Pakistan Meteorological Department

Drought Bulletin of Pakistan
July-September 2015

National Drought Monitoring Centre

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Drought Bulletin
July – September ,2015

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Quarterly Drought Bulletin
July – September ,2015

By

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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. 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 on drought situation in the country and issue advisory before time. Its national centre is in Islamabad which covers almost 25 canals adjacent to the existing Pakistan Meteorological Head office 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 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) 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

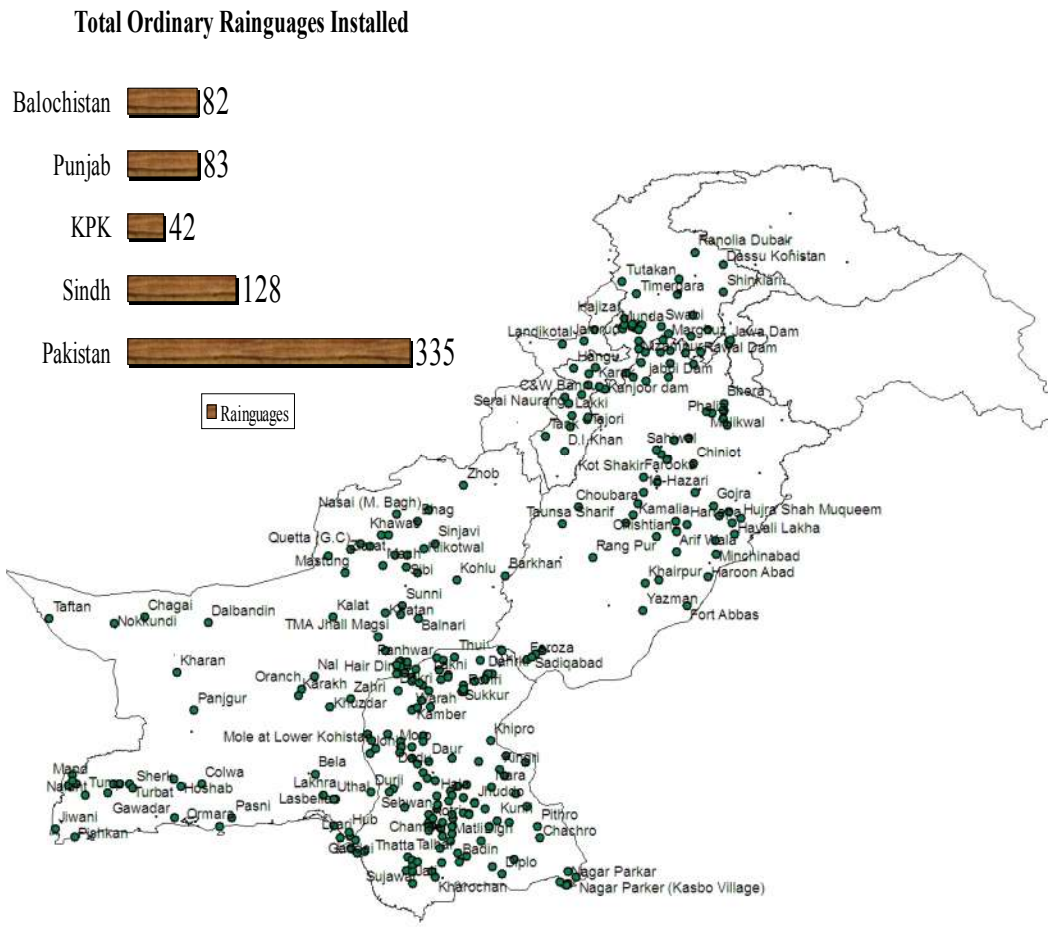


Figure-1 Rain-gauges Network of Pakistan by NDMC

NDMC also monitoring the water level situation of small dams in Barani areas of the country. NDMC using different indices like SPI, NDVI, CPA, RAI, Percent of normal, Probability of occurrence, Percentage departure and soil moisture analysis etc to monitor drought. NDMC issues fortnightly drought bulletin in different regions of the country especially the drought vulnerable

areas. 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) the southwest or summer monsoon and (b) the 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. Monsoon 2015

- **Rainfall Distribution (July-September) 2015**

During Third quarter of the year (July-September) 2015, Above Normal (16.6 %) precipitation was observed over Pakistan. During the quarter high temporal and spatial variable precipitation was observed. Normally July and August are the wettest months in the country however this year, above normal rainfall observed during July and below normal during august 2015 in the country. During the first week of September 2015, heavy rainfall developed the flash flood situation in hill

torrents region in the country while some of the urban cities (Lahore, Sialkot, Gujranwala, and Kashmir) were also influenced urban and riverine flooding. These monsoonal rainfalls lessen the moisture stress in the country along with some strong winds. The evaporation rate was less as compare to the previous quarter. Pakistan Meteorological department predicated normal rainfall in their seasonal outlook during this quarter.

