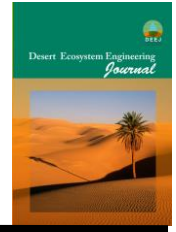




University of Kashan

## Desert Ecosystem Engineering Journal

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## Investigating Temporal and Spatial Variations of UNEP and De Martonne Aridity Indices in Iran from 1976 to 2020

Khadijeh Javan,\* Ameneh Yahyavi Dizaj<sup>†</sup>

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### Extended Abstract

**Introduction:** As one of the most threatening natural hazards that has plagued humans for a long time, drought is considered a main natural disaster that affects various aspects of human life (Mishra and Sin, 2010). On the other hand, while dryness is typically associated with desert lands, little precipitation, and very thin vegetation by laymen, it refers to a kind of permanent climatic feature of a region, showing the insufficient amount of precipitation required for the growth of life in the region (Kaviani and Alijani, 2010).

**Materials and methods:** To analyze the temporal and spatial variations of UNEP and De Martonne aridity indices in Iran throughout the study period (1976-2020), this study collected the data of forty synoptic stations in terms of the maximum and minimum temperatures (°C), average relative humidity (%), wind speed (m/s), and sunshine hours (h) using the information published by the Iranian meteorological organization. Then, different regions of Iran were classified in terms of UNEP and De Martonne aridity indices. Moreover, to investigate the influence of the factors involved in those indices such as precipitation, temperature, and reference evapotranspiration, the factors were zoned. Finally, the trend of changes in dryness indices was analyzed using the Mann-Kendall test.

**Results:** The results of the UNEP aridity index classification indicated that from among the forty stations investigated in this study, fourteen stations had a very dry climate. Moreover, ten stations were found to have been located in dry areas and eight in semi-arid regions. On the other hand, more than three-quarters of the stations with very dry, dry, and semi-arid climates were identified as the most susceptible areas to desertification. On the other hand, the results of the De Martonne aridity index analysis confirmed the results found for the analysis of the UNEP index. As for the spatial distribution of the aforementioned indices, it was found that very dry, dry, semi-dry, and Mediterranean classes were located in the southwestern, southern, southeastern, central, northwestern, western, and northeastern regions. The results also revealed that the northern regions, central Alborz highlands, and northern coasts had semi-humid, humid, and very humid climates.

On the other hand, the results of the investigation of precipitation, temperature, and reference evapotranspiration suggested that in arid regions, the plants' demand for water was increased and the soil moisture was decreased due to the decrease in precipitation and the increase in temperature and reference evapotranspiration. Moreover, the results of the Mann-Kendall test for the UNEP and De Martonne indices showed a significant decreasing trend in the confidence level by 99%, 95%, and 90% in more than half of the studied stations, indicating a main challenge in arid and semi-arid regions worldwide, especially in Iran.

This study highlighted the fact that most of Iran's regions were subject to dryness, being placed in severe and very severe desertification risk classes. Therefore, considering the significance of the subject and the necessity of its investigation in arid and semi-arid regions of the world, especially Iran, where water stress is high and water resources are critically limited, it is suggested that for more proper agricultural management, further studies be conducted on the distribution of aridity in the growing season in terms of UNEP and De Martonne aridity

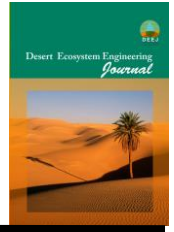
1. Associate Professor of Geography, Faculty of literature and humanities, Urmia University, Urmia, Iran; [kh.javan@urmia.ac.ir](mailto:kh.javan@urmia.ac.ir)

2. Ph.D Student in Climatology, Faculty of Earth Sciences, Shahid Beheshti University, Tehran, Iran



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indices.

**Discussion and Conclusion:** This study sought to investigate the temporal and spatial variations of UNEP and De Martonne aridity indices in Iran using the data collected from forty synoptic stations concerning maximum and minimum temperature rates ( $^{\circ}\text{C}$ ), average relative humidity (%), wind speed (m/s), and sunshine hours (h). The study also tried to classify the Iranian climate in terms of such aridity indices. To this end, the factors affecting the indices such as precipitation, temperature, and reference evapotranspiration were zoned, and the trend of changes in aridity indices was analyzed using the Mann-Kendall test. The results of the UNEP index showed that more than three-quarters of the stations have a very dry, arid, semi-arid, and Mediterranean climate and in terms of spatial distribution, they are spread in the southwest, south, southeast, center, northwest, west, and northeast regions of the country, which are prone to the occurrence of desertification in terms of climate. Moreover, the study found that less than a quarter of the stations with semi-humid, humid, and very humid climates were located in the northern regions, central Alborz highlands, and northern coasts. Also, the results of the De Martonne aridity index were reported as consistent with the UNEP index. On the other hand, the results of the investigation of precipitation, temperature, and reference evapotranspiration revealed that in dry areas, the decrease in precipitation and increase in temperature and reference evapotranspiration rates caused an increase in the plants' demand for water and a decrease in soil moisture. Moreover, the results of the Mann-Kendall test indicated a significant decrease in the confidence level by 99%, 95%, and 90% in more than half of the stations.

**Keywords:** Iran, UNEP Index, De Martonne Index, Trend, Mann-Kendall Test.