

Drought Monitoring and Zoning in western Azerbaijan province using standardized Index SPI

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Abstract— Drought is a normal and continuous manner of limited and there is the probability of its occurrence in all regions with totally different climates .

In this research , for Zoning the drought intensity in western Azerbaijan province in 20 years interval in order to analysis and separate droughts , the standard precipitation index in different chronological intervals has been studied . the obtained results show that drought has been raised from west to the east and in chronological intervals of 3 and 6 months , two western regions and in intervals of 12 , 24 , and 48 months , some parts of eastern regions of province have been suffered from severe drought .

Keywords—precipitation , drought , standardized precipitation index (SPI) , Western Azerbaijan.

1. INTRODUCTION

Drought is the situation of lack of precipitation and raising temperature that is probable to occur in every climatic situation and is often described as a reptile phenomenon and it is too difficult to describe drought from the chronological and location aspects. Quantitatively speaking there are many ways for defining drought . Including method of testing continuations , method of analyzing drought by Marckof's chain , or drought indices such as standardized precipitation index (SPI) , method of decimals and Plamer [4]. From the connoisseurs points of view there have been proposed different definitions for the word drought one of the most comprehensive and complete definitions has been suggested by Plamer in 1996. In his view drought is defined as lack of continuous and unnatural moisture. The word continuous is

attributed to continuing the shortage manner and the word unnatural is assigned to the deviation of supposed index from the natural conditions with average [5] . Wilhaite and Golnetz s investigations are representative of researchers attempt in better knowing of drought as a management tools from the far back in the history. [15]

But as drought is influenced by many climatic factors , a clear and comprehensive definition of it is not possible [9]. Henz and his co - worker s description (2004) of drought , is unnatural dryness and continuous lack of precipitation in relation to its long term average that has different effects due to its intensity and duration [13]. Mackkey and et al , (1993) , in order to define and monitor droughts , they introduced standardized precipitation index and used it for the first time at Colorado state. IN this research they used short term chronological scales of 3 and 6 months for agriculture purposes and long term chronological scales of 12,24 , 48 months for hydrology purposes and extracted the chronological continuations for drought intensity and drenched intensity and drew the drought graphs in the region [14] standardized precipitation index is one of the few flexible indices in which , predicting the onset and ending time and drought intensity is possible at long and short term chronological scale. Dowse and et al , (2007) , reformed the standardized precipitation index for zero raining amounts in climatic drought investigations at west of Africa. [11] Kansiler and et.al , (2007) predicted monthly droughts by using probability transference functions , standardized precipitation index , and the assumption of monthly precipitation data to be normal [10]. Haize and et al , (1998) in investigating drought in 1996 at united state Colorado by

standardized precipitation index proved that SPI index is appealing of identifying the onset time of drought and its progress. Their results showed that SPI indicated the onset time of drought in 1996 at one month scale better than Palmer's drought index. [12] In Iran researchers have utilized the above index only or in comparison with other indices.

The studies were often in cases and limited to some parts of Iran, and in large scales monitoring and zoning have been done less. In this regard we can refer to the studies done by Banjad and et al, (1385) they used SPI index in investigating droughts trend in Hamedan province and they Zoned the results by using Arc View software [3] Alizade and his coworkers predicted the drought of sustain and Balouchestan province by using spi index from the monitoring aspect.[1] also they analyzed the intensity, duration, frequency and drought spread of Karun realm by using scandalized precipitation index (SPI) (6). Investigating the function of climatic drought indices in evaluating drought and its zoning in Ghazvin province [7] Analyzing frequency and zoning of Iran's droughts by application distinct index of standardized precipitation index [8] Predicting drought by using phase – nervous model, climatic indices, raining, and drought index (Case study :Zahedan) [2].

II .Materials and procedures

Western Azerbaijan is located at northwest part of Iran. (Figure 1) Western Azerbaijan from the geographical point of view is located between 35 degrees and 58 minute up to 39 degrees and 47 minutes of northern Zone and 44 degrees and 2 minute up to 47 degrees and 23 minutes of Middle Eastern length. Its area is about 37.423 square kilometers.



Figure 1: the situation of stations in western Azerbaijan province from

the general climatic divisions aspect, the climatic characteristics of this region are included in a half – dry climatic district. the medium amount of annual precipitation all over the province is 375 millimeters and the annual average of temperature of this region is 11.2 centigrade.

The typical characteristic of precipitation in this region is its instability from a year to another year. No month has the monthly precipitation coefficient variance less than 39 percent. The most seasonal focusing of annual precipitation is measured to be in spring. summers portion of annual precipitation in general is very low, (about 3/5 percent) and validity and constancy of summer precipitations is very low. In this research it has been used from 7 synoptic stations with statistical data of 20 years (1986-2005) and their names and situations have been indicated in table (1).

