Variability in Rainfall for Aravalli Range of Rajasthan, India

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A B S T R A C T

The present investigation was undertaken to evaluate the rainfall variability over aravalli range of Rajasthan. The districts included under the study were Sirohi, Udaipur, Rajsamand, Bhilwara, Jaipur, Ajmer and Alwar. The mean annual rainfall was found highest in Alwar district (666.90mm) with 40.46% of coefficient of variation while Ajmer receive least annual mean rainfall (527.24mm) with 34.40% of coefficient of variation under the study area.

Introduction

The state Rajasthan receive least rainfall where the monsoon sets in the last but begin to withdrawn early. The state broadly divided into arid, semi-arid and sub humid region on the basis of rainfall intensity. The rainfall distribution in Rajasthan not even and varies considerably region to region and year to year. The presence of Aravalli's range leads to regional climate variability. Many researchers have attempted to study the rainfall analysis for crop planning Archer and Fowler (2004), have studied variation of precipitation in spatial and temporal scale in the upper Indus Basin and reported that winter precipitation is highly correlated spatially across the basin and over the last century, there is no statistically significant long term trend in annual or seasonal precipitation time series. Krishnakumar *et al.,* (2008) studied temporal variation in monthly, seasonal and annual rainfall over Kerala, India and revealed the significant decrease in southwest monsoon rainfall while increase in post monsoon season. Parthasarathi and Dhar (1975) reported that the rainfall over India was increased from 1431mm to 1960mm. The feature of rainfall variability will help farmers to proper planning of crop. Therefore it is of interest to examine the variability of rainfall over aravalli's range of Rajasthan.

Materials and Methods

The rainfall data for the 7 districts of aravalli range Rajasthan was taken from water resources department (water.rajasthan.gov.in)

for period 1986-2016. The 31 years data was future used for the rainfall variability analysis. Time series analysis such as standard deviation, coefficient of variation and mean rainfall.

Methodology

Mean rainfall

The amount of rainfall collected by a given rain gauge in 24 hrs is known as daily rainfall (mm or cm) and the amount collected in one year in known as annual rainfall. The mean of the annual rainfall over of 35 years (in India) is known as mean annual rainfall (average annual rainfall or normal annual rainfall).

$$Mean\ Annual\ Rainfall = \frac{Total\ Rainfall}{Number\ of\ Yeras}$$

Standard Deviation (SD)

It is defined as the square root of the mean of the squares of deviations of the rainfall value from the arithmetic mean of all such rainfall. It is a measure of variability or the scatter or the dispersion about the mean value. It is given by the following formula.

$$SD\ (\sigma) = \sqrt{\frac{\sum (X - \bar{X})^2}{n-1}}$$

X = Rainfall
$\bar{X}$ = Mean rainfall
n = Number of year

Coefficient of variation

CV is estimated in order to know the amount of variation in rainfall. It is calculated by dividing the SD of rainfall by its mean variability by CV presented in percentage.

$$CV\ \% = \frac{Standard\ Deviation}{Mean} \times 100$$

The greater the CV, the lesser the dependability of receiving rainfall. Considering the annual CV, the IMD is using the following criteria for assessing the rainfall in a particular area.

Normal = - 19 to 19 % of annual normal rainfall.

Deficit = - 20 to - 59 % of annual normal rainfall.

Scarce = - 60 % and above of annual normal rainfall

Results and Discussion

The results of this study have been presented in different subheadings as following:

Decadal Rainfall analysis

For this the 31years (starting from 1986 to 2016) rainfall data has been divided into 3 decades viz 1986-1995, 1996-2005 and 2006-2016 respectively district wise. In table 1 the mean and coefficient of variation of these different decades has been presented.

The lowest CV was found for the Rajsamand district for the first and second decade, while for the last decade (2006-2016) the CV was least in case of Udaipur. For first, second and third decades the least rainfall was observed in Alwar, Rajsamand and Ajmer respectively. While there is variation in maximum amount of rainfall in three decades.

The result of the study shows that the coefficient of variation during the south west monsoon was highest in Bhilwara (70.40%) and Ajmer (65.69%) district, while the lowest CV was found in the Alwar district (37.33%). Overall the range of CV for the 7 districts of aravalli range Rajasthan varied from 37.33% to 70.40% (Table 2).

