Quarterly
Drought Bulletin of Pakistan

April-June 2024

National Drought / Environment Monitoring and Early Warning Center (NDMC)

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1. Introduction

Pakistan's latitudinal range contributes to significant variability in rainfall across different seasons. The country's climate exhibits a spectrum from arid to hyper-arid in its lower southern regions, while the northern half ranges from semi-arid to humid. Certain areas experience persistent dry conditions, rendering them vulnerable to drought throughout the year. Prolonged absence of precipitation can exacerbate these conditions, leading to widespread drought impacts. Historically, all provinces of Pakistan have grappled with significant drought events.

Apart from other natural disasters such as floods, cyclones, and earthquakes, drought sometimes get gradual onset and prolonged duration and sometime as a result of heat waves emerge as flash drought. Its effects are less immediately visible and can extend across vast geographical areas, impacting a larger population than other environmental hazards.

The Pakistan Meteorological Department (PMD) launched the National Drought/Environment Monitoring and Early Warning Centre (NDMC) in 2004-05, following the severe drought of 1999- 2001. The primary objective of NDMC is to proactively monitor drought conditions nationwide and issue timely advisories.

The NDMC operates a central office in Islamabad, complemented by four Regional Drought Monitoring Centers (RDMCs) in Lahore, Karachi, Peshawar, and Quetta. These RDMCs serve as focal points for gathering, consolidating, and analyzing drought-related data from across the country. To enhance monitoring capabilities, Automatic Weather Stations (AWS) have been strategically installed, particularly in drought-prone areas. Accessing data from remote areas of the country has been significantly facilitated.

NDMC has also Ordinary Rain Gauges (ORG) network across the country covering most of the vulnerable districts in the four provinces, as illustrated in figure-1.