Table: 1 Characteristics of synoptic station at western Azerbaijan.

height	Longitude	Latitude	Foundation Year	Type of station	Stations Name
1313	45.5	37.32	1986-2005	synoptic	Uromiyeh
1455	45.8	36.4	1986-2005	synoptic	Piranshahr
1765	47.7	36.23	1986-2005	synoptic	Takab

1670	45.3	36.9	1986-2005	synoptic	Sardasht
1103	44.58	38.33	1986-2005	synoptic	Khuy
1411.3	44.26	39.2	1986-2005	synoptic	Maku
1314	46.09	36.58	1986-2005	synoptic	Miandoab

According to the monthly precipitation of each of the stations, the amount of SPI has been extracted by using Excel software and SPI and then drought situation of each period has been identified by table (2). Finally, by using Arc GIS software, Zoning map and drought intensity of each region has been given.

Table (2): Categorization of standardized precipitation (SPI)

Amount of SPI	Category
+2 and more	Too severe drenched year
1/5 up to 1/99	Much drenched year
1 up to 1/29	Medium drenched year
0/5 up to 0.99	Low drenched year
-0.49 up to 0.49	Normal
-0.99 up to -0.5	Low drought
-1/49 up to -1	Medium drought
-1/99 up to -1/5	Severe drought
-2 and Lower	Too severe drought

There have been used many different ways for investigating drought. One of these methods is standardized precipitating index. According to this method, drought or lower, and it ends when SPI amount becomes positive and accumulative amounts of index indicate greatness and intensity of drought period. Basically, the amount of standardized precipitation index will be calculated for chronological scales of 3,6,12,24, and 48 months. First at starting point, we gather the required statistical data and organize them in Excel software based on the required format and enter data with required format to SPI software by regulating output Excel and define data for different intervals, and enter the output of software that is in the form of TXT file to the Excel and we can regulate in for different chronological periods of graph, then considering the obtained percent amounts of drought, the data base will be formed and by entering data in Arch GIS software the Zoning maps will be drawn.

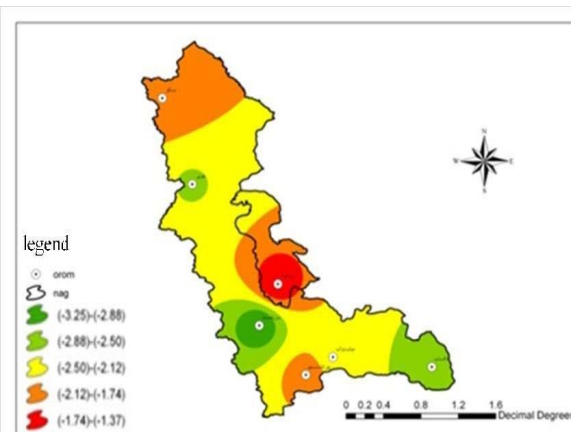
III-Discussion and Findings

By calculating drought amounts for intervals 3,6,12,24,48 months at 7 sin optic stations, output is planned in table 3 and then the zoning maps are drawn based on the table.

Table (3): SPI index of the driest years and the chose stations of province at the statistical period (1988-2005)

Miandoab	Maku	Khuy	Sardasht	Takab	Piranshahr	Uromiyeh	Year and
-1.79	-1.7	-2.54	-3.26	0.47	0.06	-1.37	3 months
-0.49	-2.32	-1.76	-2.29	-0.15	-1.67	-1.02	6 months
-1.55	-1.5	-1.25	-1.21	-2.32	-1.86	-1.72	12 months
-1.69	-1.18	-1.44	-1.44	-1.94	-0.92	-1.87	24 months
-1.57	-1.51	-1.65	-1.04	-2.03	-1.47	-1.22	48 months

On this base, the zoning map of drought at province in 3 months period for the year 1987 shows that the most severe drought is at the western south of Sardasht province with intensity (-2/88 up to -3/25) that involves a small part of the province and the severe drought has been formed at the western north of khuy and the eastern south part of Takab and huge part of the province has medium drought and Uromiyeh station (Uromiyeh lake station) has a normal moisture and Miyandoab and Piranshahr have medium and low drought respectively. Figure (2)



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figure 2:6month drought zoning at western Azarbajejan province

the zoning map of drought at province by using G months SPI for the year 1989 shows that the most severe drought is at north of Maku province and the western south of province , meaning Sardasht with intensity (-2/31 and -2/11) and at khuy and Takab and area limit there has been formed to severe drought of Sarasht province. The medium drought is seen scatter at some limit of east and western south and western north parts. Miyandoab and Piranshahr show weak drought and Uromiyeh station shows the normal manner. Figure (3).

