

Weather

MONSOON SEASON (JUNE-SEPTEMBER 1976)

CHIEF FEATURES

Advance of Monsoon

The southwest monsoon advanced into south Andaman Sea and adjoining southeast Bay on 21 May and extended to the whole of Andaman Sea, south and central Bay, Comorin-Maldives area, Kerala and south Arabian Sea by the end of May 1976. The monsoon advanced rapidly thereafter and covered the entire Bay of Bengal, Arabian Sea, the Peninsula, Gujarat State, southeast Rajasthan and west Madhya Pradesh by 7 June and Assam & adjacent States, West Bengal and Sikkim by 9 June. Its extension into east Madhya Pradesh, Orissa and Bihar States took place during the last 5 days of June; into Uttar Pradesh and the rest of northwest India during the second week of July. The monsoon covered the entire country by 15 July. The advance of the monsoon into Maharashtra, south Gujarat and west Madhya Pradesh was ahead of the normal date by about one week and into north Gujarat and southeast Rajasthan by about two weeks, whereas its advance into west Rajasthan was delayed by about a week and into Orissa, Bihar State, east Madhya Pradesh, Uttar Pradesh, and rest of northwest India by about a fortnight.

Activity of the monsoon

The monsoon rainfall during this season was normal or excess over most parts of the country. The rainfall was, however, in moderate defect in the hills of west Uttar Pradesh, south Interior Karnataka and Kerala. There was no 'break' in the

monsoon this year. Serious floods affected Bihar, Uttar Pradesh, Punjab and Jammu & Kashmir resulting in some damage to Kharif crops. Most parts of the country had normal or excess rainfall in July and August while the rainfall in many parts of the country was scanty in the second half of September. The monthly and seasonal rainfall over the 35 meteorological sub-divisions in India is given in Fig. 1. Departure of seasonal rainfall from the normal is shown in Fig. 2.

Withdrawal of the monsoon

The southwest monsoon withdrew from northwest India, west Uttar Pradesh, west Madhya Pradesh and Gujarat State between 19 and 25 September, from east Uttar Pradesh, east Madhya Pradesh north Maharashtra, Telengana, north coastal Andhra Pradesh, Bihar and Orissa between 1 and 6 October and from the rest of northwest India and of north Peninsula between 8 and 12 October 1976.

Depressions and cyclones

Two cyclonic storms of which one was severe affected the Arabian Sea; of these, one developed over land as a depression. A severe cyclonic storm and three depressions developed in the Bay of Bengal. A depression also developed over land. The tracks of these systems are given in Fig. 3. Practically the whole of June and July was free from monsoon depressions.

SIGNIFICANT MONTHLY FEATURES

JUNE

The advance of the monsoon and its activity was associated mainly with the following systems:

- (i) A cyclonic storm which formed in east central Arabian Sea off Karnataka coast on 31 May, moved practically northwards and intensified into a severe cyclonic storm with a core of hurricane winds on

the morning of 2 June when it was centred about 200 km west of Bombay. Moving north-northeast, it crossed Saurashtra coast near Gopnath point on 3rd morning and again Gujarat coast near port Cambay on 4th morning and weakened gradually into a well marked low over southeast Rajasthan and adjoining parts of west

