

Rainfall and floods in India during 1974 southwest monsoon period

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1. Rainfall

The rainfall during the 1974 southwest monsoon period was normal or above normal over northeast India, south Peninsula, Jammu & Kashmir, West Madhya Pradesh, Konkan & Goa and Madhya Maharashtra and below normal over rest of the country. The rainfall deficiencies over the deficit States were, however, between 20 and 40 per cent except in Gujarat State where it remained scanty (-60 per cent or less) throughout the period. The characteristic features of this year's monsoon were: (i) The monsoon activity continued over most parts of the country beyond 30 September and the rainfall deficiencies in most of the deficit States were made up subsequently to some extent, (ii) All time record rainfall of 58.0 cm occurred on 5 July over Bombay city (Colaba) and 450.0 cm for the month of September 1974 over Cherrapunji, (iii) A severe cyclonic storm crossed West Bengal coast near Contai on the afternoon of 15 August 1974 which is quite unusual for this time of the season and (iv) Unprecedented floods ravaged south Kanara district of Karnataka and many districts of Kerala during 25 to 31 July 1974.

The frequency of deficient years has increased from 1965 onwards. During the present decade, the years of 1965, 1966, 1972 and 1974 have been deficient years as compared to the previous decade from 1955 to 1964, when there was hardly any year of widespread deficiency.

The 1974 monsoon rainfall shows some similarity with the rainfall distribution of 1972. However this year, unlike 1972, the monsoon continued beyond 30 September and there was good rainfall over many of the deficit States during the first fortnight of October.

2. Weekly and Cumulative Rainfall

The percentage departures of the southwest monsoon rainfall week by week in the 35 meteorological sub-divisions of India are given in Table 1. The progress of the monsoon from 1 June depicting the percentage departures from normal of the cumulative rainfall for the successive weeks upto 30 October is given in Table 2. The salient features of the rainfall distribution over the country are as follows.

2.1. *June* — Excessive rainfall occurred over Sub-Himalayan West Bengal during the first week of June and over Punjab, Himachal Pradesh, Jammu & Kashmir and Rajasthan during the week ending on 12 June. Significant excesses were +114 per cent in Jammu & Kashmir, +456 per cent in West Rajasthan and +129 per cent in East Rajasthan. There was a lull in the monsoon activity between 19 and 26 June except Arunachal Pradesh, Assam & Meghalaya, Tamil Nadu & Pondicherry and Lakshadweep where highly excessive rainfall was recorded. The significant excesses were +99 per cent in Arunachal Pradesh and +122 per cent in Tamil Nadu & Pondicherry. Widespread rainfall also occurred in Haryana, Chandigarh & Delhi, Punjab, Himachal Pradesh and Jammu & Kashmir during this period, significant excesses being +341 per cent in Punjab, +100 per cent in Himachal Pradesh and +472 per cent in Jammu & Kashmir. At the end of the month, the cumulative rainfall was in excess over Punjab, Himachal Pradesh, Jammu & Kashmir and West Rajasthan and normal in Arunachal Pradesh, Haryana, Chandigarh & Delhi, Konkan & Goa, Rayalaseema and North Interior Karnataka. It was deficient or scanty over rest country.

