

# Flood Report -2023



فلڈ فور کاسٹنگ ڈویژن لاہور

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Message from

**Mahr Sahibzad Khan**

Director General

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The Flood Forecasting Division Lahore (FFD), since its establishment is serving the nation by issuing flood forecasts during each flood season (15<sup>th</sup> June, to 15<sup>th</sup> October). The Flood Forecasting Division Lahore (FFD) is an active Unit of PMD. The Flood Forecasting Division Lahore (FFD) monitored the Flood Season 2023 carefully through its Hydrometeorological Bulletins, Warnings and then by keeping informed different government agencies, press and electronic media, in order to minimize the losses.

The compilation of flood report after each flood season is a regular feature of Flood Forecasting Division Lahore. This year Flood Season 2023 Monsoon Report is attached. This report is prepared under the supervision of Director General (DG) Met Services.



Message from

**Ch Muhammad Aslam**

**Chief Meteorologist**

Flood Forecasting Division Lahore

Floods in Pakistan are mainly caused by the heavy monsoon rains during July to September. During monsoon 2023, no major riverine flood generating rainfall event was observed over the upper catchments of Indus, Jhelum and Chenab. However, two spells of heavy to very heavy rainfall observed over the upper catchments of river Sutlej in India which generated devastating flood in river Sutlej at Ganda Singh Wala and downstream. One spell of moderate to heavy fall was also recorded over the upper catchments of River Ravi which was mostly absorbed by Indian reservoirs.

This year monsoon season in Pakistan began on July 3, 2023 and it was two days delay to its normal start date 1st July. There was significant monsoon rainfall during the month of July, followed by a sudden decline in August 2023. In September 2023 near-average rainfall was observed.

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## 1 Preface

Nature is beautiful and refreshing but sometimes it shows us the other side of the coin in the form of natural disasters. Disasters which are caused due to the effect of nature are known as natural disasters. Flood is one of them. There may be many reasons due to which floods occur like starting of heavy rainfall, melting of snow, structural failures et cetera. Floods are consistently found to be the leading cause of destruction in Pakistan. Due to continuous rise atmospheric temperatures, this disaster has become more frequent and problematic over the years. This increase is the result of the climate change that has taken place in the last 2-3 decades. Floods invariably devastate the ecosystem, disrupting the habitats of plants, animals and inflicting harmful consequences on our environment. A lot of animals and plants lose their life to floods. When the infrastructure and land of an area get destructed, that region's economy suffers a lot along with the citizens. The commercial development comes to a halt as the focus gets diverted to restoring the destroyed livelihood.

Pakistan has unique meteorological causes of the floods. During summer, although monsoon is the dominating weather system, the westerly waves also continue to affect the country. Intensification of the monsoon weather system and northward recurving of the monsoon depressions is predominantly due to the westerly waves. Floods in Pakistan are mainly caused by the heavy monsoon rains during July to September. During monsoon 2023, no major riverine flood generating rainfall event was observed over the upper catchments of Indus, Jhelum and Chenab. However, two spells of heavy to very heavy rainfall observed over the upper catchments of river Sutlej in India which generated devastating flood in river Sutlej at Ganda Singh Wala and downstream. One spell of moderate to heavy fall was also recorded over the upper catchments of River Ravi which was mostly absorbed by Indian reservoirs.

This year monsoon season in Pakistan began on July 3, 2023 and it was two days delay to its normal start date 1<sup>st</sup> July. There was significant monsoon rainfall during the month of July, followed by a sudden decline in August 2023. In September 2023 near-average rainfall was observed.

## 2 Executive summary

- Quantitatively, during 2023 Monsoon Seasonal rainfall has been accrued 146.4 mm against the Long Period Average (LPA) of 140.9 mm.
- This year monsoon season set on 3<sup>rd</sup> July 2023 over Pakistan, two days later than its normal date (1<sup>st</sup> July) and withdrew during third week of September 2023. However, Significant continuous rainfall occurred during July.
- Pakistan experienced near-average rainfall during the entire monsoon season, with a +4% deviation from the normal. On a regional scale, Punjab received near-average rainfall (-1%), while Azad Jammu and Kashmir (AJK) (-14%) and Khyber Pakhtunkhwa (KP) (-17%) received below-average rainfall. Sindh (+29%) and Balochistan (+18%) recorded above-average rainfall, and Gilgit-Baltistan (GB) experienced exceptionally high rainfall, with a 90% increase.
- Seven rain-bearing spells occurred during the monsoon season 2023.
- 08 monsoon lows/Depressions developed in the season however only one of them approached the country.
- The supply of hydro-meteorological data from WAPDA, Punjab, Sindh & Khyber Pakhtunkhwa irrigation departments remained satisfactory.
- All the concerned federal and provincial authorities, the general public, along with print and electronic media were kept in touch with the prevailing weather/flood conditions through phone, fax & other electronic sources.
- The overall accuracy of forecast issued by FFD during the Monsoon Season 2023 was up to the mark.

### 3 Tracks of Monsoon Lows during Monsoon Season-2023

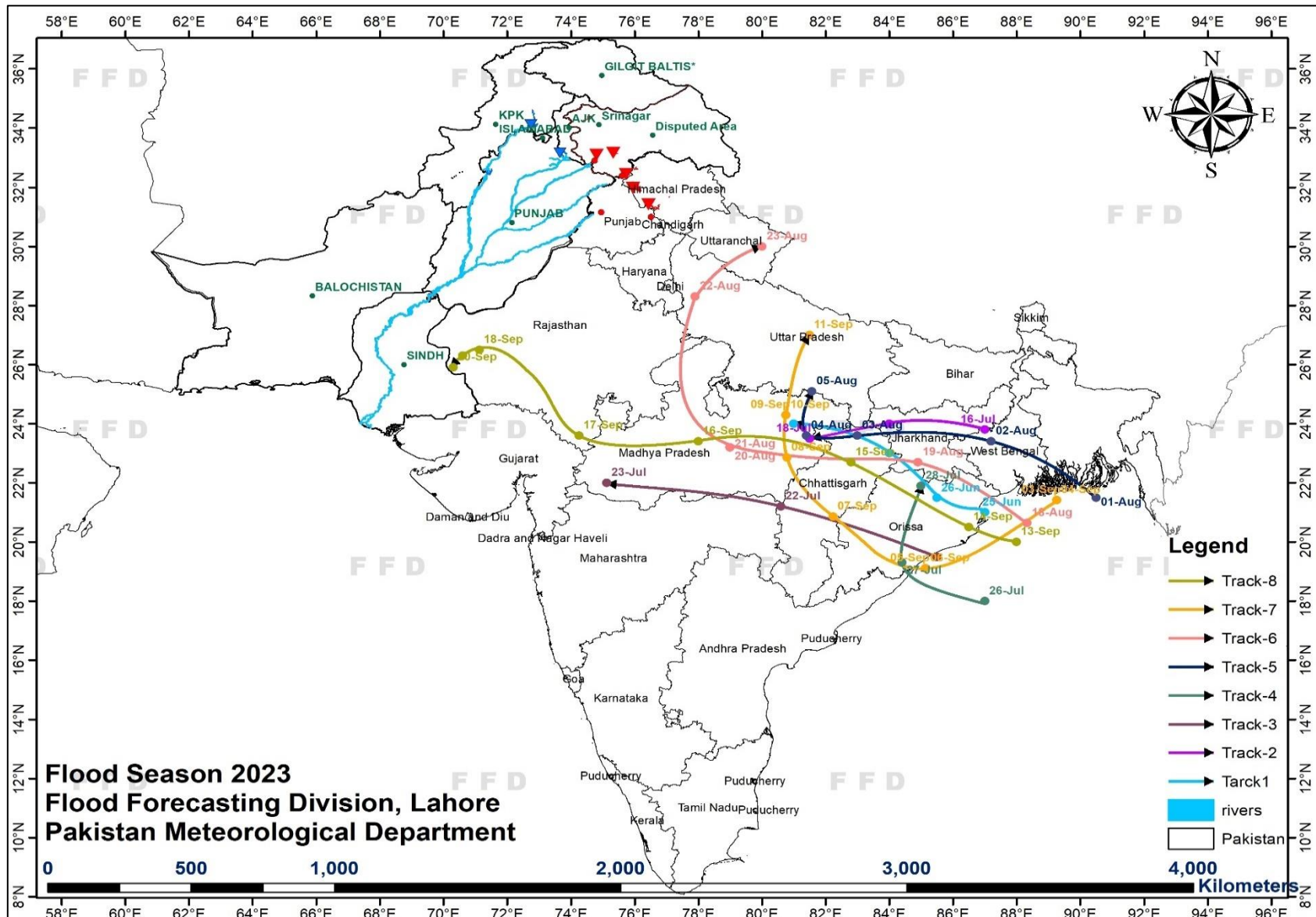
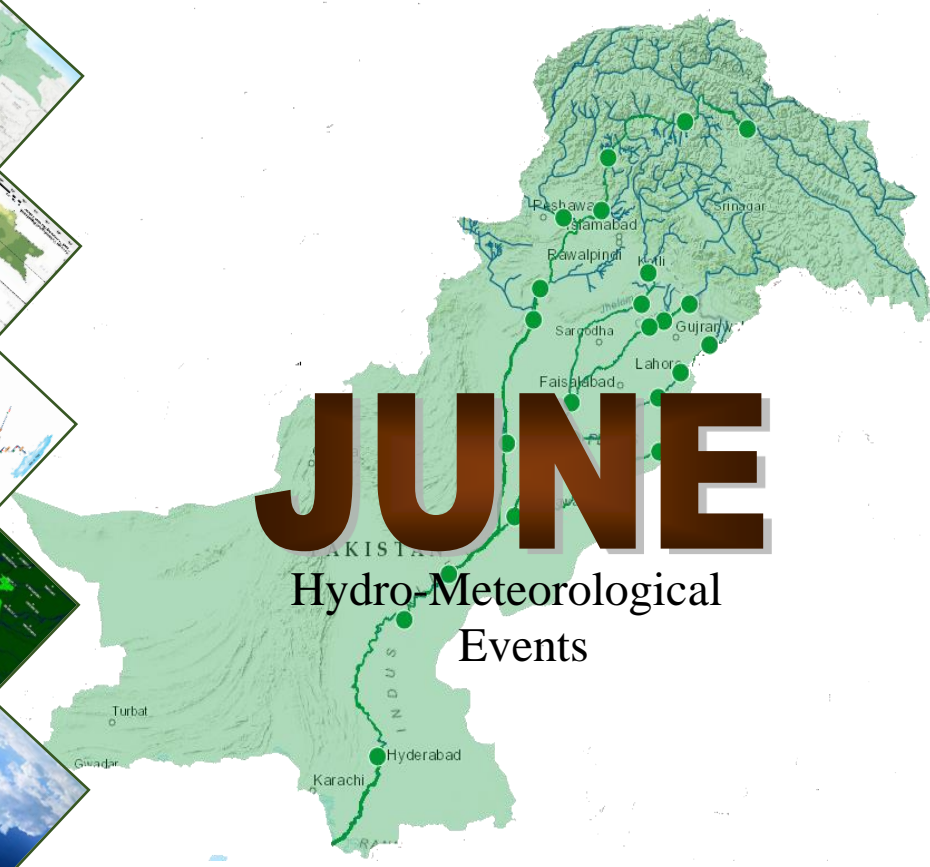
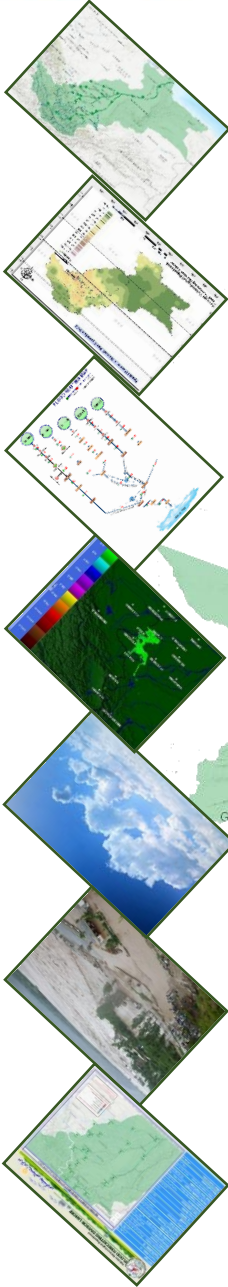


Fig (1) Seasonal Monsoon Tracks 2023



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# JUNE

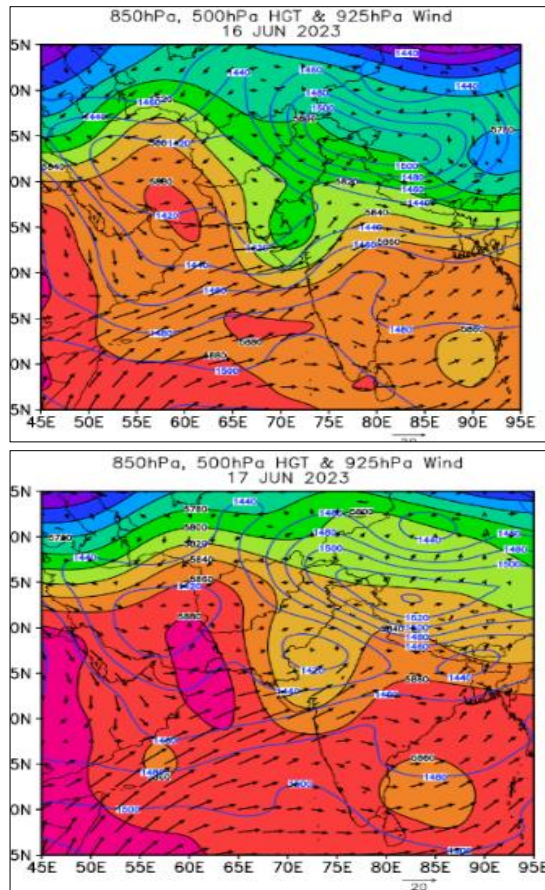
## Hydro-Meteorological Events

**4 Significant Hydro-Met events during the month of June 2023**

Two rainfall spells were reported during the month of June 2023 over Pakistan. Maximum Rivers flow observed at upstream, during the month is shown in Fig (8).

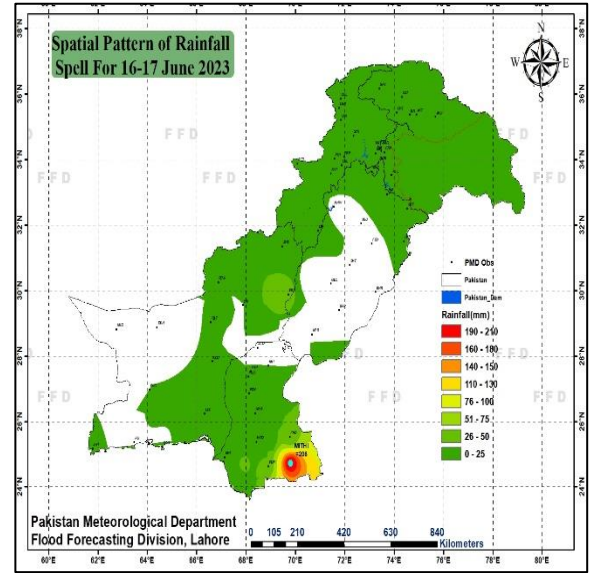
**4.1 1<sup>st</sup> wet spell of June 2023 (16<sup>th</sup>- 17<sup>th</sup>)**

The first wet spell of June 2023 which remained active for two days was mainly due to the presence of a westerly trough. Fig (2) represents 500 hPa and 850 hPa geopotential height patterns along with 925 hPa wind flow during the spell. Southwesterly winds at 925 hPa are also present ensuring presence of westerly wave.



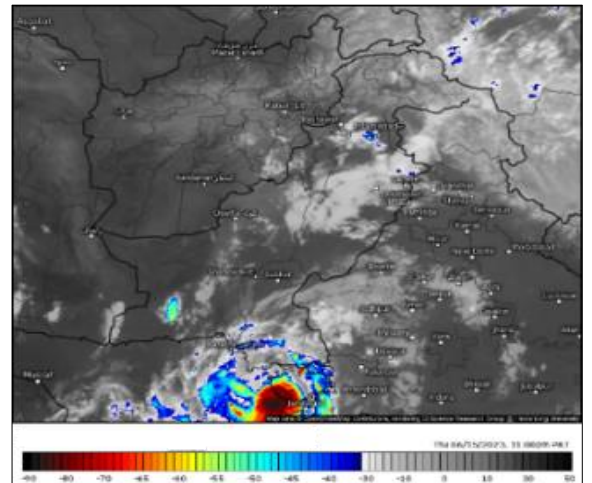
*Fig (2) hPa Geopotential Height & winds map of 1st spell of June*

Isohyetal map during the spell indicates that the maximum rainfall of 206 mm recorded over southeast Sindh at Mithi. No significant rain was observed over the rest of the country during the spell as shown in the Fig (3)



*Fig (3) 1<sup>st</sup> Spell of June total rainfall*

Satellite images during the spell are showing dense clouds over southeast Sindh as shown in the Fig (4)



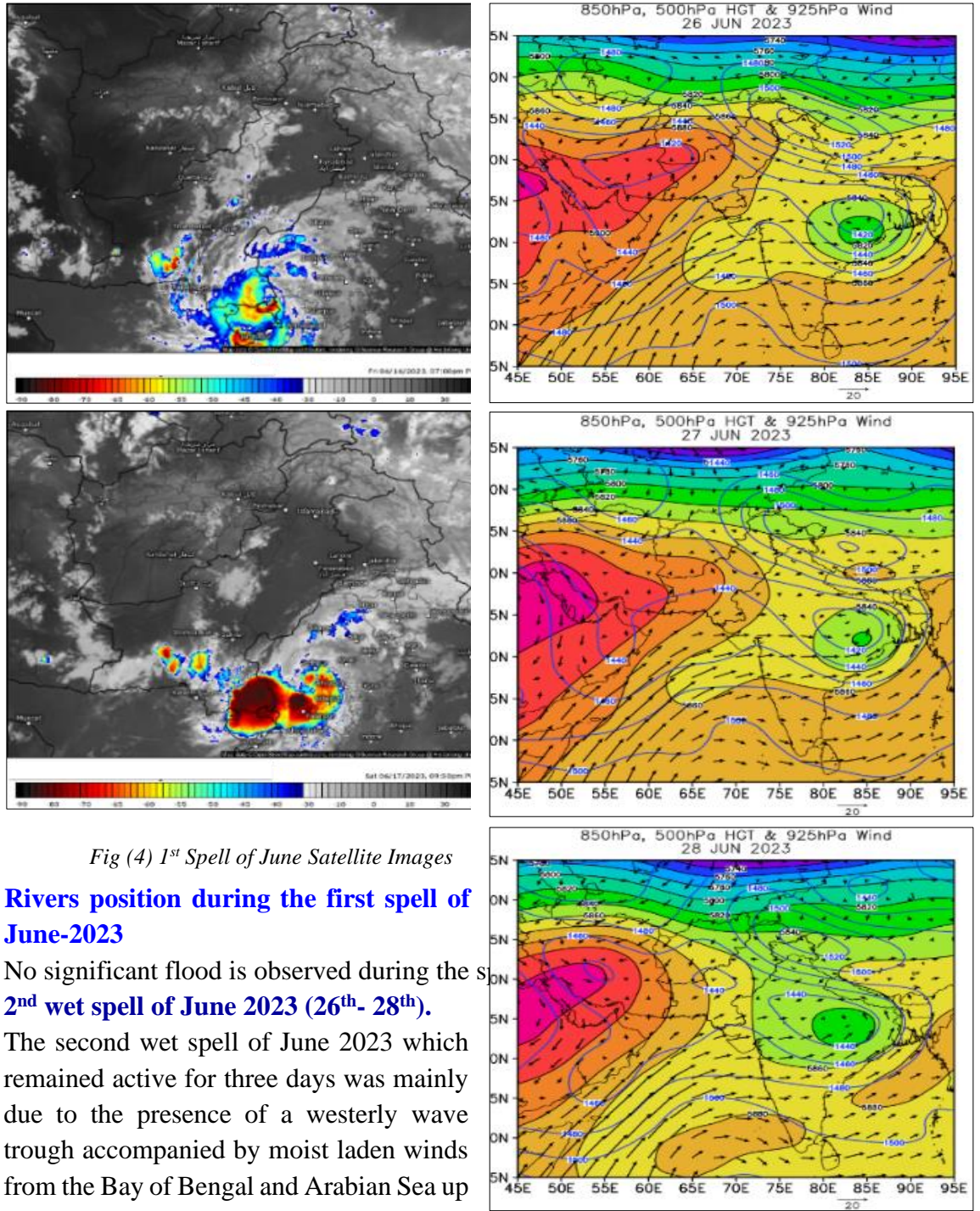


Fig (4) 1<sup>st</sup> Spell of June Satellite Images

#### 4.2 Rivers position during the first spell of June-2023

No significant flood is observed during the spell.

#### 4.3 2<sup>nd</sup> wet spell of June 2023 (26<sup>th</sup>- 28<sup>th</sup>).

The second wet spell of June 2023 which remained active for three days was mainly due to the presence of a westerly wave trough accompanied by moist laden winds from the Bay of Bengal and Arabian Sea up to 5000 feet. Fig (5) represents 500 hPa and 850 hPa geopotential height patterns along with 925 hPa wind flow during the spell. It indicates that parts of Pakistan are under the influence of the westerly wave. Moist winds at 925 hPa are also present ensuring moderate moisture supply from the source.

Fig (5) hPa Geopotential Height & winds map of 2<sup>nd</sup> spell of June

Isohyetal map during the spell shows that the maximum rainfall of 255 mm observed at Lahore Airport.

