Quarterly
Drought Bulletin of Pakistan

January-March 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 some times 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.

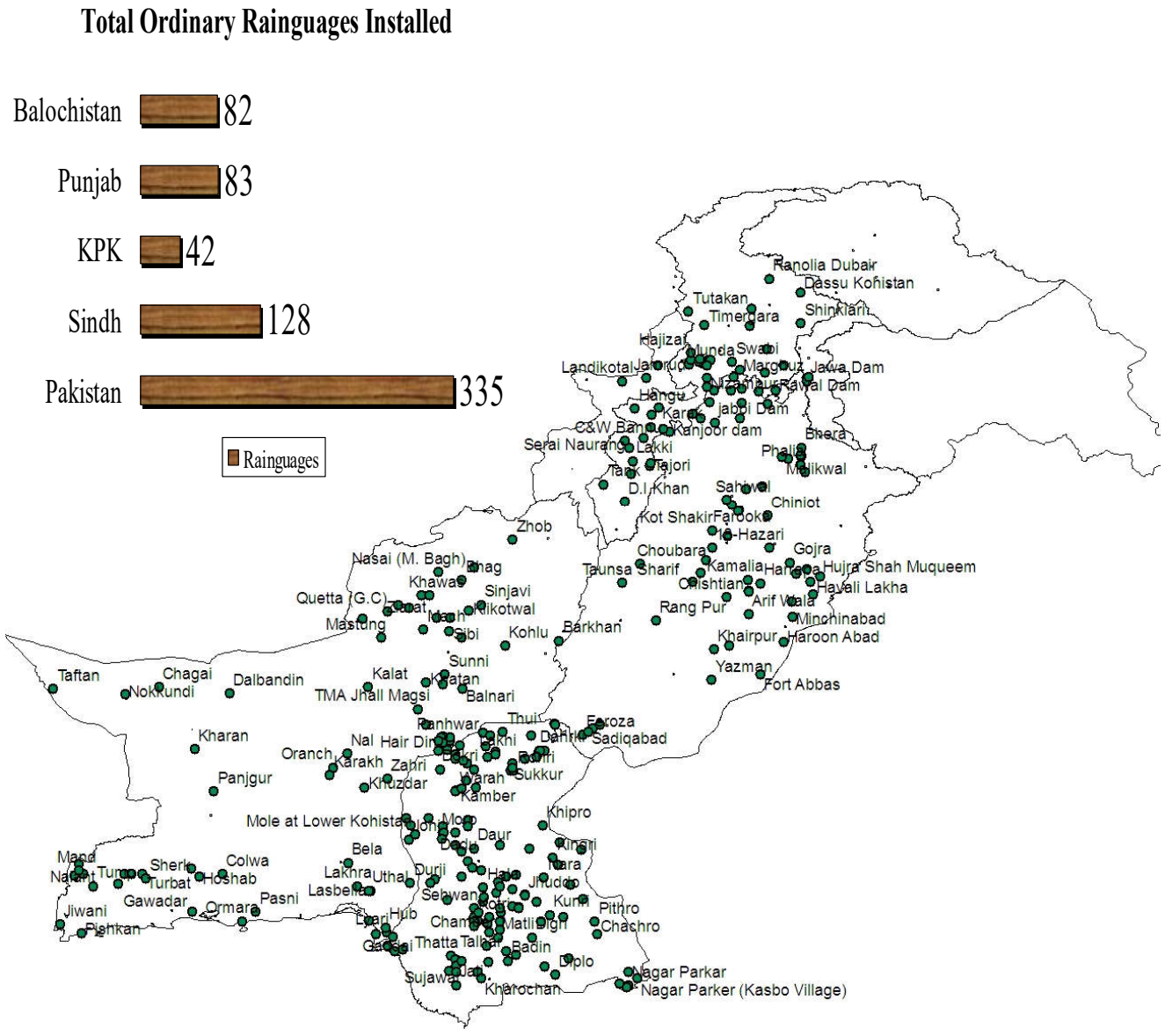

Figure-1: Rain-gauges network of Pakistan by NDMC

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 (Jan-Mar) 2024

During the first quarter of 2024 (January to March), Pakistan experienced below-average precipitation, recording a decrease of 18.0%. Typically, January and February mark the coldest period nationwide, with the northern and southwestern regions receiving considerable rainfall during winter. However, January saw significantly reduced rainfall, with departures from normal levels reaching -72%. Specifically, Sindh, Punjab, Balochistan, Khyber Pakhtunkhwa, Gilgit-Baltistan (GB), and Kashmir all experienced below-average precipitation, with departures ranging from -80% to -97%. In contrast, February witnessed an increase in rainfall, with a departure from normal levels of 23%. Notably, Sindh and Balochistan experienced well-above-average rainfall during this month, with departures of 174% and 108%, respectively. However, Khyber Pakhtunkhwa, Punjab, GB, and Kashmir recorded below-average rainfall. March exhibited a similar pattern, with a 47% increase in rainfall across Pakistan. While Punjab reported normal rainfall levels, Balochistan experienced a substantial rise of 91%. However, Khyber Pakhtunkhwa, Sindh, GB, and Kashmir witnessed varying levels of above-average rainfall.

