Government of Pakistan
Pakistan Meteorological Department

National Drought Monitoring Centre
Meteorological Headquarters
Islamabad, Pakistan

Islamabad, 14th May, 2022

Subject: <u>Technical Report on catastrophe due to heatwave instead of drought in the Cholistan, Punjab</u>

Summary

The catastrophe caused by the severe heatwave in Cholistan impacted the water reservoirs, vegetation and livestock badly. Due to abnormal increases in daily maximum temperature, heat stress situations arose in the Cholistan region. The high-intensity major heatwave persist for 41 days (11th March to 19th April 2022) followed by a short heatwave of 6 days (27th April to 2nd May 2022) of relatively low intensity. Although the region received a sufficient amount of rainfall during the winter season, however, the severe heatwave is now alarming the onset of drought in the coming days in the Cholistan region due to water depletion in ponds and reservoirs as well as soil moisture availability for vegetation.

(Note: This report is prepared under the special directive of Mahr Sahibzad Khan, Director General, PMD, Islamabad.)

1. Introduction

The Cholistan comprises three districts Bahawalnagar, Bahawalpur, and Rahim Yar Khan. The total area of Cholistan is 6,655,360 acres. The largest area of Cholistan is present in Bahawalpur which is 4,028,217 acres. The length of Cholistan is 480 km and the width ranges from 32 to 192 km.

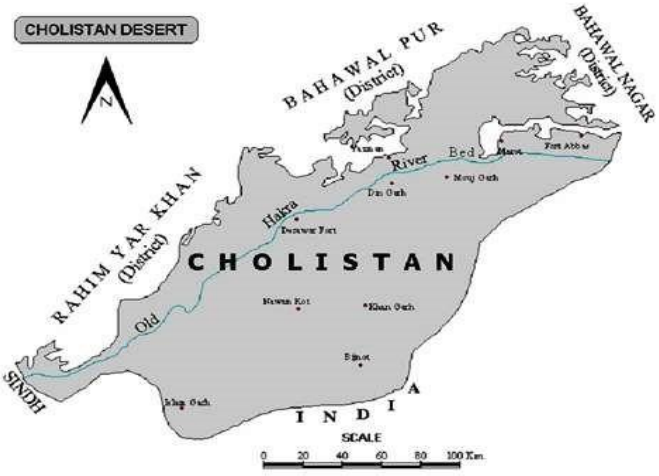


Figure 1 Geographical location of Cholistan, Punjab

The human population of Cholistan is 155,000 whereas the livestock population is 1,318,000 Paridhi et al. (2018). The livestock is mostly consisting of camels, sheep, goats and Cholistani Cattle. The geographical location of the study area is shown in Figure-1.

1.1 Climate of Cholistan

The Cholistan region falls in a hyper/extremely arid climate. According to the PMD climate normal of Pakistan, the monsoon season brings the majority of the rainfall over the Cholistan region. July is the wettest and November is the driest month in the region. The highest amount of rainfall is observed in July (48.4mm). The average maximum temperature ranges in Cholistan is from 20.0°C to 42.2°C with June being the hottest. The historical data (1981-2020) shows that the Khanpur (Rahim Yar Khan) station received the extreme highest (50.8°C) in June and the lowest (-4.3°C) in January respectively.

