

# Monsoon variability –climate change - sustainable development with special reference to Andhrapradesh

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## Abstract

India is an agricultural country and is also a monsoonal country. There are two Monsoon systems. South West monsoon (summer monsoon) and North East monsoon (winter monsoon) influencing the weather and climate of the country. It is these two monsoons which gives water by way of rainfall and this rainfall results in runoff, infiltration, percolation and deep percolation. Part of it results in storage as ground water and part of it evaporates. This rainfall sustains the water in the lakes and tanks. This replenishes the ground water and raises the water levels in the wells. This rainfall is vital for Agriculture. In order to have sustainable agricultural production, we must know not only the rainfall amount but its variation. The aim and objective of the present article is to analyze the monsoon rainfall and its variation over a long period for the state of Andhra Pradesh. The climatic trends of rainfall and climate change for various stations in Andhra Pradesh have been presented and discussed and steps to sustainable development have been suggested.

**Keywords:** Monsoon, Rainfall, Sustainability, Agriculture

## INTRODUCTION

India is an agricultural country, 70% of population is directly involved in agricultural operations. India is also a monsoonal country. India mainly depends on two monsoon systems: South West monsoon and North East monsoon. They are not only influence the weather and climate but give good amount of rainfall, which is necessary for agricultural

Production, industrial and domestic needs. Among these two the summer monsoon which is very important has 70% of country's rainfall comes from this monsoon. The North East monsoon gives rainfall to south Andhra and Telngana regions besides these two monsoon systems India gets rainfall by cyclones which originate in Bay of Bengal and Arabian Sea. For that there is rainfall due to thunder storm activity in summer months, especially the thunder storm of West Bengal and Assam which are known as "kalbaishakis" in the local area. There are also western disturbances which are extra tropical cyclones from Mediterranean Sea which gives rainfall in Punjab, Haryana, Uttar Pradesh and Uttaranchal in winter times which is very important for wheat crop. The rainfall received in the country by the above systems results in runoff, infiltration, percolation and deep percolation. Naturally part of it evaporates but part of it results storage in tanks and lakes and also as ground water. As this rainfall amount were most part of the country is limited to summer rainfall which results in runoff through river systems. So dams are built across the rivers in order to have storage by way of reservoirs which in terms feed through canal system to the fields.

Besides agricultural production the above multipurpose dam gives electricity.

So the monsoon rainfall is vital for the economy of the country, how ever monsoon rainfall is variable. It depends on number of external factors like teleconnections in other words El Nino and La Nina and Indian Ocean Dipole. This also depends on Arabian Sea parameters like the latent heat flux, find later jet and evaporation in the Arabian Sea besides these external factors the climate change is also introducing lot of variations. In order to have sustainable development we have to study and able to predict South West monsoon rainfall and also its variability. The aim and objective the present article is to attempt to study monsoon variability and climate change scenario with special reference to Andhra Pradesh.

## DATA AND METHODOLOGY

The data utilized in the present article has been taken from IMD (IDWR) which has been analyze the climatic trends of various stations in Andhra Pradesh has been presented. Figure 1 is the location map of Andhra Pradesh with is its 23 districts and the stations utilized in the present study

## RESULTS

Table 1 gives the seasonal distribution of rainfall for twenty stations shown in the location map. The rainfall in mm was given for four seasons namely

1. South West monsoon (summer monsoon)
2. The retreating South West monsoon (Post monsoon)
3. Winter season
4. Summer season

From the table it is evident that most of the stations get rainfall in summer months and many of the stations in Andhra Pradesh get

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comparable rainfall in post monsoon season this is partly due to the cyclonic activity. Even though this table gives the climatic values, it is interesting to note the station like Nellore gets more rainfall in post monsoon season. The winter rainfall for the same station Nellore is high compared to all other stations this is because of North east monsoon which is active this gives rainfall in South Andhra Pradesh.

Fig. 2 describes the annual rainfall variability from the figure it is evident that the rainfall variability is more in southern part that is ananthapur and part of Khammam region Nellore and Ongole region. Most of the state is climatologically experiencing twenty percent variation.

Table 2 is a comparison of mean annual rainfall for two Climatological period 1931-1960, 1961-90. This gives a broad idea of the climatic trends of rainfall weather it is increasing or decreasing for example kalingapatnam as shown positive variation (+61). The following stations as shown an increasing they are Ongole, Nellore, Kurnool, Cuddaph, Hyderabad, Khammam, Hanumakonda and Ramagundam from the table is cleared. That Hanumakonda show high increasing (145) similarly, the following stations shows negative trends they are Kakinada, Machilipatnam, Rentachitala, Gannavaram, and Nizamabad. It is interesting to note that maximum negative trend

in Nizamabad (-175).

