

Pakistan Meteorological Department

Drought Bulletin Of Pakistan



January-March 2021

National Drought Monitoring Centre

Pakistan Meteorological Department

Sector H-8/2, Islamabad – 44000, P.O.Box#1214,

Phone # +92-51-9250598, Fax # +92-51-9250368

Website: www.pmd.gov.pk

Drought Bulletin

January – March, 2021

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Chief Editor: Mr. Jan Muhammad Khan, Director, NDMC, Islamabad.

Editor: Dr. Shahzada Adnan, Meteorologist, NDMC, Islamabad.

Quarterly Drought Bulletin

January – March, 2021

By

National Drought/Environment Monitoring & Early Warning Centre,
Pakistan Meteorological Department,
Islamabad

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 country lies between semi arid to very humid. Some regions of the country in each seasons, remain drastically dry and area always vulnerable to drought. If subsequent seasons fail to generate significant precipitation, the drought conditions then are sure to take the vulnerable regions in the grip. All the provinces of Pakistan have a history of facing major droughts in the past.

Drought differs from other natural disaster (e.g. flood, 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 results 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 situation arose, were taken on emergency and on adhoc basis. It is thus inevitable need of the time and Pakistan Meteorological Department (PMD) took an initiative to establish 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 drought situation in the country and issue advisory before time. Its national centre is in Islamabad while four Regional Drought Monitoring Centers (RDMC's) are in Lahore, Karachi, Peshawar and Quetta. These four RDMC's cover those regions which come under their jurisdiction. These centers serve as a hub for the monitoring,

collection, consolidation and analysis of drought related data from all the possible sources in the country. In order 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 Raingauges at districts level in four provinces as shown in figure-1.

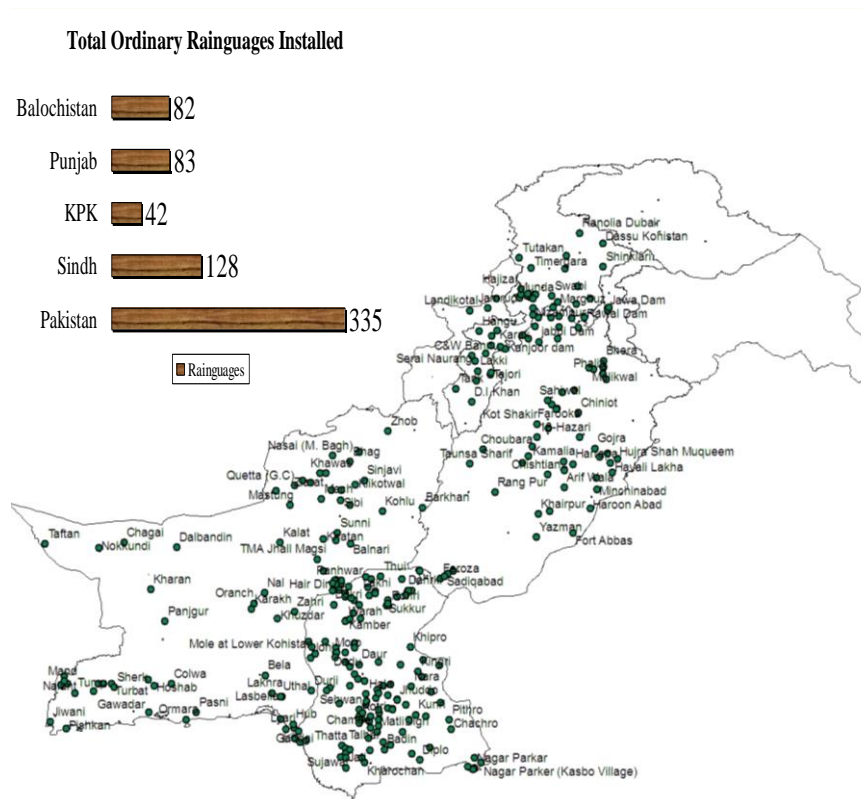


Figure-1 Rain-gauges Network of Pakistan by NDMC

NDMC is monitoring the water level situation of small dams also in Barani areas of the country. NDMC using 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 fortnightly drought bulletin of the country. Negotiations are underway with NGO's and National Disaster Management Authority (NDMA) for utilization of drought advisories / bulletin to end users.

2. Historical Background

The Indian sub-continent is predominantly characterized by a tropical monsoon climate and 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 monsoon. There are two rainfall systems operating in the region (a) Southwest or summer monsoon and (b) Northeast or the winter monsoon.

Fortunately Pakistan also falls in this region which receive 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, summer monsoon accounts 60 to 70% of the annual rainfall during July to September (Chaudhry, 1992). There is a large variability in the monsoon rainfall on both space and time scales.

Droughts in Pakistan region are mainly due to failures of rains from 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 country. The study conducted at National Drought Monitoring Centre (NDMC) of PMD revealed that the province of Sindh and Balochistan are the more vulnerable to drought. The long term data analysis of past sixty years (1951-2010) different intensity (mild to extreme) of drought were experienced in the country i.e. 31 in Sindh, 23 in Balochistan, 22 in Punjab and 18 in Khyber Pakhtunkhwa. The longest episode of drought was experienced during 1999-2001. The Punjab province experienced the worst droughts in 1899, 1920 and 1935, 1969, 1987-88, 2000-01, Khyber Pakhtunkhwa (KP) 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 and 2018 while Balochistan had 1952, 1963-64, 1965, 1968, 1970-71, 1983-84, 1987-88, 1999-2002, 2004, 2006 and 2018. Over more than hundred year's period between 1871-1988, 11 out of 21 drought years were El Nino years.

