

Rainfall and Floods during 1963 Southwest Monsoon period*

1. Introduction

The total rainfall during the southwest monsoon period of 1963 was almost normal over the country outside Marathwada and Konkan where it was above normal. Due to the absence of normal activity of depressions from the Bay of Bengal, the Monsoon activity was particularly feeble during the month of July over north and central parts of India. A very striking feature of this year's floods was their frequent recurrence in Himalayan rivers due to heavy rainfall in the hilly catchment areas associated with shifting of the axis of the seasonal trough of low pressure to the foot of the Himalayas, resulting in "break" monsoon conditions in the plains. Assam also had a series of floods during June/July due to the same reason. Major floods occurred in west U.P., and its neighbourhood in the month of September mainly due to the passage of deep depression from the Bay. In these floods about 200 persons were reported to have lost their lives, 16,000 villages were affected and property worth several crores was damaged. Another noteworthy feature of the season was a major flood in Vidarbha region in the month of August. Heavy to very heavy rains in this region were responsible for flooding of the rivers and widespread damage and devastation. The season's floods over the entire country caused the death of more than 250 persons and about 25 lakh people and 9000 villages were adversely affected. An unusual manifestation of heavy rain was floods created by the cloud burst at Pehalgam in Kashmir on 20 July 1963 in which about 50 persons were reported to have perished.

2. Chief features of rainfall

The Arabian Sea branch of the southwest monsoon advanced into extreme south Kerala by about the normal date. In association with an upper air trough over east central Arabian Sea, it extended northwards along the west coast upto south Konkan by 5 June 1963. A low pressure area which persisted over the east central Arabian Sea off the Konkan-Kanara coast during the second week of June was responsible for extending the monsoon further into Gujarat by about 12 June.

The Bay branch of monsoon advanced into northeast India under the influence of a depression which formed over the head Bay on 6 June and moved northnortheastwards. The monsoon advanced thereafter rather slowly and by about 20 June it had extended over the central parts of the country and east U.P. It extended into east Rajasthan and west U.P. under the influence of a Bay depression which formed on 23 June with centre about 100 km south of Rangoon. It crossed the coast near Calingapatam on 26th and weakened into a low pressure area over Vidarbha and adjoining Telengana on 27th. Further advance of monsoon into the rest of the country occurred on about 10 July, nearly 10 days late. It happened in association with a Bay depression which formed about 150 km southsoutheast of Calcutta on 4 July which filled up over west U.P. on 10 July.

The monsoon withdrew on 18 September from Jammu and Kashmir, Punjab (India) and West Rajasthan. It withdrew further from east Rajasthan, Himachal Pradesh, west

*Prepared by the Meteorologist-in-charge, Hydrology Section of the Headquarters office of the India Meteorological Department, New Delhi with the assistance of other officers and staff of the section