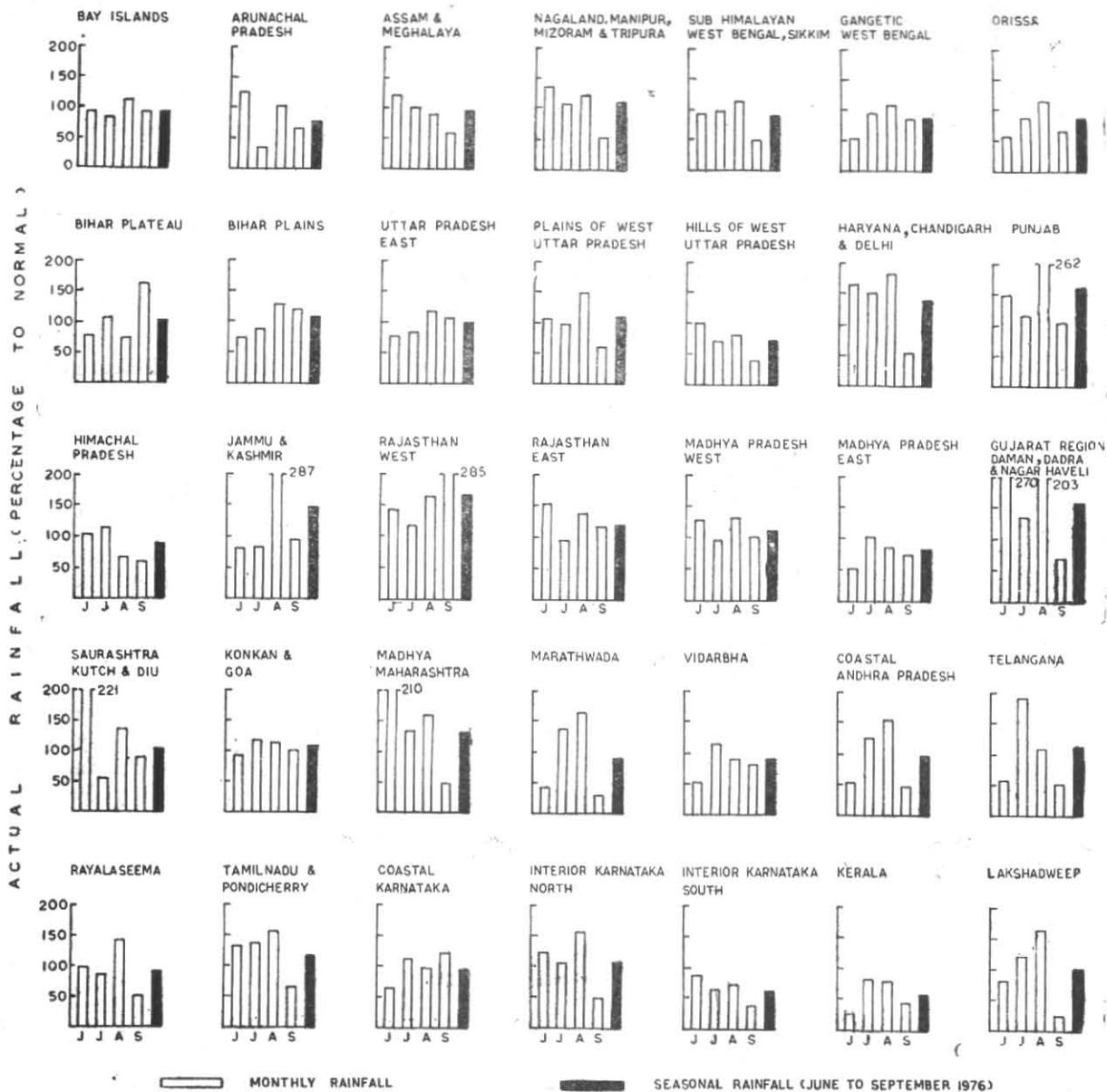


Fig. 1. Progress of monsoon month by month (June-September 1976)

Madhya Pradesh and Gujarat region by 6th. The low moved subsequently to hills of west Uttar Pradesh by 10th. This system caused a rapid advance of the monsoon into Karnataka, Maharashtra, Gujarat, west Madhya Pradesh and southeast Rajasthan. The monsoon was active or vigorous in Gujarat State Konkan and Madhya Maharashtra between 4th and 7th and in west Madhya Pradesh between 7th and 10th. Rainfall was also generally widespread in coastal Karnataka from

1st to 4th, in Marathwada and Vidarbha between 5th and 7th and in southeast Rajasthan on 7th and 8th. This cyclone is reported to have caused a few deaths in coastal Maharashtra and coastal Saurashtra and considerable damage to public and private property, particularly in Gujarat State. Seventeen fishermen lost their lives off Bombay.

(ii) A trough of low which lay over north Bay from 3rd to 7th moved into Assam and

Meghalaya by 9th, causing the advance of the monsoon into West Bengal and Sikkim and Assam and adjacent States between 8th and 9th. An east-west trough extended from Sub-Himalayan West Bengal to Assam from 10th to 16th. Two upper air troughs in the westerlies in the middle troposphere also moved eastwards across northeast India between 7th and 12th. These systems caused active or vigorous monsoon in Assam and adjacent States, Sub-Himalayan West Bengal and Sikkim in the second week of June. According to press reports, serious floods and landslides occurred in Tripura, Cachar district and adjoining parts of Manipur, causing damage to crops and houses and dislocating communications. Floods in the *Brahmaputra* inundated riverine areas in upper Assam.