TABLE 1

Southwest Monsoon 1974

Percentage departures from normal rainfall for the week ending

METEOROLOGICAL SUB-DIVISIONS	JUNE					JULY					AUGUST					SEPTEMBER					OCTOBER				
	5	12	19	26	3	10	17	24	31	7	14	21	28	4	11	18	25	2	9	16	23	30			
BAY ISLANDS	-85	-45	-22	-57	-75	-23	-39	-52	-60	-70	-69	-59	66	-62	2	-80	-12	-58	185	13	-7	-86			
ARUNACHAL PRADESH	-59	-80	-30	99	79	-41	16	-46	71	74	-82	-55	-54	140	-33	50	78	-9	-64	100	-5	-15			
ASSAM & MEGHALAYA	7	-57	-61	42	-1	-36	17	-16	0	-1	-97	-35	-7	80	-29	13	-51	29	-57	-99	43	58			
NAGALAND, MANIPUR, MIZORAM & TRIPURA	10	-80	-19	6	-23	13	-54	-26	-11	-61	-66	-11	-21	18	-20	-28	-80	13	-49	-99	45	-13			
SUB HIMALAYAN WEST BENGAL	21	-69	-76	2	20	7	4	-46	141	180	-87	25	-8	76	-39	6	24	73	-63	-99	79	-2			
GANGETIC WEST BENGAL	-34	-46	-63	-77	-50	-9	55	49	29	-46	-12	75	-43	-62	1	0	-48	79	-40	-92	-56	183			
ORISSA	-80	-73	-34	-82	-65	-43	-63	-59	-78	-84	32	-17	-24	-87	-76	-59	-55	2	15	80	-43	-37			
BIHAR PLATEAU	-44	-64	-66	-56	-69	-43	-78	-39	-52	-73	-81	-15	-55	-63	-56	-41	-19	-47	-99	-99	-98	91			
BIHAR PLAINS	-87	-40	-71	-57	-57	-53	-20	-14	17	19	-84	-19	-8	-67	-20	-23	-34	-77	-92	100	-99	144			
UTTAR PRADESH, EAST	-99	-61	-61	-82	-56	-90	-29	-46	-12	1	-77	-75	-31	-95	-61	-66	-77	-39	-98	-17	-38	200			
PLAINS OF WEST UTTAR PRADESH	-60	-47	-53	-91	-91	-69	29	-38	-40	-21	-86	-69	-70	100	-93	-98	-81	-84	100	112	100	100			
HILLS OF WEST UTTAR PRADESH	-69	-59	-45	-23	60	-65	-53	-22	4	-22	-72	-54	-43	-52	-92	-82	-61	-56	100	49	100	-99			
HARYANA, CHANDIGARH & DELHI	-34	12	-96	73	-63	-31	74	-45	-19	50	-53	-81	-84	-99	-98	100	-85	-99	100	-47	-93	100			
PUNJAB	34	95	-99	34	-99	-33	-73	-78	-54	-53	-33	-61	-73	-99	-85	100	-72	-93	100	-99	100	00			
HIMACHAL PRADESH	-66	26	-21	100	-79	-53	-26	9	-43	1	-43	-94	-82	-52	-56	-89	-80	-98	100	232	100	100			
JAMMU & KASHMIR	-67	114	-95	472	-84	-30	-41	23	-53	-7	-37	-70	-77	-67	-88	-88	-93	38	100	100	-97	-100			
RAJASTHAN, WEST	-71	456	-88	9	-100	-77	79	84	-85	-81	-83	-73	96	100	100	-91	-94	-56	100	43	150	-100			
RAJASTHAN, EAST	-86	129	-92	-86	-76	-62	72	64	-48	-39	-73	6	-69	-99	-95	100	-67	-58	100	572	885	-100			
MADHYA PRADESH, WEST	20	-44	-39	-92	-27	-50	-12	-37	-52	-31	11	177	-53	-95	-89	-96	-59	49	-73	567	197	141			
MADHYA PRADESH, EAST	-64	-75	13	-79	-41	-51	-37	-50	-53	-54	19	35	-64	-86	-84	-78	-57	-32	-52	-9	-60	269			
GUJARAT REGION, DAMAN, DADRA & NAGAR HAVELI	-99	-99	-99	-85	-47	-75	-16	-92	-99	-45	-80	-53	-92	-90	-95	-97	-26	67	-95	137	444	-67			
SAURASHTRA, KUTCH & DIU	-31	100	-98	-97	-53	-58	-76	-88	-99	-52	-87	-74	-91	-95	-98	-76	73	-13	100	-86	752	-94			
KONKAN & GOA	-9	-29	-51	31	-16	134	-14	-62	-47	81	82	-27	-50	-16	-82	-54	-23	191	3	95	665	390			
MADHYA MAHARASHTRA	-61	-90	-79	-63	23	32	4	-81	-23	108	12	-49	-81	-72	-66	75	35	106	-60	223	384	32			
MARATHWADA	-5	-79	-8	-86	19	-59	-67	-95	6	123	-33	-83	-49	-60	-43	-64	7	-8	46	596	245	-2			
VIDARBHA	-26	-61	-23	-77	-41	-35	-22	-89	-47	-22	115	-30	-85	-82	-80	-97	-46	-17	-9	280	134	1042			
COASTAL ANDHRA PRADESH	-86	12	28	-90	-19	-13	-9	-86	-37	80	3	-87	-51	-51	-18	-54	145	-2	36	60	71	-67			
TELANGANA	-61	-43	49	-61	-15	-44	-46	-99	-19	20	73	-87	-76	-73	11	-37	22	-59	164	391	139	87			
RAYALASEEMA	-84	61	5	-31	-41	-73	-47	-85	1	196	-26	-89	-95	-51	69	-41	126	89	201	-10	182	-58			
TAMILNADU & PONDICHERY	-63	-87	-59	122	184	-40	-13	-8	-21	37	-73	-52	-60	19	133	11	80	26	-14	-2	-75	-78			
COASTAL KARNATAKA	-48	-77	-12	28	15	130	-62	-43	107	58	3	-16	-76	-61	-96	-49	234	367	157	75	-5	-79			
INTERIOR KARNATAKA, NORTH	-56	-35	54	-43	-58	-30	-65	-51	-19	174	15	-92	-93	-76	102	4	-10	41	135	67	392	36			
INTERIOR KARNATAKA, SOUTH	-79	-65	-22	-67	-33	13	-56	-91	74	28	-31	-66	-89	-57	114	235	-39	-7	-42	-60	10	-25			
KERALA	-45	-79	-49	-64	-61	33	-35	45	134	17	37	195	-93	-95	-7	143	91	-25	-62	14	-98	-56			
LAKSHADWEEP	-68	-85	-29	83	91	96	-52	55	155	69	-26	-20	-95	-91	10	182	99	-25	-54	-96	-96	-76			

2.2. *July*— There was no further advance of the monsoon during the first 10 days of July, but thereafter the monsoon advanced and covered the entire country by 16 July. During the week ending on 3 July, Tamil Nadu & Pondicherry received excessive rainfall of +184 per cent. During the week ending on 10 July, heavy to very heavy rainfall occurred over Konkan & Goa, Madhya Maharashtra, Coastal Karnataka, Kerala and Lakshadweep. Bombay city (Colaba) reported 58.0 cm rain on 5th which is an all time record for that place for the last 94 years for which published data are available. The excessive rainfall amount was +134 per cent in Konkan & Goa and +130 per cent in Coastal Karnataka. During the last week of July, the monsoon was active to vigorous in Arunachal Pradesh, Sub-Himalayan West Bengal, Karnataka, Kerala and Lakshadweep. The season's rainfall for the period from 1 June to end of July was in excess in Arunachal Pradesh, Jammu & Kashmir and Lakshadweep and normal in northeast India, Haryana, Chandigarh & Delhi, Himachal Pradesh, Rajasthan, Konkan & Goa, Tamil Nadu

& Pondicherry and Coastal Karnataka. It was deficient over the remaining 19 meteorological sub-divisions of the country outside Gujarat State where it was scanty.

