MINISTRY OF EARTH SCIENCES
INDIA METEOROLOGICAL DEPARTMENT
REGIONAL METEOROLOGICAL CENTRE, NEW DELHI

A REPORT
ON SOUTH WEST MONSOON
2025
OVER NORTH WEST INDIA

Prepared By
Rajesh Kumar, Gajendra Kumar, Salini Saxena, Krishna Mishra

Regional Meteorological Centre
Lodi Road, New Delhi-110003

HIGHLIGHTS

- **Seasonal Rainfall:** The rainfall over North West India during Southwest Monsoon season (June-September, 2025) was 127% of its long period average (LPA) (based on 1971-2020 data), placing the region in the Excess category (+27% departure from LPA).

- **Monthly Rainfall Distribution:** The monthly rainfall over Northwest India was 142% of LPA in June, 113% in July, 134% in August, and 129% in September, indicating sustained monsoon activity throughout the season.

- **Subdivision-wise Rainfall Performance:**
  - Out of the total **09 meteorological subdivisions** of region:
  - **02 subdivisions** – *East Rajasthan* and *West Rajasthan* received **large excess** rainfall (>+60%).
  - **05 subdivisions** – *Jammu & Kashmir and Ladakh, Himachal Pradesh, Uttarakhand, Punjab,* and *Haryana, Chandigarh & Delhi* – received **Excess rainfall** (+20% to +59%).
  - **02 subdivisions** – *West Uttar Pradesh* and *East Uttar Pradesh* – received **Normal rainfall** (–19% to +19%).

  Overall, the region as a whole recorded **Excess rainfall** during the 2025 monsoon season.

- **State/UT-wise Rainfall Summary:**

  Among the constituent **6 States and 4 Union Territories** of Northwest India:
  - *Ladakh* and *Rajasthan* experienced **Large Excess rainfall**;
  - *Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Punjab, Haryana,* and *Delhi* experienced **Excess rainfall**;
  - *Chandigarh* and *Uttar Pradesh* recorded **Normal rainfall**.

- **Onset and Progress of Monsoon:**
  - The Southwest Monsoon set in over Kerala on **24 May 2025**, a week earlier than the normal date of 1 June, marking the earliest onset since 2009 (when it occurred on 23 May).

    It advanced into Northwest India on 17 June, and with rapid progress, covered the entire country by 29 June 2025, nine days ahead of the normal date (8 July).

- **Withdrawal of Monsoon:**
  - With reduction in rainfall and the establishment of **anti-cyclonic circulation** over lower tropospheric levels, **withdrawal commenced from West Rajasthan and Kutch on 14 September**, **three days earlier** than the normal date (17 September).

  The monsoon completely **withdrew from Northwest India by 13 October** and from the entire **country by 16 October 2025**, marking a five-day delay from the normal withdrawal date.

1. INTRODUCTION:

The North West (NW) India is one of the major agrarian regions of the country and plays a vital role in India's food grain production. The region comprises nine meteorological subdivisions — Jammu & Kashmir, Ladakh, Gilgit-Baltistan & Muzaffarabad, Himachal Pradesh, Punjab, Haryana, Chandigarh & Delhi, West Rajasthan, East Rajasthan, West Uttar Pradesh, and East Uttar Pradesh. The South-West Monsoon (SWM) season is the principal rainy season for this region, contributing the majority of its annual precipitation. Owing to its unique geographical location, complex orography, and dynamic interaction with the monsoon circulation, the region exhibits high spatial and temporal rainfall variability, making it vulnerable to weather-induced disasters such as droughts and floods. Climatologically, the Long Period Average (LPA) rainfall for the season (June–September) over NW India is **58.76 cm** based on data from 1971–2020, and the **normal onset date of the monsoon over the region is 20 June**.

2. ONSET AND ADVANCE OF SOUTHWEST MONSOON 2025:

The Southwest Monsoon advanced into parts of the South Bay of Bengal, South Andaman Sea, Nicobar Islands, and some areas of the North Andaman Sea on 13 May 2025, ahead of the normal date of 19 May. Monsoon set in over Kerala on **24th May** against the normal date of 1st June. The earliest onset in 17 years after 2009 when it was on 23rd May. Followed rapid advance till 29 May and covered south India and NE India. It was stagnated till 15th June due to impact of western Disturbances and absence of any major system formation. Further progress started on from 16th June with formation low pressure area of Bay of Bengal. It was then followed another phase of rapid advance.

The southwest monsoon advanced into parts of northwest India earlier than normal in 2025. On **17 June 2025**, the Northern Limit of Monsoon (NLM) passed through Deesa, Indore, Panchmarhi, Mandla, Ambikapur, Hazaribagh, Supaul, and 29.0°N/84.0°E**,** marking its initial entry into eastern Rajasthan and adjoining regions. By 18 June, the monsoon further advanced over additional parts of Rajasthan and East Uttar Pradesh**,** with the NLM passing through Barmer, Jodhpur, Jaipur, Gwalior, Khajuraho, Sonbhadra, Gaya, and 30.5°N/82.5°E, indicating steady northward progression. On 19 June, it extended over more parts of East Uttar Pradesh, while maintaining its western reach up to Barmer and Jodhpur in Rajasthan.

By 21 June 2025, the NLM had significantly advanced northward across the entire northwestern plains, passing through Jaipur, Agra, Rampur, Dehradun, Shimla, Manali, and 33.5°N/79.0°E, thereby covering major parts of Rajasthan, Uttar Pradesh, Delhi, Haryana, Punjab, Himachal Pradesh, and Jammu & Kashmir. The monsoon covered most parts of the country except northwest Rajasthan, western Uttar Pradesh, southern Punjab, and southern Haryana including Delhi by 26 June. With continued rapid advance, the Southwest Monsoon covered the entire country by **29 June 2025**, which was nine days ahead of its normal date of 8 July.

Isochrones of advance of monsoon 2025 are shown in Fig.1 and 2

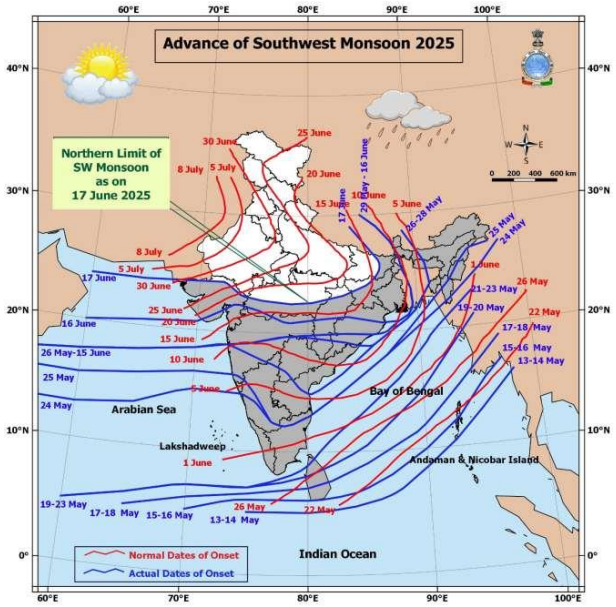


Fig.1: Progress of SW Monsoon on 17thJune

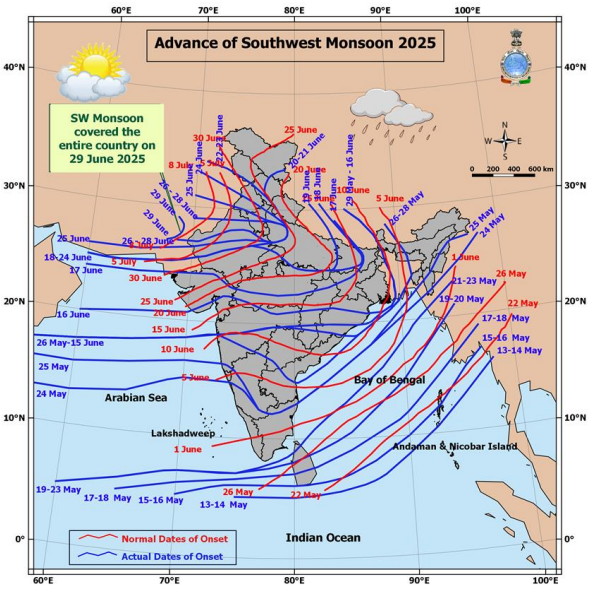


Fig.2: Progress of SW Monsoon on 29th June

3. CHIEF SYNOPTIC FEATURES OF SOUTHWEST MONSOON 2025 OVER NORTHWEST INDIA:

During the Southwest Monsoon season (June–September 2025)**,** several synoptic-scale systems — including Low-Pressure Systems (LPSs)**,** Depressions, and Western Disturbances (WDs) — significantly influenced the rainfall distribution and overall monsoon activity over Northwest India. The season featured active monsoon phases during June and August**,** primarily sustained by the combined effects of monsoon trough oscillations and successive westward-moving low-pressure systems from the Bay of Bengal and the Arabian Sea.

A total of 18 Low-Pressure Systems developed during the 2025 Southwest Monsoon season, which is higher than the climatological normal of 13.7 systems (based on the 1951–2020 mean). These included one Deep Depression**,** six Depressions**,** two Well-Marked Low-Pressure Areas, and nine Low-Pressure Areas. The total number of Low-Pressure System (LPS) days was 69, exceeding the normal of about 64.7 LPS days**. (Table-1)**

In addition, 17 Western Disturbances traversed across the region during the season, frequently interacting with the monsoon circulation and the monsoon trough. These interactions enhanced rainfall activity over the western Himalayan region and adjoining plains**,** occasionally leading to intense precipitation events**,** localized flooding, and landslides in the hilly districts of Himachal Pradesh and Uttarakhand.

The frequent formation, intensification, and westward propagation of low-pressure systems from the Bay of Bengal, combined with periodic incursions of Western Disturbances**,** maintained a sustained monsoon phase across most parts of Northwest India. The monsoon trough remained active, oscillating between its normal and south-of-normal positions during much of the season, which contributed to widespread and heavy rainfall spells across Rajasthan, Punjab, Haryana, Delhi, Himachal Pradesh, Uttarakhand, and Uttar Pradesh**.**

Overall, the Southwest Monsoon 2025 over Northwest India was characterized by enhanced synoptic activity and strong system interactions, leading to above-normal seasonal rainfall**,** with the region receiving 127% of its Long Period Average (LPA) rainfall. The formation details of Low-Pressure Systems and corresponding LPS days are presented in Table 1, while the tracks of the cyclonic storms and depressions formed during the season are shown in Figure 3**.**

3.1.1 Depressions and Low Pressure in June:

In **June 2025**, five low-pressure systems formed — three over the Head Bay of Bengal and two over the Arabian Sea. The first well-marked low-pressure area over the Head Bay of Bengal (17–23 June) and subsequent systems between 26–29 June played a significant role in the early advancement of the monsoon over Northwest India. These systems, supported by strong cross-equatorial flow and mid-tropospheric westerlies, produced widespread rainfall over Rajasthan, Punjab, Haryana, Delhi, Himachal Pradesh, Uttarakhand, and Uttar Pradesh.

