MAUSAM, **58**, 3 (July 2007), 409-458

Weather in India

MONSOON SEASON (June to September 2006)†

1 Characteristic features of southwest monsoon 2006

1.1. The seasonal rainfall over the country as a whole was 99.6% of its long period average and thus a *normal monsoon** year.

1.2. However, it was not well distributed in space and time.

1.3. Unlike last year, August was devoid of any break like situations. Instead it was the most active period in terms of the number of depressions and rainfall over central India.

1.4. During August, a record number of depressions (4) formed over the Bay of Bengal and all of them moved in a westnorthwesterly/westerly track south of Lat. 25° N, causing excess/ normal rainfall over the central parts.

1.5. The rainfall activity was subdued during June and July except during the first weeks. September received near normal rainfall.

1.6. Monsoon lows & depressions caused flood situations in several states like Maharashtra, Goa, Gujarat, Orissa, Madhya Pradesh, Chattisgarh, Rajasthan, Jammu & Kashmir, Uttar Pradesh, Bihar, West Bengal, Assam, Andhra Pradesh and Kerala.

1.7. Out of 533 meteorological districts, 59% received *excess/ normal* rainfall, and the remaining 41% received *deficient/scanty* rainfall. 130 districts (25%) experienced moderate drought and 35 districts (7%) experienced severe drought conditions at the end of the season.

1.8. Out of the 36 met. Sub-divisions, the seasonal rainfall was *excess* in 6 and *normal* in 21 sub–divisions. It was *deficient* in the remaining 9. Out of these, 4 sub–divisions *viz*., Arunachal Pradesh, Assam & Meghalaya, west Uttar Pradesh and Haryana experienced moderate drought conditions (rainfall deficiency of 26–50%) at the end of the season.

2. Various aspects of southwest monsoon - 2006

2.1. *Advance of southwest monsoon*

The monsoon advance over the country took place in four distinct spells interspersed with prolonged hiatuses in the northern limit.

2.1.1. *17 May – 6 June* - Monsoon current arrived over parts of southeast Bay, Nicobar Islands and south Andaman Sea on 17 May (in the near normal time). It further advanced steadily and covered the western parts of Peninsular India and northeast India by 6 June. The advance along the west coast was rapid after the onset over Kerala on 26 May in association with the movement of an embedded cyclonic circulation along the offshore trough.

2.1.2. *23 – 30 June* - After a prolonged hiatus of 16 days *i.e*., during 7 – 22 June (caused mainly due to the mid latitude westerly intrusion) it further advanced, comparatively as a weak current over the remaining parts of Peninsula, central India and also the northern parts of the country outside Haryana, Punjab and Rajasthan.

Features noticed during the prolonged hiatus in Northern Limit of Monsoon were,

(*i*) The mid-latitude westerly intrusion disrupted the upper airflow pattern by diluting the Tibetan High and in turn the TEJ.

(*ii*) It also made the heat low diffused by introducing downstream divergence over the area.

(*iii*) The resultant reduction in the north-south temperature making the troposphere to be less baroclinic, there by inhibiting the formation of low pressure systems.

2.1.3. *9 – 11 July* - The second hiatus lasted for 8 days (1 to 8 July). It occurred as the rainfall being mainly confined to the south of the depression track which was roughly along Latitude 21° N. Also soon after its dissipation, the seasonal trough shifted towards the foothills. This helped the subsequent gradual advance of monsoon over most parts of northwest India outside west Rajasthan during 9 to 11.

* Definition of terms in '*Italics*' are given in Appendix.

†*Compiled by* : A. B. Mazumdar, R. R. Lele and S. Sunitha Devi, Meteorological Office, Pune – 411 005, India

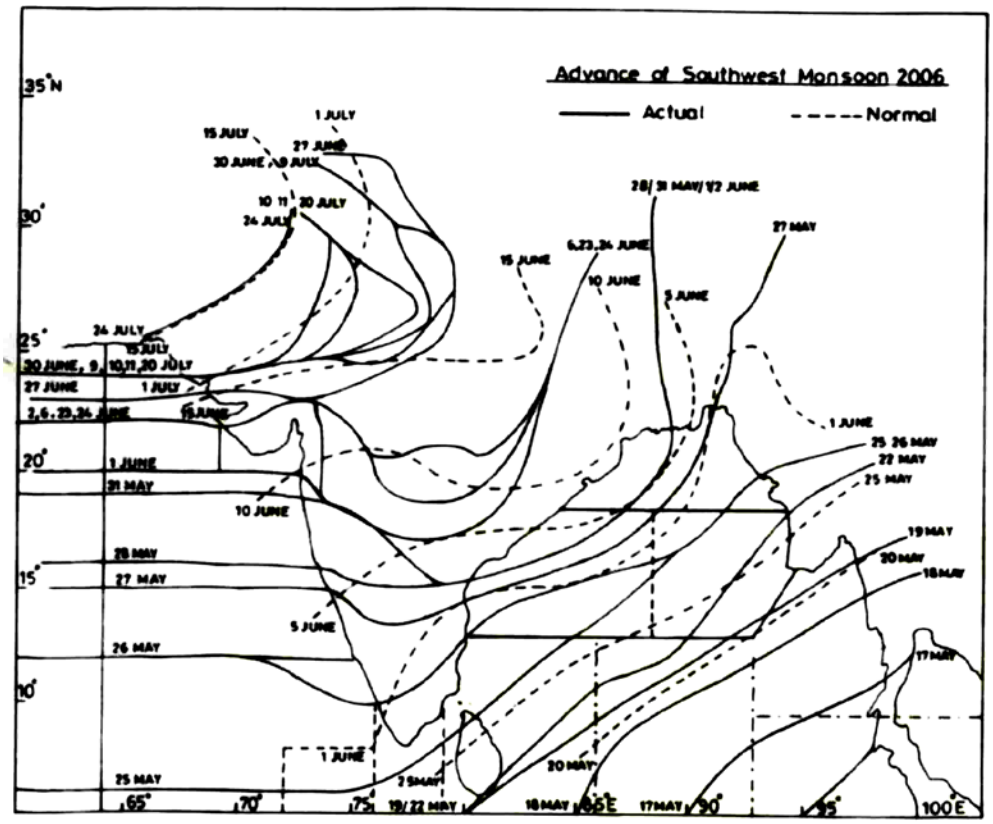


Fig. 1. Isochrones of advance of southwest monsoon 2006

2.1.4. *20 – 24 July* - Further advance over west Rajasthan took place on 20 & 24 July as the monsoon in general was in a weak phase during 12 to 19 July. It covered the entire country on 24 July, with a delay of 9 days.

The progress of monsoon over the country is given chronologically in Table 1 and Fig. 1.

2.2. *Weekly rainfall distribution*

2.2.1. *Week by week rainfall*

Meteorological sub-divisionwise weekly rainfall departures (percentage departure from normal) during the period from 1 June to 4 October 2006 comprising of 18 weeks are given in Fig. 2(a).

The first weeks of June and July were in general good and like so the last week of July. The remaining weeks of the first half witnessed subdued activity for the country as a whole. During August, almost all the subdivisions in Central India including Gujarat region, Saurashtra & Kutch, Konkan & Goa, Madhya Maharashtra and Marathwada received *excess/normal* rainfall, while the north and northeast India remained *deficient*. The first week of September was good for west Uttar Pradesh, Uttaranchal, Haryana, Punjab, Himachal Pradesh, Jammu & Kashmir, Rajasthan and Madhya Pradesh, while northeast India received good rainfall during the second week. The third and fourth weeks of September had been normal for the country as a whole.

2.2.2. *Weekly cumulative rainfall distribution*

Meteorological sub-divisionwise cumulative rainfall departures (percentage departure from normal) during the season from 1 June to 30 September, comprising of 18 weeks are given in Fig. 2 (b).

The cumulative rainfall for the northeastern sub-divisions other than Nagaland-Manipur-Mizoram-Tripura and Sub-Himalayan West Bengal & Sikkim remained to be *deficient* after 14 June. It was *excess* or *normal*, almost all through the season over Gangetic West Bengal, Orissa and Jharkhand. The major rainfall deficiency for northwest India excluding Jammu & Kashmir and Rajasthan started from the second week of August and

TABLE 1

Advance of southwest monsoon 2006

Date	SW monsoon advanced over	Remarks
17 May	Parts of southeast Bay, Nicobar Islands and south Andaman Sea.	Near normal time.
18 May	Some parts of southwest Bay, some more parts of southeast Bay, south Andaman Islands and most parts of Andaman Sea.	About a week prior.
19 May	Some more parts of southwest & southeast Bay and Andaman Sea	Do
22 May	Some more parts of southwest & southeast Bay, remaining parts of Andaman Sea and some parts of east central Bay	Near normal time.
25 May	Some parts of south Arabian Sea, Maldives-Comorin areas, some more parts of southwest Bay, entire southeast Bay, some parts of west central Bay, some more parts of east central Bay and some parts of northeast Bay.	About a week prior.
26 May	Entire southwest Arabian Sea, most parts of southeast Arabian Sea, Lakshadweep area, some parts of Kerala, Tamil Nadu, entire southwest Bay and some more parts of west central Bay.	Do
27 May	Parts of central Arabian Sea, rest parts of Kerala, most parts of coastal & south interior Karnataka, some parts of Rayalaseema, coastal Andhra Pradesh, some more parts of west central Bay, entire east central Bay, some more parts of northeast Bay and some parts of northwest Bay.	Do
28 May	Some more parts of central Arabian Sea, entire coastal Karnataka and Goa, some parts of extreme south Konkan, some parts of north interior Karnataka, some more parts of south interior Karnataka, Rayalaseema, coastal Andhra Pradesh, west central Bay, northwest Bay, entire northeast Bay, Assam & Meghalaya, Arunachal Pradesh and some parts of Sub-Himalayan West Bengal & Sikkim.	Nearly 2 weeks prior in the western parts and a week prior over northeast India.
31 May	Some more parts of central Arabian Sea, most parts of Konkan & Goa, south Madhya Maharashtra, some more parts of north interior Karnataka, most parts of Rayalaseema and some more parts of coastal Andhra Pradesh.	Nearly 2 weeks prior.
1 June	Remaining parts of Konkan.	Do
2 June	Some parts of north Arabian Sea and south Gujarat state.	Do
6 June	Most parts of north interior Karnataka, parts of Telangana, entire coastal Andhra Pradesh, some parts of Chattisgarh, most parts of Orissa, entire northwest Bay, West Bengal & Sikkim, Jharkhand and Bihar.	About 3 – 4 days prior in the western part and near normal in the eastern part.
	Ist Hiatus in northern limit of monsoon: 7 – 22 June (16 days)	
23 June	Some more parts of Gujarat region, remaining parts of Madhya Maharashtra, most parts of Marathwada and Telangana and some more parts of Chattisgarh.	About a week's delay in the western parts and 2 weeks in the central parts.
24 June	Remaining parts of Marathwada, most parts of Vidarbha, remaining parts of Telangana and some more parts of Chattisgarh.	About 2 weeks delay.
27 June	Some more parts of north Arabian Sea and Saurashtra & Kutch, Gujarat Region, most parts of Madhya Pradesh, entire Vidarbha, Chattisgarh, east Uttar Pradesh. some parts of west Uttar Pradesh, entire Uttaranchal, parts of Himachal Pradesh and entire Jammu & Kashmir..	About 2 weeks delay over the west and central India and near normal over the northwest India.
30 June	Most parts of north Arabian Sea, entire Gujarat state, some parts of east Rajasthan, entire west Madhya Pradesh, some more parts of west Uttar Pradesh, entire Himachal Pradesh and some parts of Punjab.	About 2 weeks delay.
	IInd Hiatus in northern limit of monsoon during 1 – 8 July (8 days)	
9 July	Most parts of west Uttar Pradesh and in some parts of Haryana including Delhi.	A week's delay.
10 July	Some more parts of east Rajasthan, remaining parts of west Madhya Pradesh, entire Haryana and Punjab and some parts of west Rajasthan.	Do
11 July	Entire east Rajasthan and some more parts of west Rajasthan	Do
	IIIrd Hiatus in northern limit of monsoon during 12 – 19 July (8 days)	Do
20 July	Some more parts of west Rajasthan.	Do
24 July	Remaining parts of Arabian Sea and west Rajasthan and hence the entire country.	9 days delay.

Week by week rainfall during SW Monsoon 2006

1 June – 30 September 2006

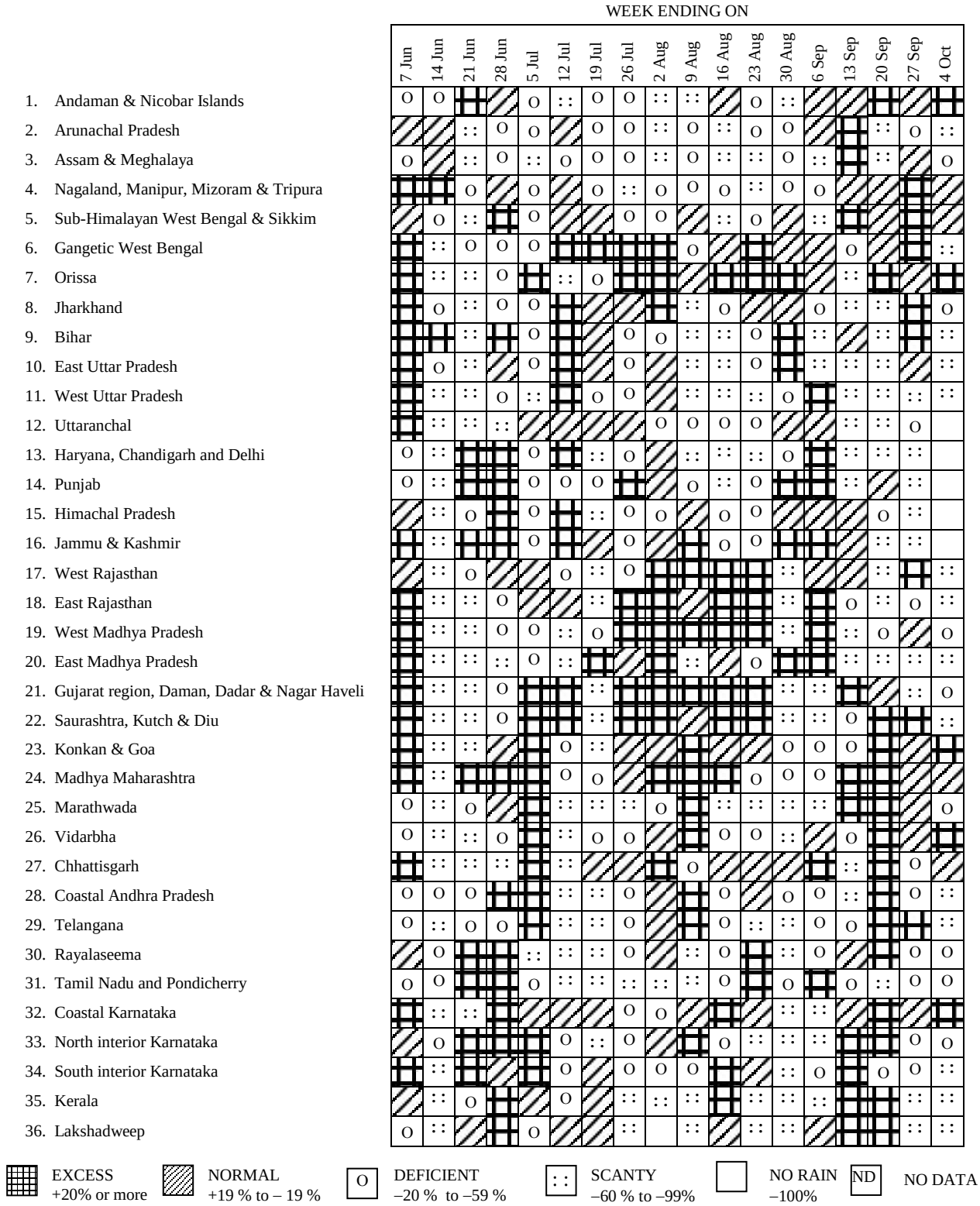


Fig. 2(a). Week by week rainfall during SW Monsoon 2006

Week by week cumulative rainfall

1 June – 30 September 2006

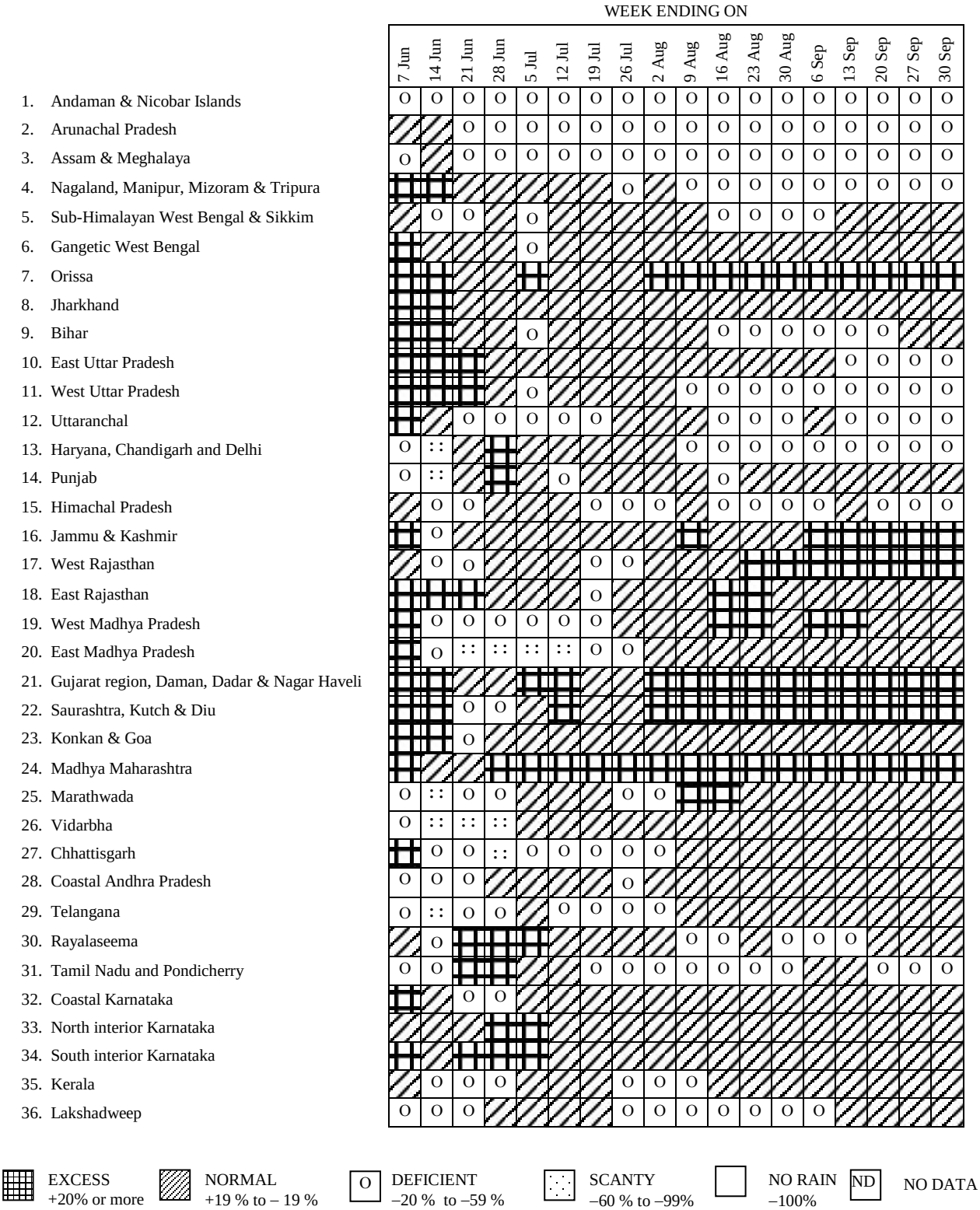


Fig. 2(b). Week by week cumulative rainfall during SW monsoon 2006 (1 June to 30 September 2006)

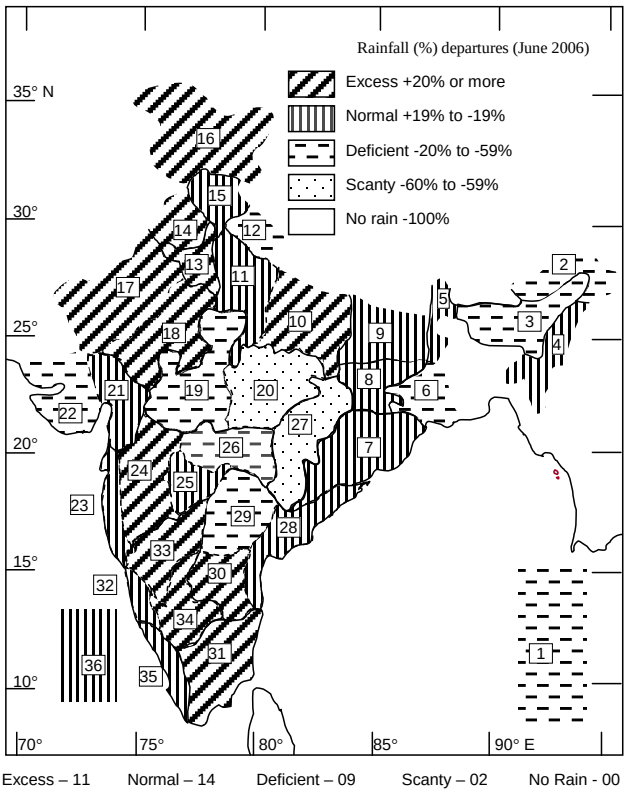


Fig. 3. Sub-divisionwise seasonal rainfall departure from normal (%) for the period (June 2006). 36 Sub-divisions are indicated by numbers on the map & bold letters in legend below. The rainfall anomaly values for these sub-divisions are indicated below :

1	–24	**7**	–14	**13**	28	**19**	–27	**25**	–15	**31**	28
2	–29	**8**	–7	**14**	42	**20**	–61	**26**	–35	**32**	–11
3	–30	**9**	3	**15**	–6	**21**	–2	**27**	–60	**33**	26
4	–6	**10**	29	**16**	33	**22**	–21	**28**	15	**34**	28
5	–15	**11**	–12	**17**	33	**23**	–9	**29**	–24	**35**	–15
6	–20	**12**	–32	**18**	25	**24**	37	**30**	57	**36**	–12

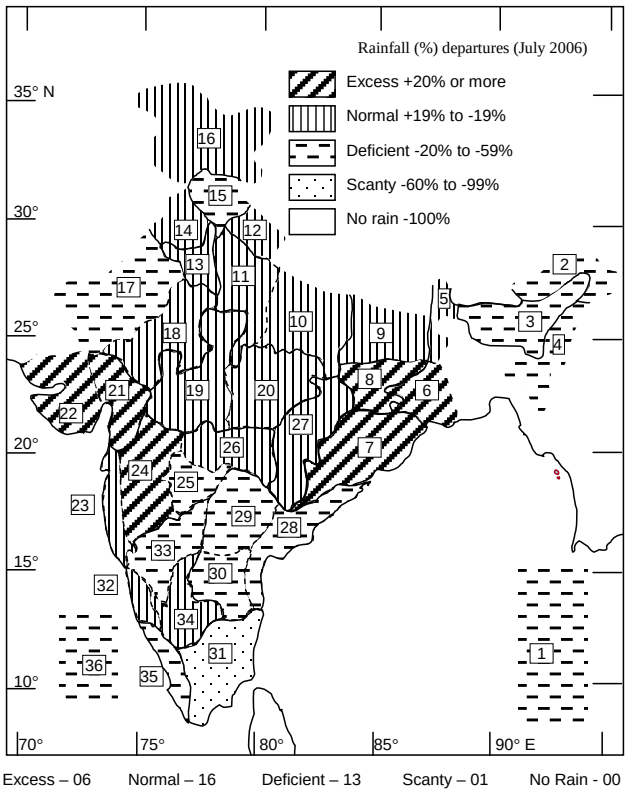


Fig. 4. Sub-divisionwise seasonal rainfall departure from normal (%) for the period (July 2006). 36 Sub-divisions are indicated by numbers on the map & bold letters in legend below. The rainfall anomaly values for these sub-divisions are indicated below :

1	–55	**7**	36	**13**	–13	**19**	–1	**25**	–36	**31**	–72
2	–30	**8**	31	**14**	–9	**20**	15	**26**	10	**32**	–13
3	–40	**9**	–13	**15**	–24	**21**	60	**27**	–3	**33**	–27
4	–21	**10**	9	**16**	2	**22**	89	**28**	–42	**34**	–14
5	–16	**11**	–9	**17**	–41	**23**	0	**29**	–40	**35**	–25
6	48	**12**	–2	**18**	–9	**24**	43	**30**	–52	**36**	–39

continued till the end of the season. For the central parts of the country rainfall was good throughout the period, except for a short spell (21 June – 12 July) of *deficient*/ *scanty* rainfall over Madhya Pradesh and Chattisgarh. The cumulative rainfall over peninsular India also had been quite good barring some subdued spells during the first half over Marathwada, Vidarbha, Telangana and Kerala. Andaman & Nicobar Islands remained *deficient* all through the weeks (based on real time data) while Lakshadweep was *deficient* during 1 – 21 June & 26 July – 6 September.

2.3. *Monthly rainfall distribution*

Figs. 3 – 6 show monthwise distribution of monsoon rainfall. Sub-divisionwise rainfall figures and departures for each month and season as a whole, are given in Table 2.

2.4. *Seasonal rainfall distribution*

Meteorological sub-divisionwise seasonal rainfall distribution in terms of percentage departures from normal is given in Fig. 7 and in Table 2. The seasonal rainfall was *excess* in 6, *normal* in 21 and *deficient* in the remaining 9 met. sub-divisions. No subdivision was *scanty* by the end of the season.

2.5. *Districtwise distribution of monsoon rainfall*

Out of the 533 meteorological districts, 59% received *excess*/*normal* rainfall and the remaining 41%

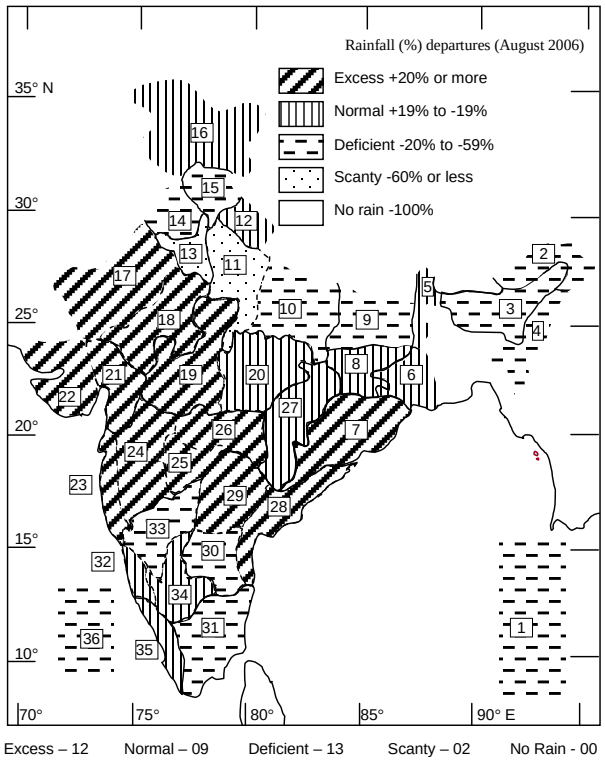


Fig. 5. Sub-divisionwise seasonal rainfall departure from normal (%) for the period (August 2006). 36 Sub-divisions are indicated by numbers on the map & bold letters in legend below. The rainfall anomaly values for these sub-divisions are indicated below :

1	–47	**7**	77	**13**	–79	**19**	48	**25**	49	**31**	–26
2	–41	**8**	–13	**14**	–37	**20**	–11	**26**	38	**32**	5
3	–56	**9**	–48	**15**	–21	**21**	111	**27**	12	**33**	–30
4	–42	**10**	–46	**16**	19	**22**	42	**28**	20	**34**	–16
5	–33	**11**	–75	**17**	117	**23**	29	**29**	33	**35**	–11
6	0	**12**	–18	**18**	37	**24**	107	**30**	–52	**36**	–29

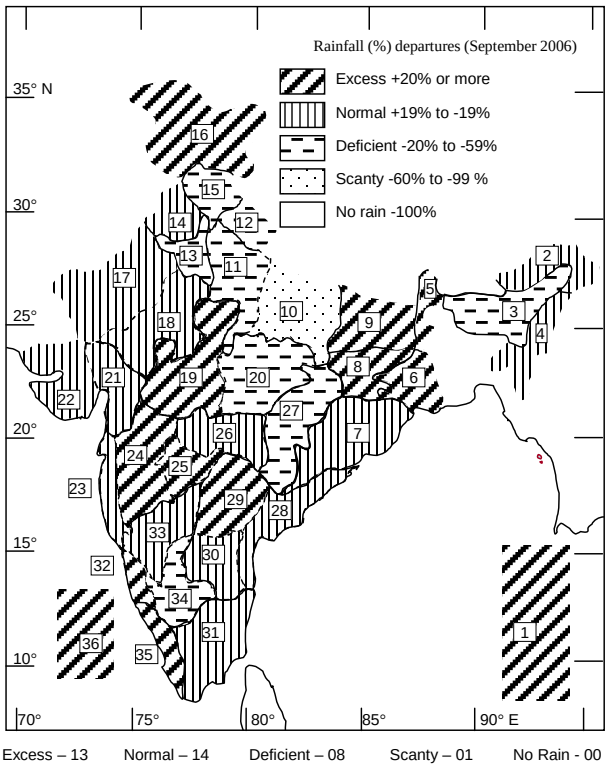


Fig. 6. Sub-divisionwise seasonal rainfall departure from normal (%) for the period (September 2006). 36 Sub-divisions are indicated by numbers on the map & bold letters in legend below. The rainfall anomaly values for these sub-divisions are indicated below :

1	26	**7**	12	**13**	–41	**19**	23	**25**	22	**31**	–4
2	–14	**8**	33	**14**	–3	**20**	–59	**26**	8	**32**	45
3	–24	**9**	25	**15**	–41	**21**	–14	**27**	–23	**33**	–12
4	–3	**10**	–65	**16**	116	**22**	–1	**28**	14	**34**	–22
5	20	**11**	–59	**17**	–15	**23**	12	**29**	69	**35**	85
6	38	**12**	–52	**18**	–17	**24**	42	**30**	3	**36**	94

received *deficient*/*scanty* rainfall during the period 1 June – 30 September 2006.

