Mausam, (1995), **46**, 1, 101-108

Weather

WINTER SEASON (JANUARY-FEBRUARY 1994)*

1. Introduction

During the winter season, the main rainfall belt lies over hilly regions of north India and Andaman & Nicobar Islands. However, this year the rainfall was deficient in Andaman & Nicobar Islands. In hilly regions of north India rainfall was normal except in the hills of west Uttar Pradesh, where it was deficient.

Monthwise synoptic features for the season are given in Tables 1 and 2. Table 3 contains the monthly and seasonal rainfall figures.

2. Chief features

(*i*) Many good spells of precipitation over northwest India in association with western disturbance activity between middle of January and February.

(*ii*) Cold wave conditions in northern parts of India.

(*iii*) Hail storm in some parts of northeast India.

3. Season's rainfall

The season's rainfall was in excess in Assam & Meghalaya, West Bengal & Sikkim, Bihar plains, east Uttar Pradesh, Punjab, Rajasthan, west Madhya Pradesh, Gujarat State, Konkan & Goa, Vidarbha, coastal Andhra Pradesh, Telangana, coastal Karnataka, south interior Karnataka, Kerala and Lakshadweep. It was normal in Nagaland, Manipur, Mizoram & Tripura, Orissa, Bihar plateau, plains of west Uttar Pradesh, Haryana, Himachal Pradesh, Jammu & Kashmir, Madhya Maharashtra, Marathwada, Tamil Nadu and north interior Karnataka. Rainfall was deficient in remaining parts of the country.

The seasonal rainfall departures are given in Fig. 1.

4. January

4.1. *Weather and associated synoptic features*

There were 8 western disturbances and 4 induced cyclonic circulations which affected north India during the month. Out of these, first one from 7 to 12, second from 14 to 16 and third from 18 to 20 were quite active and gave well distributed rainfall over parts of north and northwest India. Details of the systems are given in Table 1. Two cyclonic circulations, one over west Rajasthan and neighbourhood (10 to 14) and other over Saurashtra & Kutch (11 to 12), were quite active. These systems also contributed to the rainfall over parts of northwest India. Central and western parts of Peninsular India also received a spell of rain during mid-January.

Rain or thundershowers occurred either almost at all the places or many places on 3 to 9 days in Arunachal Pradesh, Assam & Meghalaya, Bihar plains, east Uttar Pradesh, Himachal Pradesh and Jammu & Kashmir and on one or two days in Nagaland, Manipur, Mizoram & Tripura, West Bengal & Sikkim, Orissa, Bihar plateau, west Uttar Pradesh, Haryana, Punjab, Rajasthan, Madhya Pradesh, Gujarat Region, Marathwada, Vidarbha and Kerala. Rain or thundershowers occurred either at a few places or at one or two places on 10 to 15 days in Himachal Pradesh, west Madhya Pradesh and Tamil Nadu and on 3 to 9 days in Andaman & Nicobar Islands, Sub-Himalayan West Bengal & Sikkim, Bihar plateau, west Uttar Pradesh, Haryana, Punjab, Jammu & Kashmir, east Rajasthan, east Madhya Pradesh, Maharashtra State, outside Konkan, Andhra Pradesh, Karnataka and Kerala and on 1 or 2 days in Arunachal Pradesh, Nagaland, Manipur, Mizoram & Tripura, Gangetic West Bengal, Orissa, Bihar plains, east Uttar Pradesh, west Rajasthan, Saurashtra & Kutch, Konkan & Goa and Lakshadweep.

4.2. *Month's rainfall*

Accumulated monthly rainfall was in excess in 19, normal in 6, deficient in 5 and scanty in the