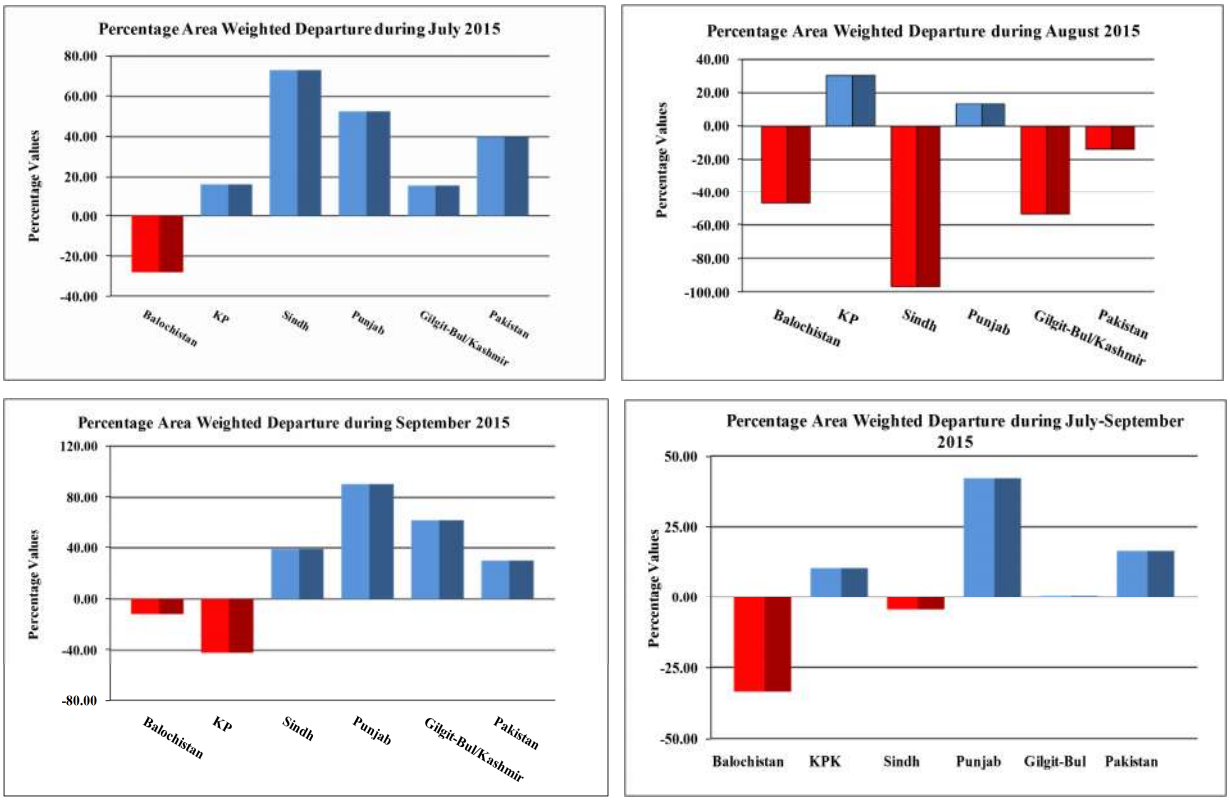


Figure-2 Percentage departure of rainfall during (July-September) 2015

During July 2015, 39.8% above normal rainfall received in the country and in Sindh it was almost 73.1%. Rainfall was above normal in all the province of the country except Balochistan(-28.18%) i.e. Punjab (52.66%), Balochistan (-28.18%), KP (16.48%) and Gilgit-Baltistan Kashmir region (15.83%). During August 2015, rainfall again in the country was below normal (-13.78%), the maximum of which was in Sindh (-97.05%), Gilgit-Baltistan and Kashmir (-53.51%), Balochistan (-46.98%) while in Punjab (13.38%), and KP (30.41%) it was above normal to above normal. During September, 2015, amount of rainfall was above normal in the country (29.95%), Well above normal rainfall was observed in Punjab (90.45%), Gilgit-Baltistan and Kashmir (62.2%) and Sindh (39.09%) while in KP (-41.88%) and in Balochistan (-11.78%), it was below normal.

The figures-2 shows percentage area weighed departure rainfall occurred during (July-September) 2015. The amount of rainfall was normal (30%) in the country during 3rd quarter of the year.

Viewing the rainfall distribution on province basis, over Punjab, it was above-normal (42.17%) ,in KP(10.43%) and in Gilgit-Baltistan and Kashmir (0.55%)while well below normal in Balochistan (-33.52%), in Sindh (-4.68%). The spatial distribution of monthly and seasonal analyses of Pakistan is as shown below in figure-3.

