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High/Low Rainfall Domain Demarcation Mapping Using Gis at Suruli Watershed, Vaigai Basin, Tamil Nadu, India

KEYWORDS: GIS (Geographic Information System); PWD (Public Work Department); Spatial Distribution; Monsoon Season.

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ABSTRACT *Rainfall analysis is employed to evaluate the season wise rainfall variation of Uttamapalyam and a small part of Periyakulam Taluk, located in the western corner of Madurai District of Tamil Nadu. an attempt has been made to understand the rainfall fluctuation study through GIS Technique. To achieve the aim, the rainfall variations Post-monsoon (January and February), Pre-monsoon (March to May), Southwest monsoon (June to September) and Northeast monsoon (October to December) has been attempted. This paper highlights the rainfall variation with respect to spatial distribution. The rainfall data for the period of 2005 to 2014 were collected in the Statistical Department wing (PWD) Govt. of Tamil Nadu. The rainfall data ware assessed for all the seasons. These results were taken into GIS platform to prepare the spatial distribution maps. The winter season GIS map reveals that all locations are having less than 34 mm rainfall noticed in the study area and were classified as poor class category. Summer season GIS image reveals that spatially 1130.44 Km2 area falls in the poor class category. The southwest monsoon GIS map reveals that spatially 79.25 Km2 area falls in the good class category and 464.83 Km2 area falls in moderate class category. Northeast monsoon GIS image reveals that spatially 1366.80 Km2 areas falls in the low rainfall category. Average annual rainfall spatial distribution result shows that spatially 0.74 Km2 areas fall in good class category, 201.59 Km2 area fall in moderate class category and rest of the area 1375.59 Km2 fall in poor class category.*

INTRODUCTION

Water is a major concern for life and any development and planning activities in the country, there is an increase in water use due to economic and industrial developments. India is a tropical country, it mainly depends on rainfall for the water resources. Groundwater is the readily available fresh water used for drinking, agricultural and industrial purpose. Its availability depends on rainfall and recharge conditions. As India is a monsoon reliant country for its major portion of rainfall, it is necessary to analyze the occurrence and distribution of rainfall. In this regard, the detailed study of monthly, seasonal and spatial variation of rainfall for the study area has been analyzed.

The study area is mainly comprises of Archaean complex with Quarternary valley filled sediments. The Archaean formations are metamorphosed Pelitic, Semipelitic, Psammitic and Calcareous rocks namely, Sillimanite and Cordierite bearing gneisses, Garnetiferous gneisses, Quartzites, Calc gneisses and Granulites. They are associated with Charnockites and occasionally gneisses. The high rising mountains composed of the above mentioned rock types have yielded material due to weathering and erosion which have found their way to the valleys and the intermountane basins. They are the valley filled sediments of colluviofluvial origin of Quarternary age.

Table-1
TEN YEARS (2005 – 2014) YEAR WISE ANNUAL RAINFALL DATA IN MM

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Rainfall in mm	816.61	705.7	704.018	659.87	713.51	1069.93	723.55	913.01	909.404	672.87

As perennial water resources are remote, the agricultural activities in the study area are mainly dependent upon the rainfall and ground water resources.

Rainfall is a distinctive variable, which reflects multiple factors locally and globally. The distribution of rainfall depends upon the various factors. Rainfall is being a single most important factor for success of crops in the farming areas. Major parts of India gets rainfall due to Southwest monsoon(June – September), the Northeast monsoon is the returning monsoon from October to December, it pours additional rainfall and apart from conventional rainfall during summer (V.V.Jagannadhasarma, 2005). Rainfall climatology brings out the general pattern and characteristics of rainfall of a particular region (RR.Jegankumar et al., 2012).

In the present study, an attempt has been made to understand the distribution of rainfall in the study area with the objectives of analyzing seasonal and spatial variations in rainfall pattern, frequency distribution of rainfall intensity at various rain gauge stations spread over the study area, and regression analysis Supiah Shamsudin and Aalisu Dan'azumi, 2015.

