Pakistan Meteorological Department

Drought Bulletin of Pakistan

April-June 2023

National Drought Monitoring Centre

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Drought Bulletin
April – June, 2023

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Quarterly Drought Bulletin
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By

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1. Introduction

Pakistan has a long latitudinal extent and the rainfall variability during different seasons is considerably high. The climate of the country in its lower southern half is arid and hyper-arid while the northern half of the country lies between semi-arid to very humid. Some regions of the country each season, remain drastically dry and areas are always vulnerable to drought. If subsequent seasons fail to generate significant precipitation, the drought conditions then are sure to take the vulnerable regions in their grip. All the provinces of Pakistan have a history of facing major droughts in the past.

Drought differs from other natural disasters (e.g. floods, tropical cyclones, tornadoes and earthquakes etc.) in the sense that the effects of drought often accumulate slowly over a considerable period of time and may linger for years even after the termination of the event. Because of this drought is often referred to as a "Creeping Phenomena". Drought impacts are less obvious and are spread over large geographical areas than are the damages that result from other natural hazards. Consequently, drought affects more people than any other environmental hazard.

Unfortunately, no organizations dealing with the drought issues exist in Pakistan and the responses to drought for the distressed economic and social sector, whenever such a situation arose, were taken on an emergency and on an adhoc basis. It is thus an inevitable need of the time and Pakistan Meteorological Department (PMD) took an initiative to establish the National Drought/Environment monitoring and Early Warning Centre (NDMC) in 2004-05 after the worst drought during 1999-2001 in Pakistan. The main objective is to monitor the drought situation in the country and issue advisory before time. Its national centre is in Islamabad while four Regional Drought Monitoring Centers (RDMCs) are in Lahore, Karachi, Peshawar and Quetta. These four RDMCs cover those regions which come under their jurisdiction. These Centre's serve as a hub for

the monitoring, collection, consolidation and analysis of drought-related data from all the possible sources in the country. To strengthen the network, 50 Automatic weather stations (AWS) have been installed in different regions, particularly the drought-prone areas of the country. The data of eleven meteorological parameters i.e. air temperature, humidity, wind speed, wind direction, dew point, sea level pressure, station level pressure, solar radiations, soil moisture at standard depths (5, 10, 20, 50,100) cm and snow level are transmitted through satellite and GPRS technology after 3 hours. So, it has now become easy to access the data of remote areas of the country. NDMC has installed 335 Ordinary Rain-gauges at the district level in four provinces as shown in figure-1.

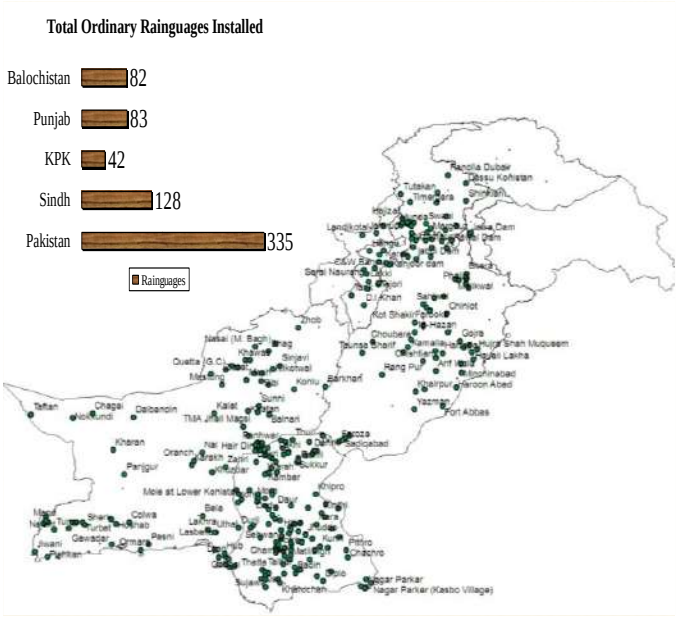


Figure-1 Rain-gauges Network of Pakistan by NDMC

NDMC is monitoring the water level situation of small dams also in Barani areas of the country. NDMC uses different indices like Standardized Precipitation Index (SPI), Normalized difference Vegetation Index (NDVI), Cumulative Precipitation Anomaly (CPA), Rainfall Anomaly Index (RAI), Percent of normal, Probability of occurrence, Percentage departure and soil moisture analysis etc to monitor drought. NDMC issues a fortnightly drought bulletin of the country. Negotiations are underway with NGOs and the National Disaster Management Authority (NDMA) for the utilization of drought advisories/bulletins to end users.

