



Incensement of Temperature Triggered to Induce Severe Drought in Thar Desert, Pakistan

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Abstract: In deserts an increase or even a small change in temperature can set ideal conditions for drought; the prolonged conditions can lead to an agricultural drought from the metrological drought. We have applied SPSS and SPI to investigate Global climate model temperature variation as a drought driven element. Met-data of two meteorological stations was analyzed to reveal the condition. The obtained results show that temperature has risen from 1°C to 2.5°C in 20th century. The data also demonstrates a negative correlation between temperature and drought.

Keywords: Severe, Temperature, Foundation, Drought.

1. INTRODUCTION

The temperature is the single most significant component to cause shift in the climate phenomena. An abrupt or steady increase in temperature creates climate unfriendly and creates drought conditions; that is especially conducive during summer monsoon, seasonal temperate, rainfall rate and natural vegetation, which also were affected since 18,000 to 20,000 years ago in Thar desert (Ivanocheko, 2004). This climate change scenario frequently took place in Thar Desert in the increasing of temperature. The very invariably presented condition caused significant climatic shift pattern of monsoon season, which led severe drought in the region (Fontugne, *et al.* 1986). The very single element at the outset of the 20th century, caused substantial increase in the drought ratio in the world (Iyengar, 2004 and Prabhu, *et al.* 2004)). Thar, the arid sub-tropical desert of Pakistan, is situated at longitude 69°, 53' and latitude 24°, 43'. It is lying at South-east of Pakistan (Fig. 1) having length is about 800 km north-south and 490 east-west wide stretched over the 22000 km² land area of sand (Herani *et al.* 2007). Thar Desert is the biggest desert in Pakistan, which covers a vast area of sand dunes with thorny bushes. The temperature is fairly scorching having mean annual summer maximum and minimum temperature record are 35°C and 19°C, respectively. The maximum daily temperature mostly exceeds 45°C from April to June and rainfall occurs with the rate between 200 and 300 mm, which occurs during monsoon season from June to September (Meghwar and *et al.* 2019). Thar desert land is covered

with fairly scattered vegetation due to high temperature (Muslehuddin *et al.* 2006). Temperature increasing is affected by the physical feature exist around near Indus river, Arabian Sea and Runn of Kuchh. The land area is a fairly distant from Arabian Sea and has high temperature in the desert.

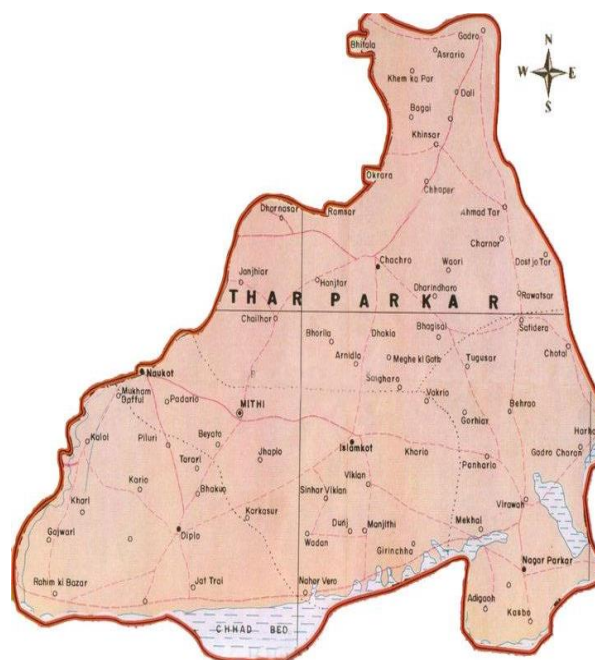


Figure 1. Location map of Thar Desert

Temperature increase rate inflict drought

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Temperature is consistently on the rise and fluctuates from season to season and year to year, however, summer temperature in particular varies significantly within a range of 40 to 45°C in last four decades (Roy *et al.* 2005). This temperature rise has accelerated evaporation rate and has also decreased 5-25 percent precipitation in the region and is therefore a major factor to induce drought (Ragab *et al.* 2001, Shamshad, 1988 and Rao, 1970). Besides, one of causes rise in Global temperature (GT) and an proliferation of carbon dioxide (CO₂) in the atmosphere offers conducive opportunity to craft arid condition over the global (Wagner *et al.* 1996). This arid condition reinforced to escalate surface temperature (ST), is another potential component to set drought at severe level (Melillo, *et al.* 1993 and Sarkar, *et al.* 1990).