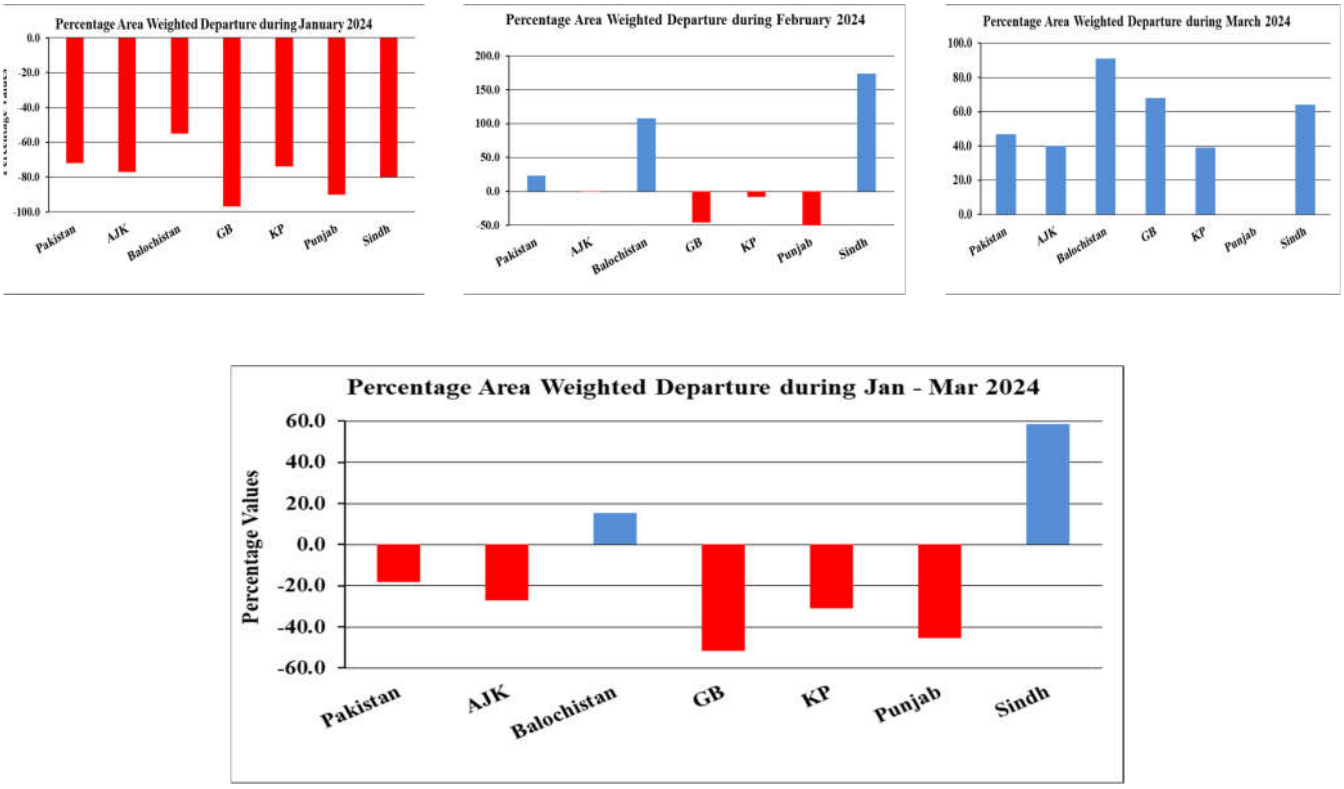

Figure-2: Percentage area weighted departure of rainfall during (Jan-Mar) 2024

Overall, the quarterly analysis indicates below-average rainfall distribution in Sindh and Khyber Pakhtunkhwa, with Gilgit-Baltistan and Kashmir experiencing normal to near-normal levels. Balochistan and Punjab also recorded below-average rainfall, as depicted in figure 2.

Spatial distribution of rainfall during the quarter (Jan-24-Mar-24) is shown in