RAINFALL AND FLOODS DURING 1963 SW MONSOON

TABLE 1

Southwest Monsoon 1963

Percentage departures from normal rainfall for week ending

MONTH METEOROLOGICAL SUB DIVISIONS	JUNE				JULY					AUGUST				SEPTEMBER				OCT	1 JUNE TO 30 SEPT
	5	12	19	26	3	10	17	24	31	7	14	21	28	4	11	18	25	2	
ASSAM (INCLUDING MANIPUR & TRIPURA)	-65	-31	5	4	-27	-43	30	10	38	-26	-17	49	37	-25	-99	-26	-23	-39	0
SUB HIMALAYAN WEST BENGAL	-60	-37	-47	-60	75	-9	-28	-32	-28	51	-23	126	33	40	-95	-15	-90	60	-2
GANGETIC WEST BENGAL	-47	101	104	-83	-28	27	-3	-25	-40	60	-31	-25	-60	-17	6	12	-94	193	-7
ORISSA	29	-29	48	-80	-70	14	-54	-57	7	-42	95	-28	13	-11	59	65	-76	143	0
BIHAR PLATEAU	2	-33	36	-91	-48	-16	6	-28	-21	-32	-35	-42	-27	19	-1	16	-100	289	-7
BIHAR PLAINS	-67	-13	27	-44	-50	-55	102	17	-61	17	-43	-49	-44	-4	-94	-3	-100	324	-2
U. P. EAST	131	52	-1	-67	-65	-24	201	-34	-42	14	82	1	-33	63	-54	7	-100	-42	4
U. P. WEST	-49	135	23	-73	-56	-66	58	-46	-19	27	83	147	-15	44	-16	360	-100	-91	25
PUNJAB (1) INCLUDING DELHI	-24	478	-32	5	-68	-39	-45	-78	-36	12	180	29	-47	49	-41	48	-100	-100	5
HIMACHAL PRADESH *																			
JAMMU AND KASHMIR	-100	-100	-58	-66	-80	-100	-92	-36	52	22	-5	-37	-94	-98	-99	-98	-100	-49	-27
RAJASTHAN, WEST	-100	-100	100	-100	-92	-75	-90	-99	-84	87	-70	-96	-82	77	50	139	-100	-100	-32
RAJASTHAN, EAST	75	100	100	-95	25	113	-95	-80	-35	-13	78	2	-28	27	66	-56	-100	-92	10
MADHYA PRADESH, WEST	110	87	-28	-92	-43	64	-47	-96	-12	-42	84	88	15	-16	2	99	-98	-94	1
MADHYA PRADESH, EAST	-39	82	-19	-87	-66	-44	-71	-67	1	-53	-33	-42	-33	11	-18	130	-57	-83	-17
GUJARAT REGION	-94	128	-94	-90	-36	118	-92	-90	-32	89	121	-69	-29	73	457	-99	-100	-98	18
SAURASHTRA AND KUTCH	-87	-72	-95	-97	-43	98	-91	-93	-35	103	-47	-84	-7	248	122	78	-99	-93	-15
KONKAN	-59	-32	-40	-34	164	85	-83	-65	135	148	171	182	397	-39	21	93	-86	-73	29
MADHYA MAHARASHTRA	14	0	-89	-15	179	179	-92	-93	-47	-14	195	51	114	-81	-71	-36	-56	-21	1
MARATHWADA	65	80	-66	-40	180	-2	-91	-88	237	98	133	337	501	-84	-49	-24	-74	-49	46
VIDARBHA	-36	78	-24	-82	48	-36	-75	-88	115	13	-20	37	77	-94	-52	-33	-84	-89	-21
COASTAL ANDHRA PRADESH	28	-24	-70	-51	108	-15	-26	-37	-35	-24	-33	70	7	17	-76	-23	-44	-55	-7
TELANGANA	164	166	-53	-88	89	-39	-96	-48	87	140	69	84	132	-64	-43	-67	-50	-24	13
RAYALASEEMA	-67	-39	-41	4	82	-9	18	133	-56	139	-94	194	224	-65	-88	93	-30	-12	16
MADRAS STATE	-30	-29	111	-33	81	-88	103	115	-54	105	-91	-2	27	56	-79	92	-34	84	11
COASTAL MYSORE	13	4	-71	-20	20	-17	-81	-56	56	65	45	110	96	-50	4	52	-95	-57	-3
INTERIOR MYSORE NORTH	90	-4	-46	-45	96	54	-91	-86	-33	85	97	81	194	-74	-94	-60	-22	-80	-1
INTERIOR MYSORE SOUTH	-80	-5	-67	-15	80	54	-69	25	-36	88	-77	64	27	-30	-92	96	193	3	-1
KERALA	-54	-9	-92	-11	24	47	-42	-79	-43	-17	66	112	65	8	51	57	117	-30	2

 LESS THAN -50%
 -50% TO -25%
 -24% TO +24%
 +25% TO +50%
 > 50%

⊗ FIGURES TAKEN FROM I.D.W.R. SUPPLEMENT DATED 1-11-63

* DATA FOR HIMACHAL PRADESH NOT GIVEN DUE TO NON-AVAILABILITY OF NORMALS

U.P. by 20 September. Further withdrawal of the monsoon was, however, slow. By 14 October it withdrew from southwest Madhya Pradesh, Maharashtra, Bihar State, southeast Madhya Pradesh, north Orissa and West Bengal. The monsoon completely withdrew from the remaining parts of northeast India and north Peninsula by 18 October.