3.1.2 Western Disturbances in June:

Four Western Disturbances (29 May–9 June, 6–9 June, 8–11 June, and 11–19 June) also interacted with monsoon currents, enhancing rainfall over the western Himalayan region and adjoining plains during the initial active phase of the season.

3.2.1 Depressions and Low Pressure in July:

In **July 2025**, A total of six number of Low Pressure Systems (LPS) were formed in the month with total duration of 28 number of low pressure system days. Out of these, four intensified into depressions — during 14–15 July, 15–16 July, 17–20 July (remnant of a depression over Gangetic West Bengal), and 25–27 July (remnant of Cyclone *Wipha* from the South China Sea). Three systems formed over land, while one originated over the North Bay of Bengal. Three of these LPSs had a long westward movement and reached upto Rajasthan from Gangetic West Bengal/North Bay of Bengal. Due to regular formation and movement of Monsoon disturbances from eastern India to Rajasthan, excess to Large-Excess rainfall were observed during almost all weeks in July across most parts of central India except during 17-23 July 2025 when Rajasthan received excess rainfall.

3.2.2 Monsoon Trough in July:

In most dates of July 2025, monsoon trough was south of its normal or along normal positions.

3.2.3 Western Disturbances in July:

The region experienced five Western Disturbances (11–13 July, 13–18 July, 18–20 July, 23–28 July and from 28 July onwards) which supported rainfall over the northern Himalayas, Punjab-Haryana plains and East/West Uttar Pradesh. These disturbances, in conjunction with monsoon low-pressure systems, contributed to heavy rainfall spells across the region and helped sustain rainfall above normal (+13 % of LPA) during the month."

3.3.1 Depressions and Low Pressure in August:

In **August 2025**, four low-pressure systems developed— slightly below the climatological normal of 5.38. These included one depression over the Bay of Bengal that formed during 18–19 August, a well-marked low-pressure area from 26–29 August, and two low-pressure areas that developed during 13–17 August and 22–25 August. The total number of low-pressure system (LPS) days was 15, compared to the normal of approximately 16.3 days. These systems were associated with strong monsoon surges and westerly moisture transport, producing above-normal rainfall over the plains of northwest India and the western Himalayan foothills.

3.3.2 Monsoon Trough in August:

During peak monsoon rainfall months of July and Aug 2025, most of the day's monsoon trough was in normal or south of its normal position, However, monsoon trough shifted to north of its normal position and there was a break monsoon like situation during 2nd August to 12th August. Again, Monsoon was active during 19th August to 25th August.

3.3.3 Western Disturbances in August:

Five Western Disturbances (28 July–5 August, 5–10, 10–13, 18–22, and 24–31 August) traversed across the region, frequently interacting with the monsoon trough positioned north of its normal position. This resulted in episodes of intense rainfall, localized flooding, and landslides over Himachal Pradesh, Uttarakhand, and adjoining areas of Punjab and Haryana.

3.4.1 Depressions and Low Pressure in September:

In **September 2025**, four low-pressure systems were observed, one of which intensified into a deep depression (6–11 September) with a distinctive sinusoidal track, and another into a

depression (26–27 September). Two additional low-pressure areas formed during 12–15 and 22–24 September.

3.4.2 Monsoon Trough in September:

The monsoon trough during September remained close to its normal position.

3.4.3 Western Disturbances in September:

These systems, in combination with three Western Disturbances (5–8, 11–13, and 19–22 September), caused recurrent spells of widespread rainfall over Rajasthan, Haryana, Delhi, and western Uttar Pradesh, sustaining the monsoon activity over the region well into mid-September.

Table 1: Number of Low-pressure System (LPS) including Low (L), Well Marked Low (WML), Depression (D), Deep Depression (DD), Cyclonic Storm (CS) and number of LPS days in monsoon 2025.

Category	CS	DD	D	WML	LOW	Total LPS	Total LPS days	Long period Average of Total monsoon systems /Days	
June	**0**	**0**	**0**	**1 (BOB)**	**2(BOB) 2(AS)**	**5**	**13**	**3**	**11**
July	**0**	**0**	**1(BOB) 3(Land)**	**0**	**1(BOB)**	**5**	**18**	**3**	**14**
August	**0**	**0**	**1 (BOB)**	**1 (BOB)**	**1(BOB)**	**4**	**15**	**4**	**17**
September	**0**	**1 (BOB)**	**1 (BOB)**	**0**	**2(BOB)**	**4**	**23**	**3**	**12**
Season	**0**	**1**	**6**	**2**	**9**	**18**	**69**	**13**	**55**
	AS: Arabian Sea) (BOB: Bay of Bengal)								

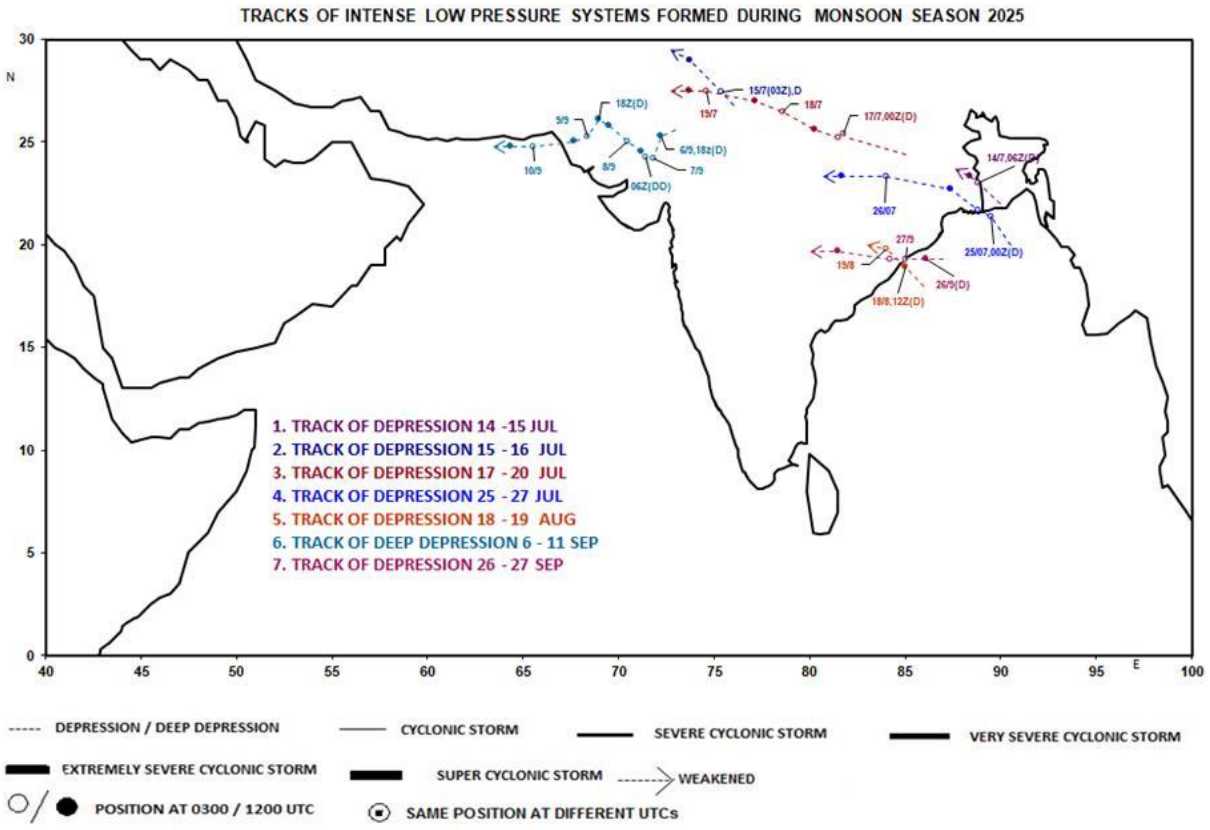


Fig. 3. Tracks of the Cyclonic Storms and Depressions formed during Monsoon 2025

4. RAINFALL DISTRIBUTION:

4.1 Distribution of cumulative rainfall over North West India:

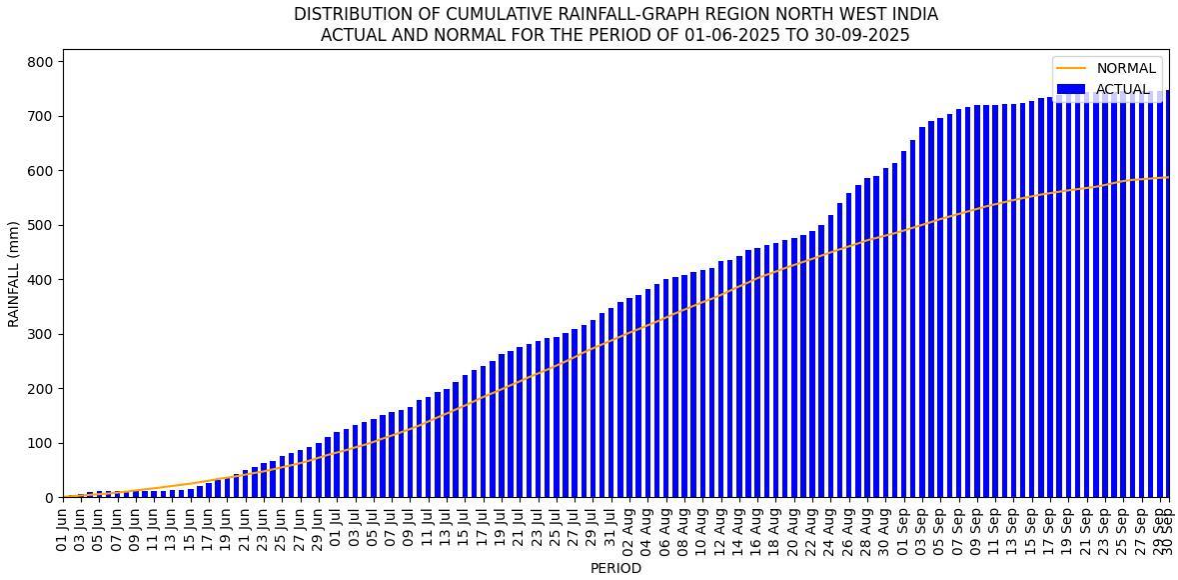


Fig. 4. Distribution of cumulative rainfall during Monsoon Season 2025

The distribution of cumulative rainfall during the Southwest Monsoon 2025 (Fig. 4) indicates that Northwest India as a whole experienced above-normal seasonal rainfall, amounting to 127% of the Long Period Average (LPA). The cumulative pattern shows a well-sustained and spatially consistent monsoon activity throughout most parts of the region. The rainfall progression was characterized by an active onset phase, followed by intermittent revival spells associated with successive low-pressure systems and favorable monsoon trough positions. Overall, the cumulative rainfall distribution highlights a vigorous and persistent monsoon regime over Northwest India during the 2025 season.