Percentage of districts with *excess*/*normal*, and *deficient*/*scanty* rainfall for the years 2001-2006 are given in Table 3.

2.6. *Withdrawal of southwest monsoon*

(*i*) Absence of rainfall for consecutive five days and establishment of an anticyclone in the lower tropospheric levels prompted the withdrawal of southwest monsoon from western parts of Punjab and Rajasthan on 21 September with a delay of almost a fortnight.

(*ii*) It withdrew from most parts of northwest India by 27 September.

(*iii*) The withdrawal completed from most parts of north India, central India and parts of Peninsula by 9 October.

(*iv*) On 16 October it withdrew from most parts, other than southern peninsula and then from the entire country, the Bay of Bengal and the Arabian Sea on 17 October.

The monsoon withdrawal over the country is given chronologically in Table 4 and Fig. 8.

3. Chief synoptic features of southwest monsoon 2006

The synoptic disturbances which affected the Indian monsoon region in June, July, August and September are given in Tables 5 to 8 respectively.

TABLE 2

Rainfall figures (mm) for each month and season as a whole (June – September 2006)

S. No.	Meteorological sub – divisions	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.	A. & N. Islands	367	482	–24	187	419	–55	220	416	–47	550	438	26	1325	1755	–25
2.	Arunachal Pradesh	351	494	–29	417	595	–30	228	388	–41	309	358	–14	1306	1835	–29
3.	Assam & Meghalaya	399	567	–30	335	564	–40	191	434	–56	244	321	–24	1169	1885	–38
4.	Naga., Mani., Mizo. and Tripura	341	361	–6	274	345	–21	179	309	–42	220	226	–3	1013	1241	–18
5.	S. H. W. B. & Sikkim	419	496	–15	507	602	–16	313	470	–33	467	388	20	1706	1955	–13
6.	Gangetic West Bengal	192	240	–20	467	315	48	313	312	0	371	270	38	1343	1136	18
7.	Orissa	177	206	–14	469	345	36	645	365	77	279	249	12	1569	1165	35
8.	Jharkhand	179	192	–7	438	336	31	281	324	–13	320	241	33	1218	1093	11
9.	Bihar	178	173	3	298	345	–13	154	295	–48	283	226	25	913	1039	–12
10.	East Uttar Pradesh	136	105	29	335	309	9	164	301	–46	69	198	–65	704	914	–23
11.	West Uttar Pradesh	60	69	–12	245	268	–9	72	286	–75	61	150	–59	438	773	–43
12.	Uttaranchal	112	164	–32	417	425	–2	350	426	–18	99	207	–52	978	1223	–20
13.	Haryana, Chandigarh & Delhi	55	43	28	148	171	–13	36	168	–79	52	89	–41	291	470	–38
14.	Punjab	59	42	42	172	189	–9	107	169	–37	99	102	–3	437	502	–13
15.	Himachal Pradesh	85	90	–6	220	288	–24	207	262	–21	79	134	–41	591	774	–24
16.	Jammu & Kashmir	78	59	33	190	186	2	207	174	19	206	95	116	680	514	32
17.	West Rajasthan	36	27	33	60	102	–41	203	94	117	34	41	–15	333	263	27
18.	East Rajasthan	77	61	25	204	224	–9	320	233	37	87	105	–17	688	624	10
19.	West Madhya Pradesh	79	108	–27	303	305	–1	466	315	48	218	177	23	1066	904	18
20.	East Madhya Pradesh	56	144	–61	425	371	15	340	382	–11	83	201	–59	903	1097	–18
21.	Gujarat region	121	123	–2	576	361	60	615	291	111	137	160	–14	1449	934	55
22.	Saurashtra & Kutch	64	81	–21	369	195	89	196	138	42	71	72	–1	700	486	44
23.	Konkan & Goa	613	675	–9	1065	1069	0	920	712	29	389	347	12	2988	2802	7
24.	Madhya Maharashtra	185	134	37	340	238	43	364	176	107	215	151	42	1103	700	58
25.	Marathwada	122	144	–15	123	192	–36	290	194	49	213	174	22	747	704	6
26.	Vidarbha	109	167	–35	360	329	10	415	300	38	195	180	8	1079	976	11
27.	Chattisgarh	75	189	–60	383	394	–3	439	391	12	178	232	–23	1075	1206	–11
28.	Coastal Andhra Pradesh	115	99	15	92	160	–42	184	154	20	184	162	14	576	575	0
29.	Telangana	104	135	–24	147	242	–40	291	218	33	289	171	69	830	767	8
30.	Rayalaseema	94	60	57	43	91	–52	47	97	–52	137	132	3	321	381	–16
31.	Tamil Nadu	53	42	28	20	71	–72	66	90	–26	109	113	–4	248	316	–21
32.	Coastal Karnataka	802	901	–11	1036	1188	–13	801	767	5	460	318	45	3099	3174	–2
33.	North interior Karnataka	124	98	26	92	126	–27	80	113	–30	135	153	–12	431	491	–12
34.	South interior Karnataka	170	132	28	193	225	–14	137	164	–16	107	137	–22	607	659	–8
35.	Kerala	577	678	–15	569	758	–25	396	447	–11	481	260	85	2024	2143	–6
36.	Lakshadweep	287	326	–12	173	282	–39	151	213	–29	318	164	94	928	985	–6

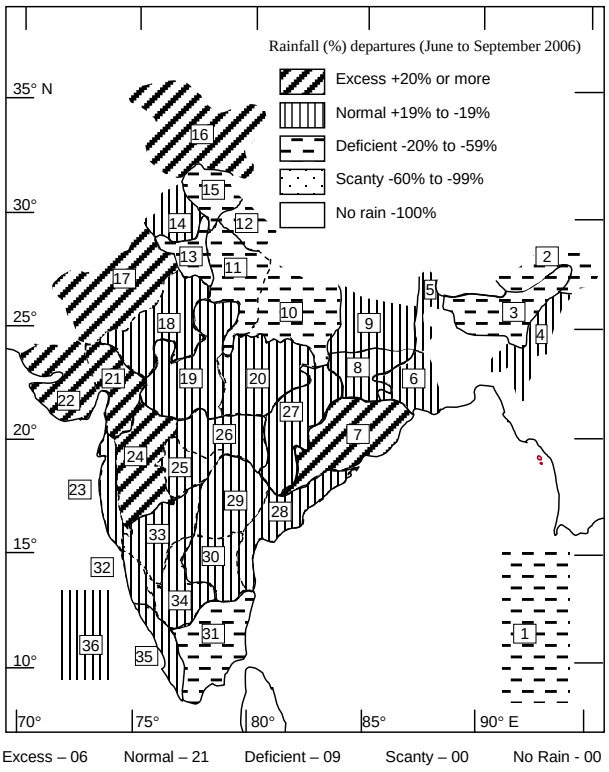


Fig. 7. Sub-divisionwise seasonal rainfall departure from normal (%) for the period (June - September 2006). 36 Sub-divisions are indicated by numbers on the map & bold letters in legend below. The rainfall anomaly values for these sub-divisions are indicated below :

1	–25	**7**	35	**13**	–38	**19**	18	**25**	6	**31**	–21
2	–29	**8**	11	**14**	–13	**20**	–18	**26**	11	**32**	–2
3	–38	**9**	–12	**15**	–24	**21**	55	**27**	–11	**33**	–12
4	–18	**10**	–23	**16**	32	**22**	44	**28**	0	**34**	–8
5	–13	**11**	–43	**17**	27	**23**	7	**29**	8	**35**	–6
6	18	**12**	–20	**18**	10	**24**	58	**30**	–16	**36**	–6

3.1. *Cyclonic storms/depressions*

September witnessed the formation of a Severe Cyclonic Storm (Mukda) over the Arabian Sea (21 – 24 September), which weakened *in situ* over the Ocean.

In the past 35 years there had been only three Cyclonic Storms formed over the Arabian Sea during September *viz*., the Severe Cyclonic Storm in 2004 (formed on 30 September, recurved towards Gujarat coast and weakened just before landfall), the Severe Cyclonic Storm in 1979 (formed on 18 September, moved away in a northwesterly/westerly direction) and the Severe Cyclonic Storm in 1974 (formed on 20 September and moved away northwestwards).

TABLE 3

Districtwise distribution of monsoon rainfall for the years 2001 – 2006

Year	Excess/Normal	Deficient/Scanty
2001	67	33
2002	39	61
2003	77	23
2004	56	44
2005	72	28
2006	59	41

Apart from this, there had been 8 Depressions formed during the season, 7 over the Bay of Bengal and one over the land.

The tracks of the systems are shown in Fig. 9. Details are given below :

3.1.1. *Severe Cyclonic storm (Mukda) over the east central and adjoining northeast Arabian Sea (21-24 September)*

Under the influence of an upper air cyclonic circulation over the east central Arabian Sea off south Maharashtra – Goa coasts, a low pressure area formed over there on 15. It lay over the east central Arabian Sea and adjoining Maharashtra coast on 16, over the east central Arabian Sea off north Maharashtra- south Gujarat coasts on 17 & 18, over south Gujarat coast and adjoining northeast Arabian Sea on 19 and over the northeast Arabian Sea off Saurashtra coast on 20. It concentrated into a Depression and lay centred near Lat. 19.5° N / Long. 66.0° E (about 450 km southwest of Porbandar) at 0300 UTC of 21. It remained practically stationary and intensified into a Deep Depression in the evening, further into a cyclonic storm (Mukda) in the early morning and lay centred near Lat. 20.0° N / Long. 66.0° E (about 400 km southwest of Porbandar) at 0300 UTC of 22. Slightly moving northeastwards, it further intensified into a severe cyclonic storm and lay centred at 1200 UTC near Lat. 20.5° N / Long. 66.5° E (about 350 km. southwest of Porbandar) and near Lat. 21.0° N / Long. 67.0° E (about 300 km westsouthwest of Porbandar) at 0300 UTC of 23. Remaining practically stationary over there, it weakened into a cyclonic storm at 1800 UTC of 23, into a Deep Depression at 0300 UTC of 24 and into a Depression over the same area at 1200 UTC of 24. During the mid night of 24, it further weakened into a well marked low pressure area over the northeast and adjoining east central Arabian Sea, persisted there on 25 and started drifting slowly westwards on 26 & 27 and moved away westwards on 28.

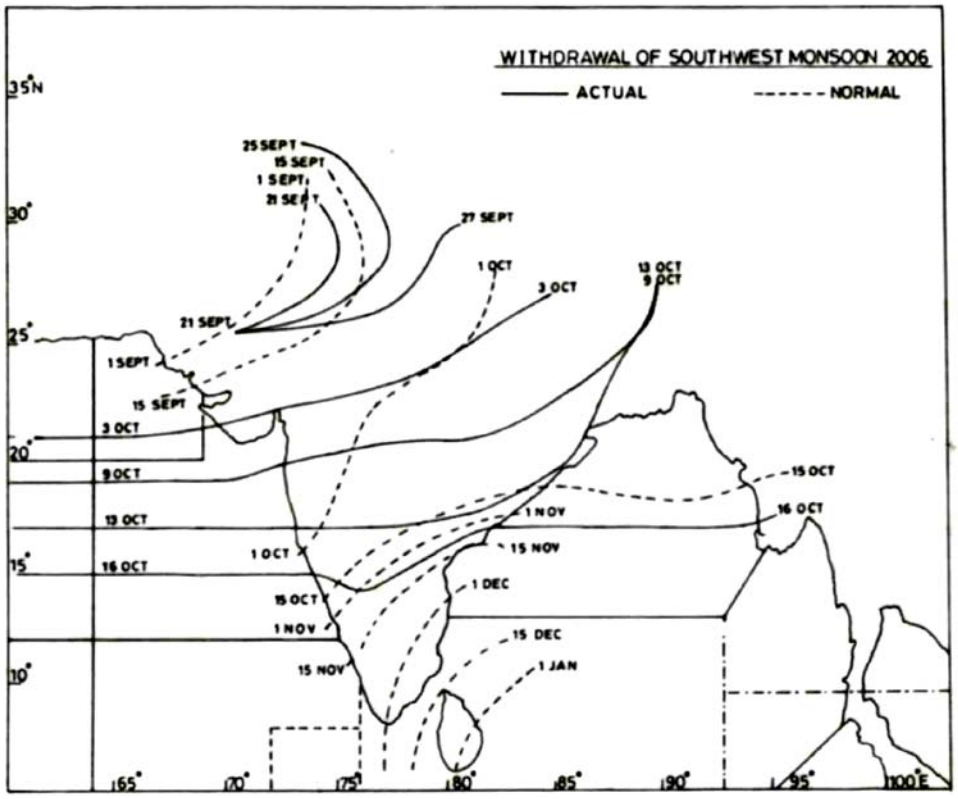


Fig. 8. Isochrones of withdrawal of southwest monsoon 2006

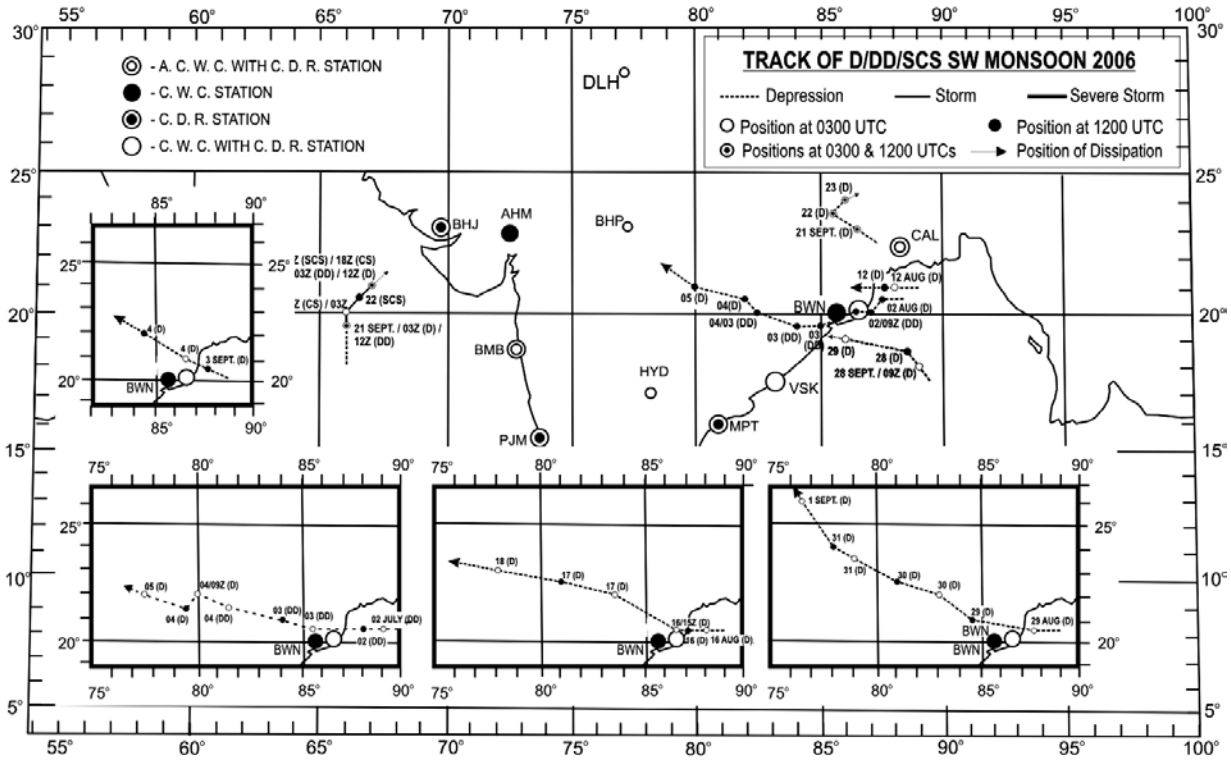


Fig. 9. Tracks of storm and depressions during southwest monsoon 2006

TABLE 4

Withdrawal of southwest monsoon 2006

S. No.	Date	Southwest monsoon withdrew from	Remarks
1.	21 September	Extreme western parts of Punjab and most parts of west Rajasthan.	about 6 to 21 days delay
2.	25 September	Some parts of Jammu & Kashmir, entire Punjab; most parts of Haryana including Delhi, west Rajasthan and some parts of east Rajasthan.	3 – 4 days delay
3.	27 September	Remaining parts of Jammu & Kashmir, entire Himachal Pradesh, Uttaranchal, remaining parts of Haryana, some parts of west Uttar Pradesh and east Rajasthan and some more parts of west Rajasthan.	Do
4.	3 October	Entire west Uttar Pradesh, most parts of east Uttar Pradesh, some parts of Bihar, west Madhya Pradesh, entire Rajasthan, most parts of Gujarat state and north Arabian Sea.	Do
5.	9 October	Entire Sub-Himalayan West Bengal & Sikkim, Bihar, east Uttar Pradesh, some parts of Gangetic West Bengal, most parts of Jharkhand, parts of Chattisgarh, entire Madhya Pradesh, some parts of Vidarbha, parts of north Madhya Maharashtra, entire Gujarat state, north Arabian Sea and some parts of central Arabian Sea.	nearly a week's delay
6.	13 October	Some more parts of Gangetic West Bengal, entire Jharkhand, most parts of Orissa, entire Chattisgarh and Vidarbha, some parts of Telangana, some parts of north interior Karnataka, entire Marathwada, most parts of Madhya Maharashtra and of Konkan & Goa and some more parts of central Arabian Sea.	normal
7.	16 October	Entire northeastern states, north Bay, some parts of central Bay, remaining parts of Gangetic West Bengal and Orissa, some parts of coastal Andhra Pradesh, entire Telangana, some parts of Rayalaseema, entire north interior Karnataka, Madhya Maharashtra, Konkan & Goa and some more parts of central Arabian Sea.	near normal time
8.	17 October	Remaining parts of the peninsular India, Bay of Bengal and of Arabian Sea and thus from the entire country.	Do

Northeast monsoon rains commenced on 19th October 2006.

3.1.2. *Deep Depression over the northwest Bay (2 – 5 July)*

Under the influence of an upper air cyclonic circulation, a low pressure area formed over the north Bay on 30 June. It became well marked over there on 1 July and rapidly concentrated into a Deep Depression which lay centred at 0300 UTC of 2 near Lat. 20.5° N / Long. 89.0° E and lay centred at 1200 UTC of 2, near Lat. 20.5° N / Long. 88.0° E about 150 km southeast of Balasore. Moving westwards, it crossed Orissa coast between Paradip and Chandbali around 1500 UTC of 2 and lay close to Cuttack at 0300 UTC of 3. Subsequently it moved westnorthwestwards and lay close to Sambalpur (Orissa) at 1200 UTC of 3 and close to Raipur (Chattisgarh) at 0300 UTC of 4. Thereafter, it weakened into a Depression over Vidarbha and neighbourhood by 0900 UTC and lay centred close to Nagpur at 1200 UTC of 4. Continuing its westnorthwestward movement, it lay close to Betul (west Madhya Pradesh) at 0300 UTC of 5. It further weakened into a well marked low pressure area over west Madhya Pradesh and adjoining southeast Rajasthan by the afternoon and lay over south Rajasthan and adjoining west Madhya Pradesh in the evening of 5. It became less marked on 6. But the upper air cyclonic circulation extending upto 3.1 km a.s.l. persisted there on 6, lay over southwest Rajasthan and adjoining north Gujarat region on 7 and became less marked on 8.

3.1.3. *Deep Depression over the northwest Bay (2 – 5 August)*

Under the influence of an upper air cyclonic circulation, a low pressure area formed over the north Bay off West Bengal – Orissa coasts on 1 August, which became well marked over there in the evening. It concentrated into a Depression and lay centred at 0300 UTC of 2, near Lat. 20.5° N / Long. 87.5° E. Drifting southwestwards, it intensified into a Deep Depression and lay centred at 0900 UTC of 2, near Lat. 20.0° N / Long. 87.0° E and at 1200 UTC near Lat. 20.0° N / Long. 86.5° E. Drifting slightly westsouthwestwards, it crossed south Orissa coast between Puri and Gopalpur around 0300 UTC of 3; when it lay centred near Lat. 19.5° N / Long. 85.0° E about 50 km northnortheast of Gopalpur. Further moving westwards, and then northwestwards, it lay centred near Lat. 19.5° N / Long. 84.0° E at 1200 UTC of 3; Lat. 20.0° N / Long. 82.5° E at 0300 UTC of 4 and after

TABLE 5

Details of the low pressure systems for the month of June 2006

S. No. (1)	System (2)	Duration (3)	Place of first location (4)	Direction of movement (5)	Final location (6)	Remarks (7)
(**A**)	*Low pressure areas*					
1.	Low pressure area	6 – 8	North Bay and adjoining Gangetic West Bengal	Northwest	Jharkhand and neighbourhood	It was seen as an upper air cyclonic circulation extending upto mid tropospheric levels over the north Bay on 4 & 5. The low pressure area rapidly moved inland and became less marked on 9. The associated upper air cyclonic circulation became less marked on 10
(**B**)	*Upper air cyclonic circulations*					
1.	Upto mid tropospheric levels	29 May – 3 Jun	East central Arabian Sea off Karnataka coast	North	Northwest Madhya Pradesh and adjoining east Rajasthan	Caused the rapid advance of monsoon along the west coast and also extremely heavy rainfalls along the west coast
2.	Between 3.6 & 5.8 km a.s.l.	10 – 12	Rayalaseema and neighbourhood	Stationary	*In situ*	Became less marked on 13
3.	Between 1.5 & 3.1 km a.s.l.	14 – 20	West central Bay off south Andhra coast	South	Southwest Bay off Tamil Nadu coast	Became less marked on 21
4.	Upto 3.6 km a.s.l.	14	West Uttar Pradesh and neighbourhood	Stationary	*In situ*	Became less marked on 15
5.	Between 3.1 & 4.5 km a.s.l.	15 – 18	North Maharashtra – south Gujarat coast	Quasi-stationary	*In situ*	Became less marked on 19
6.	Upto mid tropospheric levels	20 – 27	North Andaman Sea and neighbourhood	West	Northeast Arabian Sea	Moved away westwards on 28
7.	Between 3.6 & 7.6 km. a.s.l.	28 Jun – 4 Jul	Saurashtra & Kutch	Quasi-stationary	Gujarat region and adjoining Madhya Maharashtra	Tilted southwestwards with height. It merged with the circulation associated with the Depression on 5
8.	Upto lower tropospheric levels	22 – 25	Vidarbha and adjoining west Madhya Pradesh	Northwest	Southwest Rajasthan and adjoining Gujarat	Became less marked on 26
9.	Between 1.5 & 4.5 km. a.s.l.	25 – 27	Bihar and adjoining east Uttar Pradesh	West	West Uttar Pradesh and adjoining areas	Became less marked on 28
(**C**)	*Systems in westerlies*					
1.	Upper air cyclonic circulation upto mid tropospheric levels	2 – 5	North Pakistan and adjoining Jammu & Kashmir	Northeast	Jammu & Kashmir and adjoining Punjab	Moved away on 6
2.	Do	6 – 8	Do	Do	Jammu & Kashmir	Moved away on 9
3.	Upper air cyclonic circulation upto lower tropospheric levels	27 May – 2 Jun	Northwest Rajasthan	East	West Uttar Pradesh and neighbourhood	Became less marked on 3
4.	Trough in the lower levels	10 – 13	Sub-Himalayan West Bengal & Sikkim to north Bay	Quasi-Stationary	*In situ*	Became less marked on 14
5.	Trough in mid & upper tropospheric levels	10 – 13	Along Long. 68° E, north of Lat. 25° N	Northeast	Along Long. 70° E, north of Lat. 30° N	Became less marked on 14

TABLE 5 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
6.	Upper air cyclonic circulation upto mid tropospheric levels	11 – 20	North Pakistan and adjoining Jammu & Kashmir	Northeast	Jammu & Kashmir and neighbourhood.	Moved away northeastwards on 21
7.	Upper air cyclonic circulation upto lower tropospheric levels	15 – 18	Punjab and neighbourhood	Quasi-Stationary	*In situ*	Became less marked on 19
8.	Upper air cyclonic circulation between 1.5 & 5.8 km a.s.l.	20 – 22	Northwest Rajasthan and adjoining Haryana.	Eastnortheast	East Rajashtan and neighbourhood	Became less marked on 23
9.	Upper air cyclonic circulation upto mid tropospheric levels	21 – 27	North Pakistan and adjoining Jammu & Kashmir	Northeast	Northern parts of Jammu & Kashmir	Moved away on 27
10.	Do	27 Jun – 4 Jul	Northeast Afghanistan and adjoining north Pakistan	Northeast	Jammu & Kashmir	Moved away on 5 July

weakening into a Depression at 1200 UTC, it lay near Lat. 21.0° N / Long. 81.0° E. It lay near Lat. 21.0° N / Long. 80.0° E at 0300 UTC of 5. It further weakened into a well marked low over Vidarbha and adjoining southwest Madhya Pradesh in the evening of 5. It lay over: north Madhya Maharashtra and adjoining areas of Vidarbha and southwest Madhya Pradesh on 6 morning; southwest Madhya Pradesh and adjoining north Madhya Maharashtra on 6 evening and over west Madhya Pradesh and neighbourhood on 7. Further weakening into a low pressure area it lay over northwest Madhya Pradesh and adjoining east Rajasthan during 8 to 11; moved over to southeast Rajasthan and neighbourhood on 12; over southeast Rajasthan on 13 and merged with the heat low on 14.

3.1.4. *Depression over the north Bay (12-13 August)*

Under the influence of an upper air cyclonic circulation over the north Bay, a low pressure area formed there by the evening of 11, which concentrated into a Depression and lay centred at 0300 UTC of 12, near Lat. 21.0° N / Long. 88.0° E (about 100 km eastsoutheast of Balasore) and at 1200 UTC near Lat. 21.0° N / Long. 87.5° E. It crossed Orissa coast, close to Balasore around 1500 UTC of 12; weakened into a well marked low and lay over Chattisgarh and neighbourhood on 13; east Madhya Pradesh and neighbourhood on 14 and as a low pressure area over west Madhya Pradesh and adjoining southeast Rajasthan on 15 & 16; Saurashtra & Kutch and adjoining northeast Arabian Sea during 17-19 and became less marked on 20.