2. Historical Background

The Indian sub-continent is predominantly characterized by a tropical monsoon climate and the entire regime is distinguished mainly by the differences in rainfall both in quantity and distribution. The most important feature is the regional and temporal alteration of atmospheric

flow patterns associated with the monsoon. Two rainfall systems are operating in the region (a) Southwest or Summer monsoon and (b) Northeast or the Winter monsoon.

Fortunately, Pakistan also falls in this region which receives a heavy amount of rainfall in summer due to SW monsoon and in winter due to western disturbances. The summer monsoon accounts for 70 to 80% of the annual rainfall over major parts of South Asia (IMD, 2009). In Pakistan, the summer monsoon accounts for 45% of the annual rainfall from July to September (Adnan et al., 2017). There is a large variability in the monsoon rainfall on both space and time scales.

Droughts in the Pakistan region are mainly due to failures of rains from the southwest monsoon. Also, there seems to be some association between El Nino and La Nina events and weak monsoons. Pakistan frequently experiences droughts in southern parts of the country. The study conducted at the National Drought Monitoring Centre (NDMC) of PMD revealed that the province of Sindh and Balochistan are more vulnerable to drought. In the long-term data analysis of the past sixty years (1951-2010) different intensity (mild to extreme) of the drought was experienced in the country i.e. 31 in Sindh,23 in Balochistan,22 in Punjab and 18 in Khyber Pakhtunkhwa. The longest episode of the drought was experienced during 1999-2002.The Punjab province experienced the worst droughts in 1899, 1920 and 1935,1969,1987-88, 2000-01, Khyber Pakhtunkhwa (KPK) experienced the worst droughts in 1902 and 1951-1952,1970-71,1987-88,1999-2001, Sindh had its worst droughts in 1871, 1881,1899,1931,1947,1951-52,1958,1966,1969,1972-74, 1987-88, 1999-2001, 2003-04, 2018 and 2021 while Balochistan had 1952,1963-64, 1965, 1968, 1970-71, 1983-84, 1987-88, 1999-2002, 2004, 2006, 2018 and 2021.

Due to climate change, some years we receive more rain in wet spells and in dry spells we receive less rain. Due to less rain, we have drought and heavy rain we have floods (flash floods, urban floods, coastal floods and river floods).

3. Rainfall Distribution (April–June) 2023

During the second quarter of the year (April-June) 2023, well above normal (85.46%) precipitation was observed over Pakistan. During the quarter high temporal and spatial variability in precipitation was observed. Normally May and June are the hottest months in the country, whereas northern areas and southwestern parts received very less amount of rainfall. However, some convection rainfall lessened the moisture stress in the country along with some gusty winds. The evaporation rate remained very high during this quarter. But during this quarter, the amount of rainfall was well above normal as predicted by the Pakistan Meteorological Department in the seasonal forecast. In April 2023, normal to near normal (7.7%) rainfall was received in Pakistan. It

was very much above normal (226.1%) in Sindh and above normal in Punjab (32.2%) where in Balochistan (-0.7%), Khyber Pakhtunkhwa (-3.5%), Gilgit-Baltistan and Azad Jammu Kashmir (-19.5%). Well above normal (117.3%) rainfall was received in the country during May 2023. It was above normal in Balochistan (184.4%), Sindh (160.3%), Gilgit-Baltistan and Azad Jammu and Kashmir (-17.1%), very much above normal in Punjab (257.7%) and Khyber Pakhtunkhwa (50.6%).