figure 3. During the quarter rainfall spells were observed throughout the country, especially in KP and Balochistan. These rains reduced moisture stress on wheat crops in rain-fed areas. Above normal rainfall during January to March lessen the moisture and water stress and provided significant relief in drought vulnerable areas of Pakistan.

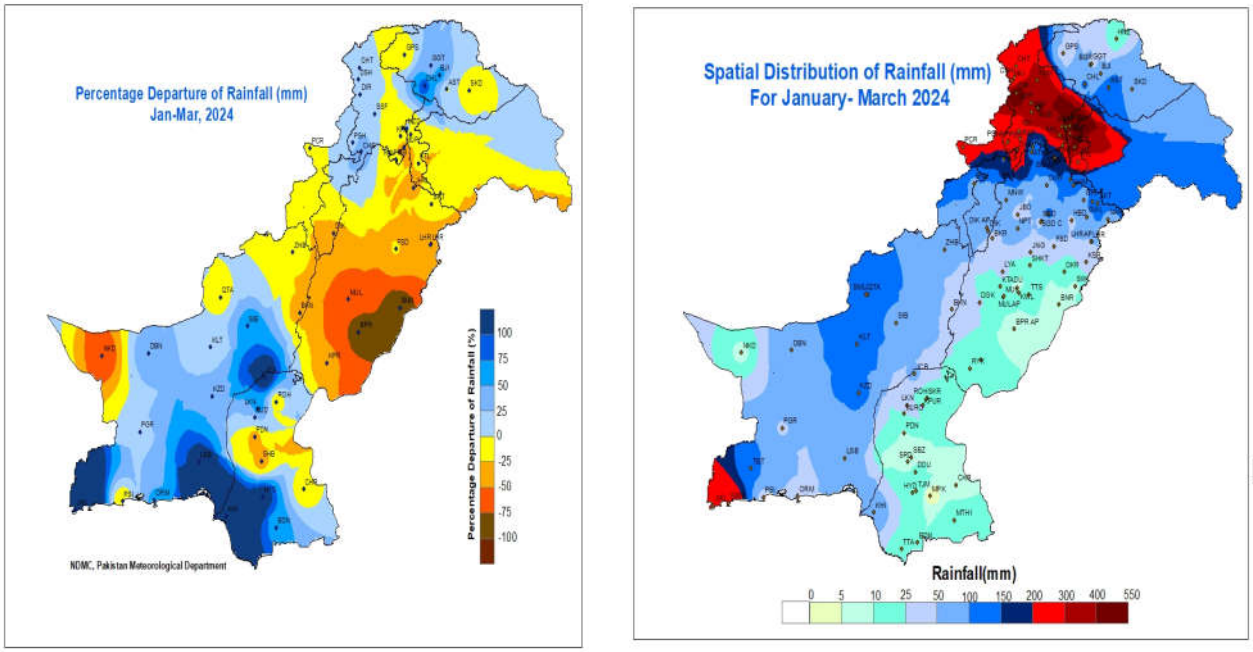

Figure-3: Spatial distribution and departure of rainfall during (Jan-Mar) 2024 in Pakistan

