GOVERNMENT OF PAKISTAN
PAKISTAN METEOROLOGICAL DEPARTMENT

Quarterly Drought Bulletin of Pakistan

October - December 2024

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URL: https://ndmc.pmd.gov.pk/new/

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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.

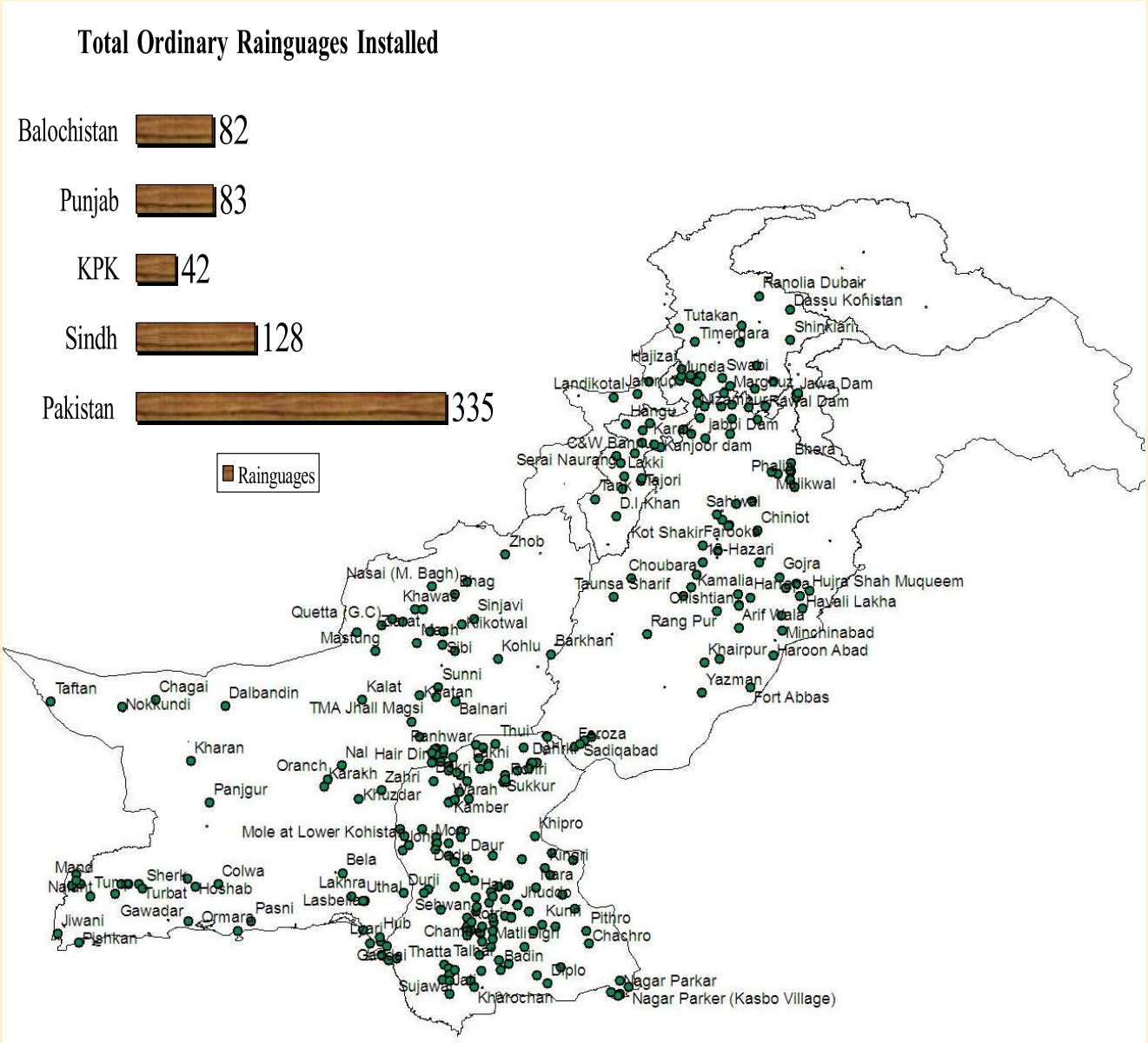

Figure-1: Rain-gauges network of Pakistan by NDMC

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 Paktunkhwa (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 (Oct-Dec) 2024

