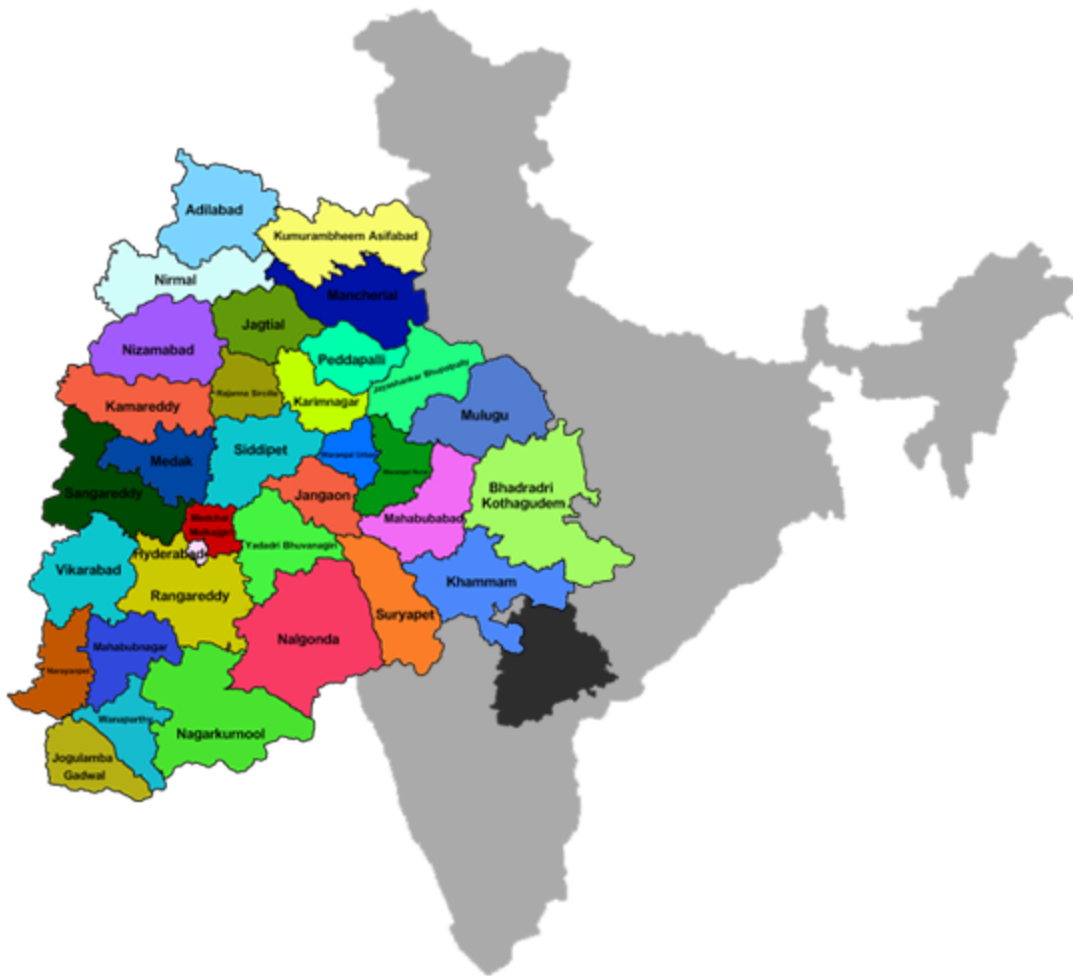# Team Anastasi

## Telangana Climate Change: A Comparative Study

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## Introduction

Telangana is one of the states in southern India, which was founded on 2 June 2014 with its sharing capital Hyderabad with Andhra Pradesh. Telangana with its population of 39.9 million people is surely a large number to affect and get affected. Being the newest state of

India, Telangana has its own share of work to do for its people and in general towards nature and climate as well.

We all are aware of the fact that climate change is a major issue, not just for a state or a nation but for the whole world. It is so important that the UN has pronounced it as one of the Sustainable Development Goals. And to combat this, several international and national organisations have come forward to deal with this problem. Among them is the state of Telangana.

But first we have to understand the meaning of climate change, what it is and how to detect it? This will pave the path of why it happens and at last how to tackle the issue?

So, first things first, Climate change is the long-term alteration of temperature and typical weather patterns in a place. It is both local and a global phenomenon. But it is so relevant and a hot debate topic? It is because of a simple reason that it is affecting the lives of the earth in general by various means like frequent and intense drought, storms, heat waves, rising sea levels melting glaciers and warming oceans.

Climate change includes both global warming driven by human-induced emissions of greenhouse gases and the resulting large scale shift in the weather patterns. These are all a clear indication of climate change in a place. There are several factors contributing to the climate change in the state as a result several intense phenomena can be observed. And these are all the signs seen in the telangana state as well, which we will see in the later part of the report.

The following report will mostly focus on the telangana state and the data related to it. The data-driven analysis following this would form the foundation of policy making of the state. Now let's dive deep into the analysis part of each factor for studying and understanding the reason for these effects in telangana especifically.

