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P Priya
Research Scholar, Dept. of Geography, Govt. Arts College (A), Kumbakonam, Tamil Nadu, India

Correspondence
P Priya
Research Scholar, Dept. of Geography, Govt. Arts College (A), Kumbakonam, Tamil Nadu, India

Decadal variations of rainfall patterns in Thanjavur district using GIS

P Priya

Abstract
The climate of Thanjavur can be termed as a fairly healthy one like other coastal areas. November to February is the pleasant months in a year with climate full of warm days and cool nights. From March onwards, the climate rather becomes sultry and the mercury shoot-up and reaches its peak by the end of May and June depending upon the onset of summer rain. The conventional method of analyzing seasonal and annual rainfall pattern has been adopted to bring out the salient features of rainfall distribution of the study area. The monthly rainfall data for the 13 Rain gauge stations located in the district were collected and compiled, seasonal annual averages calculated and interpolated to provide rainfall distribution maps for the district with the help of the formula rainfall variability for the four seasons were calculated.

Keywords: GIS, Thanjavur, rainfall, variations

1. Introduction
Weather and climate are dynamic features of our physical environment. They affect a wide range of human activities to a greater or lesser degree. Weather and climate are important factors in determining our day-to-day longer- term activities and modes of life. Though it would not be desirable to produce an exhaustive catalogue of climate impacts it is true that the ways in which the elements of climate and weather control various forms of economic and social activity are now receiving ever-increasing attention from climatologists.

Agriculture and water resources in the central and eastern United States are profoundly influenced by atmospheric circulation, precipitation, and stream flow in summer the growing season. Circulation is an influential element of regional hydro climate since moisture transports contribute substantially to local precipitation and also the circulation can influence the precipitation distribution by modulating the strength and/or position of storm tracks. Interest in the warm season' circulation and precipitation variability has greatly increased following the 1988 drought over much of the continental United States and the Midwest floods during 1993. An improved understanding of the origin and development mechanisms of the regional to continental scale variability patterns will advance the accuracy of hydro climate forecasts an important objective of the U.S. global water cycle initiative (Hornberger *et al*, 2001).

It may be pointed out that all of man's efforts towards weather modification may lead to serious meteorological consequences. Large scale activities such as crop protection, artificial precipitation hail suppression and fog dissemination are some of our efforts directed towards the modification of our environment. Today man is seriously speculating on the future possibilities of climate control on a global scale. Thus deliberate weather modification on the micro and meso scale has been in progress for the last many decades. But the problems involved in large scale weather modification are so numerous as to stagger imagination. However any fair measure of success in large scale weather modification will ultimately depend on how much more. We know and understood the mechanisms of the general circulation, the terrestrial heat budget, boundary layer exchange system, and cloud physics. Even if our science and technology are capable of modifying the weather and climate to a certain desired level, we should not forget about a number of international implications and the possible consequence. To achieve a fair measure of success in this field international co-operation and agreement up to a certain level is necessary.

2. Definition of weather and climate

In climatology the terms 'weather' and 'Climate' have different connotations "weather" refers to the state of atmosphere at any given time denoting the short -time variations of atmosphere in terms of temperature, pressure wind, moisture, cloudiness, precipitation and visibility. Weather is highly variable. It is constantly changing, sometimes from hour to hour and at other time from day to day. Trewartha "climate represents a composite of the day to day weather conditions and of the atmospheric elements" G. F. Taylor "climate is the integration of weather and is the differentiation of climate. The distinction between weather and climate is therefore, mainly on of time."

3. Precipitation

Precipitation is the term employed for all forms of atmospheric, moisture
deposited on the ground. Rain is the most common form and it is the only one, which is gauged extensively and with any degree of certainity. It has be claimed that the end product of virtually all important rainfall studies lies in the analysis and presentation of average and variability.

Types of precipitation: Precipitation is classified on the basis of the conditions under which large masses of moist air are actually in induced to raise to higher elevation. Thus the following three type precipitation is based on the types of ascent and precipitation characteristics.

a) Convectional precipitation
b) Orographic precipitation
c) Cyclonic of frontal precipitation

a) Convectional Precipitation: Resulting from convective over turning of moist, air, heavy, showery precipitation is most likely to occur. Rain or snow showers, hail. And snow pellets are the forms associated with convective precipitation.

b) Orographic Precipitation: This type of rainfall is related to the relief feature of region, when the rain bearing winds blow against mountain ranges, the mass of air is forced to flow over the slopes of the ranges. As the air rises on the windward side it gets cooled and condensation takes place. This causes rainfall on the windward side of the mountain. This is known as relief rainfall or orographic rainfall.

C) Cyclonic or frontal precipitation: Cyclonic or frontal precipitation occurs when deep and extensive air masses are made to converge and more upward so that their adiabatic cooling results. Whenever there is lifting of the air masses with entirely different physical properties atmosphere becomes unstable. When this happens the stage for large scale condensation and precipitation has been set. If an additional process in operation so that the raindrops of the required size are formed the precipitation results.

4. Rainfall in India

India has great variety of climatic variations but the influences of monsoonal changes in this sub-continent have resulted in some form of unity in the climatic conditions. The rainfall distribution is contiguous. India is noted for its diversity both in space and time. The bulk of rainfall (i.e. 50 to 95%) is however received year after June to September. Mean annual rainfall of India has been estimated to about 150cm. As regards its spatial distribution over different states of the country there are wide variations from one state to another.

The highest rainfall occurs along the west coast on the westernghats sub- Himalayan, areas in the north-east and the hill of Meghalaya. Plateau all the rainfall exceeds 1000cm. in general the distribution pattern of annual rainfall shows two main trends.

a) It steadily declines towards the west and the north-west from Bengal and Orissa coasts and
b) From the west and the east coasts it exhibit a declining trend towards the interior parts of the peninsula.

5. Rainfall in Tamil Nadu

Tamilnadu economy is largely depended on monsoonal rainfall. All the rivers and irrigational process and dependent on monsoon rainfall Tamilnadu eceive rainfall from south west monsoon, northeast monsoon and cyclonic rainfall. Large account of rainfall is received from the monsoonal rainfall.

6. Spatial Information Technology

Remote sensing: Remote Sensing is the Science and art of obtaining information about an object, area or phenomenon through the analysis of the data acquired by the device that is not in contact with it. This device can be a camera or a bank of sensors operated form an airplane or a satellite.

Geographical Information System: A GIS is "an organized collection of computer hardware, software, geographical data, and personnel designed to efficiently capture, store, update, manipulate and display all forms of geographically referenced information".

Global Positioning System: GPS is a satellite-based navigation system that uses a constellation of 24 satellites to give a user an accurate poison. It is important at this point to define 'accurate'.

7. Review of Literature

Arya *et. al* (1996) [3] has used Satellite remote sensing technology to solve the problem of mapping, monitoring and management of flood prone areas. Keeping this in view, the present study was carried out to map the extent of floods in Rohtak district, Haryana using remote sensing technology and to suggest management practices for mitigating flood. The data used are IRS IB LISS II Dispositive of September 16 and 18, 1995 and LANDSAT TM dispositive bulk scene of September 24, 1995 of the area, Survey of India topographical maps on 1:50,000 scales and other ancillary data. Two categories of flood-affected areas were identified as Standing water and Receded Water/Wet Areas. The study demonstrates the capability of satellite data for mapping and management of flood inundated areas. Moreover, the provide clues for effective management of such areas. Till now structural methods have been adopted for planning of flood affected area but with the advent of satellite based information system, including all weather satellites, priority may be given to non-structural methods such as disaster preparedness, relief and rehabilitation.