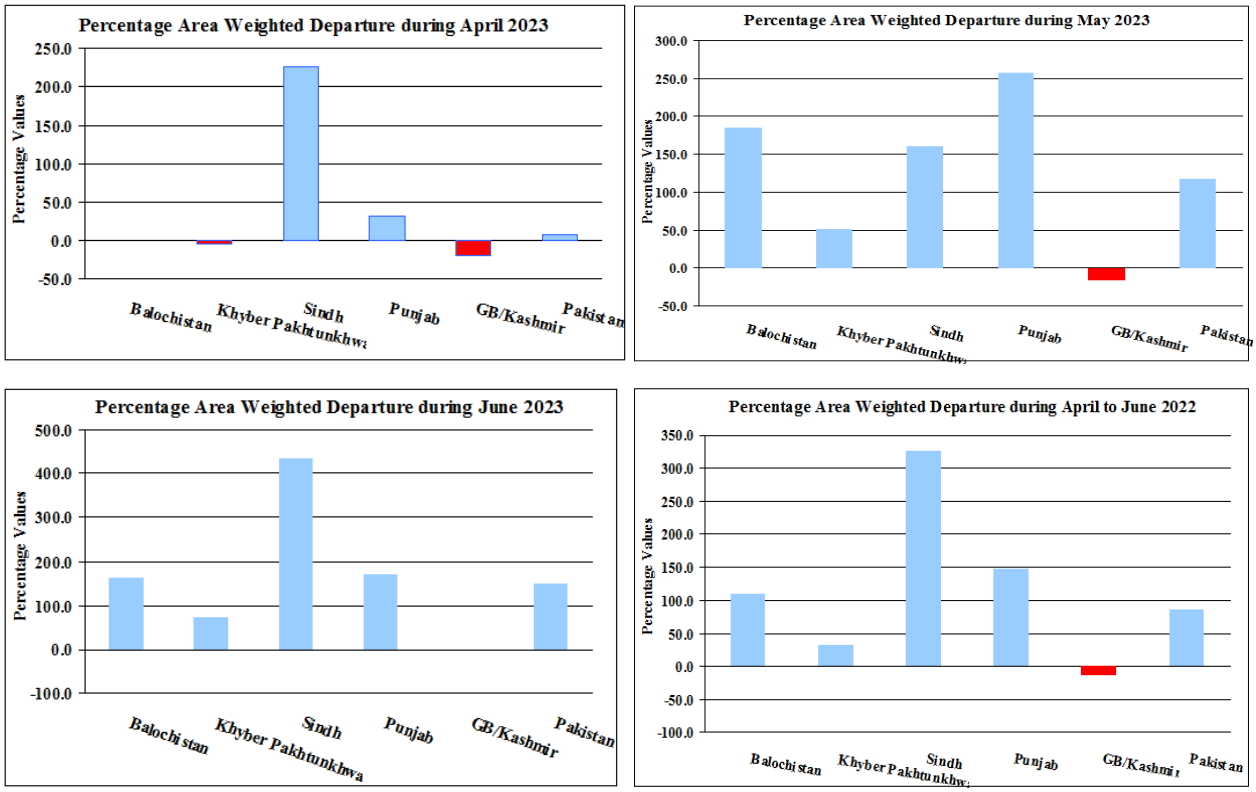


Figure-2 percentage departure of rainfall during (April-June) 2023

In June 2023, the amount of rainfall was well above normal (148.7%) in the country. However, the rainfall was well above normal in Punjab (170.9%), above normal in Khyber Pakhtunkhwa (73.3%), Balochistan (160.7%) and above normal in Gilgit-Baltistan and Azad Jammu and Kashmir (-2.5%) whereas very much above normal in Sindh (433.3%). The figure-2 shows the percentage area weighed departure rainfall that occurred during (April-June) 2023 for the whole region of Pakistan in which the country received above normal (85.46%) rainfall during this quarter. Viewing the rainfall distribution on province basis, below normal rainfall was received over Gilgit-Baltistan and Azad Jammu and Kashmir (-14.82%), Normal in Khyber Pakhtunkhwa (30.41%) and notable above normal in Sindh (325.59%) and in Balochistan (108.89%) and in

Punjab (146.17%). The rainfall was well as shown in figure-2. The spatial distribution of monthly and quarterly rainfall is shown below in figure-3.