Fig. 3 shows the mean annual rainy days. The number of rainy days varies from 60 to 40 and the trend is that the rainy days decrease South West.

Fig. 4 shows mean annual rainfall distribution, maximum rainfall of 1200mm occurs in north east part of the state followed by 1100mm in northern part and there is gradual decrease from North East to South West

Fig. 5 shows seasonal distribution of rainfall for the four seasons in A.P. As already discussed the South West monsoon gives more rainfall followed by retreating SW monsoon, summer, Winter. Winter only South of A.P is getting the rainfall. The summer rainfall is mostly confined to the northern part of A.P

The rainfall trends have been analyzed the region wise Rayalasila, Telangana, and Coastal Andhra. The rainfall trend for Rayalasila is shown in Rain fall trends (Rayalaseema). There is no clear trend in these stations. How ever thelangana region shows interesting trend. A trend is not much in Nizamabad, where as Khammam and Hyderabad are showing increasing trend. Mahaboobnagar show a decreasing trend.

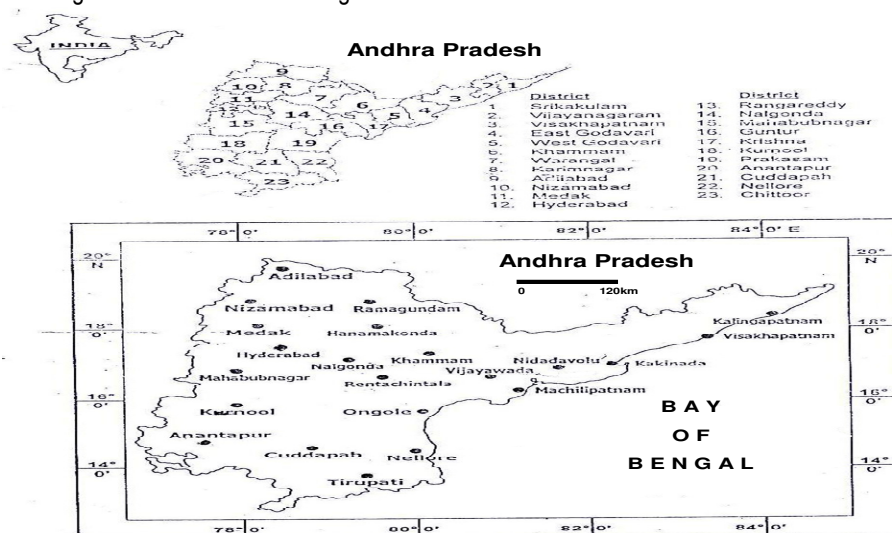


Fig 1. Location Map

Table 1. Seasonal Distribution of Rainfall

S.NO	STATIONS	SOUTH- WEST MONSOON (MM)	RETREATING SOUTH- WEST MONSOON (MM)	WINTER (MM)	SUMMER (MM)
1	KAKINADA	609.3	378.7	32.3	74.4
2	KALINGAPATNAM	598.2	285.3	34.5	86.4
3	VISAKHAPATNAM	502.1	324.9	49.3	78.0
4	MACHILIPATNAM	585.2	372.6	38.4	71.1
5	NELLORE	293.3	583.7	127.0	53.2
6	ONGOLE	352.6	385.6	44.2	60.5
7	RENTACHINTHALA	447.5	170.6	15.0	66.5
8	VIJAYAWDA	646.5	207.7	23.7	81.5
9	ANANTHAPUR	336.4	157.5	17.5	71.6
10	CUDDAPAH	454.8	203.0	32.5	57.3
11	KURNOOL	431.0	108.7	18.0	49.2
12	ADILABAD	915.7	74.2	26.4	54.6
13	HANUMAKONDA	737.9	95.2	27.4	63.5
14	MEDAK	803.2	54.2	23.7	72.3
15	NIZAMABAD	865.1	67.1	31.3	48.8
16	RAMAGUNDAM	927.1	83.9	4.3	50.2
17	HYDERABAD	574.3	104.8	25.6	67.5
18	KHAMMAM	694.0	116.1	23.4	77.6
19	MAHABOONNAGAR	691.8	100.1	19.3	53.1
20	NALGONDA	539.5	141.8	22.3	58.4

