources along the river. These findings align with previous studies, such as those conducted on Lake Chilika in India and Lake Parishan in Iran, which also demonstrated the effectiveness of NDWI in monitoring water surface changes.

Conclusion

This study underscores the utility of remote sensing and NDWI in monitoring water resources and detecting changes in river systems. The Zayandeh River basin has experienced significant water level reductions, particularly in its downstream sections, largely due to agricultural water extraction. The NDWI proved to be a reliable and efficient tool for identifying water surfaces and assessing hydrological changes over time. The findings highlight the need for sustainable water management practices to address the growing water scarcity in the region. Future research could explore the integration of additional remote sensing indices and ground-based data to enhance the accuracy of water resource monitoring and support decision-making processes.

Keywords*:* Temporal-spatial changes, Remote sensing, Landsat, Normalized difference water index