

Assessment of Rainfall and Groundwater for Agriculture of Tiruchirappalli District, Tamil Nadu, using Geospatial Technology

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Abstract -Water demand always exceeds rainfall, but the water deficit is quite low in the northeast monsoon period. Hence, due to severe water deficit, drought recurs during the southwest monsoon and also in summer months in Tamil Nadu. In recent decades, the exploitation of groundwater has increased greatly particularly for agricultural purpose, because large parts of the country have little access to rainfall due to frequent failures of monsoon. The aim of the study is to assess the status of rainfall and groundwater for agriculture with the following objectives. to analyze the mean rainfall and groundwater level to associate rainfall and water level during wet, dry and normal years. To assess the rainfall and groundwater for different cropping period. The results were effectively portrayed using simple graphs and thematic maps with the aid of open source GIS software. Tiruchchirappalli district, same name is located in the central part of Tamil Nadu between 78°09'00" - 79°03'00" east longitudes and 10°17'00" - 11°25'00" north latitudes. Where ever the excess rainfall occurrences have observed the groundwater level either goes high or low may caused due to the trend of groundwater utilization over the particular area.

Key words- Rainfall, Groundwater, Cropping Pattern, GIS

I. INTRODUCTION

Tamil Nadu experiences recurrent droughts. The state normally benefits from northeast monsoon rainfall from October to December, unlike other regions of India, which are dominated by southwest monsoon rainfall. In general, four major parameters determine the nature and extent of drought conditions in Tamil Nadu: (1) rainfall, (2) ground water, (3) reservoir levels, and (4) crop conditions. It is estimated that nearly 50% of the districts in the state are drought prone. The state receives nearly 80% of its annual rainfall during the northeast monsoon. During the southwest monsoon period, water demand always exceeds rainfall, but the water deficit is quite low in the northeast monsoon period. Hence, due to severe water deficit, drought recurs during the southwest monsoon and also in summer months in Tamil Nadu. The severity and extent of drought in the state is believed to be the result of aberrations in rainfall, overexploitation of ground water, lower reservoir levels, and crop stress conditions. Red, black, and alluvial soil types predominate in Tamil Nadu, but sandy soils in the southeast part of the state are prone to chronic droughts. The rainfall comprises an important

component of the water cycle and is the prime source of groundwater recharge. In India, the distribution of rainfall however, varies from place to place owing to different physiographic and climatic setting. In recent decades, the exploitation of groundwater has increased greatly particularly for agricultural purpose, because large parts of the country have little access to rainfall due to frequent failures of monsoon. Thus the increasing population and their dependence on groundwater for irrigation are further inducing heavy stress on groundwater resources, leading to the decline of groundwater levels in this region. Out of the total geographical area of Tiruchirappalli District, net area cropped is 1,85,193 Hectares. Out of which about 102799 Ha (55 %) are irrigated and about 82394 Ha (45 %) are rainfed. Based on the foresaid issues, Tiruchirappalli District has been taken for the present study to assess the status of rainfall and groundwater for cropping activity and also an attempt is made to suggest the modification in the cropping pattern wherever necessary.

A. Aim and Objectives

The aim of the study is to assess the status of rainfall and groundwater for agriculture with the following objectives.

- 1) To analyze the mean rainfall and groundwater level
- 2) To associate rainfall and water level during wet, dry and normal years.
- 3) To assess rainfall and groundwater for different cropping period.

B. Data base and Methodology

The mean monthly rainfall data for the 32 years (1980 –2011) have been collected for 13 stations of the study area from Directorate of Economics and Statistics, Chennai. Groundwater level data have been collected for about 60 controlled wells of the district for the period of 10 years between 2002 and 2011 from groundwater department. The data on crops and cropping season have been collected from the Directorate

of Agriculture, Tiruchirappalli District. All the data were processed and assessed using ms excel software using common statistical analysis such as mean, Standard deviation and variability. The results were effectively portrayed using simple graphs and thematic maps with the aid of open source GIS software.

C. The study area

Tiruchchirappalli district, one of the three districts carved out of the composite district of the same name is located in the

central part of Tamil Nadu between $78^{\circ}09'00''$ - $79^{\circ}03'00''$ east longitudes and $10^{\circ}17'00''$ - $11^{\circ}25'00''$ north latitudes. It has a total geographical area of 4403.83 sq.km, which is about 3.40 percent of the total geographical area of the state. It is bounded by Salem district in the north, Namakkal district in the north-west, Karur district in the west, Madurai and Pudukkottai districts in the south and Tanjavur and Perambalur districts in the east. Tiruchchirappalli district, comprising 504 villages has been subdivided into 8 taluks and 14 blocks for administrative convenience shown in Fig.1.



Fig 1 Study Area



Fig 2 Location of Control Wells

E. Results and Discussion

1) Post and Premonsoon water level :

Groundwater level analysis have been done using data collected from 60 controlled wells of the district shown in Fig. 2 and Table 2 summarizes the characterizes of groundwater level over the study Area. The annual average water level shown in Figure 3 and it depicts that the major part of the district comes under the water level between 5 and 14 meter. The mean water level of the Tiruchirappalli district during post monsoon and Premonsoon have been shown in Figure 5 and 6 respectively. During post monsoon groundwater level is higher over the parts of Andanallur, Manikandan and Uppliyapuram blocks where the water level lies within 3 meter from the surface, where as water level lies above 9 meter from the surface over the Tottiyam, Tattaiyanarpet and Thuraiyur blocks found southwest to northeast trend. This is the zone of very low water level always water level exists above 7 meter from the surface. The normal water level range

of the district exist between 5 to 7 meters observed over central and eastern blocks of the district covering entire Thiruverampur, Lalgudi Parts of Andanallur, Musiri and Manachanallur blocks Vaiyampatti and Manaparai blocks also comes under the zone normal water level. Whereas, condition during Premonsoon season, the district reveals the same pattern of water level. Notably the water level goes even above 12 meter during the month of May and nowhere water level exist above 4 meter in the district. The normal water table of the district ranges between 7 to 10 meter. In general, pattern of water level over the district exhibits higher structural control rather than climatic control. Water level during post monsoon period of the normal year shown in Figure 7 which reveals that the water level over the major parts of the district goes below 11 meter and even below 17 meter except Vaiyampatti, Manaparai, Manikandan, Thiruverampur and Andanallur blocks where the groundwater lies within 6 meter from the surface.