During the Fourth quarter of 2024 (Oct-Dec), Pakistan experienced above-average precipitation, recording a decrease of 29.0%. July saw significantly decreased rainfall, Specifically, Punjab, Sindh, and Baluchistan recorded below-average precipitation, with departures -40%, -12% and -66%, respectively, however, Khyber Pakhtunkhwa (KP), Kashmir and Gilgit Baltistan recorded above normal rainfall with departures 19%, 15% and 64%. In addition, November witnessed decrease in rainfall across all provinces with a departure range from 16% to 69% except Baluchistan. December witnessed below normal rainfall with -88% decrease in rainfall across Pakistan. Kashmir, Gilgit Baltistan, KP, Punjab, Sindh, Balochistan experienced a decrease in rainfall with departures -83.0%, -62%, -98%, -84%, -98% respectively.

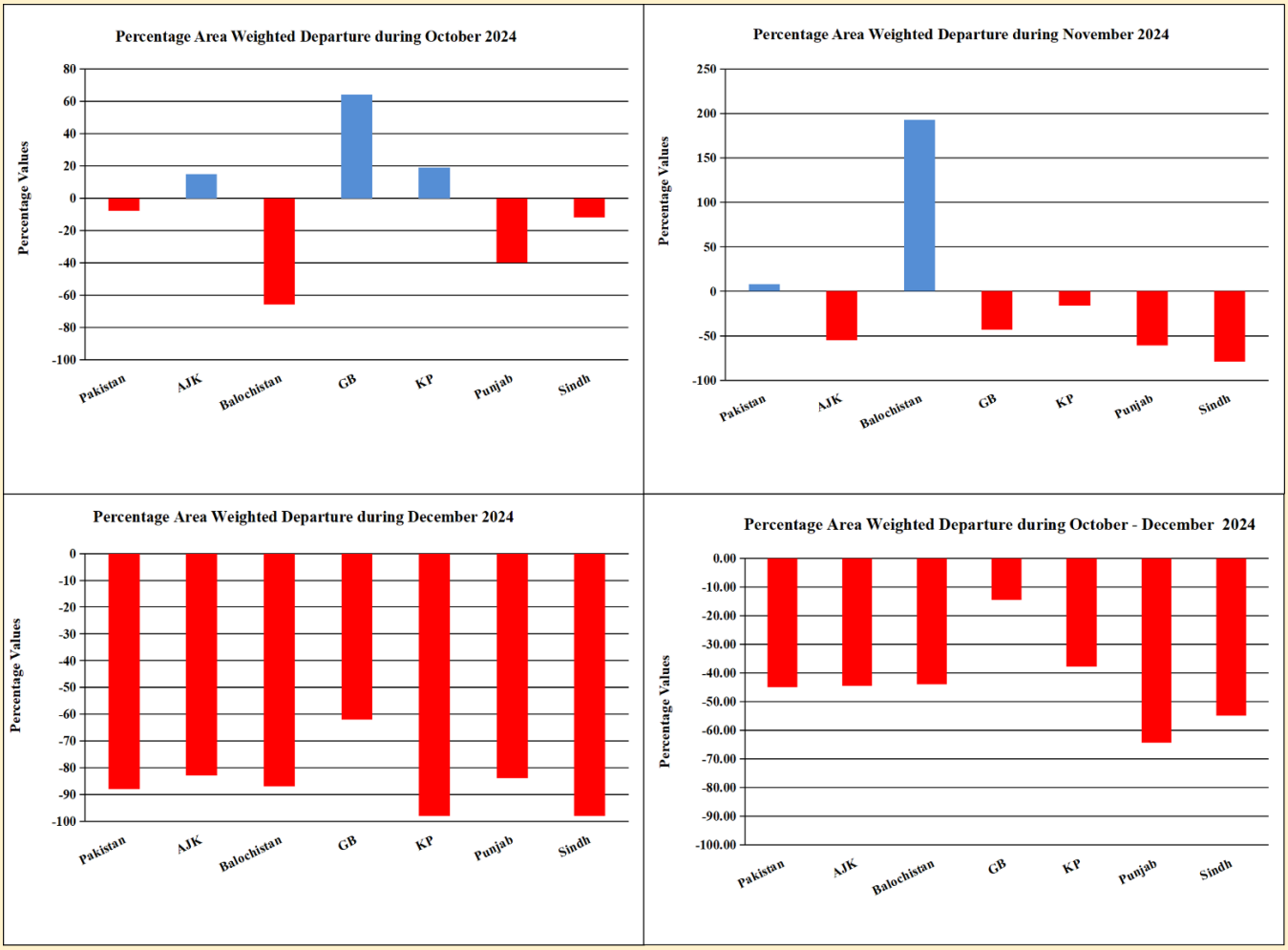

Figure-2: Percentage area weighted departure of rainfall during (October-December) 2024

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

