

Droughts and Rainfall Pattern, 1877-1999

Rainfall data from 1875 to 1999 shows a cyclical pattern. Severe and widespread drought has followed years of good monsoons. An extrapolation of these observations is not valid for predictions. But considering that India has had good monsoons since 1987, it must plan for droughts now.

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The annual and south-west monsoon seasonal rainfall in India is characterised by very high spatial and temporal variation. Over centuries people have adjusted their lifestyle to the nature of these variations. As long as the variation in any year was within 10 per cent of normal, the economy was not greatly affected. But when the variation was more than 10 per cent, the normal life of the people was severely affected. They were unable to cope with the severe shortage in drinking water, loss of agricultural production, livestock and wage earnings. If such failure of monsoon rain occurred in consecutive years, devastating famine occurred in such areas. Costly state intervention became a necessity in such situations.

Occurrence of drought is a common feature in India. Before independence droughts caused famine and the famines are well recorded. A Loveday has elaborately described the famines, mostly as a result of drought, in his book *History and Economics of Indian famine*. He observed that famines tended to recur once in five years. In small pockets intense famines occurred in the years 1343-45, 1540, 1630, 1747 and 1837. Disastrous and most extensive famines were witnessed in the years 1396, 1596, 1660-61, 1800, 1803-04, 1896 and 1900. It is interesting to note that famines occurred in the middle and at the end of every century.

Systematic records on droughts and rainfall are available since 1875. The table lists the years when widespread droughts occurred and the departure of south-west monsoon rainfall from the normal in such years (Figure 1). Widespread drought is defined as an occasion when more than 20 per cent of the geographical area of the country has been affected. In the last 123 years, 25 years witnessed widespread drought, roughly once in five years. In terms of spread, the year 1918 is the most severe, affecting more than 70 per cent of the area, followed by 1899 (68.4 per cent), 1877

(59.4 per cent), 1972 (52.6 per cent) and 1987 (47.7 per cent).

In terms of south-west monsoon rainfall departure from normal, the largest deficit occurred in the years 1872 (-33.3 per cent), 1899 (-29.4 per cent), 1918 (-24.9 per cent) and 1972 (-23.9 per cent). During the last drought of 1987, India received 19.4 per cent less than normal rainfall during the south-west monsoon.

Figure 2 shows the correlation between per cent of area affected by drought and percentage departure of rainfall from the normal. It can be seen from the figure that when the rainfall departure from the normal was between 10-20 per cent, the area affected was between 20-40 per cent and when the rainfall departure was more than 20 per cent, more than half of the country was affected by drought.

Since 1875, there were three occasions when India did not experience widespread drought for 13 years. They were from 1878-90, 1926-38 and 1952-64. These periods were invariably followed by an year of widespread drought. In the year 1891, 22.7 per cent of the area was affected by drought. Similarly, the years 1939 (28.5 per cent), 1941 (35.5 per cent), 1951 (35.1 per cent), 1965 (38.2 per cent) and 1966 (35.4 per cent) witnessed widespread drought.

Similarly, the period 1926-38 had good monsoon. It was also followed by an year of severe drought in 1939 and another widespread drought in 1941. Considering that one good monsoon does not make good the deficit of earlier droughts, one can presume that there were three consecutive years of drought in 1939, 1940, 1941.

During 1942-50, widespread drought did not occur. In 1951 again 35.1 per cent of the area was affected by drought. From 1965 to 1987 India witnessed nine droughts. 1964 and 1965 were consecutive years of drought and similarly 1985, 1986 and 1987 were also consecutive years of drought.

An attempt is made to study the cyclic trend in south-west monsoon rainfall. Cyclic trend

in annual rainfall has been studied by computing cumulative percentage deviation from normal. The normal is the average of 30-year rainfall from 1961-90. The per cent departure of the average rainfall for the country for each year is calculated since 1875. The year 1875 is taken as a base year. The reason for taking that as a base year is the availability of rainfall data from that year. The next year's per cent deviation from the normal is added to the per cent deviation of south-west monsoon rainfall in the year 1875 and the cumulative value is plotted in the graph. Likewise the cumulative per cent deviation from the normal was calculated till the year 1999 and their values are plotted against the years (Figure 3).