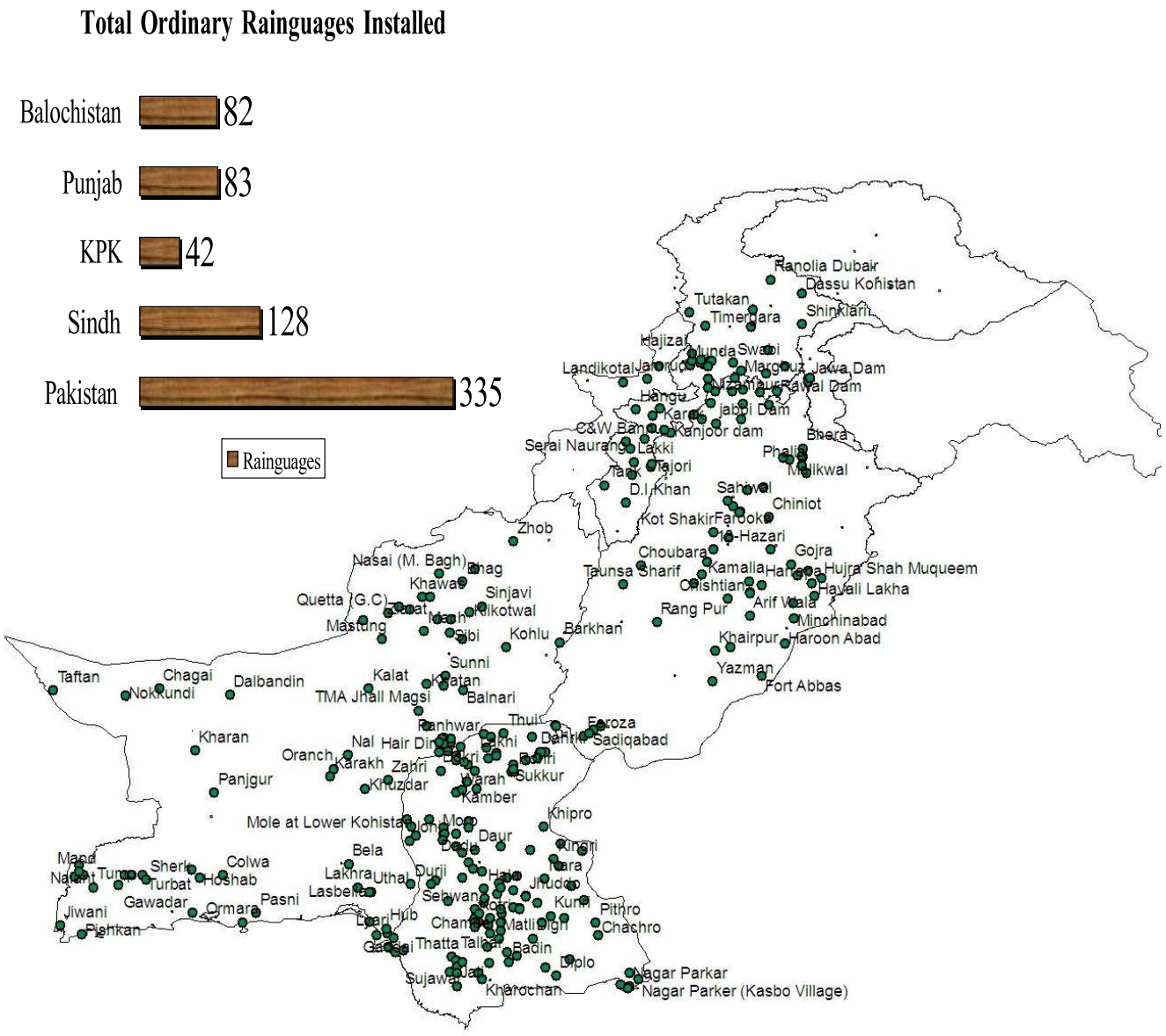

Figure-1: Rain-gauges network of Pakistan by NDMC

2. Historical Background

The Indian subcontinent experiences a tropical monsoon climate, characterized by significant fluctuations in rainfall both in quantity and distribution. Central to this climate are the regional and temporal shifts in atmospheric flow patterns associated with the monsoon. Two primary rainfall systems govern the region: the Southwest or Summer monsoon (from the end of June till September), and the Westerlies (from December to the end of March).

Pakistan, fortunately situated within this region, receives substantial rainfall during the summer months from the Southwest (SW) monsoon and in winter due to western disturbances. The summer monsoon contributes 65% of the annual rainfall in Pakistan from July to September (Waqas and Athar, 2019; Ullah et al., 2021b; Abbas et al., 2022). Monsoon rainfall varies widely across both space and time. Droughts in Pakistan primarily result from rainfall deficiencies associated with the southwest monsoon. Furthermore, there appears to be a correlation between El Niño and La Niña events and weakened monsoon activity.

Pakistan has witnessed several drought episodes with significant impacts across its provinces. The Punjab province experienced severe droughts in 1899, 1920, and 1935. North west of Khyber Paktunkwa (KP) experienced worst droughts in 1902 and 1951, while Sindh endured notable droughts in 1871, 1881, 1899, 1931, 1947, and 1999. Among the most severe nationwide droughts were those in 1999–2000, extending into 2002. These droughts significantly affected agricultural output, with a notable setback during 2000–2001. Major crops experienced a decline of nearly 10% in growth, contributing to an overall negative growth rate of 2.6% for the agricultural sector. The water shortage persisted into 2001–2002, reaching levels of up to 51% below normal supplies, compared to 40% in the previous year (Shahid Ahmad, et al 2020).

Climate change has introduced fluctuations in rainfall patterns, leading to increased precipitation during wet periods and decreased rainfall during dry spells. Consequently, periods of reduced rainfall result in droughts, while heavy rainfall events lead to various types of floods, including flash floods, urban floods, coastal floods, and river floods.

3. Rainfall Distribution (Apr-Jun) 2024

During the first quarter of 2024 (April to June), Pakistan experienced above-average precipitation, recording an increase of 32.0%. April saw significantly increased rainfall, with departures from normal levels reaching 166%. Specifically, Sindh, Punjab, Balochistan, Khyber Pakhtunkhwa, Gilgit-Baltistan (GB), and Kashmir all experienced above-average precipitation, with departures 65%, 73%, 437%, 137%, 13%, and 102% respectively. In contrast, May witnessed decrease in rainfall across all provinces, with a departure ranges from -52% to -100%. June exhibited a mixed pattern, with a -2% decrease in rainfall across Pakistan. While Balochistan, Gilgit Baltistan and Sindh experienced an increase in rainfall with departures 14%, 32% and 134% respectively. However, Khyber Pakhtunkhwa, Kashmir and Punjab witnessed below normal rainfall with departures -17%, -43% and -28 respectively.