Spatial distribution of rainfall during the quarter (Oct-Dec) is shown in Figure 3. During the quarter rainfall spells were observed throughout the country, principal amounts were observed in Upper KP (Hazara Division), Northeast Punjab, Northwest Baluchistan, Potohar region, Kashmir and adjoining areas of Gilgit Baltistan.

Below normal rainfall during October to December increased soil moisture deficit in drought vulnerable areas of Pakistan.

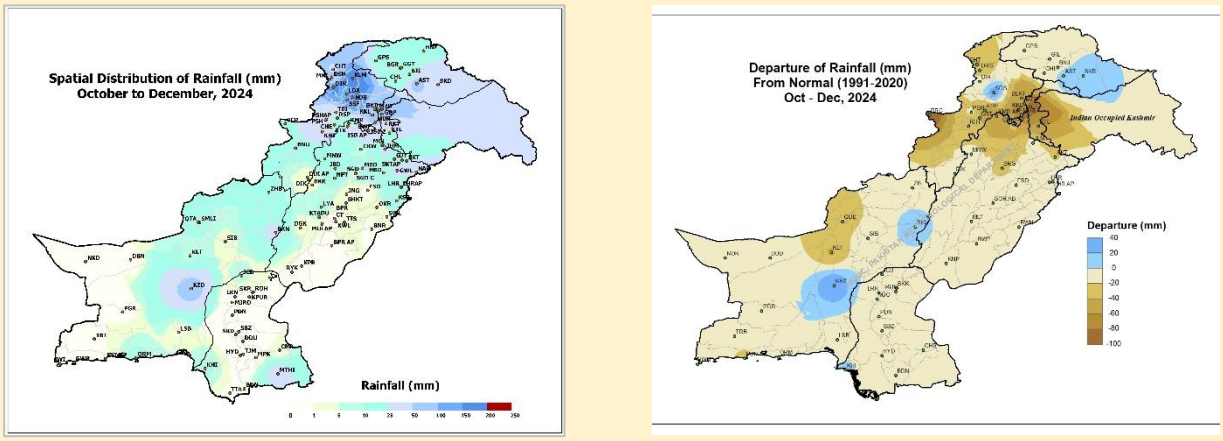

Figure-3: Spatial distribution and departure of rainfall during (Oct-Dec) 2024 in Pakistan

3.1 PMD Stations with highest rainfall (mm) (Oct- Dec) 2024

Rainfall Table					
S. No	**Station**	**Rainfall (mm)**	**S. No**	**Station**	**Rainfall (mm)**
1.	Kalam	193.5	11.	Astore	66.0
2.	Dir	185.5	12.	Kakul	62.2
3.	Malamjabba	171.0	13.	Mirkhani	60.2
4.	Saidu Sharif	140.0	14.	Drosh	55.8
5.	Pattan	114.0	15.	Murree	52.5
6.	Lower Dir	98.2	16.	Bacha Khan A/P	50.6
7.	Balakot	98.0	17.	Chaklala Airbase	50.0
8.	Muzaffarabad City	81.5	18.	Peshawar City	50.0
9.	Muzaffarabad Airport	76.4	19.	Peshawar Airbase	46.8
10.	Khuzdar	66.4	20.	G.Dopatta	44.4

3.2 The Maximum Length of Dry Spell

The maximum length of dry days spell (shown in Figure 4) was experienced in western Baluchistan particularly in Nokundi (228) and Dalbandin (160).