Patterns of sediments and riverbeds are significantly different from those of surrounding permitting easy classification. The difference of the 16-year period 1977 to

1993 was noticed. The present trend of the channel formation, spatial distribution of sedimentation observed by satellite data has inferred the current sedimentation activities and future channel developments.

8. Problem of the Study Area

The climate of Thanjavur can be termed as a fairly healthy one like other coastal areas. November to February is the pleasant months in a year with climate full of warm days and cool nights. From March onwards, the climate rather becomes sultry and the mercury shoot-up and reaches its peak by the end of May and June depending upon the onset of summer rain. The northeast monsoon in October brings complete relief. The southwest monsoon sets in June and continues till September. The rainfall during this period in much lower than that of north-east monsoon which sets in October and continues more or less till February (up to winter). However, Thanjavur district is benefited more by northeast monsoon because of its heavy rainfall and the Western Ghats invariably feeds the Kaveri and helps greatly for the vast cultivation of the deltaic region.

According to the reports from the district administration, the river Kollidam carried a maximum of 337,000 cusecs of water, which lead to a major breach at Karuppur in Papanasam taluk to a length of 50 meters and river water, entered adjacent villages in Thanjavur district. Farmers in the delta districts were the most affected persons due to this flood. Due to severe continuous drought during the past three years, cultivation of paddy crops in these districts had been severely affected. Since water has been released from Mettur dam this year, Kuruvai and Samba were cultivated in the Kaveri Delta areas. Due to unexpected heavy rain in these areas, paddy crops, which were in good condition got submerged thereby resulting in heavy damage to paddy crops besides causing untold misery to the farmers. The Collectors of the affected districts were requested to send reports to ascertain the area of the extent of lands affected so as to give relief to the affected persons. As per the reports of the Collectors, 176,864 hectares of land was damaged more than 50 per cent and above. Breaches were also noticed in a lake at Kalimedu near Thanjavur, inundating paddy crops of hundreds of acres of land. Thanjavur District out of the total cultivated area of 141,000 hectares, crop on 71,000 hectares was submerged. The flood at Peivari, a jungle river near Sengipatti washed away a temporary road across Thanjavur and Tiruchirapalli and snapped the connection. Another 50 meters of breach, along the river Kaveri was noticed in the northern bank at Vengore near the Grand Anaicut water flowed into the nearby Grand Anaicut canal, broke its two banks and entered the Vennar breaking its right bank. Floodwaters from the breach inundated a vast stretch of paddy fields, flooded the Thiruverumbur-Grand Anaicut Road and marooned a few villages, Thohur, Arasankudi, Kiliyur and Nadarajapuram. Based on the background of the flood situation in the Kaveri delta region, the problem to be addressed will be: to study the conceptual development of floods in delta region and to assess the damages caused to people living in rural and urban environment, the extent of damages to the physical conditions of the river features and tanks which lead to the discharge of water to surrounding villages and the low lying urban areas, and develop a GIS Model to reduce the flood disaster in the future.

9. Aim and Objectives

The main aim of this thesis is to study the various characteristics of rainfall in
Thanjavur district.

(i) To calculate the mean annual rainfall and analyze the seasonal distribution of rainfall patterns.
(ii) To calculate rainfall variability in different seasons, precipitation ratio and study the characteristics of the station wise rainfall in Thanjavur District.

10. Methods of Analysis

Generally secondary data is used in the preparation of this project. Monthly rainfall data for 13, Rain gauge stations in the district for the period 2005-2014 have been collected from the statistical office thanjavur district. The information regarding the study area is collected from published and unpublished reports available from the statistical office and other offices of the district.

The conventional method of analyzing seasonal and annual rainfall pattern has been adopted to bring out the salient features of rainfall distribution of the study area. The monthly rainfall data for the 13 Rain gauge stations located in the district were collected and compiled, seasonal annual averages calculated and interpolated to provide rainfall distribution maps for the district with the help of the formula rainfall variability for the four seasons were calculated.

11. Study area description

Thanjavur District stands unique from time immemorial for its agricultural activities and is rightly acclaimed as the Granary of the South India lying in the deltaic region of the famous river Kaveri. Various testimonials available in the ancient Tamil literature referring to the Kaveri as possessing the sanctity of the Ganges in conformity with the legendry and mythological stories attributed to its divine origin, rightly point out why the river is popularly called the "*Mother Kaveri*" and its sacredness is evident from historical evidences. It is no wondered therefore that at the very threshold of the district itself, one can distinguish green vegetation and call Thanjavur as '*the green monsoon'* of the south. With an average annual rice yield touching 22.33 lakh metric tones during 2005 – 2014 or roughly about one–third of the total rice yield of Tamil Nadu, the district tops all the other districts of India in the production of and remarked as the *rice bowl of India*. The economy of the district is, therefore, primarily agrarian in nature with very few industrial units.

Thanjavur district is located on the east coast of Tamil Nadu. Thanjavur district bounded on the east by Nagapattinam and Thiruvarur and the west Tiruchiraplli and Namakkal and the north by Ariyalur and the south by pudukkottai district. It is situated between 90 50' and 110 25' of the Northern latitude and 780 45' and 790 25' of the Eastern longitude. The district is bounded on the North by the coloroon which separate it from peranbalur and Thrichirapalli District and on the East it is bounded by the Tiruvarur and Nagapattinam Districts and on the South by the Palk Strait and pudukkottai and Tiruchirapalli District cauvery is the main river to give irrigation for Thanjavur (Figure -1).

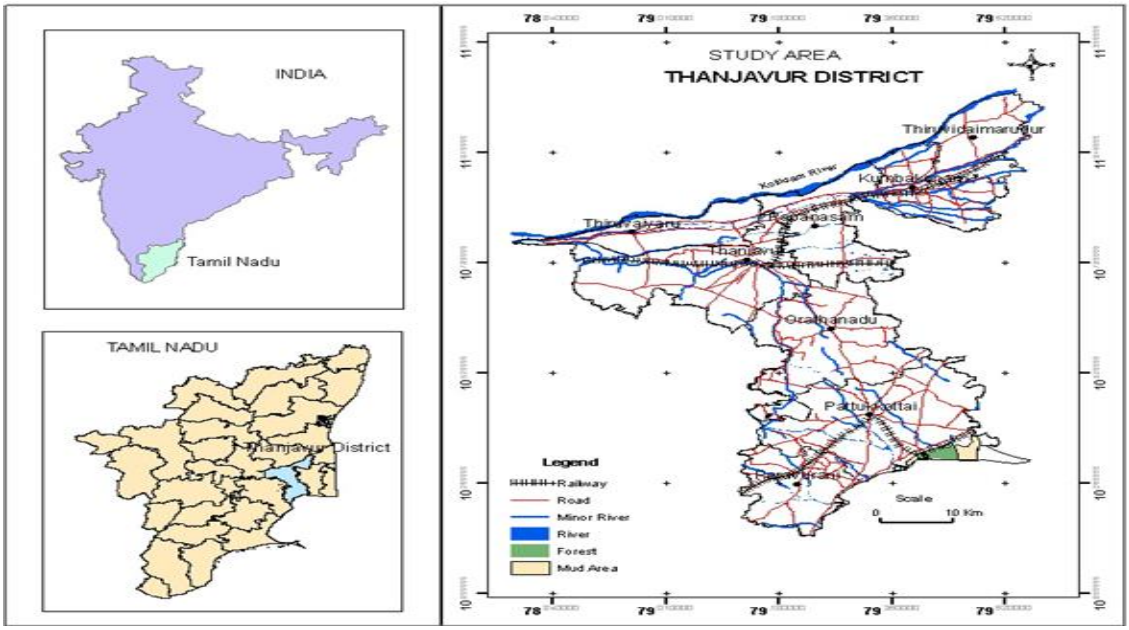

Fig 1

12. Administrative setup

Thanjavur district comprises 975 revenue villages which are in turn formed into 3 revenue divisions. 8 administrative taluks and blocks. There are no hills wherever in the district. The district being predominantly agricultural one is called the Granary of south. It is well known that Thanjavur is the home of Bharadha Natium and the centre of Karnatic music. The Mahamaham Festival of Kumbakonam takes place once in 12 years and it attracts very huge crowd from all over India. The Grand Anaicut builds by king Karikala chola on the river cauvery. (Figure – 2)