Week by week rainfall distribution (deficit or excess over normal) for period June to September 1963 over the 28 meteorological sub-divisions of India is given in Table 1. The important features of Table 1 are as follows—

- (1) The seasonal rainfall over the country as a whole was more or less normal, the departure from normal being within ± 20 per cent excepting in the sub-divisions of west U.P., Konkan, Marathwada, Jammu and Kashmir and west Rajasthan where percentage departures from normal have been rather large.
- (2) Jammu and Kashmir and west Rajasthan experienced practically continued drought conditions during the months of June and July.
- (3) During the 3rd and 4th week of July the entire country outside Assam, Sub-Himalayan areas of West Bengal, Bihar, U.P., and Madras experienced very feeble monsoon activity.
- (4) The Indian peninsula excepting for Madras State experienced excess rainfall during the month of August but during the month of September monsoon activity over this region was feeble outside Kerala.

The meteorological features which were broadly responsible for the above rainfall distribution were the following—

- (1) The activity of the monsoon depressions was less marked than usual throughout the monsoon season.
- (2) During June and July, no Bay depression moved into the Rajasthan and Gujarat areas.
- (3) Frequent 'breaks' in the monsoon, confining the rain belt to the foot of the Himalayas during the most part of July.
- (4) Increased activity in the movement of depression or lows from Bay of Bengal in the month of August across the central parts of the country.

In June there were two depressions. The first one formed on 6th with its centre 100 km south of Sandheads. It crossed the Sunderbans coast on 7th and moved in a north-northeast direction and finally dissipated over Assam. Another depression formed over North Andaman Sea on 23 June, moved in a north-westerly direction, crossed coast on 26th and weakened into a low over Vidarbha and adjoining Telengana causing active monsoon condition over the Peninsula. In the month of July a depression formed over the head Bay of Bengal by 4th, centred 150 km southeast of Calcutta, moved north-westwards and weakened into a low pressure area over northwest Madhya Pradesh and neighbourhood by 7th. There were no depressions between 7 July and 9 August 1963 and an unusually prolonged 'break' monsoon condition prevailed upto 4th week of July with the axis of the seasonal trough lying close to the foot of the Himalayas. The next depression formed on 9 August 1963 over the head Bay and moving in a north-westerly direction, crossed the coast on 10th. Continuing to move northwest it lay about 100 km west of Delhi on the 14th. It revived the rainfall activity in the central parts of the country.

Thereafter, although no depression appeared on the scene till 8 September 1963, the monsoon activity continued unabated over most parts of the country owing to a series of low pressure waves which travelled from the Bay area across the central parts of the country.



Fig. 1. Areas affected by floods

During September two depressions from the Bay caused active monsoon conditions over the different parts of the country. The first one after its formation about 100 km southwest of Rangoon on 8 September crossed coast near Balasore on 11/12 September. It began to change its course on 13th to northwest and northnorthwest. It became unimportant by 17th over west U.P. hills. It caused very heavy rains over an area extending from Gangetic West Bengal and Orissa to the Punjab (India). Another depression from the Bay in the last week of September crossed coast south of Balasore on 27th. Thereafter it moved in a northerly direction, weakened progressively and became unimportant over Bihar plains by 27 September. Under its influence monsoon remained active over northeast India and heavy rainfall occurred in Bihar and Orissa. 15 persons were reported to have lost their lives in floods associated with this depression.

3. Principal floods of 1963 monsoon season*

During the year under review, major floods occurred in the rivers of Assam, the Himalayan rivers in Bihar, U.P. and the Central parts of the country. The rivers of southern peninsula and in Jammu and Kashmir did not have any floods. The following were the noteworthy floods of the season arranged in chronological order—

1. Assam floods during the second and third week of June 1963
2. Heavy rain and floods in Gujarat and Bombay during the second week of July
3. Floods in Assam in the second week of July
4. Floods in the rivers of Bihar and U.P. in the last week of July
5. Floods in Vidarbha during the third week of August
6. Floods in U.P. during the second and third week of August
7. Floods in Assam during the 4th week of August

8. Serious floods in west U.P. and adjoining areas during the 3rd week of September

9. Floods in Orissa during the last week of September 1963.

A map indicating areas which experienced floods in 1963 is given at Fig. 1. Detailed study of a few flood situations causing considerable damage to life or property is given below—

1. *Floods in Gujarat during the second week of July 1963*

Gujarat and surrounding areas received heavy rains during the second week of July 1963. According to press reports about 45 persons lost their lives due to floods. Railway traffic between Bombay and Gujarat was disrupted owing to breaches in the railway tracks. In Surat and Broach districts many houses collapsed and property worth lakhs was damaged and low lying areas were water logged due to heavy rains on 9 July. Bombay city and other places on the western coast also had heavy rains accompanied by squally weather, dislocating road and rail communications between Bombay and Gujarat.