Due to climate change, some years we receive more rains in wet spell and in dry spell we receive less rain. Due to less rain we have drought and heavy rain we have floods (flash flood, urban flood, costal flood and riverine flood).

3. Rainfall Distribution (Jan-Mar) 2021

During the first quarter of the year (Jan-Mar) 2021, below normal (-48.46%) precipitation was observed over Pakistan. During this quarter, high temporal and spatial variable precipitation

has been observed. Normally, January and February are the coldest month in the country. The northern areas and south-western parts received good amount of rainfall during winter. The rainfall was well below normal (-55.81%) during January in the country. The rainfall departure was normal to near normal in Punjab (14.81%) and GB/Kashmir (8.84%) whereas, it was well below normal in Balochistan (-100.0%), Sindh (-100.0%) and Khyber Pakhtunkhwa (-78.02%). Similarly, the rainfall was observed well below normal during February (-88.87%) in Pakistan. The rainfall was well below normal in Sindh (-100.0%), Balochistan (-96.3%), Punjab (-93.7%), Khyber Pakhtunkhwa (-72.38%) and (-62.76%) in GB/Kashmir. The rainfall was observed near normal during March (-12.9%) in Pakistan with a maximum positive increase (4.2%) in Khyber Pakhtunkhwa and negative decrease (-68.2%) in Sindh and (-53.2%) in Balochistan. The figure-2 shows the percentage area weighed departure of rainfall occurred during (Jan-Mar) 2021. The below normal rainfall has created the drought like situation over drought prone regions of Sindh and Balochistan. Based on quarterly analysis, rainfall distribution was well below normal over Sindh (-89.24%), Balochistan (-81.30%), Punjab (-28.93), Khyber Pakhtunkhwa (-38.21%) and Gilgit-Baltistan and Kashmir (-18.41%), as shown in figure-2