STUDY AREA

The Sureli Ar watershed of Vaigai basin location of whole Taluk of Uttamapalyam and a small part of Periyakulam Taluk, located in the western corner of Theni district of Tamil Nadu. It lies between 9°34' 11" N to 10°09'17" N lati-

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tudes, and 77°10'5"' E to 77°36'5" E longitudes covering an area of 1577.92 Sq. km out of which plain area covers 1008.10 Sq. km and Hilly with Forest area covers 569.82 Sq. km (Fig.1).

This is a linear valley located at the Catchment zone of the river Sureli Ar of Vaigai basin. Sureli Ar is located in the watershed situated amidst the hills that comprise the eastern arm of Western Ghats. The area around Sureli Ar is

diversified by several ranges of hills, falls and rapids which impart to the region a picturesque appearance. The prominent mountain of the thesis area is the high wavy mountain and it is flanked on either side by hills. In the eastern portion, there is an intermountain valley called the Varshanad valley.

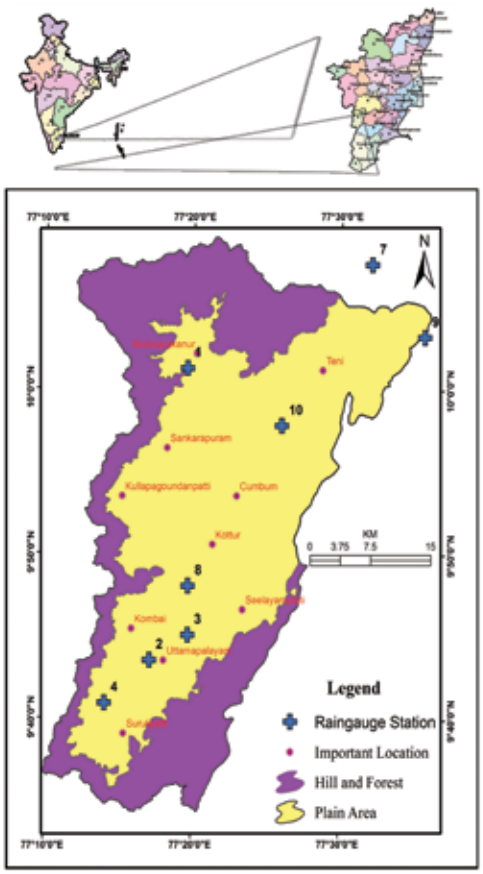

Figure 1: Key Map of Study Area

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 (2005–2014) was calculated for ten rainfall stations viz. Bodinayakanur, Cumbum, Gandamanaickanur, Gudalor, Manjalar Dam, Mailadumparai, Periyakulam, Uthamapalayam, Vaigai Dam and Veerapandi in the study area.

TABLE-2
TEN YEARS (2005 – 2014) AVERAGE ANNUAL SEASONAL RAINFALL
DATA IN MM

Stations	Winter Season	Summer Season	Southwest Monsoon	Northeast Monsoon
Bodinayakanur	39.13	188.36	113.35	327.13
Cumbum	29.12	169.48	168.21	368.55
Gandamanaickanur	22.60	171.60	197.27	383.50
Gudalor	33.30	190.75	265.27	342.81
Manjalar Dam	27.19	223.95	245.69	380.59
Mayiladumparai	48.70	181.70	155.80	502.29
Periyakulam	52.12	300.23	210.50	499.33
Uthamapalayam	31.40	165.38	171.25	394.07
Vaigai Dam	34.51	160.17	123.36	276.67
Veerapandi	31.14	208.58	136.13	317.29
Average	34.92	196.02	178.68	379.22

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

Rainfall Data Interpretation

Ten years rainfall data (2005 – 2014) were collected from Public Work Department (PWD) and were interpreted (Table 1 and Fig. 2). It was found that the average Northeast monsoon rainfall was to be 379.22 mm and average Southwest monsoon rainfall was to be 178.68 mm. In summer and winter season, the average rainfall was noticed as 196.02 mm and 34.92 mm respectively. Average annual rainfall is 788.85 mm.