Fig 2

13. Temperature and Rainfall

The climate of Thanjavur can be termed as a fairly healthy one like other coastal areas. November to February is the pleasant months in a year with climate full of warm days and cool nights. From March onwards, the climate rather becomes sultry and the mercury shoot-up and reaches its peak by the end of May and June depending upon the on set of summer rain. The northeast monsoon in October brings complete relief. The southwest monsoon sets in June and continues till September. The rainfall during this period in much lower than that of north-east monsoon which sets in October and continues more or less till February (up to winter). However, Thanjavur district is benefited more by northeast monsoon because of its heavy rainfall and the Western Ghats invariably feeds the Kaveri and helps greatly for the vast cultivation of the deltaic region.

Climate is the most important factor of environment controls of agricultural activities of the study area. Summer season maximum temperature recorded about 36.6°c. Minimum temperature recorded 32.5°c. Maximum cooler 23.5°c, minimum cooler 22.8°c in the winter season. The study area has a high mean temperature and a low degree of humidity. Even though this area is not subjected to extremes of climate the summer months are quite hot and the difference between maximum and minimum temperature are moderate. The first two months of the year are very pleasant with warm days and cool nights. By the end of February the climate becomes very sultry and as the temperature shoots up.

The district enjoys a tropical, monsoon climate. According to International Zonal Classification by Rengranlous and Gaussen, the district falls under "Class 3 tropical bio-climate" which has been further classified by Legris and Virat under 36th medium tropical category is characterized by monthly temperature always above 27º C with total annual rainfall varying from 500mm to 1500 mm with a dry period of 5 to 6 months.

Thanjavur district experiences humid and tropical climate. Thanjavur district experiences humid and tropical climate. The temperature rises slowly to maximum during summer season upto the month of May and afterwards it falls slowly. The mean maximum temperature rangs from 300C to 370C, and the mean minimum temperature from 200C to 28.450C. The year can be classified in the 4 seasons.

i) Winter - January to February
ii) Summer- March to May
iii) South west monsoon - June to September
iv) North east monsoon - October to December

Table 1: Climatic Condition in Thanjavur District – 2015

Months	Temperature in (C)	Rainfall in (mm)	Humidity in (C)
January	31.0	24.5	75.8
February	33.1	0.03	74.7
March	32.1	32.1	75.9
April	36.5	55.2	69.2
May	39.0	27.9	60.6
June	37.5	15.8	64.3
July	36.6	95.5	61.9
August	35.5	142.1	66.6
Septembr	35.1	87.9	69.6
October	33.3	36.1	77.0
November	31.2	451.4	78.4
December	29.0	322.0	83.5

The climate of Pattukkottai taluk can be termed as a fairly healthy one like other coastal areas, November, December, January and February are the pleasant in a year with climate full of warn days and cool nights. From March, the climate rather becomes saltry and reaches its peak by the end of may June depending upon the setup summer rain. The Northeast Monsoon, in October brings complete relief. The Southwest monsoon sets in June and continues till September. The rainfall during this period in much lower than that of Northeast monsoon, which sets in October and continues more are less till February (up to winter). However Thanjavur district is benefited more by north east monsoon because it's heavy rainfall and the Western Ghats invariably feeds the Kaveri and helps greatly for the vast cultivation of the deltaic area.

The mean maximum temperature varies between 29º c in November to January and 36º c in May to July the average being 32.46º c. Similarly, the mean minimum varies between 22º c and 27º c with an average of 24.75º c. (Figure -3)

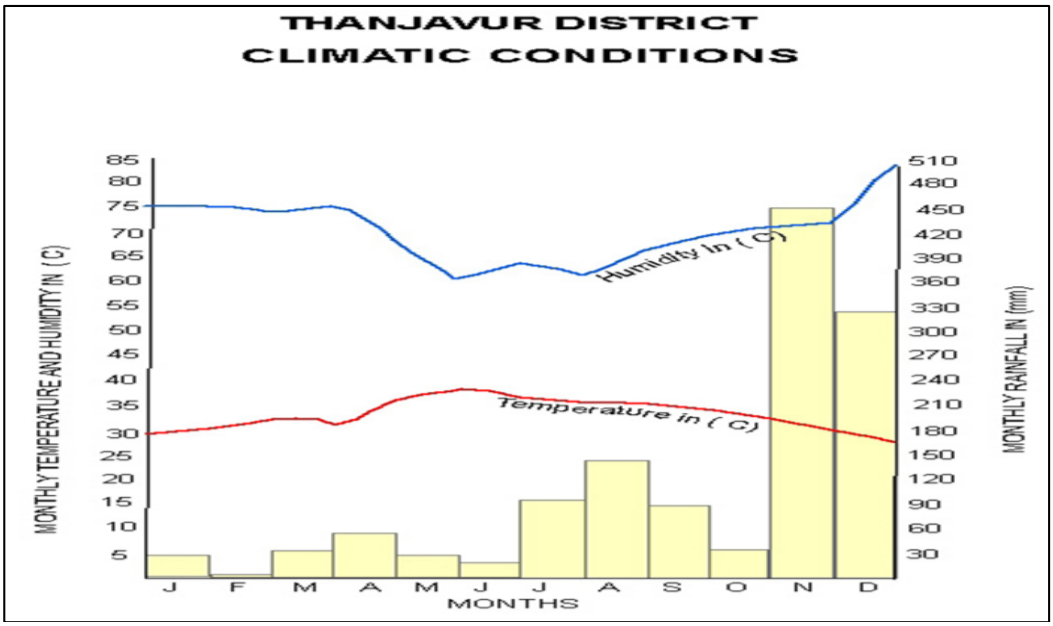

Fig 3

This district is located away from the coast. And the district receives rain in both south west and North east monsoons. The normal annual rainfall of this taluk is 1168.4 mm. About 60 per cent of the total annual rainfall is received which commences by mid October and ends by December. The southeast monsoon rains from June to September and the summer showers in April-May account for the rest. There is considerable variation in the rainfall received from place to place, the lowest being 699.5 mm at Thirukattupalli. The monthly average rainfall for the period 2005 - 2014 is 108.87 mm.

The mean relative humidity varies between 63.83 per cent in July to 79.83 per cent in November as per the metrological data. Rainfall amount 111.37mm average in the raining season. The hot season starts from March and heat subsides after June when water is let into the canals and southwest monsoon bring in showers. Maximum rainfall during November 2005 has occurred in the date 8 and 24. During the year November, 2008 maximum rainfall has occurred in the date 8 and 27.

