3 NATURE AND EXTENT OF DROUGHT

Summer monsoon, more precisely the south-west monsoon, occupies an important place in Indian agriculture. The country's agriculture and food production substantially depend on these monsoon rains. These rains also contribute to power generation and industrial production in the country.

1.2 During the summer monsoon season (June-September) of 1987, India experienced one of its severest droughts. For an appreciation of the severity and the magnitude of the drought, the failure of 1987 monsoon has to be viewed in the context of the successive monsoon failures prior to 1987. The drought of 1987 followed two and in some areas even three consecutive low rainfall monsoon periods. Consequently, the drought of 1987 became severe in the areas which received deficient rainfall during the successive years preceding the deficient rainfall of the 1987 monsoon period.

1.3 One way of viewing the rainfall situation over the country is by way of looking into the percentage departure of rainfall from the long-term normal. The rainfall is considered normal, if the seasonal departure is within (±)10 per cent of the normal rainfall. However, when percentage departure is (−)11 per cent or more, it is considered deficient monsoon year, or a drought year. The rainfall is excess if the departure is (+)11 per cent or more.

1.4 Indian monsoon rainfall has its interannual variability and in the past years of excess rains and years of droughts occurred without any discernable pattern. The period 1985-87 was unique in the history of monsoon rainfall as it witnessed successively higher deficits in all-India rainfall. The percentage departure of rainfall from the normal for 1985, 1986 and 1987 was (−)7 per cent, (−)13 per cent and (−)19 per cent respectively.

1.5 Even though the south-west monsoon during 1984 was normal in most parts of the country, rainfall deficiencies were significant in the sub-divisions of Vidarbha, Marathwada, and Telengana as shown in Table 1.

Table 1 : Seasonal Deficiency in Rainfall, 1984

S.No.	Meteorological Sub-Division	Percentage Departure of Rainfall from Normal
1.	Vidarbha	(−) 40
2.	Marathwada	(−) 28
3.	Telengana	(−) 24

Table 2 : Seasonal Deficiency in Rainfall, 1985

S. No.	Meteorological Sub-Division	Percentage Departure of Rainfall from Normal
1.	Saurashtra and Kutch	(−) 49
2.	West Rajasthan	(−) 44
3.	East Rajasthan	(−) 37
4.	Gujarat Region, Daman, Dadra and Nagar Haveli	(−) 28
5.	Vidarbha	(−) 26
6.	Marathwada	(−) 25
7.	Telengana	(−) 24

1.6 The monsoon set in Kerala on 28th May, 1985, that is, 3 days before the normal date. Progress of monsoon upto Bombay was nearly along the normal dates. However, it got delayed thereafter. Progress of monsoon was stagnant between 15th to 25th June and then from 28th June to 8th July, 1985. It covered entire country by the 14th July, 1985.

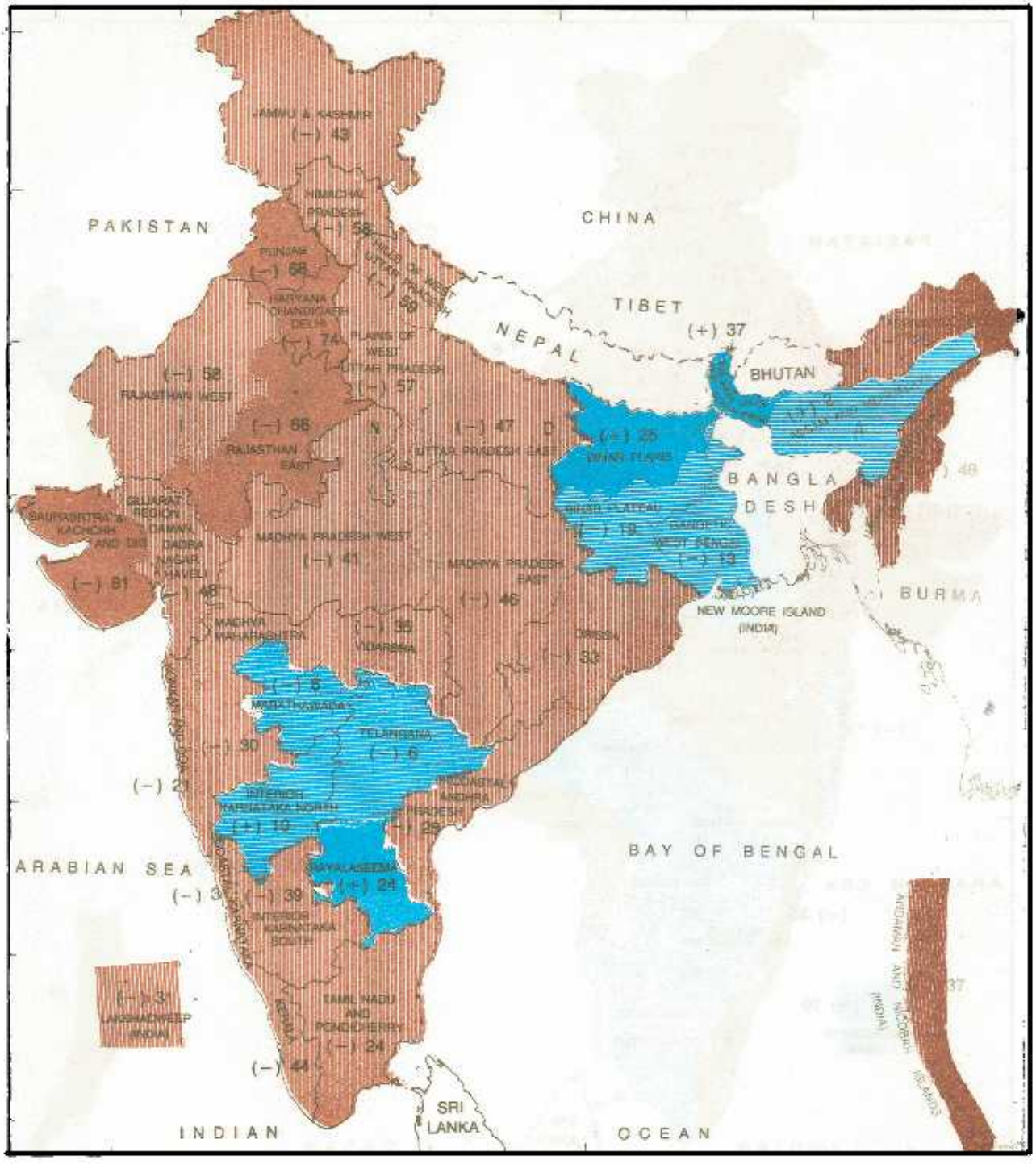
1.7 The overall rainfall distribution during 1985 was satisfactory except in Rajasthan, Gujarat, interior Maharashtra, parts of Karnataka and Andhra Pradesh. The rainfall was excess in two meteorologial sub-divisions, normal in 24 meteorological sub-divisions and deficient in 9 meteorological sub-divisions. The meteorological sub-divisions with significant seasonal deficiency in 1985 are shown in Table 2.