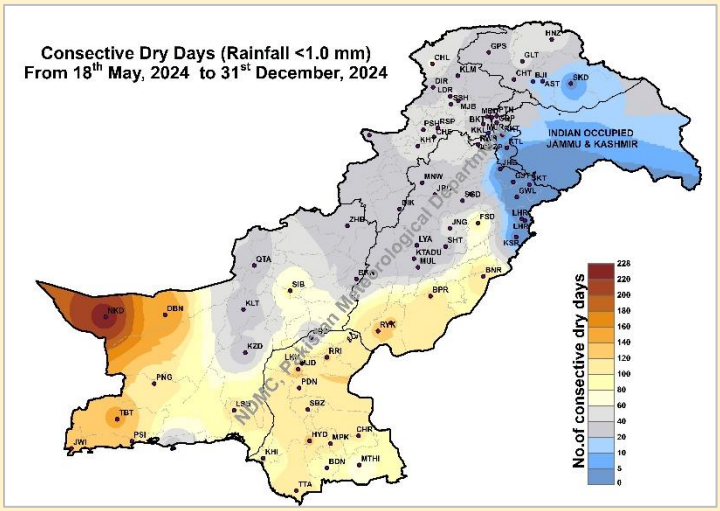

Figure-4: Maximum length of dry spell up to December 2024 in Pakistan

4. Drought Products

4.1 Drought Monitor

This drought monitor map (Figure 5) for December 2024 illustrates the varying degrees of drought severity across different regions of a country. The most severe condition, labeled as " Moderate Drought," is depicted in dark brown and affects the areas marked as Nokundi and Dalbandin. "Mild Drought" conditions are represented in pale yellow and are spread across multiple areas of the map. Regions not affected by drought are marked as "Normal" and are indicated in white, mainly located in the northern and some central parts of the map.

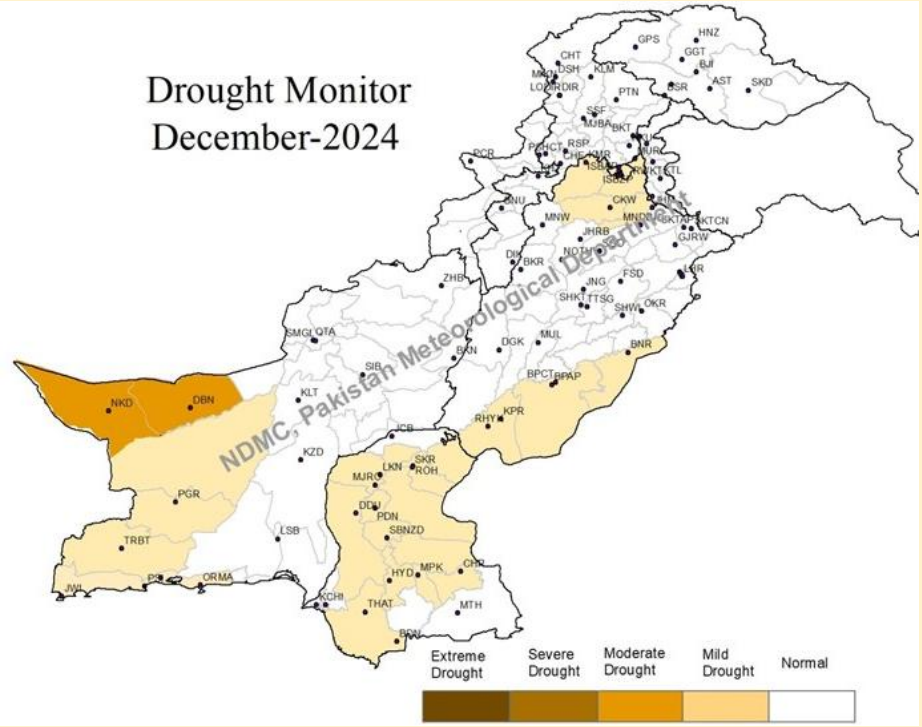

Figure-5: Drought conditions of Pakistan December 2024

4.2 Cumulative Precipitation Anomaly (CPA)

Cumulative Precipitation Anomaly (CPA) was calculated from 1st Oct, 2024 for each month. October, November and December 2024 CPA charts are shown below in Figure 6. Overall, northern areas of the country and southern KPK received below normal rainfall that is negative anomaly. However, central and southern parts of country have experienced positive anomaly that is above normal rainfall cumulative during the period.

