STUDY ON SPATIAL RAINFALL DISTRIBUTION WITH THE HELP OF GIS IN TELANGANA REGION

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ABSTRACT:
Rainfall distribution of India is most uneven and varies considerably from region to region, season to season and year to year. Present paper presents a rainfall analysis in Telangana Region by a geometric approach to prepare maps in geographic information systems environment representing spatial distribution of monthly and yearly rainfall. The spatial and temporal variation of rainfall and trend analysis has been presented in this paper. The preliminary analysis presented here is based on the data from 457 mandals and 10 districts of Telangana state. In this study various GISA remote sensor techniques were used for spatial analysis of rainfall in Telangana region of India through generation of maps. All this was done by integration multi-source-geo-reference data sets in a GIS platform.

KEYWORDS: *GIS, Rainfall Analysis, spatial distribution, hydrological studies.*

I. INTRODUCTION

The water resources of a region mainly depends on precipitation, which in turn depends upon the meteorological parameters such as temperature, evaporation etc. Rainfall data is of utmost importance to hydrologists as it forms the basis of many hydrological studies. The critical problem in dry land agriculture is the uneven distribution of the rainfall during the monsoon season and the gap between the occurrences of successive rainfall excess with the season. In order to get the maximum agricultural output i.e. yield of a crop, it is essential to supply the optimum quantity of water to the crop or to maintain correct timing of watering. In case of dry land agriculture, it is not possible to supply the optimum quantity of water to the crop or to maintain correct timing of supply of water based on the sensitive periods of crop because of dependence on rainfall. The total rainfall in a particular area may be non-uniform over the crop period.

With high demand for food production with limited irrigation schemes, there is a necessity for utilizing the existing environmental conditions to the extent of seasonal water availability. This will encourage in proper planning in proposing various types of crops and in different conditions for efficient implementation of this kind of cropping there is a necessity for a scientific approach towards rain fed agriculture as well as where supplemental irrigation is required. Study of effective rainfall and consumptive use can be used for determination of irrigation required few different crops.

This paper presents various GIS and GPS techniques used for monitoring and assessment of rainfall in Telangana region. Spatial rainfall analysis has been explored for Telangana region through generation of maps showing vulnerable mandals to various status of rainfall using GIS technology and by integrating Multi-Source geo-referenced datasets in a GIS platform. The final out put comprises the special analysis products that are useful in the decision making process for rainfall assessment.

Telangana is a newly formed state in India, it is the 29th state of India. Telangana shares its borders with Maharashtra and Chhattisgarh states on north, Karnataka on the west and Andhra Pradesh on south and east. Telangana has an area of 1,11,487 Sq.km and a population of 3,52,36,757 (2011 census). Annual rainfall is between 900-1500mm in northern Telangana and 700-900 in southern Telangana few south west monsoons. It is located 17.366^0 N latitude and 78.426^o E longitude.

Telangana has 10 districts. Adilabad, Khammam, Medak, Karimnager, Mahaboobnagar, Hyderabad, Nalgonda, Nizamabad, Ranga Reddy and Warangal. Telangana has 457 mandals and 10258 villages. Major rivers flowing are Krishna, Godavari from west to east. Minor rivers flowing are Manair, Bhima, Dindi, Kinnerasani, Manjeera, Moosi, Penganga, Pranahita, Peddraju, Easa and Taliperi. Temparature ranges from 21° C to 37° C. The soils are Red Sandy soils, Debbas, Deep Red loamy Soils, Very deep B.C soils. Crops are mango, cashew, mirchi, cotton ,rice, ginger, and flowers. This region will have a south monsoon with an average rainfall of 700-900mm and temperature ranges from 22^0 C to 34° C.

District wise Rainfall scenario is analyzed in this paper.

ADILABAD DISTRICT:

This is the largest district in Telangana State with a geographical area of 16,203 Sq.km. The district is located in the northern most part of the state and forms border with the states of Maharashtra and Chhattisgarh. The district lies between northern latitudes 18° 40$'$ and 19° 50' and east longitudes 77°46' and 80°00' as shown in fig 3.1 along with mandal boundaries. Agriculture is the main profession for livelihood. This is the least literate district in the state. The district has a population of 27,37,738 with decadal growth rate of 10.42% (2011-2012). Density of population is 169/km^2. River Godavari flows through this district and separates Nizamabad and Karimnagar districts from Adilabad.

Rainfall In Adilabad District:

The annual normal rainfall of the district is 1153mm, which ranges from 995mm at Tiryani mandal to 1348mm at individual mandals. The table indicates that the districts mean rainfall has been below normal by 1%, 10%, 24%, 5% and 40% in 2000, 2001, 2002, 2003 and 2004 respectively. The cumulative departure of rainfall from normal indicates the extent of moderate, low, rain, i.e. More than 60% below normal in 30 mandals,20% to 59% below normal in 17 mandals. In the remaining 2 mandals the rainfall was above normal. On an average the district rainfall condition was below normal by 80% . The cumulative effect of rainfall by May 2005 was scanty. The average rainfall condition of the district is very low.

KARIMNAGAR DISTRICT:

Karimnagar district has geographical area of 11,823 sq.km. The district is mainly agrarian and agriculture is the main occupation of the population. It has a population of 38,11,738 roughly equal to population of state Oregon of the USA. Population density, which was 64 per km2 in 1901, has raised to 322 persons per sq.km^2 in 2011 census and has a decadal population growth of 9.16% (2001 to 2011).

The river Godavari enters the district at Kandukurthi village and runs for a distance of 283 km forming the northern and eastern boundary of the district and leaves the district at Muknur village. The entire district is mainly drained by Manair river, a tributary of river Godavari. Literacy rate of 64.87 % has 57 mandal revenue administration units.

Rainfall in Karimnagar District:

The normal annual rainfall of the district is 968.6mm. The rainfall increases from south to northern part varying from 950 mm to 1100 mm. The south west monsoon contributes about 83% of annual rain fall which is spread over 42 rainy days. Northwest monsoon contributes 10% in 5 days. Cumulative departure for the last 5 years from the normal rainfall is 107%, which indicates that the district is facing continuous rain fall.

KHAMMAM DISTRICT:

The district lies between 16° 40$'$ and 18° 35' of the north latitude and 79° 47$'$ and 81° 47' of the east longitudes has 43 revenue mandals. The district has a geographical area of 16029 sq km. with a population of 27, 97, 370 as per 2011 censes has a density of population is 175 per km^2. Its population growth rate is 8.5% with literacy rate of 65.46 %. District has largest forest area of 8.4 lakh hectors and plays an important role in the economy of the district.

Rainfall in Khammam district:

The annual normal rainfall of Khammam district is 1124 mm. The rainfall in the district is 30% below normal.

MAHABOOBNAGAR DISTRICT:

Mahaboobnagar is geographically the largest district, with an area of 18742 sq.km., The district has 64 mandals. This lies at 77° 55$'$ north latitude and 17° 20$'$ east latitude at 77° 15'. Population of the

district is 40,42,191 roughly equals to population of Liberia state of the USA. This has a population density of 219/km^2 at growth rate of 15.3% in last decade. Has a literacy rate of 56.06%.

The district is covered by three types of of soils viz,. Red Soil, Sandy Soil, Red Earth and Black Cotton Soils.

Rainfall in Mahaboobnagar District:

The annual rainfall of the district is 605mm ranging from 404mm to 756mm in all mandals. The analysis of rainfall deficit is 32% from normal rainfall. Cumulative departure of rainfall by more than 60% below normal.

MEDAK DISTRICT:

Medak has a geographical area of 9515 sq.km lies between north latitude 17° 27$^{'}$ and 18° 18$^{'}$ and east latitudes 79° 28$^{'}$ and 79° 10$^{'}$. The district has 46 revenue mandals, has a population of 30,31,877 roughly equals to the nation of Oman. River Manjeera flows through this district out of total cropped area of 5,25,000 hectors an area of 19000 hectors is being irrigated by surface water sources and area of 1,10,000 hectors is being irrigated by ground water plays a major roles when compared to surface water.

Rainfall in Medak District:

Normal annual rainfall of the district is 873 mm, which ranges to 635mm to 1036 mm in medak district at 120% deficit from normal rainfall.

NALGONDA DISTRICT:

Geographical area of Nalgonda district is 14,322.4 sq.km with 59 mandals and 4 revenue divisions with a population of 34,83,648. The district lies between north latitude 16° 25$^{'}$ and 17° 50$^{'}$ and between east longitudes of 78° 40$^{'}$ and 80° 05$^{'}$ and forms part of major basin of Krishna River. The district has a population density of 245/km^2 with a population growth over 7.26% during 2001-2011 decade, literacy rate is at 66.05%

Rainfall in Nalgonda District:

Normal rainfall of Nalgonda district is 753 mm ranging from 573mm to 900mm cumulative effect of rainfall departure is 90% less than normal.

NIZAMABAD DISTRICT:

Nizamabad district has a geographical area of 8062 sq.km located between 18° 05$^{'}$ and 19° 0$^{'}$ north latitude and 77° 32$^{'}$ and 78° 40$^{'}$ east longitude. Nizamabad district is primarily an agrarian district rating first among district of Telangana state almost 80% of population living in rural areas. Has a population of 25,52,073 with a population density of 321/km^2 with 75% of literacy rate and has 36 mandals. Godavari enters Telangana state at Kandlakurti of Nizamabad district.

