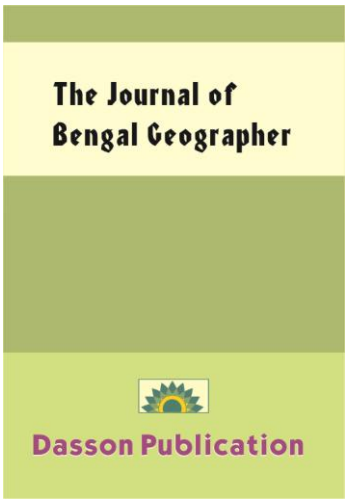
The Journal of Bengal Geographer



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Spatio - Temporal analysis of Groundwater Level for Virudhunagar District, Tamil Nadu

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Abstract: *We are heading towards a freshwater crisis that is leading to poor access to safe water for millions of people. Fresh water is therefore, the most precious substance on earth. Water can neither be added nor subtracted from the earth. Its total volume remains constant. Water levels in aquifers reflect a dynamic balance among groundwater recharge, storage, and discharge. If recharge exceeds discharge, the volume of water in storage will increase and water levels will rise; if discharge exceeds recharge, the volume of water in storage will decrease and water levels will fall. Aims and objectives this work aims to study about the groundwater resources of the Virudhunagar District. Its objectives are as follows: To assess the groundwater levels in different seasons and to find out inter seasonal variation. The present study area Virudhunagar District is located in the southern part of Tamil Nadu state. It lies between 9° 09' North and 9° 48' North latitude and 77° 20' East and 78° 29' East longitudes and it forms a part of the Survey of India (SOI). The groundwater levels were taken in four different seasons and it was used to find out fluctuation in water levels. Arc GIS 9.3.1 software was used for mapping spatial data and mathematical calculations were done MS Excel. The South West Monsoon season is highest ground water level at A.Salapuram (59.01m). And winter season have very low water level at Maraikulam (4.16m). The winter season have low ground water at Central part of the study area. The South West Monsoon season ground water level over all area is high. But, comparatively Western and Eastern part is high ground water level.*

Key word: *Annual Groundwater Level, Winter, Summer, South West and North East*

1. Introduction

Three fourth's of the earth's surface is covered with water. Of this 97% is saline and 2% is fresh which is present in the form of ice caps, glaciers, icebergs or in the atmosphere. Only 1% can be used for drinking. We are heading towards a freshwater crisis that is leading to poor access to safe water for millions of people. Fresh water is therefore, the most precious substance on earth. Water can neither be added nor subtracted from the earth. Its total volume remains constant. Its abundance only seems to vary because it is in constant motion, cycling through the oceans, the air, the land and back again, through the processes of evaporation, precipitation and run-off. This as you already know is referred to as the "water cycle". The main aim of the present study is to analyze the water level average, Virudhunagar district

2. Groundwater Level

Groundwater meets the rural drinking water needs of 80% of the population of the country it is vital in the day to day life of the population. To have a proper planning and management of this precious resource, the assessment and quantification is the pre requisite. This can be achieved by having precise data on the Groundwater draft and recharge.

Water levels in aquifers reflect a dynamic balance among groundwater recharge, storage, and discharge. If recharge exceeds discharge, the volume of water in storage will increase and water levels will rise; if discharge exceeds recharge, the volume of water in storage will decrease and water levels

will fall. Because recharge and discharge are not distributed uniformly in space and time, groundwater level are continuously rising or falling to adjust to the resulting imbalances. Water levels in wells reflect these changes and provide the principal means of tracking changes in groundwater storage over time. Water-level measurements also provide insight into the physical properties that control aquifer recharge, storage, and discharge since these factors affect the timing and intensity of responses to hydrologic stresses such as precipitation or pumping.

Long-term water level variability can be used to determine the natural range of climate-induced water fluctuations and to assess the long-term impacts of artificial stresses such as pumping. Under natural conditions, prior to development, groundwater levels are in a state of dynamic equilibrium that reflects a balance between recharge and discharge. Because natural recharge is always variable, water levels will rise and fall in response to multiyear trends of above or below normal precipitation. Over long periods of time, however, water levels will fluctuate around an average value that reflects the long-term balance between recharge and discharge.