During 1985 south-west monsoon, 65 per cent of the meteorological districts received either normal or excess rainfall and 35 per cent deficient or scanty rainall. A list of significant dry spells of duration of 4 weeks or more during the monsoon season of 1985 may be seen at Annexure I.

1.8 The onset of monsoon in 1986 was delayed by 3 to 4 days over south peninsula, 6 to 7 days over parts of central India and 10 to 15 days over eastern India. Even in north-west India the onset was delayed in west Rajasthan by 8 days. However, over some parts of north-west India, the monsoon set in a little ahead of time. For example, it set over Delhi on 27th June, that is two days earlier than its normal date. Seasonal rainfall was normal in 21 meteorological sub-divisions and deficient in 14 meteorological sub-divisions out of total 35 meteorological sub-divisions in the country. It is noteworthy that no meteorological sub-division received either excess or scanty rainfall in 1986. The details of deficiencies are shown in Table 3.

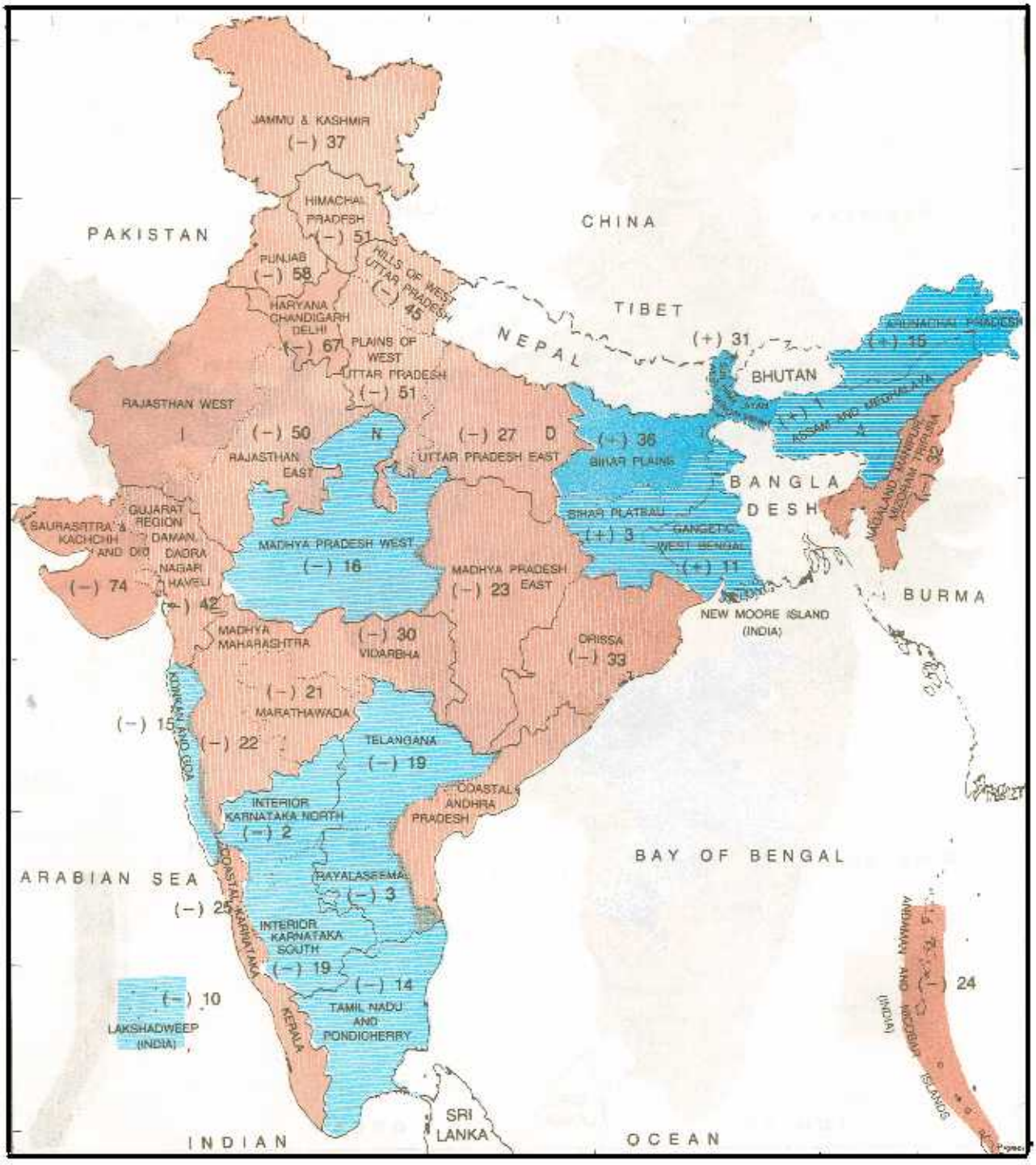
Table 3 : Seasonal Deficiency in Rainfall, 1986

