

## Investigating variations in climatic factors and drought trends in Sistan and Baluchestan Province

Hadi Darroudi<sup>1\*</sup>, Masoumeh Shahabi<sup>2</sup>, Mohammad Khosroshahi<sup>3</sup>

Received: 01/09/2020

Accepted: 29/06/2021

### Extended Abstract

**Introduction:** Drought is a long-term natural phenomenon when the average precipitation rate is less than that of the normal periods. As a natural phenomenon, drought has turned into a natural disaster occurring throughout Iran in recent decades with all its associated consequences. On the other hand, although rainfall is considered as the main indicator of water availability, the temperature is also an important factor in this regard, as it controls the evapotranspiration rate. Therefore, parameters such as precipitation and temperature can be used as indicators for analyzing the drought. Moreover, identifying drought trends based on previously recorded data, noting their occurrence in different times and places, and studying their variation over time play a significant role in managing water resources. It should be noted that the purpose of trend analysis is to determine the decreasing or increasing nature of trends in a series of observations performed for a random variable over time.

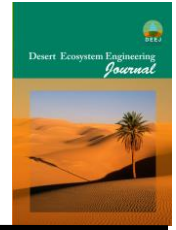
**Materials and methods:** The Standardized Precipitation Evapotranspiration Index (SPEI) is a meteorological drought index that considers the variability of both precipitation and temperature in predicting drought conditions in a region. Enjoying a multi-scale ability to monitor and analyze drought in different scientific disciplines, the index fulfills the requirements of a drought index, being recently used in a variety of drought analyses. This study measured SPEI using precipitation and temperature data from eleven meteorological stations in Sistan and Baluchestan Province, Iran, during the study period. The Drought events were then identified via the Standardized Precipitation Evapotranspiration Index over both 3 and 12-month timescales. The total geographical area of Sistan and Baluchestan Province is approximately 187,000 km<sup>2</sup>, located at 25° 03 N to 31° 28 N (latitudes), and 58° 47 E to 63° 19 E (longitudes). The province has an arid and semiarid climate with a

<sup>1</sup>. Assistant Professor, Forest and Rangelands Research Department, Baluchestan Agricultural and Natural Resources Research and Education Center; [hadi\\_f79@yahoo.com](mailto:hadi_f79@yahoo.com)

<sup>2</sup>. M.Sc, Forest and Rangelands Research Department, Baluchestan Agricultural and Natural Resources Research and Education Center

<sup>3</sup>. Associate Professor, Desert Research Division, Research Institute of Forests and Rangelands, Agricultural Research Education and Extension Organization (AREEO)

DOI: 10.22052/deej.2021.10.32.11



mean annual rainfall of about 100 mm. The monthly precipitation and temperature data recorded at the stations were obtained from the Sistan and Baluchestan's Meteorological Organization. One of the commonly used tools for detecting changes in climatic and hydrologic time series is trend analysis. Mann-Kendall is a non-parametric trend test commonly used to assess the significance of trends in time series. This study used both nonparametric trend tests (Mann-Kendall) and graphical Mann-Kendall model trend analysis (statistical significance at 95% confidence level) to explore the drought trends in each station. The purpose of trend analysis is to determine whether the time series of a random variable's observations generally increases or decreases over time. While parametric trend tests are more powerful, it is non-parametric trend tests are widely used, as they can accommodate outliers in the data and require independent data.

**Results:** The study's results indicated no negative trend in precipitation but revealed a significant trend in temperature. The SPEI values measured for the short-term time scale (SPEI 3) showed a statistically significant downward trend for all stations, which corroborates the occurrence of more critical drought periods in recent years. Moreover, the study of the frequency of drought occurrence in the stations during 10-year periods suggested an increasing trend in the occurrence of drought in recent years. As for the maximum drought index, it could be said that the index's value has typically increased in recent years, that is, more severe droughts have occurred. According to the results, the most severe drought belonged to the Khash station, and the wettest period was found in the Chabahar station.

**Discussion and Conclusion:** This study sought to identify possible drought trends in Sistan and Baluchestan province using the Mann-Kendall test, considering the fact that detecting such changes offer valuable information for future water resources management. Accordingly, the analysis of previous drought events showed that more severe droughts are expected to occur in the years to come. Although this study did not seek to find possible causes of decreasing trends, the results presented herein could be used as a benchmark for further analysis of the consequences of climate change. It could be argued that low precipitation and high potential evapotranspiration (PET), especially the PET caused by rising temperature, are the main factors that could influence drought in the future. Therefore, the influence of the PET should not be ignored in drought analysis, and it is suggested that more comparative studies of different drought indices be conducted on analyzing future climate change-induced droughts.

**Keywords:** Drought, Mann-Kendall, Sistan and Baluchestan, SPEI, Trend.