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ON THE TRENDS AND PERIODICITIES OF RAINFALL IN SOME DISTRICTS OF EAST RAJASTHAN

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ABSTRACT

Since 1979 onwards many districts in east Rajasthan have been experiencing deficit rainfall year after year. To understand the phenomenon of below normal rainfall for more than two years in succession in many districts, a statistical study of rainfall data from seven contiguous districts in east Rajasthan was undertaken. Besides tests for randomness, trend analysis by linear and polynomial regression were attempted.

Rainfall in the non-mosoon season did not have any relationship with preceding monsoon season rainfall. The serial correlation (nearly zero) indicated no persistence There was no curvilinear trend although some stations in each of the districts showed some linear trend.

INTRODUCTION

Koteswaram and Alvi (1969) and Bhargava and Bansal (1973) have studied the secular trends and periodicities in the monsoon and annual rainfall of selected stations in India. Winstanley (1973), while dealing with the aridity in the Sahel zone, established a 200 and 700 year harmonic cycle in the behaviour of rainfall and concluded that Bikaner and Jodhpur also have a similar cycle.

Rajasthan, with a total geographical area of 342271 sq km, is the third largest State in India. After a relatively good period of normal and above average rainfall from 1971 to 1978, the State has been receiving low rainfall since 1979 onwards. Many districts in east Rajasthan have been experiencing deficit rainfall year after year.

Climatic changes in and around Rajasthan desert during the 20th century examined by Indian Institute of Tropical Meteorology (1986-87) indicated a gradual decreasing trend in the mean annual surface temperature. The mean annual and south-west monsoon rainfall indicated a conspicuous increasing trend.

Sharma (1986) carried out a schematic study of twenty five monsoons in Rajasthan based on rainfall data during the period 1961-85 and indicated that areas of high precipitation, namely, Kota, Bundi, Jhalawar, Sawai Madhopur, Bhilwara, Chittorgarh and Udaipur, were not receiving their normal rainfall. Although average

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monsoon rainfall has come down from 535 mm to 524 mm, i.e. only by 2% during past 25 years, area-wise position of deteriorating condition revealed that 13% of area (in 3 districts) had already deteriorated by recording less than 80% rainfall, 20% area (in 4 districts) was under active deterioration and 33% area (in 8 districts) has started deteriorating. The remaining 34% area (in 12 districts) has, however, been improving.

The studies of Chaudhary et al. (1987), however, revealed that the rainfall in the buffer zone between 30 and 50 cm isohytes is not experiencing any systematic decreasing trend. Study of climatic water balance also does not support the view of any climatic shift.

To understand the phenomenon of low rainfall in some of the districts for 2 to 4 years successively, a statistical study of the long period rainfall data of the raingauges located in these districts was undertaken to examine the trend or periodicity, if any, in the ıainfall series of the east Rajasthan region.

THE STUDY AREA

Climatically, Rajasthan has semi-arid climate in the east and arid in the west. The south-west monsoon sets over the State in the first week of July and starts receding by the second week of September. The State has a normal annual rainfall of 586.4 mm; east Rajasthan has 704.1 mm and west Rajasthan has 311.4 mm. The coefficient of variability of annual rainfall ranges from 30 to 40% in the east to 60 to 80% in the west. There are a total of 423 non-recording raingauges in 14 river basins and 98 more in the rest of the State.

For the present study, the rainfall data (IMD, 1970) of raingauge stations located in the seven contiguous districts of Alwar, Jhunjhunu, Jaipur, Bharatpur, Sawai Madhopur, Tonk and Kota have been used (Fig. 1).

METHODOLOGY

The average monthly and annual rainfall series for each district have been computed using the arithmetic average.

The statistical parameters, mean, standard deviation and coefficient of skewness for rainfall data, have been computed for each of the twelve months and also for specific periods.

Decadal means and progressive decadal means were computed for comparison with long term mean of the respective rainfall series. A test of null hypothesis of randomness has been applied.