- (iii) A well marked low developed over west central and adjoining northwest Bay on 23rd. It moved northwest to Bihar plains and adjoining east Uttar Pradesh by 28th and subsequently merged with the seasonal trough, causing the advance of the monsoon into Orissa, Bihar State and east Madhya Pradesh between 25th and 28th. Thereafter, the eastern end of the seasonal trough shifted north and passed from Bihar plains to Arunachal Pradesh from 28th to 30th causing active or vigorous monsoon in Assam & adjacent States between 27th and 30th and in Sub-Himalayan West Bengal & Sikkim and Bihar plains on 30th. According to press reports, a second wave of floods affected Tripura and Cachar district. Landslides dislocated communications in Arunachal Pradesh.
- (iv) A well marked trough lay off the west coast from 24th to 30th. A low which developed in this trough off Goa-south Maharashtra coasts on 25th moved to northeast Arabian Sea off Gujarat coast by 28th and weakened. An east-west trough extended from Karnataka to coastal Andhra Pradesh in the middle troposphere on 23rd. Shifting northwards, it extended from north Maharashtra and adjoining Gujarat coast to Bihar on 28th. These systems caused

active or vigorous monsoon in parts of Maharashtra, Andhra Pradesh and Karnataka between 23rd and 26th.

After the cyclonic storm in the first week of June weakened, the monsoon activity was generally feeble in the Peninsula and the central parts of the country except for a short spell between 23rd and 26th. It was also weak in Assam & adjacent States and West Bengal & Sikkim between 19th and 25th. The rainfall for the month was deficient in Gangetic West Bengal, Orissa, Bihar State, east Uttar Pradesh, east Madhya Pradesh, Vidarbha, Marathwada, coastal Andhra Pradesh, Telangana, coastal and south Interior Karnataka and Kerala and normal or excess over the rest of the country.

The western disturbance activity was rather pronounced and eight western disturbances moved eastwards across northwest India during the month, causing fairly widespread rainfall over the area on many days in the first three weeks, leading to normal or excess rainfall over the area.

A trough extended from Orissa to coastal Tamil Nadu across coastal Andhra Pradesh from 20th to 23rd, when scattered to fairly widespread rain occurred in Tamil Nadu from 20th to 22nd and in Rayalaseema on 21st and 22nd, with isolated heavy falls in Tamil Nadu between 20th and 22nd.

The principal amounts of heavy rainfall (20 cm and above) during the month were: Harnai 21 on 3rd; Mahuva 25, Mahabaleshwar 23 on 4th; Bhira 31, Mahabaleshwar & Igatpuri 24 each, Santacruz & Surat 20 each on 5th; Mahabaleshwar 36, Bhavnagar 29, Surat & Bhira 21 each on 6th; Chaparmukh 28, Agartala 24 on 8th; Beltangadi (Karnataka) 26 on 9th; Cherrapungi 33 on 12th; Pasighat 21 on 13th; Pasighat & Cherrapunji 21 each on 28th; Cherrapunji 48, Pasighat 27, Raigarh 21 on 29th; Cherrapunji 32, Sevok (West Bengal) 24 Bagrakot (West Bengal) 20 on 30th.

Moderate heat wave conditions prevailed in some parts of Orissa on 3rd and 4th and in south Rajasthan on 28th. Day temperatures were markedly above normal in south Rajasthan on 27th, in north Gujarat State on 27th and 28th, in Jammu & Kashmir on 28th and in east Uttar Pradesh on 29th. They were also appreciably above normal in Jammu & Kashmir, east Uttar Pradesh, east Madhya Pradesh, Bihar State, Orissa and coastal Andhra Pradesh from 1st to 3rd, in Kerala, Interior Karnataka and in some parts of Andhra Pradesh in the third week.

JULY

The southwest monsoon advanced into east Uttar Pradesh on 8th and covered west Uttar Pradesh and the whole of northwest India by 15th. The advance of the monsoon into west Rajasthan was delayed by about a week and into Uttar Pra-

desh and the rest of northwest India outside south east Rajasthan by a fortnight or more.

