Mausam, (1996), 47, 3, 313-336

Weather in India

MONSOON SEASON (JUNE-SEPTEMBER 1995)*

1. Introduction

The monsoon seasonal rainfall from June to September 1995 over the country was 100% of the seasonal normal. It was excess or normal in 33 out of 35 meteorological sub-divisions of the country. During the season only two monsoon depressions formed in September against the average of 4 to 5 systems in the season. The seasonal rainfall departures stationwise and sub-divisionwise are given in Figs. 1 & 2.

2. Features of the monsoon

2.1. *Advance of southwest monsoon*

This year, the southwest monsoon advanced first over northeastern states on 5 June and later over Kerala and southern parts of Tamilnadu on 8 June, against the normal date of June 1. Further advance of southwest monsoon into Karnataka, Maharashtra (outside Vidarbha) and Andhra Pradesh was by 17 June with a delay of about 6 days from the normal date. Monsoon advanced into south Gujarat state, Vidarbha, east Uttar Pradesh and parts of west Uttar Pradesh, Punjab, Himachal Pradesh and Jammu & Kashmir by 22 June. There was no further advance of monsoon upto July 9. Between 10 to 13 July, it advanced over west Rajasthan and covered the rest of the country. Isochrones of advance of southwest monsoon 1995 are shown in Fig. 3.

2.2. *Week-by-week rainfall distribution (1 June-4 October 1995)*

Meteorological sub-divisionwise weekly rainfall departures (percentage departure from normal) during the period 1 June to 4 October 1995 are computed from real time data and given in Fig. 4. About 50% or more sub-divisions received normal or excess rainfall during the period from 3rd week of June to first week of September.

2.3. *Month-by-month performance of monsoon rainfall*

Figs. 5-8 show the monthwise distribution of monsoon rainfall.

Rainfall figures and departures for each month are given in Table 1 and the principal amounts of daily rainfall are given in Appendix I.

2.4. *Seasonal performance of monsoon rainfall*

The seasonal rainfall was excess in 7 and normal in 26 meteorological sub-divisions. It was deficient in only two sub-divisions namely Gujarat region (−21%) and Saurashtra & Kutch (−28%). Seasonal total rainfall for the country as a whole was normal. The country received 100% of its long period average value.

2.5. *Districtwise distribution of rainfall*

Out of 403 participating meteorological districts, 102 (25%) districts received excess rainfall and 216 (54%) received normal rainfall (Table 2).

2.6. *Withdrawal of southwest monsoon*

Southwest monsoon withdrew from west Rajasthan on 11 September as against the normal date 15 September. It further withdrew from Saurashtra & Kutch, northern parts of Gujarat region, east Rajasthan, Punjab, Haryana and Himachal Pradesh by 29 September. Further withdrawal of southwest monsoon was rather slow. By 12 October, it withdrew from Maharashtra and regions north of 20°N. It withdrew from the peninsula and rest of the country by 23 October. Northeast monsoon rains commenced over Tamilnadu and adjoining parts of Andhra Pradesh, Karnataka and Kerala on 23 October 1995, simultaneously, when southwest monsoon withdrew from the above regions. Withdrawal dates of southwest monsoon are given in Fig. 9.

* Compiled by: U. S. De, D. S. Desai and S. G. Bhandari, Meteorological Office, Pune.

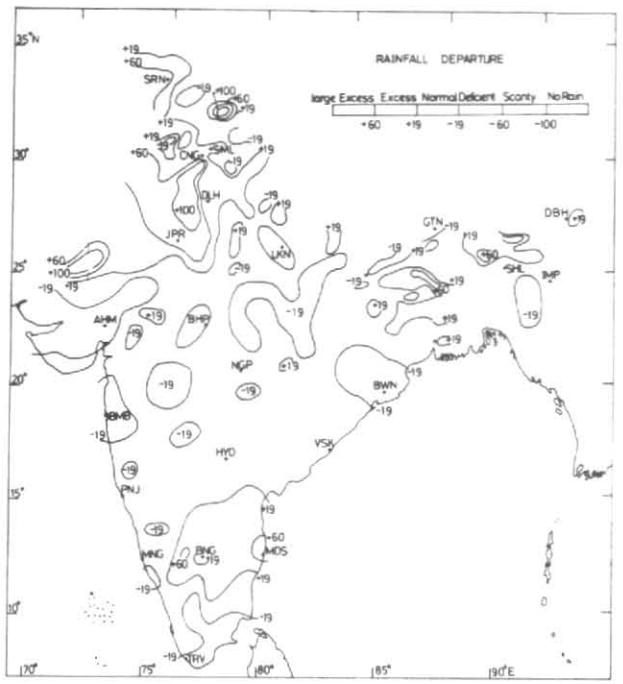


Fig. 1. Stationwise seasonal rainfall departure (%) for the period June-September 1995

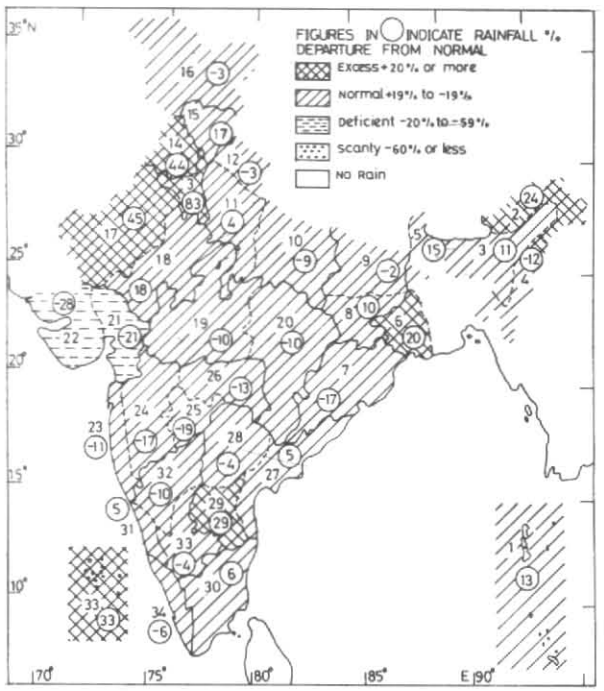


Fig. 2. Sub-divisionwise seasonal rainfall departure (%) for the period June-September 1995

3. Chief synoptic features during the monsoon

The synoptic disturbances which affected the Indian monsoon region in June, July, August and September are given in Tables 3, 4, 5 & 6 respectively.

3.1. *Cyclonic storm/depressions*

Only two depressions formed in September (Fig. 10) over the Bay of Bengal during the season.

3.1.1. *Depression over the Bay of Bengal (16-17 September 1995)*

A well marked low pressure area formed over the east-central Bay of Bengal on 14 evening. It concentrated into a depression on 16 morning. Moving in a northwesterly direction, it was centred near 20.0°N/89.0°E on the evening of 16. It, then, crossed north Orissa-West Bengal coast near Balasore on the morning of 17 and continued to move in a northwesterly direction and lay centred close to Ranchi on 17 evening. By 18 morning the system weakened into a well marked low pressure area over northeast Madhya Pradesh and neighbourhood.

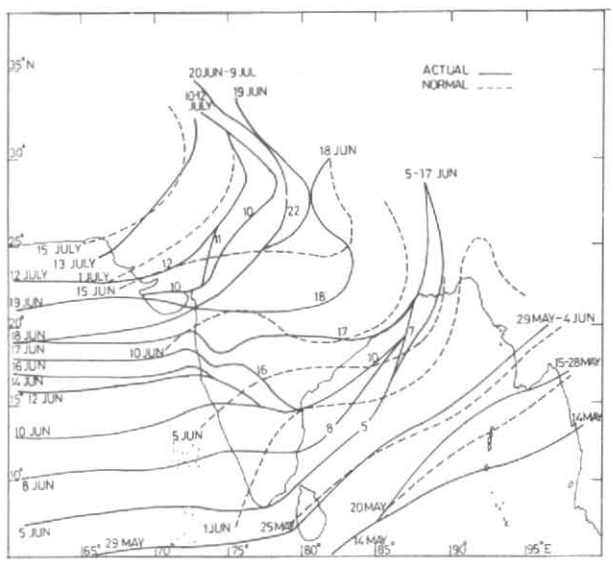


Fig. 3. Advance of southwest monsoon 1995

3.1.2. *Depression over the Bay of Bengal (26-28 September 1995)*

A well marked low pressure area formed over the northwest Bay on 25 morning. It concentrated

TABLE 1

Rainfall figures (mm) for each month and season as a whole (June-September 1995)

S. No.	Meteorological sub-division	June			July			August			September			Season		
		Actual (mm)	Normal (mm)	Dep. (%)	Actual (mm)	Normal (mm)	Dep. (%)	Actual (mm)	Normal (mm)	Dep. (%)	Actual (mm)	Normal (mm)	Dep. (%)	Actual (mm)	Normal (mm)	Dep. (%)
1.	Andaman & Nicobar Islands	370	470	−21	444	357	24	478	360	33	514	407	26	1806	1594	13
2.	Arunachal Pradesh	786	527	49	602	591	2	353	462	−24	578	296	95	2319	1876	24
3.	Assam & Meghalaya	633	560	13	554	548	1	514	435	18	391	336	17	2092	1879	11
4.	Nag., Mani., Miz. & Tripura	274	388	−29	236	332	−29	323	299	8	272	233	17	1105	1252	−12
5.	SHWB & Sikkim	583	535	9	574	615	−7	443	509	−13	809	428	89	2409	2087	15
6.	Gangetic West Bengal	129	250	−49	281	304	−8	272	303	−10	631	239	164	1313	1096	20
7.	Orissa	120	219	−45	319	362	−12	306	355	−14	238	248	−4	983	1184	−17
8.	Bihar Plateau	179	189	−5	342	336	2	263	331	−21	402	219	83	1186	1075	10
9.	Bihar Plains	139	171	−18	209	318	−35	376	313	18	292	223	31	1010	1025	−2
10.	East U.P.	125	105	19	176	306	−43	301	296	2	216	190	14	818	897	−9
11.	Plains of west U.P.	67	81	−16	184	265	−30	409	268	53	150	161	−7	810	775	4
12.	Hills of west U.P.	103	169	−39	422	449	−6	484	448	8	248	229	8	1257	1295	−3
13.	Haryana, Chandigarh & Delhi	64	51	25	174	175	0	467	179	161	234	108	116	939	513	83
14.	Punjab	48	43	13	177	190	−7	321	170	89	179	100	79	725	503	44
15.	Himachal Pradesh	67	97	−31	387	347	12	399	321	25	231	157	47	1084	922	17
16.	Jammu & Kashmir	29	57	−49	321	189	70	117	190	−39	36	82	−56	503	518	−3
17.	West Rajasthan	29	28	3	218	102	114	136	107	27	28	48	−40	411	285	45
18.	East Rajasthan	28	57	−51	276	226	22	337	230	46	105	117	−11	746	630	18
19.	West Madhya Pradesh	65	115	−43	334	333	0	287	290	−1	146	183	−20	832	921	−10
20.	East Madhya Pradesh	90	166	−46	433	405	7	353	392	−10	183	216	−15	1059	1179	−10
21.	Gujarat Region	16	145	−89	524	428	22	156	296	−47	129	181	−29	825	1049	−21
22.	Saurashtra & Kutch	10	89	−89	268	239	12	58	126	−54	50	84	−41	386	538	−28
23.	Konkan & Goa	357	685	−48	1117	1106	1	615	663	−7	398	348	15	2487	2802	−11
24.	Madhya Maharashtra	68	140	−51	268	271	−1	87	179	−51	195	155	26	618	745	−17
25.	Marathwada	136	146	−7	192	206	−7	106	187	−43	144	179	−19	578	718	−19
26.	Vidarbha	144	167	−14	343	335	2	156	277	−44	206	201	2	849	980	−13
27.	Coastal Andhra Pradesh	81	111	−28	211	168	26	215	160	35	133	271	−22	640	610	5
28.	Telangana	145	135	7	275	243	13	190	213	−11	138	188	−27	748	779	−4
29.	Rayalaseema	63	59	6	145	85	70	175	98	79	100	132	−25	483	374	29
30.	Tamil Nadu	54	53	3	85	73	17	118	98	20	91	103	−12	348	327	6
31.	Coastal Karnataka	723	868	−17	1419	1161	22	711	678	5	303	303	0	3156	3010	5
32.	N.I. Karnataka	87	97	−11	12	149	−92	109	122	−10	117	150	−22	465	518	−10
33.	S.I. Karnataka	99	149	−34	279	279	0	195	186	5	148	138	7	721	752	−4
34.	Kerala	532	692	−23	720	759	−5	458	435	5	289	248	17	1999	2134	−6
35.	Lakshadweep	306	307	0	411	283	45	385	192	101	152	161	−6	1254	943	33

