

Groundwater Level Fluctuations Study for Coimbatore Corporation using GIS

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Abstract. The Current research focuses on the groundwater table evaluation for the management of groundwater resources for the utilization of drinking, domestic usage, agricultural activities and amount of subsurface water available. The research paper deals with water table identification in various locations to understand the availability of groundwater in the study area and also for the demand of water supply, due to population growth and rapid development of industries and urbanized area. The groundwater level fluctuation depends upon climate change, rainfall and soil permeation capacity. To understand the groundwater level variations in the study area, spatial distribution maps are generated by using the GIS software and it is prepared for four seasons namely winter, summer, southwest and northeast monsoon seasons. The spatial distribution maps show that southern region of the study area receives shallow water table less than 10m because of majority of wetlands are located in this region so this area is bestowed with shallow water table level. In winter season spatial distribution map shows that the shallow water table level falls less than 10m comprising the area 24.09 sq.km. The spatial distribution map for northeast monsoon season shows the shallow water table covers an area 21.44 sq.km. The annual average groundwater level map shows that shallow water table covers an area of 14.03sq.km and moderate water table level comprises 108.92 sq.km. The moderate groundwater table level extends from south to south east zone. The total study area is 257.07 sq.km, out of this 24.09 sq.km i.e 9.3% have shallow groundwater table level and 117.8 sq.km have moderate water table level i.e 45.82% falls in this area during the winter season. In this analysis the shallow water table level is located in the southern part, so the resource management can be effectively done in region.

Keywords: Groundwater level, GIS- spatial distribution Map, Coimbatore Corporation, Seasons..

1 Introduction

The groundwater is the most important resources for the human use and agricultural activities. The resource management has a prime role for the assessment of groundwater level and quantity of water.^{1, 2, 3}. The subsurface water level fluctuations can be understood by the spatial distribution map,⁴. This study gives an idea for providing the water harvesting structures where the water having deeper zone and also the water resource management has done effectively⁵. GIS provides spatial information to understand the groundwater table level

in the study region⁶. The groundwater table level spatial distributions maps are generated for season wise.^{7,8}

2 Study Area

The study area selected for this research is Coimbatore Corporation. The figure-1 shows the study area. It is geographically located at Lat N 10°54'45'' and 11°6'12'' and long E 76°52'14'' and 77°3'52''. Coimbatore is the developing city in Tamilnadu, because of Industrial hub and high density urbanized area; the water scarcity is inflated in this region. Therefore the corporation limit was selected for this research work, based on the results the proper utilization of groundwater can be done effectively.

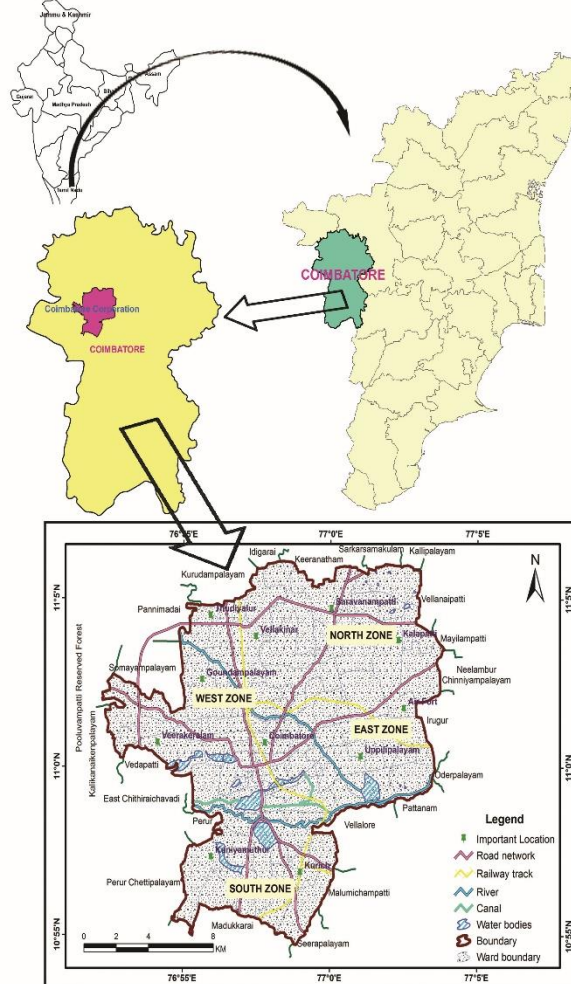


Figure-1: Coimbatore Corporation Map

3 Materials and Methodology

The seven open well systems are identified in and around the study region. The water level data are obtained from Public Work Department (PWD) and Central Groundwater Board (CGWB) to study the water level variations for the period of time 2005-2014. The Arc-GIS software is incorporated for preparing the various spatial distribution maps to understand the water table fluctuations.^{9,10,11}

