

## Weather in India

### MONSOON SEASON (June to September 2008)†

#### 1. Characteristic features of southwest monsoon 2008

1.1. The seasonal rainfall over the country as a whole was 98% of its Long Period Average (LPA).

1.2. Large temporal variation was noticed within the season.

1.3. For the country as a whole, the rainfall was 24% above LPA in June and 17% below LPA in July. It was 1% above and 5% below LPA respectively during August and September.

1.4. The spatial distribution of seasonal rainfall was largely uniform with 31 meteorological sub-divisions recording *normal*\* rainfall. Only 2 sub-divisions received *excess* rainfall and 3 received *deficient* rainfall.

1.5. The seasonal rainfall was 105% of its LPA over Northwest India, 96% each over central and south peninsula and 97% of its LPA over northeast India.

#### 2. Various aspects of southwest monsoon - 2008

##### 2.1. Advance of southwest monsoon

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

Southwest monsoon advanced over parts of southeast Bay, Nicobar Islands and Andaman Sea on 10 May, more than a week ahead of its normal as in the years 2007 & 1988. It set in over Kerala on 31 May. Further advance took place in a rapid phase.

The rapid advance phase was marked by well distributed rainfall over the country, which occurred due to the interaction between the monsoon flow and midlatitude westerlies. Thus by 16 June, southwest monsoon covered most parts of the country, outside some parts of Rajasthan. Subsequently, there was a hiatus in the further advance due to the weakening of the monsoon current. It covered the remaining parts of Rajasthan and thus the entire country by 10 July, 5 days ahead of the normal date.

\* Definitions of terms in '*Italics*' other than sub-titles are given in Appendix A.

##### 2.2. Weekly rainfall distribution

Meteorological sub-divisionwise week by week and cumulative weekly rainfall departures (percentage departure from normal) during the SW monsoon season from 1 June 2008 to 30 September 2008 comprising of 18 weeks are given in Figs. 2 (a&b).

##### 2.2.1. Week by week rainfall

The below normal rainfall period for the northeastern sub-divisions were 5 June – 9 July, 24 July – 30 July and 4 September – 1 October. Northwest India received mainly *scanty* rainfall for the period 28 August – 17 September and 25 September – 1 October. For central parts of the country, the rainfall remained *deficient* or *scanty* during 3 July – 30 July, 21 August – 17 September and 25 September – 1 October. For the south peninsula, the *excess/normal* rainfall occurred mainly during 31 July – 17 September.

During June and most parts of July, the *excess/normal* rainfall mainly occurred over the sub-divisions to the north of Lat. 15° N. It was well distributed over the country during the first 3 weeks of August and mainly occurred over the western half of the country during September.

##### 2.2.2. Weekly cumulative rainfall distribution.

The cumulative rainfall remained *deficient/scanty* over Marathwada until the week ending on 10 September and became *normal* thereafter. It remained *deficient* over : Assam & Meghalaya during 1 June – 20 August; Nagaland-Manipur-Mizoram-Tripura during 3 July – 30 September; west Madhya Pradesh during 28 August – 30 September; Gujarat region<sup>1</sup> during 19 June – 30 July, Saurashtra & Kutch during 10 July – 30 July and 28 August - 10 September; Madhya Maharashtra during 19 June – 6 August; Vidarbha during 3–23 July; Coastal Andhra Pradesh, Telangana and Rayalaseema roughly during 26 June – 30 July and over Karnataka State, roughly during 19 June – 6 August. The cumulative rainfall over Kerala became *normal* only during the period 11-24 September but became *deficient* again by the end of the season.

<sup>1</sup> The sub-division Gujarat Region, Daman, Diu & Nagar Haveli is shortened as Gujarat Region throughout the article.

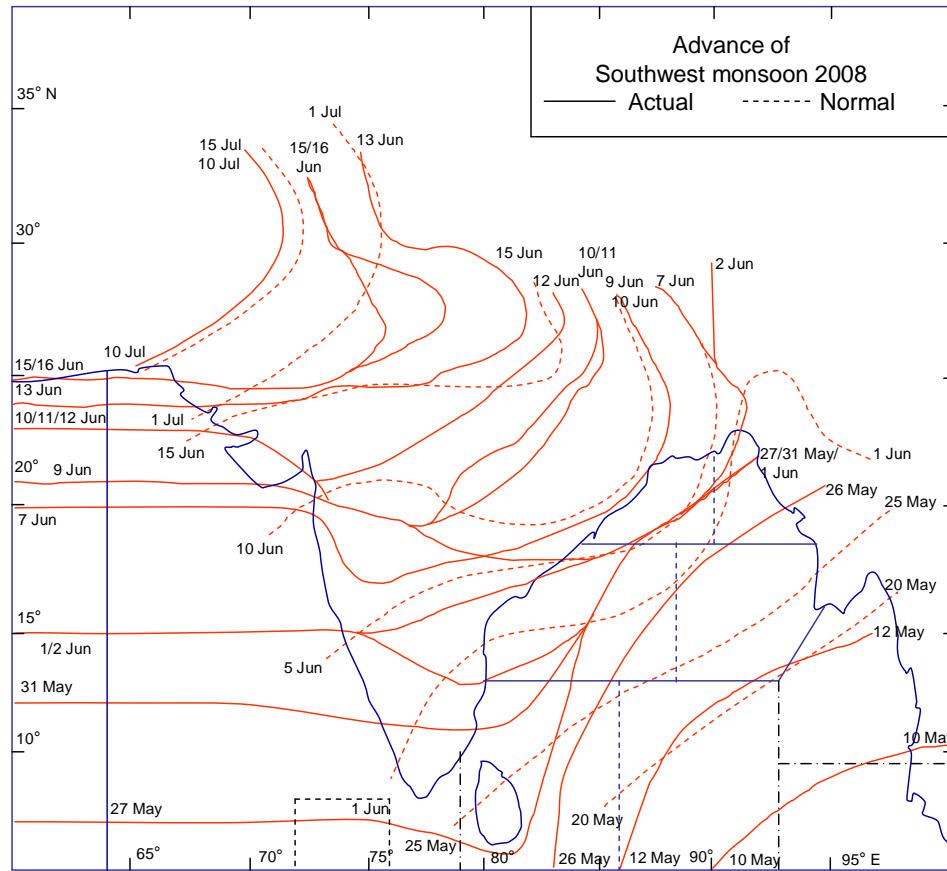


Fig. 1. Isochrones of advance of southwest monsoon 2008

### 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. The seasonal rainfall was *excess* in 2, *normal* in 31 and *deficient* in the remaining 3 met. sub-divisions. No sub-division reported *scanty* rainfall.

### 2.5. Districtwise distribution of monsoon rainfall

Out of the 516 meteorological districts for which data were available, 76% received *excess/normal* rainfall and the remaining 24% received *deficient/scanty* rainfall during the period 1 June – 30 September 2008. Out of this, 65 districts (13%) experienced moderate drought and

17 districts (3%) experienced severe drought at the end of the season.

Percentage of districts with *excess/normal* and *deficient/scanty* rainfall for the years 2003-2008 is given in Table 3.

### 2.6. Withdrawal of southwest monsoon

There was delay in the commencement of withdrawal of southwest monsoon from extreme west Rajasthan. The southwest monsoon withdrew from major parts of northwest India on 29 September. The normal date of withdrawal of southwest monsoon from western most parts of Rajasthan is 1 September. The delay was mainly due to the presence of systems in westerlies over northwest India, interacting with the monsoon circulation. In the past, the most delayed date of monsoon withdrawal from extreme west Rajasthan was 30 September, which occurred in the last year, (2007). During the period 1960-2006, such delays have occurred during the years 1964 & 1970 (28 September) and 1990 (27 September).

**TABLE 1**  
**Advance of Southwest Monsoon 2008**

S.No.	Date	Southwest monsoon advanced over	Northern limit of monsoon passed through	Remarks
1.	10 May	Some parts of southeast Bay, Nicobar Islands and Andaman Sea	5/90, Nancowry, 9/95, 10/100	-
2.	12 May	Some more parts of southeast Bay, Andaman & Nicobar Islands, entire south Andaman Sea and most parts of north Andaman Sea	5/86, 8/87, 10/89, 12/91, Mayabandar, 14/95 & 15/98	Almost 8 days prior to the normal date (20 <sup>th</sup> May)
3.	26 May	Some parts of southwest Bay, westcentral Bay, entire southeast Bay, most parts of eastcentral Bay and in some parts of northeast Bay	5/83, 10/84, 15/87 & 20/93	Near normal in the southern parts and 5 days prior over the northeast Bay
4.	27 May	Some parts of south Arabian Sea and some more parts of south, central and north Bay	7/60, 7/70, 7/75, 6/80, 7/82, 10/83, 16/85, 20/89 & 22/92	-
5.	<b>31 May</b>	<b>Southwest monsoon set in over Kerala</b> Most parts of south Arabian sea and Kerala, some parts of Tamil Nadu and some more parts of southwest and westcentral Bay	12/60, 12/70, Kozhikode, Tiruchirapalli, 12/82, 16/85, 20/89 & 22/92	Near normal time in most of these regions
6.	1 June	Remaining parts of south Arabian Sea and Kerala, some parts of central Arabian Sea, most parts of coastal and south interior Karnataka and Tamil Nadu, entire southwest Bay and in some more parts of westcentral Bay	15/60, 15/70, Karwar, Chitradurga, Vellore, Chennai, 16/85, 20/89, 22/92	3 to 4 days ahead of normal
7.	2 June	Remaining parts of south interior Karnataka, some parts of north interior Karnataka, remaining parts of Tamil Nadu, most parts of Rayalaseema, some parts of coastal Andhra Pradesh, most parts of westcentral Bay. Some more parts of north Bay, most parts of Nagaland-Manipur-Mizoram-Tripura, Assam & Meghalaya and entire Arunachal Pradesh	15/60, 15/70, Karwar, Bellary, Kurnool, Kakinada, 18/85, 20/89, Agartala, Dhubri & 27/90	Do
8.	7 June	Remaining parts of central Arabian Sea, most parts of Konkan & Goa, some parts of Madhya Maharashtra, most parts of north interior Karnataka, entire Rayalaseema, some more parts of Telangana and coastal Andhra Pradesh, some parts of Sub-Himalayan West Bengal and entire Sikkim	20/60, 20/70, Dahanu, Pune, Satara, Gulbarga, Hanamkonda, Visakhapatnam, 18/85, 20/89, Agartala, Dhubri and Gangtok	Near normal time.
9.	9 June	Some parts of north Arabian Sea, southern most of Gujarat State, entire Konkan & Goa, some more parts of Madhya Maharashtra, some parts of Marathwada, entire north interior Karnataka, some more parts of Telangana, southern parts of Chattisgarh, entire coastal Andhra Pradesh, some parts of Orissa, entire Bay of Bengal, remaining parts of Sub-Himalayan West Bengal, some parts of Gangetic West Bengal and Bihar	21/60, 21/70, Veraval, Nasik, Parbhani, Hanamkonda, Bhubaneswar, Sriniketan and Forbesganj	Do
10.	10 June	Some more parts of north Arabian Sea, Gujarat State and Marathwada, entire Telangana, some parts of Vidarbha, some more parts of Chattisgarh, entire Orissa, Jharkhand and Gangetic West Bengal and most parts of Bihar	23/60, 23/65, Okha, Rajkot, Surat, Nasik, Parbhani, Raipur, Daltonganj, Patna and Raxaul	Do
11.	11 June	Some more parts of Vidarbha, most parts of Chattisgarh and some more parts of Bihar	23/60, 23/65, Okha, Rajkot, Surat, Nashik, Parbhani, Nagpur, Pendra, Chapra and Raxaul	-
12.	12 June	Entire Maharashtra, Chattisgarh and Bihar States and some parts of Madhya Pradesh and east Uttar Pradesh	23/60, 23/65, Okha, Rajkot, Surat, Hoshangabad, Satna, Allahabad, Gorakhpur and Nautanwa	Near normal elsewhere and 5 days ahead in east Uttar Pradesh
13.	13 June	Most parts of Arabian Sea, remaining parts of Gujarat State, some parts of east Rajasthan, most parts of Madhya Pradesh, some parts of west Uttar Pradesh and Haryana, most parts of east Uttar Pradesh, entire Uttarakhand, Himachal Pradesh and Jammu & Kashmir and some parts of Punjab	24/60, 24/65, Deesa, Udaipur, Guna, Jhansi, Fatehpur, Bahraich, Pantnagar, Patiala and Jammu	Nearly 2 weeks ahead in the northern parts
14.	15 June	Entire Arabian Sea, some parts of west Rajasthan, some more parts of east Rajasthan, entire west Madhya Pradesh and east Uttar Pradesh, most parts of west Uttar Pradesh, some more parts of Haryana and entire Punjab	25/60, 25/65, Mount Abu, Bhilwara, Sawai Madhopur, Agra, Delhi and Ganganagar	2-3 weeks ahead in the northern parts
15.	16 June	Entire Uttar Pradesh and Haryana and some more parts of Rajasthan	25/60, 25/65, Mount Abu, Jaipur, Churu and Ganganagar	Do
16.	10 July	Remaining parts of Rajasthan and thus the entire country	-	5 days ahead of normal

**TABLE 2**  
**Rainfall figures (mm) for each month and season as a whole (June – September 2008)**

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	454	482	-6	511	419	22	455	416	9	332	438	-24	1752	1755	0
2.	Arunachal Pradesh	494	494	0	523	596	-12	587	388	51	205	358	-43	1810	1835	-1
3.	Assam & Meghalaya	400	567	-29	447	564	-21	501	434	15	257	321	-20	1605	1885	-15
4.	Naga., Mani., Mizo. and Tripura	281	361	-22	255	345	-26	300	309	-3	222	226	-2	1057	1241	-15
5.	S. H. W. B. & Sikkim	551	496	11	639	602	6	646	470	37	266	388	-31	2102	1955	7
6.	Gangetic West Bengal	427	240	78	339	315	8	257	312	-18	269	270	0	1292	1136	14
7.	Orissa	340	206	65	319	345	-7	392	365	7	367	249	47	1419	1165	22
8.	Jharkhand	266	192	39	388	336	16	275	324	-15	168	241	-30	1098	1093	0
9.	Bihar	277	173	60	426	345	24	303	296	3	138	226	-39	1145	1039	10
10.	East Uttar Pradesh	246	105	134	409	309	32	284	301	-6	129	198	-35	1068	914	17
11.	West Uttar Pradesh	231	69	237	264	268	-2	224	286	-22	79	150	-47	798	773	3
12.	Uttarakhand	221	164	35	409	425	-4	364	426	-15	158	208	-24	1151	1223	-6
13.	Haryana, Chandigarh & Delhi	151	43	250	116	170	-32	165	168	-2	105	89	18	536	470	14
14.	Punjab	203	42	389	96	189	-49	247	169	46	57	102	-44	604	502	20
15.	Himachal Pradesh	179	90	99	182	288	-37	229	262	-12	148	134	10	738	774	-5
16.	Jammu & Kashmir	143	59	145	169	186	-9	167	174	-3	45	95	-53	524	514	2
17.	West Rajasthan	49	27	81	59	102	-42	141	94	51	28	41	-31	277	263	5
18.	East Rajasthan	143	61	134	171	224	-24	171	233	-26	119	105	13	604	624	-3
19.	West Madhya Pradesh	178	108	65	203	305	-33	196	315	-38	138	177	-22	715	904	-21
20.	East Madhya Pradesh	297	144	107	263	371	-29	265	382	-31	121	201	-40	946	1097	-14
21.	Gujarat region	61	123	-51	268	361	-26	378	291	30	212	160	33	918	934	-2
22.	Saurashtra & Kutch	77	81	-5	145	195	-26	110	138	-21	227	72	217	559	486	15
23.	Konkan & Goa	755	675	12	789	1069	-26	890	712	25	535	347	54	2969	2802	6
24.	Madhya Maharashtra	98	134	-27	133	238	-44	224	176	27	301	151	99	756	700	8
25.	Marathwada	69	144	-52	109	192	-43	143	194	-26	264	174	52	585	704	-17
26.	Vidarbha	136	167	-19	253	329	-23	244	300	-19	151	180	-16	783	976	-20
27.	Chattisgarh	234	189	24	306	394	-22	321	391	-18	203	232	-12	1064	1206	-12
28.	Coastal Andhra Pradesh	83	100	-16	167	160	5	228	154	48	120	162	-26	599	575	4
29.	Telangana	124	136	-8	174	242	-28	354	218	62	146	171	-15	798	767	4
30.	Rayalaseema	39	60	-35	90	91	-1	112	97	15	146	132	11	388	381	2
31.	Tamil Nadu	46	42	10	77	71	9	132	90	47	69	113	-39	325	316	3
32.	Coastal Karnataka	867	901	-4	626	1188	-47	803	767	5	357	318	12	2653	3174	-16
33.	North interior Karnataka	68	98	-31	68	126	-46	133	113	18	161	153	5	430	491	-12
34.	South interior Karnataka	139	132	5	189	226	-16	259	164	58	135	137	-2	722	659	9
35.	Kerala	478	678	-30	509	758	-33	348	447	-22	344	260	32	1678	2143	-22
36.	Lakshadweep	255	326	-22	364	282	29	207	213	-3	109	164	-34	934	985	-5

Week by week rainfall during SW monsoon - 2008

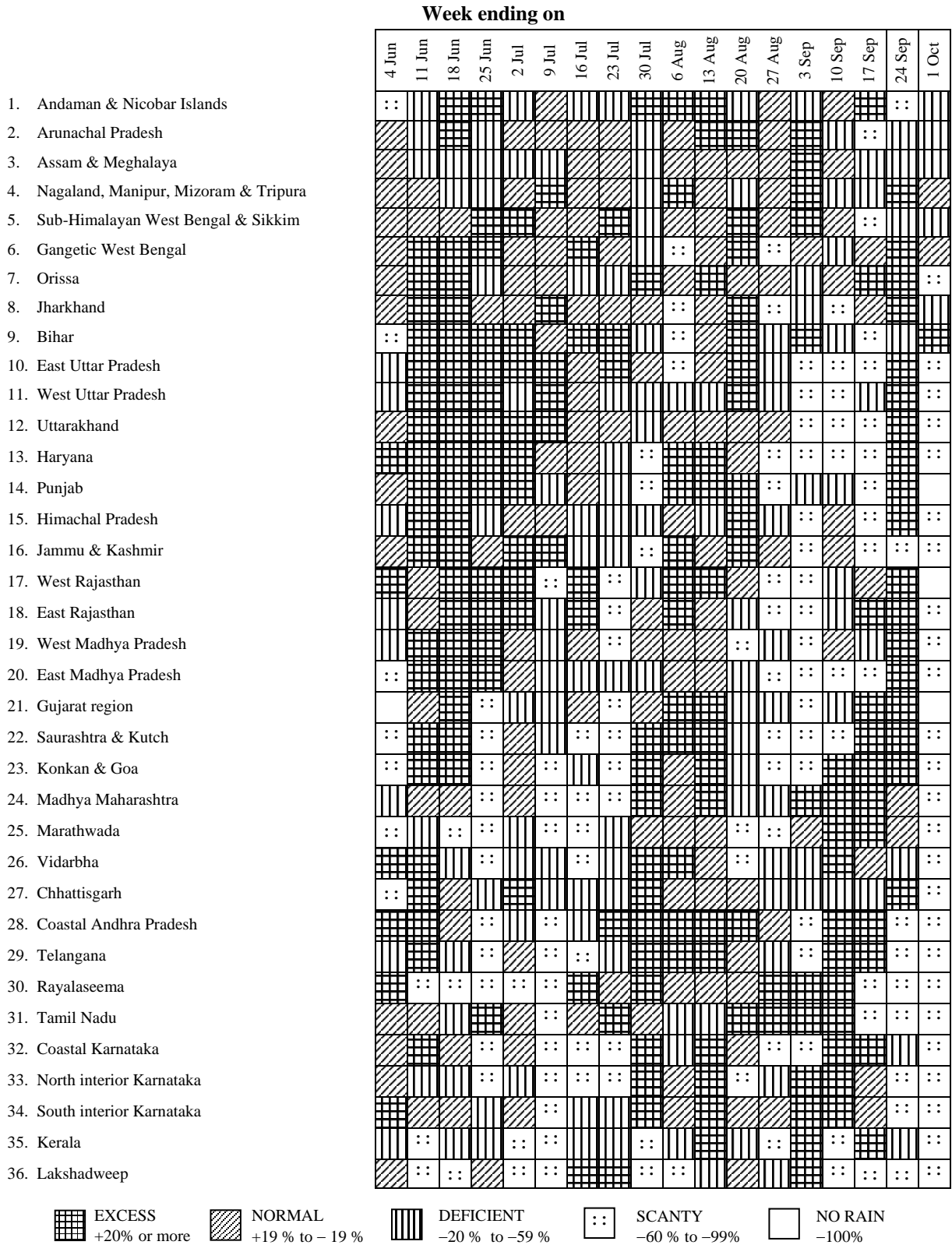
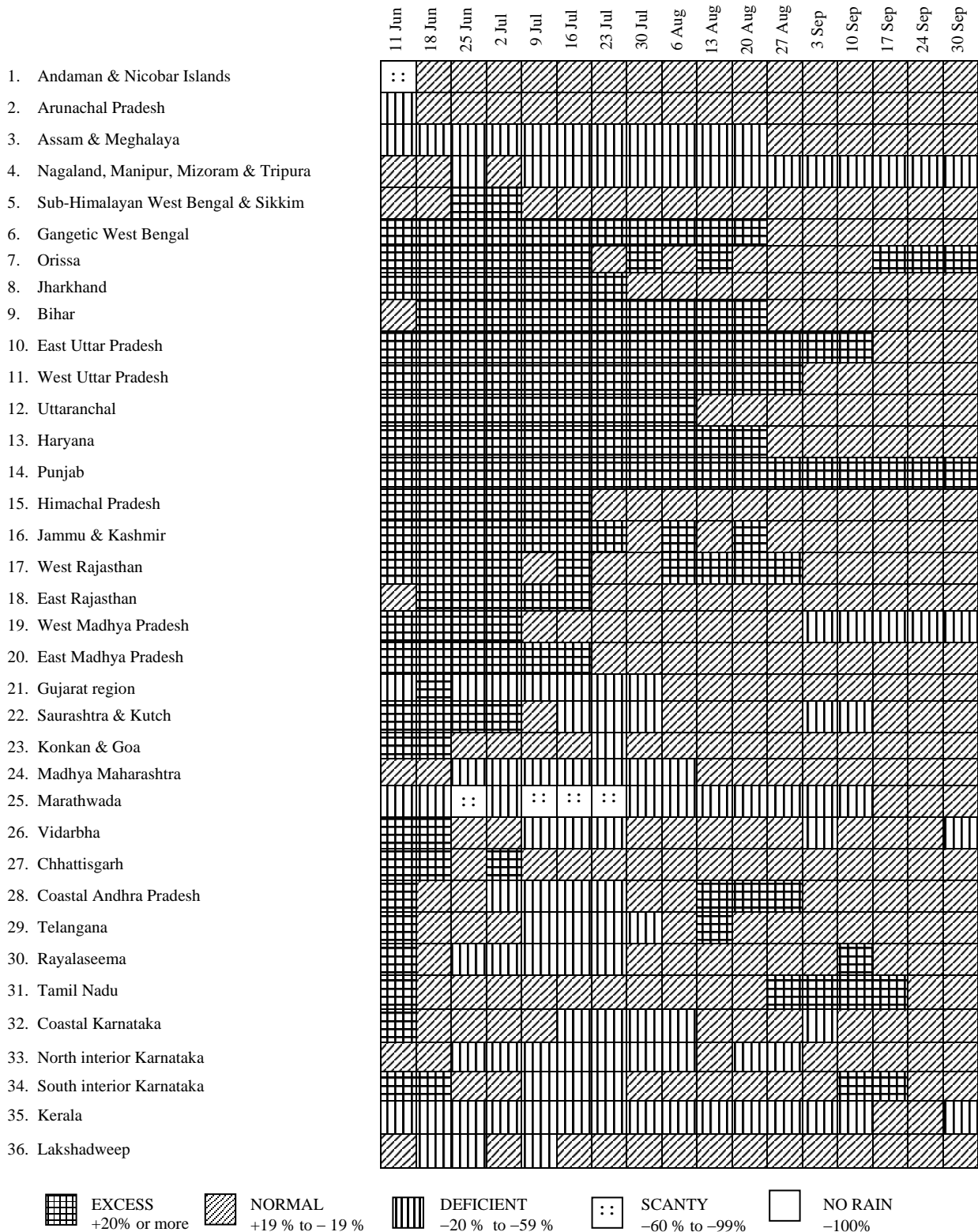
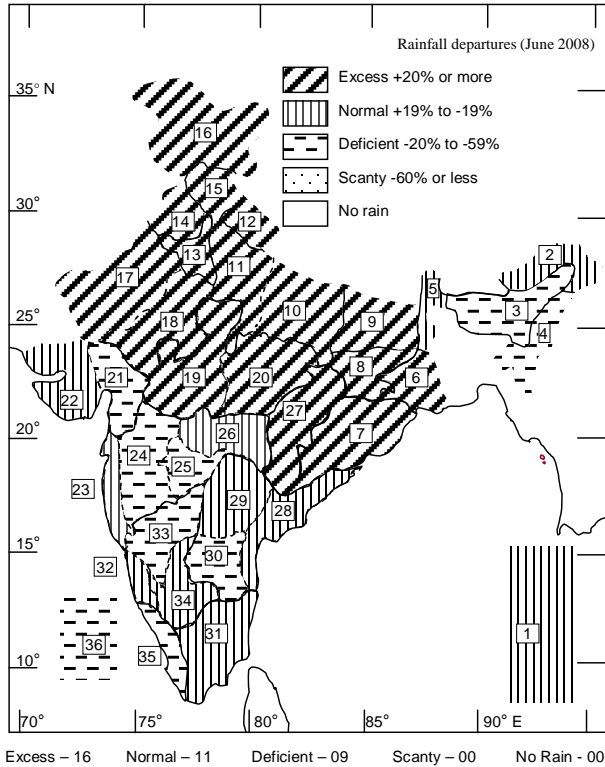


Fig. 2(a). Week by week rainfall during SW Monsoon 2008

**Week by week cumulative rainfall (1 June – 30 September 2008)**  
**Week ending on**



**Fig. 2(b).** Week by week cumulative rainfall during SW monsoon 2008 (1 June to 30 September 2008)



**Fig. 3.** Sub-divisionwise seasonal rainfall departure from normal (%) for the period (June 2008). 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 :

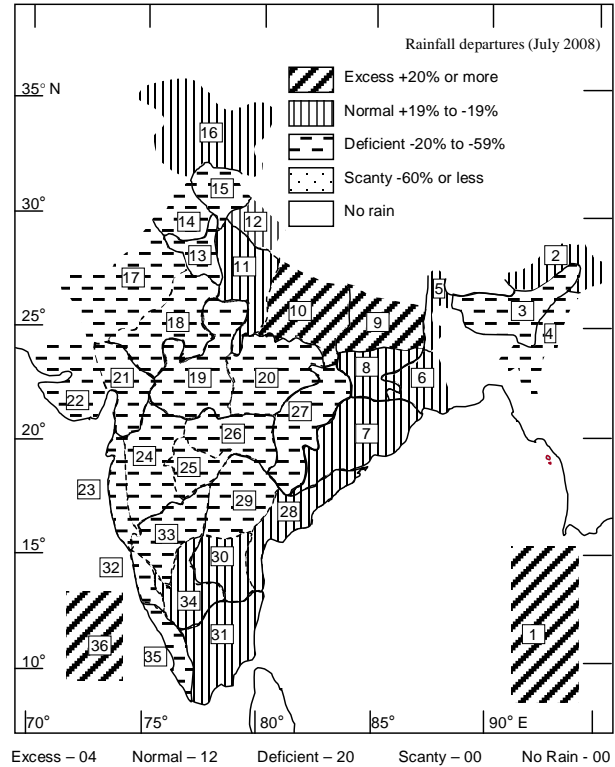
<b>1</b>	-6	<b>7</b>	65	<b>13</b>	250	<b>19</b>	65	<b>25</b>	-52	<b>31</b>	10
<b>2</b>	0	<b>8</b>	39	<b>14</b>	389	<b>20</b>	107	<b>26</b>	-19	<b>32</b>	-4
<b>3</b>	-29	<b>9</b>	60	<b>15</b>	99	<b>21</b>	-51	<b>27</b>	24	<b>33</b>	-31
<b>4</b>	-22	<b>10</b>	134	<b>16</b>	145	<b>22</b>	-5	<b>28</b>	-16	<b>34</b>	5
<b>5</b>	11	<b>11</b>	237	<b>17</b>	81	<b>23</b>	12	<b>29</b>	-8	<b>35</b>	-30
<b>6</b>	78	<b>12</b>	35	<b>18</b>	134	<b>24</b>	-27	<b>30</b>	-35	<b>36</b>	-22

It withdrew from the remaining parts of northwest India and parts of westcentral India on 11 October and thereafter the withdrawal took place in a rapid phase upto 15 October. It withdrew from the entire country, Bay of Bengal and Arabian Sea on 15 October, as per the normal schedule and simultaneously the Northeast monsoon rains commenced over the southern peninsula.