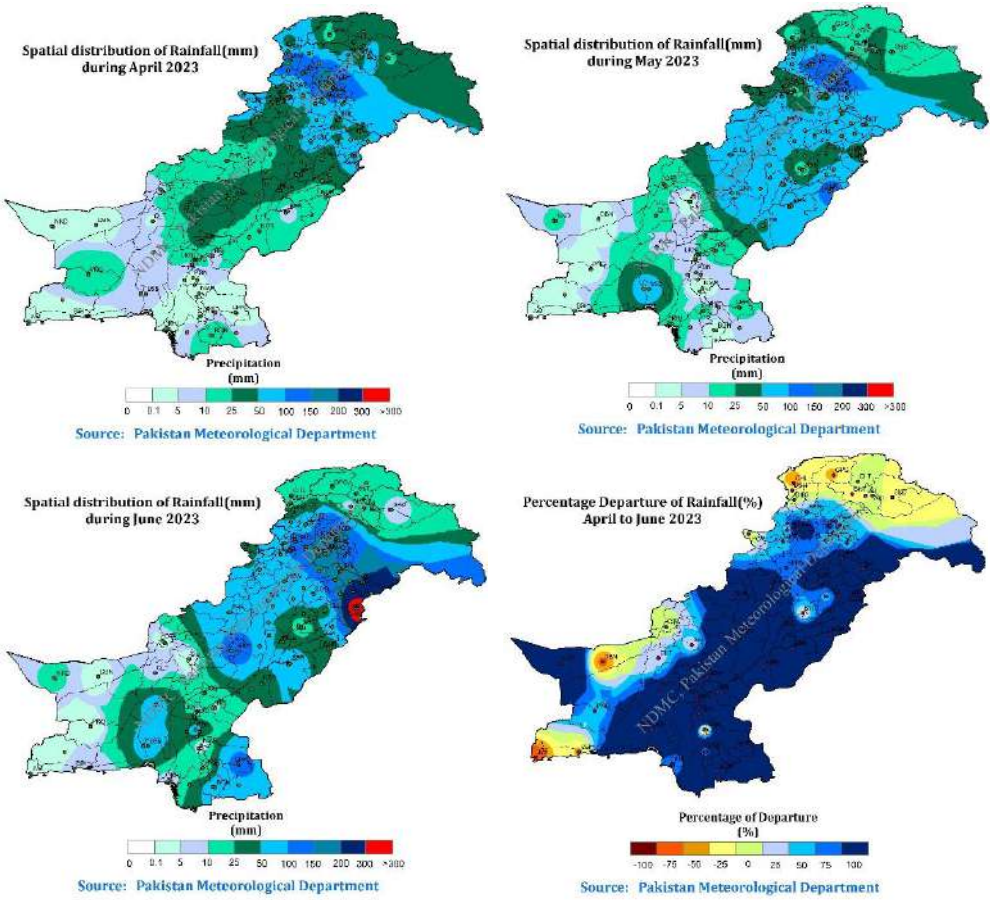


Figure-3 spatial distribution of rainfall during (April-June) 2023 in Pakistan

- **<u>Maximum length of dry Spell</u>**

  A dry spell is defined as when the amount of rainfall is less than 1.0mm over an area.

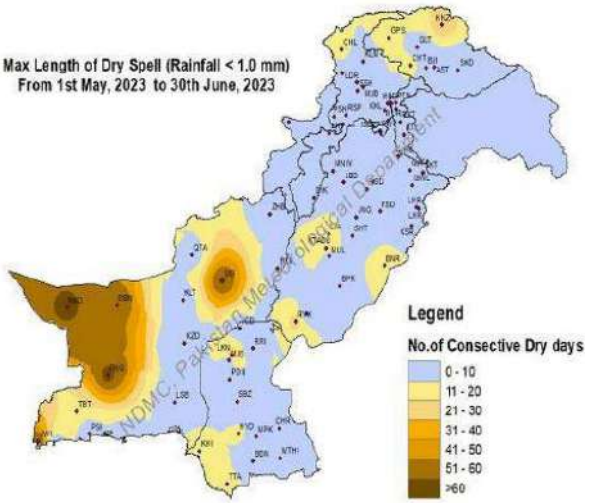


Figure-3b spatial distribution of maximum length of the dry spell

- **Monthly Highest Rainfall**

i. April 2023

Chief amounts of monthly rainfall recorded across Pakistan during April 2023					
Sr.No.	Station	Rainfall(mm)	Sr.No.	Station	Rainfall(mm)
1	Dhulli Talagang	202.2	11	Rawalakot	135.8
2	Dir	191	12	Garhi Dupatta	133.4
3	Kalam	186.2	13	Muzaffarabad Airport	133.01
4	Kakul	184	14	Pattan	133
5	Balakot	162	15	Bandi Abbaspur	119.4
6	Malam Jabba	161	16	Saidu Sharif	110
7	Haraman	154.6	17	Lakshmi-Lahore	106.02
8	Chattar Kalas	152.9	18	Buner	106
9	Gari Dopatta	149.9	19	Astore	97.4
10	Murree	140	20	Zain Sanghar Nullah	97.4

ii. May 2023

Chief amounts of monthly rainfall recorded across Pakistan during May 2023					
S. No.	**Stations**	**Rainfall (mm)**	**S. No.**	**Stations**	**Rainfall (mm)**
1	ChattarKalas-AJK	185.8	11	Bahawalnagar	125.03
2	Malamjabba	185	12	Murree	117.01
3	Kakul	163	13	Fort Munro	115.8
4	Haraman	161.7	14	Pashat-Bajaur	111.6
5	Hafizabad	152.8	15	Garhidopatta	110.7
6	BandiAbbaspur	139.5	16	Ghalanai	105.8
7	Rawalakot	131.6	17	Sialkot Airport	99.52
8	Muzaffarabad Airport	130.9	18	Barkhan	96
9	saidu Sharif	130	19	Chungi No.9-Multan	93.01
10	Balakot	126	20	Lower Dir	92

iii. June 2023

Chief amounts of monthly rainfall recorded across Pakistan during June 2023					
S. No.	**Stations**	**Rainfall (mm)**	**S. No.**	**Stations**	**Rainfall (mm)**
1	Qurtaba Chowk-Lahore	488.03	11	Shahdara-Lahore	189.53
2	Lahore, Airport	392.52	12	Shamsabad-Rawalpindi	181
3	Rawalakot	233.5	13	Narowal	178
4	Murree	213.51	14	Chaklala Airbase	174.03
5	Barnala	209.6	15	Garidopatta	172.2
6	Mithi	209.01	16	Islamabad Z.P	166.4
7	Kakul	206.01	17	Garhi Dupatta	162.4
8	Islamabad, Airport	199.51	18	Mangla	158.4
9	Sialkot Cantt	199.12	19	Attock	150.5
10	Jhelum	190.13	20	Muzaffarabad Airport	147.11

