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RELATION BETWEEN MET PARAMETER'S & AGRICULTURE PRODUCTION AS A GUIDELINE TO SUSTAINABLE DEVELOPMENT IN DISTRICTS OF ANDHRA PRADESH

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Abstract

Andhra Pradesh is a predominant agricultural state and in agricultural state water and its distribution is very important. The minimal water utility is more concerned in the modern agricultural practices are very essential. In the present study, we attempted to study the district wise Seasonal variations of the precipitation, and Potential Evapotranspiration in the state Andhra Pradesh which largely affect crop production. The main rainfall season forAndhra Pradesh is the monsoon season(JJAS). In this study, we have observed the changes in the precipitation patterns within the season there will be a good impact on yield growth. The district-wise analysis will give the location and crop-specific effects on the growth and yielding. Changes in Rainfall and increase in temperatures are playing a crucial role in crop production because of climate change. In this study, we have seen the climate model prediction from the climate model. Understanding the district level precipitation analysis will help the crop management and micro-level climate classification also.

Key Words: precipitation, potential Evapotranspiration, season, climate model.

Introduction

Crop growth is physically linked to precipitation and temperature on short (**Frieler et al., 2017**) as well as long (**Lobell et al., 2011)** timescales. The climate of India is influenced by the southwest (SW) and northeast monsoon systems that govern the Indian economy. In addition to the abnormal inter-annual, seasonal and intra-seasonal variations in the climate indices, extreme weather events such as floods, droughts, heat and cold waves are known to create adverse effects in widely separated areas of Asia. It is reported that the total flood-prone area in India is about 40×106 ha (12.16% of total land area). Globally mean temperature has increased by 1.8 to 4 degrees Celsius by 2100 (**IPCC, 2014).** In addition to the increase in temperature, the increase in the frequency of weather extreme events i.e.., heat waves, floods, cyclones and droughts projected to aggravate. These parameters are bound to affect agricultural production. The short -term climate signal shows

the much influence on the southwest or summer monsoon of India and is the decisive factor for the future of the farmer community in India. Crop production is largely affected physically by Meteorological variables, including rising temperature changing precipitation regimes and increased atmospheric carbon dioxide levels (**H.R. Patel et al., 2013**). In the present study, we studied the impact of the meteorological parameters on the Crop yield growth and sustainability using the district-wise Rainfall& temperature data for the last five years from 2015 to 2019 for the Andhra Pradesh state obtained from the IMD. We have calculated the Standard Precipitation index for the Drought calculation for the crop stress Conditions. Statistical tests have been conducted to the correlation between the Yield and the Precipitation and the correlation between the PET and crop stress the correlation is univariate. There is a significant impact on the variations in the Rainfall and Temperatures and the production Yield. The future projections are seen in this study that there is a significant rise in temperatures, changes in rainfall patterns will give an idea for the crop contingent planning. We have studied the future projections are also for the rainfall of Andhra Pradesh State with RCP 8.5 model Projection of the Three decade's 2021-2050.

Data and Methodology

Data

District wise Rainfall and Temperature data of the state Andhra Pradesh from 2015 to 2019 for June, July, August, and September data is obtained from the India Meteorological Department. Agriculture Production Data for five important crops PADDY, JOWAR, MAIZE, BLACK GRAM, GROUNDNUT Data collected for the major crops of district wise from the Andhra Pradesh state agriculture department.

Methodology

In the present study, we have empirically calculated the PET using the FAO-56 Penman-Monteith method since it is a globally accepted method for estimating the PET. To show a firm relation between the MET parameters and agriculture production the following relationships correlation, covariance, and standard deviation have been estimated. The standardized precipitation index is calculated for all the districts. The calculations and estimations have been performed using the program developed with MATLAB (version 2013R). This enables us to estimate the feature projections of rainfall and temperature by using themodels.Model scenarios RCP 4.5, RCP 8.5(Representative concentration Pathways) have been used for this purpose.

Results and Discussions

District wise analysis of rainfall (monsoon days) for Andhra Pradesh from 2015 – 2019

This study mainly concentrated in district wise seasonal analysis of precipitation and temperatureto affect the moisture and water balance in the crop which leads to the production. To understand the comparativeanalysis the entire Andhrapradesh has been divided into three sections North Andhra Pradesh (VZM, SRKLM.VSKP, EG, WG) and south Andhra Pradesh(Krishna, Guntur,Prakasam, Kurnool) and Rayalaseema(AnatapuramChittoor,Kadapa, SPSR Nellore, Chittoor). The figures-1(a.b, c,d) shows the rainfall for Srikakulam, Visakhapatnam, East Godavari & West Godavari districts. Among these five years, the pattern over Visakhapatnam is similar to Srikakulam however, the rainfall in the later period (from 100 days to 120 days is maximum). The districts of Srikakulam & Visakhapatnam are well suited for Rain Fed Rice Crops, Compared to East Godavari & West Godavari, however, it is a well-known fact that The East Godavari &West Godavari are the Rice bowl of India, it is mainly because most of the Paddy crop by irrigation &water through channels.In Srikakulam is maximum in the year 2015 (90.8 mm),The rainfall in East Godavari district maximum is 140.2mmin the year 2015. The rainfall in Visakhapatnam district maximum is 73.7mm in the year 2015. West Godavari district maximumis 129.5mm in the year 2018.

The figures-2 (a.b,c,d) shows the rainfall for Krishna Guntur Prakasam Kurnool district. Among these five years, it observed that the rainfall. In Krishna is maximum rainfall in the year 2018 (77.5mm). The rainfall in

Guntur district maximum is 61.4mm in the year 2019. The rainfall in Prakasam district maximum is 69.3mm in the year 2016. The rainfall in Kurnool district maximum is 42.7mm in the year 2016. Krishna and Guntur are irrigated systems Prakasam and Kurnool are Rain Fed Systems.

Figure-3 (a.b,c,d) shows the rainfall for Anatapuram Chittoor,Kadapa, SPSR Nellore districts . Among these five years, it is observed that the rainfall In Anatapuram is maximum in the year 2019(40.57 mm). The rainfall in Chittoor district maximum is 44.7mm in the year 2016. The rainfall in Kadapa district maximum is 64.2 mm in the year 2017. Rainfall in the SPSR Nellore district rainfall is 48.9mm in the year 2015. The district of Anatapuram & Chittoor is the Rain Fed areas, the Kadapa & SPSR Nellore are irrigated areas.

Figures 4-6(a, b, c,d) are the temperature analysis of the three divisions. The maximum temperature peaks are where the less rainfall of the years of the monsoon season. The temperature was high in the third division as compared to the one and two divisions.

District wise comparative study of Temperature, Rainfall, PET & Yielding

SRIKAKULAM

The figures-7 (a, b) are showing the Paddy crop yielding is maximum in 2017, minimum in 2015. Jowar crop yielding is maximum in 2017, minimum in 2019. Maize crop yielding is maximum in 2015, minimum in 2017. Black Gram crop yielding maximum in 2016, minimum in 2015.Groundnut crop yielding maximum in 2017, minimum in 2019.

VISAKHAPATNAM

The figures-8 (a, b) Paddy crop yielding is maximum in 2017, minimum in 2015. Jowar crop yielding is maximum in 2017, minimum in 2019. Maize crop yielding is maximum in 2016, minimum in 2017. Black Gram crop yielding maximum in 2017, minimum in 2015.Groundnut crop yielding maximum in 2015, minimum in 2016.