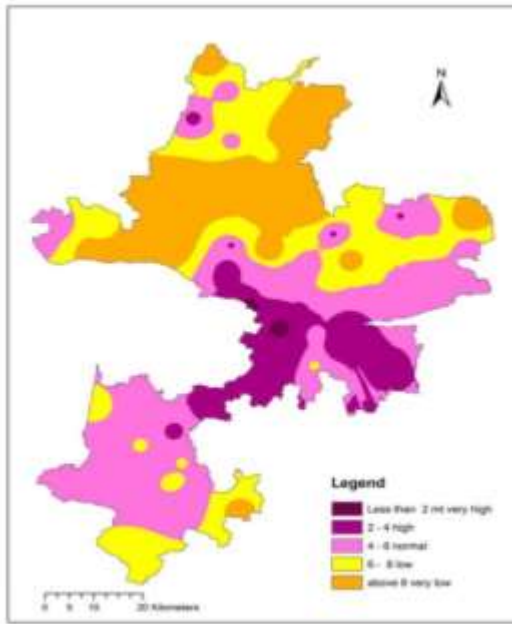


Fig. 3 Mean Annual Groundwater Level

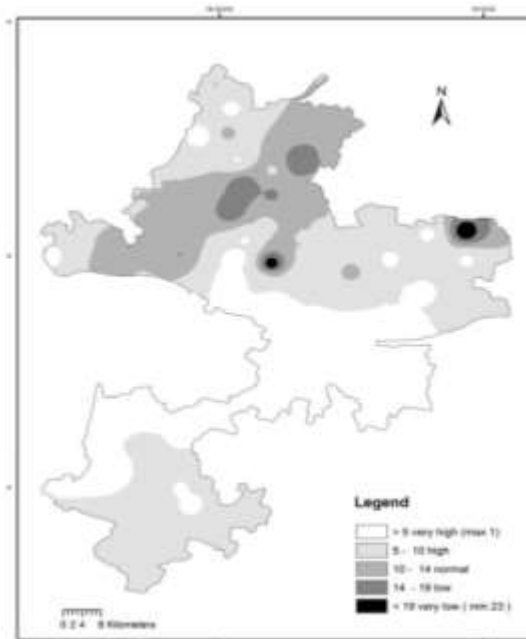


Fig. 4 Groundwater Level of Normal Year

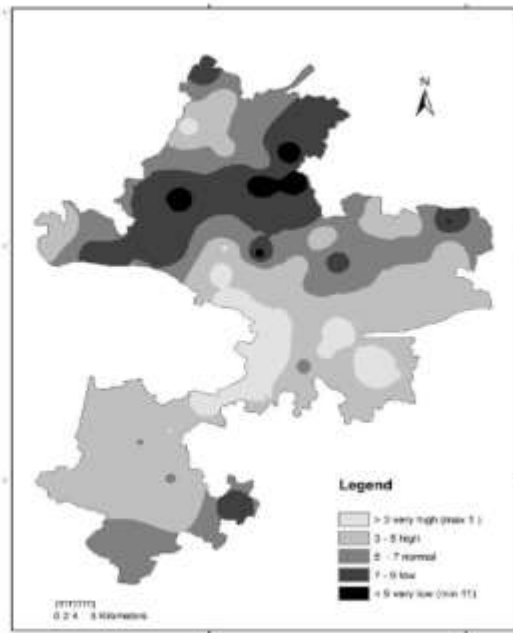


Fig. 5 Post Monsoon Ground water Level

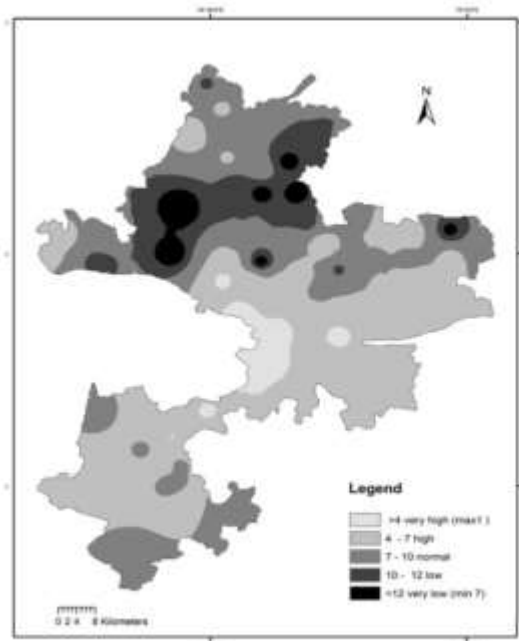


Fig. 6 Premonsoon Ground water Level

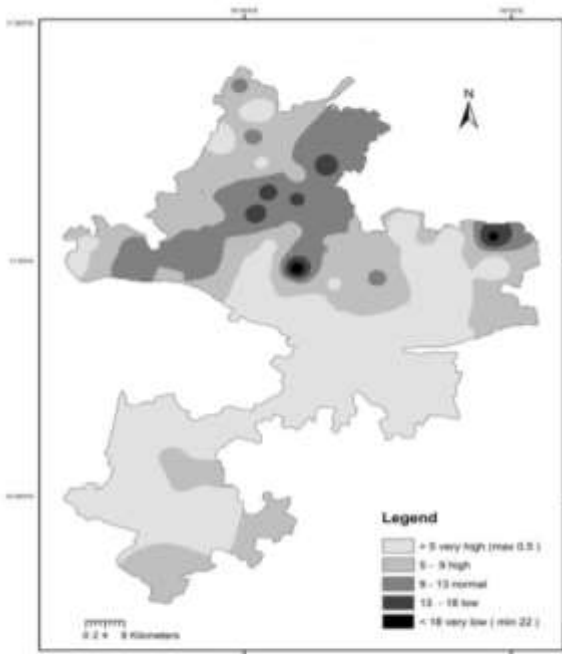


Fig. 7 Post monsoon Groundwater Level of Normal Year

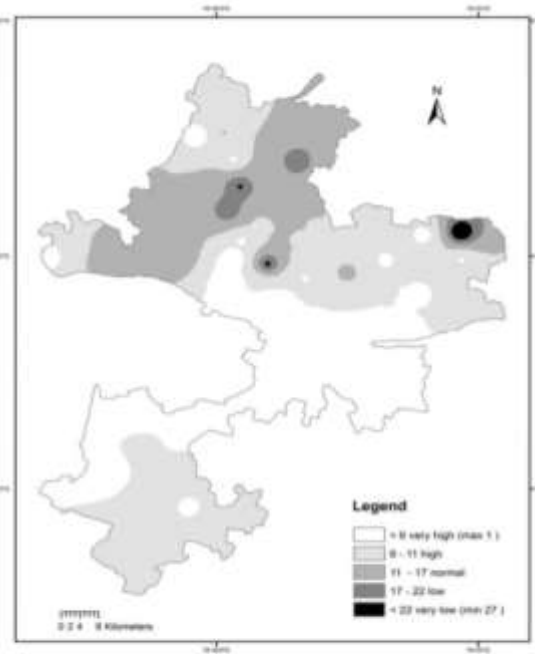


Fig. 8 Pre monsoon Groundwater Level of Normal Year

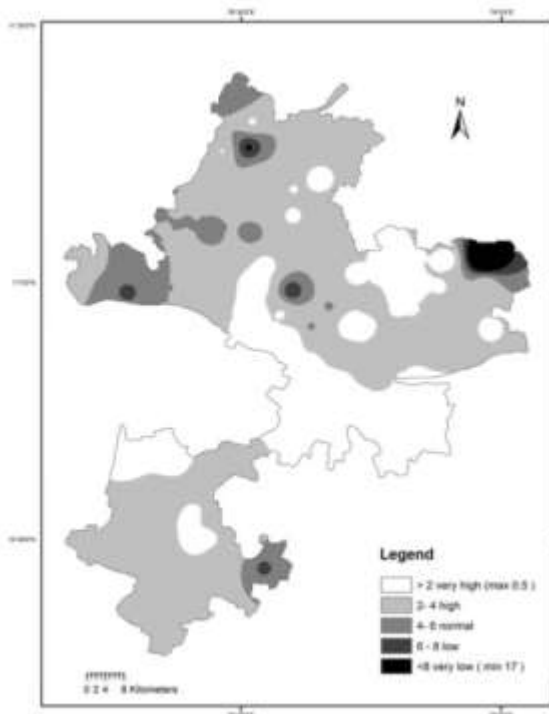


Fig. 9 Post monsoon Groundwater Level of Wet Year

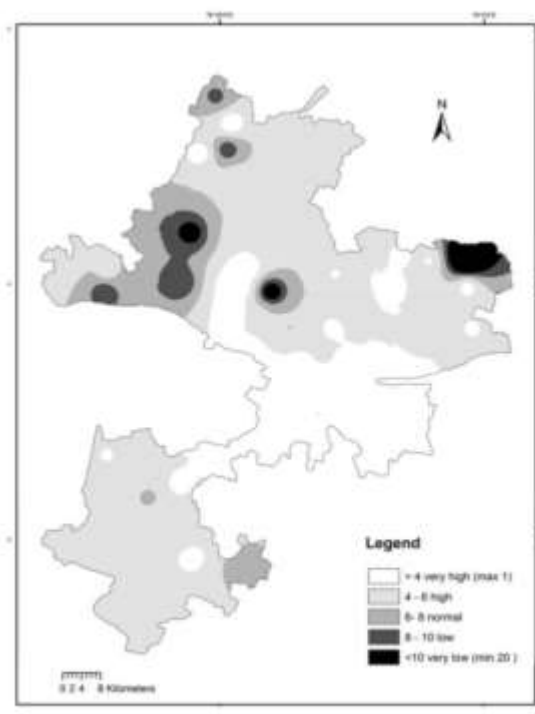


Fig. 10 Pre monsoon Groundwater Level of Wet Year

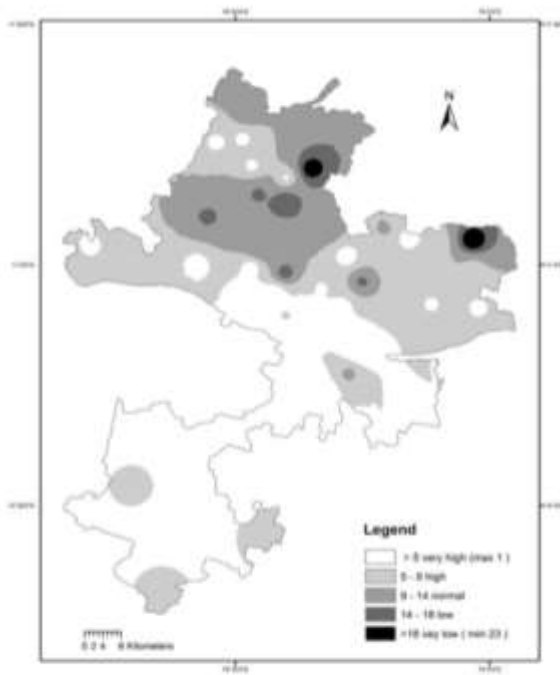


Fig. 11 Post monsoon Groundwater Level during Dry Year

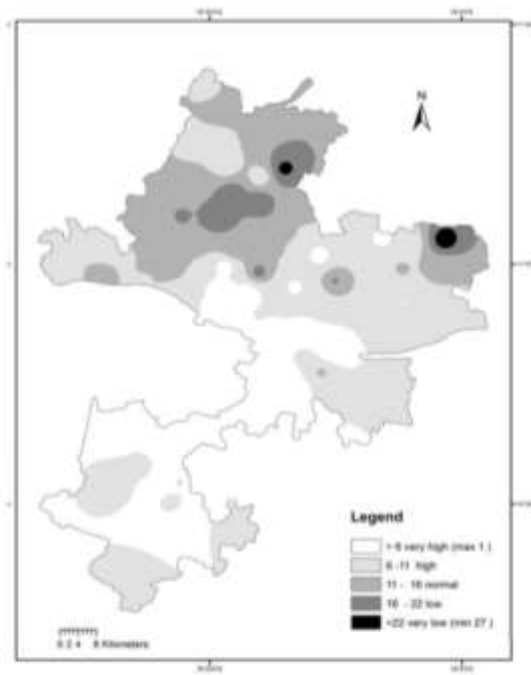


Fig. 12 Pre monsoon Groundwater Level during Dry Year

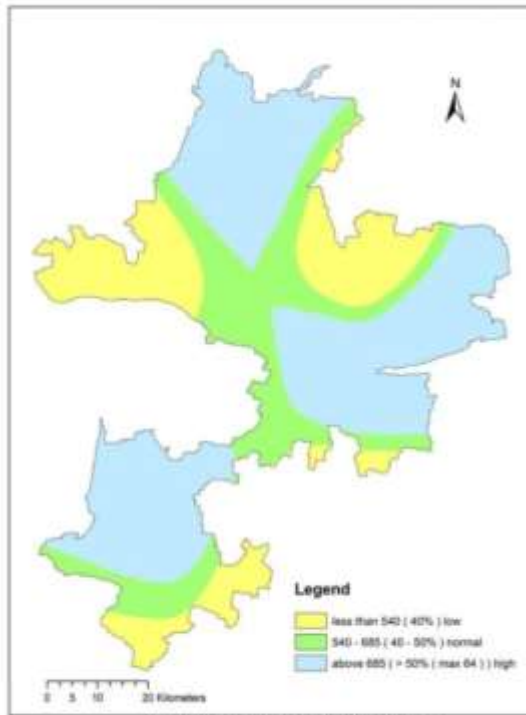


Fig. 13 Normal Rainfall Zones

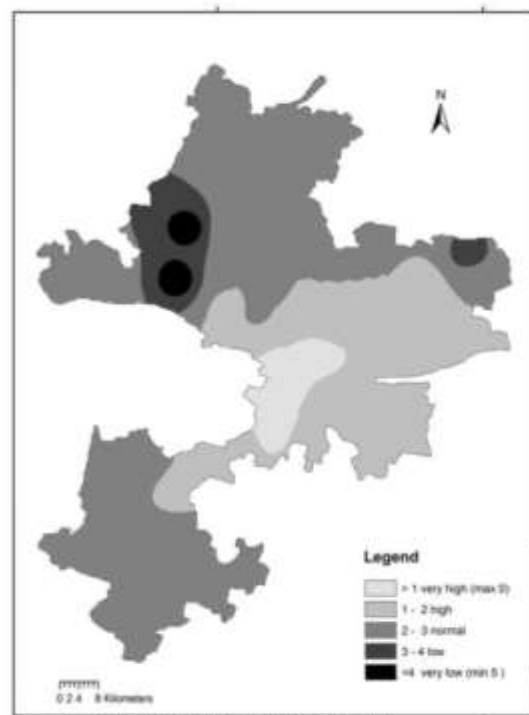


Fig. 14 Groundwater Fluctuation

2) *Water level during normal year:*

Figure 8 shows water level of the district during Premonsoon period for the normal year 2008. The overall pattern of groundwater level exhibits no variation with the mean water level condition of the district during post monsoon period. However the higher water level is estimated as less than 5 meter from the surface and very low water level estimated as above 18 meter indicates the importance of assessing groundwater level of individual years rather than mean water level observed over the blocks central and southern Tiruchirappalli district, where as low water level observed northern blocks of the district mainly Tattaiyanarpet and Thuraiyur blocks.

3) *Water level during wet year:*