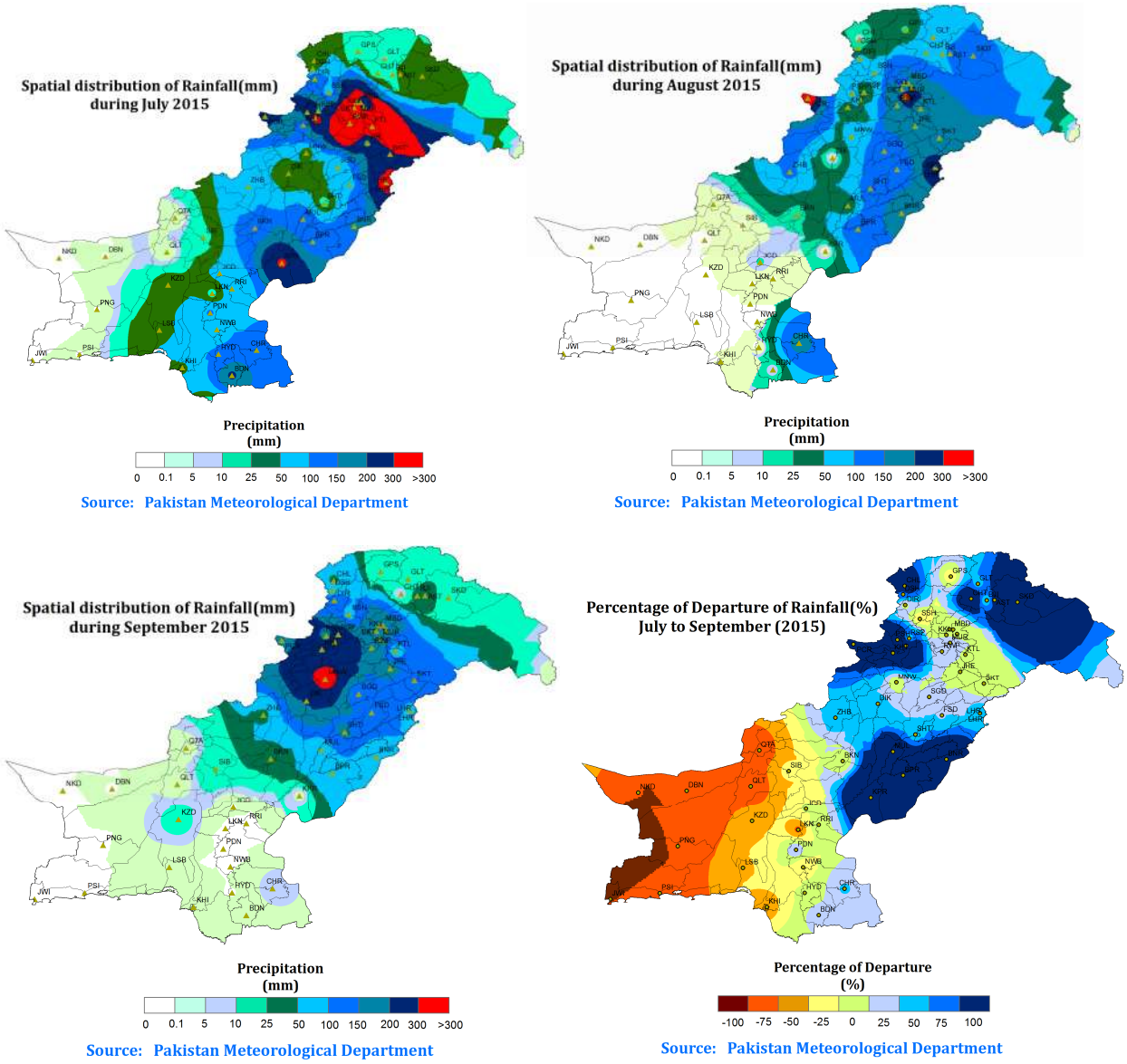


Figure-3 Spatial distribution of rainfall during (July-September) 2015

Comparing the daily intensities of rainfall and number of rainy days during the period, it depicts that monsoon systems were fairly deep enough to precipitate in somewhat cloud burst proportion especially over Islamabad, Sialkot, Lahore and Muzaffarabad areas during July to September 2015 and as depicted in following graphs.