4. Drought products

i. Standardized Precipitation Index (SPI)

The Standardized Precipitation Index (SPI) was developed to define and monitor drought (McKee *et al*., 1993). The SPI calculation for any location is based on a series of accumulated precipitation for a fixed time scale of interest (i.e. 1, 3, 6, 9, 12, months). Positive SPI values indicate greater than median precipitation, and negative values indicate less than median precipitation. Because the SPI is normalized, wetter and drier climates can be represented in the same way, and wet periods can also be monitored using the SPI. Here we are including one seasonal map that show the drought conditions in the country.

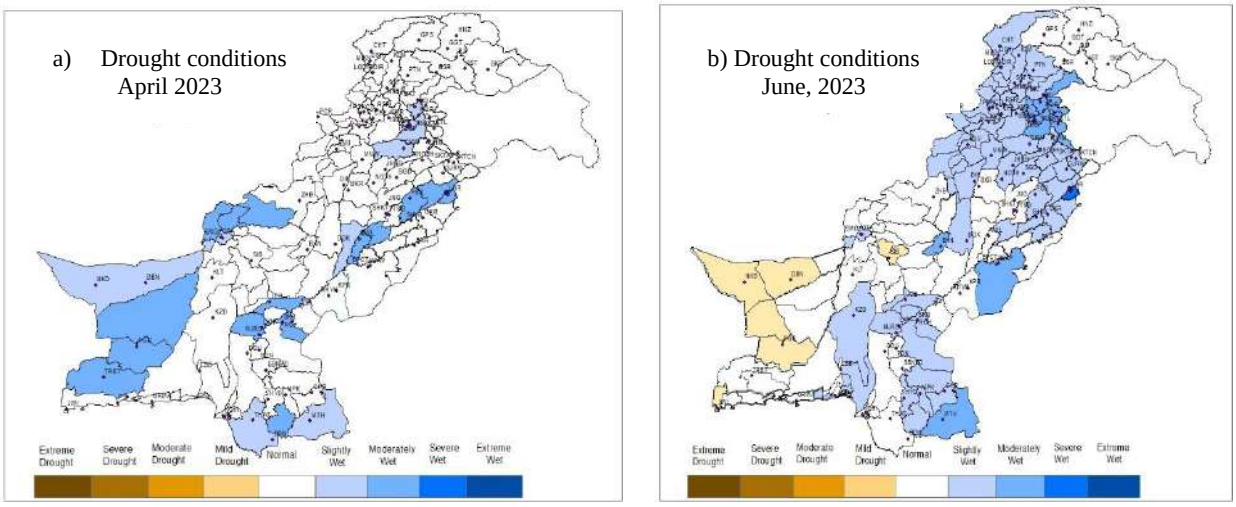


Figure-4 Drought conditions of Pakistan

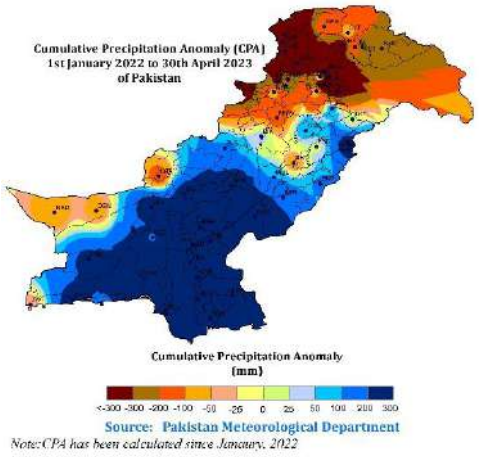
Due to monsoon rainfall, Drought conditions have become less in southwestern parts of Balochistan. Moreover, appreciable amounts of rainfall have been recorded over the agricultural plains of the country, therefore the water requirement is satisfactory.

ii. Cumulative Precipitation Anomaly (CPA)