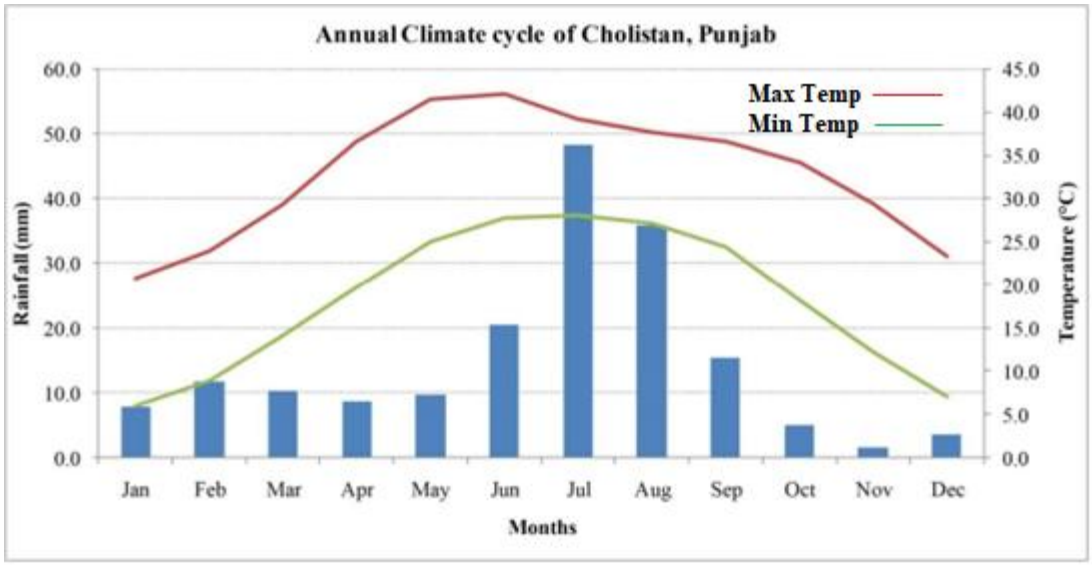


Figure 2 Annual Climate Cycle of Cholistan, Punjab.

According to the climate normal of Pakistan, the annual total rainfall of Cholistan is 179.3mm with a maximum (247.3mm) at Bahawalnagar. The monsoon system brings rainfall during the summer season (June to September) which makes up 67% of the annual rainfall whereas in the winter season (December to March) rainfall contributes 19% of its share (Fig 3). These results provide a clear indication that this reason highly depends upon summer monsoon rainfall and the failure of monsoon rainfall may cause drought in the Cholistan region.