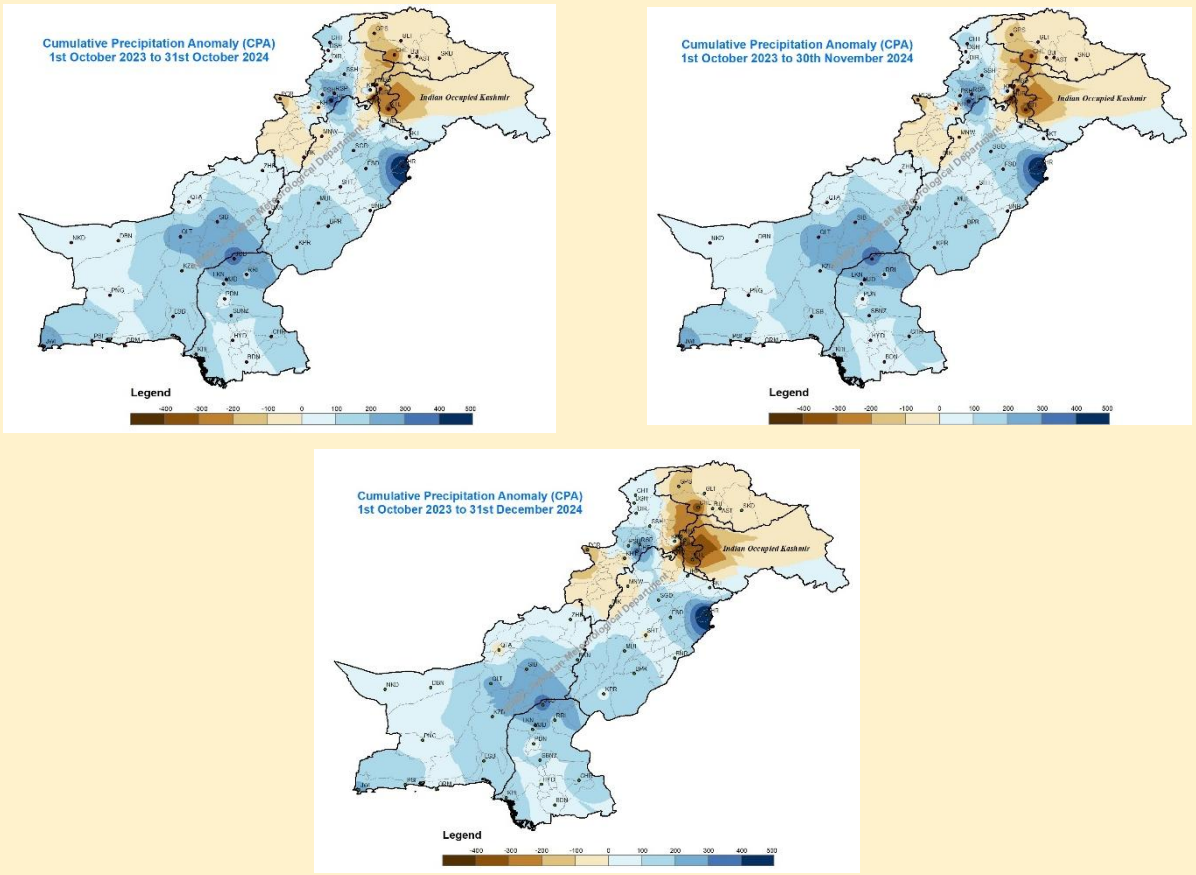

Figure-6: Cumulative precipitation anomaly during (Oct-Dec 2024 in Pakistan

4.3 Soil Moisture Anomaly (SMA)

It was observed that the amount of rainfall in some areas in the quarter 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 except Kashmir, Hazara division and Upper KP.