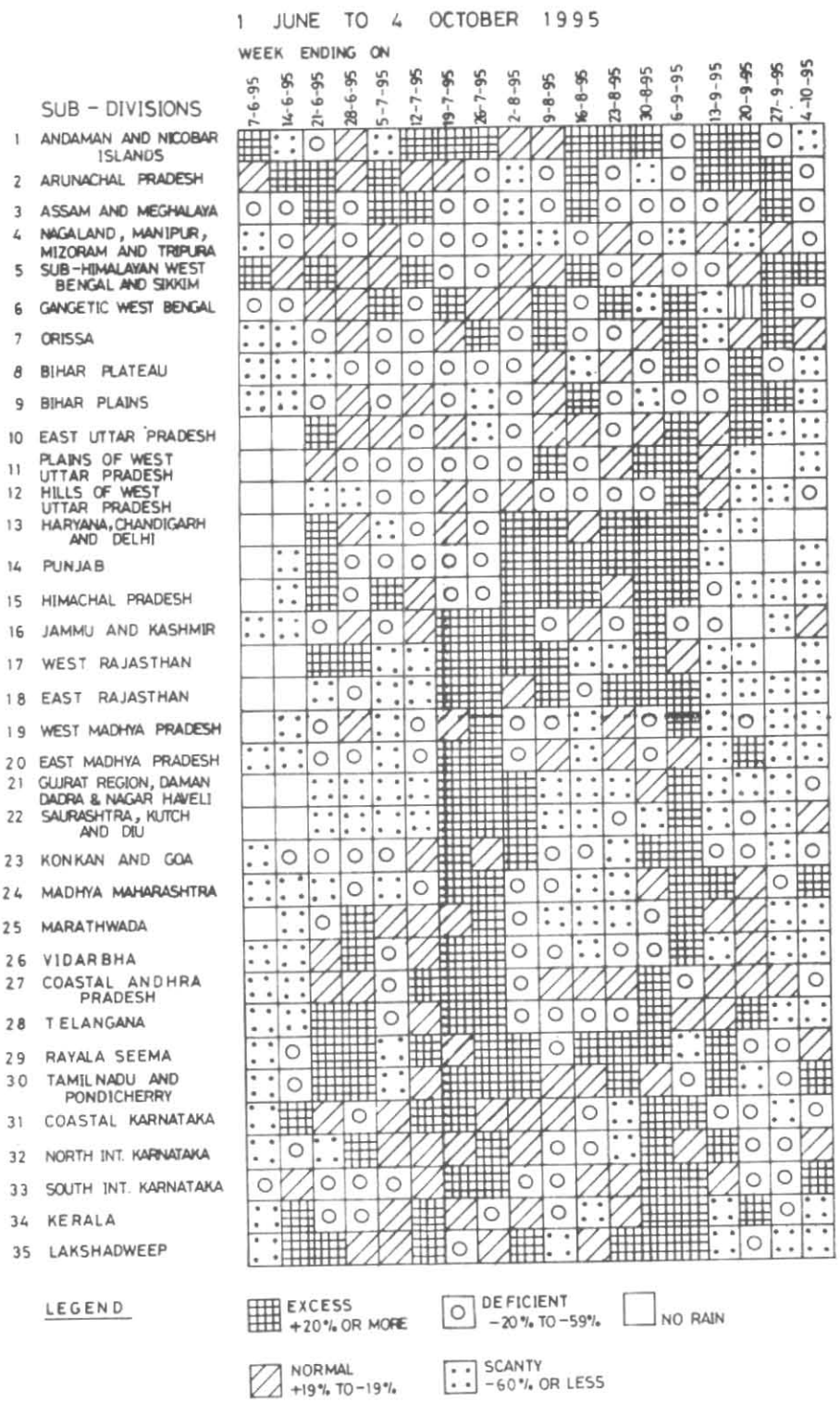


Fig. 4. Progress of southwest monsoon week by week (1 June to 4 October 1995)

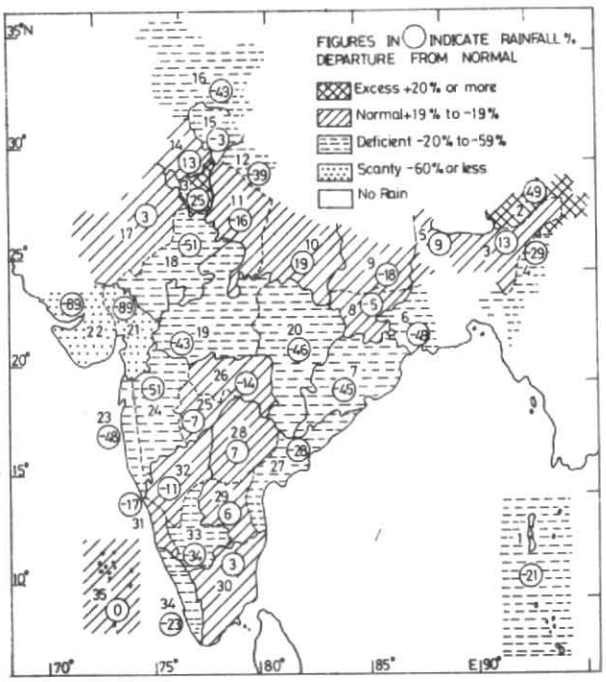


Fig. 5. Rainfall for the month of June 1995 (figures in circle indicate rainfall percentage departure from normal)

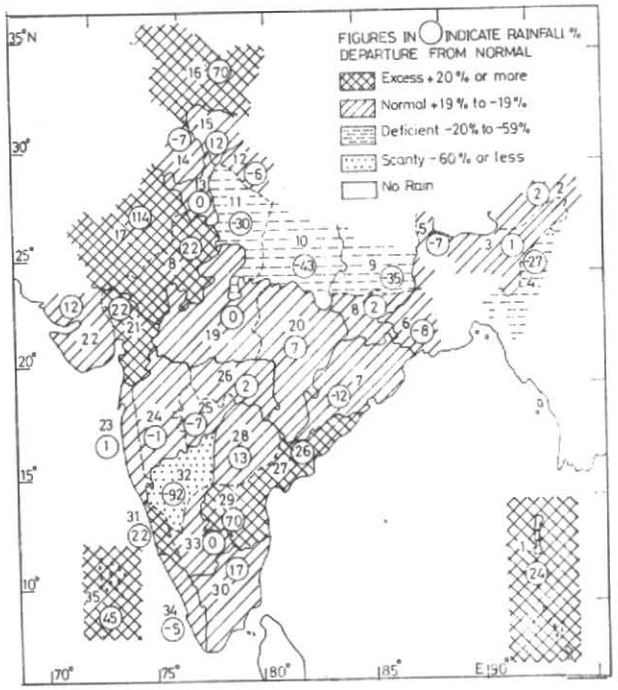


Fig. 6. Rainfall for the month of July 1995 (figures in circle indicate rainfall percentage departure from normal)

into a depression on 26 morning and lay centred close to Balasore. The system then moved in a northwesterly direction, crossed the north Orissa-West Bengal coast near Balasore around noon of 26. It lay centred near 23°N/80°E on 27 morning. The system then moved in a northeasterly direction and then remained practically stationary near 24°N/87°E on 27 evening and 28 morning. The system weakened into a well marked low pressure area over northeast Bihar Plateau and adjoining West Bengal by 28 evening.

Tracks of depressions are given in Fig. 10.

3.2. *Low pressure area/well marked low pressure area (LPA/WMLPA)*

During the season there were 11 low pressure areas/well marked low pressure areas which were the main rain producing synoptic systems over the country. Their monthwise break-up is as follows :

June-2, July-2, August-5 and September-2. Their details are given in Table 3-6.

3.3. *Cyclonic circulations (CYCIR)*

In all 40 cyclonic circulations (lower levels and upper levels) formed during this season giving well distributed rainfall over the country. The monthwise break-up is as follows :

June-10, July-9, August-12 and September-9. Their details are given in Tables 3-6.

3.4. *Off-shore trough*

During 10 June to 17 September 1995, the off-shore trough along parts of west coast (surface and in low levels) persisted on most of the days and this was one of the characteristic features of southwest monsoon 1995.

3.5. *Low level troughs*

In June, three lower level troughs in the eastern regions of country were formed. The third trough (3-5 June) helped in the advance of southwest monsoon over northeastern region of the country.

3.6. *Upper level troughs*

The westerly troughs in the mid and upper tropospheric levels which moved eastwards across north India are discussed here. Two such troughs moved across north India during June (2-3) and September (30 August-7 September). More details are given in Tables 3 & 6.