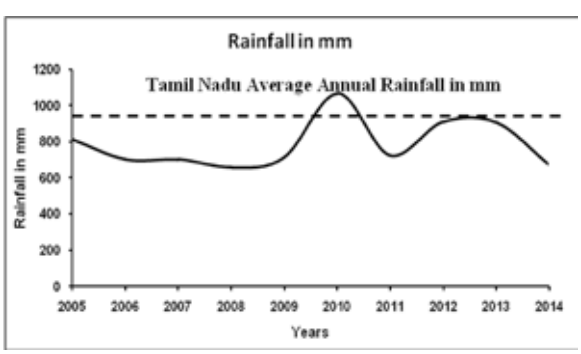

Figure 2: Annual Average Rainfall in mm

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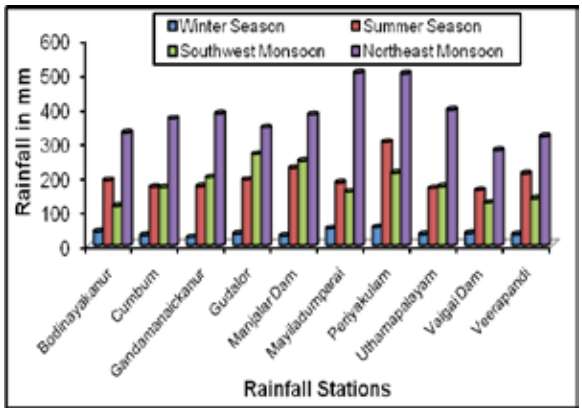

Figure 3: Season wise graph of Rainfall data for the Period of 2005 – 2014

10 years (2005–2014) data were interpreted results (Table 1 & Fig. 2). High rainfall noticed in 2010, lowest rainfall noticed in 2014. Average annual rain fall is of 788.85 mm. Season wise rainfall Table 2 and Fig. 3 reveals that high rainfall received in northeast monsoon 379.22 mm, the second dominant season is summer season 196.02 mm. In southwest monsoon season is the next highest rainfall season 178.68 mm and winter season is the lowest rainfall received in the study area 34.92 mm.

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 and weightage classification).

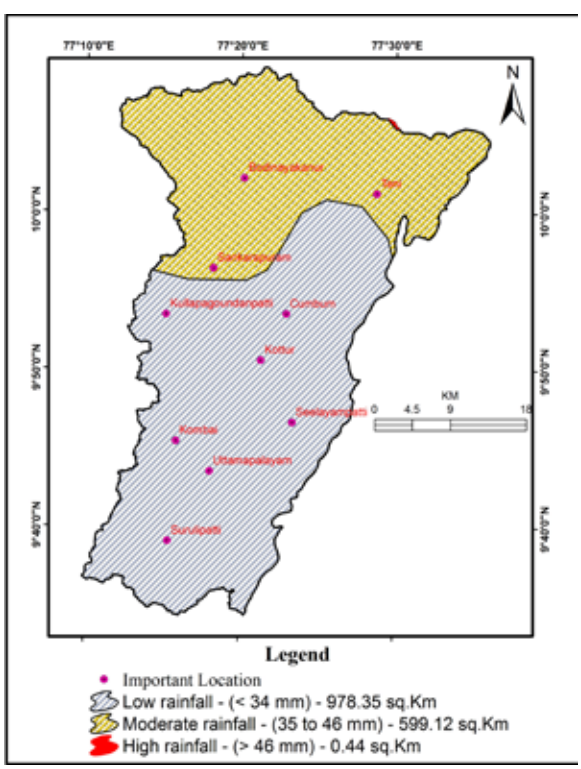

Figure 4: Winter season rainfall spatial distribution map

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 maps were derived.