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

TABLE 1

Details of the weather systems during January 1994

S. No. (1)	System (2)	Period (3)	Place of first location (4)	Direction of movement (5)	Place of dissipation (6)	Remarks (7)
(A)	*Western disturbances*					
1	Upper air system	1-4	North Pakistan and neighbourhood	Northeastwards	Moved away across Jammu & Kashmir	
2	Do.	4-7	Do.	Do.	Do.	
3	Do.	7-12	Do.	Do.		
4	Do.	14-16	Do.	Do.	Do.	
5	Do.	18-20	North Pakistan and adjoining Afghanistan	Do.	Moved away	
6	Do.	20-31	Do.	Do.	Moved away across Jammu & Kashmir	
7	Do.	24-26	North Pakistan and adjoining Jammu & Kashmir	Do.	Do.	
8	Do.	26-31	North Afghanistan and neighbourhood	Do.	Do.	
(B)	*Induced cyclonic circulations*					
1	Lower tropospheric level	1-3	North Rajasthan and neighbourhood	Northeastwards	Punjab and neighbourhood	
2	Lower level (L/L)	5-6	Northwest Rajasthan and adjoining Pakistan	Stationary	*In situ*	
3	Do.	8-9	North Rajasthan	Northeastwards	Northwest Rajasthan and adjoining Punjab	
4	Lower tropospheric level	26-29	North Pakistan and neighbourhood	Do.	Moved away across Himachal Pradesh	
(C)	*Other cyclonic circulations*					
1	Lower tropospheric level	10-14	West Rajasthan and neighbourhood	Northeastwards	Northwest Uttar Pradesh	A trough from this system extending up to 3.1 km asl ran upto Gujarat coast
2	Do.	11-12	Saurashtra and neighbourhood	Do.	—	Merged with the above trough
(D)	*Trough in the mid/ upper tropospheric westerlies/easterlies*					
1	Mid & upper tropospheric westerlies	7-18	65°E/North of 25°N	Eastwards	91°E/North of 15°N	

TABLE 1 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
2	Do.	19-22	65°E/North of 15°N	Do.	70°E/North of 15°N	
3	Easterlies (L/L)	14-15	South Tamil Nadu to south Marathwada	Stationary	*In situ*	
4	Mid & upper tropospheric westerlies	22-27	56°E/North of 20°N	Eastwards	74°E/North of 15°N	
5	Do.	28 Jan-1 Feb	65°E/North of 20°N	Do.	85°E/North of 27°N	
(E)	*Other troughs*					
1	Lower level	9-11	Southeast Arabian Sea and neighbourhood	Stationary	*In situ*	
2	Do.	6-9	Southwest Bay off Tamil Nadu coast	Do.	Do.	
3	Do.	13-18	Do.	Westwards	Moved away	It was seen as a cyclonic circulation and extended upto 0.9 km asl over north Sri Lanka
4	Lower tropospheric level	16-18	Sub-Himalayan West Bengal to north coastal Andhra Pradesh	Northeastwards	Assam to northeast Bay	
5	Lower level	17-26	Southwest Bay off Sri Lanka coast	Stationary	*In situ*	