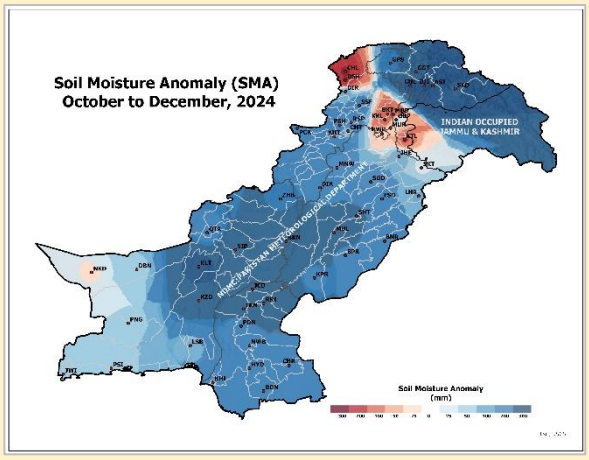

Figure-7: Soil moisture anomaly (Fourth Quarter)

4.4 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. 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 Tarbela dam in the month of December is above average, however, the water level (%) for Mangla is same as 21-year average.

The percentage of average water level from October to December 2024 calculated for both dams is shown below in Figure -7.

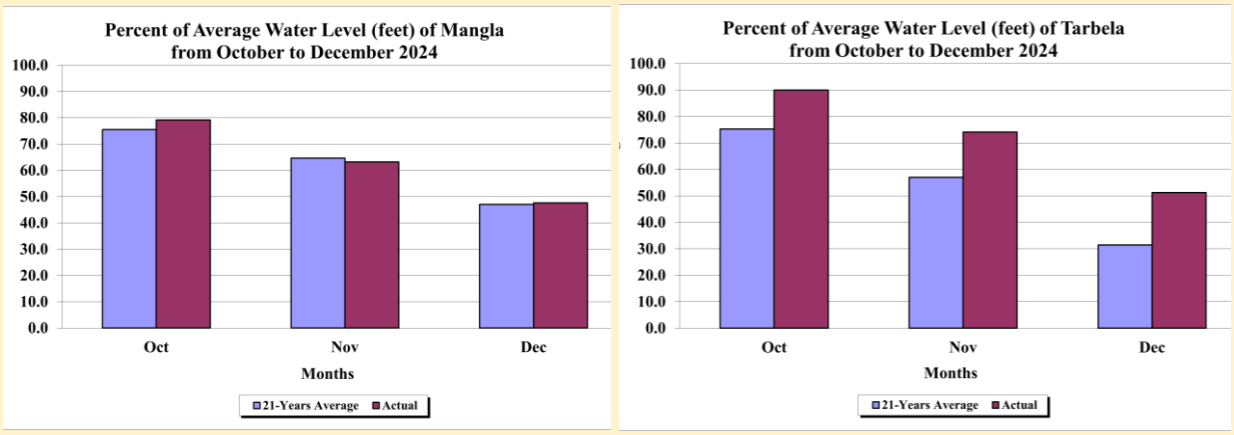

Figure-7 percent of the water level of Mangla and Tarbela during (Oct-Dec) 2024

5. District-wise impact of drought

During December mild drought like conditions were observed in western Baluchistan, Sindh, Southeast Punjab and Potohar region.

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 Rabi season (October-March) is shown in Figure 9.