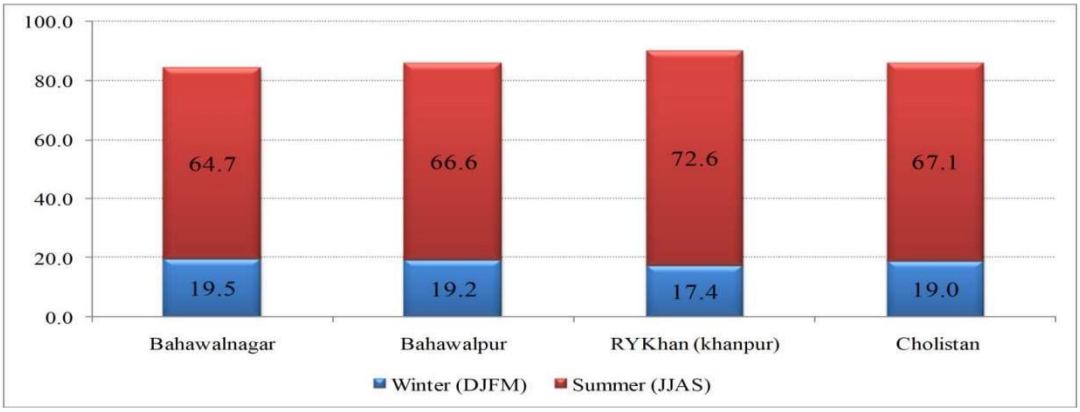


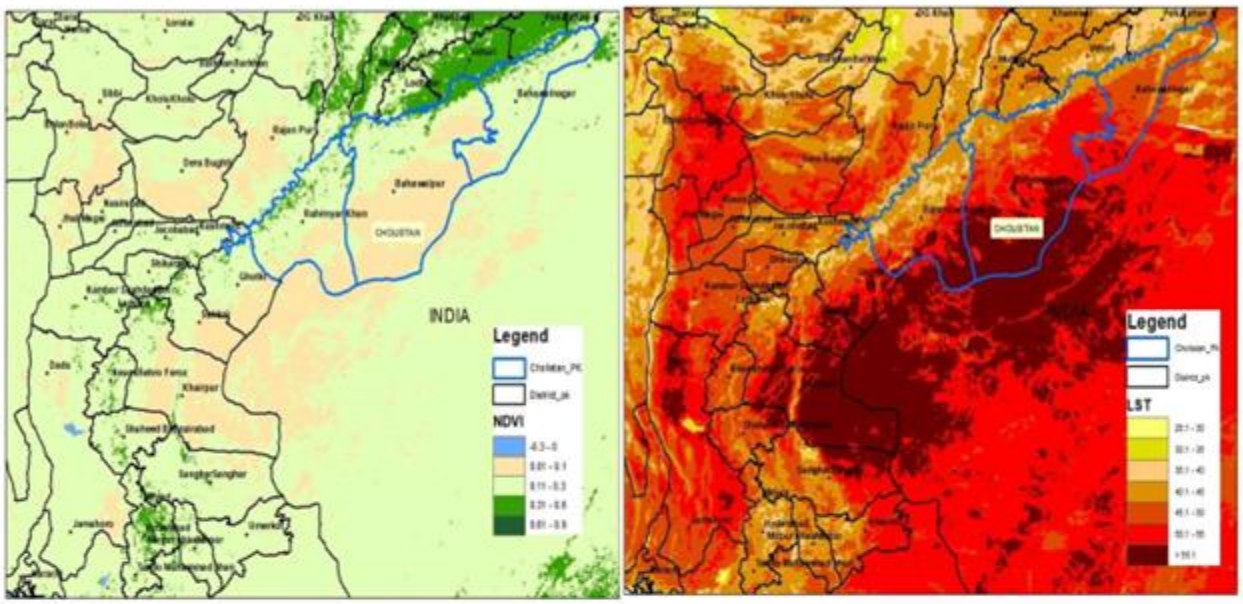
Figure 3 The seasonal rainfall contribution in the Cholistan region, Punjab.

2. Drought situation

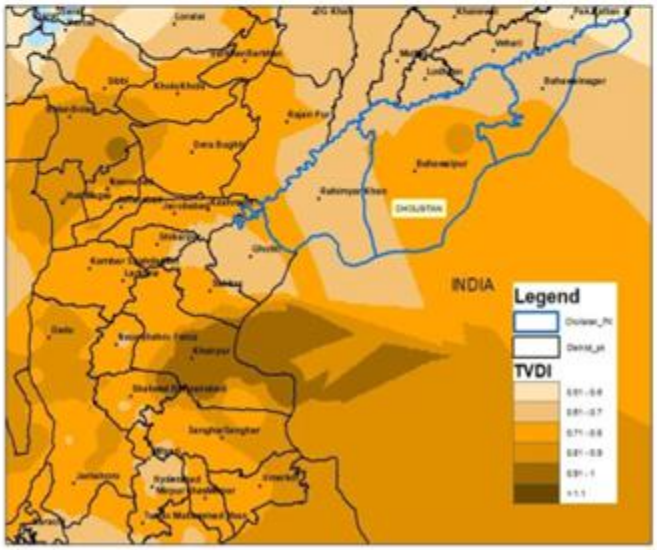
The climatology of Cholistan shows that it receives a low amount of rainfall in winter. However, this region received a good amount of rainfall (well above normal) during January 2022 in all the tehsils of the Cholistan region (Table 1). The month of February and April remained almost dry however, the intermittent rainfall that occurred during January, March and May helped to lessen the moisture stress and provide resistance to emerging drought-like conditions in the region.

Monthly Rainfall (mm) from January to 13th May 2022 in the Cholistan region							
District	**Tehsil**	**Jan-22**	**Feb-22**	**Mar-22**	**Apr-22**	**May-22**	**Total**
Bahawalpur	Bahawalpur	19.2	1.0	7.0	0.0	0.0	**27.2**
	Ahmedpur east	11.0	0.0	0.0	0.0	0.0	**11.0**
	Hasil pur	20.0	0.0	1.0	0.0	3.0	**24.0**
	Yazman	17.0	0.0	3.0	0.0	4.0	**24.0**
	Khair pur t.wali	24.5	0.0	2.0	0.0	5.0	**31.5**
Bahawalnagar	Bahawalnagar	42.0	0.0	4.0	0.0	8.0	**54.0**
	Chishtian	32.0	0.0	0.0	0.0	16.0	**48.0**
	Haroon abad	42.0	0.0	2.0	0.0	3.0	**47.0**
	Fortabbas	25.0	0.0	0.0	0.0	2.0	**27.0**
	Minchinabad	42.0	0.0	9.0	0.0	8.0	**59.0**
R.Y.Khan	R.Y.Khan	9.0	0.0	0.0	0.0	TR	**9.0**
	Sadiq abad	27.0	0.0	0.0	0.0	TR	**27.0**
	Liaqatpur	11.0	0.0	3.0	0.0	4.0	**18.0**
	Khanpur	16.0	0.0	0.0	0.0	8.0	**24.0**