S. No.	Meteorological Sub-Division	Percentage Departure of Rainfall from Normal
1.	West Rajasthan	(−) 43
2.	Saurashtra, Kutch and Diu	(−) 40
3.	Bihar Plateau	(−) 34
4.	Assam and Meghalaya	(−) 33
5.	Gujarat Region	(−) 31
6.	Konkan and Goa	(−) 31
7.	Marathwada	(−) 31
8.	Arunachal Pradesh	(−) 27
9.	Bihar Plains	(−) 26
10.	Nagaland, Manipur, Mizoram and Tripura	(−) 25
11.	Andaman and Nicobar Islands	(−) 23
12.	Plains of West Uttar Pradesh	(−) 22
13.	Haryana, Chandigarh and Delhi	(−) 22
14.	Kerala	(−) 21



EGEND
Excess + 20% or more
Normal + 19% to − 19%
Deficient − 20% to − 59%
Scanty − 60% to − 99%
No Rain −100%

Map 1: Percentage Departure of Normal Rainfall for the Period from June 1 to August 12, 1987



LEGEND

Excess + 20% or more

Normal + 19% to − 19%

Deficient − 20% to − 59%

Scanty − 60% to − 99%

No Rain −100%

Map 2 : Percentage Departure of Normal Rainfall for the Period from June 1 to September 30, 1987

It may be seen that the deficiency in rainfall was significant over 9 meteorological sub-divisions out of which 3 were in high rainfall areas (Assam and Meghalaya, Konkan and Goa, and Arunachal Pradesh). Periods of dry spells of 4 weeks or more may be seen at Annexure II.

Drought of 1987

2.1 The south-west monsoon of 1987 set in Kerala in time, that is, 2nd June, 1987. Its further northward progress was satisfactory upto middle of June. It was, however, inordinately delayed in parts of north-west India and Gujarat and it covered the entire country only by 27th July, 1987. Rainfall that year had been erratic and inadequate and there were long dry spells. By middle of August 1987, as many as 25 out of 35 meteorological sub-divisions received deficient/ scanty rainfall while only 10 meteorological sub-divisions received normal/excess rainfall as shown in Map 1. At the end of monsoon season, by 30th September 1987, as many as 21 meteorological sub-divisions received deficient/scanty rainfall, while only 14 meteorological sub-divisions received normal/excess rainfall as shown in Map 2.

2.2 The important features of the rainfall anomalies in south-west monsoon period of 1987 were as follows:

(i) *Excess* (20 per cent or more of normal) in 2 meteorological sub-divisions viz., Sub-Himalayan West Bengal and Sikkim; and Bihar Plains.

(ii) *Normal* (within 19 per cent of normal) in 12 meteorological sub-divisions, viz., Arunachal Pradesh; Assam and Meghalaya; Gangetic West Bengal; Bihar Plateau; West Madhya Pradesh; Konkan and Goa; Telengana; Rayalseema; Tamil Nadu and Pondicherrry; North Interior Karnataka; South Interior Karnataka; and Lakshadweep. Among these only 4 meteorological sub-divisions showed positive departure.

(iii) *Deficient* (-20 per cent to -59 per cent of normal) in 18 meteorological sub-divisions, viz., Andaman and Nicobar Islands; Nagaland, Manipur, Mizoram and Tripura; Orissa; East Madhya Pradesh; East Uttar Pradesh; Plains of West Uttar Pradesh; Hills of West Uttar Pradesh; Punjab; Himachal Pradesh; Jammu and Kashmir; East Rajasthan; Gujarat Region, Daman, Dadra and Nagar Haveli; Vidarbha; Madhya Maharashtra; Marathwada; Coastal Karnataka; Kerala; and Coastal Andhra Pradesh.

