CHAPTER - 4

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HYDROMETEOROLOGY

CLIMATE

The area experiences semi-arid climate. Extreme temperatures, erratic rainfall and high evaporation are the characteristic features of this type of climate. The climate of the area like other part of North Gujarat is dominated by monsoons. It is characteristic by hot summer, cold winter, meager rainfall and a general dryness except during short monsoon period. The year may be divided into four seasons. The period from March to mid June is the hot season (summer) followed by southwest monsoon, which lasts till September. October and November are the post-monsoon months when the temperatures rise again. The cold season (winter) starts from December and ends in February. Thus the climate of the area is more oppressive during the hot season and at most of the times is less healthy than along the coastline or in the north.

TEMPERATURE

There is a meteorological observatory at Ahmedabad airport. The records of this station have been taken as representative of the hydrometeorological conditions of the study area. After mid March there is a rapid rise in temperature and May is the hottest month with daily maximum temperature of 41.7°C and main daily

minimum temperature of 25.3°C. The weather is intensely hot and on some days during the period of April to mid June the day temperature occasionally rises up to 46°C. In hot season strong dust laden scorching winds blow on many days and the weather becomes uncomfortable.

With the onset of monsoon, the temperature decreases and the weather becomes milder. With the withdrawal of the monsoon by mid September, day temperature is increased in October. However, night temperature gradually decreases after the withdrawal of monsoon.

After October, both night and day temperatures decrease. January is the coldest month with mean daily maximum and minimum temperature of 28.4° C and 10.77° C respectively. During the cold season the area is affected by cold waves in association with western disturbances. The mean annual air and soil temperatures are given in table 4.1.

Table – 4.1: Mean annual air and soil temperatures.

Mean annual air temperature	27.45°C
Mean winter air temperature	21.50°C
Mean summer air temperature	32.62°C
Mean summer soil temperature	30.12°C
Mean winter soil temperature	24.0°C

The highest maximum temperature recorded at Ahmedabad was 47.8°C on 27th May, 1916. The lowest temperature recorded was 2.2°C on 6th Feb., 1920. Table 4.2 indicates normals of temperature and relative humidity of a year.

Table – 4.2: Normals of Temperature and Relative Humidity.

Month	Mean daily max. temp. (°C)	Mean daily min. temp. (°C)	Highest max. (°C)	Year	Lowest min. (°C)	Year	Relative humidity	
							Morning %	Evening %
Jan.	29.2	14.3	36.1	1912	3.3	1954	46	29
Feb.	31.2	15.7	40.6	1953	2.2	1920	46	24
Mar.	36.1	19.9	43.9	1908	9.4	1908	44	19
April	39.7	23.7	46.2	1958	12.8	1955	49	19
May	41.3	26.3	47.8	1916	19.4	1920	62	26
June	38.6	27.3	47.2	1897	19.4	1920	70	45
July	33.7	25.8	42.2	1902	21.1	1908	81	69
Aug.	32.1	24.9	38.9	1911	21.7	1929	83	65
Sept.	33.5	24.5	41.7	1951	21.6	1958	79	59
Oct.	36.1	22.7	42.8	1920	14.0	1961	62	36
Nov.	33.6	18.8	38.9	1901	9.4	1950	47	32
Dec.	30.2	15.4	35.6	1899	6.1	1954	48	30
Annu. Av.	34.6	21.6					60	38

HUMIDITY

During the monsoon period the humidity is 60 % to 80 %. On an average, humidity is low during the year. The driest periods of the year occur during winter and summer seasons when relative humidity in the afternoon is less than 30 percentage. Moisture index of the study area is (–53).

WIND

Winds are generally light and moderate with some increasing strength in late summer and early parts of monsoon period. During this period mean wind speed reaches 18.7 km/h. From April to September winds blow mostly from south and west. Winds are light and variable in direction and during October easterly and northeasterly are common in morning and westerly and northwesterly winds in the afternoon. From November to March, morning winds are mostly from north and east and afternoon winds are generally from northwest direction. The mean wind speed during this period is generally below 10 km/h. There are occasional cyclonic winds and wind velocity during such type of cyclone as recorded in the year 1959 was of the order of 100 km/h.

CLOUDINESS

The sky is moderately to heavily cloudy during monsoon period. Generally remain clear during rest of the year. During winter light clouds may appear in association with passing western disturbance for a brief spell of a day or two.

EVAPO-TRANSPIRATION

The mean annual value of potential evapo-transpiration for Ahmedabad is about 1966 mm.