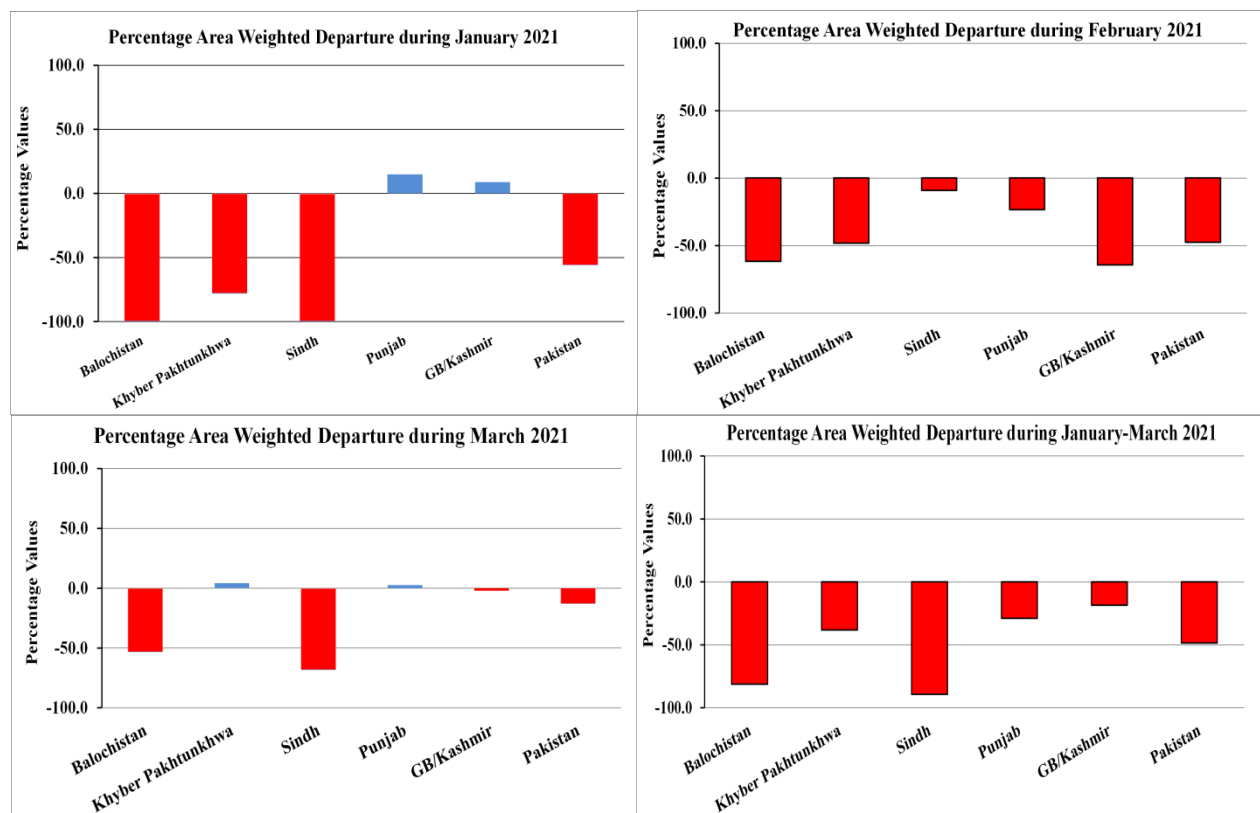


Figure-2 Percentage departure of rainfall during (Jan-Mar) 2021

During the quarter (January-March) rainfall spells were observed throughout the country especially in Punjab, Sindh and Balochistan. These rains reduced moisture stress on wheat crops in rainfed areas. Above normal rainfall during January and March lessen the moisture and water stress and provided a significant relief in drought vulnerable areas of Pakistan. The monthly and seasonal analyses on regional and country basis are as shown below in figure 3.

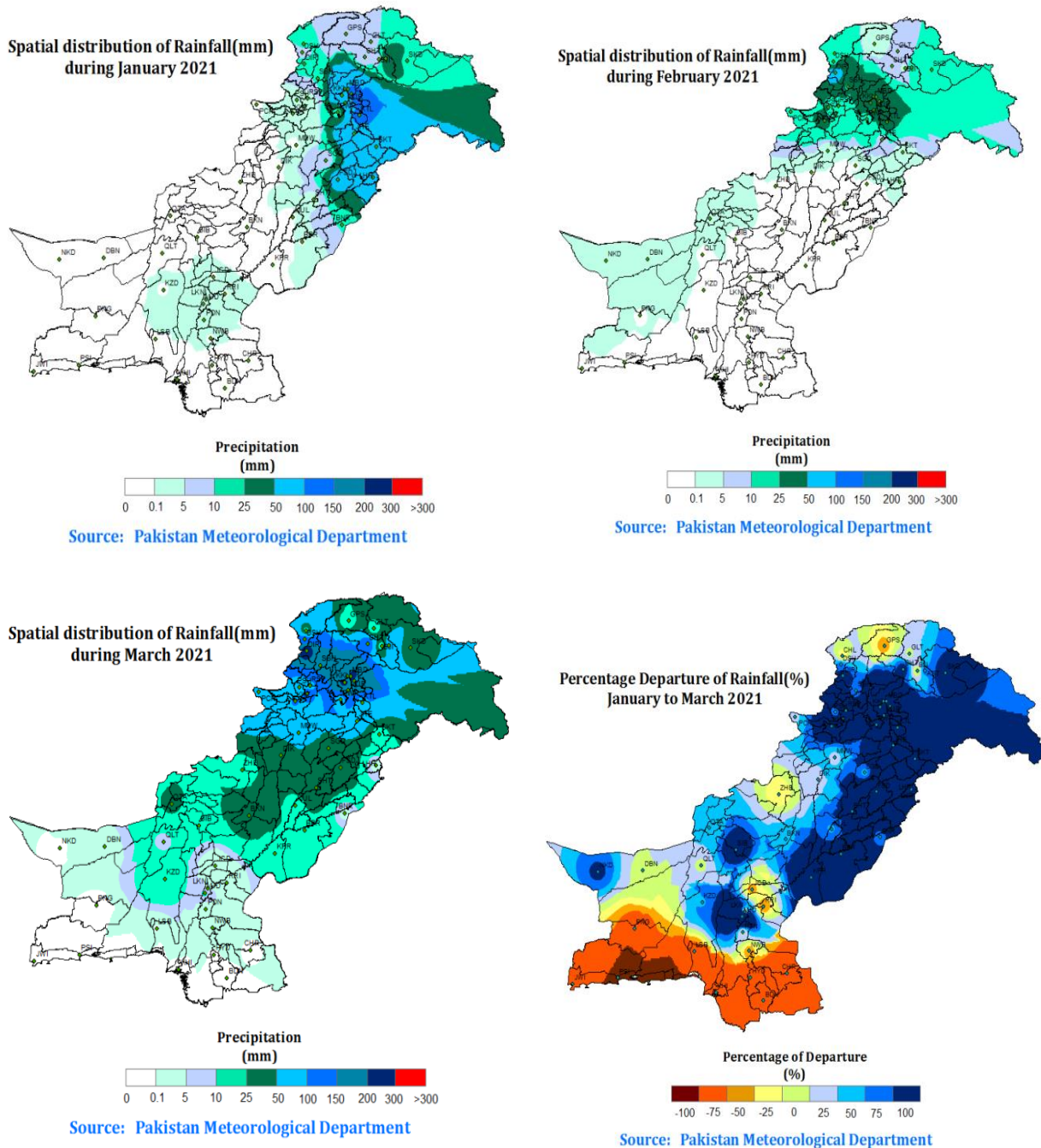


Figure-3 spatial distribution of rainfall during (Jan-Mar) 2021 of Pakistan

- **Rainfall**

During **January 2021**, 2-3 countrywide rain spells were received with light to moderate rainfall.

