Pakistan Meteorological Department

Drought Bulletin of Pakistan

January-March 2013

National Drought Monitoring Centre

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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 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 region which comes 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 strength 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 (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 Rainguages have been installed at districts level in four provinces as shown in figure-1

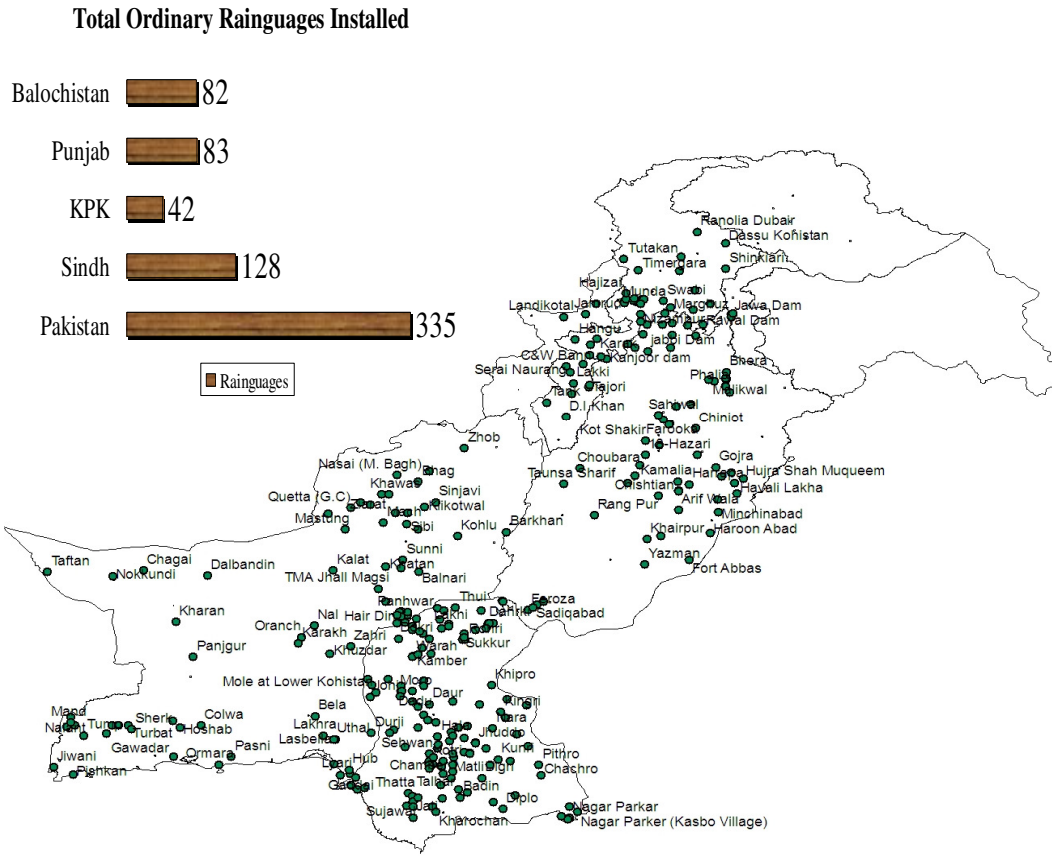


Figure-1 Rain-gauges Network of Pakistan by NDMC

NDMC also monitoring the water level situation of small dams 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 various kinds of 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 several droughts. The Punjab province experienced the worst droughts in 1899, 1920 and 1935. Khyber Pakhtunkhwa (KPK) experienced the worst droughts in 1902 and 1951, while Sindh had its worst droughts in 1871, 1881,1899,1931,1947 and 1999. Over more than hundred year's period between 1871-1988, 11 out of 21 drought years were El Nino years. The El Nino phase of the Southern Oscillations (ENSO) has direct impact on drought in Pakistan as it poses mainly negative impact on summer monsoon.

Due to climate change, wet and dry cycles 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 river flood).