RAINFALL

Over 90% of the annual rainfall occur during southwest monsoon period between June and September. July and August are wettest months receiving more than 70% of the annual rainfall. Out of the total 37 average rainy days, 30 rainy days occur during June to September. The average annual rainfall of the area is 602.58 mm for the 31-year period (1965-95). The iso-hyet map, Gujarat shows that there is progressive decrease in average annual rainfall towards west (Fig. 4.1). It is more than 700 mm in the eastern side and above 450 mm in the western side. The distribution of rainfall in space indicates orographic control. The long term annual average rainfall in the area is 765 mm as per IMD 50 years data i.e. from 1901 to 1950. Statistical analysis of rainfall data of last 45 years i.e. from 1951 to 1995 is attempted and given in the table 4.3. From this data a year verses rainfall curve is prepared and given in fig. 4.2. A graph of annual and cumulative departure is also given in fig. 4.3. The departure from normal is calculated as follows:

Departure

Departure of annual rainfall from mean annual rainfall for the period 1951 to 1995 has been worked out using the following equations.

$D = (RA/RM)-1$

Where D = Departure, RA = Annual rain fall in mm and

RM = Mean annual rain fall in mm

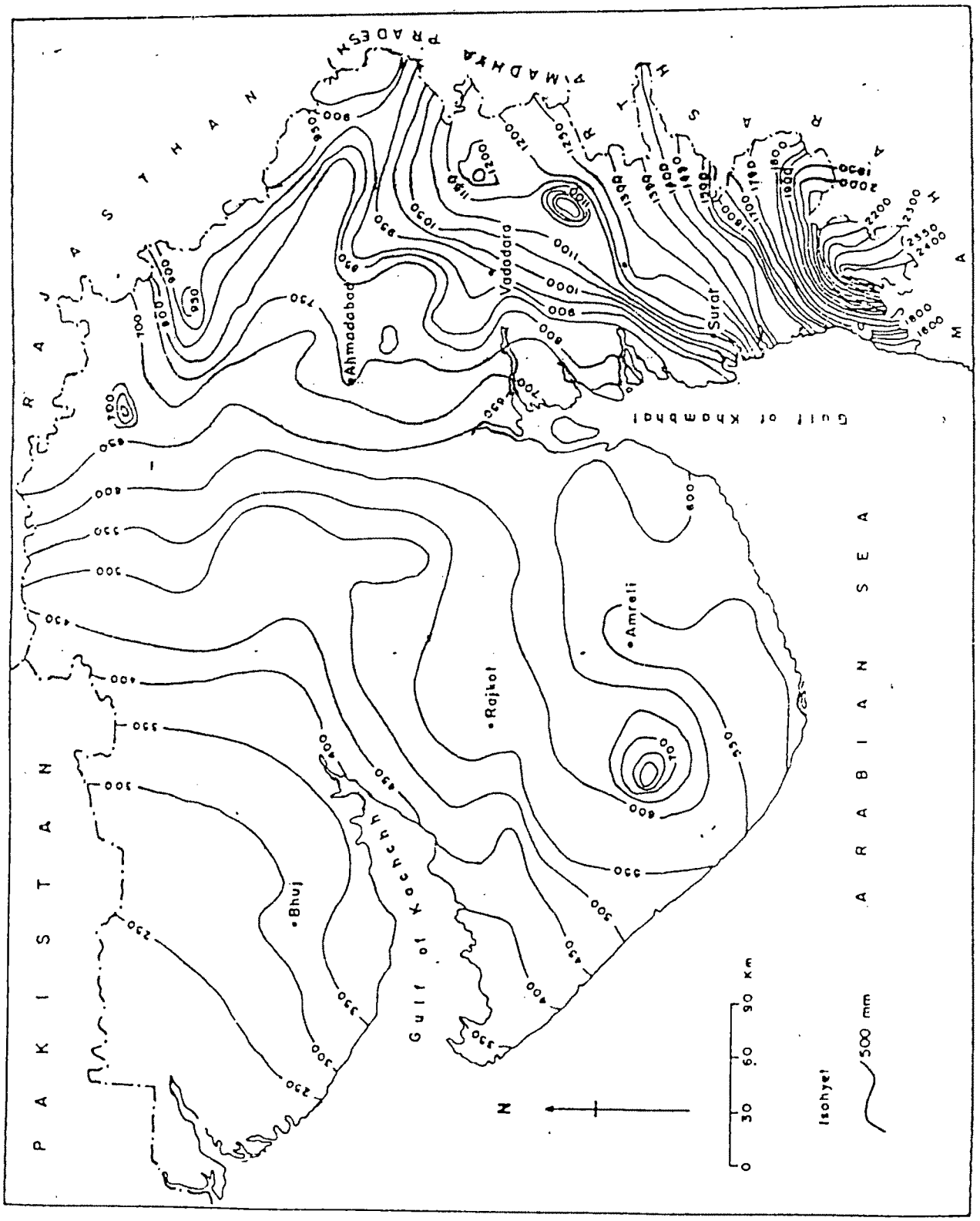


FIG. 4.1: ISOHYTE MAP OF GUJARAT.