EAST GODAVARI

The figures-9 (a, b) Paddy crop yielding is maximum in 2019, minimum in 2015. Jowar crop yielding is maximum in 2015, minimum in 2019. Maize crop yielding is maximum in 2016, minimum in 2018. Black Gram crop yielding maximum in 2015, minimum in 2019.Groundnut crop yielding maximum in 2015, minimum in 2019.

WEST GODAVARI

The figures-10 (a, b) Paddy crop yielding is maximum in 2019, minimum in 2015. Jowar crop yielding is maximum in 2015, minimum in 2016. Maize crop yielding is maximum in 2017, minimum in 2015. Black Gram crop yielding maximum in 2017, minimum in 2019.Groundnut crop yielding maximum in 2018, minimum in 2015.

KRISHNA

Figures-11 (a, b) are shows the Paddy crop yielding is maximum in 2019, minimum in 2015. Jowar crop yielding is maximum in 2015, minimum in 2019. Maize crop yielding is maximum in 2017, minimum in 2019. Black Gram crop yielding maximum in 2019, minimum in 2017.Groundnut crop yielding maximum in 2015, minimum in 2019.

GUNTUR

The figures-12 (a, b) are shows the Paddy crop yielding is maximum in 2017, minimum in 2015. Jowar crop yielding is maximum in 2015, minimum in 2019. Maize crop yielding is maximum in 2018, minimum in 2019. Black Gram crop yielding maximum in 2015, minimum in 2017.Groundnut crop yielding maximum in 2017, minimum in 2015.

PRAKASAM

Figures-13 (a, b) are shows the Paddy crop yielding is maximum in 2016, minimum in 2015. Jowar crop yielding is maximum in 2016, minimum in 2019. Maize crop yielding is maximum in 2017, minimum in 2019. Black Gram crop yielding maximum in 2015, minimum in 2017.Groundnut crop yielding maximum in 2019, minimum in 2018.

KURNOOL

The figures-14 (a, b) Paddy crop yielding is maximum in 2017, minimum in 2015. Jowar crop yielding is maximum in 2015, minimum in 2019. Maize crop yielding is maximum in 2018, minimum in 2015. Black Gram crop yielding maximum in 2015, minimum in 2018.Groundnut crop yielding maximum in 2018, minimum in 2019.

ANANTAPUR

Figures-15 (a, b) Paddy crop yielding is maximum in 2016, minimum in 2015. Jowar crop yielding is maximum in 2018, minimum in 2019. Maize crop yielding is maximum in 2018, minimum in 2019. Black Gram crop yielding maximum in 2017, minimum in 2019.Groundnut crop yielding maximum in 2018, minimum in 2019.

KADAPA

Figures-16 (a, b) Paddy crop yielding is maximum in 2019, minimum in 2015. Jowar crop yielding is maximum in 2016, minimum in 2019. Maize crop yielding is maximum in 2018, minimum in 2019. Black Gram crop yielding maximum in 2017, minimum in 2019.Groundnut crop yielding maximum in 2017, minimum in 2019.

SPSR NELLORE

The figures-17 (a, b) Paddy crop yielding is maximum in 2016, minimum in 2015. Jowar crop yielding is maximum in 2018, minimum in 2019. Maize crop yielding is maximum in 2018, minimum in 2019. Black Gram crop yielding maximum in 2018, minimum in 2019.Groundnut crop yielding maximum in 2018, minimum in 2015.

CHITTOOR

Figures-18 (a, b), Paddy crop yielding is maximum in 2018, minimum in 2015. Jowar crop yielding is maximum in 2018, minimum in 2019. Maize crop yielding is maximum in 2018, minimum in 2019. Black Gram crop yielding maximum in 2018, minimum in 2019.Groundnut crop yielding maximum in 2019, minimum in 2017.

YIELDING

The figures-19 by comparing all 12 districts of Yielding (Paddy), Nellore has maximum yielding in the year 2015,2016,2017,2018. Kurnool has maximum yielding in the year 2019.

Figures 20(a,b,c) Is the spatial analysis of the temperature, Rainfall and potential Evapotranspiration, of the years 2015-2019 though the PET is less in the monsoon season but understanding the evaporation within season which helpful to the agricultural management practices such as like the irrigation and pest management which helps to the good yielding of the principle crops.

Figures 23 and 24 are the climate projections of the next three decades of rainfall and temperature with RCP 4.5 and RCP 8.5. These projections are indicating that there will be a strong temperature rise in the Krishna Guntur and West Godavari districts than the other districts and the rainfall is also less over the places in the next 20231-2041, 2041-2050 decades both scenarios. Which will indicate with less rainfall and high temperature rise the evapotranspiration also increases which leads to the high water requirement in the field and cash crops.

Summary and Conclusions

In this study, we have seen the last five years met parameters affecting crop Growth and yield production of major crops in Andhra Pradesh.When the temperature rises it leads to the biomass production at roots of the crop and evaporation also high so the soil will be dry and water consumption and irrigation requirement is also increasing in the year 2015.The maximum temperature is high the receiving rainfall is low in the monsoon months as compared to the long term average normal.It leads to high evaporation so, we have seen the potential evaporation and related standardized precipitation index are showing the dry conditions in most districts in 2015. The yield production also decreases.While in the year 2018 though the temperatures are high the DTR diurnal average temperature is less in the monsoon months and also the rainfall high leads the less evaporation and most of the districts are in the wet condition leading to the high production of the Yield also.

We have also seen, the future projections for the coming next three decades of maximum temperature rainfall and minimum temperature each decide showing there is a significant rise in the temperature in the Prakasam, Krishna East, and West Godavari districts.This study points out the correlation between the Met parameters and agriculture productions of different crops.This also clearly points out, that districts like West Godavari and East Godavari which depend on irrigated water from the river system is having a suitable yield. In other words, the influence of rainfall is minimum, however for other districts, where irrigation facilities are not available. Precipitation and PET have been shown to have a greater influence on Yield.Anatapuram is a drought porn area, and every crop depends upon precipitation.This is evident in the variations of different crop yields, only black gram shows a little variation.The temperature along with rainfall is very important which determines the rate of Evaporation and transpiration. Hence in conclusion one can say that the temperature and rainfall however profound influence on agricultural yield.

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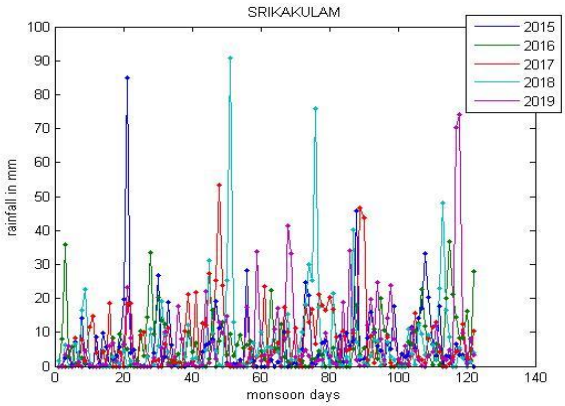
Figures

Figures -1(a.b, c,d) shows the rainfall(monsoon days) for Srikakulam, Visakhapatnam, East Godavari & West Godavari districts from 2015-2019

(a)



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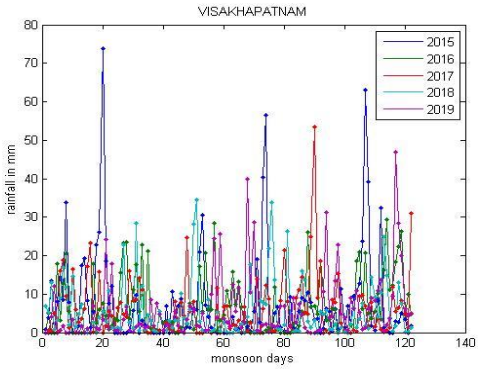