(iv) *Scanty* (-60 per cent to -99 per cent of normal) in 3 meteorological sub-divisions, viz., Saurashtra, Kutch and Diu; West Rajasthan; and Haryana, Chandigarh and Delhi.

2.3 *Excess* to *normal* rainfall covered 37 per cent and *deficient* to *scanty* rainfall covered 63 per cent area of the country. Major deficiency in rainfall was observed over north-west India and Gujarat region where seasonal deficits were more than 50 per cent of normal in many places. The overall deficit of rainfall on all-India basis for the monsoon of 1987 was (-)19 per cent and was nearly twice the standard deviation. The monsoon rainfall deficiency in 1987 was thus not only substantial in magnitude but also covered substantial area of the country.

2.4 It may be instructive to note the rainfall deficiencies in magnitude and the extent of area in earlier years also. It may be seen from Figure 1 that after 1965, the rainfall deficiency in terms of area coverage was worst in 1987 (63 per cent), followed by 1972 (57 per cent), 1974 (55 per cent) and 1979 (52 per eent). Similarly, meteorological sub-division-wise, 1987 was the most deficient (21), followed by 1972 (20), 1965 (19) and 1979 (19) as shown in Figure 2. (Figures in parenthesis denote the number of meteorological sub-divisions receiving deficient/scanty rainfall.)

2.5 For an appreciation of rainfall distribution over the country, district-wise distribution of rainfall may be taken into account. India has been divided into 384 meteorological districts. The percentage of these districts with excess, normal, deficient and scanty cumulative rainfall as on September 30, 1987 with comparative figures of rainfall from 1982 to 1987 are given in Table 4. During the monsoon of 1987, 43 per cent of the districts received excess/normal rainfall and 57 per cent of the districts received deficient/scanty rainfall. The districtwise deficiency of rainfall stands out clearly in 1987.

2.6 The week-by-week progress of rainfall distribution over the country as a whole in terms of percentage departure from the normal of the weekly rainfall can be analysed. This is shown in Figure 3. For monsoon of 1987, it may be seen that prolonged dry spells occurred from the middle of June to