TABLE 4.3: RAINFALL DATA
(NORMAL ANNUAL RAINFALL = 765.62 mm)

YEAR	RAINFALL (mm)	ANNUAL DEPARTURE FROM NORMAL	CUMMULATIVE DEPARTURE FROM NORMAL	TYPE OF DROUGHT
1951	424	-0.44	-0.44	Normal
1952	713	-0.06	-0.5	Mild
1953	974	0.27	-0.23	
1954	841	0.09	-0.14	
1955	829	0.08	-0.06	
1956	1224	0.59	0.53	
1957	373	-0.51	0.02	Severe
1958	975	0.27	0.29	
1959	1475	0.92	1.21	
1960	449	-0.41	0.81	Normal
1961	928	0.21	1.01	
1962	813	0.06	1.07	
1963	1005	0.31	1.38	
1964	637	-0.16	1.22	Mild
1965	485	-0.36	0.86	Normal
1966	610	-0.2	0.66	Mild
1967	988	0.29	0.95	
1968	393	-0.48	0.47	Normal
1969	475	-0.37	0.1	Normal
1970	922	0.2	0.3	
1971	400	-0.47	-0.17	Normal
1972	250	-0.67	-0.84	Severe
1973	1045	0.36	-0.48	
1974	411	-0.46	-0.94	Normal
1975	600	-0.21	-1.15	Mild
1976	1282	0.67	-0.48	
1977	1271	0.66	0.18	
1978	654	-0.14	0.04	Mild
1979	535	-0.13	-0.26	Normal
1980	521	-0.31	-0.57	Normal
1981	1069	0.39	-0.18	
1982	737	-0.03	-0.21	Mild
1983	1096	0.43	0.22	
1984	686	-0.1	0.12	Normal
1985	624	-0.18	-0.06	Normal
1986	453	-0.4	-0.46	Mild
1987	223	-0.17	-1.16	Severe
1988	728	-0.04	-1.2	Mild
1989	705	-0.07	-1.27	Mild
1990	870	0.13	-1.14	
1991	540	-0.29	-1.43	Normal
1992	580	-0.24	-1.67	Normal
1993	665	-0.13	-1.8	Mild
1994	1320	0.72	-1.12	
1995	445	-0.41	-1.53	Normal

FIG. 4.2: 45 YEARS' RAINFALL CURVE (1950-1995).