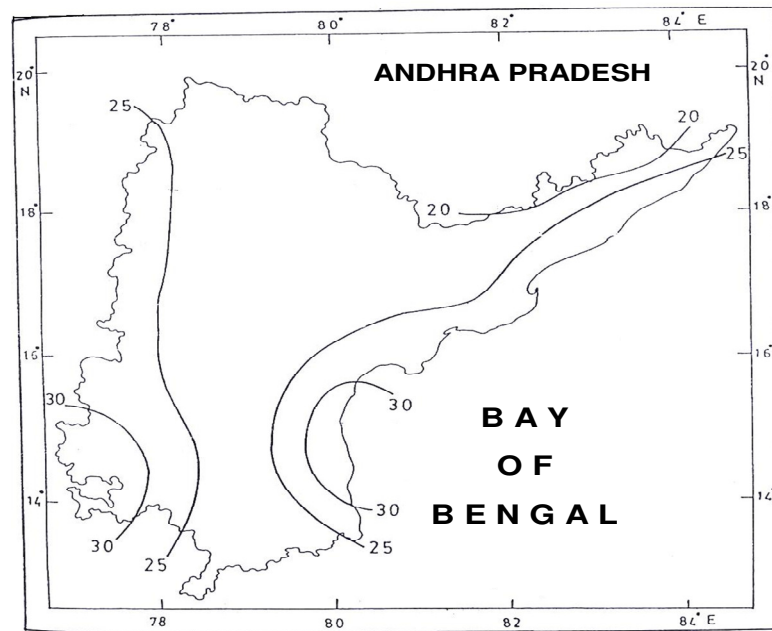


Fig 2. Annual Rainfall Variability

Table 2. Mean annual Rainfall (mm)

Sl.no	Stations	1931-60	1961-90	Variation
1	Kalingapatnam	986	1047	+61
2	Visakhapatnam	974	975	+1
3	Kakinada	1171	1098	-73
4	Machilipatnam	1075	1003	-72
5	Rentachinthala	717	688	-29
6	Gannavaram	1031	941	-90
7	Ongole	846	904	+58
8	Nellore	1032	1080	+48
9	Kumool	673	704	+31
10	Ananthapur	562	546	-16
11	Cuddapah	742	774	+32
12	Hyderabad	764	815	+51
13	Khammam	953	1078	+125
15	Hanumakonda	945	1090	+145
16	Nizamabad	1086	913	-173
17	Ramagundam	1068	1207	+139