The rainfall for the month was normal or excess over most parts of the country. The activity

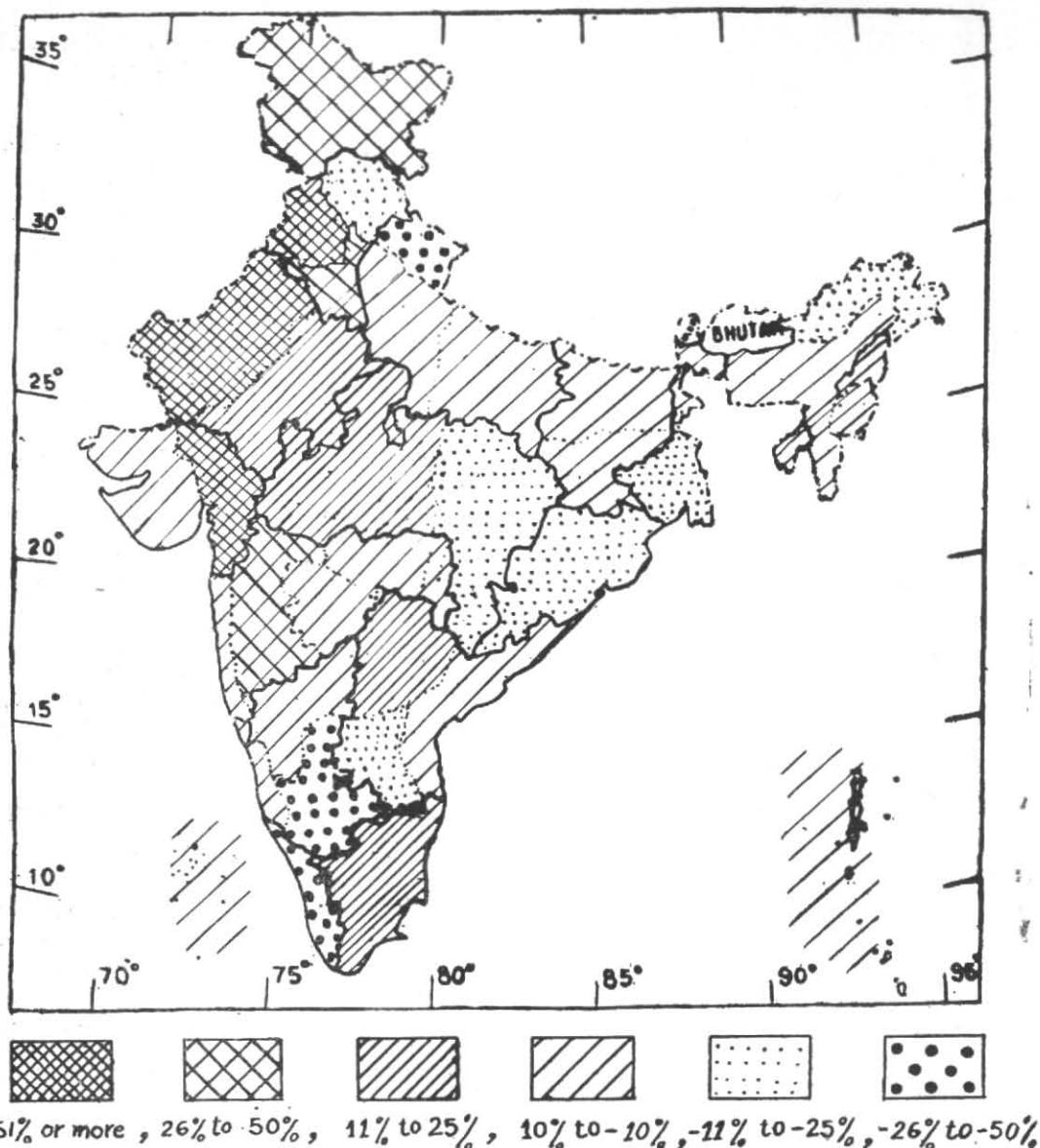


Fig. 2. Rainfall for the period 1 June to 30 September 1976 (Percentage departure from normal)

the monsoon during the month was associated mainly with the following systems :

- (i) The eastern half of the monsoon trough passed from Bihar plains to Assam & adjacent States in the first week. It moved south and passed from central Bihar to north Bay generally during the second week. Two troughs in the middle tropospheric westerlies moved eastwards across northeast India in the first week. A cyclonic circulation in the middle troposphere developed over Bangla Desh and adjoining Gangetic West Bengal on 8th, moved slowly north and weakened

over Sub-Himalayan West Bengal and neighbourhood by 14th. These systems caused fairly widespread rain in Assam & adjacent States, Sub-Himalayan West Bengal & Sikkim on many days in the first fortnight and over the rest of north-east India in the second week with active monsoon in Assam & adjacent States and Sub-Himalayan West Bengal & Sikkim on 5 or 6 days. According to press reports, the flood situation in Cachar district and Tripura worsened. Rivers in north Bengal and north Bihar also rose in spate. Considerable damage to tea plantations was reported in south Assam.