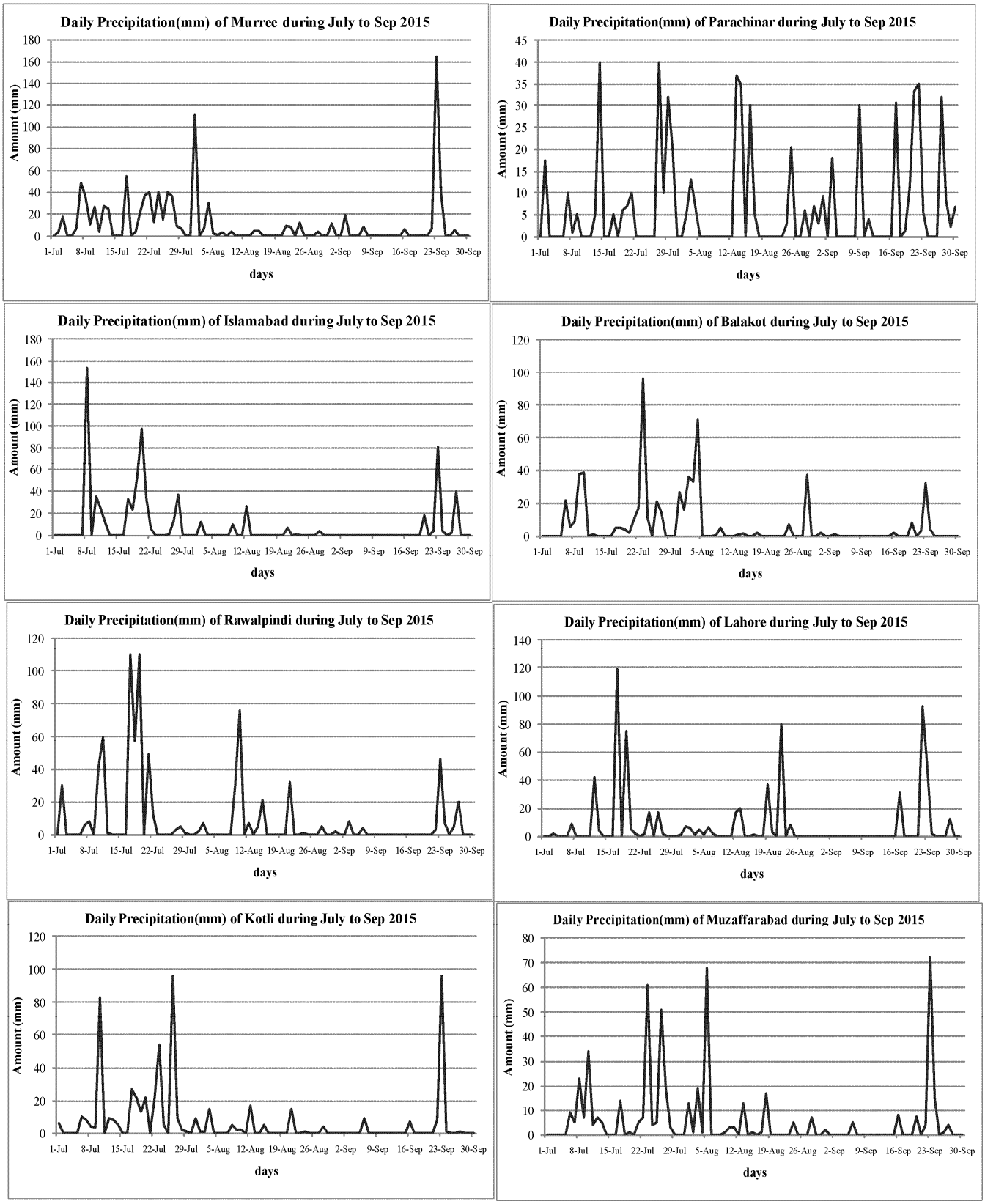


Figure-3a. Heavy daily rainfall(mm) observed during (July-September) 2015

- ***Rainfall spell***

➢ ***July-2015***

Pakistan received higher pre monsoon rains in June this year as compared to last year. Punjab and KP received 3 monsoon rain spells on 6-12 , 17-20 and 25-29 of July. Sindh received 1 spell on 24-29 July. This last spell was widespread inundating Indus and its tributries. The stations with above normal rainfall in Punjab were Bhawalnagar, Bhawalpur, Islamabad, Murree, Multan, Khanpur and Lahore. In GB Astor, Chilas, Kotli and Skardu received above normal rainfall. while above normal rainfall was received in almost all stations of KP. In Sindh, the stations of Badin, Chhor, Padidan, Hyderabad, Jacobabad, Shaheed Banazirabad, Rohri, Sukkar and Mohen Jo Daro received above normal rainfall.

The cumulative rainfall in Skardu and Chitral during July was 43 mm and 25 mm respectively. These areas however witnessed devastating flash floods due to Glacial Lake Outburst Floods (GLOFs) in these areas of high altitude mountains. There was a massive erosion and damage to settlements, infrastructure and crops in these areas. The other areas receiving flash floods were the piedmont of Suleiman Mountains. Dera Ghazi Khan, Dera Ismail Khan and Rajanpur districts were affected by these high speed hill torrents. There were lot of damages in these districts also. The maximum cumulative rainfall during July was reported in Murree 521 mm, while in Islamabad 493 mm, Lahore 328 mm, Sialkot 298 mm, Peshawar 198 mm, Bahawalnagar 154 mm, Multan 139 mm, Bahawalpur 133 mm, Jhang 121 mm and Sukkur 105 mm.

➢ ***August-2015***

Punjab and KP received 4 monsoon rain spells on 1-4 , 9-11, 15-16 and 21-22 of August. First spell was widespread inundating Indus and its tributaires. The stations with above normal rainfall in Punjab were Bhawalnagar, Bhawalpur, Multan, Sargodha, Faisalabad, Shorkot, Khanpur and Lahore. In KP stations with above rainfall Cherat, Chitral, D.I Khan, Drosh, Kohat, Parachinar, Peshawar and Risalpur. Sindh and Balochistan remained dry

➢ ***September-2015***

Two rainfall spell was observed during 21 to 23rd and 26th to 28th of September 2015 in Punjab, Gigit/Baltistan, KPK and AJ &Kashmir. The above normal rainfall is observed in most parts of Punjab including Bhawalnagar, Bhawalpur, Islamabad, Jehlum, Sialkot and Sargodha.

Temperature

Both maximum and minimum temperatures remained below (2-5°C) in last half of July this year where as it was normal in August as compared to last year.

Maximum temperature observed during September, 2015 was at least 1°C lower than normal values across the country. In Faisalabad, Mainwali, Sargodha, Shorkot and Parachinar the temperature was observed to be lower by at least 2°C

4. Drought tool

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). 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).

