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Identifying Dry Years by Using the Dependable Rainfall Index and Its Effects on the Olive Crop in Roudbar,Gilan,South Western of Caspian Sea

Bahman Ramezani Gourabi

Abstract**—**Drought is one of the most important natural disasters which is probable to occur in all regions with completely different climates and in addition to causing death. It results in many economic losses and social consequences. For this reason. Studying the effects and losses caused by drought which include limitation or shortage of agricultural and drinking water resources. Decreased rainfall and increased evapotranspiration.

Limited plant growth and decreased agricultural products. Especially those of dry-farming. Lower levels of surface and ground waters and increased immigrations. Etc. in the country is statistical period (1988-2007) for six stations in Roudbar town were used for statistical analysis and calculating humid and dry years. The dependable rainfall index (DRI) was the main method used in this research. Results showed that during the said statistical period and also during the years 1996-1998 and 2007. more than half of the stations had faced drought. With consideration of the conducted studies. Drawing diagrams and comparing the available data with those of dry and humid years it was found that drought affected agricultural products (e.g.olive) in a way that during the year 1996 1996 drought. Olive groves of Roudbar suffered the greatest damages. Whereupon about 70% of the crops were lost.

Keywords**—**Dependable Rainfall. Drought. Annual Rainfall. Roudbar. Olive. Gilan.

I. Introduction

IN the twentieth century. Drought was mostly studied as a climatic negative risk[1] and is one of the natural hazards which is observable in different climates, of course, with its gradual destructive effects [2]. Prediction of drought can enable us in preventing problems. Drought indices, usually expressed in numbers. Are used for making better decisions by planners and designers. Moreover, it is considered as one of the normal climatic features whose occurrence is unavoidable. However, there are many disagreements between researchers and policy-makers regarding its characteristics. Studies have shown that the lack of an accurate and precise definition hinders reaching agreement on the nature of drought, which in its turn, would lead to doubts and not showing a suitable reaction on the managers and policy-makers' part. Generally. With its various periodicities happening throughout the world. Drought affects countries with different economy levels including both developed and developing countries.

Bahman Ramezani Gourabi is with,Department of Geography, Islamic Azad University,Rasht –Iran.
e-mail: bahman@iaurasht.ac.ir,bahmanr2000@yahoo.com

Investigating the raining fluctuation is one of the most important climatic issues in Iran because the temporal and spatial distribution of rainfall in this country is unbalanced and its harmful effects can be observed in all economic[3]. Social, political and security aspects. Of all the rainfall-related problems. With regards to both in tensity. Frequency and occurrence and the spatial extent and the damages made by drought, it can be said that it is of great significance. Or it could be defined as the continuous and abnormal shortage of rainfall in a particular time period (usually, 1 year). In this definition. The word "continuous" implies the persistence of the state of shortage. While the word "Abnormal" refers to the deviation of the index from normal or mean conditions. Palmer [4] names frequency, intensity, extent (comprehensiveness) and continuity as the four spatial-temporal characteristics of droughts[5].

Drought, as a creeping and destructive phenomenon, has always coused numerous do mages in Iran through its history. One of the most significant existing documents about drought in Iran is an inscription from Darius that can be found in persepolis in which drought is mentioned as the second difficulty of the country [6].

As a whole, drought is a climatic event which could be seen as agricultural, hydrologic. Meteorological, economic, social and historical [7,8] forms whose features depend on the duration and intensity of the extent of the affected area. Generally, drought is a phenomenon which occurs in every area or country, with either arid or humid climate and in our country, it is not a new or unknown phenomenon, In fact, Iran’s natural conditions and its geographical location are so that we have always witnessed droughts and it can be said that some of the regions are often faced with the phenomenon. Therefore, identifying dry (drought) and humid years (wet year). Their prediction and a proper and comprehensive planning would results in reducing the effects and losses caused by drought on man and his surrounding environment [9].Drought is defined as the shortage of rainfall in a long-term period in a way that it could lead to soil moisture deficit and a decrease in the flowing waters level which would ultimately cause disorders in human activities, natural vegetation and wildlife [10].This phenomenon occurs in all climatic zones. Hence, it is considered different from the word “Aridity” since “Aridity is the permanent characteristic of some climates. But drought is a temporary feature of all climates.” [11].In a study with the topic “Determining Drought threshold and Calculating the Dependable Rainfall Index in Oroumieh Lakes Catchment

stations". By using different drought evaluation methods showed the advantage of the DRI because it can help a proper and logical understanding of the rainfall threshold, especially in agricultural planning and water resources management.