## We are studying the four following factors in response to climate change:

1. Temperature
2. Rainfall
3. Wind Speed

## Temperature

One of the notable phenomena is Temperature. We might have observed that earlier things used to happen periodically but now it is not so. Now the temperature and weather in general has become both frequent and intense at the same time, which is making the region worse. Recent temperature reports had hinted a pattern and a similar pattern had been observed from the analysis as well that temperature is going to its extreme values with time.
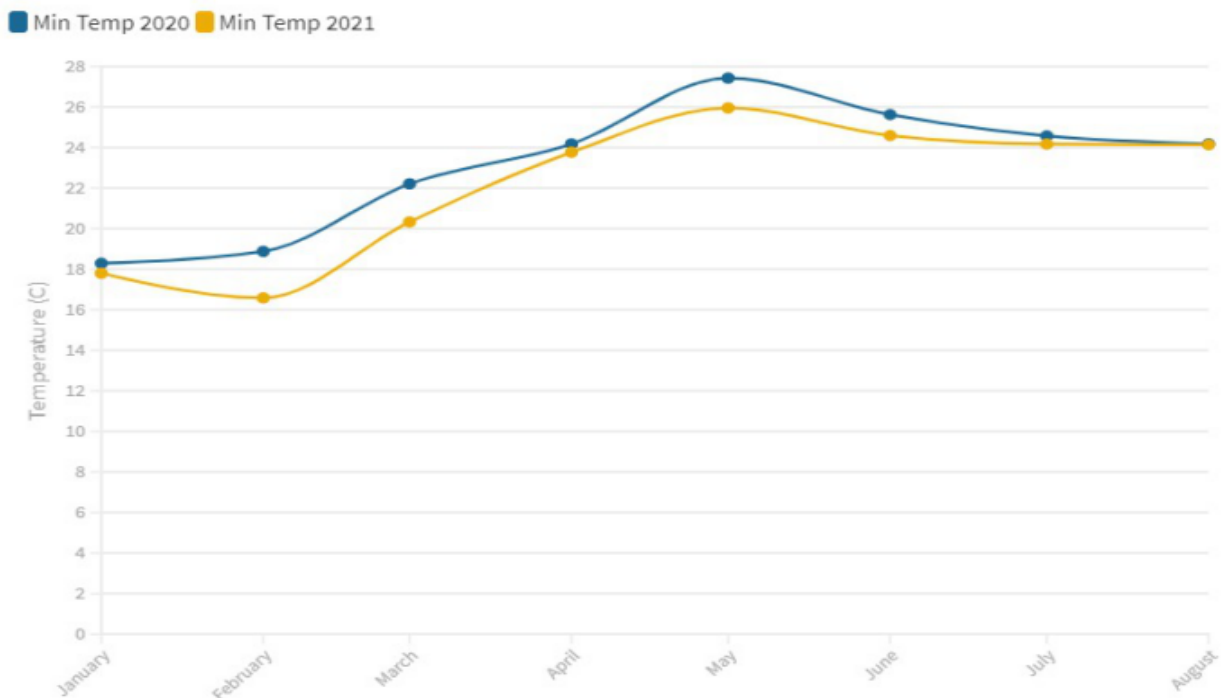


Fig. 1: Comparison of Minimum Temperature with Months for 2 years

From the plot above we can easily infer the minimum temperature had decreased further this year. The hysteresis area between the blue and the yellow line is the indication that temperature is going towards its extreme values, both in min and max values as well.