The monsoon withdrawal over the country is given chronologically in Table 4. Fig. 8 gives the isochrones of withdrawal of southwest monsoon.

### 3. Chief synoptic features of southwest monsoon 2008

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



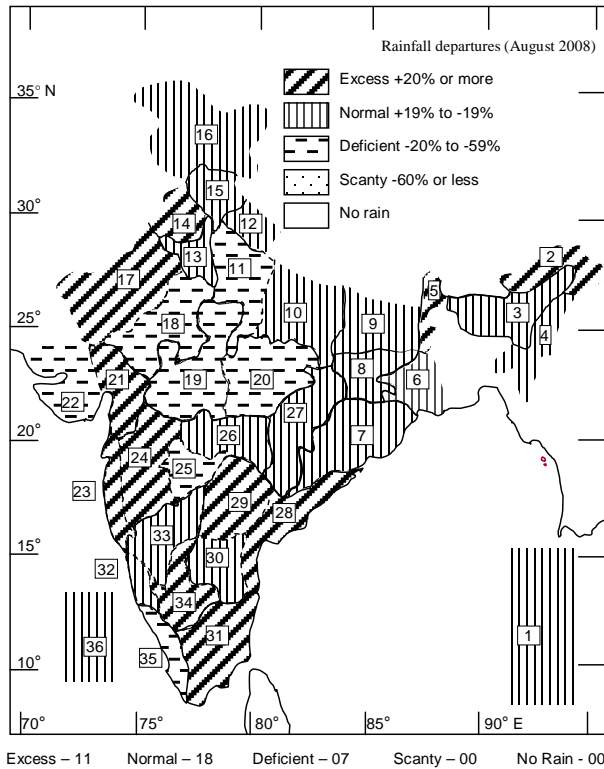
**Fig. 4.** Sub-divisionwise seasonal rainfall departure from normal (%) for the period (July 2008). 36 Sub-divisions are indicated by numbers on the map & bold letters in legend below. The rainfall anomaly values for these sub-divisions are indicated below :

<b>1</b>	22	<b>7</b>	-7	<b>13</b>	-32	<b>19</b>	-33	<b>25</b>	-43	<b>31</b>	9
<b>2</b>	-12	<b>8</b>	16	<b>14</b>	-49	<b>20</b>	-29	<b>26</b>	-23	<b>32</b>	-47
<b>3</b>	-21	<b>9</b>	24	<b>15</b>	-37	<b>21</b>	-26	<b>27</b>	-22	<b>33</b>	-46
<b>4</b>	-26	<b>10</b>	32	<b>16</b>	-9	<b>22</b>	-26	<b>28</b>	5	<b>34</b>	-16
<b>5</b>	6	<b>11</b>	-2	<b>17</b>	-42	<b>23</b>	-26	<b>29</b>	-28	<b>35</b>	-33
<b>6</b>	8	<b>12</b>	-4	<b>18</b>	-24	<b>24</b>	-44	<b>30</b>	-1	<b>36</b>	29

#### 3.1. Cyclonic storms/depressions

Cyclogenesis had been slightly subdued as compared to the last 3 years. No Cyclonic Storm formed during the season.

Altogether 4 Depressions formed, two over the Bay of Bengal, one over the Arabian Sea and one land depression. Out of these 4 depressions, 2 formed in June and one each in August and September. The month of July was devoid of any monsoon depression as in the previous July months during 1995, 1998, 2000, 2001, 2002 & 2004. No system developed from the remnants of the systems from the south China sea. The land depression during August was the first one after 1987. The systems followed climatological track, though being shorter. No system from the Bay of Bengal moved to the west of Long. 80° E as Depression.



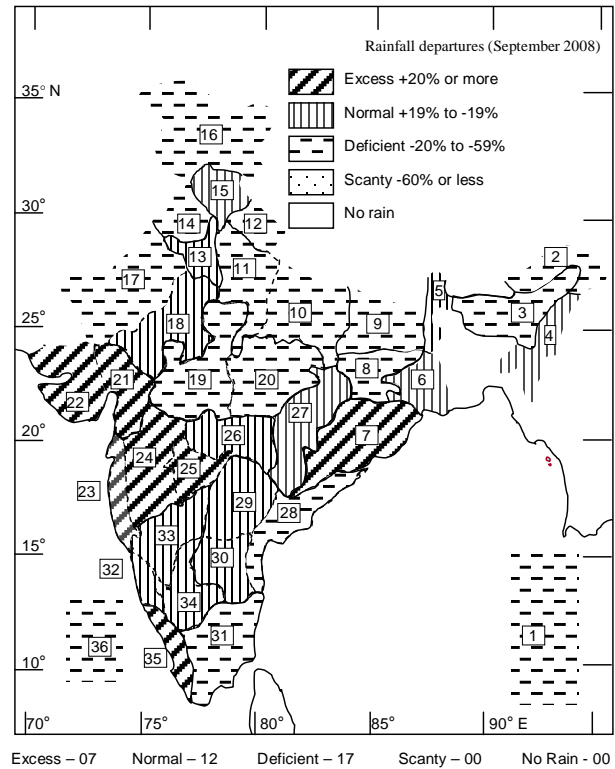
**Fig. 5.** Sub-divisionwise seasonal rainfall departure from normal (%) for the period (August 2008). 36 Sub-divisions are indicated by numbers on the map & bold letters in legend below. The rainfall anomaly values for these sub-divisions are indicated below :

<b>1</b>	9	<b>7</b>	<b>7</b>	<b>13</b>	-2	<b>19</b>	-38	<b>25</b>	-26	<b>31</b>	47
<b>2</b>	51	<b>8</b>	-15	<b>14</b>	46	<b>20</b>	-31	<b>26</b>	-19	<b>32</b>	5
<b>3</b>	15	<b>9</b>	3	<b>15</b>	-12	<b>21</b>	30	<b>27</b>	-18	<b>33</b>	18
<b>4</b>	-3	<b>10</b>	-6	<b>16</b>	-4	<b>22</b>	-21	<b>28</b>	48	<b>34</b>	58
<b>5</b>	37	<b>11</b>	-22	<b>17</b>	51	<b>23</b>	25	<b>29</b>	62	<b>35</b>	-22
<b>6</b>	-18	<b>12</b>	-15	<b>18</b>	-26	<b>24</b>	27	<b>30</b>	15	<b>36</b>	-3

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

3.1.1. *Depression over the east central Arabian Sea (5-7 June 2008)*

A low pressure area formed over the eastcentral Arabian Sea and neighbourhood on 4. It concentrated into a Depression and lay centred at 0000 UTC of 5, near Lat. 15.5° N / Long. 66.0° E. It lay centred near Lat. 16.0° N / Long. 66.0° E, about 800 km southwest of Mumbai at 0300 UTC and near Lat. 18.0° N / Long 64.5° E at 1200 UTC of 5. Moving westwards, it lay over the west central and adjoining northwest Arabian Sea, centred near Lat 19.5° N / Long. 62.0° E at 0300 UTC and near Lat. 20.0° N / Long. 61.5° E at 1200 UTC of 6. Further moving



**Fig. 6.** Sub-divisionwise seasonal rainfall departure from normal (%) for the period (September 2008). 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 :

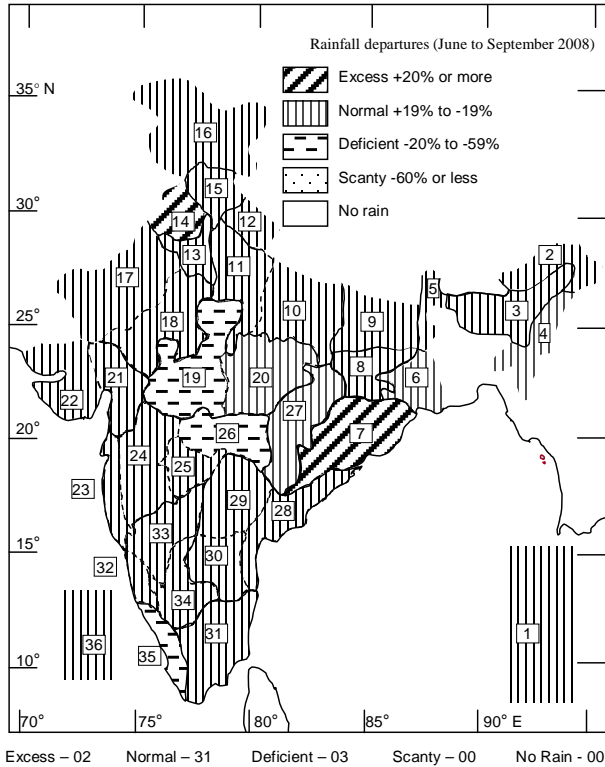
<b>1</b>	-24	<b>7</b>	47	<b>13</b>	18	<b>19</b>	-22	<b>25</b>	52	<b>31</b>	-39
<b>2</b>	-43	<b>8</b>	-30	<b>14</b>	-44	<b>20</b>	-40	<b>26</b>	-16	<b>32</b>	12
<b>3</b>	-20	<b>9</b>	-39	<b>15</b>	10	<b>21</b>	33	<b>27</b>	-12	<b>33</b>	5
<b>4</b>	-2	<b>10</b>	-35	<b>16</b>	-53	<b>22</b>	217	<b>28</b>	-26	<b>34</b>	-2
<b>5</b>	-31	<b>11</b>	-47	<b>17</b>	-31	<b>23</b>	54	<b>29</b>	-15	<b>35</b>	32
<b>6</b>	0	<b>12</b>	-24	<b>18</b>	13	<b>24</b>	99	<b>30</b>	11	<b>36</b>	-34

northwestwards, it weakened and lay as a well marked low pressure area over the northwest and adjoining west central Arabian sea and adjoining Oman coast in the early morning of 7 and as a low pressure area over the same region in the morning hours. Subsequently it moved away westwards.

3.1.2. *Depression over the North Bay of Bengal (16-18 June 2008)*

A cyclonic circulation extending upto mid tropospheric levels lay over the northwest Bay and adjoining West Bengal-north Orissa coasts on 14. Under its influence, a low pressure area formed over the northwest Bay off West Bengal – north Orissa coasts on 15. It concentrated into a Depression over the North Bay





**Fig. 7.** Sub-divisionwise seasonal rainfall departure from normal (%) for the period (June - September 2008). 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 :

<b>1</b>	0	<b>7</b>	22	<b>13</b>	14	<b>19</b>	-21	<b>25</b>	-17	<b>31</b>	3
<b>2</b>	-1	<b>8</b>	0	<b>14</b>	20	<b>20</b>	-14	<b>26</b>	-20	<b>32</b>	-16
<b>3</b>	-15	<b>9</b>	10	<b>15</b>	-5	<b>21</b>	-2	<b>27</b>	-12	<b>33</b>	-12
<b>4</b>	-15	<b>10</b>	17	<b>16</b>	2	<b>22</b>	15	<b>28</b>	4	<b>34</b>	9
<b>5</b>	7	<b>11</b>	3	<b>17</b>	5	<b>23</b>	6	<b>29</b>	4	<b>35</b>	-22
<b>6</b>	14	<b>12</b>	-6	<b>18</b>	-3	<b>24</b>	8	<b>30</b>	2	<b>36</b>	-5

off Bangladesh coast and lay centred at 0300 UTC of 16, near Lat. 21.5° N / Long. 90.0° E, about 220 km southeast of Kolkata. Moving northwards, it crossed Bangladesh coast along Long. 89.5° E, between 1100 & 1200 UTC of 16 and lay centred over coastal Bangladesh, near Lat. 22.0° N / Long. 89.5° E at 1200 UTC. It lay over Gangetic West Bengal and adjoining Bangladesh, centred close to Krishnanagar (Lat. 23.0° N / Long. 88.5° E), about 80 km north-northeast of Kolkata, at 0300 UTC of 17 and over Gangetic West Bengal, close to Burdwan (Lat. 23.0° N / Long. 88.0° E), about 100 km northwest of Kolkata at 1200 UTC. Further moving northwestwards, it lay centred at 0300 UTC of 18, over Jharkhand (near Lat. 24.0° N / Long. 87.0° E), about 50 km southwest of Dumka. It subsequently weakened and lay as a well marked low pressure area over Jharkhand and

**TABLE 3**

**Percentage of districts with excess/normal and deficient/scanty rainfall**

Year	Excess/Normal	Deficient/Scanty
2003	77	23
2004	56	44
2005	72	28
2006	59	41
2007	72	28
2008	76	24

neighbourhood, in the evening. It further weakened into a low pressure area and lay over east Uttar Pradesh and adjoining east Madhya Pradesh on 19 & 20 and became less marked on 21.

### 3.1.3. Land Depression over Orissa (9 – 10 August 2008)

Under the influence of a cyclonic circulation extending upto mid tropospheric levels over the northwest Bay and adjoining coastal areas of Orissa and Gangetic West Bengal, a low pressure area formed over the northwest Bay and adjoining coastal areas of Orissa and adjoining Gangetic West Bengal on 8. It became well marked over the same region on 9 morning and concentrated into a Depression over south Orissa-north Andhra coasts, close to Puri (Lat. 20.0° N / Long. 86.0° E) at 1200 UTC of 9. Moving in a northwesterly direction, it lay over interior Orissa, close to Keonjhar (Lat. 21.5° N / Long. 85.5° E) at 0300 UTC of 10 and weakened into a well marked low pressure area in the evening. It lay as a low pressure area over north Chattisgarh and neighbourhood on 11 morning and became less marked in the evening. The associated cyclonic circulation extending upto mid tropospheric levels tilting southwestwards with height lay over Madhya Pradesh on 11 evening. It lay over southeast Rajasthan and adjoining Gujarat region on 12 & 13; over west Rajasthan and neighbourhood on 14 & 15; over Punjab and neighbourhood during 16 – 21 and became less marked on 22.

### 3.1.4. Deep Depression over the north Bay and neighbourhood (15-19 September 2008)

Under the influence of a cyclonic circulation over the north Bay and neighbourhood, a low pressure area formed over there on 15. It concentrated into a Depression and lay centred at 1200 UTC of 15, near Lat. 19.5° N / Long. 88.5° E, about 230 km east-southeast of Paradip. Moving

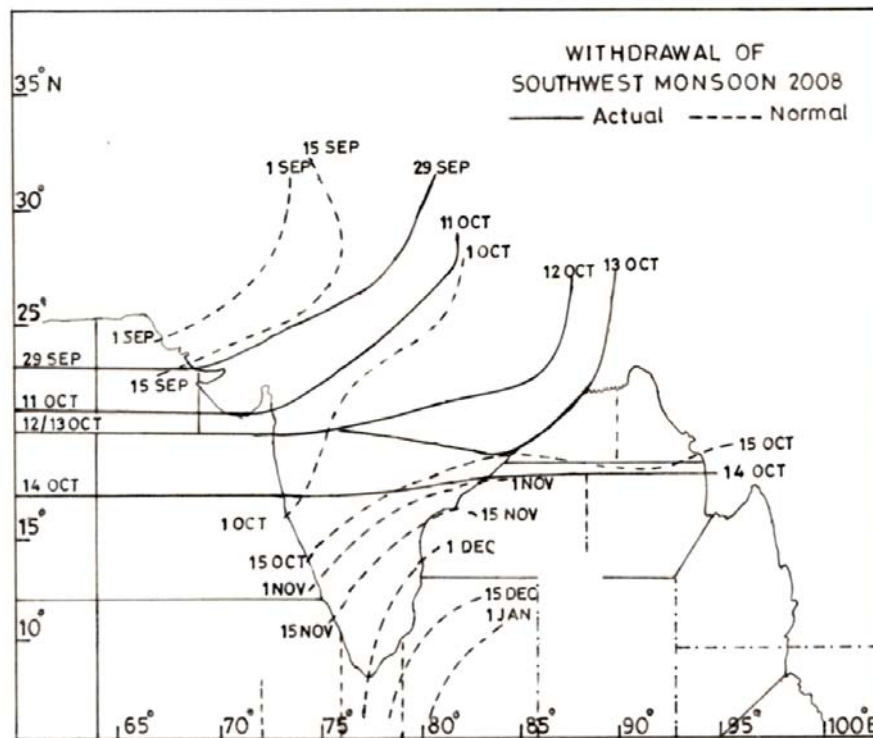


Fig. 8. Isochrones of withdrawal of southwest monsoon 2008

TABLE 4

Withdrawal of southwest monsoon 2008

S. No.	Date	Southwest monsoon withdrew from	Withdrawal line passed through	Remarks
1.	29 Sep	Entire Jammu & Kashmir, Himachal Pradesh, Punjab, Haryana, Chandigarh & Delhi, west Rajasthan, most parts of Uttarakhand, west Uttar Pradesh and east Rajasthan, some parts of north Gujarat State and north Arabian Sea	Mukteswar, Bareilly, Dholpur, Sawai Madhopur, Deesa, Naliya, Lat. 23° N / Long 65°, Lat 23° N / Long 60° E	Nearly a month's delay from the extreme west Rajasthan and an average delay of 10 days from the remaining regions
2.	11 Oct	Remaining parts of Uttarakhand, west Uttar Pradesh and east Rajasthan, some parts of east Uttar Pradesh and west Madhya Pradesh and most parts of Gujarat State and north Arabian Sea	Lat. 28° N / Long. 82° E, Lucknow, Nowgong, Indore, Surat, Veraval, Lat. 21° N / Long. 65° E, Lat 21°N / Long. 60° E	More than two week's delay
3.	12 Oct	Entire Bihar, east Madhya Pradesh, remaining parts of east Uttar Pradesh, west Madhya Pradesh, Gujarat State and north Arabian Sea, most parts of Jharkhand and some parts of north Orissa, Chattisgarh and north Maharashtra State	Lat. 28° N / Long. 87° E, Purnea, Jamsheedpur, Raipur, Aurangabad, Lat. 20° N / Long. 65° E and Lat. 20° N / Long. 60° E	More than a week's delay
4.	13 Oct	Entire West Bengal & Sikkim, remaining parts of Jharkhand, most parts of Orissa, Chattisgarh and Vidarbha and some parts of northwest Bay	Lat. 28° N / Long. 90° E, Diamond Harbour, Gopalpur, Jagdalpur, Aurangabad, Lat. 20° N / Long. 65° E and Lat. 20°N / Long. 60° E	Nearly a week's delay
5.	14 Oct	Entire northeast India, north Bay, remaining parts of Orissa, Chattisgarh, some parts of north coastal Andhra Pradesh, Telangana and north interior Karnataka, most parts of Maharashtra State and some parts of central Arabian Sea	Lat. 18° N / Long. 94° E, Lat. 18° N / Long. 88° E, Visakhapatnam, Hyderabad, Ratnagiri, Lat. 17° N / Long 65° E and Lat. 17° N / Long. 60° E	4-5 days delay
6.	15 Oct	Remaining parts of south peninsular India, Arabian Sea and Bay of Bengal and thus from the entire country	-	Normal date

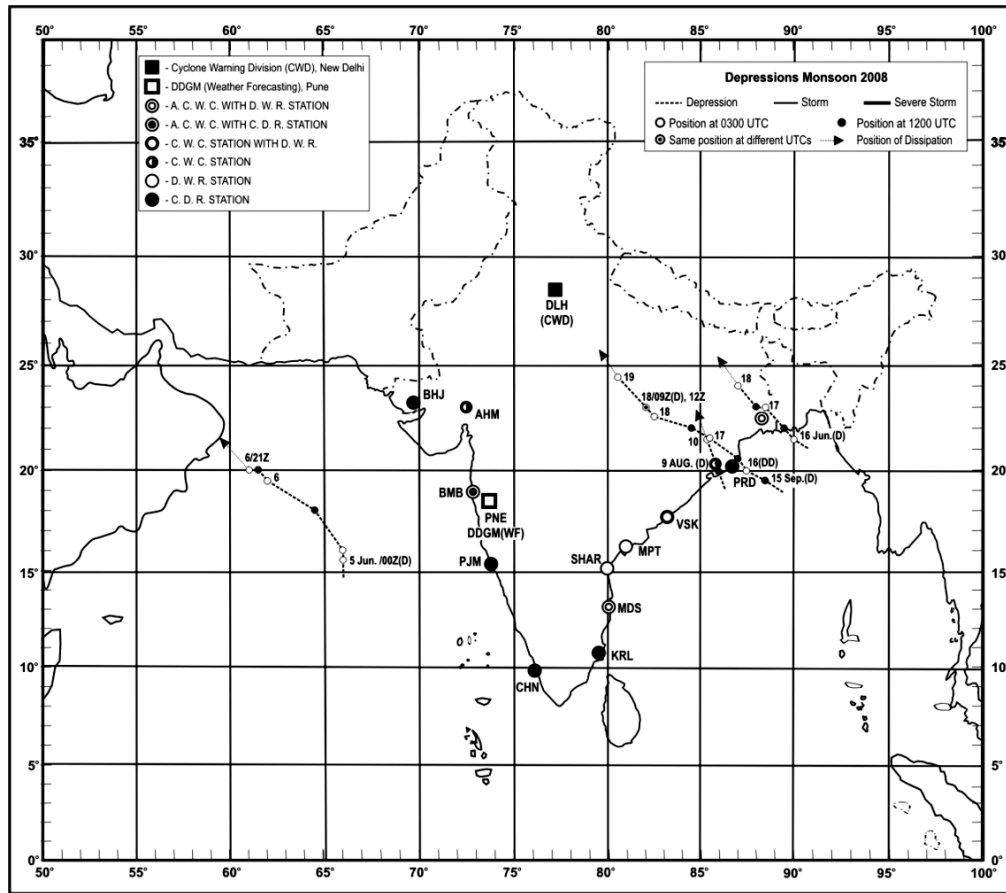


Fig. 9. Tracks of storm and depressions during southwest monsoon 2008

northwestwards, it intensified into a Deep Depression and lay centred at 0300 UTC of 16, near Lat.  $20.0^{\circ}$  N / Long  $87.5^{\circ}$  E, about 130 km southeast of Chandbali. It lay centred near Lat.  $20.5^{\circ}$  N / Long.  $87.0^{\circ}$  E, about 50 km southeast of Chandbali at 1200 UTC of 16. Further moving westnorthwestwards, it crossed Orissa coast near Chandbali between 1600 & 1700 UTC of 16. It lay centred at 0300 UTC of 17, over Orissa, near Keonjhar (Lat.  $21.5^{\circ}$  N / Long.  $85.5^{\circ}$  E) and at 1200 UTC, near Jharsuguda (Lat.  $22.0^{\circ}$  N / Long.  $84.5^{\circ}$  E). Continuing the westnorthwestward movement, it lay centred at 0300 UTC of 18, over north Chattisgarh (Lat.  $22.5^{\circ}$  N / Long.  $82.5^{\circ}$  E), about 50 km north of Champa. It subsequently weakened into a Depression and lay centred at 0900 UTC of 18, close toendra (Lat.  $23.0^{\circ}$  N / Long.  $82.0^{\circ}$  E) and remained practically stationary over there at 1200 UTC. Thereafter it moved westnorthwestwards and lay centred at 0300 UTC of 19, over northeast Madhya Pradesh, close to Satna (Lat.  $24.5^{\circ}$  N / Long.  $80.5^{\circ}$  E) and weakened into a well marked low pressure area over

Central parts of Uttar Pradesh in the evening. It further weakened into a low pressure area over northwest Uttar Pradesh and neighbourhood on 20 morning and became less marked on 21. However, the associated upper air cyclonic circulation extending upto mid-tropospheric levels persisted there on 21 and 22, which lay over west Uttar Pradesh and neighbourhood on 23, over east Uttar Pradesh and neighbourhood on 24 and 25 and became less marked on 26.