The heavy rain was caused by a Bay depression which was centred about 150 km southwest of Calcutta on 4 July, moved northwestwards and weakened by 7th into a low pressure area and then recurved northwards and finally moved away eastwards across Assam by 14th. A well marked low pressure area also formed over the Gulf of Cambay and adjoining Gujarat during the period 2nd to 5th. In association with these synoptic situations, monsoon was active over west coast, Gujarat and neighbourhood. Some noteworthy amounts of rainfall received during this period are — Dahanu 31 cm on 5th, Bombay 11 cm on 5th, Veraval 9 cm on 5th and 10 cm on 6th, Bombay 19 cm on 7th, Bhira 23 cm on 7th, Mahabaleshwar 37 cm on 7th, Devgad 14 cm on 7th, Mahabaleshwar 25 cm on 8th, Bhira 21 cm on 8th, Baroda 14 cm on 9th, Broach 16 cm on 10th and Surat 12 cm on 10th.

*Mostly compiled from flood news letter issued by C. W. P. C. and statements made in River Commissions

2. *Widespread floods in the rivers of Bihar and Uttar Pradesh during the last week of July 1963*

In Bihar the river Kamla near Jaynagar was nearing danger mark on 25 July. With slight recession thereafter it attained the danger level again on 30 July. River Kamla Balan had sub-merged over 100 miles in the Darbhanga district between 27-29 July and affected about a lakh of people in Madhubani sub-division. 35 villages were flooded to depth of 3 to 5 feet. The flood water of Kosi had encircled numerous villages in Monghyr district. The protective bund in the Bagmati river was breached near Badlaghat and sub-merged the standing crops. The river Ganga also was in medium flood. In Purnea district the river Kankai, Mahananda and Parman affected about 300 villages. The flood started receding only between 30-31 July. The flood situation in U.P. was also bad. The river Gogra which was about 3 ft above danger level on the 23rd at Chowkaghat rose again by the same margin on the 27th. River Rapti at Bridghat and river Ghagra at Turtipur were respectively $2\frac{1}{2}$ ft and 4 ft above the danger level on 28th.

In Gorakhpur district 532 villages, 90,183 acres of land and 92,072 persons were affected by floods in the river Rapti, Rohin and Little Gangdak. In Deoria district 248 villages, 66,041 acres of land and 64,006 persons were affected.

This widespread flood devastation was brought about by the following meteorological situation. The axis of the seasonal low lay close to the foot of Himalayas for nearly 10 days in July up to 24th. This resulted in heavy rain in the upper catchment of all the Himalayan rivers including those of Assam and Punjab. Subsequently the axis started moving southward under the influence of a shallow low pressure area over the head Bay on 23 July. The associated upper air cyclonic circulation extended upto 6 km. This low moved to West Bengal and adjoining Bihar Plateau on the 25th. During its westward movement it caused

fairly heavy rain in the plains of Bihar and east U.P. and aggravated the flood situation in the rivers already swollen by heavy rain in their hilly watersheds. Chief amounts of rainfall were—Hazaribagh 3.6 cm on 24th, Daltanganj 5.2 cm on 25th, Dehra Dun 9.0 cm on 28th, Nainital 4.5 cm on 29th and Ballia 10.0 cm on 30th.

3. *Vidarbha floods during the third week of August 1963*

As a result of heavy rains in the southwest Madhya Pradesh and adjoining Vidarbha between 12 to 18 August heavy floods occurred in the rivers of this region. The worst affected areas were Chanda, Yeotmal and Nanded districts. In Chanda district the rivers Pranhita, Godavari, Jarpal and Irai were in spate. Some parts of Chanda town were reported to be under five feet of water. During these floods property worth more than one crore was damaged, 47 persons lost their lives and standing crops in an area of about 7 lakhs acres were damaged.