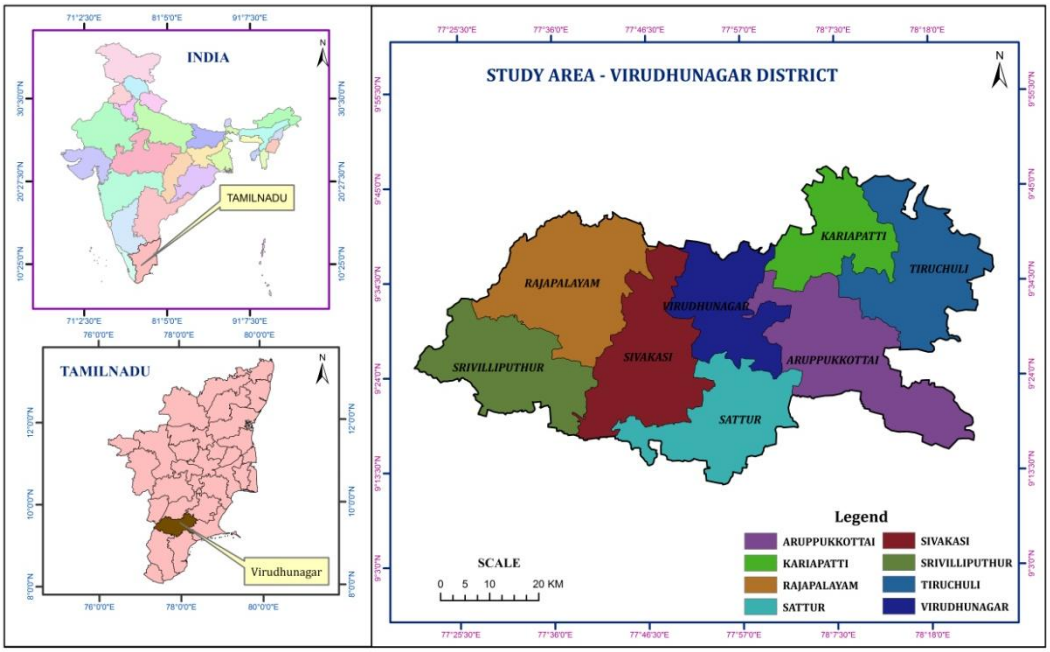
3. Aims and Objectives

This work aims to study about the groundwater resources of the Virudhunagar District. Its objectives are as follows:

- ❖ To assess the groundwater levels in different seasons and to find out inter seasonal variation

4. Study Area

The present study area Virudhunagar District is located in the southern part of Tamil Nadu state. It lies between 9° 09' North and 9° 48' North latitude and 77° 20' East and 78° 29' East longitudes and it forms a part of the Survey of India (SOI) topographic sheets (56G/6,7,10,11,12,14,15,16 and 58K/2,3,6,7,8) of 1: 50000 scale. The District covers a total area of about 4,232 sq.km with a population of about 19,43,309 in 2011. It is bounded by Madurai, Theni Districts in the north, Ramanathapuram, Sivagangai Districts in the east, Tirunelveli, Thuthukudi Districts in the south and Kerala state towards the west.



5. Methodology

The study was mainly based on secondary data. All the pertaining to groundwater were collected from PWD (Groundwater Board, Tharamani, Chennai). Weather and climatic data were collected from (Joint Directorate of Statistical Office, Chennai). The study aims to find out the for studying about groundwater. 26 wells were selected throughout the study area. The groundwater levels were taken in four different seasons and it was used to find out fluctuation in water levels.ArcGIS9.3.1 software was used for mapping spatial data and mathematical calculations were done MS Excel.

6. Annual Average Groundwater Level (2001-2016)

The 26 sample well to be overall the study area. The annual water level is found to be maximum at A.Salapuram (14.05m) and minimum at Maraikulam (2.52m) of the water level. Whereas Pillaiyarntham (12.34m), Kilavikulam (10.80m), Valayapatti (8.38m) and Ayyanarkovil (8.38m), has been high level of ground water. Saminatham (7.63m), Vellaihpuram (7.39m), Ayyanarikovil (7.26m) Pandalkudi (6.55m), Vadamalaipatti (6.50m), pandalkudi (6.35m), Perumalthevanpatti (6.19m), Virudhunagar (5.53m), Sattur (5.52m), Sattur (5.37m), Naduvapattai (5.36m), Rajapalayasm (4.46m), Pulvoypatti (4.23mm) and Sethur (3.14m), they are gradually decrease in this region. In generally southern and southwest part noticed the high level of the groundwater and the reason falls under following zone.