Rainfall in Nizamabad District:

The annual normal rainfall of the district is 36mm, which ranges from 878 mm to 1220mm. An average the district rainfall condition was below normal by 102%. The average rainfall condition of the district is very low.

RANGA REDDY AND HYDERABAD DISTRICTS:

The geographical area is 7565 km^2 ,lies between 16° 54$^{'}$ and 17°48$^{'}$ north latitude and 77° 21$^{'}$ and 78° 51$^{'}$ east longitude. Has 37 revenue mandals no irrigation projects worth mentioning except for minor irrigation projects the district is drained by there rivers namely Moosi, Kajna, and Manjeera. Has population 52,96,741 with density of 707/km^2 with a population growth rate 48.15%.

Rainfall in Ranga Reddy and Hyderabad Districts:

Has a normal annual rainfall of 783 mm Maximum and Minimum temperature 40° to 14$^{o.}$ .Rainfall of 558mm to 961mm on an average the district rainfall condition was moderate low rain i..e deficient by -34% from normal.

WARANGAL DISTRICT:

Has a geographical area of 12846 sq.km the district is mainly agrarian and agriculture is the main stay of population. The population is 35,22,644 with density of 274/km^2 with a population growth rate of 8.52% and has a literacy rate of 66.16% and has 52 mandals.

Rainfall in Warangal District:

The normal annual rainfall of the district is 994mm and ranges from 924mm to 1061mm.

II. METHODOLOGY

Methodology adopted in rainfall analysis is given under following points.

i. To demarcate ten district boundaries of Telangana State and 457 mandals administration boundaries using survey Toposheets.
ii. Geo-Database was prepared using daily rainfall for all mandals and for all districts of Telangana state.
iii. To analyze monthly and yearly rainfall for all districts of Telangana State at mandal level.
iv. To develop maps in GIS environment for annual, South-West, North-East, Summer and Winter rainfall for all Mandals of the study area in Telangana State.

Daily rainfall data has been collected for a period of 2005 to 2009 from bureau of statistics and economics (BSE), Hyderabad. This data has been checked and processed for finding the needed rainfall data for various rain gauge station and accordingly filled toposheets were collected from Survey of India, Uppal, Hyderabad. Geo database using daily rainfall for all the mandals and districts of Telangana region has been built in GIS environment ground control points have been converted into monthly, seasonal in terms of South-West, North-East, Summer, Winter and yearly rainfall for all districts of Telangana region at mandal level for further analysis in GIS environments into monthly rainfall deficiency was assessed from the deficit of rainfall by using the IMD methodology from the historical rainfall data. Finally rainfall deficiency maps especially for the study area at mandal level on monthly time scale in GIS environment for policy and decision making have been prepared.

III. RESULTS AND DISCUSSIONS

Analysis of Rainfall:

The analysis of rainfall is made monthly and yearly basis has been carried out for all mandals in each districts of Telangana State. Analysis of rainfall and the results obtained has been carried out for all mandals in each district of Telangana state. Analysis of rainfall and the results obtained has been presented district wise. Annual, seasonal in terms of south-west, north-east, Summer, Winter and mean monthly rainfall has been discussed.

i. **Adilabad:**

The annual rainfall of the district is 1153mm, which ranges from 995mm in Tiryani mandal to 1348mm in individually mandal. The annual rainfall data of 49 mandals for period 2005 – 2009 has been analyzed and the table indicates that the district mean rainfall has been below the normal by -6.74%, 0.04%, 24.62%, 18.67% and 43.82% in 2005, 2006, 2007, 2008 and 2009 respectively. The year 2009 has received the least rainfall i.e., by 43.82% below normal.

The year 2005 received highest rainfall at 6.74% above normal. The cumulative departure of annual rainfall from normal indicates the extent of rainfall at a place, in this particular district , this is very low i. e, in ranges in 17 mandals at 20% to 59% below normal rainfall. 29 mandals the rainfall is above normal. On the whole the average rainfall is below normal by 17%.

The average rainfall condition of the district is moderate low rainfall. The values of mean winter rainfall, mean summer rainfall, mean South-West monsoon rainfall, mean North-East monsoon rainfall and annual rainfall for all the mandals in the district have been analyzed and presented in table 4.2.

ii. **Khammam :**

The annual normal rainfall of Khammam district is 1124mm, which ranges from 970mm at Mandhira mandal to 1592mm at Venkatapuram mandal. During 2005, 2007 and 2008 the rainfall was 27.7%, 1.61% and 28.4% above normal 1453mm, 1142.41mm and 1443.57mm and during 2006 and 2009 the rainfall was 9.9% and 37.72% below normal respectively (1013mm and 700.15mm). low rainfall recorded in 35 mandals. The average rainfall in the district was 2.02% above normal considering the cumulative departure from normal.

The values of mean winter rainfall, mean summer rainfall, mean South-West monsoon rainfall, mean North-East monsoon rainfall and annual rainfall for all the mandals in the district have been analyzed and presented in table 4.3.

iii. **Mahaboobnagar:**

The annual rainfall of the district is 605mm ranging from 404 mm at Gattu mandal to 756mm at Amrabad mandal. The mean rainfall of the district was highest with 888mm during 2005 which is 46.68% above normal and lowest as 441.98mm during the period 2006, which is 31.36% below

normal. The district has received deficit rainfall during 2006 at -31.36% departure from the normal. The cumulative effect of 5 years rainfall for the period from 2005-2009 was 11.6% above normal. The cumulative departure of rainfall by more than 11.6% above normal was observed. The values of mean winter rainfall, mean summer rainfall, mean South-West monsoon rainfall, mean North-East monsoon rainfall and annual rainfall for all the mandals in the district have been analyzed and presented in table 4.4.

iv. **Medhak:**

Annual average rainfall of the district was 873mm ranges from 635mm at Kondapalli to 1036mm at Medak mandal. The mean district rainfall is 8444mm in 2005, 713.23 mm in 2006, 604.64mm in 2007, 885.26mm in 2008 and 593.55mm in 2009.which indicates that the annual rainfall, below normal by 3.7%, 18.37%, 26.68%, -0.86% and 32.07% in 2005,2006,2007,2008 and 2009 respectively. The cumulative departure of annual rainfall was categorized as moderate low rain i.e. below normal by 20% to 50% in 20 mandals. In the remaining few mandals, the rainfall of the district is moderate low rainfall at -20% below normal. The district has experienced deficit rainfall. The values of mean winter rainfall, mean summer rainfall, mean South-West monsoon rainfall, mean North-East monsoon rainfall and annual rainfall for all the mandals in the district have been analyzed and presented in table 4.5.

v. **Nalgonda:**

The normal rainfall of Nalgonda district is 753mm. the rainfall ranges from 540mm in Peddadisserlapalli to 932mm in Thirumulgiri. The mean rainfall of the district is 493.14mm, 749.35mm, 793.24mm, 932mm and 475.79mm during 2005, 2006, 2007, 2008 and 2009. The data shows that there is a deficit of rainfall during 2005, 2006, 2007, 2008. Cumulative effect of the rainfall departure is 9.19% less than normal. The values of mean winter rainfall, mean summer rainfall, mean South-West monsoon rainfall, mean North-East monsoon rainfall and annual rainfall for all the mandals in the district have been analyzed and presented in table 4.6.

vi. **Nizamabad :**

The annual rainfall of Nizamabad District is 1036mm which ranges from 383mm at Pitlam mandal to 1565mm at Domakonda mandal. District mean rainfall has been 14.62% above normal in 2005 and below normal by 7.92% to 37% during the rest of the period. Overall the district has 102% below normal rainfall 5.83 during the rest of the period. Cumulative departure of annual rainfall was moderate low rain i.e below normal by 20% to 50% in 8 mandals, Balance 25 mandals has rainfall above normal. The cumulative effect of rainfall by 2009 was moderate low rain. The average rainfall condition of the district is moderate low rain. The values of mean winter rainfall, mean summer rainfall, mean South-West monsoon rainfall, mean North-East monsoon rainfall and annual rainfall for all the mandals in the district have been analyzed and presented in table 4.7.

vii. **Ranga Reddy and Hyderabad:**

The district receives an average rainfall of 783mm, which increases from North-west to south-east. The mean maximum and minimum temperature vary from 40ºC to 14ºC. Then normal annual rainfall of the district is 783mm, which ranges from 538mm at Shamirpet mandal to 961 at Vikarabad mandal. The spatial variance of annual rainfall was vary high during year 2006 at 27.24%, which had minimum range of 356.4mm at Quthbullahpur mandal and Maximum of 802mm at Medchal mandal. The annual rainfall during the years 2005, 2006, 2007, 2008 and 2009 are 1049.9mm, 568.4mm, 770.16, 916.08mm and 756.03mm respectively with overall average rainfall is under normal rainfall conditions. The values of mean winter rainfall, mean summer rainfall, mean South-West monsoon rainfall, mean North-East monsoon rainfall and annual rainfall for all the mandals in the district have been analyzed and presented in table 4.8.

viii. **Warangal:**

The normal rainfall of the district is 994mm, the rainfall ranges from 749mm to 1285mm from South-West to North-East. Annual rainfall during 2005 to 2008 is above normal rainfall was 14.14% and 20.10% respectively. The cumulative departure for the last five years from normal rainfall is -2.46%, which indicates that the district is facing deficit rainfall. The values of mean winter rainfall, mean summer rainfall, mean South-West monsoon rainfall, mean North-East monsoon rainfall and annual rainfall for all the mandals in the district have been analyzed and presented in table 4.9.

ix. **Karimnagar:**

The annual rainfall of the district is 968.6mm. the rainfall ranges from 950mm to 1100mm.The south-west monsoon contributes about 83% of annual rainfall, north-west monsoon contributes 10%.The departure for the last five years from normal rainfall is -107%, which indicates that the district is facing continuous low rainfall. The values of mean winter rainfall, mean summer rainfall, mean South-West monsoon rainfall, mean North-East monsoon rainfall and annual rainfall for all the mandals in the district have been analyzed and presented in table 4.10 .