a) Drought conditions as on 1st July, 2015

b) Drought conditions as on 30th September, 2015

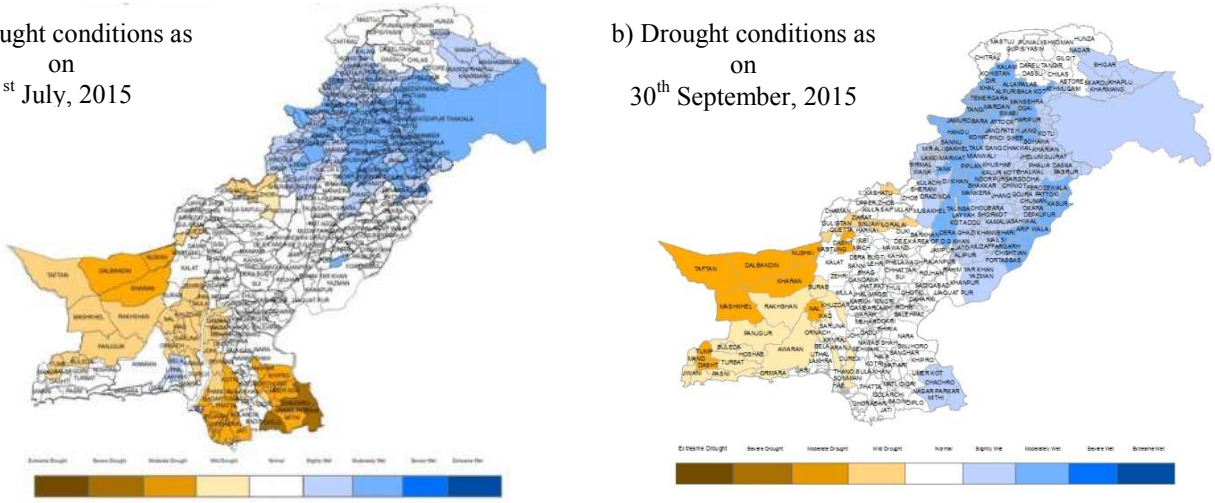


Figure-4 Drought conditions of Pakistan during (July-September) 2015

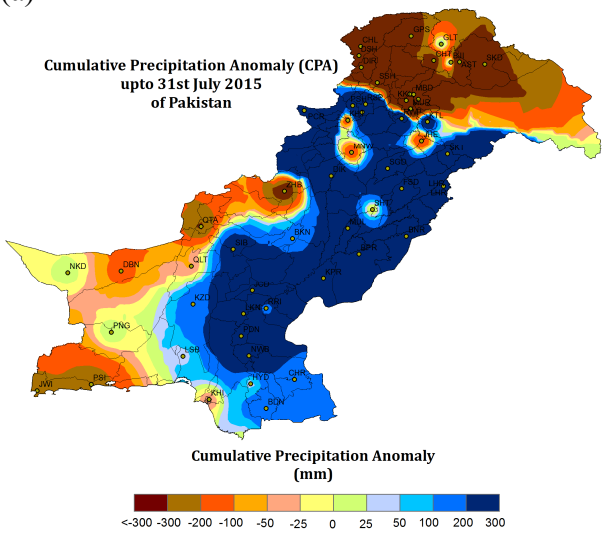
Positive SPI values indicate greater than median precipitation, and negative values indicate less than median precipitation. Because the SPI is normalized, wetter and drier climates can be represented in the same way, and wet periods can also be monitored using the SPI. Here we are showing drought conditions during the quarter in the country.

II. Cumulative Precipitation Anomaly (CPA)

Due to intense monsoon precipitation, rainfall observed almost 30% above normal during monsoon season (July to September) as forecasted by PMD. Soil moisture conditions are good, especially in

the central and southern parts of the country. However a negative anomaly can be seen in the upper and southwestern parts of the country.

(a)



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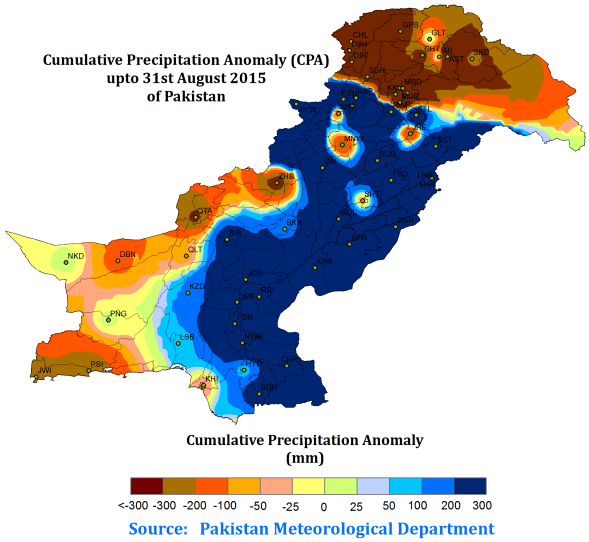


(c)

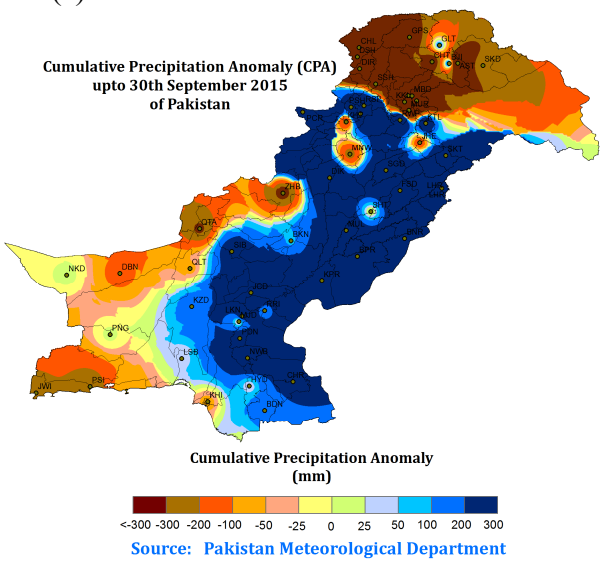


Figure-5 Cumulative precipitation anomaly during (July-September) 2015 of Pakistan