4.2 Seasonal rainfall variation over North West India:

The Southwest monsoon seasonal rainfall during June to September 2025 over the North West India as a whole was 127% of Long Period Average (LPA). It was excess for the region. Quantitatively, North West India monsoon seasonal rainfall during 1 June to 30 September 2025 has received 74.79 cm against the Long Period Average of 58.76 cm based on data of 1971-2020 (127% of its LPA).

The spatial and temporal distribution of rainfall over Northwest India exhibits significant month-to-month variation. The rainfall anomaly is assessed in terms of Percentage Departure from Normal (PDN**)** for each meteorological subdivision within the region. As per IMD's operational classification, a PDN value between –19% and +19% indicates *normal* rainfall, +20% to +59% indicates *excess* rainfall, and ≥ +60% signifies *large excess* rainfall. Similarly, –20% to –59% and ≤ –60% denote *deficient* and *scanty* rainfall categories, respectively.

Table-2 Month to month rainfall variation

Season/Month	Rainfall received in 2025	Long Period Average (LPA) Rainfall	% Departure	% of LPA	CAT.
June	111.0 mm	78.1 mm	42.2%	142%	E
July	237.4 mm	209.7 mm	13.2%	113%	N
August	265.0 mm	197.1 mm	34.4%	134%	E
September	134.2 mm	102.7 mm	30.7%	131%	E
Monsoon Season	**747.9 mm**	**587.6 mm**	**27%**	**127%**	

During June 2025, the region received 142% of its LPA rainfall, signifying *excess rainfall* conditions. Quantitatively, rainfall over Northwest India during June amounted to

111.0 mm, which is 42.2% above its LPA of 78.1 mm. This early-season surplus was mainly attributed to the timely and vigorous advance of the monsoon, supported by multiple low-pressure systems over the Bay of Bengal and Arabian Sea, and their westward movement toward Northwest India.

In July 2025, the region experienced near-normal rainfall, amounting to 113% of its LPA, with an actual rainfall of 237.4 mm against the LPA of 209.7 mm, representing a positive departure of 13.2%. Despite a few brief weak phases, successive monsoon depressions and active monsoon trough positions ensured the maintenance of normal monsoon conditions over most parts of the region.

The month of August 2025 witnessed a further intensification of monsoon activity, with the region receiving 134% of its LPA, classified as *excess rainfall*. The total rainfall recorded during the month was 265.0 mm, exceeding the LPA of 197.1 mm by 34.4**%**. Active monsoon phases, aided by frequent low-pressure systems and westerly disturbances, contributed to enhanced rainfall across the plains and hilly regions of Northwest India.

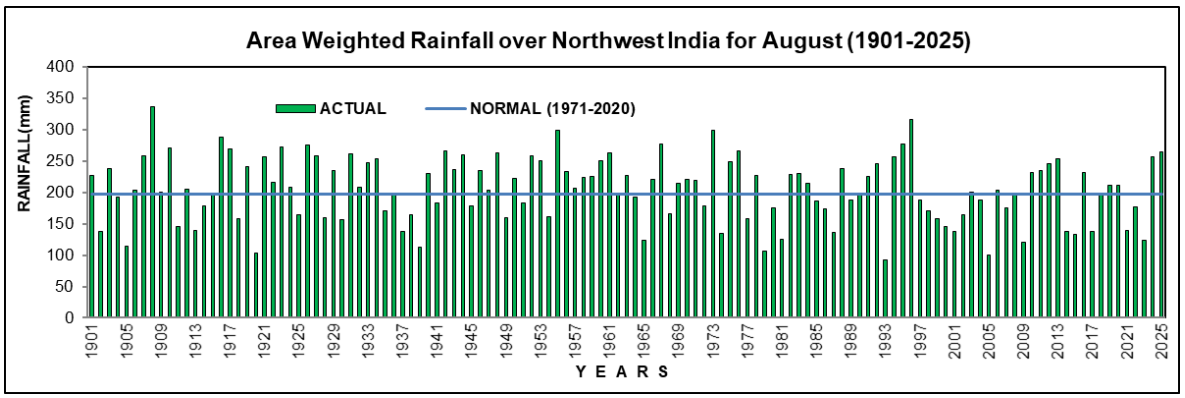


Fig 5: Time series of area weighted rainfall over Northwest India for August (1901 – 2025).

During September 2025, the rainfall activity continued to remain above normal, with the region receiving 131% of its LPA, categorized as *excess rainfall*. Quantitatively, the rainfall over Northwest India during the month was 134.2 mm, compared to the LPA of 102.7 mm, registering a positive departure of 34.7%. The persistence of the monsoon trough near its normal position, coupled with the occurrence of multiple low-pressure systems over the Bay of Bengal, sustained the monsoon rainfall over the region till mid-September.

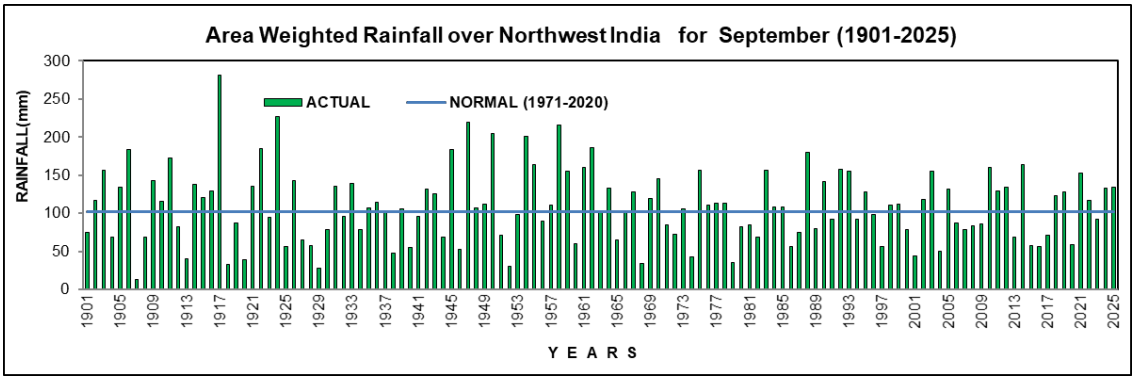


Fig. 6: Time series of area weighted rainfall over Northwest India for September (1901 – 2025)

Overall, the Southwest Monsoon 2025 over Northwest India was characterized by well-distributed and above-normal rainfall throughout the season, supported by favorable synoptic conditions, frequent low-pressure system formation, and active monsoon trough oscillations. The season contributed significantly to reservoir replenishment, agricultural activities, and the overall hydrological balance of the region.

4.3 Subdivision-wise distribution:

During the southwest monsoon season 2025 (01 June to 30 September), Northwest India as a whole received 747.9 mm of rainfall against the normal of 587.6 mm, registering a 27% excess. Out of the nine meteorological subdivisions of the region, two subdivisions, namely East Rajasthan (61%) and West Rajasthan (69%), received large excess rainfall; five subdivisions—Jammu & Kashmir and Ladakh (28%), Himachal Pradesh (39%), Uttarakhand (22%), Punjab (41%), and Haryana, Chandigarh & Delhi (33%)—experienced excess rainfall; while West Uttar Pradesh (12%) and East Uttar Pradesh (-17%) recorded normal rainfall. Overall, the Northwest India region experienced excess rainfall during the 2025 southwest monsoon season.

Table 3 Subdivision-wise distribution of rainfall

Period: 01-06-2025 to 30-09-2025					
S NO	REGION/MET. SUBDIVISION	ACTUAL (mm)	NORMAL (mm)	% DEP.	CAT.
1	JAMMU & KASHMIR AND LADAKH	**705.2**	**549.1**	**28%**	**E**
2	HIMACHAL PRADESH	**1022.5**	**734.4**	**39%**	**E**
3	UTTARAKHAND	**1420.2**	**1162.7**	**22%**	**E**
4	PUNJAB	**621.8**	**439.8**	**41%**	**E**
5	HAR. CHD & DELHI	**573.0**	**430.7**	**33%**	**E**
6	WEST UTTAR PRADESH	**749.8**	**672.0**	**12%**	**N**
7	EAST UTTAR PRADESH	**666.5**	**799.2**	**-17%**	**N**
8	WEST RAJASTHAN	**478.0**	**283.6**	**69%**	**LE**
9	EAST RAJASTHAN	**1010.0**	**626.6**	**61%**	**LE**
	REGION : NORTH WEST INDIA	**747.9**	**587.6**	27%	E

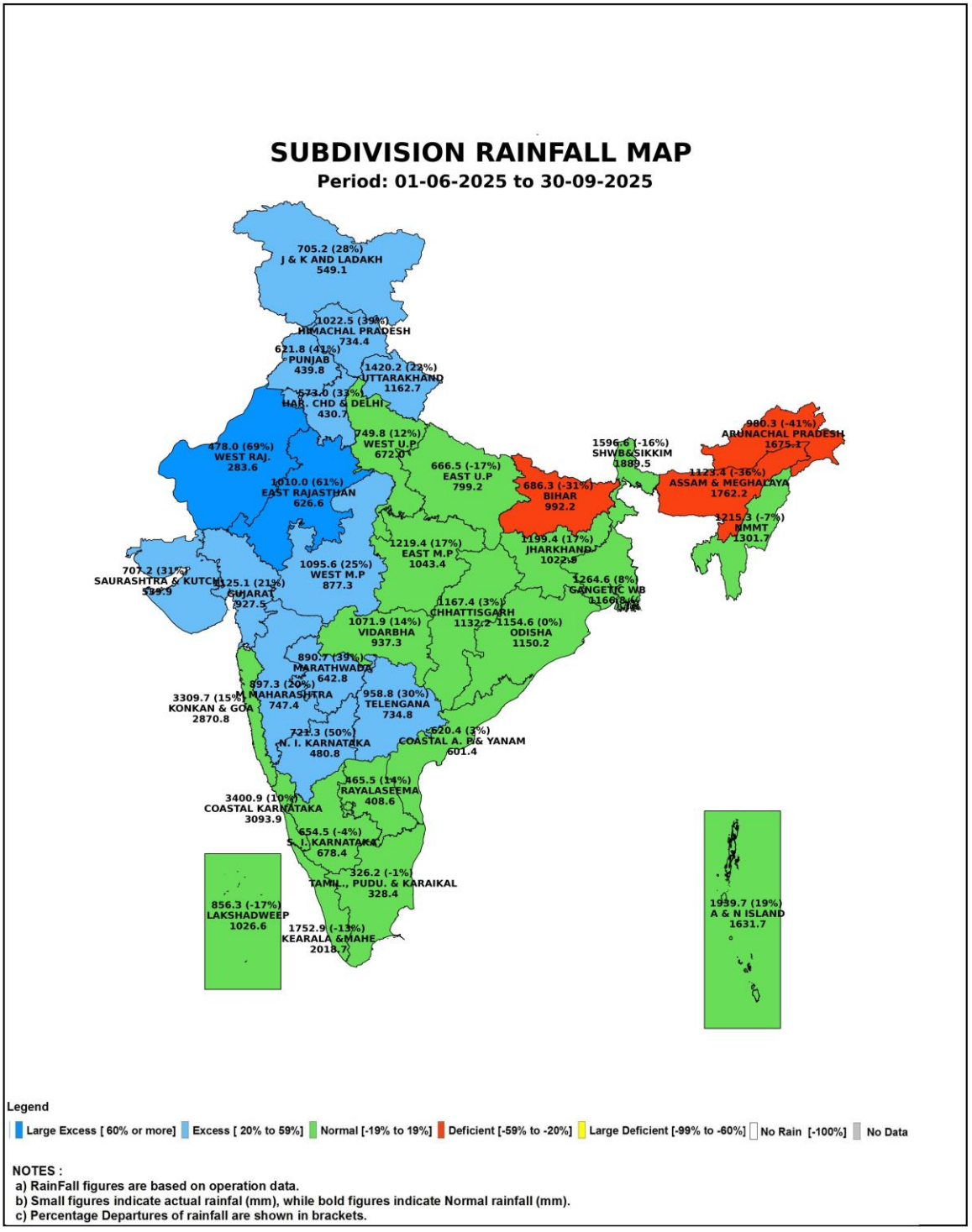


Fig.7 Subdivision-wise distribution of rainfall

4.3.1 Monthly Sub-Divisional rainfall variation:

During the southwest monsoon season 2025, rainfall activity over Northwest India exhibited significant intra-seasonal variability.