Figure 9 and 10 shows the water level during Post and Premonsoon seasons for the year 2006. The water level during Premonsoon is higher, lies within 2 meter from the surface and it goes up to 4 meter in the major parts of the district reveals the contribution of rainfall over the groundwater level. Water level during Postmonsoon period also exhibits higher lies within 4 to 8 meter in the northern blocks and southern blocks of the district. There is no much variation exist between pre and Postmonsoon period due to optimum recharge from the excess rainfall.

4) *Water Level during Dry year:*

The condition of water level during post monsoon season shown in figure 11 and the water level of the major part of the district goes 6 to 22 meters indicates the period of intensive discharge for agriculture and domestic activities. From the agriculture point of view it is essential to know the water level during deficit rainfall years. Figure 12 shows the Premonsoon water level during dry year and major part of the district observed with low water level lies between 5 to 14 meter.

5) *Rainfall and water level during normal year:*

The long term mean annual rainfall have been shown in Figure 13, and for the purpose of comparing rainfall and groundwater, 3 distinctive zones have been classified by 150 mm of variability interval, such as low (less than 540 mm) normal (540 – 685 mm) and high rainfall zone (above 685 mm) Tottiyam block Part of Thuraiyur and Manchanallur block and southern fringes (Marungapuri block)

Tiruchirappalli comes under very low rainfall zone whereas blocks of Uppliyapuram, Thuraiyur, Manchanallur, Lalgudi, Pullampadi, Vaiyampatti and Manaparai have come under high rainfall zone. The normal rainfall zone have been observed mainly over the parts of Thuraiyur, Tattaiyanarpet, Manchanallur, Musiri, Andanallur, Manikandan and Manaparai blocks.

6) *Groundwater Fluctuation characteristics:*

