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High/low rainfall domain mapping using GIS at Salem district, Tamil Nadu, India

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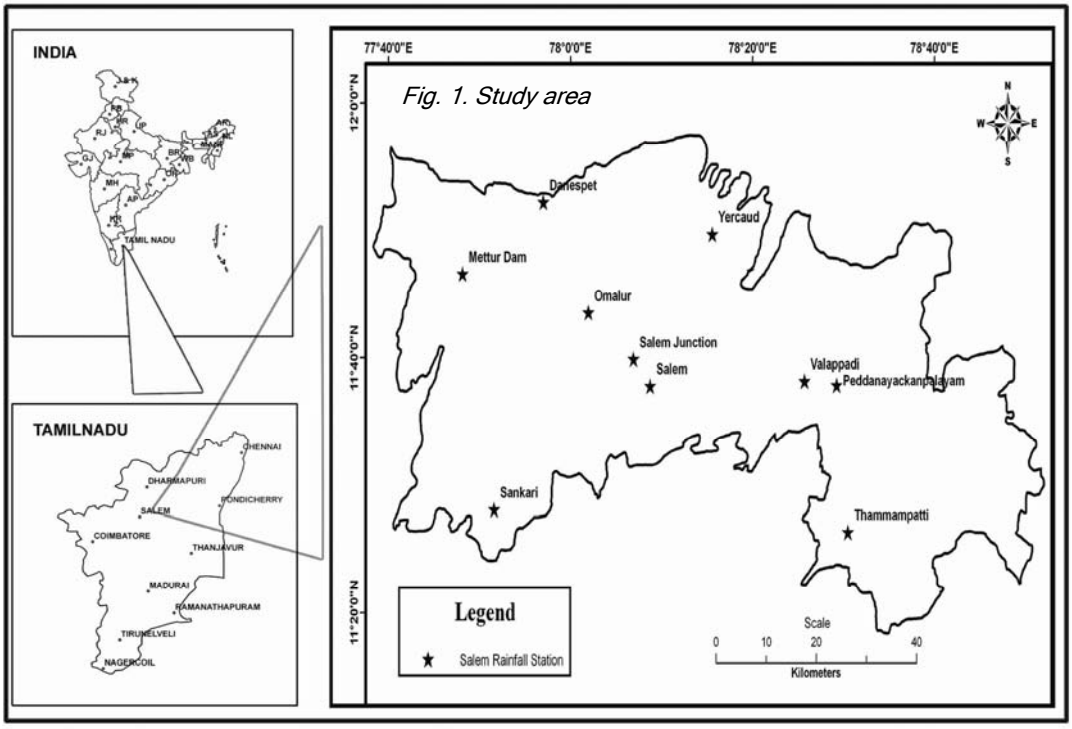
Abstract

In the present study, an attempt has been made to understand the rainfall fluctuation with respect to spatial distribution in Salem district of Tamil Nadu through GIS Technique. To achieve the aim, rainfall variations during winter (Jan. & Feb.), summer (Mar. to May), southwest monsoon (Jun. to Sep.) and northeast monsoon (Oct. to Dec.) were analyzed for the period 1998 to 2007. These results were taken into GIS platform to prepare the spatial distribution maps. The spatial distribution maps of Southwest- and Northeast- monsoon season showed that 1775.65 Km^2 and 430.48 Km^2 of the study area received above 400 mm of rainfall during the respective monsoon seasons. Annual average rainfall spatial distribution map for the years 1998-2007 revealed that 3808 Km^2 of the study area falls under less than 200 mm (poor category) of rainfall. It shows the annual average rainfall distribution is very low in the study area. The high rainfall domain occupies only 8.15 and 33.62% of the study area.

Keywords: GIS, PWD, Spatial distribution, monsoon season, rainfall, Tamil nadu.

Introduction

The study of rainfall pattern is very important for the agricultural planning of any region. Monsoon depressions and cyclonic storms are the most important synoptic scale disturbances which play a vital role in the space- time distribution of rainfall over India (Sikka, 1977). Water is the renewable resource and the per capita availability in India is fairly good. Present study area receives only two seasonal rains but sometimes the seasonal rainfall becomes inadequate. During such times the domestic, agricultural and industrial requirements are met by increased in sub-surface water. Since groundwater is a major drinking water resource and critical for irrigation in all parts of the world, evaluating and predicting the availability and accessibility of groundwater under changing boundary conditions is one of the central tasks in integrated water resources management (IWRM) (Villholth, 2006; Holman, 2006). IWRM with respect to groundwater has two main objectives namely to provide water in sufficient quantity and quality equitably to different consumers and at the same time to maintain and guarantee a sustainable qualitative and quantitative status of the groundwater resource itself (Hiscock *et al.,* 2002). A 'good status' of groundwater refers to its function in water supply (drinking water, irrigation, industrial use etc.) but also to its role as a long term reservoir to sustain aquatic ecosystems (wetlands) and to provide a source of discharge in dry periods.