In June 2025, the region as a whole received 111.0 mm of rainfall against the normal of 78.1 mm, registering a 42% excess. Rainfall was large excess over West Uttar Pradesh (60%), West Rajasthan (79%), and East Rajasthan (160%), while Himachal Pradesh, Uttarakhand, Punjab, and Haryana-Chandigarh-Delhi recorded excess rainfall. East Uttar Pradesh received normal rainfall during the month.

In July 2025, the rainfall over the region was 237.4 mm against the normal of 209.7 mm, showing a 13% above-normal rainfall. Rainfall distribution was normal over most subdivisions except East Uttar Pradesh, which experienced deficit rainfall (–23%), and West and East Rajasthan, which recorded large excess rainfall (84% and 72% respectively) due to the westward movement of monsoon disturbances from the Bay of Bengal.

In August 2025, monsoon activity intensified markedly, with the region receiving 265.0 mm rainfall against the normal of 197.1 mm, a 34% excess. Several subdivisions — Jammu & Kashmir and Ladakh, Himachal Pradesh, Punjab, and Haryana-Chandigarh-Delhi — recorded excess to large excess rainfall, while Uttarakhand and Rajasthan also received above-normal rainfall.

In September 2025, rainfall over the region was 132.7 mm against the normal of 102.7 mm, a 29% excess. The rainfall was large excess in Himachal Pradesh, Punjab, Haryana-Chandigarh-Delhi, West Rajasthan, and East Rajasthan, and excess in Jammu & Kashmir and Uttarakhand. However, East Uttar Pradesh experienced a deficit (–32%) during the month.

Overall, the monsoon season (June–September 2025) over Northwest India was characterized by excess to large-excess rainfall during most months, with particularly active conditions in August and September, driven by frequent low-pressure systems and the southward position of the monsoon trough.

Table-4 Monthly Sub-Divisional rainfall variation

	June					July			
Sub Division	Actual (mm)	Normal (mm)	% Dep.	Cat.		Actual (mm)	Normal (mm)	% Dep.	Cat.
JAMMU & KASHMIR AND LADAKH	**78.5**	75.9	**3%**	**N**		**179.0**	192.6	**-7%**	**N**
HIMACHAL PRADESH	**138.7**	101.1	**37%**	**E**		**255.4**	255.9	**0%**	**N**
UTTARAKHAND	**240.7**	176.8	**36%**	**E**		**349.9**	417.8	**-16%**	**N**
PUNJAB	**69.7**	54.5	**28%**	**E**		**146.7**	161.4	**-9%**	**N**
HAR. CHD & DELHI	**70.8**	55.3	**28%**	**E**		**175.6**	150.5	**17%**	**N**
WEST UTTAR PRADESH	**125.4**	78.6	**60%**	**LE**		**257.6**	240.3	**7%**	**N**
EAST UTTAR PRADESH	**92.7**	108.3	**-14%**	**N**		**212.2**	276.9	**-23%**	**D**
WEST RAJASTHAN	**70.4**	39.4	**79%**	**LE**		**198.5**	107.8	**84%**	**LE**
EAST RAJASTHAN	**194.1**	74.7	**160%**	N		**393.7**	228.6	**72%**	**LE**
REGION : NORTH WEST INDIA	**111.0**	**78.1**	**42%**			**237.4**	**209.7**	**13%**	
	August					**September**			
Sub Division	**Actual (mm)**	**Normal (mm)**	**% Dep.**	**Cat.**		**Actual (mm)**	**Normal (mm)**	**% Dep.**	**Cat.**
JAMMU & KASHMIR AND LADAKH	**319.3**	184.9	**73%**	**LE**		**128.4**	95.7	**34%**	E
HIMACHAL PRADESH	**440.7**	256.8	**72%**	**LE**		**205.8**	120.6	**71%**	**LE**
UTTARAKHAND	**574.4**	385.7	**49%**	**E**		**255.2**	182.4	**40%**	**E**
PUNJAB	**253.7**	146.2	**74%**	**LE**		**150.6**	77.7	**94%**	**LE**
HAR. CHD & DELHI	**196.6**	147.7	**33%**	**E**		**129.5**	77.2	**68%**	**LE**
WEST UTTAR PRADESH	**237.6**	228.3	**4%**	**N**		**129.1**	124.8	3%	**N**
EAST UTTAR PRADESH	**244.0**	240.6	**1%**	**N**		**117.6**	173.4	**-32%**	**D**
WEST RAJASTHAN	**131.2**	95.5	**37%**	**E**		**73.0**	40.9	78%	**LE**
EAST RAJASTHAN	**250.2**	231.5	**8%**	**N**		**170.8**	91.8	86%	**LE**
REGION : NORTH WEST INDIA	**265.0**	**197.1**	**34%**			**132.7**	**102.7**	**29%**	

4.4 State-wise Seasonal Rainfall distribution:

During the southwest monsoon season 2025 (01 June to 30 September), Northwest India, comprising six states and four Union Territories, received generally above-normal rainfall activity. State-wise analysis indicates that Ladakh (342%) and Rajasthan (64%) received large excess rainfall, while Jammu & Kashmir (28%), Himachal Pradesh (39%), Uttarakhand (22%), Punjab (41%), Haryana (33%), and Delhi (35%) experienced excess rainfall**.** Chandigarh (13%) and Uttar Pradesh (-6%) recorded normal rainfall during the season. Overall, the distribution pattern suggests widespread excess to large excess rainfall conditions across most parts of Northwest India during the 2025 southwest monsoon season.

Table 5 represents the state-wise seasonal rainfall distribution as percentage departures from normal over the ten states/UTs of the North West region during the period Jun-Sep 2025 and Fig.8, the state-wise seasonal rainfall over the various states and UTs over the NW region.

Table-5 State-wise distribution of rainfall

Period: 01-06-2025 to 30-09-2025					
S. NO.	STATE /UNION TERRITORIES	ACTUAL (mm)	NORMAL (mm)	% DEP.	CAT.
1	LADAKH (UT)	**98.6**	**22.3**	**342%**	**LE**
2	JAMMU & KASHMIR (UT)	**705.2**	**549.1**	**28%**	**E**
3	HIMACHAL PRADESH	**1022.5**	**734.4**	**39%**	**E**
4	UTTARAKHAND	**1420.2**	**1162.7**	**22%**	**E**
5	PUNJAB	**621.8**	**439.8**	**41%**	**E**
6	CHANDIGARH (UT)	**958.5**	**844.9**	**13%**	**N**
7	HARYANA	**568.4**	**426.0**	**33%**	**E**
8	DELHI (UT)	**736.2**	**544.3**	**35%**	**E**
9	UTTAR PRADESH	**700.8**	**746.2**	**-6%**	**N**
10	RAJASTHAN	**713.9**	**435.6**	**64%**	**LE**

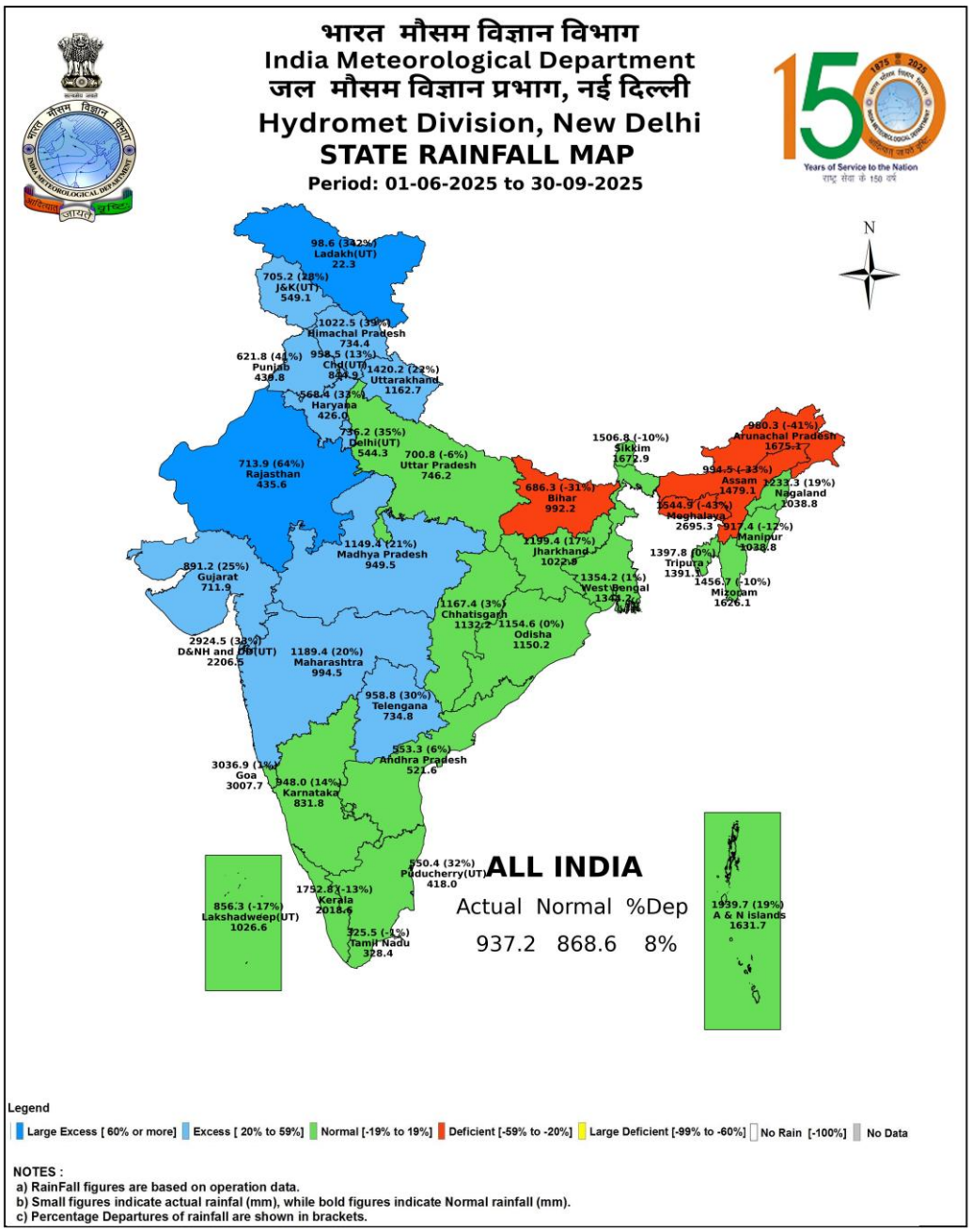


Fig.8 State-wise distribution of rainfall
(Period : 01-06-2024 to 30-09-2024)