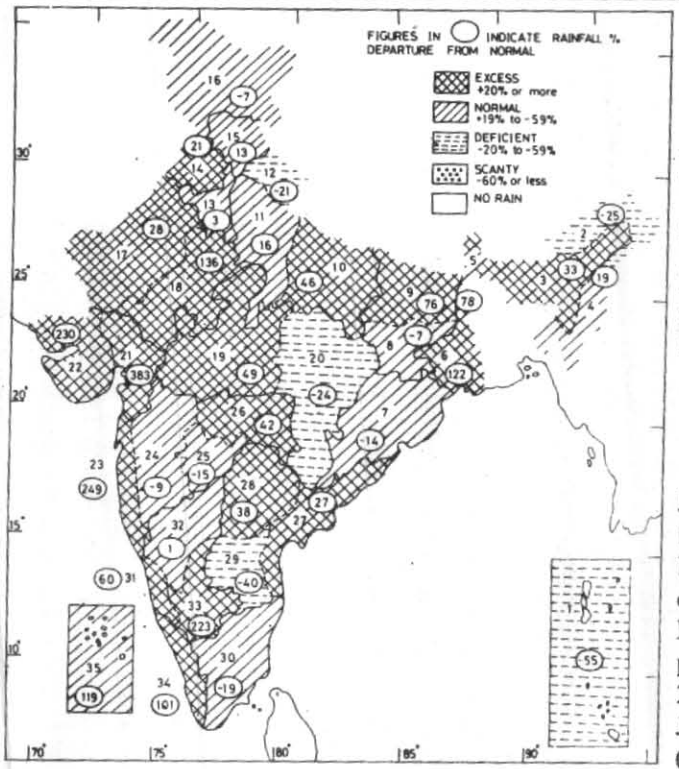

Fig. 1. Rainfall for the period 1 January to 28 February 1994

remaining 5 sub-divisions in India. Rainfall was in excess in West Bengal, Bihar plains, plains of Uttar Pradesh, Punjab, Rajasthan, west Madhya Pradesh, Gujarat, Konkan & Goa, Marathwada, Vidarbha, Telangana, Karnataka and Kerala and normal over Assam & Meghalaya, Bihar plateau, hills of west Uttar Pradesh, Haryana, Jammu & Kashmir and Madhya Maharashtra. Rainfall was deficient or scanty over rest of the country. Principal amounts of rainfall are given in Table 4.

4.3. *Temperature*

Severe cold wave conditions prevailed over Jammu on 21. Cold wave conditions also prevailed for 3 days over Jammu and one or two days over Punjab, Himachal Pradesh, east Rajasthan, plains of west Uttar Pradesh, Madhya Maharashtra and Marathwada. In the plains, lowest minimum temperature of 0°C was recorded at Adampur on 22 and 23 January and at Amritsar (Departure −5°C) on 23 January. In hills, lowest temperature of −3°C (Departure −2°C) was recorded at Srinagar on 17, 22, 23, 24 and 26 January.

TABLE 2

Details of the weather systems during February 1994

S. No. (1)	System (2)	Period (3)	Place of first location (4)	Direction of movement (5)	Place of dissipation (6)	Remarks (7)
(A)	*Western disturbances*					
1	Upper air system	31 Jan-2 Feb	North Afghanistan and adjoining Pakistan	Northeastwards	Moved away across Jammu & Kashmir	
2	Do.	5-6	Do.	Eastwards	Do.	
3	Do.	6-9	North Pakistan and neighbourhood	Northeastwards	Do.	
4	Do.	10-11	North Pakistan	Eastwards	Do.	
5	Do.	13-15	North Pakistan and neighbourhood	Northeastwards	Do.	
6	Do.	15-18	South Pakistan and neighbourhood			
7	Do.	19-23	Northwest Afghanistan and neighbourhood	Do.	Do.	
8	Do.	26-28	North Pakistan and neighbourhood	Do.	Do.	
(B)	*Induced low pressure areas*					
1	As sea level low pressure area	2-4	Iran and adjoining Afghanistan	Eastwards	Moved away across Himachal Pradesh	It was seen as an upper air cyclonic circulation between 21 and 4.5 km asl over north Pakistan and neighbourhood on 3
2	As low pressure area	3-5	Do.	Do.	Punjab to southwest Madhya Pradesh	
3	Induced low pressure area	20-21	South Pakistan and adjoining west Rajasthan	Northeastwards	Punjab and adjoining north Pakistan	Associated cyclonic circulation extended up to 1.5 km asl
(C)	*Induced cyclonic circulations*					
1	Lower tropospheric level	6-9	North Gujarat and neighbourhood	Do.	Haryana, Punjab and adjoining parts of west Rajasthan	A trough from this system extending upto lower tropospheric level was seen from Haryana to Marathwada on 8 and 9
2	Do.	11-13	Northwest Rajasthan and adjoining Pakistan	Do.	Northeast Rajasthan and adjoining parts of west Uttar Pradesh and Haryana	
3	Do.	15-18	Southwest Rajasthan and neighbourhood	Do.	Moved northeastward across Hills of west Uttar Pradesh	Associated trough from this system extended upto interior Karnataka in the lower levels