3.1.5. *Depression over the north Bay (16 – 18 August)*

Under the influence of an upper air cyclonic circulation, a low pressure area formed over the northwest Bay on 15 evening. It rapidly concentrated into a Depression and lay centred at 0300 UTC of 16 near Lat. 20.5° N / Long. 88.0 E and at 1200 UTC near Lat. 20.5° N / Long. 87.0° E (about 50 km southeast of Chandbali). Moving further westwards, it crossed north Orissa coast close to Chandbali around 1430 UTC of 16 and lay centred at 1500 UTC near Lat. 20.5° N / Long. 86.5° E close to Chandbali. Moving in a northwesterly direction it lay centred at 0300 UTC of 17 near Lat. 22.0° N / Long. 83.5° E (about 100 km. east of Champa) and at 1200 UTC near Lat. 22.5° N / Long. 81.0° E (about 80 km. west of Pendra). Further moving in a westnorthwesterly direction, it lay centred at 0300 UTC of 18 near Lat. 23.0° N / Long. 78.0° E (about 100 km. southeast of Bhopal) and subsequently weakened into a well marked low over northwest Madhya Pradesh and adjoining east Rajasthan in the same evening. It lay as a low pressure area over southeast Rajasthan and adjoining northwest Madhya Pradesh on 19 and over southwest Rajasthan and neighbourhood during 20 – 22.

TABLE 6

Details of low pressure systems for the month of July 2006

S. No. (1)	System (2)	Duration (3)	Place of first location (4)	Direction of movement (5)	Final location (6)	Remarks (7)
(**A**)	*Depression*					
1.	Deep Depression	2 – 4	North Bay, near Lat. 20.5° N / Long. 89.0° E	West	West Madhya Pradesh close to Betul	It was first seen as an upper air cyclonic circulation over west central Bay off Andhra coast during 26 – 28. Details are given in the text
(**B**)	*Low pressure areas*					
1.	Low pressure area	11 – 13	Gangetic West Bengal and neighbourhood	Quasi-Stationary	Gangetic West Bengal and adjoining Jharkhand	Formed under the influence of an upper air cyclonic circulation. It became less marked on 14
2.	Low pressure area	15 – 17	North Bay and adjoining Bangladesh and Gangetic West Bengal	Westnorthwest	Chattisgarh and adjoining Jharkhand	Though became less marked on 18, the associated upper air cyclonic circulation persisted over east Madhya Pradesh and neighbourhood upto 21
3.	Low pressure area	20 – 23	Gangetic West Bengal and neighbourhood	Northwest	Northwest Madhya Pradesh and adjoining east Rajasthan	Formed under the influence of an upper air cyclonic circulation. Became less marked on 24
4.	Well marked low pressure area	27 Jul – 1 Aug	North Bay	Northwest	West Rajasthan	Was well marked from 28 – 30 July
(**C**)	*Upper air cyclonic circulations*					
1.	Upto 3.1 km a.s.l.	16 – 17	West Uttar Pradesh and adjoining Uttaranchal	Stationary	*In situ*	Became less marked on 18
2.	Upto mid tropospheric levels	18 – 21	East central Arabian Sea off north Maharashtra – south Gujarat coasts	Quasi-stationary	Saurashtra & Kutch and neighbourhood	Became less marked on 22
3.	Between 1.5 & 3.6 km a.s.l.	19	Haryana and neighbourhood	Do	Do	Became less marked on 20
4.	Between 1.5 & 4.5 km a.s.l.	25 – 26	Jharkhand and neighbourhood	Stationary	*In situ*	Became less marked on 27
5.	Upto 3.1 km a.s.l.	24 – 29	East Uttar Pradesh and neighbourhood	Westnorthwest	Central parts of Rajasthan	Became less marked on 30
6.	Upto mid tropospheric levels	30 – 31	West Madhya Pradesh and adjoining east Rajasthan and Gujarat region	Quasi-stationary	-	Merged with the low pressure area over west Madhya Pradesh and neighbourhood on 31
7.	Upto mid tropospheric levels	31	Northwest Bay and neighbourhood	-	-	Later on caused the formation of the Deep Depression, details of which are given in the month of August
(**D**)	*Systems in westerlies*					
1.	Cyclonic circulation upto 4.5 km a.s.l.	5 – 7	North Pakistan and adjoining Jammu & Kashmir	Northeast	Jammu & Kashmir and neighbourhood	Moved away on 8
2.	Do	9 – 12	Do	Do	Do	Moved away on 13

TABLE 6 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
3.	Cyclonic circulation between 0.9 & 3.1 km a.s.l.	10 – 13	West Rajasthan and neighbourhood	Eastnortheast	Central parts of Uttar Pradesh	Became less marked on 14
4.	Cyclonic circulation upto 4.5 km a.s.l.	13 – 18	North Pakistan and adjoining Jammu & Kashmir	Northeast	Jammu & Kashmir and neighbourhood	Moved away on 19
5.	Do	19 – 20	Do	Do	Northern parts of Jammu & Kashmir	Moved away on 21
6.	Do	21 – 24	Northeast Afghanistan and adjoining north Pakistan	Do	Do	Moved away on 25
7.	Do	25 – 27	Jammu & Kashmir and neighbourhood	Do	Do	Moved away on 28
8.	Do	29 – 30	Northern parts of Jammu & Kashmir	Do	Do	Moved away on 31

Though it became less marked on 23, the associated upper air cyclonic circulation persisted there between 3.1 & 5.8 km. a.s.l. till 26 and became less marked on 27.

3.1.6. *Depression over the northwest Bay (29 August – 1 September)*

Under the influence of an upper air cyclonic circulation a low pressure area formed over the north Bay on 27, which became well marked over the northwest Bay off Gangetic West Bengal - Orissa coasts on 28. Subsequently it concentrated into a Depression and lay centred at 0300 UTC of 29 near Lat. 20.5° N / Long. 87.5° E, about 100 km eastsoutheast of Chandbali; crossed Orissa coast near Paradip around noon and lay centred at 1200 UTC near Lat. 21.0° N / Long. 84.5° E, about 100 km southeast of Sambalpur. Moving northwestwards, it lay centred at 0300 UTC of 30 near Lat. 22.0° N / Long. 83.0° E close to Champa and at 1200 UTC near Lat. 22.0° N / Long. 81.0° E, about 100 km westsouthwest of Pendra. Further moving westnorthwestwards it lay centred at 0300 UTC of 31 August near Lat. 23.5° N / Long. 79.0° E (about 50 km southeast of Sagar) and at 1200 UTC near Lat. 24.0° N / Long. 78.0° E (close to Sagar). Subsequently moving northnorthwestwards, it lay at 0300 UTC of 1 September over east Rajasthan and adjoining northwest Madhya Pradesh near Lat. 26.0° N / Long. 76.5° E (Close to Sawai Madhopur) and weakened into a well marked low over there in the evening. It moved over to Haryana and neighbourhood on 2, lay as a low pressure area over Punjab and neighbourhood on 3 and became less marked on 4.

3.1.7. *Depression over the northwest Bay (3 – 4 September)*

Under the influence of an upper air cyclonic circulation, a low pressure area formed over the north Bay on 3 early morning, which became well marked in the forenoon, subsequently concentrated into a Depression and lay centred at 1200 UTC near Lat. 20.5° N / Long. 88.5° E (about 180 km southeast of Balasore). Moving in a westnorthwesterly direction, it crossed north Orissa coast close to Chandbali; around 0100 UTC of 4 and lay centred at 0300 UTC near Lat. 21.0° N / Long. 86.5° E (close to Chandbali); at 1200 UTC near Lat. 22.0° N / Long. 84.5° E (about 50 km east of Jharsuguda). Further it moved northwestwards and weakened into a well marked low over north Chattisgarh and adjoining east Madhya Pradesh on 5 and over west Madhya Pradesh and neighbourhood on 6. It lay as a low pressure area over southwest Rajasthan and neighbourhood on 7 & 8 and moved away westwards on 9.

3.1.8. *Land Depression over Jharkhand (21 – 24 September)*

A low pressure area formed over the northeast Bay off Arakan coast and adjoining east central Bay on 18 evening. It lay over the northeast Bay on 19 and became well marked over there in the evening. It lay over Gangetic West Bengal and adjoining northwest Bay on 20 and concentrated into a Depression which lay centred close to Jamshedpur on 21. It moved slightly

TABLE 7

Details of low pressure systems for the month of August 2006

S. No. (1)	System (2)	Duration (3)	Place of first location (4)	Direction of movement (5)	Final location (6)	Remarks (7)
(**A**) *Depression*						
1.	Deep Depression	2 – 5	Northwest Bay (near Lat. 20.5° N / Long. 87.5° E)	Westsouthwest, west and northwest	Vidarbha and adjoining southwest Madhya Pradesh	Crossed south Orissa coast between Puri and Gopalpur at 0300 UTC of 3. Details are given in the text
2.	Depression	12 – 13	North Bay (near Lat. 21.0° N / Long. 88.0° E)	West	Chattisgarh and neighbourhood	Crossed Orissa coast close to Balasore around 1500 UTC. Details are given in the text
3.	Depression	16 – 18	North Bay (near Lat. 20.5° N / Long. 88.0° E)	Westnorthwest	Northwest Madhya Pradesh and adjoining east Rajasthan	Crossed north Orissa coast close to Chandbali around 1430 UTC of 16. Details are given in the text
4.	Depression	29 Aug – 1 Sep	Northwest Bay (near Lat. 20.5° N / Long. 87.5° E)	Westnorthwest and northwest	East Rajasthan and adjoining northwest Madhya Pradesh	Crossed Orissa coast near Paradip around noon of 29
(**B**) *Low pressure areas*						
1.	Well marked low pressure area	21 – 24	North Bay	West	Jharkhand and adjoining Chattisgarh	Became less marked on 25. The associated upper air cyclonic circulation persisted over Jharkhand and adjoining Bihar upto 27
(**C**) *Upper air cyclonic circulations*						
1.	Between 2.1 & 5.8 km a.s.l.	29 – 30	Southwest Rajasthan and adjoining Gujarat region	Quasi-stationary	*In situ*	Became less marked on 31
(**D**) *Systems in westerlies*						
1.	Cyclonic circulation upto mid tropospheric levels	7 – 10	North Pakistan and adjoining Jammu & Kashmir	Northeast	Northern parts of Jammu & Kashmir	Moved away on 11
2.	Cyclonic circulation upto mid tropospheric levels	10 – 16	North Pakistan and adjoining Jammu & Kashmir	Northeast	Do	Moved away on 17
3.	Do	18 – 20	Do	Do	Do	Moved away on 21
4.	Do	21 – 27	Do	Do	Do	Moved away on 28
5.	Do	25 – 27	Do	Do	Do	Moved away on 28
6.	Do	28 – 30	Do	Do	Do	Moved away on 31

northwestwards and lay centred over Jharkhand, about 50 km east of Ranchi on 22. Moving slightly northeastwards, it lay centred close to Dhanbad on 23. It weakened into a well marked low pressure area over Bihar and neighbourhood on 24 morning, lay as a low pressure area over there on 25 & 26 and became less marked on 27.

3.1.9. *Depression over the east central and adjoining northwest Bay (28 – 30 September)*

A low pressure area lay over the east central and adjoining northeast Bay off Arakan coast on 27; over the east central and adjoining northeast Bay on 28 morning;

TABLE 8

Details of low pressure systems for the month of September 2006

S. No. (1)	System (2)	Duration (3)	Place of first location (4)	Direction of movement (5)	Final location (6)	Remarks (7)
(**A**)	*Cyclonic storms*					
1.	Severe Cyclonic Storm	21 – 24	East central and adjoining northeast Arabian Sea	North	Northeast and adjoining east central Arabian Sea	Weakened *insitu*. Details are given in text
(**B**)	*Depressions*					
1.	Depression	3 – 4	Northwest Bay (near Lat. 20.5° N / Long. 88.5° E)	Westnorthwest and northwest	North Chattisgarh and adjoining east Madhya Pradesh	Crossed Orissa coast close to Chandbali around 0100 UTC of 4. Details are given in the text
2.	Do	21 – 24	Jharkhand (Close to Jamshedpur)	Northwest and then northeast	Bihar and neighbourhood	Details are given in the text
3.	Do	28 – 30	East central & adjoining northwest Bay (near Lat. 18.0° N / Long. 89.0° E)	Northwest and west	South Chattisgarh and neighbourhood	Crossed Orissa coast close to Gopalpur around 1200 UTC of 29. Details are given in the text
(**C**)	*Low pressure areas*					
1.	Low pressure area	15 – 18	West central Bay	West	Coastal Andhra Pradesh and adjoining Chattisgarh	Formed as an upper air cyclonic circulation over west central Bay off south Andhra- north Tamil Nadu coasts during 12 – 14
(**D**)	*Upper air cyclonic circulations*					
1.	Upto mid tropospheric levels	14 – 17	North Andaman Sea and adjoining Tenasserim coast	Quasi–stationary	*In situ*	Became less marked on 18
2.	Between 2.1 & 5.8 km a.s.l.	26 Evening – 27	West central Bay off south Andhra – North Tamil Nadu coasts	Do	Do	Became less marked on 28
(**E**)	*Systems in westerlies*					
1.	Trough in mid and upper tropospheric levels	3 – 5	Long. 70° E, north of Lat. 25° N	Quasi–stationary	*In situ*	Became less marked on 6
2.	Trough in the lower levels	7 – 13	Sub-Himalayan West Bengal & Sikkim to northwest Bay	Do	Do	Became less marked on 14
3.	Cyclonic circulation upto 4.5 km a.s.l.	7 – 9	North Pakistan	Northeast	Northern parts of Jammu & Kashmir	Moved away on 10
4.	Do	10 – 11	North Pakistan and adjoining Jammu & Kashmir	Do	Jammu & Kashmir and neighbourhood	Moved away on 12
5.	Trough in mid and upper tropospheric levels	21 – 26	Long. 67° E, to the north of Lat. 25° N	Eastnortheast	Long. 73° E	Became less marked on 27
6.	Cyclonic circulation upto mid tropospheric levels	23 – 25	North Pakistan and adjoining Jammu & Kashmir	Northeast	Northern parts of Jammu & Kashmir	Moved away on 26

TABLE 9(a)

Positions of off–shore trough during the Monsoon period 2006

Date	Location
27 – 31 May	Off Kerala – Karnataka coasts
1 June	Maharashtra to Kerala coasts
2 – 4 June	South Gujarat to Kerala coasts
5 – 6 June	North Karnataka to Kerala coasts
7 – 18 June	South Maharashtra to Kerala/ Karnataka coasts (feeble)
21 – 27 June	North Maharashtra to Kerala coasts
28 June – 5 July	South Gujarat to Kerala coasts (Steep pressure gradient)
6 – 16 July	South Gujarat to Kerala/ Karnataka coasts
17 July	Karnataka to Kerala coasts
18 July	North Maharashtra to Kerala coasts
19 – 31 July	South Gujarat to Kerala/ Karnataka coasts
1 – 16 August	North Maharashtra to Karnataka coasts
17 – 20 August	South Gujarat to Kerala coasts
21 – 23 August	North Maharashtra to Karnataka coasts
24 – 29 August	Off Maharashtra – Goa coasts
1 – 2 September	Do
12 September	Off Karnataka – Kerala coasts
13 – 15 September	South Maharashtra to Kerala coasts
16 – 20 September	South Gujarat to Kerala coasts
21 – 25 September	South Maharashtra to Kerala coasts

TABLE 9(b)

Details of Off-shore trough for the years 2001-2006

Year	Details of off – shore trough
2006	Extended along different parts of the west coast from 27 May to 25 September except during 19 – 20 June, 30 – 31 August and 3 – 11 September. Had been quite feeble in June except during the first week but active in July & August.
2005	Off–shore trough observed between 5 June to 24 September except during 7 & 10 August, 22 August – 5 September, 8 – 9 September and 20 – 22 September.
2004	Off-shore trough along different parts of west coast (surface and lower levels) upto 16 September from 19 May except 27 May to 3 June, 8 - 11 June, 23 - 24 June and 29 August to 7 September.
2003	Off-shore trough along different parts of west coast (surface and lower levels) observed upto 17 September from 6 June except during 18 - 21 August, 24 - 26 August, 4 September, 9 - 10 September and 12 - 15 September.
2002	Off-shore trough along different parts of west coast (surface and lower levels) observed upto 17 September except during 4 - 11 June, 25 - 31 July, 28 - 31 August and 14 - 16 September.
2001	Off-shore trough along different parts of west coast (surface and lower levels) noted upto 13 September except during 1 - 4 June and 11 September.

TABLE 10

Statistics of mid-latitude troughs

Atmospheric level	Jun	Jul	Aug	Sep	Total
300 hPa	10	1	0	11	22
500 hPa	8	1	2	9	20

TABLE 11

Statistics of systems in northwest Pacific Ocean/south China Sea during June – September 2006

Low pressure systems	Jun	Jul	Aug	Sep	Total
Tropical Depression (T.D.)	0	0	1	2	3
Tropical Storm (T.S.)	1	1	3	0	5
Typhoon	1	2	2	3	8
Total	2	3	6	5	16

became a well marked low pressure area at 0600 UTC and concentrated into a Depression over the east central Bay at 0900 UTC near Lat. 18.0° N / Long. 89.0° E (about 380 km southeast of Paradip); 1200 UTC near Lat. 18.5° N / Long. 88.5° E and at 0300 UTC of 29 it lay over the northwest and adjoining central Bay near Lat. 19.0° N / Long. 86.0° E (about 125 km eastsoutheast of Gopalpur). Moving in a westerly direction, it crossed the coast close to Gopalpur near Lat. 19.0° N / Long. 84.5° E around 1200 UTC. It continued to move westwards, weakened into a well marked low over south Chattisgarh and neighbourhood at 0300 UTC and moving further westwards, it lay over Vidarbha and adjoining south Chattisgarh at 1200 UTC of 30 September and as a low pressure area over Madhya Maharashtra and adjoining Vidarbha on 1 October. Though it became less marked in the next morning, the associated upper air cyclonic circulation extending upto mid tropospheric levels persisted and lay over Marathwada and adjoining Telangana tilting southwards with height on 2, over Madhya Maharashtra and adjoining north interior Karnataka on 3 and over Konkan & Goa and adjoining east central Arabian Sea on 4, east central Arabian Sea off north Maharashtra coast on 5 and became less marked on 6.

3.2. *Low Pressure Areas/Well-Marked Low Pressure Areas (LPA/WMLPA)*

Altogether 7 low pressure areas / well marked low pressure areas formed during the season. Most of them originated as upper air cyclonic circulations. Two of them formed over the land and the remaining five over the Bay of Bengal and subsequently moved over to land. Monthwise breakups of the systems are 1 in June, 4 in July and 1 each in August and September. The total numbers of low pressure areas during the past 5 years *viz*., 2000 to 2005 are 13, 10, 10, 12, 8 & 6 respectively.

3.3. *Upper Air Cyclonic Circulations (CYCIR)*

There were 19 upper air cyclonic circulations (in lower and middle tropospheric levels) formed during the season.

The monthwise breaks up of these are 9 in June, 7 in July, 1 in August and 2 in September.

3.4. *Off-shore Trough*

Off-shore trough along different parts of the west coast (surface and lower levels) persisted on most of the days from 27 May to 25 September except during 19 & 20 June, 30 & 31 August and 3 – 11 September. It was feeble on many days during June, but was very steep in the first week of July and on some days in August.

The details of the positions of the off-shore trough are given in Table 9(a) and that for the years 2001 to 2006 are given in Table 9 (b).

3.5. *Eastward moving cyclonic circulations/western disturbances*

There were 25 eastward moving systems as upper air cyclonic circulations. The monthwise break-up is 8 in June, 8 in July, 6 in August and 3 in September.

4. Extra Indian features

4.1. *Cross Equatorial Flow*

4.1.1. *Over the Bay of Bengal*

The Cross Equatorial flow along the equatorial belt (equator to 5° N / 5° S) over the Bay of Bengal was almost normal throughout the Southwest monsoon period, June – September 2006, except during the second and third weeks of July, during which it was stronger by 10 kts (normal : 8-10 kts).

The surface winds over the Bay of Bengal to the north of 5° N were nearly normal in the first and last weeks of June 2006, first and second weeks of July 2006 and first, second and last weeks of August 2006. They were stronger by almost 10-15 kts in the second and third weeks of June 2006 (normal: 10-15 kts), entire period during the second fortnight of July 2006 (normal: 10-15 kts), third week of August (normal : 10-15 kts)

TABLE 12

Intensity of Mascarene High during monsoon season for the years 2001-2006

Year	June		July		August		September	
	Pressure (hPa)	Departure (%)	Pressure (hPa)	Departure (%)	Pressure (hPa)	Departure (%)	Pressure (hPa)	Departure (%)
2001	1023	0	1024	-1	1028	2	1022	-3
2002	1024	2	1027	1.5	1030	4	1024	0.5
2003	1023	– 1.5	1025.5	– 1	1026	– 1	1023.5	3
2004	1028	5	1026	0.5	1026	0	1023	– 0.5
2005	1024	1	1024	-1.5	1026	0	1026	2.5
2006	1020.6	-2.4	1025.2	-0.3	1021.8	-4.2	1023.5	0.0

TABLE 13

Intensity of Australian High during monsoon season for the years 2001-2006

Year	June		July		August		September	
	Pressure (hPa)	Departure (%)	Pressure (hPa)	Departure (%)	Pressure (hPa)	Departure (%)	Pressure (hPa)	Departure (%)
2001	1020	2	1021	1	1019	– 1	1017	– 1
2002	1022	0	1022	0	1022	1.5	1017	– 1
2003	1022	– 1	1022	1	1020.5	– 1.5	1018	– 2
2004	1022	0	1022	0	1017	– 3.5	1020	2
2005	1018	– 4	1022	0	1022	1.5	1015.5	– 2.5
2006	1027.2	5.2	1024.5	2.5	1025.2	4.7	1023.6	5.6

and throughout the month of September 2006 (normal : 5-10 kts).

4.1.2. *Over the Arabian Sea*

The cross equatorial flow along the equatorial belt (equator to 5° N / 5° S) was stronger than normal by 5-10 kts, during the last week of June 2006 (normal : 10-12 kts) and first week of September 2006 (normal : 8-10 kts). It was weaker by about 5 kts in the third and last week of July 2006 (normal : 12-14 kts). Except these, the cross equatorial flow along the equatorial belt was close to the normal during the entire monsoon period, June – September 2006.

The surface winds over the Arabian Sea to the north of 5° N were stronger than normal by 10 kts during the first week of June 2006 (normal : 15-20 kts), second, third and last week of July 2006 (normal : 20-25 kts) and stronger by 10-15 kts during the entire month of September 2006 (normal : 5-10 kts). They were almost normal in the remaining weeks of June to August 2006. (normal : 20-25 kts).

4.2. *Mid-Latitude troughs*

Monthwise break-up of troughs in westerlies found between 60° E – 90° E, reaching upto or south of 30° N is given in Table 10.

There were a total of 20 and 22 mid and upper tropospheric westerlies respectively at 500 and 300 hPa during the season.

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

There were in all 16 systems (Tropical depression stage and above) in the northwest Pacific Ocean / South

TABLE 14

SST anomaly indices (ENSO)

Month	Pacific SSTA (°C)			SOI
	Nino 1+2 0°-10°S 90°-80°W	Nino 3 5°N-5°S 150°-90° W	Nino 4 5°N-5°S 160°E-150°W	
Oct 2005	-1.2	-0.2	0.5	1.1
Nov 2005	-1.2	-0.7	0.3	-0.3
Dec 2005	-0.7	-0.9	0.1	-0.2
Jan 2006	-0.3	-0.7	-0.4	1.8
Feb 2006	0.3	-0.3	-0.6	-0.2
Mar 2006	0.3	-0.6	-0.3	1.4
Apr 2006	-1.2	-0.1	-0.1	0.9
May 2006	-0.4	0	0.2	-0.8
Jun 2006	-0.2	0.1	0.5	-0.7
Jul 2006	0.4	0.3	0.5	-0.8
Aug 2006	0.8	0.5	0.8	-1.6
Sep 2006	0.9	0.9	0.9	-0.7

China Sea during June – September 2006. The month wise break-up is shown in Table 11.

4.4. *Systems in southern hemisphere*

4.4.1. *Tropical storms/ depressions*

Not a single tropical storm or depression formed during June to September 2006 in the south Indian Ocean.

4.4.2. *Mid and upper tropospheric westerly troughs over the Indian Ocean*

There were in all 19 upper air troughs in westerlies (4 each in June & July, 5 in August and 6 in September) which moved across the Indian Ocean from west to east to the north of Lat. 30^{o} S, in the Southern Hemisphere during June to September 2006. (*Source* : INSAT full disc pictures).

4.4.3. *Mascarene High*

The intensity of Mascarene High centred at 30° S / 60^{o} E was below normal by 2.4 hPa in June 2006 and by about 4.2 hPa in August 2006. It was almost normal in the months of July and September 2006. The intensity of Mascarene High along with that for the past 5 years, are given in Table 12.

(*Source* : Climate Diagnostic Bulletins, NOAA June-September 2006. Normal based on the means for the base period 1979-1995).

4.4.4. *Australian High*

The intensity of Australian High centred at 30° S / 140° E was above normal by about 5 hPa during the months of June, August and September 2006. It was above normal by 2.5 hPa during July 2006. Summary of the intensity of Australian High for the past 5 years are given in Table 13.

(*Source* : Climate Diagnostic Bulletins, NOAA June-September 2006. Normal based on the means for the base period 1979-1995).

4.4.5. *El-Nino phenomenon*

The combined oceanographic and atmospheric phenomena, ENSO which is a result of El Nino, the oceanographic phenomenon indicating the anomalous rise in sea surface temperatures over the east Pacific and see

saw relationship between sea level pressure over the southeastern Pacific Ocean and the Indian Ocean [the Southern Oscillation (SO)], the atmospheric response to the El Nino, during some years indicate an inverse relationship with the Indian summer monsoon rainfall. The phase and magnitude of the ENSO can be indicated either by the sea surface temperature (SST) anomalies over the Pacific or by Southern Oscillation Index (SOI) expressed as the difference in atmospheric surface pressure between Tahiti, an island station in the southeast Pacific Ocean and Darwin, Australia.

Table 14 depicts the monthly values of sea surface temperature anomaly indices for Nino 4, Nino 3 and Nino 1+2 regions and SOI for the period from October 2005 to September 2006. The Nino 1+2 index showed slight warming from October 2005 till March 2006, slight cooling from April till June and then slight rise from July to September 2006. Nino 3 remained cooler from October 2005 till May 2006 and steadily warmed up till September 2006. Nino 4 showed steady cooling from October 2005 to February 2006, then warming till September 2006. SOI had been -1.6 in August 2006.

5. Semi-permanent systems

5.1. *Heat low*

Heat low made its appearance in its near normal position by 23 May and remained more or less in its normal position (though diffused or sometimes even less marked, on many days in June & July) until 4 September. It was less marked on the sea level chart during 8 – 15 June.

The lowest and the second lowest pressure values of the heat low were :

Jun : 990 hPa (on 27) and 991 hPa (on 10)

Jul : 985 hPa (on 8) and 988 hPa (on 9 & 10)

Aug : 989 hPa (on 3) and 991 hPa (on 1)

Sep : 997 hPa (on 1) and 999 hPa (on 2)

Details of the lowest observed isobaric values of the Heat Low during past five years are given in Table 15.

5.2. *Axis of the monsoon trough*

The heat trough made its appearance at sea level on 1 June extending from Rajasthan to north Bay, but became diffused due to the changes in flow pattern after a week. It re-appeared during the first week of July with the formation of a Deep Depression over the northwest Bay and shifted northward rapidly with the dissipation of the system.

With a gradual change in the upper tropospheric flow pattern and revival of monsoon activity, the trough regained its normal position at sea level and got established as monsoon trough about 2° to the south of its normal position, when the monsoon covered the entire country on 24 July.

It generally remained south of the normal position (sometimes even 3°-4° to the south) during the whole of August, due to the successive formation of depressions over the north Bay. During September, either parts or the entire trough remained close to the foothills during 6 to 13. Also, a secondary trough extended along the eastern parts on a few days during the period. Though regained its normal position in the later part of the month, it gradually got diffused and became less marked from the sea level chart.

For ready comparison, a brief data on monsoon trough in the past five years are given below :

Year	*Axis of monsoon trough*
2001	Established on 3 July. Less marked on 20 September.
2002	Established on 15 August. Less marked on 16 September.
2003	Established on 5 July. Less marked on 16 September.
2004	Established on 18 July. Less marked on 22 September.
2005	Established on 30 June. Less marked on 2 September.