### 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. Five of them formed over the Bay of Bengal and 2 over the land. Monthwise breakups of the systems are 2 in June, 2 in July, 1 in August and 2 in September. The total number of low pressure areas during the past 5 years viz., 2003 to 2007 are 12, 8, 6, 7 & 6 respectively.

TABLE 5

## Details of low pressure systems for the month of June 2008

S. No. (1)	System (2)	Duration (3)	Place of first location (4)	Direction of movement (5)	Final location (6)	Remarks (7)
<b>(A) Depressions</b>						
1.	Depression	5-6	Eastcentral Arabian Sea	Northwest	Northwest and adjoining westcentral Arabian Sea	Weakened over the ocean and moved away westwards
2.	Depression	16-18	North Bay off Bangladesh coast	Northwest	Jharkhand	Remnant low pressure area moved upto east Uttar Pradesh and adjoining east Madhya Pradesh and became less marked on 21
<b>(B) Low Pressure Area/ Well marked low pressure area</b>						
1.	Well marked low pressure area	9-11	Saurashtra & Kutch and neighbourhood	Westnorthwest	Northwest and adjoining northeast Arabian Sea	Moved away westwards
2.	Low pressure area	22-23	Jharkhand and adjoining Bihar	Quasi Stationary	Jharkhand and adjoining Bihar and Gangetic West Bengal	The associated upper air cyclonic circulation became less marked on 26
<b>(C) Upper air cyclonic circulations</b>						
1.	Between 2.1 & 4.5 km a.s.l.	2-3	Lakshadweep area and neighbourhood	Quasi Stationary	-	Merged with the low pressure area over the eastcentral Arabian Sea on 4
2.	Upto the mid tropospheric levels	8-11	Northwest and adjoining westcentral Bay off south Orissa-north Andhra coasts	Northwest	Orissa and adjoining Gangetic West Bengal	Became less marked on 12
3.	Do	11-12	Chattisgarh and neighbourhood	Stationary	<i>In situ</i>	Became less marked on 13
4.	Between 2.1 & 4.5 km a.s.l.	11-16	Saurashtra & Kutch and neighbourhood	Northeast	East Rajasthan and adjoining Haryana	Became less marked on 17
5.	Upto mid tropospheric levels	12-18	Central parts of Uttar Pradesh	Oscillatory	East Uttar Pradesh and neighbourhood	Became less marked on 19
6.	Do	19-20	Gangetic West Bengal and neighbourhood	Quasi-Stationary	Gangetic West Bengal and adjoining Bangladesh	Became less marked on 21
7.	Upto lower tropospheric levels	24 Jun – 11 Jul	West Uttar Pradesh and neighbourhood	Oscillatory	West Rajasthan and neighbourhood	Became less marked on 12 July
8.	Upto mid tropospheric levels	26 Jun – 1 Jul	Gangetic West Bengal and adjoining north Orissa	Northwest	Jharkhand and neighbourhood	Became less marked on 2 July
9.	Between 1.5 & 4.5 km a.s.l.	29 Jun – 2 Jul	Eastcentral Arabian Sea off south Gujarat – north Maharashtra coasts	Quasi-Stationary	Gujarat region and neighbourhood	Became less marked on 3 July

TABLE 5(Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
<b>(D) Eastward moving upper air cyclonic circulations</b>						
1.	Upto mid tropospheric levels	4-8	North Pakistan and adjoining Jammu & Kashmir	Northeast	Jharkhand and neighbourhood	Moved away on 9
2.	Upto lower tropospheric levels	2-4	West Rajasthan and neighbourhood	Stationary	<i>In situ</i>	Became less marked on 5
3.	Upto 3.6 km a.s.l.	8-12	North Pakistan and adjoining Jammu & Kashmir	Northeast	Jammu & Kashmir and neighbourhood.	Moved away on 13
4.	Upto 2.1 km a.s.l.	17-18	Central Pakistan and adjoining west Rajasthan	Do	Punjab and neighbourhood	Became less marked on 19
5.	Upto mid tropospheric levels	13-15	North Pakistan and adjoining Jammu & Kashmir	Do	Jammu & Kashmir	Moved away on 16
6.	Upto mid tropospheric levels	14-18	Do	Eastnortheast	Eastern parts of Jammu & Kashmir	Moved away on 19
7.	Do	18-21	Do	Northeast	Jammu & Kashmir and neighbourhood	Moved away on 22
8.	Upto mid tropospheric levels	21-25	North Pakistan and neighbourhood	Northeast	Jammu & Kashmir and neighbourhood	Moved away on 26
9.	Do	19-20	Punjab and neighbourhood	Stationary	<i>In situ</i>	Became less marked on 21
10.	Do	27-28	North Pakistan and neighbourhood	Northeast	Jammu & Kashmir and neighbourhood	Moved away on 29
11.	Do	29 Jun - 2 Jul	Do	Do	Do	Moved away on 2 July
<b>(E) Troughs</b>						
1.	Lower level westerlies	21-23	Central Pakistan and adjoining west Rajasthan	Stationary	<i>In situ</i>	Became less marked on 24

### 3.3. Upper Air Cyclonic Circulations (CYCIR)

There were 27 upper air cyclonic circulations (in lower and middle tropospheric levels) formed during the season.

The monthwise breaks up of these are 9 in June, 5 in July, 6 in August and 7 in September.

### 3.4. Off-shore trough

The details of the positions of the off-shore trough are given in Table 9(a) and that for the years 2003 to 2008 are given in Table 9(b).

Off-shore trough at sea level along different parts of the west coast persisted on most of the days from 30 May

TABLE 6

## Details of low pressure systems for the month of July 2008

S. No.	System	Duration	Place of first location	Direction of movement	Final location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
<b>(A) Low pressure areas</b>						
1.	Well marked low pressure areas	7-12	North Bay and adjoining West Bengal-Bangladesh coasts	Westnorthwest	Northwest Madhya Pradesh and neighbourhood	Became less marked on 13
2.	Do	27-29	Northwest Bay and adjoining south Orissa coast	Do	Vidarbha and adjoining Chattisgarh and east Madhya Pradesh	The associated upper air cyclonic circulation persisted over north Madhya Pradesh and neighbourhood upto 31 July and became less marked on 1 August
<b>(B) Upper air cyclonic circulations</b>						
1.	Upto midtropospheric levels	18-27	North Bay off West Bengal – Bangladesh coasts	Northwest	East Uttar Pradesh and neighbourhood	Became less marked on 28
2.	Between 2.1 & 4.5 km a.s.l.	20-22	Gujarat region and adjoining north Maharashtra	Quasi-Stationary	Gujarat region and neighbourhood	Became less marked on 23
3.	Between 1.5 & 3.1 km a.s.l.	22-23	South Tamil Nadu and neighbourhood	Northwest	Eastcentral and adjoining southeast Arabian Sea off Karnataka – Kerala coasts	Became less on 24
4.	Between 2.1 & 5.8 km a.s.l.	27July - 5 Aug	Gujarat region and neighbourhood	Stationary	<i>In situ</i>	Became less on 6 August
5.	Upto midtropospheric levels	30 Jul - 1 Aug	Orissa and neighbourhood	Westnorthwest	-	Merged with the cyclonic circulation over east Madhya Pradesh and neighbourhood on 2 August
<b>(C) Eastward moving upper air cyclonic circulations</b>						
1.	Upto lower tropospheric levels	1-7	Northwest Rajasthan and neighbourhood	Northeast	Punjab and neighbourhood	Became less marked on 8
2.	Upto mid tropospheric levels	4-8	North Pakistan and adjoining Jammu & Kashmir	Northeast	Jammu & Kashmir and neighbourhood	Moved away on 9
3.	Do	9-14	North Pakistan and neighbourhood	Do	Do	Moved away on 15
4.	Do	14-15	Northwest Rajasthan and adjoining Punjab	Stationary	<i>In situ</i>	Became less marked on 16
5.	Do	16-17	North Pakistan and neighbourhood	Northeast	Jammu & Kashmir and neighbourhood	Moved away on 18
6.	Upto lower tropospheric levels	18-22	Punjab and neighbourhood	Stationary	<i>In situ</i>	Became less marked on 23
7.	Upto mid tropospheric levels	18-21	North Pakistan and neighbourhood	Northeast	Eastern parts of Jammu & Kashmir	Moved away on 22
8.	Do	19-23	Do	Do	Jammu & Kashmir and neighbourhood	Moved away on 24
9.	Upto lower tropospheric levels	26-28	Northwest Rajasthan and adjoining Punjab	Stationary	<i>In situ</i>	Became less marked on 29
10.	Upto mid tropospheric levels	25-27	North Pakistan and adjoining Jammu & Kashmir	Do	Eastern parts of Jammu & Kashmir	Moved away on 31
11.	Do	29-30	Jammu & Kashmir and neighbourhood	Do	Eastern parts of Jammu & Kashmir	Moved away on 31
<b>(D) Troughs</b>						
1.	Lower level westerlies	13-17	Sub-Himalayan West Bengal and Sikkim to North Bay	Stationary	<i>In situ</i>	Became less marked on 18

TABLE 7

## Details of low pressure systems for the month of August 2008

S. No. (1)	Systems (2)	Duration (3)	Place of first location (4)	Direction of movement (5)	Final Location (6)	Remarks (7)
<b>(A) Depressions</b>						
1.	Depression	9-10	Northwest and adjoining westcentral Bay off south Orissa-north Andhra coasts	Northnorthwest	Interior Orissa	It rapidly weakened over land. However, the remnant cyclonic circulation moved upto Punjab and neighbourhood and caused heavy rainfall over there
<b>(B) Low pressure areas</b>						
1.	Low pressure area	2-5	Northwest and adjoining westcentral Bay off Orissa-Andhra coasts	Westnorthwest	South Chattisgarh and neighbourhood	The associated upper air cyclonic circulation lay over north Chattisgarh and adjoining Jharkhand on 6 and merged with the above system, in its formative stage on 7
<b>(C) Upper air cyclonic circulations</b>						
1.	Upto lower tropospheric levels	2-3	East Madhya Pradesh and neighbourhood	Stationary	<i>In situ</i>	Became less marked on 4
2.	Between 1.5 & 5.8 km a.s.l.	13	Gangetic West Bengal and neighbourhood	Do	Do	It lay as a trough extending from Sub-Himalayan West Bengal & Sikkim to north Bay on 14 and became less marked on 15
3.	Upto lower tropospheric levels	15-28	West Uttar Pradesh and neighbourhood	Oscillatory	<i>In situ</i>	Became less marked on 29
4.	Upto mid tropospheric levels	20-27	Northwest Bay and adjoining coastal areas of West Bengal and Orissa	Westnorthwest	West Madhya Pradesh and east Rajasthan	Became less marked on 28
5.	Do	27-29	South Tamil Nadu and neighbourhood	Stationary	<i>In situ</i>	Became less marked on 30
6.	Upto mid tropospheric levels	31 Aug - 5 Sep	South Tamil Nadu and adjoining Kerala	Northwest	Eastcentral and southeast Arabian Sea and adjoining coastal areas of Karnataka and Kerala	Became less marked on 6
<b>(D) Eastward moving upper air cyclonic circulations</b>						
1.	Upto lower tropospheric levels	3-6	Southwest Rajasthan and neighbourhood	Northeast	Punjab and neighbourhood	Became less marked on 7
2.	Do	6	South Rajasthan and neighbourhood	Stationary	<i>In situ</i>	Became less marked on 7
3.	Upto mid tropospheric levels	3-7	North Pakistan and neighbourhood	Northeast	Jammu & Kashmir and neighbourhood	Moved away on 8
4.	Do	9-14	Do	Do	Do	Moved away on 15
5.	Do	16-18	North Pakistan and adjoining Jammu & Kashmir	Do	Do	Moved away on 19
6.	Do	19-25	North Pakistan and neighbourhood	Do	Eastern parts of Jammu & Kashmir	Moved away on 26
7.	Do	21-23	East Uttar Pradesh and adjoining east Madhya Pradesh	Do	East Uttar Pradesh and adjoining northeast Madhya Pradesh	Became less marked on 24
8.	Do	23-24	Punjab and neighbourhood	Stationary	<i>In situ</i>	Became less marked on 25
9.	Upto lower tropospheric levels	27 Aug - 12 Sep	Do	Do	Do	Became less marked on 13 September
10.	Upto mid tropospheric levels	25 - 27 Morning	North Pakistan and neighbourhood	Northeast	Jammu & Kashmir and neighbourhood	Moved away on 27 evening
11.	Upto midtropospheric levels	27 Aug - 1 Sep	North Pakistan and neighbourhood	Northeast	Do	Moved away on 2 September
<b>(E) Troughs</b>						
1.	Mid and upper tropospheric westerlies	18-19	Lat. 40° N / Long. 80° E to Lat. 24° N / Long. 68° E at 7.6 km a.s.l.	Stationary	<i>In situ</i>	Became less marked on 20

**TABLE 8**  
**Details of low pressure systems for the month of September 2008**

S. No. (1)	System (2)	Duration (3)	Place of first location (4)	Direction of movement (5)	Final location (6)	Remarks (7)
<b>(A) Depressions</b>						
1.	Deep Depression	15-19	North Bay and neighbourhood	Westnorthwest and then northnorthwest	Northeast Madhya Pradesh close to Satna	Remnant low pressure area moved upto northwest Uttar Pradesh and neighbourhood and became less marked on 21. The associated upper air cyclonic circulation persisted over east Uttar Pradesh and neighbourhood upto 25
<b>(B) Low pressure areas</b>						
1.	Well marked low pressure area	9-13	Westcentral Bay off north Andhra coast	West	Marathwada and neighbourhood	The associated upper air cyclonic circulation lay over west Madhya Pradesh and neighbourhood on 14 and became less marked on 15
2.	Low pressure area	22 eve – 28	North Bay and neighbourhood	North and then west	Gangetic West Bengal and neighbourhood	It persisted over the north Bay and neighbourhood as a feeble low pressure area during 22-26.  The associated upper air cyclonic circulation moved upto east Uttar Pradesh and adjoining east Madhya Pradesh and persisted there upto 3 October
<b>(C) Upper air cyclonic circulations</b>						
1.	Upto lower tropospheric levels	1-4	North Tamil Nadu and neighbourhood	Stationary	<i>In situ</i>	Became less marked on 5
2.	Do	8-9	Marathwada and neighbourhood	Northwest	Madhya Maharashtra and neighbourhood	Became less marked on 10
3.	Do	12-18	Eastcentral Arabian Sea off south Gujarat – Maharashtra coasts	Quasi-stationary	Gujarat region and neighbourhood	Became less marked on 19
4.	Between 1.5 & 3.6 km a.s.l.	24	Gujarat region and neighbourhood	Stationary	<i>In situ</i>	Became less marked on 25
5.	Upto mid tropospheric levels	30 Sep - 4 Oct	Northwest Bay off Orissa-West Bengal coasts	Drifted southwards along the east coast	Southwest Bay off Tamil Nadu coast	Became less marked on 5 October
6.	Between 3.1 & 5.8 km a.s.l.	25 Sep - 5 Oct	Eastcentral Arabian Sea off Maharashtra-Goa coasts	Quasi-stationary	Southeast Arabian Sea off Karnataka-Kerala coasts	Became less marked on 6 October
7.	Upto lower tropospheric levels	30 Sep – 6 Oct	West UttarPradesh and neighbourhood	Do	West Uttar Pradesh and adjoining Uttarakhand	Became less marked on 7 October
<b>(D) Eastward moving upper air cyclonic circulations</b>						
1.	Upto mid tropospheric levels	2-5	North Pakistan and neighbourhood	Northeast	Jammu & Kashmir and neighbourhood	Moved away on 6
2.	Do	9-11	West Rajasthan and neighbourhood	Stationary	<i>In situ</i>	Became less marked on 12
3.	Do	4-7	North Pakistan and neighbourhood	Northeast	Jammu & Kashmir and neighbourhood	Moved away on 8
4.	Do	8-11	Do	Do	Do	Moved away on 12
5.	Do	11-13	Do	Do	Do	Moved away on 14
6.	Do	12-15	Do	Do	Do	Moved away on 16
7.	Do	14-22	Do	Eastnortheast	Do	Moved away on 23
8.	Do	22-24	Do	Northeast	Do	Moved away on 25
9.	Do	24-26	Do	Do	Do	Moved away on 27
10.	Do	28-30	Do	Do	Do	Moved away on 1 October
<b>(E) Troughs</b>						
1.	Lower level westerlies	3-6	Sub-Himalayan West Bengal & Sikkim to north Bay	Stationary	<i>In situ</i>	Became less marked on 7
2.	Mid & upper tropospheric westerlies	20-28	Along Long. 72° E to the north of Lat. 25° N at 7.6 km a.s.l.	Eastnortheast	Along Long. 87° E to the north of Lat. 20° N	Moved away on 29



**TABLE 9(a)****Positions of off-shore trough during period of southwest monsoon - 2008**

Date	Location
30 May – 3 June	Off Karnataka – Kerala coasts
6 – 7 June	Maharashtra to Kerala coasts
8 – 15 June	South Gujarat to Kerala coasts
16 -28 June	Maharashtra to Kerala coasts
29 June – 2 July	South Gujarat to Kerala coasts
3 – 5 July	South Gujarat to Karnataka coasts
6 – 9 July	Maharashtra to Karnataka coasts
10 – 12 July	Maharashtra to Kerala coasts
13 July	Maharashtra to Karnataka coasts
14 July	Off Maharashtra coast
15 July	Karnataka to Kerala coasts
16 – 18 July	Maharashtra to Kerala coasts
19 – 22 July	Karnataka to Kerala coasts
23 July – 6 August	Maharashtra to Kerala coasts
7 – 8 August	Maharashtra to Karnataka coasts
9 – 17 August	Maharashtra to Kerala coasts
6 – 10 September	Maharashtra to Kerala coasts
11 – 17 September	South Gujarat to Kerala coasts

**TABLE 9(b)****Details of off-shore trough for the years 2003-2008**

Year	Details of off – shore trough
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
2004	Off-shore trough along different parts of west coast (surface and lower levels) upto 16 September from 19 May except 27 May – 3 June, 8-11 June, 23-24 June and 29 August – 7 September
2005	Off-shore trough observed between 5 June to 24 September except during 7 & 10 August, 22 August –5 September, 8–9 September & 20–22 September
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
2007	Present along various parts of the west coast from 28 May to 30 September except during 4 – 7 June, 10 – 11 June and 10 – 13 September. It was feeble during many days in June and a few days during the rest of the months
2008	Observed from 30 May to 17 September, except during 4 – 5 June & 18 August - 5 September. Even though present throughout the month of July, it was quite feeble during the period 13 – 24 July



Fig. 10. Time series of the DMI

TABLE 10

## Mid and upper tropospheric westerly troughs

Atmospheric level	Jun	Jul	Aug	Sep	Total
300 hPa	00	00	02	09	11
500 hPa	00	00	02	03	05

TABLE 11

## Systems in west Pacific Ocean/South China Sea

Low Pressure Systems	Jun	Jul	Aug	Sep	Total
Tropical Depression (T.D.)	00	00	01	01	02
Tropical Storm (T.S.)	00	00	03	01	04
Typhoon	02	02	01	03	08
Total	02	02	05	05	14

to 17 September except during 4 – 5 June and 18 August – 5 September. Eventhough present throughout the month of July, it was quite feeble during the period 13-24 July.

### 3.5. Eastward moving cyclonic circulations/western disturbances

There were 43 eastward moving systems as upper air cyclonic circulations. The monthwise break-up is 11 in June, 11 in July, 11 in August and 10 in September.

## 4. Extra Indian features

### 4.1. Cross equatorial flow

#### 4.1.1. Over the Arabian sea

The Cross Equatorial flow along the equatorial belt (equator to 5° N / 5° S) was stronger than normal by more

than 5 kts, during the last week of June and first week of August. Except these, the cross equatorial flow along the equatorial belt was close to the normal during the entire monsoon period, June – September 2008.

The surface winds over Arabian Sea to the north of 5° N were stronger than normal by about 10-15 kts during the second week of June, about 5-10 kts in the third week of June and by about 5 kts in the 4<sup>th</sup> week of June. The surface winds were also stronger than normal by about 5-10 kts in the fourth week of July, second week of August, first, second and fourth week of September and by about 10-15 kts in the third week of September.

They were weaker than normal by about 5-10 kts in the fourth week of August. They were almost normal for the remaining period during the entire season.

TABLE 12

Intensity of Mascarene High during monsoon season for the years 2003-2008

Year	June		July		August		September	
	Pressure (hPa)	Departure (hPa)	Pressure (hPa)	Departure (hPa)	Pressure (hPa)	Departure (hPa)	Pressure (hPa)	Departure (hPa)
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
2007	1021.8	-1.2	1022.0	-3.5	1021.6	-4.4	1021.0	-2.5
2008	1023.0	0	1025.0	0.5	1024.0	-2.0	1021.5	-2.0

TABLE 13

Intensity of Australian High during Southwest monsoon season for the years 2003-2008

Year	June		July		August		September	
	Pressure (hPa)	Departure (hPa)	Pressure (hPa)	Departure (hPa)	Pressure (hPa)	Departure (hPa)	Pressure (hPa)	Departure (hPa)
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
2007	1024.1	2.1	1024.3	2.3	1024.2	3.7	1019.4	1.4
2008	1023.0	1.0	1022.0	0	1022.5	2.0	1018.0	0

#### 4.1.2. Over the Bay of Bengal

The Cross Equatorial flow along the equatorial belt (equator to 5° N / 5° S) over the Bay of Bengal to the north of 5° N was stronger than normal by about 5-10 kts in the third week of June and fourth week of August and by about 10-20 kts in the third week of July. The cross equatorial flow was almost normal for the remaining period during the season. The surface winds over the Bay of Bengal to the north of 5° N were stronger than normal by about 5 kts in the third week of June and second week of August and by about 5-10 kts in the fourth week of June, third & fourth weeks of July, first week of August, second, third and fourth week of September. They were almost normal for the remaining period during the season.

#### 4.2. Mid-Latitude troughs

The number of troughs in westerlies affecting Indian region which penetrated south of 30° N is given in Table 10.

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

There were in all 14 low pressure systems (reaching the intensity of Tropical depression and above) in the northwest Pacific Ocean / South China Sea during June – September 2008. The month wise break-up is given in Table 11.

#### 4.4. Systems in southern hemisphere

##### 4.4.1. Tropical storms/depressions

No low pressure system (Tropical Depression, Tropical Storm or Typhoon) was reported in the Southern Hemisphere during June- September 2008.

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

There were 17 troughs in upper air westerlies which moved across the Indian Ocean from west to east, to the

TABLE 14

## SST anomaly indices (ENSO)

Month	Pacific SSTA (°C)			SOI
	Nino 1+2 0°-10° S 90°-80° W 150° W	Nino 3 5° N - 5° S 150°-90° W	Nino 4 5° N - 5° S 160° E	
Oct 2007	-2.1	-1.5	-0.6	0.6
Nov 2007	-2.2	-1.8	-0.9	0.9
Dec 2007	-2.0	-1.5	-0.9	1.8
Jan 2008	-0.7	-1.5	-1.5	1.9
Feb 2008	0.2	-1.3	-1.6	2.7
Mar 2008	0.8	-0.5	-1.3	1.1
Apr 2008	0.4	-0.2	-1.0	0.6
May 2008	0.1	0.0	-0.8	-0.3
Jun 2008	0.6	0.1	-0.6	0.3
Jul 2008	0.8	0.5	-0.3	0.2
Aug 2008	1.0	0.7	-0.3	0.8
Sep 2008	0.7	0.3	-0.4	1.5

north of Lat. 30° S in the Southern Hemisphere. The monthwise break-up is 4 in June, 5 each in July & September and 3 in August.

#### 4.4.3. Mascarene HIGH

The intensity of Mascarene HIGH centred at 30° S / 60° E was below normal by 0.9 hPa during the monsoon period June to September 2008. It was below normal by 2.0 hPa in the month of August and September 2008 and it was above normal by 0.5 hPa in the month of July 2008. In the month of June it was equal to normal. The intensity of Mascarene HIGH along with that for the past five years are given in Table 12.

(Source : Climate Diagnostic Bulletin, NOAA, June to September 2008. Normal based on the means for the base period of 1979-1995)

#### 4.4.4. Australian HIGH

The intensity of Australian HIGH centred at 30° S / 140° E was above normal by an average of about 0.7 hPa during the entire monsoon period June – September 2008. It was above normal by 1.0 hPa in the month of June 2008 and by 2.0 hPa in the month of August 2008. It was equal to normal in the month of July and September 2008.

Summary of the intensity of Australian High for the past 5 years is given in Table 13.

(Source : Climate Diagnostic Bulletin, NOAA, June to September 2008. Normal based on the means for the base period of 1979-1995).

#### 4.5. ENSO phenomenon

The phase and magnitude of the combined oceanographic and atmospheric phenomena viz., El Nino and Southern Oscillation, known as ENSO can be indicated either by the sea surface temperature anomalies over the Pacific or by Southern Oscillation Index (SOI) expressed as the difference in the atmospheric surface pressure between Tahiti, an island station in the Southeast Pacific ocean and Darwin, Australia. In general, during some years an inverse relationship between ENSO and Indian summer monsoon rainfall has been observed; though there is no one-to-one correspondence between these two.