- (ii) The western half of the seasonal trough passed from Punjab to Uttar Pradesh upto 10th but shifted southwards and passed from central Rajasthan to north Madhya Pradesh by 14th with a low level cyclonic circulation over west Rajasthan. Four western disturbances also moved eastwards across the Western Himalayas in the first fortnight. These systems caused only isolated or scattered rainfall in northwest India and Uttar Pradesh in the first week. The monsoon advanced into northwest India and west Uttar Pradesh in the latter half of the second week and was generally active in the plains of northwest India and west Uttar Pradesh during that time.
- (iii) A north-south trough was present over the interior parts of the Peninsula on many days in the first fortnight. A mid-tropospheric cyclonic circulation moved from north Bay to Vidarbha in the first week. A trough in the middle troposphere extended from Gangetic West Bengal to Vidarbha and adjoining Madhya Pradesh from 8th to 10th and to Gujarat State from 11 to 14th with a cyclonic circulation over west Madhya Pradesh. A trough of low also persisted off Maharashtra-Karnataka coasts on most days in the first fortnight. In association with these systems, the monsoon was active or vigorous in Andhra Pradesh on many days in the first fortnight and in Gujarat region from 11th to 14th. It was also active in Konkan and coastal Karnataka on 4 to 6 days, in Madhya Pradesh in the second week and in Vidarbha and Madhya Maharashtra on a few days in the second week. Heavy rain in Gujarat is reported to have caused floods in Baroda and Bulsar districts.
- (iv) The monsoon trough was generally well marked during the second fortnight. It was south of its normal position in the third week with a low embedded in it over southwest Rajasthan and adjoining Gujarat. A low moved from northwest Bay to southeast Madhya Pradesh between 16th and 21st and thereafter rapidly westwards to northeast Arabian Sea across Maharashtra and Gujarat by 23rd and to Gulf of Oman by 24th. Another low formed over north Bay and adjoining land areas on 26th, concentrated into a deep depression on 28th over Gangetic West Bengal and moved to northwest Rajasthan by the evening of 31st. A trough of low lay off the west coast on most days in the second fortnight. A trough/cyclonic circulation in the middle troposphere moved westwards across south Peninsula between 23rd and 25th, emerged into east central Arabian Sea off Karnataka coast on 26th and then moved north to north Maharashtra, south Gujarat and adjoining west Madhya Pradesh by 31st. In association with these systems the monsoon was active or vigorous in coastal Karnataka and Kerala in the last week and over the rest of the Peninsula, east Madhya Pradesh Bihar Plateau and Orissa on some days in the third week and again between 29th and 31st. The monsoon was also active in west Madhya Pradesh on 30th and 31st and in many parts of northwest India on 31st. According to press reports, heavy rain and landslides in the Western Ghats dislocated communications between Vasco and Londa (in Goa) in the third week of July. Many earthen dams burst their banks in Thana district. Floods and landslides affected Trichur, Idukki, Kozhikode and Kottayam districts in Kerala in the last week where about 20 persons lost their lives. Heavy rain in Gujarat region and western Maharashtra caused floods in the rivers inundating low lying areas in Poona, Solapur, Nasik, Bulsar and Surat districts in the last few days. The railway bridge between Vapi and Bhilad was washed away and road and rail communications between Bombay and Ahmadabad were disrupted.
- (v) Four western disturbances moved eastwards across the Western Himalayas in the second fortnight. The western half of the monsoon trough shifted northwards on 24th and passed from Punjab to Uttar Pradesh from 25th to 29th. Under their influence, active or vigorous monsoon prevailed in many parts of northwest India and west Uttar Pradesh between 25th and 27th.
- The principal amounts of heavy rainfall (20 cm and above) during the month were : Cherrapunji 32 on 1st; Hoshangabad 20 on 7th; Mahabaleshwar 21 on 10th; Surat 24 on 11th; Devgarh 24 on 15th; Mahabaleshwar 30, Bhira 23 on 17th; Kanker 26 on 20th; Agumbe 28, Dohad 27 on 22nd; Agumbe 33, Muvattapuzha (Kerala) 23 on 23rd; Muvattapuzha (Kerala) 25, Ponnani (Kerala) 22 on 24th; Najibabad & Mandi 20 each on 26th

