

## Climatic variability in Gujarat state (India)

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### ABSTRACT

Inter seasonal climatic variability in terms of temperature and rainfall was studied using daily historical weather data recorded at Anand (1976-02), Sagdividi (1987-02) and Sardarkrushi Nagar (SK Nagar, 1983-02) in Gujarat state. Unlike maximum and minimum temperatures, variability in rainfall was more among the stations under study, which reveals location effect due to differences in monsoon activity. Moving averages of *kharif* showed a negative deviation in rainfall at SK Nagar, by 30.97 mm unlike at Sagdividi (45.26 mm) and Anand (17.29 mm). The moving average of maximum temperature in *rabi*, deviated negatively by 0.42 °C at SK Nagar followed by 0.22 °C at Anand. While, those of minimum temperatures exhibited a positive departure at Sagdividi (0.66 °C) followed by at SK Nagar (0.63 °C) as compared with their respective averages.

**Key words :** Climatic variability, seasonal variability.

Crop growth and yield variations can be primarily attributed to inter seasonal climatic variability in terms of change in temperature, rainfall and radiation besides soil conditions and input management (Midmore *et al*, 1984, Ortiz- Monasterio *et al*, 1994 and Aggarwal *et al*, 1994). Simulation studies with WTGROWS under Anand environment (Baby, 2003) indicated decrease in wheat yields with increase in temperature. Similarly Hundal and Prabhjyot Kaur (1996) observed that increased temperatures lead to decrease in growth and yield of cereals and oilseed crops in Punjab.

The mean surface temperatures derived from 73 stations across India (Hingane *et al*, 1985) showed a significant

warming of 0.4 °C over the past 100 years, which was comparable to global mean trend of 0.3 °C increase per 100 years. Since these findings are site specific, interest was invoked to study the inter seasonal climatic variability in Gujarat state.

### MATERIALS AND METHODS

Three different locations viz., Anand (22° 35' N, 72° 55' E, 45.1 m amsl), Sagdividi (21° 31' N, 70° 33' E, 11.0 m amsl) and SardarKrushi nagar (24° 10' N, 72° 26' E, 215 m amsl) representing, respectively Central, Western and Northern parts of Gujarat were selected. The historical weather data on temperature (maximum and minimum) and rainfall for the past 26 years (1976-02) of Anand, 15

**Table 1:** Variability in temperature and rainfall during different seasons in Gujarat

Location	Maximum Temp. ( $^{\circ}\text{C}$ )			Minimum Temp. ( $^{\circ}\text{C}$ )			Rainfall (mm)		
	Avg.	S.D.	C.V. (%)	Avg.	S.D.	C.V. (%)	Total	S.D.	C.V. (%)
<b>Annual</b>									
Anand	33.5	0.62	1.9	19.8	0.45	2.3	842	330.2	39
Sagdividi	33.9	0.44	1.3	20.2	0.54	2.7	876	341.0	38
SK Nagar	33.8	0.61	1.8	19.0	0.46	2.4	622	400.2	64
<b>Kharif</b>									
Anand	33.4	1.01	3.0	25.4	0.53	2.1	778	330.9	42
Sagdividi	32.5	0.81	2.5	25.0	0.25	1.0	806	357.4	44
SK Nagar	34.8	1.17	3.4	25.4	0.61	2.4	550	413.7	75
<b>Rabi</b>									
Anand	29.2	0.65	2.2	12.0	0.78	6.5	4	7.4	170
Sagdividi	31.2	1.08	3.5	12.6	1.13	9.0	5	9.1	197
SK Nagar	28.5	0.86	3.0	10.4	1.03	9.9	3	5.2	150

years (1987-02) of Sagdividi and 19 years (1983-02) of SardarKrushi Nagar were analyzed to study annual and seasonal climatic variability for *kharif* (1 June to 30 September) and *rabi* (1 December to 28 February) in terms of standard deviation (SD), coefficient of variation (CV%) and four - year moving averages.

## RESULTS AND DISCUSSION

### *Annual Variability*

The coefficient of variance of maximum and minimum temperature were very low annually, at all the locations. Similar, was the case with standard deviation which ranged between 0.44 and 0.62  $^{\circ}\text{C}$  in case of maximum temperature and it was from 0.45 to 0.54  $^{\circ}\text{C}$  for minimum temperature (Table 1). The annual temperature at all the three locations was around 34  $^{\circ}\text{C}$ .