TABLE 2

Statewise no. of districts with excess, normal, deficient and scanty rainfall for the period 1 June to 30 September 1995

S. No.	State/UT	Excess	Normal	Deficient	Scanty	N.R.	**	Total
1.	Andaman & Nicobar Islands	—	1	—	—	—	—	1
2.	Arunachal Pradesh	—	2	—	—	—	3	5
3.	Assam	7	6	2	—	—	1	16
4.	Meghalaya	—	1	—	—	—	1	2
5.	Nagaland	—	—	1	—	—	—	1
6.	Manipur	—	1	—	—	—	—	1
7.	Mizoram	—	—	1	—	—	—	1
8.	Tripura	—	1	—	—	—	—	1
9.	Sikkim	—	—	1	—	—	—	1
10.	West Bengal	7	9	—	—	—	—	16
11.	Orissa	—	6	7	—	—	—	13
12.	Bihar	7	25	7	—	—	—	39
13.	Uttar Pradesh	11	33	12	—	—	—	56
14.	Haryana	16	—	—	—	—	—	16
15.	Chandigarh (UT)	1	—	—	—	—	—	1
16.	Delhi (UT)	1	—	—	—	—	—	1
17.	Punjab	9	2	1	—	—	—	12
18.	Himachal Pradesh	5	6	1	—	—	—	12
19.	Jammu & Kashmir	2	2	1	—	—	7	12
20.	Rajasthan	16	11	3	—	—	—	30
21.	Madhya Pradesh	4	29	12	—	—	—	45
22.	Gujarat	—	8	11	—	—	—	19
23.	Daman, Dadra & Nagar Haveli (UT)	—	—	1	—	—	—	1
24.	Diu (UT)	—	—	1	—	—	—	1
25.	Goa	—	1	—	—	—	—	1
26.	Maharashtra	—	18	12	—	—	—	30
27.	Andhra Pradesh	5	18	—	—	—	—	23
28.	Tamil Nadu	6	10	6	—	—	—	22
29.	Pondicherry (UT)	—	1	—	—	—	—	1
30.	Karnataka	4	14	2	—	—	—	20
31.	Kerala	—	11	3	—	—	—	14
32.	Lakshadweep (UT)	1	—	—	—	—	—	1
	Total	**102**	**216**	**85**	—	—	**12**	**415**

Total no. of districts from which data have been received = 403.
** Data inadequate.

TABLE 3

Weather systems during June 1995

S. No. (1)	Weather system (2)	Period (3)	Place of first location (4)	Direction of movement (5)	Place of dissipation (6)	Remarks (7)
(A)	*Low pressure areas*					
1.	Low pressure area	11-12	Meghalaya & neighbourhood	Stationary	*In situ*	It was first observed as a cycir over northwest Bay & neighbourhood on 9th. Associated cycir extended upto mid-tropospheric levels. It became less marked over northwest Bay & neighbourhood on 13
2.	Do.	22-25	Northwest Bay off Orissa coast	Northwesterly	Bihar & neighbourhood	It was first seen as a cycir over the same region on 21st. Associated cycir extended upto lower tropospheric levels over southeast Uttar Pradesh and neighbourhood till 25th and merged with the seasonal trough on 26th
(B)	*Embedded cyclonic circulations*					
1.	Lower levels	13-15	North Kerala-south Karnataka coasts	Stationary	*In situ*	
2.	Do.	17-22	North Kerala and adjoining Karnataka	Do.	Do.	
(C)	*Other cyclonic circulations*					
1.	Lower levels	4-9	Bihar & neighbourhood	Quasi-stationary	*In situ*	
2.	Mid-tropospheric levels	11-14	North Gujarat & neighbourhood	Stationary	Do.	
3.	Do.	14-16	South Maharashtra coast and neighbourhood	Do.	Do.	
4.	Do.	14-18	West-central Bay off Andhra coast	Westerly	Southeast Madhya Pradesh & neighbourhood	
5.	Lower levels	20-23	North Pakistan and adjoining Jammu & Kashmir	Northeasterly	Moved away across Jammu & Kashmir	
6.	Upper tropospheric levels	25-28	Northwest Bay off Orissa coast	Stationary	*In situ*	Merged with the cycir over Telangana & neighbourhood

TABLE 3 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
7.	Upper tropospheric levels	25-28	Maharashtra & neighbourhood	Stationary	*In situ*	
8.	Mid-tropospheric levels	29-30	East Vidarbha & neighbourhood	Do.	Do.	
(D)	*Troughs in the westerlies*					
1.	Mid and upper tropospheric westerlies	2-3	63°E north of 25°N	Easterly	66°E, north of 25°N	
(E)	*East-west troughs*					
1.	Mid-tropospheric levels	6-9	Southern parts of west-central Bay to southeast Arabian Sea across Kerala	Stationary	*In situ*	A cycir between 2.1 and 5.8 km asl lay over Lakshadweep area & neighbourhood on 9th and became less marked thereafter
2.	Do.	13-14	West-central Bay to east-central Arabian Sea	Do.	Do.	
3.	Do.	29-30	North coastal Andhra Pradesh to Karnataka	Northeasterly	Orissa to coastal Karnataka	
(F)	*Other troughs*					
1.	Lower tropospheric levels	1-2	Sub-Himalayan West Bengal and Sikkim to north Bay	Stationary	*In situ*	
2.	Do.	1-5	Bihar Plateau to south Tamil Nadu	Quasi-stationary	Do.	
3.	Do.	3-5	East Uttar Pradesh to Arunachal Pradesh across Bangladesh	Stationary	Do.	

3.7. *Eastward moving circulation/western disturbance*

Only one western disturbance as an upper air system moved across northwest India in September (22-26).

4. Extra Indian systems

4.1. *Cross-equatorial flow*

Cross-equatorial flow into the Arabian Sea (15 to 30 kt) was stronger than that in the Bay of Bengal (10 to 20 kt) throughout the monsoon. In June and July the strength of the cross-equatorial flow was 35 to 45 kt over the Arabian Sea and 20 to 30 kt over the Bay of Bengal.

Cross-equatorial flow in the Arabian Sea was stronger than normal by 5-10 kt in June, July and August. In September, they were stronger than normal by 10-15 kt. Cross-equatorial flow in the Bay of Bengal was stronger than normal by 5-10 kt in July, August and September. It was nearly normal in June.

TABLE 4

Weather systems during July 1995

S. No. (1)	Weather system (2)	Period (3)	Place of first location (4)	Direction of movement (5)	Place of dissipation (6)	Remarks (7)
(A)	*Low pressure areas*					
1.	Low pressure area	18-20	Bihar Plateau and adjoining parts of Gangetic West Bengal	Westerly	Northeast Madhya Pradesh & neighbourhood	First observed as a cycir over Bangladesh & neighbourhood on 13. Associated cycir extended upto mid-tropospheric levels which merged with the cycir over southwest Rajasthan on 21st
2.	Well marked low pressure area	22-27	Gangetic West Bengal and adjoining parts of north Orissa	First westnorthwesterly and then northwesterly	Central parts of Rajasthan	First observed as a cycir over the same area on 20, tilting southwestwards with height. Associated cycir extended upto mid-tropospheric levels. Moving northwestwards, it merged with the seasonal trough on 29th over north Rajasthan and adjoining Pakistan
(B)	*Cyclonic circulations*					
1.	Mid-tropospheric levels	30 Jun-2 Jul	Orissa & neighbourhood	Stationary	*In situ*	
2.	Do.	4-8	South Gujarat region & neighbourhood	Southwesterly	Gulf of Cambay	
3.	Lower tropospheric levels	7-9	Southeast Uttar Pradesh and adjoining east Madhya Pradesh	Easterly	East Madhya Pradesh and adjoining Bihar	
4.	Mid-tropospheric levels	10-11	North Gujarat and adjoining east Rajasthan	Stationary	*In situ*	
5.	Do.	11-23	South Gujarat and adjoining Gulf of Cambay	Northerly	Southeast Rajasthan & neighbourhood	Merged with the seasonal trough
6.	Do.	13-17	Bangladesh & neighbourhood	Westerly	Southeast Uttar Pradesh and adjoining east Madhya Pradesh	Merged with the monsoon trough
7.	Lower levels	20-22	North Pakistan and adjoining Jammu & Kashmir	Eastnortheasterly	Moved away across western Himalayas	

TABLE 4 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
8.	Lower levels	23-26	North Pakistan	Easterly	Moved away across western Himalayas	
9.	Mid-tropospheric levels	27 Jul-1 Aug	Northwest Bay and neighbourhood	—	—	Under its influence, a low pressure formed over north Orissa-West Bengal coast on 2nd August

4.2. *Mid-latitude troughs*

There were 29 mid and upper tropospheric westerly troughs which moved along Lat. 30°N in Northern Hemisphere and also along 30°S in Southern Hemisphere. 18 troughs moved across north India and 11 troughs moved across south Indian Ocean in Southern Hemisphere.

4.3. *Systems in South China Sea/northwest Pacific Ocean*

During the four months of 1995, there were 5 typhoons (including 2 super typhoons), 7 tropical storms and 4 tropical depressions making total of 16 systems against 24 in the last year. Their monthwise break-up is given in Table 7.

4.4. *Systems in Southern Hemisphere*

(a) No tropical cyclone formed in the south Indian Ocean.

(b) The intensity of Mascarene high was 1-2 hPa above normal in July, August and September (normal intensity is 1024 hPa). In June, the Mascarene high had normal intensity.

The Mascarene high was east of normal position (30°S/60°E) by 7° to 10° in June, 8° to 10° in July and August and about 2° in September.

(c) The normal intensity of Australian high is around 1020 hPa near Lat. 28°-29°S. The intensity of Australian high was above normal by 3 hPa in June. 5 hPa in August and 6 hPa in September. It was normal in July, *i.e.*, 1020 hPa. The Australian high was 4° south of the normal position (28°S) in June. While it was near normal position in July, August and September.

5. Semi-permanent systems

5.1. *Heat low*

The heat low over Pakistan and adjoining parts of west Rajasthan appeared on 13 June and persisted there almost in the same position till 3 July. It later shifted westwards. The lowest pressure value of the heat low was 985 hPa on 2 July.

The heat low again was well formed from 26 July to 1 September over Pakistan and adjoining west Rajasthan. The lowest pressure value was 991 hPa, on 13 August and 992 hPa, on 1, 2, 3 August and 993 hPa on 6, 8 and 31 August.

5.2. *Axis of the monsoon trough*

Axis of the monsoon trough (surface and at 0.9 km asl) extending from Bikaner to east-central Bay across the plains of North India was established by 20 June 1995. On 2 and 3 July, western end of the axis shifted to the foot hills of Himalayas, whereas the eastern end was over head Bay. On 4 and 5 July, monsoon trough was at foot hills of Himalayas. It shifted to the south afterwards and remained in its normal position till end of July.