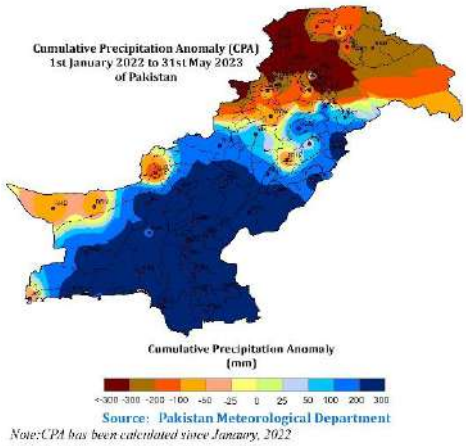
Rain bearing systems remained active over auring the quarter (April to June) in Pakistan.. From April to June 2023, it was observed that the Cumulative Precipitation Anomaly was negative in Upper KP and West Balochistan regions. Even the daytime temperature and evapotranspiration were higher as compared to the previous quarter yet the conditions are satisfactory, however, moisture stress has been observed especially in western Balochistan, KP and some areas of Punjab and Gilgit Baltistan.

The Upper and eastern parts of Punjab and Sindh will be mainly influenced by upcoming monsoon and the frequency of precipitation days and extreme events would be greater in these areas as compared to other parts of the country.

(a)



(b)



(c)

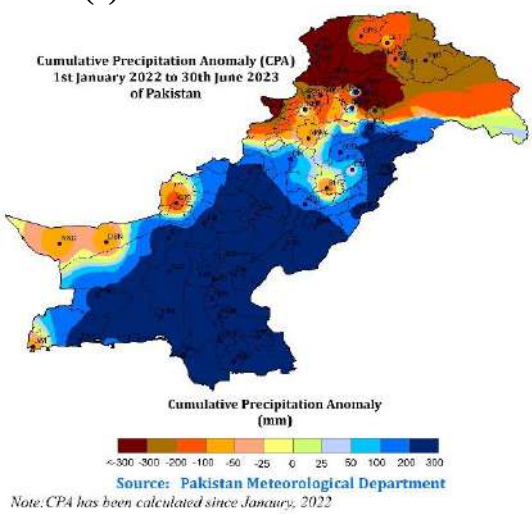
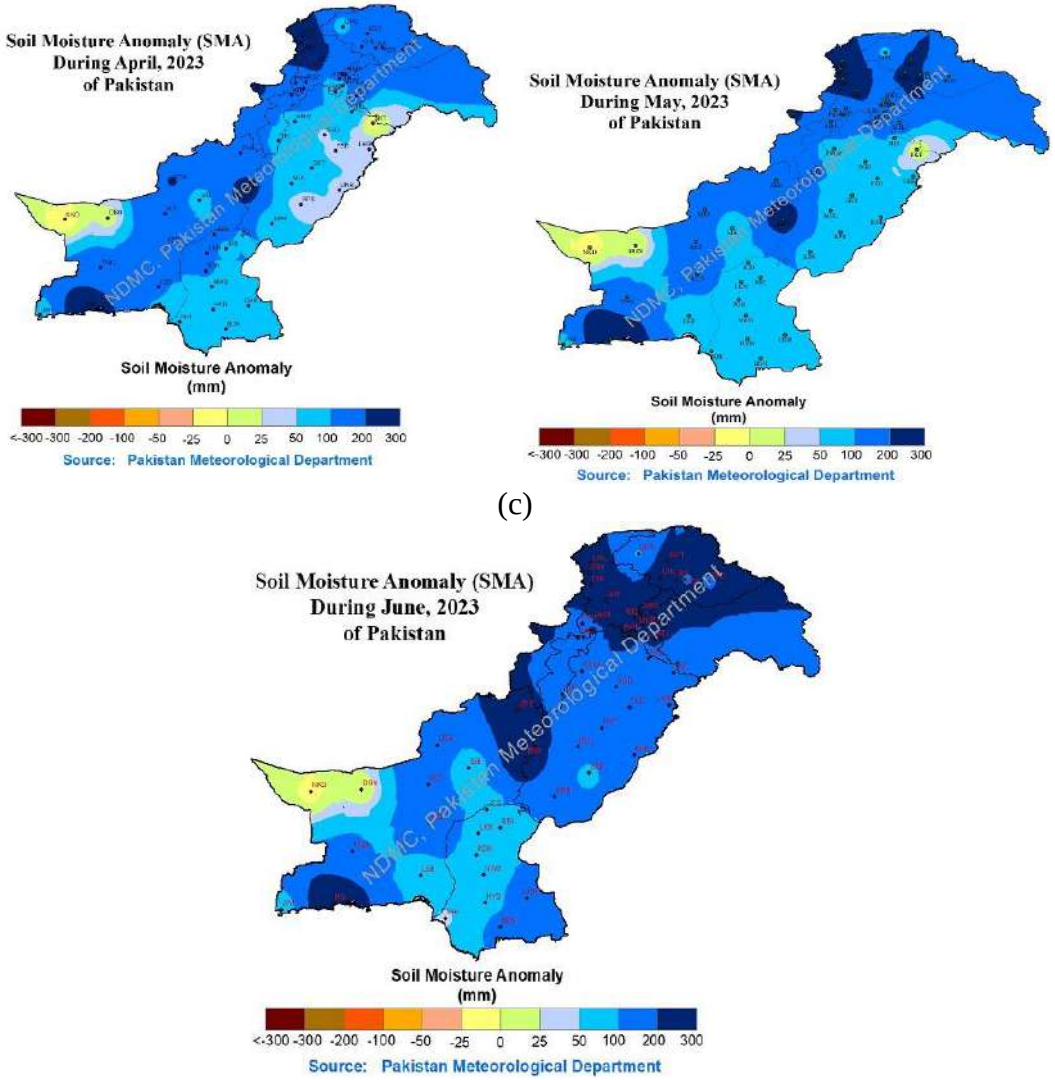