5.3. *Tibetan Anticyclone/High*

Tibetan Anticyclone (TA) was established in its near normal position at 500, 300 & 200 hPa on 7 June. But it was absent at 500 & 300 hPa on most of the days during June. In July, quite often it was to the east of the normal position. It remained slightly to the northeast of normal during August and much to the north in September. Though it was noticed upto 30 September, on many days the anticyclone was absent from 10 September onwards.

TABLE 15

Details of lowest isobaric values (hPa) of the heat low during past 5 years

Month	Year				
	2001	2002	2003	2004	2005
June	987.0 (20th & 21st)	988.0 (21st & 22nd)	986.0 (7th, 8th & 27th)	990.0 (17th)	988.0 (26th)
July	989.0 (7th)	988.0 (2nd)	990.0 (4th, 9th & 30th)	992.0 (7th)	988 (1st & 2nd)
August	990.0 (29th)	998.0 (11th)	991.0(9th)	991.0 (2nd)	990.0 (1st & 2nd)
September	995.0 (5th & 10th)	997.0 (4th)	993.0 (2nd)	998.0 (9th & 10th)	996.0 (1st)

The details of Tibetan Anticyclone for the past five years are given below.

Year *Tibetan Anticyclone*

2001 Established on 12 June. Not seen in the last week of August. Less marked on 13 September.

2002 Established on 11 July. Not seen in July at 500 hPa. Less marked on 12 September.

2003 Established on 15 June. Not seen at 500 hPa during June & first half of July. Less marked on 14 September.

2004 Established on 13 June. Not seen at 500 hPa during June & first half of July. Less marked on 18 September.

2005 Established on 26 June. Remained more or less at normal position in June, slightly to the south in August and north of its normal position till 27 September.

5.4. *Sub-Tropical Westerly Jet (STWJ)*

STWJ was seen over Srinagar and Delhi latitudes upto 11 June. Though it shifted northwards thereafter, made casual re-appearances over stations like Lucknow, Delhi, Srinagar and Jodhpur during July and sometimes during August. Towards the end of the season it was noticed over Delhi and Srinagar from 29 September onwards. The days during which the Sub–tropical Westerly Jet was observed in the past five years are given below.

Year *Sub-Tropical Westerly Jet (STWJ)*

2001 Seen over north India during last week of May and reappeared in the last week of September.

2002 Seen over north India during first week of June and reappeared in the last week of September.

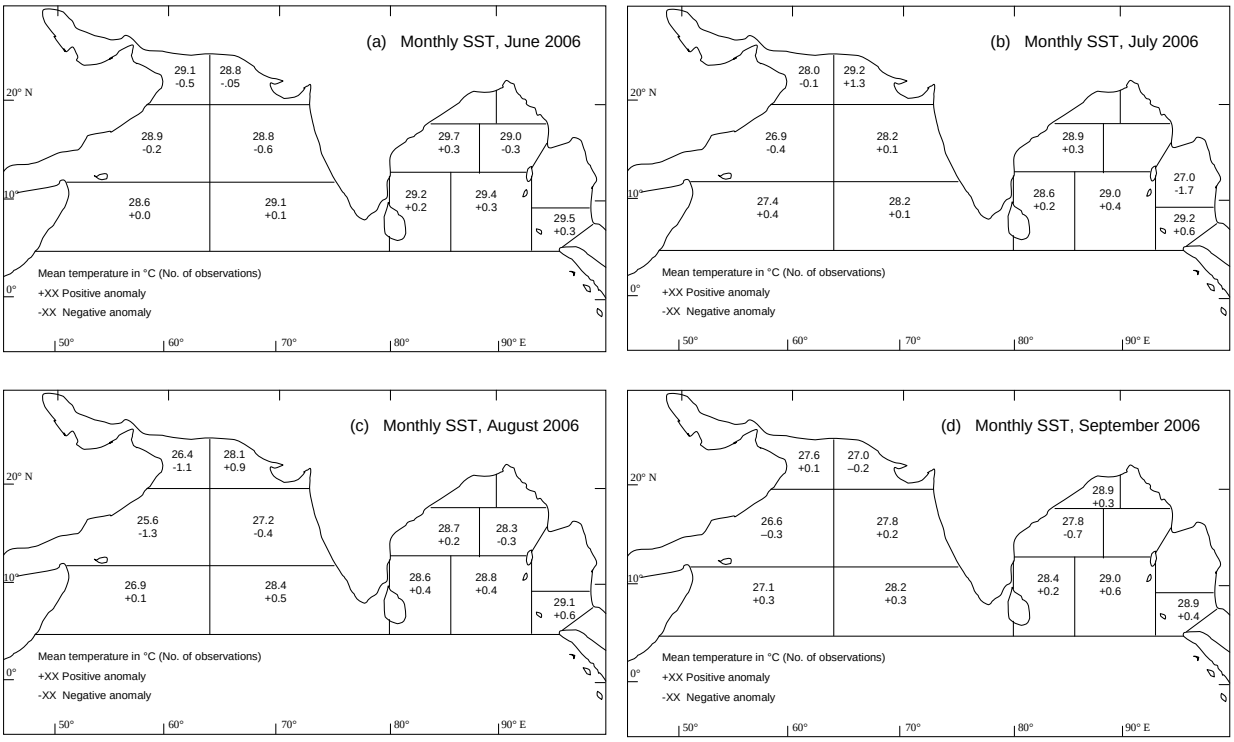
2003 Seen over Srinagar on 5 June. Reappeared on 1 October.

2004 Seen over Srinagar upto 23 June, over Ranchi until 20 June and reappeared in the first week of October.

2005 Seen over Srinagar upto 22 June, over many stations like Delhi, Lucknow, Srinagar and Lucknow during second half of July & August and over Delhi, Srinagar & Lucknow on 15, 23 and 30 September respectively.

5.5. *Tropical Easterly Jet (TEJ)*

Jet speed winds were observed at Thiruvananthapuram from 11 May to 4 October. The maximum wind speed reported was 100 kts (at 128 hPa; 1200 UTC of 1 July). It was seen over Chennai from 25 May to 1 October. Maximum wind speed noticed was 90 kts at 149 hPa and 197 hPa respectively on 0000 UTC of 18 August & 1200 UTC of 4 September. Over Minicoy,



Figs. 10(a-d). Mean SST and SST anomaly in (°C) for (a) June, (b) July, (c) August and (d) September 2006

it appeared from 25 May to 31 August. Over here, a maximum wind speed of 100 kts was reported on 25 July (1200 UTC) & 31 August (0000 UTC) at 202 & 200 hPa respectively. Over Port Blair, it appeared on 18 May and was noticed till 2 October. But it was absent almost throughout the month of July. It appeared over Mumbai on 31 May and was present until 13 September. The maximum wind noticed was 95 kts (at 59 hPa at 1200 UTC of 27 June).

Apart from these, quite often in the months of June & July, Jet speed winds were reported over Kolkata, Visakhapatnam, Hyderabad, Nagpur, Bhubaneswar, Ranchi etc.

Details of TEJ in the past five years are as follows.

Year *Tropical Easterly Jet (TEJ)*

2001 Seen from 24 May, till 15 September. Maximum wind speed 150 kts at Hyderabad at 115 hPa on 21 July.

2002 Seen from 7 June, till the end of September. Maximum wind speed 105 kts at 137 hPa over Chennai on 18 June.

2003 Seen from 9 May to 25 September. Maximum wind speed 125 kts at 116 hPa over Minicoy on 25 July.

2004 Seen from 10 May to 30 September. Maximum wind speed 180 kts at 118 hPa over Minicoy on 22 June.

2005 Seen from 6 June to 28 September. Maximum wind speed 110 kts at 198 hPa over Thiruvananthapuram on 31 July and over Chennai at 100 hPa on 8 July

6. Sea surface temperature (SST)

Monthly mean SST values for June, July, August and September 2006 for Arabian Sea, Bay of Bengal as well as Andaman Seas are discussed below :

In the Figs. 10(a-d), the monthly mean SST values alongwith the anomalies in northwest, northeast, west central, east central, southwest, southeast blocks of both the seas and also for North and South Andaman Sea, for the months June, July, August and September are given. The normal values for each block for calculating the anomalies have been estimated from the isopleths of

TABLE 16

Zonal wind anomalies

W/E	0706	1406	2106	2806	0507	1207	1907	2607	0908	1608	2308	3008	0609	1309	2009	2709	0410
									TRV								
850	-0.2	-6.3	15.1	1.3	10.8	-1.3	1.6	-0.5	-4.5	-6.4	-4.2	-1.4	-	-	5.1	1.2	4.9
500	-5.7	-10.9	-11.9	-1.6	7.5	-1.4	4.0	-1.8	4.6	-6.8	-5.8	-0.7	-	-	8.7	2.5	2.0
200	-25.4	-17.4	12.5	0.0	0.7	-8.8	-10.8	-10.6	1.0	-1.1	-1.3	-4.5	-	-	-7.5	-9.5	-12.3
									MDS								
850	3.0	-9.4	-19.1	-1.7	13.4	-0.1	2.7	-4.7	-2.8	-11.1	-8.6	-2.5	-9.5	-5.4	12.5	10.4	9.9
500	5.4	-6.1	-19.6	-11.9	20.8	-8.0	-3.5	-1.6	-3.7	-	-5.4	-3.5	-	-12.4	17.1	16.6	4.3
200	-	-22.0	7.8	-	-	-4.2	-4.4	-	-	-	-	-	-	-	-	-	-6.9
									BMB								
850	12.3	-1.0	-6.8	-14.5	9.3	6.7	0.7	13.4	12.4	7.3	8.7	1.2	-0.8	-11.4	-6.5	8.1	4.4
500	10.1	4.9	1.8	-10.7	10.1	1.4	7.5	14.1	5.1	7.6	8.0	2.8	4.6	-7.4	-5.1	8.8	-7.7
200	-11.3	-14.0	5.0	4.2	7.2	-6.0	-1.0	5.3	2.0	-	-	-	1.5	-2.6	6.6	-	-10.8
									NGP								
850	5.3	0.7	-7.3	-7.6	-3.1	10.8	1.8	9.6	5.6	-0.7	0.5	6.8	-	-4.6	-13.4	13.8	0.6
500	4.4	3.0	4.7	-6.2	19.3	5.0	-1.5	9.1	-3.2	7.5	5.8	-1.1	-	-2.6	-9.3	6.8	1.3
200	-	-19.4	2.8	2.6	-1.1	-9.5	-6.0	23.7	-	-	-	-15.3	-	-23.8	6.0	-7.6	7.1

Note : 1. Easterly anomalies (–ve) at 850 hPa means that westerlies are weaker than normal.
2. Westerly anomalies (+ve) at 200 hPa means that easterlies are weaker than normal.
3. A station reporting '-' means no data.

normal values given in the publication "Climatic Atlas of the Indian Ocean, Part I" by Stephan Hastenrath and Peter J. Lamb.

6.1. *June*

The sea surface temperature over all the sectors of northwest, northeast, west central & east central Arabian Sea and over the east central Bay were slightly less than normal and were slightly above normal over the southeast Arabian Sea, west central, southwest and southeast Bay.

6.2. *July*

Except the northwest and west central Arabian Sea all sectors of the Arabian Sea were warmer than normal with a positive anomaly of 1.3 in the northeast Arabian Sea. All the sectors of Bay of Bengal and Andaman Sea the anomalous sea surface temperature were positive except over the North Andaman sea where the sea surface temperature anomaly was negative (–1.7).

6.3. *August*

Except northwest, west central, east central Arabian Sea & east central Bay the sea surface temperature over all the sectors of the Arabian Sea and the Bay of Bengal and Andaman Sea were warmer than normal with a high positive anomaly of +0.9 over the northeast Arabian Sea and 0.6 over the South Andaman Sea. The negative anomaly of –1.3 was observed over the west central Arabian sea.

6.4. *September*

The northwest, east central, southwest and southeast sectors of the Arabian Sea were normal and remaining sectors were cooler than normal. All the sectors of the Bay of Bengal were warmer than normal except west central Bay reporting less than normal (–0.7) with highest positive anomaly of +0.6 over the southeast Bay. The sea surface temperature anomaly over the Andaman Sea was also positive.

7. Other features

7.1. *Weekly upper wind anomalies in southwest monsoon 2006*

The circulation anomaly features during SW Monsoon Season 2006 are discussed below monthwise at lower, middle and upper tropospheric levels (850, 700 & 200 hPa). Also the zonal wind anomalies observed at 4 different stations over the peninsula are given in Table 16.

7.1.1. *June wind anomaly features*

In the monthly winds anomalies, the anomalous ridge was seen over the central parts of the country at 850 and 700 hPa levels. At 500 hPa level, the ridge was seen along 20° N and at 300 and 200 hPa levels, the ridge was seen along 24° N.

In the weekly pattern, the anomalous ridge was seen persisting till the week ending on 20 June over the central region. In the week ending 29 June, the ridge is replaced by the anomalous trough between 850 hPa and 500 hPa levels. The westerly anomalous winds over the peninsula seen on week ending 29 June indicated strengthening of southwest monsoon.

7.1.2. *July wind anomaly features*

In the monthly pattern, the anomalous cyclonic circulation was observed over the central and eastern parts of the country and adjoining Bay of Bengal at 850 hPa level extending upto 500 and 200 hPa levels also.

In the weekly pattern, during the first week, the anomalous trough is seen between 20° - 22° N at 850, 700 and 500 hPa, then the trough was replaced by ridge over central India at 850 hPa extending upto 500 hPa during the 2nd week. In the third week anomalous cyclonic circulation was observed over the central India extending up to 700 hPa and also over the eastern parts of the country adjoining the Bay of Bengal extending upto 500 hPa. Similar conditions continued in the last week of July.

7.1.3. *August wind anomaly features*

An anomalous east-west trough across the central parts of the country was observed at 850 hPa extending up to 500 hPa suggesting active monsoon conditions over the central parts of country. At 200 hPa level, easterlies stronger than the normal were observed around the equator.

In the weekly pattern, anomalous cyclonic circulation was observed over the central India extending up to 700 hPa and also over the eastern parts of the country adjoining the Bay of Bengal extending upto 500 hPa. Anomalous cyclonic circulation was seen over southern peninsula extending up to 500 hPa. In the third week, anomalous cyclonic circulation was observed over Gujarat extending upto 500 hPa and also over the eastern parts of the country adjoining the Bay of Bengal extending upto 200 hPa. Same conditions prevailed in the last week of August with ridge seen between 15° - 20° N.

7.1.4 *September wind anomaly features*

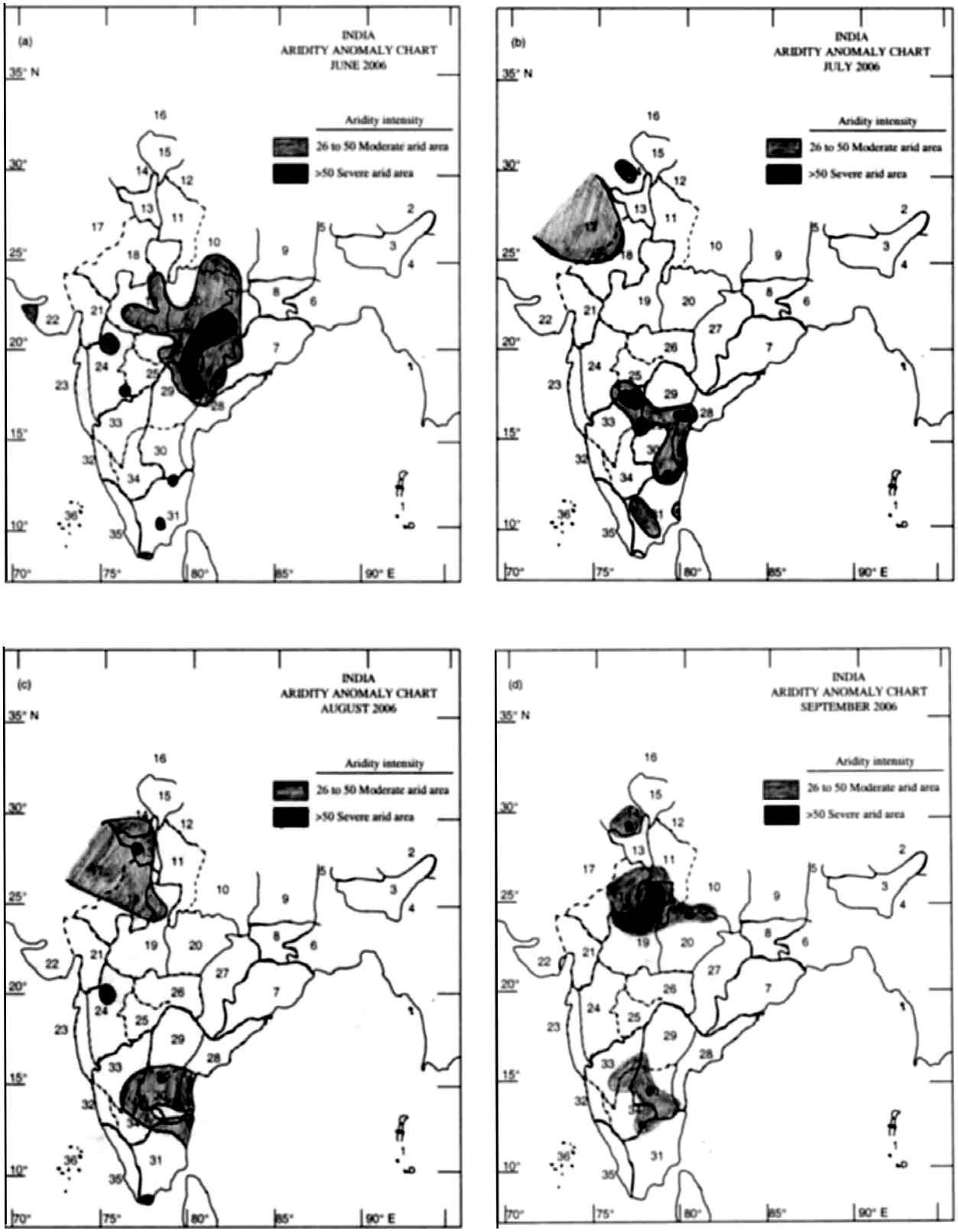
Two anomalous cyclonic circulations, one each over the east-central Arabian Sea and north Bay of Bengal and adjoining east central India were observed at 850 hPa extending up to 500 hPa.

In the weekly pattern, two anomalous cyclonic circulations were observed, one over east Madhya Pradesh and other over the Gangetic West Bengal up to 500 hPa. In the second week, the anomalous cyclonic circulation was observed over west Madhya Pradesh extending upto 500 hPa. In the third week, a ridge was observed between 22° - 24° N. In the last week, two anomalous cyclonic circulations, one each over the east-central Arabian Sea between 850-500 hPa and over Gangetic West Bengal were seen between 700-500 hPa.

7.2. *Stratospheric features*

The anomalous stratospheric circulation over India was examined using the monthly NCEP/ NCAR re-analysis data. The anomalies were computed using the base period of 1971-2000. During June, a trough line was seen along Lat. 17° N, with westerly wind anomalies to its south and easterly anomalies to its north. During the subsequent three months (July to September), the trough line showed northward movement with shift of 1-2° per month. In September, the trough line was seen along Lat. 23° N. During all the four months, the wind maximum was seen close to the equator. During June and September, the position of the wind maximum was relatively north compared to the other two months. Climatologically, easterly winds are observed over the Indian region with core of wind speed in the 15-20° N latitudinal range. Therefore, it can be inferred that during the southwest monsoon 2006, the easterlies over the equatorial region were weaker than normal. During last year (2005), the wind anomalies over the entire Indian region were easterly.

The zonal wind anomalies for the monsoon season (June-September) 2006 were averaged over the longitudinal zone of 70-90° E and the anomalies were computed using the base period of 1971 – 2000. The result showed that over the Indian region, the zonal wind



Figs. 11(a-d). Aridity anomaly chart for the month (a) June, (b) July (c) August and (d) September 2006

anomalies south of Lat. 20° N and above the 60 hPa level were westerly; whereas the zonal wind anomalies between 100 to 10 hPa and north of Lat. 20° N were mainly easterly.

7.3. *Aridity conditions during southwest monsoon 2006*

Aridity Index (AI) is computed based on Thornthwaite's formula :

$$AI = \frac{PE - AE}{PE} \times 100$$

Where, PE is potential evapotranspiration, which is nothing but the loss of water vapour to atmosphere in the form of evaporation from soil and transpiration from the plants, when the supply of water is unlimited. This is the water need of the plants. AE denotes the Actual Evapotranspiration and PE – AE denotes the water deficiency. PE is computed by Penman's modified equation and AE is obtained from the water balance procedure, which takes into account the water holding capacity of the soil.

The aridity anomaly is worked out by considering the difference between actual aridity and normal aridity for the month. Aridity of a particular region is decided based on the aridity anomalies, which have been classified as follows:

Aridity Anomaly	*Class*
0 or less	non-arid
1 to 25	mild arid
26 to 50	moderate arid
more than 50	severe arid

Aridity anomaly maps for June, July August and September are given in Figs. 11(a-d).

Moderate to severe arid conditions were noticed in the central India and regions surrounding that part of the country, with some isolated pockets in western and peninsular region, in June. In July, they disappeared and there were only moderate arid conditions over the northwestern and peninsular parts with small pockets of severe aridity in the peninsular India.

In August, severe arid conditions were found only over a few isolated places in the northern and peninsular parts of the country. Moderate arid conditions prevailed over the northwestern and peninsular India.

In September severe arid conditions prevailed in a small patch over the north central part of the country with a few isolated places in the peninsula. Moderate arid conditions prevailed in the northern, north central and peninsular India.

Details of severe and moderate arid conditions which prevailed over the country during southwest monsoon months are given below :

7.3.1. *June*

(a) *Severe arid areas*

(*i*) Small areas in the west central parts of Chattisgarh and adjoining southeastern parts of east Madhya Pradesh; eastern parts of Vidarbha and adjoining northeastern parts of Telangana.

(*ii*) Isolated areas around Malegaon (Madhya Maharashtra) and Hoshangabad (west Madhya Pradesh).

(b) *Moderate arid areas*

(*i*) Large areas of east Madhya Pradesh, west Madhya Pradesh and Chattisgarh.

(*ii*) Small areas of southern parts of east Uttar Pradesh and adjoining western parts of Bihar and Jharkhand; western parts of Vidarbha; a strip running across Telangana from northwest to southeast; west central parts of coastal Andhra Pradesh; a small patch adjacent to Malegaon (Madhya Maharashtra) and western parts of Orissa.

(*iii*) Isolated areas around Solapur (Madhya Maharashtra), Gopalpur (Orissa), Dwarka (Saurashtra & Kutch), Nellore (coastal Andhra Pradesh), Vellore, Madurai and Kanyakumari (Tamil Nadu).

7.3.2. *July*

(a) *Severe arid areas*

(*i*) Small areas in the northwestern parts of north Interior Karnataka and adjoining southeastern parts of Madhya Maharashtra and southern parts of Marathwada; west central parts of coastal Andhra Pradesh and adjoining southeastern parts of Telangana.

(*ii*) Isolated areas around Ludhiana (Punjab), Nellore (coastal Andhra Pradesh), Vellore (Tamil Nadu) and Raichur (north interior Karnataka).

TABLE 17

Representative rainfall amounts (>7 cm) during June – September 2006

Date (1)	June (2)	July (3)	August (4)	September (5)
1.	Dharavi & Quilandy 18 each, Bhatkal, Karipur & Kozhikode 17 each, Shirali & Karkala 16 each, Thane Belapur 15, Alibag, Udupi, Kundapur, Ankola, Agumbe & Thalassery 13 each, Dahanu, Mumbai & Cannur 12 each, Lengpui, Kollur, Kumta & Piravom 11 each, Mahabaleshwar 10, Harnai, Honavar, Mudibidre, Bhagamandala, Kammardi, Sringeri & Kalasa 9 each, Kailashahar, Thirthahalli & Alapuzha 8 each, Naduvattam, Ratnagiri, Dapoli, Panjim, Valpoi, Quepem, Siddapura, Karwar, Yellapura, Hosanagara, Koppa, Alathur & Kodungallur 7 each	Nimapara 23, Kakatpur & Vyara 19 each, Mahabaleshwar 16, Bardoli & Madhuban 15 each, Mandvi 13, Mangrol & Sutrapada 12 each, Navsari 11, Silvasa & Mumbai 10 each, Alipingal & Songadh 9 each, Nanipalsan, Valod & Kodinar 8 each, Beki Road Bridge, Belgaon, Daman, Gandevi, Palsana, Ukai, Umargaon, Mangrol & Upleta 7 each	Arnod 29, Bakani 25, Mount Abu 23, Panchpahad 21, Aspur & Garoth 20 each, Aklera, Manohar Thana & Mahabaleshwar 19 each, Dariabad & Pindware 17 each, Bhanpura, Chachora & Neemuch 16 each, Asnawar, Mavli, Sallumber, Bhopal & Mandsaur 15 each, Akhuapada, Udaipur, Ghatol & Kurwai 14 each, Bari Sadri, Dungla, Girwa, Kotda, Pratapgarh, Jawad, Shajapur & Kedbrahma 13 each, Keonjhargarh, Chittorgarh, Nimbahera, Suarresa, Gerusoppa & Nilkund 12 each, Swampatna, Jhalawar, Chabra, Jhalod, Loharia, Nithuwa, Sirohi, Tonkhurd & Halol 11 each, Anandpur, Sehore, Vijaynagar & Baroda 10 each, Pattamundai, Thakurmunda, Banswara, Bhadesar, Dungarpur, Dhambola, Gangdhar, Ganeshpur, Sarada, Veia, Agar, Jhabua, Sailana, Thandola, Danta, Savli & Ratnagiri 9 each, Diana, Jajpur, Kendrapada, R. Udayagiri, Paradip, Galiakot, Kherwara, Railmogra, Depalpur, Mungaoli, Narsinghgarh, Petlabad, Sironj, Tarana, Vidisha, Dashoi, Bhira, Poladpur, Matheran & Talaguppa 8 each, Purihansa, Arthuna, Ganjbasoda, Khachrod, Ratlam, Ujjain, Shajapur, Satlasana, Dantiwada, Deesa, Bayad, Idar, Sagbara, Mahad, Trimbak, Paradip, Bali & Lakkavalli 7 each	Mandal 32, Narsinghgarh 25, Khilchipur 24, Rajgarh 23, Bhopal, Raisen & Biora 21 each, Ganjbasoda 20, Ujjain 18, Asnawar, Banswara & Khachrod 17 each, Bakani 16, Arnod, Begamganj & Sironj 15 each, Tonkhurd 14, Aklera & Vidisha 13 each, Chachora, Guna, Subsera & Tarana 12 each, Begu, Dug, Kesarpura, Ladpur, Pirawa & Bareli 11 each, Anta, Bundi, Chittorgarh, Kota, Talera, Dewas, Nimach & Kurwai 10 each, Khurai, Danpur, Jhanpur, Mandana, Manohar Thana, Nimbhera, Bhanpura, Jawad & Sarangpur 9 each, Hut Bay, Bhainsroadgarh, Bijolia, Chhoti Sadri, Degod, Jhalarapatan, Pipalkhunt, Sangod, Sawai Madhopur, Ashoknagar, Chanderi & Hoshangabad 8 each, Gangdhar, Sagar, Jhalawar, Pachypahar, Phuliakalan, Gautampura & Bandnagar 7 each
2.	Vapi 18, Amreli & Babra 17 each, Surat 13, Dhubri & Gandevi 12 each, Bhatkal 11, Mahuwa, Viramgam, Valsad & Ankola 10 each, Agartala, Dediapada, Pardi, Chikhli, Lajalpur, Valpoi, Ratnagiri, Mahabaleshwar & Kumta 9 each, Nimbahera, Degod, Panvel & Udupi 8 each, Begu, Jawad, Ahmedabad, Talaja, Vallabhipur, Talasari, Pernem, Gaganbavad, Karwar, Honavar & Siddapura 7 each	Puri 27, Bhira & Gaganbavada 17 each, Mangrol & Mahabaleshwar 16 each, Alipingal & Nimapara 15 each, Radhanagari 13, Athagarh, Sawantwadi, Mangaon & Mhasala 12 each, Mohana, Chhatrapur & Bhubaneshwar 11 each, Ratnagiri, Mahad, Nilkund & Kamma 10 each, Paradip, Naraj, Poladpur & Matheran 9 each, Alipurduar, Berhampore, Mandvi, Naliya, Ranavav & Sringeri 8 each, Cuttack, Mahendragarh, Purushottampur, Banpur, Tangi, Bolangir, Mumbai, Sanguem, Karjat, Virar, Dodamar, Roha, Panhala, Valparai & Gerusoppa 7 each	Wav 29, Baliguda 25, Surajpur 20, Mount Abu 18, Kotagarh & Mahabaleshwar 16 each, Hindol, Madanpur Rampur, Dhanera, Kankrej & Bhira 15 each, Prantij 14, Pattamundai, Daringibadi, Bausan, Sanchore, Tharad & Baikunthpur 13 each, Kadi & Radhanpur 12 each, Kantamal, Tikabali & Dhori–manna 11 each, Kakatpur, Bissam Cuttack, Kotraguda & Dhansura 10 each, Athagarh, Bhavanipatna, Mehsana Kendrapada, Puri, Lanjigarh, Jeypore, Koraput, Uttarkashi, Kangra, Bhinmal, Kalol, Vadgam, Patan, Dashoi, Chikhli, Lakhapat, Poladpur, Igatpuri & Nilkund 9 each, Paradip, Dhenkanal, Khairamal, Chandbali, Mundali, Sonepur, Gudari, Vadnagar, Himmatnagar, Chhotaudaipur, Sankheda, Bansda, Songadh, Pali, Mahad & Katghora 8 each, Alipingal, Jenapur, Kamakhya Nagar, Naraj, Rajkanika, R Udayagiri, Nimapara, Phulbani, Dehra Dun, Baiytu, Jaswantpura, Satlasana, Vijapur, Danta, Palanpur, Sidhpur, Idar, Gandevi, Mahuva, Valod, Rahpar, Matheran, Tala & Trimbak 7 each	Batote 17, Khairi 15, Amritsar & Bhainsroadgarh 14 each, Baderwah 13, Banihal, Katra & Jhalawar 12 each, Kachola, Mandana, Ramganjmandi & Thiruvannamalai 11 each, Choura & Chabra 10 each, Udhampur, Jammu, Asnawar & Wav 9 each, Narwana, Tohana, Quazi Gund, Pahalgam, Anta, Jhalarpatan, Bhanpura, Madurai & Thiruthuraipoondi 8 each, Auriya, Chirag Dilli, Madhopur, Chamba, Bhinmal, Sindseri, Atru, Bakani, Bijoliya, Jahajpur, Shahbad, Guna, Narsinghgarh, Shivpuri, Ramanathapuram & Vridhachalam 7 each

TABLE 17 (*Contd*.)

