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Drought Evaluation of a Thirty-year Period (1988 – 2017) in Lurestan Province Using the Percent of Normal Precipitation Index (PNI)

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1-Introduction

One of the most important issues, facing the human society and environment, is water resources management. Regarding the drought, this issue turns to a serious challenge for decision makers, and affect the the people more than other natural hazards (Hagman, 1984). Normally, drought occurs in all climatic conditions (Dai, 2010). Through the current research, we try to investigate drought in Lurestan Province using Percent of Normal precipitation Index (PNI) which evaluates meteorological drought (Hayes, 2006; Zargar et al., 2011). Lurestan Province located in the western Iran, and has an area of about 29,308 Km². Geographically, it sits between northern latitudes of 32 °38 '39" and 34 °24 '17" and between eastern longitudes of 46 °52 '14" and 50 °01 '59". Climatic differences has led to the emergence of three conspicuous climates: (1) mountainous cold climate in the northern and eastern parts, (2) temperate climate in central parts, and (3) warm climate in the south and southeastern parts.

2-Methodology

The meteorological drought intensity is evaluated through different methods including Standardized Precipitation Index (SPI), Percent of Normal Index (PNI), Deciles Index (DI), Effective Drought Index (EDI), China-Z (CZI), Modified China-Z (MCZI), Rainfall Anomaly Index (RAI), Z-Score Index (ZSI), Palmer Drought Severity Index (PDSI), (Willeke et al., 1994; Byun and Wilhite, 1999; Hayes, 2006; Salehnia et al., 2017). To evaluate drought, a period of thirty-year (1988 – 2017) data were adopted from nine synoptic weather stations including Khorramabad, Borujerd, Aligudarz, Aleshtar, Noorabad, Poldokhtar, Kohdasht, Azna, and Dorud. For calculating PNI, the following equation has been applied (equ.1):

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$$PNI = P/P^- * 100 \quad (1)$$

where PNI stands for Percent of Normal precipitation Index, P for annual precipitation (mm), P^- for average precipitation of the thirty-year period. PNI (%) ≤ 110 represents Moderately to Extremely wet climate, 80-110 Normal, 55-80 Moderately dry, 40-55 Very dry, and $40 \geq$ Extremely dry (Morid et al., 2006).

3-Results and Discussion

Considering 67 years recorded data for Khorramabad, 32 years for Aligudarz, and 30 years for Borujerd, these stations are considered as milestones to reconstruct the data for stations with lack of data for the thirty-year period of study. For other stations, 13 to 17 years of data were reconstructed (Table 1). To find the best reference station for incomplete stations, geographic and climatic resemblance with the stations of complete thirty-year period data was considered. Temperature, precipitation, De Martonne aridity index, and climatic classification by Iran Meteorological Organization (IMO) were evaluated for all stations to find similarities.

Table (1): Reconstructed years of data for each station based on geographic and climatic resemblance with the stations of complete thirty-year period data.

Station	Reconstructed years	Available years	IMO classification	De Martonne classification	I_{DM}
Khorramabad	0	67	Moderately wet, warm summer, moderately cold winter	Semi-arid	21.3
Azna	13	17	Moderately wet, temperate summer, very cold winter	Semi-arid	17.8
Aligudarz	0	32	Moderately wet, temperate summer, very cold winter	Semi-arid	18.4
Dorud	13	17	Moderately wet, warm summer, cold winter	Dry or Arid	7.55
Borujerd	0	30	Moderately wet, warm summer, moderately cold winter	Semi-arid	18.4
Aleshtar	10	20	Moderately wet, temperate summer, cold winter	Semi-arid	18.6
Noorabad	13	17	Moderately wet, temperate summer, very cold winter	Semi-arid	19.5
Kuhdasht	10	20	Moderately wet, warm summer, cold winter	Semi-arid to Arid	14.8
Poldokhtar	11	19	Moderately wet, very warm summer, moderately cold winter	Dry or Arid	10.9

4- Conclusion

None of stations show Extreme drought. Severe drought is observed in 6 stations with little percentages (3.3-6.6%). Weak droughts has been recorded between 6.6 to 30% in all stations (Table 2). Therefore, dried 80% of springs and rivers in Lurestan could not be solely resulted from meteorological drought in Lurestan. The role of water management in creating this crisis should not be neglected.

Table (2): Percentage of different intensities of drought in the studied stations

Station	Extremely dry	Very dry	Moderately dry	Normal	Moderately to Extremely dry
Khorramabad	0	3.3	30	43.3	23.3
Azna	0	6.6	23	40	30
Aligudarz	0	6.6	23.3	43.3	26.6
Dorud	0	6.6	6.6	66.3	20
Borujerd	0	0	20	50	30
Aleshtar	0	0	16.6	46.6	36.6
Noorabad	0	0	26.6	36.6	36.6
Kuhdasht	0	6.6	20	40	33.3
Poldokhtar	0	6.6	16.6	50	26.6

Keywords: Meteorological drought, Drought intensity, drought prediction, Lurestan

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