2.3. *August*— During the first week of August, significant rainfall excesses were +180 per cent in Sub-Himalayan West Bengal, +108 per cent in Madhya Maharashtra, +123 per cent in Marathwada, +196 per cent in Rayalaseema and +174 per cent in North Interior Karnataka.

During the subsequent week, excessive rainfall of +115 per cent was recorded over Vidarbha. During the week ending on 21 August, vigorous monsoon prevailed over West Madhya Pradesh, West Bengal and East Rajasthan in association with a severe cyclone which developed near Sagar Island on 14th night and moved inland. The significant excess was +177 per cent in West Madhya Pradesh. The cumulative rainfall during the period from 1 June to 28 August was in excess over

TABLE 2
Southwest Monsoon 1974

Percentage departures from normal rainfall for the period 1 June to week ending

METEOROLOGICAL SUB-DIVISIONS	JUNE				JULY				AUGUST				SEPTEMBER				OCTOBER				1 JUN	1 JUN	
	5	12	19	26	3	10	17	24	31	7	14	21	28	4	11	18	25	2	9	16	23	TO 30	TO 30
BAY ISLANDS	-85	-57	-36	-41	-48	-33	-34	-36	-39	-29	-28	-30	-23	-26	-18	-21	-21	-22	-13	-10	-9	-10	-20
ARUNACHAL PRADESH	-59	-70	-53	-7	13	26	23	15	21	26	71	69	51	55	53	54	55	53	64	62	61	61	52
ASSAM & MEGHALAYA	7	-31	-46	-20	-16	3	5	5	4	3	16	12	11	15	39	37	34	34	32	29	29	29	32
NAGALAND, MANIPUR, MIZORAM & TRIPURA	10	-31	-39	-29	-28	-12	-19	-19	-19	-22	-19	-18	-18	-15	-9	-9	-11	-10	-9	-11	-10	-10	-13
SUB-HIMALAYAN WEST BENGAL	21	-15	-46	-29	-18	-6	-7	-11	2	17	13	13	12	17	15	14	16	18	19	17	17	17	14
GANGETIC WEST BENGAL	-34	-61	-59	-64	-60	-47	-31	-19	-11	-15	-11	-1	-5	-8	-4	-3	-5	-1	-1	-1	-2	1	-6
ORISSA	-80	-77	-59	-68	-65	-53	-54	-53	-57	-61	-50	-45	-40	-43	-37	-38	-39	-37	-33	-33	-34	-34	-37
BIHAR PLATEAU	-44	-87	-77	-63	-63	-53	-58	-54	-53	-55	-37	-35	-36	-39	-33	-32	-31	-32	-17	-18	-19	-18	-31
BIHAR PLAINS	-87	-46	-60	-46	-47	-47	-43	-34	-25	-20	-12	-11	-9	-12	-5	-6	-7	-9	0	-1	-2	-1	-9
UTTAR PRADESH, EAST	-99	-73	-67	-72	-66	-75	-63	-52	-43	-37	-23	-28	-27	-32	-34	-34	-35	-35	-37	-37	-37	-36	-39
PLAINS OF WEST UTTAR PRADESH	-60	-30	-42	-61	-75	-75	-48	-44	-44	-37	-15	-18	-23	-29	-33	-37	-38	-40	-41	-40	-40	-39	-40
HILLS OF WEST UTTAR PRADESH	-69	-52	-49	-35	-54	-55	-55	-49	-40	-36	-28	-30	-31	-33	-35	-38	-38	-39	-40	-39	-39	-39	-39
HARYANA, CHANDIGARH & DELHI	-34	16	-37	4	-25	-25	3	-8	-10	-1	9	2	-3	-10	-18	-24	-29	-30	-32	-32	-32	-32	-30
PUNJAB	34	83	13	137	39	43	6	-21	-27	-32	-8	-13	-17	-24	-24	-28	-30	-32	-34	-34	-34	-35	-32
HIMACHAL PRADESH	-66	6	-5	44	-10	-9	-15	-1	-10	-8	-4	-14	-19	-21	-20	-23	-24	-26	-28	-26	-26	-26	-26
JAMMU & KASHMIR	-67	55	-18	101	95	86	52	26	22	15	5	0	-3	-9	-12	-15	-14	-15	-17	-18	-20	-16	-16
RAJASTHAN, WEST	-71	234	84	60	7	-31	3	22	0	-12	-21	-27	-36	-42	-47	-48	-49	-49	-49	-49	-48	-48	-48
RAJASTHAN, EAST	-86	45	-24	-47	-59	-65	-25	-1	-10	-14	-6	-5	-11	-19	-15	-19	-21	-21	-22	-16	-14	-14	-21
MADHYA PRADESH, WEST	20	-17	-30	-55	-44	-48	-37	-37	-39	-38	-18	0	1	-7	-9	-13	-13	-14	-9	-8	-7	-13	-13
MADHYA PRADESH, EAST	-64	-62	-20	-36	-37	-43	-40	-40	-41	-43	-26	-19	-21	-26	-26	-29	-29	-29	-29	-29	-29	-29	-29
GUJARAT REGION, DAMAN, DADRA & NAGAR-HAVELI	-99	-99	-99	-93	-72	-73	-58	-64	-71	-67	-68	-67	-69	-70	-71	-72	-71	-67	-68	-66	-65	-65	-68
SAURASHTRA, KUTCH & DIU	-31	-96	-97	-97	-69	-64	-67	-69	-74	-71	-73	-73	-74	-75	-77	-77	-74	-72	-72	-73	-69	-69	-72
KONKAN & GOA	-9	-18	-36	-7	-8	24	17	5	-1	7	19	16	13	12	8	7	6	10	10	11	14	15	10
MADHYA MAHARASHTRA	-61	-78	-79	-73	-46	-29	-23	-32	-31	-15	-9	-12	-17	-21	-24	-16	-12	-4	-7	-1	9	10	-5
MARATHWADA	-5	-62	-33	-52	-30	-33	-38	-47	-40	-26	-25	-30	-31	-34	-36	-38	-35	-34	-31	-24	-21	-21	-33
VIDARBHA	-26	-45	-32	-53	-48	-41	-37	-43	-43	-41	-25	-25	-30	-33	-33	-35	-35	-33	-29	-28	-22	-22	-35
COASTAL ANDHRA PRADESH	-86	-30	-2	-36	-31	-24	-22	-31	-32	-20	-18	-24	-26	-28	-31	-33	-20	-18	-14	-9	-2	-5	-17
TELANGANA	-61	-50	1	-27	-23	-26	-29	-40	-37	-30	-16	-22	-27	-30	-25	-26	-23	-24	-19	-9	-5	-3	-25
RAYALASEEMA	-84	-11	-1	-16	-39	-40	-48	-41	-13	-8	-17	-25	-27	-20	-22	-5	6	17	16	24	22	7	7
TAMILNADU & PONDICHERRY	-63	-76	-69	-23	20	7	3	1	-2	3	-3	-10	-16	-13	0	1	13	14	14	12	1	8	14
COASTAL KARNATAKA	-48	-81	-50	-30	-19	7	-4	-9	1	6	9	7	4	2	0	-1	3	10	12	13	13	12	9
INTERIOR KARNATAKA, NORTH	-56	-49	-7	-18	-29	-4	-25	-28	-27	-9	1	-8	-16	-21	-10	-9	-9	-5	-1	2	15	17	-21
INTERIOR KARNATAKA, SOUTH	-79	-80	-65	-65	-56	-45	-47	-54	-37	-31	-22	-26	-31	-33	-23	-3	-5	-3	-2	-6	-5	-6	4
KERALA	-45	-75	-64	-63	-63	-46	-44	-34	-20	-17	-7	3	0	3	-2	2	6	7	6	6	3	0	8
LAKSHADWEEP	-68	-78	-62	-33	-8	26	15	19	28	31	39	36	29	22	24	29	43	37	33	30	26	24	36