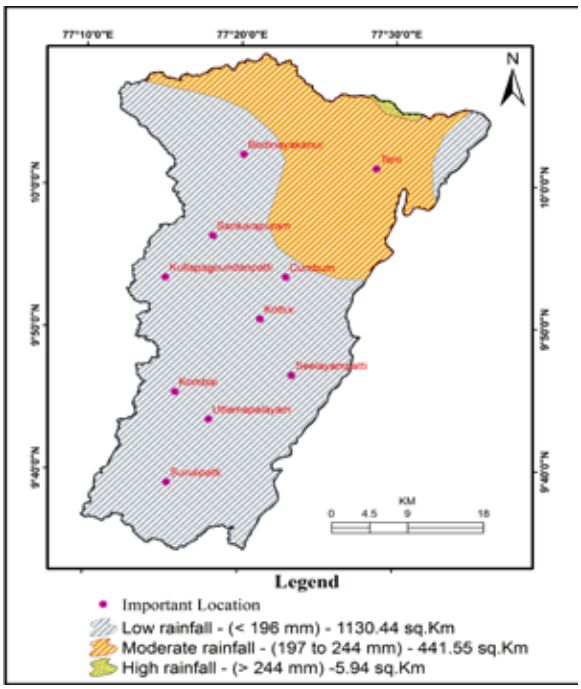

Figure 5: Summer season rainfall spatial distribution map

The results of winter, summer, southwest monsoon, northeast and annual average rainfall for the period 2000-2009 GIS spatial distribution maps are shown in Figs. 4 to 8.

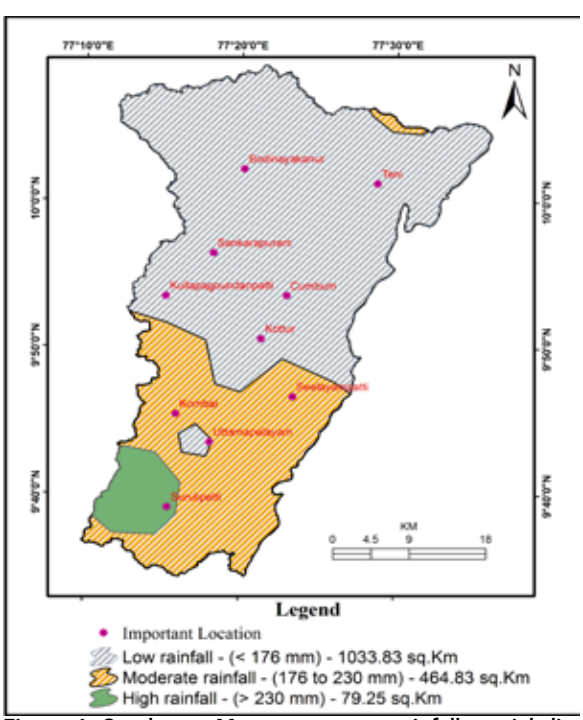

Figure 6: Southwest Monsoon season rainfall spatial distribution map

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By taking average annual and seasonal rainfall values spatial distribution map have been prepared using Geographic Information Software (GIS) for understanding the spatial behaviour of rainfall intensity over the study area (Subramani, 2013).