In August, monsoon trough was seen in its normal position or south of its normal position except from 12 to 15 August when it lay close to the foot hills of Himalayas. On 1 to 5 September monsoon trough was seen along its normal position and became less marked afterwards.

5.3. *Tibetan anticyclone/high*

Tibetan anticyclone/high got established and was well defined during the last week of June, both at 500 hPa as well as at 300 hPa level. Its position at 300 hPa level was near 20°N/88°E and at 500 hPa it was near 26°N/92°E.

TABLE 5

Weather systems during August 1995

S. No. (1)	Weather system (2)	Period (3)	Place of first location (4)	Direction of movement (5)	Place of dissipation (6)	Remarks (7)
(A)	*Low pressure areas*					
1.	Well marked low pressure area	7-11	Northwest Bay and adjoining parts of north Orissa-West Bengal coasts	Westnorthwesterly	North Madhya Pradesh and adjoining parts of Uttar Pradesh	It was observed as a cycir extended upto mid-tropospheric levels over northeast Bay & neighbourhood on 7th. Associated cycir extended upto mid-tropospheric levels which became unimportant over south Uttar Pradesh & neighbourhood on 12th
2.	Do.	27 Aug - 2 Sept	Northwest Bay off Orissa-West Bengal coasts	First southwesterly then westnorthwesterly and westerly (Recurved in northerly direction)	North Vidarbha & neighbourhood	First observed as a cycir over south Orissa coast & neighbourhood. Associated cycir extended upto mid-tropospheric levels tilting southwestwards with height. Due to the presence of deep trough in the upper tropospheric westerlies, it recurved in northerly direction and lay over central parts of west Madhya Pradesh on 3rd. Moving further in northerly direction, it lay over Haryana & neighbourhood on 4th and became less marked on 5th
3.	Low presure area	2-6	North Orissa-West Bengal coast and adjoining parts of northwest Bay	Northwesterly	South Uttar Pradesh (merged with the seasonal trough)	First observed as a cycir over northwest Bay & neighbourhood on 29th July. Associated cycir extended upto upper tropospheric levels tilting southwestwards with height
4.	Do.	13-15	North Pakistan and adjoining Afghanistan	Stationary	*In situ*	
5.	Do.	17-19	Northwest Bay off Orissa coast	Northwesterly	North Orissa and adjoining Bihar Plateau	First observed as a cycir over northwest Bay & neighbourhood on 16th. Associated cycir extended upto mid-tropospheric levels, tilting southwestwards with

TABLE 5 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
						height which merged with the monsoon trough on 21st over north Madhya Pradesh and adjoining parts of Uttar Pradesh
(B)	*Cyclonic circulations*					
1.	Mid-tropospheric levels	29 Jul-3 Aug	North Gujarat Region & neighbourhood	Stationary	*In situ*	
2.	Do.	3-9	Northwest Madhya Pradesh & neighbourhood	Northwesterly and then westerly	Northwest Pakistan & neighbourhood	
3.	Mid-tropospheric levels	6-7	Bihar Plateau & neighbourhood	Stationary	*In situ* (merged with the seasonal trough)	
4.	Do.	8-12	Northwest Madhya Pradesh & neighbourhood	Northwesterly	North Pakistan & neighbourhood	
5.	Do.	9-10	Southwest Rajasthan & neighbourhood	Do.	Northwest Pakistan & neighbourhood	
6.	Do.	10-20	North Gujarat & neighbourhood	Northwesterly and then southeasterly	North Gujarat Region and adjoining parts of Kutch	
7.	Lower tropospheric levels	15-17	Punjab & neighbourhood	Stationary	*In situ*	
8.	Mid-tropospheric levels	21-26	Gangetic West Bengal and adjoining parts of Bihar Plateau	Northwesterly	East Rajasthan & neighbourhood	Merged with the seasonal trough
9.	Do.	22-31	Gangetic West Bengal & neighbourhood	Northwesterly	Punjab & neighbourhood	
10.	Do.	23-24	South Tamil Nadu & neighbourhood	Stationary	*In situ*	
11.	Do.	24-26	North Gujarat & neighbourhood	Southeasterly	North Madhya Maharashtra	
12.	Do.	30 Aug-1 Sep	North Maharashtra coast and adjoining parts of east-central Arabian Sea	Stationary	*In situ*	Tilting southwestwards with height

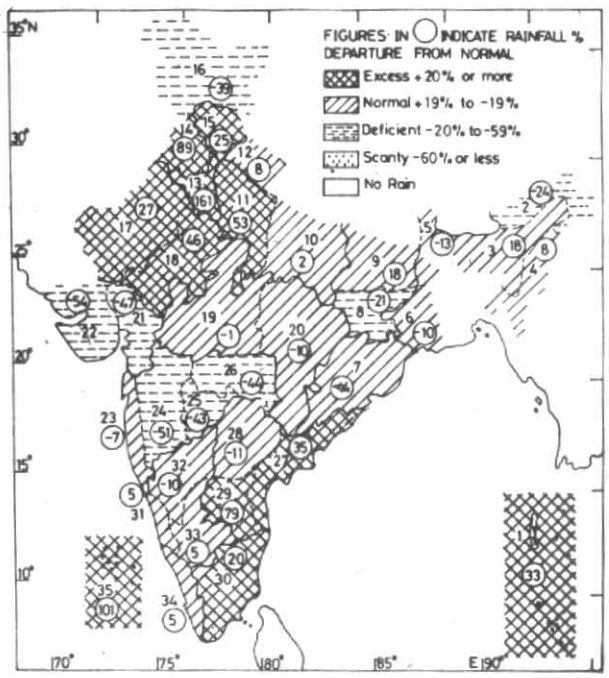


Fig. 7. Rainfall for the month of August 1995 (figures in circle indicate rainfall percentage departure from normal)

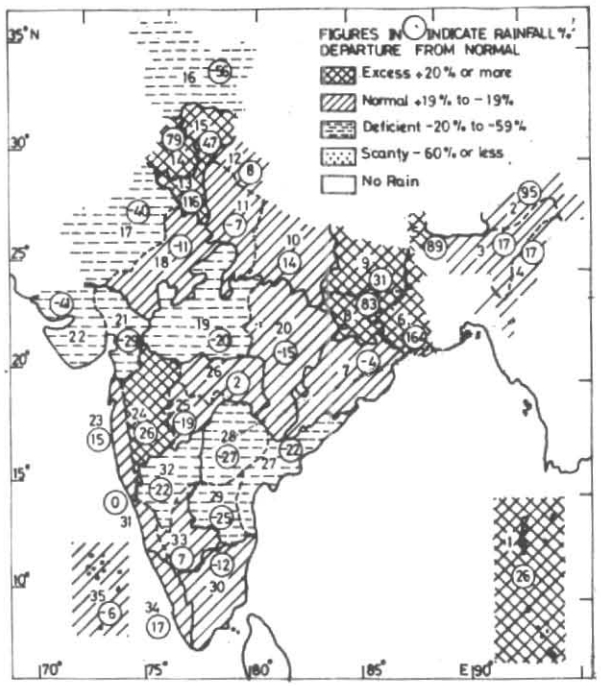


Fig. 8. Rainfall for the month of September 1995 (figures in circle indicate rainfall percentage departure from normal)

It was well defined again from 10 to 28 July near 30°N/95°E at 500 hPa and near 30°N/92°E at 300 hPa level. In August, it was seen near 32°N/90°E at 500 hPa and 30°N/95°E at 300 hPa. From the second week of September, it became unimportant at both levels.

5.4. *Westerly jet*

As the core of westerly jet was north of 35°N, winds were less than 60 kt at 200 hPa level over Jodhpur, Delhi, Srinagar, Gwalior, Lucknow, Calcutta and Guwahati during the almost entire season.

5.5. *Tropical easterly jet (TEJ)*

Tropical easterly jet was well formed from 16 June onward between the latitude 12° to 15°N over the Indian peninsula. On 25 June, Port Blair reported maximum wind of 80 kt at 117 hPa; on July 18, Madras reported 110 kt at 118 hPa. Maximum wind of 95 kt was recorded at Madras on 2 August. The core winds of the TEJ were between 100 to 120 kt during July to mid-September 1995. A second core of TEJ was formed between Lat.18°N to 20°N during July and August. The maximum wind of 120 kt at 107 hPa was recorded by Aurangabad on 12 August.

6. Sea surface temperature (SST)

6.1. *Monthly mean SST over Arabian Sea and Bay of Bengal*

Isopleths of normal values and the anomalies of SST for the months of June, July, August and September are given in Figs. 11 (a-d).

In June, SSTs were above normal by about 1°C over most parts of Arabian Sea except northeast Arabian Sea and over southeast Bay. They were nearly normal over southwest Bay.

In July, SSTs were above normal by about 1°C over south and central Arabian Sea and over south Andaman Sea. They were nearly normal over south Bay.

In August, SSTs were normal by about 1°C over east central and south Arabian Sea and over south Bay. They were above normal by 2°C over west-central Arabian Sea and south Andaman Sea.

In September, SSTs were above normal by about 1°C over west central and south Arabian Sea and over southeast Bay and south Andaman Sea. They were nearly normal over east central Arabian Sea and southwest Bay.