Table 1 Monthly rainfall in the Cholistan region from January to 13th May 2022. (TR means rainfall less than 0.1mm)



a) Normalized Difference Vegetation Index (NDVI) b) Land Surface Temperature (LST) °C



c) Temperature Vegetation Dryness Index (TVDI)

Figure 4 Satellite based indices output to monitor drought situation in the Cholistan.(a) NDVI (b) LST (c) TVDI. (Note: Blue border lines show the Cholistan region)

The drought situation in the Cholistan region was accessed by using satellite-based indices (Fig 4). NDVI shows normal conditions in the Cholistan region except on some of the eastern sides where there is no vegetation due to sandy desert (Fig 4a) whereas land surface temperature (LST)

was exceptionally high (> 55°C) which affected the moisture conditions and causes the dryness in the vegetation as shown in Figure 4c. The LST increased due to an increase in daytime temperature which ultimately caused heat stress in the region. Keeping in view the climatology and the results of recent data depicts that there is a probability of drought emergence in the eastern side of the Cholistan region in the coming days.

3. Heatwave situation

The daily temperature remains low during winter and it gradually increases during transition months i.e., March and April. However, a sharp increase in daily temperature was observed in Cholistan region. The first high-intensity major heatwave with duration of 41 days was observed from 11th March to 19th April 2022 in which daily maximum temperature remained consistently above 5°C to 11.5°C than normal over all the districts of Cholistan (Fig 5). Another heatwave of relatively low intensity was observed from 27th April to 2nd May with a duration of 6 days where the daily maximum temperature was above 3.8 to 6.8°C than normal (Fig 5).

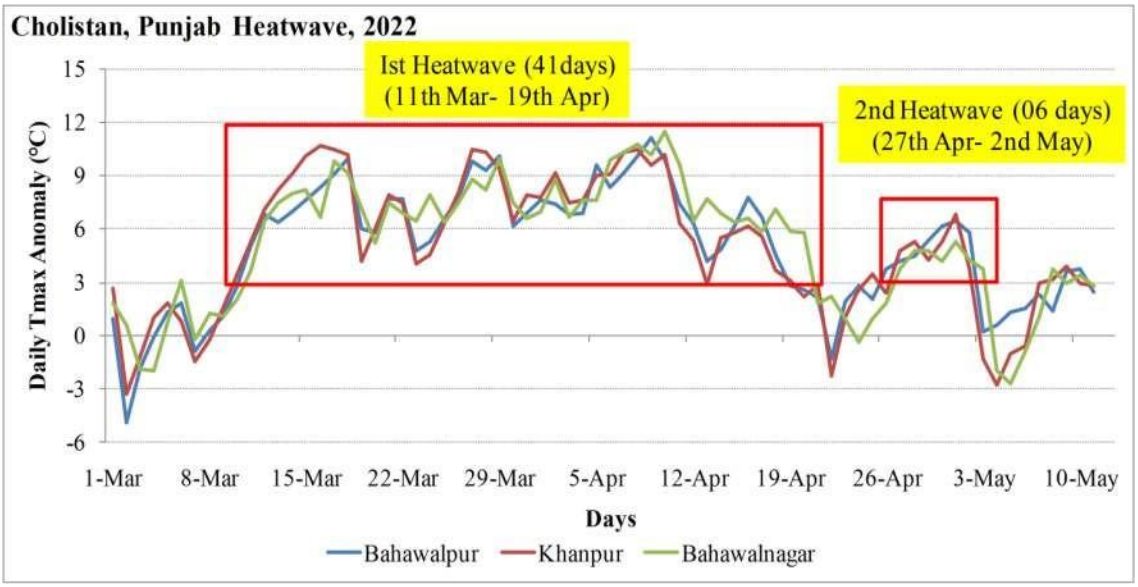


Figure 5 Heatwave episodes experienced in the Cholistan region, Punjab.