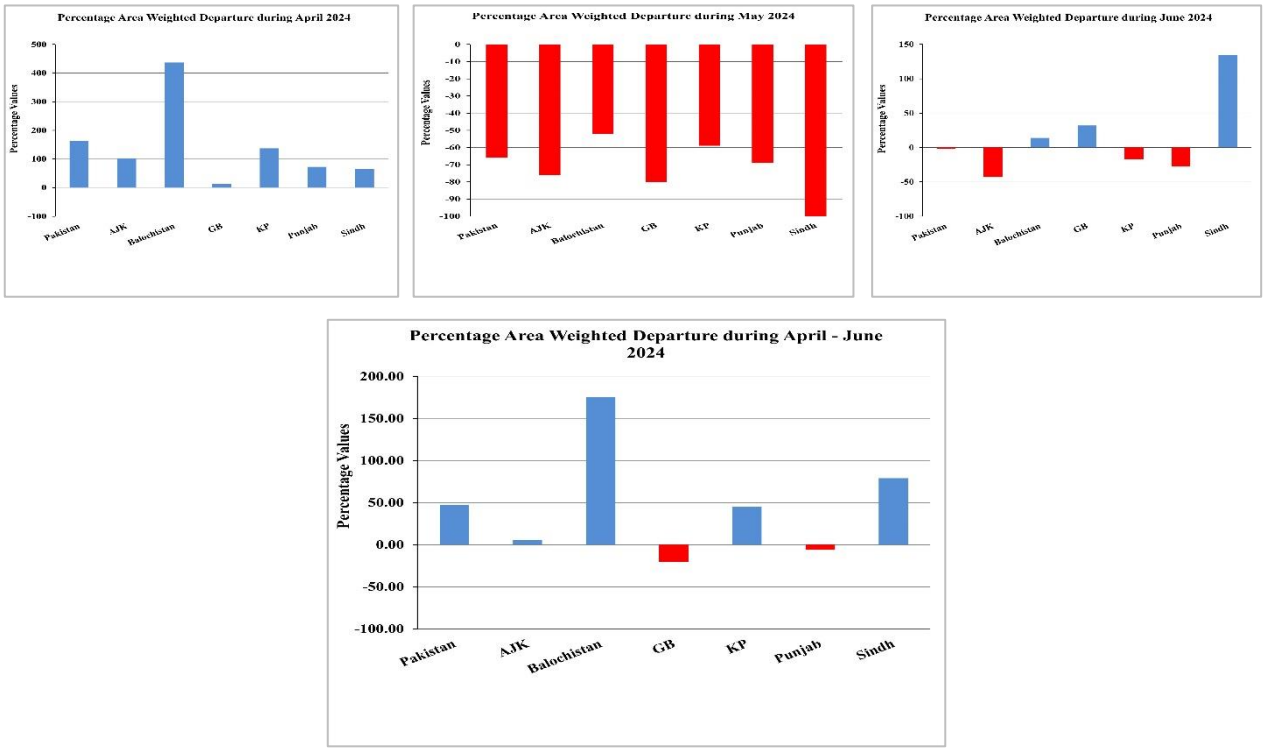

Figure-2: Percentage area weighted departure of rainfall during (Apr-Jun) 2024

Overall, the quarterly analysis indicates above-average rainfall across the country. The area weighted rainfall is depicted in figure 2.

Spatial distribution of rainfall during the quarter (Apr-Jun) is shown in figure 3. During the quarter rainfall spells were observed throughout the country, principal amounts were observed in Upper KP, Kashmir and adjoining areas. These rains reduced moisture stress on wheat crops in rain-fed areas. Above normal rainfall during April to June lessen the moisture and water stress and provided significant relief in drought vulnerable areas of Pakistan.