MEAN ANNUAL RAINFALL:

The daily rainfall data collected has been cumulated to arrive at yearly rainfall data. Mean annual rainfall has been calculated for the period from 2005 to 2009 for all the ten districts of Telangana state. The values of mean annual rainfall for Adilabad, Karimnagar, Khammam, Mahboobnagar, Madak, Nalgonda, Nizamabad, Ranga Reddy and Hyderabad and Warangal districts have been found to be 962.61mm ,1147.47 mm ,873.63 mm ,675.05 mm ,730.97 mm ,684.31 mm ,917.49 mm ,816.5 mm ,971.47 mm and 864 .39 mm respectively. The maximum and minimum annual rainfall for all the mandals in each district has been calculated and presented in table 4.11. The analysis of spatial variation of annual rainfall for years from 2005 to 2008 has been carried out in GIS environment and represented in fig 4.1 and 4.4.

MEAN SOUTH-WEST RAINFALL:

The daily rainfall data collected has been cumulated to arrive at southwest rainfall data. Mean South-west rainfall has been calculated for the period from 2005 to 2009 for all the ten districts of Telangana state.

The value of mean southwest rainfall for Adilabad, Karimnagar, Khammam, Mahaboobnagar, Medak, Nalgonda, Nizamabad, Ranga Reddy and Hyderabad, and Warangal districts has been found to be 862.23mm, 944.63mm, 751.99mm, 495.38mm, 610.71mm, 510.01mm, 807.78mm, 637.35mm and 817.99mm respectively. The maximum and minimum southwest rainfall for all the mandals in each district has been calculated and presented in table 4.11. This analysis of spatial variation of southwest rainfall for the year 2005 to 2009 has been carried out in GIS environment and presented graphically in fig 4.5 to 4.8.

MEAN NORTHEAST RAINFALL:

The daily rainfall data collected has been cumulated to arrive at northeast rainfall data. Mean northeast rainfall has been calculated for the period from 2005 to 2009 for all the ten districts of Telangana state. The values of mean northeast rainfall for Adilabad, Karimnagar, Khammam, Mahaboobnagar, Medak, Nalgonda, Nizamabad, Ranga Reddy and Hyderabad, and Warangal districts has been found to be 543.53mm, 124.42mm, 74.85mm, 123.71mm, 58.28mm, 123.46mm, 53.14mm, 102.62mm, 88.71mm respectively. The maximum and minimum northeast rainfall for all the mandals in each district has been calculated and presented in table 4.11.This analysis of spatial variations of northeast rainfall for years from 2005 to 2009 has been carried out in GIS environment and presented graphically in fig 4.9 to 4.12.

MEAN SUMMER RAINFALL:

The daily rainfall data collected has been cumulated to arrive at summer rainfall data. Mean summer has been calculated for the years from 2005 and 2009 for all the district of Telangana state. The values of mean summer rainfall for Adilabad, Karimnagar, Khammam, Mahaboobnagar, Medak, Nalgonda, Nizamabad, Ranga Reddy and Hyderabad, and Warangal districts has been found to be 23.08mm, 64.99mm,33.73mm, 53.00mm, 48.36mm, 43.77mm, 37.37mm, 66.23mm and 54.27mm respectively. The maximum and minimum rainfall for all the mandals in each district has been calculated and presented in table 4.11. This analysis of spatial variations of northeast rainfall for years from 2005 to 2009 has been carried out in GIS environment and presented graphically in fig 4.13 to 4.16.

MEAN WINTER RAINFALL:

The daily rainfall data collected has been cumulated to arrive at winter rainfall data. Mean winter rainfall has been calculated for the years from 2005 and 2009 for all the district of Telangana state. The values of mean winter rainfall for Adilabad, Karimnagar, Khammam, Mahaboobnagar, Medak, Nalgonda, Nizamabad, Ranga Reddy and Hyderabad, and Warangal districts has been found to be 22.77mm, 13.42mm, 13.03mm, 2.44mm, 13.67mm, 7.07mm, 19.21mm, 10.30mm and 10.5mm respectively. The maximum and minimum rainfall for all the mandals in each district has been calculated and presented in table 4.11. This analysis of spatial variations of northeast rainfall for years

from 2005 to 2009 has been carried out in GIS environment and presented graphically in fig 4.17 to 4.20.

MEAN MONTHLY RAINFALL:

The daily rainfall data collected has been cumulated to arrive at winter rainfall data. Mean winter rainfall has been calculated for the years from 2005 and 2009 for all the district of Telangana state. The values of mean winter rainfall for Adilabad, Karimnagar, Khammam, Mahaboobnagar, Medak, Nalgonda, Nizamabad, Ranga Reddy and Hyderabad, and Warangal districts has been found to be 80.22mm, 95.62mm, 72.80mm, 56.25mm, 60.91mm, 57.03mm, 76.46mm, 68.04mm and 80.96mm respectively. The maximum and minimum rainfall for all the mandals in each district has been calculated and presented in table 4.11. This analysis of spatial variations of northeast rainfall for years from 2005 to 2009 has been carried out in GIS environment.

TREND ANALYSIS:

The daily rainfall data collected has been cumulated to arrive at yearly rainfall data. Mean annual rainfall has been calculated for the period for 2005 to 2009 for all the districts of Telangana state. The values of mean annual rainfall for Adilabad, Karimnagar, Khammam, Mahaboobnagar, Medak, Nalgonda, Nizamabad, Ranga Reddy and Hyderabad, and Warangal districts have been found to be 962.61mm, 1147.47mm, 873.63mm, 675.05mm, 730.97mm, 654.31mm, 917.49mm, 816.5mm, 971.47mm and 864.39mm respectively. Trend analysis of rainfall for each mandal was carried out for each mandal and presented in table 4.1 to 4.9.

Most of the mandals have been found to register a negative trend and the corresponding trend equation has been incorporated in the table. Here, the X-Axis value represents the year and Y-axis represents rainfall in mm that year. For the entire study area average rainfall has been computed and the trend line was made.

Trend analysis of yearly rainfall in districts was carried out and presented in Fig 4.33.4.41

IV. CONCLUSION

Conclusions drawn from the study analysis:

1. Maximum rainfall was encountered at khammam district is 1435.73mm in 2005 and minimum rainfall was encountered at Mahaboobnagar is 416.73mm in 2006.
2. Negative rainfall trend was observed in most of the mandals of all districts in Telangana state
3. GIS has been formed to be a potential tool to carry out the study of spatial distribution of rainfall over a large area such as the the study area of Telangana state.
4. The analysis shows that moderate low rainfall is noticed in most of the areas of Telangana state during last few years, so the government with use of these studies can take necessary steps to over come the short fall of food grains to grow commercial crops for sustainability of farmers as well as protected water supply systems.

V. FUTURE SCOPE

Present scope of the study was limited to mandal level for Telangana state in Urban areas only. This can be extended to village level meticulously for better results for the past and future years. Further, this study could be extended to village level in order take proper administrative policy decisions in all directives for rainfall related measures and optimum utilization of resources.