1. High Water Level Zone (above12m): A.Salapuram, Pillaiyaranatham,
2. Moderate Water Level Zone (8-12m): Kilavikalam, Vidthakulam, Karichiyampatti, Valakarai, Muthuramaliyapuram, Valayapatti, Ayyanarkovil.
3. Low Water Level Zone (4-8m): Saminatham, Vellaihparam, Ayyanarkovil, Pandakudi, Vadamalaipatti, Panalkudi, Perumathevanpatti, Virudhunagar, Sattur, Sattur, Naduvapatti, Rajapalayam, Pulvoypatti.
4. Low Water Level Zone (below 4): Sethur, Maraikulam, Amathur.

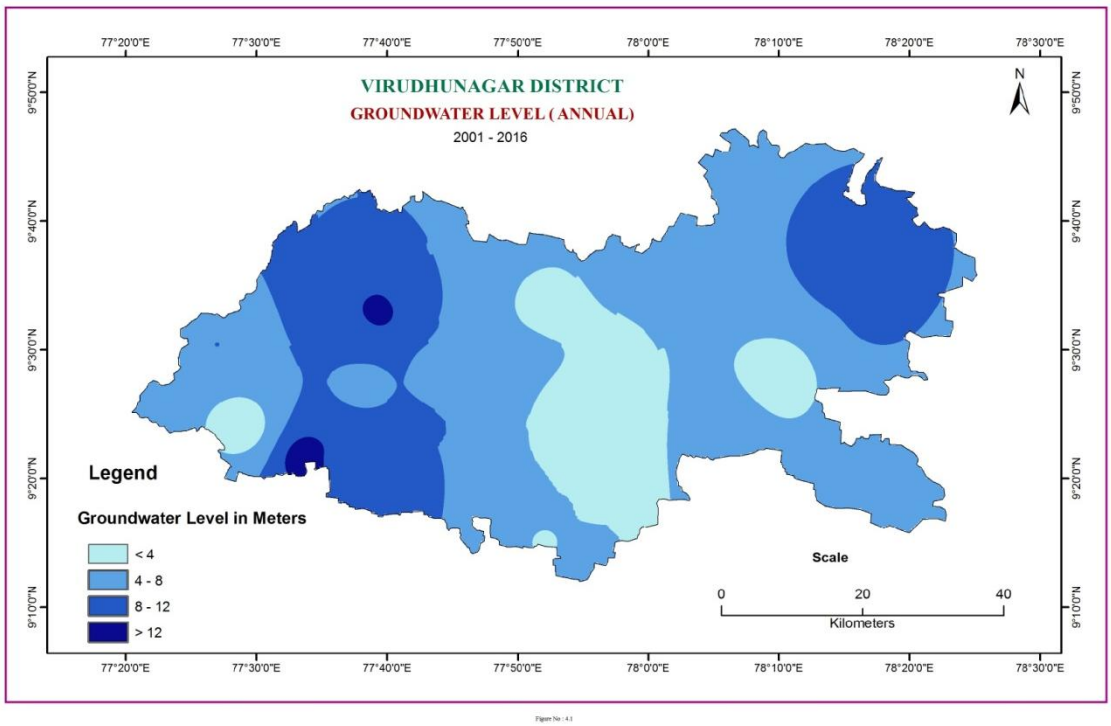


Table No: 1 Annual Average and Seasonal Groundwater Level

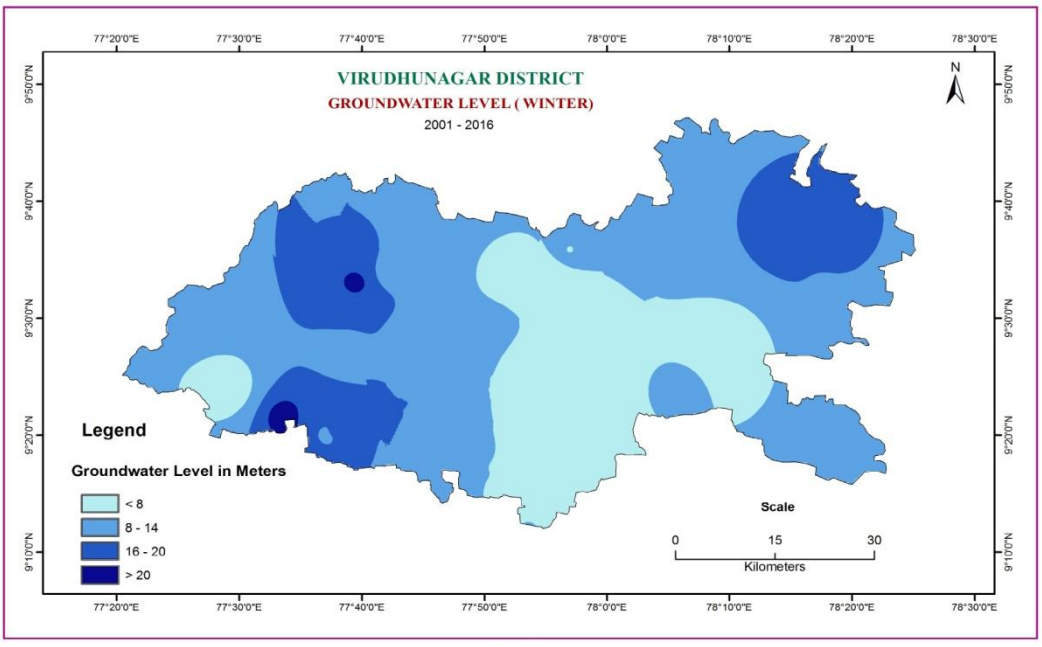
Sl No	Village	Annual average	Winter	Summer	South West Monsoon	North East Monsoon
1	Srivilliputhur	10.29	17.92	29.70	44.52	31.39
2	Sethur	3.14	4.17	8.38	15.60	9.49
3	Rajapalayam	4.46	6.25	11.67	21.58	14.07
4	Ayyanarkoil	8.38	14.99	24.14	36.75	24.73
5	Ayyanarkoil	7.26	12.31	19.28	32.97	22.53
6	Pandalkudi	6.34	9.36	18.34	30.71	17.71
7	Pandalkudi	6.55	10.11	19.22	31.23	18.05
8	Amathur	3.73	5.56	11.03	18.10	10.12
9	Virudhunagar	5.53	10.19	16.63	23.54	15.94
10	Sattur	5.52	9.47	15.93	24.14	16.65
11	Sattur	5.37	9.17	15.99	23.72	15.60
