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VARIABILITY OF SOUTHWEST MONSOON IN WEST RAJASTHAN DURING LAST TWO DECADES

1. West Rajasthan is a region prone to water scarcity but two to three days heavy rain may lead to flood situation over a large area. The districts of west Rajasthan, viz., Jaisalmer, Barmer, Jodhpur, Bikaner, Churu, Phalodi and Jalore are highly sensitive to drought where the probability is more than 46% (Banerjee and Upadhyay 1976). Cases of severe floods in desert area (*Luni* river) were studied in detail by Ramaswamy (1971) and Sharma *et al.* (1982). The variability in southwest monsoon *vis-a-vis* duration of dry and wet spells in west Rajasthan during last two decades is attempted here.

2. Data utilised

July and August are the principal rainy months each contributing to about 30% of the annual normal rainfall. The rainfall data for evaluating spatial distribution during July and August for the period 1969-1990 have been utilised from *Weekly Weather Reports* (WWR) published by IMD. Rainfall, temperature data received at M.C. Jaipur from each individual station in the State for the period 1980-1990, have also been used in this study. The details of synoptic weather situations were taken from the WWRs for individual selected occasions.

3. Analysis of data

3.1. *Spatial distribution*—The spatial distribution of rainfall in west Rajasthan show on an average 43% of the dry days during the last 22 years (1969-90). Rain events were 9% fairly widespread, 16% scattered and 32% isolated (Table 1). The variation of number of days (out of total 62 days in July & August) when this sub-division received widespread/fairly widespread (W/FW) and scattered (SCT) rain events during the period 1969-1990 is represented in Fig. 1.

Less monsoon rainfall were noticed in the years 1969, 1974, 1979 and 1987 when the number of days with FW rainfall activity were less than 3 days in July and August. The good monsoon years were 1973, 1976, 1978 and 1983 when FW rainy days were more than 10.

Considering the scattered, fairly widespread rain events as one unit the good monsoon years were 1973, 1975, 1976, 1978, 1983 and 1988. Out of the above data series, 1987 is considered to be worst monsoon year when 92% of the days were dry while 1978 was the year when 48% of the days received good amount of rainfall during July and August.

3.2. *Frequency of dry/wet spells*—It has been observed that there were only two years, viz., 1969 and 1987 when the sub-division had not received fairly wide spread rain at all. The event of getting fairly widespread rain either in July or August is equally probable. Table 2 gives an account of dry and wet spells during July and August. Continuous dry period for more than 5 days may occur at any time in each month. Larger number of dry spell of duration 10-14 days in July may be associated with the late onset of monsoon over the sub-division.

TABLE 1
Spatial distribution of rainfall (Jul-Aug, 1969-1990)

Year	Average number of days			
	W/FW	SCT	ISOL	Dry
1969-1970	7	15	43	59
1971-1980	74	93	176	277
1981-1990	41	116	215	248
Total	122	224	434	584
(%)	9	16	32	43

W/FW—Widespread/Fairly widespread, SCT—Scattered
ISOL—Isolated.

TABLE 2
Frequency of dry and wet spells
(1969-1990)

Duration (days)	No. of days of occurrence		
	Jul	Aug	Total
Dry spells			
5-9	15	12	27
10-14	6	2	8
15-19	1	1	2
20-24	1	1	2
Wet spells			
5-10	12	10	22

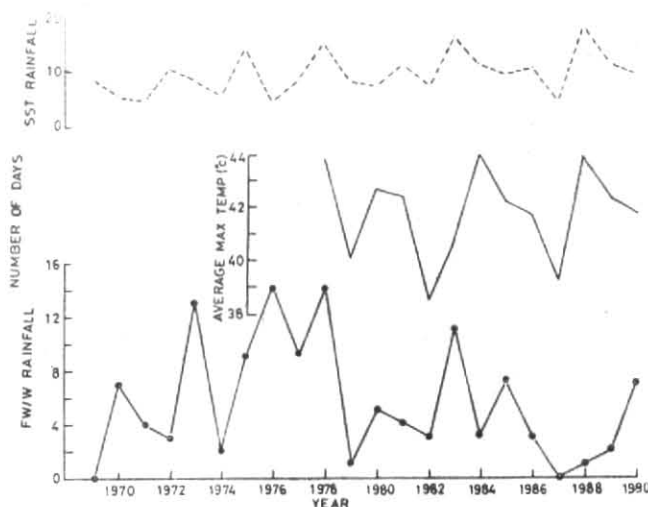


Fig. 1. Variation of rain events in west Rajasthan during July-Aug (1969-1990)

There were only 22 wet spells in the present data series when spells of duration 5-10 days is considered. This included SCT, FW and W rain events. Analysis showed no wet spells of duration more than 5 days have occurred. These years were 1969, 1971, 1979, 1984 and 1987. The longest spell of duration 10 days was