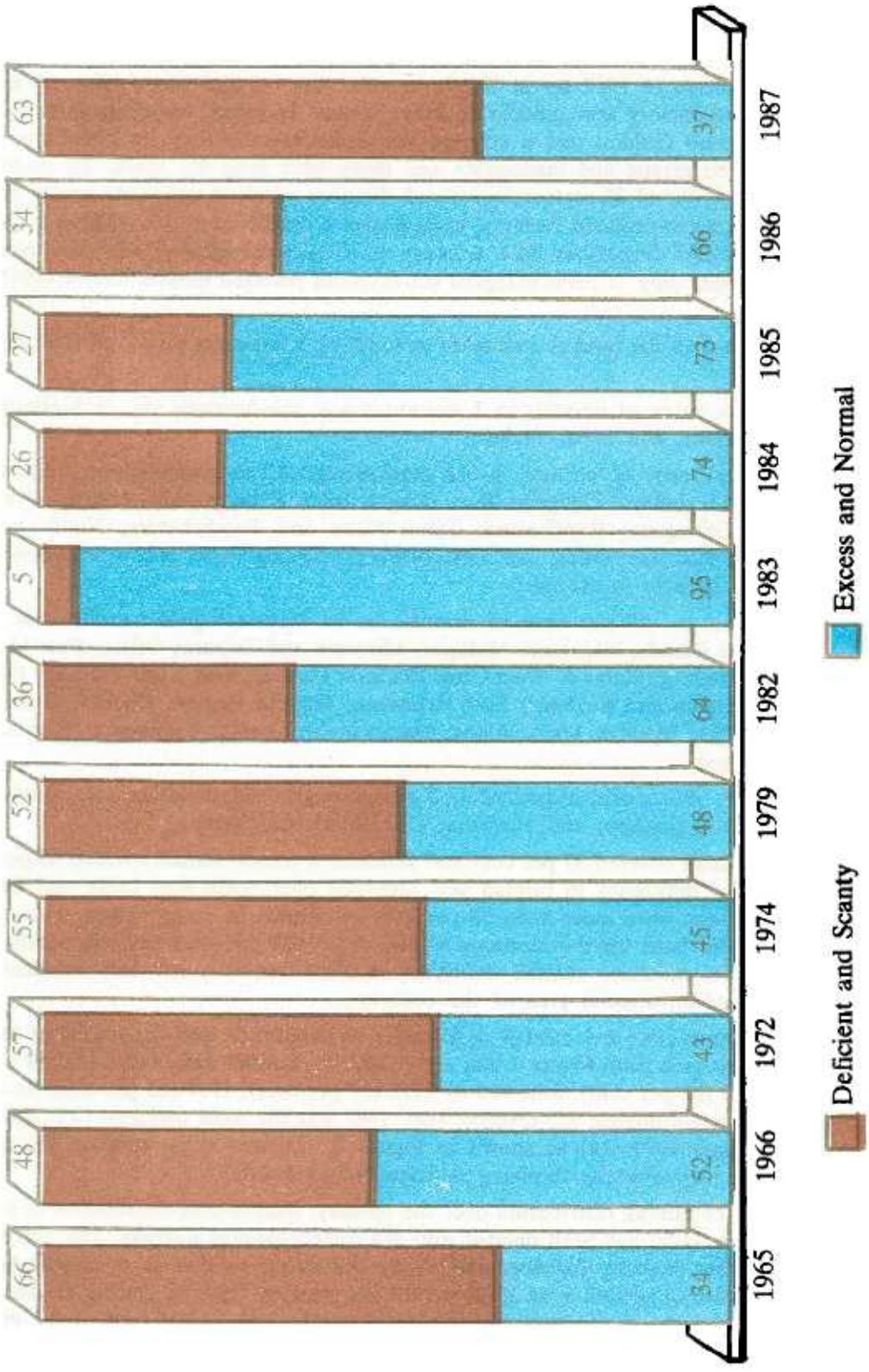


Figure 1: **Percentage of Area with Excess/Normal and Deficient/Scanty Rainfall from June 1 to September 30 for Selected Year, 1965-87.**

Table 4 : Districtwise Percentage Distribution of Rainfall 1982-87.

S.No.	Category	1982	1983	1984	1985	1986	1987
1	Excess	9	38	18	16	8	10
2	Normal	39	47	46	49	44	33
3	Deficient	47	15	35	32	45	42
4	Scanty	5	0	1	3	3	15

middle of August, 1987 over majority of metereological sub-divisions comprising north-west India. It is observed that cumulative below normal rainfall persisted in all weeks throughout the monsoon of 1987. It is also revealed that the rainfall was minimum during the period from 20th June to middle of August, which is normally the rainiest period in the country. This had adverse impact on cumulative seasonal rainfall figures.

2.7 On most of the days in 1987, daily all-India monsoon rainfall remained below the normal except for a few spells. Also daily rainfall distribution of the monsoon of 1987 was broadly similar to that of 1972 season except that pronounced spells of above normal rainfall occurred from the 20th June to 10th July, 1972.

2.8 In 1987 percentage departure of monsoon rainfall from the normal for the country as a whole was (-) 19 per cent. In the past there were only four years for which the percentage departure of monsoon rainfall was less than that of monsoon of 1987. These were 1877 (-31 per cent), 1899 (-29 per cent), 1918 (-26 per cent) and 1972 (-25 per cent). Thus the drought of 1987 is the fifth severemost since 1876 and the third severemost in the century. Rainfall departure in 1987 was similar to that of 1979 (-) 19 per cent and 1951 (-19 per cent) and very close to 1965 (-18 per cent). However, over north-west India the percentage departure of rainfall in monsoon of 1987 was (-) 46 per cent. In this respect, it was the second worst during the century. It was only in 1918 that the percentage departure of rainfall over north-west India exceeded this figure when it was (-) 56 per cent of the normal. Over peninsular India the percentage departure of rainfall in monsoon of 1987 was (-) 27 per cent, and it was the third severemost drought in this century. This comparison demonstrates that the rainfall performance in monsoon of 1987 was exceptionally below normal. The impact of such an extreme deficiency would be much more pronounced to-day as our dependence on the monsoon rains has become crucial for not only agricultural production but also for power generation, industrial production and several other economic activities.

2.9 Over a small area, when the percentage departure of rainfall is between (-) 26 per cent and (-) 50 per cent of normal, the area is considered under moderate drought. Severe drought prevails over an area when the percentage departure of rainfall over the area is (-) 51 per cent or more of the normal. During monsoon of 1987, as many as 6 meteorological sub-divisions were hit by severe drought. These constitute about 17 per cent area of the country. The percentage area of the country affected by moderate to severe drought since 1875 is shown in Figure 4. It may be seen that 1918 was the worst year in this century when 70 per cent area of the country was affected by drought. In terms of total area affected by drought, the monsoon season of 1987 ranks fourth since 1875 and second since 1901. This again establishes the severity of water stress resulting from the poor performance of monsoon of 1987. It is of particular interest to note that the normal foodgrains production accounted for by the affected area is 53.6 per cent while this percentage was much less in all the previous years except 1965. This would go to show that most of the productive area got affected by the drought of 1987.

2.10 The details of damage due to drought reported by State Governments on account of rainfall deficiency during the monsoon season of 1984 to 1987 are shown in Table 5. It may be seen that damage due to drought increased progressively and attained a peak level in 1987. No other drought on previous occasions followed a series of moderate to severe droughts as the drought of 1987. Drought of 1965-66 had a good monsoon during the preceding year 1964-65. In 1972, except State of Maharashtra, all the other States received satisfactory rainfall during 1971 monsoon period. Drought of 1979 was preceded by very good monsoon of 1978. Statewise impact of drought on human and cattle population and the cropped area may be seen in Annexure III.