TABLE 2 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
(D)	*Other cyclonic circulations*					
1	Lower tropospheric level	31 Jan-5 Feb	Assam and neighbourhood	Northeastwards	Moved away	
2	Mid-tropospheric level (MTL)	2-5	Bihar plains and adjoining east Uttar Pradesh	Stationary	*In situ*	
3	Lower tropospheric level	2-3	Orissa and neighbourhood	Do.	Do.	
4	Lower level	13-14	South Tamil Nadu and neighbourhood	Do.	Do.	
5	Mid-tropospheric level	17-19	Gulf of Cambay and neighbourhood	Eastwards	Nagaland, Manipur, Mizoram and Tripura and neighbourhood	
(E)	*Trough in the mid/upper tropospheric westerlies/easterlies*					
1	Mid & upper tropospheric westerlies	1-6	80°E/North of 20°N	Eastwards	93°E/North of 15°N	
2	Mid & upper tropospheric westerlies	8-9	68°N/North of 20°N	Do.	Moved away across northeast India	
3	Easterlies (MTL)	6-7	South Kerala to Marathwada	Stationary	*In situ*	
4	Easterlies (L/L)	9-11	South interior Karnataka to south Tamil Nadu	Westwards	Marathwada to Kerala across Karnataka	
5	Easterlies (L/L)	12-28	Interior Karnataka to Lakshadweep	Westwards	Lakshadweep to coastal Karnataka	
(F)	*Other troughs*					
1	Lower level	1-6	Southwest Bay off Tamil Nadu-Sri Lanka coast	Stationary	*In situ*	
2	Do.	18-20	Tamil Nadu to north interior Karnataka	Westwards	Kerala to north interior Karnataka	
3	Do.	23-28	South Tamil Nadu to south interior Karnataka	Do.	Lakshadweep to coastal Karnataka	

4.4. *Disastrous weather events and damages*

According to reports hail storms/thunder squalls on 17 January in parts of northeastern States of India caused damage to houses and standing crops and also caused erosion of vast cultivated lands along the banks of Kolong and Kapilee rivers in Assam. Due to sea erosion, about 11 houses were damaged, 400 coconut trees uprooted and 1.5 acres of land washed away in Kozhikode district of Kerala.

5. February

5.1. *Weather and associated synoptic features*

8 western disturbances and 3 induced low pressure areas and 3 induced cyclonic circulations at lower tropospheric levels affected north India. Out of these, systems which formed during the week 3 to 9 February and 17 to 23 February, were active and yielded good rainfall in Haryana, Punjab, Himachal Pradesh and Jammu & Kashmir. Details of the

TABLE 3

Rainfall figures (mm) for each month and season as a whole (January-February 1994)

S. No.	Sub-division	January			February			Season		
		Actual (mm)	Normal (mm)	Dep (%)	Actual (mm)	Normal (mm)	Dep (%)	Actual (mm)	Normal (mm)	Dep (%)
1	Bay Islands	5	72	−93	49	47	3	54	120	−55
2	Arunachal Pradesh	30	46	−36	54	66	−17	84	112	−25
3	Assam & Meghalaya	21	18	17	39	27	43	60	45	33
4	Naga., Mani., Mizo. & Tri.	6	15	−58	45	28	61	51	43	19
5	S.H.W.B. & Sikkim	32	17	83	39	22	74	71	40	78
6	Gangetic West Bengal	22	13	61	53	20	162	75	34	122
7	Orissa	3	12	−74	29	25	17	32	37	−14
8	Bihar plateau	17	20	−16	25	25	1	42	46	−7
9	Bihar plains	28	15	83	27	16	69	55	31	76
10	East Uttar Pradesh	28	18	54	22	16	37	50	34	46
11	Plains of west Uttar Pradesh	28	22	26	17	17	2	45	39	16
12	Hills of west Uttar Pradesh	54	66	−19	51	66	−23	104	132	−21
13	Har., Chand. & Delhi	24	22	11	18	19	−7	42	41	3
14	Punjab	36	30	20	32	26	22	68	56	21
15	Himachal Pradesh	62	79	−21	110	73	52	172	152	13
16	Jammu & Kashmir	74	80	−8	84	90	−6	158	170	−7
17	West Rajasthan	16	8	93	1	5	−83	16	13	28
18	East Rajasthan	26	7	274	1	4	−83	27	11	136
19	West Madhya Pradesh	22	13	65	9	7	20	31	21	49
20	East Madhya Pradesh	14	20	−27	17	22	−22	31	42	−24
21	Gujarat Region	14	2	678	0	1	−98	14	3	383
22	Saur., Kutch & Diu	6	1	458	0	1	−88	6	2	230
23	Konkan & Goa	7	1	447	0	1	−100	7	2	249
24	Madhya Maharashtra	5	4	19	0	2	−85	5	6	−9
25	Marathwada	5	3	76	0	3	−95	5	6	−15
26	Vidarbha	16	12	39	14	10	46	30	21	42
27	Coastal Andhra Pradesh	3	10	−66	23	11	110	26	21	27
28	Telangana	6	4	32	9	6	41	15	11	38
29	Rayalaseema	3	8	−63	5	5	−3	8	13	−40
30	Tamil Nadu	7	33	−78	32	15	112	39	48	−19
31	Coastal Karnataka	6	2	156	0	1	−93	6	4	60
32	N.I. Karnataka	4	2	79	1	3	−55	5	5	1
33	S.I. Karnataka	18	3	524	4	4	1	22	7	223
34	Kerala	32	15	119	31	17	86	63	31	101
35	Lakshadweep	12	25	−51	63	9	590	75	34	119