Arunachal Pradesh and Lakshadweep and normal in Assam & Meghalaya, Nagaland, Manipur Mizoram & Tripura, West Bengal, Bihar Plains, northwest India, West Madhya Pradesh, Konkan & Goa, Madhya Maharashtra, Tamil Nadu & Pondicherry, Karnataka and Kerala. It was deficient over the rest of the country outside Gujarat State where it continued to remain scanty.

2.4. September — During the first week of September, the monsoon became active to vigorous in Assam & Meghalaya, Arunachal Pradesh and Sub-Himalayan West Bengal, the significant excess being +140 per cent in Arunachal Pradesh. There was, however, good thundershower activity in many parts of the Peninsula and East Uttar Pradesh during the week ending on 11 September 1974. The week's rainfall was in excess by +133 per cent in Tamil Nadu & Pondicherry, +100 per cent in North Interior Karnataka and +114 per cent in South Interior Karnataka. During the subsequent week, Cherrapunji reported all time monthly rainfall record during the week, the heaviest rainfall for four consecutive days being 97 cm on 12th, 99 cm on 13th, 80 cm on 14th and 96 cm on 15th. The cumulative rainfall for the period

from 1 June to 30 September 1974 as in Table 2 shows that the seasonal rainfall was in excess in Arunachal Pradesh (+52 per cent), Assam & Meghalaya (+32 per cent) and Lakshadweep (+36 per cent) and normal in Nagaland, Manipur, Mizoram & Tripura, West Bengal, Bihar Plains, Jammu & Kashmir, West Madhya Pradesh Konkan & Goa, Madhya Maharashtra, Coastal Andhra Pradesh, Rayalaseema, Coastal Karnataka, South Interior Karnataka and Tamil Nadu & Pondicherry. The rainfall was deficient over the rest of the country outside Gujarat State where it remained scanty (about -70 per cent) throughout the season.

2.5. October — During the week ending on 2 October, good monsoon activity continued in many parts of the country, the excesses being +367 per cent in Coastal Karnataka, +191 per cent in Konkan & Goa and +106 per cent in Madhya Maharashtra.