Moving averages (four years) of both maximum and minimum temperature at all the three locations remained closer to the respective averages. This feature has been reflected in terms of statistical parameters of standard deviation and variation. At Anand, the maximum temperature exhibited relatively higher deviation by + 0.48  $^{\circ}\text{C}$  as compared with Sagdividi and SK Nagar (Table 2).

Unlike annual temperature, variability in rainfall was more among the stations under study. The annual rainfall (Table 1) was more at Sagdividi (876 mm) followed by Anand (842 mm) and SK Nagar (622 mm) in succession. Larger value of SD (400.2 mm) and CV (64 %) were observed at SK Nagar as compared with those at Anand and Sagdividi.

The moving averages showed (Table

**Table 2:** Seasonal variability in temperature and rainfall of moving average (four years) at different locations in Gujarat

Station	Maximum Temp. ( $^{\circ}\text{C}$ )		Minimum Temp. ( $^{\circ}\text{C}$ )		Rainfall (mm)	
	$\bar{d}$	SD	$\bar{d}$	SD	$\bar{d}$	SD
Anand						
Annual	0.48	0.35	0.19	0.19	2.95	150.32
<i>Kharif</i>	0.50	0.42	0.55	0.27	17.29	155.39
<i>Rabi</i>	-0.22	0.37	-0.004	0.32	-0.52	3.59
Sagdividi						
Annual	0.17	0.17	-0.04	0.27	36.22	122.81
<i>Kharif</i>	0.45	0.25	0.003	0.06	45.26	131.45
<i>Rabi</i>	0.06	0.53	0.66	0.57	-0.45	3.89
SK Nagar						
Annual	0.26	0.33	0.02	0.16	-31.61	253.56
<i>Kharif</i>	0.11	0.56	-0.40	0.31	-30.97	291.11
<i>Rabi</i>	-0.42	0.37	0.63	0.37	-0.87	3.00

2) positive departures at Anand (+2.95 mm) and Sagdividi (+36.22 mm), while at SK Nagar, negative deviation of the order of -31.61 mm was noticed.

#### *Variability during kharif season*

Neither maximum nor minimum average temperatures exhibited notable deviation at all the locations under study. Similar was the case with moving average (Table 1 and 2).

Considerable variation in rainfall among the stations was noticed. Sagdividi recorded highest average rainfall (806 mm) followed by Anand (778 mm) and SK Nagar (550 mm).

Moving averages showed a similar

pattern like annual rainfall and at SK Nagar, rainfall deviated by -30.97 mm, unlike at Sagdividi (+45.26 mm) and Anand (+17.29 mm). At Anand, moving averages remained closer to average except during the period ranging from 1984 to 1990 (Fig 1.a), where the rainfall was much below the average value. At Sagdividi, moving average was closer to average for most of the period (Fig 1.b), while at SK Nagar, it was above average during the period following 1990 (Fig.1.c). This interestingly reveals variation in monsoon activity with respect to location.

#### *Variability during rabi season*

The average maximum temperatures (Table 1) recorded at different locations in

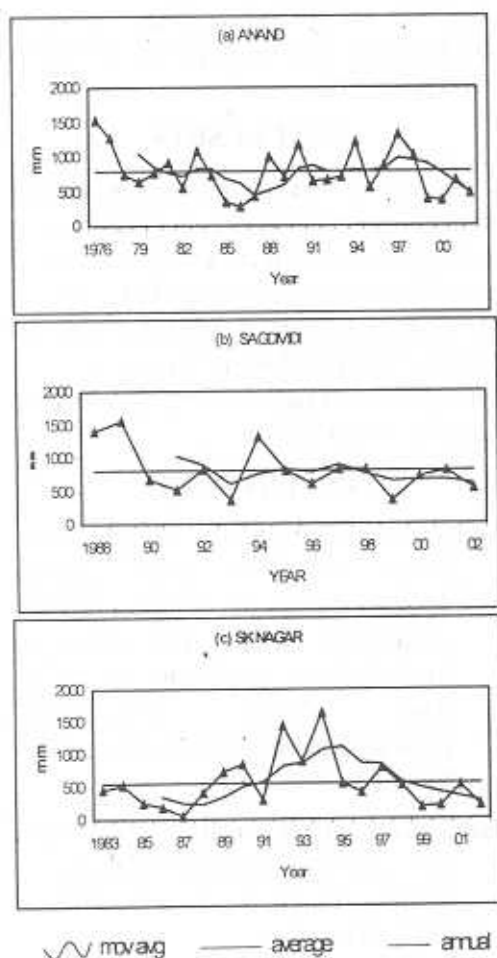


Fig.1 : Rainfall during *kharif*

ascending order of magnitude are 28.5 °C (SK Nagar), 29.2 °C (Anand) and 31.2 °C (Sagdividi). The moving average (Table 2) revealed a negative deviation in maximum temperature by 0.42 °C at SK Nagar followed by 0.22 °C at Anand (Table 2).