TABLE 6

Weather systems during September 1995

S. No. (1)	Weather system (2)	Period (3)	Place of first location (4)	Direction of movement (5)	Place of dissipation (6)	Remarks (7)
(A)	*Depressions/low pressure areas*					
1.	Depression	14-21	East-central Bay	Westnorthwesterly and then northwesterly	Bihar Plains and adjoining parts of Uttar Pradesh	First observed as a trough over east-central Bay to north Andaman Sea off Tenasserim coast, low pressure area formed on 14th. Associated cycir extended upto mid-tropospheric levels. It crossed West Bengal-Orissa coasts near Balasore in the early morning of 17th
2.	Do.	24-29	Northwest Bay off north Orissa coast & neighbourhood	Initially northwesterly then northerly and finally northwesterly	Northeast Bihar Plateau and adjoining parts of West Bengal	First observed as a cycir over west-central and adjoining southwest Bay on 21. Under its influence a low pressure area formed over northwest Bay off north Orissa coast & neighbourhood on 24. It became well marked over the same region on 25, concentrated into a depression on 26th close to Balasore (21.5°N/87.5°E). It crossed Orissa coast near Balasore on the same evening, weakened into well marked low pressure area on 28th over northeast Bihar Plateau and adjoining parts of West Bengal and became less marked on 29th
3.	Low pressure area	6-8	West Bengal coast and adjoining northwest Bay	Northwesterly	Southern parts of west Uttar Pradesh	First observed as a cycir over Gangetic West Bengal and north Orissa and associated cycir extended upto mid-tropospheric levels. It persisted till 13th and became less marked over Himachal Pradesh
4.	Do.	11-12	West-central Bay off Andhra coast	Stationary	*In situ*	First observed as a cycir over northnorth Andaman Sea and neighbourhood on 8th and

TABLE 6 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
						associated cycir extended upto mid-tropospheric levels, moving westwards. It became less marked over east-central Arabian Sea on 15th
(B)	*Cyclonic circulations*					
1.	Mid tropospheric level	6-11	Saurashtra and Kutch	Southwesterly	East-central Arabian Sea and adjoining Gujarat coast	
2.	Lower tropospheric levels	13-15	Northern parts of Madhya Pradesh & neighbourhood	Northeasterly	East Uttar Pradesh and adjoining Bihar Plains	
3.	Mid-tropospheric levels	12-14	East-central Arabian Sea, off Maharashtra coast	Westerly	Central Arabian Sea	
4.	Do.	14-18	East Madhya Pradesh and adjoining Orissa	Stationary	*In situ*	Merged with the well marked low pressure area
5.	Do.	19-21	Gulf of Siam & neighbourhood	Northwesterly	Tennasarim coast and adjoining parts of north Andaman Sea	
6.	Do.	14-17	Central Pakistan and adjoining west Rajasthan	Stationary	*In situ*	
7.	Do.	23-27	Gulf of Cambay and neighbourhood	Quasi-stationary	Gujarat coast	
8.	Do.	25-29	Off north Karnataka-Goa coasts	Northwesterly	South Maharashtra coast & neighbourhood	
9.	Do.	29-30	Punjab & neighbourhood	Northeasterly	Moved away northeastwards across Himachal Pradesh	
(C)	*Western disturbance*					
1.	Upper air system	22-26	North Pakistan & neighbourhood	Northeasterly	Moved away across Jammu & Kashmir	
(D)	*Trough in the westerlies*					
1.	Mid and upper troposphere	29 Aug-7 Sept	72°E, north of 25°N	Easterly	74°E, north of 25°N	

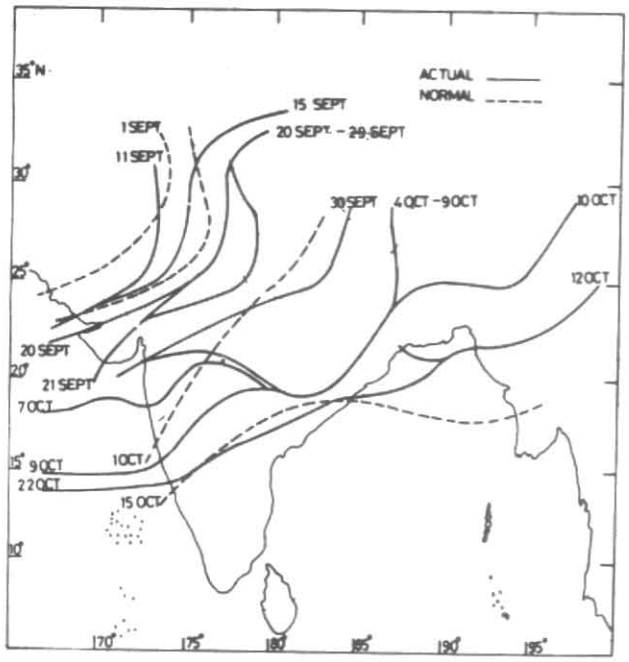


Fig. 9. Withdrawal of southwest monsoon 1995

The values of normal SSTs for calculation of anomalies are estimated from the isopleths of normal values.

These statements are based on real time data which were sometimes not adequate in number.

7. Other features

7.1. *Weekly anomalies in monsoon circulation 1995*

Weekly anomaly charts are prepared for 850, 700 and 200 hPa levels and the corresponding anomaly troughs and ridges are marked. Weekly wind anomalies for some stations are given in Table 8.

June-July — During these two months, prominent anomaly troughs were seen in the lower levels (850 & 700 hPa). First anomaly trough in lower levels was seen on 13 June along 10°N which remained more or less at same position on 20 June and subsequently became unimportant. The second anomaly trough was seen along 11°N on 11 July and moved to 22°N on 18 July and to 24°N on 25 July. The anomaly ridge in lower levels was along 20°N on 20 June, along 12°N on 27 June, along 20°N on 4 July, along 22°N on 11 July between 10° to 15° on 18 July and between 10° to 15°N on 25 July. Ridge was along 21°N on 1 August.

At 200 hPa, during June, anomaly winds over the peninsula were throughout westerlies. In first two weeks and in the last week of July anomaly winds were easterly. On 18 and 25 July, mostly northerly anomaly winds were present.

August-September — First anomaly trough on 8 August was seen in NW-SE orientation and was running from north Rajasthan to Gangetic West Bengal. The second anomaly trough was seen along 14°N on 29 August and was weak. It moved to 19°N on 5 September. The third anomaly trough was along 19°N on 19 September. Anomaly ridge was seen between 10-15°N on 8 August, along 18°N on 15 August and 22 August, along 23°N on 12 September along 10°N on 19 September.

At 200 hPa, during second fortnight of August and on 12 September, the anomaly winds over peninsula were mostly westerlies. On 19 September easterly winds were present over peninsula and for rest of the period the anomalies were variable.

7.2. *Stratospheric features*

Launching of rocket from Thumba and Balasore have been stopped from September 1993 and April 1995, respectively. Therefore, data of 10 hPa over these stations are not available. However, the Rawindsonde data over Balasore is available upto 30 hPa on most of the days. The analysis of the data shows that the easterly winds prevailed in lowest stratosphere upto 3 hPa during entire monsoon season. Around 50 hPa, the easterlies were prominent during monsoon reaching at times upto 30 hPa.

7.3. *Aridity conditions during monsoon 1995*

Aridity index (AI) is computed based on standard Thornthwaite's formula.

The difference between actual aridity for the week and normal aridity, *i.e.*, the aridity anomaly is worked out. The aridity anomaly has been classified into the following categories :

Aridity Anomaly	*Category*
Zero or less	Non-arid
1 to 25	Mild arid
26 to 50	Moderate arid
More than 50	Severe arid

TABLE 7

Tropical storms/depressions in the northwest Pacific 1995

S. No.	Weather systems	June	July	August	September	Total
1.	Depressions	0	1	1	2	4
2.	T.S.	2	1	3	1	7
3.	Typhoons	0	1	0	2	3
4.	Super Typhoons	0	0	0	2	2
5.	Total	2	3	4	7	16

N.B. — Six systems recurved northeastwards.

TABLE 8

Anomaly winds during June-September 1995

	6 Jun	13 Jun	20 Jun	27 Jun	4 Jul	11 Jul	18 Jul	25 Jul	1 Aug	8 Aug	15 Aug	22 Aug	29 Aug	5 Sep	12 Sep	19 Sep	26 Sep
Lower tropospheric westerly — weekly wind anomalies*																	
TRV																	
850 hPa	04905	24008	32410	11404	28805	32206	27601	13604	04502	04805	12912	10605	29004	27416	07806	20603	35006
700 hPa	08915	25811	03609	10805	31507	32605	08505	09314	09207	10106	12014	08811	29405	27702	04505	14202	00606
BMB																	
850 hPa	01008	01201	19102	01104	35904	09709	20309	25707	01104	30805	17301	02104	32203	35201	10105	04412	28505
700 hPa	34707	31707	14709	06312	01309	11016	18611	28207	33405	35005	10205	02405	08703	32502	13712	04515	23805
NGP																	
850 hPa	34413	29606	18707	02502	00803	11910	26009	26012	15607	28807	25006	33409	33901	29703	10906	07606	31407
700 hPa	03706	20809	22103	00509	04503	11412	28209	25806	18307	25807	26507	00802	27301	35102	10305	05606	31604
Tropical easterly jet — wind anomalies*																	
MDS																	
200 hPa	21808	19106	34504	31711	07515	08609	01912	31716	13802	25906	27503	25107	30509	05709	26007	07701	34806
TRV																	
200 hPa	23921	16408	08613	33504	13214	14508	—	00704	18604	14806	17008	21910	28213	10113	22308	17815	12608

* Easterly anomalies at 850 and 700 hPa means westerlies are weaker than normal.
* Westerly anomalies at 200 hPa means easterlies are weaker than normal.

Aridity anomaly maps for June and July are given in Fig. 12 (a & b) and for August and September are given in Fig. 12 (c & d). Moderate to severe arid conditions prevailed mostly over northwest India and few parts of peninsula during the period July to September.

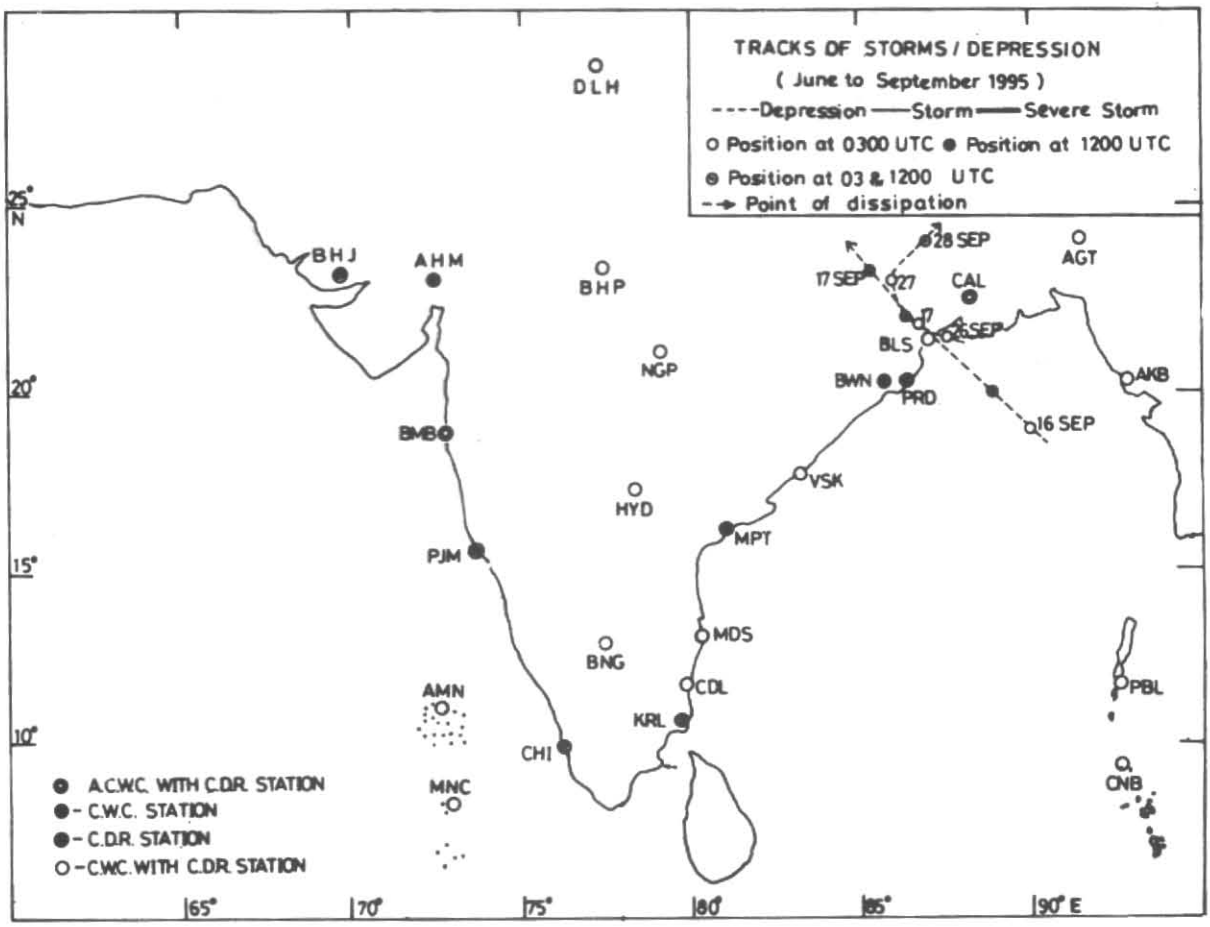


Fig. 10. Tracks of storms/depressions (June-September 1995)