TABLE 4

Principal amounts of rainfall (cm) for the month of January and February 1994

S. No.	January	February
1	Sarasawa 2, Naninuthar 1	Midnapore 2, Cherrapunji, Durgachak, Gorakhpur and Pamban 1 each
2	Nil	Jamshedpur, Konsabati Dam and Midnapore 4 each, Krisnagar 3, Rupsi 2
3	Nil	Cherrapunji 3, Dhoparmukh, Contal and Uluberia 2 each, Rajghat 1
4	Nil	Champasarai 2
5	Karaikal 2, Needamangalam 1	Sirkali 8, Kumbakonam 7, Nagapattinam 4, Manali 3
6	Vedaranayam 1	Batole, Kallam, Minicoy and Nagpur 2 each, Betul and Manali 1 each
7	Sirkali 2	Chidambaram 6, Kumbakonam 5, Anjangaon 2, Akola 1
8	Tiruchendur 5, Sathankulam and Tuticorin 3 each, Pamban 2	Tiruchendur 10, Mauranipur 5, Chamba and Pondicherry 4 each, Jagadhari and Nawashahar 3 each
9	Tiruchendur 1	Mavelikara 12, Tuticorin 5, Barailly and Sankalan 4 each, Kodaikanal, Naraingarh and Varanasi 3 each
10	Nil	Palayamkottai and Minicoy 9 each, Mongalagiri 8, Madurai 3 Gangtok and Passighat 2 each
11	Meerut 3, Alwar Jhajjar and Muzaffarnagar 2 each, New Delhi 1	Senkottah 12, Tiruvananthapuram 5, Nagarjunasagar Dam 4, Jurala 3
12	Dasuya 4, Indore, Kaithal, Malpura, Moradabad and Mukerion 3 each, Ambala and Jaipur 2 each	Periyanaickanpalayam 10, Vijayawada 4, Thenmala 3, Batote 2, Dibrugarh 1
13	Pathankot 13, Banihal 10, Nagpur 6, Fatehabad and Sikandrarao 4 each, Muktaswar 3	Senkottah 14, Yerrangondapalem and Vaikom 5 each, Gopalpur 3, Bharmour and Machilipatnam 2 each
14	Kumar Sain 7, Morena, Nedumangad, Sonepat and Subramanya 2 each, Kanpur 1	Kalingapatnam and Tekkali 4 each, Rohru 3, Batala and Bhuntar 2 each, Punalur 1
15	Cochi 9, Ambah and Salempur 5 each, Bhuntar and Lansdown 4 each, Kalpa and Mandla 3 each	Kozha 7, Lakhandur 5, Bramhapuri and Paravathipuram 3 each, Purulia 1
16	Ermakkal 6, Chunar, Darbhanga, Jalpaiguri and Rohru 4 each, Ambikapur and Muzaffarpur 3 each	Alipingal, Bankura and Ichchapuram 4 each, Calcutta and Nagpur 3 each, Raipur 1
17	Piravom 7, Melkole and Slempur 5 each, Kalimpong and Tumkur 4 each, Dibrugarh and Cooch Behar 2 each	Bhubaneswar 4, Aheri and Dondilohar 3 each, Chintapalli, Lakhandur and Quazi Gund 2 each
18	Mysore 11, Tumkur 6, Chinthalapudi 2, Anantpur 1	Nagbhir 3, Bramhapuri 2, Pamban and Rajanandgaon 1 each
19	Kunnamkulam 7, Melapalli 3, Hyderabad and Malavalli 2 each	Aryankavu 1
20	Deoli 6, Yeotmal 5, Balaghat and Umrer 3 each, Nagpur 2	Damoh 1
21	Subramanya 4, Ambasamudram and Jintoor 2 each	Bharmour 11, Banihal 10, Kapurthala 5, Kalka 3
22	Dharwad and Panambur 2 each	Batole 5, Manali 4, Kailashahar and Thiruvananthapuram 3 each, Malda, Pathankot and Silchar 2 each