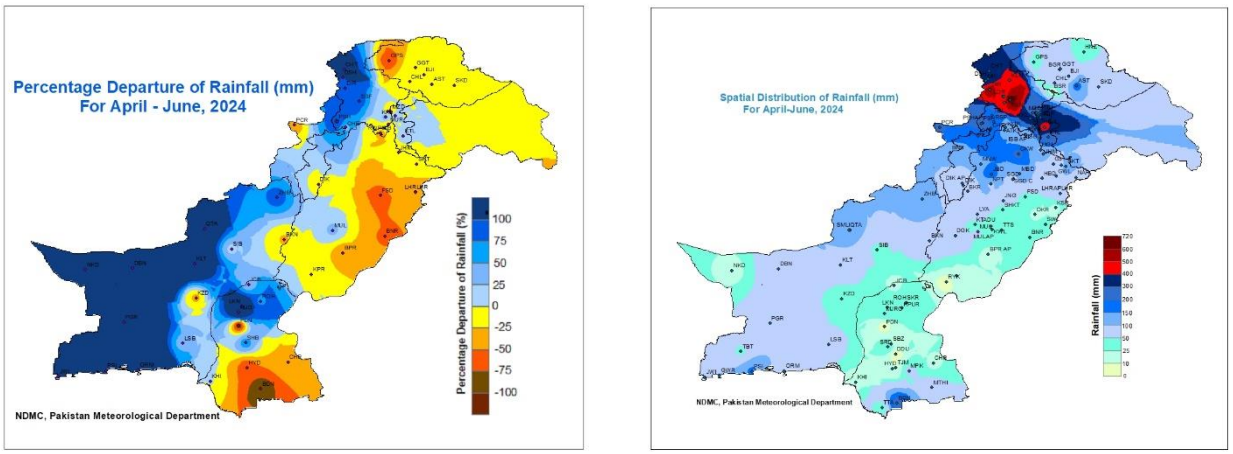

Figure-3: Spatial distribution and departure of rainfall during (Apr-Jun) 2024 in Pakistan

3.1 PMD Stations with highest rainfall (mm) during period (Apr – Jun) 2024

Table1: PMD Stations with Highest Rainfall (mm) during period Apr - Jun 2024					
Sr. No	Station	RF(mm)	Sr. No.	Station	RF(mm)
1	Malam Jabba	713	11	Mirkhani	319
2	Dir	594	12	Pattan	309
3	Kalam	471	13	Murree	287
4	Saidu Sharif	468	14	Muzaffarabad	270
5	Rawalakot	456	15	Balakot	268
6	Kakul	414	16	Peshawar	245
7	Lower Dir	370	17	Kotli	234
8	Garhi Dupata	359	18	Badin	228
9	Drosh	348	19	Chakwal	214
10	Chitral	320	20	Parachinar	208

3.2 The Maximum Length of Dry Spell

The maximum length of dry days spell shown in figure 4 was experienced in some of the southern parts of Pakistan where it reached up to 80 days of no rainfall. The rainfall spell during April provided relief to the northern and central parts of the country whereas, Sindh and Balochistan received slightly less rainfall (which is the climatology of the region).

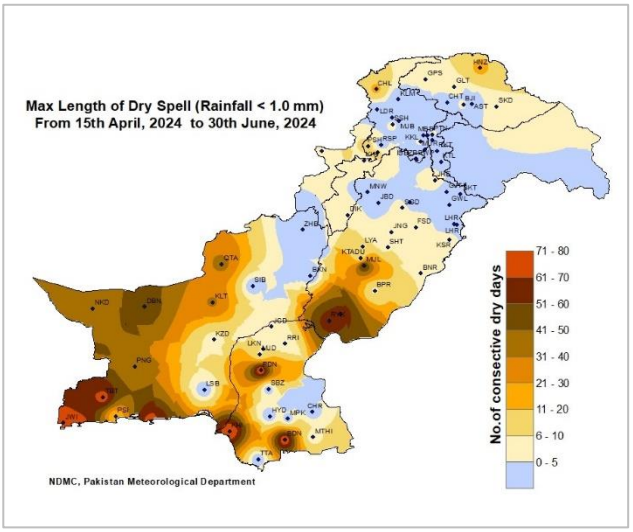

Figure-4: Maximum length of dry spell up to June 2024 in Pakistan

4. Drought Products

4.1 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). Such a series is fitted to a probability distribution, which is then transformed into a normal distribution so that the mean SPI for the location and desired period is zero (Edwards and McKee, 1997). 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. Drought conditions of Pakistan June 2024 shown in figure 5.