8. Characteristic features of southwest monsoon 1995

(*i*) The southwest monsoon first set in over northeastern states on 5 June and later over Kerala on 8th June. The delay of one week from the normal date was the largest during the past decade (1986-95). No onset vortex over Arabian Sea was associated with the onset process. The event of earlier onset of monsoon over northeastern states than Kerala happened in the earlier years of 1972 and 1975.

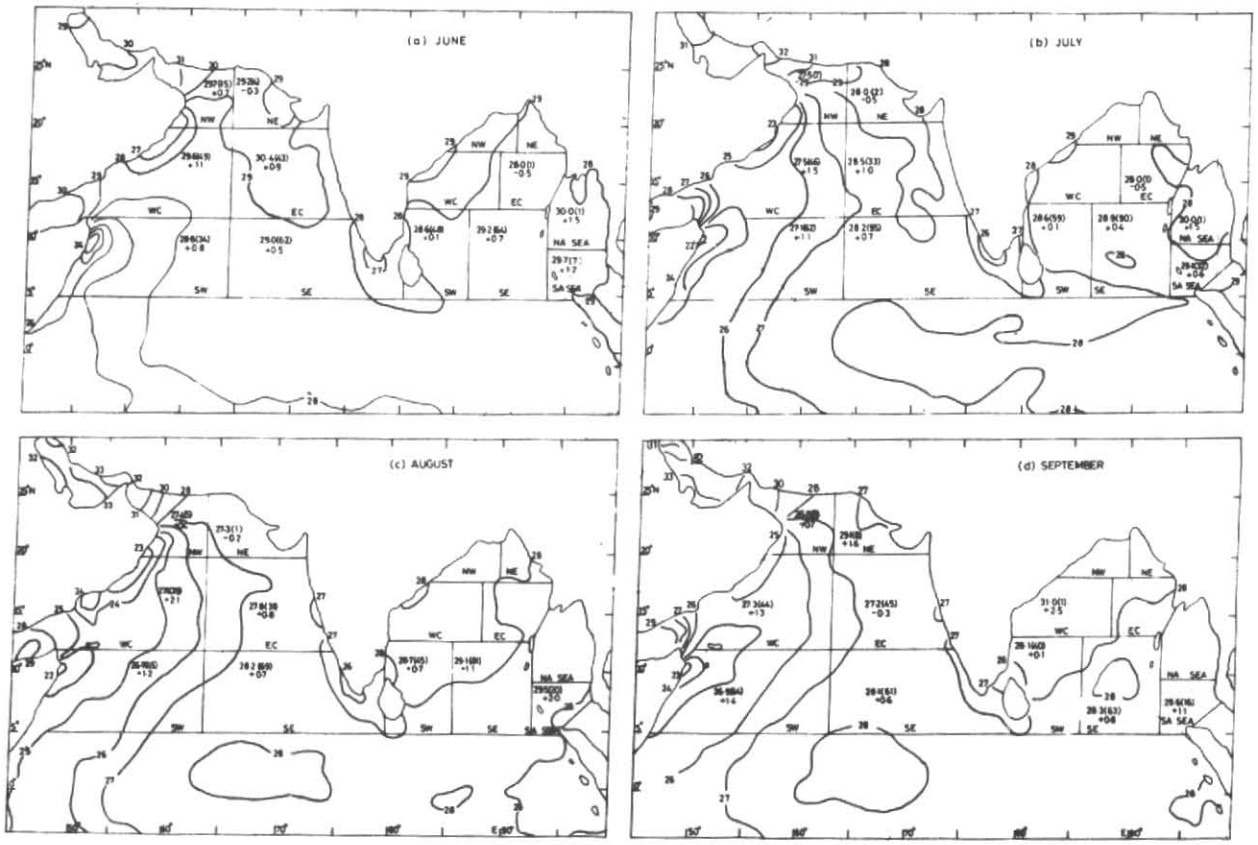
(*ii*) No depression formed in the months of June, July and August. During the season only two monsoon depressions formed in September.

(*iii*) Several low pressure systems and upper air cyclonic circulations have contributed well distributed rainfall in space and time over the country. Only two sub-divisions, Gujarat region and Saurashtra & Kutch, had marginal deficient rainfall in the season.

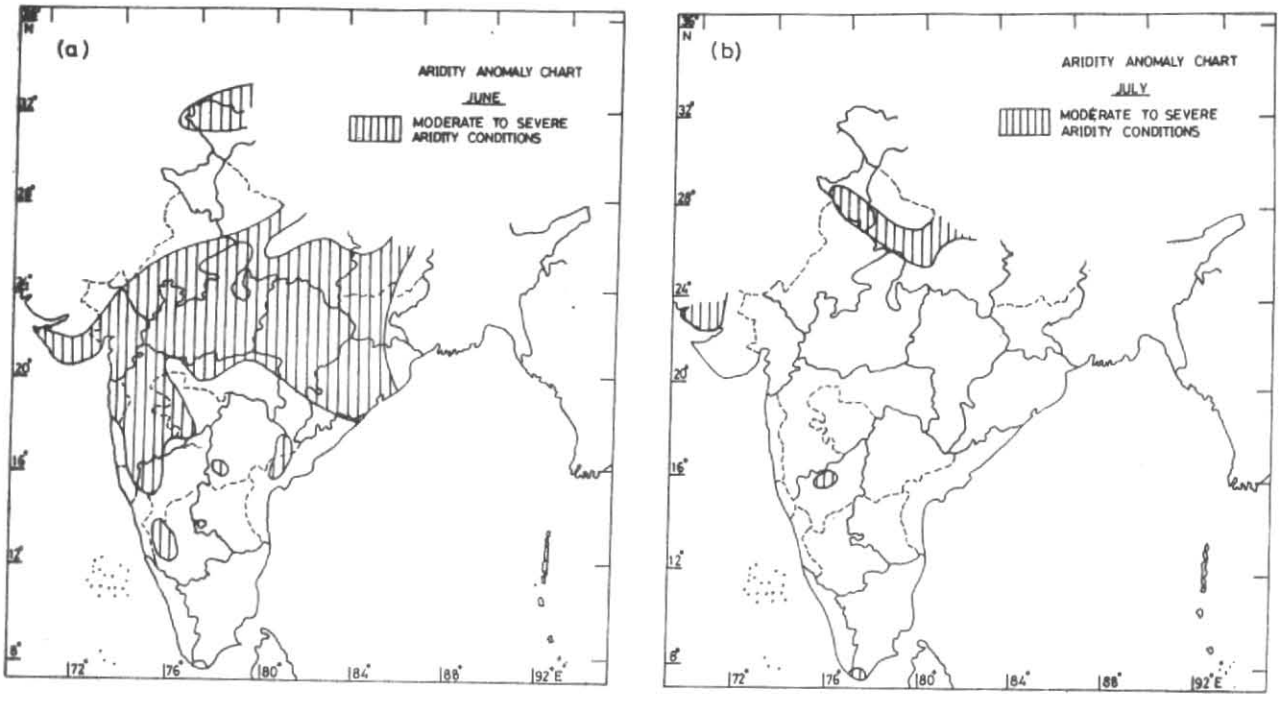
(*iv*) More than 25 meteorological sub-divisions received excess or normal rainfall in the month of July, August and September.

(*v*) All the low pressure areas except one, which formed over north Pakistan and adjoining Afghanistan in August (13-15), formed as an upper air cyclonic circulations and then descended to the surface as low pressure areas.

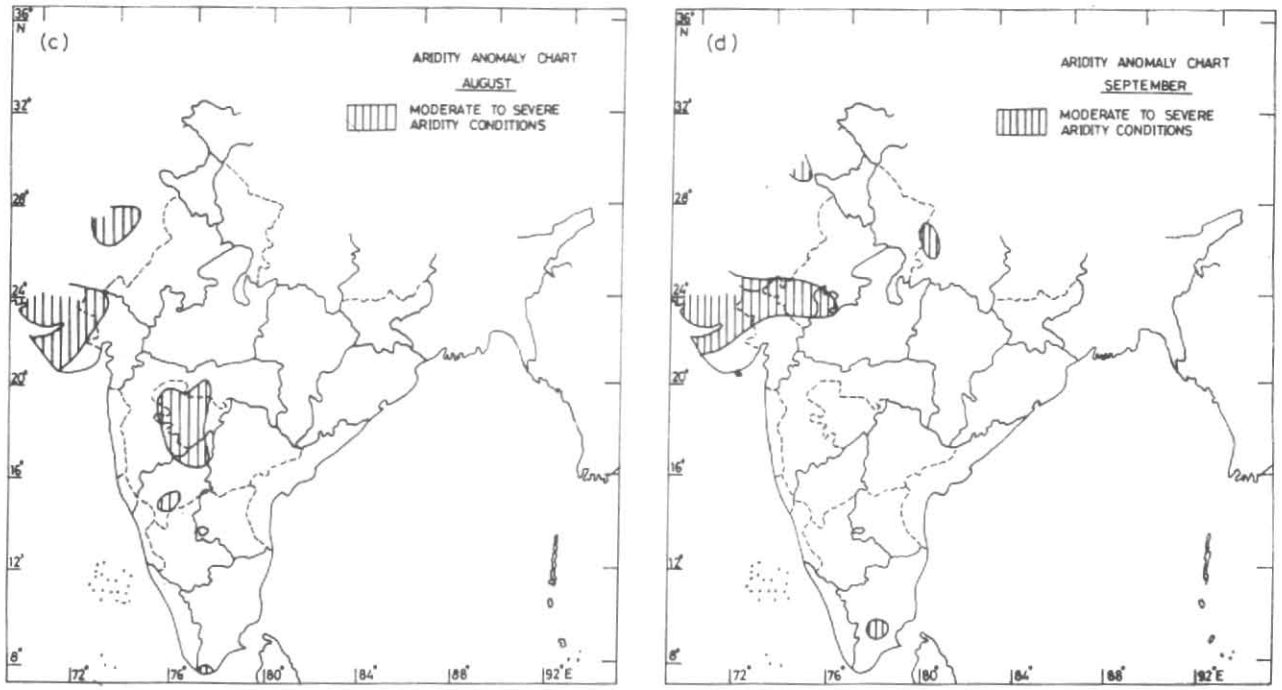
(*vi*) The seasonal trough remained active near its normal position on most of the days in the season. Break monsoon situation was present for a very short



Figs. 11 (a-d). Mean monthly (June-September 1995) SST anomalies (°C) of Indian seas during SW monsoon 1995



Figs. 12 (a & b). Meteorological sub-divisions affected by moderate to severe aridity conditions during (a) June and (b) July 1995



Figs. 12 (c & d). Meteorological sub-divisions affected by moderate to severe aridity conditions during (c) August and (d) September 1995

spell between 4 & 5 July and 12 & 15 August.

