

Studying the Trend of Drought in Fars Province (Iran) using SPI Method

A. Gandomkar, R. Dehghani

Abstract—Drought is a natural and climate phenomenon and in fact serves as a part of climate in an area and also it has significant environmental, social, and economic consequences. Drought differs from the other natural disasters from this viewpoint that it is a creeping phenomenon meaning that it progresses little and it is difficult to determine the time of its onset and termination. Most of the drought definitions are based on precipitation shortage and consequently, the shortage of water in some of the activities related to the water, such as agriculture. In this research, drought conditions in Fars province were evaluated using the SPI method within a 37-year statistical period (1974-2010) and maps related to the drought were prepared for each of the statistical period years. According to the results obtained from this research, the years 1974, 1976, 1975, 1982 with SPI (-1.03, 0.39, -1.05, -1.49) respectively, were the driest years and 1996, 1997, 2000 with SPI (2.49, 1.49, 1.46, 1.04) respectively, were the most humid within the studying time series and the rest are in more normal conditions in terms of drought.

Keywords—Fars Province, Drought, SPI Method, Time Series

I. INTRODUCTION

DROUGHT is a phenomenon involving large areas all over the world each year obviously. The consequences of drought have influenced not only on the production of agricultural products but also simultaneously all the living creatures including various plants and animals.

Iran, a vast country has a variety of weather because of its special location has been estimated around 244-275 mm that is about one third of the global mean precipitation (800 mm) and less than one third of the global mean precipitation (1133mm) [1]. One of the major and important issues in the country is the optimal utilization of the water and arid it's wasting. Maximum utilization needs to be implemented regarding the priorities through a basic planning. To achieve these goals, it's necessary to identify drought periods and determine the regions influenced by the drought [2]. Drought is a natural feature of a climate occurs in all the climate zones but its features differ from one region to the other. Drought occurrence is the worst environmental event bearing unique climate and hydrologic features in an area [3]. Precipitation is as the most unstable climate variable in the arid and semi-arid zones its changes reflected directly on the soil humidity, surface and underground flows. For this reason, precipitation is the first factor that may be taken into account when studying the drought especially meteorology drought [4]. In this research, the quality of the drought trend is studied in Fars province using one of the methods related to the drought in order to cope with it by applying the necessary measures.

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Among the indices used in the drought topic, standard precipitation index (SPI) has been taken into account introduced by Mack and his colleagues in 1995 obtained based on the precipitation difference from the average for their given internal periods and then its division by the standard deviation.

The only effective factor in calculation of this index is precipitation element which may be accounted for different time scales. To conduct management activities it's easier to use a long-term time scale [5]. Lashani zand and colleagues [6] extracted the intensity of mean drought from their studies titled as studying the continuation, intensity and, frequency of climate droughts in six zones located in the west and North West of the country for all the stations in each basin by applying the time series of the standard index and concluded that the onset of the drought with one to three months duration is a common and recurrent phenomenon even in stations located in semi-humid areas. The aim of this research is to study and measure the arid periods using SPI rates. For this purpose, the zone method was used.

II. METHODOLOGY

Fars province with an area about 133000 square kilometers involves around 8.1 percent of the country's total area and locates on latitude between 27:30 and 31:40 Northern and longitude between 50:36 and 55:35 Eastern. This province is limited to Isfahan from the North, Hormozgan from the South, Kerman and Yazd from the East and Booshehr and Yasooj from the West. Average precipitation in this province is 312 mm. One of the features of this province is its high various climates. In this research, 26 stations inside the province (Abadeh, Takhtejamshid, Shiraz, Fasa, Neyriz, Darab, Lar and Lamerd) and outside the province (Yazd, Bafgh, Rafsanjan, Shahr Babak, Sirjan, Bandarab, Sirjan, Bushehr, Kangan, Bandarab, Bandar Deylam, Dogonbadan, Yasooj and Broojen) were selected with a 37 years common statistical period (1974-2010).