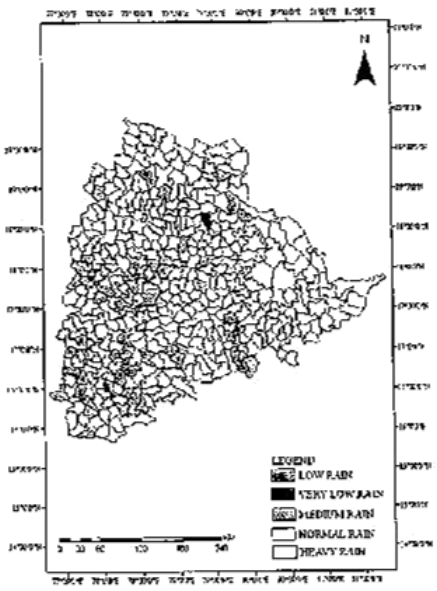


Fig 4.1 Variation of annual rainfall for the year 2005

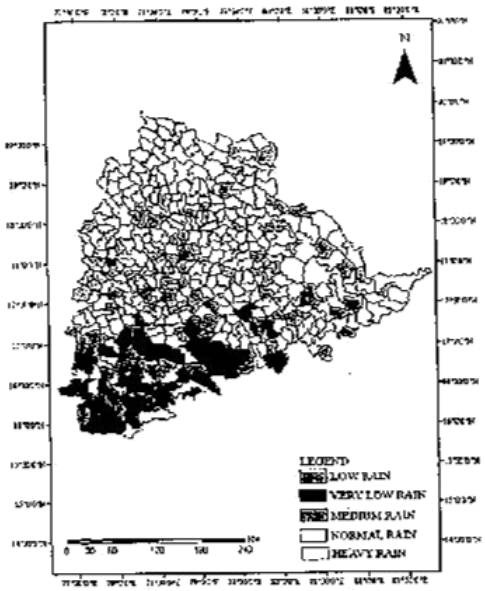


Fig 4.2 Variation of annual rainfall for the year 2006

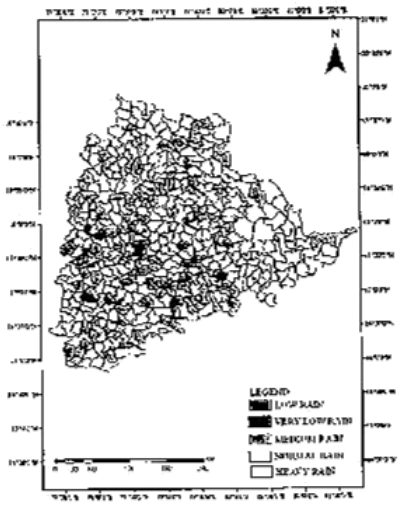


Fig 4.3 Variation of annual rainfall for the year 2007

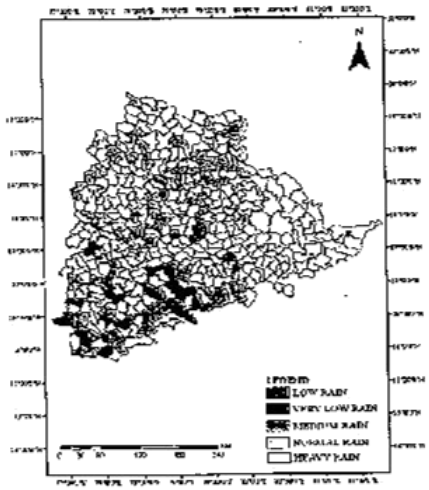


Fig 4.4 Variation of annual rainfall for the year 2008

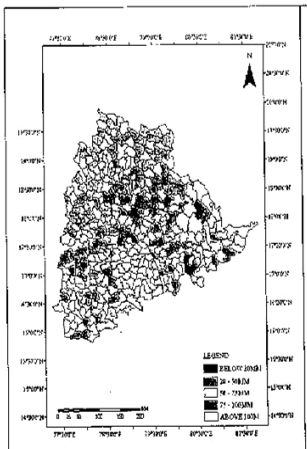


Fig 4.5 South West average monthly rainfall for the year 2005

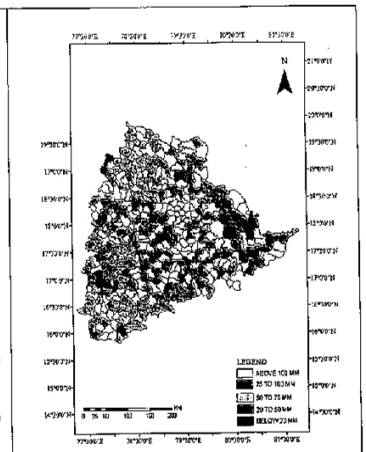


Fig 4.6 South West average monthly rainfall for the year 2006

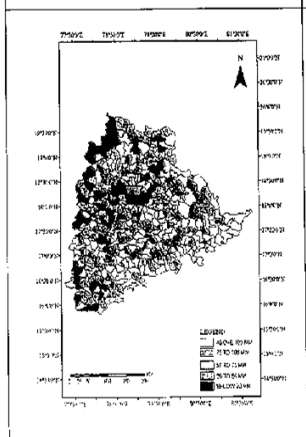


Fig 4.7 South West average monthly rainfall for the year 2007

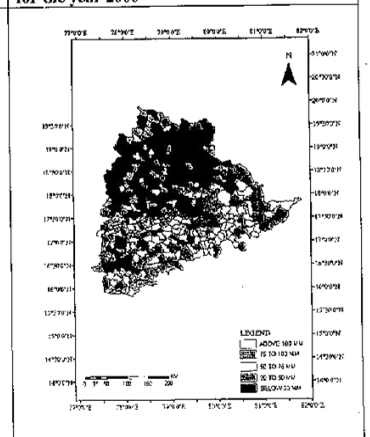


Fig 4.8 South West average monthly rainfall for the year 2008

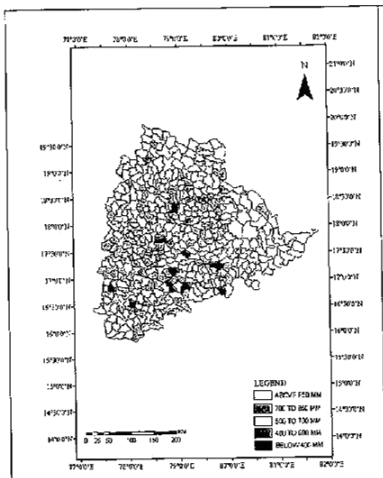


Fig 4.9 North East average monthly rainfall for the year 2005

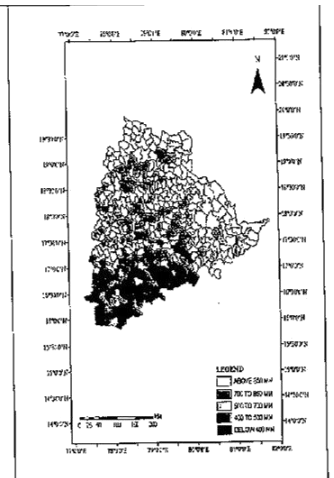


Fig 4.10 North East average monthly rainfall for the year 2006

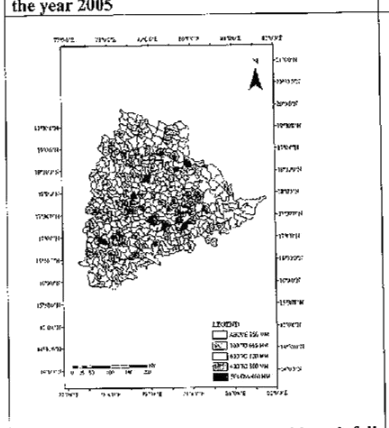


Fig 4.11 North East average monthly rainfall for the year 2007

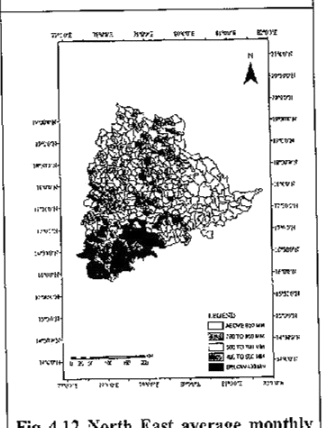


Fig 4.12 North East average monthly rainfall for the year 2008

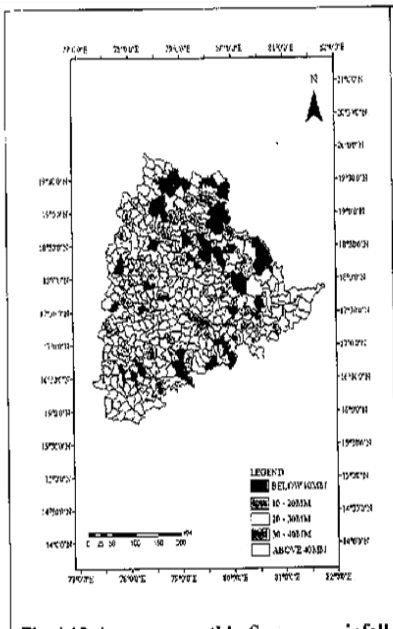


Fig 4.13 Average monthly Summer rainfall for the year 2005

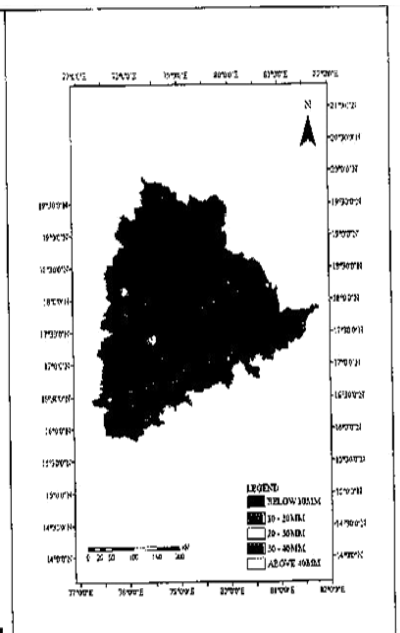


Fig 4.14 Average monthly Summer rainfall for the year 2006

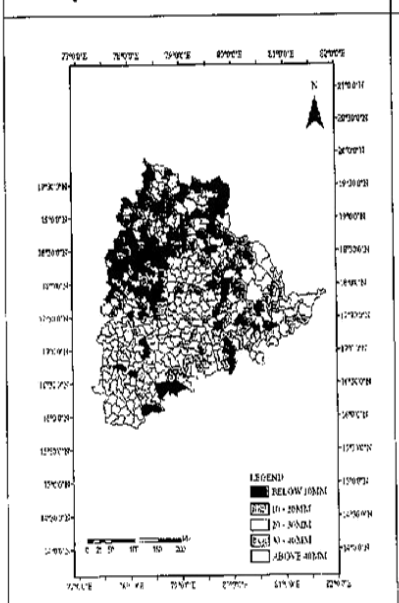


Fig 4.15 Average monthly Summer rainfall for the year 2007

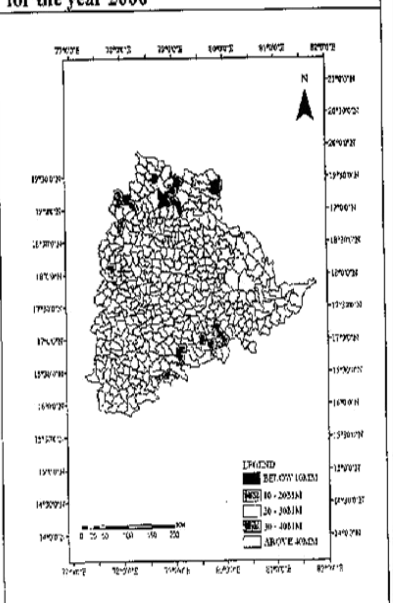


Fig 4.16 Average monthly Summer rainfall for the year 2008

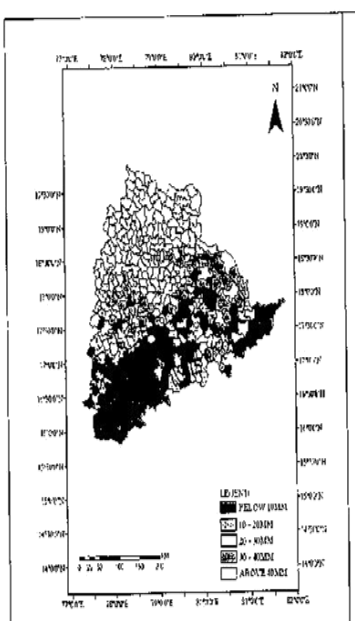


Fig 4.17 Average monthly Winter rainfall for the year 2005

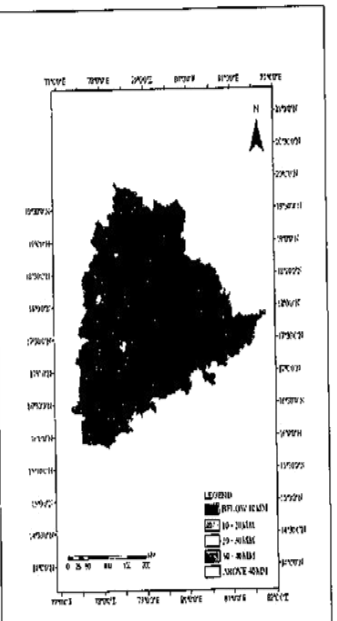


Fig 4.18 Average monthly Winter rainfall for the year 2006

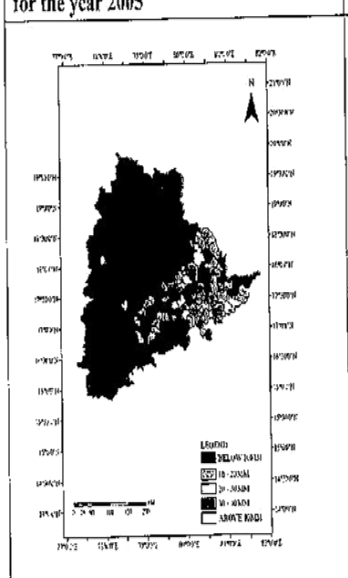


Fig 4.19 Average monthly Winter rainfall for the year 2007

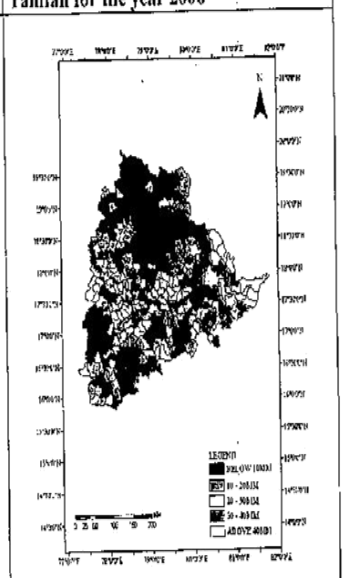


Fig 4.20 Average monthly Winter rainfall for the year 2008

Table 4.11 Maximum, Minimum, Average, Of Annual, Winter, Summer, South West And North East Rainfall Of All The Districts

District Name	Mandal/Year	Annual Rain fall	Winter Rain Fall	Summer Rain fall	South West Monsoon	North East Monsoon
Adilabad	Max	1282.82	41.80	46.20	1193.74	110.32
	Min	682.64	13.58	5.80	602.44	32.88
	Average	965.71	23.08	23.29	865.16	55.75
KarimNagar	Max	1087.70	28.24	71.64	962.48	113.62
	Min	562.28	3.06	13.68	494.36	32.52
	Average	873.63	13.03	33.76	751.99	74.85