The synoptic situation responsible for these floods is briefly described below—

Two sea level cyclonic systems which travelled one after another in quick succession from the head Bay towards Rajasthan were responsible for the spell of heavy rainfall over the region. The first developed into a depression over northwest Bay and adjoining areas on 9th and was centred near Ambikapur on 11 August. Moving westnorthwestwards, it was centred near Nowgong on 12th and near Alwar on 13th. It weakened into a low pressure area by 15th. Under its influence monsoon became strong to vigorous over Madhya Pradesh and adjoining area. A feeble sea level low formed over the head Bay of Bengal on 15th. Moving westnorthwestwards it lay over northwest Madhya Pradesh and neighbourhood on 17th and merged into the seasonal trough by 19th. It also caused widespread and locally heavy rain over Central India. Some noteworthy rainfall amounts are given below—Champa 26 cm on 11th, Gadawara (Narsinghpur) 15 cm on 11th, Ratlam 13 cm on 12th, Mehidpur (Ujjain)

21 cm on 12th, Pusad 25 cm on 17th and Wardha 13 cm on 17th.

The isohyetal pattern of the above rain storm is given in Fig. 2. It can be seen from this pattern that the centre of the rainstorm was at Pusad which recorded nearly 32 cm of rain during a period of 2 days. Depth-Area-Duration analysis of this storm was carried out and actual depths of precipitation for the standard areas for the storm period 16-17 August are reproduced in Table 2.

4. *Serious floods in west Uttar Pradesh and adjoining areas during 3rd week of September*

All the rivers of Uttar Pradesh and adjoining regions of the Punjab (India) were in high floods during the third week of September. In the western districts of U.P. alone, about 237 people were reported to have lost their lives in the wake of floods. In this flood it is estimated that nearly 16,000 villages were affected and property worth crores was damaged or destroyed. The worst affected districts of the west U.P. were Meerut, Mainpuri, Agra, Aligarh, Bulandshahr and Moradabad.

In the adjoining Punjab, river Yamuna at Tajewala was in high floods on 16th. Rivers Markanda and Ghaggar in the Punjab also rose in high floods. In the union territory of Delhi, due to heavy rains on 15 September, many villages were inundated. Among the affected areas in the west U.P., Meerut was the worst affected district where about 109 persons were reported missing, 560 villages got flooded and 33,000 houses collapsed. Bulandshahr, Mainpuri and Agra were the next worst affected districts in west U.P. In Bulandshahr district, Kalinadi was in high floods and all low lying parts of Bulandshahr town were under flood waters. The river Ganga at Kanpur crossed the danger level on 23 September. Aligarh, Mathura, Almora, Banaras, Firozbad and Moradabad districts of U.P. also suffered from the fury of floods.

The floods were caused by a concentrated spell of heavy rainfall on 15 and 16 September associated with a Bay depression

TABLE 2

Area (sq. miles)	500	1000	2000	5000	10,000
Depths (cm) 16-17 August	29.4	28.0	25.7	21.1	16.0

which crossed the coast near Balasore on the night of 11 September. It lay as a depression with its centre about 150 km east of Jharsuguda on 12 September. Moving westnorthwestwards it lay with its centre near Jabalpur on 14th September morning. Thereafter, it intensified into a deep depression while recurving and moving northwards, lay over U.P. on the morning of 15 September and produced vigorous monsoon conditions over west Uttar Pradesh and neighbourhood on 15 and 16 September. The depression weakened over the Punjab (India) after 15 September and became unimportant by 17 September. Some noteworthy amounts of very heavy rainfall that occurred on 15th and 16th are—15 September 1963: Mawana (Distt. Meerut) 16 cm, Shaha Swan (Distt. Badaun) 15 cm and Mainpuri and Kasgong (Distt. Etah) 14 cm each; 16 September 1963: Mawana (Distt. Meerut) 37 cm, Delhi (University) 25 cm, Nainital 22 cm, Meerut rain gauge flooded, Najibabad and Kotdwara (Distt. Garhwal) 18 cm each, Delhi (Safdarjung), Atrauli (Distt. Aligarh) 17 cm each, Roorkee 17 cm, Salempur (Distt. Saharanpur) 16 cm, Satgarh, Sahaswan and Saharanpur 14 cm each and Mussoorie, Jaranda (Distt. Saharanpur) and Nagina (Distt. Bijnor) 13 cm each.