## Variation of Maximum Temperature with Months
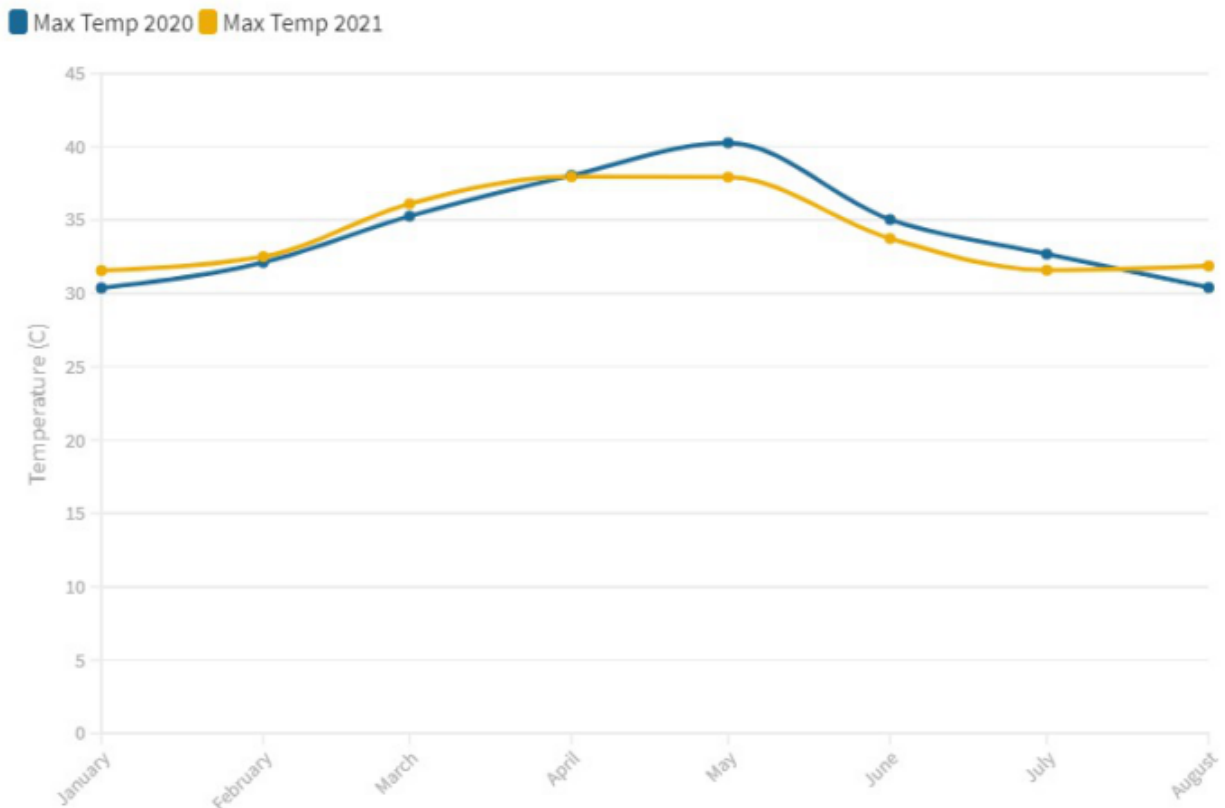
■ Max Temp 2020 ■ Max Temp 2021



Fig. 2: Comparison of Maximum Temperature with Months for 2 years

From the plot above we see a similar trend as well with a mixed baggage here, yet the majority of the months had observed the surge in the maximum temperature.

Both the plots denote the factor of temperature going to its extremities. There are a variety of reasons as to why it happens, one of them being the increase in the infrastructures and population. Population might sound a weird factor to include but it is one of the related factors on why temperature is increasing.

As per a report, the population of telangana has seen a rise of about 12.45% since 2011 till now. With the increase in population comes congestion, and with congestion comes more

CO2 emissions which further makes the climate hot. This is the reason for increased frequency in the heat waves and temperatures in the region.