Monsoon was active to vigorous in Andhra Pradesh, Coastal Karnataka and North Interior Karnataka, Marathwada and Bay Islands during the week ending on 9 October. The week's rainfall

was in excess by +185 per cent in Bay Islands, +164 per cent in Telangana, +201 per cent in Rayalaseema, +157 per cent in Coastal Karnataka and +135 per cent in North Interior Karnataka. In the subsequent two weeks ending on 16th and 23rd October excessive rainfall occurred over several parts of the country. In the subsequent week ending on 30 October, the monsoon practically withdrew from the country. Excessive rainfall, however, occurred over East Madhya Pradesh (+269 per cent), Konkan & Goa (+390 per cent), Vidarbha (+1042 per cent), East Uttar Pradesh (+200 per cent), Gangetic West Bengal (+183 per cent) and Bihar Plains (+144 per cent). The cumulative rainfall for the period from 1 June to 30 October as given in Table 2 shows that the rainfall was in excess in Arunachal Pradesh (+61 per cent), Assam & Meghalaya (+29 per cent), Rayalaseema (+22 per cent) and Lakshadweep (+24 per cent) and normal in Bay Islands, Nagaland, Manipur, Mizoram & Tripura, West Bengal, Bihar, East Rajasthan, West Madhya Pradesh, Konkan & Goa, Madhya Maharashtra, Coastal Andhra Pradesh, Telangana, Tamil Nadu & Pondicherry, Karnataka and Kerala. It was deficient in Orissa, Uttar Pradesh, Haryana, Chandigarh & Delhi, Punjab, Himachal Pradesh Jammu & Kashmir, West Rajasthan, East Madhya Pradesh, Marathwada and Vidarbha. The deficiencies were, however, mostly between 20 and 40 per cent. Gujarat was the only State where the rainfall was scanty (-60 per cent or less) throughout the season.

3. Major flood producing rain spells

3.1. *Floods in the rivers of Manipur in the first week of June*—The cyclonic storm which formed in Bangla Desh on 30 May moved northeastwards and subsequently weakened into a low over Assam and adjacent States. This system caused widespread rain and thundershowers. Imphal recorded 11 cm of rain on 2 June. Due to torrential rain almost all the rivers in Manipur were in high floods and crossed the warning stages in the first week of June. Embankment along rivers *Imphal, Thoubal, Nambal, Tural* and *Singda* were breached at several places and many wooden bridges across some of these rivers were washed away. According to *Flood News Letter**, more than half of the standing paddy crops were totally destroyed. Three human lives were lost and many cattle heads were washed away. A large number of families were evacuated from the affected areas.

3.2. *River Brahmaputra in floods during the third week of July*—Due to vigorous monsoon activity, there was widespread rain and thundershowers over Assam and adjacent States during the

third week of July resulting in flooding of river *Brahmaputra* in upper Assam. According to preliminary assessment made by the State Government an area of 2.36 lakh hectares including a cropped area of 0.63 lakh hectare and a population of 7.56 lakhs were affected. Over ten thousand houses were damaged and 8 human lives and about 300 cattle heads were lost. The marooned people were shifted to safer places.

3.3. *Heavy rainfall in Karnataka and Kerala resulting in unprecedented floods during the last week of July*—Under the influence of a trough of low which lay off Kerala-Karnataka coasts from 25 to 31 July and a low pressure area which moved from central and adjoining south Bay of Bengal to Telangana and adjoining Maharashtra and North Interior Karnataka between 25th and 29th and persisted there upto 31 July, heavy to very heavy rain occurred in Kerala and Karnataka during the week. This resulted in disastrous floods in *Nethravathy* and *Ganpur* rivers in South Kanara district on 26 July. According to *Flood News Letter* about 5,000 families in 181 villages were affected. Five human lives and 14 cattle heads were lost.

The districts of Cannanore, Kozhikode, Mallapuram, Trichur, Ernakulam, Kottayam and Alleppey also were affected by devastating floods and landslides during this week. As a result 36 human lives were lost, about 2000 houses collapsed and several thousand damaged. There was extensive damage to crops and several bridges were destroyed by the floods. The right wall of the Kutyadi Irrigation Project collapsed, causing estimated loss of 5 to 6 crores of rupees.

A detailed study of this heavy rainfall which occurred over Coastal Karnataka and Kerala during the period from 25 to 27 July 1974 has been carried out by depth-area-duration method and included under Sec. 4.

3.4. *Heavy rainfall in Maharashtra resulting in floods during the first week of July and August*

(i) *Unprecedented rain over Bombay City in July*—A well marked trough of low lay off the west coast from 4 to 10 July. A cyclonic circulation also lay over Maharashtra and neighbourhood by this period. These systems caused heavy to very heavy rainfall in Konkan & Goa, Karnataka and Kerala. Bombay city (Colaba) reported 58 cm of rain on 5 July resulting in loss of 49 human lives and injuries to many persons. Extensive damages to several buildings were also reported.

(ii) *Disastrous floods in Ratnagiri district of Maharashtra in August*—A trough of low was lying