4.4.1 State-wise Monthly rainfall variation:

The month-wise state rainfall variation over North-West India during the 2025 monsoon season shows significant spatial and temporal fluctuations. In June, most states and Union Territories experienced deficient rainfall, with Ladakh being an exception, recording 385% above normal rainfall due to isolated convective activities. Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Punjab, Haryana, and Chandigarh all recorded large deficits ranging from 38% to 92%, indicating a weak onset phase of the monsoon. Rajasthan and Delhi, however, received near-normal to excess rainfall, suggesting localized monsoon advancement.

In July, rainfall improved in Uttarakhand with 15% above normal rainfall, while most other states continued to experience deficits. Himachal Pradesh, Punjab, Haryana, and Jammu & Kashmir recorded rainfall departures between -29% and -45%, reflecting the uneven spatial distribution of monsoon activity during the peak month.

August marked a strong recovery across most states, with widespread normal to large excess rainfall. Rajasthan registered a remarkable 121% excess, followed by Delhi (61%), Haryana (27%), and Chandigarh (23%). This improvement was primarily due to active monsoon conditions and multiple monsoon low-pressure systems.

In September, rainfall activity remained robust, particularly in the plains and western regions. Punjab, Haryana, and Chandigarh received large excess rainfall (70–94%), while Jammu & Kashmir, Himachal Pradesh, Uttarakhand, and Delhi reported excess to normal rainfall. Rajasthan maintained a strong positive anomaly of 83%. Only Uttar Pradesh showed a notable deficiency of 20%. Overall, after an initial weak onset in June and uneven distribution in July, the monsoon over North-West India revived substantially from August onwards, leading to near-normal cumulative rainfall by the end of the season.

Table-6 State-wise Monthly rainfall variation

	June					July			
State	Actual (mm)	Normal (mm)	% Dep.	Cat.		Actual (mm)	Normal (mm)	% Dep.	Cat.
LADAKH (UT)	**14.1**	**2.9**	**385%**	**LE**		**1.0**	**9.0**	**-89%**	**LD**
JAMMU & KASHMIR (UT)	**47.1**	**75.9**	**-38%**	**D**		**111.9**	**192.6**	**-42%**	**D**
HIMACHAL PRADESH	**46.5**	**101.1**	**-54%**	**D**		**180.6**	**255.9**	**-29%**	**D**
UTTARAKHAND	**89.5**	**176.8**	**-49%**	**D**		**481.9**	**417.8**	**15%**	**N**
PUNJAB	**29.4**	**54.5**	**-46%**	**D**		**89.4**	**161.4**	**-45%**	**D**
CHANDIGARH (UT)	**11.9**	**155.5**	**-92%**	**LD**		**178.2**	**273.2**	**-35%**	**D**
HARYANA	**29.3**	**54.7**	**-46%**	**D**		**87.8**	**149.1**	**-41%**	**D**
DELHI (UT)	**95.6**	**66.5**	**44%**	**E**		**134.6**	**185.1**	**-27%**	**D**
UTTAR PRADESH	**62.5**	**95.9**	**-35%**	**D**		**238.8**	**261.7**	**-9%**	**N**
RAJASTHAN	**50.3**	**55.0**	**-9%**	**N**		**162.2**	**161.4**	**1%**	**N**
	August					**September**			
State	Actual (mm)	Normal (mm)	% Dep.	Cat.		Actual (mm)	Normal (mm)	% Dep.	Cat.
LADAKH (UT)	**9.0**	**4.8**	**87%**	**LE**		**17.3**	**5.6**	**209%**	**LE**
JAMMU & KASHMIR (UT)	**161.9**	**184.9**	**-12%**	**N**		**128.4**	**95.7**	**34%**	**E**
HIMACHAL PRADESH	**243.6**	**256.8**	**-5%**	**N**		**205.8**	**120.6**	**71%**	**LE**
UTTARAKHAND	**419.4**	**385.7**	**9%**	**N**		**255.2**	**182.4**	**40%**	**E**
PUNJAB	**153.7**	**146.2**	**5%**	**N**		**150.6**	**77.7**	**94%**	**LE**
CHANDIGARH (UT)	**351.6**	**284.8**	**23%**	**E**		**252.1**	**131.4**	**92%**	**LE**
HARYANA	**186.0**	**146.1**	**27%**	**E**		**129.2**	**76.1**	**70%**	**LE**
DELHI (UT)	**302.1**	**187.6**	**61%**	**LE**		**129.5**	**105.1**	**23%**	**E**
UTTAR PRADESH	**221.9**	**235.5**	**-6%**	**N**		**122.4**	**153.1**	**-20%**	**D**
RAJASTHAN	**344.6**	**155.7**	**121%**	**LE**		**116.3**	**63.5**	**83%**	**LE**

4.5 District-wise seasonal rainfall distribution:

Northwest India region comprising nine meteorological subdivisions and 210 districts exhibited highly variable rainfall distribution across the region. Out of these 210 districts, 48 districts recorded large excess rainfall, 60 districts experienced excess rainfall, 63 districts received normal rainfall, 34 districts reported deficit rainfall, and 3 districts recorded large deficit rainfall, while 2 districts had no data.

At the district level, Ladakh (Leh) recorded the highest positive departure of +343% of the Long Period Average (LPA), whereas Deoria district (East Uttar Pradesh) experienced the lowest departure of –88% of the LPA. In terms of actual rainfall, **Bageshwar** district (Uttarakhand) received the **highest seasonal rainfall of 2717.4 mm**, while **Kargil** district (Ladakh UT) received the lowest rainfall of **44.8 mm** during the season.

Overall, the rainfall distribution pattern indicates widespread excess to large excess rainfall across many parts of Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Punjab, Haryana, Delhi, and Rajasthan, while eastern parts of Uttar Pradesh experienced normal to deficit rainfall. The regional rainfall pattern was largely influenced by the frequent formation and westward movement of low-pressure systems from the Bay of Bengal and their interaction with monsoon troughs and orography over the northwest region.

Table 7 represents the district rainfall distribution as percentage departures from normal over the nine meteorological subdivisions of the North West region during the period Jun-Sep 2025 and Fig.9, the district-wise seasonal rainfall over the various states and UTs over the NW region.

Table-7 District-wise seasonal distribution of rainfall

SUB DIVISION	STATE	CATEGORY	DISTRICTS WITH % DEPARTURE OF RAINFALL
JAMMU & KASHMIR AND LADAKH	JAMMU & KASHMIR (UT)	LARGE EXCESS	DODA (105%), RAMBAN (67%), UDHAMPUR (81%)
		EXCESS	ANANTNAG (20%), JAMMU (20%), PULWAMA (20%), RAJOURI (55%), REASI (56%), SAMBA (57%), SRINAGAR (21%)
		NORMAL	BADGAM (-12%), BANDIPORE (-19%), BARAMULA (-10%), GANDERBAL (-8%), KATHUA (0%), KULGAM (-5%), POONCH (-11%)
	LADAKH (UT)	LARGE EXCESS	KARGIL (44.8), LADAKH (LEH) (115.3)
HIMACHAL PRADESH	HIMACHAL PRADESH	LARGE EXCESS	BILASPUR (78%), KULLU (93%), MANDI (73%), SHIMLA (96%), SOLAN (67%), UNA (61%),

		EXCESS	CHAMBA (30%), HAMIRPUR (58%), SIRMAUR (36%),
		NORMAL	KANGRA (17%), KINNAUR (17%),
		DEFICIT	LAHAUL & SPITI (-21%),
UTTARAKHAND	UTTARAKHAND	LARGE EXCESS	BAGESHWAR (243%), CHAMOLI (88%),
		EXCESS	ALMORA (25%), DEHRADUN (37%), GARHWAL TEHRI (56%), HARDWAR (55%), UDHAM SINGH NAGAR (20%),
		NORMAL	CHAMPAWAT (-7%), NAINITAL (-6%), PITHORAGARH (0%), RUDRAPRAYAG (-6%), UTTARKASHI (14%),
		DEFICIT	GARHWAL PAURI (-30%)
PUNJAB	PUNJAB	LARGE EXCESS	BARNALA (78%), GURDASPUR (90%), JALANDHAR (71%), LUDHIANA (74%), MOGA (78%), PATHANKOT (69%), TARN TARAN (140%)
		EXCESS	AMRITSAR (42%), FARIDKOT (48%), FEROZEPUR (54%), MANSA (49%), RUPNAGAR (34%), SANGRUR (54%)
		NORMAL	BHATINDA (-2%), FATEHGARH SAHIB (9%), FAZILKA (14%), HOSHIARPUR (11%), MUKTSAR (17%), PATIALA (1%), SBS NAGAR (5%)
		DEFICIT	KAPURTHALA (-27%), SAS NAGAR (MOHALI) (-20%)
HARYANA, CHANDIGARH & DELHI	HARYANA	LARGE EXCESS	FATEHABAD (118%), HISAR (72%), JHAJJAR (82%), KURUKSHETRA (86%), MAHENDRAGARH (108%), SIRSA (63%)
		EXCESS	BHIWANI (27%), CHARKHI DADRI (35%), GURGAON (27%), NUH (50%), PALWAL (32%), PANIPAT (39%), REWARI (58%), ROHTAK (34%), YAMUNA NAGAR (25%)
		NORMAL	AMBALA (-18%), FARIDABAD (2%), JIND (-2%), KAITHAL (11%), KARNAL (-10%), PANCHKULA (-9%), SONEPAT (16%)
	CHANDIGARH (UT)	NORMAL	CHANDIGARH (13%)
	DELHI (UT)	EXCESS	CENTRAL DELHI (43%), EAST DELHI (30%), NORTH EAST DELHI (32%), SOUTH EAST DELHI (25%), SOUTH WEST DELHI (44%)