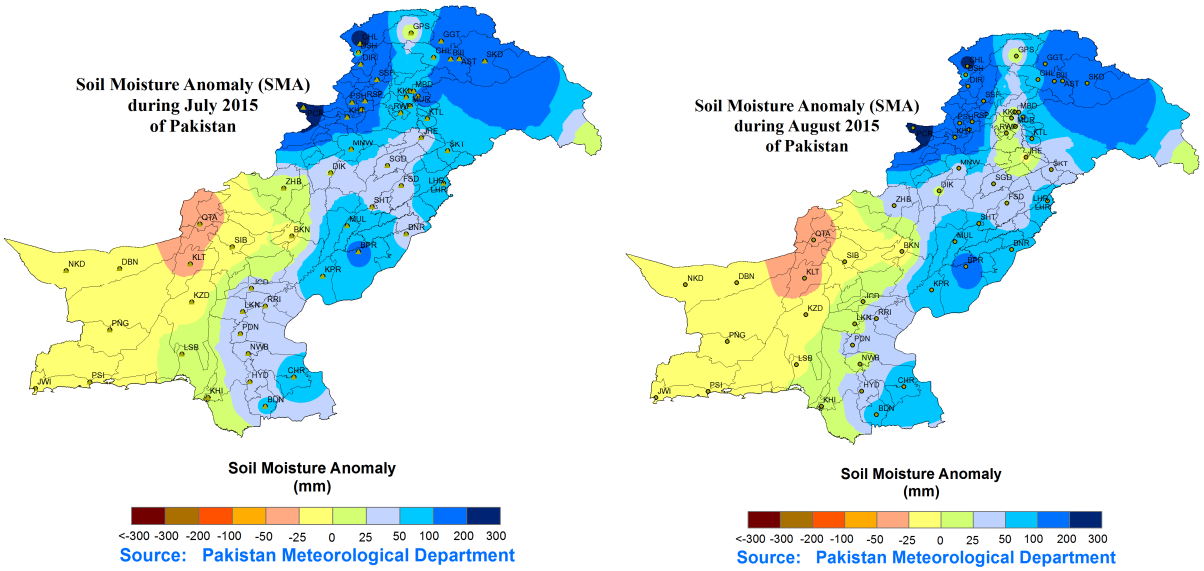
This positive anomaly in rainfall will be sufficient to provide enough moisture to the soil and fulfill the sowing of Rabi crops in these regions. Most parts of Eastern Sindh and southern Punjab districts (Ranjan Pur and D.G.Khan) are under flood water due to intense rainfall in the region.

III. Soil Moisture Anomaly (SMA)

Due to the normal rainfall (11%) during July-September, 2015 in the country, most of the moisture stress was observed in some districts of KP, Potwar region, Southwest Balochistan and Sindh as

shown in figure-6. Soil moisture conditions in north eastern Punjab including Barani areas and central and north western parts of the country were normal.

(a) (b)



(c)

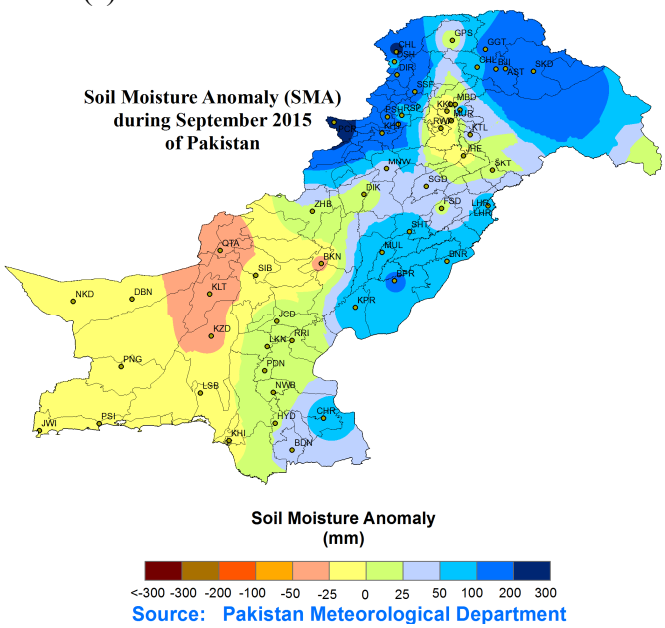


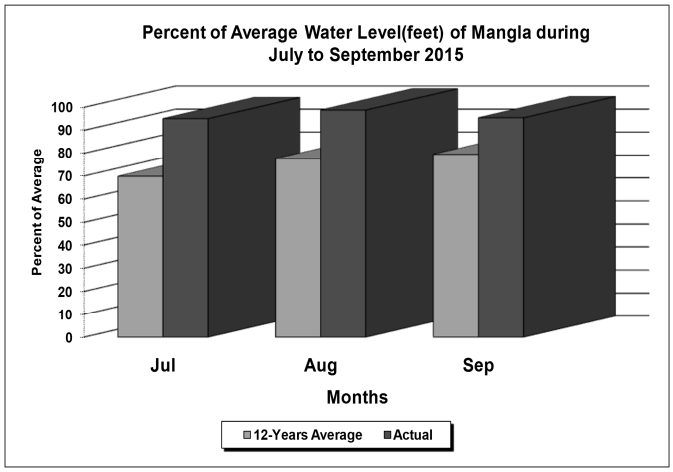
Figure-6 soil moisture anomaly during (July-September) 2015 of Pakistan

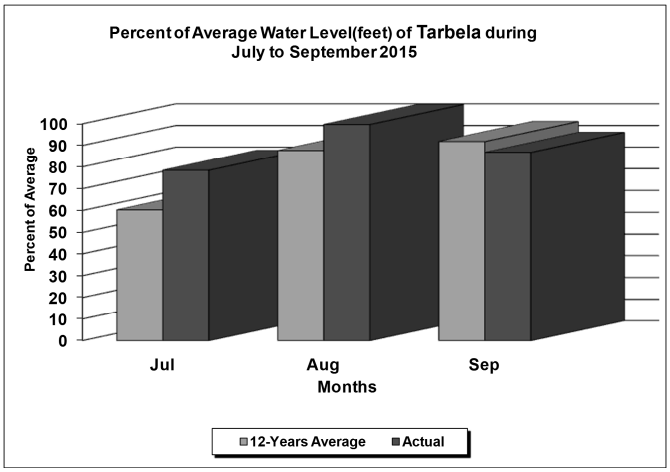
It was predicted that rainfall will be normal (10%) during July-September 2015 and because of this, soil moisture stress was lessen especially in the rainfed and agricultural plains of the country. The rainfall was below normal which strength the moisture stress in southern parts of the country. However the above normal rainfall during September caused a slight moisture stress in the country as shown in figure-6.