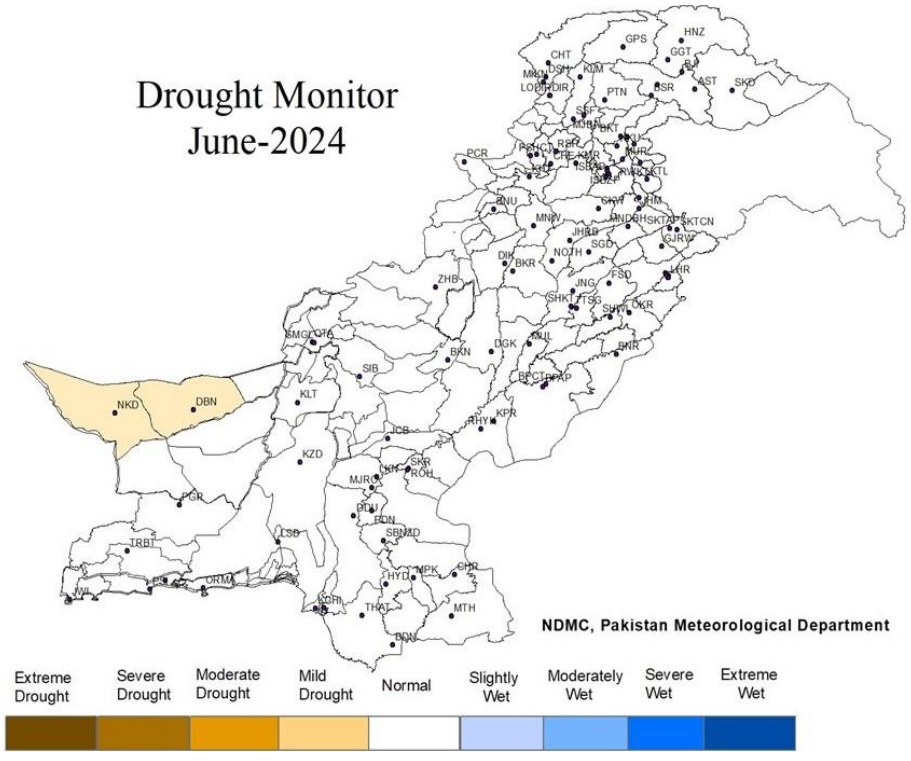

Figure-5: Drought conditions of Pakistan June 2024

4.2 Cumulative Precipitation Anomaly (CPA)

Cumulative Precipitation Anomaly (CPA) was calculated from 1st July 2022 for each month. April, May and June 2024 CPA charts are shown below in figure 6. Overall, northern and central half of the country has received below normal rainfall that is negative anomaly. However, central and southern parts have experienced positive anomaly that is above normal rainfall cumulative during the period.