3.1 PMD Stations with highest rainfall (mm) during period (Jan – Mar) 2024

Table1: PMD Stations with Highest Rainfall (mm) during period Jan - Mar 2024					
Sr.No	Station	RF(mm)	Sr.No.	Station	RF(mm)
1	Astore	151	11	Kakul	314
2	Dir	531	12	Lower Dir	306
3	Muzaffarabad	462	13	Balakot	303
4	Pattan	451	14	Gawader	294
5	Rawalakot	448	15	Parachinar	288
6	Malam Jabba	434	16	Murree	263
7	Garidopatta	359	17	Chitral	258
8	Kalam	357	18	Risalpur	251
9	Saidu Sharif	344	19	Jiwani	249
10	Cherat	318	20	Drosh	241

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 120 days of no rainfall. The rainfall spell during November and December 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).

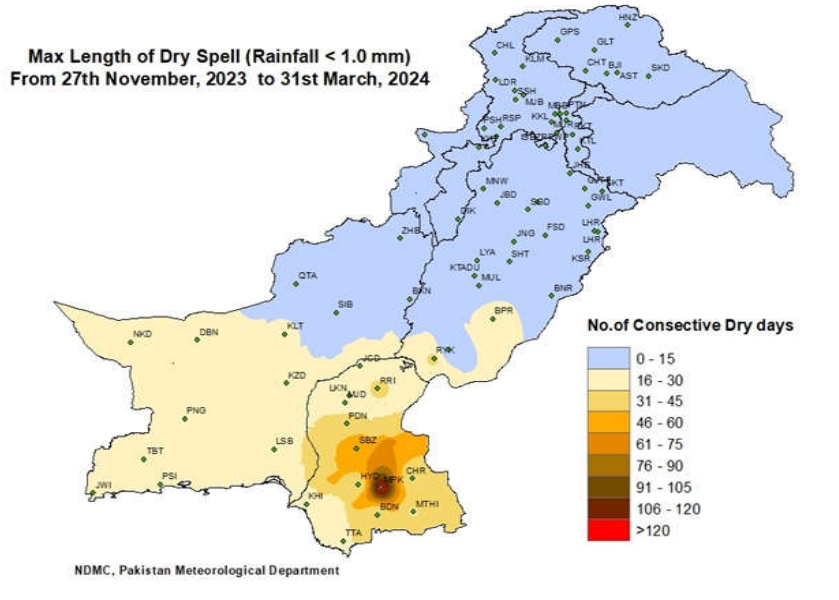

Figure-4: Maximum length of dry spell up to march 2024 in Pakistan

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 march 2024 shwon in figure 5.