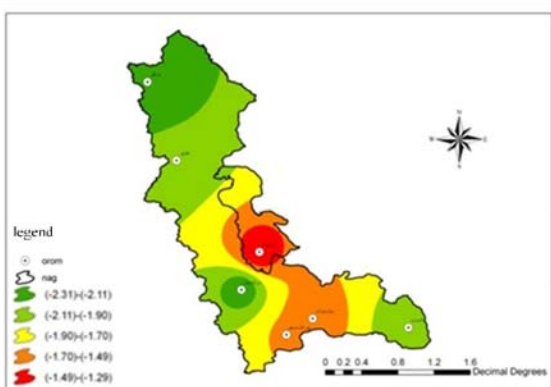


figure 3-6month drought zoning at western Azarbajejan province

The drought zoning map of province by using 12 months SPI for the year 1999 shows that the most severe drought has happened at the western south part of the province at Takab with intensity (-2/07 and -2/22). Severe drought has happened at very small zone of west part of Takab and medium drought has happened at Piranshahr and limit of east part at Miyandoab. The most area of the province is involved in weak drought that consists of Uromiyeh nd Maku and after weak drought it is the normal moisture manner that is involved a large area of the region Figure (4).

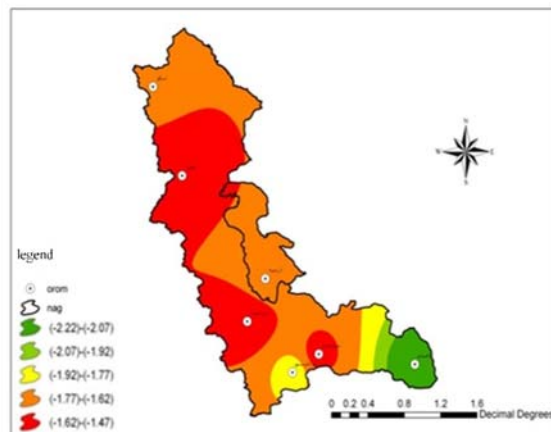


figure 4-12month drought zoning at western Azarbajejan province

The drought zoning map of proviacle by using 24 months SPI for the year 2000 shows that the most severe drought has happened at Uromiyeh lake station in west and Takab in westernsouth part of the province with intensity (-1/78 up to -1/93). Severe drought has formed at Uromiyeh and Miyandab and east part of Takab . Medium drought has involved the most area of the province that starts from khuy and has proceeded in some areas at south and eastern sough. Figure (5).

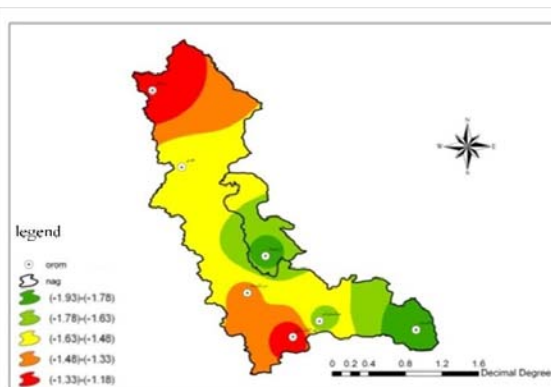


figure 5-24month drought zoning at western Azarbajejan province

The drought zoning map of province by using 48 months SPI for the year 2002 shows that the most severe drought has happened ant Takab station with intensity (-1/92 up to -2/02) severe drought involves in very small region at west of Takab , so does the medium drought , weak drought in involved in khuy region and a small part at east of Miyandoab. The most area of the province is involved in the normal

moisture manner that is consisted of Miyandoab , Sardaht at Uromiyeh , Piranshahr and Maku . Figure 6.

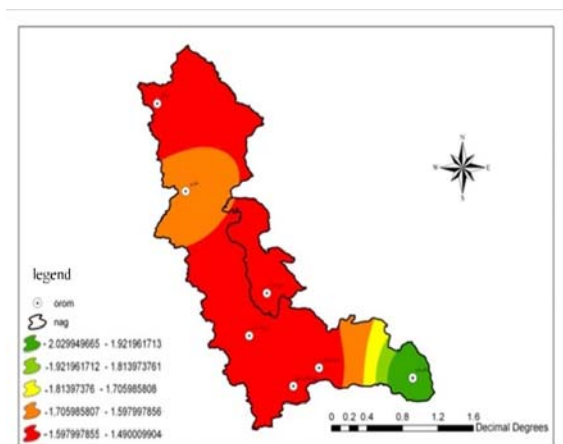


figure 6-48month drought zoning at western Azarbaijan province

IV. Conclusion

The obtained results of zoning the intensity of drought at this province show that drought has been raised from west to the east and the most droughts have happened in 1989 and 2000.

At chronological intervals of 3 and 6 months (short term) , two regions of west and at 12,24, and 48 months (long term) , some East parts of the province have suffered from the most severe drought.

The effects of drought on the district of Uromiyeh lake have been effective and also has effect on its ecosystem considering undesirable effects of drought on natural ecosystems and human activities , it is necessary that watering activities and consumption and optimized control of water supplies at this region must be considered with more sensitivity.

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