		NORMAL	NEW DELHI (-3%), SOUTH DELHI (-17%), WEST DELHI (4%)
WEST UTTAR PRADESH	UTTAR PRADESH	LARGE EXCESS	ETAH (74%), SAMBHAL (60%)
		EXCESS	FIROZABAD (45%), HAMIRPUR (51%), HATHRAS (47%), LALITPUR (47%), MAHOBA (46%), MEERUT (44%), MUZAFFARNAGAR (40%)
		NORMAL	ALIGARH (16%), AMROHA (-17%), AURAIYA (16%), BADAUN (-7%), BAREILLY (7%), BULANDSHAHAR (-1%), ETAWAH (2%), JALAUN (7%), JHANSI (-8%), KASGANJ (17%), MATHURA (17%), MORADABAD (2%), RAMPUR (-13%), SAHARANPUR (15%)
		LARGE DEFICIT	PILIBHIT (-63%)
EAST UTTAR PRADESH	UTTAR PRADESH	EXCESS	BANDA (40%), CHITRAKOOT (35%)
		NORMAL	AYODHYA (-3%), BAHRAICH (-16%), BALRAMPUR (5%), BARABANKI (17%), GONDA (-15%), HARDOI (-19%), KANNAUJ (16%), KANPUR CITY (15%), KHERI (6%), LUCKNOW (-3%), MIRZAPUR (-17%), PRATAPGARH (8%), PRAYAGRAJ (-1%), RAE BAREILLY (-19%), SONBHADRA (13%), SULTANPUR (-18%), VARANASI (15%)
		DEFICIT	MAU (-54%), SANT KABIR NAGAR (-54%), SHRAWASTI NAGAR (-22%), SIDDHARTH NAGAR-34%), SITAPUR (-32%), UNNAO (-29%)
		LARGE DEFICIT	DEORIA (-88%), KUSHI NAGAR (-65%)
WEST RAJASTHAN	RAJASTHAN	LARGE EXCESS	CHURU (90%), HANUMANGARH (127%), JALORE (84%), JODHPUR (66%), NAGAUR (101%), PALI 68%), SRI GANGANAGAR (122%)
		EXCESS	BARMER (42%), BIKANER (55%), JAISALMER (27%)
EAST RAJASTHAN	RAJASTHAN	LARGE EXCESS	AJMER (91%), BARAN (91%), BHILWARA (67%), BUNDI (94%), DAUSA (109%), DHOLPUR (94%), JAIPUR (74%), JHUNJHUNU (70%), KARAULI (84%), KOTA (70%), SAWAI MADHOPUR (102%), SIKAR (98%), TONK (104%)

		EXCESS	ALWAR (33%), BANSWARA (23%), BHARATPUR (45%), CHITTORGARH (28%), DUNGARPUR (20%), JHALAWAR (31%), PRATAPGARH (34%), RAJSAMAND (56%), SIROHI (23%), UDAIPUR (44%)

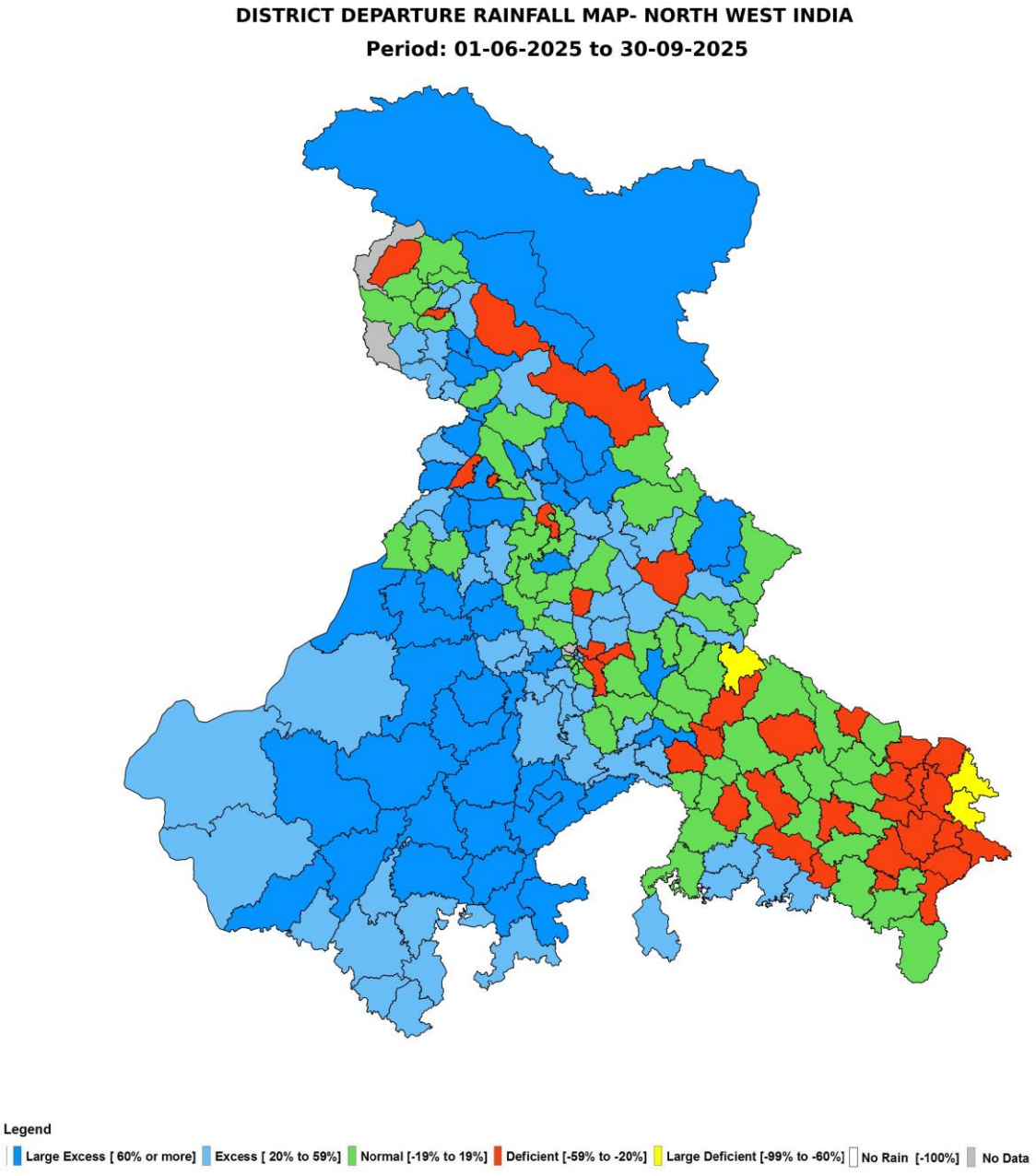


Fig.9 District rainfall departure

4.5.1 District -wise Monthly rainfall variation:

In the month of **June 2025**, Out of these 210 districts, 78 districts recorded large excess rainfall, 31 districts experienced excess rainfall, 41 districts received normal rainfall, 44 districts reported deficit rainfall, and 16 districts recorded large deficit rainfall.

At the district level, Ladakh (Leh) recorded the highest positive departure of +458% of the Long Period Average (LPA), whereas Deoria district (East Uttar Pradesh) experienced the lowest departure of –95% of the LPA. In terms of actual rainfall, Bageshwar district (Uttarakhand) received the highest monthly rainfall of 573.1 mm, while Kargil district (Ladakh UT) received the lowest rainfall of 1.2 mm during the month of June 2025.

In the month of **July 2025**, Out of these 210 districts, 41 districts recorded large excess rainfall, 31 districts experienced excess rainfall, 61 districts received normal rainfall, 57 districts reported deficit rainfall, and 17 districts recorded large deficit rainfall, while 2 districts had no data.

At the district level, Dholpur recorded the highest positive departure of +188% of the Long Period Average (LPA), whereas Deoria district (East Uttar Pradesh) experienced the lowest departure of –90% of the LPA. In terms of actual rainfall, Baran district (East Rajasthan) received the highest monthly rainfall of 711.3 mm, while Kargil district (Ladakh UT) received the lowest rainfall of 0.4 mm during the month of July 2025.

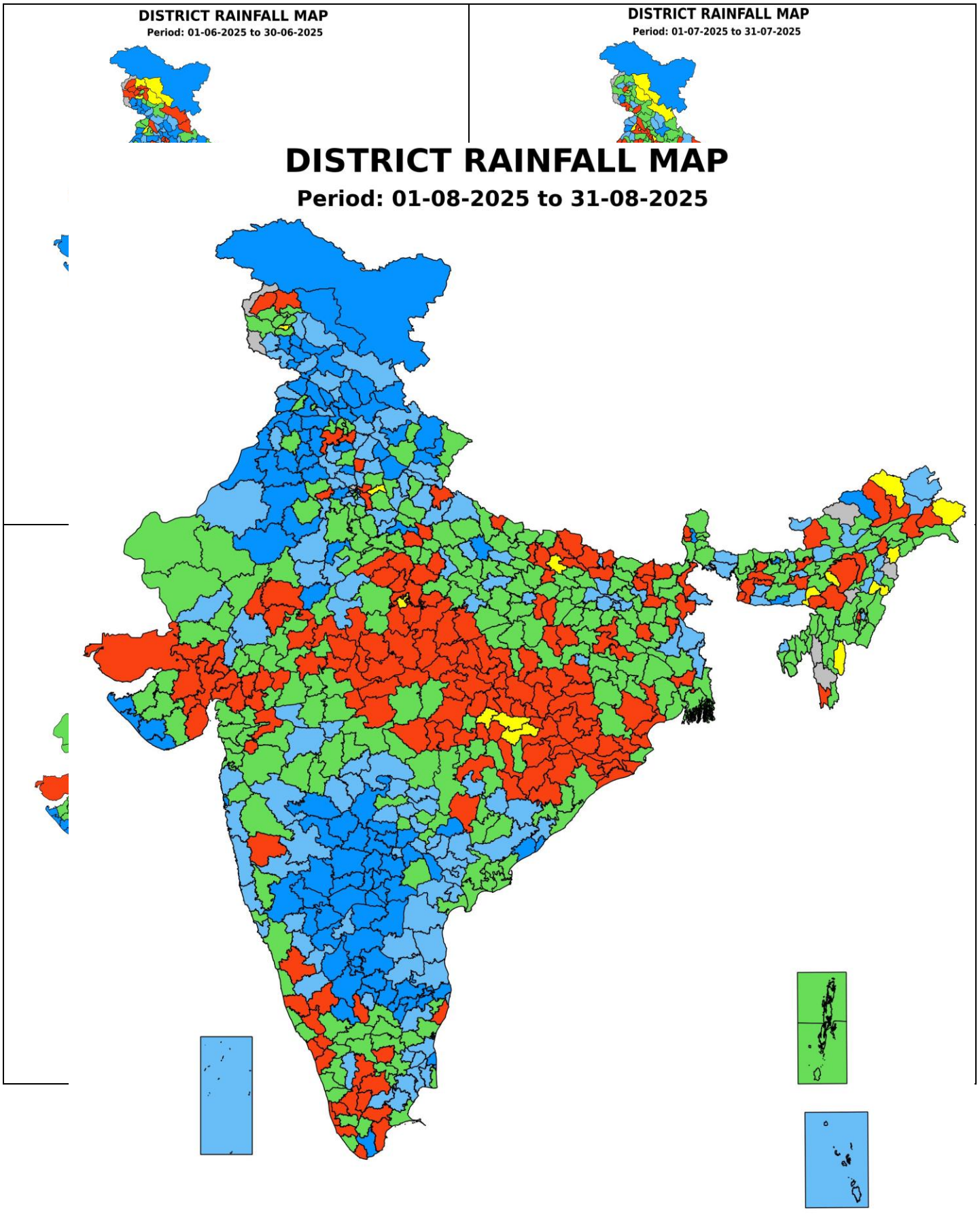
In the month of **August 2025**, Out of these 210 districts, 52 districts recorded large excess rainfall, 51 districts experienced excess rainfall, 76 districts received normal rainfall, 26 districts reported deficit rainfall, and 03 districts recorded large deficit rainfall, while 2 districts had no data.