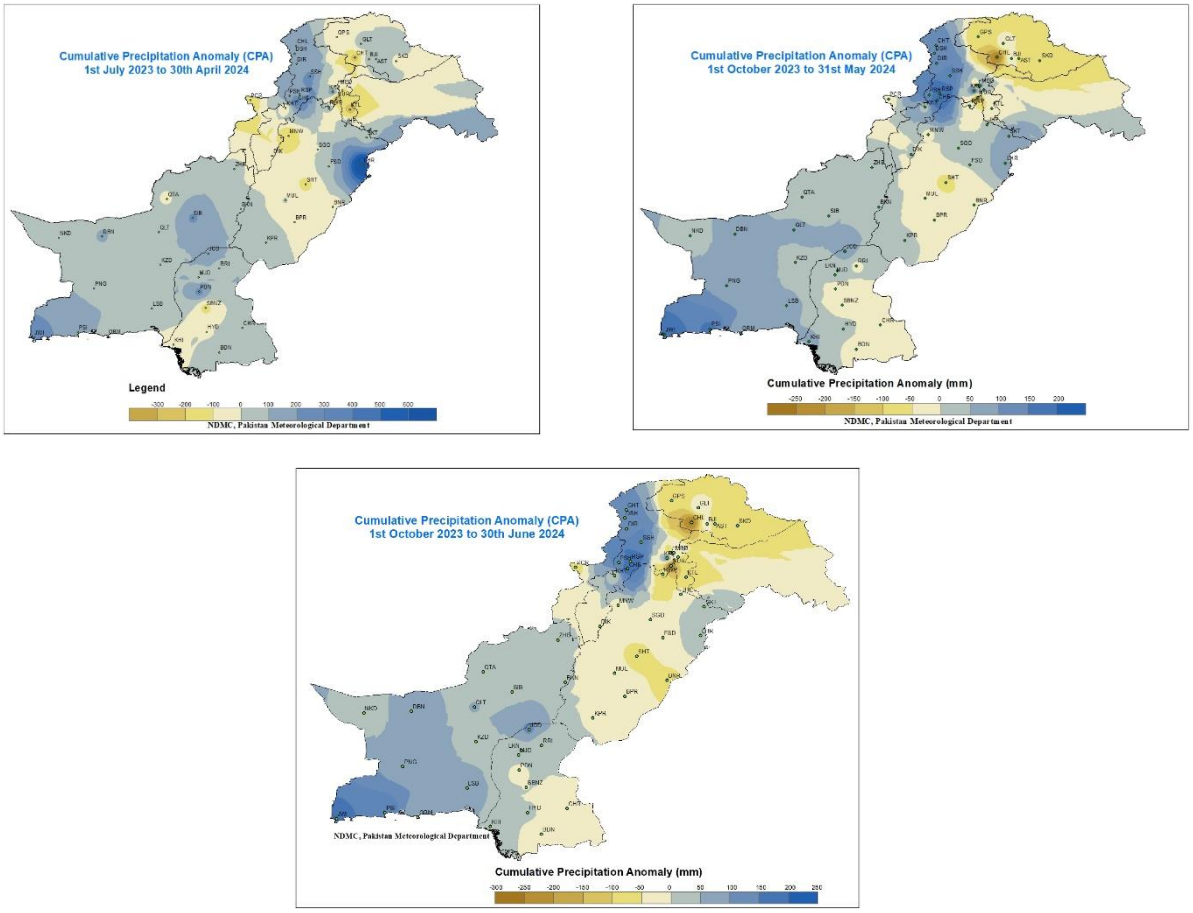

Figure-6: Cumulative precipitation anomaly during (Apr-Jun) 2024 in Pakistan

4.3 Soil Moisture Anomaly (SMA)

It was observed that the amount of rainfall in some areas from April to June was above normal which improved the soil moisture conditions in the country as shown in figure 7. Soil moisture conditions are above normal in most parts of the country.