The total isohyetal pattern of the storm of 15-16 September 1963 over west U.P. is shown in Fig. 3. It is seen that the rain storm had several heavy rain centres. In the plains area, the heavy rain centre at Mawana recorded 52.3 cm, the highest amount of rainfall during the 2-day period. D.A.D. analysis of this storm was carried out and depths of rain over standard areas are given in Table 3. For the sake of comparison the D.A.D. values of maximum 2-day depths of heaviest storm of the area, viz., 29-30 September 1924 is given along with the data of the September 1963 storm.

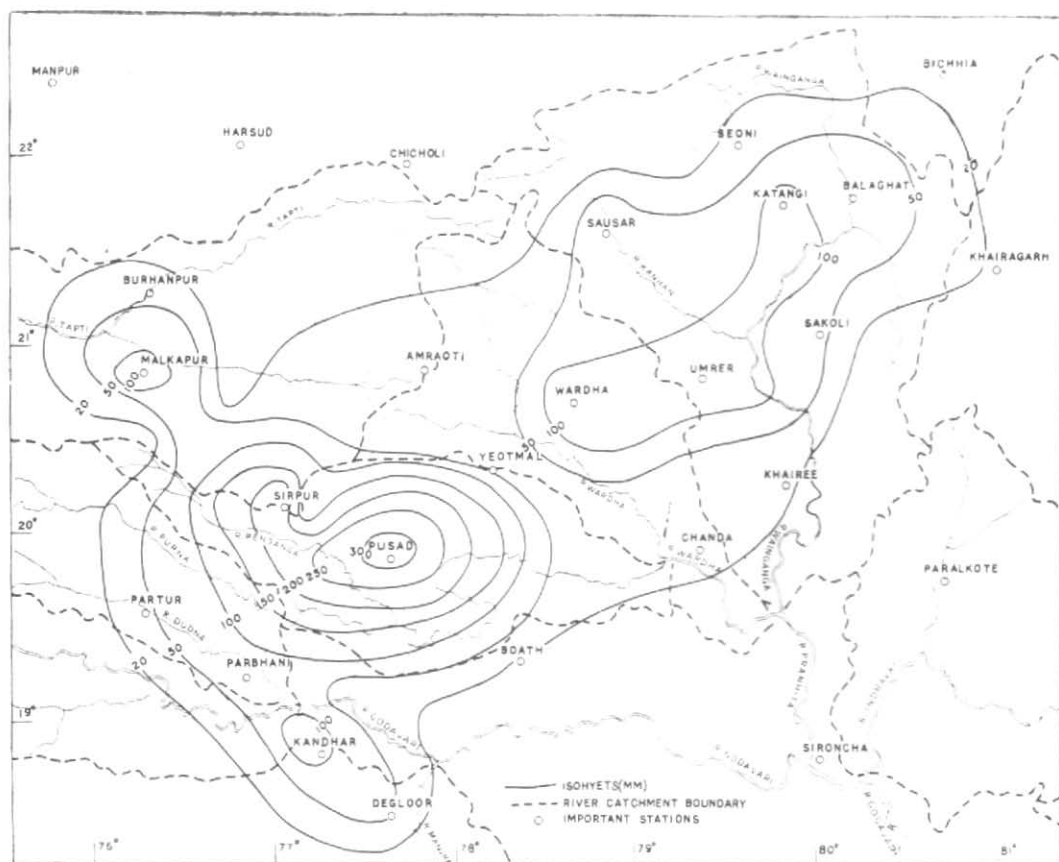


Fig. 2. Vidarbha storm of 16-17 August 1963

TABLE 3

Area (sq. miles)	500	1000	2000	5000	10,000
Depths (cm) of 15-16 September 1963 storm	48.0	41.0	35.1	30.8	27.1
Depths (cm) of 29-30 September 1924 storm	52.8	51.3	47.5	39.1	33.0