## Temperature comparison with Districts

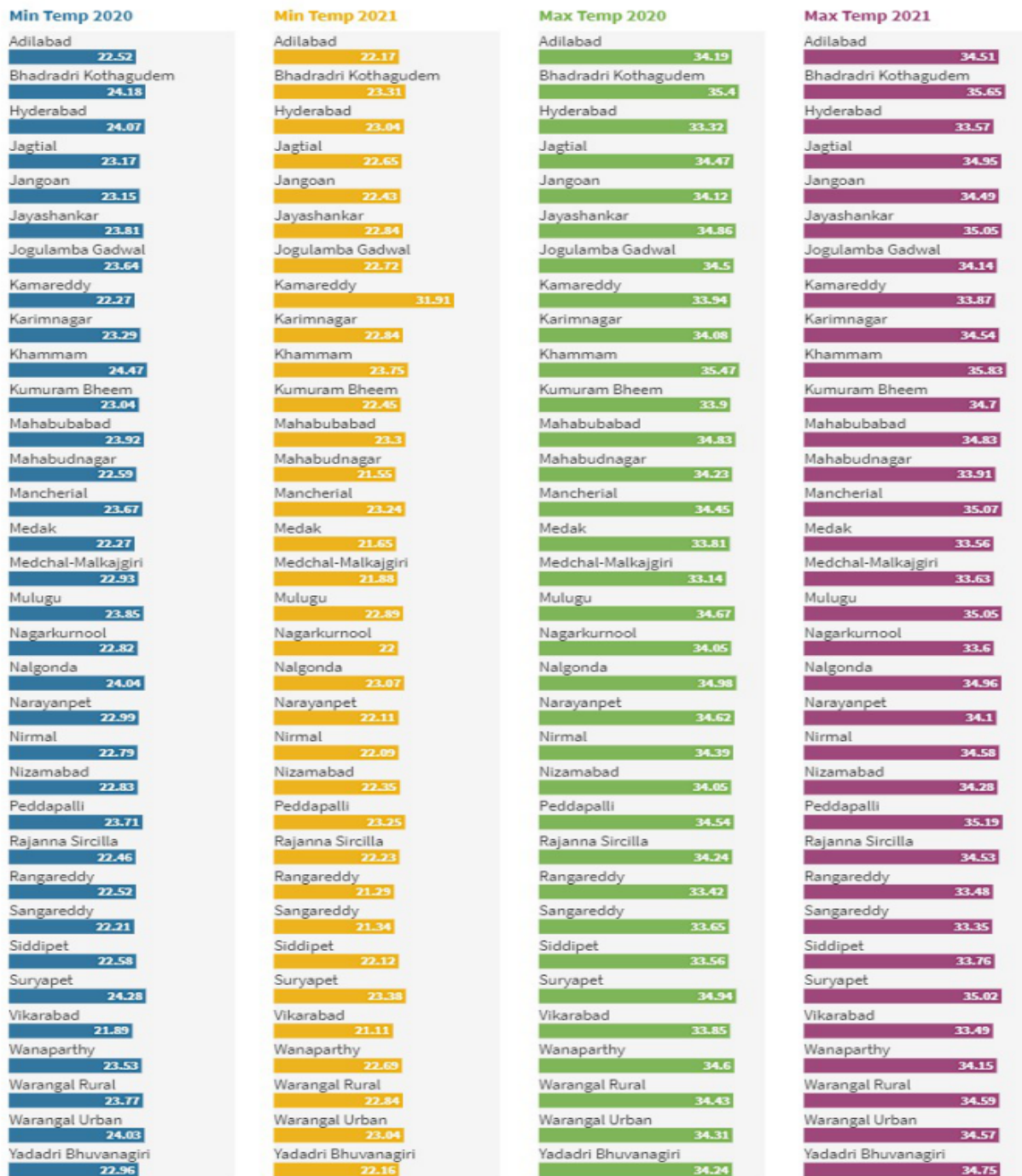| District | Min Temp 2020 | Min Temp 2021 | Max Temp 2020 | Max Temp 2021 |
|---|---|---|---|---|
| Adilabad | 22.52 | 22.17 | 34.19 | 34.51 |
| Bhadradri Kothagudem | 24.18 | 23.31 | 35.4 | 35.65 |
| Hyderabad | 24.07 | 23.04 | 33.32 | 33.57 |
| Jagtial | 23.17 | 22.65 | 34.47 | 34.95 |
| Jangoan | 23.15 | 22.43 | 34.12 | 34.49 |
| Jayashankar | 23.81 | 22.84 | 34.86 | 35.05 |
| Jogulamba Gadwal | 23.64 | 22.72 | 34.5 | 34.14 |
| Kamareddy | 22.27 | 31.91 | 33.94 | 33.87 |
| Karimnagar | 23.29 | 22.84 | 34.08 | 34.54 |
| Khammam | 24.47 | 23.75 | 35.47 | 35.83 |
| Kumuram Bheem | 23.04 | 22.45 | 33.9 | 34.7 |
| Mahabubabad | 23.92 | 23.3 | 34.83 | 34.83 |
| Mahabudnagar | 22.59 | 21.55 | 34.23 | 33.91 |
| Mancherial | 23.67 | 23.24 | 34.45 | 35.07 |
| Medak | 22.27 | 21.65 | 33.81 | 33.56 |
| Medchal-Malkajgiri | 22.93 | 21.88 | 33.14 | 33.63 |
| Mulugu | 23.85 | 22.89 | 34.67 | 35.05 |
| Nagarkurnool | 22.82 | 22 | 34.05 | 33.6 |
| Nalgonda | 24.04 | 23.07 | 34.98 | 34.96 |
| Narayanpet | 22.99 | 22.11 | 34.62 | 34.1 |
| Nirmal | 22.79 | 22.09 | 34.39 | 34.58 |
| Nizamabad | 22.83 | 22.35 | 34.05 | 34.28 |
| Peddapalli | 23.71 | 23.25 | 34.54 | 35.19 |
| Rajanna Sircilla | 22.46 | 22.23 | 34.24 | 34.53 |
| Rangareddy | 22.52 | 21.29 | 33.42 | 33.48 |
| Sangareddy | 22.21 | 21.34 | 33.65 | 33.35 |
| Siddipet | 22.58 | 22.12 | 33.56 | 33.76 |
| Suryapet | 24.28 | 23.38 | 34.94 | 35.02 |
| Vikarabad | 21.89 | 21.11 | 33.85 | 33.49 |
| Wanaparthy | 23.53 | 22.69 | 34.6 | 34.15 |
| Warangal Rural | 23.77 | 22.84 | 34.43 | 34.59 |
| Warangal Urban | 24.03 | 23.04 | 34.31 | 34.57 |
| Yadadri Bhuvanagiri | 22.96 | 22.16 | 34.24 | 34.75 |

Fig. 3: Comparison of temperatures with Districts for 2020 and 2021

Upon further analysis, we have inferred and tried to pinpoint the major surge in temperature which might help in the policy making process. The above diagram shows the information that Vikarabad has seen the extremities in minimum temperature and Khammam has seen the extremities in maximum temperature for 2021. If we look at the data of 2020, we can easily point that Vikarabad and Khammam were the districts to face the extremities again. Through this data, we can pinpoint the districts and make related specialized policies.