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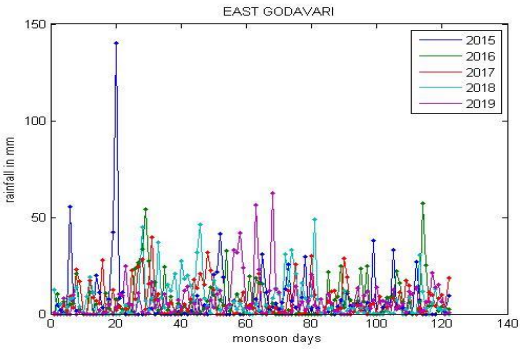


(d)

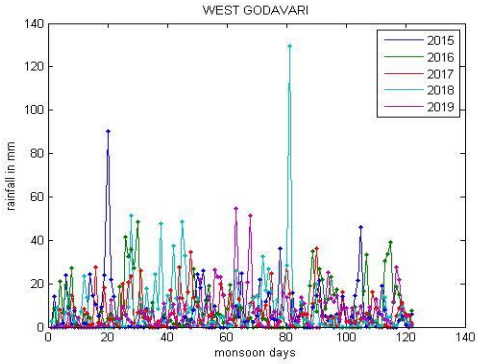
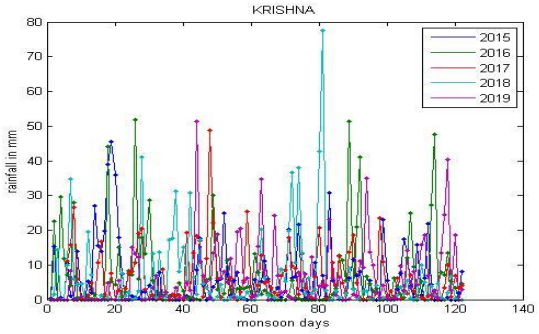


Figure-2 (a.b, c, d) shows the rainfall (monsoon days) for Krishna, Guntur, Prakasam, and Kurnool district from 2015-2019

a)



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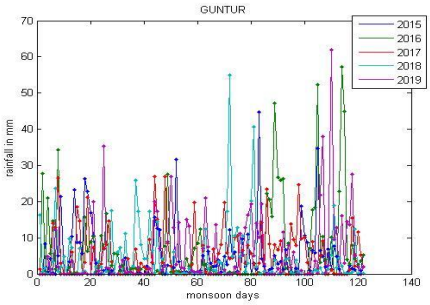

c)

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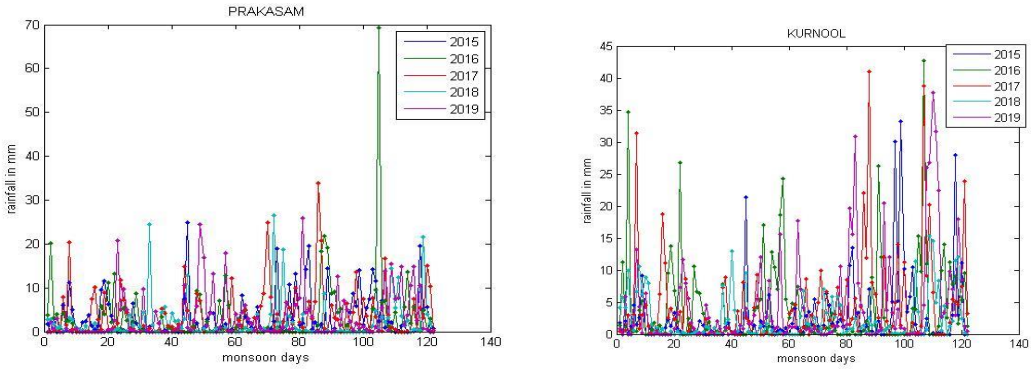
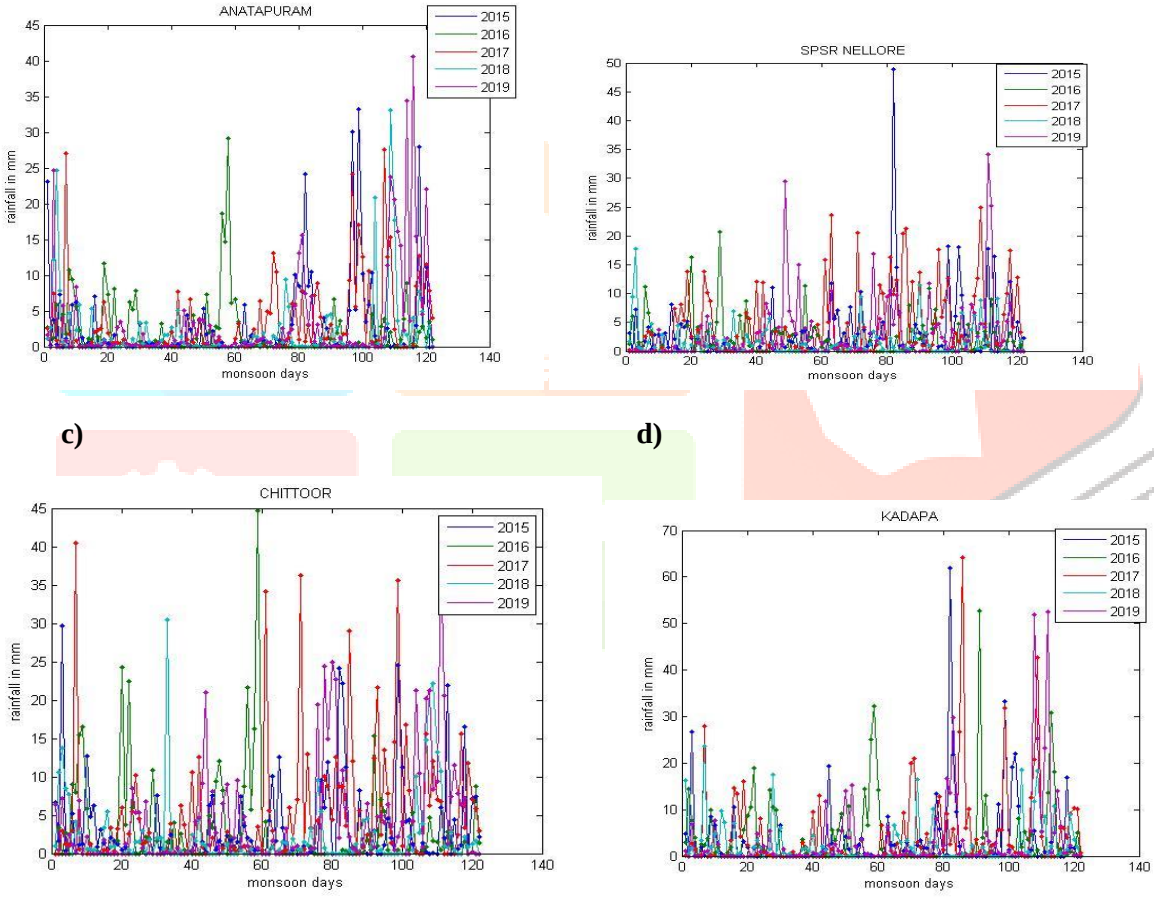


Figure-3 (a. b, c, d), shows the rainfall (monsoon days) for Anatapuram, Chittoor, Kadapa, SPSR Nellore districts from 2015-2019.