vigorous in Maharashtra State and Gujarat region on a few days from 1st to 6th. According to press reports serious floods affected Jammu & Kashmir particularly Anantanag and Srinagar districts, causing damage to crops, roads, houses and irrigation schemes. Floods in the *Narmada* and the *Indravathi* disrupted road communications in Madhya Pradesh. Many parts of Punjab were also affected by floods resulting in damage to crops and houses. Some parts of Bolangir district in Orissa and some parts of Rajasthan were also affected by floods.

(iv) A low developed over north Bay on 11th and concentrated into a depression on 12th with its centre near 20.5°N , 89.0°E . It crossed coast on 13th morning and became deep over Orissa and adjoining Bihar Plateau. Moving westnorthwest, it reached northeast Rajasthan and adjoining southwest Uttar Pradesh and northwest Madhya Pradesh on 16th. Then moving slowly and recurving northwards, it lay as a cyclonic storm over Haryana with its centre near Delhi on 18th morning. It rapidly weakened into a low by 19th and moved to the Western Himalayas by 20th. The western half of the monsoon trough also shifted to the foot hills of the Himalayas and lay there from 21st to 23rd.

(v) Two western disturbances moved eastwards across extreme north of the country between 15th and 21st as upper air troughs.

(vi) The eastern half of the monsoon trough passed from east Uttar Pradesh to northern parts of Assam between 16th and 22nd, with a cyclonic circulation extending to the middle troposphere lying over West Bengal and adjoining Bihar from 16th to 18th.

In association with these systems, the monsoon was active to vigorous in Orissa from 12th to 14th, in east Madhya Pradesh from 13th to 15th and in west Uttar Pradesh and Haryana from 15th to 20th. It was also vigorous in east Rajasthan and Gujarat region on 17th and generally active in Assam & adjacent States and Sub-Himalayan West Bengal in the third week, in Gangentic West Bengal between 14th and 17th, in west Madhya Pradesh on 15th and 16th, in Rajasthan from 15th to 18th and in east Uttar

Pradesh and Bihar plains for 3 to 4 days between 17th and 23rd. Generally widespread rain also occurred in Himachal Pradesh between 16th and 20th. According to press reports, floods affected many parts of Haryana damaging crops and houses. Bharatpur district in east Rajasthan also suffered some damage due to heavy rain and floods. Many districts in west and central Uttar Pradesh were also affected seriously by floods. Most of the rivers in north Bihar and north Bengal were also in spate. Heavy rain caused house collapses in Gwalior and disrupted road communication between Gwalior and other places.

(vii) A low developed in west central and adjoining northwest Bay on 23rd and persisted there upto 25th. It became well marked on 26th, moved inland and concentrated into a depression on 27th over southeast Madhya Pradesh and adjoining Orissa. Moving westnorthwest across west Madhya Pradesh, it lay as a deep depression over north Gujarat on 30th. It intensified into a cyclonic storm as it emerged into northeast Arabian Sea on 31st morning and lay with its centre near Naliya. An upper air cyclonic circulation moved westwards from Burma to central Madhya Pradesh between 26th and 31st. In association with these systems the monsoon was active to vigorous in Gujarat State between 28th and 31st and Maharashtra State on 3 to 4 days between 24th and 31st. It was active in coastal Andhra Pradesh and Telangana on many days between 24th and 31st, in west Madhya Pradesh and east Rajasthan between 26th and 29th and in Orissa between 29th and 31st. Rainfall was also generally widespread in east Madhya Pradesh from 25th to 31st and in Bihar Plateau, West Bengal and southern parts of Assam & adjacent States on many days between 25th and 31st. Ahmadabad reported 25 cm of rain on 30th which is a record for that station for August. Heavy rain and floods disrupted road and rail communications in many parts of Gujarat. Floods also affected some parts of West Bengal in the last week.

(viii) A western disturbance moved across the Western Himalayas as an upper air trough between 26th and 30th causing scattered or fairly widespread rain in Western

Himalayas, Punjab, Haryana and west Uttar Pradesh during this period.