Diurnal variation in body temperature, ranging from about 37.5 °C from 10 a.m. to 6 p.m., and falling to about 36.4 °C from 2 a.m. to 6 a.m. ***Cheng et. al. (2014)*** identified the effects of Diurnal Variation of Temperature (DVT) on human health. The DVT is significantly associated with mortality and morbidity, particularly for cardiovascular and respiratory diseases.

All animals have a thermal comfort zone, which is a range of ambient environmental temperatures that are beneficial to physiological functions (FAO, 1986). During the day,

livestock keeps a body temperature within a range of ±0.5 C (Henry et al., 2012). When temperature increases more than the upper critical temperature of the range (varies by species type), the animals begin to suffer heat stress (FAO, 1986). Warm and humid conditions that cause heat stress can affect livestock mortality. Howden et al. (2008) reported that increases in temperature between 1 and 5 °C might induce high mortality in grazing cattle. The daily diurnal temperature variation recorded in Cholistan was 14.9°C to 22.7°C during the heatwave period (Fig 6).

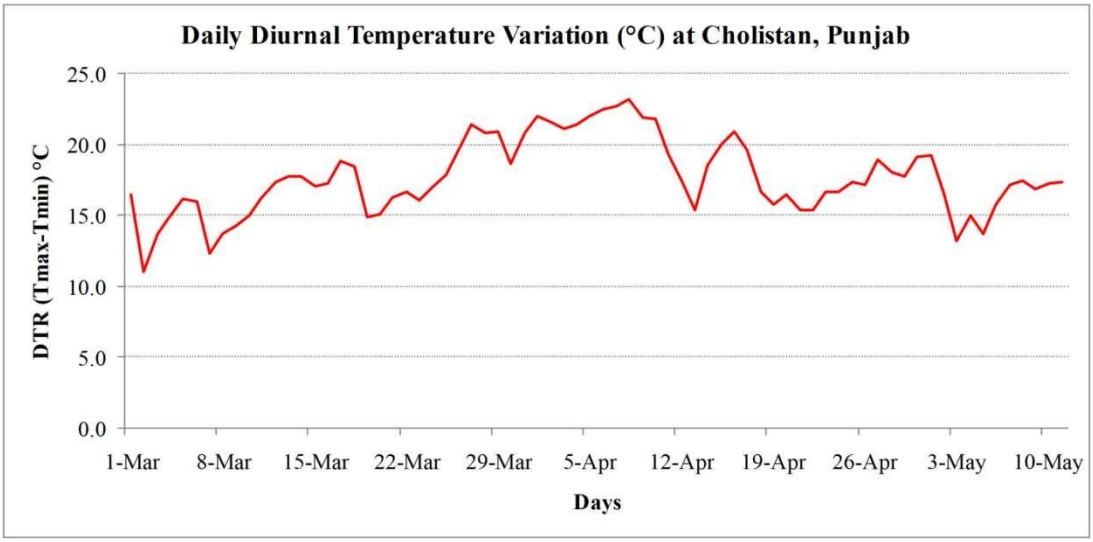


Figure 6 Daily diurnal temperature variations in the Cholistan, Punjab

4. Conclusion

Based on the above results, it is concluded that severe heatwave impacted the vegetation, water resources and most importantly the livestock in the Cholistan region instead of drought. The severe heatwaves trigger the evapotranspiration by 1.5mm/day to 3.5mm/day which impacted the soil moisture, water table/resources and vegetation in the region. The high temperature caused heat stress which affected livestock mortality. Furthermore, high variation in the daily diurnal temperature (≥ 5 °C) increased the probability of high mortality in grazing cattle. Finally, this heatwave has also enhanced the probability of the drought emergence in the Cholistan region.

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