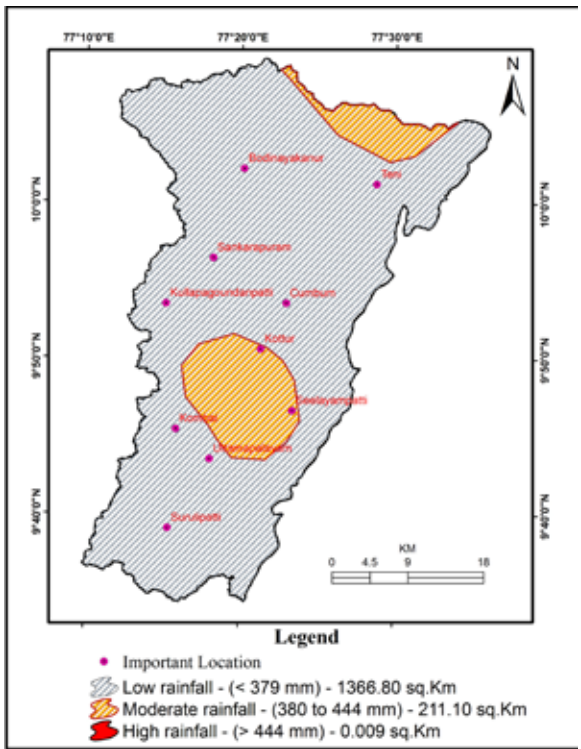

Figure 7: Southeast Monsoon season rainfall spatial distribution map

It is observed from Figures 5 to 9 that the isohyetal maps of Pre-monsoon, NE monsoon and annual rainfall are similar and spatial distribution of rainfall shows a unique pattern in chalk hill area and also it indicates that Southwest region gets more rainfall than the Northeast part of the study area during Pre monsoon and North-east monsoon periods, the western part of the study region gets more rainfall than the eastern part during Southwest and Post monsoon periods (Sahu, 2003).

fall in good class category, 201.59 Km^2 area fall in moderate class category and rest of the area 1375.59 Km^2 fall in poor class category.

CONCLUSION

The rainfall data interpretation during the years 2005 to 2014 reveals the rainfall pattern and it is widely fluctuating. Average annual rainfall varied from 659.87 mm to 1069.93 mm. The lowest rainfall was noticed in the year 2008. The highest rainfall recorded in the year 2010. The highest average seasonal rainfall observed during northeast monsoon about 379.22 mm. The lowest average seasonal rainfall noticed in winter season is 34.92 mm respectively. The rainfall data spatial distribution maps reveal that high rainfall was

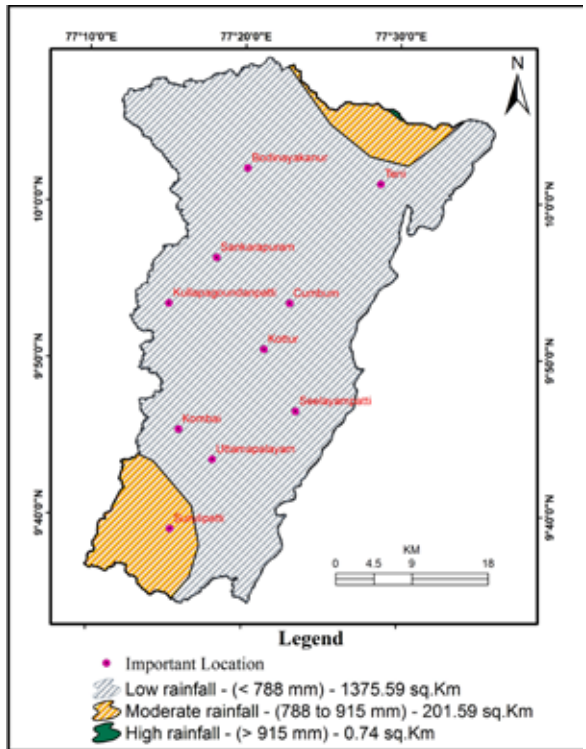

Figure 8: Annual average rainfall spatial distribution map

The winter season GIS map reveals that all locations are having less than 34 mm rainfall noticed in the study area and were classified as poor class category (Fig. 4). Summer season GIS image reveals that spatially 1130.44 Km^2 area falls in the poor class category and 5.94 Km^2 area falls in the high rainfall category (Fig. 5). The southwest monsoon GIS map (Fig. 6) reveals that spatially 79.25 Km^2 area falls in the good class category and 464.83 Km^2 area falls in moderate class category. Northeast monsoon GIS image reveals that spatially 1366.80 Km^2 areas falls in the low rainfall category and rest of the area 211.10 Km^2 area falls in moderate class category. Average annual rainfall spatial distribution result shows that spatially 0.74 Km^2 areas

noticed in small portion of the study area. The rain bearing winds give a great amount of rain to the windward side of the Western Ghats (Kerala state) due to Orographic effects and bring low rainfall to the leeward.

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 79.25 Km^2 with 5%. The rest of the region i.e 1498.67 Km^2 and 95% for the northeast & southwest monsoon season falls in poor category. The study concludes that the Sureli Ar watershed of Vaigai basin receives meager amount of rainfall over the last ten years.

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