Khammam	Max	1476.56	28.60	121.16	1254.90	195.48
	Min	937.08	2.76	31.92	717.08	64.40
	Average	1147.79	13.42	64.99	944.95	124.42
Mahaboobnagar	Max	1050.36	17.48	121.00	760.48	212.00
	Min	467.70	0.00	5.20	361.26	43.80
	Average	674.98	2.94	53.02	495.31	123.71
Medak	Max	899.58	28.56	82.84	754.38	97.02
	Min	538.00	2.88	8.60	436.88	32.04
	Average	734.78	13.65	48.69	613.86	58.58
Nalgonda	Max	865.02	23.24	98.32	678.88	205.62
	Min	363.74	0.40	12.28	262.52	67.66
	Average	684.36	7.07	43.77	510.05	123.46
Nizamabad	Max	1107.68	30.84	63.12	977.32	76.28
	Min	708.26	5.96	17.60	634.20	31.58
	Average	917.13	19.03	37.22	807.80	53.07
Rangareddy	Max	1029.22	27.64	103.72	872.62	155.10
	Min	530.18	0.66	40.20	392.36	60.60
	Average	816.50	10.30	66.23	637.35	102.62
Warangal	Max	1276.36	18.36	94.04	1156.06	146.80
	Min	602.90	3.06	28.96	478.92	47.68
	Average	970.63	10.49	54.43	817.46	88.25

Table 4.1 Karimnagar Mandal wise Rainfall Trend Analysis

S.No.	Name of Mandal	Trend Line
1	MUDIGONDA	y = -100.3x + 1405.3
2	BURGAMPADU	y = -100.59x + 1389.2
3	GARLA	y = -101.02x + 1389.3
4	THOLLADA	y = -103.24x + 1480.2
5	VENKATAPURAM	y = -103.72x + 1421.8
6	WYRA	y = -108.99x + 1664.6
7	THIRUMALAYAPALEM	y = -109.35x + 1280.4
8	CHERLA	y = -109.68x + 1604
9	VARARAMACHANDRAPUR	y = -110.16x + 1628.7
10	MANUGURU	y = -112.74x + 1347.6
11	BHADRACHALAM	y = -113.38x + 1816.7
12	YERRUPALEM	y = -115.42x + 1306
13	DAMMAPETA	y = -122.16x + 1319.7
14	ENKURU	y = -124.88x + 1634.9
15	BAYYARAM	y = -126.56x + 1376.3
16	PALAWANCHA	y = -126.8x + 1542.1
17	CHINTHAKAM	y = 13.52x + 1334.8
18	PINAPAKA	y = -135.72x + 1551.9
19	KUKUNOOR	y = -140.16x + 1497.1
20	PENUBALLI	y = -143.32x + 1671.3
21	KOTHAGUDEM	y = -148.8x + 1565.7
22	KUNAVARAM	y = -150.36x + 1688.4
23	GUNDALA	y = -151.36x + 1747.8
24	TEKULAPALLE	y = -159.38x + 1674.5
25	MADHIRA	y = -169.6x + 1750.4
26	SATHUPALLE	y = -186.28x + 1718.5
27	KALLURU	y = -187.78x + 1642.1
28	VELAIRPAD	y = -189.38x + 1769.8
29	KONIJERLA	y = -199.38x + 1877
30	KAMEPALLE	y = -26.63x + 1289.5
31	CHINTUR	y = -28.06x + 1021.3
32	DUMMUGUDEM	y = -39.24x + 1126.4
33	KHAMMAM RURAL	y = -46.56x + 1093.2
34	CHANDRUGONDA	y = -47.38x + 1158.4
35	WAZEED	y = -53.44x + 1341.6
36	ASWARAOPETA	y = -55.04x + 1371.8
37	NELAKONDAPALLE	y = -58.24x + 1495.5
38	JULURPAD	y = -62.08x + 1535.6
39	VEMSOOR	y = -63.96x + 1198.9
40	KUSUMANCHI	y = -66.56x + 1612.1
41	MULAKALAPALLE	y = -70.82x + 1221.7
42	SINGARENI	y = -72.02x + 1298.9
43	DHONKALU	y = -85.42x + 1286.4
44	ASWAPURAM	y = -86.52x + 1375.6
45	KHAMMAM URBAN	y = -91.7x + 1255.9
46	YELLANDU	y = -96.12x + 1342.5