Study area

Salem is an interior district of Tamil Nadu in India with an area of 8634.23 Km^2 (Fig.1) and is bounded by Dharmapuri district on the North, Coimbatore on the West, South Arcot on the northeast and

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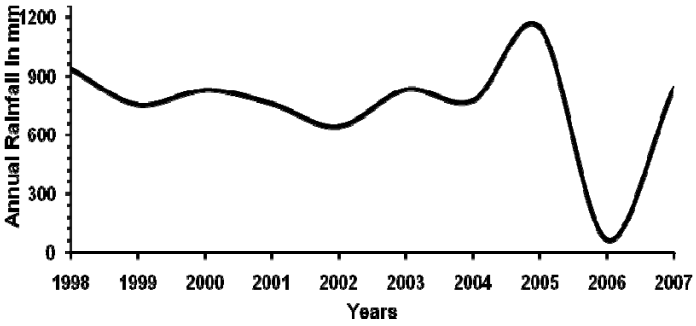
Table 1. Average annual rainfall data in mm (1998-2007) for Salem district

Years	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Rainfall in mm	935.71	755.29	829.27	760.95	643.08	832.34	775.95	1152.94	62.39	842.34

Fig. 2. Fluctuation graph of rainfall data for the Period of 1998-2007 in Salem district



Tiruchirapalli on the South and South-West. The district lying between latitudes N 11°00' and 12°00 and longitudes E 77°40' and 78°50'. The major source for groundwater in the study area is rainfall during monsoonal season. The average 10 years annual rainfall is about 759.03 mm.

Table 2. Average annual seasonal rainfall data of the study area in mm (1998 -2007)

Stations	Winter	Summer	Southwest monsoon	Northeast monsoon
Salem	1.27	164.30	440.60	319.01
Junction	0.84	157.37	421.75	286.74
Yercaud	13.4	260.54	667.08	502.95
Valappadi	0.96	117.52	270.96	293.37
Thammampatti	7.08	138.74	334.81	413.59
Peddanaicken-palayam	1.40	81.97	266.23	367.87
Mettur Dam	8.05	201.30	356.08	332.40
Omalur	4.48	190.12	420.48	330.68
Danespet	1.40	194.85	415.13	249.79
Sankari	1.52	133.70	220.84	254.34
Average	4.32	167.41	399.24	344.04

Methodology

The daily rainfall data were collected from statistical department, Govt. of Tamil Nadu and converted into average seasonal rainfall like winter (Jan. & Feb.), summer (Mar., Apr. & May) and southwest (Jun., Jul., Aug. & Sep) and northeast (Oct., Nov. & Dec.) monsoon seasons.

From the above data, the average annual rainfall for the last ten years (1998-2007) was calculated for ten rainfall stations *viz*. Salem, Junction, Yercaud, Valappadi, Thammampatti, Peddanaickenpalayam, Mettur Dam, Omalur, Danespet and Sankari in the study area. Based on the data, month wise and seasonal wise average rainfall was derived. Finally the annual average rainfall was interpreted. To find out the spatial distribution of the rainfall variation in the study area, GIS was employed. The rainfall location was digitized and the corresponding values (Average winter, summer, southwest, northeast and annual average rainfall) of its attributes were given as an input. Using this data, the interpolation raster maps were generated. Subsequently, these maps were classified with respect to our interest and converted into vector maps. These maps were clipped with the boundary to arrive within the boundary of the study area.

Result and discussion

10 years (1998-2007) data were collected from statistical department wing (PWD) Govt. of Tamil Nadu and were interpreted (Table 1 & Fig. 2). High rainfall noticed in 2005, lowest rainfall noticed in 2006. The average southwest monsoon rainfall is 399.24 mm and average northeast monsoon rainfall is 344.04 mm. In summer and winter season, the average rainfall is noticed as 167.41 mm and 4.32 mm respectively. Average annual rain fall is of 759.03 mm.

Out of ten rainfall stations, Yercaud showed a good response of rainfall. Three stations namely Salem, Junction and Omalur show a moderate rainfall as the other seven stations, namely Valappadi, Peddanayackanpalayam, Thammampatti, Mettur Dam, Danespet and Sankari show a poor rainfall.

