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Research Article

Statistical analysis of the SPI index and discharge potential of the Khansar Sarcheshmeh springs

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Extended Abstract

Introduction

Drought is a natural phenomenon with significant adverse effects on economic activities, social structures, and human life, threatening the sustainability of natural environments. In agricultural regions, drought leads to land degradation, reduced crop yields, water stress, and increased migration risks. The Zayandeh Rud River, a critical water source for the Khansar region in Iran, has experienced severe drying in recent decades, impacting agriculture and local livelihoods. This study aims to evaluate the relationship between the Standardized Precipitation Index (SPI), precipitation, and spring discharge in the Khansar region to estimate groundwater resources and optimize water allocation for agricultural planning.

Materials and Method

The study utilized meteorological data from synoptic and climatological stations in Khansar, Golpayegan, and Aligudarz to analyze precipitation trends and spring discharge. The SPI was calculated for various time intervals (3, 6, 12, 24, and 48 months) to assess drought severity and its impact on spring discharge. Statistical distributions, including the Generalized Extreme Value distribution, were used to estimate the probability and return periods of drought events. The correlation between SPI, precipitation, and spring discharge was analyzed to predict water availability for agricultural planning.

Results and Discussion

The analysis revealed that the Khansar region experienced severe drought in 2007, with the most significant wet periods occurring between 1985-1989, 1991-1993, and 2001-2006. The probability of normal and near-normal climatic conditions was 67.5%, with a return period of 1.48 years. Moderate drought conditions had a 9% probability and a return period of 11.1 years, while severe drought conditions had an 8.5% probability and a return period of 11.7 years. The study found a strong correlation (0.84) between the 12-month SPI and annual spring discharge, indicating that precipitation significantly influences groundwater recharge and spring flow. Similarly, the 6-month SPI showed a high correlation (0.91) with annual spring discharge, suggesting that precipitation in the first half of the water year is a reliable predictor of water availability for the entire year.

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Conclusion

This study demonstrates the effectiveness of the SPI in predicting spring discharge and managing water resources in the Khansar region. The findings highlight the importance of using precipitation data and drought indices for agricultural planning and water allocation. By understanding the relationship between precipitation and spring discharge, policymakers and farmers can make informed decisions to mitigate the impacts of drought and ensure sustainable water use. The results also emphasize the need for integrated water resource management strategies to address the challenges posed by climate variability and water scarcity in arid regions.

Keywords: Drought, Spring, SPI, Khansar city