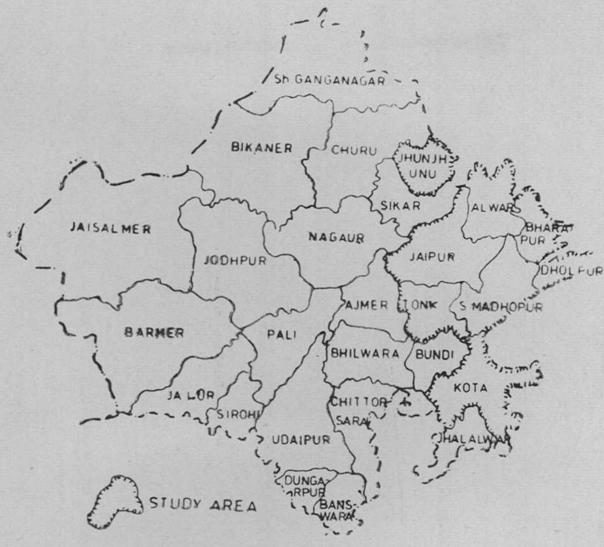

Fig. 1

To study the relationship, if any, of the non-monsoon season rainfall with the previous monsoon season rainfall, correlation coefficient of the non-monsoon rainfall with previous monsoon season rainfall has been worked out.

Also, to study the relationship of the rainfall during each of the monsoon months among themselves and on the monsoon season total, cross correlation between monsoon months (June-Sept) and monsoon total rainfall series were worked out.

Besides testing for non-randomness in the rainfall series, the dependence of rainfall in a particular month on the rainfall during the previous month or months in the same year or earlier years was determined by computing the serial correlation with different lag periods of 3, 5, 15 and 20 months.

The presence of liner or curvilinear trend in the rainfall series was studied by (i) Comparison of decade means with whole period mean, (ii) Linear regression, and (iii) Polynomial regression.

Linear and polynomial regression of 1st and 2nd order was fitted to the rainfall series for examining the possibility of trend in the rainfall series. The linear regression was tested using 't' test and the polynomial by 'F' test.

RESULTS AND DISCUSSION

To identify the presence of any trend by visual interpretation, annual rainfalls of all the raingauges are plotted. In Figure 2, the annual rainfall time series of one long term raingauge/observatory representing respective districts are shown. The