Drought increasing scale in Thar Desert

Drought is scientifically proved a major factor to change climate pattern and phenomena in Thar Desert; It is correlated with the increase in temperature and decrease in precipitation during 1950-60, it has been getting worse climatic condition whenever extreme drought took place, during 1950 in particular (Singh *et al.* 1974). This drastic shift in drought led significant change in climatic condition across this region (Hu, 2000 and Borole, *et al.* 1982).

2. RESEARCH METHODOLOGY

To understand the latent aspect of the problem at hand scientifically, we collected some 67 years temperature and rainfall data from two weather stations Badin and Chhor from Department of Meteorology, Karachi. Temperature and rainfall data were analysed in statistical function Residual to expound variation in temperature. Rainfall data is analysed using standardised precipitation Index (SPI). The monthly

rainfall data of the total 67 years delineates scale for subsequent years and months. Rainfall of some months is missing, therefore the scale for three and six months is not considered to detect accurate drought periods. The result minus (-) represented drought and plus (+) indicated wet condition. SPI value for moderate drought is -1.00 to 1.49, for severe drought 1.50-1.99 and for extreme drought is <-2. In addition, SPSS is used to see socio-environmental understanding of local population a survey questionnaire (English and Sindhi languages) was from the peoples above 60 years of age, because the persons of this age have very profound practical knowledge about the shifting phases of climate in the region. The anthropogenic social response indicated significance increase of drought with the increase of temperature. The drought and temperature increase are significantly correlated to cause devastating shift in the Thar desert climate (Schlesinger *et al.* 1990).

3. RESULT

The land area of Thar desert had been confronting extreme fluctuation in temperature with the rate of 34 percentages during last century which led to severe drought across the region. Average temperature during summer days have risen with range of 1°C to 2.50 °C and it has reached more than forty degree centigrade (40°C) (Juyal, *et al.* 2006). At the same time, the annual mean temperature of Badin and Chhor weather stations are shot up in the annual range between 26° c to 30° c. Thus triggered alarming situation of drought in the area. Chhor weather station is fairly distant from Arabian Sea indicates significant variation in temperature during years of 1986, 1990 and 1916 and it's an average of above 30° C (Fig. 2).