Figure-5 Cumulative precipitation anomaly during (April-June) 2023 in Pakistan

iii. Soil Moisture Anomaly (SMA)

It was observed that the amount of rainfall from April-June was above normal which improved the soil moisture conditions in the country as shown in Figure 5. Soil moisture conditions are near normal. Above-normal rainfall during April-June 2023 provided significant relief to soil moisture stress and conditions are back to normal in most of the southern parts of Pakistan. It is predicted that above normal monsoon rainfall in 2023 is expected in the country, especially in the northeastern and southeastern parts.

(a) (b)



(c)

Figure-6 soil moisture anomaly during (April-June) 2023 in Pakistan

iv. Water Level of Reservoirs

Pakistan has two main reservoirs of water in the form of dams i.e. Tarbela and Mangla. The dead level of Tarbela is 1402 feet while the maximum conservation level is 1550 feet whereas Mangla has a dead level of 1050 feet and a maximum conservation level of 1242 feet. Pre-monsoon rains, along with the snow melting play an important role in the water levels of dams. In addition, small dams in various parts of the country were also filled that would help boost agriculture and improve socio-economic activities in the country. The water level (%) of the and Tarbela dam is above average whereas Mangla is slightly below the average value, especially in May and June. However, the dam's situation will be increased and significantly improved due to the incursion of

the monsoon season during July. The percentage of average water level from April to June 2023 calculated for both dams is shown below in figure -7.

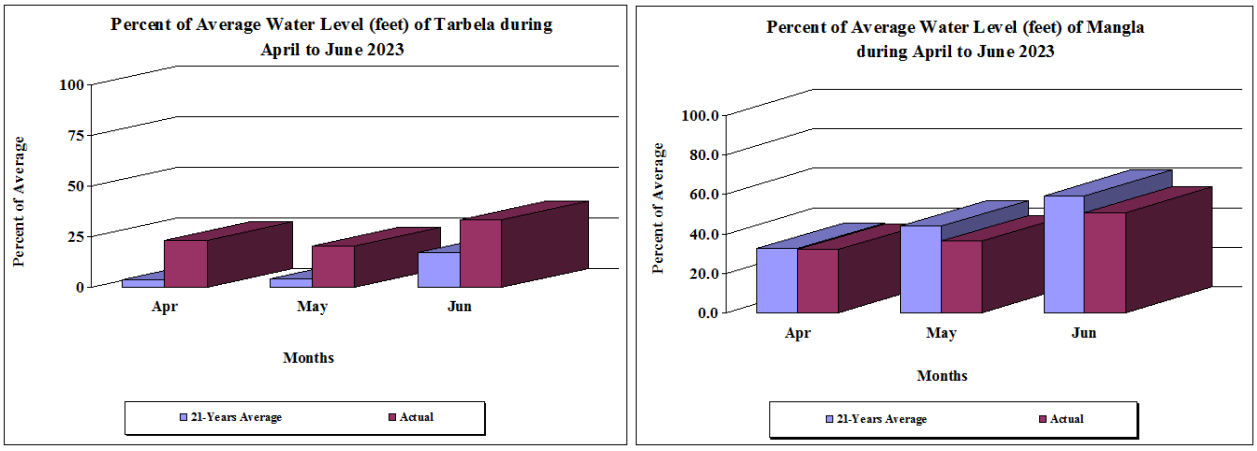


Figure-7 percent of water level of Tarbela and Mangla during (April-June) 2023

5 District-wise impact of drought

No impacts of drought have been reported from any part of the country

6 Government reactions to drought

Due to above normal rainfall, no drought conditions emerged in the country. The water availability in major reservoirs is insufficient due to below-normal snowfall in the catchments areas; currently, the water situation in the dams is improving day by day. NDMC is continuously monitoring the drought situation. It is therefore advised to all stakeholders to adopt an immediate water management strategy to avoid the negative impacts of deficit rainfall on the agriculture sector. And keep themselves regularly updated on a weekly, fortnightly and monthly basis at the PMD website http://www.pmd.gov.pk/ndmc/index.htm.