* Issued by the Central Water & Power Commission, New Delhi

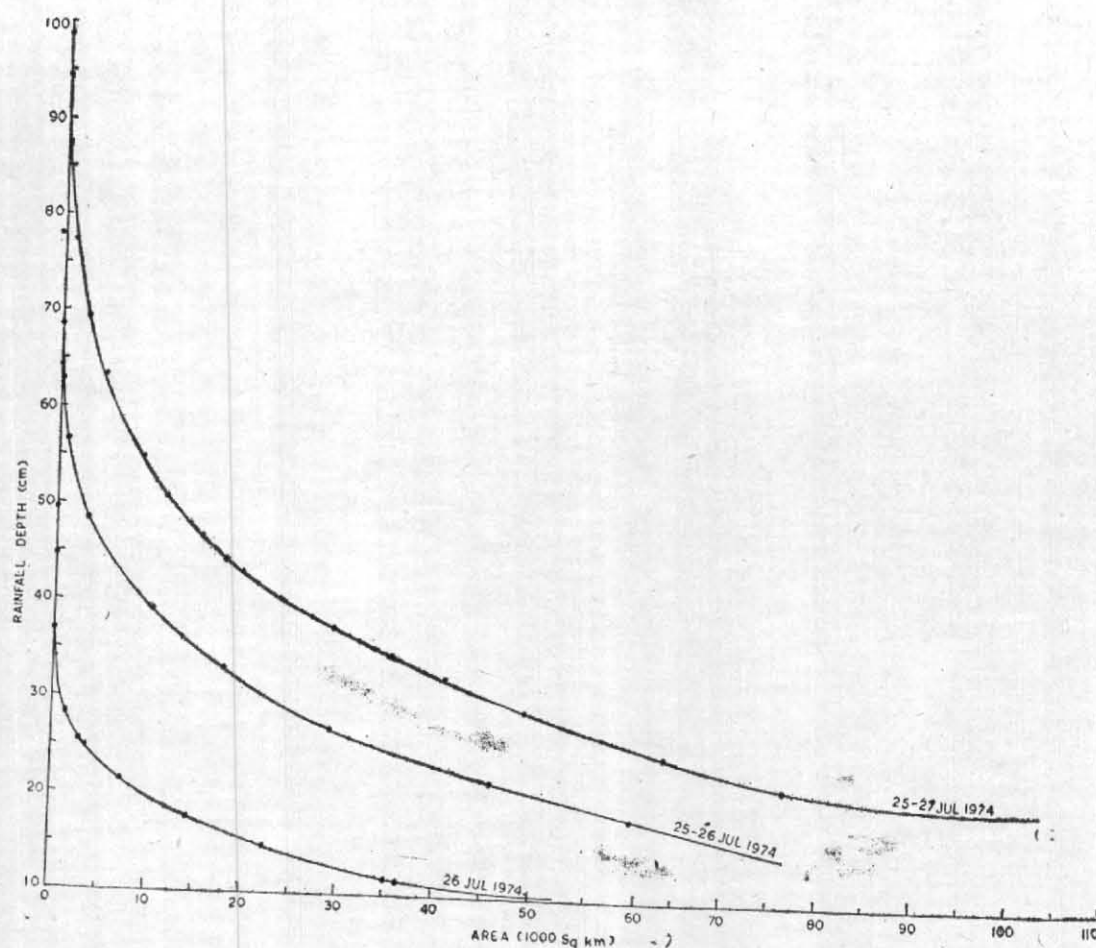


Fig. 1. Depth-area-duration curves of rainfall for the storm of 25-27 July 1974

off the west coast from 1 to 4 August and a cyclonic circulation persisting over Maharashtra during this period. These systems caused heavy rainfall resulting in floods and landslides in Ratnagiri district on 6 August. According to *Flood News Letter* over 12000 people were affected. 26 human lives and many cattle heads were lost. Extensive damage to crops and houses was reported. The total damage had been assessed as Rs. 22.8 lakhs in Ratnagiri district alone.

3.5. Floods in the rivers of Ghaghra and Rapti during the first fortnight of August 1974 — During the 1st week of August, the monsoon trough was extending from North Rajasthan to Assam. A cyclonic circulation was also lying over Uttar Pradesh from 5 to 7 August. Under the influence of these systems, monsoon was active with widespread rain on many days in East Uttar Pradesh resulting in high floods in rivers *Ghaghra* and *Rapti*. River *Rapti* surpassed the previous highest level of 76.73 m recorded in 1925 by 21 cm on 9 August.

The floods also caused breaches in several bunds in the districts of Basti, Gorakhpur, Deoria and Ballia. According to *Flood News Letter* an area of 1.05 lakh hectare including 0.80 lakh hectare cropped area and a population of over 6 lakhs were affected in 1352 villages due to floods. 2900 houses valued at Rs. 17 lakhs were damaged. Two human lives and some cattle heads were reported to have been lost.

3.6. Heavy rainfall and floods in south Bengal rivers during middle of August — A depression formed over northwest Bay of Bengal on 12 August which became a deep depression on 13th and finally developed into a cyclonic storm on 14 August 1974. It moved westnorthwest and crossed West Bengal coast near Contai at noon on 15 August. Moving further in a northwesterly direction, it was centred near Kalaikonda on 15th evening and was near Jamshedpur on 16th morning. Wind speed from 100 to 120 km per hour lashed the coastal areas of 24-Parganas and Midnapore on 15th with widespread rainfall occurring over there on 15 August. Many rivers in south Bengal were in spate. Low lying

areas between Digha and Juneput were also inundated by tidal waves. The flood affected the districts of Midnapore, 24-Parganas, Hooghly, Howrah and Murshidabad. Many breaches occurred between Canning Jetty Ghat Nos. II & III due to heavy erosion on 16 August. An area of 24 lakh hectares and a population of 12.38 lakh people were affected by floods. Crops over an area of 1.19 lakh hectares and over seventy thousand houses were damaged. 17 human lives and about 250 cattle heads were lost. The total damage was estimated to be Rs. 19.3 crores.

The formation of this severe cyclonic storm in the month of August was quite unusual and as per 83 years record of the India Meteorological Department, only one such system had developed over north Bay of Bengal in the year 1900.