Table.1 Decadal Rainfall Variability in Aravalli Range Districts of Rajasthan

District	1986-1995	1996-2005	2006-2016	1986-1995	1996-2005	2006-2016
	Mean Rainfall	Mean Rainfall	Mean Rainfall	CV	CV	CV
Sirohi	562.71	533.13	645.85	67.05	41.71	44.63
Udaipur	564.42	573.30	724.18	41.09	22.69	20.71
Rajsamand	542.81	476.60	678.91	23.96	20.78	27.51
Bhilwara	710.17	606.11	680.29	29.94	35.06	33.80
Jaipur	558.87	544.90	631.24	27.86	40.18	42.21
Ajmer	519.89	513.78	546.16	37.01	44.88	23.79
Alwar	519.06	654.48	812.82	39.44	49.09	25.32

Table.2 Variability of SW monsoon of aravalli range regions of Rajasthan

Months	Sirohi	Udaipur	Rajsamand	Bhilwara	Jaipur	Ajmer	Alwar
June	56.95	71.83	70.63	53.7	61.1	46.6	88.5
July	197.17	211.54	193.4	246.1	162.9	188.3	174.7
August	192.22	179.64	183.22	252.3	171.5	215.2	203
September	90.99	113.91	70.73	67.5	80.1	66.7	109.8
Total	537.33	576.92	517.98	619.6	475.6	516.8	576
SD	71.1	63.1	68.04	109.06	56.41	84.88	53.76
CV	52.93	43.75	52.54	70.40	47.44	65.69	37.33

Table.3 Variability of NE monsoon of aravalli range regions of Rajasthan

Months	Sirohi	Udaipur	Rajsamand	Bhilwara	Jaipur	Ajmer	Alwar
October	17.49	17.03	18.48	6.5	11.8	17.2	12.7
November	6.23	3.93	7.61	5.1	3.4	3.4	3.1
December	1.18	1.12	2.14	3	1.5	2	4
Total	24.9	22.08	28.23	14.6	16.7	22.6	19.8
SD	8.35	8.49	8.31	1.76	5.48	8.4	5.3
CV	100.60	115.35	88.31	36.21	98.56	111.55	80.30

From the Table 2 it may be concluded that the there is high variation in the amount of rainfall in different districts of the aravalli range Rajasthan. During SW monsoon the Bhilwara district received the highest amount of rainfall (619.6mm) and Jaipur received 475.6mm of rainfall Similar kind of study had been conducted by Biradar *et al.,* (2011), Which suggested that the analyzed daily rainfall data of thirty fours (1976-2009) for establishing the long term averages of monthly, seasonal and annual and its variability. The mean annual rainfall was 937.3 mm with coefficient of variation of 22.2 per cent indicated that the annual rainfall was more or less stable over the years. The season wise per cent contribution to annual rainfall was 1.6, 8.4, 75.5 and 14.5 per cent of winter, summer, monsoon and post monsoon seasons, respectively.

The result of the study shows that the coefficient of variation during the north east monsoon was highest in Udaipur (115.35%) and Ajmer (111.55%) district, while the lowest CV was found in the Bhilwara district (36.21%). Overall the range of CV for the 7 districts of aravalli range Rajasthan varied from 36.21% to 115.35% (Table 3). From the Table 3 it may be concluded that the there is high variation in the amount of rainfall in different districts of the aravalli range Rajasthan.

During NE monsoon the Rajsamand district received the highest amount of rainfall (28.23mm) and Bhilwara received only 14.6mm of rainfall Similar kind of study had been conducted by Kothari *et al.,* (2007), reported a comprehensive study on rainfall data of Bhilwara district, Rajasthan state for a period of 45 years were analyzed from two approaches viz.; 'Meteorological' approach and 'Onset of monsoon' approach. The results revealed considerable difference in rainfall characteristics with respect to length of growing period, water surplus/deficit and probability of intervening dry spells due to these approaches.

In this study different months of the data for the period (1986 - 2016) has been used to evaluate rainfall variability of different districts of aravalli range regions of Rajasthan. It was found that the SW monsoon rainfall is higher at Bhilwara district followed by Udaipur and Alwar. The mean SW monsoon rainfall is lowest at Jaipur. The NE monsoon rainfall is higher at Rajsamand district. The mean NE monsoon rainfall is lowest at Bhilwara. The monthly values of CV during monsoon months were lower when compared to other months. However the lowest values of CV were in the month of July and August. In month of August rainfall occurred due to cyclonic activity. Mainly when the CV for the SW monsoon rainfall was examined, it was found be the least at Alwar and highest in Bhilwara and the CV for the NE monsoon rainfall was examined, it was found be the least at Bhilwara and highest in Udaipur.

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