January2021					
S. No.	Stations	Rainfall (mm)	S. No.	Stations	Rainfall (mm)
1	Bandi Abbaspur	174.8	11	Tandali	105.5
2	Chakothi	168.2	12	Sialkot Airport	101.7
3	Hajira	165.3	13	W.S.R Mangla	87.7
4	Garhi Dopatta	131.4	14	Jhelum	87.2
5	Chattar Kalas	123.0	15	Barnala	86.4
6	Kotli	120.0	16	Hafizabad	75.5
7	Rawalakot	111.2	17	Gujranwala	73.6
8	Muzaffarabad Airport	110.3	18	Lahore Airport	73.4
9	Panjera	108.0	19	Murree	68.8
10	Gujrat	107.0	20	Brarkot	68.3

During **February 2021**, 2-3 wide spread rain spells were received throughout the country.

February2021					
S. No.	Stations	Rainfall (mm)	S. No.	Stations	Rainfall (mm)
1	Kalam	92.6	11	Buner	37.3
2	Pattan	89.0	12	G7arhi Dupatta	36.0
3	Dir	78.0	13	Kotli	35.0
4	Bandi Abbaspur	75.5	14	Haraman	34.3
5	Hajira	66.7	15	Kohat Airbase	31.5
6	Rawalakot	61.6	16	Muzaffarabad City	31.1
7	Chakothi	53.6	17	Tandali	30.5
8	Balakot	50.5	18	Panjera	29.8
9	Malamjabba	49.0	19	Mirkhani	28.2
10	Besham	47.8	20	Murree	28.1

During **March 2021**, 3-4 wide spread rain spells were received throughout the country.

March2021					
S. No.	Stations	Rainfall (mm)	S. No.	Stations	Rainfall (mm)
1	Dir	249.6	11	Brarkot	204.2
2	Malam Jabba	247.0	12	Garhi Dupatta	196.5
3	Pattan	237.0	13	ChattarKalas	179.0
4	Tandali	232.8	14	Balakot	165.8
5	Chakothi	229.9	15	Murree	164.0
6	Haraman	220.9	16	Saidu Sharif	161.0
7	Muzaffarabad (A/P)	220.5	17	Chitral	147.3
8	Kakul	215.0	18	Mir Khani	146.0
9	Rawalakot	214.2	19	Buner	142.5
10	Kalam	210.6	20	Besham	140.4

- **Temperature**

Maximum temperature remained 2-5°C less compared to last five years during this quarter. Minimum temperature during early January remained well below normal, and further decreased during the second half of the month. In January, severe cold wave (20-25) days was observed in most parts of the country due to which temperature fell below zero degree in the agricultural plains of the country including Sindh.

- **Mist and Fog Development**

Mist and Fog are atmospheric natural phenomena where small water droplets become suspended in air for a longer period of time. The water vapors condense into fog when ambient temperatures become cooler. In South Asian region, fog formation starts from foothills of Himalayas in India and moves towards the eastern parts of Pakistan in Punjab. It finally covers large parts of Punjab, major areas of Sindh crossing into adjoining districts of Balochistan across Sibbi, southern parts of Khyber Pakhtunkhwa mainly around Indus River. Dense fog covered upper half of the country about two weeks earlier compared to last year due to lower temperatures. This fog continued for almost the second half of December up to the mid of February.

4. Drought products

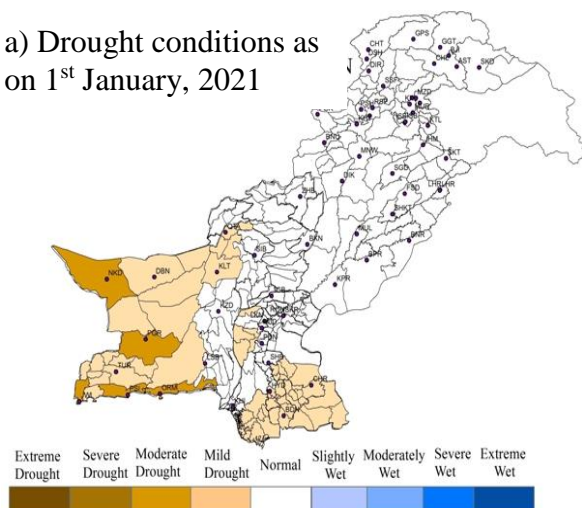
i. Standardized Precipitation Index (SPI)

The Standardized Precipitation Index (SPI) was developed for the purpose of defining and monitoring 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.

As predicted by Pakistan Meteorological Department (PMD), the country overall received below normal (-41.5%) rainfall during (Oct-20 to Mar-21). The main thrust was in Balochistan (-74.5%) and Sindh (-77.3%) while it remained above normal during November throughout the country. The west to the south-west districts of Balochistan are winter (Dec-Mar) rainfall dominant and do not receive rainfall during April to November. Due to deficient of pre-winter and winter rainfall, a moderate drought like condition emerged in the southern parts of Balochistan and Sindh (Fig-4). The moderate drought is prevailing in districts of Balochistan (**Chagi, Gawadar, Harnai, Kech, Kharan, Mastung, Nushki, Pishin, Panjgur and Washuk**) and Sindh (**Badin, Qambar Shahdadkot, Mirpur Khas, Umerkot, Sanghar, Tharparkar, Thatta and Sajwal**). The

climatological normal shows that the Sindh province remains dry during October to May, and moderate drought prevailed during these months.