In his research with the topic "A study of the Drought phenomenon By Using the Normal Precipitation percentage in Cental Parts of Gilan." Ramezani [12] studied the occurrence of drought in those parts and obtained result sindicated that with consideration of the normal precipitation percentage, coastal regions and plains are in drought conditions, while piedmont and mountainous regions are in wet-year conditions.

In another research with the topic "Identifying the Drought By using Precipitation Data in Anzali Lagoon Basin [13] specified the existing conditions of the lagoon in term of the drought conditions. Research results suggest that Anzali lagoon in the coostal regions and plains is considered to be in drought conditions, while in the piedmont region it is in normal conditions and in the mountainous region, it is in wet-year conditions and that this trend would be almost continued for the next lo years [14].The objective of this paper was to analyze drought through the rainfall element by using the dependable rainfall index at Roudbar stations so that it could be of some help to the planners of the preparation of this vast country towards achieving its regional applied climatic goals [15].

II. Data and Methodology

For this research, the mean annual rainfall data of six stations, geographically located in the south of Gilan province, including Manjil, Lowshan, Paroudbar, Gilvan, Shah-eShahidan and Shahr-e-Bijar collected during a twenty-years period since 1988 to 2007 by Gilan Regional Water Organization along with crop production rate data collected by Gilan Organization of Agriculture were selected for this study. Specifications of the said stations and their spatial domains are shown in Table 1.

In order to process the data and to control their quality (reconstructing and completing in complete data) and also to assess the accuracy and homogeneity of the data, Excell software was used. Also, to draw the domain of the studied region's map. Surfer software was used.It should be said that there were statistical deficiencies in Manjil station's 1998-2001 data and also in those of Shah-e-Shahidan station for the 1988-1998 period. Thus, with consideration of the data from adjacent stations, statistical reconstruction measures were taken.

Table I Geographical coordinates of Stations at the studied Region

Station	Latitude (0)	Longitude (0)	Elevation (m)	Type of Station	Statistical Year
Manjil	36-45	49-23	232	Lysimetric	1988-2007
Lowshan	36-37	49-31	300	Lysimetric	1988-2007
Paroudbar	36-36	49-43	495	Lysimetric	1988-2007
Shahr-e-Bijar	37-00	49-38	140	Lysimetric	1988-2007
Shah-e-Shahidan	36-52	49-46	1780	Lysimetric	1988-2007
Gilvan	36-46	49-07	311	Lysimetric	1988-2007

To calculate the Dependable Rainfall Index (DRI) and to determine wet/dry-years, this index was used as follows:

$$DRI = \left(\sqrt[N]{P_1 \times P_2 \times P_3 \ldots P_N \times}\right) * 0/8$$

The presented scale for classifying the intensity of rainfall and also to determine the rainfall quality through the DRI is as follows :

$$NP = DR \le P \le GM$$

$$D = P \prec DR$$

$$W = P \succ GM$$

In the above-mentioned equations, the amount of rainfall has been calculated in millimeters, Here, DR is the dependable rainfall index, 0.8 is the constant coefficient, P is the given year's precipitation, N is the number of the annual precipitations' observations (duration of the statistical period). GM is the geometric mean. NP is the normal precipitation range. D is the drought thres hold and W is the number of the wet-year threshold. DRI is one of the hydroclimatic indices which is used for estimating the minimum water requirement of a region and water resources as well.

III. Results

The most important results obtained from the statistical anolysis of the rainfall parameter by using the DRI at Roudbar stations are given in Table 2.

1. With consideration of the region's mean rainfall. Shahr-e-Bijar and Shah-e-shahidan stations had the highest rainfall level, thus, they were among the most humid stations. On the other hand. Gilvan, Lowshan, Manjil and Paroudbar had the lowest rainfall level.
2. With the values of standard deviation and precipitation changes coefficient taken into account. Paroudbar and Gilvan Stations were the least stable. While Shahr-e-Bijar station was the most dependable in terms of rainfall distribution.

Table II Statistical specifications of rainfall in the studied stations

Station	Manjil	Lowshan	Paroudbar	Shah-e-hahidan	Shahr-e-Bijar	Gilvan
Average	268.03	223.72	328.13	590.94	1241.54	189.74
Geometric Mean	259.70	212.88	305.94	562.73	1228.80	180.58
Rainfall Range	226.9	321.7	480	802	166	304.4
Minimum	159.3	82.1	146	184	901	90.4
Maximum	386.2	403.8	626	986	1607	394.8
Standard Deviation	66.6	70.12	122.2	168.9	181.1	65.3

Coefficient of Changes	24	31	37	28	14	34

By using the DRI, relevant values for each station were calculated and given in Table 3 and by considering them as base values, the level of rainfall for each statistical year of the stations was classified. DRI calculated values, besides dry-year and wet-year thresholds, specified the normal range. This value is a relatively acceptable value for rainfall which in long-term could be relied on for planning.