Table 14 depicts the monthly values of Sea Surface Temperature (SST) anomaly indices for Nino 4, Nino 3 and Nino 1+2 regions and SOI for the period from October 2007 to September 2008. The Nino 1+2 index showed slight cooling from October 2007 till December

**TABLE 15**  
**Details of lowest isobaric values (hPa) of the heat low during past 5 years**

Month	Year				
	2003	2004	2005	2006	2007
June	986.0 (7 <sup>th</sup> , 8 <sup>th</sup> & 27 <sup>th</sup> )	990.0 (17 <sup>th</sup> )	988.0 (26 <sup>th</sup> )	988 (26) & 990 (18 <sup>th</sup> & 19 <sup>th</sup> )	988.3 hPa (on 15) and 990 hPa (on 14)
July	990.0 (4 <sup>th</sup> , 9 <sup>th</sup> & 30 <sup>th</sup> )	992.0 (7 <sup>th</sup> )	988 (1 <sup>st</sup> & 2 <sup>nd</sup> )	988 (1 <sup>st</sup> & 2 <sup>nd</sup> ) & 990 (11 <sup>th</sup> )	990 hPa (on 5) and 992 hPa (on 1)
August	991.0 (9 <sup>th</sup> )	991.0 (2 <sup>nd</sup> )	990.0 (1 <sup>st</sup> & 2 <sup>nd</sup> )	990 (1 <sup>st</sup> & 2 <sup>nd</sup> ) & 992 (16 <sup>th</sup> )	992 hPa (on 8 & 10) and 993 hPa (on 12)
September	993.0 (2 <sup>nd</sup> )	998.0 (9 <sup>th</sup> & 10 <sup>th</sup> )	996.0 (1 <sup>st</sup> )	996 (1 <sup>st</sup> ) & 997 (4 <sup>th</sup> , 5 <sup>th</sup> & 6 <sup>th</sup> )	997 hPa (on 14 & 19) and 1000 hPa (on 17)

2007, then slight warming from January 2008 to September 2008.

The SST over Nino 3 region remained cooler than normal from October 2007 to February 2008 and was warmer than normal till September 2008, SST over Nino 4 region was cooler than normal from October 2007 to August 2008 and was marginally warmer than normal till September 2008.

#### 4.6. Indian Ocean Dipole (IOD) event

Indian Ocean Dipole (IOD) phenomenon is one of the manifestations of the tropical air-sea interaction, which is characterized by the anomalous cooling of the sea surface temperature (SST) in the southeastern equatorial Indian Ocean and anomalous warming of SST over the western equatorial Indian Ocean. The Dipole Mode Index (DMI) is defined as the SST anomaly difference between tropical western Indian Ocean (50-70° E, 10° S – 10° N) and the southeastern Indian Ocean (90 – 110° E, 10° S – Equator). Whenever DMI is positive, the phenomenon is referred as positive IOD and whenever DMI is negative, it is known as negative IOD. Many studies have shown that IOD events have impact on rainfall of the Indian Summer Monsoon.

The time series of SST anomalies over the equatorial east Indian Ocean showed an abrupt development of persistent cold SST anomalies over the east equatorial Indian Ocean indicating the positive phase of IOD. Some recent literature indicated a positive relationship between the positive phase of the dipole event and the Indian monsoon rainfall. It was also shown that the relationship is strongest during the month of September.

Fig. 10 shows the time series of the DMI. It can be seen that the positive phase continued almost throughout the season. But unlike last year, it did not influence the rainfall distribution over the country much.

## 5. Semi-permanent systems

### 5.1. Heat low

The Heat low established in its near normal position by 5 June. However, it was observed to be diffused during major parts of the season *viz.*, from: 18-22 June; 6-28 July; 1-7 August and from 1-13 September. It became unimportant from 25 September.

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

Jun : 988.3 hPa (on 15) and 990 hPa (on 14)

Jul : 990 hPa (on 5) and 992 hPa (on 1)

Aug : 992 hPa (on 8 & 10) and 993 hPa (on 12)

Sep : 997 hPa (on 14 & 19) and 1000 hPa (on 17)

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 appeared slightly to the north of normal position during 3-6 June. It then gradually shifted southwards, in association with the formation of a low pressure area over the north Bay. On 9 June, the eastern part of it remained to the south of normal position.

With the advancement of monsoon over the entire country, monsoon trough got established on 10 July. It remained at its near normal position upto 12 July, started shifting northwards from 13, when another branch of it extended eastwards to northeastern states. It was close to the foothills of Himalayas from 14-18 July. Though shifted southwards thereafter, it remained to the north of its normal position upto 26. The formation of a low

**TABLE 16**  
**Tropical Easterly Jet (TEJ) observations**

Station	Period	Maximum core wind speed (kts)	Level (hPa)	Date/Time
Thiruvananthapuram	11 June – 1 October	85	130	5 Jul / 0000 UTC
Chennai	11 June – 19 September	90	137	5 Jul / 1200 UTC
Minicoy	25 May – 26 September	95	150	20 Sep / 1200 UTC
Port Blair	4 May – 30 September	100	100, 122, 190, 199 & 141	15 Jun / 0000 UTC; 27 Jun / 0000 UTC; 30 Jul / 1200 UTC; 10 Sep / 0000 UTC & 18 Sep / 0000 UTC
Mumbai	13 July – 26 September	75	150 150 102	12 Jul / 0000 UTC; 18 Jul / 1200 UTC & 10 Aug / 0000 UTC

pressure area over the northwest and adjoining westcentral Bay caused the trough to shift southwards and it remained south of its normal position during 27 July – 5 August. Subsequently, it remained in near normal position during 7-15 August. The western end of it shifted northwards during 16-20 August. After regaining the normal position, it remained there during 21-27 August. Thereafter the western end remained close to the foothills on 28 & 29 August. The entire trough lay close to the foothills during 30 August – 3 September. It shifted southwards on 6 September and thereafter remained south of its normal position, in association with the low pressure area over the westcentral Bay and neighbourhood, upto 19 September. It then started shifting northwards and the western end lay close to the foothills during 24-28 September. Subsequent to the withdrawal of monsoon from northwest India, the trough became less delineatable on the sea level chart from 29 September.

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

Year	Axis of monsoon trough
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.
2006	Established on 24 July. Less marked on 14 September.
2007	Established on 4 July. Less marked on 23 September.

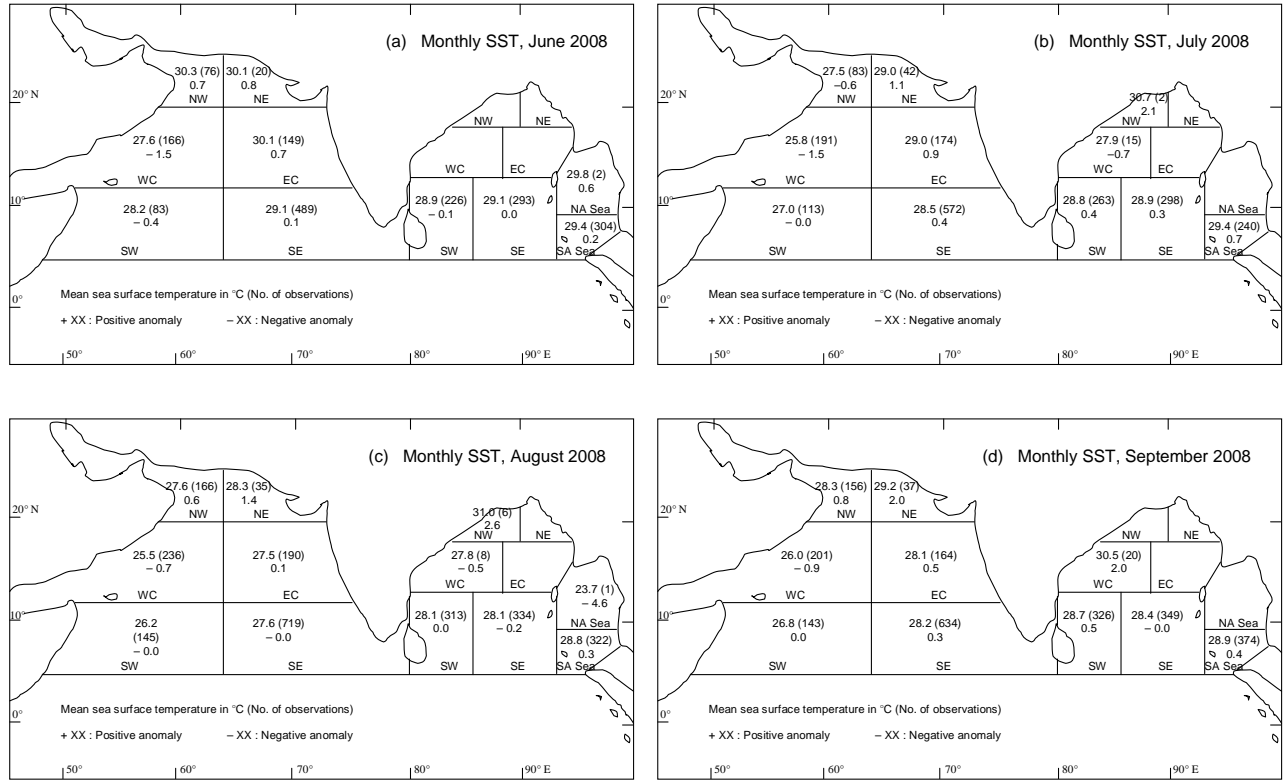
### 5.3. Tibetan Anticyclone/High

The Tibetan Anticyclone (TA) was established in its near normal position at 300 & 200 hPa on 26 June. It was noticed upto 15 September. On many days during the later half of July, it remained to the east of normal position and to the northeast on many days during August and to the north during September. The details of Tibetan Anticyclone for the past five years are given below.

Year	Tibetan Anticyclone
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.
2006	Established on 7 June. Not seen at 500 and 300 hPa on most of the days during June and July. Less marked from 10 September onwards.
2007	Established on 26 June. Less marked from 15 September onwards.

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

Sub-Tropical Westerly Jet was seen over Delhi and Guwahati latitudes upto 10 June. It re-appeared over Delhi on 10 September.



**Figs. 11(a-d).** Mean SST and SST anomaly in (°C) for (a) June, (b) July, (c) August and (d) September 2008

The days during which the Sub-tropical Westerly Jet was observed in the past five years are given below:

- | Year | <i>Sub-Tropical Westerly Jet (STWJ)</i>                                                                                                                                                                         |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 and August and over Delhi, Srinagar & Lucknow on 15, 23 and 30 September respectively. |
| 2006 | Seen over Srinagar and Delhi Latitudes upto 11 June, shifted northwards thereafter and made                                                                                                                     |

casual re-appearances. It was seen over Delhi and Srinagar from 29 September.

- 2007 Seen over Srinagar and Ranchi Latitudes upto 27 June, it re-appeared over Srinagar on 3 October and over Delhi on 7 October.

**5.5. Tropical Easterly Jet (TEJ)**

Though jet speed winds were noticed over Port Blair on 4 May, the southernmost stations started reporting these wind speeds on a regular basis only from 25 May onwards. It was present until the beginning of October. During July and August, on many days, the jet stream was spread over to northern latitudes, sometimes even upto 20° N. A core wind speed of 100 kts was noted over Port Blair on a few days in June, July and September.

Some of the upper air observations which reveal the characteristics of the jet stream are given in Table 16.

**TABLE 17**  
**Zonal wind anomalies 2008**

W/E	Week ending																	
	4/6	11/6	18/6	25/6	2/7	9/7	16/7	23/7	30/7	6/8	13/8	20/8	27/8	3/9	10/9	17/9	24/9	1/10
<b>TRV</b>																		
850	-3.6	-0.2	-1.6	-11.6	-2.8	-5.5	-10.2	-9.8	7.0	-5.3	-3.1	-10.4	-1.4	-8.1	2.3	6.5	-	-5.0
500	-	2.8	-	-	-5.0	-0.6	-16.4	-	-	-	-	-13.1	-11.7	-13.0	-	8.4	6.5	2.6
200	-	-17.2	-	-	-	-18.2	-	-	-	-	-	-	-	8.1	-	-	-	-1.2
<b>MDS</b>																		
850	-4.0	1.2	7.0	-6.0	-4.6	-1.4	-8.9	-18.0	8.3	0.8	12.0	-6.4	-11.2	-16.7	-5.3	20.0	6.1	-2.0
500	-3.8	2.4	-	-	-	1.9	-12.5	-15.2	-	1.8	-	-	-9.5	-24.3	-18.6	22.5	-	14.5
200	-1.9	-	-	-	-	-	-	-	-	-	-	-	-	-15.1	-	-	-	-9.2
<b>BMB</b>																		
850	2.3	0.3	8.8	1.2	1.0	3.9	0.0	-10.9	-0.5	1.2	14.0	1.9	-6.5	-15.2	-11.6	10.0	11.0	5.1
500	1.4	4.8	7.8	2.3	-0.5	-0.3	10.9	0.3	-1.5	-1.1	0.7	-3.2	1.8	-11.5	-5.2	2.1	11.4	-0.7
200	-1.1	7.0	-18.4	-8.0	-4.3	-8.8	-3.5	-8.2	1.9	-0.6	-1.0	-3.1	-3.9	-8.7	7.6	-0.4	1.7	-1.2
<b>NGP</b>																		
850	-4.4	3.7	13.6	5.9	1.4	3.0	3.8	-4.7	-2.4	10.4	1.4	-0.8	-6.3	-6.5	-8.0	-1.3	5.6	2.5
500	-	-	7.9	4.0	9.5	-2.5	6.5	-0.0	-13.7	-9.6	2.0	8.6	-3.5	0.1	-6.3	-0.9	11.3	4.0
200	-	-	-22.3	-7.0	-6.0	-3.5	-9.3	-8.9	-2.8	3.2	-2.7	-2.4	-10.0	-7.2	13.2	0.4	0.2	-4.4

- 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.

Apart from these, Jet speed winds were also reported over Visakhapatnam, Bhubaneswar, Hyderabad, Nagpur, Kolkata, Ranchi and Ahmedabad during various parts of the season.

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

Year	Tropical Easterly Jet (TEJ)
2003	Seen from 9 May to 25 September. Maximum wind speed 125 knots at 116 hPa over Minicoy on 25 July.
2004	Seen from 10 May to 30 September. Maximum wind speed 180 knots 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.

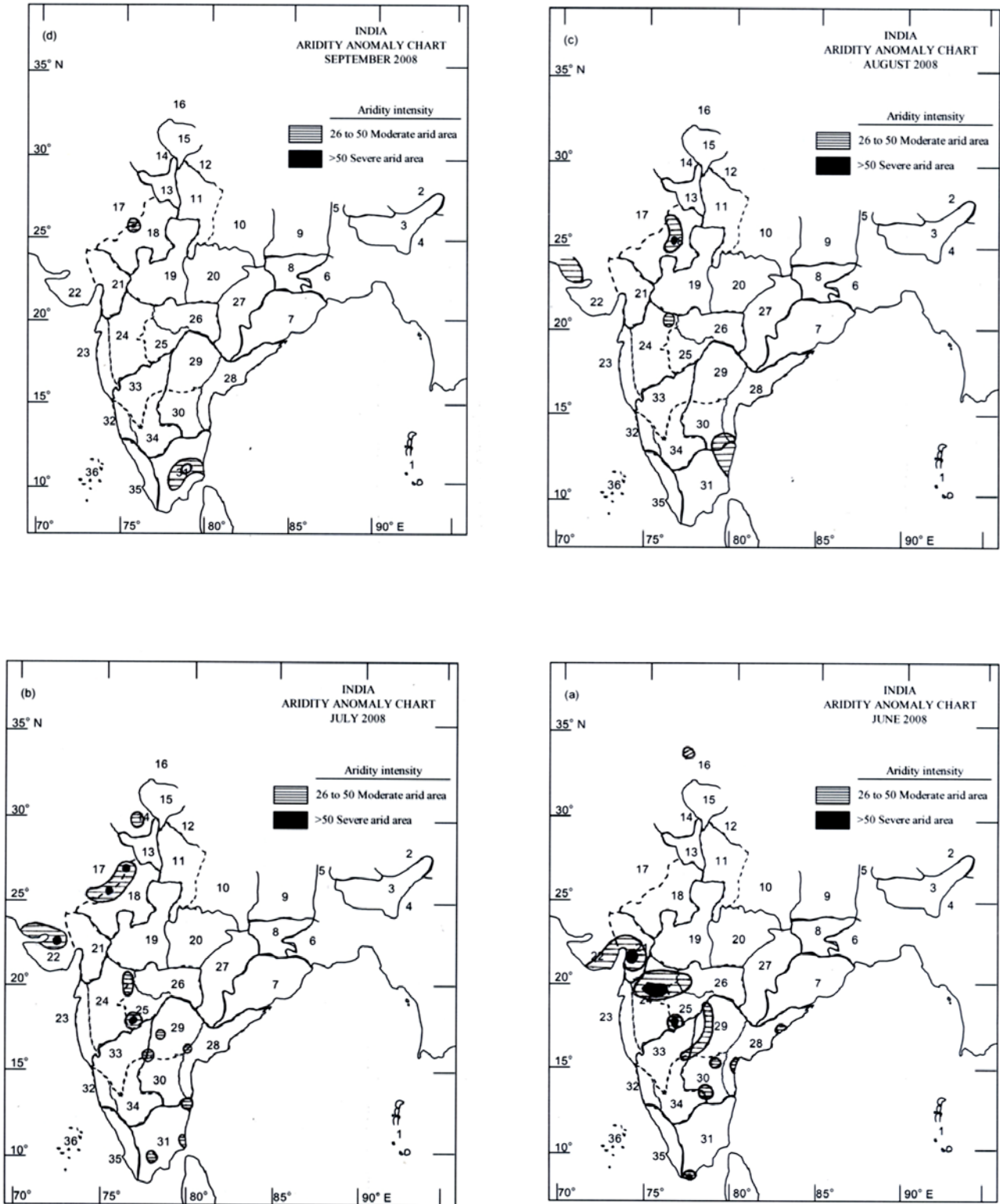
2006 Seen from 11 May to 4 October. Maximum wind speed 100 kts at 128 hPa on 1 July over Thiruvananthapuram and over Minicoy on 25 July and 31 August at 202 and 200 hPa respectively.

2007 Seen from 19 May to 6 October. The maximum wind speed reported was 100 kts at Thiruvananthapuram on 28 June & 16 August; at Minicoy, on 17 July, 2 August & 10 September and at Port Blair, on 13 July & 7 August.

## 6. Sea Surface Temperature (SST)

Figs. 11(a-d) show the monthly mean Sea Surface Temperature values along with the anomalies in northwest, northeast, westcentral, southwest, southeast blocks of both the seas and also for North Andaman (NA) and South Andaman (SA) seas for the months of June, July, August and September. The normal values for each block for calculating the anomalies have been estimated from the isopleths of normal values given in the





**Figs. 12(a-d).** Aridity anomaly chart for the month (a) June, (b) July (c) August and (d) September 2008

publication, "Climatic Atlas of Indian Ocean, Part-I" by Stephen Hastenrath and Peter J. Lamb.

The northwest, northeast, eastcentral sectors of Arabian Sea and northwest sector of Bay of Bengal and SA Sea were warmer than normal having positive anomaly of +1.4° C over the northeast Arabian Sea and 2.6° C over the northwest Bay of Bengal. The westcentral Arabian Sea, westcentral Bay of Bengal and NA Sea were cooler than normal.

## 7. Other features

### 7.1. Monthly wind anomalies during southwest monsoon 2008

The zonal wind anomalies observed at 4 different stations over the peninsula are given in Table 17. The monthly wind anomaly features are discussed below :

#### 7.1.1. June wind anomaly features

Anomalous cyclonic circulations were seen at 850 hPa over Bihar and Bangla Desh. Anomalous cyclonic circulation was seen over west Uttar Pradesh extending up to 700 hPa. Anomalous cyclonic circulation was seen between 700 & 500 hPa over east Rajasthan. An anomalous anticyclone was seen at 850 hPa over Maharashtra, Andhra Pradesh and adjoining north interior Karnataka extending up to 500 hPa.

#### 7.1.2. July wind anomaly features

An anomalous cyclonic circulation was seen between 850 & 700 hPa over west Uttar Pradesh. Anomalous anticyclonic circulation was seen at 850 hPa over Gujarat region and neighborhood. Another anomalous cyclonic circulation was seen at 700 hPa over west Madhya Pradesh. Also anomalous cyclonic circulations were seen at 500 hPa one over north Konkan off east central Arabian sea and another over north Andhra coast. At 200 hPa level, anomalous anticyclonic circulation over the northern parts of the country was observed.

#### 7.1.3. August wind anomaly features

The anomaly winds were easterly/eastsoutheasterly over peninsula up to 500 hPa. An anomalous cyclonic circulation was seen at 500 hPa over Assam & Meghalaya. Anomalous anticyclones were seen at 500 hPa over south Rajasthan and north Gujarat region. Anomalous anticyclones were seen between 500 & 100 hPa over north Orissa and adjoining Gangetic West Bengal.

During the last week of August, a ridge line was seen along the latitudinal belt 25° - 28° N between 850 & 500 hPa and along Lat. 31° N at 200 hPa.

#### 7.1.4. September wind anomaly features

Anomalous cyclonic circulations were seen at 850 hPa over Gujarat region and over south Uttar Pradesh. Anomalous cyclonic circulations were also seen between 850 & 700 hPa over Gangetic West Bengal and over northeastern parts of India. Anomalous anticyclonic circulation was seen at 850 hPa over Punjab, Haryana & Chandigarh.

### 7.2. Aridity conditions during southwest monsoon 2008

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

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

Where, PE is Potential Evapotranspiration, which is 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:

<i>Aridity Anomaly</i>	<i>Class</i>
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. 12(a-d).

TABLE 18

## Representative rainfall amounts (&gt;7 cm) during June – September 2008

Date (1)	June (2)	July (3)	August (4)	September (5)
1.	Matizuri 9, Tangla & Dholai 8 each, Karimganj & Bangalore 7 each	Wada 21, Mumbai 20, Panvel 18, Vikramgarh & Matheran 17 each, Cherrapunji & Panbari 14 each, Sahapur, Uran, Gandevi, Chikhli & Talala 13 each, Barpeta, Valsad, Palghar, Pen & Mhasala 12 each, Rewaghat & Kalyanpur 11 each, Dahanu, Mokhada, Alibag, Karjat, Roha, Pali, Igatpuri, Haripad & Veraval 10 each, Munger, Mansa, Diu, Kalyan, Jawahar, Thane, Ulhasnagar, Bhira, Mangaon, Khalapur, Mahad & Mancompu 9 each, Beki Road Bridge, AIE NH Xing, Talasari, Bhiwandi, Mahabaleshwar, Bajpe, Kunnamkulam, Alapuzha & Seoni 8 each, Manas NH Xing, Kakatpur, Motihari, Allahabad, Vasai, Tala, Panambur, Shirali, Kayamkulam & Almore 7 each	Jabalpur & Gondia 16 each, Amgaon 15, Pathankot 13, Pachmarhi 12, Bhagamandala 10, Silchar & Subramanya 9 each, Gurgaon, Hut Bay, Agumbe & Nayagarh 8 each	Alur 12, Gaganbavda & Hassan 11 each, Subramanya & Kochi 10 each, Khalapur, Pune & Balehonnur 9 each, Bhalukpong, Sonbarsa, Navalgund & Hosdurg, Perumbavur 8 each, Cherrapunji, Chouldhowaghat & Chintamani 7 each
2.	Cherrapunji 13, Harnai & Harangi 12 each, Mellabazar, North Lakhimpur, Beki Mathanguri & Motunga 11 each, Barpeta, Subramanya, K. R. Sagara, Jia Bharali & N. H. Xing 10 each, Mancompu, Kasargod, Srirangapatna, Y. N. Hotshot & Mulki 9 each, Tiruvuru 8, Napoklu, K. R. Nagara, Shrikaripur, Nagamangala, Bobbili, Gajapathinagaram, Panberi, Beki Road Bridge & Williamnagar 7 each	Varanasi 32, Barwala 23, Mangrol 22, Bhavnagar 20, Dhandhuka 19, Valsad 17, Bhatkal 16, Olpad, Kodinar & Veraval 15 each, Dharampur 14, Murti, Neora & Matheran 13 each, Mirzapur, Uttarkashi, Nanipalsan, Chikhli, Jabalpur & Botad 12 each, Lava, Navsari, Silvasa & Agumbe 11 each, Surat, Maliya & Dahanu 10 each, Nagrakata, Vaishali, Jaunpur, Dhansura, Pardi, Gandevi, Madhuban, Bardoli, Mahuva, Vallabhipur, Karjat, Panvel, Shirali & Honavar 9 each, Chouldhowaghat, Sevoke, Pedong, Alipurduar, Hasimara, Neemsar, Ranpur, Karjan, Keshod, Bhira, Mulki, Mani, Karkala, Kollur, Kasargode, Hosdurg & Chinna Kallar 8 each, Jalpaiguri, Narayanpur, Khagaria, Sripalpur, Ghazipur, Idar, Jambusar, Bansda, Junagad, Dhrangdhra, Limbdi, Mahuva, Umarala, Ranavav, Bhanvad, Lalpur, Mahad, Bantwal, Mudibidre & Kudulu 7 each	Sanand 26, Ahmedabad 21, Rawat Bhata 13, Pachmarhi 12, Bhanjanagar & Patan 10 each, Hut Bay 9, Agumbe, Car Nicobar, Bhiwandi & Igatpuri 7 each	Barackpur & Gariaband 11 each, Govindpur, Gargoti & Penukonda 10 each, Ganagavarhy & Thondebhavi 9 each, Perumbavur 8, Passighat, Beki Mathanguri, Chouldhowaghat, Diana, Paikmal, Janjgir, Kharaghoda, Chilamattur, Kadiri, Gowribidanur, Holalkere, Karad & Bangalore 7 each
3.	Cooch Behar 16, Amini Divi 9, Sawantwadi & Darjeeling 8 each, Kolkata 7	Maliya 34, Banda 21, Bagsra & Mangrol 20 each, Dhari, Junagad & Talala 17 each, Alipurduar 15, Keshod 14, Sawarkundla & Vantwali 11 each, Sultanpur, Bharwain, Petlad, Manavadar & Jetpur 10 each, Rampurhat, Ballia, Turtipur, Bangana, Karjan, Bardoli, Palsana & Dhoraji 9 each, Chouldhowaghat, Meghraj, Waghodia, Hansot & Mandvi 8 each, Barobhisa, Hasimara,	Navrangpur 20, Eturunagaram 17, Dummagudem & Sevoke 15 each, Car Nicobar 14, Vapi & Visnagar 12 each, Mathabhanga 10, Purnea 9, Bhagamandala 8	Cherrapunji 21, Palamner 13, Ziro, Itanagar 11, Motunga, NH-31 & Pune 10 each, Dibrugarh, Chittoor, Cheyur & Kanekal 9 each, Passighat, Gangtok, Tadong, Cooch Behar & Sakoli 8 each, Kokrajhar, Jai Bharali, N. T. Xing, Alipurduar, Barobhisa, Domohani, Chikodi & Chikkanahalli 7 each

TABLE 18 (Contd.)