At the district level, Kargil district (Ladakh UT) recorded the highest positive departure of +1530% of the Long Period Average (LPA), whereas Deoria district (East Uttar Pradesh) experienced the lowest departure of –84% of the LPA. In terms of actual rainfall, Reasi district (Jammu & Kashmir UT) received the highest monthly rainfall of 1024.7 mm, while Kargil district (Ladakh UT) received the lowest rainfall of 32.6 mm during the month of August 2025.

In the month of **September 2025**, Out of these 210 districts, 73 districts recorded large excess rainfall, 43 districts experienced excess rainfall, 37 districts received normal rainfall, 41 districts reported deficit rainfall, and 15 districts recorded large deficit rainfall, while 1 districts had no data.

At the district level, Kargil district (Ladakh UT) recorded the highest positive departure of +324% of the Long Period Average (LPA), whereas Deoria district (East Uttar Pradesh) experienced the lowest departure of –83% of the LPA. In terms of actual rainfall, Reasi district (Jammu & Kashmir UT) received the highest monthly rainfall of 494.8 mm, while Kargil district (Ladakh UT) received the lowest rainfall of 10.6 mm during the month of June 2025.

Fig.10-13, represents the month-wise district rainfall variation during the period Jun-Sep 2025.


DISTRICT RAINFALL MAP
Period: 01-06-2025 to 30-06-2025
DISTRICT RAINFALL MAP
Period: 01-07-2025 to 31-07-2025
DISTRICT RAINFALL MAP
Period: 01-08-2025 to 31-08-2025

5. EXTREME WEATHER EVENTS DURING SOUTH WEST MONSOON 2025 OVER NORTH WEST INDIA:

5.1 Heavy Rainfall events:

During the period June-September (JJAS), 2025, there were isolated heavy rainfall (64.5 mm to 115.5 mm)/day) activities on 11 days over J&K; 35 days over Himachal Pradesh; 33 days over Uttarakhand; 28 days over Punjab; 40 days over Haryana; Chandigarh & Delhi; 36 days over West Uttar Pradesh; 33 days over East Uttar Pradesh; 24 days over West Rajasthan; 42 days over East Rajasthan.

Isolated very heavy rainfall (115.6 mm to 204.4 mm) /day) activities on 8 days over J&K, 24 days over Himachal Pradesh, 26 days over Uttarakhand, 9 days over Punjab, 15 days over Haryana, Chandigarh & Delhi, 22 days over West Uttar Pradesh, 23 days over East Uttar Pradesh, 9 days over West Rajasthan, 30 days over East Rajasthan.

Isolated extremely heavy rainfall (exceeding 204.4 mm) /day) activities were recorded on 3 day over J&K, 4 days over Himachal Pradesh, 6 days over Uttarakhand, 2 days over Punjab, 1 days across Haryana, Chandigarh & Delhi, 2 days over West Uttar Pradesh, 4 days over East Uttar Pradesh, 3 days over West Rajasthan, 7 days over East Rajasthan during the season. The number of days of heavy rainfall reports over each subdivision as per the classifications of heavy rainfall by the India Meteorological Department (IMD) is presented in **Table-8**

Udhampur witnessed historic 24-hour rainfall 629.0 mm on 27th August 2025 broken its previous record 342.0 mm rainfall on 31st July 2019 and similarly on the same day Jammu received 296.0 mm broken its previous record 272.6 mm rainfall on 09 August 1973.

• SOLAN (NAUNI) station received record rainfall (24 hours) 187 mm on 01-09-2025 breaking its earlier record 140.8 mm on 20-09-2008

• Late monsoon (September) saw extremely heavy rainfall episodes across Uttarakhand and Himachal Pradesh, with record-breaking 24-hour rainfall.

Table-8 Number of days of heavy rainfall occurrences over various subdivisions in the Northwest region during June-September 2025

Sub Div	JUN			JUL			AUG			SEP			JUN-SEP		
	H	VH	EH	H	VH	EH	H	VH	EH	H	VH	EH	H	VH	EH
J&K	1	1	0	3	3	0	6	3	2	1	1	1	11	8	3
HP	10	4	0	8	4	1	14	10	1	3	6	2	35	24	4
UK	13	5	0	5	7	1	12	8	3	3	6	2	33	26	6
PUNJAB	7	0	0	5	3	0	12	4	2	4	2	0	28	9	2
HAR,CHD &DEL	8	3	0	12	3	0	18	5	1	2	4	0	40	15	1
WEST UP	12	5	0	11	6	0	8	8	1	5	3	1	36	22	2
EAST UP	11	3	0	6	6	3	9	10	1	7	4	0	33	23	4
WEST RAJ	7	0	0	10	3	2	4	4	0	3	2	1	24	9	3
EAST RAJ	17	5	0	6	14	3	12	5	3	7	6	1	42	30	7

Legend: H: Heavy rain (≥ 7 cm (64.5 mm)/day);VH: Very Heavy rain (≥ 12 cm (115.6 mm) /day);EH: Extremely Heavy rain (≥ 21cm (204.5 mm) /day).

5.2 Thunderstorm events

The spatial distribution of cumulative thunderstorm activity during the 2025 southwest monsoon season indicates that most parts of northwest India experienced normal to above normal thunderstorm occurrences. Enhanced convective activity was observed particularly over the northern plains and adjoining hill regions, while comparatively subdued activity was noted over a few isolated pockets. Overall, the regional pattern suggests that the monsoon dynamics and associated weather systems contributed to a generally active convective season across the region as a whole.

The sub-division wise distribution of thunder storm days during the southwest monsoon season 2025 (June–September) ranged from 44 days over Jammu & Kashmir and Ladakh to 72 days over East Uttar Pradesh, reflecting spatial variability linked to regional synoptic influences and orographic effects.

Among the hill states, Himachal Pradesh (57 days) and Uttarakhand (50 days) experienced a higher frequency of thunderstorm days, particularly during September, when monsoon activity revived over the western Himalayan region. In the plains, Punjab (59 days), Haryana–

Chandigarh–Delhi (55 days), and West Uttar Pradesh (63 days) recorded well-distributed rainfall events throughout the season, coinciding with frequent passages of low-pressure systems and active monsoon trough phases. West Rajasthan (68 days) and East Rajasthan (51 days) reporting significant rainfall frequency, much above the climatological normal for arid and semi-arid zones. **(Table-9)**

Table-9 Thunderstorm events during South West Monsoon 2025

STATE	JUNE	JULY	AUGUST	SEPTEMBER	TOTAL
J&K AND LADAKH	7	14	14	9	44
HP	16	12	14	15	57
UK	12	10	10	18	50
PUNJAB	8	18	20	9	59
HAR,CHD &DEL	8	17	17	14	55
WEST UP	10	19	20	14	63
EAST UP	8	18	18	24	72
WEST RAJ	7	15	15	9	68
EAST RAJ	8	16	16	11	51

Overall, the data reflect a highly active monsoon season, characterized by regular rainfall occurrences across the region, sustained by multiple synoptic systems and favorable monsoon dynamics throughout the 2025 season.

5.3 Dharali Flash Flood, Uttarkashi District, Uttarakhand – 5 August 2025

During the 2025 southwest monsoon season, a catastrophic debris-flood occurred at Dharali, Uttarkashi district, on 5 August 2025, resulting in multiple deaths, many persons missing, and extensive destruction of houses, hotels, shops, and road infrastructure. Flash-floods and debris flows along the Bhagirathi River corridor washed away stretches of highway and several bridges.

Multiple sources—including state authorities, media reports, and ISRO/NRSC satellite imagery assessments—described the Dharali disaster as being triggered by a “cloudburst” or intense flash-flood event. However, the India Meteorological Department clarified that no rainfall station in the vicinity recorded precipitation meeting the formal cloudburst threshold. IMD’s operational gauge network reported only light to moderate rainfall across Uttarkashi district during the period of the flood.

Table-10 Dharali Flash Flood event, Uttarkashi District, Uttarakhand

Date / Time (IST)	Event Description	Source
3–5 Aug 2025	IMD issues a press release: "Very heavy to extremely heavy rainfall event over Uttarakhand during 03–05 Aug."	IMD Press Release 05-Aug-2025
5 Aug 2025 (~13:45)	Cloudburst over Kheer Ganga / Dharali catchment triggers flash flood; torrent sweeps through Dharali village & nearby pilgrim/tourist zone in Uttarkashi.	Joint Rapid Needs Assessment & ReliefWeb SitRep
5 Aug 2025	Media / news report: At least 4 deaths, ~100 people missing; extreme rainfall ~21 cm in some parts of Uttarakhand.	News articles (The Guardian, People.com)
6 Aug 2025	Situation Report 1: Rescue and relief operations underway, major road/bridge links damaged; large number of tourists/pilgrims evacuated.	ReliefWeb SitRep
7 Aug 2025	Situation Report 2: Continued multi-agency rescue, missing persons list updated; heavy rainfall warning remains in region.	ReliefWeb SitRep
8 Aug 2025	IMD issues fresh heavy rainfall alert for Uttarkashi/Late monsoon activity; warns of possible further flash-flood / landslide risk.	Media coverage of IMD alert
Aug-Sep 2025	ISRO and DRR (disaster risk reduction) agencies cite the Dharali event in studies of Himalayan chain-reaction disasters (cloudburst → flash-flood → landslide).	PreventionWeb article

ISRO/NRSC Findings:

- ISRO's NRSC used high-resolution Cartosat-2S satellite imagery (pre-event: 13 June 2024, post-event: 7 Aug 2025) to map the disaster site.
- The imagery revealed a fan-shaped deposit of sediment and debris of about 20 ha (approx. 750 m × 450 m) at the confluence of the Kheer Gad and Bhagirathi rivers, showing large-scale geomorphological change (widened stream channels, altered river morphology) caused by a surging debris-laden flood.
- ISRO described the event as "intense rainfall triggered flash flood" and specifically stated that several buildings appear to be submerged or swept away by intense mud flow and debris. The rapid assessment aimed to aid search & rescue operations and help restore connectivity to isolated regions.