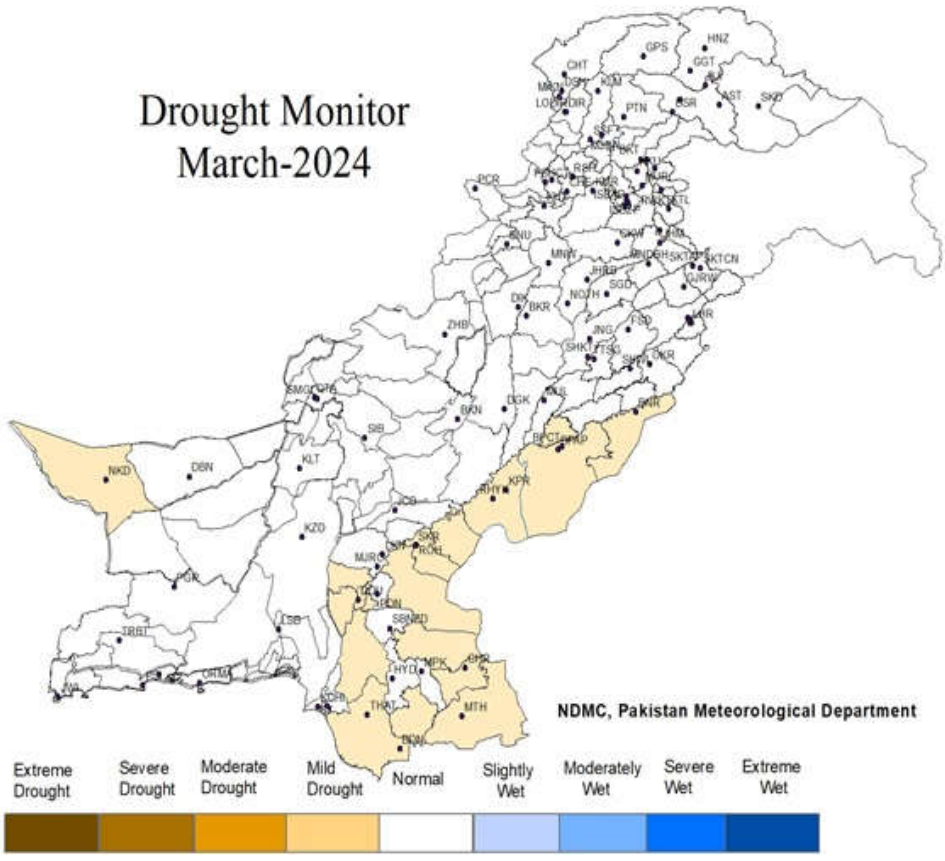

Figure-5: Drought conditions of Pakistan march 2024

4.2 Cumulative Precipitation Anomaly (CPA)

Cumulative Precipitation Anomaly (CPA) was caculated from 1st July 2022 for each month. jan-24 and march 2024 CPA charts are shown below in figure 6. Overall, northern half of the country has received below normal rainfall that is negative anomly. However, central and southern parts have gor positive anomly that is above normal rainfall cumulative during the period.