*The following are highlighted in this section over which the authorities and people in general can work upon:*

This is clear from the data of 2021 and 2020 that climate change is real and the temperature is going to its extremes as we progress through the time. If the situation remains the same, the trend will follow and it will keep on going to extreme values.

Next is the population control and infrastructure management which has to be controlled in general.

## Rainfall

Today, the whole world has seen an upsurge in climate change in many different sectors and factors. One of them being the rainfall received. Rainfall can be a boom as well as a curse, and a well balance is maintained when received in the right amount. Recently, weather reports have surfaced about the issue of heavy rainfall in Telangana, which has caused loss of property and a big barrier in the general works of people.

In this section, we present an analytical and comparative study of rainfall patterns over years in Telangana. We also suggest what can be the underlying causes of such changes in climate.
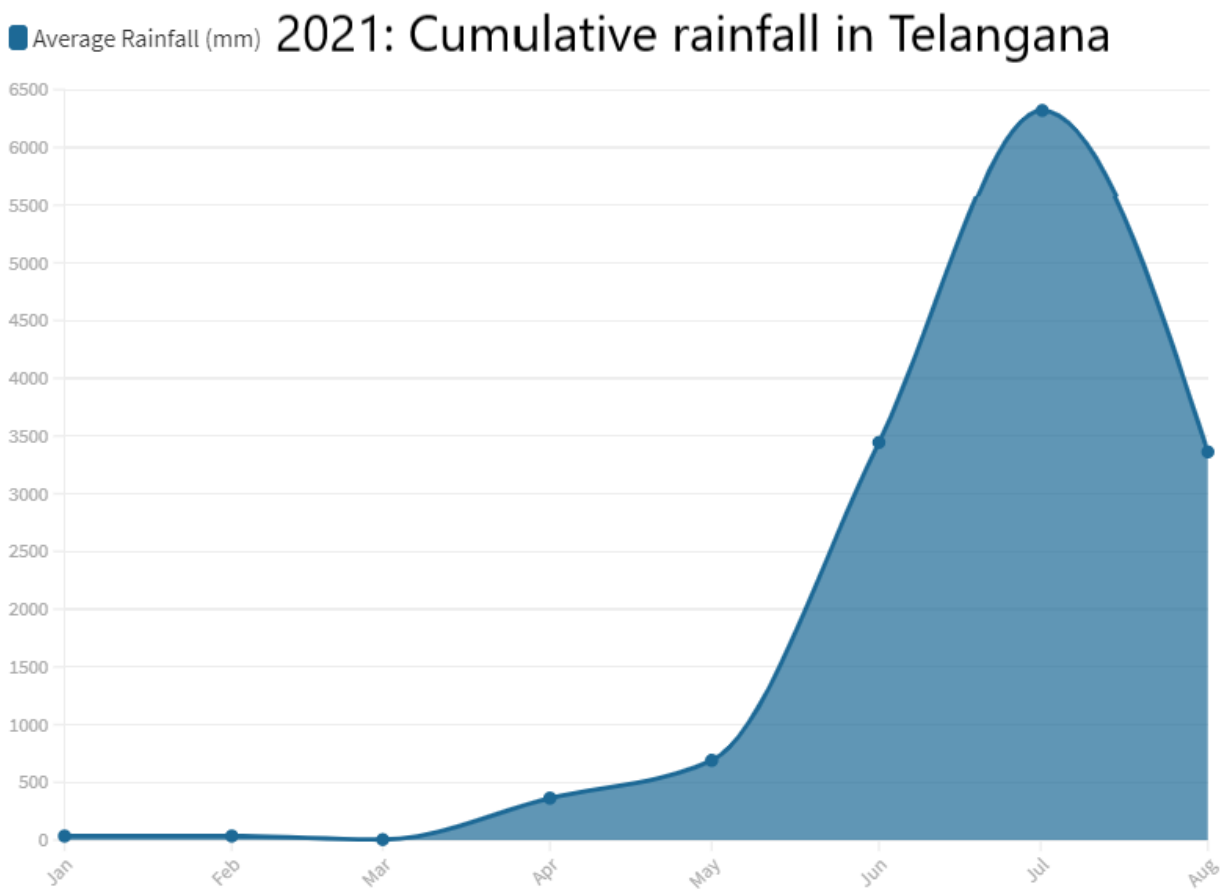
Fig.4: Year 2021: Monthly cumulative rainfall in Telangana