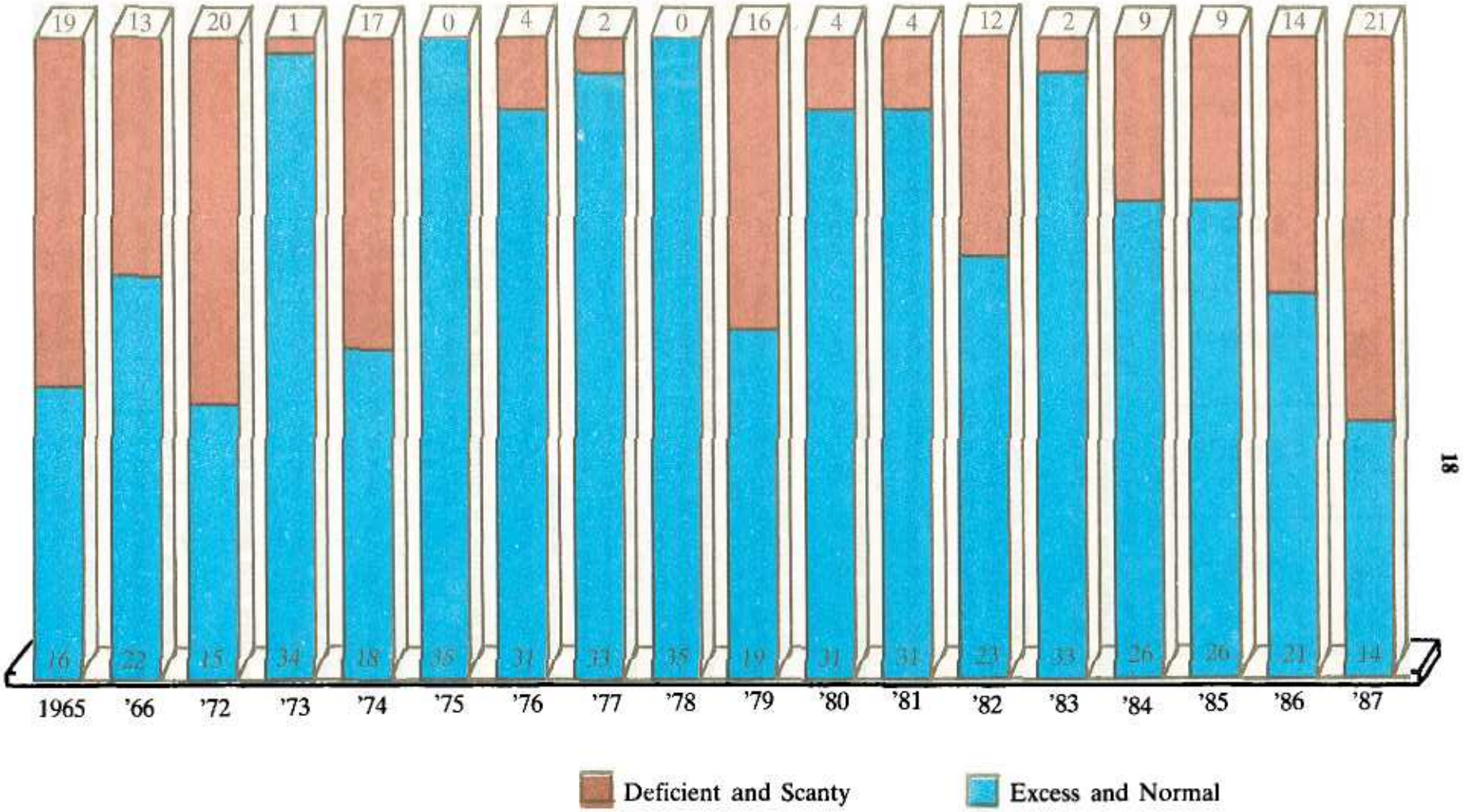


Figure 2: **Number of Sub-Division with Excess/Normal and Deficient/Scanty Rainfall for the Period June 1 to September 30 for Selected Years, 1965-87.**

