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Original Article

Study of drought in northern Karun watershed

Mohammad Dashti Marvili[1*], Danial Dabiri[2]

[1]M.Sc. Graduated, Borujerd Branch, Islamic Azad University, Borujerd, Iran
[2]M.Sc. Student, Department of Natural Resource, University of Sari, Iran

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ABSTRACT

Drought is a natural hazard that has significant impact on economic, agricultural, environmental, and social aspects. In the present study details analysis of rainfall data has been carried out for the years 1981-2011. Standard precipitation index (SPI) has been used to evaluate the precipitation deficit in the Karun watershed of Iran. The results indicated that 1981-82,82-83,83-84, 84-85, 88-89, 89-90, 90-91, 93-94, 96-97, 98-99, 99-2000, 2000-2001, 2002-2003, 2007-2008, 2008-2009, 2009-2010 and 2010-2011 the SPI values is negative. It is very anguish. And also this found threat drought the water resource and agriculture.

Introduction

The less predictable characteristics of droughts with respect to their initiation and termination, frequency and severity make drought both a hazard and a disaster: a hazard because it is a natural accident of unpredictable occurrence but of recognizable recurrence; a disaster because it corresponds to the failure of the precipitation regime, causing the disruption of the water supply to the natural and agricultural ecosystems as well as to other human activities (Pereira et al., 2002). A better understanding of droughts is essential to develop tools for prediction or forecasting of drought initiation and ending, so that these occurrences may be clearly recog nized (Sharma, 1997; Chiewetal, 1998) ..Droughts are of great importance in water resources planning and management, and for a review o f drought concepts the reader is referred to(Mishra and Singh, 2010). The overall impact of a drought depends on several factors, severity, frequency, area, and duration which are essential for spatial-temporal analysis or in other words regional drought analysis (Mishra and Singh, 2009). In a regional drought analysis, spatio temporal patterns are investigated at different scales based on different threshold sand the region is classified based on different severity levels. Information on regional drought characteristics is critical and should be in corporate in strategic short as well as long-term water resource management. Therefore, one of the areas needing further research is the regional or spatial behavior of droughts (Rossietal, 1992; PanuandSharma, 2002). Standardized Precipitation Index (SPI) has been used to monitor meteorological drought. SPI offers a quick, handy, simple approach with minimal data requirements (Komuscu, 1999). The SPI is able to take in to account the different time scales at which the drought phenomenon occurs and, because of its standardization, is particularly suited to compare drought conditions among different time periods and regions with different climatic conditions (Bonaccorso *et al*, 2003). Guttmann (1998) demonstrated that SPI compares favorably to the more

***Corresponding Author:** Mohammad Dashti Marvili**,** M.Sc. Graduated, Borujerd Branch, Islamic Azad University, Borujerd, Iran

prominent Palmer Index (Palmer, 1965; Palmer, 1968). Mishra and Desai (2005), argue that drought forecasting plays an important role in the planning and management of water resources. They in own research used the stochastic model (ARIMA And SARIMA) to drought predict (with using SPI index) results indicated that the predicted values of this model, are in good agreement with real data. They also argue that using these models to forecast droughts with duration of more than two months is more accurate. Zamani Poor (1380), in their study with traditional methods of contrast with drought and famine in Qaenat region tell that the drought affected on various aspects of life stated people in the area and people have to adapt and with a good use of facilities and produce local face and contrast with it well. In his research was mentioned to the approaches and methods used such a multiuse dam, planting specific trees and the resistance specious to dehydration. Shir Mohammadi *et al* (1381) Have used SPI index in survey the spatial and temporal patterns of drought in the Khorasan province and believed that this criteria is suitable for monitoring of dry periods. Overall, these studies show that the SPI index has potential good for drought monitoring. In this study after correct and complete data from 19 basic rainfall station in Karun we study drought with SPI index.

Materials and Methods

Site of study, Data used, SPI and drought classes

Northern Karun Watershed is sub basin of Karun river basin (With geographical 31˚ 18' to 32˚ 40' North and 49˚ 34' to51˚ 47' East) located in Iran. Input data to this study consists of SPI Annually values for the period September 1981 to September 2011, for 19 rainfall sites. These stations were included statistical period at least for 30 years. After completion, amendment and assimilation, they transformed to a common time scale. Then the SPI was used identify dry and wet periods of rainfall. SPI could be used to compute monthly rainfall or analysis total rainfall in each delight intervals (3 to 6-month). SPI index is resulting by a statistical gamma distribution on the precipitation and calculate probability gamma distribution cumulative. The gamma distribution function as a probability density function or frequency is defined as follows:

$$g(x)=\frac{1}{\beta^{\alpha}T(\alpha)}x^{\alpha-1}e^{-x/\beta}$$

Using maximum likelihood methods optimized values of α and β can be estimated According to the following equations:

$$\hat{\alpha}=\frac{1}{4A}\left[1+\sqrt{1+4A/3}\right]\quad A=\ln\left(\bar{x}\right)-\frac{\sum\ln(x)}{n}$$

$$\hat{\beta}=\frac{\bar{x}}{\hat{\alpha}}$$

Using the following relationships SPI value for the cumulative probabilities is obtained.