(1)	(2)	(3)	(4)	(5)
3.	Ankola 23, Bhatkal 18, Palsana, Sondad & Jalpaiguri 15 each, Mahabaleshwar 14, Bajpe & Cherrapunji 11 each, Mudigere 10, Santrampur, Panambur, Valod & Bansda 9 each, Vyara 8, Gerusoppa, Gandevi & Sawarkundla 7 each	Nawarangpur 38, Mahabaleshwar 34, Pali 33, Rayagada 30, Gunupur & Bhira 27 each, R. Udayagiri, Jeypore, Banpur & Kanker 25 each, Chhatrapur, Junagarh, Puri, Kotagarh, Bissa–Cuttack & Keshkal 23 each, Gudari 22, Nagri 20, Gopalpur, Purushottampur, Koraput, Tangi, Poladpur, Gariaband, Komarada & Patpatnam 19 each, Madhabarida, Krishnaprasad & Kondagaon 18 each, Matheran & Mumbai 17 each, Daringibadi, Mohana, Aska, Berhampore, Bhanjanagar & Kotraguda 16 each, Khariar, Kahu, Alibag, Veeranghattam, Linganamakki, Kammardi & Kalasa 15 each, Kosagumda, Baliguda, Tala, Devbhog & Palakonda 14 each, Thane, Radhanagari, Palasa & Medikeri 13 each, Mahendragarh, Sarada, Mangaon, Pen, Patan, Somwarpet & Hosanagara 12 each, Athagarh, Kakatpur, Uttarkashi, Khalapur, Mahad, Mhasala, Jagdalpur, Antagarh, Mandasa, Tekali, Sringeri & Mananthavady 11 each, Hindol, Pottangi, Uran, Panvel, Baikunthpur, Dhamtari, Sompeta, Jayapura & Sakaleshpura 10 each, Naraj, Parlakhemundi, Komana, Nimapara, Pipli, Bhubaneshwar, Ambernath, Karjat, Gurur, Bobbili, Ichapuram, Joida, Nilkund, Siddapura & Yellapura 9 each, Vasai, Panhala, Sahuwadi, Narainpur, Dharamasthala, Sulya, Puttur, Sirsi & Sagar 8 each, Alipingal, Udala, Titlagarh, Gudalur Bazar, Kalyan, Bhiwandi, Sawantwadi, Ajra, Gunperdeh, Kurup, Kalingapatnam, Gerusoppa, Khanapur, Belgaum, Virajpeth, Thirthahalli, Koppa, Munnar & Kudulu 7 each	Jeypore & Koraput 23 each, Komna, Pottangi, Bhanupratappur & Ranasthalam 20 each, Kalingapatnam 19, R. Udayagiri 16, Nawarangpur, Basholi & Palakonda 15 each, Malkangiri 14, Gunupur & Parvathipuram 13 each, Kashinagar & Umerkote 12 each, Jaipatna, Katra, Veeranghattam & Venkatapuram 11 each, Dehra Dun, Gariaband, Tekkali, Bobbili, Komarada & Kunavarm 10 each, Kosagumda, Rayagada, Kamrej, Mahabaleshwar, Narainpur, Dhenkanal, Nayagarh, Dantewada, Visakhapatnam, Salur, Terlam & Eturunagaram 9 each, Tadong, Paikmal, Songadh, Vyara, Jagdalpur, Kondagaon, Dashoi, Dumagudem & Kaleswaram 8 each, Mahendragarh, Mohana, Radhanagari, Perur, Chhatrapur, Baliguda, Kotagarh, Gudari, Kotraguda, Narendranagar, Gandevi, Talala, Valpoi, Canacona, Sanguem, Surgana, Gaganbavada, Sukma, Palasa, Patapatnam & Koida 7 each	Jammu 14, Amritsar 13, Moradabad 12, Vadiapatti 11, Diamond Harbour, Katra & Sholavandan 10 each, Kolkata, Kalagarh, Banihal, Ketti & Chamarajnagara 9 each, Canning Town, Batote & Gandevi 8 each, Narora, Nainital, Bahadurgarh, Kadavur, Musiri & Thethiengapet 7 each
4.	Murud 11, Lucknow & Alibag 8 each, Poonamally & Koratur 7 each	Titlagarh 32, Junagarh & Kosagumda 31 each, Bhavanipatna 30, Tikabali 29, Bhira 27, Nawarangpur 25, Mahabaleshwar & Antagarh 24 each, Manpur 23, Pakhanjur 22, Kanker, Bhanupratappur & Kalasa 21 each, Gariaband 19, Lanjigarh, Washim, Nagari, Churiya & Narharpur 17 each, Yeotmal, P. G. Bridge & Kammardi 16 each, Kantamal, Mumbai, Jagdalpur, Ambagarh & Mananthavady 15 each, Dibrugarh, Tajala & Mohala 14 each, Alibag & Charama 13 each, Bijapur 12, Jeypore, Bolangir, Daringibadi, Phulbani, Parda, Babra, Dhamtari, Kundapur & Londa 11 each, Kotraguda, Khairamal, Sonepur, Gudari, Tilakwada, Gurur & Nilkund 9 each, Kalimpong, Rayagada, Amreli, Bopalpatna & Medikeri 8 each, Binika, Bakani, Unjha, Jafrabad, Dongargarh & Dantewada 7 each	Koida 36, Pottangi 32, Kaleswaram & Eturunagaram 29 each, Eturunagaram 26, Yellandu 24, Venkatapuram & Pottangi 23 each, Jeypore & Narsampet 22 each, Koraput, Visakhapatnam & Kunavaram 21 each, Mulugu & Perur 19 each, Mahabubabad 18, Veeranghattam 17, Rajamundry & Tuni 15 each, Paderu & Parkal 14 each, Huzurabad 13, R. Udayagiri, Kakinada, Kalingapatnam & Bheemunipatnam 4 each, Dowlaiswaram 12, Tikabali, Chintalapudi, Gajapathinagaram, Peddapuram, Khammam, Jagityal, Mancherial & Manthani 11 each, Salur, Srungavarapukota, Chinnoor, Dubbak, Kama–reddy & Sultanabad 10 each, Gunupur, Ramagundam, Desuri, Sumerpur, Karimnagar & Subramanya 9 each, Dibrugarh, Tekkali, Medak, Luxettipet, Nizamsagar, Ramayampet & Nilkund 8 each, Sibsagar, Darjeeling, Nawarangpur, Amalapuram, Nuzvid, Patapatnam, Hakimpet, Nizamabad, Jangaon, Sircilla, Mudibidra & Mani 7 each	NH–5, Govindpur 15, Jaipur 14, Rajkanika 13, Udala & Dahanu 12 each, Tiruttani & Vadipatti 11 each, Kendrapada, Nilgiri, Paradeep, Ambur & Sholavandan 10 each, Konner, Kumbakonam & Thuraiyur 9 each, Akhuapada, Chandbali, Sikadia, Thiruvallur, Thiruvannamalai & Harur 8 each, Gharmura, Pattamundai, Sukinda, Ghatagaon, Balasore, Jajpur, Balimundali, Baripada, Dewas, Umargaon, Kancheepuram, Attur, Thammanpatti, Pullambadi & Thathiyangarpet 7 each

TABLE 17 (*Contd*.)

(1)	(2)	(3)	(4)	(5)
5.	Nil	Gaganbavada 46, Ahwa 39, Mahuwa 37, Chikhli 36, Fatepur 31, Bansda & Jahajpur 29 each, Dharampur, Kamrej & Bhira 27 each, Daman 26, Gandevi 25, Bardoli, Vyara & Mumbai 23 each, Palsana & Jalgaon 22 each, Navsari 21, Mahabaleshwar 20, Pardi & Surgana 19 each, Valod, Roha, Ratnagiri & Radhanagari 18 each, Valsad & Songadh 16 each, Mandvi, Thane Belapur & Chandwad 15 each, Nanipalsan, Surat, Panvel, Gudalur Bazar, Bhagamandala & Kalasa 14 each, Pen, Pali, Poladpur, Yeola, Khuldabad & Kamardi 13 each, Rajpipla, Sagbara, Khalapur, Mhasala, Igatpuri & Sakaleshpura 12 each, Kheda, Bodeli, Vagra, Mangrol, Mangaon, Mahad, Shrivardhan, Kelvan, Trimbak, Kannad & Siddapura 11 each, Naduvattam, Balasinor, Murud, Matheran, Niphad, Chandgad, Gangapur, Aurangabad, Naduvattam, Akola & Hosanagara 10 each, Miao, Nanad, Kapadvanj, Matar, Padra, Madhuban, Silvasa, Khambha, Kodinar, Uran, Alibag, Dahanu, Beglan, Vaijapur & Sringeri 9 each, Tezu, Gajoldoba, Narendranagar, Balsad, Tarapur, Tilakwada, Vapi, Lathi, Vallabhipur, Karjat, Peint, Sahuwadi & Sirsi 8 each, Passighat, Baghdogra, Vallabhvidyanagar, Dahegam, Umargaon, Lilia, Nandgaon, Nasik, Sillod, Soegaon, Yellapura & Jayapura 7 each	Kaleswaram 63, Utnoor 31, Kamareddy 28, Nizamabad & Chinnoor 23 each, Adilabad, Ramagundam & Sircilla 22 each, Manthani & Metapalli 21 each, Huzurabad, Karimnagar, Nizamsagar & Sirpur Hingoli 20 each, Ramayampet & Sultanabad 19 each, Amroor, Asifabad, Mulugu & Basmat 18 each, Kalamnoori, Bodhan, Navipet, Mudhol & Sriramsagar 17 each, Parbhani & Perur 16 each, Parkal, Jagityal, Dubbak & Medak 15 each, Boath & Aurad 14 each, Narsampet, Mahabubabad, Jangaon, Nirmal & Udgir 13 each, Eturnagram, Khanapur, Adnoor & Venkatapuram 12 each, Latur, Ahmedpur, Kamrup, Bhimgal, Yellandu, Bhongir, Vikarabad, Siddapura, Bidar & Agumbe 11 each, Hakimpet, Hyderabad, Nayankhed, Chakur, Chandrapur & Sangareddy 10 each, Katra, Patti, Vyara, Deoli, Manora, Medchal, Suryapet & Bhalki 9 each, Washim, Karanja, Nilkund, Thirthahalli & Kammardi 8 each, Shahapur Kandi, Madhopur, Jammu, Desuri, Ujjain, Madhuban, Nilanga, Renapur, Akola, Manglurpir, Tiruvuru, Kunavaram, Khammam, Ramannapet, Tehri, Dehra Dun, Dharamasthala & Humnabad 7 each	Pallahara 13, Nawarangpur & Bhubaneshwar 12 each, Sukinda, Ghatagaon, Lanjhi & Dharavi 11 each, Tezu, Kamakhya Nagar, Naraj & Kendrapada 10 each, Mundali, Baripada, Raipur, Mana & Durg 9 each, Balasore, Jaipur, Jaleswar, Akhuapada, Athagarh, Cuttack, Bangirposhi, Thakurmunda, Jaipur & Jaleswar 8 each, Dhollabazar, Madanpur Rampur, Balimundali, Ghansore, Beglan & Champa 7 each
6.	Nagrakata & Maharajganj 12 each, Diana, Kansabati Dam & Ranchi 10 each, Golaghat, Bankura, Digha & Tusuma 8 each, Mathabhanga, Purihansa, Kharidwar, Chandbali & Keonjhargarh 7 each	Balsad 30, Vyara 25, Songadh 23, Umargaon, Gandevi & Bhira 21 each, Detroj & Mahabaleshwar 19 each, Passighat, Jalalpur & Bhiwandi 18 each, Navsari, Silvasa, Kamrej, Mahuva & Tala 17 each, Harij, Padra, Sankheda, Nandod, Chikhli & Sihor 16 each, Anklav, Becharaji, Jambugoda, Dediapada, Vapi, Ahwa, Madhuban, Palsana, Valod, Vallabhipur & Roha 15 each, Patan, Sagbara, Dharampur, Pardi, Bansda, Chotila, Palitana, Jasdan, Murud & Vasai 14 each, Bardoli, Olpad, Sallumber, Dhari, Dahanu, Kalyan, Sahapur, Igatpuri & Peint 13 each, Kathala, Sarada, Radhanpur, Idar, Kadi, Karjan, Nanipalsan, Broach, Mandevi, Mangrol, Lathi, Bhavnagar, Gariyadhar, Mumbai (SCZ), Pali, Poladpur, Thane–Belapur & Hosanagara 12 each, Chepan, Dholka, Dhanera, Palanpur, Kheda, Sami, Kheralu, Tilakwada, Daman, Surat, Amreli, Bagsra, Lilia, Wadhwan, Harnai, Karjat, Mumbai, Panvel, Talasari, Thane, Uran & Wada 11 each, Barpeta, Manas NH Xing, Limkheda, Anand, Matar, Bayad, Visnagar, Baroda, Sinor, Hansot, Vagra, Ukai, Babra, Dhrangdhra, Muli, Sayla, Talaja, Lodhika & Jawahar 10 each, Mathabhanga, Sanand, Borsad, Vallabhvidyanagar, Deesa, Wav, Sidhpur, Dhansura, Jhagadia, Gogha, Morvi,	Parbhani 28, Washim 25, Jalgaon 22, Matheran & Gaganbavad 21 each, Thane 19, Dholla Bazar 18, Patti, Pali & Mahabaleshwar 17 each, Bhira 16, Latur, Karjat & Akola 15 each, Nilanga & Chakur 14 each, Jaisalmer, Vaibhavwadi, Radhanagari, Ahmedpur & Renapur 13 each, Ahore, Poladpur, Mhasala, Aurangabad & Yeotmal 12 each, Bhoond, Revdor, Mumbai, Roha, Mahad, Metapalli, Nizamabad & Bodhan 11 each, Basoli, Murud, Igatpuri, Ausa, Navipet, Sriramsagar & Kollur 10 each, Miao, Mount Abu, Pindwara, Satlasana, Kadana, Mangaon, Pen, Shrivardhan, Panvel, Ratnagiri, Kagal, Udgir, Sukma, Armoor, Banswada, Madnoor, Udupi & Nilkund 9 each, Tezpur, Sevoke, Khairi, Jalore, Jamsugoda, Santrampur, Danta, Nanipalsan, Khalapur & Nizamsagar 8 each, Haripur, Jaswantpura, Siwana, Palanpur, Vedgam, Meghraj, Chhotaudaipur, Kankavali, Sawantwadi, Peint, Kolhapur, Jagityal & Shirali 7 each	Ujjain 18, Depalpur 13, Agar 12, Devas, Passighat, Ashta, Shajapur, Tarana & Katangi 11 each, Sajangarh, Kannod, Tonkhurd, Harda, Gautampura, Indore, Mow & Susner 9 each, Pachmarhi, Nacha, Alirajpur, Hareli & Raisen 8 each, Dug, Narsullaganj, Thandola, Sehore, Sujalpur, Badnagar, Khachrod, Umargaon & Yellandu 7 each

TABLE 17 (*Contd*.)

(1)	(2)	(3)	(4)	(5)
		Rajkot, Mhasala, Mokhada, Ambernath, Palghar, Shrivardhan, Surgana, Trimbak & Mudigere 9 each, Nagrakata, Dantewada, Kapadvanj, Meghraj, Mehsana, Vijapur, Raipipla, Amod, Botad, Umarala, Ambernath, Palghar, Shrivardhan, Velhe & Kollur 8 each, Motunga, Barobhisa, Ganeshpur, Dhanduka, Dhanpur, Dohad, Garbada, Tarapur, Dahegam, Danta, Vadgam, Mahudha, Bhiloda, Dharoi, Bodeli, Dabhoi, Jambusar, Junagarh, Sutrapada, Lakhatar, Mahuva, Jodia, Mangaon, Gaganbavda, Radhanagri, Sirsi & Kammardi 7 each		
7.	Dengraparaghat 13, Gaya 11, Purihansa 9, Beki Mathanguri 8, Sriniketan & Patna 7 each	NH–31 42, Domohani 33, Kalyanpur 31, Jalpaiguri 25, Gajoldoba 20, Cooch Behar & Bhanvad 18 each, Diana 17, Baghdogra 16, Alipurduar & Murti 14 each, Barobhisa 12, Hasimara & Nagrakata 11 each, Chepan & Neora 10 each, Dhubri & Mundra 9 each, Manas NH X–in, Champasari, Songadh & Porbandar 8 each, Passighat, Tikrikilla & Agumbe 7 each	Karjat 40, Matheran 37, Panvel 31, Dharavi 29, Jawahar 25, Bhira 23, Mumbai, Mokhada, Sahapur & Vasai 22 each, Kalyan 21, Ambernath, Khalapur & Poladpur 20 each, Vyara & Uran 19 each, Wada & Thane 18 each, Halol, Jambugoda, Palanpur, Baroda & Dashoi 17 each, Palghar, Murbad, Bhiwandi & Tala 16 each, Dahanu & Roha 14 each, Alibag, Mangaon Nanipalsan, Mandvi, Ukai, Valod, Mahabaleshwar & Akola 13 each, Sankheda, Waghodia, Mahuva & Talasari 12 each, Kalol, Wanakbori, Patan, Savli, Dharampur, Ahwa, Mangrol, Songadh & Murud 11 each, Gandhinagar, Sidpur, Prantij, Madhuban, Kamrej, Pen & Pali 10 each, Chouldhowaghat, Bagidora, Sajangarh, Santrampur, Vadgam, Mahad, Malegaon, Dhule, Kelvan & Junnar 9 each, Kheralu, Vadnagar, Dantiwada, Chhotaudaipur, Dediapada, Nandod, Sagbara, Tilakwada, Ulhasnagar, Nasik & Panambur 8 each, Didihat, Ahmedabad, Garbada, Mehsana, Godhara, Pardi, Umargaon, Bansda, Bardoli, Surat, Ratnagiri, Mhasala, Pune, Aurangabad, Hingoli & Mangrulpir 7 each	Banswara 30, Bagidora 29, Sajangarh 28, Shergarh 27, Kadana 25, Kesarpura 24, Kedbrahma 23, Garhi 22, Danpur, Dhansura 21, Ratlam & Sankheda 20 each, Bhungra, Badnagar, Jambugoda, Prantij & Bodeli 19 each, Meghraj & Modasa 18 each, Vijaynagar 17, Kushalgarh, Sailana, Viramgam & Kadi 16 each, Arthuna, Mansa, Bayad & Dabhoi 15 each, Fatepura 14, Kherwara, Loharia & Bhiloda 13 each, Santrampur 12, Ghatol, Mandal & Idar 11 each, Mount Abu, Ahmedabad, Jhalod, Dahegam, Gandhinagar, Lunawada, Himmatnagar & Mahabaleshwar 10 each, Kotda, Khachrod, Dhanpur & Vijapur 9 each, Jaora, Dharoi, Chhotaudaipur & Sawarkundla 8 each, Khonsa, Pindwara, Dohad, Mehsana, Kalol, Khanpur, Danta, Kapadvanj, Kathala, Patan, Padra, Halvad, Kharaghoda & Lakhatar 7 each
8.	Patna 15, Gaya 14	Karwar 16, Birdghat 15, Agumbe 14, Gerusoppa 13, Cooch Behar, Gorakhpur, Sujanpur Tira & Siddapura 12 each, Bhalukpong, Jalpaiguri & Nilkund 11 each, Bansi 9, Kakrahi, Kollur & Honavar 8 each, Darjeeling, Karkala & Kundapur 7 each	Lunawada 34, Igatpuri 26, Bayad 24, Jawahar 23, Karjat 22, Patan, Wada & Murbad 21 each, Kalyan & Mahabaleshwar 20 each, Ambernath, Bhira, Gaganbavada & Gokarna 19 each, Talasari 18, Trimbak 17, Bakani, Umargaon, Palghar, Mokhada, Sahapur, Panvel & Surgana 16 each, Tharsa, Dahanu, Bhiwandi & Mumbai 15 each, Jhalarapatan, Kathalal, Dhansura, Waghodia, Ahwa, Vasai, Valpoi & Kadana 14 each, Asnawar, Matar, Modasa & Radhanagari 13 each, Panchpahad, Balasinor, Kapadvanj, Wanakbori, Thane, Khalapur, Tala & Kadra 12 each, Borsad, Umareth, Mahudha, Ulhasnagar, Margoa, Nasik, Karwar & Kumta 11 each, Indore, Kalol, Dhanera, Prantij, Dashoi, Sinor, Dharampur, Dabolim, Quepem,	Kankrej 33, Gajoldoba 31, Alipurduar & Patan 21 each, Hasimara 20, Champasari 18, Diana 16, AIE NH X–ing & Tharad 15 each, NH–31 & Chotan 14 each, Nagrakata 13, Murti 12, Mount Abu 11, Chepan, Unjha, Wav & Sidhpur 10 each, Goalpara, Baghdogra, Perumbavur & Konni 9 each, Beki Road Bridge, Reodar & Deesa 8 each, Cherrapunji, Kokrajhar, Motunga, Domohani, Neora, Dantiwada & Vadgam 7 each

TABLE 17 (*Contd*.)

(1)	(2)	(3)	(4)	(5)
			Sanguem & Ponda 10 each, Bhinmal, Sanchore, Dohad, Khanpur, Karanpur, Nadiad, Himmatnagar, Dediapada, Pali, Mahad, Panjim, Pernem, Akole, Kelvan, Panhala, Siddapura & Ankola 9 each, Alipurduar, Dhambola, Jhalawar, Anklav, Mansa, Jambugoda, Shehra, Jambugoda, Mhasala, Uran, Marmugoa, Yeola, Shirala, Walva, Kundapur & Bhatkal 8 each, Maya Bandar, Sankalan, Raniwara, Chikhli, Loharia, Pirawa, Revdor, Jhalod, Deesa, Kheda, Baroda, Karjan, Padra, Nandod, Tilakwada, Pardi, Mangaon, Roha, Poladpur, Ratnagiri, Sinner, Sahuwadi, Gerusoppa, Honavar, Yellapura, Sirsi, Jagalbet & Londa 7 each	
9.	Nil	Jaunpur 35, Mirzapur 22, Fatehgarh 21, Neemsar 20, Sultanpur 19, Phaphamau, Bareilly & Raibareilly 18 each, Varanasi 15, Lucknow 14, Narayanpur, Bhinga, Hanumansetu & Allahabad 12 each, Daltonganj, Bahraich & Jalalabad 11 each, Nandidah & Moradabad 10 each, Tilpara Barrage, Bhatpurwaghat, Elginebridge, Katerniaghat, Kakardharighat, Palliakalan & Pawaya 9 each, Krishnanagar, Suri, Putky, Chandradeepghat, Shardanagar & Banbasa 8 each, Bankura, Messenjore, Maharo, Inderpuri, Saulighat, Hayaghat, Dalmau, Hardwar & Katra 7 each	Danta 33, Mahabaleshwar 26, Satlasana & Bhira 22 each, Begu 21, Himmatnagar 18, Igatpuri, Radhanagari & Gaganbavad 17 each, Surgana 16, Peint 15, Vadnagar & Thane 14 each, Kotda, Jhalarapatan, Bhavani, Kheralu, Khalapur & Trimbak 13 each, Gargoti 12, Arnod, Chhoti Sadri, Deogarh, Dharoi, Visnagar, Balasinor, Dhansura, Idar, Umargaon & Dahanu 11 each, Baran, Modasa & Mumbai 10 each, Raniwara, Anta, Sirohi & Dindori 9 each, Siwana, Banera, Keroikala, Panchpahad, Danpur, Bhungra, Pindwara, Vijapur, Sidhpur, Prantij, Dharavi, Mahad, Nasik, Kelvan, Chandwad, Niphad & Ajra 8 each, Kareda, Kachola, Shahbad, Kishanganj, Bundi, Nimbahera, Pratapgarh, Rashmi, Dharampur, Panjim, Panhala & Shahuwadi 7 each	Sevoke 24, Neora & Varkala 17 each, Gajoldoba 15, Champasari 12, Baltara & Perinthalmanna 11 each, Baghdogra, Diana, Nagrakata, Sukinda & Basua 10 each, Murti & Colgaon 9 each, Mathabhanga, Nalagarh, Sujanpur Tira & Minicoy 8 each, Darjeeling, Singlabazar, NH–31, Hasimara, Simulia, Bhagalpur, Kursela, Valparai, Punalur & Kollam 7 each
10.	Cherrapunji 11, Gadag 8, Agartala 7	Burdwan 24, Durgapur & Nuh 18 each, Sriniketan & Gheropara 17 each, Panagarh 16, Narayanpur & Bilaspur 15 each, Asansol 14, Tantloi, Jamshedpur, Mathura, Indri & Mudibidre 13 each, Naraingarh, Bharwain & Bhadra 11 each, Mastusabad 10, Suri, Patna, Basua, Narora, Dehra Dun, Jind, Sadaura, Ranjit Sagar Dam Site, Ghamroor, Nagrota Surian & Sangaria 9 each, Bankura, Messenjore, Maithon, Sripalpur, Sirsa, Shahpur Kandi, Guler, Sunni Bhajji, Patti, Tizara & Agumbe 8 each, Tilpara Barrage, Kansabati Dam, Bagati, Krishnanagar, Sikadia, Titaiya, Sikandarpur, Sarsawa, Hrishikesh, Pilukheri, Radaur & Sadulshahar 7 each	Ujjain 34, Peint 29, Gogunda, Jhalawar & Mount Abu 19 each, Jhalarapatan & Surgana 18 each, Sangod 17, Asnawar, Bakani, Dewas, Badnagar & Trimbak 16 each, Pidawa, Garoth & Tarana 15 each, Jahajpur, Ramganjmandi, Narsinghgarh, Agar & Kelvan 13 each, Tala 12, Tonkhurd, Depalpur, Gautampura, Igatpuri, Radhanagari & Mahabaleshwar 11 each, Pachpahar, Shajapur, Khachrod, Dindori & Chandwad 10 each, Anta, Bhadesar, Deogarh, Nimbahera, Bhanpura, Subsera, Jawad, Neemuch, Sailana, Dharampur, Gaganbavada & Nilkund 9 each, Belonia, Bosan, Sinderi, Aklera, Masuda, Sarangpur, Sujalpur, Tilakwada & Kollur 8 each, Bashirhat, Barackpur, Sedwa, Bhilwara, Bijoliya, Chotisadri, Danpur, Hindoli, Indergarh, Kushalgarh, Mandal, Mandana, Seopurkalan, Indore, ‘Shivpuri, Limkheda, Nandod, Pardi, Nasik & Devla 7 each	Katra 15, Passighat 11, Ranjit Sagar Dam 10, Chouldhowaghat & Bansi 9 each, Bihubar, Jalpaiguri, Sundernagar & Raipur 8 each, Dillighat, Lengpui, Domohani, Krishnanagar & Minicoy 7 each

TABLE 17 (*Contd*.)