(1)	(2)	(3)	(4)	(5)
		Kandapada, Chillaghat, Banbasa, Ranjit Sagar Dam Site, Amb, Sallumber, Veja, Anklav, Cambay, Sagbara, Valsad, Jambusar, Bulsar & Japala 7 each		
4.	Sironcha 12, Barpeta 10, Midnapore 9, Koraput 8, Anantpur, Beki Road Bridge & Panbari 7 each	Hasimara 17, Cherrapunji & Jalpaiguri 16 each, Domohani 15, Kodinar 15, Taibpur, Bier & NH-31 13 each, Allahabad 12, Khowang, Berhampore, Sarmathura & Bayana 11 each, Diana, Rajghat, Galgalia, Chikhli & Vikramgarh 10 each, Champasari, Nagrakata, Suri, Phaphamau, Banbasa, Bosan, Barwala, Bansda, Talasari & Talala 9 each, Belonia, Murthi, Birpur, Chatnag, Sultanpur, Turtipur, Dadbai, Mandryal, Nowgong, Nandod, Umargaon, Ukai & Igatpuri 8 each, Sabroom, Saulighat, Mehre, Kaman, Baseri, Sinor, Vapi, Silvasa, Bardoli & Palghar 7 each	Sironcha 28, Chinoor 21, Adilabad 19, Varora 16, Chandrapur 15, Sevoke 14, Kotraguda & Tuni 13 each, Baghdogra 11, Agumbe, Kadi & Kalol 10 each, Dharamsala 8	CIAL Cochi & Kayamkulam 15 each, Athagarh & Marungapuri 12 each, Kokrajhar, Mohanpur, Koppal & Sandur 11 each, Cherthala 10, Lava & Chinnakallar 9 each, Phoolberia, Govindpur, Bolangir, Penukonda, Thrissur, Paravur & Alapuzha 8 each, Cherrapunji, Goalpara, Khanitar, Durg Kondal, Pamidi, M. M. Hills, H. B. Halli & Surgana 7 each
5.	Panbari 17, Vadakara 10, Karimganj & Renuka 8 each	Cherrapunji 28, Kanpur 26, Panbari 19, Bhalukpong & Passighat 14 each, Chikhli 13, Nalbari 12, Dibrugarh, Hamirpur & Shahjina 10 each, Beki Mathanguri, Murti, Dalmau, Gandevi & Jalalpur 9 each, Motunga, Badatighat, Chouldhowaghat, Valsad, Bansda, Mahuva, Bharwain & Bulsar 8 each, Manas NH Xing, Barpeta, Dhollabazar, Dhekiajuli, Neora, Chillaghat, Gonda, Kakrahi, Etawah & Pardi 7 each	Sirpur 21, Domohani 16, Dasuya 15, Dharamsala & Tuni 13 each, Ambala, Chandrapur & Aheri 12 each, Mukerian 11, Sohana, Katra, Mathura & Mahabaleshwar 9 each	Midnapore & Panbari 17 each, Cherrapunji 13, Balurghat & Sevoke 11 each, Mathanguri & Challakere 10 each, B. Bagewadi & Karimganj 8 each, Neora, Bhalukpong, Gondpipri, Thalasserry & Kolkata 7 each
6.	Cuttack 13, Dahanu 8, Miao, Namsai & Tikrikilla 7 each	Kanpur 34, Hamirpur & Kalpi 26 each, Jalpaiguri 21, Baghdogra 19, Shahjina & Hamirpur 16 each, Sevoke, Dalmau, Agra & Auraiya 12 each, Lava & Tazawala 11 each, Sundernagar & Jashpurnagar 10 each, Aligarh, Etawah & Matheran 9 each, Champasari, Jammu & Ambikapur 8 each, Matizuri, Goalpara, NH 31, Gajoldoba, Neora, Bausan & Reamal 7 each	Jalpaiguri 22, Mhasala & Gaganavada 18 each, Valpoi 17, Domohani 16, Gandevi 15, Vani & Dapoli 14 each, Ambala, Ahwa, Chandrapur & Yeotmal 12 each, North Lakhimpur 8	Kamrej 19, Kokrajhar 16, Narharpur & Ukai 13 each, Sidlaghatta 11, Motala 10, Bhagalpur, Cooch Behar, Roha, Devgad, Selu, Nagpur, Sira & Chintamani 9 each, Alipurduar, Kosagumda, Buldhana, Dhamtari, Hindupur, Shrirampur, Gowribidanur & Kandaghat 8 each, Mathabhanga, Diana, Talcher, Galgalia, Taibpur, Mandvi, Vasai, Mohol, Warud, Telhara, Malegaon, Deulgaonraja, Jagdalpur, Rentachintala, Miryalguda, Thambalapalle, Hungund, Kushtagi, Chintamani, Arki & Peermade 7 each
7.	Mumbai 16, Harnai & Gerusoppa 13 each, Roha 12, Mandangad, Mhasala & Dapoli 11 each, Alibag, Porbandar, Mudhol, Panambur, Bajpe & Moradabad 10 each,	Mathura, Samari & Jammu 10 each, Sonbarsa 17, Dharampur & Pardi 16 each, Buxar, Triveni & Madhuban 14 each, Taranagar, Gandevi & Bhiwandi 13 each, Hirkud, Khadda, Naraingarh & Thane Belapur 12 each, Bansda, Talasari, Sakti 11,	Badami 16, Sangola, Paravur & Kanjirapalli 15 each, Ketti 11, Thanaghazi, Venkatagirikota, Kallakurichi, Kochi & Cherthala 10 each, Navalgarh, Shankarpuram, Harur & Punalur	

TABLE 18 (Contd.)

(1)	(2)	(3)	(4)	(5)
	Shrivardhan, Valpoi, Sudhagad, Pali, Khairmal, Thakurmunda, Mahabubabad, Narsampet, Kumta & Karwar 9 each, Gaganbavada, Colaba, Mangaon, Kudal, Rajapur, AIE NH Xing, Kadra & Agumbe 8 each, Murud, Pen, Kankavli, Guhagar, Ratnagiri, Mudibidre, Kotta, Udipi, Kollur, Siddapura, Jagalbet, Linganamakki, Kottigehara & Quilandy 7 each		Diana, Patnagarh, Allahabad, Turtipur, Bhiwani, Rajgarh, Vyara & Malkharoda 10 each, Chargharia, Balia, Dadri, Nahar, Sagbara, Ahwa, Daman, Silvasa, Jawahar, Vasai, Vikramgarh, Pusad & Agumbe 9 each, Tikabali, Patna, Dediapada, Vapi, Kalyanpur, Palghar, Mahendragarh, Ghumarwin & Dapoli 8 each, Cooch Behar, Bijepur, Baudhgarh, Gorakhpur, Safidon, Taoru, Ramgarh, Wada, Gaganbavada, Igatpuri, Mahabaleshwar & Jaijapur 7 each	9 each, Maya Bandar, Udaipurwati, Pungannur, Alapuzha, Kottayam 8, Chandbali, Nadauti, Kushalgarh, Mahad, Deoni, Kuppam, Valparai, Narainpur & Chikbalapur 7 each
8.	Dabholim 22, Dapoli 15, Panjim 14, Gaganbavada 13, Mumbai, Margherita, Cherrapunji & Nimapara 11 each, Shrivardhan, Rajapur & Karwar 10 each, Paderu 9, Dummagudem, Mulki, Kumta & Kamadhi 8 each, Williamnagar, Harnai, Murud, Murbad, Mhasala, Guhagar, Kota, Karkala & Ankola 7 each	Julana & Jabalpur 9 each, Nuh, Mukerian, Pathankot, Dasuya, Dholpur, Sapotra, Surajpur, NH-5 & Govindpur 7 each	Madanpur Rampur 19, Baliguda & Agumbe 15 each, Sawantwadi 14, Junagarh, Lanjigarh & Koraput 13 each, Bhiwani & Katra 12 each, Athagarh & Jaipatna 11 each, Sikandarpur, Vengurla, Mahabaleshwar & Siddapura 10 each, Jaleswar, Hanumansetu, Lucknow, Naraingarh, Jhajjar, Delhi, Dadri, Madhopur, Shahapur Kandi, Nainadevi, Baikunthpur & Gerusoppa 9 each, Kantamal, Navrangpur, Kakatpur, Belgaon, Indrapuri, Patti, Khajuraho, Kankavali, Mapusa, Konda & Pantnagar 8 each, Baragaon, Bhavanipatna, Jaypore, Pottangi, Bhatpurwaghat, Chatnag, Palliakalan, Sultanpur, Rania, Gurgaon, Ballabhnagar, Amb, Nalagarh, Bhoond, Kudal, Malvan, Dodamarg, Panjim, Pernem, Kollur, Honavar & Sringeri 7 each	Valpoi 17, Gaganbavada 15, Dholai & Karwar 12 each, Barshi 10, Maya Bandar, Uluberia, Aaddanki, Chikodi & Etapalli 8 each, Long Island, Matizuri, Pernem, Karmala, Medha, Raibag, Tavaragera, Afzhalpur, Vadakara, Thrithala & Piravom 7 each
9.	Mandangad 15, Shirali 12, Mundali, Thane, Mhasal & Karwar 11 each, Shrivardhan, Mahad, Kota, Kundapur & Ankola 10 each, Kohima, Mumbai, Siddapura, Bhatkal & Bareilly 9 each, Panbari, Pattamundai, Bhiwandi, Harnai, Alibag, Mahabaleshwar, Poladpur, Kumta & Devakottai 8 each, Nalbari, Sujanpur, Panvel, Rajapur, Dapoli, Uran, Khed, Roha, Dummagudem, Mulki, Mangalore, Belthangadi & Kozhikode 7 each	Sambalpur 15, Hirakud & Ramgarh 13 each, Janjgir 11, Tusuma, Tikabali, Ranchi, Champa Masturi & Malkharoda 10 each, Jharsuguda, Hindigir, Bamanwas & Palampur 9 each, Telkoi, Khairamal, Laikera, Soheta, Hazaribagh, Konner, Tenughat, Bansi & Lalsot 8 each, Lengpui, Jamankira, Bargarh, Sundargarh, Bolangir, Binika, Mustafabad, Narnaul & Jaijapur 7 each	Gaganbavada 24, Matheran 23, Madanpur Rampur 22, Paleru Bridge 21, Karjat 20, Panvel 17, Lanjigarh, Madhira, Gerusoppa & Talaguppa 15 each, Maya Bandar, Sawantwadi, Nandigama, Gerusoppa & Joida 14 each, Bhavanipatna, Bolangir, Armoor & Golkonda 13 each, Paradip, Baliguda, Ahwa, Mumbai, Bhira, Prakasam Barrage, Hyderabad, Medchal, Kollur, Agumbe & Bansda 12 each, Vaibhavwadi, Dodamarg, Nuzvid, Repalle, Bhimgal, Eturnagram, Jangaon, Suryapet & Sirsi 11 each, Kotraguda, Rajpura, Ratnagiri, Kankavali, Valpoi, Malkharoda, Avani-gadda, Vijayawada, Hakimpet, Narsampet, Sangareddy, Honavar, Ankola & Jayapura 10 each, Khairamal, Amalapuram, Machilipatnam, Mangalagiri, Tenali, Khammam, Rayampet, Sircilla, Venkatapuram, Sringeri & Vythiri 9 each, Sambalpur, Gopalpur, Titlagarh,	Udipi 18, Baramati & Hosdurg 17 each, Bantwal 16, Thalassery 15, Malsiras 14, Mumbai, Bhira, Thali, Mani & Cannur 13 each, Agumbe 12, Mudibidre 11, Karmala & Kota 10 each, Guna, Mhasala, Mahabaleshwar, Mulki, Dharmasthala & Pune 9 each, Puthimari, Alibag, Malvan, Canacona, Harnai, Valpoi, Phaltan, Bajpe, Karkala, Kundapur, Kasargode, Enamackel, Thodupuzha, Jalna & Madhugiri 8 each, Bhalukpong, Hasimara, Gajoldoba, Pattamundai, Bakani, Sawantwadi, Pen, Mahad, Shrivardhan, Ratnagiri, Chiplun, Dapoli, Malvan, Makhtal, Tandur, Madakasir, Chinnakalar, Viralimalai, Panambur, Puttur, Bijapur, Neelamangala, Pavgada & Aluva 7 each

TABLE 18 (Contd.)

(1)	(2)	(3)	(4)	(5)
			Cuttack, Faridkot, Derabassi, Bansda, Konta, Atchampet, Guntur, Bhongir, Karimnagar, Perur, Sriramsagar & Yellapura 8 each, Chandbali, Berhampur, Baudhgarh, Kakatpur, Tilaiya, Ambala, Igatpuri, Gudivada, Tiruvuru, Bhadrachalam, Chevella, Dubbak, Hanamkonda, Huzurabad, Kamareddy, Metapalli, Nagarjunsagar, Nizamabad, Parkal, Yellandu, Siddapura, Kamareddy & Mathura 7 each	
10.	Mandangad 13, Malwan & Siddapura 12 each, Uran 11, Rajapur, Shirali & Kottigehara 10 each, Keonjharagarh, Hirakud, Roha, Sawantwadi, Panambur, Dharmasthala & Paradip 9 each, Dibrugarh, Panvel, Harnai, Bhatkal & Linganamakki 8 each, Mhasala, Poladpur, Bhiwani, Alibag, Mahad, Sudhagad, Pali, Mumbai, Bajpe, Kundapur, Kodra, Manchikere, Kumta, Kasargod, Hosdurg, Kudulu, Kozhikode, Vadakara & Quilandy 7 each	Gharmura 17, Kurwai 15, Deegond 13, Dholai, Margherita, Sangner & Ambikapur 10 each, Sanghria, Jaipur, Rajgarh, Keolari & Simga 9 each, Sriganganagar, Itanagar, Bijolia, Bhanpura, Vidisha, Umaria, Tilda, Baliagarh, Rajpur, Peddapuram & Jaipur 8 each, Sadulshahar, Kota, Mandana, Narsinghgarh, Mahendragarh & Bhatinda 7 each	Mahabaleshwar 44, Gaganbavada 36, Radhanagari 20, Poladpur & Bhira 27 each, Khed 25, Sangamneshwar 22, Khalapur & Vaibhavwadi 21 each, Malvan 20, Karjat & Mahad 19 each, Chiplun, Kudal & Nuzvid 17 each, Kankavali 16, Navrangpur, Mhasala, Matheran, Rajapur, Lanja, Sawantwadi, Dodamarg, Banswada, Medak, Manchikere & Thirthahalli 15 each, Madangad, Vengurla, Chandgad, Dubbak, Siddapura & Yellapura 14 each, Devgad, Panjim, Marmugoa, Tiruvuru, Jangaon, Mehbubabad, Ramayampet, Yellandu, Bhagamandala & Sringeri 13 each, Koraput, Gunupur, Ratnagiri, Pernem, Mulshi, Narainpur, Eluru, Paleru Bridge, Hakimpet, Kamareddy, Khammam, Taliparamba & Chinna Kallar 12 each, Junagarh, Kosagumda, Jabalpur, Mangaon, Ajra, Bhudargad, Amalapuram, Chintalapudi, Koyyalagudem & Prakasam Barrage 11 each, Sagar, Amgaon, Devbhog, Tanuku & Hyderabad 10 each, Parlakhemundi, Jaipatna, Damoh, Pali, Shrivardhan, Shahuwadi, Naigaon, Keshkal, Bhimavaram & Chincholi 9 each, Motunga, Panvel, Dapoli, Panhala, Dhamtari, Nagri, Piduguralla, Tadepalligudem, Tenali & Vythiri 8 each, Cherrapunji, Kailashahar, Gajoldoba, Mohana, Phulbani, Bakani, Tala, Igatpuri, Trimbak, Billoli, Jarkot, Gondia, Dondilohara, Gannavaram, Gudivada & Palasa 7 each	Malvan 17, Ankola 14, Agumbe 13, Khammam 12, Kammardi & Belthangadi 11 each, Nagrakata, Pottangi, Ponda, Karwar, Belthangadi, Mudibidre & Linganamakki 10 each, Champasarai, Devgad, Dabolim, Ahmednagar, China Kallar, Kottigehara & Madhuban 9 each, Rajapur, Marmugoa, Quepem, Sanguem, Bijapur, Bhopalpatnam, Bhagamandala, Kasargode, Aurad & Vadakara 8 each, Baghdogra, Murti, Murbad, Harnai, Khed, Kudal, Mapusa, Chakur, Deoni, Selu, Sironcha, Hakimpet, Dharmasthala, Mani, Subramanya & Kudulu 7 each
11.	Bhatkal 19, Pallahara 15, Gerusoppa 14, Karwar 10, Chouldhowaghat, Alibag, Shirali, Honavar, Linganamakki, Agumbe & Kamareddy 9 each, Sibsagar, Rajkishorenagar, Budhanagar, Sudhagarh Pali, Pen, Siddapura, Bhagamandala,	Chittorgarh 23, Gangdhar & Nimach 17 each, Nanipalsan 16, Baghdogra, Champasari & Barwala 15 each, Domohani & Kurwai 13 each, Gangrar, Kadana, Valsad, Madhuban, Silvasa & Olpad 12 each, Cherrapunji, Hasimara, Devgadbaria, Santrampur, Gandevi, Surat & Mokhada 11 each, Pirava,	Mahabaleshwar 49, Bhira 34, Gaganbavada 33, Gandevi 31, Poladpur 29, Mokhada & Kottigehara 28 each, Umargaon, Jalalpur, Mahad, Valpoi & Radhanagari 26 each, Dharampur, Pardi & Agumbe 25 each, Silvasa & Pali 24 each, Nanipalsan, Madhuban & Sangamneshwar 23 each, Karjat &	Rajapur & Devgad 23 each, Gaganbavda 19, Ratnagiri & Malvan 17 each, Karkala 14, Kudal 13, Udupi & Chikodi 12 each, Pottangi, Lanja, Vaibhavwadi, Kota & Agumbe 11 each, Thane Belapur, Kankavli, Sawantwadi & Anakapalli 10 each, Dharampur,

TABLE 18 (Contd.)

(1)	(2)	(3)	(4)	(5)
	Mudibidre & Itanagar 8 each, Lakhimpur, Rajapur, Valpoi, Uran & Chinnakallar 7 each	Chabra, Chotisadri, Talasari, Wada & Rajpura 10 each, Pachpahar, Umargaon, Vapi, Mandvi, Jawahar, Murbad, Vasai, Igatpuri, Peint & Taibpura 9 each, Dhollabazar, NH-31, Galgalia, Dungala, Begu, Dabok, Kalyan, Bhiwandi, Ulhasnagar, Thane Belapur, Matheran, Ratnagiri & Trimbak 8 each, Joshimath, Bhilwara, Mandryal, Nimbahera, Bhadesar, Bhopal, Sojitra, Daman, Mahuva, Valod, Talaja, Dahanu, Shahapur, Bhira & Koderu 7 each	Chiplun 22 each, Dahanu, Jawahar, Igatpuri & Peint 21 each, Itanagar, Valsad, Chikhli, Talasari, Kankavli, Chinna Kallar & Jayapura 18 each, Vapi, Dodamarg, Dabholim, Chandgad, Yellapura & Sringeri 17 each, Vikramgarh, Sawantwadi, Malwan, Morgaon, Pernem, Siddapura, Jagalbet, Bhagamandala, Kalasa & Yelburga 16 each, Khalapur, Pen, Khed, Mapusa & Ponda 15 each, Daman, Palghar, Murbad, Mhasala, Mulshi, Naduvattam, Kollur, Gerusoppa & Linganamakki 14 each, Jaleswar, Palsana, Mangaon, Mandangadh, Kudal, Maval, Ankola & Talaguppa 13 each, Naharkatia, Rengali, Dehra Dun, Bansda, Shahapur, Matheran, Dapoli, Panjim, Canacona, Marmugoa, Nashik, Ajra, Sakti, Paudi-Uproda, Dharmasthala, Bhatkal, Shirali, Karwar, Manchikere & Khanapur 12 each, Bhubaneswar, Navsari, Kalyan, Wada, Vasai, Alibag, Roha, Vaibhavwadi, Kota, Honavar & Balehonnur 11 each, Bardoli, Vengurla, Karkala, Kundapur & Peermade 10 each, Deogaon, Uttar Kashi, Bawal, Ajmer, Kishangarh, Aria, Chincholi, Guna, Bhiwandi, Tala, Rajapur, Lanja, Akola, Satara, Katghora, Kartala, Chhuria, Banavasi, N. R. Pura, Lakkavalli & Kasargode 9 each, Kalaikunda, Ratlam, Jabalpur, Ahwa, Shahuwadi, Gadhinglaj, Shirala, Koregaon, Ghodegaon, Junnar, Rajgurunagar, Rajura, Umrer, Kunkuri, Rajgarh, Mani, Puttur, Sirsi, Haliyal, Dharwad & Cannur 8 each, Cherrapunji, Barpeta, Paikmal, Turekela, Sirsa, Bhoranj, Pushkar, Betul, Mahuva, Surat, Thane, Ulhasnagar, Mumbai, Uran, Panvel, Guhagar, Dindori, Surgana, Chandrapur, Deori, Gharghoda, Valparai, Devala, Gudalur Bazar, Subramanya, Mudibidre, Chikodi, Medikeri, Madapura, Tarikere, Thalasserry, Vythiri, Nilambur & Munger 7 each	Harnai, Valpoi, Sanguem, Ranasthalam & Bulsar 9 each, Lakhimpur, Lumding, Dabolim, Pernem, Chodavaram, Koderu, Vizinagaram, Jangaon, Gerusoppa, Honavar, Raibagh 8, Sukinda, Nayagarh, Shrivardhan, Sangamneswar, Dodamarg, Canacona, Ponda, Pusad, Ichapuram, Karwar & Kalasa 7 each
12.	Rajapur 22, Uran 20, Mumbai, Bhira & Car Nicobar 17 each, Roha & Panambur 16 each, Bantwal 15, Kasargod & Bajpe 14 each, Ratnagiri, Gaganbavada, Mulki & Gerusoppa 13 each, Mangalore 12, Mhasala, Panvel, Matheran, Mudibidre & Car Nicobar 11 each, Bhalukpong, Kankavali, Chiplun, Sawantwadi, Alibag,	Cherrapunji & Chouldhowaghat 17 each, Akkalkuwa 14, Nahan 13, Sawai Madhopur, Bansda & Ahwa 12 each, Viratnagar, Shahpura, Dharampur & Ukai 11 each, Mandsaur, Sagbara & Umargaon 10 each, Passighat, Jambugoda, Bhinmal, Dera Bassi & Rajpura 9 each, Benibad, Gorakhpur, Uttarkashi, Naraina, Bamanwas, Bhiloda, Sinor & Ghatol 8 each,	Palghar 36, Jawahar & Jambugoda 35 each, Daman 30, Panbari & Baroda 27 each, Matheran 26, Umargaon, Valod & Mokhada 25 each, Vapi & Madhuban 24 each, Halol, Dharampur, Vikramgarh & Igatpuri 23 each, Silvasa & Mahuva 22 each, Devgandhararia, Mandvi, Dahanu, Trimbak & Agumbe 21 each, Vyara, Wada, Mahabaleshwar & Bhatkal 20 each, Talasari 19, Beki Road Bridge	Gaganbavda 21, Guhagar 20, Shrivardhan 18, Ratnagiri 17, Sangamneswar, Nizamabad & Sultanabad 16 each, Lanja, Billoli & Navipet 14 each, Port Blair, Dapoli, Vaibhavwadi, Elamanchili, Koyyalagudem & Bhimgal 13 each, Bodhan & Mulugu 12 each, Rajapur, Polavaram, Visakhapatnam & Bhadrachalam 11 each,

TABLE 18 (Contd.)