(*vii*) Northeast monsoon rains commenced over Tamilnadu and adjoining parts of Andhra Pradesh, Karnataka and Kerala on 23 October 1995, simultaneously when southwest monsoon withdrew from the above area.

(*viii*) Tibetan anticyclone/high was well defined on most of the days in the season both at 500 hPa as well as at 300 hPa level.

(*ix*) Off-shore trough along the parts of west coast on the surface and/or in the lower levels persisted for most of the days.

9. Damage due to floods etc. during monsoon season

Heavy rains/floods caused considerable damage in the states of Jammu & Kashmir, Himachal Pradesh, Punjab, Rajasthan, Haryana, Uttar Pradesh, Bihar, Orissa, West Bengal, Assam and Arunachal Pradesh. According to press reports, millions of people were affected due to heavy rains/floods and landslide. About 780 people lost their lives due to floods mainly in northwest, north and northeastern states of the country.

9.1. *Significant spells of heavy rains*

During June, widespread rains with isolated heavy falls occurred in Sub-Himalayan West Bengal & Sikkim on a number of days, in Andaman & Nicobar Islands, Gangetic West Bengal and Orissa between 20 and 26, in Assam & Meghalaya, coastal Karnataka and Kerala between 9 and 17 and 3 to 4 days between 20 and 30. Widespread rains with isolated heavy rains also occurred on 5 to 8 days in Arunachal Pradesh, Konkan & Goa, Vidarbha and Telangana during 2nd half of June.

In July, widespread rains with isolated heavy falls occurred over Sub-Himalayan West Bengal & Sikkim and Konkan & Goa on a number of days. Widespread rains with isolated heavy falls occurred in Assam & Meghalaya between 6-9 and 27-31; in Orissa between 14-23; in Himachal Pradesh between 2-9 and 23-30; in Madhya Pradesh between 19 and 25; in Gujarat region and in madhya Maharashtra between 16 and 31; in coastal Andhra Pradesh between 15 and 25 and in coastal

APPENDIX I

Principal amounts of rainfall during June, July, August and September 1995

Rainfall amounts in cm (7 cm and above)

Date (1)	June (2)	July (3)	August (4)	September (5)
1	Champasarai 19, Kokrajhar 6	Champasarai 23, Kottayam 15, Mangalore 11, Saralpara & Vengurla 10 each, Panjim 7	Rajapur 30, Karwar 13, Chandradeepghat & Harnavwier 10 each, Basua 9, Kalimgapatnam & Rangagora 8 each, Buldhana & Madras 7 each	Dapoli 25, Karkala 20, Bhagamandala 19, Vythiri 17, Bombay 16, Deesa & Raipur 8 each, Aurangabad 7
2	Lakhimpur 8, Sevoke 7	Kakrahi 18, Sevoke 16, Goalpara 13, Dapoli, Koilwar & Madikeri 7 each	Jogindernagar 30, Khairamal & Kunda Bridge 10 each, Mahabaleshwar & Sawantwadi 9 each, Gohana 8, Kharagpur 7	Mahabaleshwar 24, Bhagamandala & Rajapur 17 each, Karwar 14, Maheshwar & Yeotmal 12 each, Champua 10, Ambejogai 7
3	Domohani 14, Passighat 9, Jalpaiguri 8, Agartala 7	Sandheads 19, Naraingarh 13, Goalpara & Panjim 12 each, Sringeri 11, Bharari, Kondul & Panchet 7 each	Sawai Madhopur 17, Diamond Harbour 15, Ankola, Humcha & Mathura 11 each, Pathankot 10, Mandi & Sibsagar 9 each	Bhira 35, Mahabaleshwar 20, Guna, Nanipalsan & Somwarpeth 15 each, Narnaul 13, Paratwada 12, Bhavnagar & Kalimpong 9 each
4	Nil	Sandheads 17, Shimla 10, Koilwar & Sundernagar 9 each	Naharkatia 12,, Agumbe & Tusuma 11 each, Belthangady, Bhatinda & Sundernagar 9 each, Kota & Palwal 8 each	Barota 39, Chamba 28, Samana 27, Naraingarh 16, Gwalior 15, Peermade 12, Uttarkasi 7
5	Port Blair 14, Malda 10	Beki Mathanguri 28, Kahu 10, Itanagar 9, Jammu 7	Bhatinda & Honavar 12 each, Manjeri 9, Kota 8, Agumbe & Jaipur 7 each	Barota 37, Ludhiana 29, Chamba 26, Tijara 22, Chandigarh 19, Daltonganj 11, Itanagar 7
6	Port Blair 24, Chauldhaghat 8, Gangtok 7	Beki Mathaguri 18, Taliparamba 13, Kundapura 9, Maya Bandar 8	Kancheepuram 13, Sevoke 12, Patti & Taibpur 8 each, Aurraiya, Basti, Bhanwargarh & Guna 7 each	Kangsabati 12, Gangtok 10, Katerniaghat 9, Jamshedpur & Maya Bandar 8 each
7	Dhubri 10	Galgalia 15, Amini Divi & Beki Mathanguri 13 each, Khammam, Mangalore & Quilandy 11 each, Thirupattur 10, Malvan 8	Munger 13, Pathankot 11, Adoor & Numaligarh 9 each, Delhi & Diamond harbour 8 each, Dindigul, Gudur & Jaipur 7 each	Gaya 12, Gazipur 10, Karkala, Nancowry & Passighat 8 each, Dibrugarh, Japal 7 each
8	Chouldhowaghat 8, Margherita & Sandheads 7 each	Beki Mathanguri 23, Mathabhanga 22, Nahan 9, Honavar & Ratnagiri 8 each, Naraingarh & Raipur 7 each	Bharatpur 18, Naraingarh 14, Gwalior 12, Balarampur 9, Darauli, Nagrota & Surian 8 each	Kanpur & Mohana 9 each, Nancowry 8, Dharamsala 7
9	Midnapore 10	Shimla 18, Chepan 14, Basua 13, Kokrajhar 11, Sind-Khed 9, Panjim 8	Gurudaspur 15, Agumbe & Narnaul 12 each, Karkala & Thakurmunda 11 each, Khowang 8, Hindon & Nurpur 7 each	Car Nicobar 8
10	Kasargode & Mangalore 11 each	Basti 23, Malwan & Shirali 11 each, Patna 10, Dholai 9, Chengannur 8, Dasuya 7	Jabalpur 15, Port Blair 9, Bhatinda 8, Berhampur, Honavar & Kalpi 7 each	Nangal 21
11	Peermade 16, Mulki 13, Mangalore & Perinthalmanna 9 each, Agartala 7	Mudibagere 36, Qulandy 21, Sawantwadi 16, Jhanjharpur 15, Lakhipur & Panjim 11 each	Khowang 23, Cooch Behar 18, Sevalahabad 9, Channapatna & Tezu 7 each	Golaghat 14, Barota 10, Hoskote & Namakkal 8 each, Sholapur 7

APPENDIX I (*Contd.*)