Here we see the graph of monthly cumulative rainfall (mm) for the year 2021. The peak value is in the month of July with over 6000 mm of total rainfall. This is followed by the months of June and August with over 3500 mm of rainfall.
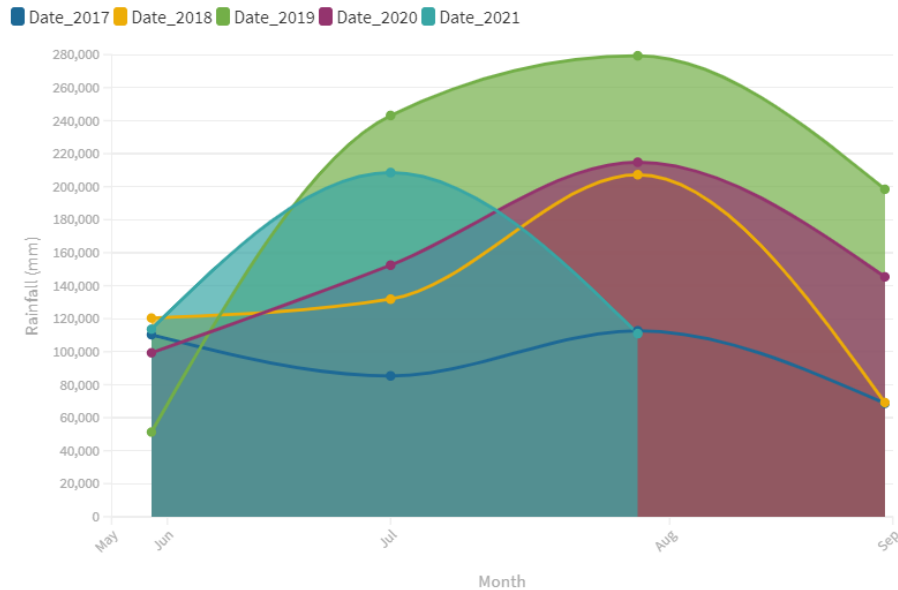
**Month wise rainfall Jun-Sept**

Fig.5: Month wise rainfall June-Sept

The peak rainfall months are seen in the previous figure, and from our observations are the months of June to September. The figure above shows how rainfall varies per month for the months of June to September spanning over five years, 2017-2021.

Two very noticeable patterns can be inferred from the plot. For the years 2017-2020, the average rainfall seems to be higher than that of 2021. Here, the claim that there has been an upsurge in total rainfall doesn't hold. But the rainfall just in the month of July is higher in 2021 than the rest of the years. This brings us to an interesting interpretation of whether the rainfalls have actually increased, or it is something else that is causing the problem. The plot here shows, keeping the situation of Telangana in this year's rainy season in view, that even a lesser amount of rainfall has caused more damage. This may be so due to increased infrastructure density, and incompatible water management system to hold in place.

Another interesting pattern we see is the shift in the peak rainfall month. For the years 2017-2020, maximum rainfall has occurred in the month of August, but for the year 2021, the same is so in the month of July. The peak rainfall has shifted behind by a month. This change in the rainfall pattern may cause serious disruptions in the overall climate

maintenance. Evidently, unsustainable acts like increased $CO_2$ emissions, inadequate water management, etc. have impacted the weather patterns.
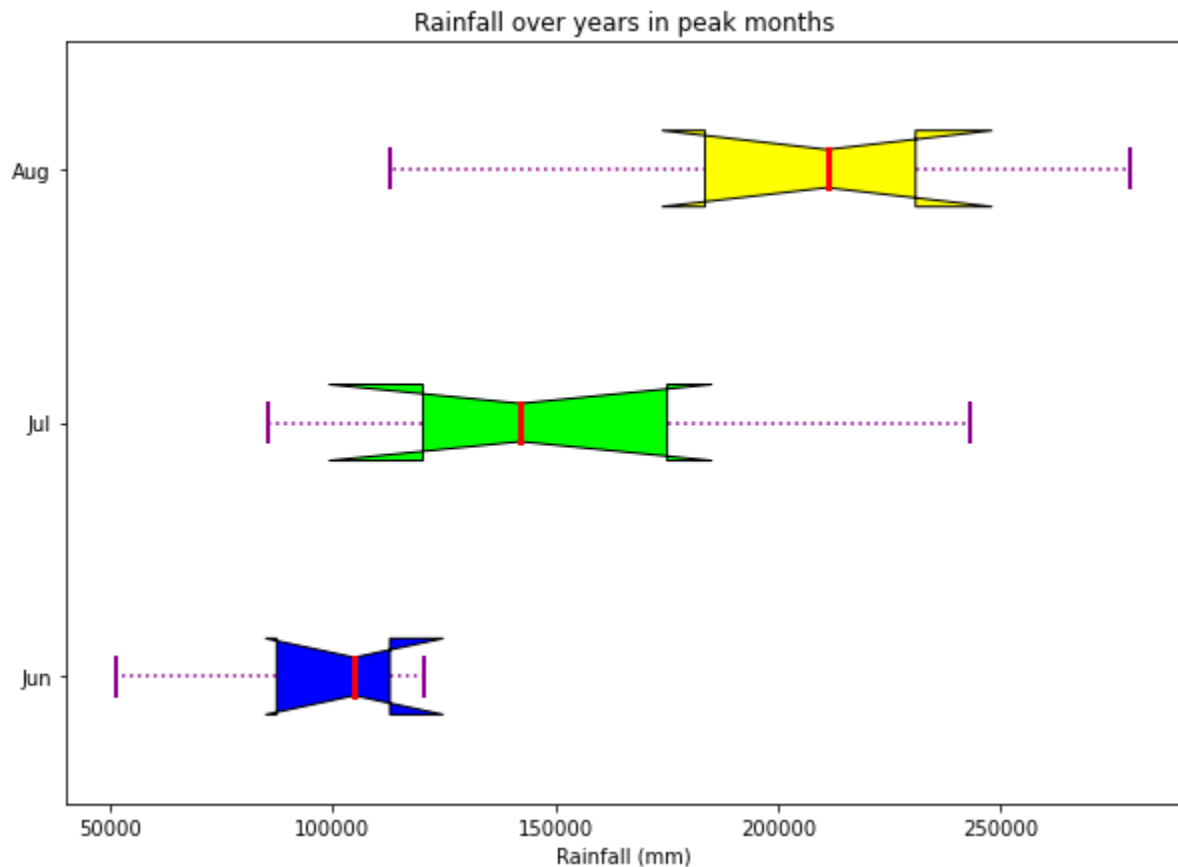