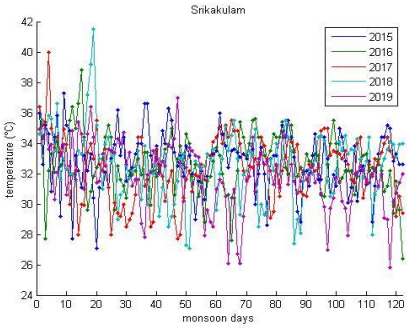
a) **b)**

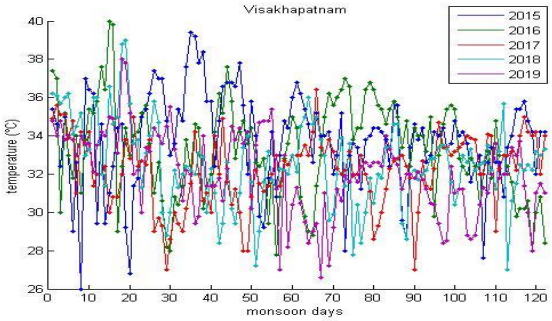


c) **d)**

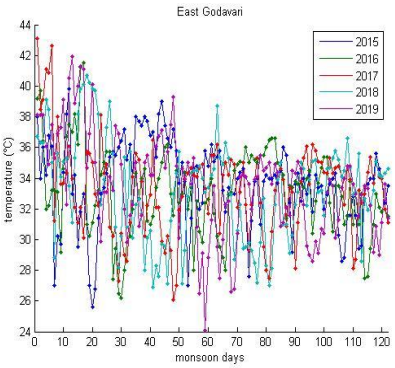
Figures 4-6(a.b, c,d) are the temperature analysis of the three divisions

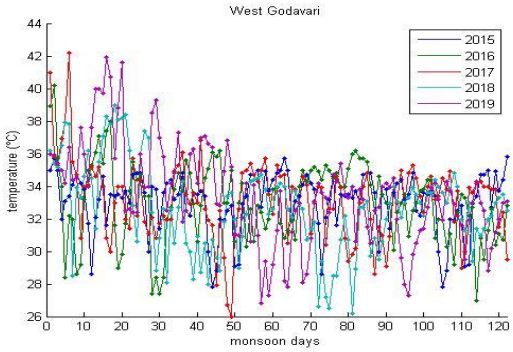
a) **b)**



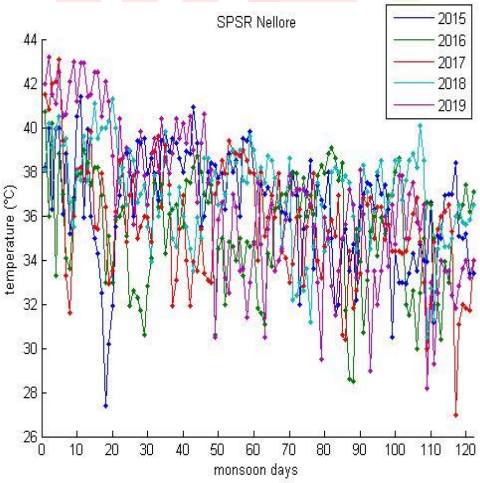


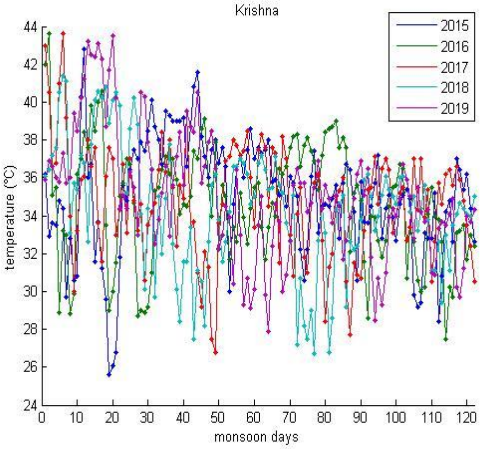
c) **d**

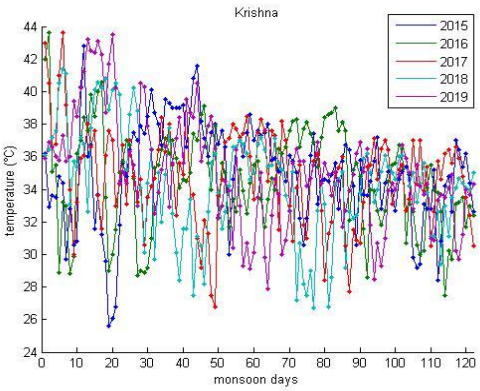


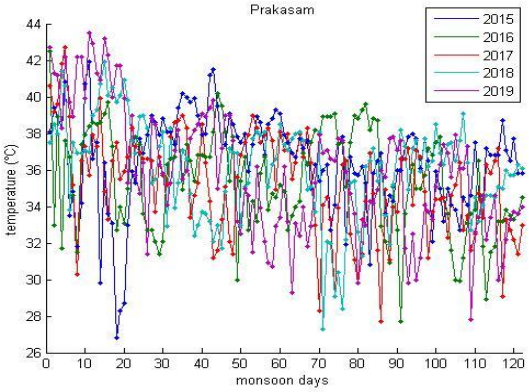


Figures-5 (a.b, c,d)



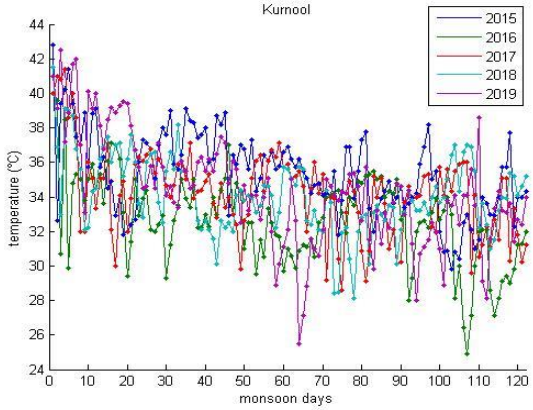






Figures-6 (a.b,c,d),

a)



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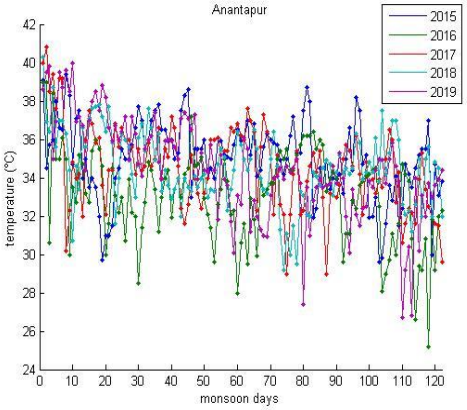

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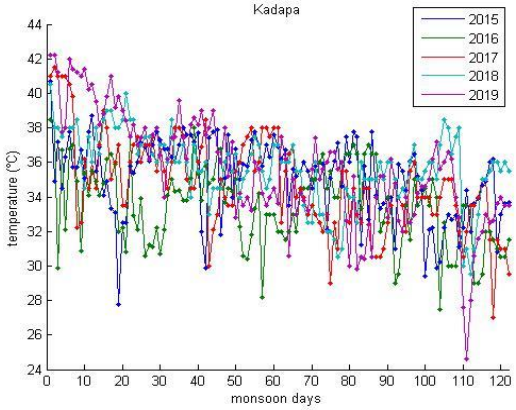