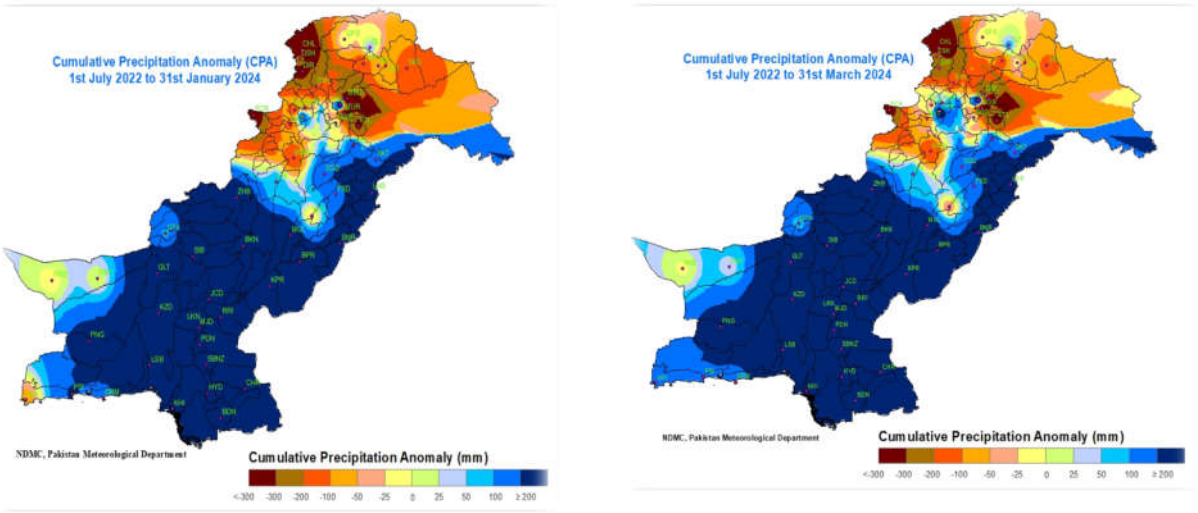

Figure-6: Cumulative precipitation anomaly during (Jan-Mar) 2024 in Pakistan

4.3 Soil Moisture Anomaly (SMA)

It was observed that the amount of rainfall in some areas from january to march was near normal which improved the soil moisture conditions in the country as shown in figure 7. Soil moisture conditions are near normal, in southern parts of Pakistan. normal rainfall during january-march 2024 provided significant relief to soil moisture stress and conditions are back to normal in most of the southern parts of Pakistan.