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 1242 feet. Due to good monsoon rains, reservoirs were filled to their capacity. Water situation in reservoirs is comparatively better than last year the end of July, the water levels in Tarbela and Mangla dams were 1531 and 1209.40 feet amsl, respectively. The sources of water storage in dams are rainfall and snow/glaciers melting from May to September. The water stored during this period is a major factor of irrigation water supply in the next Rabi 2015-15. Water accumulation in Tarbela and Mangla dams reservoirs started in early June 2015. Total water accumulated in both reservoirs is at 8.521MAF

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 monsoon 2015 was calculated for both dams are shown below.





V. Water Discharge

AVERAGE WATER DISCHARGE AT KABUL DURING KHARIF		
S.No	Years	Water discharge (MAF)
1	Last 20	17.22
2	Last 10	14.77
3	Last 5	17.94

AVERAGE WATER DISCHARGE AT TERBELA DURING KHARIF		
S.No	Years	Water discharge (MAF)
1	Last 20	51.78
2	Last 10	48.28
3	Last 5	50.27
4	Average	50.53

This discharge indicates that this flow is gradually decreasing

AVERAGE WATER DISCHARGE AT MANGLA DURING KHARIF		
S.No	Years	Water discharge (MAF)
1	Last 20	17.01
2	Last 10	13.78
3	Last 5	15.51
4	Average	17.28

This discharge indicates that this flow is gradually decreasing

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.

5.1 Crop Condition:July-2015

The Kharif crops are main source of cash flows at the farms. These are generally generated by early season crops of sugarcane and cotton. The late season Kharif crops of rice and autumn maize provide a foothold both for food security and as cash crops. The Rabi season in Pakistan is mainly dominated by wheat crop which is highly important in the context of national food security. The cash generating crops in Rabi include potato and spring maize in small pockets of Punjab. The onions and tomatoes are the important cash crops in Sindh and Balochistan. The virginia tobacco in Peshawar division is an important cash crop of the area.

- **Cotton Crop**

Cotton in Pakistan is mainly concentrated in central & southern Punjab along left bank of Indus river in Sindh. The areas in Sindh include southern parts of Mirpur Khas, Sanghar, Umerkot,

Khairpur, Sukkur and Shaheed Benazirabad. The early sown cotton crop cultivated during March/April was affected by high temperature during May and was mostly re-sown in Punjab.

The early sown cotton crop is at boll formation and the May sown crop is at vegetative cum flowering stage. There are reports of mild breaking of Bt cotton resistance to bollworm attack. The Punjab Agriculture Research system may conduct further investigations to probe the fact. The rains of July have further added to the discomfort of cotton growers. The effectiveness of agro-chemicals has been compromised due to continuing rains and the frequency of spraying/ the investment cost have increased. The moist season and moderate temperatures have also flared up multiplication of insect pests and attack on cotton crop. The early sown cotton crop in Mirpurkhas and some other areas is at picking stage. The rains have slowed down the cotton picking

- **Sugarcane Crop**

Sugarcane is the second most important industrial crop of Pakistan after cotton. The crop is mainly concentrated in Peshawar/ D.I Khan divisions of KP ; Central/ Southern Punjab and left bank of Indus River in Sindh. Sugarcane crop is at varying height from 3 to 6 feet depending upon sowing time and inputs availability. The crop is performing better due to sufficient rainfall in July and reduced pest attacks. The Gurdaspur borer (Acigona steniella) is a serious pest of sugarcane crop and can pose a problem during the month of August.

- **Rice Crop**

Rice is a highly important Kharif cereal crop and grown in all the federating units of Pakistan. The aromatic basmati rice is sown in the agroecological zones of North-East Punjab. It requires a meticulous blend of soil and climate. The sowing of coarse rice has been completed in all the provinces. The transplantation of basmati rice is in progress and will be completed in August.

5.2 Crop Situation: August, 2015

Agriculture meteorological condition outlines the prevalent meteorological conditions and its impacts on crops in term of crop developments and productivity. Among various meteorological parameters, temperature regime and rainfall contribute significantly in terms of crop yield. The monthly data of current season have been compared to normal pattern to delineate the impacts on crops evapotranspiration, crop water productivity, irrigation efficiency and others.

The main features of Kharif 2015 mainly include (a) Low commodity prices of major Kharif crops (b) High rainfall during July and August (c) Substitution of rice area by other crops (d) Increase in area of maize, moong bean, vegetables and fodders (f) some damages to cotton and other Kharif crops.

- **Cotton Crop**

The month of August is very crucial for cotton crop as picking season starts to kick off in most of Sindh and in some parts of Punjab. Cotton is under stress due to high temperature and less rainfall lead to some local infection of disease and pest in some parts of Khairpur, Sanghar and adjoining area. In Punjab, cotton has been infested by sucking pests like jassids, thrips, aphids etc. Farmers have effectively controlled the pest infestations.