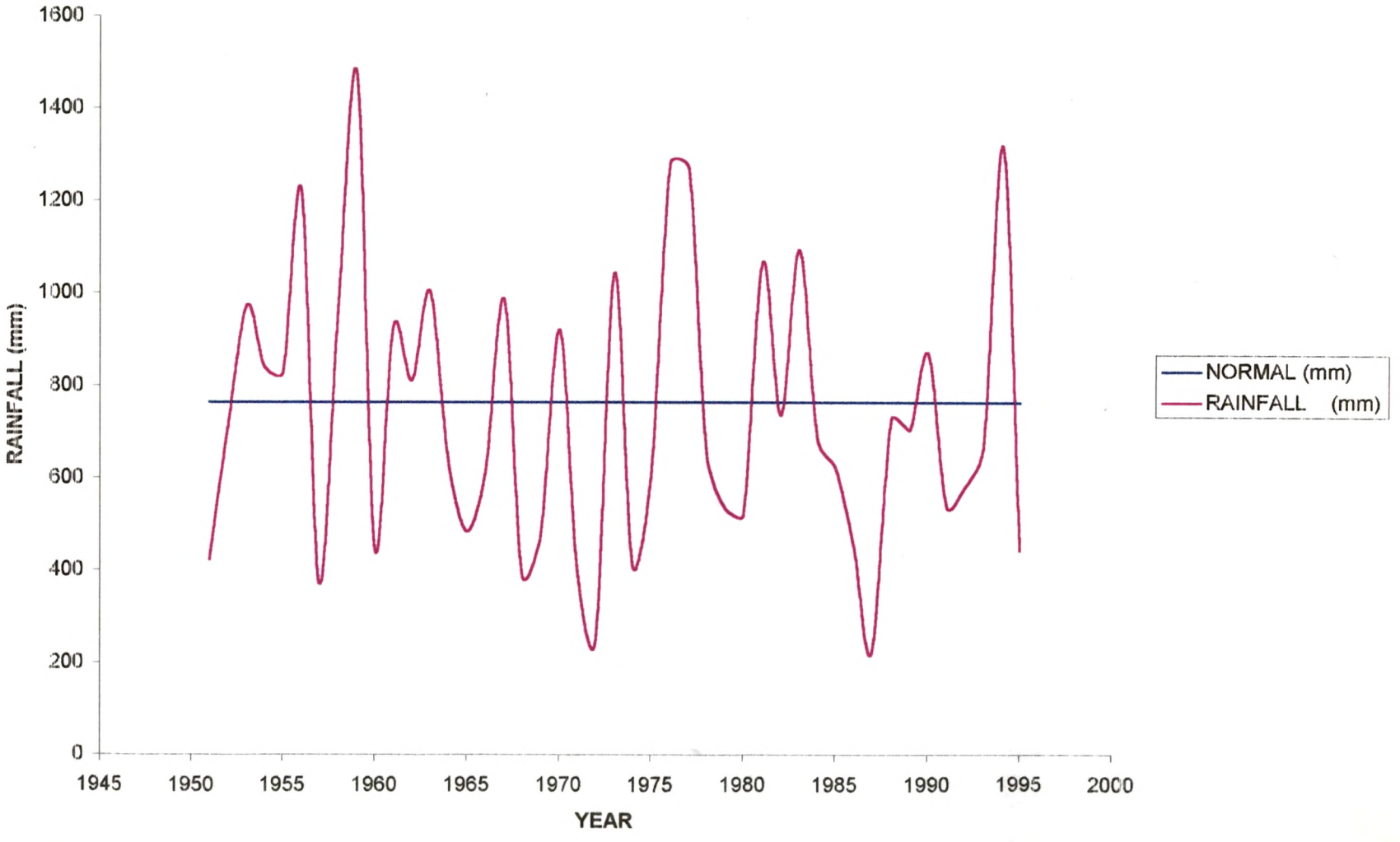
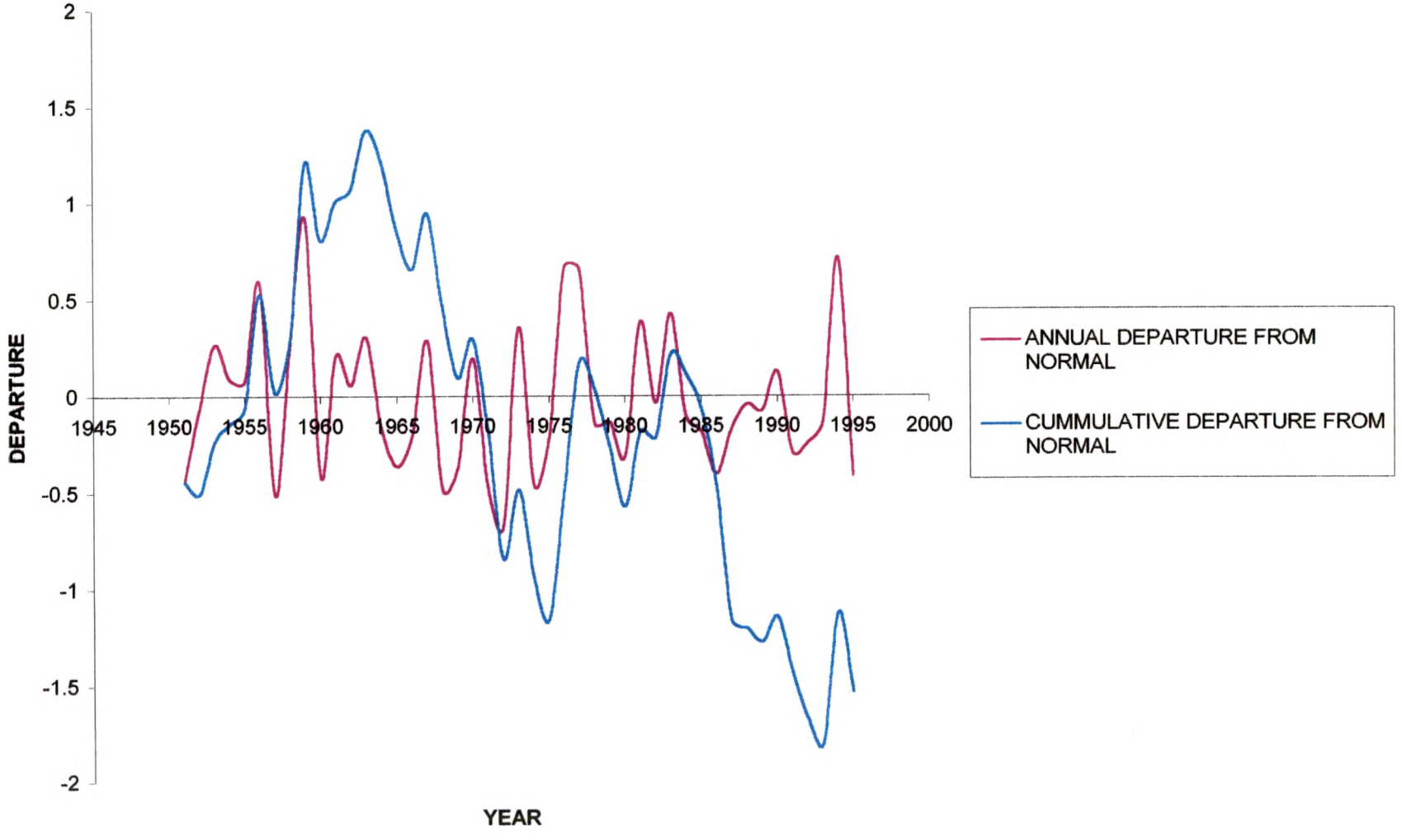