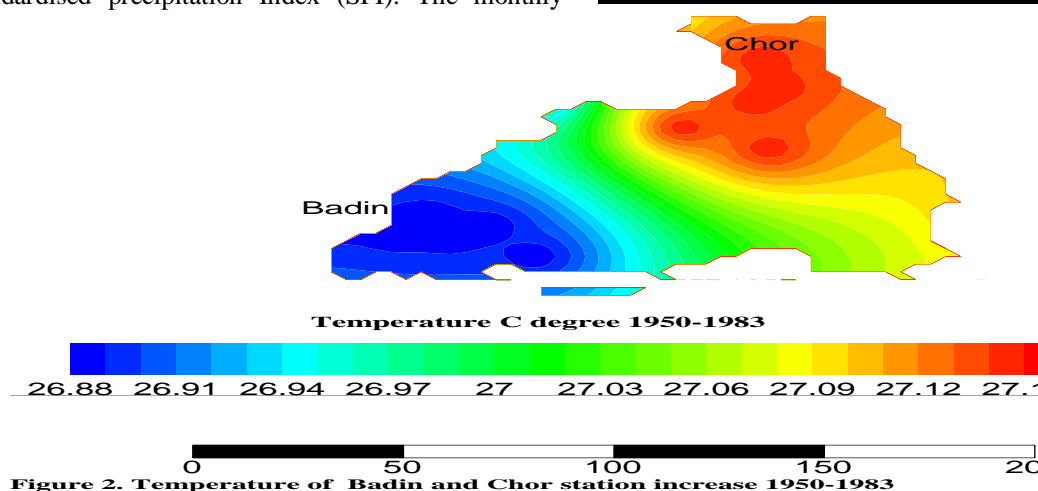


Figure 2. Temperature of Badin and Chhor station increase 1950-1983

When comparing choor with Badin weather station a small variation in temperature is seen. The statistical data obtained for temperature in Badin shows that 1981, 1986, 2003 were the years with high temperature (Fig. 3).

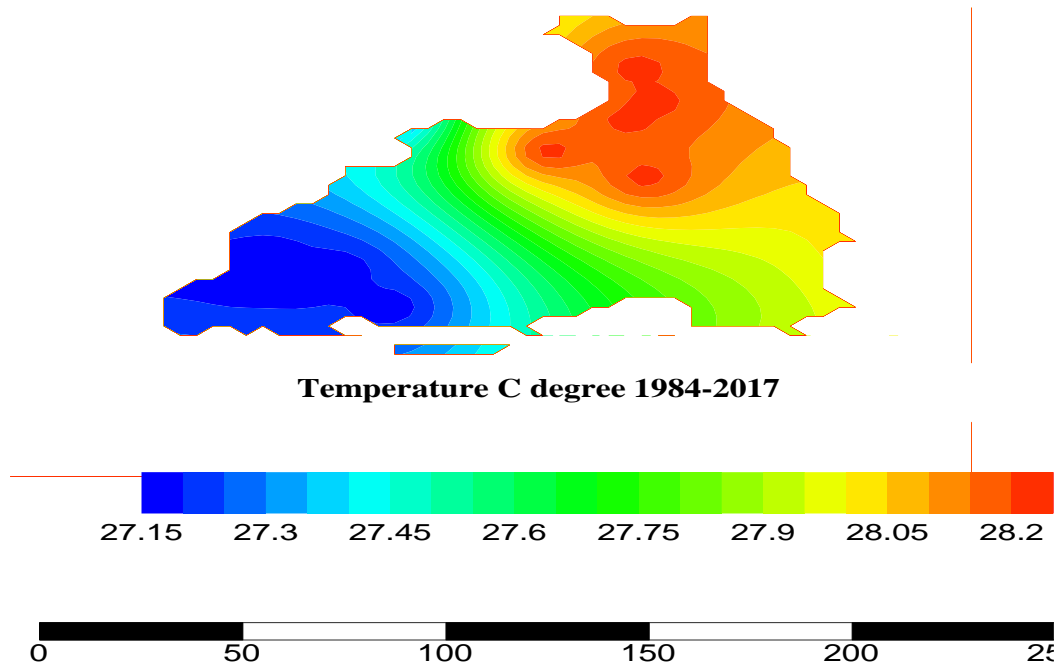


Figure 3. Temperature of Badin and Chor station increase 1984-2017

It was flawless character of same era of high temperature in near Chhor weather station, yet it was slightly different due to peripheral territories and distance from the Arabian Sea. Both stations temperature demonstrated identical era of significant droughts during 1950-1960. The anthropogenic survey indicated significant increasing of temperature, which was experienced by 71 percent of the population of the region. This increase originated drought at different level and the extreme rise of the temperature led to severe drought (Fig. 4).