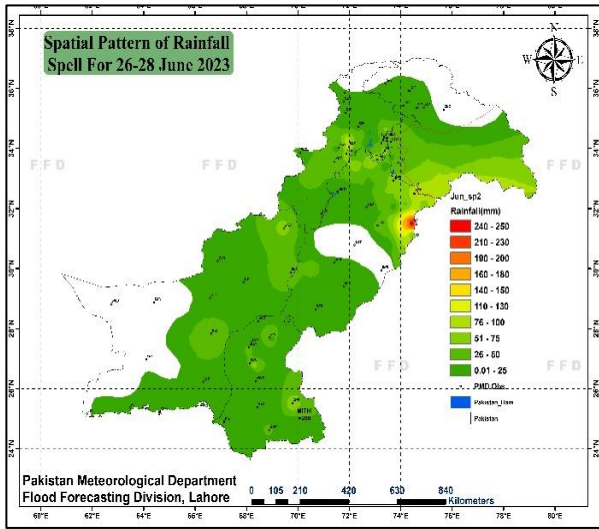


Fig (6) 2<sup>nd</sup> Spell of June total Rainfall

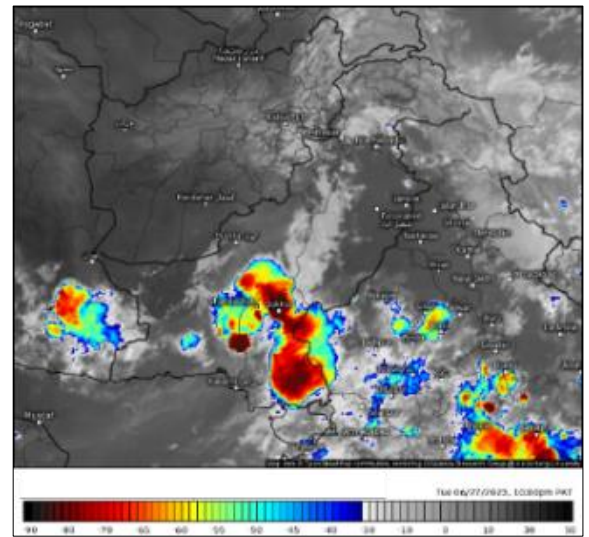
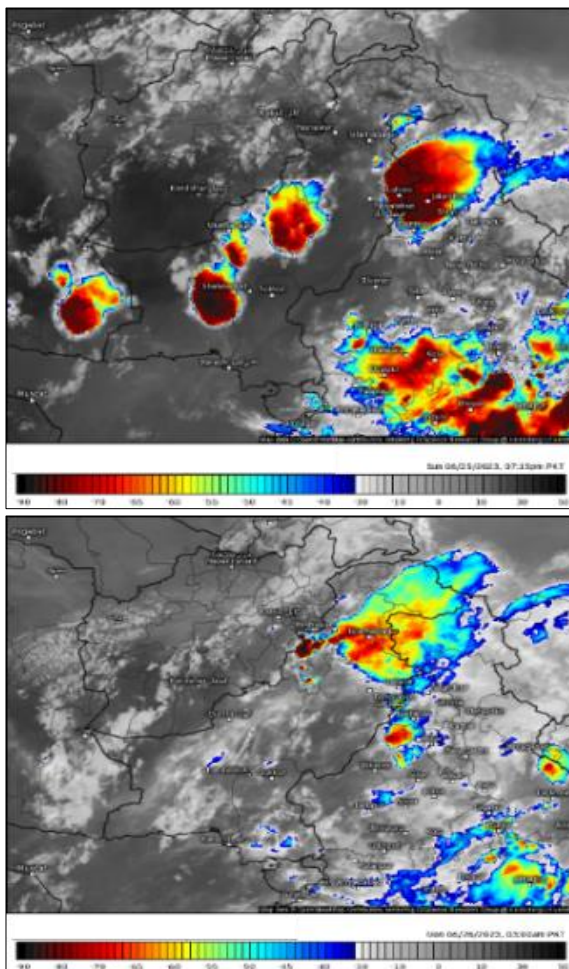


Fig (7) 2<sup>nd</sup> Spell of June Satellite Images

Satellite images as shown in the Fig (7). The figure is showing a cluster of dense clouds in Northeast Punjab and adjoining Kashmir.



#### 4.4 Hydrograph & maximum peaks recorded during the month of June-2023

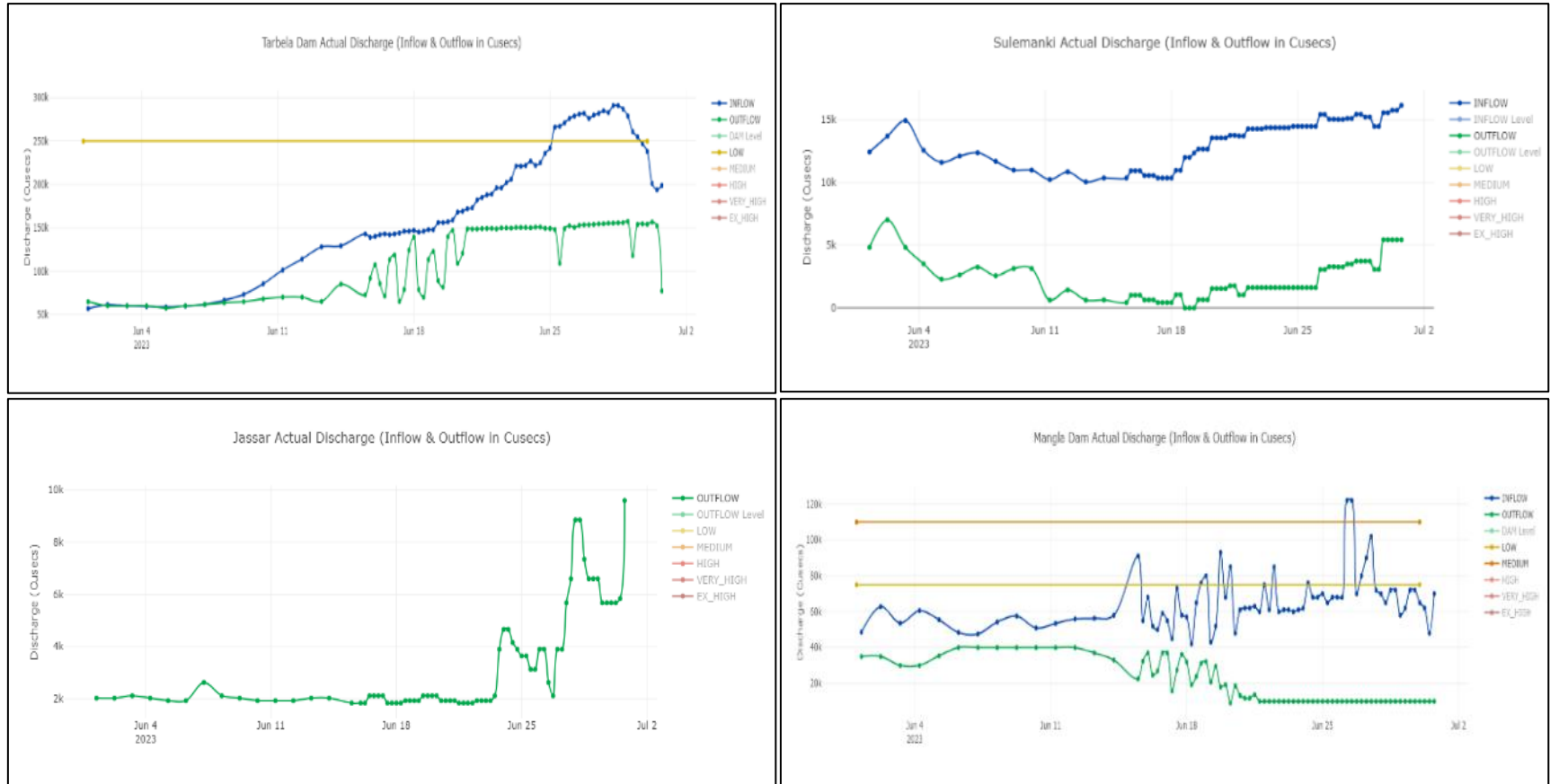


Fig (8) Hydrograph & Maximum peaks recorded during the month of June

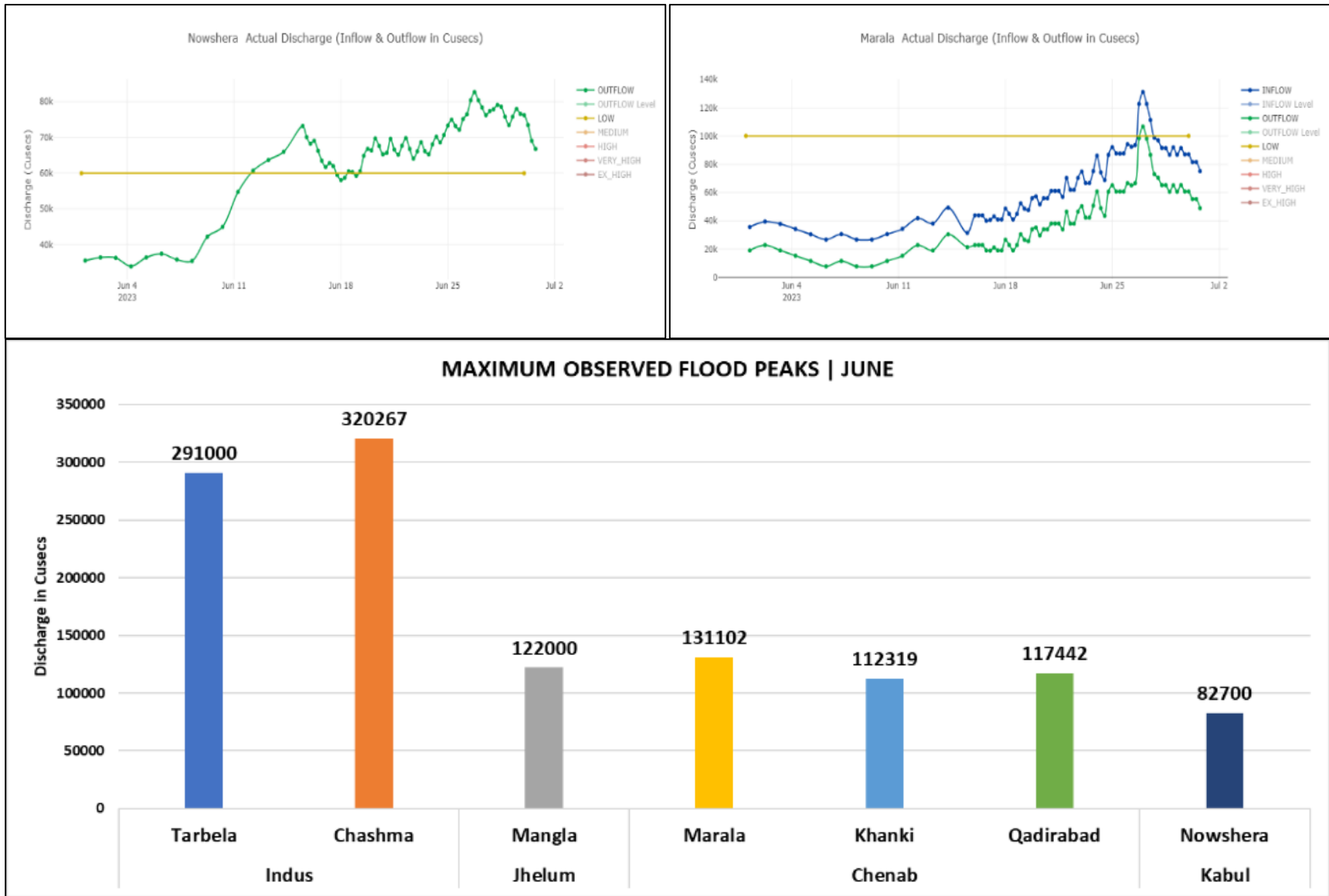
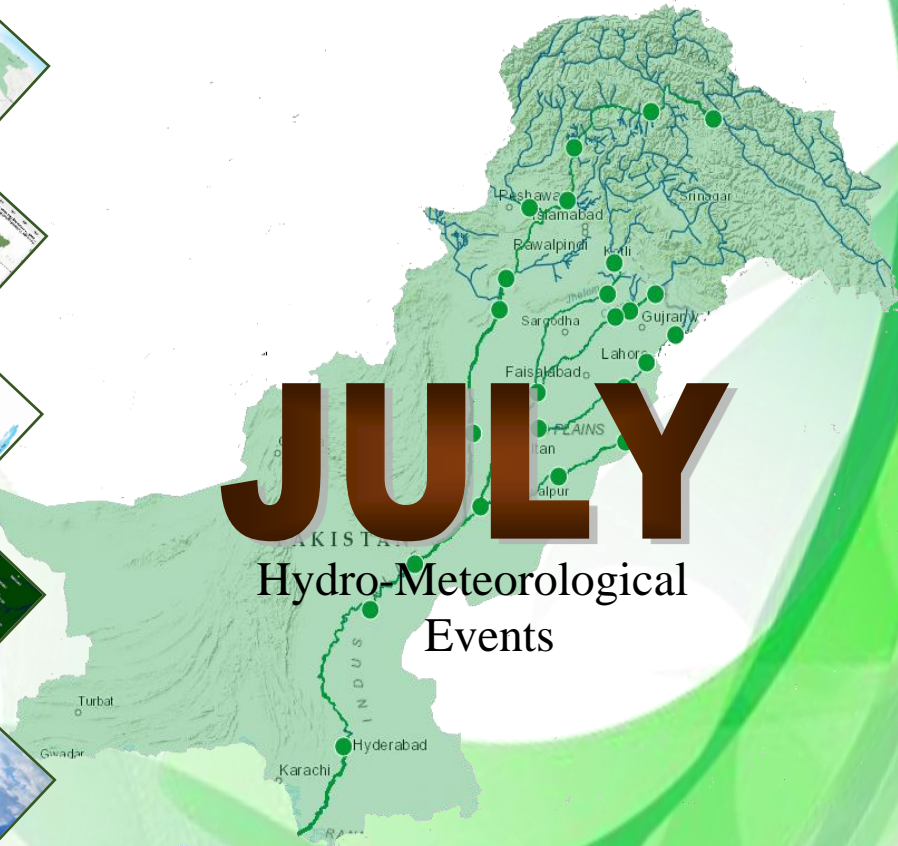
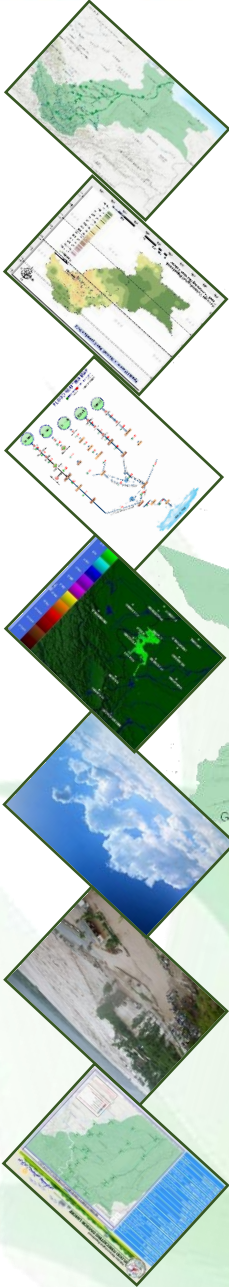


Fig-a (8) hydrograph & Maximum peaks recorded during the month of June



# JULY

## Hydro-Meteorological Events

## 5 Significant Hydro-Meteorological events during the month of July 2023

Two rainfall spells were reported during the month of July 2023 over Pakistan. Maximum Rivers flow observed at upstream, during the month is shown in Fig (19) which shows River Chenab at Marala and Qadirabad attained one high and one medium flood peak. While at Khanki, two high flood peaks. Two sharp peaks of medium level flood at upstream Mangla were also recorded.

One medium flood peak was also observed in River Indus at Tarbela, Chashma, Taunsa, Guddu and Sukkur.

An upper air circulation which developed over Bay of Bengal on 04<sup>th</sup> July. After travelling from Bay of Bengal it reached Rajasthan on 9<sup>th</sup> July and recurved to northeastwards and significantly affected upper and lower catchments of Rivers Ravi Sutlej and Beas. Track of this upper air low can be shown in the Fig (9).

Water generated due to this weather system luckily absorbed in Indian reservoirs and no significant water released from the Indian reservoirs. However, rain at down stream of the reservoirs affected the GS Wala as shown in Fig (19)

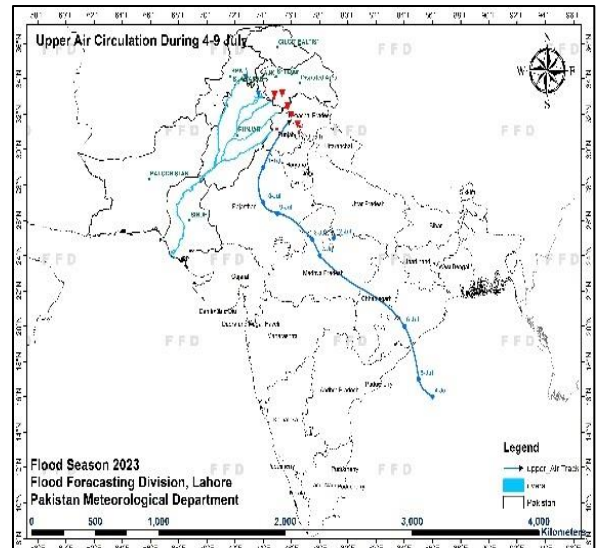
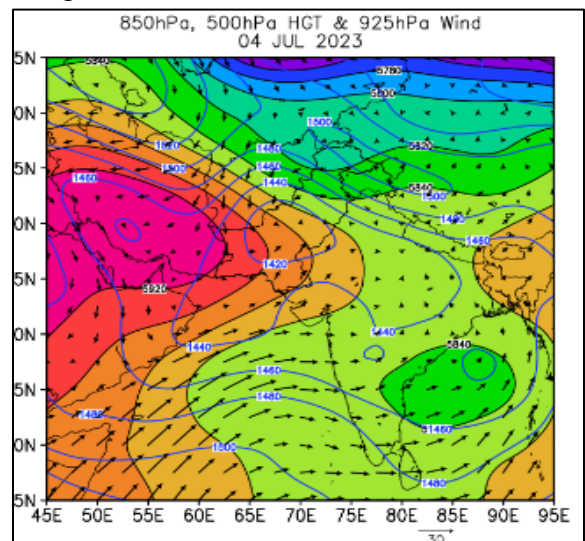


Fig (9) Track of upper air circulation formed on 4th July 2023.

### 5.1 1<sup>st</sup> wet spell of July 2023 (04<sup>th</sup>-09<sup>th</sup>)

The first wet spell of July 2023 which remained active for six days was mainly due to the presence of a westerly trough accompanied by moderate to strong moist currents from the Arabian Sea as well as Bay of Bengal. Fig (10) represents 500 hPa and 850 hPa geopotential height patterns along with 925 hPa wind flow during the spell. Southwesterly winds at 925 hPa are also present ensuring enough moisture supply from the Arabian Sea and Bay of Bengal.



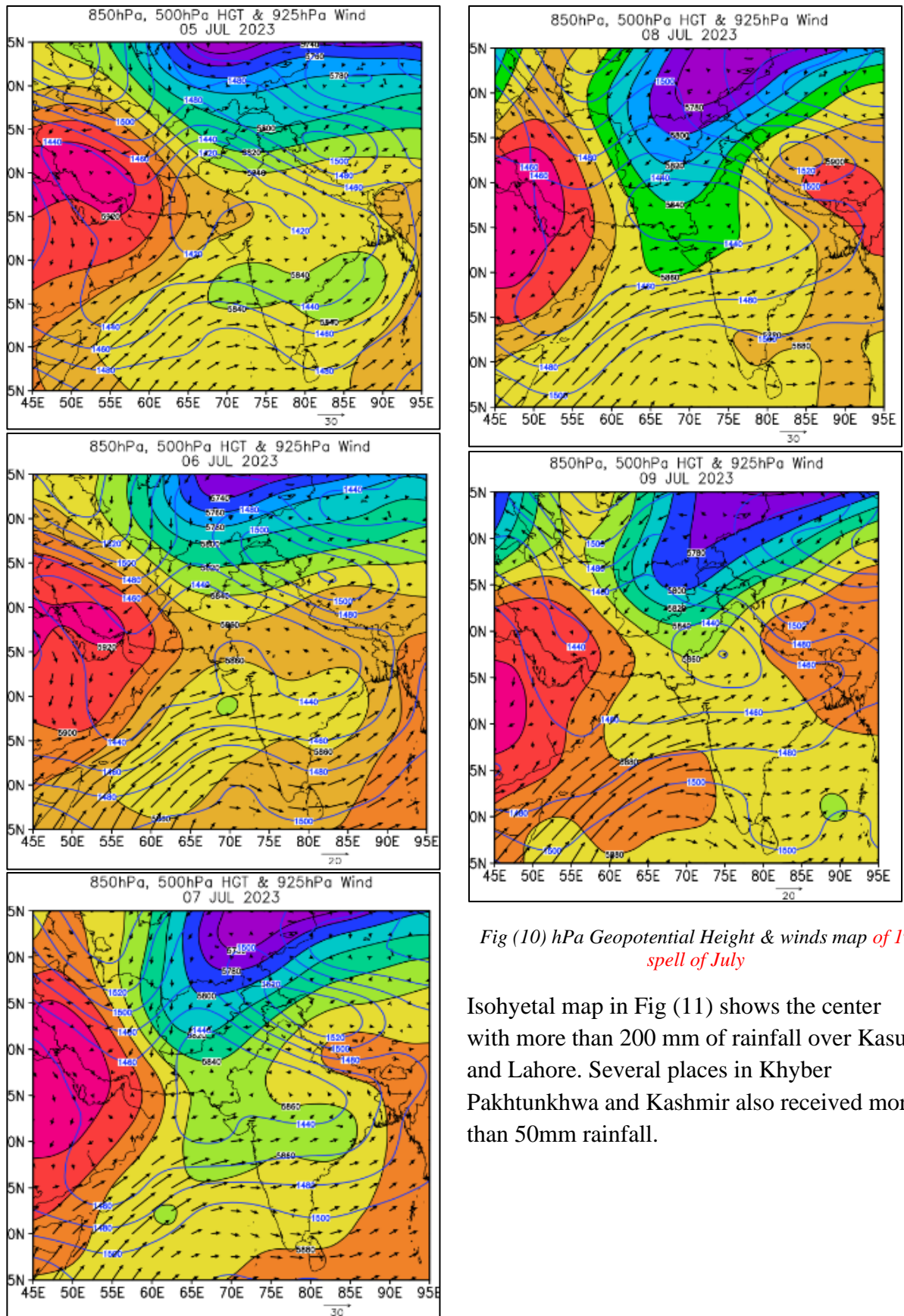


Fig (10) hPa Geopotential Height & winds map of 1<sup>st</sup> spell of July

Isohyetal map in Fig (11) shows the center with more than 200 mm of rainfall over Kasur and Lahore. Several places in Khyber Pakhtunkhwa and Kashmir also received more than 50mm rainfall.