3. Rainfall Distribution (Jan–Mar) 2013

During first quarter of the year (Jan-Mar) 2013, above-normal (+62 %) 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 and northern areas

and southern western parts receive good amount of rainfall. The rainfall amount was well above normal as predicted by Pakistan Meteorological department in seasonal forecast. During January2013, highest rainfall departure was observed in Balochistan (-97%) and lowest in Gilgit-Baltistan (-22%). Unlike January, February was the wettest month of the first quarter in which above normal rainfall was observed through out the country. Highest departure of rainfall was again observed in Balochistan (+157%) and lowest in Gilgit-Baltistan (+29%) during February 2013. During March 2013, Amount of rainfall was in well below normal in Sindh (-89%), Gilgit-Baltistan (-61%) while it was well above normal (+68%) in Balochistan. The figure shows the percentage area weighed departure rainfall occurred during (Jan-Mar) 2013. In Pakistan, it was above normal (+62%) during the first quarter of 2013. Viewing the rainfall distribution on province basis, over Balochistan, Punjab and Sindh it was highly above-normal (+127%), (+88%) and (+60%) respectively, over Khyber-PK (+34%) and moderately below normal (-55%) in Gilgit-Baltistan as shown in figure-2

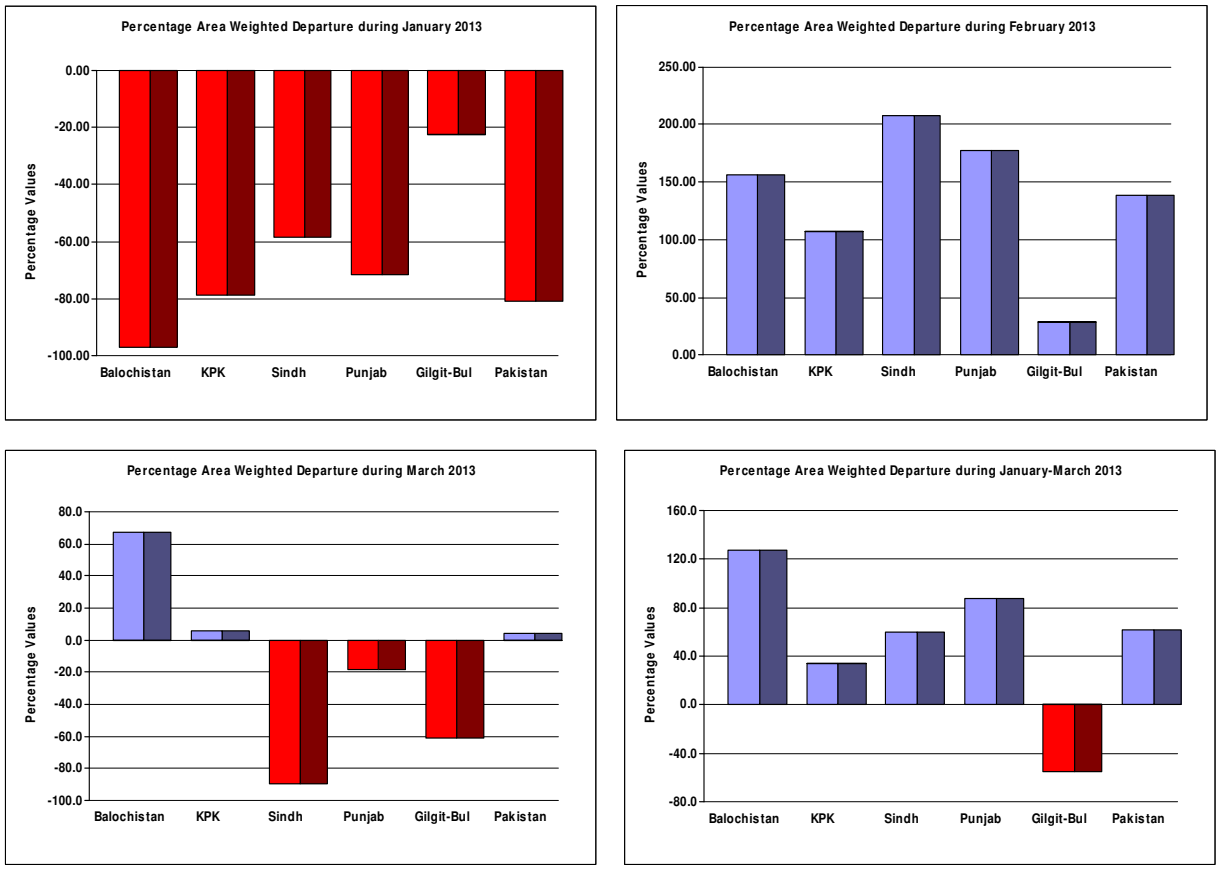


Figure-2 Percentage departure of rainfall during (Jan-Mar) 2013

. The monthly and seasonal analyses on regional and country basis are as shown below in figure-3.