During May, dust storms, whirlwinds and dusty winds flow from various directions. The south west winds that set in during April, become strong in June and continue till September cyclonic storms of high velocity affect the district once in 3 or 4 years during November - December. Maharajasamudram River Agniar, Kannanar and Nasuvinar are the four minor river basins in this taluk.

In the month of May there is sudden spurt of rainfall in Papanasam taluk. This convection shower accompanied with thunderstorms before the on-set of the southwest monsoon. Cyclonic storms are the main weather phenomenon of northeast monsoon.

14. Distribution of Rainfall in Thanjavur District

Indian economy is mainly based on agriculture is influenced by various factors, such as physiographic, soil, climate, economic factors and other most of the rainfall received in the Indian sub continent is through monsoon any delay on departure will affect the various aspects of agriculture coastal areas of Tamilnadu receive much of their rainfall through the retreating monsoon (i.e) North east monsoon. Here on attempt has been made to analyze the distribution of rainfall. Variability of rainfall and rainfall ratio of Thanjavur district.

15. Rain Guage Station

Rainfall analysis of Thanjavur district is based on the rainfall data received from the various reengage stations. There are 12 rain gauge stations are widely distributed all over the district (Figure – 4).

16. Rainfall Distribution

The distribution of rainfall is divided into the 4 seasons. There are

1. Winter seasons (January-February)
2. Summer seasons (March-May)
3. South west monsoon seasons (June-September)
4. North east monsoon seasons (October-December)

a) Rainfall Distribution in South West Monsoon

The characteristics features of this season are low pressure. Inland, shorelines of the al parts of the country gets more rainfall during this season. As a result of rainfall there is a fall in temperature generally. During this season rainfall amount ranges from 212.7mm Thiruvaiyaru 446.9mm in Orathanadu. Rainfall is increases in Orathnadu, Grand Anicut. Rainfall decreases in Vallam, Thirukkattupalli, Thiruvaiyaru, and Peravoorani (Table 2).

The characteristics features of this season are low Pressure. Inland shorelines of the all parts of the country gets more rainfall during this season. As a result of rainfall there is a fall in temperature generally. During this season Thiruvaiyaru receives 212.7 mm and Orathanadu receives 446.9 mm. The rainfall decreases from central to both north and south of the district. Very low rainfall received in Aduthurai, Thiruvaiyaru, Thirukkattupalli, Papanasam, Pattukottai, Adhirampattinam, and Peravoorani. Low rainfall received in Kumbakonam moderate rainfall received in Grand Anicut and Neduvasal, very high rainfall received in Orathanadu (Figure– 5).

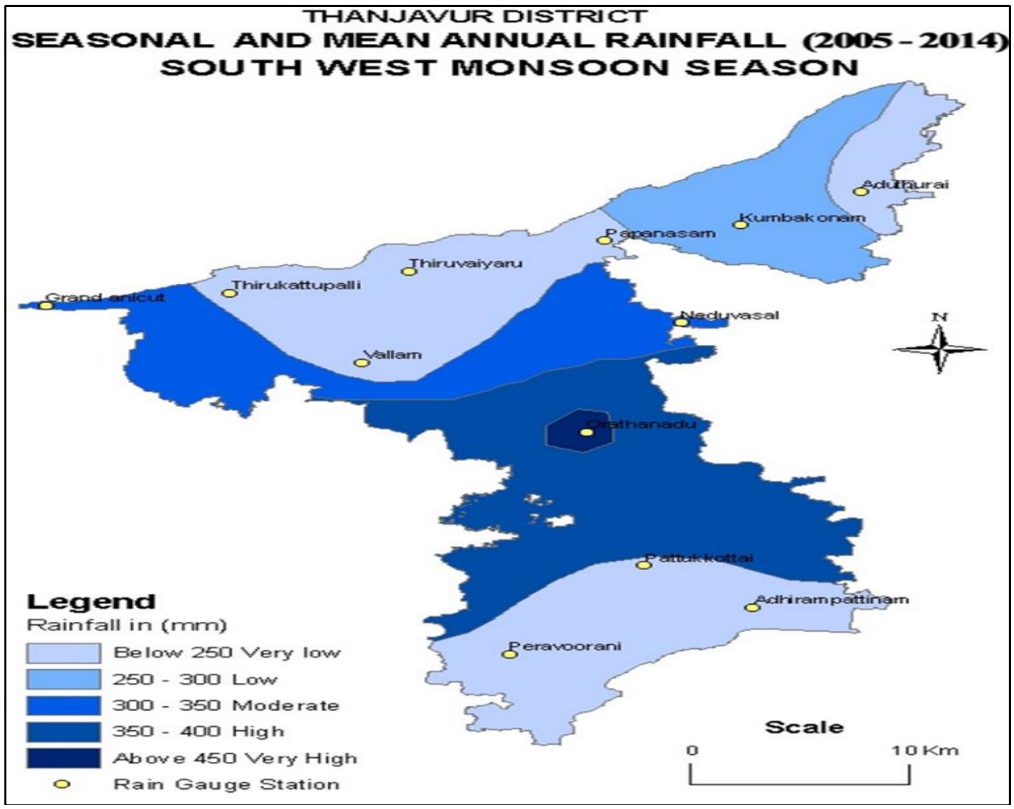

Fig 5:

b) Rainfall Distribution in north east monsoon

During this season rainfall amount ranges from 502.7mm in Grand Anicut to 746.5mm in Aduthurai low rainfall received in Grand Anicut (502.7m) Thirukkattupalli (518.7mm) Peravoorani (531.4mm) Thiruvaiyaru (540.9mm). High rainfall received in Aduthurai (746.5mm). Orathanadu (734.5mm) Papanasam (723.9mm) (*Appendix1*). During this season rainfall amount ranges from 502.7 mm in Grand Anicut to 746.5 mm in Aduthurai. Very low rainfall received in Grand Anicut, Thirukkattupalli, Thiruvaiyaru, Peravoorani and Neduvasal. Moderate rainfall received in Kumbakonam, Vallam, Pattukottai and Adhirampattinam. Very high rainfall received in Aduthurai, Papanasam, and Orathanadu. Low rainfall received in western and southern part and very high rainfall received in earthen part of the Thanjavur District (Figure – 6).