12	Vadakarai	9.69	16.10	26.36	45.78	28.09
13	Kurichiyampatti	9.70	13.53	27.10	44.73	31.06
14	A.Salapuram	14.05	25.85	40.46	59.01	43.33
15	Kilavikulam	10.86	17.37	31.19	49.75	32.03
16	Valayapatti	8.38	13.05	25.28	39.71	22.46

17	Pillaiyarnatham	12.34	21.82	37.09	52.71	36.52
18	Perumalthevanpatti	6.19	11.02	17.90	26.49	18.88
19	Saminatham	7.63	14.42	22.66	32.90	21.61
20	Vellaihpuram	7.39	12.90	21.91	31.79	22.10
21	Vadamalaipatti	6.50	11.21	19.40	27.76	19.65
22	Naduvapatti	5.36	9.01	16.42	24.71	14.19
23	Pulvoypatti	4.23	6.48	12.65	20.31	11.29
24	Muthuramalingapuram	8.66	14.82	25.43	37.64	26.10
25	Vidthakulam	10.79	20.30	32.82	45.93	30.39
26	Maraikulam	2.52	4.16	8.34	11.55	6.18

7. Groundwater Level Winter

The winter seasonal ground water level is having maximum at A.Salapuram (25.25m) and minimum at Maraikulam (4.16m). Pillaiyarnatham (21.82m) and Vadthakulam (20.30m), they are high level of during this season. Pulvoypatti (6.48m), Rajapalayam (6.25m), Amathur (5.56m), Sethur (4.17m), found to be low water level during this season. In generally southeast and western part noticed the high level and the reason falls under following:

1. High Water Level Zone (above20m): Salapuram, pillaiyarnatham & Vidthakulam.
2. Moderate Water Level Zone (14-20m): Sirvilliputhur, Kilavikulam, Vadakarai, Ayyanarkovil, Muthuramalingapuram, Saminatham.
3. Normal Water Level Zone (8-14m): Kurichiyampatti, Valayapatti, Vellaihpuram.
4. Ayyanarkovil, Vadamalaipatti, Ayyanarkoil, Virudhunagar, Pandalkudi, Sattur, Sattur, Naduvapatti, Pandalkudi.
5. Low Water Level Zone (Below 8): Pulvoypatti, Rajapalayam, Amathur, Sethur, Maraikulam.

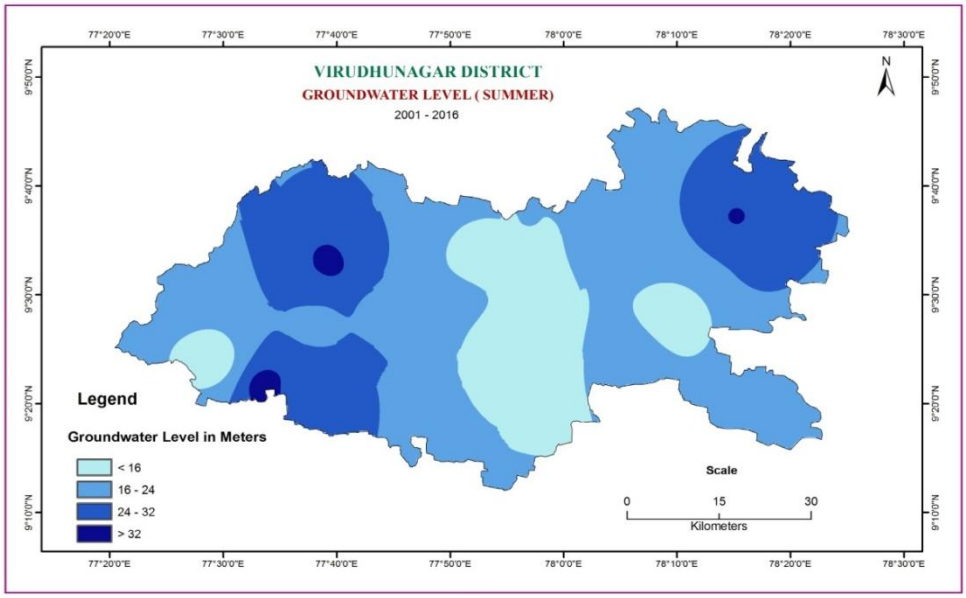


8.

Groundwater Level Summer

The summer seasonal having maximum ground water level at A.Salapuram (40.46m) and minimum at Maraikulam (8.34m). Pillaiyarnatham (37.09m), Kilavikulam (31.19m), Srivilliputhur (29.70m), Vidthakulam (32.82m), Kurichiyampatti (27.10m), Vadakarai (26.36m), Valayapatti (25.28m) and Ayyanarkoil (04.14m), They are high level of ground water. Whereas Sattur (15.99m), Pulvoypatti (12.65m) , Rajapalayam (11.67m), Amathur (11.03m) , Sethur (8.38m). They are low Ground water level in this region. In Generally Northeast, Northwest & Southwest part notice high water level and the all over the central part of area in low and moderate ground water level in this region.