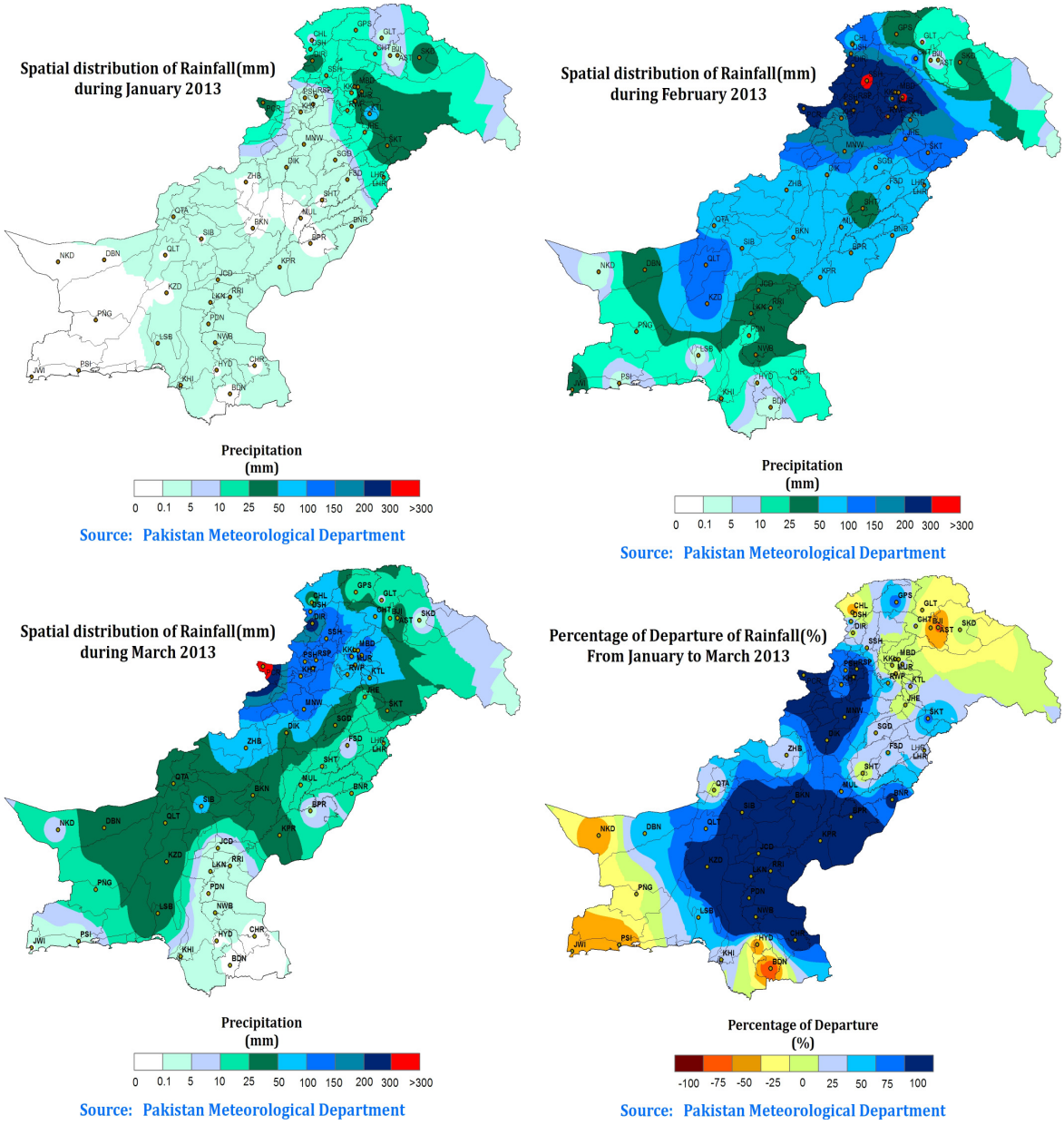


Figure-3 spatial distribution of rainfall during (Jan-Mar) 2013 of Pakistan

- **<u>Mist and Fog Development</u>**

Mist and Fog are atmospheric natural phenomena where small water droplets become suspended in air for longer period of time. The water vapors condense into fog when ambient temperatures become cooler. In South Asian region, fog formation starts from foot hills 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.