Date (1)	June (2)	July (3)	August (4)	September (5)
12	Mangalore & Piravom 10 each, Bahalpur 9, Sevoke 7	Sandheads 19, Nahan 17, Katol 16, Agumbe & Kasargode 15 each, Passighat & Saralpara 9 each	Beki Mathanguri 42, Katra & Miao 17 each, Sikandarpur 13, Mathabhanga 12, Bharari & Sira 11 each, Sattenapalli 8	Muddebihal 9, Nalagonda 8, Sompeta 7
13	Agumbe 18, Hosdurg 14, Agartala & Passighat 10 each, Amini Divi & Panbari 8 each	Kakrahi 28, Sandheads 22, Chouldhowaghat & Ganganbavda 11 each, Ankola & Jabalpur 8 each	Chanpatia 35, Guler 17, Dhubri 16, Baghdogra 13, Khadda & Naraingarh 11 each, Marora 10, Kunnavaram 8	Kaladgi, Rajampet & Srigonda 10 each, Malvan 9, Mainpuri 7
14	Kunnamkulam 20, Bahalpur, Mulki & Sankalan 18 each, Cooch Behar 11, Sawantwadi 9	Bhira 13, Mahabaleshwar 11, Hosdurga 10, Gazipur, Motisagar & Sandheads 9 each	Beki Mathanduri 29, Patiala 18, Cooch Behar 17, Naraingarh 16, Bhagalpur & Sujanpur Tera 15 each, Palliakalan 11	Paithan & Paint 9 each, Mohana 8, Hinganghat 7
15	Kokrajhar 51, Hasimara 35, Sankalan 12, Mulki & Passighat 11 each, Irikkur & Kankavli 9 each	Kankavli 15, Bhimdole, Jharsuguda & North Lakhimpur 12 each, Kancheepuram 11, Gangtok 10	Beki Mathanguri 31, Malvan 10, Bareilly & Nagrakata 8 each, Madras 7	Niphad 11, Japla 7
16	Cooch Behar 33, Dhubri 26, Thrissur 16, Itanagar 9, Panambur 8, Alibag 7	Keshod 24, Kota 15, Silvasa 13, Atchanta & Bhira 10 each, Akot & Erinpura Road 9 each	Chapra 37, Port Blair 12, Khadda 11, Morana 10, Pili Banga 9, Beki Mathanguri 7	Mavelikara 12, Haripad 10
17	Dholai 33, Agartala 17, Mulki 16, Polavaram 14, Jalpaiguri 11, Arani 9, Ratnagiri 8, Birpur & Kasargode 7 each	Mani 27, Agumbe 26, Keshod 22, Kunnamkulam 19, Ganganbavda 16, Thiruvaiyur & Rajapur 12 each, Madhuban 10	Lakipur 19, Chottabekra 11, Dehra Dun 8, Berthin & Silchar 7 each	Balimundali 27, Beki Road Bridge 16, Calcutta 12, Alapuzha 11
18	Canning Town 17, Lalbegiaghat 10, Aruppurkottai 9, Kakardarighat 8, Karwar 7	Sandheads 27, Paonta 25, Silvasa 18, Dholpur 12, Mahabaleshwar & Naraingarh 11 each, Japla 10	Sandheads 23, Mangalagiri 11, Matizuri 10, Namsai 9, Uttarkashi 8, Thrissur 7	Guwahati, Narainpur & Ranchi 11 each, Namsai 9, Gudari 7
19	Shillong 8, Kahu, Sundernagar & Tezu 7 each	Sandheads 20, Surat 17, Gaganbavda 16, Bhira 15, Pollachi & Yellapur 13 each, Hut Bay 11	Namsai 14, Alur & Eluru 10 each, Kottayam & Raisen 7 each	Varanasi 31, Jalpaiguri 12, Madhabarida 10, Neamatighat 8, Gorakhpur 7
20	Sevoke 17, Kherunighat & Port Blair 9 each, Shillong 8, Passighat 7	Mahabaleshwar 24, Sirsi 18, Vapi 16, Mudibagere & Poladpur 14 each, Boond 13	Katra 16, Koderu & Uttarkashi 13 each, Sawai Madhopur 12, Suri 11, Karkala 10, Champasarai & North Lakhimpur 9 each	Dhubri 19, Gazipur 18, Hut Bay 13, Miao 10, Guwahati 7
21	Patiala & Ranchi 7 each	Sandheads 27, Rajapur 23, Kargal 22, Mahabaleshwar 18, Surat 17, Sirsi 15	New Delhi 14, Maya Bandar & Shantiniketan 11 each, Guler 9, Calcutta 7	Cooch Behar 31, Kokrajhar 21, Itanagar 18, Tezu 9, Nancowry 8
22	Galgalia 13, Billoi 11, Long Island 9, Ratnagiri 7	Sandheads 21, Gaganbavda & Madhuban 11 each, Kollur 10, Banbasa, Bhira & Kargal 9 each	Kotputli 13, Chengannur 12, Dehra Dun 11, Mohanpur 10, Ambur & Neelamangala 9 each	Tezu 21, Bihubar 15, Cooch Behar 8, Rayadurga & Taibpur 7 each
23	Hut Bay 11, Panjim 9, Ausa, Durgapur & North Lakhimpur 8 each	Jammu & Kargal 12 each, Mahabaleshwar & Shirali 11 each, Jogindernagar & Khairamal 10 each	Margherita 13, Kalpi 10, Kottayam 8, Chengannur & Harur, Salem 7 each	Tezu 11, Sibsagar 9

APPENDIX I (*Contd.*)

Date (1)	June (2)	July (3)	August (4)	September (5)
24	Panambur 13, Buxar 10, Durgapur & North Lakhimpur 8 each, Kaleshwaram & Maya Bandar 7 each	Patti 15, Agumbe & Rajnandgaon 13 each, Narsingpur 11, Chittorgarh 10, Golaghat & Thirumayam 9 each, Chowari 8	Qulandy 22, Namakkal 13, Hoskote 9, Kangra 8, Nagarakata, Punganur & Rajamundry 7 each	Gaya 10, Sandheads 8, Imphal & Paradip 7 each
25	Bhagalpur 13, Madangad & Tezpur 9 each, Long Island 7	Thiruvayur 18, Chikhaldara & Mount Abu 15 each, Dohad & Ratlam 13 each, Panjim & Paravur 11 each	Tamini 10, Bihubar & Guna 9 each, Agumbe & Paradip 8 each, Car Nicobar 7	Paradip 9, Sandheads 8
26	Maya Bandar 7	Mount Abu 19, Pali 16, Diana 15, Panjim 14, Karwar & Katra 12 each, Bodeli, Chowari, Nidadavole & Vadagara 7 each	Baijnath 13, Kota 12, Cooch Behar & Peermade 11 each, Golaghat, Hut Bay & Indore 9 each, Amini Divi & Karaikal 8 each, Srinagar 7	Jalpaiguri 15, Badami 12, Dharamtul, Jamsolaghat & Osmanabad 11 each, Sandheads 10, Chapra 7
27	Bhusawal & Durgapur 8 each, Arangudi & Ramadurga 7 each	Jalpaiguri 16, Quazhigund 10, Ponnani 9, Nandyal & Rajapur 8 each, Chamba, Champua, Ferozepur & Gokarna 7 each	Agumbe 19, Chitrasani 18, Mount Abu 12, Balmikinagar, Malvan, Naraingarh & Shirali 11 each, Guwahati 10	Paridip 21, Khusiary 20, Pen 9, Bhagalpur 8, Khandala & Passighat 7 each
28	Gaganbavda 11, Mulki & Sevoke 9 each, Chouldhwaghat & Panjim 7 each	Bangana 24, Nawashahar 16, Jammu & Pendra 14 each, Sandheads 11, Amraghat, Bodhan, Dehra Dun & Kakrapar 7 each	Bhivani 20, Jaipur 11, Bharari & Hut Bay 9 each, Bardoli & Tamini 8 each, Bilara, Champasarai & Purna 7 each	Malda 57, Colgaon 34, Cooch Behar 11, Berhampur 10
29	Sandheads 16, Sholapur 11, Kannur, Khammam & Mangalore 9 each, Margherita 7	Champua & Rajapur 11 each, Jammu & Sagar 9 each, Long Island 8, Khowang 7	Garudeshwar & Jagadhari 15 each, Piravom 11, Agumbe, Ambone & Ramagundam 10 each, Nalagarh & Shirali 9 each	Sevoke 10, Visakhapatnam 9, Parangipettai 8
30	Nagrakata & Panjim 12 each, Chiplun 11, Bombay 10, Piravom 9, Narsinghpur 8, Amini Divi 7	Ratnagiri 24, Silvasa 23, Gaganbavda 15, Punalur 10, Amini Divi & Honavar 9 each, Paliakalan 8, Ghumarwin 7	Koida 33, Ambala 20, Sawantvadi 19, Patiala 18, Agumbe 16, Betul 8	Janjira Murud 9, Channapatna 8, Mysore 7
31	Nil	Sevoke 17, Kasol 14, Agumbe, Chandigarh & Vapi 12 each, Chengannur & Pen 11 each, Chandradeepghat & Guwahati 10 each	Palliakalan 21, Bhagamandala 20, Berhampur 17, Karkala 16, Gaganbavda 14, Chhindwara 9, Kozhikode 8	

Karnataka between 17 and 31. Widespread rain with isolated heavy falls also occurred on 7 to 10 days in Jammu & Kashmir and Kerala.

In August, widespread rains with isolated rains with isolated heavy falls occurred over Assam & Meghalaya, West Bengal & Sikkim, Orissa, Himachal Pradesh and Karnataka on 12 to 14 days. Widespread rains with isolated heavy falls occurred in Andaman & Nicobar Islands, coastal Andhra Pradesh and South Interior Karnataka between 25 and 30; in Haryana & Chandigarh and Punjab between 3-10 and 27-30; in Konkan & Goa 1-5 and 26-31 and Kerala between 18 and 31.

In September, widespread rains with isolated heavy falls occurred on 7 to 10 days over West Bengal & Sikkim, Orissa and Kerala. Widespread rains with isolated heavy falls occurred on 4 to 6 days in Andaman & Nicobar Islands, Bihar, west Madhya Pradesh, Konkan & Goa, madhya Maharashtra and coastal Karnataka during 1st half of September.

10. Significant monthly features

10.1. *June*

Heat wave conditions prevailed over plains of northwest and north India upto middle of June. The spell in some parts had commenced in late May.

Due to delay in onset of monsoon over northern India, heat wave conditions prevailed over parts of Haryana, Punjab, Rajasthan, plains of Uttar Pradesh, east Madhya Pradesh and interior Maharashtra during 1st half of June 1995. Heat wave was severe on 3 to 5 days in Haryana, Punjab, west Rajasthan and plains of west Uttar Pradesh.

Highest day temperature was 50°C at Dholpur on 2nd & 3rd June 1995.

Southwest monsoon set in over Kerala on 8 June without any onset vortex.

10.1.1. *Disastrous weather events and damages during June*

According to press reports, more than 500 people died due to heat wave in different parts of north India during 1st half of June.

In June and July, thousands of hectares of crops were damaged and vast land area was submerged in Assam & Meghalaya and neighbouring states due to heavy rains and floods. 2070 villages and more than one million people were affected. Torrential rains also took lives of 43 persons in Assam & Meghalaya.

10.2. *July*

10.2.1. *Disastrous weather events and damages during July*

Heavy spells of rain caused floods and landslides in Jammu & Kashmir in the later part of July. In Bihar, thousands of hectares of paddy fields and 309 villages were affected due to heavy rains and floods. In Orissa heavy rains severely affected agriculture, disrupted roads and communication and breached water reservoirs and bridges. Due to heavy rains and floods, 55 people died in Rajasthan, 15 in West Bengal, 8 in Bihar and 13 in Jammu & Kashmir.

10.3. *August*

10.3.1. *Disastrous weather events and damages during August*

During the last week of August, most parts of northwest India including Himachal Pradesh, Punjab, Rajasthan, Haryana and parts of Bihar experienced floods. According to press reports, floods affected a population of 1.5 lakhs and destroyed standing crops in 7150 hectors of land in Bihar. Heavy rains and floods claimed 32 lives in northern parts of India.

10.4. *September*

10.4.1. *Disastrous weather events and damages during September*

In September, floods occurred in East Uttar Pradesh, Bihar, Orissa and West Bengal. Severe floods and heavy spells of rain disrupted normal life, damaged standing crops in east Uttar Pradesh, Bihar and West Bengal. 73 workers were trapped or died inside coal mines in Bihar following flash floods and heavy rains. 18 people in Rajasthan, Himachal Pradesh, Punjab and Haryana and 11 in Maharashtra lost their lives in floods and heavy rains in the 1st week of September. In West Bengal, floods and heavy rains caused deaths of 140 persons and affected 10 millions people.

As per press reports, floods and heavy rains caused death toll of about 680 people over the different parts of country.

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