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Assessment of the drought analysis by the Standardized Precipitation Index (SPI) in Nadiad,Gujarat,India

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ABSTRACT - Drought assessment and monitoring is very essential in identifying climate and water supply trends and thus to detect the probability of occurrence and the anticipated severity of drought. Drought occurs when precipitation is lower than normal. When this phenomenon extends over longer period of time, precipitation is inadequate to demand of human activities. This paper includes developing a methodology to assess drought severity and monitoring of the study area. Drought originates from a deficiency of precipitation over a given period of time: short time scales (months) characterize meteorological drought, while longer time scales (years) hydrological drought. A useful index for drought monitoring based only on monthly precipitation data is the Standardized Precipitation Index (SPI). It has been proposed to monitor dryness and wetness on multiple time scales. The present situation examines the SPI drought index in application for the Nadiad and it is evaluated accordingly by historical precipitation data (1991-2006) for meteorological station. From the result, the worst drought years of 1992, 1996 and 2005 in the Nadiad indicate severe dryness and hence, the irrigation requirement can be evaluated on the rainfall deficits & its severity for the given years. SPI Index is a useful tool to assess the severity of drought for the study area.

1. Introduction

Drought is an extended period when a region receives below average precipitation. Drought has many effects on human activities, human lives and various elements of the environment. Conventionally, decrease of precipitation is considered as the origin of drought. This leads to a reduction of storage of water and fluxes involved in the hydrological cycle depending on the choice of the hydrological or agricultural. Drought is

an unexpected reduction in precipitation over period of time in an area which is not necessarily arid. Characterizing periods of deficit and drought has been an important aspect of planning and management of water resources systems for many decades. Drought is one of the most harmful natural disasters that affected the human population. Low precipitation levels can lead to severe hydrologic deficits. These deficits may impact on low crop yields for agriculture, un replenished ground water resources, depletion in lakes/reservoirs, and shortage of drinking water and, reduced fodder availability etc, which can negatively impact on local populations. Consequently, the ability to forecast and predict the characteristics of droughts, especially their frequency, monitoring and severity are important. Drought assessment and monitoring is necessary for water resource management as well as for the agricultural industry.

2. Methodology

This section describes how the SPI has been calculated for the Nadiad region. Set up an input file containing precipitation data from the selected study area, all input files must follow 3-column format: Year, Month, and Monthly Precipitation Value. In this study, the SPI_SL_6 program developed by the National Drought Mitigation Centre, University of Nebraska-Lincoln has been used to compute time series of drought indices (SPI) for the selected region and for each month of the year at different time scales.

Different SPI timescales to be computed 1-month,3-month, 6-month, 9-month, 12-month, 24-months and 36- months SPIs. Positive and negative SPI values indicate wet and dry conditions respectively. A drought event starts when SPI value reaches -1.0 and ends when SPI becomes positive again.

3. STUDY AREA

CITY: Nadiad

Geography: Nadiad is located at 22.7°N 72.87°E.[1] It has an average elevation of 35 metres (114 feet).

Climate: Nadiad usually has mild winters and very hot summers, with an average of from 32 °C (90 °F) to 46 °C (115 °F), and an average rainfall from 70 centimetres (28 in) to 120 centimetres (47 in). Monsoon floods can be catastrophic, dropping from 300

millimetres (12 in) to over 500 millimetres (20 in) of rain, causing widespread flooding such as the 2005 Gujarat floods or the 2008 Indian floods.

Figure: Nadiad City

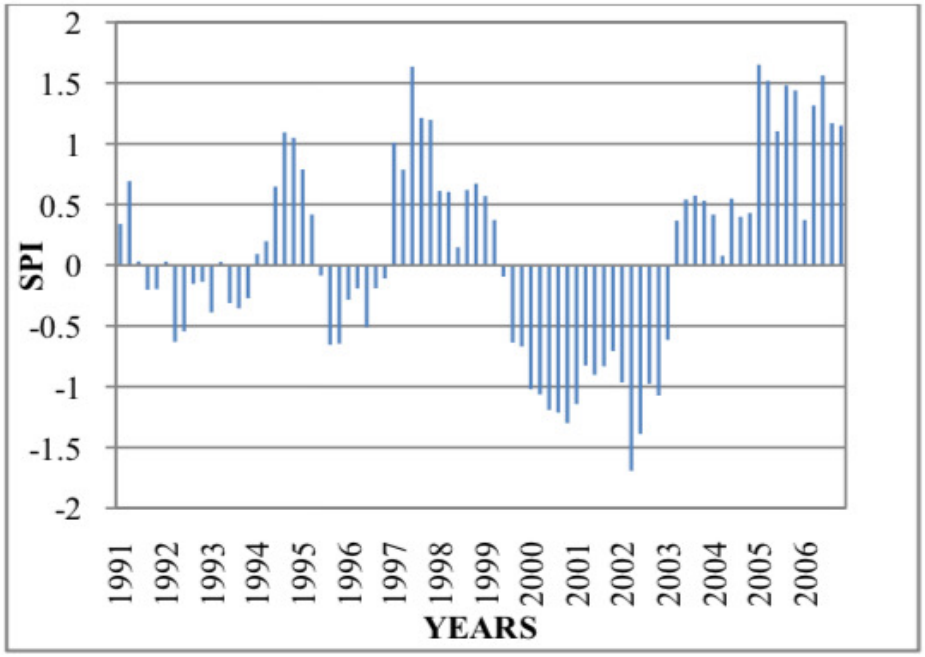
4. Data Collection

Year	Avg. Rainfall (mm)
1991	42.948
1992	45.675
1993	51.958

1994	31.583
1995	59.025
1996	28.011
1997	31.710
1998	33.184
1999	44.284
2000	49.914
2001	57.899
2002	61.011
2003	54.174
2004	41.298
2005	38.021
2006	37.954

Avg. Rainfall Data From 1991-2006 of Nadiad

5. Results



SPI_SL_6 Result

SPI values	*Class*
>2	extremely wet
1.5 to 1.99	very wet
1.0 to 1.49	moderately wet
-0.99 to 0.99	near normal
-1 to –1.49	moderately dry
-1.5 to-1.99	severely dry
< -2	extremely dry

SPI Values

6. Conclusion

· This study has tried to assess the drought severity of the Nadiad region for the year of 1991 to 2006. Although SPI permits comparisons over space and time better than any other index.

· At a given region, the drought intensity has been found to be more sensitive to the SPI in low rainfall station. The severity of drought may vary with the intensity of rainfall.

· To assess the drought situation, wide range of SPI index should be selected to represent dryness or wetness of the region.

· From the result, the worst drought years of 1996, 1999 and 2005 in the Nadiad region indicate severe dryness. And hence, the irrigation requirement can be evaluated on the rainfall deficits & its severity for the given years.

· From trend analysis of SPI it reveals that from 1991 to 1994 Nadiad region was under drought condition but from 1995-2006 the area has not experienced the drought condition

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