TABLE III CALCULATED DRI VALUES FOR EACH STUDIED STATION

Station	Manjil	Lowshan	Paroudbar	Shah-e-Shahidan	Gilvan	Shahr-e-Bijar
DRI	207.76	170.30	244.75	450.18	144.47	983.04
Normal Domain	Between 207.76 and 259.70	Between 170.30 and 212.88	Between 244.75 and 305.94	Between 450.18 and 562.73	Between 144.47 and 180.58	Between 983.04 and 1228.80
Dry-year Threshold	<207.76	<170.30	<244.75	<450.18	<144.47	<983.04
Wet-year Threshold	>259.70	>212.88	>305.94	>562.73	>180.58	>1228.80

After calculating the DRI for each of the stations in the studied region, humid/dry years and the statistical characteristics of droughts and years of the stations, which included the frequency of occurrence, extent (comprehensiveness) and duration (continuity) were determined for area and major temporal and spatial characteristics of stations in the studied region in accordance with the dependable rainfall index can be explained as follows at table 4 and 5.During the twenty-years statistical period, Manjil station with 5 years of drought, 12 wet-years and 3 years of rainfall, Lowshan station with 4 years of drought, 12 wet-years and 4 years of rainfall, Paroudbar station with 7 years of drought, 10 wet-years and 3 years of rainfall, Shah-e-Shahidan station with 3 years of drought, 13 wet-years and 4 years of rainfall, Gilvan station with 4 years of drought, 10 wet-years and 6 years of rainfall and lastly, Shahr-e-Bijar with 1 year of drought, 10 wet-years and 9 years of rainfall (Table 5) were put in the normal domain.

TABLE IV DRI VALUES AND THE FREQUENCY DISTRIBUTION OF HUMID. DRY AND NORMAL YEARS OF THE SELECTED STATIONS

Parameter / Station	DRI	Number of wet-years	Number of Normal years	Number of Droughts
Manjil	207.76	12	3	5
Lowshan	170.30	12	4	4
Paroudbar	244.75	10	3	7
Shah-e-	450.18	13	4	3
Gilvan	144.47	10	6	4
Shahr-e-	983.04	10	9	1

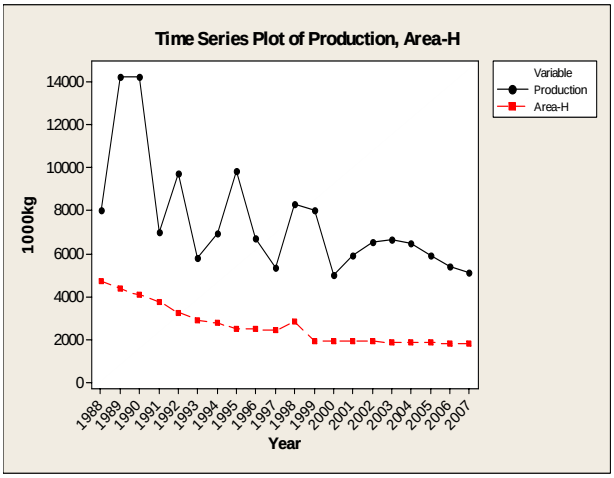

Fig. 1. Comparison of the planted area and the production level during the studied years.

A) Based on the spatial distribution of dry and humid years, Paroudbar and Manjil Stations with 7 and 5 frequencies of occurrence. Respectively had the highest number of droughts, while Shah-e-Shahidan and Manjil stations with 13 and 12 times, respectively had the highest frequency of wet-years in the region.

B) The greatest sequence of the drought period was that of two consecutive 3-years periods at Lowshan and Paroudbar stations during 1996-1998 and also that of a two- years period at Manjil station during 1996-1997.

C) The most frequent wet-year period was an eight-years period at Lowshan station during the 1988-1995 period. Also, two 6-years periods were recorded for Paroudbar (2002-2006) and Shah-e-Shahidan (1991-1995) stations.

D) The most comprehensive wet-year periods for all stations, the phenomenon we mostly witness, have been observed in 1991, 1993, 1995 and 2002.

E) The most comprehensive dry-year period for the stations was at first observed in 1996 at Manjil, Lowshan, Paroudbar and Gilvan stations and then, at Manjil, Paroudbar, Shahr-e-Bijar, Shah-e-Shahidan and Gilvan stations in 2007.