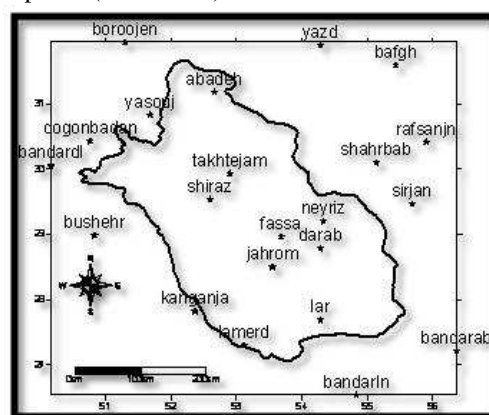


Fig. 1 Location of synoptic stations in relation to Fars province

The time base at Synoptic station was considered 37 years (1974-2010). The condition of droughts and wet years were determined at Synoptic station using SPI. This index is calculated by relation (1):

$$SPI = \frac{P_i - \bar{P}}{Sd} \quad (1)$$

Where SPI is the desired variable rate (precipitation), \bar{P} the desired average parameter and Sd the standard deviation of the rates (precipitation). Droughts and wet years are identified by using standard table I

TABLE I
 CLASSIFYING SPI AND DEFINING CLASSES CORRESPONDING TO IT

Rate	Class
2 and more	Very humid
1.5 to 1.9	Extreme humid
1 to 1.49	Average humid
+0.99 to -0.99	Normal precipitation
-1 to -1.49	Mild arid
-1.5 to -1.99	Sever arid
-2 and less	Very arid

In this research based on the above classification, SPI (-0.5) has been determined as the threshold of the drought onset to study and investigate all of the monthly drought events more accurate during the desired statistical period.

III. DISCUSSION

Based on SPI, the years 1974, 1976, 1975, 1982, with the SPI rates (-1.03, 0.93, -1.05 and -1.49) respectively, are the most arid years and the years (1996, 1997, 2000 and 1994) with the SPI rates (2.49, 1.49, 1.46, 1.04) respectively, the study and the rest are in normal conditions of wet year and drought. Studying the widespread maps show that all of the areas in this province have experienced drought but some parts of the province like Lar, Lamerd, Shiraz and Fasa have been more susceptible to drought. Therefore, it's necessary to pay a special attention to these areas when planning and managing the water of the province.