Table 4.2 Adilabad Mandal wise Rainfall Trend Analysis

S.No.	Name of Mandal	Trend Line
1	THIMMAJIPETA	y = -1.42x + 587.94
2	VANGOOR	y = -1.82x + 908.3
3	AMRABAD	y = 10.64x + 689.16
4	DAMARAGIDDA	y = -105.48x + 1034.8
5	ALAMPUR	y = -108.94x + 1195.3
6	GHATTU	y = -12.15x + 748.41
7	UTKOOR	y = 13.44x + 836.04
8	BUINAPALLE	y = -13.71x + 772.03
9	ADDAKAL	y = 14.22x + 693.86
10	DEVARKADARA	y = -155.66x + 1517.3
11	MANOPADU	y = -158.33x + 1088.4
12	MAHBUBNAGAR	y = 15x + 728.24
13	KALWAKURTHY	y = 18.02x + 716.94
14	BALANAGAR	y = 18.82x + 550.18
15	ATMAKUR	y = 18.82x + 602.82
16	WANAPARTHY	y = 19.98x + 651.34
17	AMANGAL	y = 2.62x + 653.78
18	JADCHERLA	y = -21.47x + 602.91
19	ACHAMPETA	y = -23.1x + 862.54
20	GADWAL	y = 23.22x + 546.66
21	PEBBAIR	y = -23.5x + 602.26
22	KOTHUR	y = 24.18x + 537.42
23	KODANGAL	y = -24.84x + 820.88
24	FAROOQNAGAR	y = 25.34x + 489.3
25	BHOOTHPUR	y = -25.96x + 728.46
26	GHANPUR	y = 26.24x + 388.98
27	DHANWADA	y = 26.9x + 577
28	MIDJIL	y = 27.1x + 563.66
29	CHINNA CHINTA KUNT	y = 27.28x + 523.34
30	NARAYANPET	y = -29.51x + 607.77
31	AIZA	y = -29x + 741.12
32	VEEPANGANDLA	y = -3.4x + 662.2
33	PEDDAKOTHAPALLE	y = 3.88x + 646.2
34	DOULATABAD	y = 31.52x + 714.74
35	HANWADA	y = 32.71x + 672.37
36	TADOOR	y = -32.75x + 965.41
37	UPPUNUNTHALA	y = -34.91x + 825.53
38	NARVA	y = 36.7x + 636.62
39	WADDEPALLE	y = -4.55x + 565.61
40	MAGANOOR	y = -42.59x + 596.61
41	MADGUL	y = -45.52x + 753.9
42	KODAIR	y = 46.07x + 477.83
43	KOTHAKOTA	y = 49.26x + 391.28
44	LINGAL	y = 49.62x + 536.62
45	KESHAMPETA	y = 5.57x + 576.67
46	PANGAL	y = -5.68x + 610.02
47	KOLLAPUR	y = -54.26x + 940.12
48	VELDANDA	y = 54.94x + 595.24
49	MAKTHAL	y = -58.04x + 831.14
50	KOSGI	y = 5x + 718.16
51	NAGAR KURNOOL	y = -6.34x + 648.16
52	KOILKONDA	y = -6.9x + 885.84
53	MALDAKAL	y = -62.24x + 822.82
54	TALAKONDAPALLE	y = 7.5x + 607.3
55	BOMRASPETA	y = 7.84x + 628.6
56	KONDURG	y = -71.68x + 843.18
57	PEDDAMANDADI	y = -72.38x + 886.86
58	BALMOOR	y = -77.08x + 865.58
59	NAWABPET	y = -85.92x + 781.24
60	TELKAPALLE	y = 9.79x + 609.59
61	DHARUR	y = -90.62x + 882.78
62	MADDUR	y = -90.6x + 978.56
63	ITIKYAL	y = -92.09x + 927.81
64	GOPALPETA	y = -96.94x + 880.26

Table 4.3 Khammam Mandal Wise Rainfall Trend Analysis

S.No.	Name of Mandal	Trend Line
1	T(ELIGEDU)	y = -101.76x + 1244.6
2	MUSTABAD	y = -103.4x + 1195
3	ILLANTHAKUNTA	y = -104.03x + 1256.4
4	MUTHARAM MANTHANI	y = -106.63x + 1370.3
5	KATARAM	y = -108.77x + 1035.4
6	IBRAHIMPATNAM	y = -110x + 1192
7	ELKATHURTHI	y = -111.09x + 1242
8	RAIKAL	y = -111.2x + 1077.2
9	SRIRAMPUR	y = -111.32x + 1138.7
10	SULTANABAD	y = -111.39x + 1203.7
11	VELGATOOR	y = -115.11x + 1238
12	GAMBHIRAOPET	y = -116.37x + 1290.6
13	YELLA REDDI PETA	y = -116.48x + 1379.8
14	KORATLA	y = -116.54x + 1306.2
15	GOLLAPALLE	y = -133.55x + 1388.5
16	SAIDAPUR	y = -134.07x + 1345.5
17	DHARMAPURI	y = -134.6x + 1214.2
18	CHOPPADANDI	y = -143.79x + 1519.1
19	KARIMNAGAR	y = -149.18x + 1450.1
20	KESAVAPATNAM	y = -150.57x + 1366.6
21	VEENAVANKA	y = -163.66x + 1402.9
22	MUTHARAM MAHADEVPU	y = -174.1x + 1388.3
23	JULAPALLE	y = -183.47x + 1582.7
24	MANAKONDUR	y = -197.9x + 1652.1
25	PEDDAPALLE	y = 26.92x + 496.54
26	VEMULAWADA	y = 27.46x + 773.92
27	ODELA	y = -27.67x + 860.13
28	KATHLAPUR	y = -28.02x + 1154.9
29	Z(MALHARRAO)	y = 36.1x + 779.6
30	KONARAOPETA	y = 43.8x + 809.96
31	MALLIAL	y = -44.72x + 874.3
32	RAMADUGU	y = -52.42x + 883.26
33	HUSNABAD	y = -52.8x + 1101.5
34	HUZURABAD	y = -53.86x + 1098.1
35	MANTHANI	y = -53x + 1111
36	PEGADAPALLE	y = -63.62x + 1034.6
37	MAHADEVPUR	y = -67.4x + 832.82
38	KAMALAPUR	y = -67.61x + 1127.6
39	KODIMIAL	y = -67.78x + 992.16
40	CHANDURTHI	y = -68.76x + 1076.8
41	METPALLE	y = -69.01x + 942.53
42	SIRSILLA	y = -69.95x + 772.13
43	KAMANPUR	y = -69.9x + 1039
44	KOHEDA	y = -71.35x + 1138.8
45	BOINPALLE	y = -72.09x + 944.49
46	MAIDPALLE	y = -75.55x + 1119.4
47	GANGADHARA	y = -76.05x + 1002
48	BHEEMADEVARPALLE	y = -76.38x + 1017.4
49	THIMMAPUR	y = -76.7x + 1197.3
50	BEJJANKI	y = -77.92x + 1056.1
51	RAMAGUNDAM	y = -78.91x + 1192.1
52	MALLAPUR	y = -80.22x + 1067.7
53	JAMMIKUNTA	y = -91.36x + 1195.7
54	DHARMARAM	y = -95.92x + 1158.1
55	SARANGAPUR	y = -96.41x + 1203.7
56	JAGTIAL	y = -97.21x + 1196.4
57	CHIGURUMAMIDI	y = -99.56x + 1057.8

Table 4.4 M'nagar Mandal wise rainfall trendAnalysis

S.No.	Name of Mandal	Trend Line
1	KOUTHALA	y = -102.25x + 1306
2	ICHODA	y = -104.87x + 1234.2
3	DILAWARPUR	y = -108.52x + 1325.5
4	ADILABAD	y = -112.32x + 1309.5
5	LUXETTIPET	y = -112.5x + 1291.9
6	MANDAMARRI	y = -116.31x + 1437.9
7	TIRYANI	y = -120.11x + 1251.5
8	CHENNUR	y = -123.46x + 1053
9	KUBEER	y = -124.59x + 1406.6
10	VEMANPALLE	y = -133.95x + 1250
11	REBBANA	y = -138.49x + 1370.1
12	MANCHERIAL	y = 14.62x + 697.86
13	BELLAMPALLE	y = -140.82x + 1339.5
14	SIRPUR (U)	y = -141.42x + 1425.1
15	SARANGAPUR	y = -142.08x + 1357.2
16	GUDIHATHNUR	y = -142.87x + 1280.2
17	INDERAVELLY	y = -143.11x + 1349
18	JANNARAM	y = -150.52x + 1331.9
19	BAZARHATHNOOR	y = -151.06x + 1532.4
20	LOHESRA	y = -155.84x + 1343.5
21	KASIPET	y = -160.28x + 1472.1
22	KERAMERI	y = -160.57x + 1458.4
23	NARNOOR	y = -163.92x + 1490.8
24	BHAINSA	y = -164.03x + 1548.7
25	JAIPUR	y = -164.3x + 1447.5
26	DANDEPALLE	y = -170.53x + 1341.3
27	TANUR	y = -175.09x + 1637.1
28	KADDAMPEDDUR	y = -176.73x + 1506.7
29	BELA	y = -180.96x + 1582.6
30	JAINOOR	y = -190.02x + 1852.9
31	ASIFABAD	y = -195.27x + 1417.5
32	LAXMANCHANDA	y = -197.52x + 1704.8
33	MAMDA	y = -204.01x + 1566.2
34	KOTAPALLE	y = -204.69x + 1619.8
35	BOATH	y = -221.49x + 1747.9
36	WANKDI	y = -229.02x + 1626.4
37	TAMSI	y = -248.2x + 1790.1
38	NENNAL	y = -256.32x + 1873.8
39	DAHEGAON	y = -38.95x + 1089.3
40	MUDHOLE	y = -50.21x + 1102.2
41	UTNUR	y = -67.57x + 1199.5
42	KHANPUR	y = -70.21x + 953.69
43	KUNTALA	y = -74.1x + 1157.3
44	TANDUR	y = -76.33x + 1134.8
45	BHEEMINI	y = -77.65x + 1143.4
46	KAGAZ NAGAR	y = -77.98x + 1110.5
47	SIRPUR (T)	y = -83.98x + 1224.2
48	JAINAD	y = -85.72x + 1451.8
49	NIRMAL	y = -86.43x + 1114.1
50	NERADIGONDA	y = -90.2x + 1207.5
51	BEJJUR	y = -90.56x + 1140.8
52	TALAMADUGU	y = -96.04x + 1387.6

