

Analysis of rainfall variability for district Karauli, Rajasthan

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Abstract

An attempt has been made to study the rainfall variability analysis of districts Karauli of Rajasthan. Study was performed on data sets of annual rainfall for the period of 1991-2020 (30 years) for district Karauli of Rajasthan. The coefficient of variation and standard deviation for weekly, monthly and annual rainfall were also computed for district. The normal onset of monsoon in district Karauli is between June to September. It was found that the annual rainfall is higher at Karauli block during last two decade followed by Sapotra and Mandrayal block. The mean annual rainfall is lowest in Todabhim block. When the CV for the annual rainfall was examined, it was found be the least in Mandrayal block followed by Hindaun, Nadauti, Sapotra and Karauli block, it was the highest.

Keywords: Estimation rainfall, karauli, rainfall variability, variability analysis.

Introduction

Karauli district comes in flood prone eastern plain area and agro climatic zone III B of Rajasthan state, India. The soils of this zone are predominantly deep brown loamy and clay type under alluvium prone to water logging and Lithosols and Regosols group. These are alluvium calcareous. The mean annual rainfall is 559mm. The mean daily maximum temperature at district Karauli from 25.0°C in January to 42.0°C in June. Similarly the mean daily minimum temperature ranges from 9.0°C in January to 29.0°C in June. The principal crops of the zone are pear millet, cluster bean, groundnut, wheat, Mustard and Gram. Rainfall is one of the most important natural resource input to crop production in this region.

Material and Methods

Rainfall characteristics

Rainfall variability of six block (Hindaun, Karauli, Mandrayal, Nadauti, Sapotra and Todabhim block) of flood prone eastern plain area, Rajasthan during the period 1991-2020 (30 years) was computed from available daily rainfall data recorded at rain-gauge stations of the district. The data were downloaded from the web site (www.waterresources.rajasthan.gov.in), for further scrutinized and checked for their use in the present study.

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 was calculated by given formula

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

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

Assessment of rainfall variability through Coefficient of variation (CV %) appears to be simple. CV is defined as the Standard deviation divided by the mean value of rainfall. It shows the variability of rainfall in percentage.

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

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

Decadal Rainfall analysis

From the Table 1, indicated that decadal rainfall for 30

years (1991 to 2020). The analysis of rainfall were performed on decade basis, Decade I from 1991 to 2000, Decade –II from 2001 to 2010) and Decade III from 2011 to 2020. The calculated mean rainfall data for different blocks was reported in table 1. The maximum mean rainfall was observed in Karauli (765.98 mm) and (683.16 mm) block for the decade I (1991-2000) and II (2001-2010), respectively followed by Sapotra (715.9

mm) and Mandrayal (677.8 mm) block for decade III (2011-2020). The lowest CV was observed for block Mandrayal, Nadauti and Hindaun for the decadelll (2011-2020). The least rainfall observed in Hindaun block for the decade I (1991-2000) and II (2001-2010). Similar study trends were observed by other authors (Yadav and Nath, 2018; Yadav *et al.* 2018 and Rajbanshi, 2015).

Table 1. Mean rainfall variability for the period of 1991-2020 (3 decades) district Karauli of Rajasthan

Block	1991-2000	2001-2010	2011-2020	1991-2000	2001-2010	2011-2020
	Decade -I	Decade -II	Decade -III	Decade -I	Decade -II	Decade -III
	Mean Rainfall	Mean Rainfall	Mean Rainfall	Coefficient of Variance	Coefficient of Variance	Coefficient of Variance
Hindaun	531.80	529.1	658.1	54.05	28.46	26.86
Karauli	765.98	683.16	647.42	48.90	41.08	33.17
Mandrayal	683.30	621	677.85	84.74	40.18	25.02
Nadauti	541.55	611.3	607.3	57.49	45.31	26.53
Sapotra	743.20	619.8	715.9	54.81	29.46	30.20
Todabhim	579.86	534.8	573.5	51.00	43.00	44.28

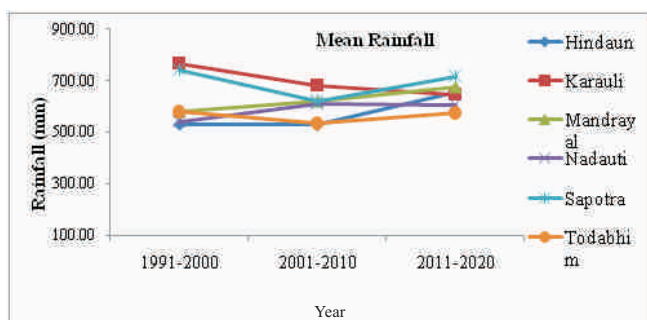


Fig 1: Mean rainfall for the period of 1991-2020 (3 decades) district Karauli of Rajasthan

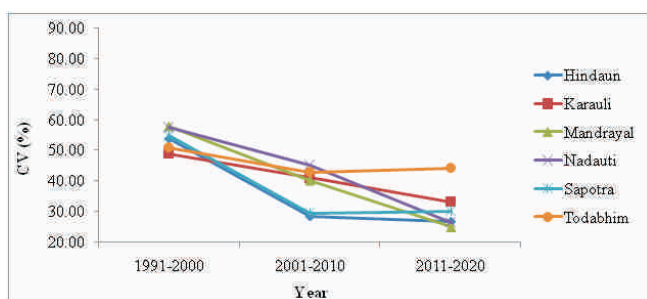


Fig 2: Coefficient of variation for period of 1991-2020 (3 decades) district Karauli of Rajasthan

Monthly variation of rainfall, standard deviations and coefficient of variation for the period of 1991-2020 (30 years).