a) Drought conditions as on 1st January, 2021



b) Drought conditions as on 31st March, 2021

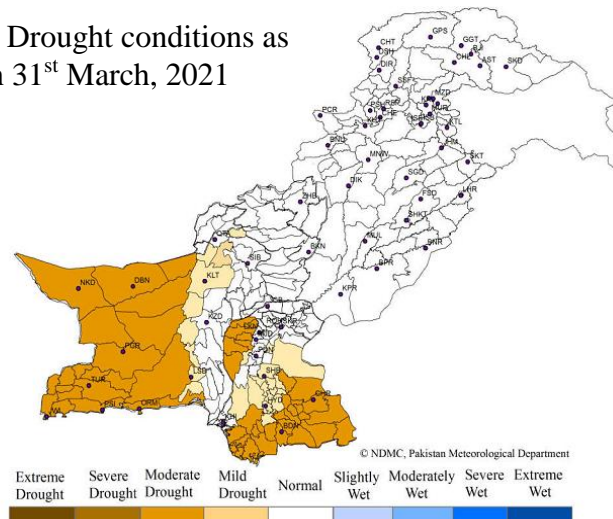


Figure-4 Drought conditions of Pakistan during January to March 2021.

Note: The drought monitor is prepared on the basis of different drought indices.

ii. Cumulative Precipitation Anomaly (CPA)

January is the coldest month of the year for Pakistan. Due to lower solar angle, active western disturbance and sometimes due to the extension of secondary disturbances of fronto-genetic systems, higher latitudes of the country are cooler than the lower latitudes. At high elevations, the frequency of occurrence of freezing temperature is highest in January as a normal feature. Westerly waves would continue to move along the middle latitudes and their troughs are expected to extend south-wards occasionally affecting country's agricultural plains.

During February, the days were cooler and night's temperatures were very cold. Such daytime and night temperatures resulted into below normal mean daily temperatures throughout the cultivated plains of the country. In this way temperature regime during February remained less favorable for Rabi crop's growth and development process. The soil moisture reserves were available and lower temperatures retarded evapo-transpirative loss of moisture.

March is normally the wettest month of the winter season. Heating starts over the subcontinent due to increasing solar angle and the sunshine over the equator during last decade of the month. Heating trend triggers energetic weather systems, which resulted in increasing number of dust / wind storms and precipitation. March marks substantial addition to Rabi season, precipitation and rising temperatures contribute significantly in photosynthesis process

During January to March 2021, it was observed that Cumulative Precipitation Anomaly was negative in the country. Therefore, conditions are becoming un-satisfactory and moisture stress has been observed due to below normal rainfall in the country which created drought (moderate) situation in southern half of Pakistan. However, the extreme cold wave gripped the whole country due to which the minimum temperature was observed below the freezing level in most parts of the country during January.