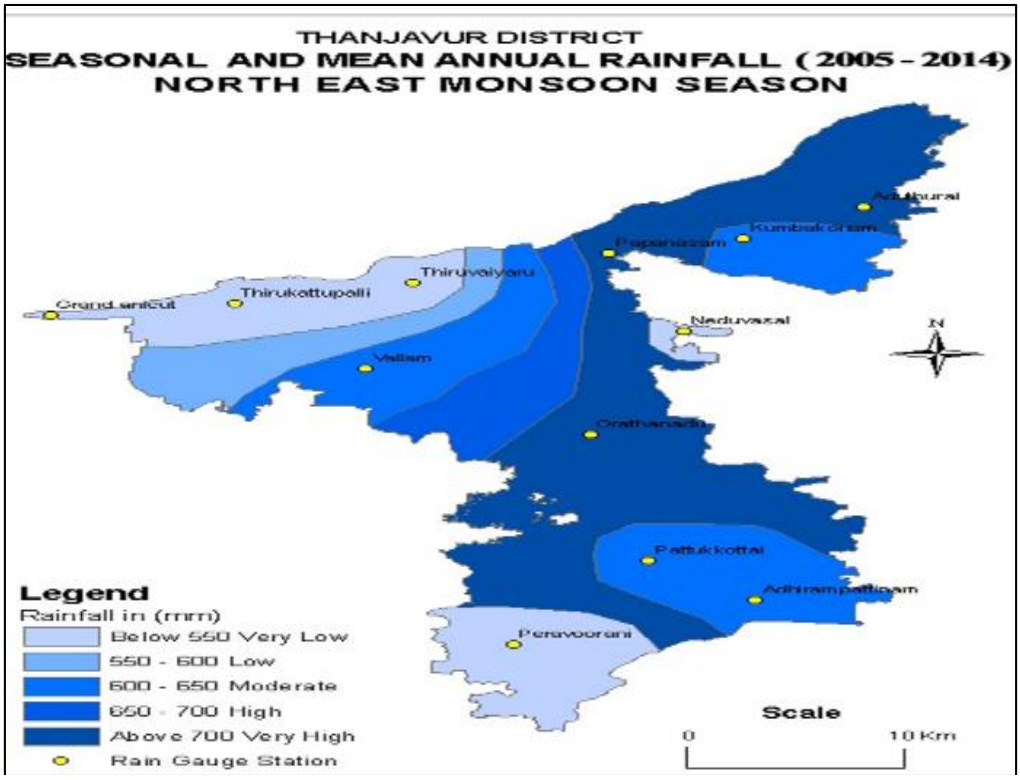

Fig 6

c) Mean Annual Distribution of Rainfall

The mean annual rainfall distribution is show in the map. The rainfall amount ranges from 893.7mm in Thiruvaiyaru moderate rainfall received in Grand Anicut (1040.8mm) Vallam (1019.5mm). High rainfall received in Orathanadu (1435.2mm) (*Table 2*).

Table 2: Thanjavur Districtseasonal Rainfall And Mean Annual In (Mm) 2005 – 2014

Station Name	Winter (Jan – Feb)	Suimmer (Mar – May)	south west (Jun – Sep)	north east (Oct – Dec)	Mean annual
Adhirampattinam	70.00	201.50	241.70	646.40	1159.60
Aduthurai	52.90	143.90	226.10	746.50	1169.40
Grand anicut	28.00	166.10	344.00	502.70	1040.80
Kumbakonam	41.10	111.50	282.00	698.90	1133.50
Orathanadu	61.40	192.40	446.90	734.50	1435.20
Neduvasal	65.00	146.60	315.40	508.80	1035.80
Papanasam	45.10	116.80	244.80	723.90	1130.60
Pattukkottai	67.60	190.80	246.20	630.10	1130.60
Peravoorani	70.40	153.00	223.40	531.40	978.20
Thiruvaiyaru	30.80	109.30	212.70	540.90	893.70
Thirukattupalli	30.10	144.70	222.70	518.70	916.20
Vallam	35.40	141.50	215.50	627.10	1019.50

The mean annual rainfall distribution is show in Figure – 7. The rainfall amount varies from 893.7 mm in Thiruvaiyaru to 1435.2 mm in Orathanadu. Very low rainfall received in Thirukkattupalli, Thiruvaiyaru and Peravoorani and the low rainfall received in Grand Anicut, Vallam and Neduvasal. The moderate rainfall received in Kumbakonam, Papanasam and Pattukottai. The high rainfall received in Aduthurai and Adhirampattinam. The very high rainfall received in Orathanadu. The rainfall decreased from central part of Thanjavur towards south and north western part of the District.

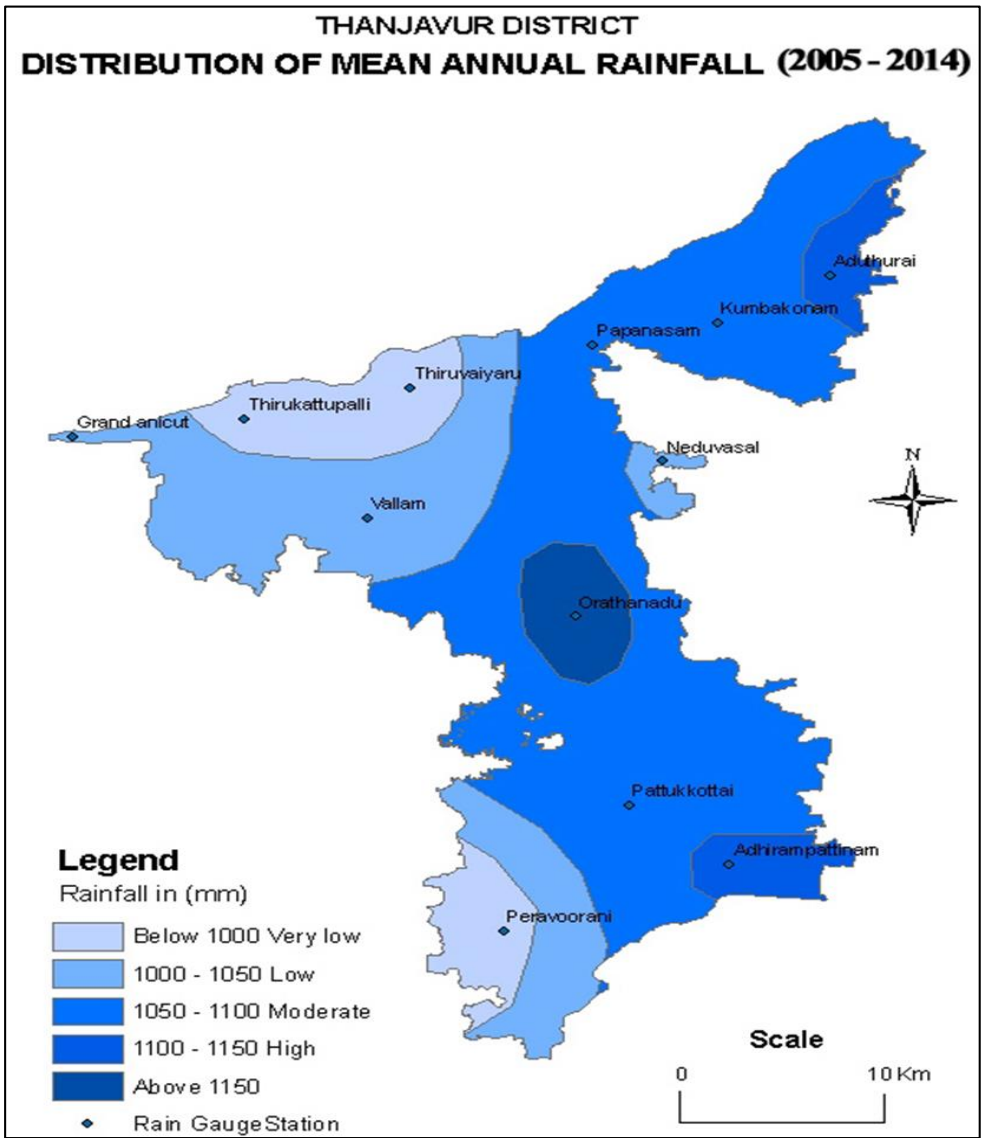

Fig 7

17. Rainfall Variability

The analysis of variability over a period of time is useful because the distribution of rainfall varies from year to year. In general the variability of rainfall and where the variability is less the dependability of rainfall is more the following formula is used to estimate the variability of formula.

$$\text{Rainfall Variability} = \frac{\text{Standard Deviation}}{\text{Mean rainfall}}$$

The co-efficient of rainfall variability is calculated for seasons namely winter, summer, south west monsoon, North east monsoon. Annual rainfall variability is also calculated and analyzed.

a) Rainfall Variability in winter

The winter variability of rainfall ranges between Grand Anicut 144.05 mm to Peravoorani 261.7 mm. (*Table 3*). Very low variability received in Aduthurai and Grand Anicut low variability received in Kumbakonam, Papanasam, Thiruvaiyaru and Thirukkattupalli, Moderate rainfall received in Pattukottai and Adhirampattinam, High variability received in Vallam, Orathanadu and Neduvasal. Very high variability received in Peravoorani rainfall increased from north to southern part of the Thanjavur district (Figure – 8).