Water level fluctuations in the observation wells in an area between two periods is indicative of the net changes in the ground water regime during the period in response to the recharge and discharge components and is an important parameter for planning sustainable ground water development. The water level difference between post and Premonsoon period implies the influence of both rainfall and draft shown in Figure 14. The fluctuation is minimum (less than 1) or nil over the areas of Manikandan and Andanallur blocks. Over the vicinity of blocks covering parts of Musiri, Manchanallur, Pullambadi, Lalgudi, Thiruverampur and parts of Manaparari blocks. The water levels fluctuate between 1 to 2 meter. Entire northern southern blocks of the district are observed with the fluctuation range between 3 to 4 meter and goes even very high fluctuation of above 5 where may be caused by higher extraction of groundwater over these area.

Figure 15 shows the difference of the rainfall in % from the annual mean (840 mm) and used to access the influence of rainfall over groundwater occurrence over the district. The difference between districts mean rainfall and rainfall during to 2007 depicts the excess rainfall condition over Vaiyampatti Manaparai, Uppliyapuram, Lalgudi, Pullampadi blocks and the excess rainfall is estimated as above 20 % from the mean annual rainfall which comes around 150 mm. The condition of remaining parts of the district is apparent by deficiated rainfall estimated as above 10% from the mean which comes around 75 mm of rainfall.

There is a random association exist between mean groundwater level and normal year rainfall. Where ever the excess rainfall occurrences have observed the groundwater level either goes high or low may caused due to the trend of groundwater utilization over the particular area. However, Pullambadi, Lalgudi, parts of Uppiliyapuram and Vaiyampatti and Manaparai blocks have positive trend with reference to the rainfall and groundwater shown in Figure 16.