3.7. Floods in the river Narmada in the third week of August 1974 — The severe cyclonic storm which crossed West Bengal coast near Contai on 15 August, moved slowly westnorthwest across Madhya Pradesh as a deep depression and then weakened into a low over northeast Rajasthan on 21 August. It caused widespread rain in Madhya Pradesh on many days of the week. Pachmarhi recorded 38 cm and 11 cm on 19 and 20 August respectively. High floods occurred in the river Narmada and it crossed the warning stages at Hoshangabad on 20 August.

The floods submerged the road bridges at Rajghat and Kalaghat near Barwani and the water was flowing 4 metres above the bridges on 19-20 August. The districts of Mandla, Jabalpur, Narsinghpur, Hoshangabad, Khandwa and Kargone were badly affected and the road communications disrupted at many places. According to the *Flood News Letter*, the preliminary assessment made by the State Government indicated that crops over an area of 10,000 hectares valued at Rs. 25 lakhs were affected and 2746 houses were damaged. 3 human lives were reported to have been lost.

3.8. Floods in the rivers of North Bihar during third week of August — A low moved from south Bangla Desh to Bihar Plains in the second half of the week. It caused widespread rain in West Bengal, Bihar Plains, Assam and adjacent States with isolated heavy rainfall between 19 and 21 August.

According to State Government an area of 14 lakh hectares and a population of about 70 lakhs were affected. Crops over an area of 6.32 lakh hectares valued at Rs. 70 crores and 10 thousand houses were damaged. 6 human lives and 40 cattle heads were reported to have been lost.

4. Depth-area-duration analysis of rainstorm for the period 25-27 July 1974 over Coastal Karnataka and Kerala

Very heavy rainfall during the period 25 to 27 July caused devastating floods which ravaged South Kanara district of Coastal Karnataka and the districts of Cannanore, Kozhikode, Mallapuram, Trichur, Ernakulam, Kottayam and Alleppey of Kerala. The significant rainfall amounts in cm recorded during the storm period are :

Bantwala 23.9, Belthangady (Seed farm) 25.2, Subramanya 31.5, Nagarhole 34.5, Kottigehera 30.7, Vytheri 14.9, Quilandy 13.0 on 25th; Belthangady 39.3, Seetharady 35.3, Charmady 35.1, Hybridge 32.8, Sriman ala 21.0, Makut 49.5, Kottigehera 28.8, Munnar 17.5 and Nilambur 19.3 on 26th; Karkala 25.7, Sanoor 28.5, Mundrote 28.3, Makut 30.2, Nilambur 19.3, Thirungadi 16.5, Kozhikode 16.3 and Quilandy 18.3 on 27 July.

The storm has been studied by isohyetal method.

The heavy rainfall centres were located at Belthangady and Makut in Karnataka and Velur in Kerala. Depth-area-duration curves of rainfall for the storm of 25-27 July 1974 are given in Fig. 1.

The maximum depths of precipitation for various standard areas as picked up from these curves are as under :

Area (sq. km)	Average depths (cm)		
	1-day	2-day	3-day
500	32.5	58.0	82.5
1000	29.8	55.5	77.5
5000	23.3	45.5	62.3
10000	19.8	39.3	52.8
20000	15.8	31.6	42.8
50000	10.2	21.0	29.2
75000	—	15.3	22.3
100000	—	—	20.0

5. Behaviour of 1974 Monsoon

The seasonal percentage departures of monsoon rainfall (1 June to 30 September) for the different meteorological sub-divisions of the country for 24 years from 1951 to 1974 are shown in Table 3 for the sake of comparison. The 1974 monsoon rainfall shows some similarity with the rainfall distribution of 1972. However, this year, unlike 1972, the monsoon continued beyond 30 September and there was good rainfall over many of the deficit States during the

TABLE 3

Percentage departures of rainfall for monsoon seasons (June-September) during the period 19.1 to 1974