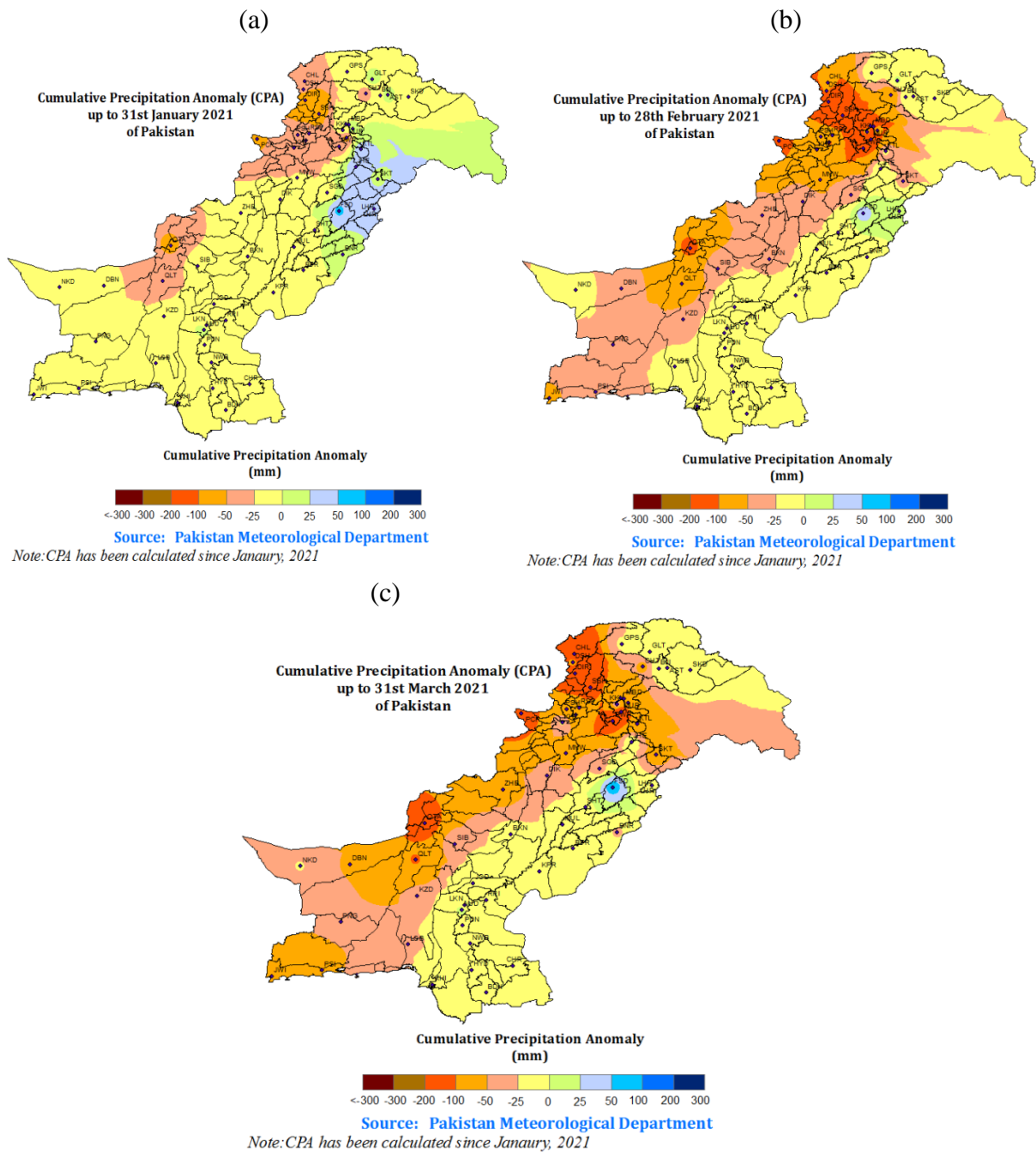


Figure 5: Cumulative precipitation anomaly during (Jan-Mar) 2021 of Pakistan

iii. Soil Moisture Anomaly (SMA)

It was observed that the amount of rainfall during January to March was well above normal in the country as shown in figure 6. Soil moisture conditions are near normal after the slight stress of soil moisture during the previous quarter (October-December) 2019, in southern parts of Pakistan. Above normal rainfall during January-March 2021 provided a significant relief to soil moisture stress and conditions are back to normal in most of the southern parts of Pakistan.