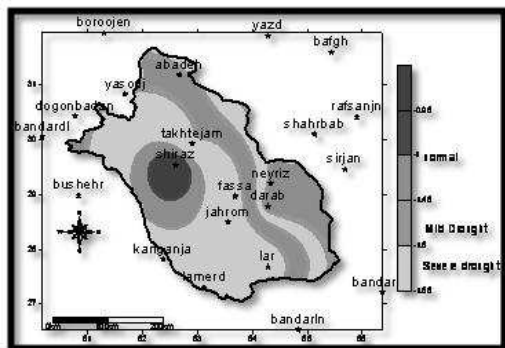


Fig. 2 SPI Map for Year 1974

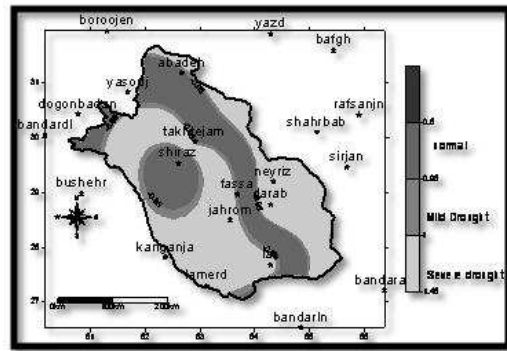


Fig. 3 SPI Map for Year 1975

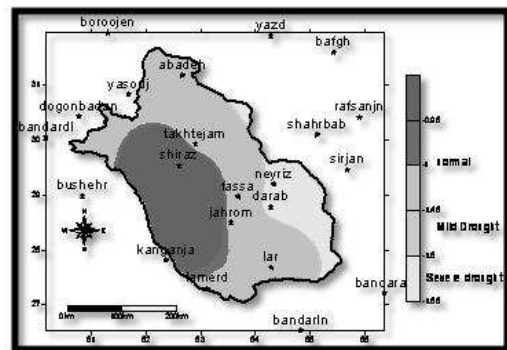


Fig. 4 SPI Map for Year 1976

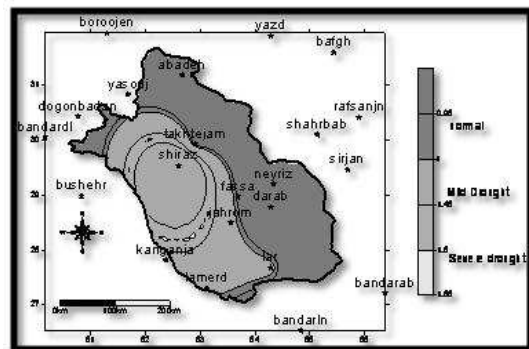


Fig. 5 SPI Map for Year 1982

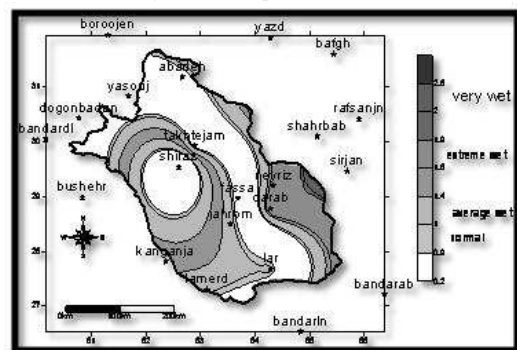


Fig. 6 SPI Map for Year 1994

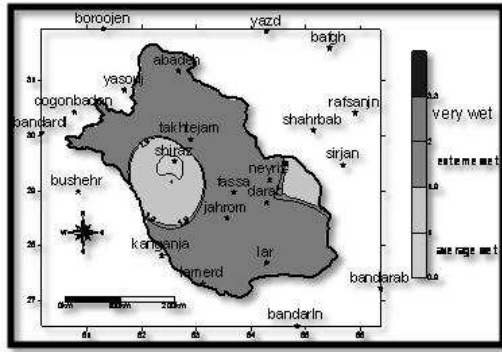


Fig. 7 SPI Map for Year 1996

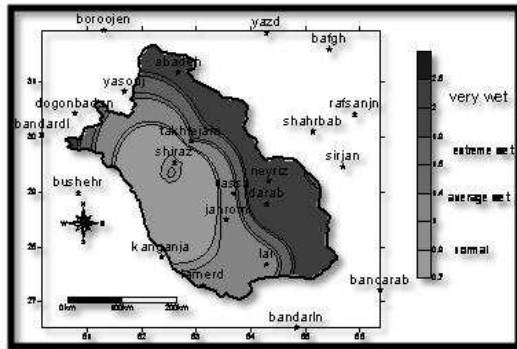


Fig. 8 SPI Map for Year 1997

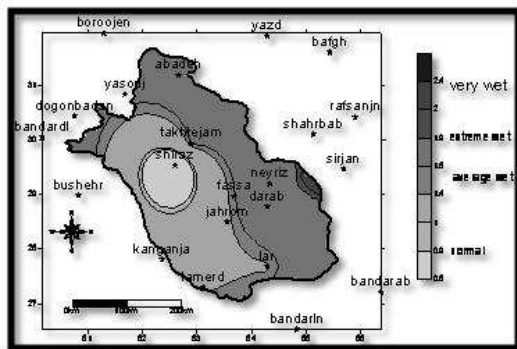


Fig. 9 SPI Map for Year 2000

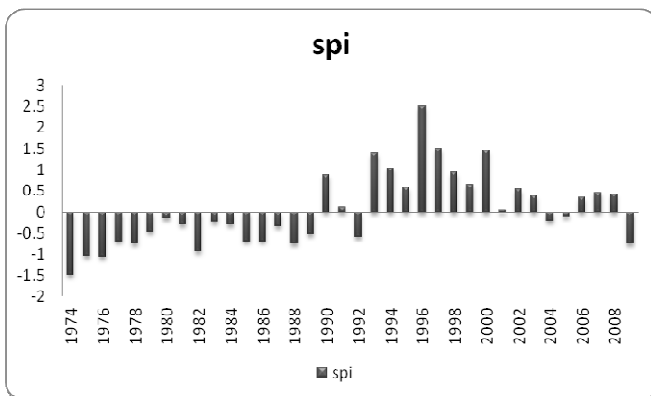


Fig. 10 37-Years SPI Chart for Fars Province

IV. CONCLUSION

Drought is a phenomenon involving large areas all over the world each year obviously. The consequences of drought have influenced not only on the production of agricultural products but also simultaneously all the living creatures including various planets and animals. Drought is a natural feature of a climate occurs in all the climate zones but its features differ from one region to the other. Drought occurrence is the worst environmental event bearing unique climate and hydrologic features in an area.

In this research the drought condition of Fars province was statistical period and drought widespread maps were prepared during a 37 years statistical period and drought widespread maps were prepared for each of the statistical period years.

Based on SPI, the years 1974, 1976, 1975, 1982, with the SPI rates (-1.03, 0.93, -1.05 and -1.49) respectively, are the most arid years and the years (1996, 1997, 2000 and 1994) with the SPI rates (2.49, 1.49, 1.46, 1.04) respectively, the study and the rest are in normal conditions of wet year and drought. Studying the widespread maps show that all of the areas in this province have experienced drought but some parts of the province like Lar, Lamerd, Shiraz and Fasa have been more susceptible to drought. Therefore, it's necessary to pay a special attention to these areas when planning and managing the water of the province.

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