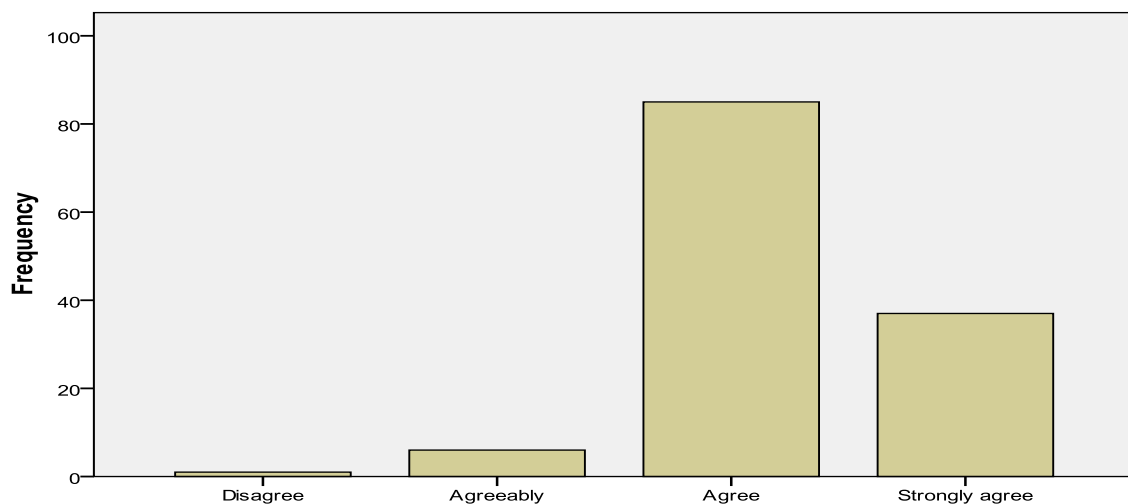


Figure 4 Temperature increase cause drought

This suggested severe drought. The drought is a major phenomenon in the changing of climatic conditions of in any region, which affected thoroughly Thar desert. It was revealed that drought frequency is increasing day to day. 93 percent local population has experienced and shared that the drought conditions are shooting up to an alarming rate (Fig. 5). The anthropogenic responses were concerning over the period of the temperature on the rise.

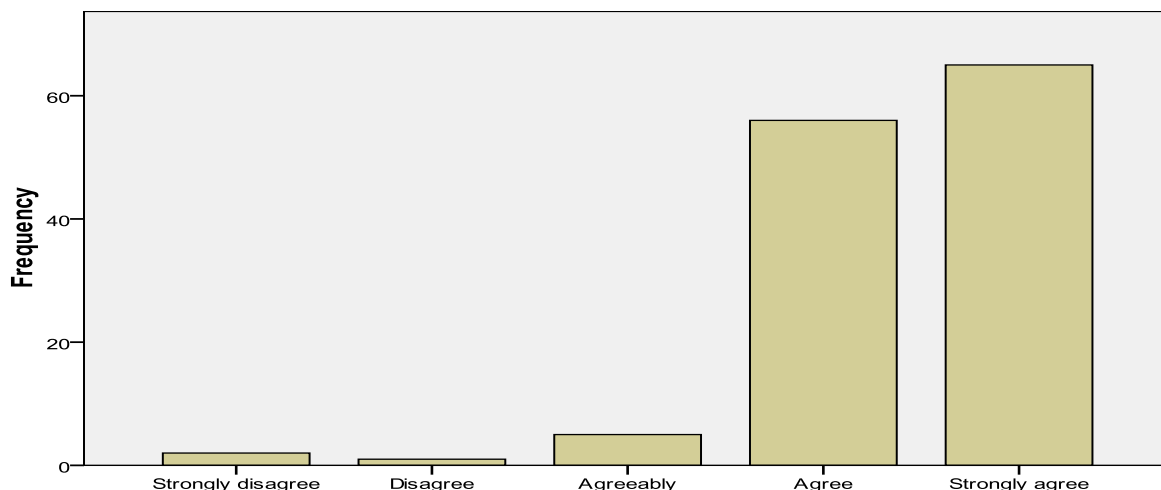


Figure 5 Drought increase day to day

It is observed that drought magnitude has increased since 16th century and it was encompassed during 17th, 18th, 19th and 20th century over the desert region in world. (Juyal *et al.* 2006 and Armond *et al.* 1978). (Juyal *et al.* 2006) (Armond *et al.* 1978) has reported that drought magnitude has increased since 16th century and encompassed through 18th, 19th to the 20th century in the desert regions of the world. The average rainfall of Badin and Chhor was 235mm in 2016 between 1950-2017. This was 34 percentages fluctuation caused the rise to drought, that co-relation demonstrated the triggering of moderate drought at scale of every 5-6 years and it led to a very severe drought every 11 years (Figure 6 and 7).