(1)	(2)	(3)	(4)	(5)
	Kudulu, Mani, Puttur, Honavar, Kadra, Siddapura, Bhagamandala, Saraipali & Kanpur 10 each, Itanagar, Mahabaleshwar, Khalapur, Chandgad, Pen, Kudal, Khed, Panjim, Cannur, Karkala, Kamardi & Jeypore 9 each, Naharalangan, Shrivardhan, Hosdurg, Shirali & Agumbe 8 each, Dhollabazar, Kokrajhar, Mahad, Murud, Karjat, Poladpur, Nilambur, Mannarkad, Bhatkal, Medikeri, Ankola, Soraon & Gondia 7 each	Bahraich, Kakrahi, Karanprayag, Dhorimanna, Bagoda, Pisagan, Karauli, Sapotra, Pratapgarh, Vadnagar, Gandhinagar, Danta, Bayad, Kedbrahma, Pardi, Broach & Chouldhowaghat 7 each	18, Nanipalsan, Navsari, Mangrol, Vasai, Radanagari & Siddapura 17 each, Cherrapunji, Bahalpur, Bodeli, Pardi, Chikhli & Kamrej 16 each, AIE NH Xing, Dediapada, Sagbara, Gandeve, Bhira, Peint, Mulki, Ankola & Humchadakatte 15 each, Barpeta, Jalpaiguri, Kalol, Santrampur, Ahwa, Karjat, Bhagamandala & Kottigehara 14 each, Manas NH Xing, Kokrajhar, Limkheda, Surat, Ukai, Mahad, Sawantwadi, Kagal, Chinna Kallar, Jayapura & Kammardi 13 each, Port Blair, Champasari, Sankheda, Cambay, Waghodia, Rajpipla, Shahapur, Mangaon, Panvel, Guhagar, Valpoi, Mani, Gerusoppa, Sringeri & Koppa 12 each, Domohani, Dabhoi, Nandod, Kalyan, Murbad, Ulhasnagar, Bantwal, Belthangadi, Dharmasthala, Kumta, Banavasi, Yellapura, Thirthahalli, Soraba & Kalasa 11 each, Maharo, Bansda, Songadh & Mudigere 10 each, Goalpara, Baghdogra, Narayanpur, Mohana, Pithoragarh, Dariaband, Pratapgarh, Neemuch, Anklav, Godhara, Valsad, Bardoli, Talaja, Tala, Canacona, Gaganbavada, Karkala, Karwar & Talaguppa 9 each, Bhalukpong, Williamnagar, Desuri, Ghatol, Girwa, Dohad, Savli, Vagra, Bhiwandi, Khalapur, Pali, Devgad, Surgana, Chandgad, Mangalore, Bajpe, Shirali & Sirsi 8 each, Sonamura, Alipurduar, Dehra Dun, Sabla, Banswara, Bhungra, Kotda, Choti Sadri, Deesa, Karjan, Olpad, Palsana, Bhavnagar, Ambernath, Mumbai, Poladpur, Chiplun, Mandangad, Kudal, Dodamarg, Sanguem, Nashik, Dindori, Shahuwadi, Gargoti, Panambur, Kota, Joida, Napoklu, Sagar, Hosanagara, Vythiri, CIAL Cochi & Konni 7 each	Malakhera, Mukhed, Rajamundry, Mudhol, Parkal & Ramagundam 10 each, Pottangi, Armoor, Nirmal, Shirali & Bidar 9 each, Mohana, Bahadurpur, Anta, Harnai, Karimnagar, Yellandu & Kollur 8 each, Maya Bandar, Khed, Panjim, Lonar, Chinnor, Dummagudem, Metapalli, Perur, Kota, Afzalpur, Sedam & Agumbe 7 each
13.	Maya Bandar 17, Karwar 16, Malvan & Vengurla 15 each, Kota & Motihari 14 each, Udupi & Ponda 13 each, Dehra Dun, Ankola, Kadra, Canacona, Madgaon & Panjim 12 each, Cherrapunji, Sangamneswar & Agumbe 11 each, Kundapur & Pernem 10 each, Jhansi, Patiala, Mahad, Mudibidre & Kapadvanj 9 each, Khed, Valpoi, Mangaon, Puttur & Mount Abu 8 each, Tajewala, Lanja, Mandangad, Kozhikode, Mulki, Mani, Kamareddy, Jagpura, Sukma, Roorkee & Bassoli 7 each	Gohar, Kasauli & Kahu 13 each, Sinor 12, Cherrapunji, Baghdogra, Gorakhpur, Jagadhari, Jatusana & Broach 11 each, Kakrahi, Uskabazar, Radaur, Niwai, Jhagaria & Bhadra 10 each, Neora, Birdghat, Naraingarh, Bilaspur, Assandh, Panipat, Amritsar, Mansot & Phagwara 9 each, Jalpaiguri, Regoli, Mustafabad, Gurgaon, Samrala, Nandod, Rajpipla & Gunnaur 8 each, Itanagar, Krishnanagar, Bahraich, Bansi, Hanumansetu, Lucknow, Hardwar, Bosan, Didighat, Rewari, Bason, Piplu, Dabhoi & Tilakwada 7 each	Agumbe & Dahegam 27 each, Mahuda, Vijapur & Mahudha 25 each, Amritsar & Gerusoppa 21 each, Munger, Bhatkal & Tyagarthi 20 each, Amb, Sitapur & Iगतपुरी 16 each, Sukiapokhri 15, Dasuya & Wankaner 14 each, Adampur 13, Derabassi & Salumber 11 each, Kolkata, Una & Yercaud 10 each, Bahalpur, Munsong, Birdghat & Patti 9 each, Hut Bay, Bausan, Anandpur Sahib & Guler 8 each, Port Blair, Cherrapunji, Jalpaiguri, Jhawa, Bhatpurwaghat, Jaunpur, Ghamroor, Bharwain, Gudamalani & Kannur 7 each	Nandgaon & Bhalki 15 each, Gaganbavda 14, Ahwa 13, Srirampur & Nashik, 12 each, Maliya, Osmanabad, Sindhakhedraja & Perur 11 each, Agumbe 10, Port Blair & Panjim 9 each, Mangrol, Pernem, Ahmednagar & Aurad 8 each, Maya Bandar, Gunpur, Ukai, Sangamneswar, Dabolim, Valpoi, Malegaon, Udgir, Ramayampet & Kottigehara 7 each



TABLE 18 (Contd.)

(1)	(2)	(3)	(4)	(5)
14.	Cooch Behar 35, Jamnagar 30, Nahargun 26, Itanagar & Kamrej 25 each, Dharamsala 21, Lalpur 19, Champasarai 18, Baghdogra 17, North Lakhimpur 15, Dasuya & Kottigehara 14 each, Ghamroor, Cherrapunji Hoshiarpur & Rajitsagar Dam site 13 each, Manavadar, Rajkot & Bhagalpur 12 each, Beki Road Bridge 11, Seppa, Kota & Alipurduar 10 each, Badatighat, Dhoraji & Agumbe 9 each, Port Blair & Kumher 8 each, Pathankot, Adampur, Palsana, Shrivardhan, Maya Bandar, Dhari, Kalawad, Jetpur & Lodhika 7 each	Shardanagar 19, Cherrapunji 18, Bhinga 16, Dillighat 15, Turtipur & Bahadurgarh 13 each, Batrampur & Valparai 11 each, Katerniaghat & Kolkata 10 each, Jia Bharali, NT Xing, Uluberia, Kakrahi & Neemsar 9 each, Khilabad & Medawal 8 each, Long Island, Jorhat, Sabroom, Chhendipada, Parlakhemundi, Bahraich, Palliakalan, Balachaur & Natham 7 each	Mahabaleshwar, Bhatkal & Agumbe 23 each, Gaganbavda 17, Nainadevi 16, Valpoi & Shirali 15 each, Cherrapunji, Shivana & Gerusoppa 14 each, Balachaur, Pachpadra, Balotra, Bhira & Mani 13 each, Ambala, Nawanshahar, Pardi, Poladpur, Bantwal & Honavar 12 each, Kota, Kollur, Linganamakki, Talaguppa, Hosanagara & Sringeri 11 each, Chatia, Guler, Bangana, Nadaun, Jhunjhunu, Mahad, Sangamneshwar, Mandangad, Radhanagari, Mulki, Panambur & Subramanya 10 each, Ratia, Talwandi, Ghamroor, Nagrota Surian, Renuka, Bharwain, Fatehgarh, Modasa, Matheran, Bajpe, Mudibidre, Mudigere & Kudulu 9 each, Luni, Giba, Ulhasnagar, Chiplun, Panjim, Ponda, Siddapura, Kumta, Kottigehara & Kammardi 8 each, Panbari, Berhampur, Siwana, Tanakpur, Pehowa, Jagadhari, Barnala, Halwara, Mehre, Lunkansar, Bhopalgarh, Behror, Vadgam, Murbad, Mangaon, Roha, Lanja, Canacona, Mapusa, Sanguem, Igatpuri, China Kallar, Mangalore, Puttur, Belthangadi, Dharmasthala, Karkala, Kundapur, Ankola, Bhagamandala, Thirthahalli, Humchadakatte & Kasargode 7 each	Gaganbavda 19, Kapadvanj 11, Mahabaleshwar 10, Jambugoda, Kathalal, Mahudha & Savli 9 each, Bihubar, Dhandhuka, Matar, Mangaon, Dapoli, Chandwad & Agumbe 8 each, Sallopat, Dohad, Kalol, Mahuva, Songadh, Ukai, Dhari, Rahpar, Bhira, Mhasala & Kottigehara 7 each
15.	Ghamroor 21, Rajghat 19, Kanpur & Anjar 18 each, Gandhidham 17, Morvi, Chanpatia & Becharaji 16 each, Mahabaleshwar, Poladpur & Mangrol 15 each, Kottigehara & Sikandapur 14 each, Varanasi, Pathankot, Bhira & Sondhgadh Pali 13 each, Roha & Kakrahi 12 each, Soro & Balarampur 11 each, Digha 10, Shahajahanpur, Balachaur, Mandangad, Lanja, Long Island, Pupunki & Patna 9 each, Mahad & Tenughat 8 each, Dehra Dun, Matheran, Kudulu, Napoklu, Asansol, Sambalpur, Ranchi, Mirzapur, Nazibabad, Rajitsagar Dam & Shahapur Kandi 7 each	Cherrapunji 24, Sikandarpur 17, Sabroom 14, Tangla, Arundhutinagar & Galgalia 13 each, Domohani & Basar 11 each, Balarampur 10, Agartala, Balurghat, Asansol, Udala, Matheran, Neemsar & Rajakhore 9 each, Baghdogra, Gajoldoba, Karanjia, Bhinga & Patna 8 each, Goalpara, Dhekiajuli, Sevoke, Baragaon, Basua, Khagaria, Elginebridge, Mahoba, Sira & Samari 7 each	Chhansa & Bharwain 15 each, Bhalukpong, Deogaon, Jamshedpur & Sambalpur 14 each, Paradip & Agumbe 13 each, Agra, Ballabagarh, Bhira & Mahabaleshwar 12 each, Phagwara, Sambalpur, Jharsuguda, Sundergarh, Aligarh, Bagpat & Matheran 11 each, Hardoi & Delhi 10 each, Cherrapunji, Chanpatia, Gomatia, Pataudi, Hissar, Una, Kollur & Bhatkal 9 each, Gaighat, Ballia, Pantnagar, Bosan, Mulki, Kota, Kundapur, Shirali & Ankola 8 each, Margherita, Phoolberia, Araria, Buxar, Kanpur, Dhansa, Faridabad, Indri, Ludhiana, Nawanshahar, Nangal, Ghamroor, Nangal Dam, Kotputli, Dasuya, Dharampur, Ahwa, Chandgad, Dummagudem, Bajpe, Udupi, Karkala, Gerusoppa, Talaguppa, Jayapura & Kammardi 7 each	Upleta 27, Vanthali 23, Kutiana, Diu, Lalpur & Matheran 21 each, Keshod 19, Jetpur 18, Kodinar & Dhoraji 16 each, Khalapur 14, Navsari, Junagad, Ranavav & Karjat 13 each, Talala & Veraval 11 each, Manavadar, Porbandar, Roha & Pali 10 each, Maliya, Bhanvad, Gondal, Bhira, Pen & Panvel 9 each, Kamrej, Dhari, Mangrol, Rajkot, Dapoli & Mahabaleshwar 8 each, Chandbali, Angul, Jharsuguda, Jalalpur, Gogha, Kalawad, Lodhika, Alibag, Shrivardhan, Uran, Tala, Harnai & Mandangad 7 each
16.	Jind 19, Chandbali 17, Mahabaleshwar 16, Gobindpur & Pathankot 15 each, Todabhim 14, Sadavas 13, Nilgiri, Jaipur, Patiala & Neemrana 12 each, Harabhanga, Telkoi, Baripada	Pechipparai 23, Cherrapunji 19, Kuzhithurai 18, Agumbe & Kanjirapalli 17 each, Alapuzha & Thiruvalla 13 each, Katerniaghat, Bareilly, Marmugoa, Mancompu, Chengannur & Srinivasapura 11 each, Basti, Dabholim, Thodupuzha	Raigarh 15, Narora 13, Uskabazar, Cherrapunji & Ghatagaon 12 each, Sukiapokhri, Dunguripalli, Chargharia, Sunnibhaji & Baijnath 11 each, Bosan, Janakpur & Agumbe 10 each, Baragaon, Galgalia, Monghyar, Nowgong & Satna 9 each,	Junagarh 20, Vanthali 17, Paradeep 16, Talala 15, Madanpur Rampur, Lanjigarh & Bhilwara 11 each, Telkoi, Komna & Dwarka 10 each, Pattamundai & Udaipur 9 each, Bissam-Cuttack 8, Keonjhar,

TABLE 18 (Contd.)

(1)	(2)	(3)	(4)	(5)
	& Sirsa 11 each, Balasore & Narwana 10 each, Balimundali, Julana, Kalayat, Hissar, Moradabad, Kalaghar & Shahpura 9 each, Rajghat, Bangirposhi, Jagadhari, Sohana, Nadauti, Bhatpurwaghat, Bilaspur & Rajgarh 8 each, Jamsolaghat, Rajkishorenagar, Athamalik, Aligarh, Bharwain, Sadaura, Sarmathura, Bansur & Kolkata 7 each	& Balrampur 10 each, Hasimara, Ayodhya, Ghazipur, Penukonda, Thuckalay, Neelamangala, Mavelikara & Varkala 9 each, Sultanpur, Valpoi, Manjeri, Kottayam & Sukinda 8 each, Barobhisa, Durgapur, Dhenkanal, Chargharia, Triveni, Ganghat, Mukerian, Rajpura, Koppa, Haripad, Konni & Talli 7 each	Chouldhowaghat, Baghdogra, Lava, Bolangir, Shivarinarayan, Baikunthpur & Shivarinarayan 8 each, Itanagar, Passighat, Munsong, Sevoke, NH-31, Pedong, Mundali, Chinyalisaur, Mussoorie, Mukerian, Khajuraho, Rewa, Jashpurnagar & Pamgarh 7 each	Athagarh, Kendrapada, Rajkanika, Rengali, Kakatpur, Khandapara, Kotraguda, Sutrapada, Okha, Dhoraji, Mahabaleshwar & Purihansa 7 each
17.	Rairangpur 32, Contai 26, Jaleshwar & Rajghat 25 each, Uluberia & Kharagpur 24 each, Midnapur 21, Bhograi & Kalaikunda 19 each, Canning Town 18, Joshipur, Digha, Jaisamand & Malakhera 17 each, Banyana, Baseri & Silisad 15 each, Antal, Nilgiri, Balasore, NH5, Jamsolaghat, Baripada, Durgachak & Neemrana 14 each, Khandapara & Tiring 13 each, Jaypore, Balimundali, Roopwas, Jorhat & Bani 12 each, Ghatgaon, Thakurmunda, Bangirposh, Karanjia, Kolkata, Dholpur & Alwar 11 each, Cherrapunji, Pallahara & Beir 10 each, Tangla, Telkoi, Anandpur, Sukinda, Soro, Bawal, Ateli, Bansur & Sakleshpura 9 each, Champua, Dharamtul & Harinkhola 8 each, Sapido, Narnaul, Basua, Dengraparaghat, Keonjargarh & Jhansi 7 each	Shahajahanpur 19, Dholpur 14, Vengurla 12, Bhatpurwaghat, Lucknow & Rajapur 11 each, Pernem 10, Birdghat, Gorakhpur, Uskabazar, Bareilly & Mapusa 8 each, Munger, Allahabad, Neemsar, Baijnath, Panjim, Kayamkulam, Haripad & Katra 7 each	Cherrapunji 21, Hardwar & Passighat 15 each, Kanpur & Tadepalligudem 13 each, Dengraghat & Tehri 12 each, Kotkasim & Polavaram 11 each, Mahoba, Auraiya, Dabri, Shahjina, Dehra Dun, Madhopur, Hamirpur & Thanjavur 10 each, Khagaria, Ranjit Sagar Dam Site, Koida & Medchal 9 each, Kashinagar, Lanjigarh, Kanpur, Hardwar, Shahpur Kandi, Gaganbavda & Patapatnam 8 each, Tilaiya, Forbesganj, Bani, Ankinghat, Bareilly, Gomatia, Devprayag, New Tehri, Kalagarh, Hrishikesh, Bilaspur, Pathankot, Tikamgarh, Baikunthpur, Hyderabad, Kamareddy & Thanjavur 7 each	Akhuapada 31, Jenapur & Lakhatar 30 each, Baliguda 24, Rajkanika & Jetpur-Moni 23 each, Mundali & Pattamundai 22 each, Tikabali 21, Madanpur-Rampur, Narwana & Junagad 20 each, Belgaon, Bolangir, Binika & Daringibadi 19 each, Chandbali, Kendrapada, Bhavanipatna, Vanthali & Matheran 17 each, Ghatagaon, Athagarh & Lathi 16 each, Paradip, Kotagarh, Talala, Lilia, Umarala & Dharavi 15 each, Alipingal, Lanjigarh, Kalinga, Sawarkundla, Wankaner & Gaganbavda 14 each, Jajpur, Tikarpada, Titlagarh, Pipalda, Gandevi, Jamnagar, Dhoraji & Bhandup 13 each, Khairamal, Cuttack, Naraj, Patnagarh, Sonepur, Phulbani, Barwala, Dhari, Chotila, Muli, Gariyadhar, Gondal, Jasdhan, Mumbai & Karjat 12 each, Digha, Bonth, Thakurmunda, Bhubaneshwar, Bhilwara, Lilia, Upleta, Bagsra, Limbdi & Panvel 11 each, Rajghat, Athamalik, Bargarh, Khariar, Kantamal, Dwarka, Ahwa, Khambha, Kalawad, New Kandla & Ulhasnagar 10 each, Contai, Bhogari, Altuma, Bijepur, Paikmal, Bhanjanagar, Junagarh, Udaipur, Mandal, Kotri, Begu, Vadgam, Keshod, Barmul, Viramgam, Kapadvanj, Bansda, Babra, Junagarh, Halvad, Sayla, Wadahvan, Morvi, Khalapur, Mahabaleshwar & Khairagarh 9 each, Chouldhowaghat, Girwa, Banera, Nasirabad, Mandalgarh, Lalsot, Bhim, Kalyanpur, Lalpur, Kutch Mandvi, Keonjargarh, Aska, Madhabarida, Khandapara, Dunguripalli, Ranpur, Songadh, Amreli, Vallabhipur, Rajkot & Vasai 8 each, North Lakhimpur, Lava, Diamond Harbour, Mohanpur, Gangrar, Karera,

TABLE 18 (Contd.)

(1)	(2)	(3)	(4)	(5)
				Manavadar, Anandpur, Jhumpura, Swampatna, Dhenkanal, Kamakhya Nagar, Narsinghpur, Jaipatna, Komna, Kakatpur, Nimapara, Pipli, Dashpalla, Kotraguda, Nanipalsan, Madhuban, Palitana, Rajapur, Valpoi, Igatpuri, Devbhog, Nagari & Chuura 7 each
18.	Kalaikunda 53, Midnapur 37, Jamshedpur 34, Rairangpur 32, Mohanapur 31, Jaleswar 29, Rajghat 28, Baripada 25, Bangirposhi 20, Karanjia & Joshiapur 19 each, Chandanpur, Jhumpura & Phoolberia 17 each, Champua 16, Balimundali, Thakurmunda & Kharidwar 15 each, Ghatgaon & Ranchi 14 each, Swampatna & Lawa 13 each, Passighat, Pallahara, Telkoi, Pedong, Simulia & Dabri 12 each, Khowang, Bhograi & Guler 11 each, Jaypore, Balasore, Udala, Kasol, Kansabati Dam, Dengarparaghat & Kulpahar 10 each, Nilgiri, Lahunipara, Bargaon, Nagrota Surian, Shimla, Sujanpur Tira, Bari, Gangtok, Darjeeling, Tenughat & Shivpuri 9 each, Anandpur, Harinkhola Konner, Pupunki & Jhansi 8 each, Mahoba, Tusuma & Digha 7 each	Khagaria 17, Piravom 15, Dharamsala 11, Monghyar, Pantnagar, Srungavarapukota, Kottayam & Marmugoa 9 each, Krishnanagar, Burdwan, Dehra Dun, Pandoh, Dabholim, Aluva, Paravur & Perambavour 8 each, Kohima, Kansabati Dam, Bareilly, Kalagarh, Nadaun, Panjim, Margaon, CIAL Cochi, Vaikom, Kozha & Katra 7 each	Cherrapunji 19, Barobhisa 17, Alipurduar 14, Govindgarh, Vanur & Tirumayam 11 each, Hasimara, Sathanur Dam, Harur & Vanur 10 each, Chouldhowaghat, Malda, Sultanpur, Dholpur Tehsil & Berla 9 each, Nalbari, Villupuram, Grand Anaicut, Paramathi, Dharamsala & Tehri 8 each, North Lakhimpur, Sabroom, Bijanbari, Gajoldoba, Nagrakata, Murti, Pallahara, Patnagarh, Hazaribagh, Tiruchirapalli, Alangayam, Gingee, Panruti, Polur, Baheri & Pawayan 7 each	Dhandhuka 50, Lakhatar 48, Wadahvan & Madhuban 37 each, Limdbi 30, Pantnagar & Ranpur 27 each, Kantamal, Kasargode & Dhrangdhra 26 each, Titlagarh & Sojitra 25 each, Rairakhol 24, Kotagarh, Tarapur & Chuda 23 each, Sambalpur & Borsad 22 each, Batagaon, Madanpur Rampur, Bolangir & Muli 20 each, Hirakud, Jharsuguda, Laikera, Baliguda, Petlad & Narharpur 19 each, Tikabali, Ukai & Vallabh Vidyannagar 18 each, Kuchinda, Junagarh, Belgaon, Barwala, Mandal & Pusor 17 each, Khairamal, Hemgiri, Sonepur & Nagri 16 each, Devgaon, Baudhgarh, Viramgam & Patan 15 each, Jamankira, Devgarh & Lanjigarh 14 each, Rajghat, Naktideul, Pallahara, Reamal, Ambabhona, Paikmal, Bhavanipatna, Dunguripalli, Phulbani, Anklav, Sami, Halvad, Gariaband & Raigarh 13 each, Bargarh, Tensa, Jaipatna, Becharaji, Matar & Champa 12 each, Athamalik, Bijepur, Sohela, Daringibadi, Kotraguda, Raipur & Chhura 11 each, Telkoi, Padampur, Baran, Gandevi, Sihor, Morvi & Baramkela 10 each, Chhendipada, Rengali, Bargaon, Binika, Kalinga, Roopaheli, Cambay, Nadiad, Chansma, Harij, Ahwa, Igatpuri, Gaganbavada, Basan, Korba, Karthala, Janjgir, Pathalgaon, Gharghoda, Malkha Road & Lailunga 9 each, Lahunipara, Wav, Mahudha, Bansda, Bardoli, Jasdan, Wankaner, Rajim, Saraipali, Baliagarh, Kharsia & Nawapur 8 each, Dengarparaghat, Rajgangapur, Harabhanga, Navrangpur, Bissam Cuttack, Gudari, Kanpur, Chipagod, Dholpur, Kheda, Sauli, Botad, Palitana, Mahasamund, Sakti, Shivarinarayan & Sarangarh 7 each

TABLE 18 (Contd.)