Table 4.5 Medak Mandal wise Rainfall Trend Analysis

S.No.	Name of Mandal	Trend Line
1	PULKAL	y = 0.12x + 772.4
2	JINNARAM	y = 1.68x + 569.28
3	TUPRAN	y = 11.08x + 527.08
4	MUNPALLE	y = -11.18x + 874.4
5	DUBBAK	y = -11.81x + 754.33
6	PATANCHERU	y = -13.9x + 721.78
7	JAGDEVPUR	y = -130.02x + 1231.7
8	RAMCHANDRAPURAM	y = -14.94x + 754.14
9	DOULTABAD	y = -15.28x + 802.76
10	NARSAPUR	y = 15.85x + 639.19
11	CHEGUNTA	y = -16.37x + 807.19
12	PAPANNAPET	y = -17.28x + 762.6
13	JHARASANGAM	y = -17.64x + 936.96
14	MANOOR	y = 20.08x + 764.28
15	WARGAL	y = -22.86x + 652.72
16	MULUG	y = -23.49x + 952.91
17	SANGAREDDY	y = -26.84x + 874.22
18	SADASIVPET	y = 29.28x + 731.18
19	SHIVAMPET	y = -30.74x + 772.34
20	KALHER	y = -31.71x + 837.93
21	KANGTI	y = -39.5x + 973.86
22	TEKMAL	y = -40.66x + 965.78
23	SIDDIPET	y = -41.78x + 689.62
24	SHANKARAMPET (R)	y = -46.02x + 743.08
25	YELDURTHY	y = -47.74x + 857.94
26	MEDAK	y = -49.87x + 1007.6
27	GAJWEL	y = -5.78x + 646.66
28	KONDAPUR	y = -51.02x + 980.4
29	MIRDODDI	y = -51.46x + 871.54
30	RANGAMPET KULCHARAM	y = 54.1x + 513.14
31	RAMAYAMPET	y = -55.2x + 931.36
32	KOWDIPALLE	y = -57.64x + 1018.4
33	HATHNOORA	y = -59.48x + 833.56
34	NARAYANKHED	y = -65.96x + 735.88
35	ANDOLE	y = -68.61x + 1105.4
36	KOHIR	y = 69.23x + 519.73
37	ALLADURG	y = -74.76x + 1043.8
38	ZAHIRABAD	y = -75.48x + 1122.6
39	KONDAPAK	y = -8.47x + 789.71
40	SHANKARAMPET (A)	y = -82.26x + 964.08
41	REGODE	y = -82.54x + 801.94
42	NYALKAL	y = -86.46x + 935.72
43	RAIKODE	y = -9.96x + 810.9
44	NANGANUR	y = -91.97x + 842.25
45	CHINNA KODUR	y = -99.56x + 1011.3

Table 4.6 Nalgonda Mandal wise Rainfall Trend Analysis

S.No.	Name of Mandal	Trend Line
1	NIDAMANUR	y = -1.26x + 568.26
2	GUNDALA	y = -101.04x + 1098.8
3	ATMAKUR (M)	y = -101.58x + 1063.2
4	CHANDAM PET	y = -110.34x + 1093.5
5	SURYAPET	y = -111.06x + 1116.4
6	ALAIR	y = -112.3x + 1185.9
7	PEDDAVURA	y = -121.56x + 1161.3
8	SALIGOURARAM	y = -122.1x + 1073.9
9	MELLACHERVU	y = -122.5x + 968.24
10	CHANDUR	y = -122x + 1177.5
11	GUNDLA PALLE	y = -127.56x + 1015.4
12	PEDDA ADISERLAPALL	y = -128.58x + 1023.3
13	NAKREKAL	y = -128.74x + 1001.7
14	KATTANGOOR	y = -149.6x + 1051.1
15	KANGAL	y = -17.08x + 612.56
16	VEMULAPALLE	y = -2.02x + 369.8
17	MUNAGALA	y = -22.28x + 734.32
18	GARIDE PALLE	y = -23.96x + 750.78
19	ANUMULA	y = -25.28x + 792.36
20	RAMANNAPETA	y = -27.6x + 503.76
21	MOTHKUR	y = -30.06x + 730.02
22	JAJI REDDI GUDEM	y = 30.98x + 610.68
23	NERED CHERLA	y = -31.68x + 791.64
24	CHITYALA	y = -37.24x + 806.96
25	KODAD	y = -37.53x + 740.69
26	CHILKUR	y = -39.04x + 720.44
27	YADAGIRIGUTTA	y = 4.4x + 577.28
28	NADIGUDEM	y = 4.8x + 457.72
29	THUNGA THURTHI	y = -40x + 708.58
30	NARKETPALLE	y = 41.42x + 494.7
31	VALIGONDA	y = -43.34x + 858.46
32	HUZURNAGAR	y = -43.86x + 731.9
33	BIBINAGAR	y = -44.38x + 830.94
34	NARAYANAPUR	y = -45.88x + 796.92
35	MUNUGODE	y = -47.6x + 898.74
36	NUTHANKAL	y = -5.16x + 678.98
37	RAJAPET	y = -5.72x + 570.64
38	DAMERACHERLA	y = -50.42x + 950.42
39	CHIVVEMLA	y = -50x + 761.44
40	MOTHEY	y = -51.72x + 743.66
41	THIRUMALAGIRI	y = -53.14x + 857.46
42	MARRI GUDA	y = -58.84x + 940.12
43	M TURKAPALLE	y = -58x + 776.92
44	CHOUTUPPAL	y = -59.76x + 962.54
45	CHINTHA PALLE	y = -60.56x + 840.4
46	MATTAMPALLE	y = -64.16x + 1057.5
47	PENPAHAD	y = -64.84x + 889
48	BHUVANAGIRI	y = -66.09x + 867.45
49	NALGONDA	y = -66.44x + 1029.8
50	POCHAMPALLE	y = -66.72x + 926.72
51	KETHEPALLE	y = -69.7x + 998.64
52	THRIPURARAM	y = -70.46x + 995.64
53	ATMAKUR (S)	y = -76.5x + 1006.7
54	TIPPARTHI	y = -77.56x + 1020.4
55	GURRAMPODE	y = -78.9x + 1046.5
56	BOMMALARAMARAM	y = -8.96x + 754.2
57	NAMPALLE	y = -82.52x + 885.08
58	MIRYALAGUDA	y = -86.18x + 939.14
59	DEVARAKONDA	y = -88.02x + 1118.3

Table 4.7 Nizamabad Mandal wise Rainfall Trend Analysis

S.No.	Name of Mandal	Trend Line
1	BODHAN	y = -100.34x + 1009.3
2	YELLAREDDY	y = -103.99x + 1181.8
3	BHIKNUR	y = -104.21x + 1256.6
4	TADWAI	y = -104.94x + 1277.8
5	BIRKOOR	y = -105.41x + 1172.9
6	KAMMAR PALLE	y = -106.15x + 1259.6
7	VARNI	y = -116.14x + 1190.3
8	MADNUR	y = -116.29x + 1247.9
9	BALKONDA	y = -118.8x + 1283.2
10	BICHKUNDA	y = -123.41x + 1365.4
11	MACHAREDDY	y = -131.58x + 1227.5
12	NIZAMABAD	y = -144.32x + 1449.2
14	NAVIPET	y = -158.94x + 1318.3
15	MORTAD	y = -159.38x + 1451
16	BHEEMGAL	y = -175.44x + 1468.2
17	DOMAKONDA	y = -190.97x + 1528.2
18	PITLAM	y = -202.26x + 1589.3
19	NANDIPET	y = -208.23x + 1568.8
20	SADASIVANAGAR	y = -35.27x + 973.49
21	BANSWADA	y = -37.78x + 1221
22	VELPUR	y = -48.01x + 1034.1
23	GANDHARI	y = -48.66x + 1056.3
24	ARMUR	y = -51.33x + 1095.4
25	DHAR PALLE	y = -67.46x + 1131.4
26	KAMAREDDY	y = -70.63x + 1185.2
27	MAKLOOR	y = -81.19x + 1092.4
28	DICH PALLE	y = -83.74x + 1156.7
29	LINGAMPET	y = -85.95x + 1102.5
30	JUKKAL	y = -86.5x + 1114.5
31	RANJAL	y = -89.13x + 1233.5
32	SIRKONDA	y = -92.26x + 1243.1
33	NIZAM SAGAR	y = -96.17x + 1104.9
34	JAKRANPALLE	y = -98.42x + 1247.2
35	KOTGIRI	y = -98.48x + 1326.8
36	NAGA REDDIPET	y = -98.9x + 1157.7