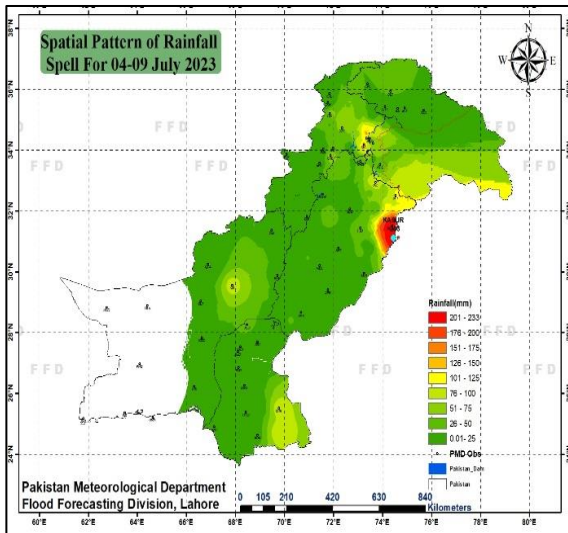


Fig (11) 1<sup>st</sup> Spell of July Total Rainfall

Satellite images during the spell are shown below in Fig (12)

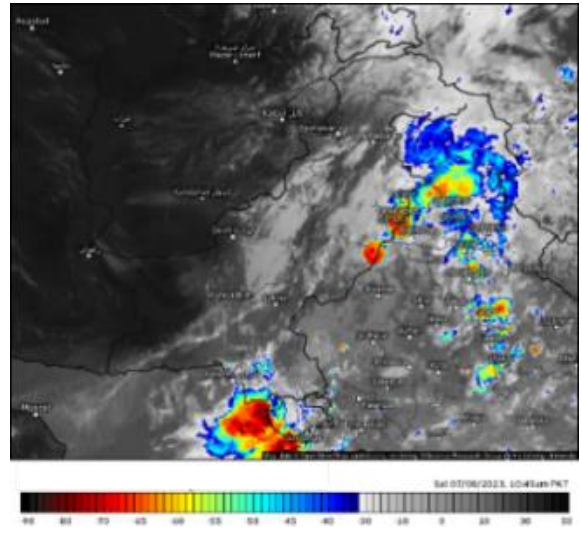
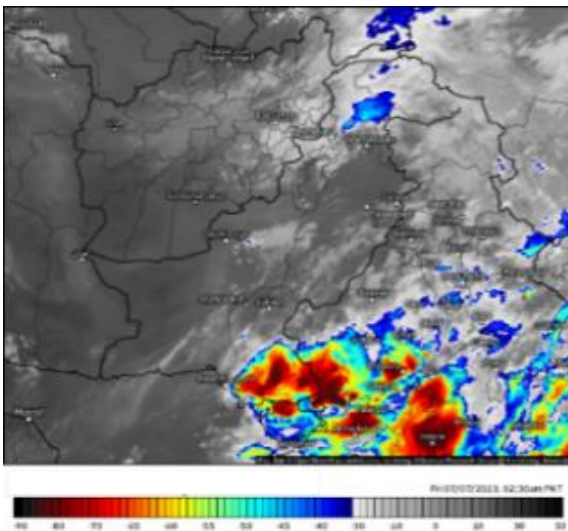
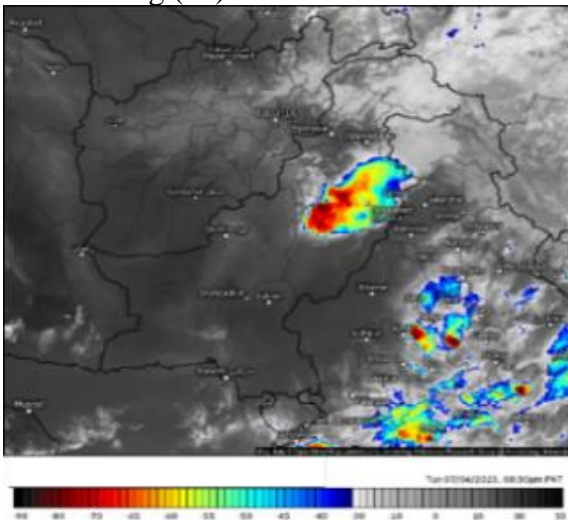


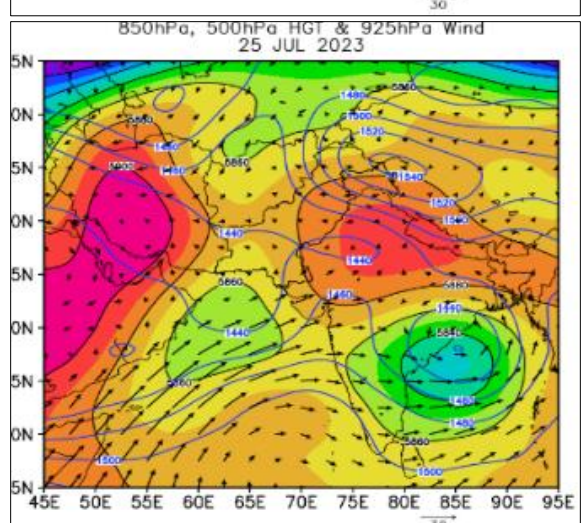
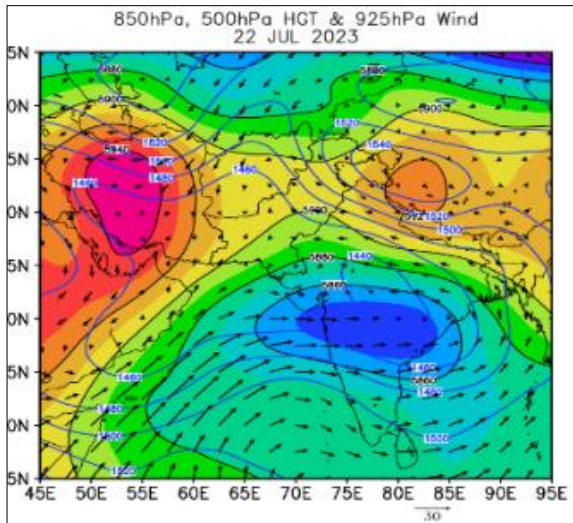
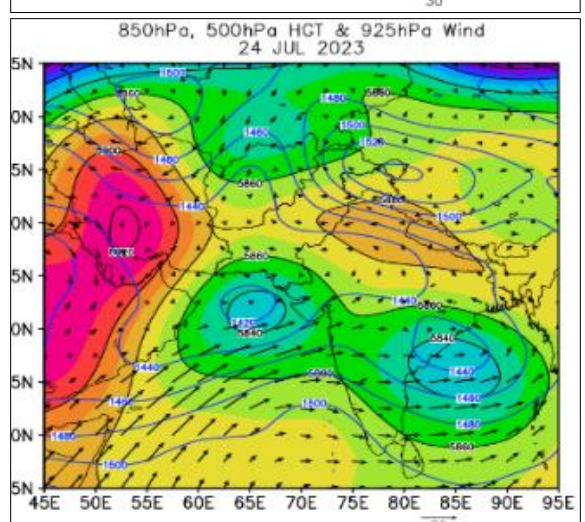
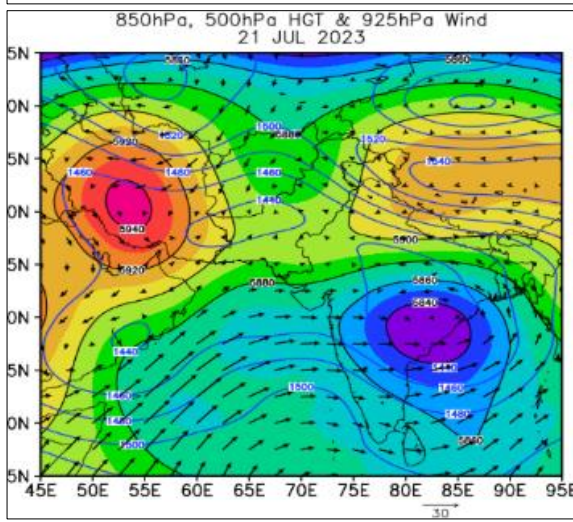
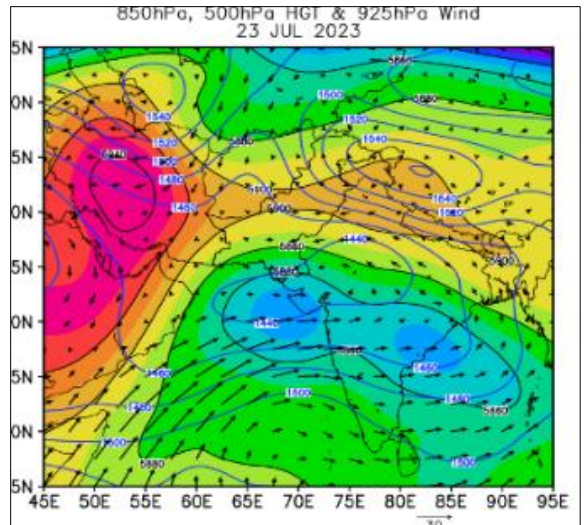
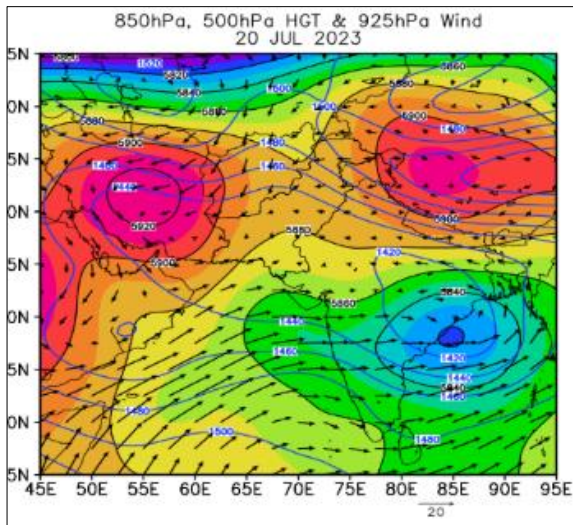
Fig (12) 1<sup>st</sup> Spell of July Satellite Images

## 5.2 Rivers position during the first spell of July-2023

River position during the spell can be seen From the hydrographs in the Fig (19).

## 5.3 2<sup>nd</sup> wet spell of July 2023 (20<sup>th</sup> –28<sup>th</sup>)

The Second long wet spell of July 2023 remained active for nine days and was mainly due to the presence of a subsequent westerly waves accompanied by strong moist winds from the Bay of Bengal and Arabian Sea. Fig (13) represents 500 hPa and 850 hPa geopotential height patterns along with 925 hPa moist wind flow during the spell. It indicates that parts of Pakistan remained under the influence of the westerly wave. Southeasterly winds at 925 hPa are also present ensuring strong moisture supply from the Bay of Bengal and moderate moist currents from Arabian Sea.



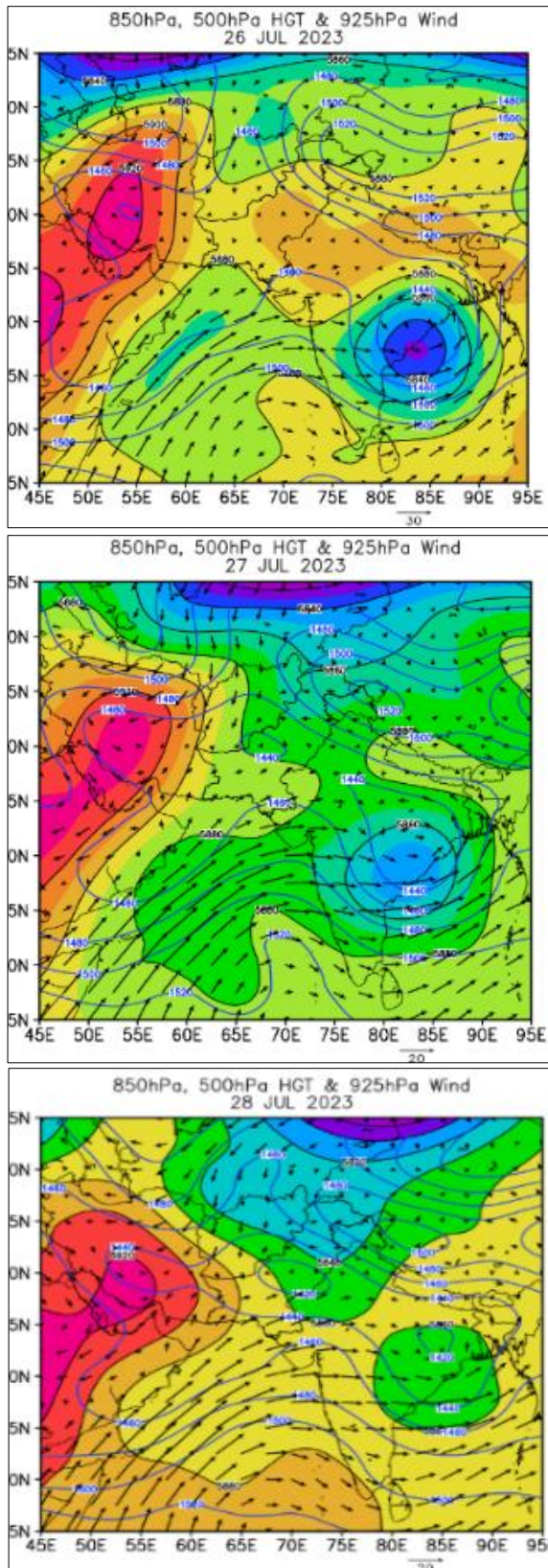


Fig (13) hPa Geopotential Height & winds map  
2<sup>nd</sup> spell of July.

Lahore Airport received 418.81 mm rainfall during the spell. In Sindh Padidan observed more than 300mm of rainfall. Rainfall received in rest of the country can also be seen from the Fig (14)

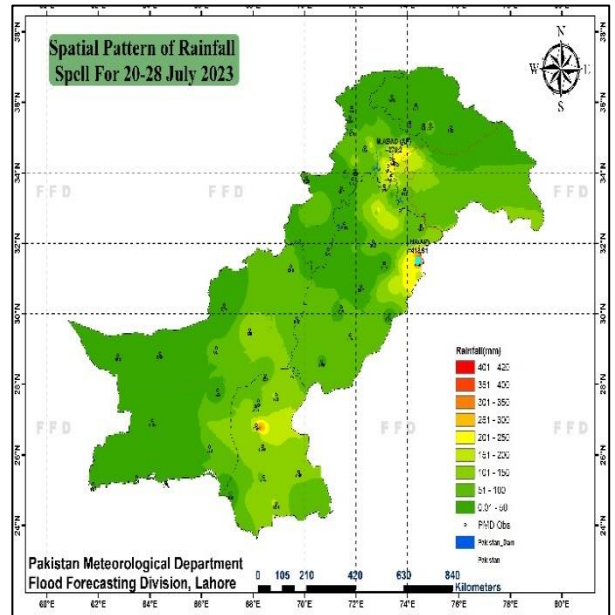
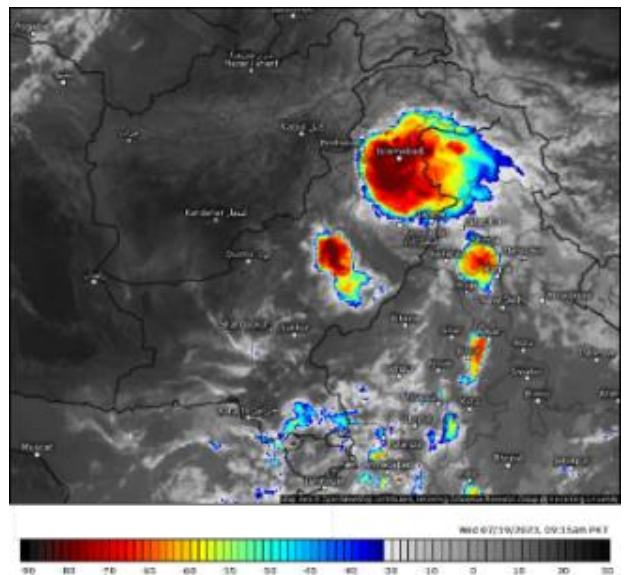
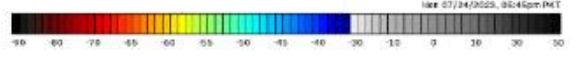
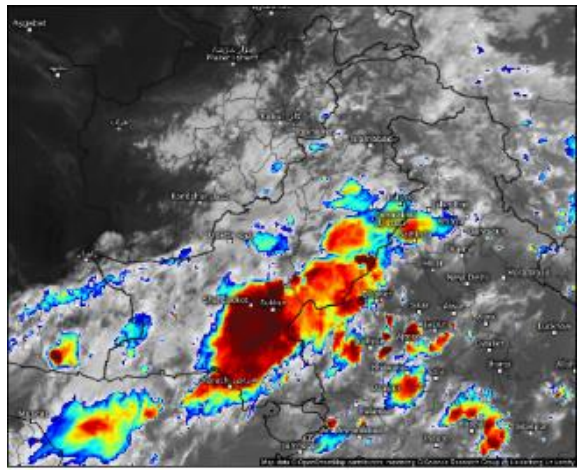
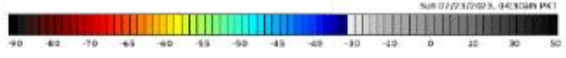
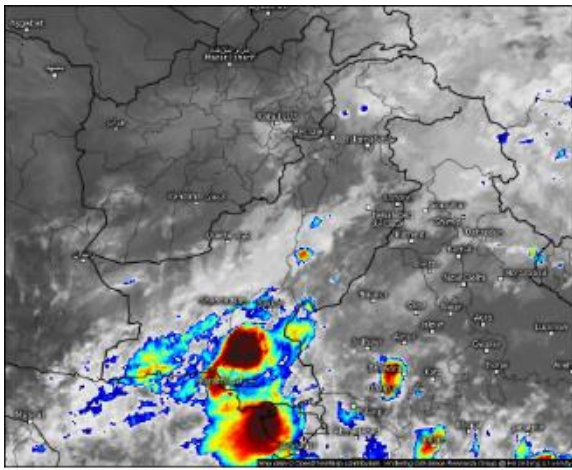
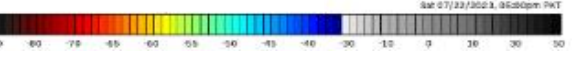
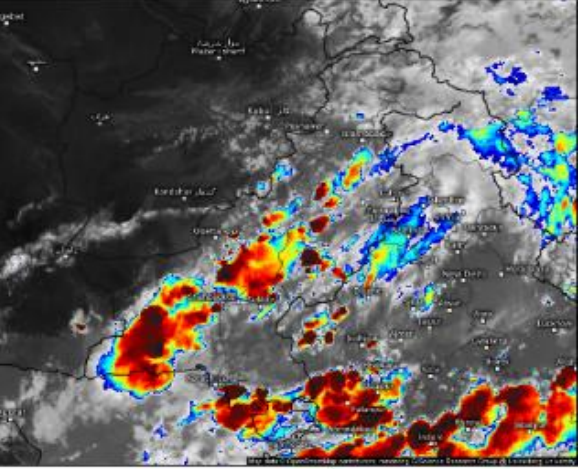
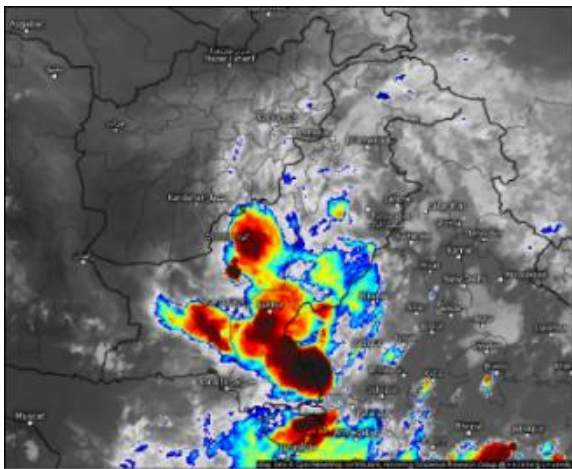
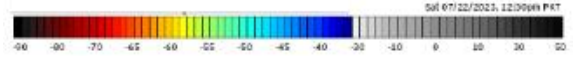
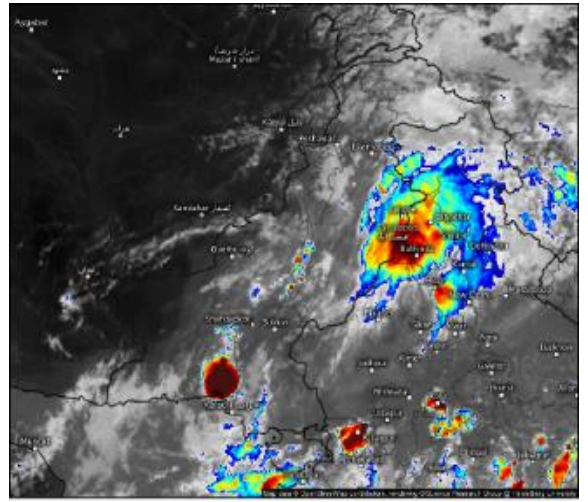
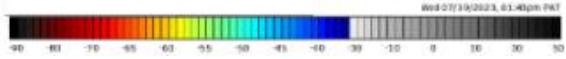
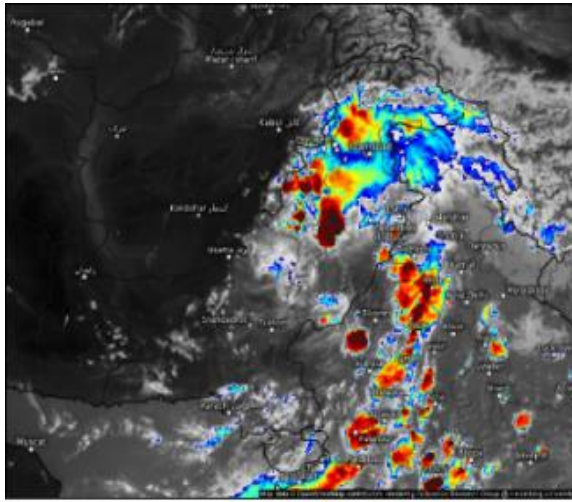


Fig (14) 2<sup>nd</sup> Spell of July total Rainfall

Dense clouds observed by satellite during the spell is shown in the Fig (15).