(1)	(2)	(3)	(4)	(5)
19.	Tikamgarh 25, Nowgong 21, Jhansi 15, Khajuraho 13, Cherrapunji 12 Shahbad 11, Didihat & Bhoranj 10 each, Durgapur, Datia, Kollur, Kozhikode & Sagar 9 each, Daltonganj & Agumbe 8 each, Goalpara, Darjeeling, Bankura, Burdwan, Panagarh, Karanjia, Sujapur Tira, Dharamsala & Damoh 7 each	Mohanpur & Tirupattur 14 each, Mangalagiri 13, Kalagarh 12, Amraghat & Dhekiajuli 11 each, Dholai 10, Nancowry, Dehra Dun, Arani, Magalapuram, Kozha & M.M. Hills 9 each, Kotdwar, Anakapalli, Macherla, Midnapore & Nancowry 8 each, Diana, Phoolberia, Midnapore, Kalaikunda, Dengarparaghat, Mahendragarh, Bareilly, Sathanur Dam, Vellore, Dharmapuri, Paramathi, Salem, Nandigama, Dehra Dun & Guwahati 7 each	NH-31 Bridge 14, Cherrapunji & Champasari 13 each, Balrampur 12, Matizuri, Sevoke, Domohani, Nawrangpur & Birdghat 11 each, Kosagumda, Kakrahi 10, Sukiapokhri, Gajoldoba, Bansi, Sulurpet, Peravurani & Thali 9 each, Darjeeling, Alipurduar, Barobhisa, Gorakhpur, Uskabazar, Gomatia, Seetharamapuram, Pattukottai & Polur 8 each, Goalpara, Annapurnaghat, Numaligarh, Bijanbari, Jalpaiguri, Baragaon, Dashpalla, Narendranagar & Porumamilla 7 each	Ukai 20, Katghora 17, Arki, Durg & Pantnagar 16 each, Safidon & Umaria 15 each, Kotkasim, Baliagarh & Navapur 14 each, Thanaghazi, Viratnagar, Jhagadia, Vagra, Pithora, Basna & Banbasa 13 each, Narnaul, Anand, Nadiad, Dediapada, Mandevi, Babra, Umarala, Thane Belapur, Pamgarh, Baloda, Saja & Pendra 12 each, Hodel, Jalalpur, Songadh, Vallabhipur, Chhura, Gariaband & Mahasamund 11 each, Rajgarh, Dasuya, Nadauti, Nanipalsan, Broach, Ahwa, Mokhada, Pali, Uproad, Masturi, Dabhra, Dharamjaigarh, Raipur, Arang, Rajim & Akaltara 10 each, Kalayat, Nuh, Vyara, Bhavnagar, Talasari, Iगतपुरी, Peint, Rajnandgaon, Dongargarh, Kurud, Mana, Kharsia, Lailunga & Saraipali 9 each, Haridwar, Sohna, Assandh, Guhla, Taoru, Sojitra, Navsari, Madhuban, Amreli, Lilia, Kakatpur, Marwahi, Malkharoda, Bemetara, Bilaspur & Kandaghat 8 each, Pantnagar, Narnaul, Gharaunda, Panipat, Ateli, Bawal, Jubbal, Banera, Mahuva, Mandwar, Neemrana, Dhandhuka, Tarapur, Vapi, Hansot, Gandevi, Mahuva, Palsana, Surat, Valod, Lathi, Gogha, Wankaner, Amgaon, Dongargaon, Korba, Kartala, Abhanpur, Tilda, Gurur, Baghbahra, Bilha, Pusor, Palari, Simga, Berla, Pandaria, Sakti, Jaijaipur & Kundapur 7 each
20.	Sevoke & Galgalia 23 each, Baghdogra 19, Chamsarai 18, Neora 17, Gajoldoba 16, Murti & Tikamgarh 14 each, Haridwar 13, Diana, Domohani & Jalpaiguri 11 each, NH31 & Sagar 10 each, Cherrapunji, Darjeeling, Hasimara, Nagrakata & Agumbe 9 each, Bijanbari, Triveni, Pandoh, Jamua Ramgarh, Chipabarod & Guna 8 each, Khanitar & Narora 7 each	Sikandarpur 21, Uskabazar 20, Munger 12, Polavaram 11, Sukiapokhri, Chanchal & Katghera 10 each, Darjeeling, Jhanjharpur, Rewaghat, Sriniketan & Yellandu 9 each, Beki Road Bridge, Bijanbari, Purnea & Ganaur 8 each, Nalbari, Dillighat, Sevoke, Arjunimorgaon, Kharangha & Joypur 7 each	Varanasi & Rajghat 29 each, Fursatganj 22, Pantnagar 21, Bankura 16, Monghyar 15, Elginebridge & Lakhimpur Kheri 13 each, AIE NH Xing & Alipurduar 12 each, Gonda & Pathalgaon 11 each, Manas NH Xing, Bankura, Lucknow, Chennai, Poondi & Thamaraiakkam 10 each, Beki Road Bridge, Bahalpur, Panbari, Daltonganj, Hazaribagh, Gaya, Mirzapur, Phaphamau, Kartala & Rajpur 9 each, Lakhipur, Kokrajhar, Kolkata, Chatnag, Saraon, Samari & Palamner 8 each, Barpeta, Chouldhowaghat, Chandbali, Jharsuguda, Balarampur, Hanumansetu, Korba, Sakti, Ambikapur, Malkha Road, Kharsia, Ibrahimpatnam & Puttur 7 each	Biswan 37, Shardanagar 28, Nighasan & Roha 27 each, Lakhimpur Kheri, Dharampur & Kasauli 26 each, Hanuman Setu & Iगतपुरी 24 each, Katerniaghat, Rajgarh & Bhira 23 each, Palliakalan, Solan & Ambala 21 each, Lucknow 20, Kandaghat, Elginebridge, Rajpura, Ropar, Kahu & Gohar 19 each, Arki, Chandigarh, Banjar, Shimla, Sunnibhaji & Ropar 18 each, Bhatpurwaghat, Guhla, Naraingarh, Patiala & Derabassi 17 each, Pantnagar & Jatusana 16 each, Rampur Bushahar & Laxmangarh 15 each, Dhaurara & Pali 14 each, Fursatganj, Banbasa, Talayat, Meham, Pehowa, Rewari, Sampla, Ghumarwin & Anand 13 each,

TABLE 18 (Contd.)

(1)	(2)	(3)	(4)	(5)
				Dhundhi, Mukteswar, Nainital, Kaithal, Bhuntar, Berthin & Khalapur 12 each, Jind, Narwana, Uchana, Samrala, Balachaur, Jhandutta, Sundernagar, Kasol, Solangnala, Bhang & Mahabaleshwar 11 each, Nahan, Renuka, Dadahu, Bahaich, Mohamdi, Neemsar, Anandpur Sahib, Ahwa, Mangaon, Matheran & Tala 10 each, Balarampur, Dalmau, Kakardharighat, Raibareilly, Ukhimath, Beri, Kalka, Karsog, Mandi, Pandoh, Kotkhal & Daman 9 each, Bhinga, Pithogharh, Tiuni, Kalka, Hissar, Julana, Pilukhera, Patsio, Bhoranj, Malakhera, Karjat, Nashik 8, Bani, Bhiwani, Didihat, Hardwar, Bilaspur, Chhachharauli, Mustafabad, Sadaura, Tohana, Kalpa, Nalagarh, RL-1700, Udaipur, Kishangharh, Neeramrana, Alwar, Arnod, Bahadurpur, Tharad, Silvasa, Mahad & Cochi 7 each
21.	Damoh 14, Mehroni 13, Cherrapunji 12, Kharidwar, Khagaria, Jamwaramagarh & Tikamgarh 10 each, Chaksu, Didwana & Parvatsar 8 each, Mettupatti, Bhagalpur, Kahalgaon, Sambhar, Todaraisingh, Jabalpur, Banda, Garhakotta, Rehli, Sagar, Umaria, Subramanya & Abohar 7 each	Cherrapunji 34, Tiruchirapalli 16, Hasimara 15, Beki Mathanguri, Bansi, Jaunpur & Tiruchirapalli 13 each, Triveni & Uskabazar 12 each, Chanpatia, Chandradeepghat & Balodabazar 11 each, Mukerian, Subramanya, Barobhisa & NH-31 10 each, Passighat, Alipurduar, Bareilly & Bosan 9 each, Tezu, Araria, Lalbegiaghat, Khetikhan, Kamareddy, Bangalore, Gubbi & Agumbe 8 each, Cooch Behar, Domohani, Ahirwalia, Kakrahi, Turtipar, Khol, Agumbe & Hosekote 7 each	Matizuri 10, Amraghat, Dholai, Naharkatia, Kakatpur & Nahan 9 each, Gonda & Metturdam 8 each, Bokajan, Paikmal, Sakti, Bhavani, Bisauli & Tehri 7 each	Banbasa 28, Nainital & Bareilly 21 each, Barabanki 19, Baheri 16, Nighasan & Palliakalan 15 each, Misrikh 14, Elginebridge, Gonda, Pantnagar & Malegaon 13 each, Bahaich, Lakhimpur Kheri, Mukteswar & Mahad 12 each, Mohamdi & Poladpur 11 each, Bhalukpong, Dharamshala, Pithoragarh & Mahabaleshwar 10 each, Sitapur, Parbhani, Akot & Amraoti 9 each, Udgir & Pullandurai 8 each, Kherunighat, Kampur, Balimundali, Bhubaneshwar, Kanpur, Shardanagar, Sangamneswar, Bhuvanagiri & Konni 7 each
22.	Nagrakata 30, Murti 27, Neora 21, Long Island & Cherrapunji 18 each, Gajoldoba 16, Diana 13, Amini Divi 11, Maya Bandar 10, Sriperumbuder, Red Hills, Rewaghat, Dehra Dun & Agumbe 9 each, Janakpur 8, Chennai, Keeranur, Poondi, Champasari, Lalitpur, Mahendragarh & Mannarkad 7 each	Cherrapunji 37, Passighat 21, Tezu 19, Barobhisa, NH-31 16, Panbari, Baghdogra, Jalpaiguri, Murti & Neora 15 each, Cooch Behar, Alipurduar, Gajoldoba & Galgalia 13 each, Domohani, Tikabali, Taiipur 12, Bolangir & Bansi 10 each, AIE, NH Xing, Kokrajhar, Nagrakata, Balimundali & Kakrahi 9 each, Beki Mathanguri, Diana, Hasimara & Alipingal 8 each, Beki Road Bridge, Bahalpur, Barpeta, Motunga, Champasari, Mathabhanga, Fursatganj, Sapua, Ponda, Katghora, Jagdalpur, Kamareddy, Kasargode & Mulugu 7 each	Orathanadu 20, Ambabhona 12, Rairakhol & Pusor 11 each, Bijepur & Manamelkudi 10 each, Silchar, Dholai, Matizuri & Hirakud 9 each, Telkoi, Altuma, Kamakhya Nagar, Bargarh, Dhundhi & Silchar 8 each, Alipingal, Sukinda, Tiring, Kalanaur, Pandoh, Katra, Udampur, Devala & Thiruvadanai 7 each	Athani 14, Chiplun 13, Birdghat 12, Lengpui 9, Jenapur, Bhubaneshwar, Bahaich, Kakardharighat, Gariaband, Dharmnagar, Guhagar & Paradip 7 each

TABLE 18 (Contd.)

(1)	(2)	(3)	(4)	(5)
23.	Bhalukpong & Cherrapunji 14 each, Ketti 13, Jalpaiguri 12, Chinna Kallar, Sevoke & Krishnaprasad 11 each, Devala, Nagrakata, Berhampore, Elginebridge, Dholpur, Thirukoilur, Kanjirapalli, Thalassery, Puthimari & Poonampet 7 each	Cherrapunji 33, Domohani 20, Jalpaiguri 17, Vengurla 15, Lalbegiaghat, Ayodhya, Gonda & Khalilabad 12 each, NH-31, Kamtaul & Shardanagar 11 each, Kokrajhar, Galgalia, Mukhlisipur & Malvan 10 each, Hasimara, Nagrakata, Murti, Neora, Madanpur Rampur, Araria, Gorakhpur, Kakardharighat, Gauribidanur, Kayamkulam & Haripad 9 each, Dhubri, Diana, Kalaikunda, Birpur, Jhanjharpur, Pali & Dharwad 8 each, Dhollabazar, Chanpatia, Basti, Palliakalan, Yeotmal, Bhadravati & Kumbakonam 7 each	Dabri 9, Mawana 8, Maya Bandar, Deogaon, Balimundali, Titlagarh & Udampur 7 each	Tenughat 12, Tikabali & Barkisurya 9 each, Lakhipur & Tilaiya 8 each, Itanagar, North Lakhimpur, Athagarh, Hazaribagh, Maithon, Ramgarh & Pilani 7 each
24.	Devala 19, Valpoi 11, Maya Bandar, NH Xing, Jia Bharali & Chatia 9 each, Long Island 8, Diana, Panposh, Surajpur, Ilkal & Agumbe 7 each	Cherrapunji 34, Bhatpurwaghat 14, Kosagumda, Varanasi, Kansabati Dam & Tiring 11 each, Solapur & Agumbe 10 each, Sukiapokhri, Chaibasa, Basti, Elginebridge, Jaunpur, Neemsar, Dharamsala, Alapuzha, Chinna Kallar & Purihansa 9 each, Pipli, Gazipur, Lucknow, Mahendragarh, Konta, Chhura, Peddapuram, Bheemtal & Mancherial 8 each, Tikrikilla, Pedong, Hindol, Allahabad, Chatnag, Mudhol, Sriramsagar, Kayamkulam, Port Blair & Lonar 7 each	Gajoldoba 13, Hasimara, Bengaon & Belgaon 9 each, Baramkela & Sitapur 8 each, Silchar, Neematighat, Naraj, Dahanu & Srisailam 7 each	Rairangpur 7
25.	Turtipar 13, Gharmura 10, Lumding 9, Dholai & Motihari 8 each, Deogaon, Buxor, Baikunthpur & Haridwar 7 each	Alibag 18, Vasai & Malvan 15 each, Kollur 13, Ghatgaon 12, Rajgangapur, Mumbai, Uran, Ratnagiri, Devgarh, Udupi & Bhatkal 11 each, Baragaon, Shirali & Devala 10 each, Shrivardhan, Karkala, Siddapura & Agumbe 9 each, Port Blair, NH-31, Champua, Auraiya, Dabri, Kalpi, Canacona, Mudhol, Kota, Kundapur, Honavar, Karwar, Ayoriya & Rath 8 each, Champasari, Diana, Jalpaiguri, Kotraguda, Hamirpur, Didihat, Naraingarh, Valsad, Dabholim, Margaon, Pungannur, Mulki, Panambur, Bajpe, Mudibidre, Dharmasthala, Gerusoppa, Ankola, Kasargode & Banda 7 each	Virudhunagar 11, Kokrajhar & Chipurupalli 10 each, Panbari, Diana 9, Banbasa 8, AIE NH Xing, Bijanbari, Ramtek, Nuzvid & Magalapuram 7 each	Sikandarpur 14, Muzaffarpur 11, Belawadi 10, Kaveli, Red Hills & Dharwad 9 each, Dhenkanal, Athagarh, Bhubaneswar, Hazaribagh, Chanpatia, Atmakur, Chittoor & Kancheepuram 7 each
26.	Athagarh 20, Athamalik & Mandangad 13 each, Naharkatia 11, Naraj & Puttur 10 each, Bokajan & Paradip 9 each, Kohima, Devgarh, Dodamarg, Durg & Narsampet 8 each, Margherita, Harabhanga, Mahad, Tala, Pali, Udupi & Honavar 7 each	Ratnagiri 17, Fursatganj 15, Mumbai 13, Murud & Bansda 12 each, Barpeta, Annapurna Ghat, Alibag, Amalapuram, Karkala, Agumbe & Chinna Kallar 11 each, Junagarh, Navrangpur, Bhandup, Mhasala & Gaganbavada 10 each, Panagarh, Sami, Babra, Shrivardhan, Gondpipri, Tadepalligudem, Navipet & Mulki 9 each, Amraghat, Cooch Behar, Pardi, Roha, Tala, Rajura, Alampur, Mudibidre, Bajpe, Sringeri, Jayapura & Kasargode 8 each, Hut Bay, Puthimari, Nalbari, Barobhisa, Nayagarh, Chincholi, Mahad, Uran,	Cherrapunji 36, Cooch Behar 21, Tiruchirapalli 16, Alipurduar & Karmala 14 each, Passighat, Domohani 13, Badvel 12, Barobhisa, Mehbubnagar & Mahabubabad 11 each, Gooty 10, Diana, Jalpaiguri, Murti, Galgalia, Kakardharighat, Mandla, Kanekal & Valparai 9 each, Champasari, Gajoldoba, Prantij, Tadepalligudem, Chittoor, Pamidi & Gubbi 8 each, Panbari, Baghdogra, Hasimara, NH-31, Anta, Banswara, Idar, Rajim, Kaleswaram & Pennagaram 7 each	Harinkhola & Contai 9 each, Krishnanagar & Uluberia 8 each

TABLE 18 (Contd.)

(1)	(2)	(3)	(4)	(5)
		Harnai, Warora, Aheri, Pakhanjur, Bobbili, Machilipatnam, Tanuku, Dummagudem, Hanamkonda, Sultanabad, Belthangadi, Gerusoppa, Bantwal, Kundapur & Panambur 7 each		
27.	Bomdila 26, Gariaband 15, Balasore & Bosan 13 each, Dibrugarh & Masturi 12 each, Cherrapunji, Dashpalla, Sonbarsa, Patiala & Baloda Bazar 11 each, Marora, Balachaur & Paonta 10 each, Sevoke, Galgalia, Rishikesh & Naraingarh 9 each, Binika, Dunguripalli, Ludhiana, Mukerian, Phillour, Akatara & Madnoor 8 each, Champasari, Neora, Samrala, Nahan, Raisen, Durg, Huzurabad, Bhagamandala, Manjeri & Degod 7 each	Chiplun 17, Lanja 15, Vasai & Agumbe 14 each, Bolangir, Matheran & Gerusoppa 13 each, Mangaon & Buldhana 12 each, Thane, Tala, Mahabaleshwar, Bhiwapur, Katghora, Sringeri & Chinna Kallar 11 each, Sambalpur, Barmul, Banbasa & Bhiwandi 10 each, Jaleswar, Roha, Poladpur, Radhanagari, Umrer, Kollur, Talaguppa, Jayapura, Gudalur Bazar & Nuzvid 9 each, Hirakud, Maya Bandar, Pallikalan, Bhainsroadgarh, Dhambola, Uran, Gaganbavada, Bijapur, Puttur, Karkala, Kottigehara & Sakaleshpura 8 each, Long Island, Puri, Uttarkashi, Rawat Bhata, Chabra, Kalyan, Thane Belapur, Bhira, Khalapur, Pali, Panvel, Pendra, Baikunthpur, Mulki, Mani, Dharmasthala & Devala 7 each	Cooch Behar 21, Tiruchirapalli 16, Kokrajhar 15, Passighat & Idar 14 each, Cherrapunji, Narendranagar & Hrishikesh 13 each, Nadauti & Thali 11 each, AIE NH Xing, Taibpur & Karjan 10 each, Barpeta, Ghatgaon, Sikandarpur, Madakasira & Palacode 9 each, Barobhisa, Broach, Alangudi, Dharapuram, Krishnagiri, Mariachi, Mettupatti, Pudukottai & Jhalawar 8 each, Tezu, Bahalpur, NH-31, Baghdogra, Dehra Dun, Haridwar, Kotdwar, Jhalawar, Sallumber, Jambugoda, Bhiloda, Himmatnagar, Padra, Mangrol, Talaja, Rajampet, Rayachoty, Arantangi, Dharmapuri, Hosur, Sholavandan, Vadipatti, Bangalore & Chikkanahalli 7 each	Barackpur, Barpeta & Bashirhat 7 each
28.	Narnaul 19, Mahasamund 18, Bomdila & Gariaband 17 each, Chandbali 15, Aheri & Agumbe 13 each, Junagarh & Dharamsala 12 each, Itanagar, Athagarh & Chabra 11 each, Madanpur Rampur, Batrampur, Fursatganj, Kalagarh & Damoh 10 each, Binika, Bansi, Bhingra, Chandradeepghat, Mahenderghar & Shimla 9 each, Paradip, Cuttack, Padampur, Khariar, Birdghat, Sundernagar, Kurwai, Kurkheda, Mani, Puttur & Bhagamandala 8 each, Naraj, Kendrapada, Belgaon, Titlagarh, Gorakhpur, Kakrahi, Varanasi, Gomatia, Pandoh, Raisen, Rajgarh, Umaria, Devbhog, Raigarh & Kasargode 7 each	Bajpe 39, Roha 37, Tala 28, Mangaon 26, Mumbai 25, Chinna Kallar 23, Alibag & Agumbe 22 each, Uran & Gerusoppa 21 each, Vythiri 20, Poladpur 19, Puri, Sallumber & Talaguppa 18 each, Maya Bandar & Sringeri 17 each, Bhira, Pali, Mahad, Mahabaleshwar, Dharmasthala, Jayapura, Devala & Naduvattam 16 each, Pen, Dantewada, Medikeri, Kalasa & Peermade 15 each, Valpoi, Antagarh, Madapura & Kottigehara 14 each, Sagbara, Bodeli, Mhasala, Murud, Shirali, Jagalbet, Kammadi, Sakaleshpura & Munnar 13 each, Kosagumda, Krishnaprasad, Badisadri, Panvel, Harnai, Gudalur Bazar, Kollur, Bhatkal & Gudalur Bazar 12 each, Sarara, Halol, Mangrol, Khalapur, Siddapura, Napoklu, Linganamakki, Arasalu, Humchadakatte, Nilambur, Valparai & Kamptee 11 each, Dariabad, Dugla, Bhugra, Valparai, Honavar, Joida & Periyar Dam 10 each, Bhoond, Ghatol, Jagpura, Umareth, Dahegam, Kadana, Kalol, Sutrapada, Veraval, Dhoraji, Shrivardhan, Jagdampur, Kota, Nuzvid, Mananthavady & Kottayam 9 each, Navrangpur, Malkangiri, Banswara, Banera, Himmatnagar, Kankavali, Dodamarg, Radhanagari, Gaganbavada, Gariaband, Konta, Chipurupalli, Siddapura, Tyagarthi, Perinthalmanna, Vaikom & Idukki 8	Cherrapunji 25, Diana 19, Galgalia 14, Beki Mathanguri 13, Hasimara, Alur & Hassan 11 each, Chouldhowaghat, Murti, Kanerkal & Thundebhavbi 10 each, Bhagalpur, Kokrajhar, Baghdogra, Neora, Madurai, Salem & Valparai 9 each, Nagrakata, Kapsan, C. N. Halli, Gubbi & Belur 8 each, Numaligarh, Mathabhanga, Domohani, Gajoldoba, Jalpaiguri, Chanpatia, Sonbarsa, Saulighat, Attur, Mayanur & Kunigal 7 each	Krishnanagar 11, Canning Town 9, Cherrapunji & Barpeta 8 each, Goalpara & Ginge 7 each

TABLE 18 (Contd.)

(1)	(2)	(3)	(4)	(5)
		each, Bhanjanagar, Galiakot, Garhi, Loharia, Shahapura, Prantij, Bagsra, Kodinar, Karjat, Matheran, Malvan, Vaibhavwadi, Mapusa, Quepem, Ponda, Chandgad, Charama, Eluru, Khammam, Madhira, Mulki, Kadra & Lakkavalli 7 each		
29.	Deomali 42, Mukhlispur 21, Kakrahi & Kollur 16 each, Bansi 15, Basti, Agumbe & Kasargode 14 each, Bajpe 13, Panambur 12, Ghazipur, Masturi & Kota 11 each, Purnea & Hosanagara 10 each, Birdghat, Khadda, Regoli, Turtipur, Hindoli, Umariya, Ambagarh Chowki, Pendra, Udupi & Coimbatore 9 each, Araria, Rajakhera, Ladpura, Sangamneswar, Durg, Mani, Mudibidre, Bhatkal & Chinna Kallar 8 each, Sonamura, Simulia, Chatia, Darauli, Banda, Agra, Jahajpur, Jabalpur, Mandangad, Chandgad, Gaganbavada, Dharmasthala, Mulki, Karkala, Kundapur, Shirali, Bhagamandala & Kottigehara 7 each	Sudhagad & Pali 23 each, Mulchera 22, Vanthali, Veraval, Bagsra, Bhiwandi, Bhira & Dantewada 21 each, Thane & Vasai 20 each, Kalyan & Arvi 19 each, Junagarh, Manavadar, Palghar & Belthangadi 17 each, Kosagumda 16, Sanand, Umargaon, Kutiana, Bhanwad, Matheran, Narayanpur & Somwarpet 15 each, Kapadvanj, Daman, Ashti & Chinna Kallar 14 each, Kathalal, Dhari, Talala, Ulhasnagar & Mumbai 13 each, Malkangiri, Upleta, Dahanu, Roha, Igatpuri, Tiwsa & Sukma 12 each, Bayad, Vapi, Jafrabad, Uran, Tala, Mahabaleshwar, Bhadravati, Hinganghat, Karanjia, Kurkheda, Samudrapur & Madapura 11 each, Lakhipur, Pardi, Ranavav, Wada, Kondagaon, Bhagamandala & Vythiri 10 each, Jogindernagar, Valod, Kodinar, Alibag, Karjat, Panvel, Radhanagari, Bhamragad, Desalganj, Wardha, Siddapura, Sringeri, Kamareddy, Ottapalam & Peermade 9 each, Deomali, Silchar, Jai Bharali, NT Xing, Multai, Seoni, Mahudha, Dabhoi, Madhuban, Vyara, Sutrapada, Mahua, Lalpur, Jetpur, Sahapur, Vikramgarh, Pen, Chandgarh, Armori, Bramhapuri, Chimur, Deoli, Shindewahi, Valparai, Dharmasthala & Yellapura 8 each, Maya Bandar, Dholai, Margherita, Atner, Kheralu, Balasinor, Kheda, Prantij, Waghodia, Jhagadia, Vagra, Keshod, Dhoraji, Mokhada, Murbad, Ambernath, Khalapur, Murud, Kankavali, Sakri, Arjunimorgaon, Dhanora, Etapalli, Kuhi, Lakhundur, Nagbhir, Selu, Umbreer, Basna, Chhuria, Kondal, Bheemunipatnam, Sulya, Joida, Medikeri, Agumbe, Kottigehara, Sakaleshpura, Mannarkad, Thirthala & Kanjirapalli 7 each	Gajoldoba 16, Sabroom & Jalpaiguri 14 each, Durgachak 13, Cherrapunji & Champasarai 12 each, Williamnagar, Domohani & Baltara 11 each, Sevoke 10, Belonia, Ghazipur & Palampur 9 each, Lava, Gheropara, Panagarh, Araria, Uskabazar & Palani 8 each, Goalpara, Narainpur, Midnapore, Taibpur, Ballia, Sendamangalam, Nagamangala, Huliurdurga, Punalur & Gaighat 7 each	Chargharia & Purnea 15 each, Jhawa, Dharamtul, Ahirwalia & Sikandarpur 11 each, Berhampur, Sikandarpur, Naharkatia & Patna 10 each, Silchar & Patna 9 each, Bhalukpong, Khesiary, Messenjore, Maharo, Dillighat & Chargharia 7 each
30.	Bomdila 26, Poladpur 23, Mahabaleshwar 22, Bhira 20, Roha 19, Chandigarh, Mahad & Kasargode 18 each, Pali 17, Mangaon 16, Sikandarpur, Kanpur & Matheran 15 each, Cherrapunji & Basti 14 each, Mauli, Pen, Mhasala & Mangalore 13 each, Karjat &	Jawahar, Vikramgarh & Parseoni 19 each, Dwarka 16, Silvasa, Selu & Chinna Kallar 15 each, Renuka, Nanipalsan & Kalyanpur 14 each, Madhuban, Talasari, Mokhada, Pali & Bhagamandala 13 each, Kahu, Vapi, Nagbhir & Agumbe 12 each, Ghumarwin, Valod, Palghar, Karjat, Khalapur, Roha, Matheran &	Cherrapunji 39, Barobhisa 28, Mathabhanga 25, Cooch Behar 24, 8 each, Kokrajhar 18, Dhubri & Alipurduar 13 each, Boath 12, Beki Mathanguri 11, Bhagalpur, Goalpara, Monghyar & Bandipura 9 each, Tikrikilla, Champasarai & Sriramsagar 8 each, Motunga, Gajoldoba, Nagrakata, Uluberia, Umerkote, Kursela,	



TABLE 18 (Contd.)