The moving averages of maximum

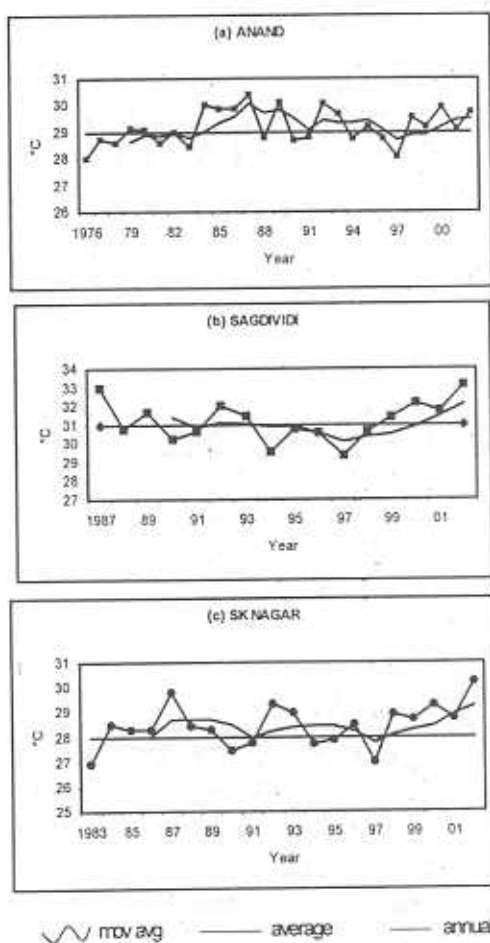


Fig 2 : Maximum temperature during *rabi*

temperature at Sagdividi remained closer to the average (Fig. 2.b) during much of the study period unlike at Anand (Fig 2.a) and SK Nagar (Fig. 2.c)

The average minimum temperatures (Table 1) recorded at different locations in ascending order of magnitude are 10.4 °C (SK Nagar), 12.6 °C (Sagdividi) and 12.0

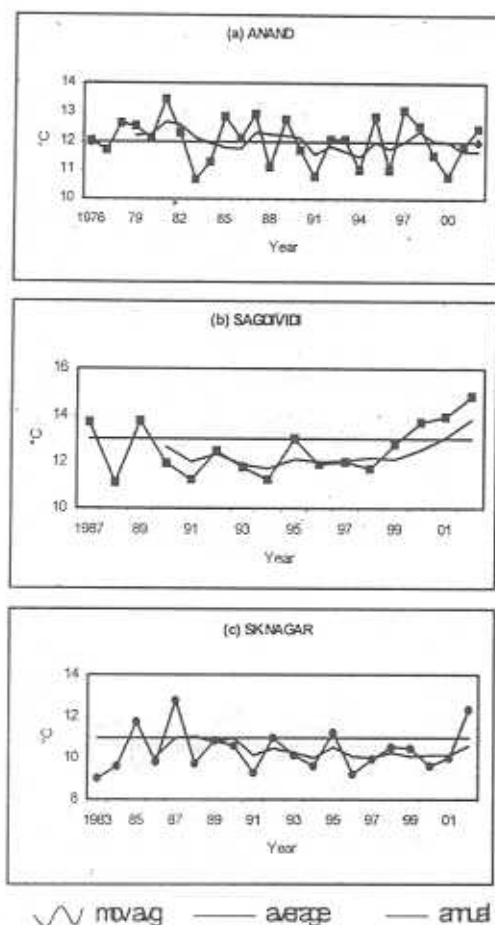


Fig 3 : Minimum temperature during rabi

°C (Anand).

The moving averages of minimum temperatures exhibited a positive deviation by 0.66 °C at Sagdividi and 0.63 °C at SK Nagar as compared with their respective averages (Table 2). Moving averages of minimum temperature at Anand remained more or less close to averages (Fig. 3.a) with a deviation of 0.44 unlike at Sagdividi

(Fig. 3.b) and SK Nagar (Fig. 3.c) which exhibited noticeable departure from the average.

## CONCLUSION

Unlike maximum and minimum temperatures, variability in rainfall was more among the stations under study, which reveals location effect on rainfall variation. Moving averages of *kharif* showed a decrease in rainfall at SK Nagar, by -30.97 mm unlike at Sagdividi (+45.26 mm) and Anand (+17.29 mm).

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