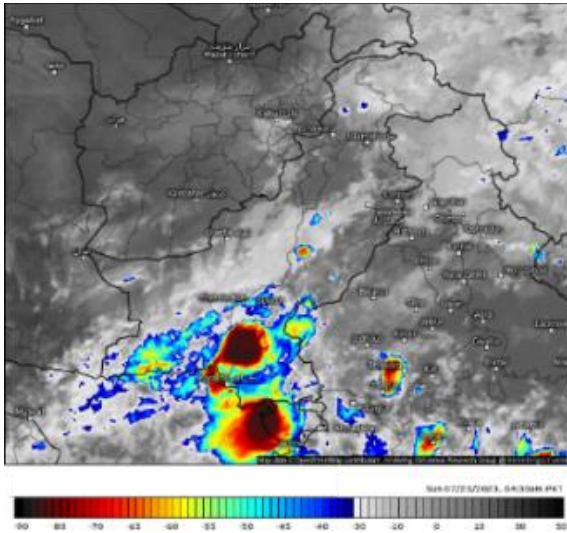


Fig (15) 2<sup>nd</sup> Spell of July Satellite

**5.4 Monthly maps of Total rainfall, Departure and Temporal Distribution during July 2023.** Isohytal map of July 2023 indicates that the maximum rainfall region lies around Lahore. The region of the second maximum rainfall lies in Khyber Pakhtunkhwa at Balakot. Most part of Sindh and Punjab, North Balochistan, Khyber Pakhtunkhwa and Kashmir received more than 180 mm of rainfall as shown in the Fig (16)

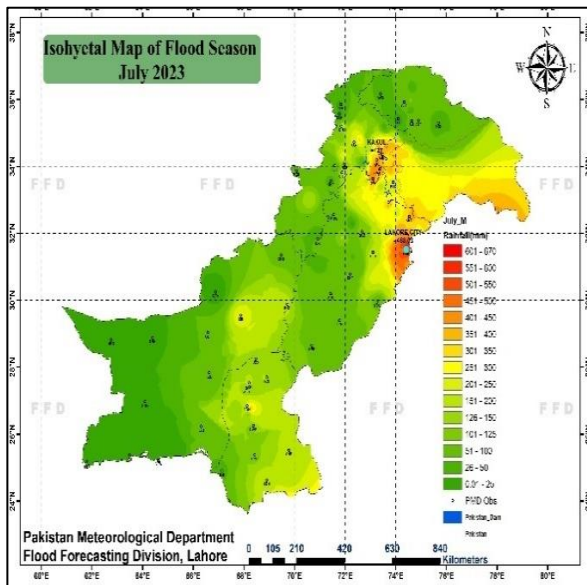


Fig (16) Monthly total rainfall map of July 2023.

Departure of rainfall during July is shown in the figure below.

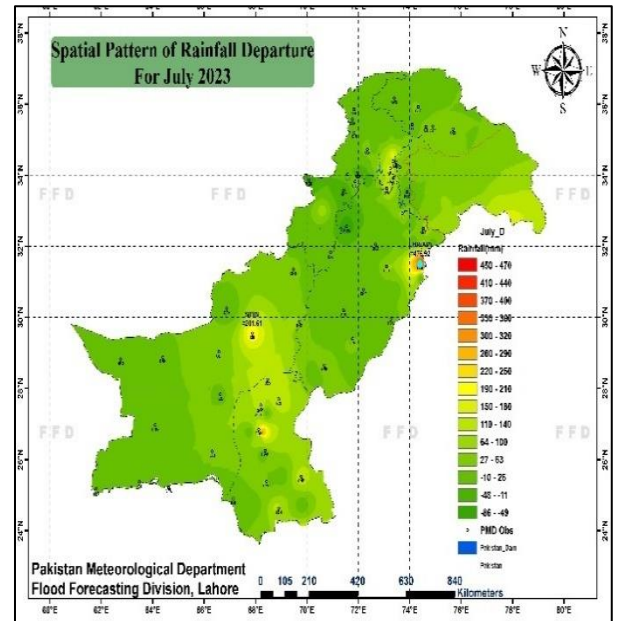


Fig (17) Monthly rainfall Departure map of July

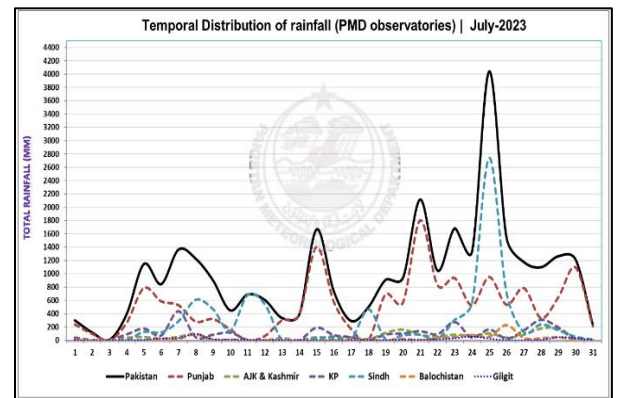


Fig (18) Monthly Rainfall Temporal distribution of July

## 5.5 Hydrographs & Peaks recorded during July 2023



Fig (19) Hydrograph & Maximum peaks recorded during the month of July



Fig-a (19) Hydrograph & Maximum peaks recorded during the month of July

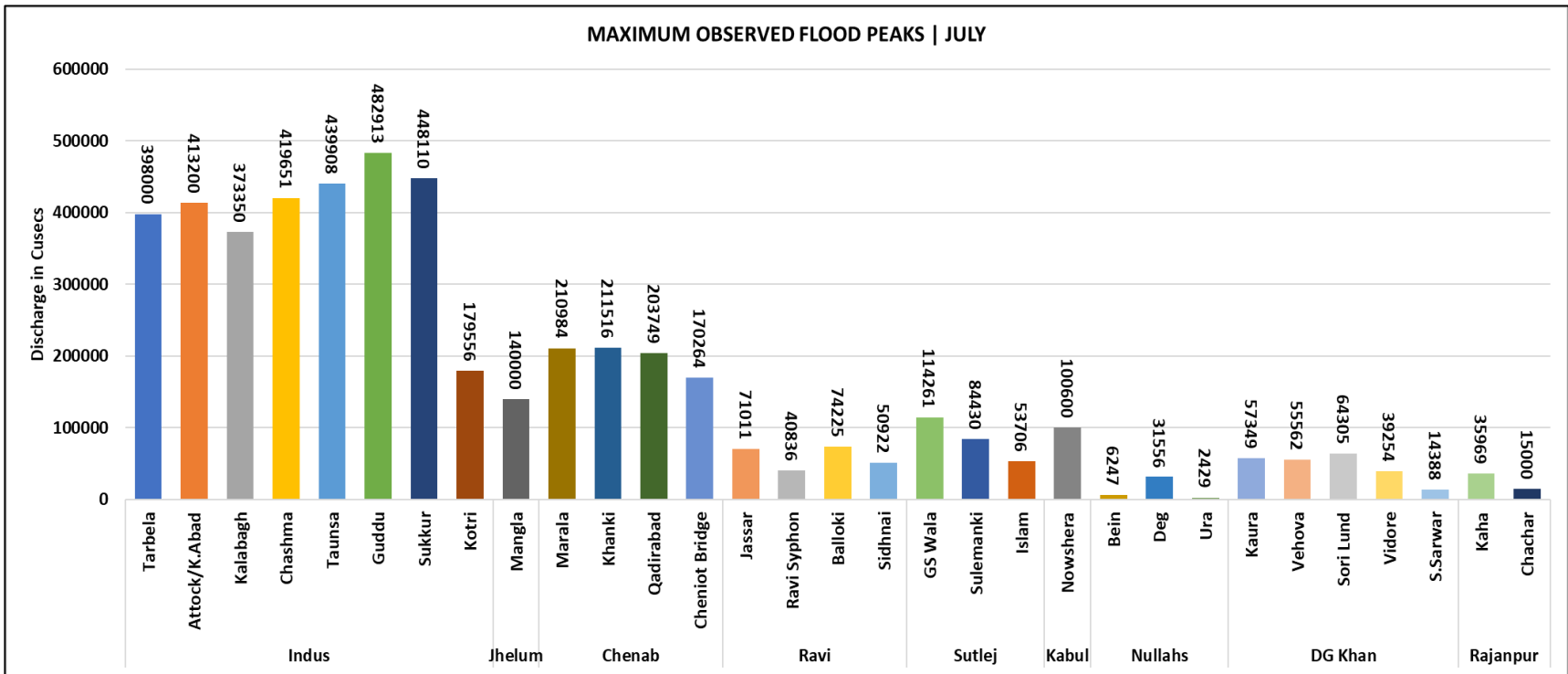
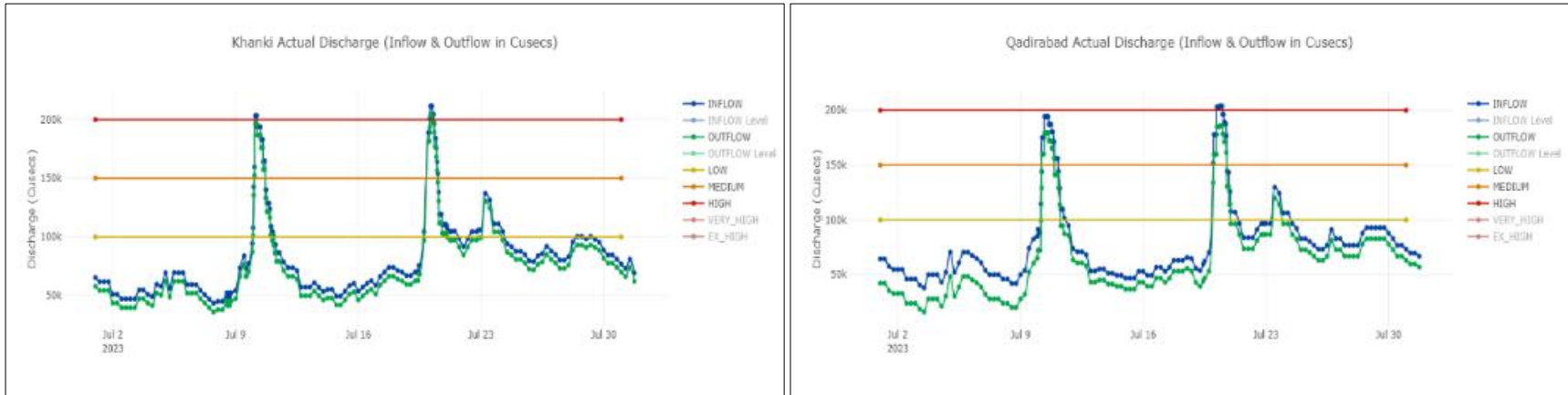
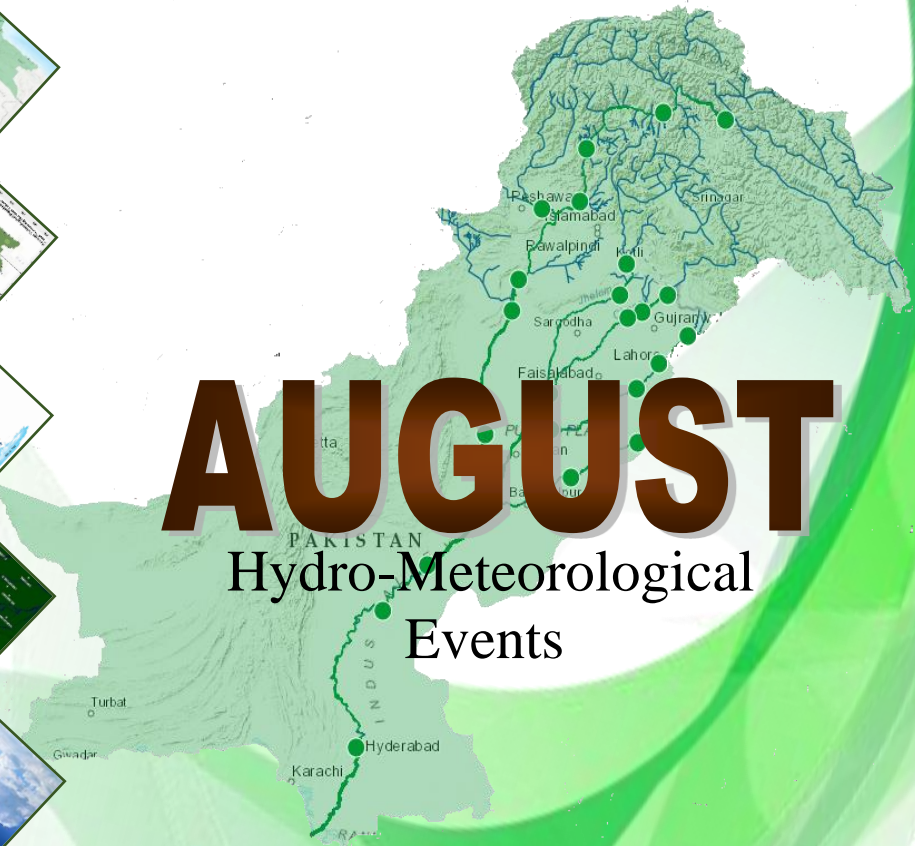
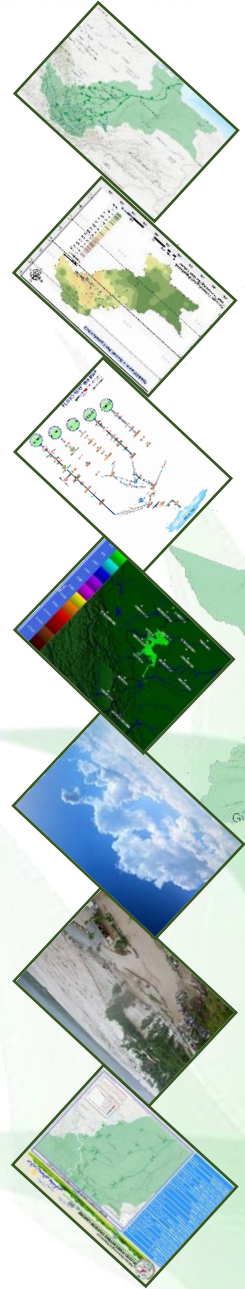


Fig-b (19) Hydrograph & Maximum peaks recorded during the month of July



# AUGUST

## Hydro-Meteorological Events



## 6 Hydro-Meteorological events during the month of August

Two wet spells were recorded during the month of August. The first spell which occurred from 05<sup>th</sup> to 07<sup>th</sup> August 2023 was the result of penetration of light to moderate moist currents from Arabian Sea and also due to the effect of westerly wave passing over northern parts of the country. The second spell of August was observed from 25<sup>th</sup> to 28<sup>th</sup> August 2023. It was caused by the interaction of westerly wave passing over northern parts of the country and the moist influx from Arabian Sea.

Due to cloud burst in Himachal Pradesh India, heavy to very heavy rainfall was recorded over the upper catchments of river Sutlej and Beas. Under the effect of this intense rainfall India released water from Bhakra and Pong reservoirs which affected the country in River Sutlej at Ganda Singh Wala from 17 August and at Sulemanki from 18<sup>th</sup> August and at Islam form 22<sup>nd</sup> August 2023. Very high flood peaks at Ganda Singh Wala and Sulemanki were recorded while Islam attained High flood as shown in the Fig(29) Manageable flows were observed in the other rivers.

### 6.1 1<sup>st</sup> wet spell of August 2023 (05<sup>th</sup>-07<sup>th</sup>)

The first wet spell of August 2023 which remained active for three days was result of penetration of light to moderate moist currents from Arabian Sea, the effect of westerly wave passing over northern parts of the country. Fig (20) represents 500 hPa and 850 hPa Geopotential height patterns along with 925 hPa wind flow during this spell. It indicates that many parts of Pakistan are under the influence of westerly wave. Southwesterly winds at 925 hPa are also present ensuring enough moisture supply from Arabian Sea.

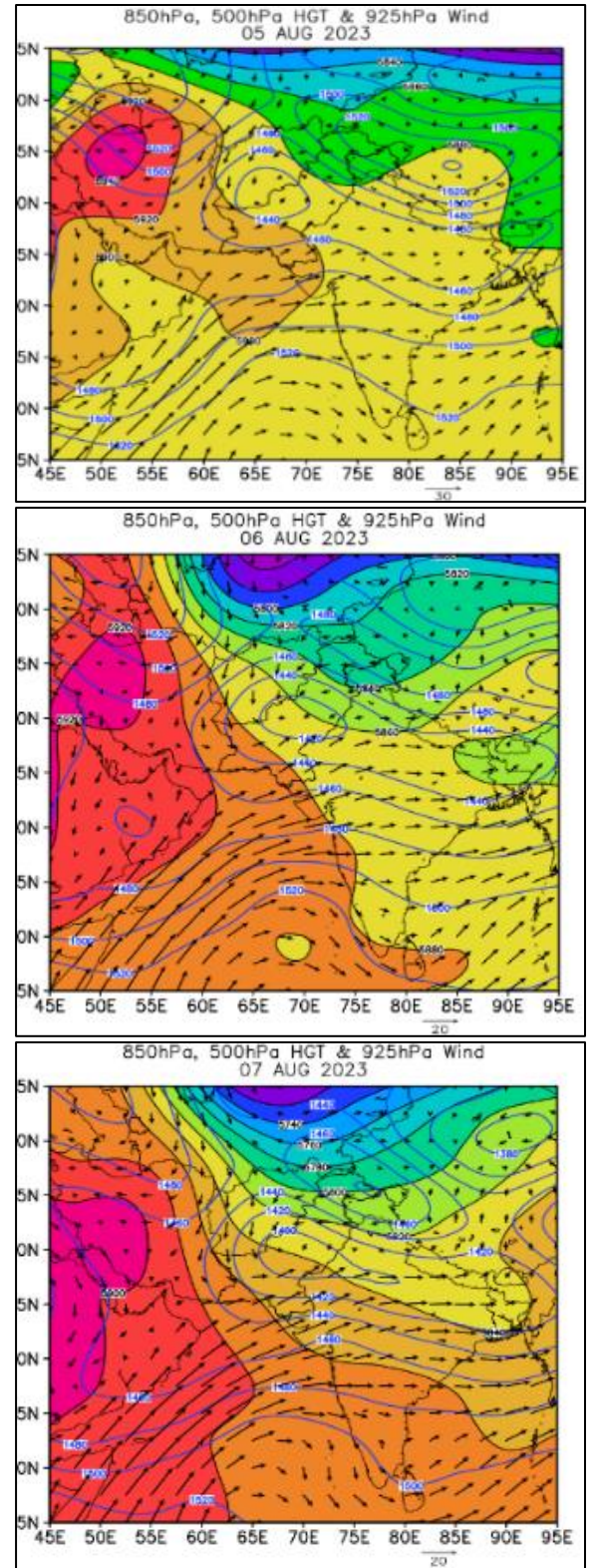


Fig (20) hPa Geopotential Height & winds 1<sup>st</sup> spell of map August

The wet spell affected upper and central Punjab, upper Khyber Pakhtunkhwa, Gilgit Baltistan and Kashmir. Generally, light to moderate rain recorded during the spell. The center of maximum rainfall during the spell is located around Gujranwala division.

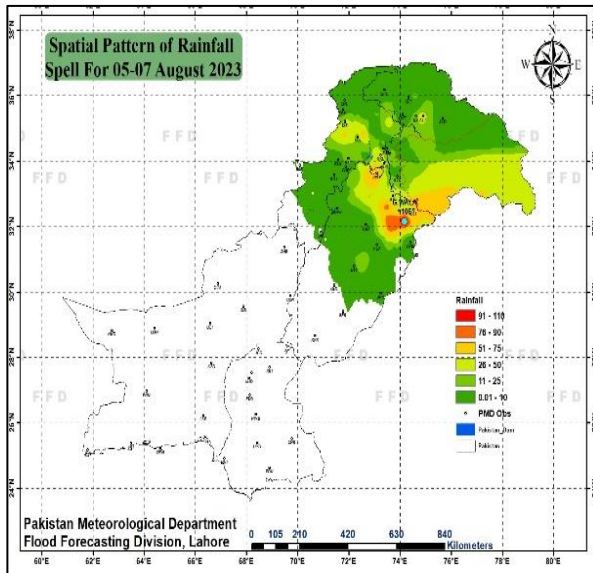


Fig (21) 1<sup>st</sup> Spatial total rainfall August

Cloud observation through satellite image during the spell is shown below.

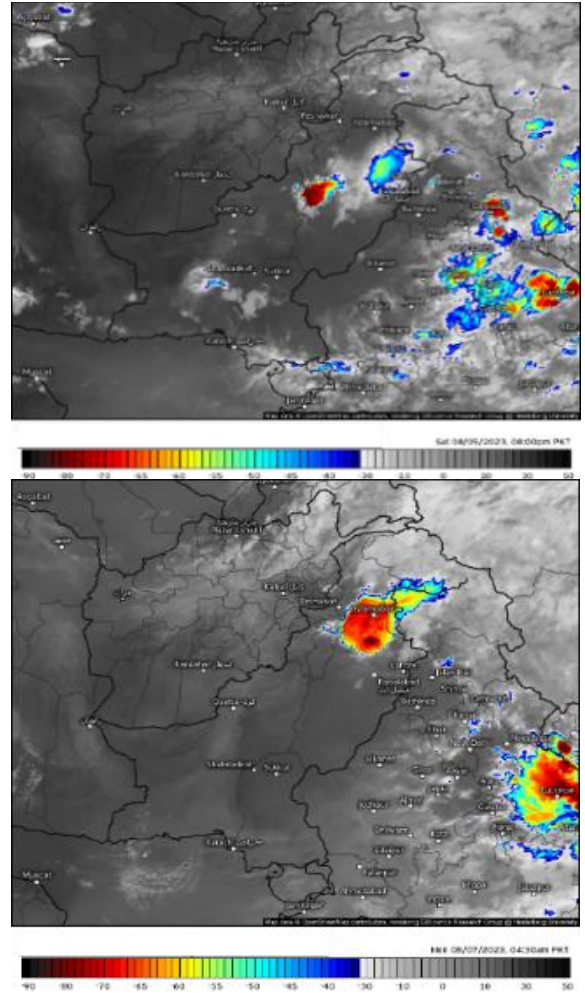
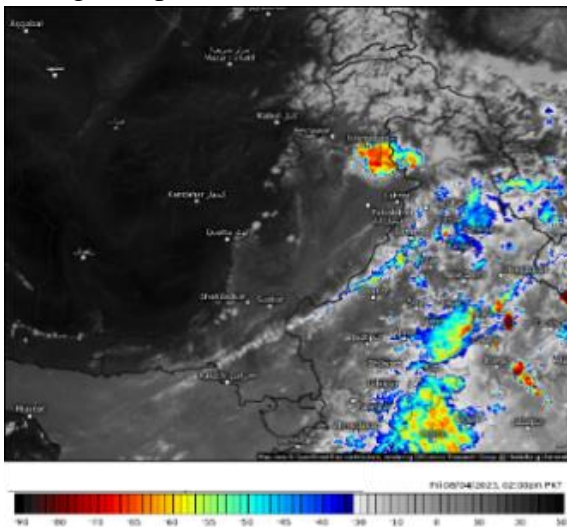


Fig (22) 1<sup>st</sup> spell of August Satellite images.

## 6.2 Rivers position during the first spell of August-2023

No disaster generating flows were recorded during the spell.

## 6.3 2<sup>nd</sup> wet spell of August 2023 (25<sup>th</sup>-28<sup>th</sup>)

The second wet spell of August 2023 which remained active for four days was mainly due to the interaction between westerly trough over northern parts of the country and moist currents from the Arabian Sea. Figure 25 represents 500 hPa and 850 hPa Geopotential height patterns along with 925 hPa wind flow during this spell.

It indicates that upper parts of Pakistan are under the influence of westerly waves. Southwesterly winds at 925 hPa are also present ensuring enough moderate moisture supply from the Arabian Sea.