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..

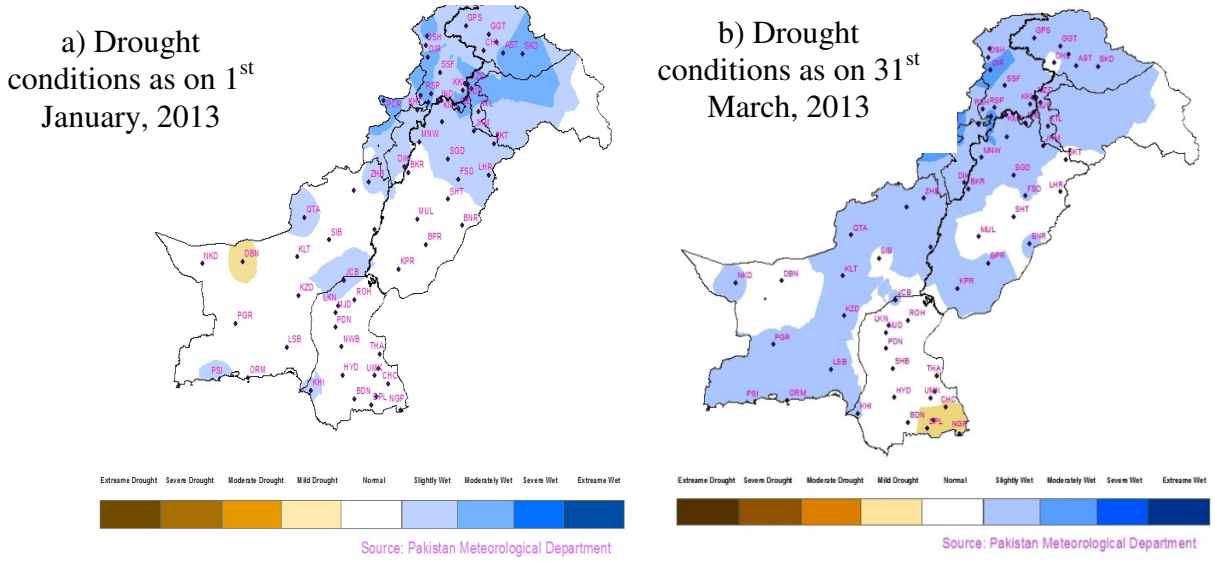


Figure-4 Drought conditions of Pakistan

Due to deficient rainfall, drought like conditions has emerged in southeastern parts of Sindh. However, an appreciable amount to rainfall has been recorded over agricultural plains of the country that fulfilled the demands of irrigation water for rabi crops which were at grain formation stage.