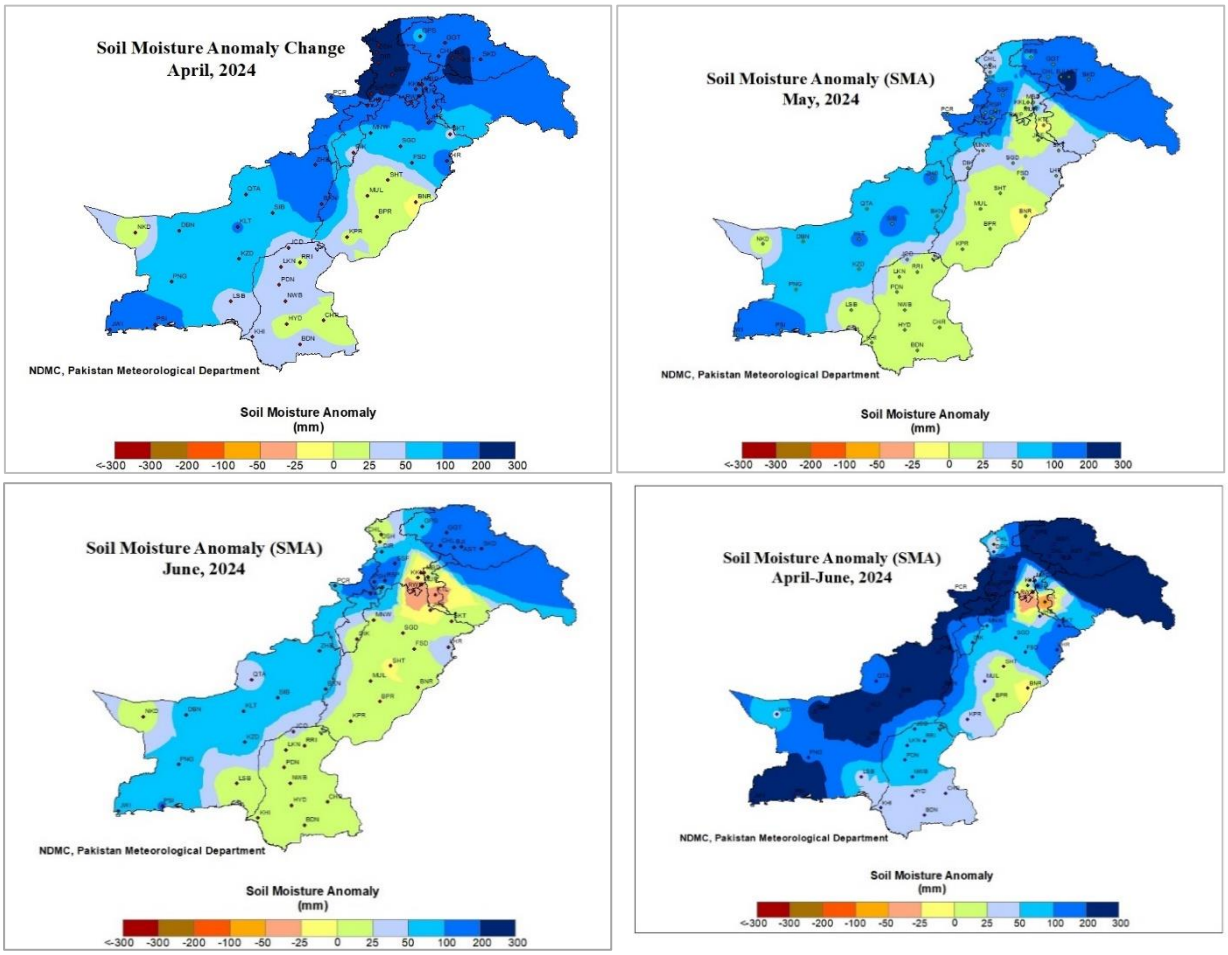

Figure-7: Soil moisture anomaly during (Apr-Jun) 2024 in Pakistan

5. District-wise impact of drought

During first half of May mild flash drought conditions prevailed which were dissipated later dissipated due to rainfall.

6. Kharif season forecast of Mangla and Tarbela Dams (2024)

The predicted water availability forecast (MAF) forecast in two big reservoirs i.e., Tarbela and Mangle during the Kharif season (April-September) 2024 is shown in figure 9.