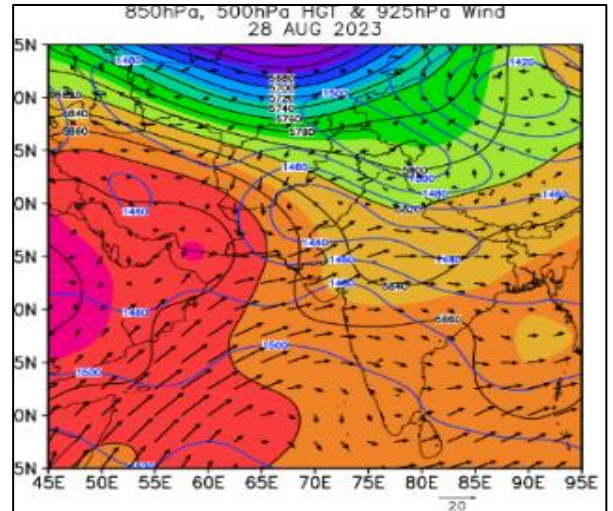
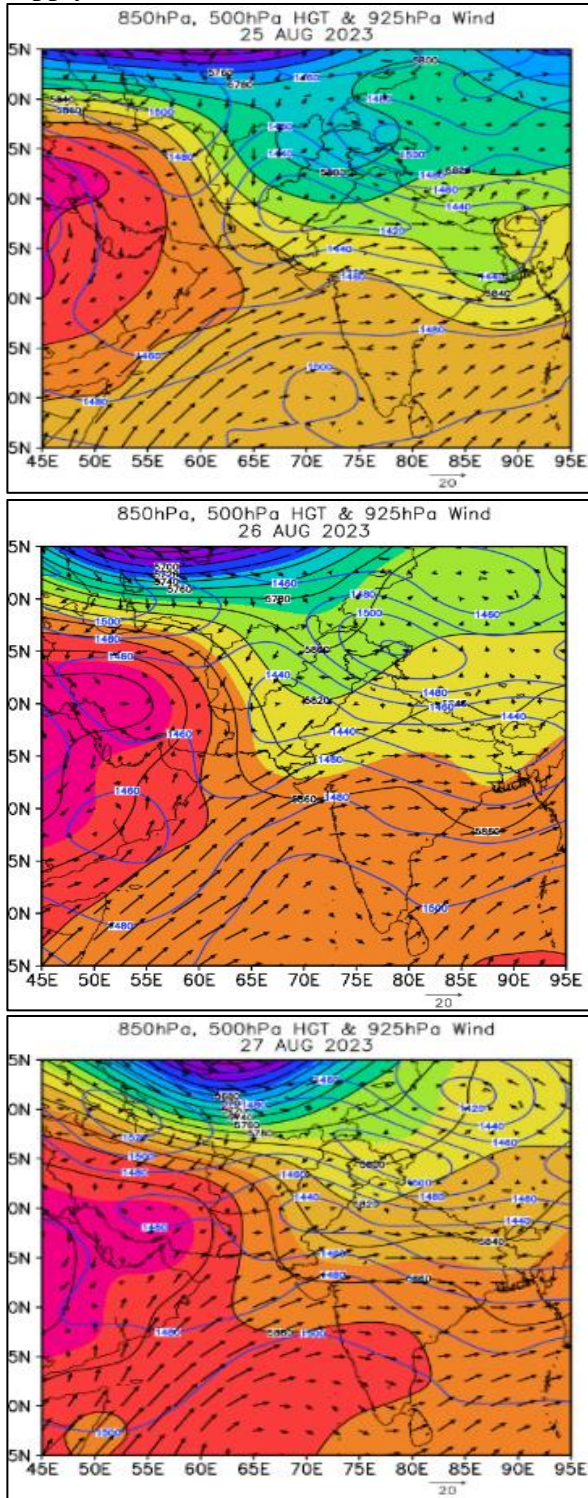


Fig (23) hPa Geopotential height & winds 2<sup>nd</sup> spell of August

Light to moderate rainfall occurred during the spell. Mostly, rain occurred in Punjab, Khyber Pakhtunkhwa, Kashmir and Gilgit Baltistan while Sindh and Balochistan remained dry.

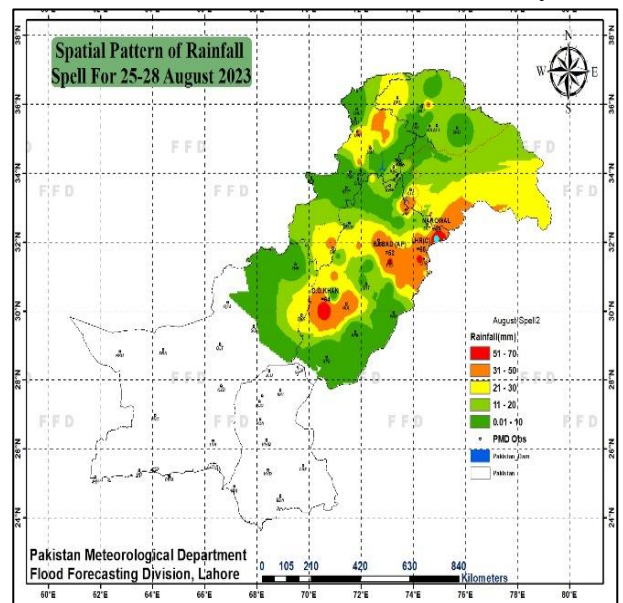


Fig (24) 2<sup>nd</sup> Spell total rainfall of August

Clouds formed during the spell are shown in the Fig (25) below.

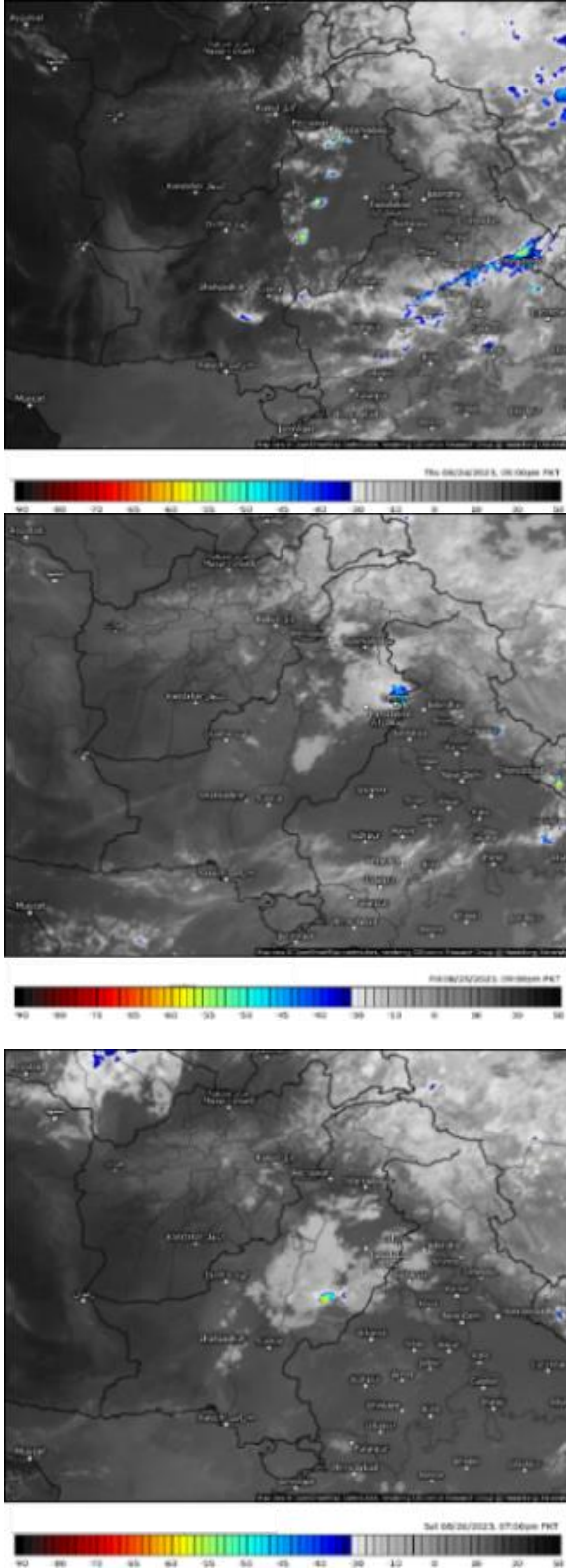


Fig (25) 2<sup>nd</sup> Spell of August Satellite Images.

### 6.5 Rivers position during the second spell of August-2023

No significant flood situation developed due to this spell.

### 6.6 Monthly maps of Total rainfall, Departure and Temporal Distribution August 2023

The center of maximum rainfall of more than 200 mm during August is located one around Dir, second around Islamabad and third around Gujranwala division. Rest of the rainfall distribution can be seen in the Fig (26).

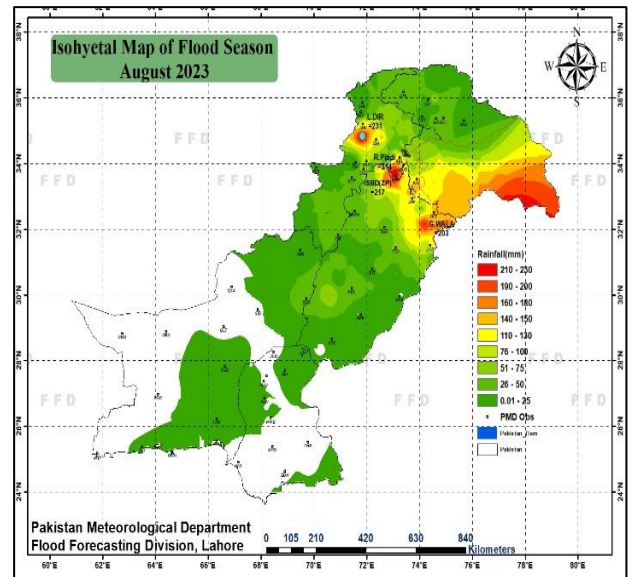


Fig (26) Total Rainfall rainfall map of August

Fig (27) shows the monthly rainfall temporal distribution during the month of August.

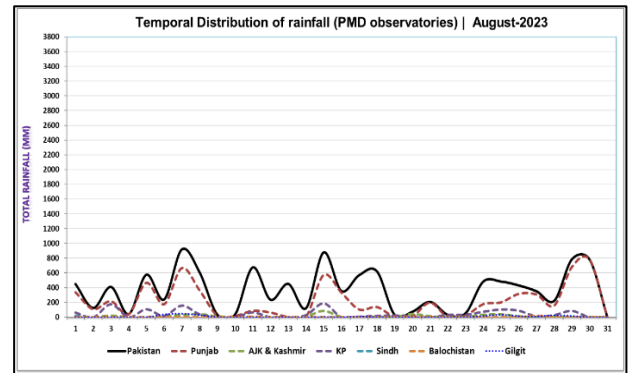


Fig (27) Monthly Rainfall Temporal distribution of Aug.

Most parts of the country received below normal rainfall while it remained significantly below normal over North and Northeast Punjab and Kashmir.

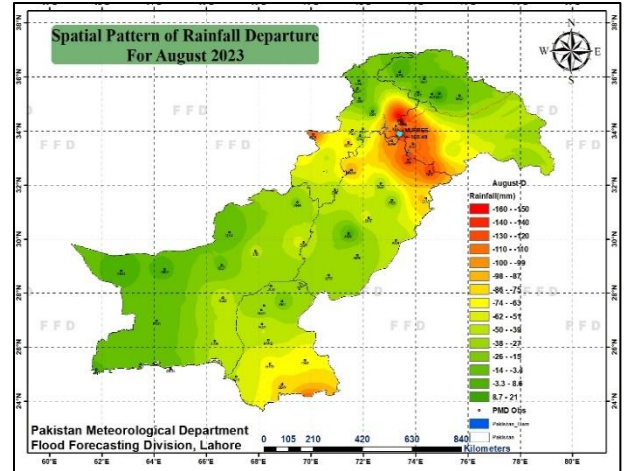


Fig (28) Monthly Rainfall Departure of August

### 6.7 Hydrographs & Peaks recorded during August 2023.

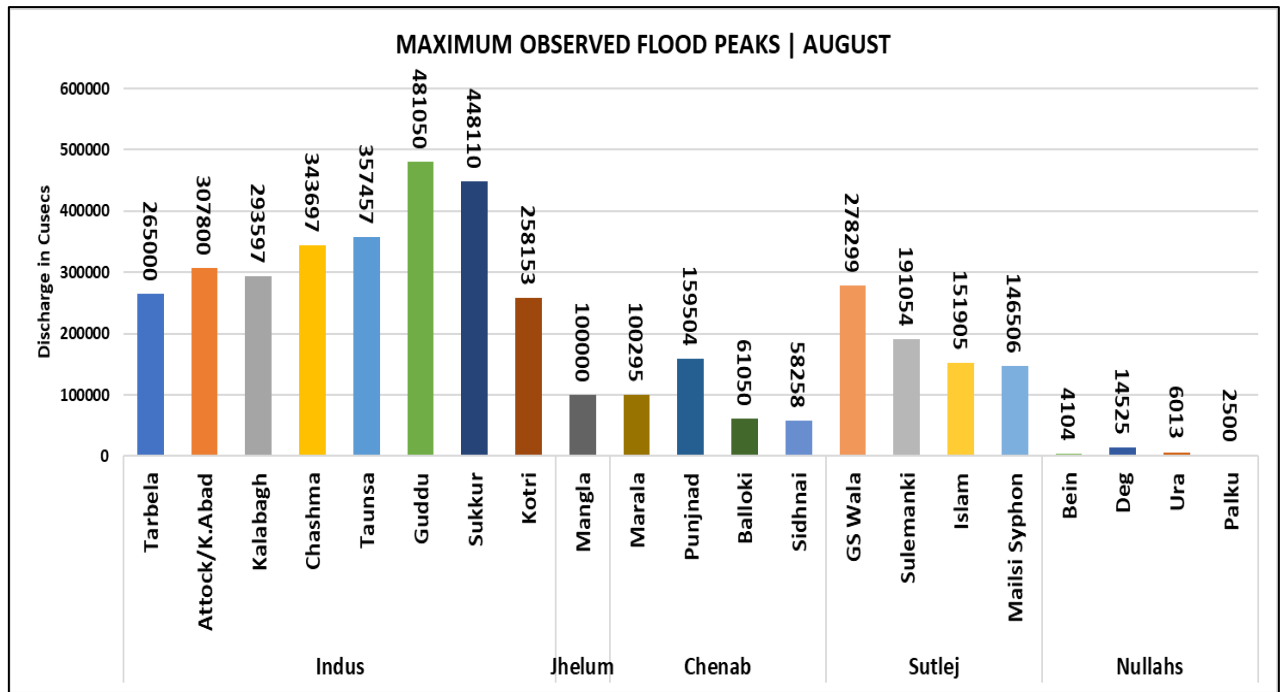
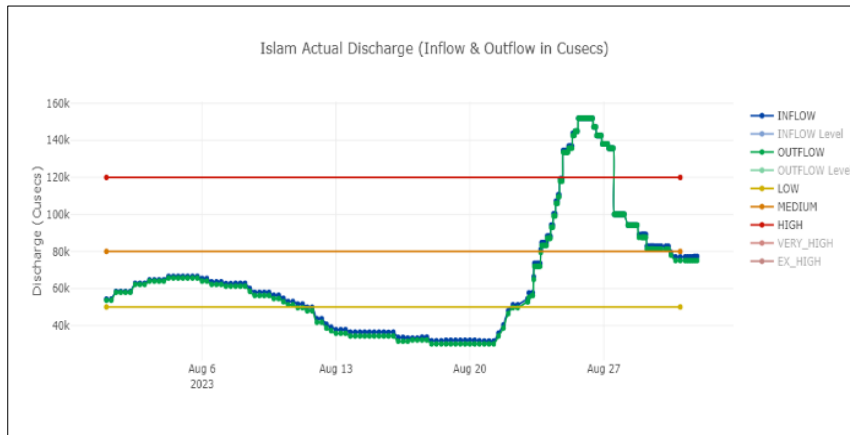
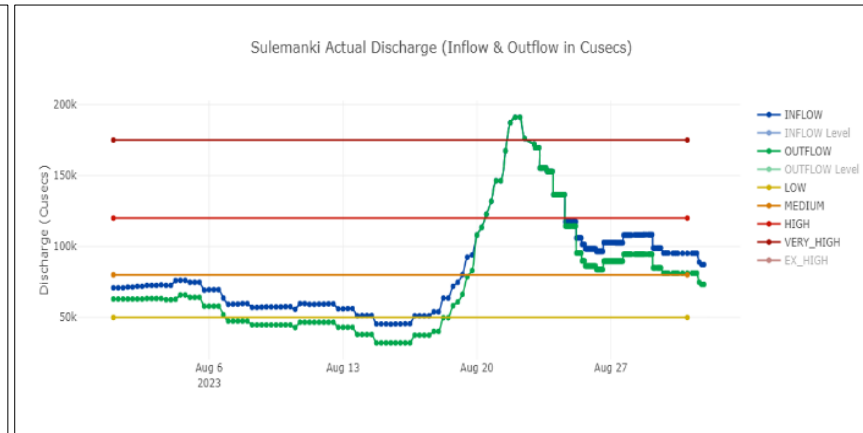
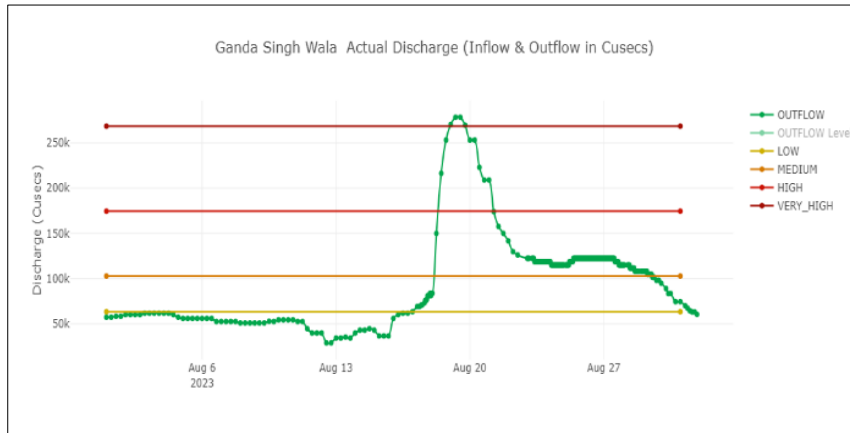


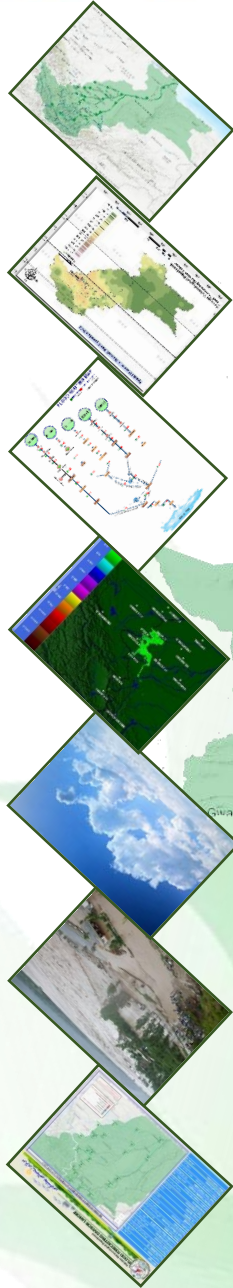
Fig (29) Hydrograph & Maximum peaks recorded during the month of August