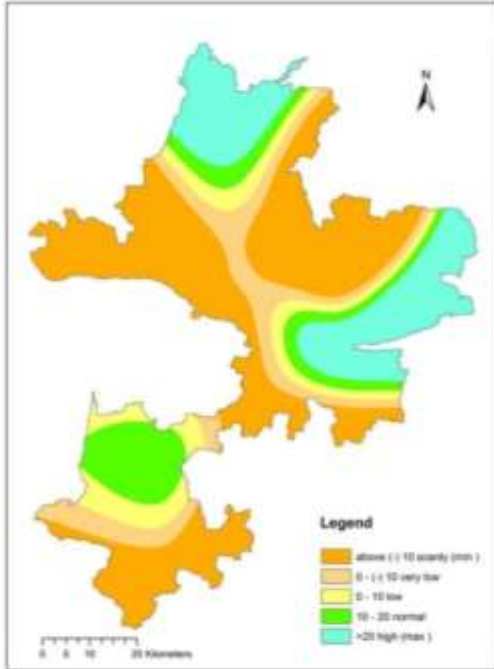


Fig. 15 Normal Year Rainfall Departure (in %) from Mean

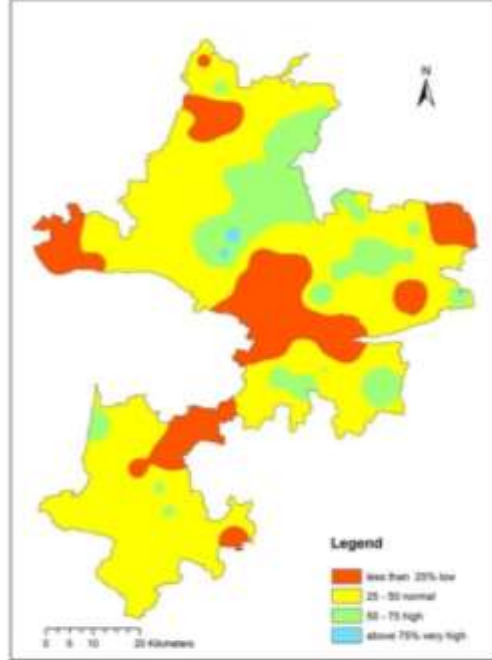


Fig. 16 Normal Year Groundwater Departure (in %) from Mean

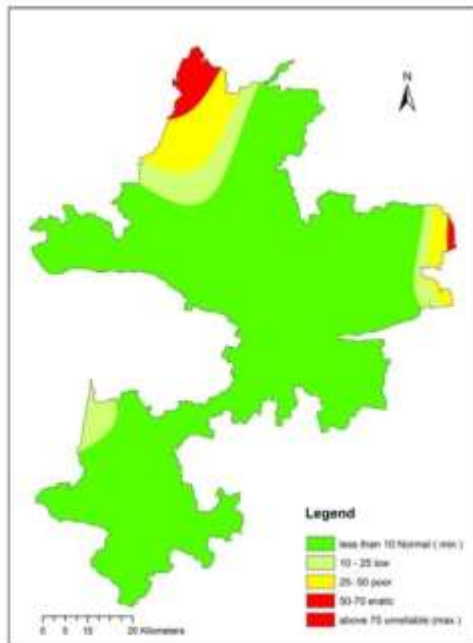


Fig. 17 Dry Year Rainfall Departure (in %) from Mean

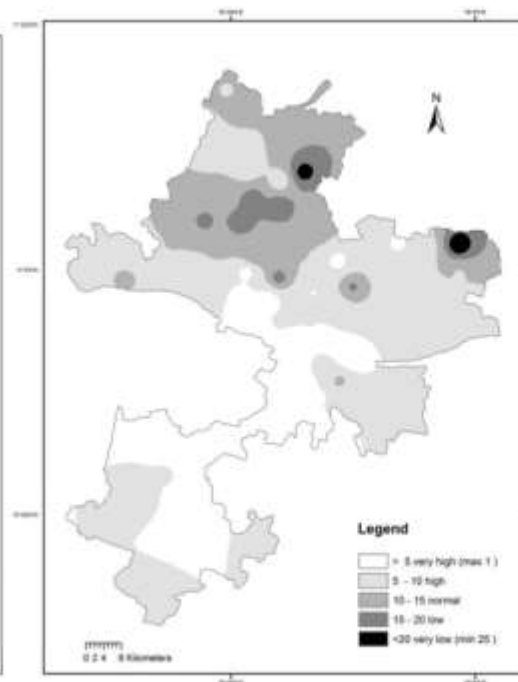


Fig. 18 Dry Year Groundwater Level

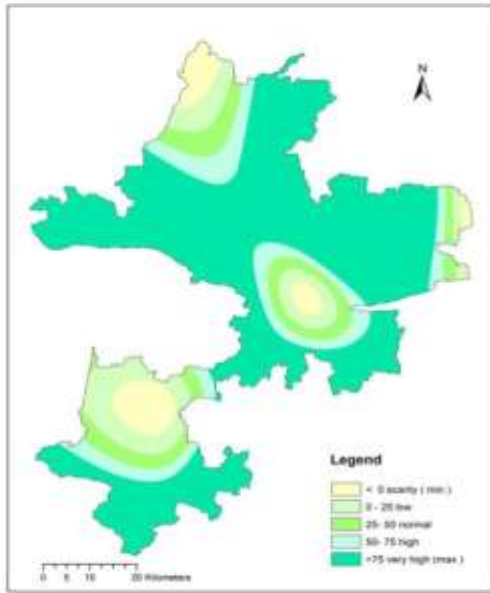


Fig. 19 Wet Year Rainfall Departure (in %) from Mean

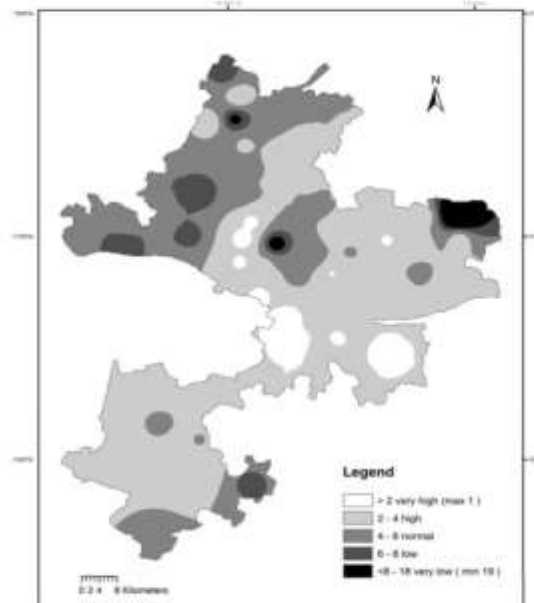


Fig. 20 Wet Year Groundwater Level



Fig 21 Percentage of Irrigated Area



Fig. 22 Percentage of Rainfed Area

7) Rainfall and Groundwater during Dry Year:

The spatial pattern and its association between rainfall groundwater level for deficit rainfall year have been shown in Figure 17 and 18. Major northern half of the district observed with 10 to 25 % deficit rainfall causes above 50% of deficit over groundwater level. It indicates that the deficit ratio between rainfall and groundwater during dry year is 1:2, that is 10% of deficit rainfall has been leading in to 20% of declined groundwater level and so on. There is no significant pattern observed in the mean groundwater level during deficit rainfall year (Figure 18).

8) Rainfall and Groundwater during Wet Year:

The difference between normal and wet year rainfall groundwater level shown in Figure 19 and 20 there is a close association between rainfall and groundwater level with

reference to percentage estimation the areas with 25% deficit rainfall flows declined groundwater level by 25% and so on. The annual average water level during 2006, shown in Fig. 20 and it clearly portrays that the influence of rainfall over the groundwater level and almost entire district comes under water level of 2 to 8 meter.

9) Water level during normal, wet and dry years:

The annual rainfall of individual years plays vital role in the determining groundwater level during the current and subsequent years to access the groundwater level during normal rainfall year excess rainfall year and deficient rainfall year shown in table 1 for the respective years 2008, 2006 and 2003 have been taken into consideration. This assessment portrays the general relationship between rainfall and groundwater occurrences.