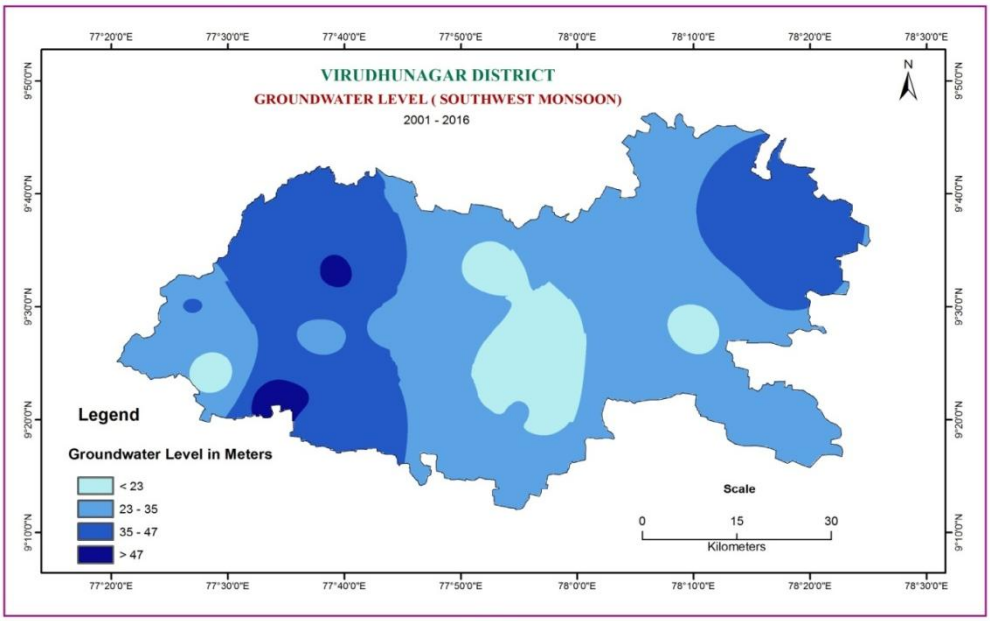
1. High Water Level Zone (above 32m): A.Salapuram, Vidthakulam, Pillaiyarnatham
2. Moderate Water Level Zone (24.32m): Kilavikulam, Kilavikulam, Vadakarai, Kurichiyampatti, Muthuramalingapuram, Ayyanarkoil, Valayapatti.
3. Normal Water Level Zone (16-24m): Saminatham, Vellaihpuram, Vadamalaipatti, Ayyanarkoil, Pandalkudi, Pandalkudi, Perumalthevanpatti, Virudhunagar.
4. Low Water Level Zone (Below 16m): Sattur, Sattur, Rajapalayam, Amathur, Sethur, Maraikulam.



9. Groundwater Level South West Monsoon

The seasonal ground water level during this season found to be maximum at A.Salapuram (59.01m) and minimum Maraikulam (11.55m), Pillaiyarnatham (52.71m), Kilavikulam (49.75m), Virudhunagar (45.75m), Vadakarai, (45.75m), Kurichiyampatti, 44.73m), Srivilliputhur (44.52m), Valayapatti, (39.71m), Muthuramalingapuram (37.64m), They are high Water Level in this region. Whereas Rajapalayam (21.58m), Pulvoypatti(20.31m), Amathur (18.10m), Sethur, (15.60m) and Maraikulam (11.55m) They are Low Ground Water Level in This study area. The high and moderate water level in found the Western and Eastern direction. Normal In all over the Study area and low level in west, central and Eastern parts. And the reason falls under following.

1. High Water Level Zone (above47m): A.Salapuram, Pillaiyarnatham, Kilavikulam.
2. Moderate Water Level Zone (35-47m): Vidthakulam, Vadakarai, Kurichiyampatti, Srivilliputhur, Valayapatti, Perumalthevanpatti, Ayyanarkoil.
3. Normal Water Level Zone (23-35m): Ayyanarkoil, Pandalkudi, Vadamalaipatti, Perumalthevanpatti, Sattur, Sattur, Virudhunagar.
4. Low Water Level Zone (below23m): Rajapalayam, Pandalkudi, Amathur, Sattur, Maraikulam.