(ix) A sea level north-south trough lay over Andhra Pradesh and Tamil Nadu on most days between 5th and 11th. A mid-tropospheric cyclonic circulation was also present over south Peninsula and adjoining southwest Bay from 7th to 9th. These systems caused scattered to fairly widespread rainfall in Andhra Pradesh from 5th to 11th with active monsoon conditions from 8th to 10th and scattered to fairly widespread rain with isolated heavy falls in Tamil Nadu from 7th to 9th. The monsoon was generally weak over the rest of the Peninsula during the second week.

(x) A north-south trough was again present over south Peninsula on most days between 14th and 25th. It caused scattered to fairly widespread rain in Andhra Pradesh, Tamil Nadu and Interior Karnataka on most days during this period with active monsoon conditions in Andhra Pradesh on 4 or 5 days.

(xi) A trough of low lay off Kerala-Karnataka coasts on some days in the first week and again on many days in the second fortnight. This system caused generally widespread rainfall in coastal Karnataka on most days in the first week and second fortnight, in Kerala in the first and last week, and in Lakshadweep in the last week with active monsoon conditions in Kerala on some days in the first and last week and in coastal Karnataka from 29th to 31st.

The principal amounts of heavy rainfall (20 cm and above) during the month were : Mahabaleshwar 33, Bhira 28 Ferozepore 24, Ratlam 21 on 1st; Mahabaleshwar 22, Naraj (Orissa) 20 on 2nd; Pasighat 23, Mahabaleshwar 22, Bhira 20 on 3rd; Cherrapunji 26, Contai 20 on 4th; Broach 46, Ahuva (Gujarat) 31, Bombay (Santacruz) 26, Cherrapunji 22, Reasi 20 on 5th; Abu 45 on 6th; Talcher (Orissa) 24 on 13th; Nowgong 23, Panna 20 on 15th; Abu 28 on 16th; Rangiya 28, Abu 24 on 17th; Dehra Dun 20 on 19th; Paradip 23, Dehad 22 on 29th; Gandhinagar 26, Ahmadabad 25 on 30th.

SEPTEMBER

The rainfall during the month was in excess in Bihar State and Rajasthan, generally deficient in the Peninsula, east Madhya Pradesh, west Uttar Pradesh, Himachal Pradesh, Haryana and rest of northeast India and normal over the rest of the country. The activity of the monsoon during this month was associated mainly with the following systems :

(i) The cyclonic storm which lay over north-east Arabian Sea and adjoining Kutch with its centre close to Naliya on 31st August, moved westwards and weakened into a depression on 2 September over north Arabian Sea. Moving southeast, it made a loop in its track and re-intensified into a cyclonic storm on 5th morning when it was centred about 80 km south of Porbandar. It skirted the Gujarat coast and then moved away westwards, weakening into a depression over northwest Arabian Sea off Oman coast by 8th morning.

(ii) A depression formed in northwest and adjoining west central Bay on 2nd with

its centre about 100 km east of Gopalpur. It moved westnorthwest, weakened into a low over west Madhya Pradesh on 3rd evening and merged with the monsoon trough by 4th evening. A low also lay over northwest and adjoining west central Bay off south Orissa-north Andhra coasts from 3rd to 5th and weakened. The axis of the monsoon trough passed from south Rajasthan to Orissa from 1st to 5th and started moving northwards from 6th.

In association with these systems, the monsoon was active or vigorous in coastal Andhra Pradesh and Telangana between 1st and 5th, in interior Maharashtra on 2nd and 3rd, in Gujarat State on 1st and 2nd and in Madhya Pradesh from 1st to 4th. Rainfall was also generally widespread in Orissa and Rajasthan from 1st to 4th with some heavy falls in east Rajasthan on 2nd and 3rd and fairly widespread in Saurashtra & Kutch from 4th to 6th. According to press reports, the *Godavari* was in spate and inundated low

lying areas along its banks at some places in Andhra Pradesh. Road communications in some parts of Madhya Pradesh were temporarily disrupted due to floods in the *Narmada*, the *Tapti* and the *Wain-ganga*.

(iii) The western half of the monsoon trough passed through north Rajasthan and south Uttar Pradesh on 7th and shifted to the foot of Western Himalayas by 9th. A cyclonic circulation in the lower troposphere lay over central Uttar Pradesh from 7th to 10th. Three western disturbances moved eastwards across the Western Himalayas as upper air troughs in the middle troposphere between 1st and 9th. In association with these system, monsoon was active or vigorous in Punjab for four days and in the hills of west Uttar Pradesh, Haryana and Himachal Pradesh on two or three days between 1st and 9th. It was also active in west Madhya Pradesh and east Rajasthan between 6th and 9th and in the plains of Uttar Pradesh on 9th and 10th. Fairly widespread rain also occurred in Gujarat region from 8th to 10th.