(1)	(2)	(3)	(4)	(5)
11.	Cherrapunji 19, Bhalukpong 11, Annapurnaghat 9, Silchar & Diana 8 each, Dhubri, Sevoke & Honavar 7 each	Tantloi 25, Behror 17, Rampurhat, Narayanpur, Dataramgarh & Ladnu 15 each, Tilpara Barrage, Sujangarh, Ladnu, Sikar & Didwana 13 each, Suri, Pataudi, Nadaun, Jayal & Kochi 12 each, Baghdogra 11, Bhagalpur & Kumarakkom 10 each, Kalimpong, Bashirhat, Benibad, Sonepat, Nangal, Neem Ka Thana, Shahpur, Nilkund & Kottayam 9 each, Kolkata, Hayaghat, Haripur, Sonepat, Thanaghazi, Cherthala, Perumbavur & Dabri 8 each, Sriniketan, Gheropara, Bosan, Ganaur, Rewari, Bajpe, Aluva, CIAL Kochi & Pottangi 7 each	Mahabaleshwar 24, Nilkund 23, Arnod, Radhanagari & Bhagamandala 19 each, Jambugoda 16, Dariabad, Pipalkhunt, Pratapgarh, Jaora, Gaganbavada, Gerusoppa & Agumbe 15 each, Jagpura & Kollur 14 each, Banswara, Sallopat, Dashoi, Modasa, Wav & Linganamakki 13 each, Desuri, Sajjangarh, Ghatol, Subsera, Baroda, Jambusar, Ratnagiri & Dharamasthala 12 each, Dehragopipur, Badisadri, Begu, Kushalgarh, Ratlam, Sailana, Devgadhbaria, Dohad, Jhalod, Limkheda, Lunawada, Chandgad, Shahuwadi & Siddapura 11 each, Bhungra, Gangdhar, Nimbahera, Anand, Bhiloda, Dhansura, Fatepura, Santram–pur, Poladpur, Mani, Belthangadi, Siddapura, Bajpe, Khanapur & Talaguppa 10 each, Panposh, Bijolia, Loharia, Mokhunda, Nithuwa, Veza, Dewas, Bayad, Dediapada, Halol, Panhala, Bhudargad, Jagalbet, Puttur, Subramanya, Karkala, Kadra, Yellapura, Belgaum, Thirtha–halli, Hoshangabad, Pattambi, Quilandy, Kochi & Chalakudy 9 each, Ghamroor, Danpur, Mandalgarh, Pirawa, Tonkhurd, Jawad, Chhotaudaipur, Garbada, Ajra, Mulki, Sagar & Thrissur 8 each, Port Blair, Ghatgaon, Asnawar, Aspur, Dhambola, Dungarpur, Dungla, Kachola, Kesarpura, Kotda, Raipur, Railmogra, Sabla, Sallumber, Garoth, Neemuch, Shajpur, Borsad, Dhanpur, Kathalal, Meghraj, Thasra, V. V. Nagar, Wanakbori, Karjat, Gadhinglaj, Bantwal, Mudibidre, Kundapura, Sirsi, Nippani, Humchadakatte, Soraba & Paravur 7 each	Manas NH–Xing 13, Barpeta 11, Beki Road Bridge 10, AIE NH–Xing, Nadaun 9, Annapurna Ghat, Karimganj, Barobhisa & Silchar 8 each
12.	Gharmura 18, Dholai, Karimganj & Silchar 17 each, Amraghat & Matizuri 16 each, Annapurnaghat & Nalbari 13 each, Motunga 12, Barpeta & Lakhipur 11 each, Beki Mathanguri & Chouldhowaghat 9 each, Passighat & Tezu 8 each, AIE NH–Xing, Margherita & Puthimari 7 each	Buhana & Kotputli 19 each, Shahpur 16, Chirawa & Paota 15 each, Behror 14, Bharwain 12, Beki Road Bridge, Khusiary, Chanpatia & Bahadurgarh 11 each, Kolkata, Munger, Beltara & Tizora 10 each, Khonsa, Koilwar, Hatidah, Khagaria, Katerniaghat, Kotkasim, Nagar, Pilani & Viratnagar 9 each, Daraui, Kamtaul, Srinagar, Batote, Tapukar, Bantwal, Mani & Kollur 8 each, Rosera, Samastipur, Gaya, Lalganj, Sikandarpur, Delhi, Madhopur, Kosal, Shimla, Katra, Kathumer, Srimadhopur, Udaipurwati & Kochi 7 each	Nimapara 25, Bhiloda 24, Gope & Kadana 23 each, Visnagar 22, Puri 21, Meghraj, Modasa & Mahabaleshwar 20 each, Vadnagar & Jayapura 18 each, Kakatpur, Kathala, Matar & Sringeri 17 each, Bijepur, Loharia, Kadi, Lunawada & Wanakbori 16 each, Dhansura & Kamardi 15 each, Bargarh, Krishnaprasad, Jagpura, Khanpur & Kalasa 14 each, Dungarpur, Ghatol, Thasra, Mani, Siddapura, Bhaga–mandala & Kozhikode 13 each, Galiakot, Nithuwa, Paradip, Rairakhol, Garthi, Gandhinagar, Balasinor, Sidhpur, Panvel, Balehonnur & Perinthalmanna 12 each, Athagarh, Garhi, Pipal–khunt, Cuttack, Sagwara, Jhalod, Limkheda, Dahegam, Santrampur, Kapadvanj, Kheda, Mahudha, Bayad, Idar, Subramanya, Bel–thangadi & Jagalbet 11 each, Bhubaneshwar, Thandola, Fatepura, Mansa, Nadiad, Harili, Patan, Himmatnagar, Yellapura, Mudigere & N. R. Pura 10 each, Pipli, Aspur,	Cherrapunji 36, Bhalukpong 23, Sankalan & Haripur 14 each, Murti 13, Bosan & Kannur 12 each, Passighat & Jalpaiguri 11 each, Alipurduar, Ratnagiri, Karipur, Kozhikode, Manjeri & Vadakara 9 each, Cooch Behar, Peint & Quilandy 8 each, Balurghat, Barobhisa, Chepan, Athani, Devanahalli & Perinthalmanna 7 each

TABLE 17 (*Contd*.)

(1)	(2)	(3)	(4)	(5)
			Ahmedabad, Sanad, Dashoi, Bajpe, Medikeri, Lakkavalli & Karipur 9 each, Mundali, Naraj, Sabla, Sarada, Jhagua, Vijapur, Umareth, Sehra, Bhuj, Dodamarg, Sanguem, Londa, Enmackel & Kundapur 8 each, Tadong, Ali–pingal, Jenapur, Rengali, Ambabhona, Sohela, Thakurmunda, Barmul, Chikhli, Danpur, Ganeshpur, Veja, Petlabad, Detroj, Dholka, Viramgam, Dhanpur, Dohad, Dharoi, Mehsana, Unjha, Kalol, Bhira, Mahemdabad, Kedbrahma, Valpoi, Kundapur, Panambur, Sirsi, Kadra, Joida, Kannur, Quilandy & Peermade 7 each	
13.	Gharmura 23, Machilipatnam 8, Lakhipur & Kaikalur 7 each	Bhatkal 17, Patna 16, Siddapura 14, Shirali, Nilkund, Kollur & Agumbe 12 each, Gerusoppa 11, Sripalpur & Kundapura 10 each, Kavaratti 9, Sonepat, Bajpe, Kannur & Karipur 8 each, Balimundali, Baghdogra, Rewaghat, Lalbegiaghat, Basua, Chatia, Chembarambakkam, Karkala, Kozhikode & Kochi 7 each	Bijepur 32, Durg 26, Khairamal, Bargarh & Baudhgarh 19 each, Mana & Ambabhona 17 each, Raipur 16, Dunguripalli 15, Padra 14, Baroda, Nilkund & Sringeri 13 each, Kantamal & Phulbani 12 each, Angul, Sohela, Baliguda, Halol, Dharampur & Bhuj 11 each, Jambugoda, Savli, Abdasa & Naliya 10 each, Sambalpur, Nimapara, Pipli, Kotda, Pardi, Mundra & Kamardi 9 each, Padampur & Thrissur 8 each, Naktideul, Chhendipada, Bhubaneshwar, Bolangir, Anklav, Dabhoi, Waghodia, Okha, Kutch Mandvi, Bhira, Dahanu, Bhagamandala, Thirthahalli, Aluva & Gondia 7 each	Kaleswaram 24, Cherrapunji & Sukma 17 each, Nargund 15, Quilandy 14, Sevoke, Neora, Vimpalli & Kannur 12 each, Murti & Kozhikode 10 each, Karkala, B. Bagewadi & Karipur 9 each, Chepan, Kelvan & Mannarkad 8 each, Car Nicobar, Barpeta, Motunga, Mandi, Sulya & Lokapur 7 each
14.	Kailashahar 11, Vridhachalam 8, Agartala, Arundhutinagar, Lengpui & Pantruti 7 each	Bhatkal 50, Nilkund 22, Panambur & Bajpe 21 each, Mulki, Kota, Udupi & Shirali 19 each, Kolar 18, Mangalore & Kundapur 16 each, Bantwal 14, Balarampur, Jalpaiguri, Amritsar & Mani 13 each, Siddapura 12, Baghdogra, Gajoldoba, Banda, Bhinga, Bahraich, Gunnour & Agumbe 11 each, Mudigere, Alipurduar & Dabri 10 each, NH–31, Kolkata, Dengraghat, Elginebridge, Vital, Guler, Karkala & Honavar 9 each, Sevoke, Indrapuri, Puttur & Kumta 8 each, Chouldhowaghat, Champasari, Domohani, Jaleswar, Galagalia, Nainital, Gurudaspur, Siddapura & Kannur 7 each	Hoshangabad 38, Amrawara 34, Lanjhi & Budhni 33 each, Bhopal 29, Gondia 24, Pachmarhi & Sehore 23 each, Raisen 21, Waraseaoni 18, Kalyanpur 17, Katangi 16, Narsullaganj & Keolari 14 each, Sironj, Ranavav, Mahabaleshwar & Dongargaon 13 each, Jorhat, Bareli, Udaipura, Narsingpur, Bhanwad, Dwarka & Bhira 12 each, Mundali, Vidisha & Ambagarh Chowki 11 each, Chindwara, Vanthali, Porbandar, Dongargarh & Palakkad 10 each, Jodia, Subramanya & Nilkund 9 each, Harda, Junagarh, Manavadar, Kutiana, Matheran, Thirthahalli & Kunnamkulam 8 each, Miao, North Lakhimpur, Cuttack, Naraj, Ashta, Sujalpur, Tendukheda, Mangrol, Jamnagar, Dhoraji, Upleta, Kutch Mandvi, Nakhtrana, Rajnandgaon, Avinashi, Kollur, Siddapura, Kammardi, Lakkavalli & Nilambur 7 each	Quepem 23, Mudibidre 18, Canacona & Margoa 17 each, Mangalore 16, Ponda 14, Bantwal, Mulki, Puttur & Raichur 13 each, Baghdogra, Cooch Behar, Kurnool, Panambur & Athani 12 each, Dharmavaram 11, Karwar, Shirali & Vittal 10 each, Kokrajhar, Chepan, Mohol, Karkala & Belthangadi 9 each, Sankalan, Subramanya, Dharamasthala, Udupi & Mangalore 8 each, Long Island, Car Nicobar, Alipurduar, Dhansa, Dhone, Pathikonda, Tadpatri,Honavar, Mani, Kundapura, Manvi & Wanaparthy 7 each
15.	Denkanikottai & Namakkal 9 each, Passighat 8, Harur & Arantangi 7 each	Mudibidre 31, Dabri 19, Kulda Bridge 18, Dillighat & Palliakalan 13 each, Agumbe 12, Bhograi & Belthangadi 11 each, Karkala & Mani 10 each, Margherita, Jaleswar, Jhawa & Banbasa 9 each, Bahraich, Bantwal, Dharamasthala, Subramanya & Munnar 8 each, Khanapara,	Jhalawar & Shajapur 18 each, Sangod, Ratlam & Kala Pipli 17 each, Khanpur, Shahpura & Sujalpur 15 each, Baripada & Sailana 14 each, Mohanpur, Jaten Barrage, Danpur, Dwarka & Mahabaleshwar 13 each, Gaganbavada & Radhanagari 12 each, Ghatol & Agar	Srisailam 25, Sevoke 20, Honavar 18, Port Blair & Pottangi 15 each, Huzurabad, Shirali & Agumbe 14 each, Quepem, Sanguem & Udupi 13 each, Ankola 12, Atmakur & Kollur 11 each, Car

TABLE 17 (*Contd*.)

(1)	(2)	(3)	(4)	(5)
		Digha, Jeypore, Nawarangpur, Patnagarh, Rajghat, Shardanagar, Ankinghat, Valparai, Sulya & Medikeri 7 each	11 each, NH–5, Baran, Kota & Kannod 10 each, Gangrar, Loharia, Rawat Bhata, Harda & Ujjain 9 each, Jeypore, Aspur, Kotda, Kushalgarh, Tonkhurd, Khachrod & Tarana 8 each, Midnapore, Digha, Jaleswar, Altuma, Bosan, Jahajpur, Mavli, Nathdwara, Vidisha, Gerusoppa & Aluva 7 each	Nicobar, Gaganbavada, Bhatkal & Gerusoppa 10 each, Champasari, Mumbai, Koderu, Yerragonda–palem, Yellandu, Koilkuntla & Bidar 9 each, Hut Bay, Gajoldoba, Ratnagiri, Harnai, Amalapuram, Piduguralla, Prodattur, Rayachoty, Mudibidre, Panambur, Kundapura, Kumta & Karwar 8 each, Poladpur, Canacona, Margoa, Igatpuri, Ongole, Atchampet & Nilkund 7 each
16.	Honavar 11, Dhubri & Hospet 10 each, Shimoga & Devanahalli 9 each, Munirabad & Sidhaghatta 8 each, North Lakhimpur, Chouldhowaghat, Denkanikottai & Malur 7 each	Jaleswar & Jamshedpur 14 each, Janjgir & Champa 13 each, Katghora 11, Akaltara 10, Rajghat, Jamsolaghat, Ranchi & Korba 9 each, Aizwal, Lengpui, Chandanpur & Jaunpur 8 each, Simga 7	Dharoi 27, Visnagar, Bhiloda & Himmatnagar 26 each, Kheralu 25, Kankrej 23, Vadnagar 22, Wav & Idar 20 each, Kadi & Kherwara 18 each, Sidhpur 17, Mehsana, Unjha & Vijayanagar 16 each, Matheran & Mahabaleshwar 15 each, Vadgam 13, Palanpur, Kedbrahma & Prantij 12 each, Loharia, Sarada & Patan 11 each, Nimapara, Radhanpur, Meghraj, Dhrangdhra, Bhira, Kollur & Agumbe 10 each, Keonjhargarh, Thakurmunda, Kakatpur, Satlasana, Tharad, Modasa, Dashoi, Ukai, Karjat, Sawantwadi, Kagal, Radhanagari & Gaganbavada 9 each, Athagarh, Ranpur, Neemuch, Becharaji, Kadana, Deesa, Mahudha, Panvel, Sringeri & Kozhikode 8 each, Ghatagaon, Purushottampur, Gop, Krishnaprasad, Dashpalla, Tikabali, Chittorgarh, Garhi, Gangrar, Mount Abu, Fatepura, Gandhinagar, Dantiwada, Vyara, Roha, Chandgad, Valparai & Karipur 7 each	Manvi 39, Nawarangpur & Agumbe 14 each, Sindagi 10, Hyderabad & Perinthalmanna 9 each, Matheran, Kalingapatnam, Indi, Karipur & Mannarkad 8 each, Long Island, NH–31, Khandapara, Jobet, Sangola, Visakhapatnam, Honavar, Karwar, Bhagamandala, Kozha, Mancompu, Manjeri, Mavelikara & Varkala 7 each
17.	Agumbe 13, Ambur 12, Subramany 11, Tezpur, North Lakhimpur, Bhinga, Venkatagirikota, Sulya, Hirekerur, Jagalur & Periyapatna 7 each	Laikera 22, Gurur 12, Bhanupratappur, Dhamtari & Narharpur 11 each, Jorhat, Paikmal, Deogaon, Nagari, Nilkund & Sakaleshpura 10 each, Matizuri 9, Silchar, Jharsuguda & Talaguppa 8 each, Kuchinda, Banbasa, Dondi, Mohalla, Belthangadi, Thirthahalli, Kammardi, Koppa, Lakkavalli, Idukki & Agumbe 7 each	Matheran 27, Mahabaleshwar 18, Panvel 17, Athagarh, Wav Bhira, Khalapur & Kalasa 16 each, Kollur & Jayapura 15 each, Jeypore, Digha, Karjat, Belthangadi & Sringeri 13 each, Umerkote, Uran & Radhanagari 12 each, Mumbai, Pen & Gagan–bavada 11 each, Thane–Belapur, Sanguem, Venkatapuram, Yellapura & Bhagamandala 10 each, Vijaynagar, Bhavanipatna, Tharad, Rahpar, Mahad, Poladpur, Quepem, Durg, Kammardi & Balehonnur 9 each, Soro, NH–5, Dhenkanal, Jamsolaghat, Kotraguda, Jamshedpur, Palanpur, Nakhtrana, Rajnandgaon & Jagdalpur 8 each, Burdwan, Bhograi, Jaleswar, Jaipur, Keonjhargarh, Pallahara, Tikarpada, Jaipatna, Khariar, Nawapara, Harbhanga, Bangirposhi, Baripada, Khandapara, Vadgam, Valpoi, Margoa, Simga, Karkala, Londa & Thrissur 7 each	Harnai 13, Maya Bandar & Panvel 12 each, Utnoor 10, Kalyanpur, Shrivardhan & Sawantwadi 9 each, Lalpur, Polavaram, Repalle, Venkatapuram, Bidar, Panjim & Canacona 8 each, Madhuban, Mhasala,Ratnagiri, Vengurla, Malvan, Guntur, Bhongir, Narsampet, Salgaon, Karipur & Perinthalmanna 7 each

TABLE 17 (*Contd*.)

(1)	(2)	(3)	(4)	(5)
18.	Sevoke 8, Gajoldoba 7	Nagpur 17, Betul 12, Dharamasthala 10, Bokajan & Paonta 9 each, Badatighat, Sibsagar & Haripur 8 each, Chandgad, Mahabaleshwar, Bhanupratappur, Nilkund & Agumbe 7 each	Hoshangabad 18, Karwar 14, Pachmarhi, Dillighat & Bhopal 11 each, Gaganbavada 10, Matheran & Siddapura 9 each, Jeypore, Quepem, Mahabaleshwar, Churiya, Dharamasthala & Sringeri 8 each, Bashirhat, Pathalgaon, Narayanpur, Belthangadi, Kammardi & Lakkavalli 7 each	Venkatapuram 35, Eturunagaram 34, Sukma 25, Perur 22, Chinnoor 15, Pottangi 14, Vyara 13, Mohana & Kaleswaram 11 each, Bopalpatna & Asifabad 10 each, Jeypore, Koraput, Bhira & Tala 9 each, Tadepalligudem & Mancherial 8 each, Cooch Behar, Nawarangpur, Roha, Pali, Shrivardhan, Mahabaleshwar, Aurangabad, Bapatla, Ranasthalam, Karimnagar, Manthani, Luxettipet & Sirpur 7 each
19.	Maya Bandar, Pottangi & Ariyalur 7 each	Bhagamandala 23, Siddapura & Linganamakki 14 each, Canning Town, Shahjapur & Londa 12 each, Champasari & Sevoke 10 each, Kolkata, Diamond Harbour, Govindgarh, Sagar, Dharamasthala, Puttur, Kollur, Hosanagara & Kalasa 9 each, Auraiya, Uttarkashi, Mani, Bantwal, Belthangadi & Mudigere 8 each, Chepan, Durgachak, Laxmangarh, Nilkund, Khanapur & Kammardi 7 each	Bhiloda 35, Ratlam 24, Banswara 23, Danpur & Mahidpur 21 each, Sailana 20, Arnod, Agar & Shahjapur 19 each, Khachrod 18, Garoth & Mandsaur 17 each, Pratapgarh 16, Ujjain 15, Udaipur, Arthuna, Pindwara, Depalpur, Jawad, Susner, Tarana, Unjha, Visnagar & Meghraj 14 each, Dungla, Garhi, Ghatol & Jaora 13 each, Desuri, Kushalgarh, Loharia, Mount Abu, Sallumber, Vallabhnagar, Sujalpur, Daroi & Idar 12 each, Sukinda, Mavli, Badnagar, Danta, Matar & Kedbrahma 11 each, Rajasmand, Sarada, Ashta Bhanpura, Budhni, Gautampura, Nimach & Subsera 10 each, Alipingal, Cuttack, Bharwain, Amet, Begu, Badisadri, Chotisadri, Nathdwara, Hoshangabad, Satlasana & Kadana 9 each, Shivganj, Indore, Kannoj, Tonkmuro, Kheralu, Vadnagar & Santrampur 8 each, Guler, Jaisalmer, Bali, Erinpura Road, Fatehgarh, Rawat Bhata, Beawar, Durg, Jawaja, Kherwara, Dewas, Mehsana & Gerusoppa 7 each	Perur 27, Huzurabad 25, Sultanabad 22, Sukma 21, Manthani & Ramagundam 14 each, Utnoor 11, Jeypore, Chinnoor, Jagityal, Sircilla & Sirpur 10 each, Eluru, Luxettipet & Venkatapuram 9 each, Bhira, Bopalpatna, Nuzvid, Eturunagaram & Thiruvananthapuram 8 each, Asifabad & Nirmal 7 each
20	Yelhanka 11, Goeribidanur & Ketti each, Arani 9, Pondicherry & Biligi 8 each, Maya Bandar, Nilanga, Dhrawad, Badami, Sindagi, Bangalore & Hosdurg 7 each	Kollur 16, Tantloi & Karkala 15 each, Ramanujganj 14, Dabri & Dehra Dun 13 each, Tilpara Barrage, Diamond Harbour & Mudibidre 12 each, Ghazipur, Kangra & Belthangadi 11 each, Gheropara, Suri, Solangnala, Bantwal, Udupi & Hosanagara 10 each, Darjeeling, Chouldhowaghat, Kalimpong, Durgachak, Messenjore Tiuni, Lundra, Mani, Puttur, Thirthahalli, Sringeri & Mudigere 9 each, Paonta, Sonhat, Gerusoppa & Milurid 8 each, Tangla, Idar, Khanitar, Sriniketan, Narayanpur, Kendrapara, Banda, Uttarkashi, Dhundi, Baran, Dholpur, Sawai Madhopur, Chachora, Chanderi, Dabra, Gaganbavada, Samri, Panambur, Bajpe, Subramanya & Bhagamandala 7 each	Kotda 28, Danta 26, Radhanpur 23, Gokunda & Vadgam 21 each, Devgarh & Raipur 17 each, Betu, Amet, Ballabhnagar & Palanpur 16 each, Pachpadra & Mavli 15 each, Mokhunda & Cheyyar 14 each, Visnagar, Meghraj, Jatan Barrage, Guda, Bhim, Kareda, Kumbalgarh & Paramballur 13 each, Bhopalsagar, Railmogra & Dantiwada 12 each, Dungla, Jhalod, Tatgarh, Deesa & Bangarpet 11 each, RL–1700, Shimla, Balotra, Gyangarh, Girva, Salumbar, Udaipur & Arani 10 each, Gharmura, Tantloi, Rajghat, Rajgangapur, Jamsolaghat, Dhorimanna, Siwana, Sinderi, Asind, Badi Sadri, Nathdwara, Sarada & Tharad 9 each, Jamankira, Panposh, Uttarkashi, Barmer, Chotisadri, Jawaja, Satlasana, Wav & Chintamani 8 each, Midnapore, Paradip, Puri, Luni, Bagor, Chikli, Hurda, Dhanera, Patan & Sagar Dam 7 each	Sircilla 30, Mancherial & Jagitiyal 11 each, Kalamnoori 10, Burdwan, Contai, Midnapore & Kalyanpur 9 each, Sawantwadi 8, Malwan, Porbandar & Durgachak 7 each

TABLE 17 (*Contd*.)