TABLE 3
Major duration of long break and rain spells

S. No.	Days	Year	Duration
(a) Dry spells			
1	24	1972	15 Jul to 7 Aug
2	10	1979	1 to 10 Jul
	9	1979	14 to 22 Aug
	6	1979	26 to 31 Aug
3	10	1980	13 to 23 Jul
	24	1980	7 to 30 Aug
4	15	1986	17 to 31 Aug
5	18	1987	18 Jul to 4 Aug
(b) Wet spells			
1	5	1973	6 to 10 Aug
	6	1973	14 to 19 Aug
2	8	1978	9 to 16 Jul
	5	1978	23 to 27 Jul
	6	1978	14 to 19 Aug
3	10	1983	14 to 23 Aug
	7	1983	23 to 29 Jul
4	9	1985	12 to 20 Jul
5	5	1990	3 to 7 Jul
	5	1990	3 to 7 Aug

observed in 1983. Some of the major duration of long break and rain spells are detailed in Table 3.

3.3. *Synoptic analysis and periodicity*—In general, the delayed onset of monsoon by 10 days or so is likely to affect the total seasonal rainfall amount. As the monsoon current is characterised by pulsatory in nature, its onset over west Rajasthan may be delayed on certain occasions (depending upon synoptic situation in each individual year) while it arrives over Kerala on normal dates. Although the humidity in upper levels in this region is comparable with that of other neighbouring areas, the large scale dust present in the lower atmosphere affects to some extent the radiation regime as pointed out by Bryson (1967). The dust acts as a barrier in the vertical growth of clouds and as such mostly duststorm etc are being experienced in this region. On studying the synoptic situations on different occasions, it has been observed that depressions while recurring in the regions of west Rajasthan, give fairly widespread rain because of the convergence zone formed and increase in moisture supply from Arabian Sea at this juncture. Monsoon activity over this region is enhanced on certain occasion with the passage of moving western disturbance over the area.

Although the present data set is very much limited (22 years) but considering fairly widespread rain events only 4 years of very low frequency have been noticed. Cycles of good and bad monsoon years are repeated at an interval of nearly 2 to 3 years which confirm the presence of QBO (Fig. 1).

3.4. *Variation of summer temperatures and monsoon rainfall*—With the non-availability of upper air data,

TABLE 4
Variation of average maximum temperature in west Rajasthan

Year	Seasonal rainfall	Average maximum temperature (°C) and departure from normal (for week ending on)		
1978	-42	10 May	17 May	24 May
		44 -3	45 -4	44 -2
1979	-3	16 May	23 May	30 May
		42 -1	39 -3	37 -5
1982	-35	5 May	12 May	19 May
		37 -4	35 -6	37 -6
1983	-32	11 May	18 May	25 May*
		42 +1	40 -1	38 -4
1987	-60	6 May	13 May	20 May
		39 -2	36 -5	39 -3
1988	-6	11 May	18 May	25 May
		45 +4	45 +3	44 +2
1990	51	2 May	9 May*	16 May
		43 +3	39 -2	41 -3

*Denotes rain/thunderstorm activity during the week due to passage of western disturbance.

only the surface maximum temperatures during the month of May for intercomparison of monsoon activity have been considered. Although, with the passage of western disturbance, temperature patterns may get affected but on an average, low temperatures during summer specially during the month of May would be an indicator of deficient rainfall in the subsequent monsoon season.

Fig. 1 indicates the variation of mean monthly maximum temperature during May and the number of days when west Rajasthan reported good rainfall activity during the period 1978 to 1990. The decreasing trend in average temperatures in the years 1979, 1982 and 1987 is indicator of drought spells. Maximum temperature patterns on weekly basis also confirms this fact (Table 4) wherein positive temperature departures were noticed in 1978 and 1988 indicating good rainfall years. It has been seen that average maximum temperatures of the order of 44 °C or more in the month of May and first week of June, is an indication of timely onset of monsoon and also nearly normal/excess rainfall in the coming monsoon season, while below normal temperatures by 3-5 °C may yield deficient conditions.

4. Conclusions

(i) The study of spatial distribution of rainfall in west Rajasthan during last two decades indicate high variability of rainfall and proneness towards drought over this region.

(ii) In the data set (1969-1990), for the month of July and August, nearly 75% of days were either dry or almost dry when very light rain occurred; while SCT and FW/W rainfall occasions were 16% and 9% respectively. The dry spells of 5-10 days duration may occur at any time in the month of July/August. Cases of continuous spell of FW rain more than three days were very few.

(iii) At times, monsoon depressions while on recurrence over the region with available moisture support from Arabian Sea may cause good rainfall activity, resulting to severe flood situations.

(iv) High surface temperatures in this sub-division during May are favourable for timely onset as well as good monsoon activity during the coming monsoon season.

(v) The present data set indicates the presence of QBO in a qualitative form.

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