IMD Findings:

- IMD stated that rainfall data available for the Dharali/upper catchment do *not support* the occurrence of a "cloudburst" (as per IMD's definition: rainfall >100 mm in one hour over ~20-30 km²) on that day. They recorded only about 27 mm rainfall in the district on the event day, which IMD deemed "too little" for a cloudburst.
- IMD emphasised that the precise cause of the flash flood remains under investigation and cannot yet be conclusively attributed to a standard cloudburst event.

Possible Causes and Scientific Interpretation:

From the combined account of ISRO and IMD (and professional commentary), several plausible triggers and contributory mechanisms emerge:

1. **Intense Localised Rainfall**: ISRO affirms intense rainfall triggered the flood; although IMD's formal gauge data do not substantiate a standard cloudburst, localised convective or orographic precipitation may still have been severe but returned insufficient gauge records.
2. **Debris-laden Flow / Channel Amplification**: The debris-fan observed suggests that the flood was not pure water runoff, but carried large amounts of sediment, rock, moraine, and possibly ice/rock collapse mobilising a debris-flow surge through a narrow Himalayan valley. These enhanced the destructive power of the flood.
3. **Orographic & Catchment Effects**: The narrow high-altitude terrain, steep slopes, and confluence of tributaries (Kheer Gad & Bhagirathi) enhanced the flow intensification and deposition. Terrain acted as a funnel for debris and water.
4. **Possible Glacier/Ice/Moraine Failure or Landslide Trigger**: Given low recorded rainfall, some experts (and reports) suggest that a glacier collapse, moraine dam breach, or rock/ice fall triggered the sudden surge rather than purely convective rainfall.
5. **Terrain Instability, Land-use & Catchment Changes**: The event also underscores systemic vulnerabilities – tectonically young Himalayan terrain, unstable slopes, recent development on flood-fan zones, deforestation, and infrastructure in hazard-prone channels.

In summary, the Dharali event appears to have been triggered by intense, though not necessarily well-gauged, localised rainfall in a sensitive high-altitude catchment and compounded by geomorphological amplification via debris flow and steep terrain. While ISRO confirms major morphological changes and intense effects, IMD cautions that the rainfall data do not fit their formal cloudburst definition. Investigations continue to better understand the exact combination of rainfall, landslide or ice/rock collapse, debris mobilisation, and valley geometry that together produced this catastrophic flash flood.

6. WITHDRAWAL OF SOUTHWEST MONSOON:

With the reduction in rainfall activity and the establishment of an anti-cyclonic circulation over the lower tropospheric levels, the withdrawal of the southwest monsoon 2025 commenced from West Rajasthan and Kutch on 14 September, about three days earlier than its normal date of 17 September. The withdrawal progressed gradually eastward and southward in the subsequent

weeks. The withdrawal dates of the Southwest monsoon season 2025 as on 30th September are shown in **Fig. 14**. By 12 October 2025, the monsoon had withdrawn from almost the entire northwestern region, except a few areas of eastern Uttar Pradesh, and by 13 October, the withdrawal was complete over northwest India. The monsoon fully withdrew from the entire country by 16 October 2025, marking a near-normal and well-defined retreat.

The isochrones of monsoon withdrawal for 2025, depicted in **Fig.-15**, illustrate the spatial and temporal pattern of withdrawal, showing an orderly progression compared to normal dates.

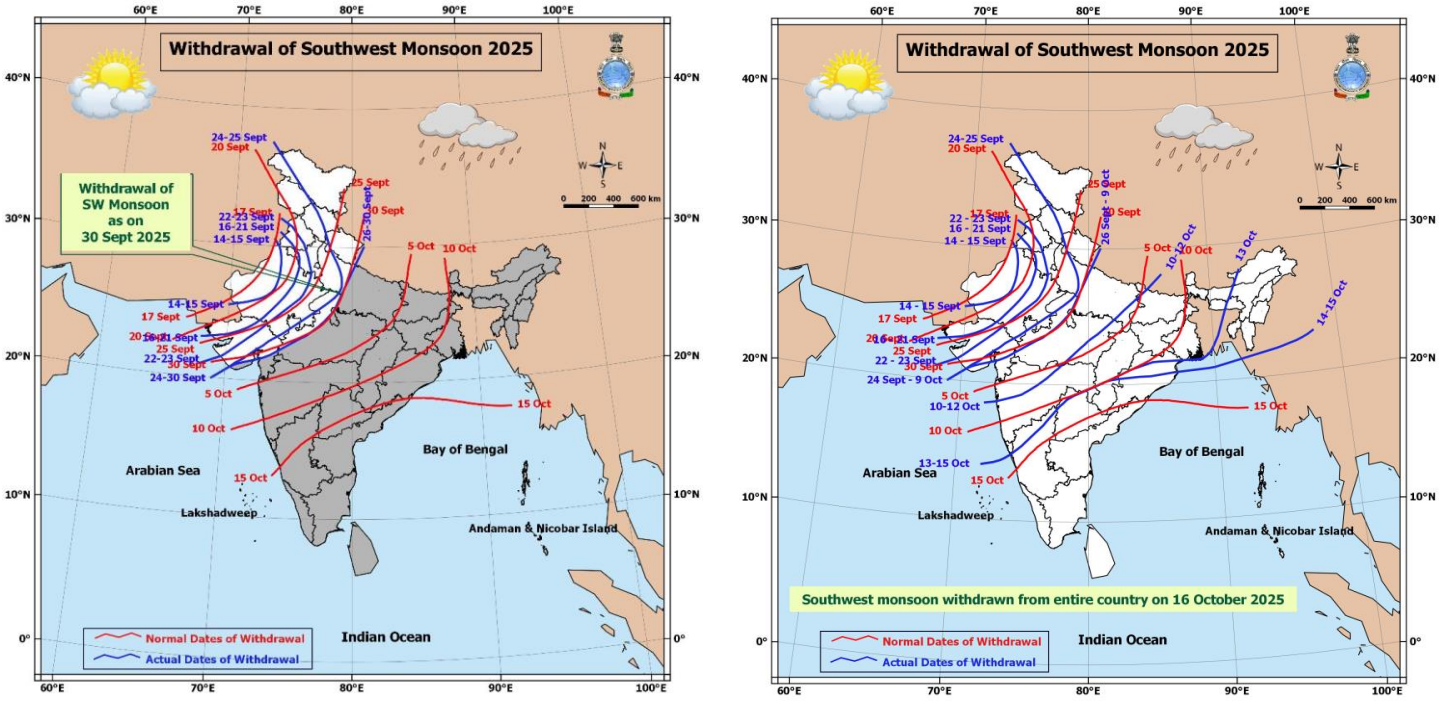


Fig. 14-15 Isochrones of withdrawal of SW Monsoon 2025

7. VERIFICATION OF LONG-RANGE FORECAST ISSUED FOR SW MONSOON 2025:

The forecast for the onset of monsoon over Kerala in 2025 was accurate, marking the nineteenth successful prediction since 2005, except for the year 2015. The monsoon onset was forecasted for 27th May (±4 days) and was realized on 24th May, well within the model error range. The first stage forecast issued on 15th April had predicted 105% of LPA for all-India rainfall, while the updated forecast at the end of May indicated 106% of LPA (±4%). The actual seasonal rainfall realized was 108% of LPA, confirming the forecast's accuracy.

For Northwest India, the monsoon rainfall was forecasted to be above normal (>108% of LPA), and the realized rainfall was 127% of LPA, further validating the forecast and indicating a significantly wetter-than-normal season over the region.

The sub-division-wise verification of the seasonal rainfall forecast for JJAS 2025 indicates that the overall monsoon performance over the northwest region was better than predicted, with most sub-divisions receiving above-normal rainfall. Although Jammu &

Kashmir and Ladakh were forecasted to receive *near normal rainfall (88–112% of LPA)*, the realized rainfall was 128% of LPA, indicating a higher-than-expected outcome. Similarly, all other sub-divisions except East Uttar Pradesh received rainfall significantly above the forecast range. East Uttar Pradesh, which was predicted to experience above-normal rainfall (>110% of LPA), instead recorded deficient rainfall at 83% of LPA, showing an underperformance. The most notable positive departures were observed over West Rajasthan (169% of the LPA) and East Rajasthan (161%), followed by Punjab (141% of the LPA), Himachal Pradesh (139% of the LPA), and Haryana, Chandigarh & Delhi (133% of the LPA), all indicating a much wetter monsoon season than expected. Overall, the verification suggests that the seasonal rainfall forecast underestimated the rainfall activity over most sub-divisions, except for East Uttar Pradesh, where it was overestimated. Sub-division wise rainfall forecast for the season (JJAS) 2025 is given in **table-11** below:

Table-11 Subdivsionwise JJAS 2025 Rainfall Probability Forecast Category

S.No.	Sub Division Name	Forecast	Realized
1.	Jammu & Kashmir and Ladakh	Near Normal (88-112% of the LPA)	128% of the LPA
2.	Himachal Pradesh	Above Normal (>109% of the LPA)	139% of the LPA
3.	Uttarakhand	Above Normal (>108% of the LPA)	122% of the LPA
4.	Punjab	Above Normal (>115% of the LPA)	141% of the LPA
5.	Haryana, Chandigarh & Delhi	Above Normal (>114% of the LPA)	133% of the LPA
6.	West Uttar Pradesh	Above Normal (>112% of the LPA)	112% of the LPA
7.	East Uttar Pradesh	Above Normal (>110% of the LPA)	83% of the LPA
8.	West Rajasthan	Above Normal (>115% of the LPA)	169% of the LPA
9.	East Rajasthan	Above Normal (>110% of the LPA)	161% of the LPA

8. CONCLUSION:

The Southwest Monsoon 2025 over Northwest India was distinguished by its timely onset, sustained activity, and well-distributed rainfall supported by frequent formation of synoptic-scale systems and active monsoon trough conditions. The monsoon advanced over the South Andaman Sea and Nicobar Islands on 13 May 2025, reached Kerala on 24 May (ahead of the normal onset date of 1 June), covered the entire country by 29 June, and began its withdrawal from West Rajasthan on 14 September, three days earlier than normal. The region received

127% of its Long Period Average (LPA) rainfall, indicating an above-normal monsoon season, consistent with IMD's seasonal forecast issued in May 2025.

Despite the favourable rainfall distribution, the season was punctuated by several high-impact localized weather events, including intense rainstorms, flash floods, and cloudburst-like incidents, particularly over the hilly terrain of Uttarakhand, Himachal Pradesh, and adjoining Himalayan foothills. These events, though spatially confined, caused significant hydrological and societal impacts, underscoring the need for enhanced mesoscale monitoring, denser observational networks, and improved high-resolution forecasting capabilities.

In summary, the 2025 monsoon season over Northwest India was meteorologically vigorous and hydrologically beneficial, characterized by well-predicted rainfall patterns and a generally successful forecast performance.