The observed mean rainfall, coefficient of variation and

standard deviation for a period of 1991 to 2020 (30 years) for different blocks of district Karauli . The observed mean rainfall reported in the Table 2. It was found that the annual rainfall is higher at Karauli (698.85 mm) block followed by Sapotra (692.97 mm) and Mandrayal (662.25 mm) block. The mean annual rainfall is lowest at Todabhim (562.72 mm) block. The observed monthly rainfall highest at Sapotra (246.40 mm) block followed by Mandrayal (217.90 mm) block in the month of July. The higher rainfall always observed in the month of July and August due to the monsoon season. From observation of Table 3 data showed that the calculated coefficient of variation. 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 the variation of coefficient value due to the cyclonic activity perform in the district. When the CV for the annual rainfall was examined, it was found be the least at Hindaun (77.73 %) followed by Sapotra (81.82 %), Nadauti (84.58 %) block and highest in Todabhim (89.60 %) block. The calculated standard deviation reported in the Table 4. It was found that the annual standard deviation is higher at Sapotra (57.74) block followed by Mandrayal (54.39) and Karauli (52.03) block. The annual standard deviation is lowest at Hindaun (38.35) block. (Similar study on variability and trend analysis of rainfall data for Rajasthan by (Singh, 2016, Yadav and Nath, 2018). Other authors worked on rainfall analysis (Asim and Nath, 2015; Roy, 2015) .

Table 2. Monthly variation of mean rainfall for the period of 1991-2020 (3 decades) district Karauli of Rajasthan

Mean rainfall (mm)						
Month	Hindaun	Karauli	Mandrayal	Nadauti	Sapotra	Todabhim
January	9.60	7.90	12.13	8.40	10.80	8.84
February	6.00	9.93	6.20	7.83	6.97	9.17
March	9.90	4.19	5.77	7.62	3.67	8.77
April	4.27	6.53	4.08	5.25	5.43	4.23
May	10.50	7.32	12.20	10.47	10.50	11.77
June	70.97	81.52	81.20	67.97	61.07	66.87
July	164.00	206.79	217.90	188.23	246.40	167.56
August	206.23	240.56	221.07	196.15	242.30	187.83
September	74.97	100.26	74.37	76.10	82.97	74.53
October	9.60	14.76	15.23	10.47	9.97	14.27
November	3.27	14.09	8.73	3.63	9.83	4.67
December	3.70	5.02	3.37	4.60	3.07	4.21
Total	573.00	698.85	662.25	586.72	692.97	562.72

Table 3. Monthly Coefficient of variation for the period of 1991-2020 (3 decades) district Karauli of Rajasthan

Coefficient of Variation (%)						
Month	Hindaun	Karauli	Mandrayal	Nadauti	Sapotra	Todabhim
January	144.69	182.67	237.21	204.23	260.41	163.67
February	164.88	163.35	177.11	172.75	188.76	171.85
March	181.52	243.11	297.36	201.40	237.69	172.65
April	187.90	142.15	128.15	173.08	140.06	156.04
May	157.78	136.75	147.06	143.36	170.33	135.55
June	104.18	83.64	97.19	103.14	73.57	131.02
July	56.72	60.06	56.88	58.18	54.92	63.08
August	57.11	69.31	81.38	64.69	78.70	65.75
September	76.08	86.00	83.50	94.21	77.11	82.30
October	187.71	230.27	200.46	194.57	231.52	203.08
November	256.36	279.43	223.03	322.47	260.59	277.54
December	294.54	251.74	204.82	344.70	256.04	384.50
Annual	77.73	84.63	87.86	84.58	81.82	89.60

Table 4. Monthly standard deviation for the period of 1991-2020 (3 decades) district Karauli of Rajasthan

Block						
Month	Hindaun	Karauli	Mandrayal	Nadauti	Sapotra	Todabhim
January	13.89	14.42	28.78	17.16	28.12	14.47
February	9.89	16.22	10.98	13.53	13.15	15.75
March	17.97	10.19	17.15	15.34	8.72	15.14
April	8.02	9.28	5.23	9.09	7.61	6.61
May	16.57	10.01	17.94	15.01	17.88	15.95
June	73.93	68.19	78.92	70.10	44.93	87.62
July	93.03	124.20	123.94	109.52	135.33	105.70
August	117.79	166.73	179.89	126.88	190.70	123.50
September	57.03	86.22	62.10	71.69	63.98	61.34
October	18.02	33.98	30.54	20.37	23.07	28.97
November	8.37	39.36	19.48	11.72	25.62	12.95
December	10.90	12.65	6.90	15.86	7.85	16.20
Annual	38.35	52.03	54.39	42.05	57.74	41.49

Conclusions

The present study concluded that “Rainfall variability estimation for district Karauli Rajasthan” for the period (1991 - 2020) to evaluate basis on different precipitation data. It was found that the annual rainfall is higher at Karauli block followed by Sapotra and Mandrayal block. The mean annual rainfall is lowest in Todabhim block. Coefficient of variation for the annual rainfall was examined, it was found be the least at Hindaun followed by Sapotra, Nadauti and highest in Todabhim block and Coefficient of variation in monsoon months were lower than other months. However the lowest values of CV were observed in the month of July and August due to cyclonic activity the maximum rainfall observed in the month of August.

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