Fig-a (29) Hydrograph & Maximum peaks recorded during the month of August

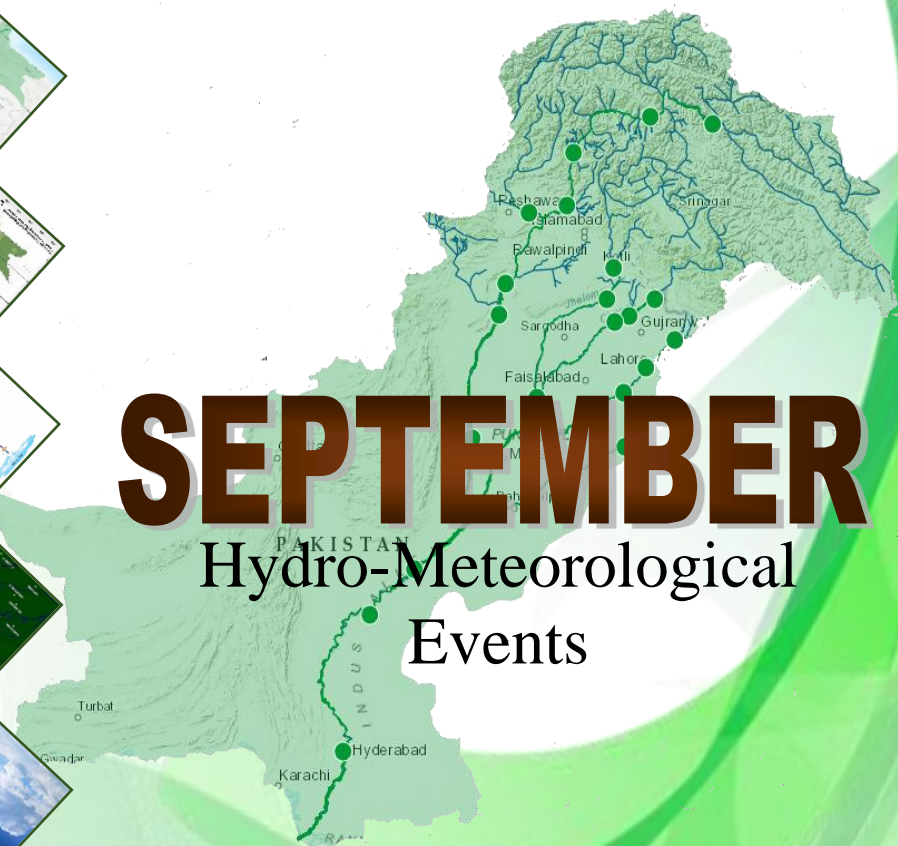


*Fig-b (29) Hydrograph & Maximum peaks recorded during the month of August*



# SEPTEMBER

## Hydro-Meteorological Events

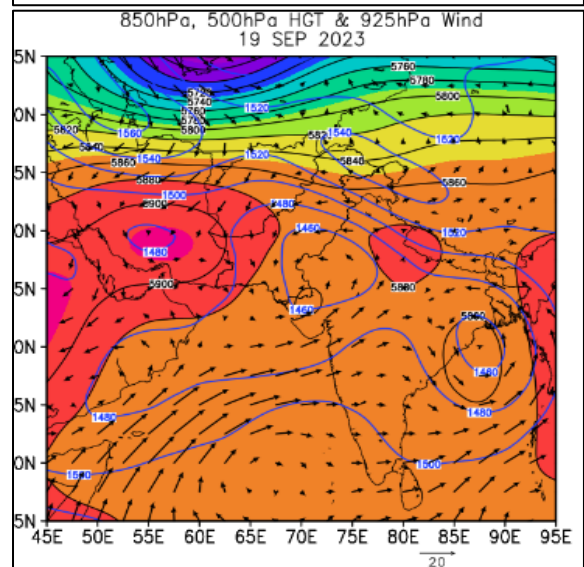
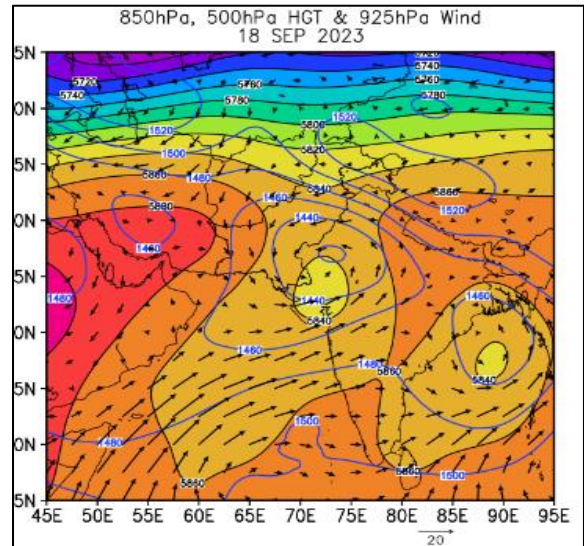
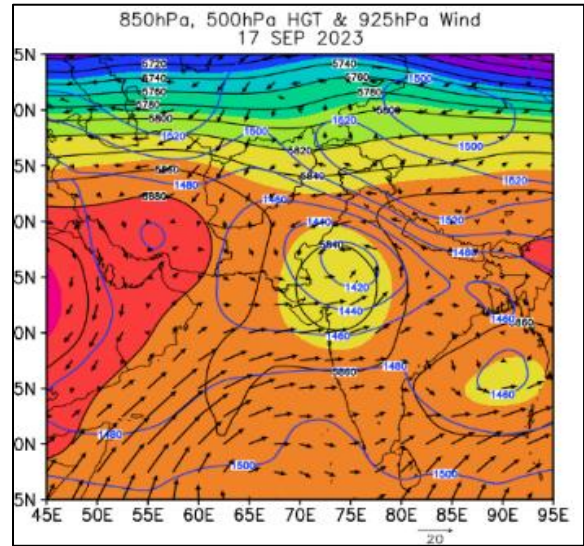
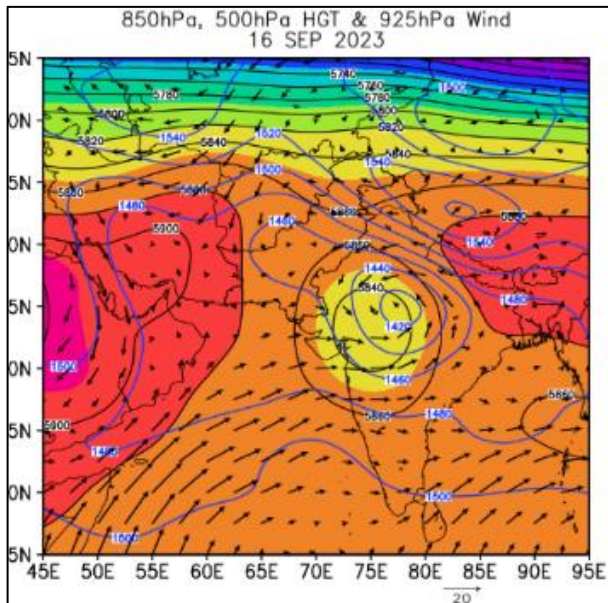


## 7 Significant Hydro-Met events during the month of September-2023

During September remained mainly dry over the most parts of the country. During the month of September, one wet spell was observed. Almost all the rivers remained in the state of their normal flows.

### 7.1 1<sup>st</sup> wet spell of September 2023 (16<sup>th</sup>-20<sup>th</sup>)

This spell remained active for five days. During this event light to moderate rain with heavy falls at isolated places was reported from north & northeast Punjab and Southeast Sindh. No significant rain recorded over rest of the country during the spell. This situation was created by the presence of a westerly wave over north of Pakistan, interacting with the monsoon low over West Rajasthan with necessary moisture available as shown in Fig (30)



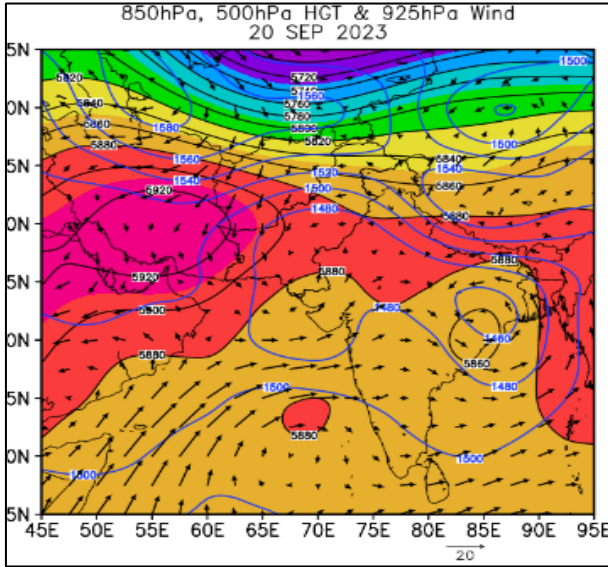


Fig (30) hPa geopotential height & hPa winds map 1<sup>st</sup> spell of Sep

Rainfall distribution during the spell is shown below. The center of maximum rain is located one around Lahore and other over Southeast Sindh.

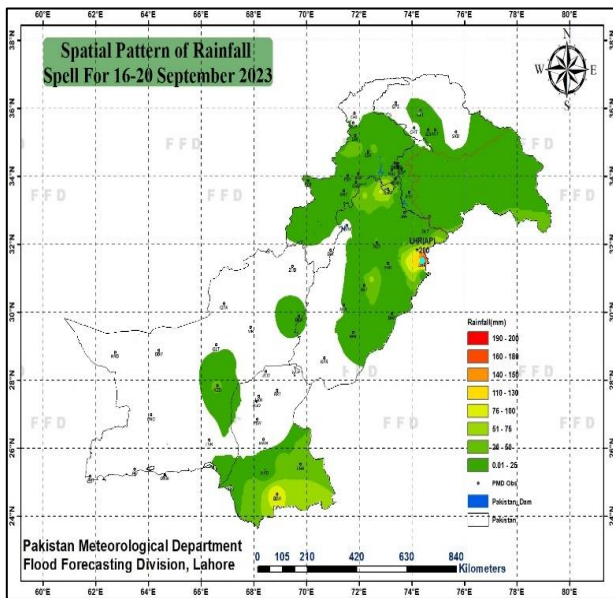
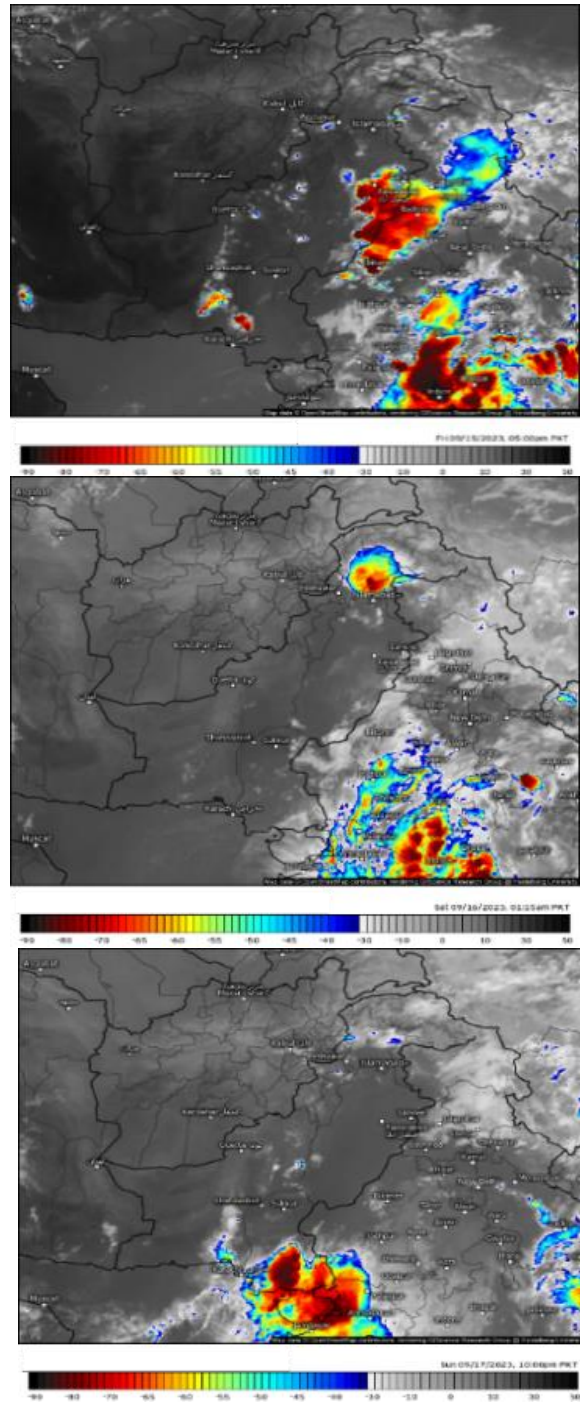


Fig (31) 1<sup>st</sup> Spell total rainfall of September

Position of significant cloud formation during the spell is shown below.



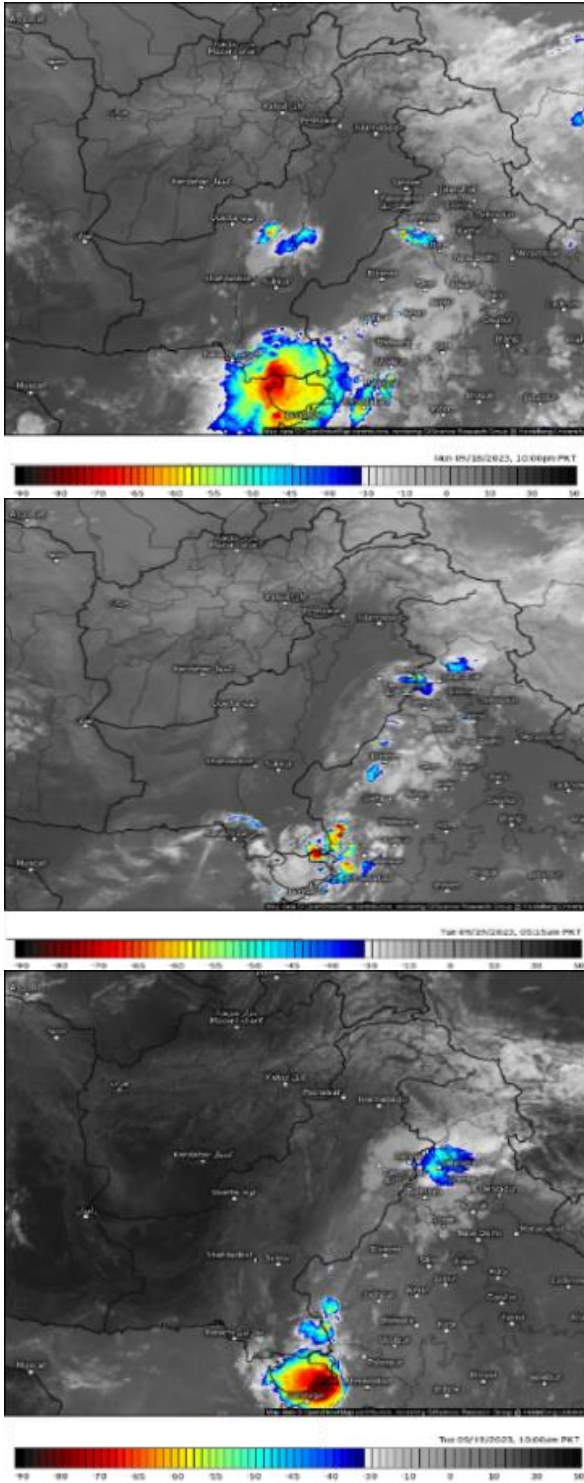


Fig (32) 1<sup>st</sup> Spell of Sep. satellite images

## 7.2 Monthly maps of Total rainfall, Departure and Temporal Distribution Sep-2023

The center of maximum rainfall of more than 300 mm during September is located one around Lahore, second, more than 200 mm around Islamabad and third, more than 100 mm around Badina. Rest of the rainfall distribution can be seen in the Fig (33).

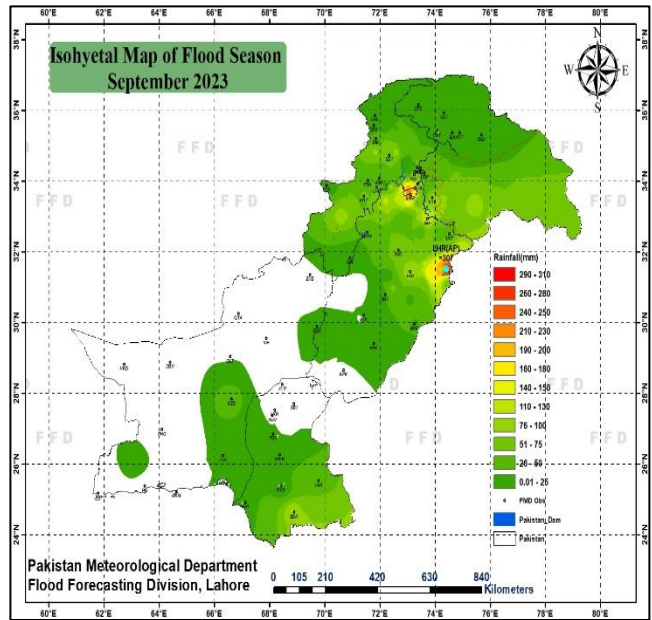


Fig (33) Monthly Total rainfall of September

Fig (34) shows the monthly rainfall temporal distribution during the month of september.

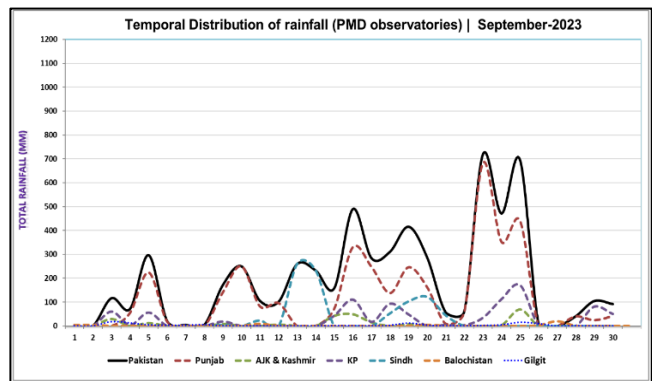


Fig (34) Monthly Total Rainfall temporal Distribution of Sep

Kashmir, upper Sindh and some parts of Balochistan and Khyber Pakhtunkhwa received below normal rainfall. However, north and northeast Punjab, southeast Sindh received above normal rainfalls. The rainfall departures are also depicted in the Fig (35).