Table 4.8 Ranga Reddy Mandal wise Rainfall Trend Analysis

S.No.	Name of Mandal	Trend Line
1	YELAL	y = -1.09x + 792.69
2	TANDUR	y = -10.29x + 858.87
3	MANCHAL	y = -10.68x + 980.64
4	CHEVELLA	y = -10.92x + 733.56
5	SHAMSHABAD	y = -106.3x + 1217.1
6	YACHARAM	y = -108.78x + 1163.6
7	RAJENDRANAGAR	y = -121.15x + 1090.1
8	HAYATHNAGAR	y = -13.8x + 839.76
9	MEDCHAL	y = -17.98x + 1052.3
10	BALANAGAR	y = 18.65x + 633.27
11	MOMINPET	y = 23.24x + 754.44
12	SHABAD	y = -24.3x + 887.22
13	DOMA	y = -25.18x + 963.04
14	IBRAHIMPATAM	y = -27.96x + 957.08
15	KANDUKUR	y = 28.88x + 816.98
16	BASHEERABAD	y = 3.51x + 907.33
17	QUTHBULLAPUR	y = -3.52x + 540.74
18	MARPALLE	y = -31.77x + 991.93
19	GANDEED	y = -32.62x + 973.62
20	PEDDEMUL	y = 34.32x + 795.42
21	PARGI	y = -42.78x + 878.4
22	UPPAL	y = 5.32x + 811.16
23	DHARUR	y = -50.32x + 1180.2
24	VICARABAD	y = -50.3x + 856.82
25	SHAMIRPET	y = -53.16x + 955.62
26	SHANKARPALLE	y = -53.36x + 928.26
27	MOINABAD	y = -61.21x + 844.25
28	SERILINGAMPALLE	y = 61.66x + 664.8
29	KEESARA	y = -62.31x + 985.85
30	BANTARAM	y = -7.79x + 844.05
31	NAWABPET	y = 71.35x + 598.95
32	SAROORNAGAR	y = 75.65x + 534.45
33	MAHESWARAM	y = -8.71x + 951.93
34	PUDUR	y = 9.38x + 570.88
35	KULKACHARLA	y = -90.73x + 1178.3
36	GHATKESAR	y = -91.56x + 1089.2
37	MALKAJGIRI	y = -99.7x + 889.18

Table 4.9 Warangal Mandal Wise Rainfall Trend Analysis

S.No.	Name of Mandal	Trend Line
1	DORNAKAL	y = -102.02x + 1021.5
2	SANGAM	y = -103.45x + 1193.9
3	MUGUG	y = -107.06x + 1324.9
4	NALLABELLY	y = -108.14x + 1451.1
5	KODAKANDLA	y = -116.76x + 1525.7
6	MAHABUBABAD	y = -121.38x + 1373.6
7	TADVAI	y = -128.16x + 1597.3
8	GEESUGONDA	y = -128.98x + 1539.3
9	VENKATAPUR	y = -131.19x + 1669.9
10	DEVARUPPULA	y = -141.7x + 1629.2
11	BACHANNAPETA	y = -150.87x + 1613.1
12	KHANAPUR	y = -153.01x + 1304.7
13	HANAMKONDA	y = -155.01x + 1677.5
14	CHENNARAOPET	y = -189.73x + 1777.2
15	ZAFFERGADH	y = -225.92x + 1687.5
16	NARSAMPET	y = -27.79x + 967.25
17	GHANPUR	y = -35.91x + 917.09
18	JANGAON	y = -4.33x + 634.47
19	BHUPALPALLE	y = -41.66x + 1058.8
20	PARVATHAGIRI	y = -42.03x + 1053.5
21	MANGAPET	y = -43.88x + 1090.3
22	REGONDA	y = -46.08x + 1159.6
23	PARKAL	y = -48.36x + 1076
24	PALAKURTHI	y = -51.88x + 1000.1
25	RAIPARTHY	y = -56.02x + 1158
26	KESAMUDRAM	y = -56.46x + 963.78
27	SHAYAMPET	y = -57.3x + 1134.2
28	NARSIMHULAPET	y = -57.75x + 1165
29	KOTHAGUDEM	y = -59.79x + 1313.7
30	DHARMASAGAR	y = -60.63x + 1141.7
31	ETURNAGARAM	y = -61.93x + 857.99
32	WARDHANNAPET	y = -62.58x + 1142.4
33	RAGHUNATHA PALLE	y = -66.73x + 803.09
34	GHANAPUR	y = -69.42x + 1223.3
35	NARMETTA	y = -71.62x + 1347.3
36	KURAVI	y = -72.42x + 1236.8
37	MARIPEDA	y = -74.23x + 1391.2
38	THORRUR	y = -75.06x + 1178.3
39	NELLIKUDUR	y = -75.73x + 1281.3
40	HASANPARTHY	y = -80.29x + 1020.1
41	MOGULLAPALLE	y = -83.23x + 1199.5
42	GUDUR	y = -84.35x + 1385.6
43	LINGALA GHANPUR	y = -84.36x + 1046
44	DUGGONDI	y = -86.93x + 1203.3
45	GOVINDARAOPET	y = -91.24x + 1156.2
46	CHERIYAL	y = -92.77x + 1312.6
47	MADDUR	y = -93.76x + 1057.2
48	ATMAKUR	y = -95.81x + 1236.3
49	CHITYAL	y = -96.54x + 1172.7
50	NEKKONDA	y = -97.32x + 1169.3

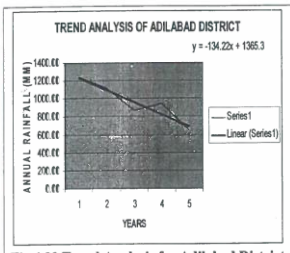


Fig 4.33 Trend Analysis for Adilabad District for a period of 2005-2009

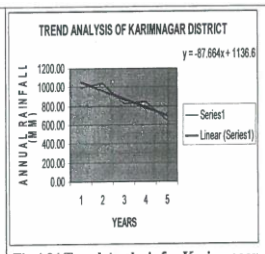


Fig 4.34 Trend Analysis for Karimnagar District for a period of 2005-2009

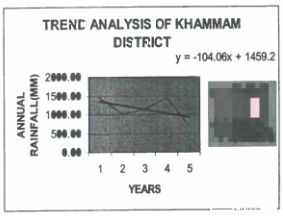


Fig 4.35 Trend Analysis for Khammam District for a period of 2005-2009

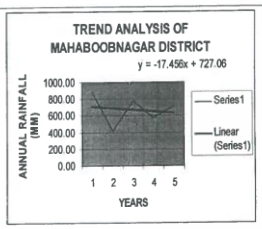


Fig 4.36 Trend Analysis for Mahaboob Nagar District for a period of 2005-2009

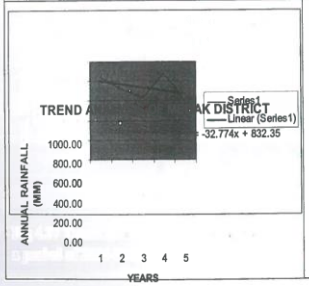


Fig 4.37 Trend Analysis for Medak District for a period of 2005-2009

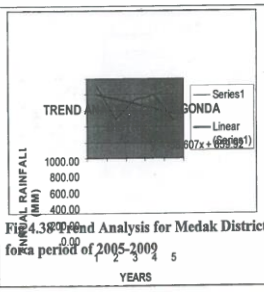


Fig 4.38 Trend Analysis for Medak District for a period of 2005-2009

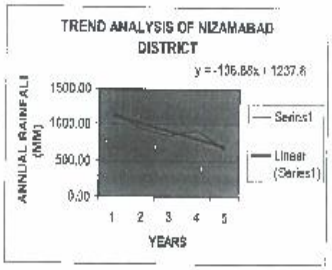


Fig 4.39 Trend Analysis for Nizamabad District for a period of 2005-2009

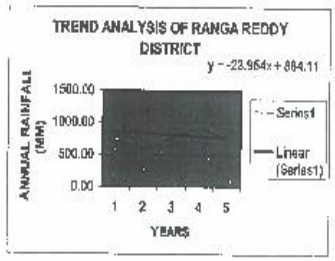
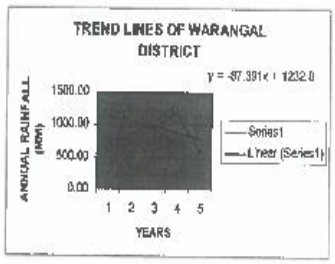


Fig 4.40 Trend Analysis for Ranga Reddy District for a period of 2005-2009



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