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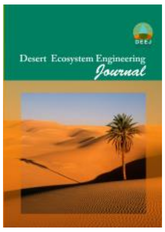

Comparison and Evaluation of Six Climatological Drought Indices and Zoning of the Most Appropriate Index Using Inverse Distance Weighting (A Case Study: Isfahan Province)

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Extended Abstract

Introduction: Drought, as a natural disaster, has a major impact on agriculture and ecosystem of the affected region. Droughts occur mainly in areas like Iran being located in the world dry belt, with below normal levels of rainfall. There is a need to study and predict the drought situation because, according to statistics, Iran is among the most water-stressed countries, with serious problems in occurring floods, supplying drinking water and generation of electricity, so assessing the drought situation in order to reduce damage, comprehensive drought plans are essential for the country and the studied province.

In this study drought situation in Isfahan province, has been evaluated using a relatively long (> 27 years) monthly precipitation data, with simultaneous considering of six drought indies including MCZI, CZI, ZIS, SPI, DI and PNPI.

Materials and methods: Study area and data: Isfahan province has geographical coordinates of 30 degrees 43 minutes to 34 degrees and 27 minutes north latitude and 49 degrees and 38 minutes to 55 degrees 32 minutes east length and area of 107145 square kilometers (equivalent to 3.6 percent of the total area of Iran). The annual rainfall in the study area is 130 mm which is less than half the country's average rainfall and one sixth of the global average. In this study, in order to study the drought indices of Isfahan province, 27 year precipitation data of 12 stations in the province and neighboring areas were used with appropriate statistical quality. Case Study Indicators: In this study, six drought indexes based on rainfall were selected to evaluate drought indices of Isfahan province. The basis of drought indicators is often based on the estimation of precipitation deviation from the long-term average over a given period. General features and formulas used to calculate each of the drought indicators are: $PNPI = \frac{Pi}{\overline{P}}$, $P_i = \frac{i}{N+1}100$, $Z = \frac{X_i - \bar{x}}{S}$, $SPI = \frac{P_i - \overline{P}}{S}$, $CZI_i = \frac{6}{C_s}\left(\frac{C_s}{g}\varphi_j + 1\right)^{1/3} - \frac{6}{C_s} + \frac{C_s}{6}$ and $C_s = \frac{\sum_{j-1}^{n}(x_j - \bar{x})^3}{n \times \sigma^3}$ each of the indicators has different classes of drought.

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Evaluating the Efficiency of Drought Indicators: The meteorological drought is based on the assumption that the minimum rainfall during the long term of the weather represents a very severe or severe meteorological drought that occurred in the studied area. In order to investigate this hypothesis, rainfall at each station was determined using drought indices and the indicators that were most consistent with the climate conditions were identified. Finally, using inverse distance method in ArcGIS tools, the most accurate index maps were developed.

Results: In the first stage of this research, in order to better evaluate the spatial variations of rainfall in the selected stations, in addition to the quantity and quality of data, latitude and longitude, and altitude from the sea level, the 27-year time base (from 1990-2017) as the common statistical basis for the study of time variation Precipitation was taken into consideration. Then, the accuracy and homogeneity of the data and the incomplete statistics of precipitation of the stations were reconstructed using correlation method and normal ratio method. In the second stage, using the moving average method, dry and wet periods were measured by long-term rainfall data with continuity periods and drought severity using different drought indices. Then, to determine the hypothesis, the minimum rainfall was determined at each station and then evaluated using drought indices. Using inverse interpolation method and using the GIS and based on available spatial distribution data, an interpolation map was prepared and using the superior climatic index (CZI, DI, SPI and PNPI) during the 27-year statistical period (1990- 2017), drought zoning maps were prepared monthly, quarterly, and five-monthly and annual.

Discussion and Conclusion: The results showed that the ability of the SPI, DI, PNPI, ZSI, CZI and MCZI indices is based on the relationships defined in the climatic drought conditions. Drought indicators at different stations have different results that can be seen even at nearby stations. The reason for this is the high rainfall variation in the study area. Among the indices, the DI ranked first, the second highest SPI, the third highest CZI, and the PNPI index, the ZSI index, and the MCZI index in the next ranking. Therefore, in order to zoning the drought, the first three indicators are used. Although the results of the hypothesis test showed that the SPI index and Decile precipitation (DI) index were consistent with the minimum rainfall year, but showed a severe and severe drought occurrence in all stations, and, in terms of other indicators, had more performance. Display Severe drought, but the range of monthly and annual Deciles of Index (DI) is slightly higher than other indicators in the charts. Especially in the graphs shown by the decimal index (DI), it seems a small increase in the rate of drought and tropical manifestations. It can be said that according to this study, precipitation index fluctuations (DI), although according to other indicators, are more marked in monthly and annual rainfall graphs. Based on the calculations, six climatic indicators at annual time scale showed that SPI, ZSI and CZI indices are consistent with drought persistence and drought severity. The results of selected criteria show that in the years 1994 to 1995, 2001 to 2005 and 2008 severe drought occurred in most parts of the province. From the station's point of view, the highest drought frequency in the studied area for DI, SPI, ZSI and CZI indicators from Natanz and Kebootar Abad stations and the longest drought resistance in different time scales in the study area; DI: Kabottarabad station from 2007 to 2009 and Naine station from 1993 to 1995 on a seasonal scale is the longest drought. According to the SPI index, the Neen station spent the longest drought from late 1999 to the beginning of 2007 on a 24-month scale from 2001 to early 2007 at Reza Station. In the preparation of annual drought maps using the indicators, it was found that annual time indices cannot accurately represent drought zoning and estimate the severity of drought at the lower end. So, for these indicators, drought plans should be prepared monthly to month. This result shows that droughts are heavily dependent on the time of occurrence and vary locally and locally according to short-term time. Therefore, providing annual drought map

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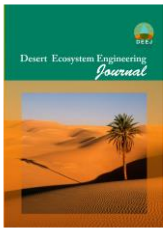

using monthly indicators cannot provide a realistic picture of spatial development and drought severity. In the droughts map, the most severe droughts during the studied period show severe droughts in the center and south-east of the area around the stations of Naein, Kabootar Abad, KhoroBiabanak, Ardestan and Shah Reza compared to other areas of the area. From the point of view of the longest continuity in the region, the central and south-east and north parts of the area are more susceptible to potential, and the western and southwest sections are less susceptible. This feature is especially important in the southeast and the center of the area surrounding the Naein, Kabootar Abad, Shah Reza and Ardestan stations

Keywords: Arc GIS, Drought zoning, IDW, Isfahan, Meteorological Index.