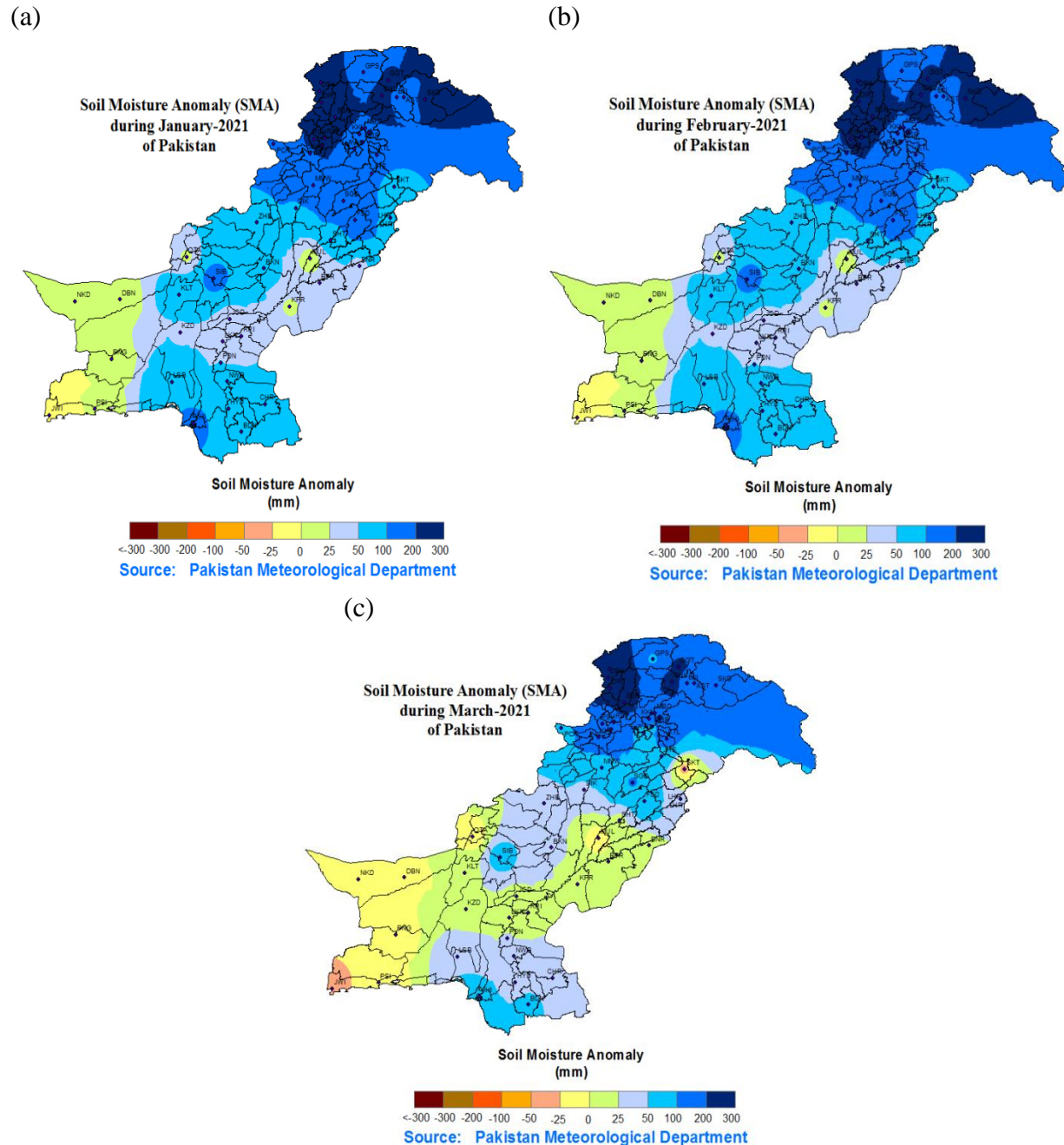


Figure 6: soil moisture anomaly during (Jan-Mar) 2021 of Pakistan
(Courtesy http://www.cpc.ncep.noaa.gov/soilmst/glb_lb/curr.w.anas.gif)

iv. Water Level of Reservoirs

Pakistan has two main reservoirs of water in the form of dam, i.e. Tarbela and Mangla. The dead level of Tarbela is 1378feet and its maximum conservation level is 1550feet while Mangla has dead level of 1040 feet and maximum conservation level of 1242feet. The water level of Mangla and Tarbela reservoir has improved and it was well above normal due to above normal rainfall experienced in the catchment areas of these two reservoirs. Percentage of average water level during January to March 2021 was calculated for both dams are shown below in figure 7.

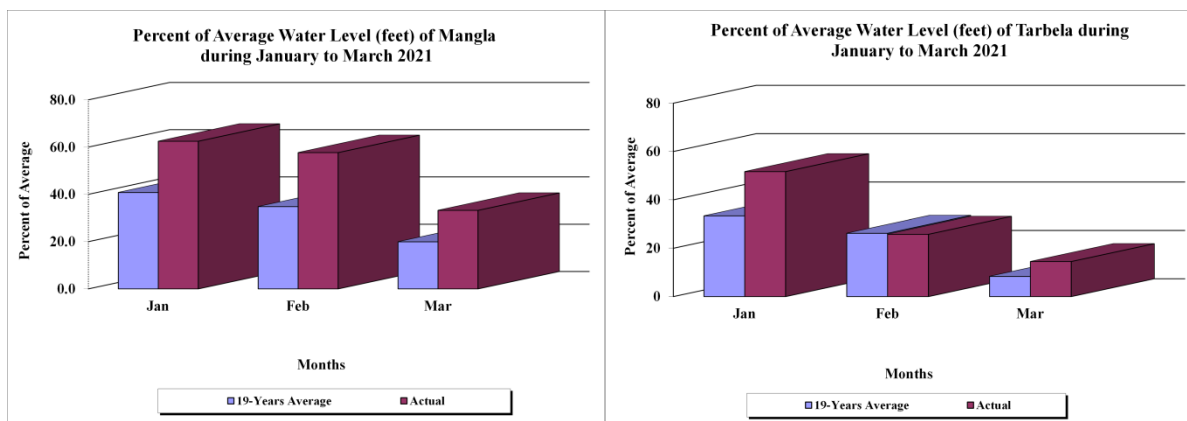


Figure 7:Percent of water level of Mangla and Tarbela during (Jan-Mar) 2021

5. District wise impact of drought

Due to above than below normal rainfall during this quarter of the year, mild to moderate drought have been reported from southern parts of the country especially Balochistan and Sindh. The districts of Balochistan (**Chagi, Gawadar, Harnai, Kech, Kharan, Mastung Nushki, Pishin, Panjgur, Kalat, Quetta and Washuk**) and Sindh (**Badin, Qambar Shahdadkot, Mirpur Khas, Umerkot, Sanghar, Tharparkar, Thatta and Sajwal**) experienced moderate drought conditions. In this regard, NDMC issued drought advisory on 18th February, 2021for stakeholders.

6. Drought Advisory

The most districts of west to south west Balochistan are winter rainfall dominant and rainfall amount lies between 71 to 231mm. Due to deficient winter rainfall, moderate drought like condition has emerged over most of the central and southern districts of Balochistan. The west to the south-west districts of Balochistan are winter (Dec-Mar) rainfall dominant and do not receive rainfall during April to November. According to the climatological normal (1981-2010), Sindh province remains dry during October to May, whereas, the rainy season prevails from June to September. The mild drought conditions are prevailing in south eastern parts of Sindh. Due to

deficient of pre-winter and winter rainfall, a moderate drought like condition has emerged in the southern parts of Balochistan and Sindh



Pakistan Meteorological Department

National Drought Monitoring Centre (NDMC)

Meteorological Headquarters

Islamabad, Pakistan

Islamabad, 18th February, 2021

SUBJECT: DROUGHT ADVISORY-I

As predicted by Pakistan Meteorological Department (PMD), the country overall received below normal (-31.0%) rainfall during (Oct-20 to Jan-21). The main thrust was in Balochistan (-73.2%) and Sindh (-70.2%) while, it remained above normal during November throughout the country. The rainfall departure (%) detail is as under:

Table-1 Area weighted rainfall departure (%) during October 2020 to January, 2021