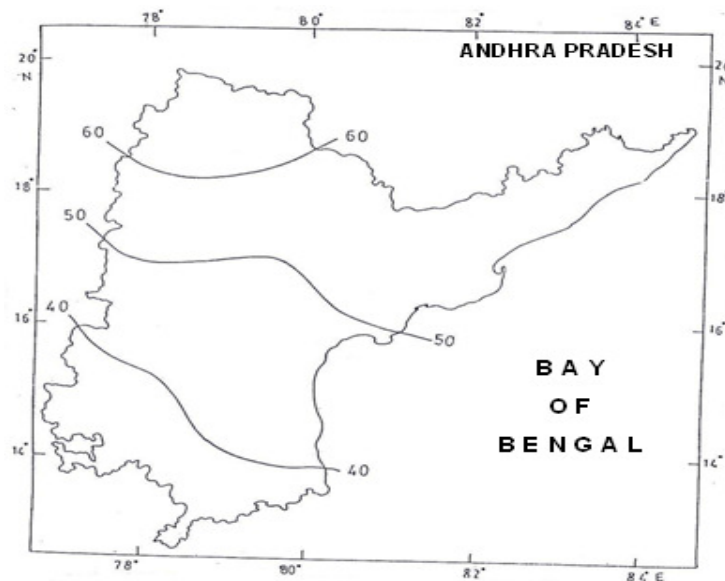


Fig 3. Mean annual Rainy days

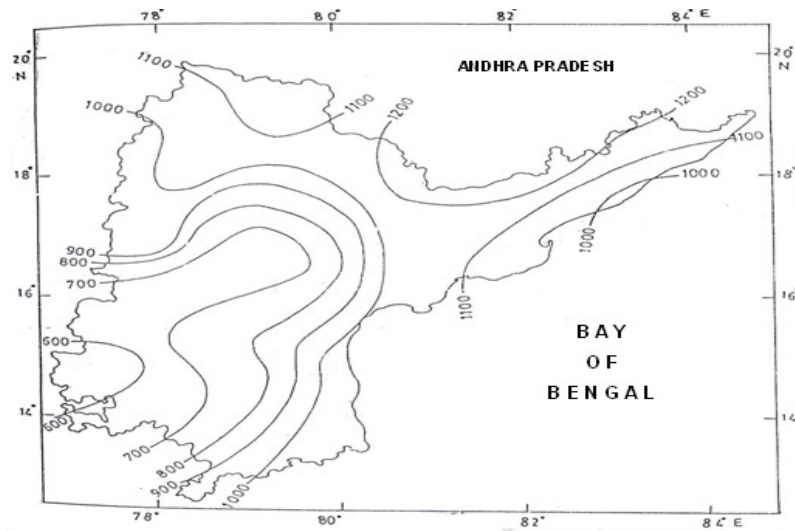


Fig 4. Mean Annual rainfall distrubution (mm)

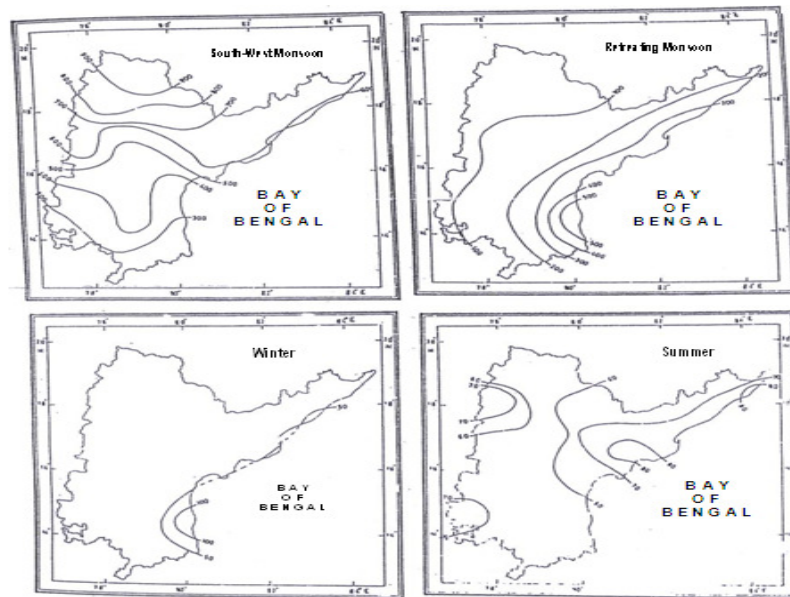
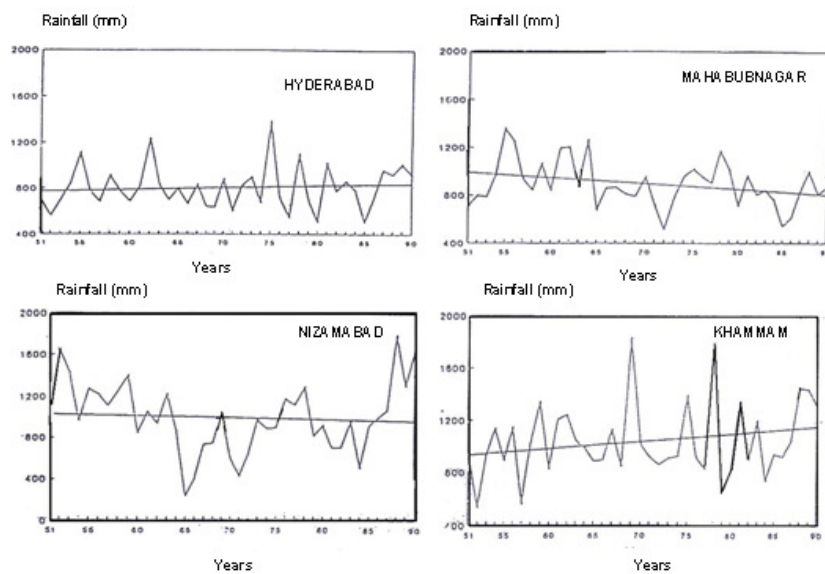
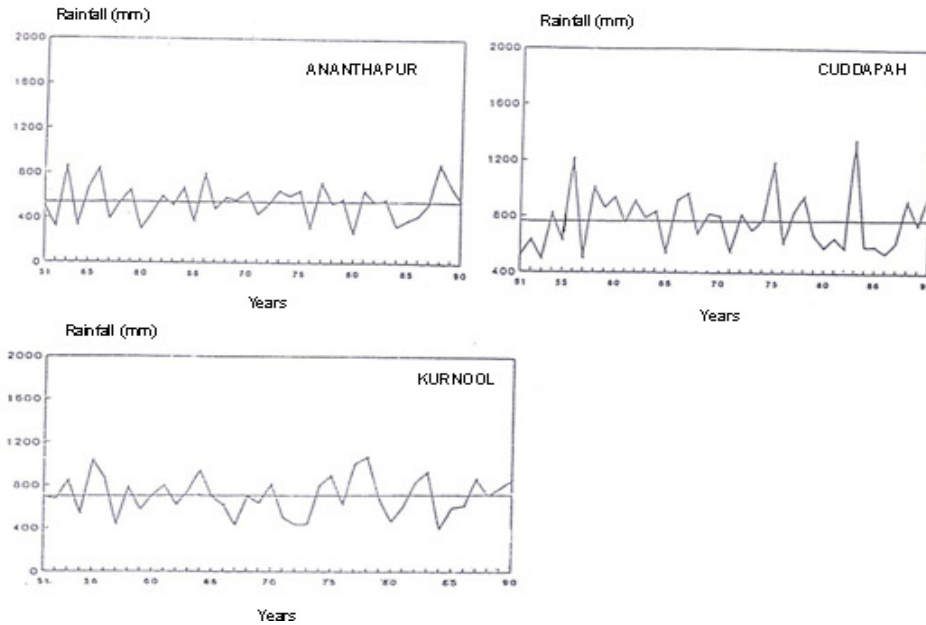