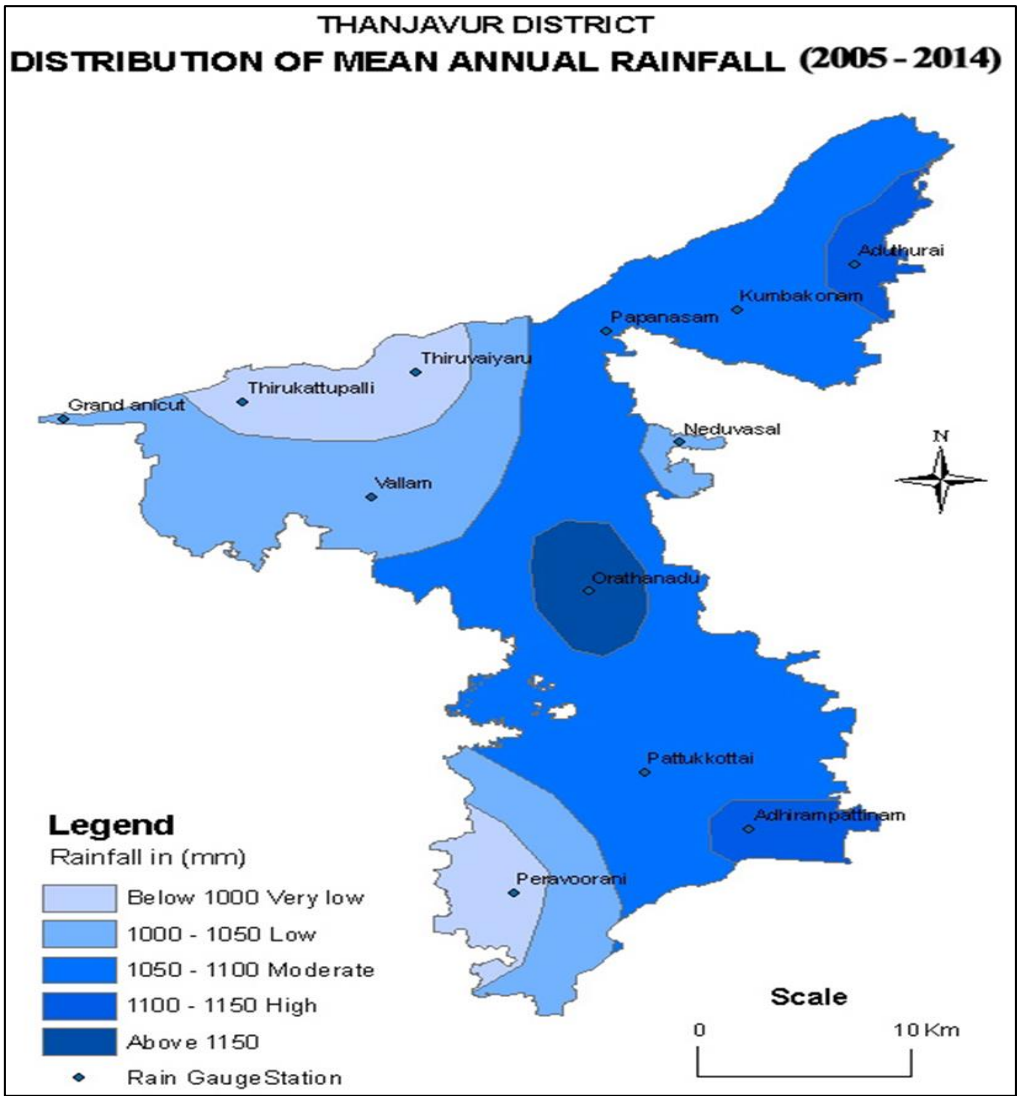

Fig 8

Table 3: Thanjavur districtprecipitation ratio and variability of mean Annual and seasonal rainfall in (%)2005 – 2014

Station Name	Precepitation Ratio	Winter (Jan – Feb)	Suimmer (Mar – May)	South West (Jun – Sep)	North East (Oct – Dec)	Mean Annual
Adhirampattinam	74.00	161.10	35.90	17.70	29.08	23.90
Aduthurai	58.80	147.40	61.60	30.40	23.60	86.60
Grand anicut	91.20	144.05	46.20	34.90	40.90	77.80
Kumbakonam	74.50	153.90	66.50	30.60	29.60	100.60
Orathanadu	111.40	177.60	65.90	32.30	49.20	72.80
Neduvasal	106.50	172.02	118.60	51.70	41.20	72.30
Papanasam	51.80	152.80	81.50	37.70	23.10000	100.70
Pattukkottai	583.20	161.70	43.09	83.90	21.05000	81.50

Peravoorani	68.00	261.70	53.60	44.90	36.08000	83.40
Thiruvaiyaru	76.90	154.70	68.30	35.09	35.90000	94.50
Thirukattupalli	118.40	155.90	60.80	44.70	43.00000	82.80
Vallam	139.70	176.90	89.00	63.30	50.70000	95.90

b) Rainfall variability in summer

The pattern of distribution of rainfall variability during summer season is shown in figure. The summer variability of rainfall ranges between Adhirampattinam 35.9 mm to Vallam 89 mm (*Table 3*).Very low rainfall variability received in Adhirampattinam, low variability of rainfall received in Grand Anicut, Moderate rainfall variability received in Peravoorani, High rainfall variability received in Aduthurai and Very high rainfall variability received in Papanasam, Neduvasal and Vallam. The variability of rainfall increases from to south to north (Figure-9).