	2020			2021	Oct-2020 to Jan-2021
	October	November	December	January	
Balochistan	-100.0	98.5	-74.2	-100.0	-73.2
Sindh	-100.0	68.8	-54.9	-100.0	-70.2
KP	-94.8	246.5	-29.2	-73.7	-12.9
Punjab	-100.0	153.3	-14.1	86.7	9.8
GB/Kashmir	-100.0	54.2	-11.3	46.9	4.3
Pakistan	-98.3	157.3	-43.6	-45.9	-31.0

- The most districts of west to south west Balochistan are winter rainfall dominant and rainfall amount lies between 71 to 231mm. Due to deficient winter rainfall, moderate drought like condition has emerged over most of the central and southern districts of Balochistan (Fig-1). The mild to moderate drought is prevailing in most parts of Balochistan (**Chagi, Gawadar, Harnai, Kech, Kharan, Mastung Nushki, Pishin, Panjgur, Kalat, Quetta and Washuk**). According to the climatological normal (1981-2010), Sindh province remains dry during October to May, whereas, the rainy season prevails from June to September. The mild drought conditions are prevailing in south eastern parts of Sindh (Fig-2).
- Keeping in view the climatology and current seasonal forecast of PMD for these areas, drought conditions may exacerbate and affect the agriculture and live stocks and its adjacent districts. Dry conditions will cause water stress in the cultivated lands/areas of the country due to limited supply of irrigation water for Rabi crops.
- It is advised to all stakeholders to take pre-emptive measures for disaster prone districts. Farmers/agriculturists are advised to keep themselves updated from PMD website <http://www.pmd.gov.pk>.
- NDMC is continuously monitoring drought situation over the country and keeping the stakeholders and general public updated by issuing drought information on fortnightly and monthly basis.


Jan Muhammad Khan
 Director (NDMC)
 Phone #: 051-9250598
 Fax #: 051-9250368

7. Kharif season forecast of Mangla and Tarbela Dams (2021)

The predicted water availability forecast (MAF) forecast in two big reservoirs i.e. Tarbela and Mangla during Kharif season (April-September) 2021 is shown in figure 8.

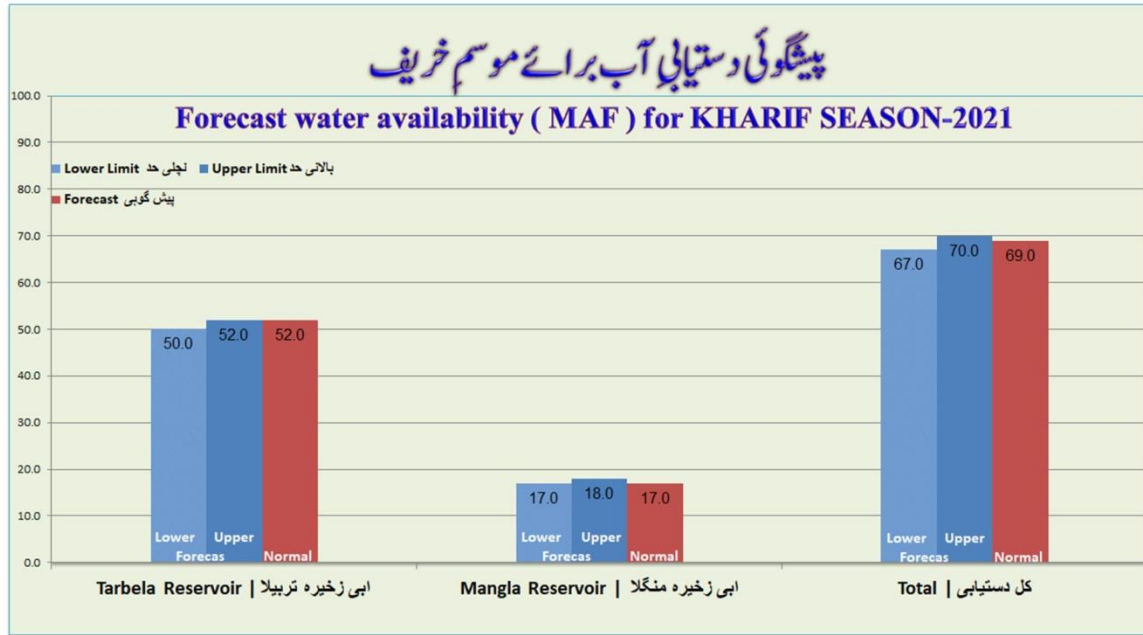


Figure 8: Forecasted water volume (MAF) for Kharif Season 2021 in Tarbela and Mangla

8. Recommendations

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. Water situation in the dams have improved due to the above rainfall and will further improve with the increase of temperature after mid April. It is, therefore, advised to all stakeholders for an immediate water management strategy to avoid drought impacts on agriculture sector in future. NDMC continued its monitoring activities and drought monitor was regularly updated on weekly basis at PMD website <https://ndmc.pmd.gov.pk/new>

9. Acknowledgement

National Drought Monitoring Centre (NDMC), Pakistan Meteorological Department, Islamabad acknowledges, National Agromet Centre PMD, Islamabad, SUPARCO, CPC, NOAA, and NDMA for sharing the information.

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