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 extension of secondaries of frontogenatic systems at higher latitudes of the country are cooler than the lower latitudes independent of elevation of the location. 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 ward 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 favourable for Rabi crop's growth and development process. The soil moisture reserves were available and lower temperatures retard evapotranspirative loss of moisture.

March is normally the wettest month of winter season. Heating starts over the subcontinent due to increasing solar angle and the sun shine 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 2013, it was observed that Cumulative Precipitation Anomaly was positive in southern and central parts except some of the barani areas, extreme north and south western parts of Balochistan. Most parts of Eastern Sindh are under flood water because of monsoon 2011 intense rainfall. The day time temperature is low and Evapotranspiration is relatively stumpy as compare to the previous quarter therefore conditions are satisfactory and no moisture stress has observed especially lower and central regions of the country. While the barani areas of KPK and Potohar regions are under water stress.

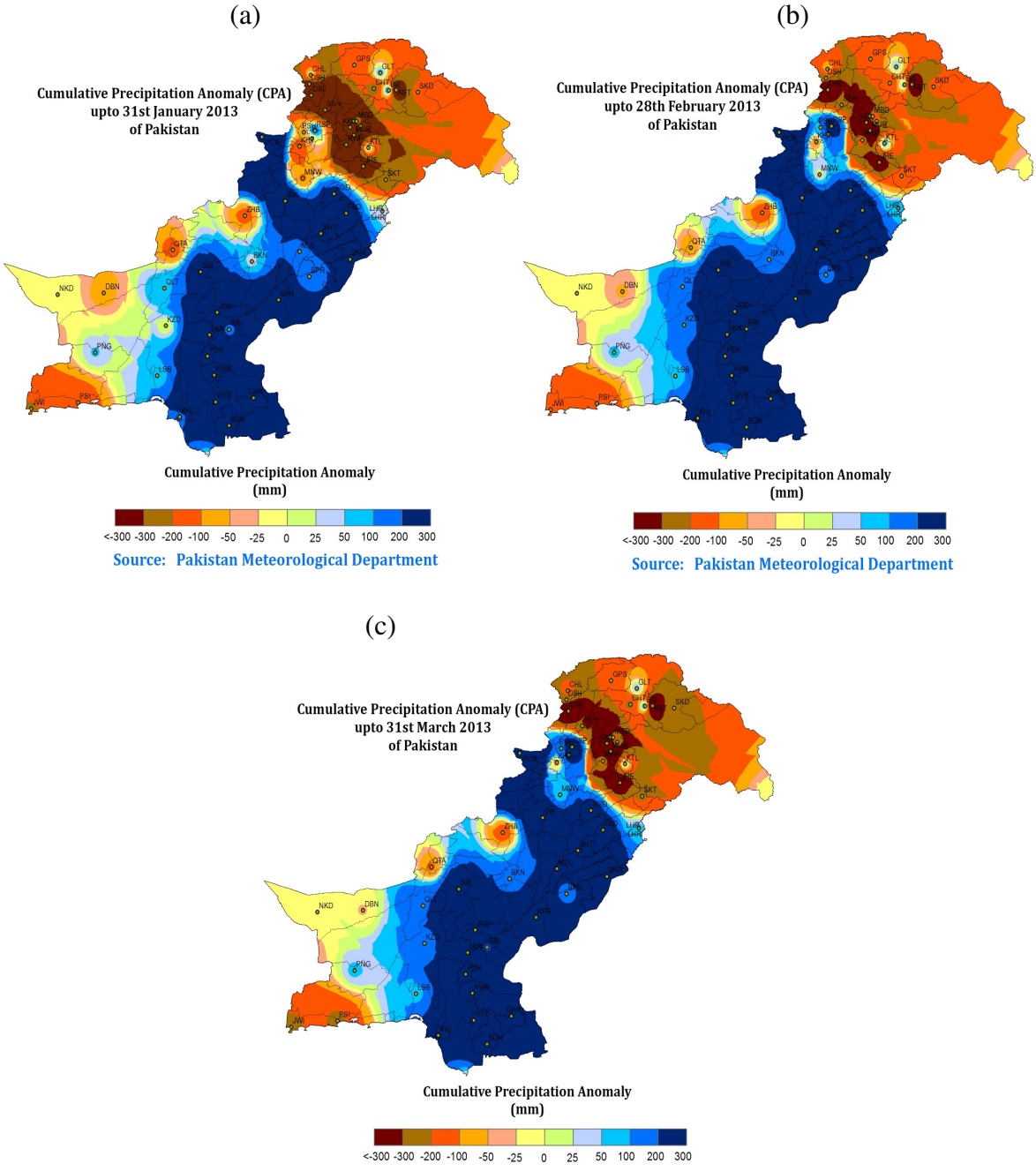


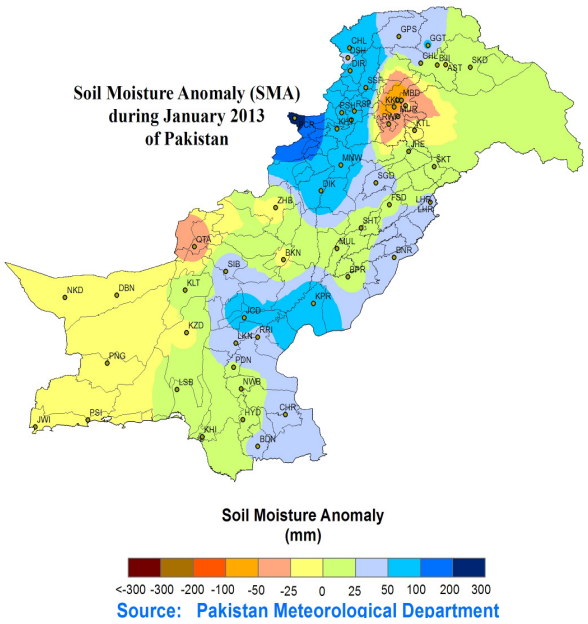
Figure-5 Cumulative precipitation anomaly during (Jan-Mar) 2013 of Pakistan

iii. Soil Moisture Anomaly (SMA)

It was observed that amount of rainfall during January to March was below normal in the country as shown in figure-6. Soil moisture conditions in north eastern Punjab including barani areas and central and north western parts of the country are slightly under stress. It was predicted that rainfall

will be well below normal in January-March 2013 due to which soil moisture stress may be more strengthen especially in the rainfed areas of the country.

(a)



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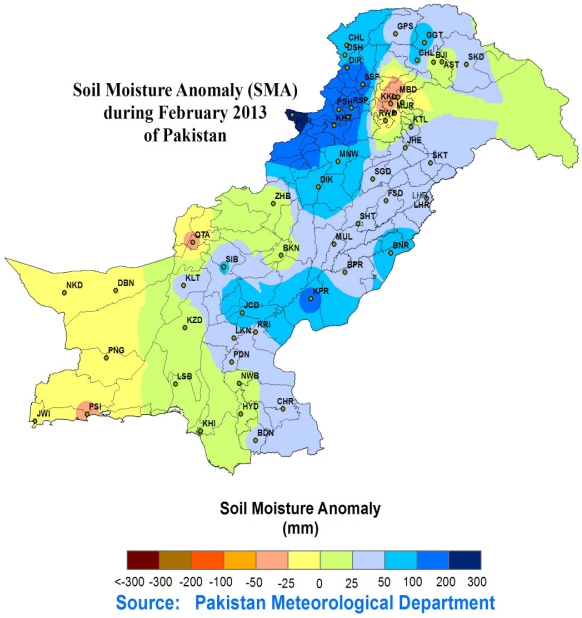

(c)