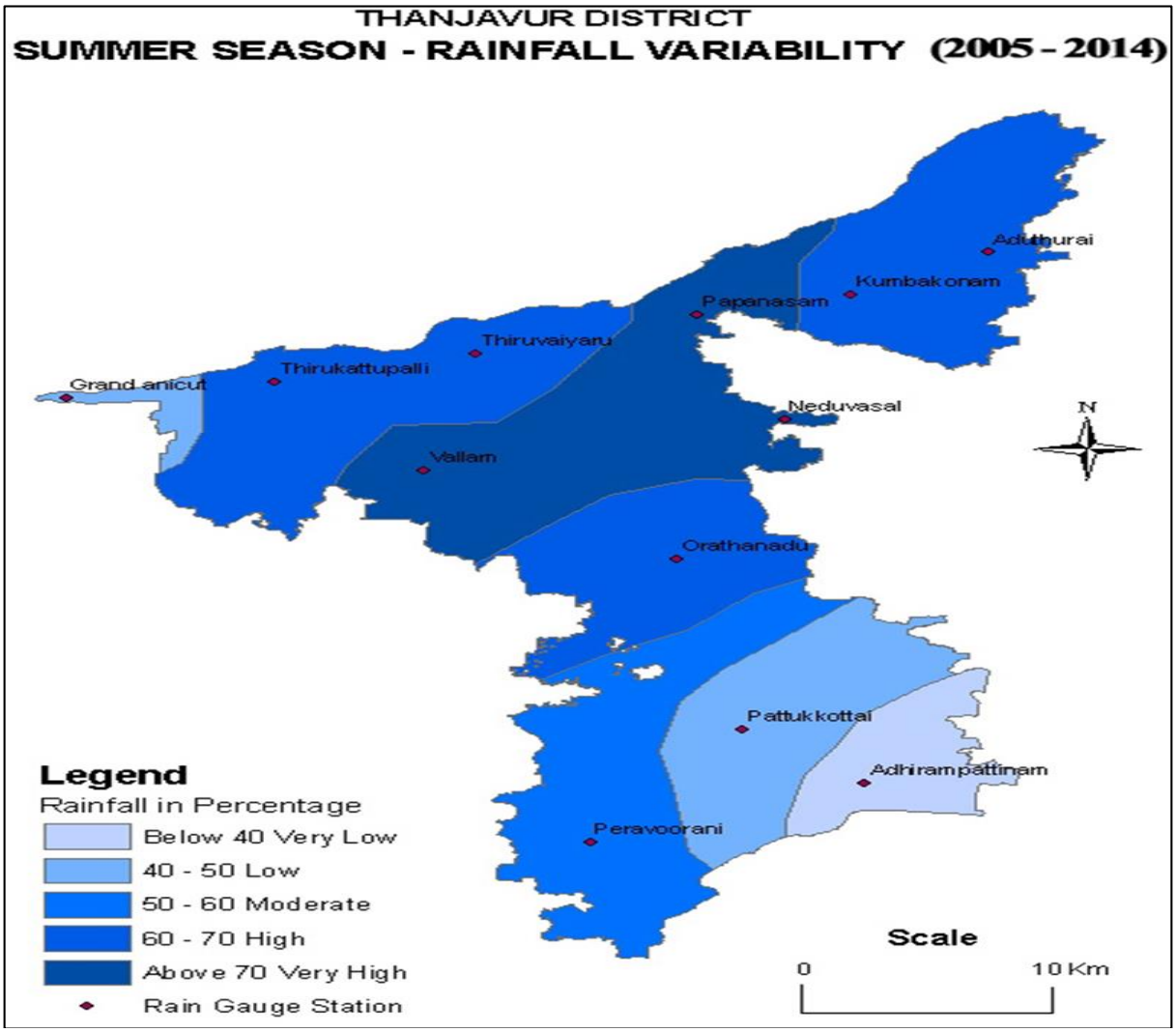

Fig 9

c) Rainfall variability in south west monsoon

The spatial variation in the figure-10 shows variability of south west monsoon. When compare the variability of rainfall to other season, the variable value is very low in south west monsoon season. The variability is very low in Adhirampattinam 17.75 mm, (*Table 3*). The high rainfall variability found along Pattukottai 83.9mm, very low variability received in Adhirampattinam, low rainfall variability received in Aduthurai. Moderate variability received in Kumbakonam, Papanasam, Thiruvaiyaru, Orathanadu and Grand Anicut. High variability received in Thirukkattupalli and Peravoorani. Very high variability received in Vallam, Neduvasal and Pattukottai. North and south eastern part have low variability in the district.

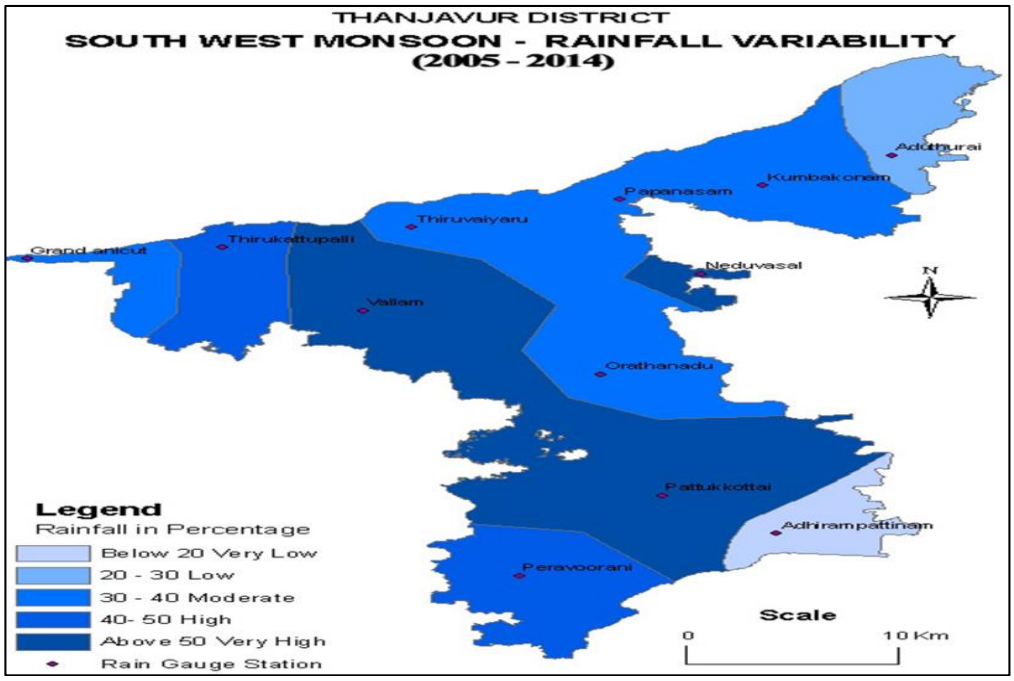

Fig 10

d) Rainfall variability in north east monsoon

The pattern of distribution of rainfall variability during North East monsoon season is depicted in (figure 11) the high variability received in Orathanadu (49.2) and Thirukkattupalli 43 and Vallam (50.7) (Table 3).