St. No.	Station	2008 GW RF2007N	2006 GW RF2005W	2003 GW RF2002D	RF Mean	% wet RF	% Dry RF	Difto mean
11	Lalgudi	808	1985	612	889	123	-31	19
3	Manaparai	976	786	724	880	-11	-18	17
10	Trichy Airport	871	949	715	855	11	-16	14
17	Thuraiyur	785	1690	785	837	102	-6	12
15	Pullambadi	993	1687	757	815	107	-7	9
2	Ponnaiyar Dam	944	1098	714	793	39	-10	6
6	Trichy Junction	846	1268	556	782	62	-29	4
4	Nandhiyar Head	849	1632	343	751	117	-54	0
14	Musuri	713	1293	623	683	89	-9	-9
9	Upper Anaicut	845	1273	519	649	96	-20	-13
1	Marungapuri	880	1271	0	633	101	-100	-16
12	Samayapuram	641	1307	318	627	108	-49	-16
16	Thathaiangarpur	739	1095	586	533	105	10	-29

Table 1. Comparison of Mean Rainfall with Wet, Dry and Normal Years

Sl. No.	B lock	Mean			Normal year (2008)			Wet year (2006)			Dry year (2002)		
		JAN	MAY	fluc	JAN	MAY	Avg	JAN	MAY	Avg	JAN	MAY	Avg
1	Andanallur	5.0	7.3	2	6.9	8.3	7.6	3.0	5.6	4.3	3.1	6.2	4.7
2	Lalgudi	4.7	6.5	2	8.0	9.5	8.8	1.0	4.0	2.5	3.9	4.2	4.0
3	Lalgudi	10.1	15.1	5	8.7	11.3	10.0	4.5	11.5	8.0	15.0	16.4	15.7
4	Manachanallur	2.5	3.8	1	2.4	3.4	2.9	2.9	3.4	3.1	0.7	0.9	0.8
5	Manachanallur	6.4	8.3	2	9.7	12.5	11.1	4.5	5.1	4.8	7.6	8.1	7.8
6	Manachanallur	2.2	3.2	1	1.9	3.6	2.7	3.3	3.4	3.3	0.5	0.9	0.7
7	Manaparai	2.1	4.7	3	2.0	3.5	2.8	2.0	3.0	2.5	4.2	9.1	6.6
8	Manaparai	6.5	8.2	2	8.2	9.2	8.7	0.3	3.5	1.9	4.2	8.2	6.2
9	Manapparai	5.6	7.4	1	3.8	6.2	5.0	1.8	4.3	3.1	8.4	11.5	9.9
10	Manapparai	4.0	6.5	3	1.2	6.2	3.7	1.8	2.6	2.2	12.0	13.3	12.6
11	Manapparai	3.5	5.2	1	0.7	1.3	1.0	1.3	5.3	3.3	5.4	6.6	6.0
12	Manapparai	4.3	6.2	2	2.4	5.8	4.1	2.0	3.3	2.6	7.2	12.3	9.7
13	Manikandam	5.5	7.9	2	7.5	11.4	9.5	1.9	4.9	3.4	4.5	6.7	5.6
14	Manikandam	5.1	7.9	3	2.7	6.4	4.5	1.2	4.8	3.0	2.3	7.5	4.9
15	Mannachchanallur	2.0	3.1	1	1.4	2.1	1.7	1.2	1.9	1.6	1.8	3.0	2.4
16	Mannachchanallur	0.9	1.4	0	1.0	1.5	1.2	0.7	1.7	1.2	0.9	1.0	0.9
17	Mannachchanallur	9.1	12.8	4	19.1	27.1	23.1	17.2	20.4	18.8	22.5	26.7	24.6
18	Mannachchanallur	3.0	3.9	1	2.6	3.3	2.9	3.3	3.4	3.3	0.9	0.8	0.9
19	Marungapuri	5.0	7.7	3	3.8	6.2	5.0	1.4	4.8	3.1	9.5	10.3	9.9
20	Marungapuri	0.7	1.5	1	0.8	0.9	0.8	0.7	1.7	1.2	0.7	0.9	0.8

21	Marungapuri	8.2	11.2	3	14.5	22.4	18.5	3.1	5.9	4.5	14.8	19.8	17.3
22	Musiri	5.0	7.4	2	6.3	9.6	7.9	3.6	6.5	5.1	3.6	7.5	5.6
23	Musiri	3.4	6.0	3	4.7	7.0	5.8	3.6	5.1	4.3	4.1	8.6	6.4
24	Musiri	8.2	10.2	2	9.6	10.5	10.0	5.6	8.4	7.0	9.6	10.2	9.9
25	Musiri	9.7	13.0	3	10.0	13.4	11.7	2.9	4.4	3.7	12.9	14.2	13.5
26	Musiri	3.4	4.8	3	1.6	3.6	2.6	1.0	4.0	2.5	4.1	5.3	4.7
27	Musiri	3.1	4.6	2	5.2	7.2	6.2	1.9	3.4	2.7	2.8	3.8	3.3
28	Pullambadi	3.7	5.5	1	4.5	5.7	5.1	4.2	6.0	5.1	4.4	7.1	5.7
29	Pullambadi	2.7	4.5	2	0.6	1.3	0.9	1.2	2.3	1.8	10.6	11.9	11.2
30	Pullambadi	5.0	8.1	3	0.9	2.8	1.9	1.5	4.0	2.7	4.1	4.9	4.5
31	Pullampadi	3.7	5.3	1	2.7	4.8	3.7	3.6	5.0	4.3	4.7	6.0	5.3
32	Pullampadi	8.5	10.6	3	9.1	10.8	9.9	3.4	5.7	4.6	10.0	10.6	10.3
33	Pullampadi	5.5	7.3	2	3.4	5.5	4.4	1.0	2.5	1.8	5.8	10.6	8.2
34	Srirangam	4.2	6.4	2	3.9	5.5	4.7	2.7	4.6	3.7	4.1	6.7	5.4
35	Tattayangarpettai	7.6	9.7	2	8.1	9.6	8.8	3.2	4.6	3.9	12.5	14.3	13.4
36	Thathayangarpettai	5.7	7.0	1	3.3	3.6	3.5	1.0	4.0	2.5	4.2	5.5	4.8
37	Thiruverumbur	9.9	12.7	3	15.0	20.1	17.5	1.5	6.0	3.8	21.1	24.0	22.6
38	Thiruverumbur	8.9	13.8	5	11.2	16.9	14.1	3.6	9.8	6.7	3.4	12.5	8.0
39	Thiruverumbur	3.6	4.4	0	3.6	4.5	4.0	3.5	4.3	3.9	3.1	3.9	3.5
40	Thiruverumbur	8.5	10.5	2	10.4	12.5	11.4	2.4	6.0	4.2	15.3	16.5	15.9
41	Thottiyam	2.8	4.8	2	1.8	2.4	2.1	0.5	1.0	0.8	3.1	4.0	3.5
42	Thottiyam	6.3	8.0	2	6.4	7.0	6.7	3.4	5.8	4.6	6.0	8.5	7.2
43	Thottiyam	3.6	5.0	1	1.5	2.0	1.7	1.3	3.5	2.4	5.6	7.3	6.4
44	Thottiyam	6.5	9.1	2	3.5	5.5	4.5	1.1	1.3	1.2	14.1	14.6	14.3
45	Thuraiyur	4.1	5.4	1	4.3	5.8	5.1	4.2	5.8	5.0	4.7	5.1	4.9
46	Thuraiyur	11.0	13.2	2	14.0	15.1	14.5	1.6	5.0	3.3	17.9	19.5	18.7
47	Thuraiyur	4.5	6.0	2	3.7	4.7	4.2	0.9	3.9	2.4	5.6	6.5	6.1
48	Thuraiyur	2.5	4.8	2	0.9	2.1	1.5	0.7	2.2	1.4	4.8	7.1	5.9
49	Thuraiyur	4.4	5.8	2	3.3	4.5	3.9	3.6	5.1	4.3	6.6	7.6	7.1
50	Thuraiyur	4.7	8.1	3	10.8	11.1	10.9	8.3	9.5	8.9	4.0	8.6	6.3
51	Thuraiyur	1.9	3.1	1	0.5	1.4	1.0	0.3	1.6	1.0	0.8	1.0	0.9
52	Tiruverumbur	3.4	5.2	3	5.7	6.7	6.2	1.9	5.7	3.8	1.2	2.5	1.9
53	Uppliyapuram	4.9	6.6	2	2.9	4.5	3.7	2.2	5.3	3.8	7.0	7.5	7.2
54	Uppliyapuram	3.0	4.6	2	5.2	8.0	6.6	1.4	3.9	2.6	2.4	3.8	3.1
55	Uppliyapuram	8.2	9.3	2	7.2	8.5	7.8	6.3	7.5	6.9	7.8	8.5	8.2
56	Uppliyapuram	7.2	10.3	2	15.1	20.9	18.0	4.9	5.8	5.3	13.8	20.4	17.1
57	Uppliyapuram	3.3	5.6	3	3.7	5.5	4.6	2.3	3.3	2.8	1.0	1.1	1.0
58	Vaiyampatti	9.0	11.5	2	10.9	12.4	11.7	6.5	9.4	7.9	8.9	13.0	10.9
59	Vaiyampatti	9.8	13.4	3	21.8	22.9	22.4	7.8	12.8	10.3	16.9	18.3	17.6
60	Vaiyampatti	5.0	6.9	2	8.3	9.8	9.0	1.5	3.8	2.7	4.5	8.1	6.3