Three large cycles can be identified, one from 1877-1907, 1907-52 and 1952-87. While the cycles 1877-1907 and 1951-87 are similar and characterised by frequent occurrence of drought in the latter part of the cycle, the cycle 1907-52 was free from frequent occurrence of drought. This cycle can be divided into two shorter cycles one from 1907 to 1932 (26 years) and another from 1932 to 1952. As already indicated 1939, 1940 and 1941 are consecutive drought years.

Both the frequency and cyclic analysis indicate the following. (1) In the past strong monsoon pulse has not lasted more than 13 years. Strong monsoon pulse is defined as a period of years when monsoon rainfall is within 10 per cent of the normal. Weak monsoon pulse is defined as a period when the monsoon rainfall fluctuates over the normal

Table : South-West Monsoon Rainfall, Negative Departure from Normal and Area Affected by Drought

Year	Per Cent Departure (-) from Normal Rainfall	Per Cent Area Affected by Drought
1877	33.3	59.4
1891	6.3	22.7
1899	29.4	68.4
1901	12.1	30.0
1904	11.8	34.4
1905	11.4	37.2
1907	10.0	29.1
1911	14.7	28.4
1913	10.0	24.5
1915	9.4	22.2
1918	24.9	70.0
1920	16.7	38.0
1925	3.3	21.1
1939	8.7	28.5
1941	13.3	35.5
1951	18.7	35.1
1965	18.2	38.2
1966	13.2	35.4
1972	23.9	52.6
1974	12.0	34.0
1979	18.9	34.6
1982	14.5	29.1
1985	7.1	32.3
1986	12.7	19.7
1987	19.4	47.7

Source: *The Drought of 1987, Response and Management*, Volume 1 (1989), Ministry of Agriculture, Government of India.

Figure 1: South-West Monsoon Rainfall Departure from Normal (Per Cent)