(iv) A low which developed over north Andaman Sea on 6th, moved north-west and concentrated into a depression on the morning of 8th with its centre near 17.5°N, 93.0°E. Moving northwest, it intensified into a severe cyclonic storm on 10th over north Bay. It developed a core of hurricane winds on 11th early morning and was centred near Sagar Island at 0300 GMT that morning. It crossed coast near Contai around noon of 11 September and reached southeast Uttar Pradesh and adjoining northeast Madhya Pradesh as a cyclonic storm by 13th morning. Recurving northeastwards, it weakened into a deep depression on 14th morning over southeast Uttar Pradesh, and moved slowly southeastwards to Bihar Plateau the next day. It persisted there as a depression upto 19th and weakened into a low on 20th. In association with this system the monsoon was active in Gangetic West Bengal and Orissa on 11th and 12th, in Madhya Pradesh from 12th to 14th and active to vigorous in Bihar State between 12th and 18th and in east Uttar Pradesh from 13th to 15th. Gaya reported 29 cm of rain on 16th which is an all-time record for that station. Rainfall was also fairly

widespread in Bay Islands from 6th to 9th and in Sub-Himalayan West Bengal & Sikkim from 12th to 17th.

According to press reports as well as reports from State Government authorities the severe cyclonic storm caused damage in the coastal districts of West Bengal and in the northern parts of Balasore district. About 40 persons lost their lives and about 4000 heads of cattle perished. Many trees and telephone posts were uprooted. Several thousands of houses were damaged. Tidal waves of 2 to 3 m inundated coastal areas in 24-Parganas and Midnapore districts. Crops in about 1.25 lakh acres were damaged. Sagar Island reported the maximum wind speed of 160 kmph in gusts on 11th. Very heavy rain in Bihar and east Uttar Pradesh caused serious floods resulting in damage to crops and houses in those States. In Bihar, an area of about 40 lakh hectares and a population of 50 lakhs were affected. Road and rail communications in Bihar and in the eastern districts of Uttar Pradesh were dislocated.

(v) A trough of low lay off the west coast during the first fortnight causing fairly widespread rain in Konkan and coastal Karnataka on most days in the first fortnight and in Kerala from 2nd to 5th and from 12th to 14th with active monsoon conditions over these areas on 3 or 4 days.

(vi) A north-south trough that lay over Tamil Nadu from 9th to 12th caused scattered to fairly widespread rain in Tamil Nadu from 9th to 12th with isolated heavy falls on 9th and 12th.

(vii) Three western disturbances moved eastwards across the Western Himalayas as upper air troughs between 10th and 18th, causing scattered or isolated rainfall in the Western Himalayas and the plains of northwest India and west Uttar Pradesh on a few days during this period.

In the wake of the western disturbance that moved across the Western Himalayas on 18th, the southwest monsoon withdrew from northwest India by 20th. It also withdrew from west Uttar Pradesh on 22nd, from west Madhya Pradesh on 23rd and from Gujarat State on 25th. The monsoon was generally weak over the rest of the country in the second fortnight. However, there was a spell of scattered to fairly

widespread rainfall in some parts of northeast India and east Uttar Pradesh in the last week with active or vigorous monsoon in east Uttar Pradesh on 27th and in Bihar and Sub-Himalayan West Bengal & Sikkim on 27th and 28th, in association with (i) the seasonal trough extending from east Uttar Pradesh to north Bay (ii) a low embedded in this trough over Bihar and neighbourhood from 27th to 29th and (iii) two upper air troughs moving eastwards across northeast India in the last week. Two western disturbances

moved eastwards across northwest India between 26th and 30th causing widespread rain in the hills of west Uttar Pradesh on 27th and in Jammu & Kashmir on 30th. Scattered or isolated rainfall also occurred in northwest India on 28th and 30th.

The principal amounts of heavy rainfall (20 cm and above) over the country during the month were : Bhograi (Orissa) 31, Rajghat (Orissa) & Balipal (Orissa) 24 each on 12th; Varanasi AP 25, Allahabad 21 on 14th; Varanasi AP 25 on 15th; Gaya 29 on 16th.