TABLE 4 *(Contd.)*

S. No.	January	February
23	Indore 2. Ratlam 1	Cooch Behar 3. Agartala and Passighat 2 each
24	Nil	Nil
25	Nil	Nil
26	Nil	Nil
27	Banihal and Quazi Gund 2 each. Manali 1	Nil
28	Bharmour 6. Banihal and Quazi Gund 5 each	North Lakhimpur 4. Dibrugarh and Gangtok 2 each
29	Batole and Bharmour 3 each. Banihal 2. Patti 1	
30	Kalpa 3. Meja and Varanasi 2 each. Kalimpong 1	
31	Krisnagar 5. Passighat 4. Diamond Harbour 2. Kailash-shahar 1	

systems are given in Table 2. During the weeks 3 to 9 and 10 to 16 February, many parts of the country received a short spell of rain.

Rain or thundershowers occurred almost at all the places or at many places on 1 to 3 days in Andaman & Nicobar Islands, west Bengal & Sikkim, Orissa, Bihar, plains of Uttar Pradesh, Punjab and coastal Andhra Pradesh and on 4 to 7 days in Arunachal Pradesh, Assam & Meghalaya, Nagaland, Manipur, Mizoram & Tripura, Himachal Pradesh and Kashmir. Rain or thundershowers occurred either at a few places or at one or two places on 11 to 14 days in Andaman & Nicobar Islands, Sub-Himalayan West Bengal & Sikkim, Jammu & Kashmir, east Madhya Pradesh and Kerala and on 4 to 10 days in Assam & Meghalaya, Gangetic West Bengal, Orissa, Bihar plateau, Haryana, Punjab, Jammu & Kashmir, east Rajasthan, west Madhya Pradesh, Vidarbha, Andhra Pradesh and south interior Karnataka and on 1 to 3 days in Arunachal Pradesh, Sub-Himalayan West Bengal & Sikkim, Bihar plains, Uttar Pradesh, west Rajasthan, Madhya Maharashtra, Marathwada and north interior Karnataka.

5.2. *Month's rainfall*

Accumulated monthly rainfall was in excess in Assam & Meghalaya, Nagaland, Manipur, Mizoram & Tripura, West Bengal and Sikkim, Bihar plains, east Uttar Pradesh, Punjab, Himachal Pradesh, west Madhya Pradesh, Vidarbha, coastal Andhra Pradesh, Telangana, Tamil Nadu, Kerala and Lakshadweep and was normal in Andaman & Nicobar islands, Arunachal Pradesh, Orissa, Bihar plateau, plains of west Uttar Pradesh, Haryana, Jammu & Kashmir, Rayalaseema and south interior Karnataka. Rainfall was either deficient or scanty over rest of the country except Konkan & Goa which was mainly dry during the month. Principal amounts of rainfall are given in Table 4.

5.3. *Temperature*

Severe cold wave conditions prevailed over Himachal Pradesh on 22. Cold wave conditions also prevailed for 6 days in Himachal Pradesh, 3 to 4 days in Jammu & Kashmir and on one or two days in Bihar, west Madhya Pradesh and west Rajasthan. In the plains, lowest temperature of 2°C (Departure −3°C) was recorded at Amritsar on 1. In the hills, lowest temperature of −3°C (Departure −4°C) was recorded at Srinagar on 24 and 25 February.

5.4. *Disastrous weather events and damages*

According to press reports about 32 houses were reported damaged in an earthquake in Koyna Region (epicentre was near Lat. 17.3°N and Long. 73.7°E) in Maharashtra on 1 February.

Hailstorm with gale winds and thunder bolt on 1 and 27 February caused damage to houses and public services. It affected Gangetic West Bengal and Assam taking a toll of 4 lives.