(1)	(2)	(3)	(4)	(5)
	Agumbe 12 each, Panvel 11, Mukhlisapur, Surat, Valpoi & Shrivardhan 10 each, Rishikesh, Balachaur, Sardarsahar, Bhadesar, Uniwara, Neemkhatana, Khalapur, Tala & Ratnagiri 9 each, Lava, Baltara, Bagnor, Khagaria, Srinagar, Mumbai & Alibag 8 each, North Lakhimpur, Malda, Tilpara Barrage, Colgaon, Birdghat, Uskabazar, Bosan, Jhalod, Pernem, Neemkhatana & Periyar Dam 7 each	Radhanagari 11 each, Bosan, Taibpur, Navipet, Srigonda, Gautampura, Daman & Peint 10 each, Deomali, Hardwar, Karanprayag, Savasara, Kodinar, Bhanvad, Dahanu, Pen, Arjunimorgaon, Bajpe, Mani, Sulya, Kasargode & Devala 9 each, Dehra Dun, Ukhimath, Nahan, Nimbaheera, Chikhli, Keshod, Diu, Wada, Igatpuri, Trimbak, Mahabaleshwar, Dhule, Bhiwapur, Bramhapuri, Dhanora, Gudalur Bazar, Naduvattam, Subramanya, Bantwal, Belthangadi, Munnar, Valparai, Gudalur Bazar, Naduvattam & Harbhanga 8 each, Didihat, Rishikesh, Kasol, Jateon Barrage, Sangrah, Katra, Badesar, Ranavav, Tala, Kamptee, Ramtek, Samudrapur, Saoner, Wardha, Gariaband, Panambur, Mudibidre, Dharmasthala, Karkala, Yellapura, Medikeri, Somwarpet, Sringeri, Kottigehara, Lakkavalli, Kudulu & Vythiri 7 each		
31. -		Katra 19, Naraingarh & Dehra Dun 16 each, Ambala & Agumbe 15 each, Palampur & Bhagamandala 12 each, Dharamsala 11, Koderu & Munnar 10 each, Reamal & Kurkheda 9 each	Cherrapunji 17, Barobhisa 15, Patoda 14, Barpeta, Khairagarh & Thiruvananthapuram 13 each, Beki Road Bridge 12, Hasimara & Kollam 11 each, Nagrakata, Thodupuzha & Agathi 10 each, Jai Bharali, N T. Xing, Tikrikilla & Karmala 9 each, Osmanabad, Avinashi, Gulbarga & Lingasugur 8 each, North Lakhimpur, Dhubri, Dhekiajuli, Diana, Kosagumda, Ludhiana, Bhokardan, Sindhanur, Amini Divi & Chikhli 7 each	

Moderate to severe arid conditions were noticed in the western and peninsular parts with an isolated pocket in northern parts of the country in June.

In July, moderate and severe arid conditions reduced to some extent in the western and peninsular parts of the country. However, some parts of northwest India came under moderate to severe drought conditions. Some isolated pockets of moderate conditions were found in peninsular region.

In August, moderate to severe arid conditions decreased substantially over the country.

In September except in the southeastern parts of the peninsula, non-arid conditions prevailed almost over the entire country.

The details of severe and moderate arid conditions which prevailed over the country during the southwest monsoon season are given below monthwise :

#### 7.2.1. June

(i) Small areas of northeastern parts of Madhya Maharashtra and northern parts of Marathwada.

(ii) Isolated areas around Baroda (Gujarat), Solapur (Madhya Maharashtra) and Kanyakumari (Tamil Nadu<sup>2</sup>).

<sup>2</sup> The sub-division Tamil Nadu & Puducherry is shortened as Tamil Nadu throughout the article

TABLE 19

Monthwise Vigorous, Active, Extremely Heavy, Very Heavy and Heavy spells of rain (number of days) 2008

S. No.	Sub-division	June					July					August					September					Season				
		Vigorous	Active	Extra heavy rain	Very heavy rain	Heavy rain	Vigorous	Active	Extra heavy rain	Very heavy rain	Heavy rain	Vigorous	Active	Extra heavy rain	Very heavy rain	Heavy rain	Vigorous	Active	Extra heavy rain	Very heavy rain	Heavy rain	Vigorous	Active	Extra heavy rain	Very heavy rain	Heavy rain
1	A. & N. Islands	-	-	-	1	5	-	-	-	1	8	-	-	-	2	6	-	-	-	1	2	-	-	-	5	21
2	Arunachal Pradesh	-	5	3	2	5	1	3	-	2	7	-	10	-	4	1	-	4	-	-	7	1	22	3	8	20
3	Assam & Meghalaya	-	1	1	6	17	3	2	5	7	8	3	4	2	7	11	1	3	-	3	8	7	10	8	23	44
4	Naga. Mani. Mizo. & Trip.	-	1	-	-	3	-	2	-	1	3	-	4	-	-	2	-	4	-	-	1	-	11	-	1	9
5	Sub-Himalayan W B & Sikm.	2	4	1	1	5	-	7	-	8	7	3	12	-	10	5	-	6	-	-	6	5	29	1	19	23
6	Gangetic West Bengal	2	8	1	1	6	-	6	-	1	13	1	3	-	2	4	2	5	-	1	10	5	22	1	5	33
7	Orissa	3	9	2	6	9	1	4	-	4	8	3	7	-	2	6	4	4	2	1	5	11	24	4	13	28
8	Jharkhand	3	1	1	-	2	-	9	-	-	1	1	7	-	1	2	-	4	-	-	-	4	21	1	1	5
9	Bihar	2	3	-	-	7	-	11	-	-	3	-	5	-	-	5	1	2	-	1	1	3	21	-	1	16
10	East Uttar Pradesh	-	-	-	5	1	1	2	1	4	12	-	3	1	1	10	-	-	1	1	3	1	5	3	11	26
11	West Uttar Pradesh	-	-	-	2	9	-	1	1	2	10	-	-	-	1	8	-	-	-	1	1	-	1	1	6	28
12	Uttarakhand	-	-	-	1	5	-	3	-	1	8	-	-	-	2	9	-	-	1	1	1	-	3	1	5	23
13	Haryana Chnd. & Delhi	2	1	-	3	6	-	4	-	2	7	1	5	-	-	9	3	-	-	2	-	6	10	-	7	22
14	Punjab	5	-	-	3	3	-	1	-	-	8	3	6	-	4	5	-	1	-	1	1	8	8	-	8	17
15	Himachal Pradesh	6	-	-	2	10	-	7	-	4	11	2	7	-	3	11	3	-	1	1	1	11	14	1	10	33
16	Jammu & Kashmir	-	-	-	-	1	-	-	-	1	4	-	-	-	-	4	-	-	-	-	-	-	-	-	1	9
17	West Rajasthan	-	-	-	-	2	-	-	-	-	2	-	3	-	-	3	-	-	-	-	-	-	3	-	-	7
18	East Rajasthan	-	-	-	3	5	-	4	-	1	7	-	3	-	1	10	-	2	-	-	3	-	9	-	5	25
19	West Madhya Pradesh	1	1	-	-	4	-	2	-	1	1	1	2	-	1	2	-	3	-	-	1	2	8	-	2	8
20	East Madhya Pradesh	7	2	-	3	2	-	2	-	-	5	1	4	-	-	6	1	2	-	1	-	9	10	-	4	13
21	Gujarat Region #	1	-	1	1	1	2	4	-	7	7	3	4	4	3	8	6	2	1	3	4	12	10	6	14	20
22	Saurashtra & Kutch	2	-	1	1	-	3	1	-	4	4	2	2	-	1	3	5	-	3	1	3	12	3	4	7	10
23	Konkan & Goa	2	6	-	9	5	1	2	1	9	8	2	6	3	5	6	1	10	1	11	6	6	24	5	34	25
24	Madhya Maharashtra	-	1	-	4	3	-	-	-	5	5	2	2	3	4	7	3	9	-	3	14	5	12	3	16	29
25	Marathwada	-	1	-	-	-	-	2	-	-	1	-	3	-	1	2	4	8	-	3	6	4	14	-	4	9
26	Vidarbha	-	2	-	-	2	-	4	-	-	6	1	2	1	2	4	1	3	-	-	7	2	11	1	2	19
27	Chattisgarh	1	4	-	-	2	-	1	-	-	2	1	3	-	-	-	2	1	-	1	2	4	9	-	1	6
28	Coastal Andhra Pradesh	-	-	-	-	3	2	2	-	2	5	3	2	-	3	4	1	1	-	1	2	6	5	-	6	14
29	Telangana	-	3	-	-	7	-	5	-	-	7	4	5	-	6	5	1	1	-	1	1	5	14	-	7	20
30	Rayalaseema	1	-	-	-	1	-	-	-	-	2	1	1	-	-	6	-	-	-	-	3	2	1	-	-	12
31	Tamil Nadu & Puduchhery	-	-	-	-	1	-	-	-	3	5	1	1	-	-	2	-	1	-	1	3	1	2	-	4	11
32	Coastal Karnataka	-	6	-	6	10	-	2	-	3	5	1	8	-	6	5	3	4	-	3	4	4	20	-	18	24
33	North interior Karnataka	-	-	-	-	3	-	1	-	-	1	2	2	-	-	5	1	5	-	2	12	3	8	-	2	21
34	South interior Karnataka	1	-	-	4	16	-	3	-	4	9	2	5	2	6	10	1	1	-	1	11	4	9	2	15	46
35	Kerala	-	2	-	3	12	-	5	-	3	15	-	1	-	1	8	2	10	-	5	6	2	18	-	12	41
36	Lakshadweep	-	-	-	-	1	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	3
	Total	41	61	11	67	174	14	102	8	80	216	44	132	16	79	195	46	96	10	51	135	145	391	45	277	720

TABLE 20

Dates of occurrence of heat wave/severe heat wave and various categories of maximum temperatures - June 2008

S. No.	Sub-division Name	Dates (Number of days)						
		Severe heat wave	Heat wave	Hot day	Appreciably to markedly above normal	Above normal	Appreciably to markedly below normal	Below normal
2.	Arunachal Pradesh	Nil	Nil	Nil	Nil	Nil	1	Nil
3.	Assam & Meghalaya	Nil	Nil	Nil	1	1	Nil	Nil
4.	Naga., Mani, Mizo and Tri.	Nil	Nil	Nil	Nil	1	Nil	Nil
5.	S. H. W. B. & Sikkim	Nil	Nil	Nil	Nil	2	4, 5, 6	6
6.	Gangetic West Bengal	Nil	Nil	Nil	2	Nil	6	4, 5
7.	Orissa	Nil	Nil	Nil	Nil	1, 5	1, 5, 7, 9	7, 8
8.	Jharkhand	Nil	Nil	Nil	Nil	3	8, 9	Nil
9.	Bihar	Nil	Nil	Nil	1	3	5, 7, 8, 9	4, 6
10.	East Uttar Pradesh	Nil	Nil	Nil	Nil	1, 3	4, 5, 6, 7, 8, 9, 11	10
11.	West Uttar Pradesh	Nil	Nil	Nil	Nil	Nil	4, 5, 6, 7, 8, 9, 10, 11, 12, 14	3, 13
12.	Uttarakhand	Nil	Nil	Nil	Nil	Nil	6, 7, 8, 9, 10, 11, 12	3
13.	Haryana, Chandigarh & Delhi	Nil	Nil	Nil	Nil	Nil	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14	3, 13
14.	Punjab	Nil	Nil	Nil	Nil	Nil	2, 3, 4, 6, 7, 8, 9, 10, 11, 12	5
15.	Himachal Pradesh	Nil	Nil	Nil	Nil	Nil	5, 6, 7, 12	9
16.	Jammu & Kashmir	Nil	Nil	Nil	6	2, 5, 7, 8, 9, 12, 14	3, 9, 10, 11	5
17.	West Rajasthan	Nil	Nil	Nil	Nil	Nil	2, 3, 4, 10, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 25, 28	3, 5, 6, 9, 11, 13, 24, 26, 29, 30
18.	East Rajasthan	Nil	Nil	Nil	Nil	1	2, 3, 4, 7, 9, 10, 12, 14, 15, 16, 17, 18, 19	3, 5, 6, 11, 13
19.	West Madhya Pradesh	Nil	Nil	Nil	6	1, 5, 8	3, 8, 9, 10, 11, 12	2, 7, 9
20.	East Madhya Pradesh	Nil	Nil	Nil	6	1, 4, 5	8, 9, 10, 11	7
21.	Gujarat Region	Nil	2	Nil	Nil	4	7, 10, 11, 12	2, 8
22.	Saurashtra & Kutch	Nil	4	Nil	Nil	1, 2, 3, 5, 7, 8	12	Nil
23.	Konkan & Goa	Nil	Nil	4	4, 5, 6	2, 3	Nil	Nil
24.	Madhya Maharashtra	Nil	1, 4	Nil	1, 2, 3, 4, 5	Nil	7, 8	Nil
25.	Marathawada	Nil	Nil	Nil	4	2	8	Nil

TABLE 20 (Contd.)

Sub-division		Dates (Number of days)						
S. No.	Name	Severe heat wave	Heat wave	Hot day	Appreciably to markedly above normal	Above normal	Appreciably to markedly below normal	Below normal
26.	Vidarbha	Nil	1	Nil	1, 4	3	7, 8, 9, 10	5, 8
27.	Chattisgarh	Nil	Nil	Nil	1, 2, 6	4	5, 9, 10	Nil
28.	Coastal Andhra Pradesh	Nil	1	Nil	2	Nil	Nil	Nil
29.	Telangana	Nil	Nil	Nil	2, 6	1	Nil	Nil
30.	Rayalaseema	Nil	Nil	Nil	Nil	Nil	Nil	1
31.	Tamil Nadu	Nil	1	Nil	Nil	Nil	Nil	Nil
32.	Coastal Karnataka	Nil	Nil	Nil	Nil	Nil	Nil	Nil
33.	North Interior Karnataka	Nil	Nil	Nil	6	2	Nil	Nil
34.	South Interior Karnataka	Nil	Nil	Nil	Nil	2	Nil	1
35.	Kerala	Nil	Nil	Nil	Nil	Nil	Nil	Nil

## 7.2.2. July

## (a) Severe Arid Areas

Isolated areas around Sikar and Ajmer (East Rajasthan); Rajkot (Saurashtra & Kutch) and Osmanabad (Marathwada).

## (b) Moderate Arid Areas

(i) Small areas of eastern parts of West Rajasthan and adjoining western parts of East Rajasthan; westcentral parts of Saurashtra & Kutch; northeastern parts of Madhya Maharashtra and adjoining northern part of Marathwada; southern parts of Marathwada and adjoining southeastern part of Madhya Maharashtra.

(ii) Isolated areas around Ludhiana (Punjab), Hyderabad (Telangana), Raichur (North Interior Karnataka), Rentachintala (Coastal Andhra Pradesh), Chennai-Nagapattinam-Madurai (Tamil Nadu<sup>2</sup>).

## 7.2.3. August

## (a) Severe Arid Areas

(i) Isolated area around Jaipur (East Rajasthan).

## (b) Moderate Arid Areas

Small areas of western parts of East Rajasthan; western parts of Saurashtra & Kutch; northeastern parts of Tamil Nadu and adjoining southern part of Rayalaseema and Coastal Andhra Pradesh.

(i) Isolated area around Jalgaon (Madhya Maharashtra).

## 7.2.4. September

## (a) Severe Arid Areas

(i) Isolated areas around Tiruchirapalli (Tamil Nadu).

## (b) Moderate Arid Areas

(i) Small areas of eastcentral parts of Tamil Nadu.

(ii) Isolated area around Ajmer (East Rajasthan).

## 8. Significant spells of heavy rains

Amounts of heavy, very heavy and extremely heavy rainfall are given in Table 18. The number of vigorous

TABLE 21

## The meteorological aspects of severe floods during southwest monsoon 2008

S. No.	Region affected	Period	Cause	Damage	Synoptic features prevailed
1.	Assam & Arunachal Pradesh (Lakhimpur and Sonitpur districts)	11 Jun – 3 Jul	Heavy rain	8 people died and displaced nearly 4,00,000 people in 359 villages in Lakhimpur and Sonitpur districts	By 2 June, the southwest Monsoon had advanced over most parts of Nagaland-Manipur-Mizoram-Tripura and Assam & Meghalaya and entire Arunachal Pradesh and by 9 June, it covered the entire north-eastern states. Heavy rains associated with the active monsoon conditions led to flood situations
2.	Assam, Orissa, West Bengal	5-14 Jul	Heavy rain	-	(i) A well marked low pressure area formed over the north Bay of Bengal and adjoining areas of West Bengal-Bangladesh coasts and moved inland during 7-12 July.  (ii) A cyclonic circulation extending upto mid tropospheric levels lay over Gangetic West Bengal and adjoining Bangladesh on 13 & 14. It lay as a trough extending upto 2.1 km a.s.l. from Sub-Himalayan West Bengal & Sikkim to north Bay during 15-17
3.	Karnataka	20-31 Jul	Heavy rains	Five people lost their lives. More than 10 houses were damaged. Many trees were uprooted and road transport was badly affected	(i) A cyclonic circulation lay between 1.5 and 3.1 km a.s.l. over east central and adjoining southeast Arabian sea off Karnataka-Kerala coasts on 23.  (ii) During the period 24-30 July, the formation of a low pressure area over the Bay of Bengal caused a revival of rainfall activity over the peninsular India
4.	Assam, Uttar Pradesh and Bihar	20 Jul - 8 Aug	Heavy rains in the northern plains as well as in Bangladesh and Nepal	Floods affected thousands of people in Assam, Uttar Pradesh and Bihar	A cyclonic circulation extending upto mid tropospheric levels lay over the northwest Bay off West Bengal-Bangladesh coasts on 18 & 19 July, Bihar and adjoining east Uttar Pradesh on 20 July and over east Uttar Pradesh and neighbourhood during 21-27. The system lingered over Uttar Pradesh with an east-west oscillatory movement due to the interaction between mid-latitude westerly flow and the monsoon circulation pattern. The same situation caused enhanced rainfall over Nepal as well as Bangladesh, which in turn caused the downstream flooding
5.	Andhra Pradesh	5-11 Aug	Heavy rain	Floods took a toll of 70 lives in Andhra Pradesh. Many low lying areas were inundated. Rail and road traffic were also badly affected	The southwest Monsoon had been active owing to the formation of Depression over the northwest and adjoining west central Bay off south Orissa- north Andhra coasts and its subsequent inland movement
6.	Punjab	21-27 Aug	Incessant heavy rain	Twenty two lives were lost. An infrastructure cum crop loss of Rs. 945 crores were incurred due to incessant rain and flooding. As many as 75,000 to 80,000 acres of crop land have been destroyed. Floods also damaged barbed wire fencing at several places along the border security force observational posts	Three cyclonic circulations persisted over Punjab, one followed by the other, during the period 21-27 August
7.	Bihar	18 Aug – 24 Sep	Torrential rains caused the Kosi river in neighbouring Nepal to burst its banks	Flood in Bihar claimed 47 human lives, over 20 lakh people were affected in the 14 districts of the state	Eastward moving systems continued to pass across the Himalayas. Even though the monsoon trough remained in its near normal position, the monsoon activity over the country as a whole remained subdued during 18-27 August

TABLE 21 (Contd.)

S. No.	Region affected	Period	Cause	Damage	Synoptic features prevailed
8.	Assam and Bihar	30 Aug – 8 Sep	Heavy rain	About 24 people lost their lives and 2.1 lakh people were displaced. The worst hit districts were Dhubri, Jorhat, Kamrup, Lakhimpur, Dhemaji and Morigaon. The swirling flood water of Brahmaputra river had cut a treacherous swath across Assam, breaching more than 54 vital embankments, besides sweeping away road bridges	Widespread rainfall activity occurred over northeast India, due to the northward shifting of the monsoon trough. The eastern end of it passed through northern parts of Bihar towards northeast India on 28 & 29 August and remained close to the foothills of the Himalayas during 30 August – 5 September
9.	Orissa	22-29 Sep	Heavy rains in the catchments area of Mahanadi river	Large parts of the state were inundated after opening dozens of sluice gates of the Hirakud dam on the Mahanadi river. Floodwaters swept away highways in some areas. In Boudh district of Orissa, many villages remained marooned	A deep depression formed over the northwest Bay during 15-19 September, it crossed Orissa coast near Chandbali and moved westnorthwestwards across the state

and *active* days on a sub-divisional scale along with the number of days on which *extremely heavy*, *very heavy* and *heavy* rainfall occurred is given in Table 19.

#### 8.1. Exceptionally heavy rainfall

Kalaikunda (Gangetic West Bengal) received 53 cms of rainfall on 18 June which was the highest rainfall received during the season. Dhandhuka (Gujarat Region) 50 cms and Lakhatar (Saurashtra & Kutch) 48 cms on 18 September, Biswan (east Uttar Pradesh) 37 cms on 28 September and Sharadanagar (east Uttar Pradesh) and Banbasa (Uttarakhand) 28 cms on 20 and 21 September respectively are some other *exceptionally heavy rainfall* amounts.

#### 9. Significant temperature during the season

The dates of occurrence of heat waves and dates on which the maximum temperature remained appreciably to markedly above/below normal and above/below normal are given in Table 20. A same date appearing in two different columns of a sub-division may be reckoned as occurrence of that category over parts of the sub-divisions. Maximum temperatures were normal for the rest of the days.

The rapid advance of monsoon restricted the heat wave occurrence during June to a minimum of one or two days as can be noticed from the table.

The highest maximum temperature of 44° C was recorded in Ganganagar on 1 June 2008.

#### 10. Disastrous weather events and damage during monsoon months

##### 10.1. June

According to media reports, heavy rains, floods, lightning and landslides took a toll of 226 persons (64 in West Bengal, 47 in Arunachal Pradesh, 31 in Jharkhand, 17 in Orissa, 15 in Karnataka, 11 in Uttar Pradesh, 9 in Gujarat, 6 each in Bihar, Vidarbha and Madhya Pradesh, 4 in Punjab, 3 in Andhra Pradesh, 2 each in Kerala, Tamil Nadu and Assam and 1 in Tripura). Lakhs of people were affected and thousands of houses were damaged.

##### 10.2. July

According to media reports, heavy rains, floods, lightning and landslides took a toll of 206 persons (144 in Uttar Pradesh, 15 in Jharkhand, 9 in West Bengal, 8 in Vidarbha, 7 in Haryana, Chandigarh & Delhi, 6 in Karnataka, 5 each in Madhya Pradesh and Tamil Nadu, 4 in Assam and 3 in Kerala). Incessant rain paralysed the normal life and caused extensive damage to agriculture in Uttar Pradesh, Haryana, Karnataka and Kerala. The flood situation was grim in Bihar and Orissa.

### 10.3. August

According to media reports, heavy rains, floods, lightning and landslides took a toll of 476 persons (118 in Maharashtra, 82 in Bihar, 70 in Andhra Pradesh, 48 in northeast India, 44 in Punjab, 30 in Karnataka, 14 in West Bengal, 11 each in Orissa, Jharkhand and Uttar Pradesh, 10 in Rajasthan, 9 each in Himachal Pradesh and Madhya Pradesh, 4 each in Tamil Nadu and Kerala, 1 in Haryana). A change in the course of Kosi river, affected over 20 lakh people in 14 districts of Bihar. Huge crops were damaged and several villages inundated in several parts of the country.

### 10.4. September

According to media reports, heavy rains, floods, lightning, landslides and thunder squalls took a toll of 121 persons (60 in Assam, 49 in Himachal Pradesh, 5 in Vidarbha, 3 in Himachal Pradesh and 2 in Haryana and Gujarat). Heavy rain and lightning disrupted normal life in Haryana, Chandigarh & Delhi and Punjab. Orissa also reeled under flood situation.

## 11. The meteorological aspects of severe floods during southwest monsoon – 2008

During the southwest monsoon season 2008, many states viz., Assam, West Bengal, Arunachal Pradesh, Orissa, Uttar Pradesh, Punjab, Bihar, Andhra Pradesh and Karnataka experienced flood situations during various parts of the season. Incessant heavy rainfall due to synoptic features including interaction of monsoon flow with the mid-latitude westerly flow as well as the northward shift of monsoon trough over north/northeast India were the major causes of flooding over the northern plains and northeast India.

The source of the flood data provided in Table 21 is mainly from the website maintained by the Dartmouth flood observatory, supplemented with other media reports and damage reports provided by various RMCs & MCs.

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## Appendix

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

#### Rainfall

<i>Excess</i>	- Percentage departure from normal rainfall is + 20% or more.
<i>Normal</i>	- Percentage departure from normal rainfall is between – 19 % to + 19 %.
<i>Deficient</i>	- Percentage departure from normal rainfall is between – 20 % to – 59 %.
<i>Scanty</i>	- Percentage departure from normal rainfall is between – 60 % to – 99 %.
<i>Widespread (Most places)</i>	- 75% or more stations of a meteorological sub-division reporting at least 2.5 mm rainfall.
<i>Fairly widespread (Many places)</i>	- 51% to 74% stations of a meteorological sub-division reporting at least 2.5 mm rainfall.
<i>Heavy rain</i>	- Rainfall amount from 6.5 cm to 12.4 cm.
<i>Very heavy rain</i>	- Rainfall amount more than 12.5 cm to 24.4 cm.
<i>Extremely heavy rainfall</i>	- Rainfall amount more than 24.5 cm.
<i>Exceptionally heavy</i>	- 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

<i>Active</i>	- 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.
<i>Vigorous</i>	- 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.

### Maximum/day temperatures

According to the new criteria, since 1<sup>st</sup> March 2002, Heat Wave is 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 where the normal maximum temperature is more than 40° C and +7° C or more for regions where the normal maximum temperature is 40° C or less.

#### *Heat wave conditions*

- Departure of maximum temperature from normal is + 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

#### *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.

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