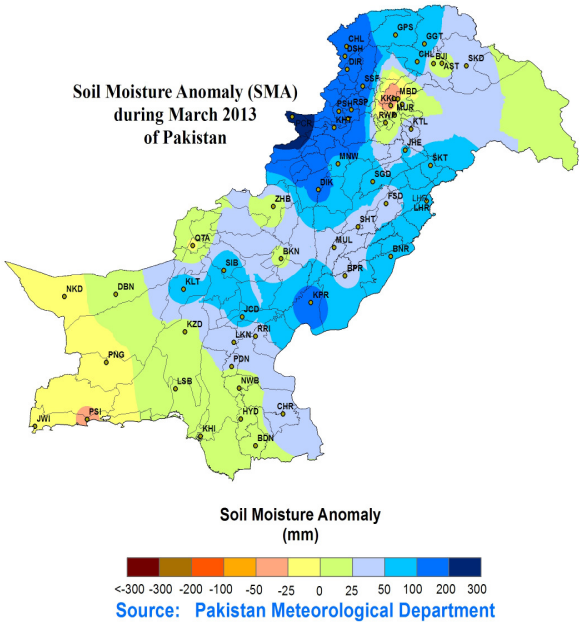

Figure-6 soil moisture anomaly during (Jan-Mar) 2013 of Pakistan

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 while maximum conservation level is 1550feet while Mangla has dead level of 1040feet and maximum conservation level of 1242feet. Due to good monsoon rains,

reservoirs were filled to their capacity. In addition, small dams in various parts of the country were also filled to their capacity that would help boost agriculture and improve socio-economic activities in the country. Percentage of average water level during January to March 2013 was calculated for both dams are shown below in figure -7;

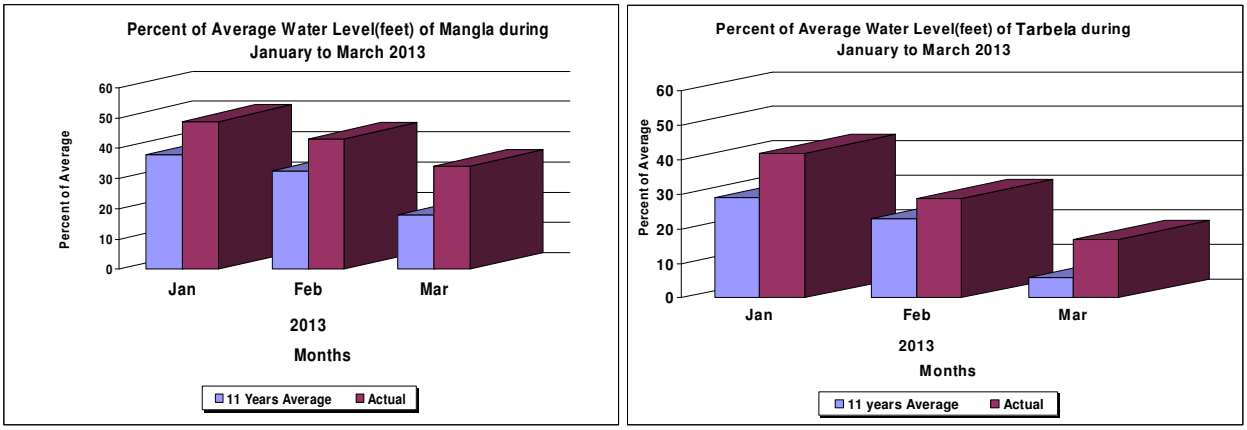

Figure-7 percent of water level of Tarbela and Mangla during (Jan-Mar) 2013

5. Agriculture

Agriculture is main livelihood of about 70% population of the country. Due to direct relationship between agriculture and water scarcity/drought, drought mapping data is of vital importance. Efforts are being made to inform farmers of drought information in a timely fashion for better utilization of data. The sowing period of wheat crop in various regions and cropping patterns of Pakistan starts from 20th October and concludes around the end of December. As per rule of thumb, the wheat productivity decreases by about 1 percent for each passing day after 20th November. The wheat sowing time frame can be divided into two main categories.viz. (a) Prime sowing time, covering period of late October to end November. This is long duration wheat, sown on fallow fields. The prime time sown wheat has two sub categories of (i) rainfed, un-irrigated wheat or wheat irrigated once during crop growth by non-perennial canals /other sources (ii) wheat sown on Irrigated fallow fields.