(1)	(2)	(3)	(4)	(5)
21.	Bhatkal 16, Kochi 15, Dibrugarh 13, Kocha 12, Sibsagar 11, Nancowry & Sikandarpur 10 each, Cherthala 9, Piravom 8, Panjim 7, Bhira, Jawahar, Marmugoa, Quepem, Paravur & Kollam 7 each	Binika 18, Athamalik 17, Rajkishorenagar & Banswara 15 each, Baudhgarh, Thakurmunda 14, Rega 13, Ghatgaon, Telkoi, Cuttack, Bhungra, Saraipali & Kartala 12 each, Naraj, Kendrapada, Pallahara, Bijapur, Begu & Matheran 11 each, Mundali, Talcher, Dunguripalli, Varanasi, Bagore, Kesarpura, Bhainsroadgarh, Bijolia, Mandalgarh & Nilkund 10 each, Pradeep, Sukinda, Keonjhargarh, Khairamal, Rajkinaka, Sonepur, Tikabali, Danpur, Pirawa, Mahabaleshwar, Belthangadi, Kollur & Kamardi 9 each, Alipingal, Dhenkanal Rairakhol, Athagarh, Tikarpada, Komna, Nayagarh, Allahabad, Mehre (Barsar), Khairi, Bhoond, Patti, Rajasmand, Amer, Dhambola, Guna & Neemuch 8 each, Motunga, Anandpur, Hindol, Altuma, Chandbali, Bhubaneshwar, Mathura, Uttarkashi, RL–1700, Guler, Bundi, Rawatbhat, Mungaoli, Deori & Gaganbavada 7 each	Musiri 16, Khairamal 15, Binika & Jaisalmer 14 each, Baitu, Sedwa & Shoe 13 each, Tiruchirapalli & Barmer 12 each, Wav & Kalakurichi 11 each, Hirakud, Sambalpur & Chotan 10 each, Rajkishorenagar, Sonepur, Rudraprayag, Raipur, Dabhoi, Sidhpur, Thasra & Viralimalai 9 each, Jamankira, Balotra, Dhorimanna, Pachpadra, Mahudha, Tharad, Namakkal, Gobichettipalayam & Thogaimalai 8 each, Athamalik, Bolangir, Dunguripalli, Kantamal, Madanpur Rampur, Tanakpur, Bagoda, Sallopat, Kedbrahma, Vijaynagar, Tirukoilur, Tirumangalam, Natham & Tirupattur 7 each	Ratnagiri 25, Durgachak 21, Canning Town 14, Berhampore, Jamshedpur & Vaibhavwadi 13 each, Krishnanagar, Diamond Harbour, Dengraparaghat, Khairamal & Umerkote 12 each, Rampurhat & Sawantwadi 11 each, Dharampur, Bashirhat & Devgad 10 each, Uluberia, Kolkata, Barackpur, Bagati, Athamalik, Sonepur, Banbasa, Vengurla & Mahabubabad 9 each, Narayanpur, Kharagpur, Jeypore, Pottangi, Maharo & Kaleswaram 8 each, Purihansa, Kalaikunda, Malkangiri, Sikadia, Messenjore, Arnod, Upleta, Bopalpatna, Palakonda, Prakasam Barrage, Nizamabad & Sircilla 7 each
22.	Berhampore 13, Matizuri 12, Dummagudem, Koida, K. R. Nagara, Thrissur & Aluva 9 each, Jeypore, Akkalkot, Paravur & CIAL Cochi 8 each, Digha, Sholapur, Bhadrachalam, Bellatti, Chalakudy, Alapuzha, Kottayam & Kollam 7 each	Songadh 39, Banswara 38, Bari 24, Galiakot 22, Bhungra, Danpur & Kesarpura 19 each, Hirakud 17, Bijepur, Bagidora & Vyara 16 each, Arthuna & Ghatol 15 each, Dharampur, Kamrej & Mahuva 14 each, Bargarh, Dubla, Sagwara, Valod, Mahabaleshwar & Bhanupratappur 13 each, Sohela, Bansda, Chikhli, Mandevi, Meghraj & Champa 12 each, Laikera, Bagore, Loharia, Pipalkhunt, Himatnagar, Kadana, Surat, Maliya Miyana, New Kandla, Matheran, Katghora, Janjgir & Akaltara 11 each, Jharsuguda, Narsullaganj, Bardoli & Gandevi 10 each, Naharkatia, Kuchinda, Ambabhona, Chikhli, Dhambola, Jagpura, Roopwali, Valsad, Vapi, Poladpur, Gaganbavada & Mungeli 9 each, Diana, Dunguripalli, Kareda, Raipur, Kheralu, Mehsana, Pardi, Silvasa, Vijapur, Lathi, Dahanu, Mahad, Mhasala, Valpoi, Radhanagari, Pali, Sakti 8, Jamankira, Sambalpur, Deogaon, Arnod, Nithuwa, Sabla, Veja, Sujalpur, Tarana, Ujjain, Bayad, Daman, Dhansura, Idar, Kapadvanj, Navsari, Olpad, Palsana, Prantij, Ukai, Vadnagar, Visnagar, Gariyadhar, Junagad, Kodinar, Lodhira, Mundra, Shrivardhan, Panvel, Bilaspur, Korba, Saraipali & Kartala 7 each	Sambalpur 28, Ramsar 21, Binika 18, Thakurmunda & Gadra Road 17 each, Swampatna, Laikera & Barmer 16 each, Ghatagaon & Jaunpur 15 each, Hirakud 14, Baliguda & Bissam Cuttack 13 each, Nilgiri, Pallahara & Sonepur 12 each, Khairamal 11, Hemgiri & Baikunthpur 10 each, Jalpaiguri, Asansol, Jaipur, Athamalik, Harbhanga, Balimundali, Udala, Mount Abu, Saraipali & Pendra 9 each, Diana, Soro, Baudhgarh, Daringibadi, Phulbani, Tikabali, Janjgir & Champa 8 each, Contai, Paradip, Keonjhargarh, Kuchinda, Rairakhol, Deogaon, Madanpur Rampur, Karanjia, Bolangir, Kotagarh, Mirzapur, Chotan, Jaswantpura & Sakti 7 each	Tantloi & Kolkata 21 each, Suri 15, Tilpara Barrage & Jamshedpur 14 each, Barackpur 13, Khanapara & Bhograi 12 each, Gheropara 11, Sriniketan, Asansol, Durgapur, Canning Town, Diamond Harbour, Digha, Anandpur & Jhabua 10 each, Panagarh, Durgachak, Jenapur & Ratnagiri 9 each, Margherita, Rampurhat, Kansabati Dam & Sukinda 8 each, Bahalpur, Belonia, Malda, Narayanpur, Purihansa, Dengraparaghat, Swampatna, Jamankira, Baripada, Lodhika & Dabolim 7 each
23.	Peermade 25, Vadakara, Quilandy & Vadakkancherry 14 each, Diana, Kannur, Kozhikode, Piravom & Punalur 13 each, Ottapalam 12, Murti, Mannarkad, Pattambi & Kunnamkulam 11 each, Nagrakata, Thalasserry,	Songadh 20, Mahabaleshwar 18, Gadra Road 15, Bhira, Igatpuri & Gaganbavada 14 each, Trimbak 13, Danta 12, Katra, Kannod, Nanipalsan, Madhuban & Morvi 11 each, Dharaoi, Kathalala & Peint 10 each, Naraingarh, Udhampur, Kodinar, Manavadar, Ranavav, Mandvi, Lodhika, Gandhidham, Radhanagari & Nangal Dam 9 each, Tezu, Satlasana, Palanpur, Vadgam & Porbandar 8 each, Susner, Karanprayag,	Naktideul 17, Khariar 16, Midnapore & Mohanpur 14 each, North Lakhimpur, Bhavanipatna, Junagarh, Lanjigarh, Komna & Baliguda 13 each, Rairakhol 12, Madanpur Rampur 10, Passighat, Kalaikunda, Titlagarh & Bissam Cuttack 9 each, Telkoi, Baripada, Sonepur, Daringibadi, Kotraguda & Chatnag 8 each, Ghatgaon, Pallahara, Rengali, Ambabhona, Balimundali,	Tantloi, Tilaiya & Messenjore 17 each, Nandidah 16, Barkisurya, Sikadia 15, Ramgarh & Maharo 14 each, Suri Ranchi & Hindigir 13 each, Bankura 12, Tilpara Barrage & Asansol 11 each, Tusuma, Canning Town & Khusiary 10 each, Cherrapunji, Sevoke, Tenughat &

TABLE 17 (*Contd*.)

(1)	(2)	(3)	(4)	(5)
	Alathur, Kodungallur, Karipur, Thrissur & Enmackel 10 each, Dharamtul, Neora, Sevoke, Manjeri, Kannara, Kochi, Mancompu & Kozha 9 each, Haripad, Chandanpur, Konni, Perumbavur, Kumarakkom & Thiruvalla 8 each, Champasarai, Cuttack, Tangi, Mangalore, Ponnani, Mavelikara, Nedumangad, Palakkad, Aluva, Kottayam & Varkala 7 each	Kheralu, Dabhoi, Chikhli, Silvasa, Keshod, Mahuva, Talaja, Kutch Mandvi, Bosan & Ramsar 7 each	Rairangpur, Bolangir, Binika, Kotagarh, Phaphamau, Chillaghat, Ambikapur & Mudukulathur 7 each	Durgachak 9 each, Krishnaprasad, Mython, Konner, Palmerganj Ballia & Ghazipur 8 each, Gaya, Darauli, Indrapuri & Rohtak 7 each
24.	Karwar 34, Kollur 21, Udupi 20, Ankola 19, Agumbe 17, Kunnamkulam 14, Bajpe, Karkala, Panambur & Bhagamandala 13 each, Ratnagiri 12, Belthangadi, Belgaum, Karipur, Mannarkad, Pattambi, Quilandy & Vadakkancherry 11 each, North Lakhimpur, Jaleswar, Bantwal, Chalakudy, CIAL Cochi, Paravur, Perumbavur & Amini Divi 9 each, Lengpui, Rajghat, Dabolim, Kundapur, Mangalore, Virajpet, Kannur & Kozhikode 8 each, Panjim Goa, Marmugoa, Sanguem, Ponda, Naduvattam, Valparai, Kumta & Ottapalam 7 each	Vyara 16, Tala 15, Jalpaiguri 13, Madhuban & Igatpuri 12 each, Dengraghat & Maliya Milana 11 each, Nagrotasurrian, Mahabaleshwar & Chotan 10 each, Guler, Ghamroor, Mahuva, Palsana, Valod & Bhira 9 each, Nadaun, Radhanpur, Nanipalsan, Vapi, Matheran, Trimbak & Ankola 8 each, Taibpur, Bhilwara, Dhanera, Dharampur, Bardoli, Songadh, Ukai, Gandevi, Karjat & Mahendragarh 7 each	Deogarh 16, Naktideul 13, Passighat & Aranthangi 11 each, Panna 10, Dharamtul & Ambikapur 9 each, Janakpur 8, Nilakottai, Jamankira, Pallahara, Reamal, Bargarh, Sohela, Umaria, Wav & Nilakottai 7 each	Bhagalpur 18, Sevoke & Colgaon 11 each, Baltara 10, Singlabazar, Narayanpur, Ramgarh, Mukhlishpur & Jodia 8 each, Alipurduar, Chepan, Gajoldoba, Khusiary, Hindigir, Khagaria, Aurangabad & Srisailam 7 each
25.	Baghdogra 13, Gwalior 12, Jalalpur, Mangalore & Kozhikode 11 each, Cherthala 10, Chatnag, Karjat, Panambur, Irikkur, Nedumbassery, CIAL Cochi & Babra 9 each, Navsari, Honavar, Perinthalmanna & Kottayam 8 each, Chouldhowaghat, Moradabad, Bansda, Songadh, Kannur, Aluva & Thodupuzha 7 each	Barpeta & Amritsar 10 each, Saulighat 9, Ziro & Kamtaul 7 each	Kodavasal & Janakpur 9 each, Saraipali 7	Benibad 31, Motihari 30, Muzaffarpur 27, Kursela & Khusiary 24 each, Lalbegiaghat, Sikandarpur & Sonbarsa 21 each, Colgaon 20, Maharo & Saulighat 19 each, Basua 18, Enmackel & Aluva 16 each, Kunnamkulam 15, Khagaria, Rosera, Nalgonda & Mavelikara 13 each, Ahirwalia, Jainagar & Kozha 12 each, Tantloi, Ambur, Paravur, Kanjirapally & Chalakudy 11 each, Darjeeling, Baltara, Chargharia, Lalganj, Upleta, Chengam, Piravom, Perumbavur & CIAL Cochi 10 each, Port Blair, Araria, Visakhapatnam, Vellore,

TABLE 17 (*Contd*.)

(1)	(2)	(3)	(4)	(5)
				Tiruppuvanam, Nedumangad & Kannara 9 each, Cuttack, Rewaghat, Red hills, Thiruvananthapuram & Kollam 8 each, Tenughat, Patna, Thiruvalla, Gudiyatham, Kuzhithurai, Varkala, Thodupuzha, Ponnani, Neyyattinkara, Kumarakkom & Kodungallur 7 each
26.	Valpoi & Karwar 14 each, Kollur 13, Ankola 12, Shirali & Kumta 11 each, Taibpur, Galgalia, Chargharia, Quepem, Sanguem, Bhatkal, Gerusoppa, Honavar & Bhagamandala 10 each, Babra, Ponda & Dharamasthala 9 each, Murti, Neora, Shardanagar, Amreli, Gaganbavada, Mangalore, Panambur, Bajpe & Karkala 8 each, Cooch Behar, Bhatpurwaghat, Hanumansetu, Khadda, Panjim, Dabolim, Margoa, Subramanya, Kundapur, Siddapura, Sirsi, Yellapura & Kannur 7 each	Gaganbavada 16, Pantnagar, Bosan & Bodhan 15 each, Kherunighat, Basua & Chandigarh 14 each, Gurudaspur 13, Araria, Uttarkashi & Ropar 12 each, Gharmura, Ambala & Didwana 11 each, Amraghat, Maharo, Indri, Tajewala & Subramanya 10 each, Khonsa, Karimganj, Hemgiri, Jeypore, Dehra Dun, Panipat, Naraingarh, Paonta, Nimbahera, Sapotra, Vizinagaram, Aurad & Kottayam 9 each, Sabour, Jhanjharpur, Ellenabad, Nawanshahar, Nainwa, Sawai Madhopur, Mudhol & Narayankhed 8 each, Lakhipur, Gudari, Messenjore, Chargharia, Chandradeepghat, Kakrahi, Jalalabad, Mussoorie, Haripur, Veeranghattam, Banswada & Belthangadi 7 each	Pantnagar 19, Triveni & Nainital 17 each, Kotdwar 13, Raibareilly 12, Palliakalan & Gingee 11 each, Jalpaiguri 10, Darjeeling & Bahraich 9 each, Kodumudi, Umareth, Tharad & Chatrapatti 8 each, North Lakhimpur, Hindigir, Bhinga, Didihat & Berthin 7 each	Malda 18, Bhatkal 17, Rajghat 12, Varkala 11, Bilara & Enmackel 10 each, Khowang, Panambur, Thiruvananthapuram & Kannara 9 each, Sikandarpur, Mangalore & Thrissur 8 each, Birpur & Thalasserry 7 each
27.	Sevoke 18, Mathabhanga & Ponda 12 each, Rohtak, Dharamsala, Gaganbavada & Kollar 11 each, Gajoldoba, Neemsar, Palampur, Pernem & Mahabaleshwar 10 each, Alipurduar, Dahanu & Kankavali 9 each, Chepan, Delhi (Ridge), Belthangadi, Siddapura & Shirali 8 each, Nancowry, Bhagalpur, Una, Devgad, Malvan, Valpoi, Radhanagari & Karwar 7 each	Dabri 19, Bhanupratappur 18, Parlakhemundi & Bhatpurwaghat 16 each, Ankinghat, Uchana, Patapatnam & Kaleswaram 15 each, Kalpi 13, Mahabaleshwar & Hakimpet 12 each, Madhabarida, Bareilly, Sarsawa, Hyderabad, Parigi & Subramanya 11 each, Komna, Fatehgarh, Gharaunda, New Delhi, Behror, Mandawar, Sagar & Kollar 10 each, Amraghat, Lengpui, Baliguda, Shardanagar, Gomatia, Nainital, Ganaur, Jind, Panipat, Rajgarh, Alwar, Sringeri, Yelhanka & Kollengode 9 each, Dashpalla, Balarampur, Chandradeepghat, Kanpur, Hindon, Delhi, Narwana, Bahadurpur, Kotkasim, Rajnandgaon, Jagdalpur, Machilipatnam, Mantralaya, Bhira & Kammardi 8 each, Angul, Tikarpada, Paikmal, Aska, Berhampore, Bhubaneshwar, Belgaon, Chanpatia, Lucknow, Mukhlishpur, Shajahanpur, Ateli, Bawal, Rewari, Dhundi, Karauli, Neemrana, Trimbak, Arang, Bametara, Ambagarh Chowki, Palakonda, Dundigal, Sangareddy, Yadgir, Jayapura & Chittoor 7 each	Bansi 23, Triveni 21, Balrampur 19, Bijepur 18, Kakrahi 15, Khadda 13, Katerniaghat, Birdghat & Kakardharighat 12 each, Basholi 11, North Lakhimpur & Sonbarsa 10 each, Barrackpore, Hayaghat, Chatia, Sonepur, Chandradeepghat, Gorakhpur, Basti, Binga, Ghamroor & Turtipar 9 each, Chouldhowaghat, Gangtok, Tusuma & Khairamal 8 each, Govindpur, NH–5, Sikandarpur, Colgaon, Mukhlishpur & Rengali 7 each	Hanumansagar 9, Panagarh, Sindagi & Sindhanur 7 each

TABLE 17 (*Contd*.)

(1)	(2)	(3)	(4)	(5)
28.	Chepan 24, Alipurduar 18, Bhalukpong & Cooch Behar 16 each, Mathabhanga, Diana, Nagrakata & Alipurduar 15 each, Neora & Ratnagiri 14 each, Bissam–Cuttack, Siddapura & Udupi 13 each, Murti & Agumbe 12 each, Passighat & Baghdogra 11 each, Champasarai, Hasimara, Rayagada, Dhoraji, Veeranghattam, Shirali & Mahabaleshwar 10 each, Sevoke, Gajoldoba, Gunupur, Umargaon, Mahabaleshwar & Kozhikode 9 each, Miao, Jalpaiguri, Gorakhpur, Harnai, Dahanu, Subramanya, Gerusoppa, Kadra, Belthangadi, Siddapura & Shirali 8 each, Simulia, Barmul, Madhuban, Panjim, Bhatkal, Linganamakki & Karipur 7 each	Mahabaleshwar & Samri 23 each, Sawantwadi 19, Bhira 15, Dindori, Mahad & Yellapura 12 each, Padampur, Binika Rawat Bhata, Poladpur, Matheran, Radhanagari, Lundra, Jagalbet & Londa 11 each, Neemsar, Jammu, Tala, Valpoi, Trimbak, Chandgad & Sakti 10 each, Nilgiri, Bahadurgarh, Jhalawar, Kolaras, Balaghat, Katangi, Bodeli, Karjat, Roha, Gaganbavada, Sahuwadi, Subramanya, Kadra, Nilkund & Thirthahalli 9 each, Gunupur, Chincholi, Waraseaoni, Madhuban, Mhasala, Vaibhavwadi, Dodamarg, Nasik, Igatpuri, Peint& Kammardi 8 each, Kolkata, Komna, Nawapara, Jeypore, Kosagumda, Kalpi, Garonth, Lanjhi, Chindwara, Kalyanpur, Mangrol, Pali, Kankavali, Quepem, Surgana, Gariaband, Ambikapur, Sitapur, Dharamasthala, Belthangadi, Bhatkal, Khanapur & Linganamakki 7 each	Bharwain 15, Kolkata 11, Bausan 9, Khadda, Kotdwar, Nangal Dam & Berthin 8 each, Durgachak, Haldia & Gaganbavda 7 each	Yercaud & Hadagalli 8 each, Port Blair & Ariyalur 7 each
29.	Khed 23, Mangrol & Nilkund 20 each, Bhalukpong 16, Mahabaleshwar & Bhudargad 15 each, Kumta 14, Bajpe, Subramanya & Kadra 13 each, Yellapura 12, Bhira, Mani, Karkala, Gerusoppa & Nilkund 11 each, Belthangadi, Dharamasthala, Panambur & Siddapura 10 each, Lunawada, Bissam Cuttack, Bayad, Modasa, Sanguem & Honavar 9 each, Maya Bandar, Kadi, Valpoi, Bhatkal, Mangalore, Mulki, Udupi, Shirali, Karwar, Gokarna, Ankola, Thirthahalli, Koppa & Lonavala 8 each, Tadong, Gangtok, Tantloi, Devgarh, Visnagar, Thane, Ponda, Quepem, Gaganbavada, Adilabad, Khanapura, Hosanagara, Sringeri, Rayagada, Mangalore, Mulki, Udupi, Shirali, Karwar & Gokarna 7 each	Songadh 40, Broach 34, Mahabaleshwar 32, Anand, Thasra & Kamrej 30 each, Dediapur 28, Vagra 27, Lunawada & Vyara 26 each, Mangrol 25, Poladpur 24, Mahuwa, Gandevi, Bhira, Surgana & Trimbak 23 each, Nandod, Nanipalsan, Jhagadia, Igatpuri & Matheran 22 each, Kathalala, Sagbara & Navsari 21 each, Dabhoi, Bansda & Chikhli 20 each, Wanakbori, Chhotaudaipur, Hansot, Jalalpur & Valod 19 each, Kalbinor, Kapadvanj, Tilakwada, Ahwa, Madhuban, Mahuwa, Olpad & Peint 18 each, Alirajpur 17, Kadana, Valia & Khambha 16 each, Santrampur, Dharampur, Palsana & Tala 15 each, Anklav, Kheda, Bardoli, Mandvi, Surat & Mhasala 14 each, Godhara, Matar, Bhiloda, Savli, Valsad, Ankleshwar, Silvasa & Kodinar 13 each, Kalaikunda, Petlad, Karian, Pardi, Vapi, Ukai & Karjat 12 each, Devgadhbaria, Halol, Nadiad, Sankheda & Amod 11 each, Badwani , Dhanpur, Tarapur, Modasa, Umargaon, Harnai, Mangoan, Pali & Roha 10 each, Diamond Harbour, Dimkheda, Kalol, Kelvan & Pen 9 each, Canning Town, Durgachak, Nilgiri, Jamshedpur, Jhabua, Shehra, Mahemdabad, Baroda, Gogha, Dhari, Bagbra, Padra & Khalapur 8 each, Chandanpur, Jamsolaghat, Joshipur, Jaora, Lanjhi, Sanad, Dohad, Fatehpur, Garbada, Jambugoda, Waghodia, Daman, Katghora, Munnar & Satara 7 each	Baliguda 21, Tikabali 17, Nimapara 16, Phulbani 14, Daporijo, Bahalpur, Alipingal & Pipli 13 each, Goalpara & Bhubaneshwar 12 each, Baudhgarh & Puri 11 each, Paradip 10, Khairamal, Lahunipara, Madanpur Rampur, Kantamal, Gop, Krishnaprasad & Ramanujganj 9 each, Tangla, Chandbali, Deogarh, Aska, Banpur, Sonepur, Daringibadi & Marmugoa 8 each, Jamankira, Cuttack, Kendrapada, Rajkanika, Athamalik, Bhanjanagar, Madhabarida, Lanjigarh, Bangirposhi, Khandapara, Titlagarh, Bhatpurwaghat, Sawantwadi & Sanguem 7 each	Puri & Visakhapatnam 12 each, Krishnaprasad 10, Banpur, Pipli & Tangi 8 each, Gopalpur, Aska, Thirukattupalli & Pullambadi 7 each

TABLE 17 (*Contd*.)

(1)	(2)	(3)	(4)	(5)
30.	Vyara 23, Mangrol 20, Songadh, Bhanupratappur & Dharamasthala 19 each, Lonavala 18, Naliya 17, Valod & Belthangadi 16 each, Karkala 15, Keshod, Veraval & Khopoli 13 each, Manavadar 12, Srinagar, Bhanvad, Mangrol, Bhagamandala, Sringeri & Kannur 11 each, Pindwara, Nathdwara, Vapi, Radhanagari, Subramanya, Quilandy & Karipur 10 each, Makrana, Gandevi, Mahuva, Upleta, Arang, Pakhanjur, Bantwal, Sulya, Mudigere & Enmackel 9 each, Nagrota Surian, Dediapada, Talala, Lumbdi, Bhira, Washim, Tekkali, Mani, Mulki, Bajpe, Puttur, Udupi, Nilkund, Kuppa, Irikkur & Kozhikode 8 each, Gudalur Bazar, Silvasa, Jalalpur, Navsari, Mandvi, Mahuva, Kodinar, Khed, Somwarpet, Thalassery, Kochi, Manjeri, Mannarkad, Ottapalam, Kollengode & Belgaon 7 each	Padra 47, Dabhoi 34, Mahabaleshwar 31, Tarapur 30, Sankheda 29, Petlad 27, Sojitra 26, Vyara 24, Amreli 23, Anklav, Kheda & Chhotaudaipur 22 each, Modasa 21, Dholka, Baroda, Mangrol & Jetpur 20 each, V. V. Nagar, Matar & Songadh 19 each, Dhanduka, Bodeli & Trimbak 18 each, Lunawada, Nadiad, Bagsra & Umarala 17 each, Dediapad, Kamrej, Lilia & Vallabhipur 16 each, Dengraparaghat, Waghodia & Igatpuri 15 each, Junagarh & Bhavnagar 14 each, Mahudha, Karjan, Sagbara, Tilakwada, Broach, Magadia, Valod & Sihor 13 each, Anand, Halol, Mansot, Mandvi, Ukai, Sawarkundla, Dhoraji, Gondal, Korba & Kartala 12 each, Bangirposhi, Cambay, Jambugoda, Bayad, Sinor, Nandod, Jambusar, Vagra, Ahwa, Palitana, Peint, Bhira & Surgana 11 each, Kathalal, Mahuva, Botad, Gogha & Rajkot 10 each, Panposh, Jamsolaghat, Masani Barrage, Dascoi, Viramgam, Devgadhbaria, Limkheda, Balasinor, Dhansura, Nanipalsan, Navsari, Dhari, Lodhira & Jashpurnagar 9 each, Cooch Behar, Sundergarh, Fatepura, Borsad, Wanakbori, Valia, Bansda, Jalalpur, Babra, Lathi, Vanthali, Talaja, Kutiana, Ranavav, Kalyanpur & Jasdan 8 each, Alipurduar, Canning Town, Bhograi, Barwala, Ranpur, Anand, Wav, Amod, Gandevi, Bardoli, Olpad, Khambha, Rajula, Upleta, Surgana & Sorada 7 each	Bijepur & Tikabali 32 each, Baliguda 30, Sohela 29, Dunguripalli 23, Phulbani 20, Belgaon 18, Binika 17, Paikmal, Umerkote & Titlagarh 15 each, Darjeeling, Alipingal, Athamalik, Ambabhona & Padampur 13 each, Bargarh 12, Krishnaprasad & Nimapara 11 each, Bhanjanagar & Barmul 10 each, Narsingpur, Tiring, Pipli, Bhubaneshwar, Mukteswar, Khetikhan & Nainital 9 each, Khanitar, Hindol, Rairakhol, Jamsolaghat, Kakatpur, Kotraguda, Almora & New Delhi 8 each, Tangla, Khairamal, Cuttack, Mundali, Khandapara & Sonepur 7 each	Bhanupratappur 20, Mahendragarh 17, Udayagiri 15, Jeypore 13, Kondagaon 12, Mohana & Sorada 11 each, Gunupur, Narayanpur & Subramanya 10 each, Kotraguda & Sompeta 9 each, Manas NH X–ing, Bangirposhi, Udala, Jagdalpur, Kanker, Ariyalur & Shirali 7 each
31.	Nil	Morvi 33, Lakhapat 22, Naliya Miyana 20, Rajkot 19, Mundra 17, Naliya & Mahabaleshwar 16 each, Igatpuri 15, Kamrej, Dhrol, Gandhidham & Trimbak 13 each, Chotila, Jamnagar & Nakhtrana 12 each, Kutiana, Jodia, Wankaner, Anjar & Valpoi 11 each, Kapadvanj, Kutch Mandvi, Londa & Kalyanpur 10 each, Sagar, Borsad, Maliya, Halvad, Lodhika, Bhuj & New Kandla 9 each, Dholka, Kathala, Sayla & Kollur 8 each, Jamshedpur, Mandal, Tarapur, Nanipalsan, Manavadar, Dhoraji, Bachhau, Rahpar, Bhira, Peint, Ambikapur, Nilkund & Yellapura 7 each	Gandai 19, Malanjkhand & Lanjhi 16 each, Betul 15, Deori 14, Bhasdehi, Chincholi, Narsingpur & Kurkheda 13 each, Mukteswar, Tendukheda, Seoni & Hinganghat 12 each, Deori, Arjunimorgaon, Pachmarhi & Tumsar 11 each, Nainital, Bakani, Balaghat, Katangi, Amarwada, Kowardha & Bhanupratappur 10 each, Khanpur, Multai, Begamganj, Waraseaoni, Khurai, Samudrapur, Selu, Bhiwapur & Dongargarh 9 each, Pirawa, Jhalawar, Ashoknagar, Shajapur, Susner, Ganjbasoda, Chindwara, Lakhandur, Ramtek, Wardha, Bametara & Ambagarh 8 each, Almora, Patti, Asnawar, Chanderi, Sehore, Karera, Sagar, Ghansore, Bramhapuri, Saoner, Narkhed, Asthi, Deoli, Karanjia, Baloda Bazar & Rajnandgaon 7 each	–

TABLE 18

Characteristics of monsoon 2006 rainfall

S. No.	Sub – division	(No. of days)				
		Vigorous	Active	Extr. Heavy	V. Heavy	Heavy
1.	Andaman & Nicobar Islands	0	0	0	2	12
2.	Arunachal Pradesh	0	15	0	4	27
3.	Assam & Meghalaya	0	8	1	11	46
4.	Naga., Mani., Mizo. & Trip.	4	9	0	5	20
5.	S.H.W.B. & Sikkim	5	23	3	18	40
6.	Gangetic West Bengal	8	21	2	12	31
7.	Orissa	10	21	10	26	30
8.	Jharkhand	4	16	1	3	14
9.	Bihar	2	11	1	8	16
10.	East Uttar Pradesh	1	2	1	9	20
11.	West Uttar Pradesh	1	0	0	8	11
12.	Uttaranchal	0	2	0	5	9
13.	Haryana	3	3	0	2	17
14.	Punjab	4	6	0	5	12
15.	Himachal Pradesh	5	16	1	9	24
16.	Jammu & Kashmir	0	0	0	2	9
17.	West Rajasthan	0	0	0	6	10
18.	East Rajasthan	0	0	5	13	18
19.	West Madhya Pradesh	8	13	4	14	21
20.	East Madhya Pradesh	2	12	1	11	13
21	Gujarat Region	12	16	13	16	20
22.	Saurashtra & Kutch	7	12	1	9	19
23.	Konkan & Goa	7	10	7	21	34
24.	Madhya Maharashtra	11	17	8	23	27
25.	Marathwada	4	15	1	6	12
26.	Vidarbha	0	0	1	9	16
27.	Chattisgarh	4	9	2	9	22
28.	Coastal Andhra Pradesh	7	9	1	9	17
29.	Telangana	8	10	5	8	6
30.	Rayalaseema	4	3	1	3	5
31.	Tamil Nadu & Pondicherry	1	0	0	3	26
32.	Coastal Karnataka	5	13	3	21	39
33.	North interior Karnataka	1	9	0	4	28
34.	South interior Karnataka	3	6	0	23	33
35.	Kerala	8	18	1	15	33
36.	Lakshadweep	0	0	0	0	4
Total		139	324	74	353	738

(b) *Moderate arid areas*

(*i*) Large areas of west Rajasthan.