METEOROLOGICAL SUB-DIVISION	YEARS																								
	'67	'73	'72	'71	'70	'69	'68	'67	'66	'65	'64	'63	'62	'61	'60	'59	'58	'57	'56	'55	'54	'53	'52	'51	
BAY ISLANDS	-20	-11	1	-14	-5	1	-7	-19	-13	-1	17	13	19	-11	39	27	26	-10	-3	74	-3	1	-3		
ARUNACHAL PRADESH	52	-2	-19	-12	3	-4	-8	-13	-15	-24															
ASSAM & MEGHALAYA	32	-2	-5								6	-1	-20	-14	18	-20	-4	-14	-9	5	-4	1	-5	-18	
NAGALAND, MANIPUR, MIZORAM & TRIPURA	-13	-18	-39	-19	-7	-3	2	-20	-13	-7															
SUB-HIMALAYAN WEST BENGAL	14	-3	-28	-7	2	-7	-5	-10	-4	10	18	-6	-14	-29	-4	-27	13	-19	-20	9	6	-14	-22	-3	
GANGETIC WEST BENGAL	-6	13	-4	34	13	-2	16	5	-29	-10	-13	-8	-17	-3	-6	11	-21	-7	18	-16	-13	6	2	-13	
ORISSA	-37	2	-11	-4	-5	-5	-16	0	30	35	-1	2	-14	32	19	-17	-16	-33	28	7	-15	-5	0	-8	
BIHAR PLATEAU	-31	2	-16	36	-5	-6	-1	-5	-39	-31	-7	-7	-13	9	-1	1	-13	-17	12	-26	-28	27	-3	-18	
BIHAR PLAINS	-9	-8	-40	7	-8	11	9	-14	-49	-17	-1	-4	-32	-19	4	-25	-11	-26	11	-8	-7	6	5	-24	
EAST UTTAR PRADESH	-35	-11	-32	30	12	8	-18	2	-41	-41	-3	3	6	-1	9	-35	-18	-31	5	26	-18	32	-10	-31	
PLAINS OF WEST UTTAR PRADESH	-40	2	-24	20		-2	4	-20	33	4	-32	15	29	-3	27	21	-3	16	-15	10	7	3	-2	6	-15
HILLS OF WEST UTTAR PRADESH	-39	-3	-5	24																					
HARYANA, CHANDIGARH & DELHI	10	12	2	42	5	15	8	21	6	-46	90	4	30	6	40	16	21	-8	2	14	-12	16	-3	-50	
PUNJAB	-32	21	-14	12	16	-4	6								10										
HIMACHAL PRADESH	-26	-14	-28	25	1	7	-26	18	-7	-61	-15	19	NA	NA	-4	24	56	-16							
JAMMU & KASHMIR	-16	30	21	49	20	-24	-8	-14	4	-64	4	-45	-10	-16	-12	-3	76	108	36	-12	-14	71	-12	-44	
WEST RAJASTHAN	-48	49	-28	-31	18	-58	-56	0	-22	-42	30	-40	-13	45	-16	56	-12	-34	29	20	6	7	-2	-19	
EAST RAJASTHAN	-21	35	-43	20	17	-5	-26	10	-38	-39	1	-3	-6	25	-7	19	11	-5	28	36	9	-21	2	-47	
WEST MADHYA PRADESH	-13	42	-22	7	13	5	-8	-12	-30	-46	-6	-1	0	30	-1	13	1	-17	4	19	16	-15	-18	-25	
EAST MADHYA PRADESH	-29	-5	-14	10	9	-8	-20	1	-30	-37	7	-19	-23	27	-8	10	-7	-16	15	-2	-2	11	-7	-10	
GUJARAT REGION, DAMAN, DADRA & NAGAR HAVELI	-68	39	-40	-10	40	-25	-28	6	-32	-45	8	8	-28	27	-28	74	9	-27	32	-8	57	32	-18	-53	
SAURASHTRA, KUTCH & DIU	-72	-15	-55	5	51	-35	-30	22	-43	-33	13	-9	13	118	-18	93	51	-4	53	-20	68	68	-5	-24	
KONKAN & GOA	10	4	-32	-4	21	11	-24	-3	-31	-20	0	18	4	15	11	10	55	7	13	28	53	28	-12	4	
MADHYA MAHARASHTRA	-5	13	-44	-20	3	32	-14	2	-14	-8	22	7	-3	9	4	8	23	4	32	14	33	25	-23	-8	
MARATHWADA	-33	19	-55	-31	37	11	-12	-9	-6	-5	-7	46	4	26	-10										
VIDARBHA	-35	0	-37	-33	20	-8	-17	-16	-10	-32	2	-17	5	20	-11	45	-1	-8							
COASTAL ANDHRA PRADESH	-17	-27	-27	-18	11	-32	-40	3	-3	-1	0	37	-7	26	25	15	23	10	22	62	7	31	12	-25	28
TELANGANA	-25	-3	-34	40	27	9	-28	9	-3	-7	10	12	26	-3	-2	36	22	10	25	48	17	37	-22	-15	
RAYALASEEMA	7	-5	-19	-35	38	-4	24	-1	20	-4	71	10	-14	-3	2	21	14	27	22	25	-8	16	-52	-12	
TAMILNADU & PONDICHERY	14	15	9	7	6	-32	-17	13	45	-1	30	7	25	30	2	-23	-20	-14	23	0	-3	13	-34	-12	
COASTAL KARNATAKA	9	0	-26	2	35	-2	0	3	-23	-19	-3	-7	3	62	-2	22	4	-9	-11	6	22	-9	-23	-8	
NORTH INTERIOR KARNATAKA	-21	-3	-31	-16	26	18	-11	12	-1	9	-52	-4	9	9	15	21	-15	14							
SOUTH INTERIOR KARNATAKA	4	16	-10	16	-21	-17	10	-12	10	-18	45	-1	-13	0	-6	42	11	-34	-12	-4	-12	1	-20	2	
KEPALA	8	-10	-15	23	-3	-10	39	15	-10	-24	5	2	4	68	-7	47	-4	8	-18	11	-3	2	-26	3	
LAKSHADWEEP	36	10	-11	26	24		17	1	13	-18	-40	-3	7	6	5	-1	-27	-39							

• NORTH ASSAM † SOUTH ASSAM

first fortnight of October. A comparative statement showing the cumulative rainfall from 1 June to 30 September and 1 June to 30 October is also shown in Table 2.

The deficiencies in Bihar Plateau, hills of west Uttar Pradesh, East Rajasthan, Marathwada, Vidarbha, Telangana and North Interior Karnataka were reduced considerably during the month of October 1974. Except for Gujarat State which continued to receive scanty rainfall (less than -60 per cent), the deficiency in the remaining meteorological sub-divisions was generally between -20 to -40 per cent. The year of 1965 and 1966 were

drought years owing to sub-normal rainfall for two consecutive years. The year 1972 experienced considerable drought due to an unusually long (three weeks) 'break' in monsoon activity in July-August 1972 over north and central India and early withdrawal of the monsoon from north India. This year (1974), the first half of the monsoon period was deficient due to the absence of monsoon depressions but the later half was made up by weak low pressure areas travelling across the country. The monsoon stayed on later than usual and withdrew from northwest India during the first week of October and from the rest of the country by the last week of October.