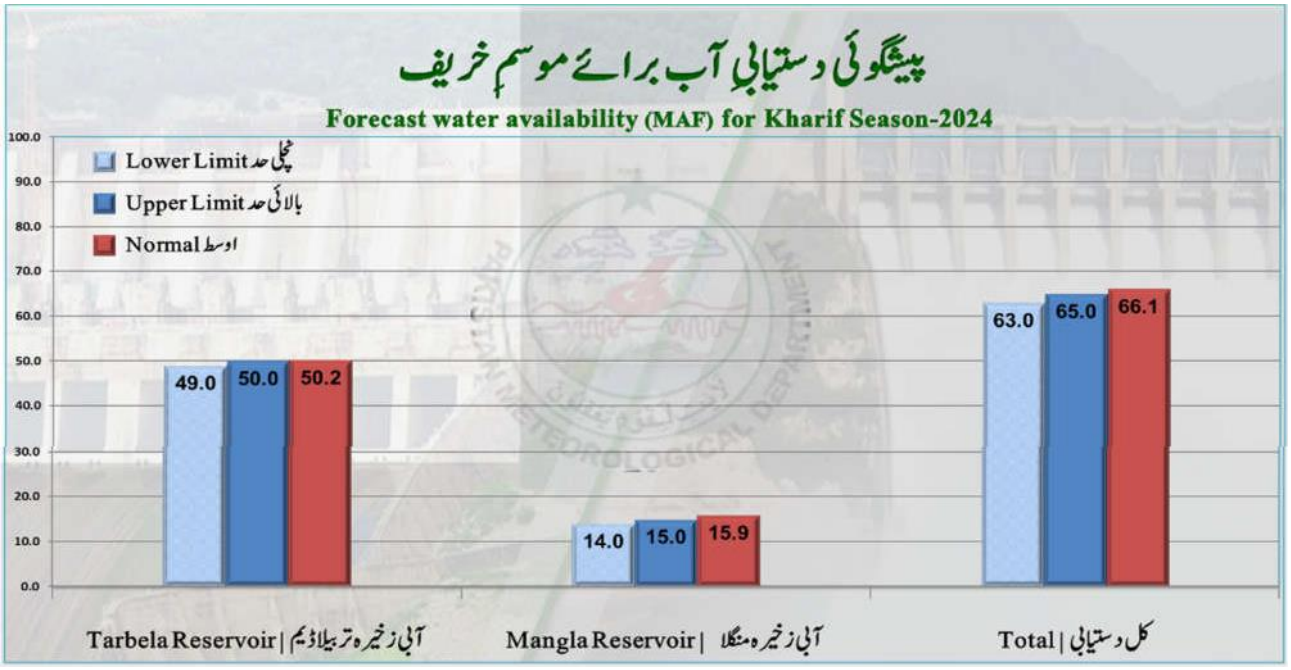

Figure-8 Kharif season forecast of Mangla and Tarbela dams (2024)

7. Crop Report: April-June 2024

Punjab:

In Punjab, major crops include wheat, sugarcane, maize, and rice. Wheat is the main Rabi crop, but recent adverse weather has delayed its harvest and Kharif crop preparation, affecting crop quality. In May and June 2024, below-normal rainfall and high temperatures stressed soil moisture, impacting seasonal vegetables and standing crops. Despite this, cotton, a key Kharif cash crop, remains in good condition in some areas.

Sindh:

Wheat harvesting is mostly complete with good yields. Oilseed crops and seasonal fruits are growing well. Cotton and rice sowing is ongoing, supported by April rains.

In Sindh, major crops are sugarcane, cotton, and rice. Seasonal fruits are doing well, and cotton and rice sowing is mostly complete. However, below-normal rains have stressed soil moisture, damaging some crops and agricultural activities. Cotton and sugarcane remain in good condition.

Khyber Pakhtunkhwa:

The wheat crop is maturing and has been harvested in some areas by the end of April. Chickpeas harvesting is complete, and oilseed crops are growing satisfactorily. Winter vegetable picking and marketing are ongoing, and citrus yields are good. However, April rains and gusty winds damaged some wheat and vegetables, delaying harvest. By May, below-normal rains in Khyber Pakhtunkhwa stressed soil moisture, damaging seasonal crops and delaying land preparation. In June, continued below-normal rains further stressed soil moisture and damaged crops

Balochistan:

Rainfall, thunderstorms, and hailstorms have damaged ripe wheat and other seasonal crops, including orchards of apple, cherry, apricot, and plum in some areas. Harvesting is complete in some districts, while ongoing in others, particularly colder districts like Quetta, Kalat, and Pishin, where it has yet to begin. Standing crops and orchards are in satisfactory condition. Most apple varieties have matured, and picking is in progress. Winter vegetable yields are good and available in the market.

Gilgit-Baltistan:

Agricultural activities slowed due to extreme cold in most of the region. However, in the lower belt, including the Gilgit region, farmers have resumed activities for vegetables and seasonal fruits. The growth of seasonal vegetables and orchards is reported to be satisfactory

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 the neighboring countries like India. Therefore, it is the need of the hour to build large and small dames in catchment areas specially to conserve the rainfall water during the monsoon period.
- Manage the floods and storage of water.
- The stored water will help in protecting food security specially to fulfill the water requirements of crops during drought periods in the country.
- NDMC is continuously monitoring drought situations over the country and keeping the stakeholders and general public updated by issuing drought information on weekly, monthly and Quarterly basis.
- Over all, normal conditions are prevailing in the country so no intervention has been made by the government for drought during this quarter. For detailed information regarding the drought situation in Pakistan, please visit http://www.ndmc.pmd.gov.pk/index.htm

8. Acknowledgement

National drought monitoring Centre, Pakistan Meteorological Department, Islamabad acknowledges SUPARCO and, NOAA for sharing the information.

9. References

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