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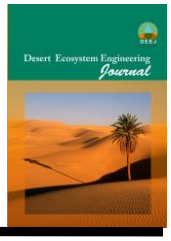

Spatial and temporal analysis of PDI drought index in the Northwest of Iran

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Extended Abstract

Introduction: Drought stands as an inevitable natural disaster with no means of prevention. Its detrimental impacts extend across diverse sectors, including water resources, agriculture, and the environment. Drought is typically defined as a substantial scarcity of natural freshwater resources persisting over an extended period due to shifts in precipitation and temperature patterns. Consequently, periods marked by below-average rainfall often result in temporary drought, particularly in arid and semi-arid regions characterized by relatively high temperatures. Globally, drought events are classified into four categories: meteorological, soil moisture (agricultural), hydrological, and socio-economic. Studying drought becomes imperative for implementing optimal solutions and strategies to manage water resources and ensure food security, among other concerns.

Materials and Methods: This research utilizes the Pedj Drought Index (PDI), a unique and potent tool, to delve into drought analysis. The PDI, grounded in precipitation and temperature data, offers a more accurate and accessible understanding of drought's spatial and temporal characteristics. Based on yearly averages at stations, this innovative approach provides a fresh perspective on drought analysis. We gathered and scrutinized annual rainfall and temperature data from 20 synoptic stations in Northwestern Iran from 1987 to 2021 to conduct this study. The PDI's accuracy and accessibility make it a reliable choice for drought analysis, providing a comprehensive view of the situation.

Results: From 1991 to 1995, most of the studied stations experienced wet conditions, while from 2013 to 2017, they faced a severe drought. The most extended wet period occurred in the south at the Bijar station (9 years), and the most prolonged drought period happened in the east at the Ardabil station (8 years). The maximum wet period based on the PDI index (9 years) was observed at the Bijar station, and the most prolonged drought period was at the Ardabil station (8 years). In the northwest of the country, the average duration of the most extended wet periods is 5.5 years, and the average duration of the most prolonged drought periods is 7.5 years. Additionally, the central station experienced two 5-year drought periods, and the Tabriz station underwent two 4-year wet periods. Based on the precipitation anomaly index, 60% of the stations (12 stations) showed a decreasing trend in precipitation anomalies, with the Sanandaj and Maragheh stations having a significant 95% decrease. In comparison, only 40% (8 stations) exhibited an insignificant upward trend in precipitation. The temperature anomaly index showed an upward trend in all studied stations, with only Bijar, Takab, Sarab, and Miandoab stations (highlighted in red) having a significant 95% increase. According to the drought index PDI, none of the stations experienced extremely dry (ExD) or moderately dry (MiD) conditions. The highest percentage of severe drought was observed in Zanjan (71.5%), moderate drought in Khalkhal (20%), and mild drought in Tabriz, Maragheh, and Piranshahr (42.85%). Severe dryness was observed in the Bijar station (42.85%), moderate dryness in Maku (17%), severe dryness in Takab, Khormabad, and Miandoab (71.5%), and highly severe dryness (71.5%) in Ardabil Province. These findings underscore the urgent need for effective drought management and water resource planning in the northwest region of Iran. These findings underscore the urgent need for effective drought management and water resources planning in the northwest area of Iran.

Discussion and Conclusion: This study investigated the effects of annual mean precipitation and temperature changes on drought and long-term dry events using the PDI index in 20 stations in the northwest region of Iran,

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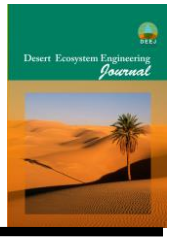

spanning five provinces over 35 years (1987-2021). The northwest Iran stations experienced wet periods from 1990 to 1994, dry periods from 1998 to 2001, and from 2013 to 2017. The most extended wet period was approximately 5.5 years, and the longest prolonged drought period was around 7.5 years. On an annual scale, the PDI could describe the spatiotemporal variations of drought and wetness in the study area to a considerable extent. Despite its simplicity, the PDI provided highly accurate results compared to common drought indices such as SPI and SPEI, which rely on statistical assumptions and distribution-related parameters. The stronger correlation of PDI with SPEI, as opposed to SPI, demonstrates the capability of PDI to explain the effects of precipitation and temperature changes on drought and wetness in the northwest region of Iran.

Keywords: Meteorological Drought, Trend Analysis, Climate Change.