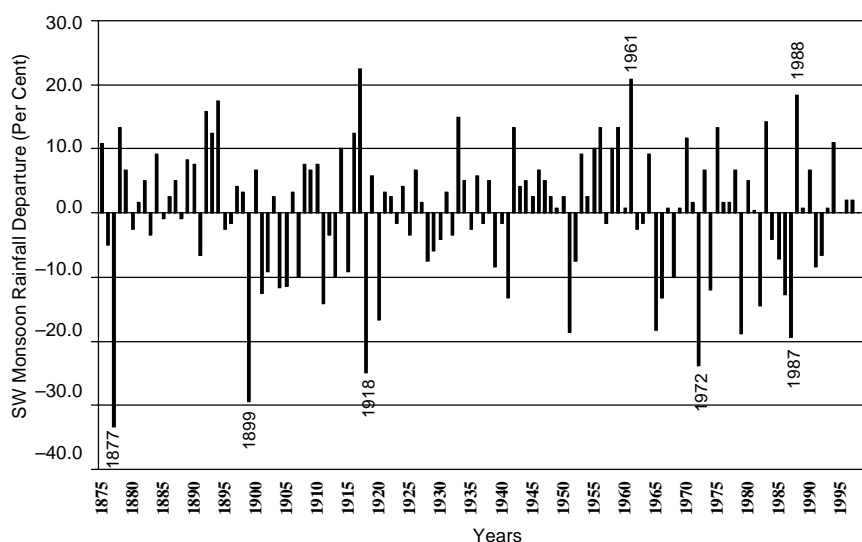


Figure 2: Departure from Normal Rainfall and Area Affected: Correlation

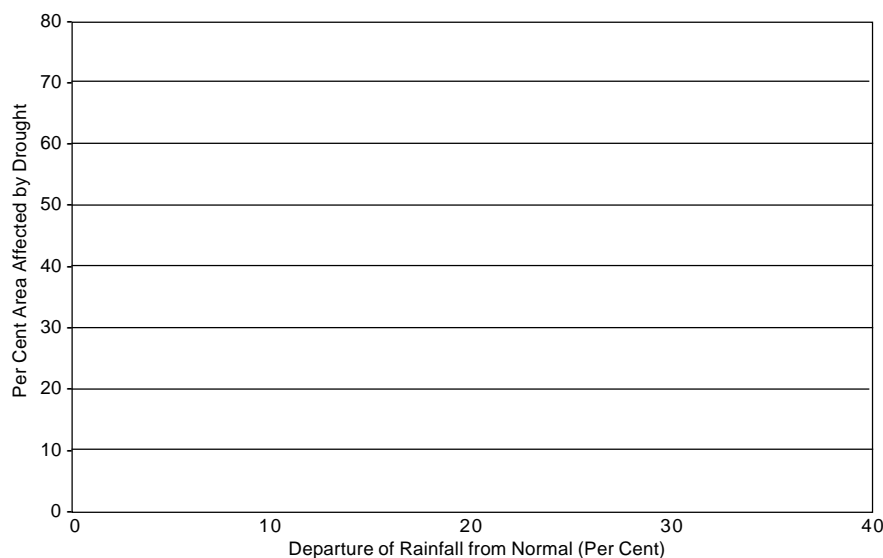
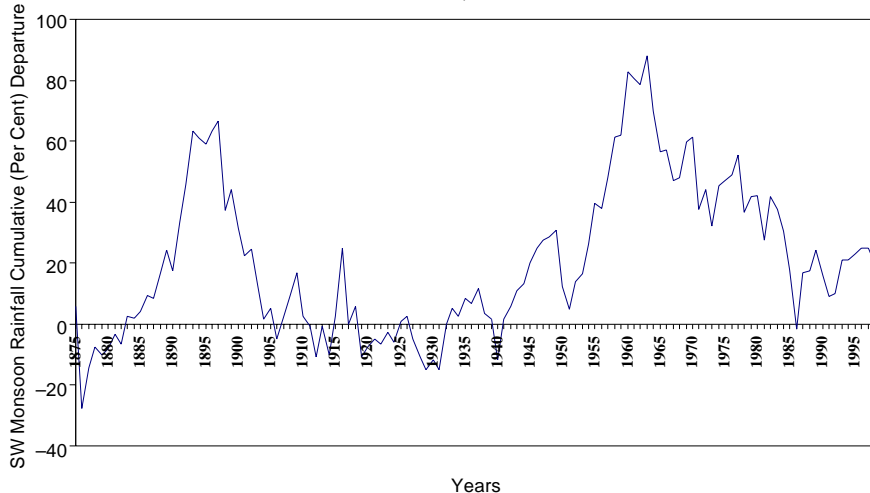


Figure 3: South-West Monsoon Rainfall Cumulative (Per Cent) Departure from Normal, 1875-99



and the negative departure of more than – 10 per cent. (2) Severe widespread drought invariably followed a strong monsoon pulse. It may be for a year followed by a short strong monsoon spell and then succeeded by frequent failure of monsoon rainfall over large area.

In the past 12 consecutive years since 1987, India witnessed a golden run of normal monsoon. This golden run may last for another year. After a peak is reached, as per the past rainfall pattern, widespread and severe drought can occur. Such a drought year may be followed by a short period of strong monsoon pulse. After such a lull frequent failure of monsoon over a wide area can happen. Another scenario is the possibility of occurrence of two consecutive years of drought once the peak is reached.

Good monsoon pulse from 1878 to 1890 was followed by occurrence of droughts in 10 years out of which 1904 and 1905 were two consecutive years of widespread drought. Similarly good monsoon pulse from 1926 to 1938 was followed by occurrence of droughts in three years. After 1964, widespread droughts were witnessed in nine years, including two consecutive years of drought in 1965 and 1966.

These incidences are random. The present knowledge on the causes of drought and the data do not permit extrapolation of these events into the future. Nevertheless, it is worthwhile to consider the possibility of frequent and widespread occurrence of drought, that too in consecutive years. This is all the more important considering that per capita availability of water has diminished considerably since 1987, when India witnessed widespread drought. It is time to plan for such an eventuality. There should be no let up in monitoring rainfall behaviour, in continuing water conservation practices and intensifying efforts for completing ongoing projects and maintaining water related works at maximum efficiency. Any lack in the political will in handling the water crisis in a rational manner will turn natural vagary into a catastrophe for India.