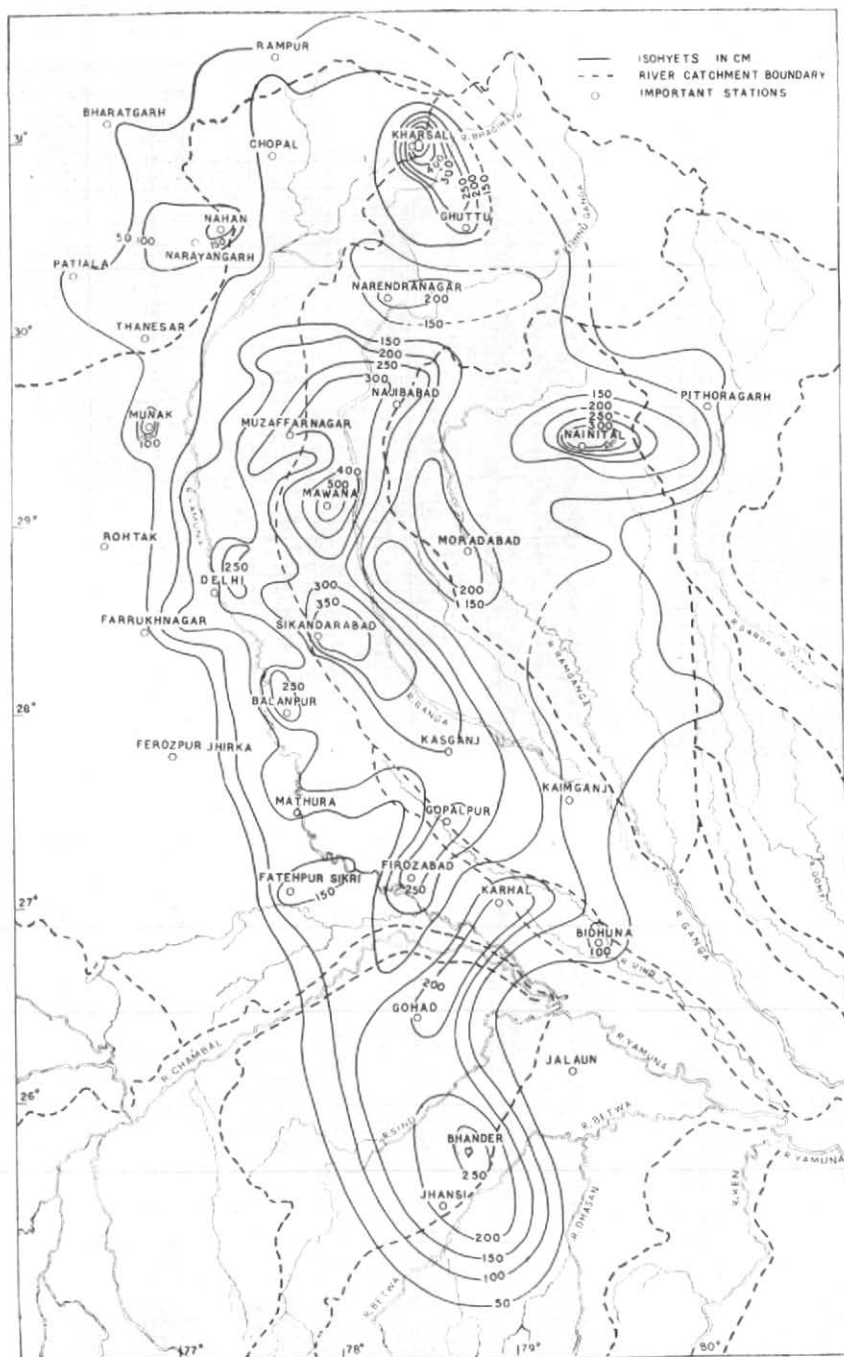


Fig. 3. West Uttar Pradesh storm of 15-16 September 1963

4. Conclusions

- (i) The seasonal rainfall associated with the southwest monsoon of 1963 was more or less normal over the country except in Jammu and Kashmir and West Rajasthan where it was 27 to 32 per cent below normal and in West U.P. and Konkan where it was 25 to 29 per cent above normal. The only sub-division where it was nearly 50 per cent in excess of normal was Marathwada which received more than 200 per cent of its normal rainfall in the month of August alone.
- (ii) There was unusual monsoon activity in the foot hills of Himalayas due to frequent "break" monsoon conditions which was particularly prolonged in July. This resulted in floods of the Himalayan rivers in U.P., Bihar, north Bengal and Assam. Brahmaputra registered high floods on several occasions.
- (iii) As in the previous seasons, during this season also depressions which moved upto Madhya Pradesh, Punjab or Rajasthan got intensified on recurving and caused widespread floods in U.P. and the Punjab. Such situations have been observed to occur generally during the month of September.
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