Fig. 6:  Boxplots: Rainfall over years in peak months

The figure above shows boxplots for the months of June, July, and August, which are the peak rainfall months. Even though for the year 2021, there was a pattern shift in rainfall, still on an average, the pattern of rainfall over the years is maintained.

This gives an idea that even though the weather patterns seem to get disrupted, nonetheless, they can still be restored back to what ideal and good rainfall looks like.

*The following are highlighted in this section over which the authorities and people in general can work upon:*

Total rainfall in the year 2021 has been lesser than the previous years, still we face an increased issue of waterlogging and property damage. This indicates that water management is not conducted properly and this is a topic to be looked upon. Also there is an indication of a shift of the whole rainfall season by a month, which is a serious issue. Unsustainable acts have surely contributed to it having a big impact on overall climate change.

## Wind( Speed )

Wind Speed is one of the important factors of climate in an Area. The wind carries the moisture and clouds to or from an Area depending upon the seasons and the place of the land with respect to the water bodies.

Below is the trend of average rainfall over the year in 2021 and 2020.

If we see from 2020 to 2021 - the average wind speed has minor changes. The report had been shown for only a few months owing to the inadequacies in the data. If we observe the wind speed is peaking in June in almost all years of study, just during the start of rainy season in Telangana.
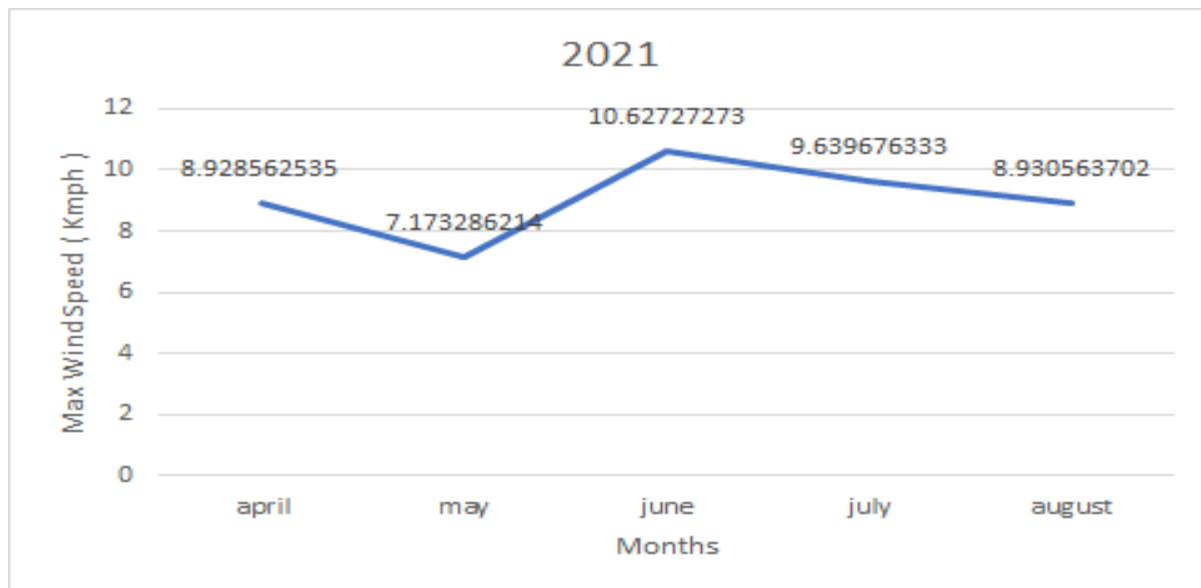