FIG. 4.3: 45 YEARS' NORMAL AND CUMMULATIVE DEPARTURE CURVE (1950-1995)



From the analysis of the data it is inferred that during 27 years out of last 45 years the area has received below normal rainfall. The negative rainfall departure has been (–0.00) to (–0.25) during 1952, 1964, 1966, 1975, 1978, 1982, 1986, 1988, 1989 and 1993, indicating mild drought. The departure from (–0.25) to (–0.50) during the years 1951, 1960, 1965, 1969, 1970, 1972, 1974, 1979, 1980, 1984, 1985, 1991, 1992 and 1995 causing normal drought conditions. Severe drought conditions resulted in the study area during the years 1957, 1972 and 1987 when the departure was above (–0.50).

DROUGHT ANALYSIS

Drought frequencies were computed for the study region and are given in the table 4.4. These frequencies are based on the agricultural definition of drought which takes in to account the negative departures of annual rainfall from mean annual rainfall, as defined below:

Departure from annual mean (%)	Type of Drought
0.1 – 25.0	Mild
25.0 – 50.0	Normal
50.0 – 75.0	Severe
75.0 – 100.0	Most severe (rare)

Table – 4.4: Drought Frequency Analysis (1951 – 1995).

Mild drought			Normal drought			Severe drought		
Year	Total nos. of year	Frequency (%)	Year	Total nos. of year	Frequency (%)	Year	Total nos. of year	Frequency (%)
1952, 64, 66, 75, 78, 82, 86, 88, 89, 93	10 (30%)	22.22	1951, 60, 65,69, 70, 72,74, 79, 80,84, 85, 91,92, 95	14 (42%)	31.11	1957, 72, 87	3 (9%)	6.66

From the analysis of drought it can be inferred that during seven out of ten years, the area has received below normal rainfall.

SPECIAL WEATHER PHENOMENA

In association with some cyclonic storms from the Arabian sea, which move towards the area and the surrounding parts during April to June bring the gusty winds and wide spread heavy rains accompanied by thunder storms. Dust storms occur occasionally in April and May.

As discussed above, climate over the area plays a very significant role in controlling various geo-environments of the study area. The collective effects of various parameters of climate decide the behaviour of physical set up of the area. As such the climate of the area is very harsh. The periodic occurrence of droughts and increasing temperature is the two main factors, which have altogether changed

the environmental balance. Droughts have caused over dependence on subsurface water resources, which are depleting at a rapid pace. Similarly, air pollution and moisture deficiency of soil has lead to increase in temperature. This type of climate has largely affected the soil capability and land use pattern.

Thus, climatic conditions are one of the most important geo-environmental attributes, which along with the geological setting of the area would be responsible for landscape generation. The study of the climatic conditions will help to understand workings of agencies like fluvial and aeolian, which have given rise to different landforms in the area. These landforms and their genesis are described in the following chapter.