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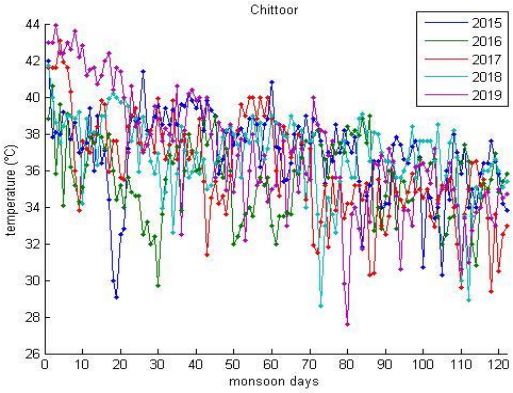
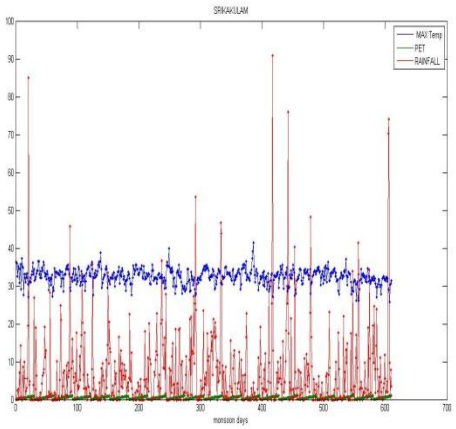
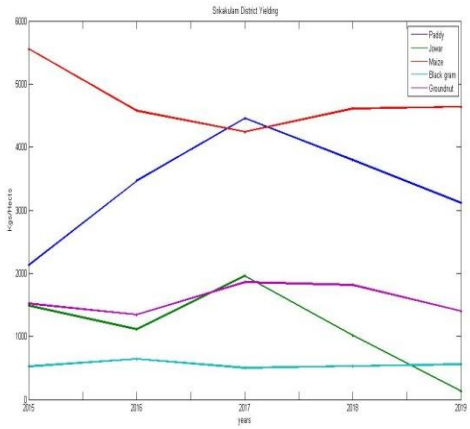


Figures-7 (a, b) comparative study of Temperature, Rainfall, PET & Yielding for Srikakulam District.

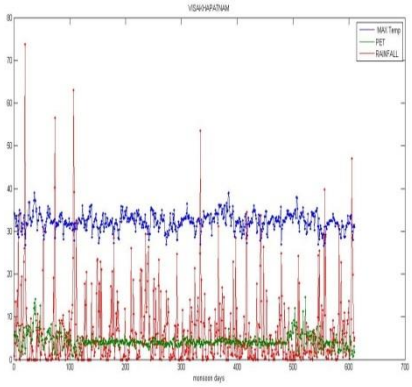
a) **b)**

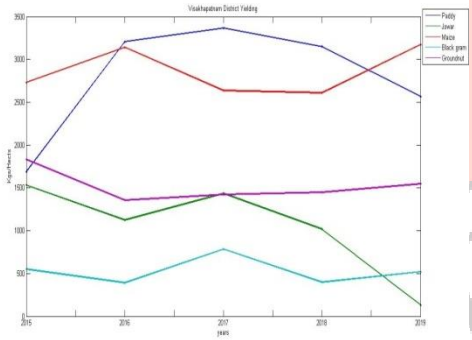




Figures-8(a, b) comparative study of Temperature, Rainfall, PET & Yielding for Visakhapatnam District.

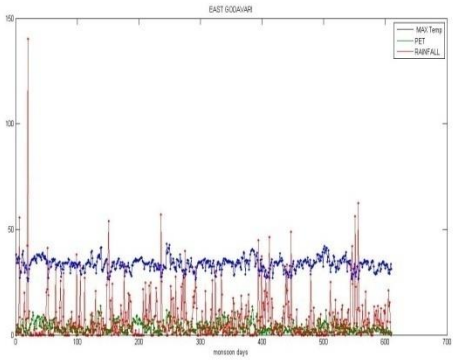
a) **b)**

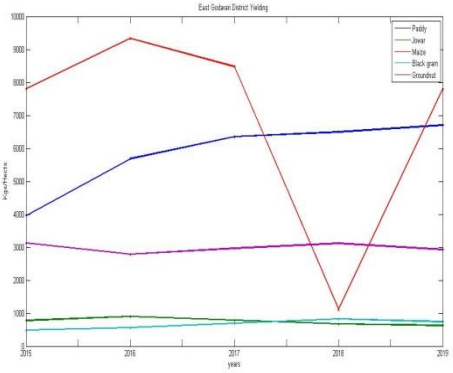




Figures-9(a,b) comparative study of Temperature, Rainfall, PET & Yielding for East Godavari District.

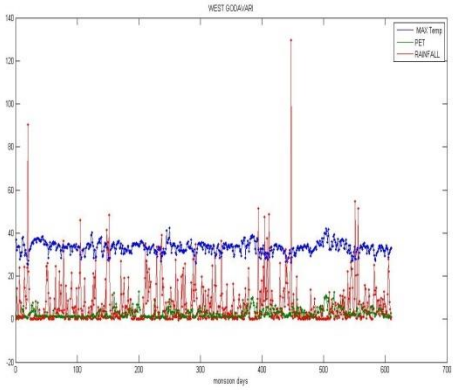
a) **b)**

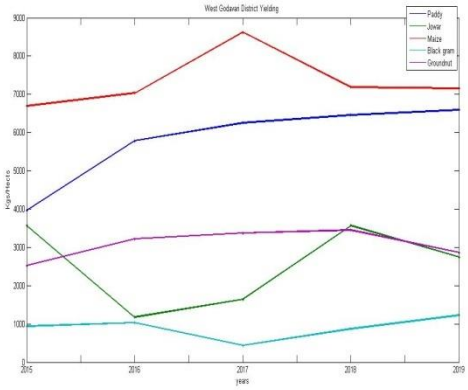




Figures-10 (a, b) comparative study of Temperature, Rainfall, PET & Yielding for West Godavari District.

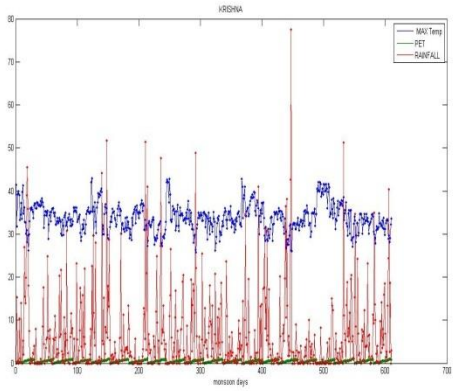
a) **b)**

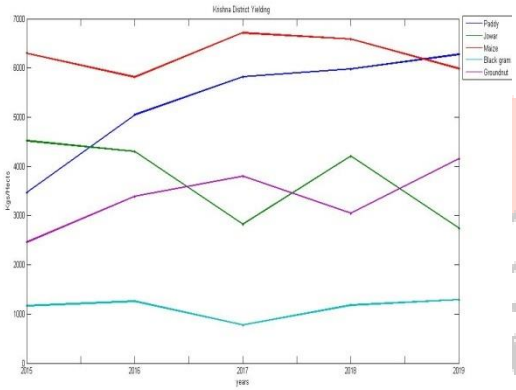




Figures-11 (a, b) comparative study of Temperature, Rainfall, PET & Yielding for Krishna District.