Fig. 7: Wind speed in year 2021

The Trend after the first half of the year has been same for both years 2019 and 2020. During the first half of the year there is drastic change between the years.
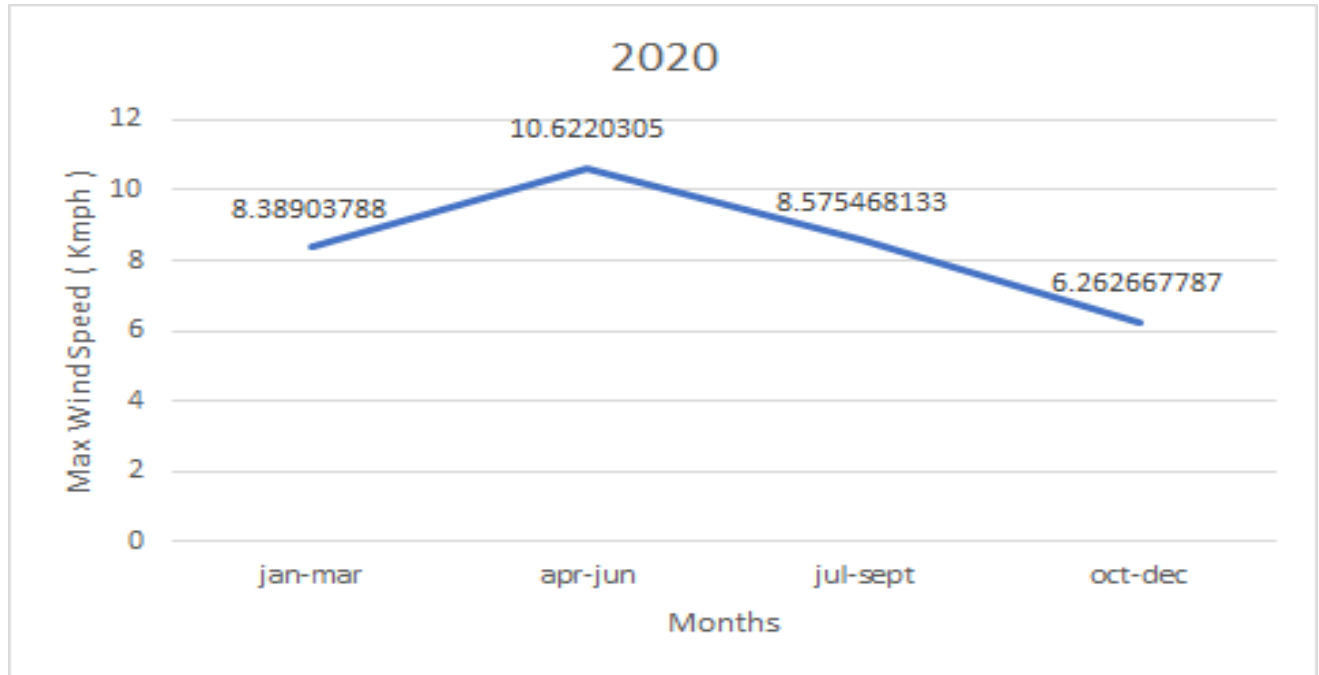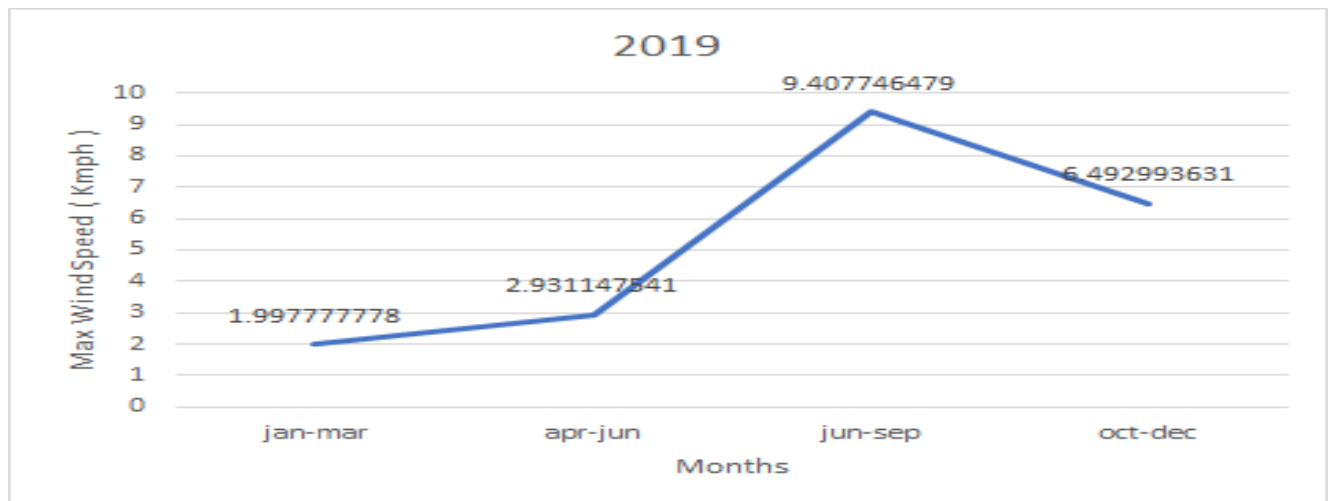


Fig. 8: Wind speed in year 2020



Fig. 9: Wind speed in year 2019

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