(*ii*) Small areas in the northwestern parts of East Rajasthan; southern parts of coastal Andhra Pradesh; northwestern and eastern parts of Rayalaseema and adjoining eastern parts of south interior Karnataka and northern parts of Tamil Nadu; southern parts of Telangana; east central parts of north interior Karnataka; southeastern parts of Madhya Maharashtra and adjoining southern parts of Marathwada; west central parts of Tamil Nadu.

(*iii*) Isolated areas around Mysore (south interior Karnataka), Nagapattinam and Kanyakumari (Tamil Nadu).

7.3.3. *August*

(a) *Severe arid areas*

(*i*) Isolated areas around Hissar (Haryana), Malegaon (Madhya Maharashtra), Nandyal and Tirupathi (Rayalaseema) and Cuddalore (Tamil Nadu).

(b) *Moderate arid areas*

(*i*) Large areas of Rayalaseema and Haryana.

(*ii*) Small areas in the northern parts of west Rajasthan; southern parts of Punjab; northern parts of east Rajasthan; northwestern parts of west Madhya Pradesh; southern parts of Coastal Andhra Pradesh; southern tip of Telangana; eastern parts of south interior Karnataka; northern parts of Tamil Nadu; a small patch adjacent to Malegaon (Madhya Maharashtra).

(*iii*) Isolated area around Kanyakumari (Tamil Nadu).

7.3.4. *September*

(a) *Severe arid areas*

(*i*) Small areas in the northwestern parts of west Madhya Pradesh and adjoining southwestern parts of west Uttar Pradesh and eastern parts of east Rajasthan.

(*ii*) Isolated areas around Patiala (Punjab), Banda (east Uttar Pradesh), Anantpur (Rayalaseema) and Mysore (south interior Karnataka).

(b) *Moderate arid areas*

(*i*) Large areas of Rayalaseema.

(*ii*) Small areas in the eastern parts of Punjab and adjoining western parts of Haryana; east-central parts of East Rajasthan; southern parts of west Uttar Pradesh; southwestern parts of east Uttar Pradesh and adjoining northern parts of east Madhya Pradesh; northeastern parts of west Madhya Pradesh; southeastern parts of north interior Karnataka and adjoining southwestern parts of Telangana and northeastern parts of south interior Karnataka; southeastern parts of south interior Karnataka and adjoining northwestern parts of Tamil Nadu.

(*iii*) Isolated areas around Jodhpur (west Rajasthan), Bhavnagar (Saurashtra & Kutch), Malegaon (Madhya Maharashtra) and Cuddalore (Tamil Nadu).

8. Significant spells of heavy rains

Amounts of *heavy*, *very heavy* and *extremely heavy* rainfall are given in Table 17 and the spatial distribution of *extremely heavy rainfall*, *very heavy* and *heavy* rainfall is given in Table 18. Table 18 also indicates the *activity* of monsoon and sub-divisionwise extent of rainfall in terms of number of days when it was *widespread* or *fairly widespread*.

8.1. *Exceptionally heavy rainfall*

The rainfall reported by many stations like Karwar 43.0 cm. (30 May) (all time record), Ratnagiri 63.7 cm (31 May) (all time record), Mahuva 36.7 cm (5 July) (All time record), Banswara 37.9 cm (22 July), Kaleswaram 63 cm (5 August), Jalgaon 22.1 cm (6 August) and Hoshangabad 38.7 cm (14 August) (all time record) comes under the exceptionally heavy category during the season.

Monthwise description of heavy rainfall events are given below :

8.2. *Heavy rainfall during June*

During the month, *extremely heavy* rain occurred on 1 day each in Sub-Himalayan West Bengal & Sikkim, coastal Karnataka and Kerala.

Very heavy rain occurred on 7 to 8 days in coastal & south interior Karnataka; on 4 to 6 days in Nagaland-Manipur-Mizoram-Tripura, Sub-Himalayan West Bengal & Sikkim, Orissa, Konkan & Goa and Kerala and on 1 to 3 days in Assam & Meghalaya, Gangetic West Bengal, Bihar, Uttar Pradesh, Punjab, Gujarat State, Madhya Maharashtra, Marathwada, Vidarbha and north interior Karnataka. Also *Heavy* rainfall occurred on 8 to 12 days in Arunachal Pradesh, Assam & Meghalaya, Orissa, east Uttar Pradesh, Konkan & Goa, Tamil Nadu and

Karnataka; on 4 to 7 days in Andaman & Nicobar Islands, Nagaland-Manipur-Mizoram-Tripura, West Bengal & Sikkim, Bihar, west Uttar Pradesh, east Rajasthan, Gujarat State, Madhya Maharashtra, Marathwada, coastal Andhra Pradesh and Kerala and on 1 to 3 days in Jharkhand, Uttaranchal, Haryana, Punjab, Himachal Pradesh, Madhya Pradesh, Vidarbha, Chattisgarh, Telangana, Rayalaseema and Lakshadweep.

8.3. *Heavy rainfall during July*

During the month, *extremely heavy* rainfall occurred on 4 to 5 days in Gujarat Region, Konkan & Goa, Madhya Maharashtra and on 1 to 3 days in West Bengal & Sikkim, Orissa, east Uttar Pradesh, east Rajasthan, Saurashtra & Kutch, Chattisgarh and coastal Karnataka.

Very heavy rain occurred on 4 to 8 days in Gangetic West Bengal, Orissa, west Uttar Pradesh, Himachal Pradesh, east Rajasthan, east Madhya Pradesh, Gujarat State, Konkan & Goa, Madhya Maharashtra, Chattisgarh and coastal and south interior Karnataka and on 1 to 3 days in Arunachal Pradesh, Assam & Meghalaya, Nagaland-Manipur-Mizoram-Tripura, Sub-Himalayan West Bengal & Sikkim, Jharkhand, Bihar, east Uttar Pradesh, Uttaranchal, Haryana, Punjab, west Rajasthan, west Madhya Pradesh, Marathwada, Vidarbha, Andhra Pradesh and Kerala. Also *heavy rain* occurred on 13 to 15 days in west Madhya Pradesh and coastal Karnataka; on 8 to 12 days in Arunachal Pradesh, Assam & Meghalaya, West Bengal & Sikkim, Orissa, Jharkhand, Bihar, Haryana, Himachal Pradesh, east Rajasthan, Konkan & Goa, Madhya Maharashtra Vidarbha, Chattisgarh, interior Karnataka and Kerala; on 4 to 6 days in east Uttar Pradesh, Punjab, Jammu & Kashmir, west Rajasthan, east Madhya Pradesh and Saurashtra & Kutch, and on 1 to 3 days in Nagaland-Manipur-Mizoram-Tripura, west Uttar Pradesh, Uttaranchal, Gujarat Region, Marathwada, coastal Andhra Pradesh, Telangana and Tamil Nadu.

8.4. *Heavy rainfall during August*

During the month, *extremely heavy* rainfall occurred on 4 to 7 days in Orissa, Gujarat Region and Madhya Maharashtra and on 1 to 3 days in Himachal Pradesh, east Rajasthan, Madhya Pradesh, Konkan & Goa, Marathwada, Vidarbha, Chattisgarh, coastal Andhra Pradesh and Telangana.

Very heavy rain occurred on 8 to 12 days in Orissa, east Rajasthan, west Madhya Pradesh and Madhya Maharashtra; on 4 to 7 days in Gangetic West Bengal, west Rajasthan, Gujarat Region, Konkan & Goa, Vidarbha, Chattisgarh and coastal & south interior Karnataka and on 1 to 3 days in Arunachal Pradesh, Assam & Meghalaya, Sub-Himalayan West Bengal & Sikkim, Bihar, east Uttar Pradesh, Uttaranchal, Himachal Pradesh, east Madhya Pradesh, Saurashtra & Kutch, Marathwada, coastal Andhra Pradesh, Telangana, Tamil Nadu, north Interior Karnataka and Kerala. Also *heavy rain* occurred on 11 to 14 days in Assam & Meghalaya, Sub-Himalayan West Bengal & Sikkim, Konkan & Goa and coastal Karnataka; on 8 to 10 days in Gangetic West Bengal, Himachal Pradesh and Chattisgarh; on 4 to 7 days in Arunachal Pradesh, Orissa, east Uttar Pradesh, Uttaranchal, Punjab, Rajasthan, east Madhya Pradesh, Gujarat State, Madhya Maharashtra, coastal Andhra Pradesh, Tamil Nadu, interior Karnataka and Kerala and on 1 to 3 days in Andaman & Nicobar islands, Nagaland-Manipur-Mizoram-Tripura, Bihar, west Uttar Pradesh, Haryana, Jammu & Kashmir, west Madhya Pradesh, Marathwada, Vidarbha and Telangana.

8.5. *Heavy rainfall during September*

During the month, the *extremely heavy* rainfall occurred on 1 to 3 days in Assam & Meghalaya, Sub-Himalayan West Bengal & Sikkim, Jharkhand, Bihar, east Rajasthan, west Madhya Pradesh, Gujarat Region, Konkan & Goa, Telangana and Rayalaseema.

Very heavy rain occurred on 6 to 8 days in Sub-Himalayan West Bengal & Sikkim and coastal Andhra Pradesh; on 3 to 5 days in Assam & Meghalaya, Gangetic West Bengal, Orissa, Bihar, Konkan & Goa, Telangana, coastal & south interior Karnataka and Kerala and on 1 to 2 days in Andaman & Nicobar Islands, Arunachal Pradesh, Jharkhand, Uttar Pradesh, Uttaranchal, Punjab, Himachal Pradesh, Jammu & Kashmir, west Rajasthan, Madhya Pradesh, Gujarat Region, Madhya Maharashtra, Marathwada, Chattisgarh, Rayalaseema, Tamil Nadu and north interior Karnataka. *Heavy rain* also occurred on 7 to 9 days in Assam & Meghalaya, Nagaland-Manipur-Mizoram-Tripura, Sub-Himalayan West Bengal & Sikkim, Orissa, Konkan & Goa, Tamil Nadu, south interior Karnataka and Kerala; on 4 to 6 days in Andaman & Nicobar Islands, Arunachal Pradesh, Gangetic West Bengal, Gujarat State, Madhya Maharashtra, Marathwada, Vidarbha, coastal Andhra Pradesh and coastal & north interior Karnataka and on 1 to 3 days in Jharkhand, Uttar Pradesh, Haryana, Punjab, Himachal Pradesh, Jammu & Kashmir, Rajasthan, Madhya Pradesh, Chattisgarh, Telangana, Rayalaseema and Lakshadweep.

9. Significant temperature during the season

9.1. *June*

During the month of June, *severe heat wave conditions* prevailed on 1 to 2 days in Jammu & Kashmir,

west Rajasthan and Gujarat Region. Also *heat wave conditions* prevailed on 4 days each in east Uttar Pradesh, Vidarbha and on 1 to 3 days in west Uttar Pradesh, Haryana, Jammu & Kashmir, Rajasthan, Madhya Pradesh, Gujarat State and Chattisgarh.

Day temperatures were *appreciably to markedly above normal* on 6 to 10 days in east Uttar Pradesh, Jammu & Kashmir, west Rajasthan, Madhya Pradesh, Vidarbha and Chattisgarh; on 3 to 5 days in Haryana, Punjab, Himachal Pradesh, east Rajasthan and on 1 to 2 days in west Uttar Pradesh, Gujarat State, Madhya Pradesh, Marathwada and Telangana and were above normal on 4 to 7 days in west Uttar Pradesh, Rajasthan, Madhya Pradesh and on 1 to 3 days in east Uttar Pradesh, Uttaranchal, Haryana, Punjab, Himachal Pradesh, Jammu & Kashmir, Saurashtra & Kutch, Madhya Maharashtra, Marathwada, Vidarbha and Chattisgarh. They were *appreciably to markedly below normal* on 7 to 11 days in east Uttar Pradesh, Haryana, Punjab and Rajasthan; on 3 to 5 days in Uttar Pradesh, Himachal Pradesh, Jammu & Kashmir, Madhya Pradesh, Madhya Maharashtra, Marathwada, Vidarbha and Chattisgarh and on 1 to 2 days in Gujarat State and Telangana and were below normal on 3 to 5 days in west Uttar Pradesh, Uttaranchal, Punjab, Himachal Pradesh and Rajasthan and on 1 to 2 days in Sub-Himalayan West Bengal & Sikkim, Orissa, Haryana, Jammu & Kashmir, Madhya Pradesh, Gujarat State, Madhya Maharashtra, Vidarbha, Chattisgarh and Telangana.

The highest maximum temperature of 47° C was recorded at Ganganagar (west Rajasthan) on 1 June and at Barmer (west Rajasthan) on 24 June.

9.2. *July*

During July, day temperatures were *appreciably above normal* on 2 to 4 days in Haryana and Rajasthan and above normal on 4 days each in Haryana, west Rajasthan and on 1 day in east Rajasthan. They were appreciably to markedly below normal on 7 days in west Rajasthan and on 1 day each in Haryana, Punjab and east Rajasthan and were below normal on 4 days in west Rajasthan and on 1 day in east Rajasthan.

The highest maximum temperature of 45° C was recorded at Bikaner (west Rajasthan) on 4 July.

9.3. *August*

Lack of rains during the period 10 to 23 August over northeast India caused high day temperatures in Assam & Meghalaya and other northeastern sub-divisions.

10. Disastrous weather events and damage during monsoon months

10.1. *June*

During the month, thunderstorms, lightning, heavy rains, floods took a toll of 83 lives in Maharashtra, 25 in Kerala, 17 in West Bengal & Sikkim, 11 each in Bihar and Madhya Pradesh, 10 each in Vidarbha and Orissa, 9 in Assam & Meghalaya, 3 in Tamil Nadu and 1 in Karnataka. Heat wave claimed the lives of two in Vidarbha.

10.2. *July*

During the month, thunderstorms, heavy rains, floods took a toll of 67 lives in Maharashtra, 41 in Vidarbha, 36 in Orissa, 24 in Bihar, 17 in West Bengal & Sikkim, 13 in Kerala, 7 in Karnataka, 5 in Madhya Pradesh, 3 in Andhra Pradesh and 1 in Assam & Meghalaya.

10.3. *August*

During the month, thunderstorms, heavy rains, floods took a toll of 355 lives in Maharashtra, 176 in Gujarat, 135 in Rajasthan, 125 in Madhya Pradesh, 64 in Andhra Pradesh, 45 in Orissa, 17 in Assam & Meghalaya, 13 in Vidarbha, 6 in Chattisgarh, 5 in West Bengal & Sikkim and 4 in Jharkhand. Lack of rains led the temperature to soar which claimed 9 lives in Assam. Also lakhs of hectares of farmland was affected by drought conditions during the first half of August.

10.4. *September*

During the month, thunderstorms, lightning, heavy rains, floods took a toll of 436 lives in Maharashtra, 152 in Madhya Pradesh, 135 in Rajasthan, 109 in Orissa, 100 in West Bengal & Sikkim, 92 in Andhra Pradesh, 72 in Bihar, 69 in Vidarbha, 38 in Kerala, 30 in Assam & Meghalaya, 8 in Karnataka, 6 each in Kashmir and Chattisgarh, 4 in Jharkhand and 3 in Tamil Nadu. Heavy rain claimed 504 lives in Gujarat from July to September.

11. Damage due to floods etc. during monsoon season

During the southwest Monsoon (June-September 2006), many states *viz*., Maharashtra & Goa, Gujarat, Orissa, Madhya Pradesh, Chattisgarh, Rajasthan, Jammu & Kashmir, Uttar Pradesh, Bihar, West Bengal, Assam and Kerala experienced flood situations during various parts of the season, due to Depressions, lows, interaction between the westerly flow with the monsoon current etc. According to some available reports floods, heavy rain,

TABLE 19

The meteorological aspects of severe floods during southwest monsoon 2006

S. No.	Region affected	Period	Cause	Damage	Synoptic features prevailed
1.	*Assam and Tripura states* Bramhaputra and its tributaries including Madura, Barak, Longai, Singla and Kushiara flooded many districts of Assam & Tripura	1 – 21 Jun 2006		According to media reports, 16 persons in Assam and 5 in Tripura lost their lives. 800 villages and 55,000 hectares of agriculture field submerged in Assam	(*i*) Monsoon advanced over Tripura and parts of Assam on 27 May. (*ii*) Following the first week of June, monsoon was in a weak phase. The upper level divergence provided by a deep westerly trough caused heavy rainfall over the above regions
2.	Ganges and its tributaries Rapti, Ganga & Varuna overflowed, flooding many districts of Uttar Pradesh, Bihar and West Bengal	24 Jun – 3 Aug 2006	Heavy rain causing floods & landslides	160 dead in Uttar Pradesh since the beginning of monsoon. Incessant heavy rains claimed the lives of 17 persons in Bihar and it also caused landslides and disrupted road & rail traffic	(*i*) During the hiatus period in the advance phase, westerly systems had been active, which caused copious rainfall over north India
3.	*Orissa* Gajapati, Rayagada, Jhingirital districts of Orissa reeled under flood situation because the rivers Vamsadhara & Nagavali over flooded	3 – 8 Jul	Incessant heavy rains	Incessant heavy rains claimed the lives of 33 people in Orissa. It also caused landslides and disrupted the road & rail traffic and also flight operations	(*i*) A Deep Depression (2 – 5 July) over the Bay which crossed Orissa coast between Porbandar & Chandbali on 2, moved westnorthwestwards and weakened over south Rajasthan and adjoining west Madhya Pradesh
4.	*Mumbai* Mithi river over flowed because of heavy monsoon rains, flooding various districts of Maharashtra including Mumbai.	3 – 6 Jul	Heavy monsoon rains	9 people died. It also caused landslides and disrupted road & rail traffic and also flight operations	(*i*) The offshore trough at sea level extended from south Gujarat to Kerala coasts throughout the week (week ending 5-7-06) with a steep pressure gradient along the west coast. (*ii*) An upper air cyclonic circulation over Gujarat region and adjoining Madhya Maharashtra on 3 & 4 July which merged in the cyclonic circulation associated with Depression (2 – 5 July) on 5
5.	*Gujarat*	4 – 7 Jul	Heavy rains	Heavy rains led to the death of 24 persons	An upper air cyclonic circulation lay over Saurashtra & Kutch and neighbourhood on 28 June which persisted over the northeast Arabian Sea and adjoining Gujarat state till 1 July and later merged with the associated cyclonic circulation of Depression (2 – 5 July)
6.	*Jammu & Kashmir* Monsoonal rain caused overflowing of Jhelum & Chenab river	24 Jul – 22 Aug	Monsoonal rain	Monsoonal rain caused floods and landslides leaving 15 dead, 800 evacuated, 20 villages inundated and 22 bridges damaged. Heavy rains disrupted road/ rail traffic in Rajasthan	(*i*) 6 Upper cyclonic circulations in westerlies moved away northeastwards during the periods mentioned below: (a) 21 – 25 July (b) 25 – 28 July (c) 1 – 7 August (d) 6 – 11 August (e) 10 – 21 August (*ii*) Also there had been a trough in the westerlies to the rear of some of these cyclonic circulations mentioned above

TABLE 19 (*Contd*.)

S. No.	Region affected	Period	Cause	Damage	Synoptic features prevailed
7.	*Gujarat, Maharashtra, Madhya Pradesh and Rajasthan* Surat, Ahmedabad, Pune, Nagpur, Bhopal, Ujjain, Udaipur, Barmer are some of the districts in Gujarat, Maharashtra, Madhya Pradesh and Rajasthan respectively that reeled under flood situation	28 Jul – 12 Sep	Monsoonal rain	Gujarat (101), Maharashtra (330) and Rajasthan (138) people lost their lives, 1500 villages and towns submerged. Unusual rainfall in Thar desert 200 year record (549 mm rain between August 16 & 25). Thousands of hectares of crops destroyed. 75,000 farm animals dead. Estimated losses about 450 million dollars. More than 100 dead & tens of thousands displaced in Barmer district. Madhya Pradesh: on August 14, Bhopal received the heaviest rain in 30 years. More than 1.05 lakh people were affected and 600 heads of cattle and poultry perished. More than 70,000 people were evacuated from parts of Gujarat on 7 as the water levels in all the rivers (including Narmada) and dams crossed the danger mark	(*i*) A well marked low pressure area over north Bay on 28 July moved westnorthwestwads through Jharkhand, Orissa, Chattisgarh, northwest Madhya Pradesh on 30. It was over west Rajasthan on 1 August and became less marked on 2. (*ii*) An upper air cyclonic circulation lay over west Madhya Pradesh and neighbourhood on 29 and merged with the cyclonic circulation associated with the above low pressure area over west Madhya Pradesh and adjoining Rajasthan and Gujarat region. (*iii*) Formation of 5 monsoon depressions in succession over the head Bay and their west/ westnorthwestward movements. (*iv*) Monsoon trough was south of its normal position by 3-4°. (*v*) A well marked low pressure area over north Bay and adjoining coastal areas of Gangetic West Bengal and Orissa on 22 was quasi-stationary and became less marked over Jharkhand and adjoining Chattisgarh on 24. (*vi*) The offshore trough at sea level also had been active
8.	*Orissa, Andhra Pradesh and Chattisgarh* Mahanadi, Godavari, Sabri and many other rivers were flooded due to incessant very heavy to extremely heavy rain	1 – 10 Sep	Incessant very heavy to extremely heavy rain	106 dead in Andhra Pradesh. More than 200 villages in Andhra Pradesh were submerged with Godavari river in spate. 70 dead in Orissa, 500000 affected, 2 million homeless, 27 of 30 districts in the state hit by flooding. Also heavy rains disrupted the traffic in Orissa. In Chattisgarh 8 persons died and 100 were reported missing	Same as above
9.	*Uttar Pradesh* River Rapti, Ghagra and Sarayu were flooded because rivers in Nepal over flooded due to monsoonal rains	29 Aug – 4 Sep	Monsoonal rains	42 dead, 100 villages were flooded and over 10,000 affected	The monsoon trough at sea level shifted gradually to the north & generally remained north of the normal position towards the later part of the week (week ending 23 August). The western end of monsoon trough remained to the north of the normal position till 29 August. This also led to heavy to very heavy rain over east Uttar Pradesh on 26, 27 & 29
10.	*Punjab and Jammu & Kashmir* Jhelum, Sutlej, Lidder, Chenab, Tawi rivers were flooded due to incessant rains and unseasonal snowfall	31 Aug – 11 Sep	Incessant rains and unseasonal snowfall	Floods and landslides left 19 dead, 200 villages inundated, 92,724 hectare field submerged in Jammu & Kashmir. Also 15,000 people were affected by flooding. Valley remained cut off due to landslides on highways. Torrential rains and flash flood claimed 20 lives in Punjab, 200 villages inundated	(*i*) The remnant of the Depression (29 August – 1 September) lay over Punjab & neighbourhood on 3 September as a low pressure area. (*ii*) A trough in mid & upper tropospheric westerlies with its axis at 9.5 km a.s.l. extended along Long.70° E to the north of 25° N during 3 to 5 September. (*iii*) Western end of monsoon trough north of its normal position. (*iv*) On 7 & 8 September eastern end of monsoon trough was near the foothills of Himalayas. (*v*) Two upper air cyclonic circulations extending upto mid tropospheric levels moved away northeastward across northern parts of Jammu & Kashmir during 7 – 12

TABLE 19 (*Contd*.)

S. No.	Region affected	Period	Cause	Damage	Synoptic features prevailed
11.	*Andhra Pradesh, West Bengal and Bihar* Mouths of Ganges in Sunderbans delta; Haldi river, Godavari & Krishna and their tributaries over flowed.	18 Sep – 5 Oct	Heavy to very heavy rains	Andhra Pradesh : 31 dead, 5000 evacuated, 200 villages inundated in Karimnagar district. Very heavy rains lashed Telangana from 17 to 20 September. West Bengal:- 50 dead in Sunderbans region, 300 injured. 30,000 mud houses destroyed. The heaviest rains in 23 years left large parts of Kolkata city under water. 2000 evacuated from the city. (Heavy to very heavy rains from 20 – 26 September). Bihar : 33 dead, 25 bridges washed away due to heavy to very heavy rains from 23 – 25 September.	(*i*) A Land Depression (21 – 23 September) close to Jamshedpur on 21 moved northwestward and was near Ranchi on 22. It lay as low pressure area from 24 – 26 over Bihar and neighbourhood. (*ii*) A low pressure area over the west central Bay on 15 moved over to north coastal Andhra Pradesh and adjoining south coastal Orissa on 18 and became less marked over coastal Andhra Pradesh and adjoining Chattisgarh on 18. But the associated upper air cyclonic circulation extended upto mid tropospheric levels on 19. (*iii*) A Depression (28 – 29 September) crossed coast close to Gopalpur on 29 September. It moved westwards and weakened into a well marked low pressure area over south Chattisgarh and neighbourhood. Associated cyclonic circulation extended upto mid tropospheric levels over Marathwada and adjoining Telangana tilting southwards with height on 2 October.

landslides, lightning etc. took a toll of about 1543 human lives in various parts of the country. Maharashtra was the worst affected state, where 1015 people lost their lives, due to floods and heavy rain. Gujarat was the second worst affected state, where 215 people lost their lives. Assam (78), Andhra Pradesh (77), Madhya Pradesh (68), Kerala (54), Goa (24) and Karnataka (12) were the other affected states.

Some of the major flood events occurred during the season are summarised in Table 19. The data are compiled from various sources like www.dartmouth.edu, press reports and other disaster reports.

Acknowledgments

Valuable inputs from the offices of India Meteorological Department *viz*., (*i*) Additional Director General of Meteorology (Hydromet), New Delhi and (*ii*) Additional Director General of Meteorology (Research), Pune are gratefully acknowledged. Thanks are due to S/Shri M. V. Mande, S.A, Smt. Bharati Sabade, S.A., V. S. Khobragade, S.O., P. N. Chopade, D' Man and P. S. Kulkarni, L.D.C. for their help in bringing out this report.

Appendix

Definitions of the terms given in '*Italics*' Rainfall

Excess - percentage departure from normal rainfall is + 20% or more.

Normal - percentage departure from normal rainfall is between –19 % to + 19 %.

Deficient - percentage departure from normal rainfall is between –20 % to –59 %.

Scanty - percentage departure from normal rainfall is between –60 % to –99 %.

Widespread (Most places) - 75% or more stations of a meteorological sub-division reporting at least 2.5 mm rainfall.

Fairly widespread (Many places) - 51% to 74% stations of a meteorological sub-division reporting at least 2.5 mm rainfall.

Heavy rain - rainfall amount from 6.5 cm to 12.4 cm.

Very heavy rain - rainfall amount more than 12.5 cm to 24.4 cm.

Extremely heavy - rainfall amount more than 24.4 cm.

Exceptionally heavy - When the amount is a value near about the highest recorded rainfall at or near the station for the month or season. The highest ever recorded should be more than 12 cm.

Monsoon activity

Active - Average rainfall of a sub-division is more than 1½ to 4 times the normal with minimum 5 cm along the west coast and 3 cm elsewhere in at least two stations in the sub-division.

Vigorous - Average rainfall of a sub-division is more than 4 times or more than the normal with minimum 7 cm along the west coast and 5 cm elsewhere in at least two stations in the sub-division.

LRF Terminology

Normal monsoon - 90 to 110 percent of long period average seasonal rainfall.

Maximum/day temperatures

According to the revised criteria, since 1st March 2002, Heat Wave will be declared only when the maximum temperature of a station reaches at least 40° C for plains and at least 30° C for Hilly regions.

Severe heat wave conditions - Departure of maximum temperature from normal is +6° C or more for the regions were the normal maximum temperature is more than 40° C and +7° C or more for regions were the normal maximum temperature is 40°C or less.

Heat wave conditions - + 4° C to + 5° C or more for the regions where the normal maximum temperature is more than 40° C and departure of maximum temperature from normal is + 5° C to + 6° C for regions where the normal maximum temperature is 40° C or less. (declared only when the maximum temperature of a station reaches at least 40° C for Plains and at least 30° C for Hilly region).

Markedly above normal - Departure of maximum temperature from normal is between +5° C to +6° C for the regions where the normal maximum temperature is 40° C or less.

Appreciably above normal - +3° C to +4° C for the regions where the normal maximum temperature is 40° C or less.

Appreciably below normal - Departure of maximum temperature from normal is – 3° C to – 4° C.

Markedly below normal - Departure of maximum temperature from normal is – 5° C or less.