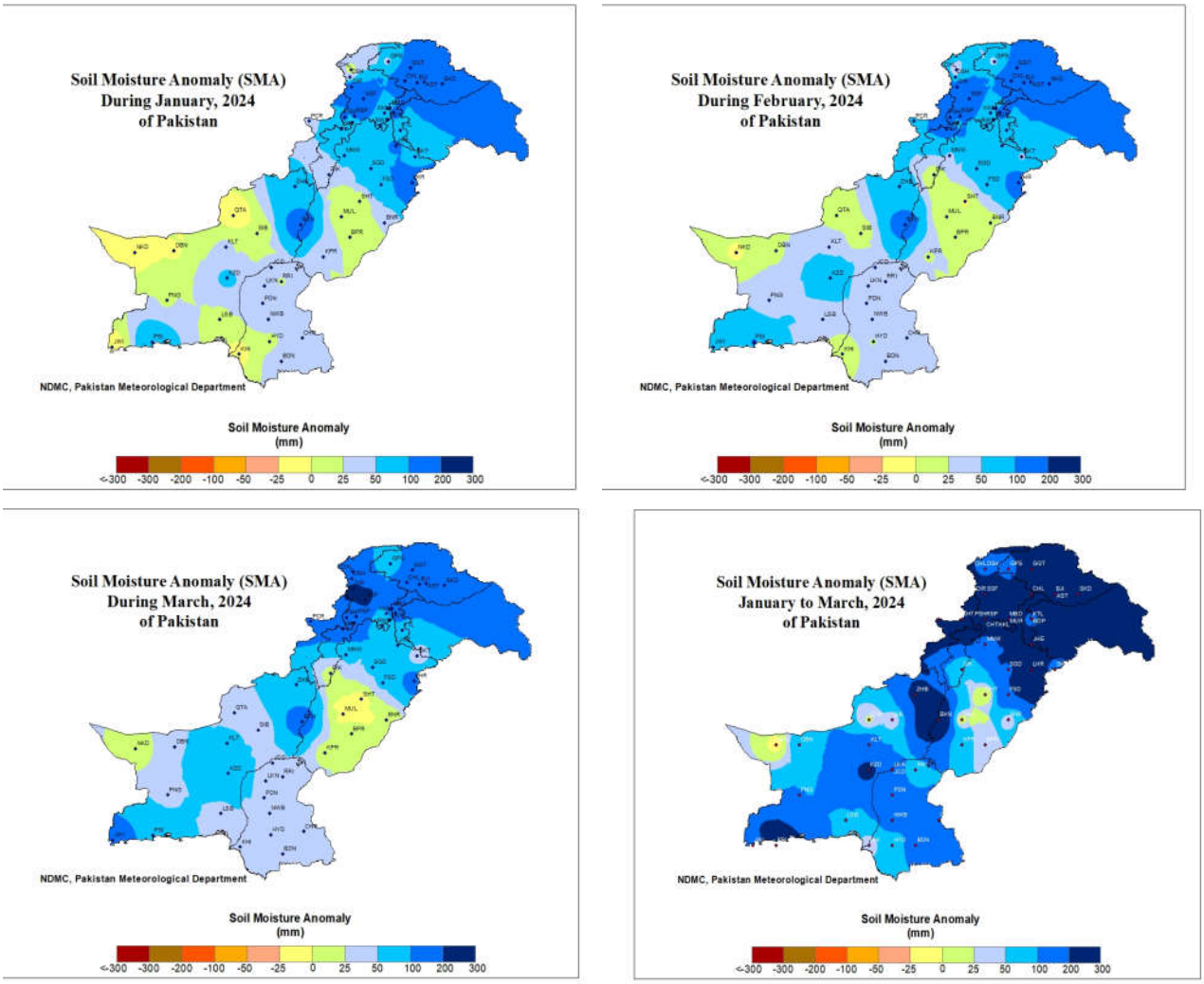

Figure-7: Soil moisture anomaly during (Jan-Mar) 2024 in Pakistan

5. Water Level of Reservoirs:

Pakistan has two main reservoirs of water in the form of the dam, i.e. Tarbela and Mangla. The dead level of Tarbela is 1378 feet and its maximum conservation level is 1550 feet while Mangla has a dead level of 1040 feet and a maximum conservation level of 1242 feet. The water level of Mangla and Tarbela reservoirs has improved and it was well above normal due to inreased rainfall experienced in the catchment areas of these two reservoirs. Percentage of average water level from January to March 2024 was calculated for both dams is shown below in figure 8.

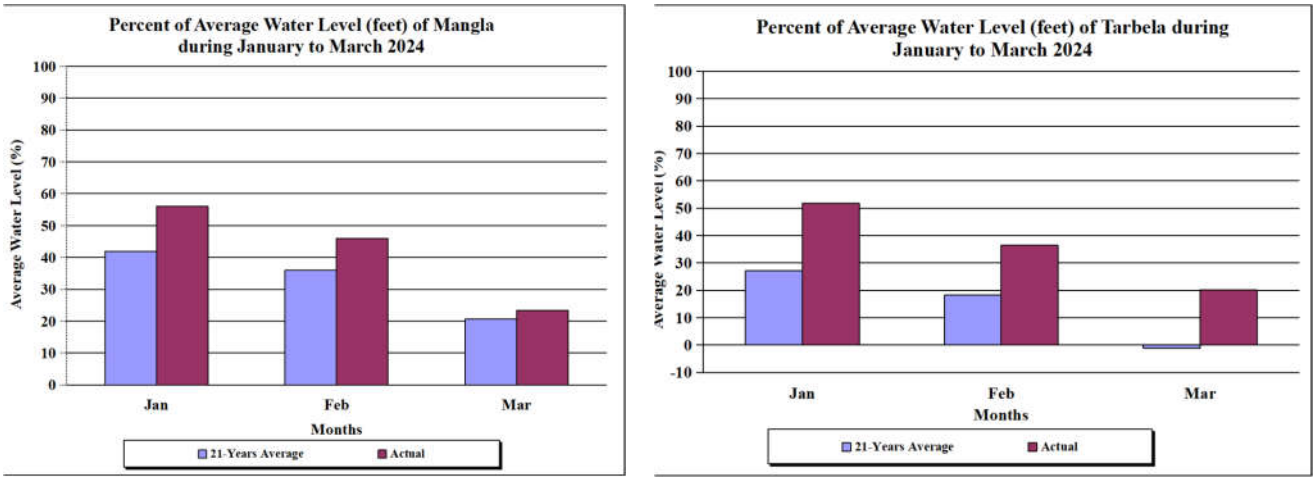

Figure-8: percent of the water level of Mangla and Tarbela during (Jan-Mar) 2024

6. District-wise impact of drought

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

7. 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.