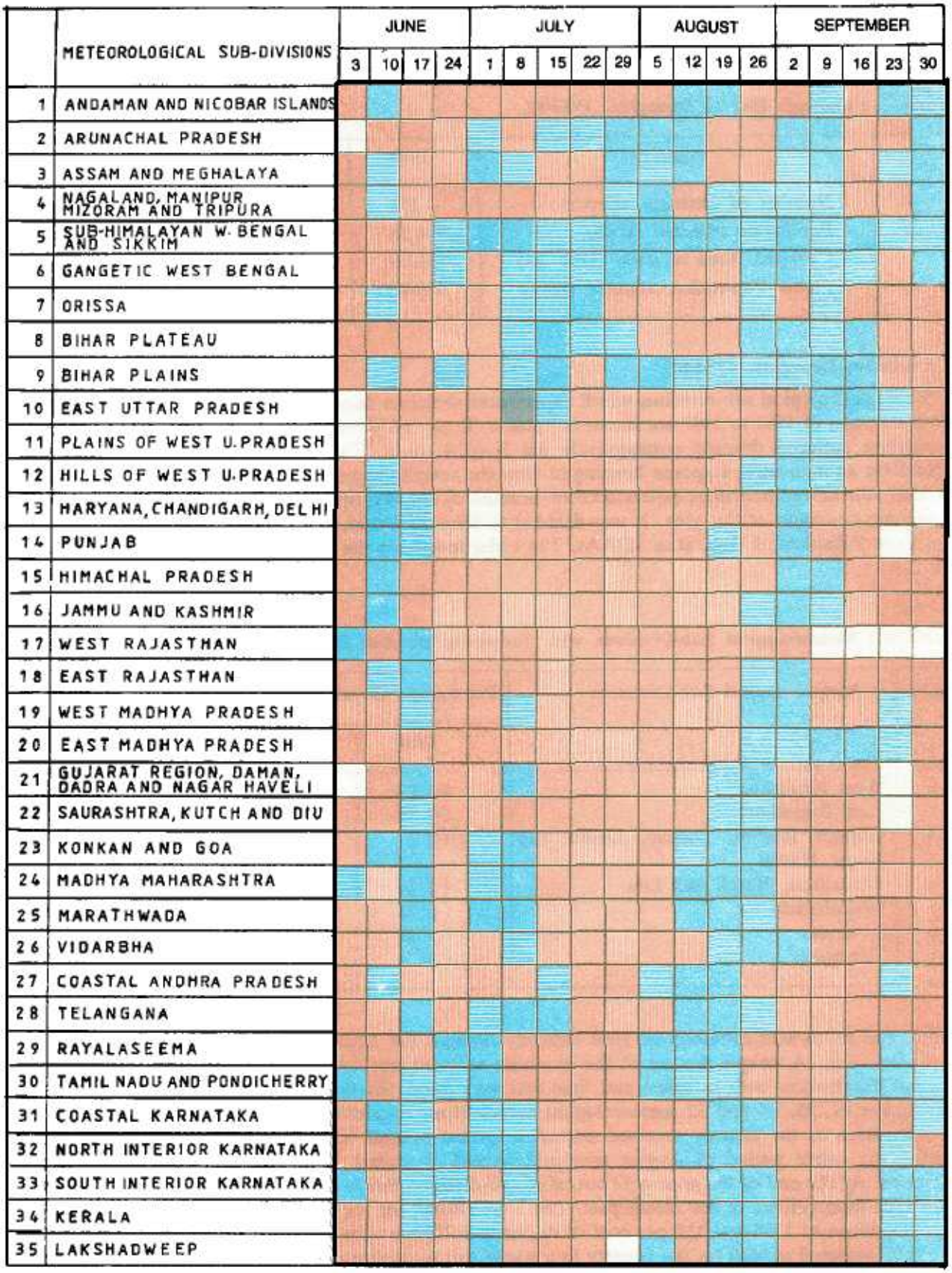


Figure 3: Week by Week Progress of the Monsoon from June 3 to September 30, 1987.

Table 5 : **Damage Due to Droughts, 1984-87.**

S.No.	Damage	1984	1985	1986	1987
1	Number of Districts affected	151	109	280	263
2	Population affected (lakh)	704.58	785.91	1919.42	2854.19
3	Cropped Area affected (lakh ha)	153.69	282.10	400.13	586.00
4	Cattle Population affected (lakh)	475.06	654.30	1119.89	1681.11