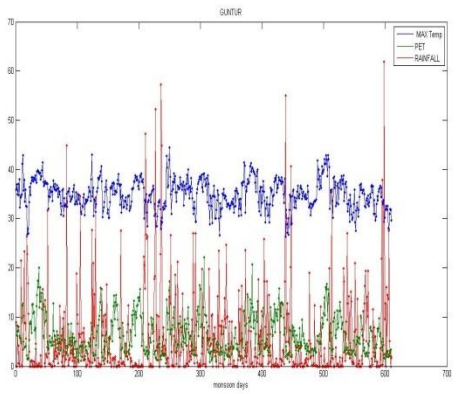
a) **b)**

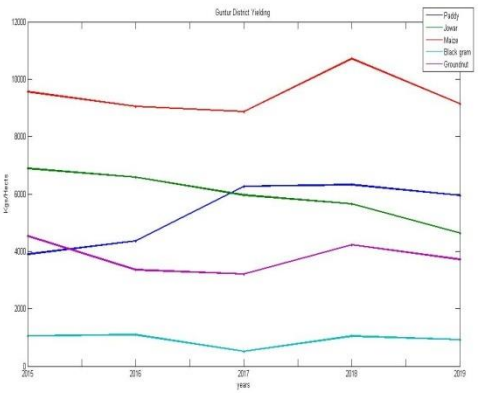




Figures-12 (a, b) comparative study of Temperature, Rainfall, PET & Yielding for Guntur District.

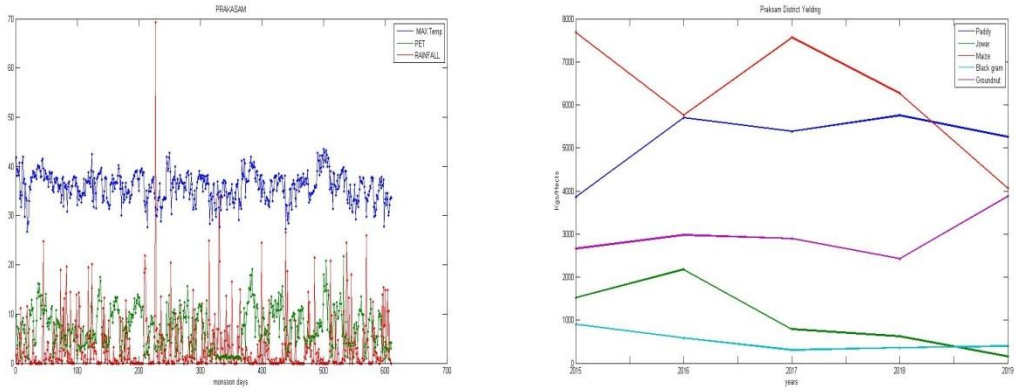
a) **b)**





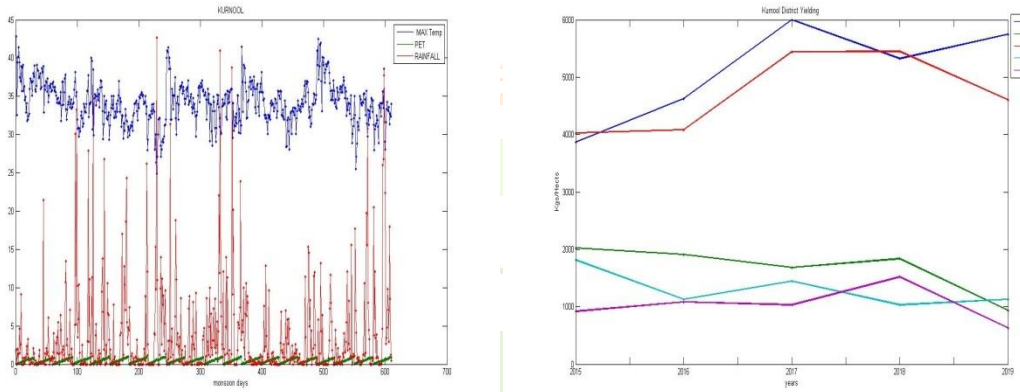
Figures-13 (a, b) comparative study of Temperature, Rainfall, PET & Yielding forPrakasam District.

a) **b)**



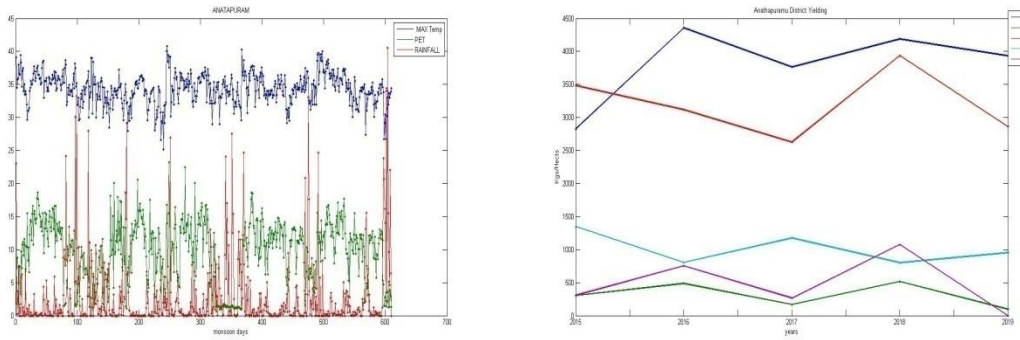
Figures-14 (a, b) comparative study of Temperature, Rainfall, PET & Yielding for Kurnool District.

a) **b)**



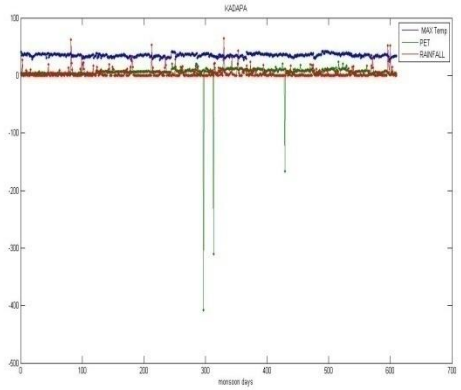
Figures-15 (a, b comparative study of Temperature, Rainfall, PET & Yielding for Anatapur District.

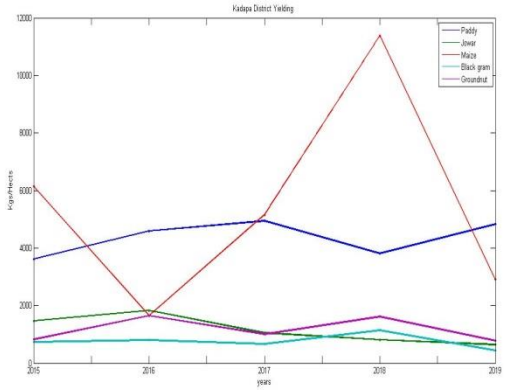
a) **b)**



Figures-16 (a, b) comparative study of Temperature, Rainfall, PET & Yielding for Kadapa District.

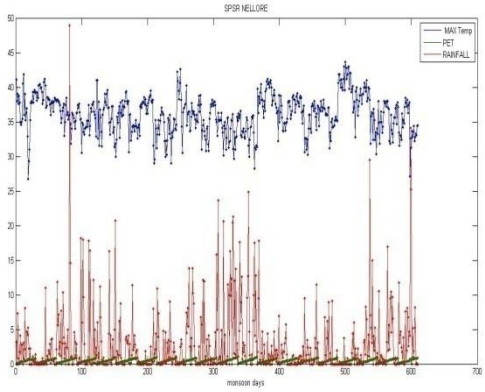
a) **b)**

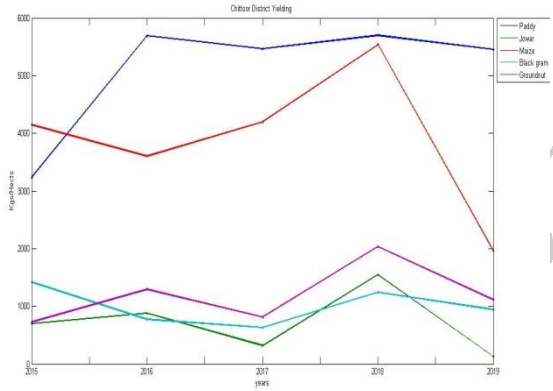




Figures-17(a, b) comparative study of Temperature, Rainfall, PET & Yielding for SPR Nellore District.