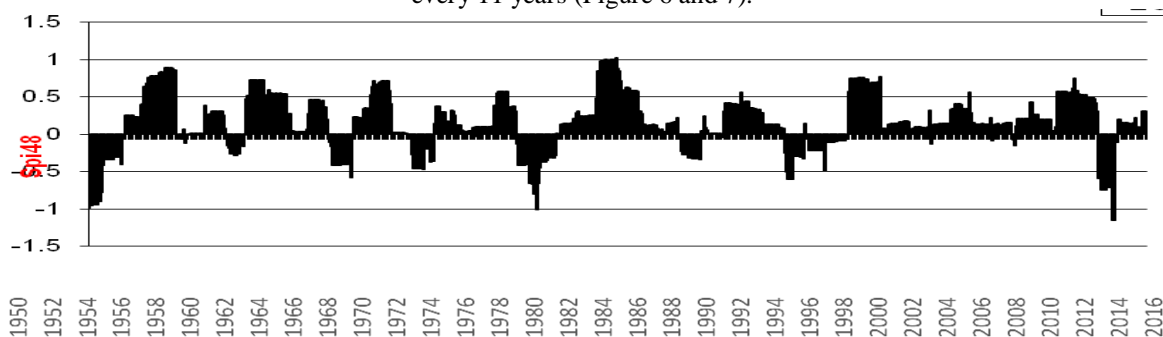


Figure 6 Drought SPI 48 scale of Chhor weather station 1950-2017

Which led to severe subsequent droughts reported during 1956, 1981 and 2013, whereas moderate drought took place during 1952, 1970, 1980, 1996, 2001, and 2014 respectively (Fig. 6).

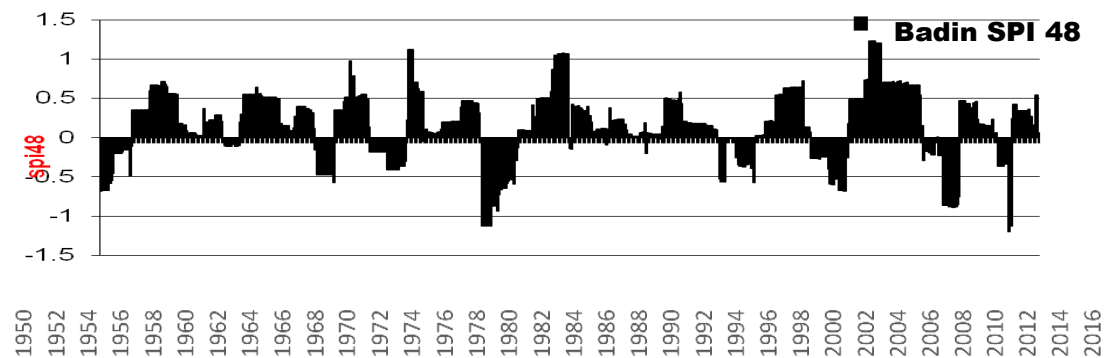


Figure 7 Drought SPI 48 scale of Badin weather station 1950-2017

The weather station Badin is a fairly close to Arabian yet confronted severe drought in the years of 1956, 1978, 2012, whereas moderate drought was a common climatic phenomenon during 1953, 1980, 1993, 1996, 2003, 2006, 2011, 2014. Thus the study pin points towards one of the single most significant factors Temperature turned out key element leading to alarming increase in drought across the region.

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