- **Sugarcane Crop**

Sugarcane is a very important cash crop of Pakistan. It is mainly cultivated in central & southern Punjab and along left bank of Indus River in Sindh. The cotton crop requires well drained loam soils with high rate of infiltration. This is a highly sensitive crop that is damaged by standing water in the root zone for prolonged periods. The crop in Punjab had a mild to severe attack of insect pests particularly whitefly and jassid.

- **Rice Crop**

Rice is cultivated in all the four provinces of Pakistan. The best Basmati rice is limited to the North Eastern parts of Punjab. The Coarse varieties of rice are sown at different acreage levels in Punjab, right bank districts of Sindh (Badin and Thatta). In Balochistan the major Coarse rice areas are Nasirabad and Jaffarabad. Coarse rice is also grown in different parts of KP, mainly Swat, Mansehra, Upper & Lower Dir and D. I. Khan.

5.3 Crop Situation: September, 2015

Major Kharif crops, including cotton, rice and sugarcane are progressing with no serious threat of floods, insects, pests /diseases attack beyond the economic threshold during the month of September, 2015.The weather has generally remained dry during September in the cotton growing areas and the crop escaped the high humid weather responsible for widespread pests and disease attacks. The cotton crop sown in February– March is at picking stage while that sown in May is at boll opening and picking stage.

The Sugarcane crop is at maturity stage of growth. Harvesting of early maturing varieties may start during November that of mid-season during December while that of late maturing varieties during January. The sugarcane crop benefited from rains during monsoon and is under sucrose translocation and accumulation in the stalk. The rice crop is actively growing and is at different growth stages depending on the type (IRRI and basmati) and locality. Uprooting of standing crop

by flood and late transplanting of the basmati crop in Central and North-East Punjab during August were responsible factors affecting crop productivity.

Agriculture meteorological condition, outlines the prevailing meteorological conditions and its possible impacts on crops in term of crop developments and final productivity. Among various meteorological parameters, temperature regime and rainfall contribute significantly in terms of final yield. The current season monthly data in this bulletin were compared against the climate norm.

Spells of heavy rains affected various parts of the country during July- August 2015 resulting in riverine/ flash flood in local nullahs flooding in north-eastern Punjab, hill torrents in South-western Punjab & Balochistan and riverine flood in Indus, Chenab, Ravi and Sutlej rivers. Floods largely remained within the embankments causing damage to crops and infrastructure within the flood plains.

Kharif Crops

- **Cotton Crop**

In Pakistan, the cotton area has shown variability over years depending upon (a) fluctuations in price of seed cotton (b) intensity of pests and diseases especially cotton leaf curl virus and (c) situation of floods and rains. The weather has generally remained dry in September and the crop escaped the humid and hot seasons responsible for wide spread of pests and disease attacks. Overall the crop is generally in marginal condition.

- **Sugarcane Crop**

Crop is at healthy growth stage in most part of the country due to sufficient water availability. Sugarcane crop is at maturity stage in Punjab and Sindh. Significant reduction in sugarcane area has been observed in Punjab while stable acreage in Sindh. Overall, crop condition is satisfactory in most parts of Punjab and Sindh.

- **Rice Crop**

Rice crop in Punjab is different in term of season as well as type as compared to Sindh province. In Punjab, IRRI (coarse) has reached the harvesting stage, while an aromatic basmati crop is at the grain filling stage by end September. In Sindh, mainly right bank of Indus river is characterized by IRRI rice and transplantation has reached the grain filling stage. These districts include Jacobabad, Kashmore, Larkana, Shikarpur, Dadu, Qamber Shahdad Kot and Thatta.

6. District wise impact of drought

Due to wetter than normal season, no negative impacts of drought have been reported from any part of the country. In monsoon season below normal rainfall observed, which creates mild ot moderate drought conditions in **southwest parts of Balochistan**. Whereas significant rainfall occurred during September proved to be helpful to reduce the drought conditions in Tharparkar. Damages to crops, infrastructure and livestock have been reported in northeastern and south Punjab due to flash and urban flooding.

7. Government reactions to drought

All functionaries of the state machinery remained engaged in providing relief to flood affective of Punjab and drought regions of Sindh. There is the significant impact of drought during the quarter in **southwestern districts of Balochistan** like **Awaran, Dasht, Kharan, Noshki, Loralai and Gawadar** etc.. Intervention was made at official level these districts. NDMC continued its monitoring activities and drought monitor was regularly updated on a fortnightly basis at the PMD website http://www.pmd.gov.pk/ndmc/index.htm

8. Seasonal Advisory/Outlook

Synthesis of the latest model forecasts for Oct-Dec, 2015 (OND), current synoptic situation and regional weather expert's judgment indicates normal to above normal (1981-2010) precipitation is expected in most parts of the country during the season October-December 2015. Khyber Pakhtoonkhwa, Azad Jammu and Kashmir, Punjab and Baluchistan are expected to get above normal precipitation with maximum bias in stations like Muree, Muzafarabad, Saidu Sharif and the adjoining areas. While southern parts of Sindh province are expected to get slightly below normal rainfall durind the seasonthat slightly above normal precipitation is expected all over the country with above average during December and normal during October and November. Slightly above average night temperature is likely to occur during whole predicted period with higher values over eastern parts of the country.

9. 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 neighboring 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.

10. 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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