Table 2: Analysis of Groundwater Availability for Irrigation

Si n o	block	Crops irrigated (Area in Ha)									
		Pady	Chola m	Groundnet	Maize	Sugarcane	Pulses	Cotton	Cumbu	Gingili	Total
1	Andanallur	3656.770	-	-	-	170.905	-	-	-	-	3827.675
2	Lalgudi	13022.845	-	-	-	808.295	-	-	-	254.680	14085.820
3	Manachanallur	2923.450	-	52.230	7.105	136.000	-	18.180	927.610	7.175	4071.750
4	Manapparai	2092.760	-	373.260	-	176.975	-	38.990	4.500	3.450	2689.935
5	Manikandam	5051.640	-	-	-	113.265	-	-	-	-	5164.905
6	Marungapuri	4387.425	-	643.785	-	612.840	38.110	46.670	20.270	14.785	5763.885
7	Musiri	4299.750	4.220	47.810	19.700	176.965	11.150	49.585	2.975	24.850	4637.005
8	Pullambadi	4872.770	-	73.580	-	842.135	1.430	-	8.470	32.740	5831.125
9	Thathayangarpettai	2165.280	261.360	170.580	8.335	128.805	10.510	11.980	19.555	15.560	2791.965
10	Thiruverumbur	8118.350	-	-	-	30.100	20.000	-	-	-	8168.450
11	Thottiyam	1940.755	143.385	106.280	1.935	606.480	6.980	13.720	-	0.790	2820.325
12	Thuraiyur	3201.675	15.075	161.560	130.125	132.605	11.820	37.205	52.575	45.460	3788.100

1 3	Uppiliapuram	8777.580	24.470	82.425	57.100	457.540	13.255	101.595	0.705	13.220	9527.890
1 4	Vaiyampatti	1738.265	38.650	1954.715	8.950	424.145	12.310	68.425	0.030	15.825	4261.315

Table 3: Area of Rainfed and Irrigated Crops in Tiruchirappalli District.

Pady	Crops Rainfed (Area in Ha)									Total Area in %	
	Cholam	Groundnet	Maize	Sugarcane	Pulses	Cotton	Cumbu	Gingili	Total	Percentage	Percentage
-	-	-	-	1.355	2562.010	-	-	-	2563.365	60	40
-	216.750	-	-	5.795	1412.425	-	-	-	1634.970	90	10
-	1865.155	278.565	236.090	12.755	647.190	3357.225	927.610	-	7324.590	36	64
-	2631.960	288.440	-	0.480	75.220	6.500	77.595	23.500	3103.695	46	54
-	33.815	2.525	-	3.750	980.445	-	-	-	1020.535	84	16
-	793.625	1703.325	-	2.130	784.330	18.160	35.150	34.800	3371.520	63	37
-	4266.275	1612.870	2.685	0.050	417.520	91.850	390.925	0.235	6782.410	41	59
-	-	1.430	3503.455	1.015	131.610	8681.380	17.240	-	12336.130	32	68
-	3988.130	807.765	23.335	0.205	140.105	14.905	70.495	2.250	5047.190	36	64
-	0.460	-	-	6.880	1004.600	-	-	-	1011.940	89	11
-	4774.945	1338.010	0.900	2.595	69.635	2.780	24.010	0.580	6213.455	31	69
852.430	1187.685	83.810	418.400	0.030	102.100	817.700	75.660	0.685	3538.500	52	48
62.960	309.360	16.700	289.065	0.415	19.285	724.790	81.305	1.200	1505.080	86	14
-	2435.250	723.345	44.020	0.010	213.885	375.525	83.295	13.825	3889.155	52	48

Source: Directorate of Agriculture, Chennai.

10) Assessment of Groundwater and Rainfall during Normal, Wet and Dry Years:

In order to compare the water level during normal, wet and dry climatic years with the mean water level, the mean annual rainfall of the individual years have been taken into consideration based on which, 2007 have been taken as a normal year (840 mm), 2005 have been taken as a wet year (1330 mm) and 2002 has been taken to represent dry year (560 mm). The subsequent years to the climatic year are 2008, 2006 and 2003 have been taken to depict the groundwater level after the normal, wet and dry year occurrences. (Table 1.)