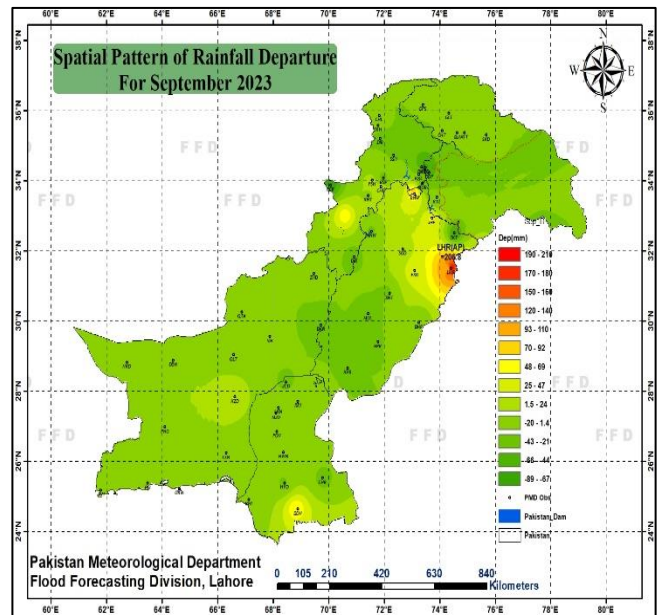


Fig (35) Monthly Total Rainfall Departure of September

### 7.3 Hydrographs & Peaks recorded during the month of September 2023 are as below

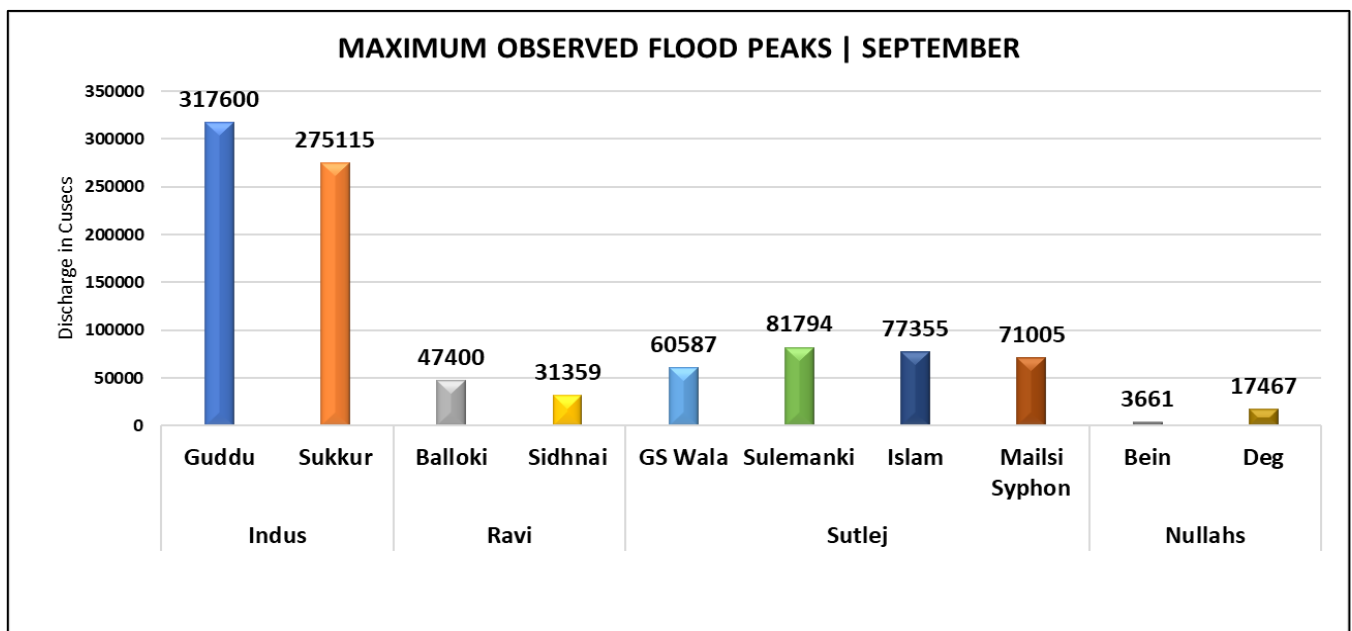


Fig (36) Hydrograph & Maximum peaks recorded during the month of September

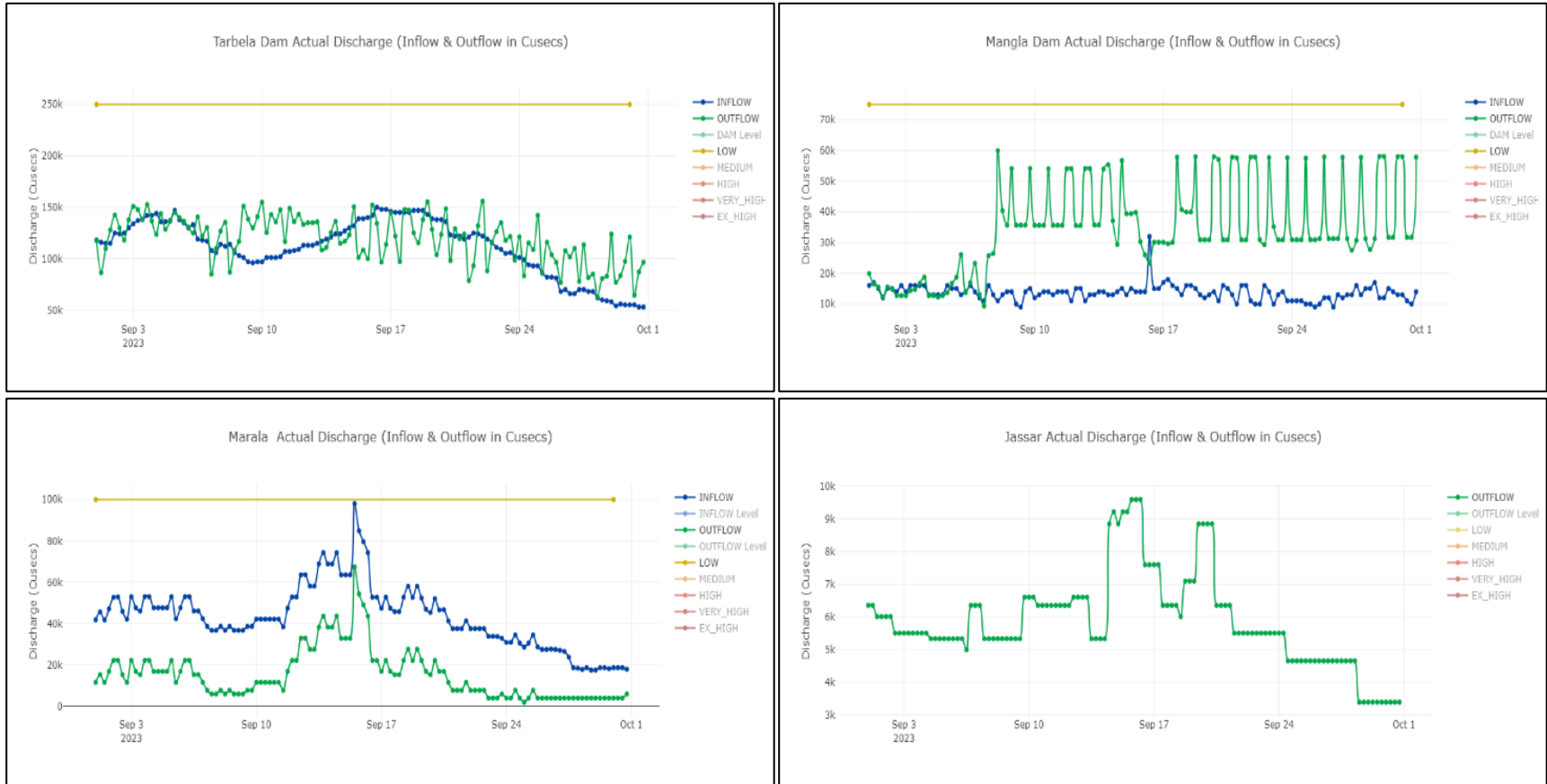


Fig-a (36) Hydrograph & Maximum peaks recorded during the month of September

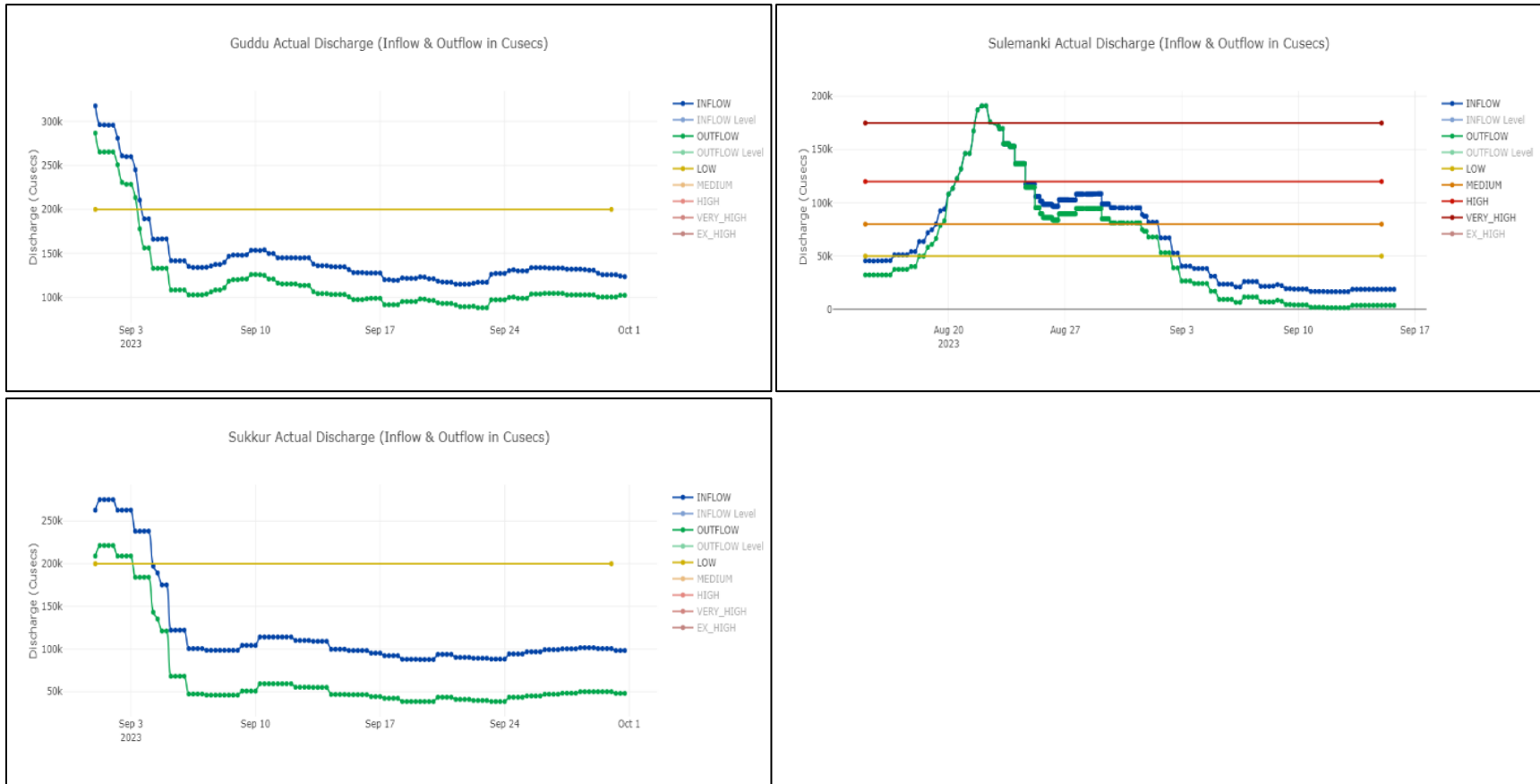
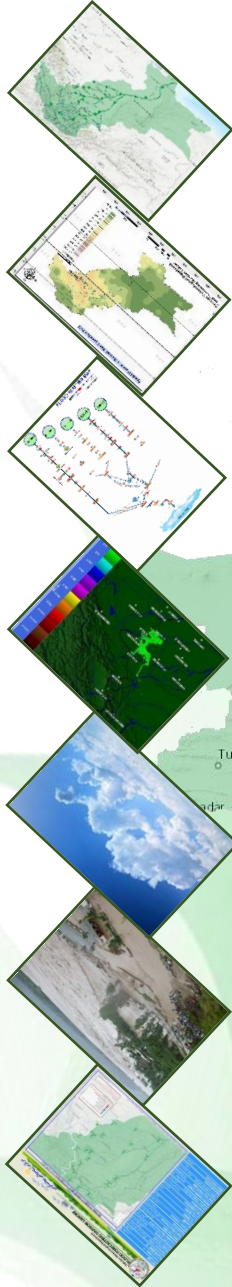


Fig-b (36) Hydrograph & Maximum peaks recorded during the month of September



قلم فور کاسٹنگ ڈویژن لاہور



# SEASONAL

Departure Anomaly, Total Rainfall  
& Area Weighted



## 8 Seasonal rainfall pattern 1<sup>st</sup> Jul-30<sup>th</sup> Sep,2023

Seasonal rainfall distribution during the season is shown in Fig (37). Region of maximum precipitation (around 1100 mm) is located over Lahore in Punjab. Other extreme rainfall of more than 900 mm is located over, Islamabad. Rainfall recorded over rest of the observatories during the season is also shown below.

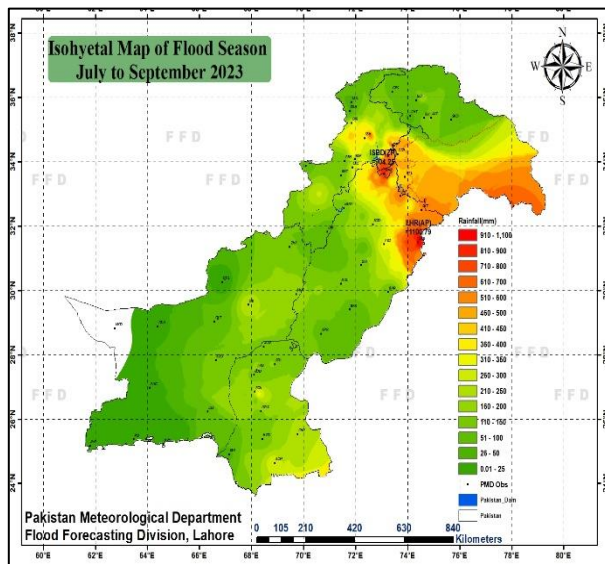


Fig (37) Seasonal total rainfall map of July-Sep-2023.

### 8.1 Departure Anomaly during the Season July-September 2023

Pakistan experienced near-average rainfall during the entire monsoon season, with a +4% deviation from the normal. On a regional scale, Punjab received near-average rainfall (-1%), while Azad Jammu and Kashmir (AJK) (-14%) and Khyber Pakhtunkhwa (KP) (-17%) received below-average rainfall. Sindh (+29%) and Balochistan (+18%) received above-average rainfall, and Gilgit-Baltistan (GB) experienced exceptionally high rainfall, with a 90% increase.

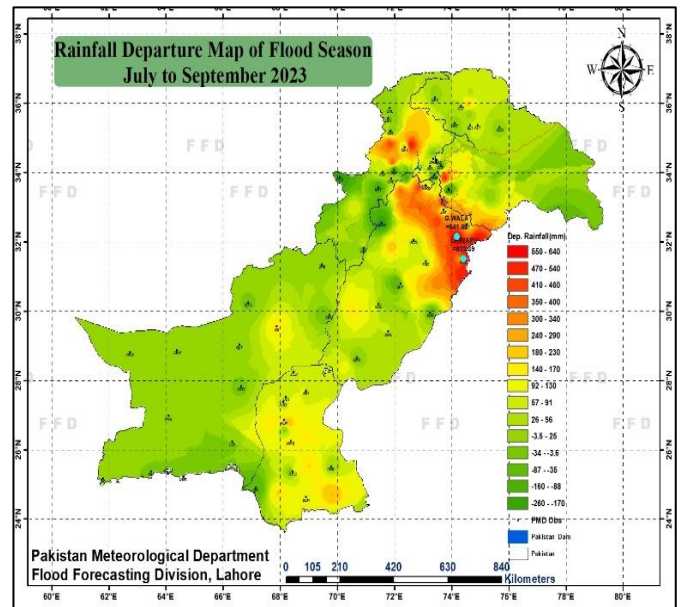


Fig (38) Seasonal Total Rainfall Departure July-Sep-23.

## 8.2 Pakistan Based Temporal Rainfall Distribution ( July-September ) 2023

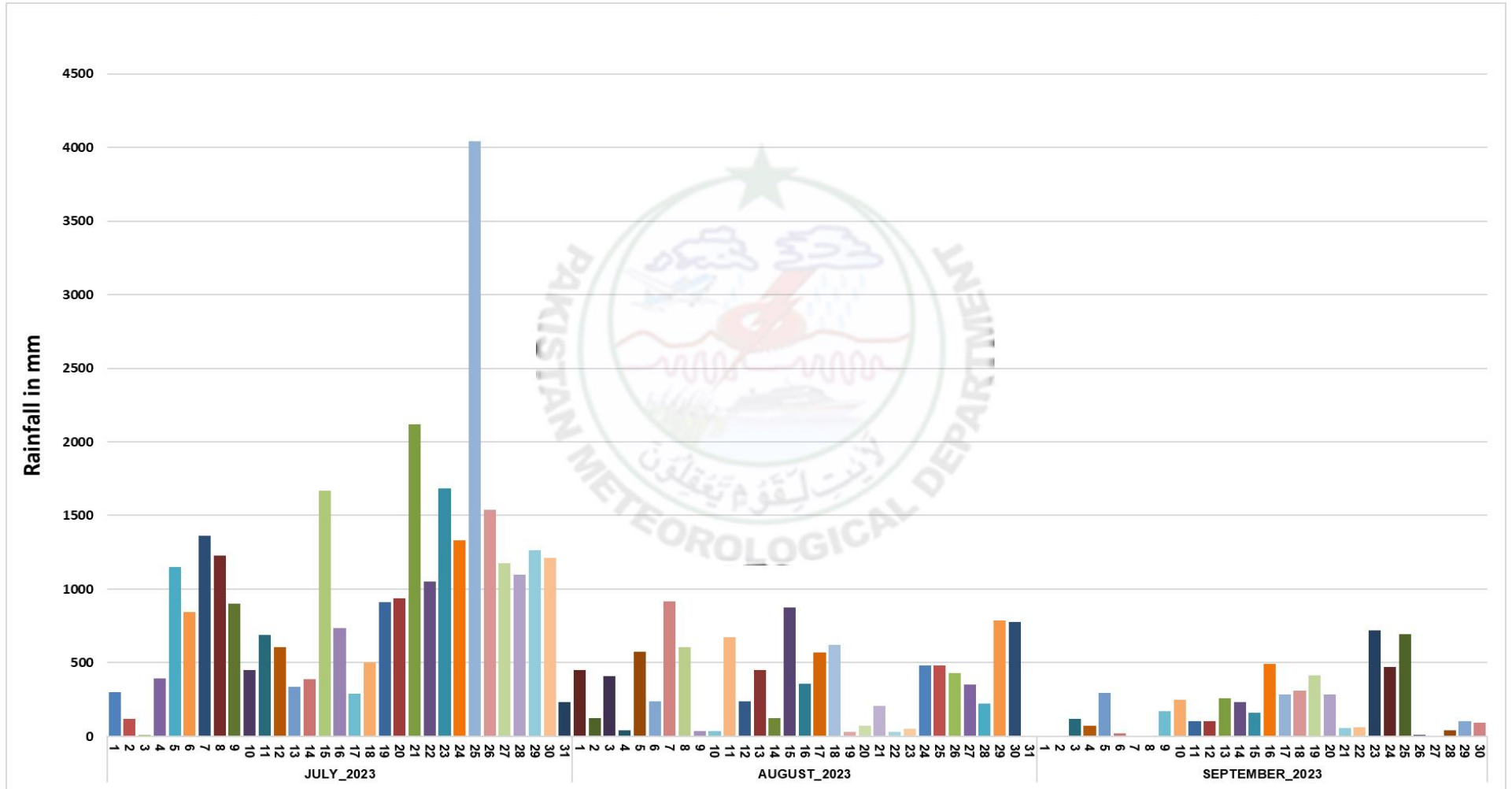


Fig (39) Pakistan Based Temporal Rainfall Distribution ( July-September ) 2023

## 9 Seasonal area weighted precipitation during July-September 2023.

### July 2023:

- National rainfall was excessively above average (+70%) across Pakistan.
- Regions with excessively above-average rainfall included GB (+233%), Sindh (+143%), Balochistan (+111%), and Punjab (+47%).
- AJK (+31%) and KP (+19%) also observed above-average rainfall.

### August 2023:

- National rainfall was excessively below average (-66%).
- Sindh (-98%), Balochistan (-89%), Punjab (-58%), KP (-51%), and AJK (-55%) all recorded excessively below-average rainfall.
- GB was the only region with above-average rainfall (+28%).

### September 2023:

- Rainfall during the month was near average (-7%).
- GB (+1%) and Punjab (+7%) observed near-average rainfall.
- Balochistan (-43%) and AJK (-40%) recorded below-average rainfall.
- Sindh was the only region with above-average rainfall (+25%).

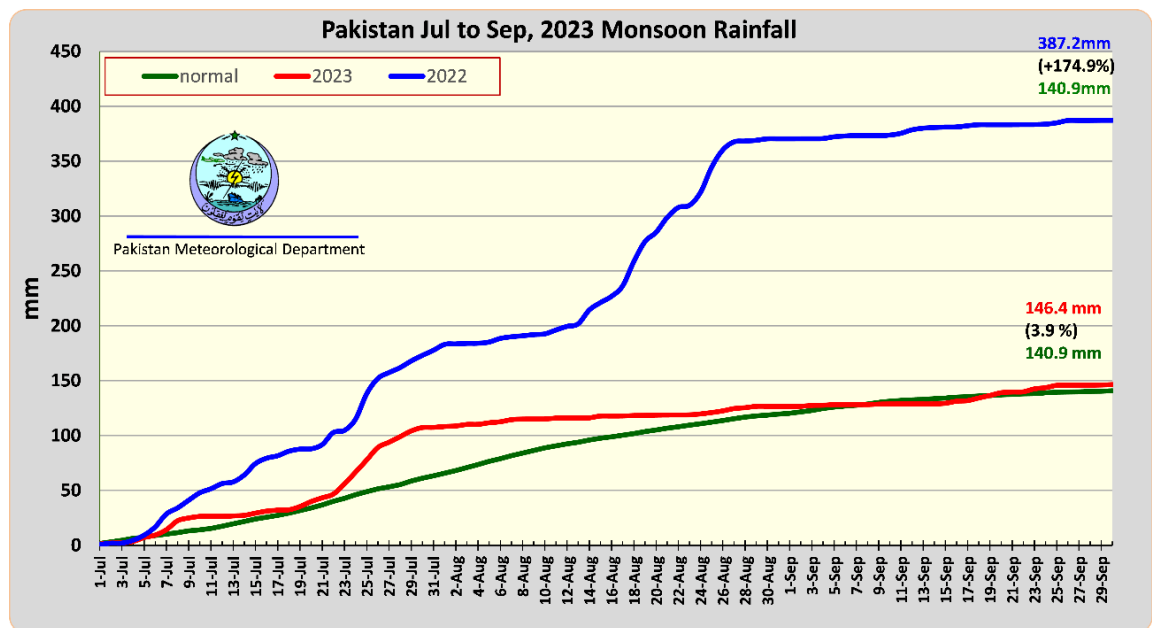
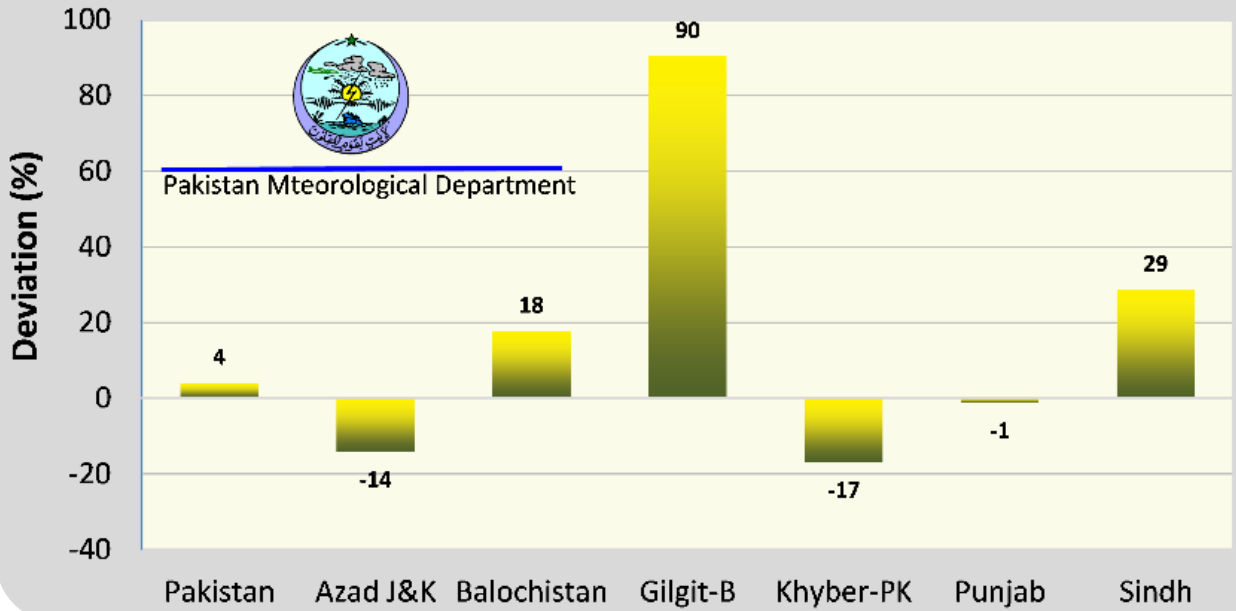


Fig (40) Monsoon July-Sept (JAS) 2023 rainfall.

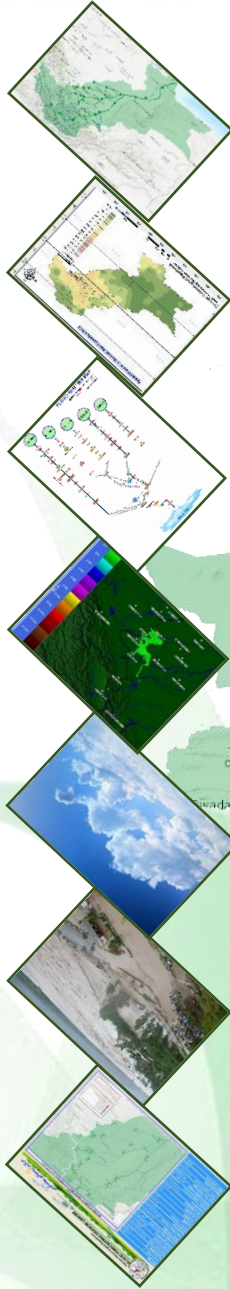
### Pakistan Monsoon Jul to Sep, 2023 Rainfall deviation (%)



### MONSOON 2023 RAINFALL UPDATE

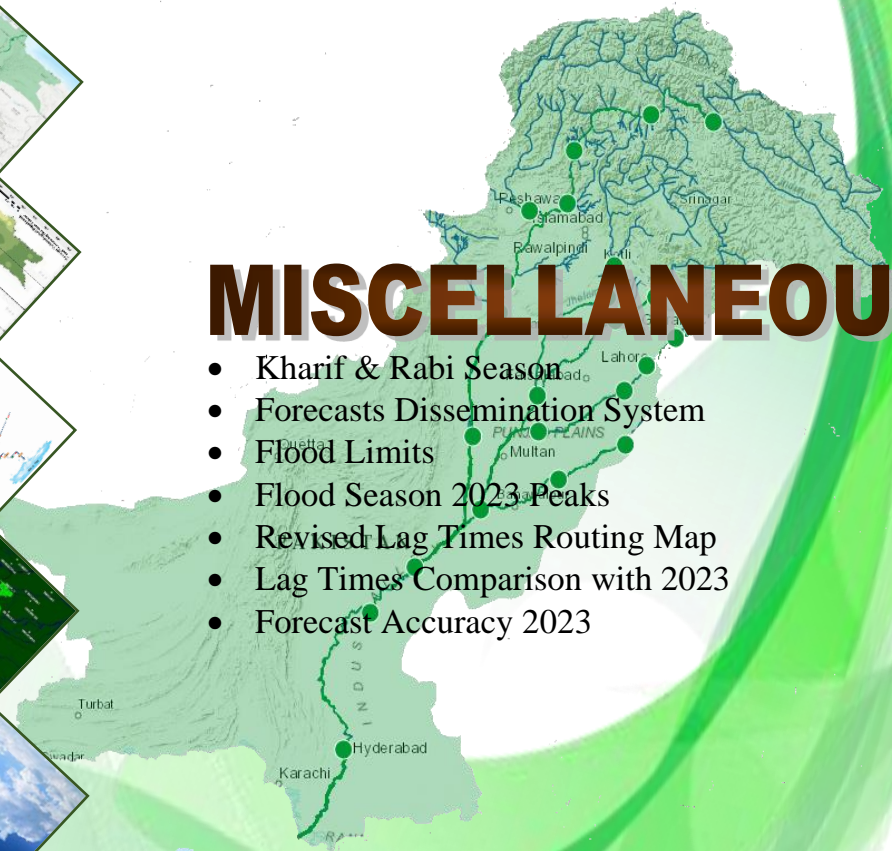
Region	Rainfall (% Deviation)			
	Jul	Aug	Sep	Jul to Sep
Pakistan	70	-66	-7	4
Azad J&K	31	-55	-40	-14
Balochistan	111	-89	-43	18
Gilgit-B	233	28	1	90
Khyber-PK	19	-51	-23	-17
Punjab	47	-58	7	-1
Sindh	143	-98	25	29

Fig-a (40) Monsoon July-Sept (JAS) 2023 rainfall.