GIS results

It is an analytical technique associated with the study of locations of geographic phenomena together with their spatial dimension and their associated attributes (like table analysis, classification, polygon classification & weight classification). The winter, summer, southwest monsoon, northeast monsoon and annual average rainfall thematic maps as described above have been converted into raster form considering 30m as cell size to achieve considerable accuracy. These were then reclassified and assigned suitable weightage and spatial distribution results (Table 3). The results of winter season, summer season, southwest monsoon season, north east monsoon and average annual rainfall data for the period 1998-2007 Were used and the spatial distribution maps. GIS spatial distribution maps and its results are given in Fig. 4-8 and Table 3. The winter season GIS map reveals that all locations are having less than 200 mm rainfall noticed in the study area and were classified as poor class category (Fig. 4). Summer season GIS image reveals that spatially 4861.68 Km^2 area falls in the poor class category and 420.58 Km^2 area falls in the moderate class category (Fig. 5). The southwest monsoon GIS map (Fig. 6) reveals that spatially 1775.65 Km^2 area falls in the good

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Fig. 3. Season wise graph of rainfall for the period -1998 to 2007

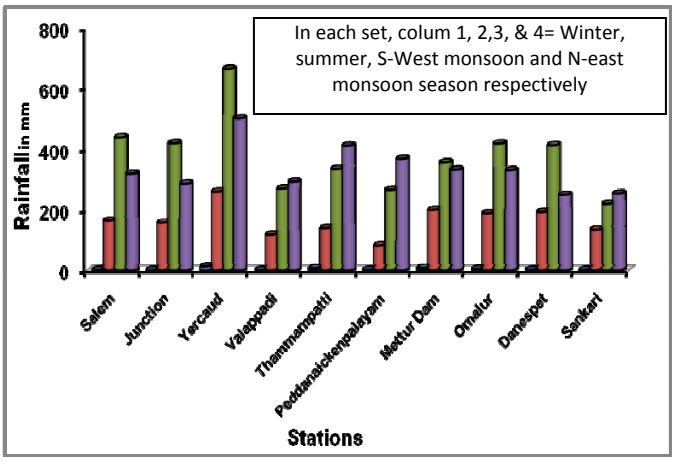


Fig.4. Annual average rainfall winter season - Spatial distribution map

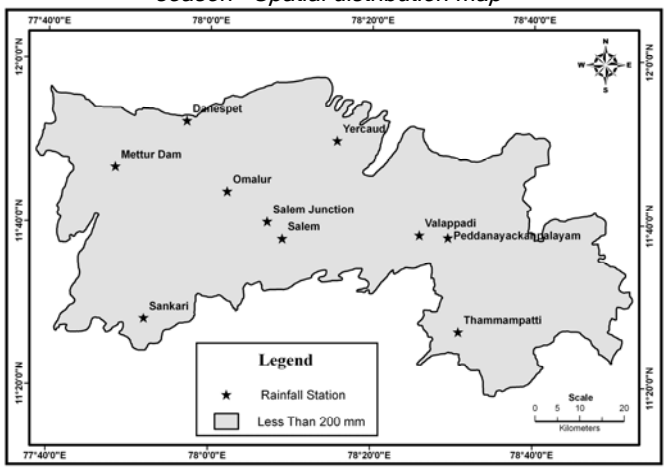


Fig.5. Annual average rainfall summer season - Spatial distribution map

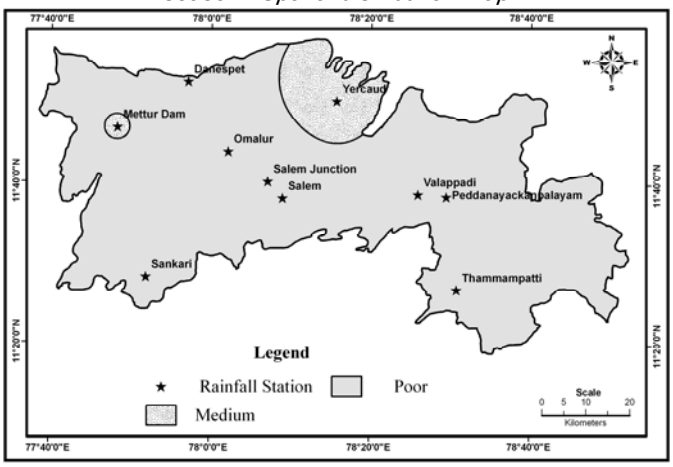


Fig.6. Annual average rainfall southwest monsoon season - Spatial distribution map