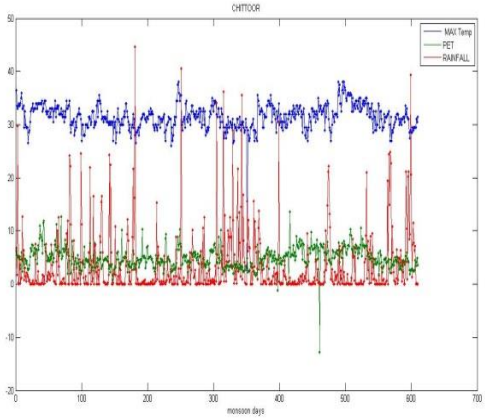
a) **b)**

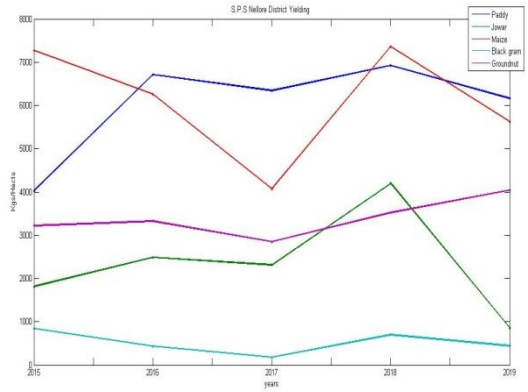




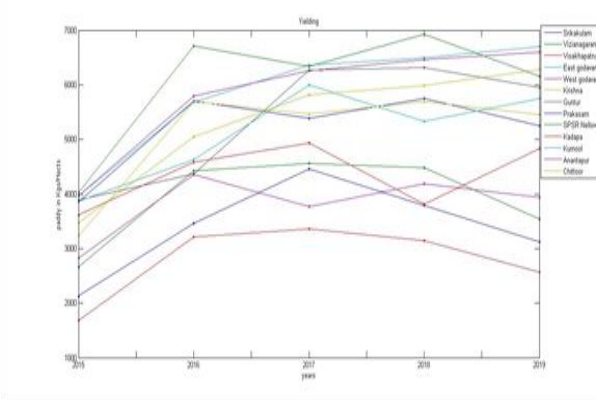
Figures-18 (a, b) comparative study of Temperature, Rainfall, PET & Yielding for Chittoor District.

a) **b)**





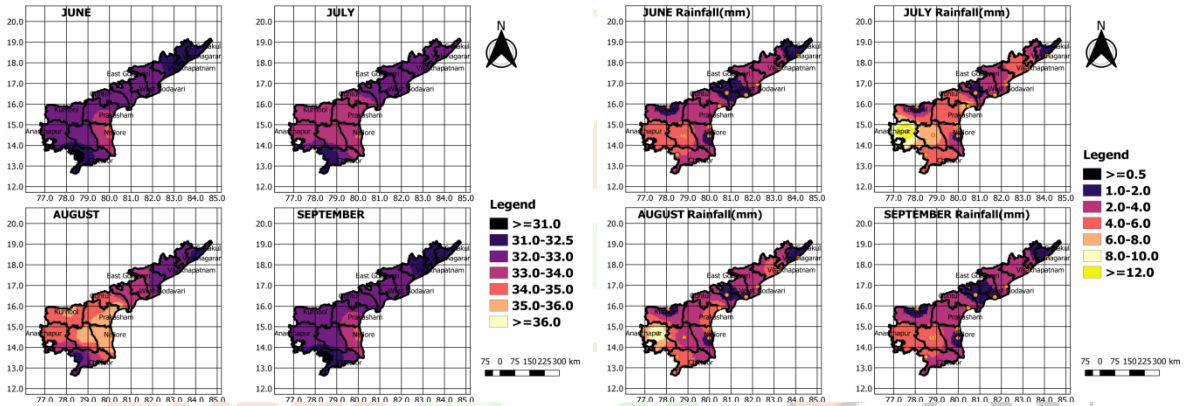
Figures-19, comparing all 12 districts of Yielding for 2015- 2019



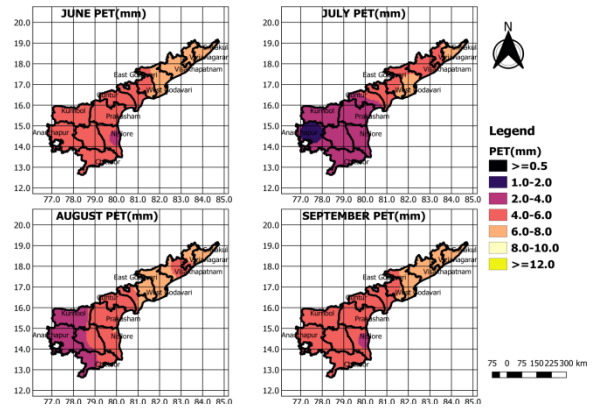
Figures-20, shows 2015-2019 Monthly Average Temperature (0c) June-Septembers

Figures-21, shows 2015-2019 Monthly Average Rainfall (mm) June-September

The figures-20 **The figures-21**

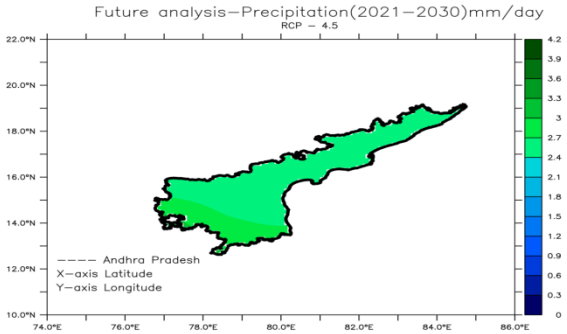


Figures-22, shows 2015-2019 Monthly Average PET (mm) June-September

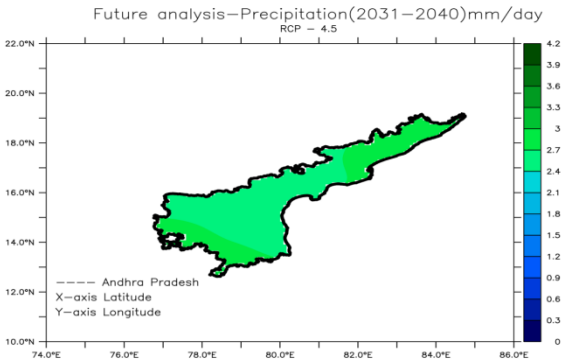


Figures-23, future projections of rain fall (mm) (model, RCP 4.5 & RCP 8.5)