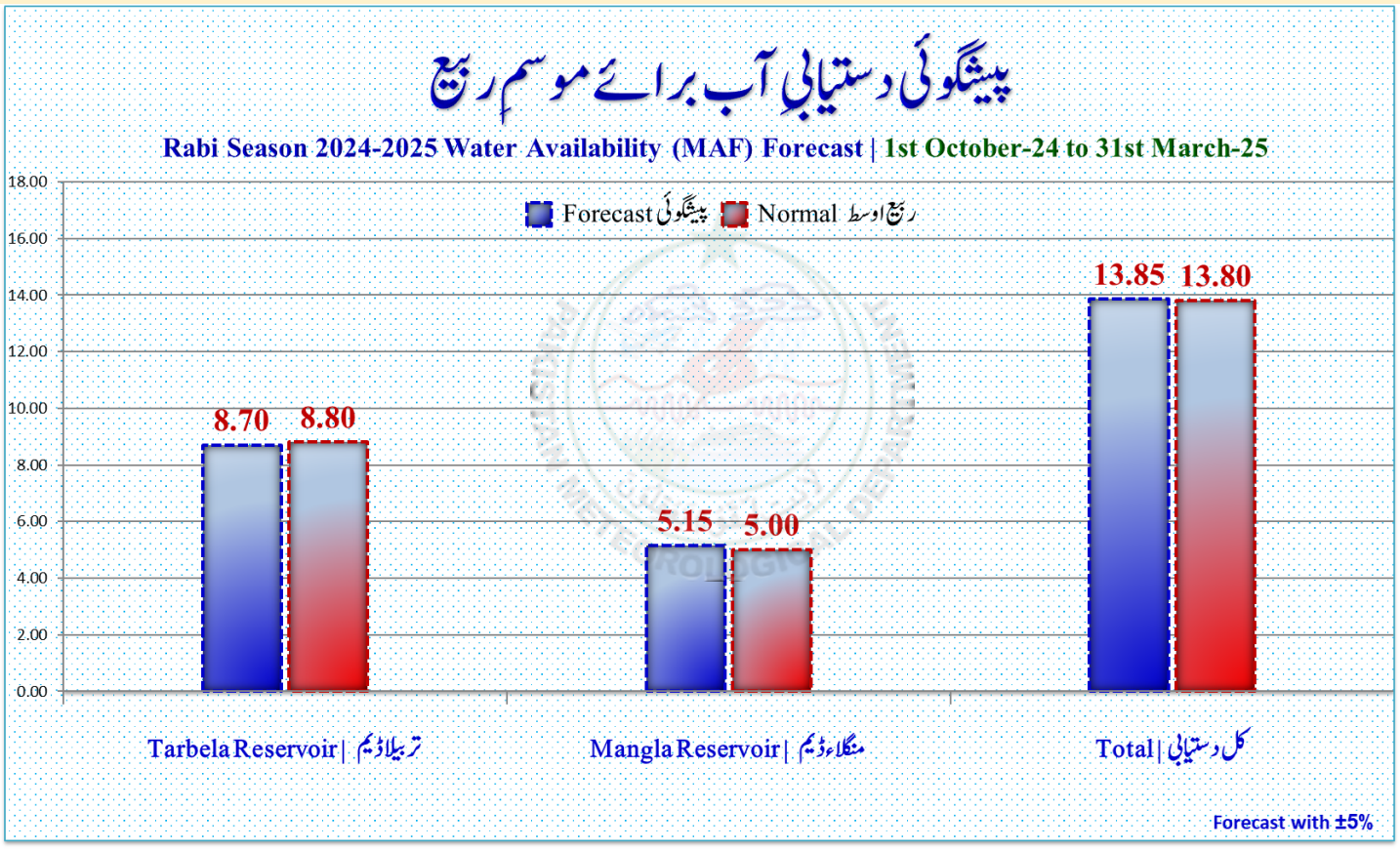

Figure-8 Rabi season forecast of Mangla and Tarbela dams

7. Crop Report: October-December 2024

Punjab

From September to November 2024 in Punjab, the transition through the agricultural seasons was marked by the nearing harvest of cotton and the grain-filling of rice and maize, leading to their harvesting despite below-normal rainfall and moisture stress. Preparations for the Rabi season included sugarcane cutting and sowing of wheat and winter vegetables.

Sindh

In Sindh, cotton reached the picking stage and rice was in the flowering to grain-filling phases, both requiring adequate moisture. The Rabi season saw the sowing of wheat and vegetables like onions, tomatoes, and cauliflower, though moisture stress was prevalent due to insufficient rainfall.

Khyber Pakhtunkhwa

Khyber Pakhtunkhwa experienced maize progressing from tasseling to grain-filling stages, with early varieties harvested and preparations made for wheat sowing. Cooler weather allowed for the sowing of vegetables and the harvesting of fruits like apples and pomegranates, supported by normal to above-normal rainfall.

Baluchistan

Balochistan’s agriculture involved the harvesting of fruits and the yielding of seasonal vegetables. Key Kharif crops like cotton and maize underwent crucial growth stages, with pulses like chickpeas and lentils prepared for Rabi sowing. Favorable rainfall in November supported the sowing of wheat, barley, mustard, and coriander.

Gilgit Baltistan

In Gilgit-Baltistan, maize advanced from tasseling to grain-filling, supported by adequate moisture. The growth of potatoes and pulses was strong, and fruits like peaches, cherries, and grapes were harvested, all benefiting from generally good rainfall conditions.

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.

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