Consecutive **Droughts, 1984-87**

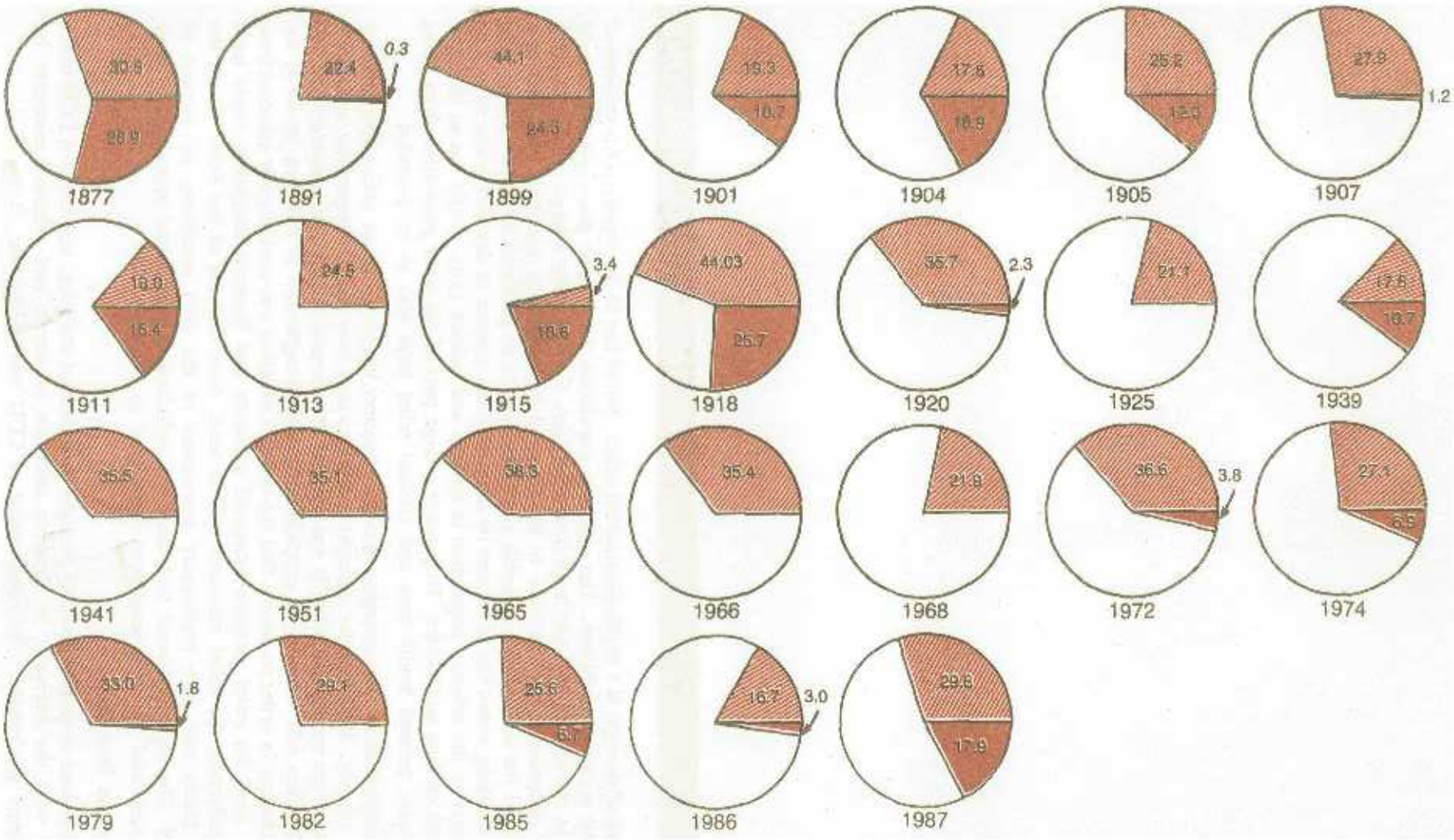
3.1 Meteorological sub-divisions which experienced deficient rainfall consecutively during the south-west monsoon of 1984 to 1987 are shown in Table 6. It may be observed that most parts of Gujarat and Rajasthan suffered drought consecutively for 3 to 4 years. This prompted the Govenrment to formulate an innovative response keeping in view the severity as reflected by deficiency in the rainfall of 1987, the severe hardships experienced on account of consecutive years of drought, and the general economic condition of the area. It was decided to treat 37 blocks of 6 districts in Rajasthan and 36 blocks in 5 districts of Gujarat as SDAAs. The order specifying the SDAAs may be seen at Annexure IV.

Table 6 : **Meteorological Sub-Divisions with Successive Rainfall Deficiency, 1984-87.**

S.No.	Meteorological Sub-Divisions	Percentage Departure of Rainfall from Normal			
		1984	1985	1986	1987
1.	West Rajasthan	(-) 20	(-) 44	(-) 43	(-) 67
2.	East Rajasthan	(-) 15	(-) 37	(-) 18	(-) 50
3	Gujarat Region, Daman, Dadra and Nagar Haveli.	(-) 1	(-) 28	(-) 31	(-) 42
4.	Saurashtra, Kutch and Diu	(-) 14	(-) 49	(-) 40	(-) 74
5	Marathwada	(-) 28	(-) 25	(-) 31	(-) 21
6	Vidarbha	(-) 40	(-) 26	(-) 3	(-) 30
7.	Telangana	(-) 24	(-) 24	(-) 6	(-) 19

3.2 The south-west monsoon of 1988 radically changed the situation almost all over India due to continual rains. A unique feature of the monsoon season (June to September) of 1988 was that the rainfall distribution both in space and time was very good. At the end of June, July, August and September,19, 35, 35 and 32 meteorological sub-divisions respectively out of the 35 meteorological sub-divisiions in the country received normal to excess rainfall. Cumulative rainfall for the season during the entire period of August remained normal or excess in all the 35 meteorological sub-divisions. At the end of the season 32 out of 35 sub-divisions fell in this category. This was among the best such distributions in the recent past. The total rainfall for the country as a whole during south-west monsoon of 1988 was 116 per cent of the normal. There were only 3 years in this century when the total seasonal rainfall for the country as a whole was more than that of 1988. They were 1917 (121 per cent of normal), 1933 (117 per cent of normal) and 1961 (121 per cent of normal).

3.3 As a result of good rains, the water availability in 47 major reservoirs at the end of monsoon of 1988 was about 80 per cent of their total live storage capacity. This was the highest live storage at the end of monsoon season since 1983. Due to the excellent rains throughout the country, ground water table also went up significantly over most parts of the country holding good prospect for drinking water and ground water irrigation. The drought of 1987 thus ended with the south-west monsoon of 1988.



Moderate Drought — Rainfall Deficiency 26% to 50% of the Normal Severe Drought — Rainfall Deficiency Exceeding 50% of the Normal

Figure—4 **Area of the Country Affected by Moderate and Severe Drought in Deficient Rainfall Years**