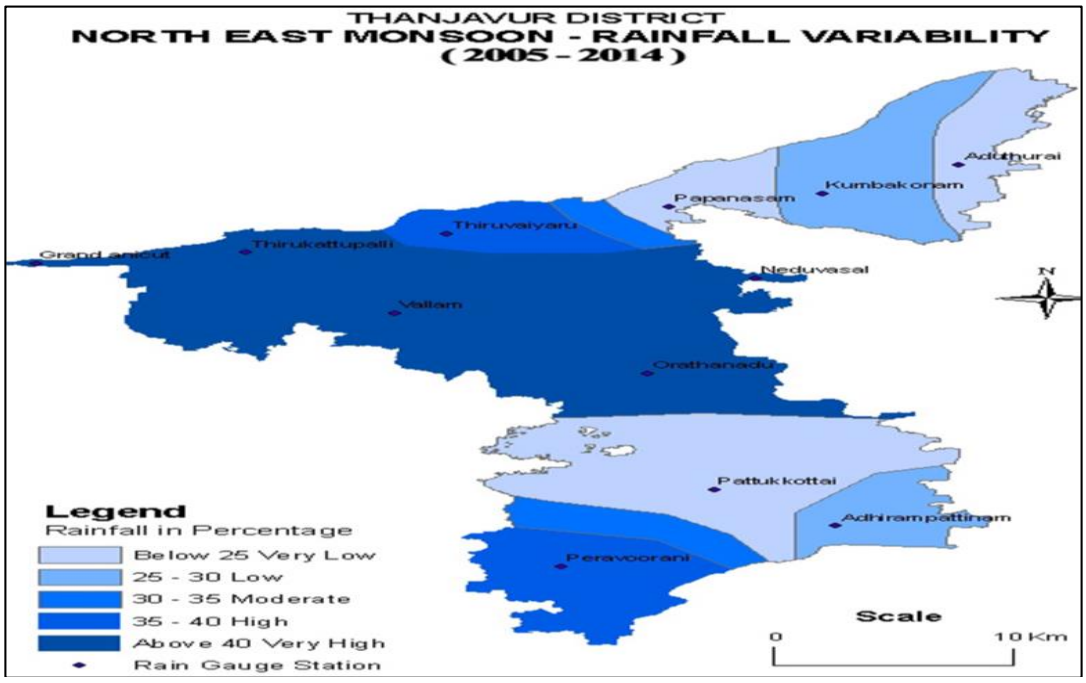

Fig 11

The pattern of distribution of rainfall variability during North East monsoon season is depicted in figure – 11. The variability is very low in Pattukottai 21.05 mm. The variability is high in Vallam 50.7 mm. Very low variability received in Aduthurai, Papanasam and Pattukottai, Low variability received in Kumbakonam and Adhirampattinam. High variability received in Thiruvaiyaru and Peravoorani. Very high rainfall variability received in Thirukkattupalli, Grand Anicut, Vallam and Orathanadu. The variability is decreased from central to north and south.

e) Mean annual rainfall variability

The mean annual rainfall variability ranges between Adhirampattinam 23.9mm to Kumbakonam 100.6mm and Papanasam 100.7mm (Table 3). Very low variability received in Adhirampattinam, moderate variability received in Neduvasal and Orathanadu, high variability received in Aduthurai, Thirukkattupalli, Thiruvaiyaru, Grand Anicut Vallam, Pattukottai and Peravoorani. Very high variability received in Papanasam and Kumbakonam. When compare the southern part to northern part, the northern part of the district have high rainfall variability (Figure-12).

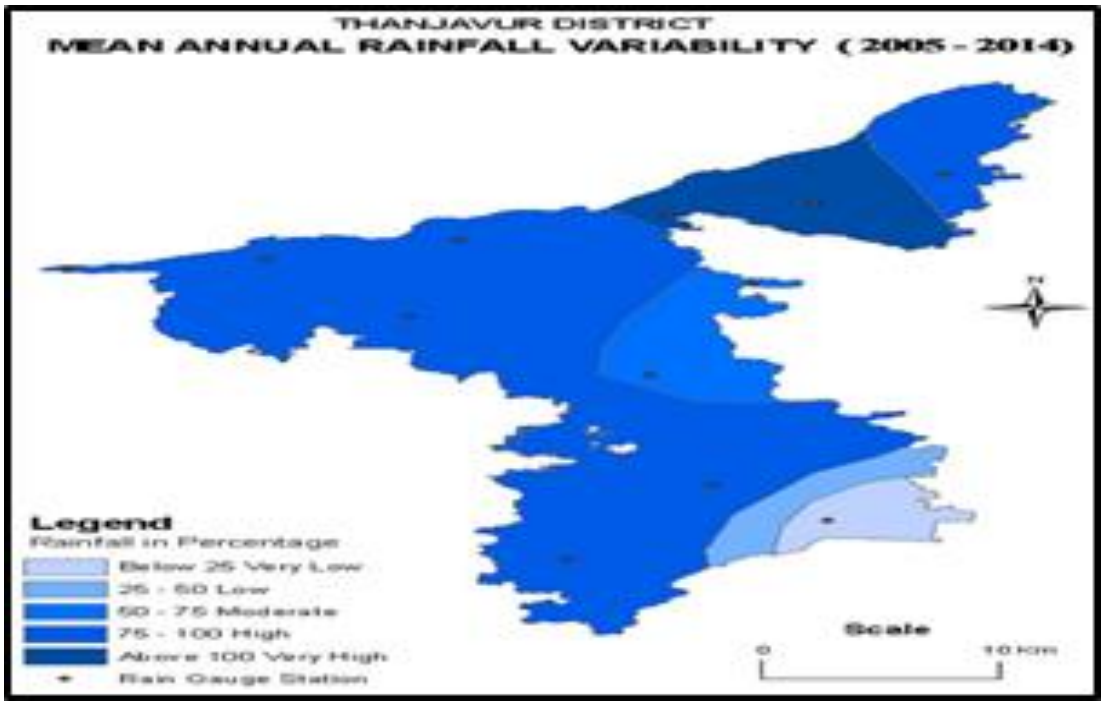

Fig 12

18. Conclusion

Changes in temperature and rainfall in developing countries did not receive enough concern globally and locally even though these countries suffer serious environmental, agricultural and water resources problems. Jordan is one of the ten most well known countries with the lowest levels of water resources and faces severity in water shortage. By the year 2025, it is expected that Jordan will be in the category of having an absolute water shortage. Rain in Jordan is the only assured renewable water source. Rain-fed agriculture in Jordan is the most important mode of employment and food production.

The Rainfall data for 10 year for 12 Rainguage station in and around Thanjavur District have been collected the mean monthly and mean annual are presented. In Thanjavur district North east monsoon season is the main season for rainfall. However the north east monsoon contribules 54.9 percent of the amount of rainfall. However the north east monsoon contribules 54.9 percent of the amount of rainfall of rainfall to the district. The maximum rainfall of 1435.2mm receives in Orathanadu station. The moderate rainfall is recorded in three stations vallam and Grand Anicut. The low rainfall in Thiruvaiyaru.

Winter rainfall received only percent of the total amount of rainfall. The occurrence of rainfall in winter is due to the influence of posts monsoon season Grand Anicut receives 28mm of rainfall. This is the lowest amount of rainfall in the district. Highest amount of rainfall received in Peravoorani 70.4mm. and Adhirampattinam (70mm) also. The summer highest rainfall received in Adhirampattinam 201.5mm. The lowest rainfall 111.5mm recorded in Kumbakonam. During south west and north east monsoon period it gets enough rainfall generally the rainfall is dependable. The agriculturalists can rely on the rainfall for their various agricultural activities.

The district receives percent of rainfall during this season. It is mainly associated with south west monsoon winds elevation of topography. During this season the rainfall of different station between lowest of 212.7mm recorded at Thiruvaiyaru and highest of 446.9mm at Orathanadu. The rainfall characteristic of summer is totally reversed in the south west monsoon period a major portion of district influenced the high rainfall.

The North east monsoon period gets rainfall throughout district. During this season the district receives. The pattern of distribution of rainfall clearly shows that the decreasing trend is from. The high rainfall is recorded during this season is due to depressions formed in the Bay of Bengal. This area receive more rainfall zone of north east monsoon. During south west and North east monsoon period it gets enough rainfall. The annual variability of district varies between 23.9 to 102-6 percentage. The highest variability recorded in Kumbakonam and Papanasam. The lowest annual variability recorded in Adhirampattinam.

The winter variability of rainfall ranges between 129.7 in Kumbakonam to 261.7 in Peravoorani. The highest variability recorded in Peravoorani, Orathnadu, Vallam. The lowest variability covering Aduthurai, Grand Anicut region.

The summer variability ranges from 35.9 to 118.6 percentage of rainfall. It shows the high variability. The lowest variability found in Adhirampattinam, Grand Anicut and Pattukottai. The south west monsoon variability varies from 17.75 to 83.9 percentages. The highest variability found in Pattukkottai 83.9 the lowest variability found in Adhirampattinam. 17.75. The North East Monsoon variability varies between 18.4 to 50.7. highest variability found in Vallam.

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