Rainfed and Irrigated Cropping based on 2010 data about 43% of area is sown in Thiruchirappalli districts out of which Lalgudi taluk leads in the net zone area (59.6%) followed by Mushri, Manachanallur, Thottiyam, Srirangam, Triuchirappalli, Manaparai and Thuraiyur taluks. Regarding cropping pattern rice occupies first rank over Srirangam (63%), Triuchirappalli (57%), Lalgudi (38%) and Thuraiyur (37%). Whereas in Manaparai millets accounts 30% of cultivated area and exceeds as a first rank crop over. Similarly millets is the first rank crop over Manachanallur and Mushri. Pulses is the leading crop over Thottiyam taluk.

Table 3 summarizes the area of rainfed and irrigated crops in Triuchirappalli districts. From this table one can understand the utilization of ground water and dependency of rainfall or both over different parts of the districts. Notably Lalgudi block

has the larger proportion of irrigated area (above 90%) and little area under rainfed cultivation.. Similarly Thiruverumbur, Manikandam also registered with maximum proportion of irrigated crops shown in figure 21. In contrast to irrigated crops Thottiyam, Pullampadi, Manachanallur and Thathingar pettai are registered with larger rainfed areas, by exciding 60% of the cultivated area shown in figure 22. It is clear from the foregoing discussion that Southern taluks of Tiruchirappalli, Vaiyampadi, Marungapuri and Manapari taluks are highly depends on ground water as the irrigation source. On the other hand Northern parts of Triuchirappalli districts covering Thathingar pettai, Thiruverumbur, Manachanallur and pullampadi taluks. Mainly depends on rainfall has the source of cultivation. It is also indicates that the areas of forshed rainfed areas may also extract ground water during pre-monsoon season and dry years.

Regarding rainfed cropping pattern there is a close association exists with rainfall zones (Figure 13). , Triuchirappalli districts wherever the rainfall is exceeds 685 mm annually. There is higher proportion of rainfed crops is observed, however Lalgudi, Manikandam, and Thiruverumbur blocks shows an condictory pattern influenced by the cauvery canal irrigation.

During wet year ground water level is higher over North eastern and Southern blocks of Thiruchirappalli districts will favours the irrigated crops over these blocks, whereas also during dry year the ground water level not declines 10 meters from the surface also supports the irrigated crops over the Thiruchirappalli districts. Regarding normal year ground water

level Thuraiyur, Thathingar pettai and Manachanallur block are typically noted by 50-75% of declining of ground water level from mean suggest that there is a risk exists from the ground water irrigation and rest of the areas also registered by around 50% of declining ground water level during normal year pronounces the significance of ground water management over the districts.

II. CONCLUSION

Thus the increasing population and their dependence on groundwater for irrigation are further inducing heavy stress on groundwater resources, leading to the decline of groundwater levels in this region. Out of the total geographical area of Tiruchirappalli District, net area cropped is 1,85,193 Hectares. Out of which about 102799 Ha (55 %) are irrigated and about 82394 Ha (45 %) are rainfed.

Tiruchchirappalli district, one of the three districts carved out of the composite district of the same name is located in the central part of Tamil Nadu between 78°09'00" - 79°03'00" east longitudes and 10°17'00"- 11°25'00" north latitudes. It has a total geographical area of 4403.83 sq.km, which is about 3.40 percent of the total geographical area of the state.

The data available indicate that about 23 percent of the total geographical area of the district is under irrigated agriculture. Out of this, about 20 percent is being irrigated by canals and dug wells in more or less equal measure. Irrigation by Bore/Tube wells accounts for less than 1 percent of the total area. Dug wells are the major source of water for irrigation in the district accounting for 44.05 percent of the total area irrigated. Daytime highest temperature is recorded during May (38.2°C) followed by April (37.4°C). During winter, the highest temperature recorded as 30°C in the day and during nights the minimum temperature recorded in the month of May as 26.8°C while it is only 20.1°C during January. In the study area the highest rainfall is received during the month of November (181 mm) followed by October (146 mm) and September (135 mm). The month July, May and August also receive a considerable amount of rainfall (more than 50 mm). The lowest rainfall is received during the month of January (7 mm).

The principal crops grown is rice in 73,090 hectares (30.04%), millets in 65,000 hectares (26.72%) pulses in 33,090 hectare (13.60%) and oil seeds in 30,350 hectares (12.48%)

The chief source of irrigation in the district is river. Cauvery river system is the major source. Considerable extent of lands is benefitted by tank irrigation in the taluks of Manapparai (384 nos), Thuraiyur (396 nos) and Lalgudi (151 nos.) Besides river and tanks the other source of irrigation is wells. The number of wells is more in Thuraiyur (14552 nos). Followed by Lalgudi (9878 nos) and Musiri (8193 nos) taluks.

The Major crops cultivated in this district are rice, millets, pulses, banana, sugarcane and oil seeds. In upland area rice is

grown a rainfed crop. Millets are grown both as irrigated and rainfed crops. Oil seeds such as ground nut and gingelly are cultivated both under irrigated and rainfed conditions.

The major part of the district comes under the water level between 5 and 14 meter. The normal water level range of the district exist between 5 to 7 meters observed over central and eastern blocks. In general, pattern of water level over the district exhibits higher structural control rather than climatic control.

The overall pattern of groundwater level exhibits no variation with the mean water level condition of the district during normal year post monsoon period.

Water level during wet year shows the water level during Post and Pre monsoon seasons for the year 2006. Lies within 2 meter from the surface and it goes up to 4 meter in the major parts of the district reveals the contribution of rainfall over the groundwater level.

Water Level during Dry year over the major part of the district goes 6 to 22 meters indicates the period of intensive discharge for agriculture and domestic activities.

The fluctuation is minimum (less than 1) or nil over the areas of Manikandam and Andanallur blocks. Over the vicinity of blocks covering parts of Musiri, Manachanallur, Pullambadi, Lalgudi, Thiruverampur and parts of Manaparari blocks. The water levels fluctuate between 1 to 2 meter. Entire northern southern blocks of the district are observed with the fluctuation range between 3 to 4 meter and goes even very high fluctuation of above 5 where may be caused by higher extraction of groundwater over these area.

There is a random association is exist between mean groundwater level and normal year rainfall. Where ever the excess rainfall occurrences have observed the groundwater level either goes high or low may caused due to the trend of groundwater utilization over the particular area.

Major northern half of the district observed with 10 to 25 % deficit rainfall causes above 50% of deficit over groundwater level. It indicates that the deficit ratio between rainfall and groundwater during dry year is 1:2 that is 10% of deficit rainfall has been leading in to 20% of declined groundwater level and so on.

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