7 Kharif season forecast of Mangla and Tarbela Dams (2023)

The predicted water availability forecast (MAF) forecast in two big reservoirs i.e. Tarbela and Mangle during Kharif season (April-September) 2023 is shown in figure 8.

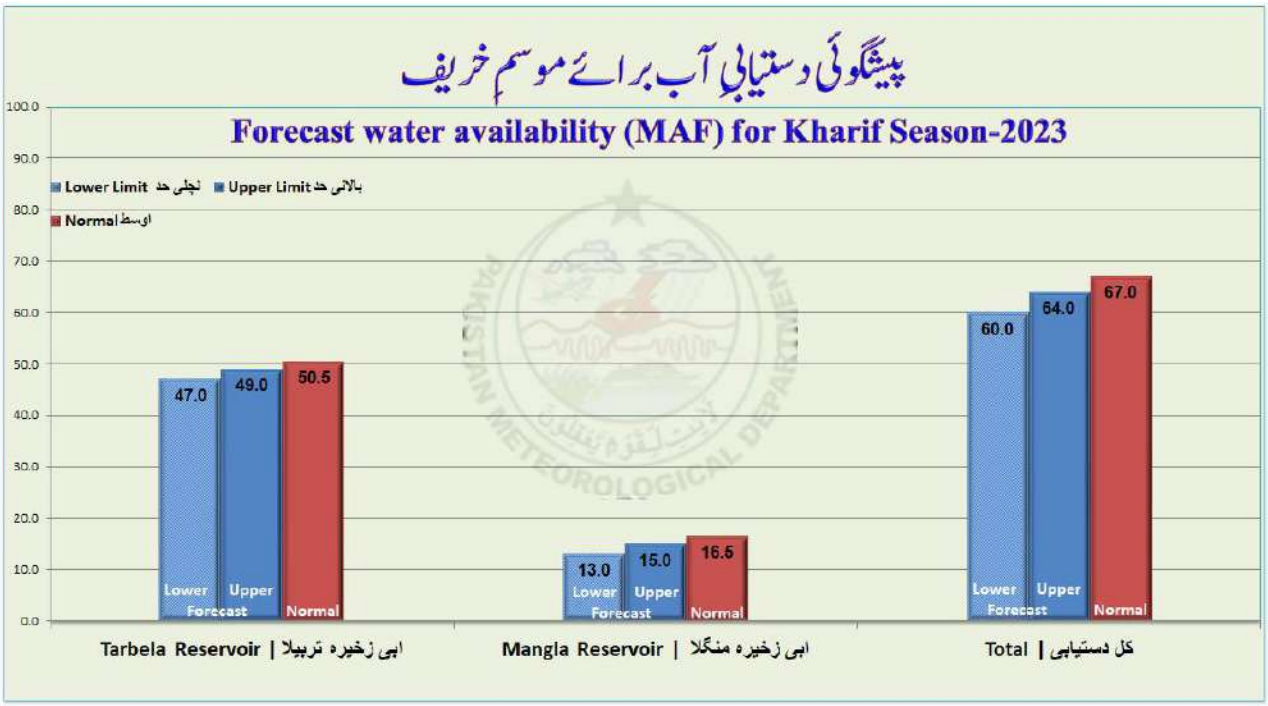


Figure 8: Forecasted water volume (MAF) for Kharif Season 2023 in Tarbela and Mangla

8 Recommendations

A natural disaster could not be stopped. Each disaster gives us a lesson to do better planning, management and taking some precautionary measures to minimize its impacts in future. Following are some recommendations to cope with the floods and droughts in Pakistan

- Pakistan dam's water storage capacity is much less than that of neighboring countries like India. Therefore, it is the need of the hour to build large and small dams to manage the floods and store the water.
- The stored water will protect food security, especially fulfilling the water requirements of crops during drought periods in the country.
- The water will also help generate hydropower electricity which is an essential requirement of the country and reduce unemployment in the country.

9 Acknowledgement

National drought monitoring Centre, Pakistan Meteorological Department, Islamabad acknowledges SUPARCO and district office agricultural departments for sharing the information.

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