$$G(x)=\frac{1}{T\left(\hat{\alpha}\right)}\int_0^x t^{\hat{\alpha}-1}e^{-t}dt\qquad t=x/\hat{\beta}$$

$$H(X)=q+(1+q)G(x)$$

$$Z=SPI=-\left[t-\frac{c_o+c_1t+c_2t^2}{1+d_1t+d_2t^2+d_3t^3}\right]$$

$$0\prec H(x)\le 0.5$$

$$Z=SPI=+\left[t-\frac{c_o+c_1t+c_2t^2}{1+d_1t+d_2t^2+d_3t^3}\right]$$

$$0.5\prec H(x)\le 1$$

$$t=\sqrt{\ln\left[\frac{1}{(H(x))^2}\right]}\quad 0\prec H(x)\le 0.5$$

$$t=\sqrt{\ln\left[\frac{1}{(1-H(x))^2}\right]}\quad 0.5\prec H(x)\le 1$$

(Richard and Heim 2002)

And Coordinate coefficients are:

$c_0=2.515517$ $\quad d_1=1.432788$

$c_1=0.8028530$ $\quad d_2=0.189269$

$c_2=0.010328$ $\quad d_3=0.001308$

Table 1. SPI index values and the drought intensity

Climate situation	SPI value
Intensely moist	≥ 2
Very moist	1.5≤ x ≤ 1.99
Moderately moist	1 ≤ x ≤ 1.49
Low moisture	0 ≤ x ≤0.99
Borderline drought	-0.99≤ x ≤ 0
Moderate drought	-1.49≤ x ≤ -1
Severe drought	-1.99≤ x ≤ -1.5
Intense drought	x ≤ -2

Result and Discussion

As pointed out earlier, we have used SPI to get a picture of the alternation of moist and dry periods in the region under study. Figures 2 shows that the variation of the index over a 30 year from 1981 to 2011. A study of this figure and table 1 tells us that the periods 2007-2008 and 2008-2009 were intense dry for Karun. We can also see that the drought persisted through subsequent years, albeit with less severity. The results indicated that 1981-

82, 82-83, 83-84, 84-85, 88-89, 89-90, 90-91, 93-94, 96-97, 98-99, 99-2000, 2000-2001, 2002-2003, 2007-2008, 2008-2009, 2009-2010 and 2010-2011 the SPI values is negative. It is very anguish. And also this found threat drought the water resource and agriculture. In overall cane be mentioned that drought periods are repeat with annual four frequency.

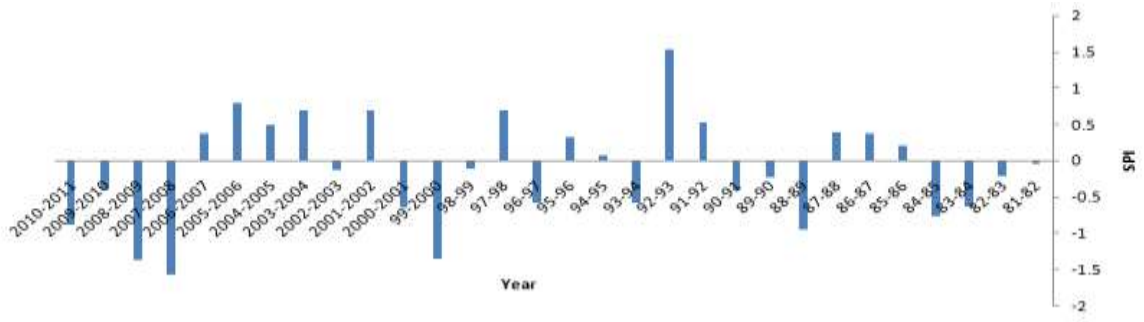

Figure 2. pattern of changes of SPI value for Karon basin during the studied 30 year

Conclusion

Assessment and Past experiences, at the water resources management During Drought, show that most Countries as Iran in drought time are adopted guidelines reaction from available conditions that have been defects and not effectiveness sufficient and coordination with available Water Resources at it time. Although it is one way solution Possible to damage reduction deals with Drought at Long-term , But its Prerequisite is basic changes at a water management resources viewpoints . To the prospects water resources, dynamics and logical view to drought equivalent with strategic program Planning water resources Management to preparation confronting with drought and Its losses reduction . More of the planning program are doing Performance way of actions that before from drought occurrence , at drought time and then from it with target reduction of effects and water shortage from drought. This proceedings included short and long term proceedings with attention to offer and demand water at during of drought and included full of the section that linked with water use . This point of view and proceedings are important at water resources management in talented drought countries. Of course this planning process is not Simple, Should ones is performance that proportional with legal frame and available water shortage conditions from between number of high possible and practical proceedings to drought confronting. Also existence one of the water resources monitoring system without defect relationship with accomplished proceedings is necessary. at this process that its main target is proportional of water demand with amount of available water resources at different steps of drought, Surely " how performance proceedings not accidental and form on basis modeling and improvement of water consumption. also clearly such this planning specified the role and influence rate of each decision making at achieve to general target . Awareness to need move to active and dynamics point of view and program in water resources management during of Drought increases but unfortunately, capacity of this Program implementations is low and yet at many of countries are need the scientific and proficiency help to the Start and advance this program and water management resources during drought in order to damage reduction at opposite the next Droughts

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