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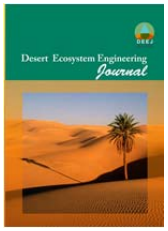

Evaluating the Efficiency of Vegetation Indices in Analyzing Drought Using MODIS Images: A Case Study Qom, Isfahan, Chaharmahal Bakhtiari, and Markazi Provinces

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Extended Abstract

Introduction: As a natural disaster, drought may occur in any climate. In recent decades, widespread severe droughts have continuously affected Iran, imposing detrimental effects on the country's various economic sectors, including agriculture, environment, and water resources. Today, vegetation indices obtained from remote sensing are widely used to identify and analyze meteorological droughts. Remote sensing technology enables near-real-time monitoring of drought conditions by analyzing high-resolution spectral data, allowing for pixel-level calculations over large geographic areas. The Iranian provinces of Qom, Isfahan, Chaharmahal Bakhtiari, and Markazi are among those regions whose drought conditions have frequently been warned about within the last few years. Therefore, as the study of drought in these four provinces bears special significance due to the sensitivity of the provinces and the large population they accommodate, the current research selected the provinces as its study areas.

Material and methods: this study set out to investigate the correlation between SPI, NDVI, and EVI that were obtained from MODIS images from 2011 to 2020, seeking to monitor drought in central regions of Iran. To this end, changes made over a period of 10 years were identified using the images of the Modis satellite sensor and the precipitation data collected from the synoptic stations located in the study area. In this regard, four months (April, May, June, and July) were selected as sample periods by reviewing the data collected from the existing stations using the standardized precipitation index (SPI) model. This study selected MODIS Terra MOD13A2 imagery from 2011 to 2020 due to its high temporal resolution, broad spectral coverage, ease of access, and the absence of atmospheric and geometric correction requirements. This dataset was chosen to ensure the capture of both wet and dry periods. Subsequently, the Standardized Precipitation Index (SPI) was compared with the Normalized Difference Vegetation Index (NDVI) and Enhanced Vegetation Index (EVI). Moreover, the Pearson correlation coefficient was used to determine the correlation between the SPI meteorological drought index and remote sensing indices.

Results: According to the study's results, the correlation between SPI NDVI and EVI was found to be 0.832 and -0.149, respectively. In general, the results indicated that in areas with insufficient precipitation data and poor distribution of drought monitoring, remote sensing, and NDVI data can be used to monitor vegetation changes. Moreover, the results of drought monitoring revealed that during the ten-year study period, severe droughts occurred in some years. For instance, severe drought and extremely wet periods occurred in 2020 and 2011, respectively. On the other hand, the results of the correlation between SPI and remote sensing indices suggested that SPI had the highest correlation with NDVI at the level of 0.01. The results of this study can effectively contribute to the decisions made by decision-makers in monitoring, investigating, and resolving drought conditions.

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Discussion and conclusion: Vegetation characteristics, the studied time period, soil characteristics, and the distribution and intensity of precipitation are important factors involved in the establishment of the highest correlation coefficient between the NDVI and the SPI during the delay period. Satellite indices show a remarkable correlation with each other in terms of detecting the magnitude of change, and the highest correlation between satellite indices and terrestrial indices is found in the NDVI-SPI pair. Therefore, the NDVI is used to monitor meteorological drought. Compared to point meteorological methods (precipitation recording stations), satellite images offer greater advantages, including the number of sampling points, wider coverage area, higher time resolution, and lower cost. Therefore, remote sensing knowledge is suggested for drought monitoring. Generally, remote sensing data and NDVI are suggested as appropriate indices to be used for monitoring vegetation changes in areas with insufficient rain gauge data and inappropriate distribution of drought monitoring.

Keywords: Drought, SPI, Vegetation Indices, NDVI and EVI, Central Regions of Iran.