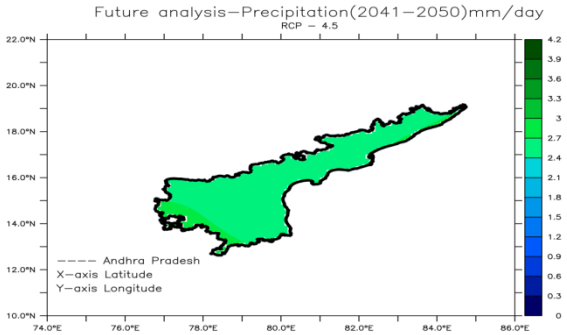
RCP 4.5



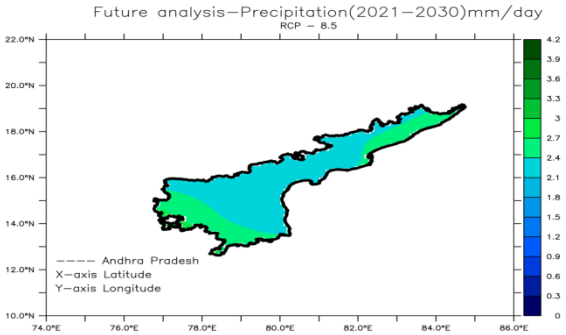
RCP 4.5



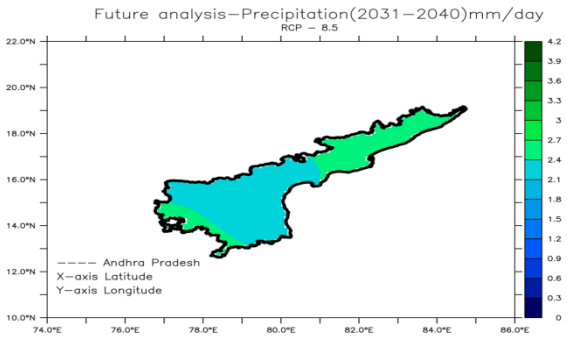
RCP 4.5



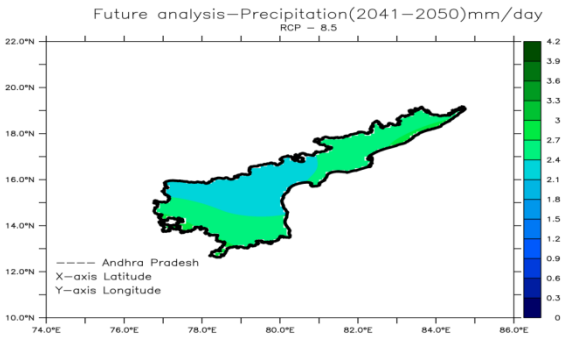
RCP 8.5



RCP 8.5

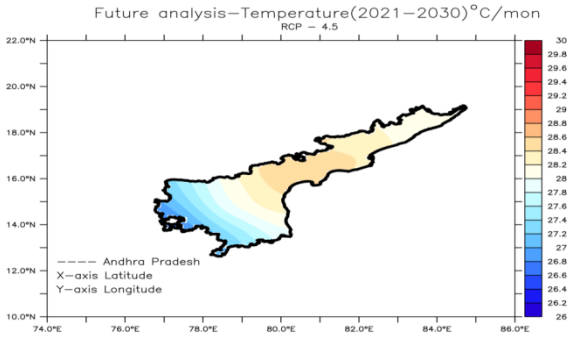


RCP 8.5

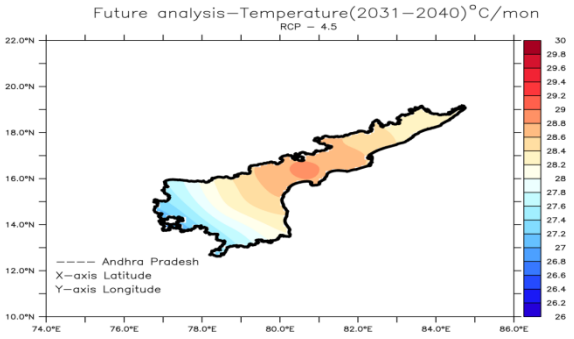


Figures-24, future projections of temperature (0c) (model RCP 4.5 & RCP 8.5)

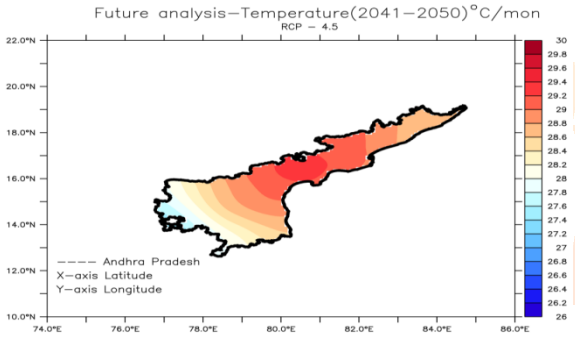
RCP 4.5



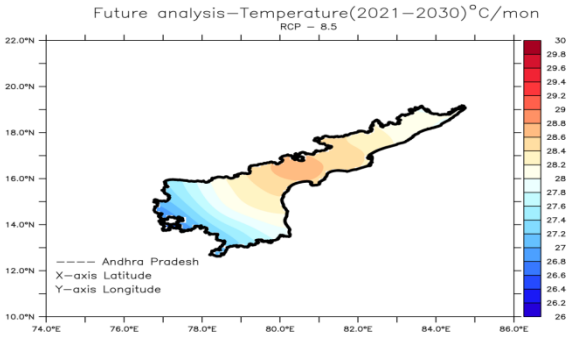
RCP 4.5



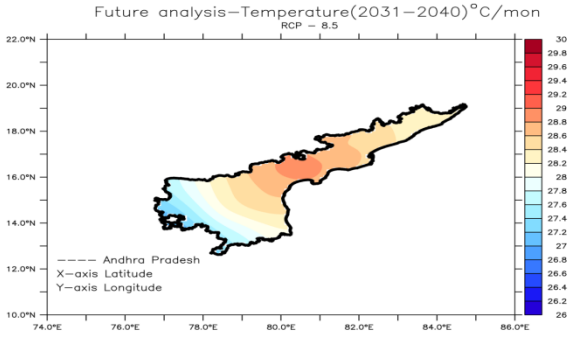
RCP 4.5



RCP 8.5



RCP 8.5



RCP 8.5

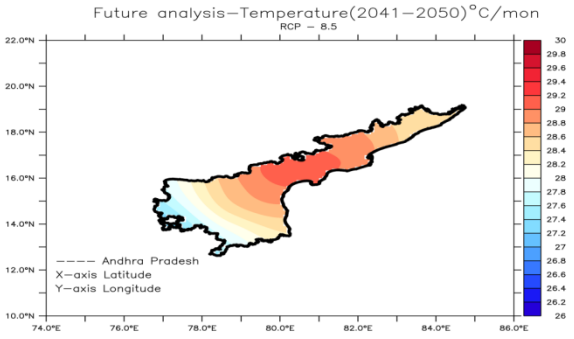


Table-1

STASTICAL PARAMETERS

	STANDARD DEVIAITION			correlation		CO VARIANCE	
DISTRICT	MAX Temp(°C)	PET (mm)	Rainfall (mm)	TEMPVs PET	RF Vs PET	temp Vs PET	PET Vs RF
ANATAPURAM	2.3	4.8	5.4	0.5	-0.4	5.0	-11.5
CHITOOR	2.4	2	6.4	0.5	-0.2	2.4	-2.4
GUNTUR	3	3.8	8.7	0.7	-0.4	8.3	-11.9
KADAPA	2.7	22.5	7.6	0.0	0.0	2.6	2.7
EAST GODAVARI	3	2.5	11.2	0.6	-0.3	4.1	-8.0
SRIKAKULAM	2.1	0.3	10.6	-0.2	0.1	-0.1	0.4
SPSR NELLORE	2.8	0.3	4.9	-0.3	0.1	-0.2	0.1
KURNOOL	2.7	0.3	6.3	-0.3	0.1	-0.2	0.2
KRISHNA	3.2	0.3	9.6	-0.3	0.1	-0.3	0.3
WEST GODAVARI	2.6	2.1	11.1	0.4	-0.2	2.5	-5.1
PRAKASAM	2.9	4.1	5.7	0.6	-0.3	7.6	-8.0
VISAKHAPATNAM	2	1.6	8.9	0.5	-0.3	1.7	-3.9