A comparison of droughts with the level of olive production in Roudbar shows that during dry years, its production has decreased. This finding indicates the importance of applied Climatology research in agriculture, thus, conducting

continuous climatology and topoclimatology studies in piedmont and mountainous regions could be effective in predicting drought, how to scientifically deal with it and to avoid greater damages which would result in less economic crop production (Table 5 and Figure 1).

TABLE V MEAN ANNUAL PRODUCTION (TN) AND OLIVE PLANTED AREAS (HR) IN ROUDBAR

Production level(tn)	Condition	Fertile Planted Area(hr)	Statistical year
8012.6	Normal	4713.3	1987-1988
14192.7	Wet-year	4340.3	1988-1989
14180.6	Dry-year	4051.6	1989-1990
6954.2	Wet-year	3759	1990-1991
9697.8	Wet-year	3232.6	1991-1992
5790	Wet-year	2895	1992-1993
6897.5	Wet-year	2759	1993-1994
9828	Wet-year	2457	1994-1995
6679.8	Dry-year	2457	1995-1996
5341	Dry-year	2420	1996-1997
8283.5	Normal	2802.5	1997-1998
8022	Wet-year	1910	1998-1999
5000	Wet-year	1910	1999-2000
5921	Normal	1910	2000-2001
6520	Wet-year	1890	2001-2002
6660	Wet-year	1850	2002-2003
6475	Wet-year	1850	2003-2004
5920	Dry-year	1850	2004-2005
5400	Wet-year	1800	2005-2006
5115	Dry-year	1787	2006-2007

IV. CONCLUSION

In order to determine and specify dry and humid years at six stations in Roudbar town, the dependable rainfall index (DRI) was used because the estimation of the minimum water requirement of a region. Especially in terms of agriculture, was a chievable through this index. Furthermore, of the statistical means (arithmetic and geometric). Only the geometric mean was used. The said method is usually used to determine mean values of the phenomena which are changed at different times. Statistical analyses at the said region's stations showed that Paroudbar and Manjil stations with 7 and 5 cases, respectively, had the highest drought frequencies. Also, the frequency of wet-years along with the most consecutive and comprehensive wet/dry-years periods of the stations were determined by the DRI and its comparison with the olive production level. Moreover, droughtrelated years which were identified y the above-mentioned index were consistent withagricultural droughts and reduced production levels. This finding can be used in predicting the trend, future plannings and preparing the region for producing olive and other products.

REFERENCES

[1] J.Gonzalez,M. Vieente, Drought pattern and its ecological effects in east Spain during the second half of 20th century, Mill press, Rotterdam, 2004.
[2] A.Rajaei , Applying Natural Geography in Urban and Rural Planning. SAMT publications,p3, 2004.
[3] B. Ramezani , Identifying the Drought Trend by Using Precipitation Data from the Anzali Lagoon Basin, Journal of the Geographical Space, No.12,p121, ,2004.
[4] W.C. Palmer, Meteorology drought , research paper office of climatology, 45, us, weather bureau, P.58 ,.1965.
[5] M .Zahedi., R. Ghavidel ,Determining the Drought Treshold and Cakulating the Dependable Rainfall Index for the Stations at Oroumieh Lake Catchment, Journal of Geographical Researches, No.59. Tehran University,2007.
[6] M .Farajzadeh, D. Movahed ,Drought in Iran, Journal of Agricultural Knowledge, No.4,1995.
[7] D .Camp, Global environmental issue , Rutledge , New York, 1994.
[8] K .Smith, Environmental Hazards, Rutledge, New York, , 1998.
[9] P. Kordovani,Drought and the Ways to Confront It in Iran, Tehran University publications, 2001.
[10] H .Ghayour, A. Masoudian ,Magnitude and Extent of Droughts in Iran, Journal of Geographical Researches. No, 45,1997.
[11] F. Khosh Akhlagh,Ghaemi & M.Zahehi, A Study of Monthly Patterns of Dry-and wet-years in Iran, Journal of Geographical Researches, No.45, 2006.
[12] B.Ramezani ,Astudy of the Drought Phenomenon by using the Normal Precipitation Percentage Index in the central Regions of Gilan Province, Biyaban Scientific and Research Journal, No.2, 2005, Tehran University.
[13] B.Ramezani, Drought in Gilan, Dessert Journal, University of Tehran,No.9,p97,2004.
[14] B. Ramezani, Recognition of climatic drought in south western of Caspian sea, Red book,IAHS pub,p 319, 2008.
[15] M.Farajzadeh ,Climatology Techniques. SAMT publications, (2007).