5.1 Crop Condition:January-2013

The sowing of Rabi crops in Pakistan stretches from mid September to end December. During the Rabi season 2012-13, large areas were sown under rapeseed, vegetables chickpeas, fodders, wheat and other crops. In barani areas (rainfed) the sowing of Rabi crops was affected due to long dry

spell. The crops in these areas have been under moisture stress and there is a dire need of rainfall in barani areas (rainfed) during early part of January. The sowing of wheat crop started from the barani (rainfed) areas during mid October. This operation proliferated to irrigated-fallow areas in November and to areas from the harvest of cotton and rice crops in December.

Rabi Crops

The sowing situation of Rabi crops is as follows:

- **Wheat Crop**

Wheat is the crop grown on the largest area in Pakistan. A question has arisen on the fraction of wheat area coming from different cropping patterns. The temperature regimes greatly affect growth of crop plants. Wheat crop flourishes with in a range of 4.0 °C to 37.0°C. The meiosis process responsible for plant growth comes to a halt in wheat crop at ambient temperature of 4 0C or below

5.2 Crop Situation: February, 2013

Wheat is the most important food security crop of Pakistan. The growth of wheat crop is generally slow across the country due to multiple factors mainly low ambient temperatures. The harvest of the crop is likely to be delayed by 10 days or so.

The weather variables as rainfall and temperature regimes significantly influence the productivity of wheat crop. This is an opportune rabi season in terms of receiving nine rains of varying intensity from December 2012 to February 2013, almost all over the country. This has kept the soils, free of moisture stress and ambient temperatures in the cool range.

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- **Sowing of wheat in cotton-wheat cropping region:**

The sowing of Rabi crops during the year 2012-13 started in a customary way except on the flood affected districts of Sindh and Balochistan where irrigation water from flash floods kept ponding for long periods.

5.3 Crop Situation: March, 2013

The principal time for harvest operations of wheat crop in Pakistan start mainly in early March from Thar region of Sindh and gradually moves upcountry, touching Peshawar Valley of KP in mid May.

Wheat Crop

The harvesting of wheat crop in lower Sindh starts at the end of February from areas around UmerKot, Mirpurkhas and others. The harvest season moves upcountry progressively. The crop is harvested in Upper Sindh, Southern parts of Balochistan, KP and Punjab in April and Central Punjab and Potohar in late April /early May. The crop harvesting in Peshawar valley of KP is carried in late May and in GB / Northern KP during June

5 District wise impact of drought

Due to wetter than normal season, no serious negative impacts of drought have been reported from any part of the country. However there is mild drought reported in northeastern, southwestern parts of Balochistan and barani areas of Punjab including Potohar plateau because of the below normal rainfall during October to December 2011

6 Government reactions to drought

Due to deficient rainfall, mils drought was reported in southeastern parts of Sindh. The water availability in major reservoirs is sufficient and higher than their past averages. These conditions will increase due to above normal snowfall in the catchments areas. Water situation in the dams will improve with the increase of temperature after mid-March It is therefore advised to all stakeholders for an immediate water management strategy to avoid negative impacts of deficit rainfall on agriculture sector. NDMC continued its monitoring activities and drought monitor was regularly updated on fortnightly basis at PMD website http://www.pmd.gov.pk/ndmc/index.htm.

7 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. 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 built large and small dames in catchments areas especially the rainfall water during monsoon period.
- Manage the floods and storage the water
- The stored water will protect food security especially fulfill the water requirements of crops during drought period in the country.

- The water will also be helpful in generating hydropower electricity which is essential requirement of country and reduce the unemployment in the country.

8 Acknowledgement

National drought monitoring centre, Pakistan Meteorological Department, Islamabad acknowledges SUPARCO and district office agricultural department Sargodha for sharing the information.

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