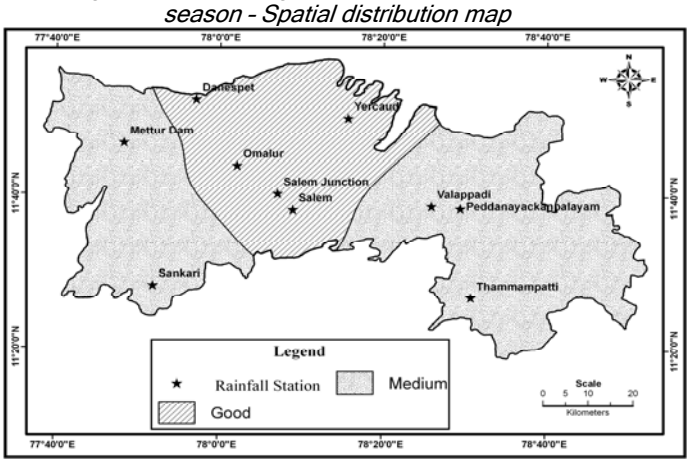


Fig.7. Annual average rainfall northeast monsoon season - Spatial distribution map

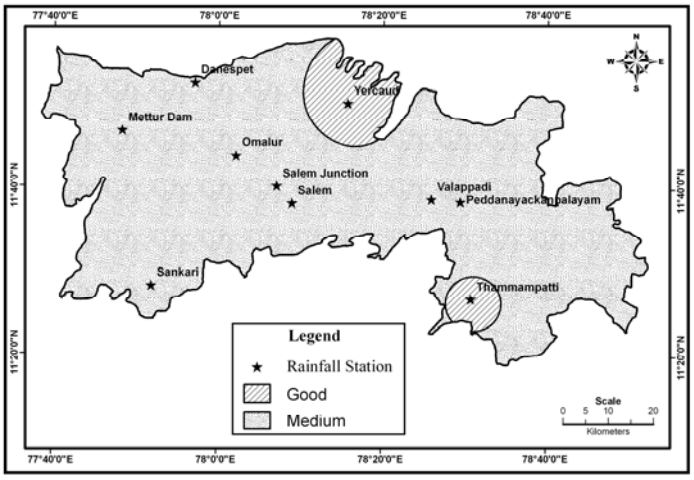
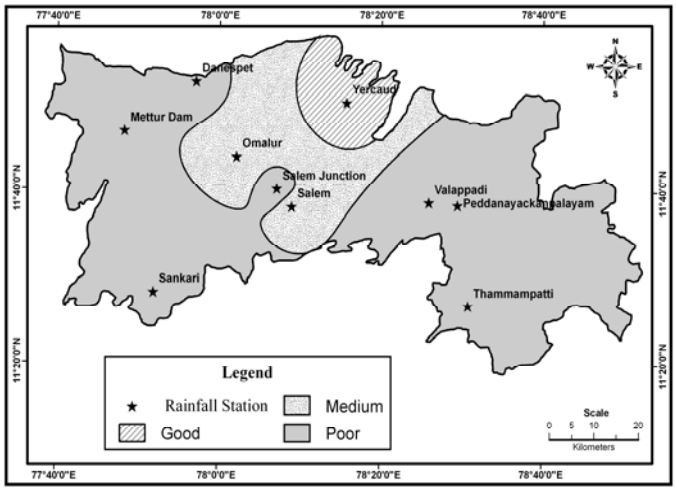


Fig.8. Annual average rainfall in 1998 to 2007 - Spatial distribution map



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class category and 3506.61 Km^2 area falls in moderate class category. Northeast monsoon GIS image reveals that spatially 430.48 Km^2 areas falls in the good class category and rest of the area 4851.77 Km^2 area falls in moderate class category. Average annual rainfall spatial distribution result shows that spatially 363 Km^2 areas fall in good class category, 1110.41 Km^2 area fall in moderate class category and rest of the area 3808 Km^2 fall in poor class category.

Table 3. Average seasonal rainfall data spatial distribution results

Rainfall seasons	Class Category	Area in km^2	Area in %
Winter	Good	-	-
	Moderate	-	-
	Poor	5282.26	100
Summer	Good	-	-
	Moderate	420.58	7.96
	Poor	4861.68	92.04
Southwest monsoon	Good	1775.65	33.62
	Moderate	3506.61	66.38
	Poor	-	-
Northeast monsoon	Good	430.48	8.150
	Moderate	4851.77	91.85
	Poor	-	-
Annual average	Good	363	6.870
	Moderate	1110.41	21.02
	Poor	3808.85	72.11

Conclusion

The present study reveals that the use of GIS in spatial analysis for rainfall variation. It shows that higher amount of rainfall for northeast and southwest monsoon seasons spatial distribution is 8.15 and 33.62%. The rest of the region i.e 91.85 and 66.38% for the northeast & southwest monsoon season falls in moderate class category. The study concludes that the Salem district receives meager amount of rainfall over the last ten years.

Acknowledgement

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