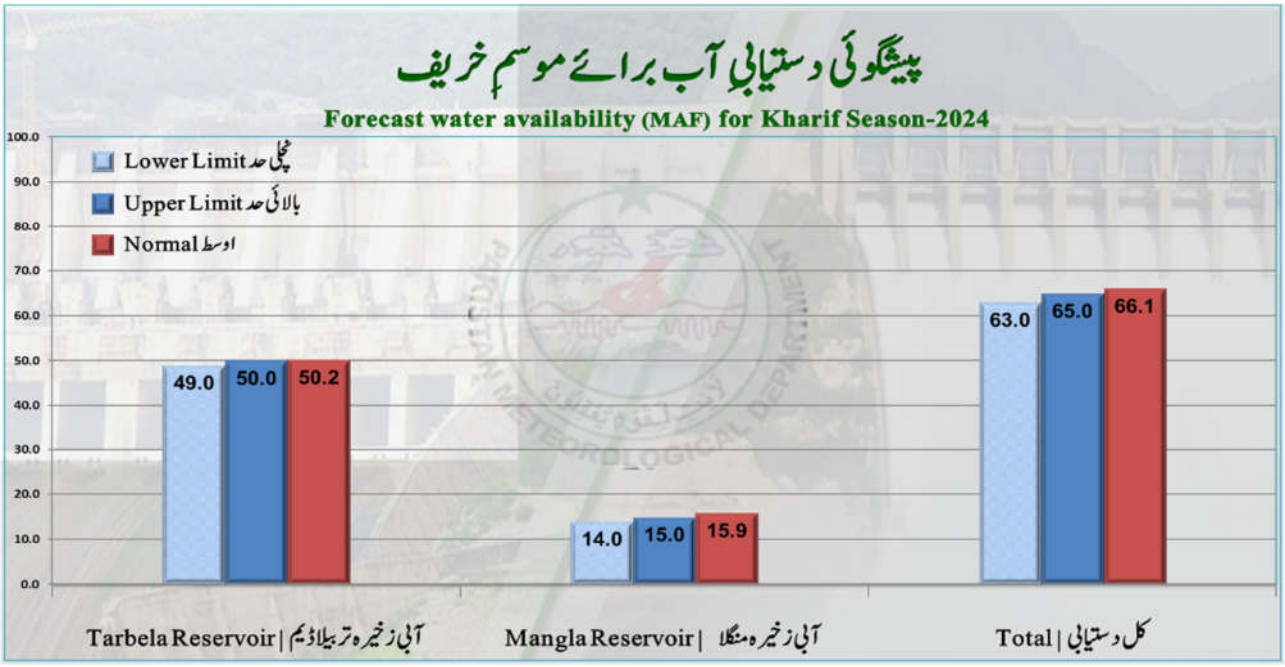

Figure-9 Kharif season forecast of Mangla and Tarbela dams (2024)

8. Crop Report: January-March 2024

Punjab:

In January, despite dry weather and fog, Punjab's crops, particularly wheat, grams, and chickpea, showed satisfactory growth. However, wheat was adversely affected in rainfed areas. February saw the successful harvesting of high-grade rice and the ongoing sowing of maize. By March, Rabi crops, including wheat, reached maturity despite localized damages from hails and gusty winds.

Sindh:

From January to March, Sindh's wheat crop progressed satisfactorily, with harvesting underway in most areas by March. Sugarcane crushing and sowing of pulses and winter vegetables were completed during this period. Seasonal fruits like guava and banana maintained good conditions throughout.

Khyber Pakhtunkhwa:

Satisfactory rains in January bolstered crop growth in KP, with wheat reaching maturity by march. Sugarcane harvesting and the growth of oilseed crops remained positive, while winter vegetables continued to be picked and marketed. Orchards, especially citrus, yielded well.

Balochistan:

Throughout the period, Balochistan's crops and orchards reported satisfactory conditions, with apples nearing maturity for picking. Winter vegetables maintained good yields, meeting market demands consistently.

Gilgit-Baltistan:

Extreme cold conditions hampered agricultural activities, particularly in higher altitudes. However, lower regions saw some resumption in vegetable and seasonal fruit cultivation, albeit at a slower pace.

Overall, despite localized challenges such as dry weather, fog, and extreme cold, most regions experienced satisfactory crop conditions, with significant progress in harvesting and sowing activities observed across the country.

9. 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 neighbouring countries like India. Therefore it is the need of the hour to build large and small dames in catchment areas especially 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 especially 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

10. Acknowledgement

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

11. References

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