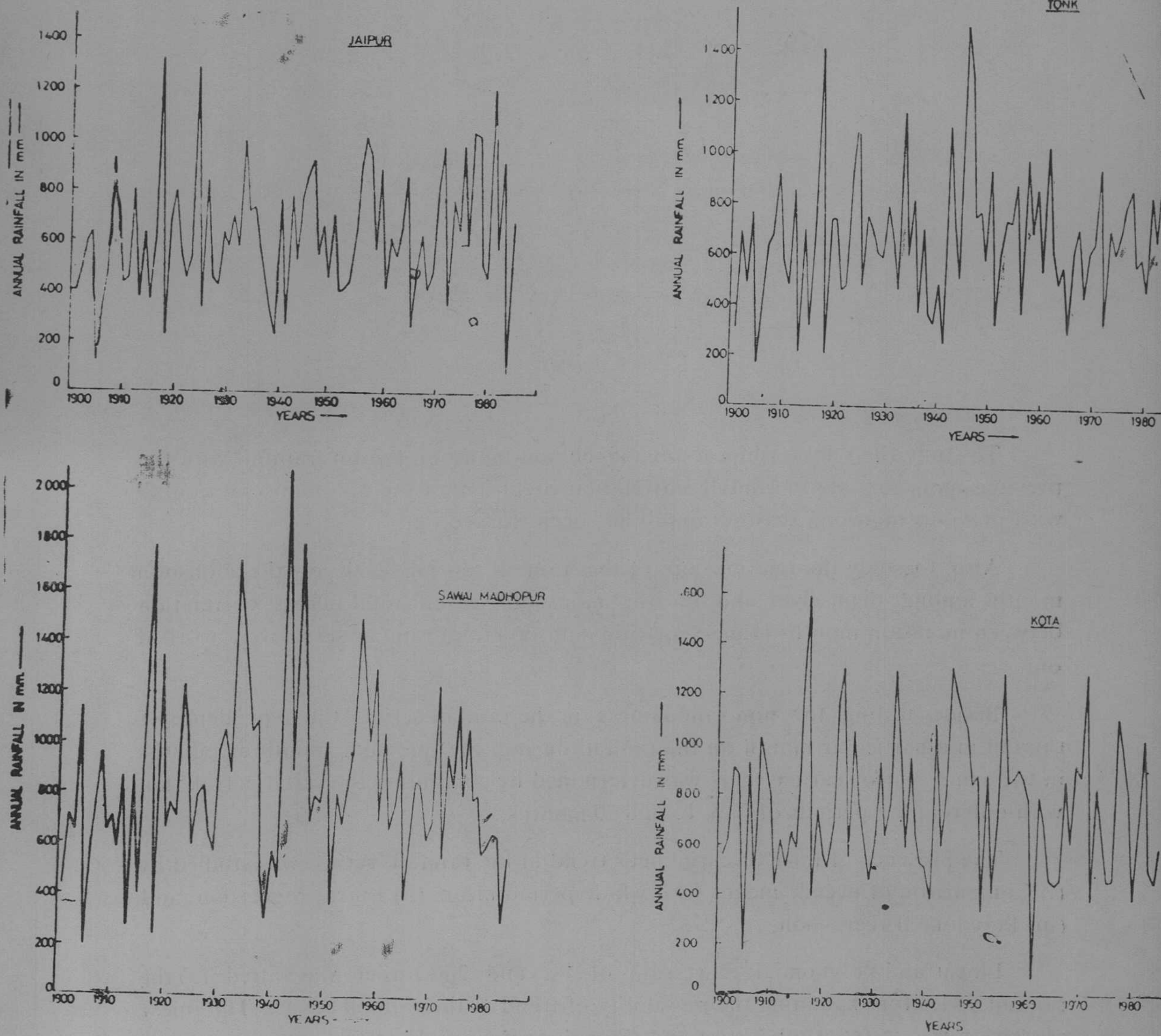

Fig. 2. Annual Rainfall Time Series

rainfall series did not indicate any trend. Ramasastri (1979) studied the trends of seasonal and annual rainfall of west Rajasthan.

Table 1 : Serial correlation coefficient of rainfall series

District/Station	Lag in months			
	3	5	15	20
Alwar	0.10	0.02	0.01	0 00
Alwar	0.10	0 02	0.05	0.02
Govindgarh	0.09	0.04	0 04	—
Kotkasim	0 05	0.01	0.03	—
Tijara	0.08	0 01	0.03	–0.02
Lachmangarh	0.04	0.01	–0.04	–0.04
Nimrana	0.09	0.04	0.03	0.00
Mandawar	0.08	0.00	0.02	0.02
Kishangarh	0 09	0.02	0.04	0.0
Ramgarh	0.05	0.09	–0.04	
Jhunjhunu	0.01	–0 02	0.03	–0 01
Jhunjhunu	0.02	0 01	0.03	–0 01
Chirawa	0.01	0.0	0.03	0.04
Khetri	0.01	–0.03	0.04	–0.02
Bharatpur				
Bharatpur	0.03	0.02	0.05	0.0
Sepao	0 05	–0.02	0 08	—
Srimuthra	–0.01	0.01	–0.05	—
Kaman	0.06	0.0	–0.01	–0.02
Dholpur	–0.05	–0.02	0.0	0.01
Baseri	0.02	0.07	–0.03	—
Rajakheru				
Bari	0.0	0.04	–0.06	—
Biana	0.03	0.03	–0.03	0.01
Nadbai				
Sawai Madhopur	0.02	0.0	0.02	0.0
Sawai Madhopur	–0.02	0.0	0.01	0.02
Sapotra	0.01	0.0	0.01	0.02
Karauli	0.01	0.01	0.04	–0.05
Hindaun	0 02	0.0	0.03	–0.02
Gangapur	0 02	0.02	0.01	0.02
Khandar	0.04	0.0	0 0	—
Jaipur	0 04	–0 01	–0.01	–0.03
Jaipur	0.04	0.0	–0.04	–0.03
Sanganer	0.02	–0 02	0.0	–0.01
Lalsot	0.03	–0.01	–0.01	–0.0
Dausa	0.01	0 06	0.02	–0.02
Kotputli	0.06	–0.06	0.05	–0.02
Chatsu	0.0	0.0	–0.01	–0.04
Baswa	0.07	0.07	–0.01	—

Polynomial regression

Polynomial regression of 1st and 2nd order has been fitted to the rainfall data series. A few stations in each of the districts indicate a rising trend in rainfall. None of the stations indicate a curvilinear trend.

CONCLUSIONS

From the analysis and results, it could be broadly concluded that except Sawai Madhopur, none of the rainfall series indicate the presence of any trend or persistence.

i) The coefficient of variation of monthly rainfall varies from 100% to 250% while that of the monsoon season and annual rainfall varies from 25% to 48%.

ii) The coefficient of skewness of monsoon season and annual rainfall is nearly zero indicating a near normal distribution of the rainfall. The coefficient of skewness of monthly rainfall is, however, positive and high, indicating the presence of large number of low rainfall values.

iii) The non-monsoon season rainfall does not bear any relationship with the preceding monsoon season rainfall. Also the rainfall series of indlvidual months in the monsoon season do not have any correlation among themselves nor do they bear any relationship with the total monsoon rainfall.

iv) Split sample analysis of Sawai Madhopur data had indicated a falling trend in the monthly rainfall series after 1945 which is significant for the months of April, August and September.

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