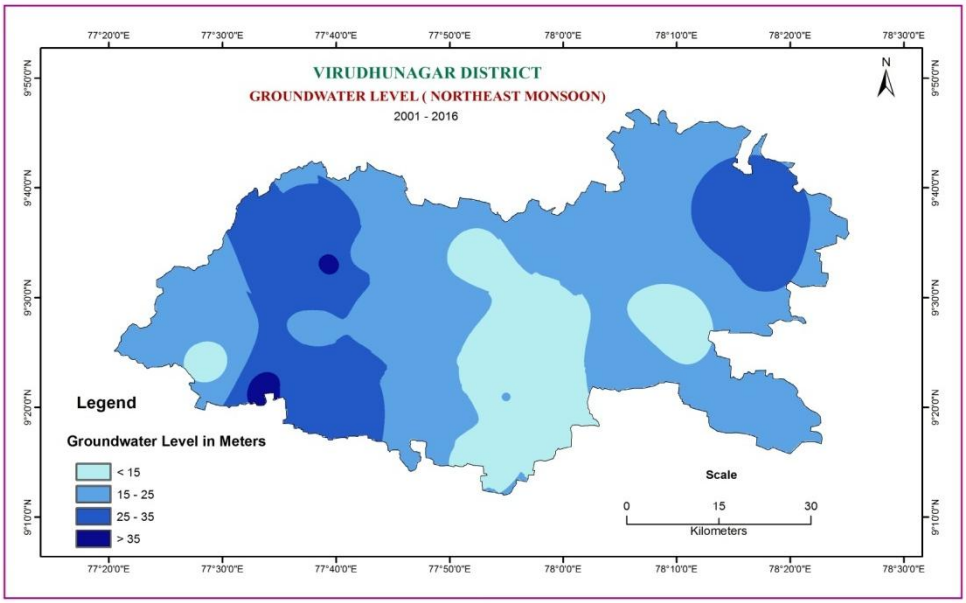


10.

Groundwater Level North East Monsoon

The seasonal groundwater level during this northeast monsoon season found to be maximum at A.Salapuram (43.33m), and minimum, Maraikulam (6.18m). Whereas Pillaiyarnatham (36.52m), Srivillipudhur (31.39m), Kilavikulam (30.03m), Kurichipatti (31.06m), Vidthakulam (30.39m), Vadakarai, (28.09m), Muthuramalingapuram, (26.10m), Ayyanarkoil (24.73m), Ayyanarkoil(22.53m) , Valayapatti(24.40m), Vellaihpuram(22.10m), Saminatham(21.61m), Vadamalaipatti (19.65m), Perumalthevanpatti,(18.88m), Pandalkudi (17.71m) Sattur (16.65m), Virudhunagar(15.94m), Sattur(15.60m), Naduvapatti(14.19m), Rajapalayam(14.07m), Pulvoypatti (11.29m), Amathur(10.12m), Sethur(9.49m), they are gradually decrease overall the study area. In generally southwest and southwest part of the region high water level in this reason. In middle, east and southwest in low level in all over the study area.

1. High Water Level Zone (above 35m): A.Salapuram, Vidthakulam, Pillaiyarnatham.
2. Moderate Water Level Zone (25-35m): Srivilliputhur, Vadakarai, Kurichipatti, Vidthakulam, Kilavikulam, Muthuramalingapuram,
3. Normal Water Level Zone (15-25m): Ayyanarkoil, Ayyanarkoil, Valayapatti, Virudhunagar, Sattur, Sattur, Perumalthevanpatti, Saminatham, Vellaihpuram, Pandalkudi Vadamalaipatti.
4. Low Water Level Zone (below15): Sethur, Rajapalayam, Amathur, Naduvapatti, Pulvoypatti, Maraikulam.



11.Conclusion

- The ground water level data to take the 26 wells and the period is 2001-2016. The high annual average ground water level is 14.05m and low is 2.52m. The high average ground water level on A.Salapuram.
- The winter seasonal ground water level having high is 22.25m and low is 4.16m.
- The summer seasonal ground water level having maximum is 40.46m and the minimum is 8.34m.
- The South West Monsoon seasonal ground water level maximum is 59.01m and minimum is 11.55m.
- The North East Monsoon season ground water level maximum is 43.3m and minimum is 6.18m.
- The ground water level is 16 years seasonal and annual changes are there. The all season and annual maximum at A.Salapuram and minimum at Maraikulam. The small changes on the seasons. The South West Monsoon season is highest ground water level at A.Salapuram (59.01m). And winter season have very low water level at Maraikulam (4.16m). The winter season have low ground water at Central part of the study area. The South West Monsoon season ground water level over all area is high. But, comparatively Western and Eastern part is high ground water level.

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