# MISCELLANEOUS

- Kharif & Rabi Season
- Forecasts Dissemination System
- Flood Limits
- Flood Season 2023 Peaks
- Revised Lag Times Routing Map
- Lag Times Comparison with 2023
- Forecast Accuracy 2023



## 10 Kharif Season Water Availability (MAF) Forecast.

The water availability (in MAF) forecast on the basis of prevailing hydrometeorological conditions was issued on 29<sup>th</sup> March 2023 for River Indus at Tarbela & for River Jhelum at Mangla. A comparison of forecasted and observed volume (MAF) is shown below.

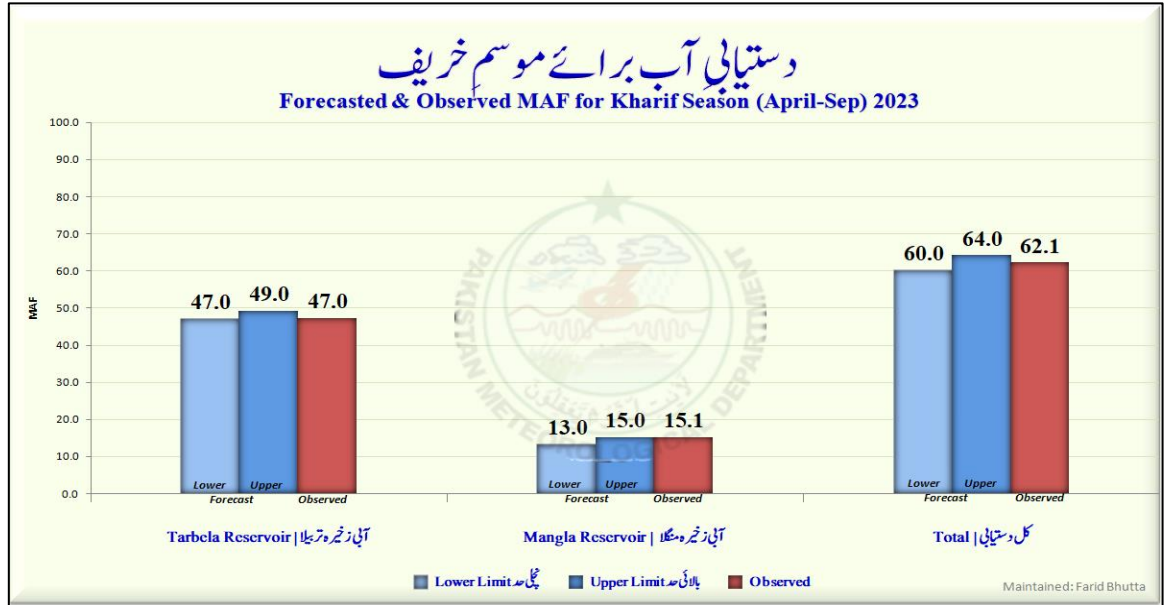


Fig (41) Kharif Season forecasted & Observed MAF (April-Sep-23).

## 11 Rabi Season Water Availability (MAF) Forecast.

Similarly, the water availability forecast for Rabi season was issued on 26<sup>th</sup> September 2023 for River Indus at Tarbela & for River Jhelum at Mangla and is shown below.

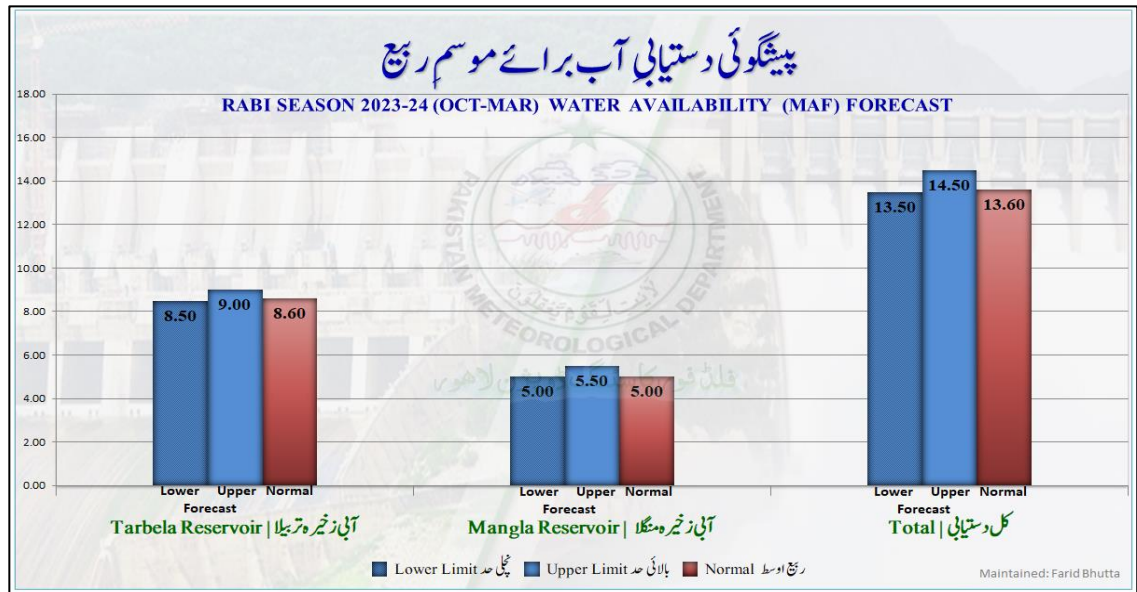
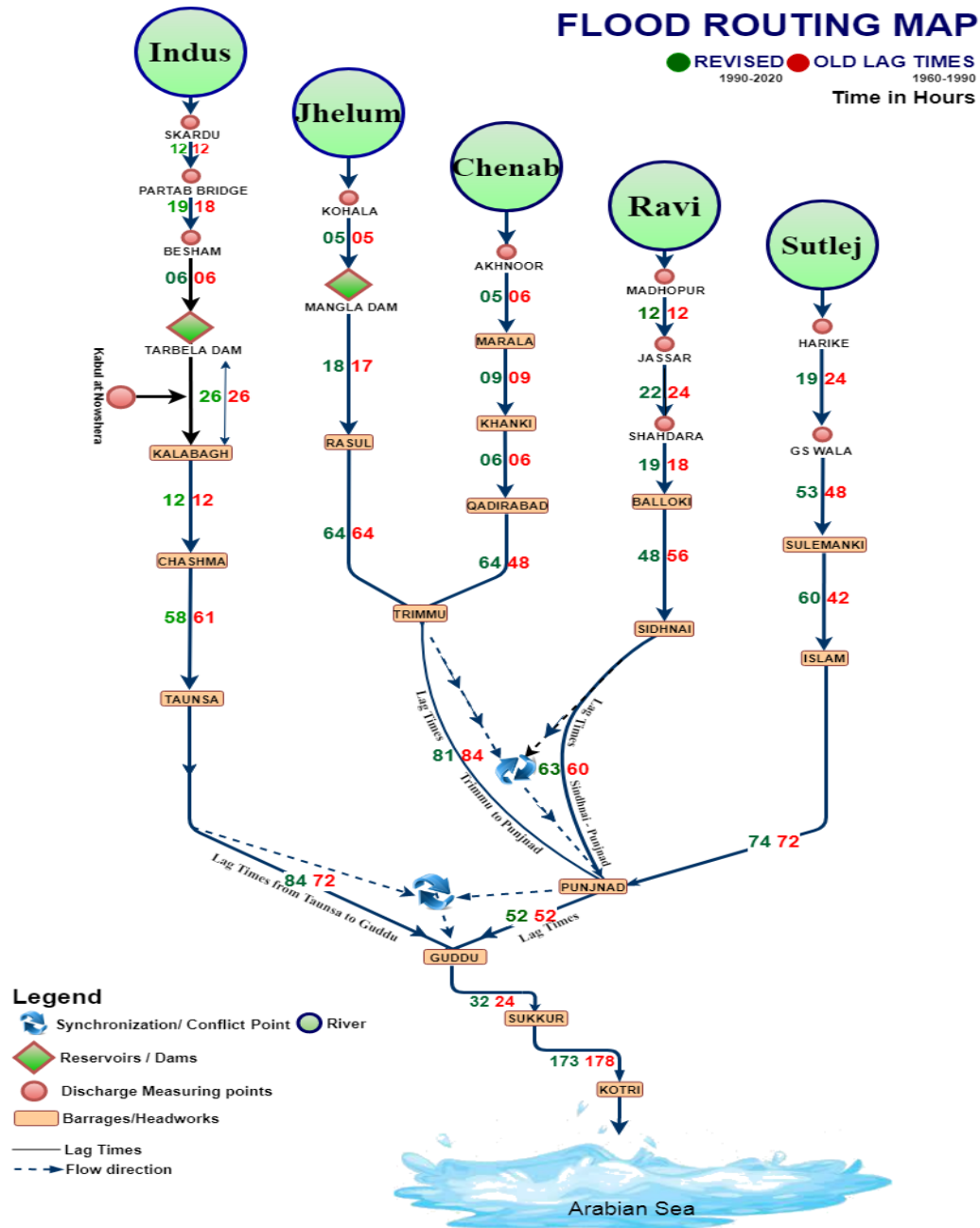


Fig (42) Rabi Season forecast MAF (Oct-2023 to March-2024)

## 12 Revised Lag Times (Maximum Observed Flood Peaks level) | Flood Routing Map



**Chief Met FFD Lahore | Head of team: Sahibzad Khan**  
 Flood Routing Map | Revised Lag Time Team  
 Team member: Akhtar Mahmood, Saqib Hussain, Mamoona, Ghulam Farid

Routing Map designed | Ghulam Farid

Fig (43) Revised lag Times



## 14 Maximum Flood Peaks Discharge (Cusecs) during Flood Season-2023.

Maximum Flood Peaks recorded during Flood Season-2023 is shown below

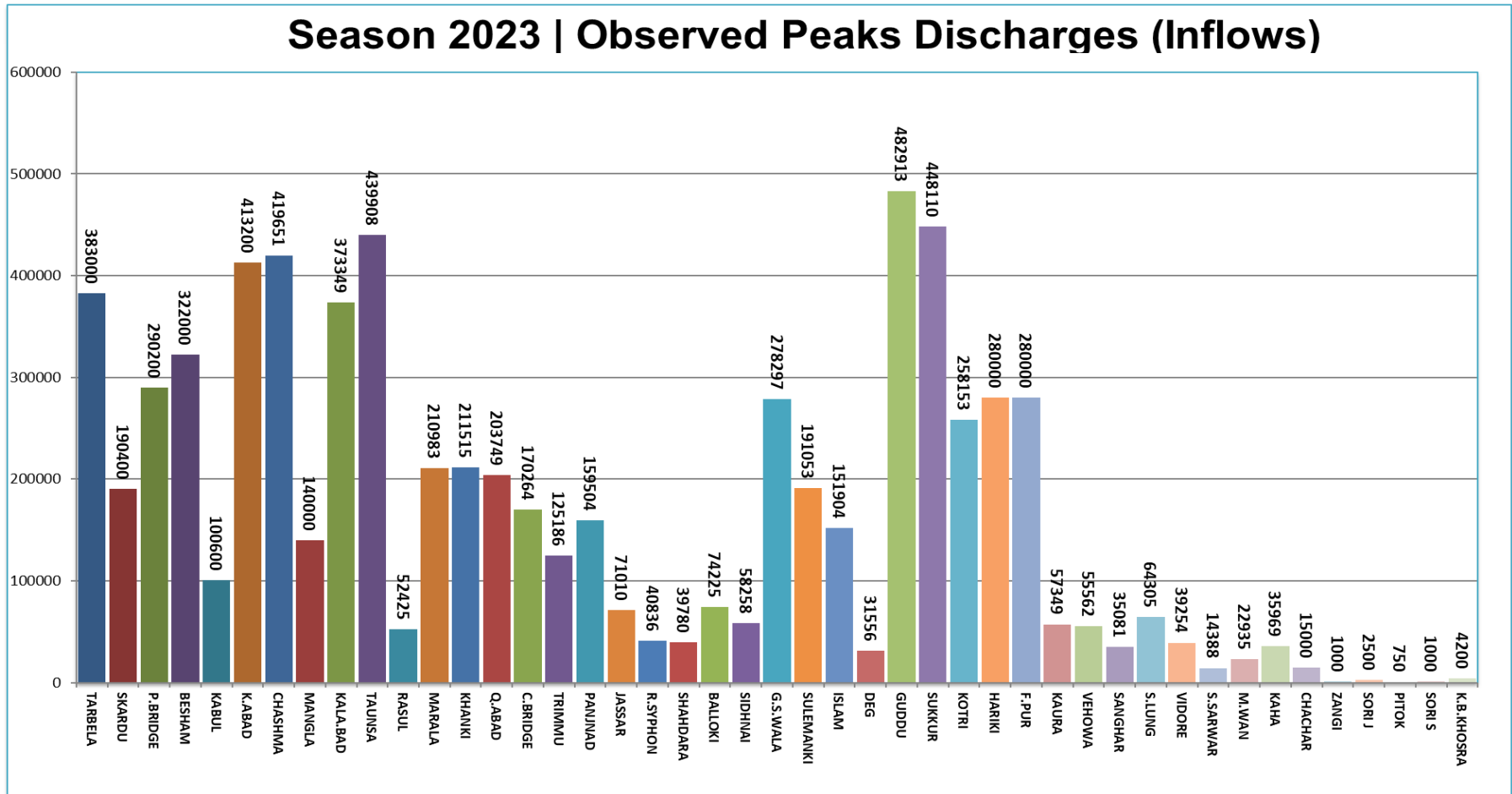


Fig (45) Maximum Observed Peaks 2023

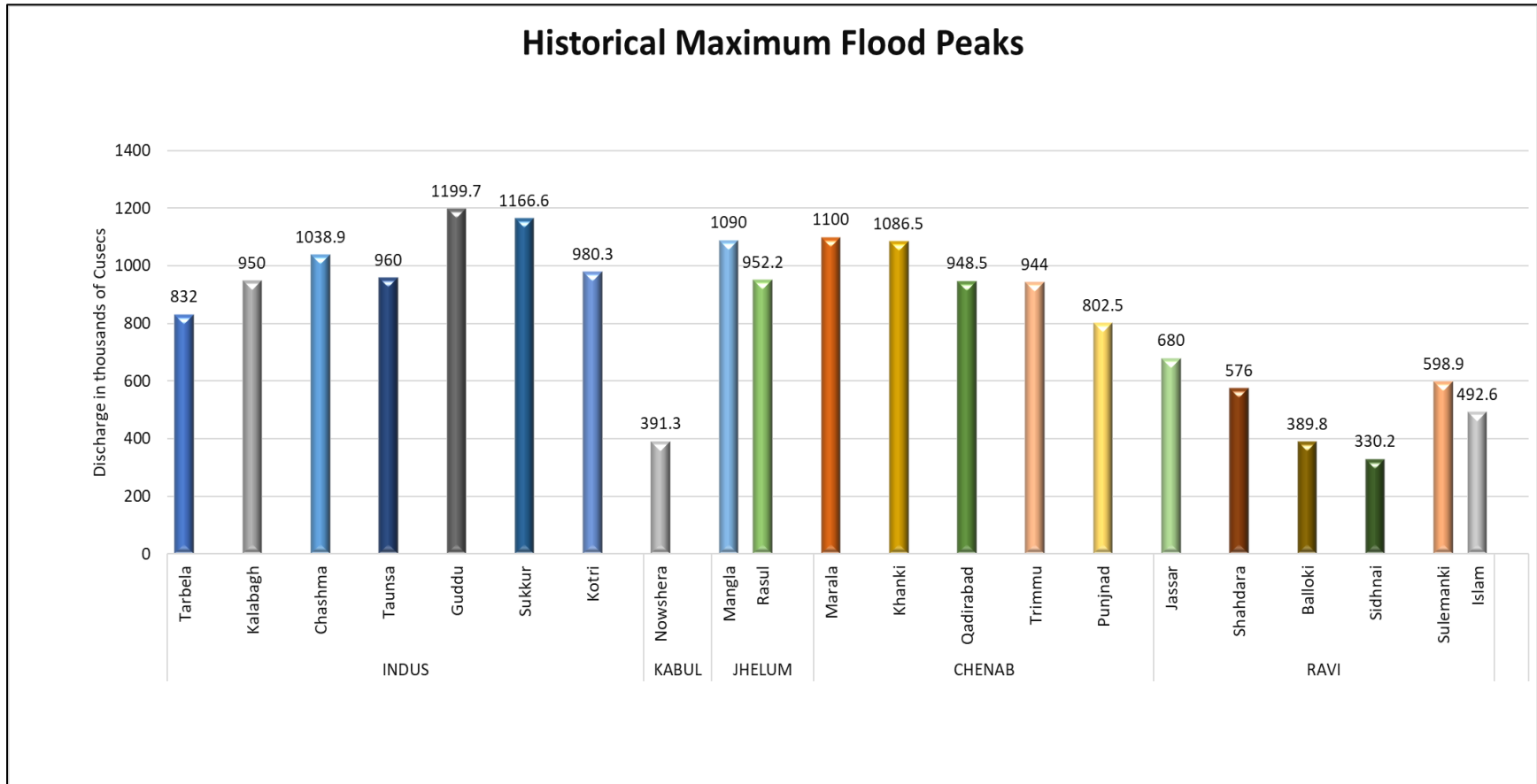


Fig (46) Historical Flood Peaks

15 Flood Forecast Dissemination

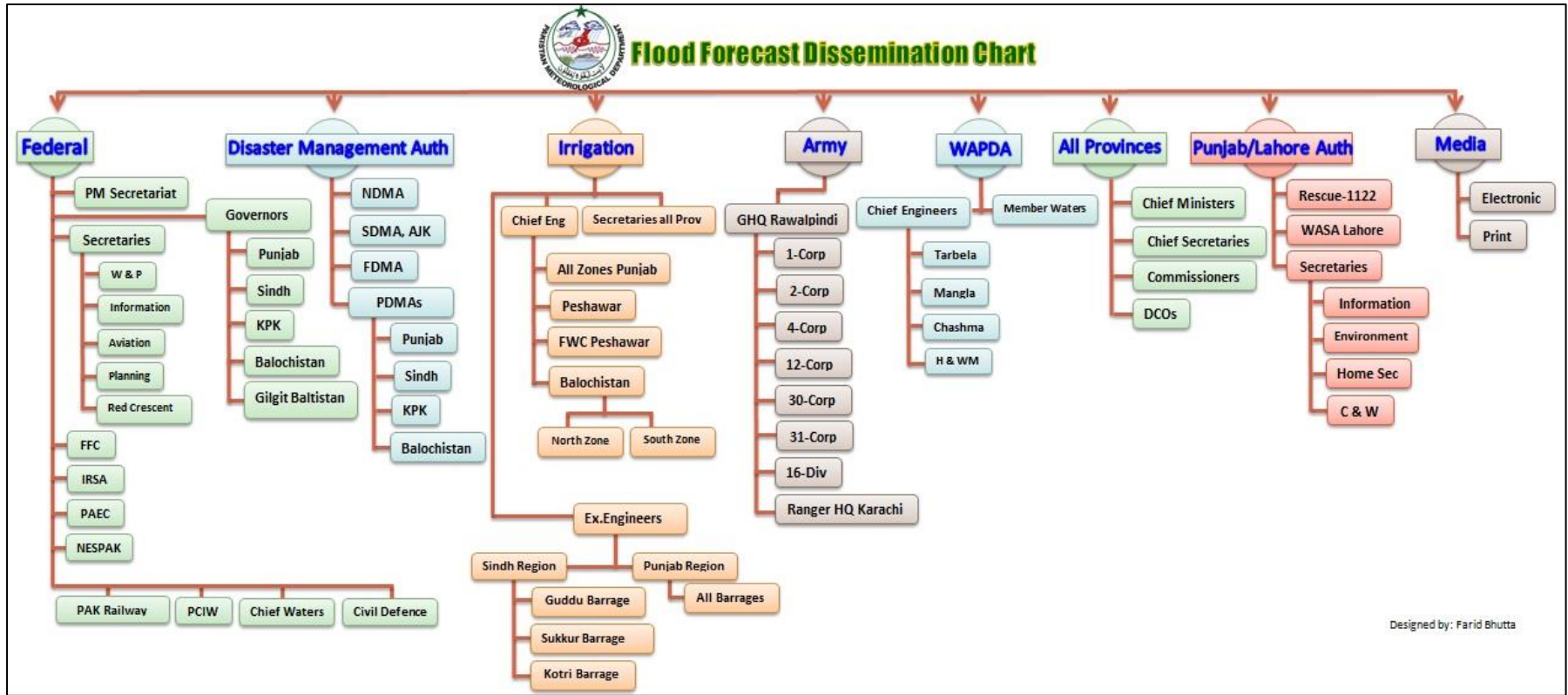


Fig (47) Flood Forecast Dissemination Chart

**16 Flood limits (in thousands of cusecs)**

River	Site	Design Capacity	Low	Med	High	V.high	Ex.high
Kabul	Nowshera	-	0.75	1.0	1.5	2.0	4.5
	Warsak	15.0	0.30	0.45	1.0	2.0	4.0
Indus	Tarbela	15.0	2.5	3.75	5.0	6.5	8.0
	Attock	-	2.5	3.75	5.0	6.5	8.0
	Kalabagh	9.5	2.5	3.75	5.0	6.5	8.0
	Chashma	9.5	2.5	3.75	5.0	6.5	8.0
	Taunsa	10.0	2.5	3.75	5.0	6.5	8.0
	Guddu	12.0	2.0	3.5	5.0	7.0	9.0
	Sukkur	9.0	2.0	3.5	5.0	7.0	9.0
	Kotri	8.5	2.0	3.0	4.5	6.5	8.0
	Jhelum	Kohala	-	1.0	1.5	2.0	3.0
Mangla		10.6	0.75	1.1	1.5	2.25	3.0
Rasul		8.5	0.75	1.1	1.5	2.25	3.0
Chenab	Marala	11.0	1.0	1.5	2.0	4.0	6.0
	Khanki	8.0	1.0	1.5	2.0	4.0	6.0
	Qadirabad	8.07	1.0	1.5	2.0	4.0	6.0
	Trimmu	6.45	1.5	2.0	3.0	4.5	6.0
	Panjnad	7.0	1.5	2.0	3.0	4.5	6.0
Ravi	Jassar	2.75	0.5	0.75	1.0	1.5	2.0
	Ravi syphon	4.5	0.4	0.65	0.9	1.35	1.8
	Shahdra	2.5	0.4	0.65	0.9	1.35	1.8
	Balloki	2.25	0.4	0.65	0.9	1.35	1.8
	Sidhnai	1.5	0.3	0.46	0.6	0.9	1.3
Sutlej	Sulemanki	3.25	0.5	0.8	1.2	1.75	2.25
	Islam	3.0	0.5	0.8	1.2	1.75	2.25

Fig (48) Flood Limits