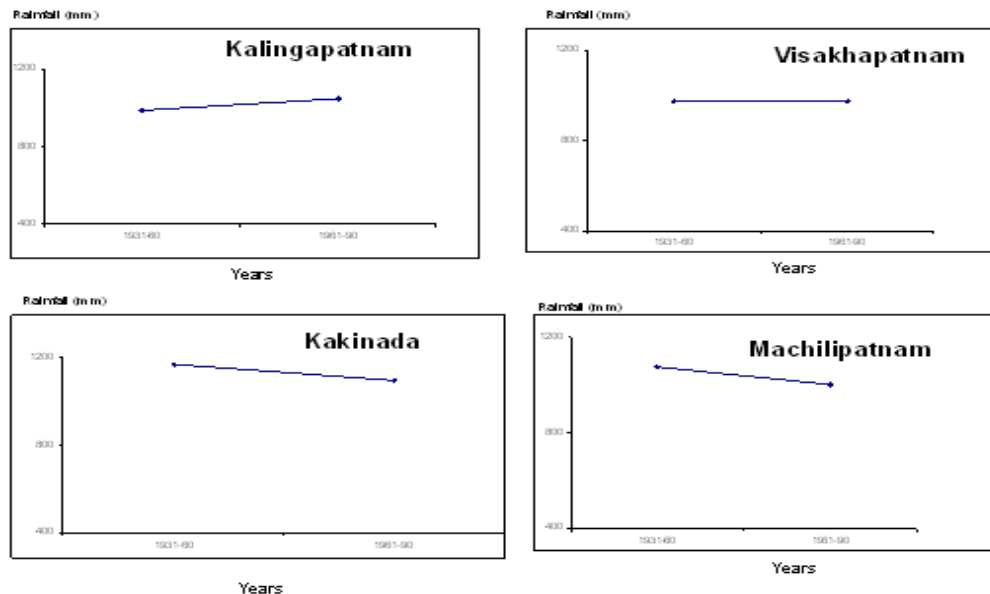
Fig 5. Seasonal Distrubution of Rainfal (mm)



Rainfall Trends (Telangana)



Rainfall Trends (Rayalaseema)



Rainfall Trends (Andhra)

## CONCLUSIONS

- The rainfall trends have been analyze in order to segregate the increasing and decreasing trends for A.P
- A care full analyze point out that Rayalsima is not showing any significant trend or in other words any significant change
- Telangana region shows mixed trends
- Hyderabad and Khammam are showing increasing trend whereas Nizamabad and Mahaboobnagar showing a decreasing trend.
- The stations in Andhra region kalingapatnam,

Visakhapatnam,kakinada,and machilipatnam have not shown any significant trend

- It is further concluded that now technically to avail to argue the rainfall the cloud seeding , so these one can have sustainable development
- The cropping pattern would also be change according to long term trends of rainfall for example mahboobnagar district shall have crops like BAJRA, JOWAR which have less water requirement.
- The station in Andhra region kalingapatnam, Visakhapatnam, kakinada, and machilipatnam have not shown any significant trend

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