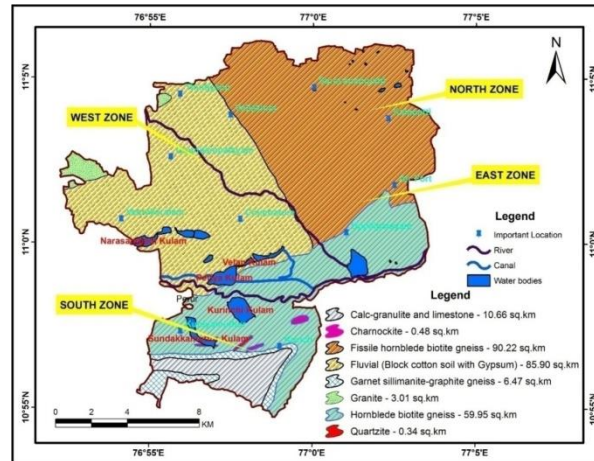


Figure-2: Geology Spatial Map

Geology of Study Area

Geological characteristics of study area emphasis the occurrence of groundwater,¹² in this current study the geology map used to interpret the availability of groundwater the spatial distribution map figure-2 shows that 90.22 sq.km of area is covered under Fissile hornblende biotitegenesis rock in the northern portion of the study area, where as in the southern region the hornblende biotitegenesis rock, calc-granulite and limestone rock possess the good source of groundwater zone because of the high porous in nature^{13,14,15}, The remaining portion of the study area is enveloped with fluvial rock small portions of charnockite and meager of quartzite rock.

Groundwater Table Analysis- Year Wise

The year wise water table level is calculated and tabulated in table-1, it shows that the shallow water table level was noticed in the year of 2007 and deepest water table was noticed in the year of 2011.

Years	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Water Level in m	17.42	15.88	13.65	13.76	14.48	17.90	18.19	14.23	15.86	18.15

Table-1: Yearly water table data (2004 to 2014)

The precipitation was highest in the year of 2011 and it was noticed that the groundwater table increased to the shallow depth in the year of 2012. There is a very good relationship between the rainfall and groundwater table level which is shown in the figure-3.

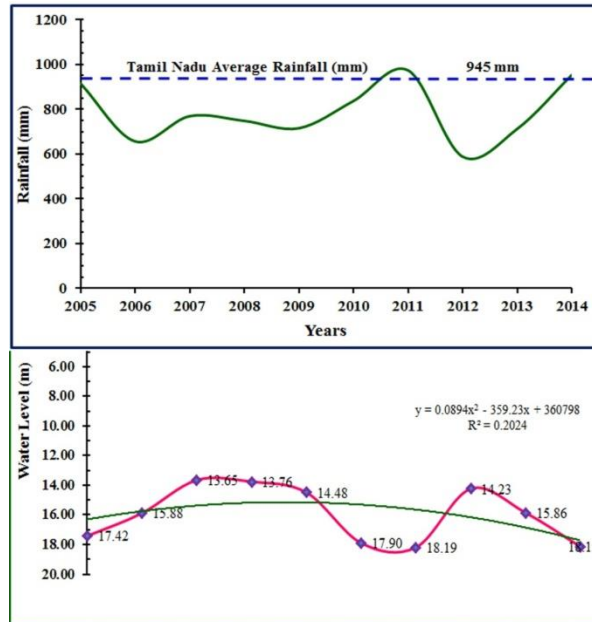


Figure-3: Precipitation and Water table comparison.

Based on the groundwater level data for the various locations in the study area, the kuruchi area is nourished with shallow water table level compared to other regions. The table-2 & figure-2 shows the change in the water table level over a period from 2005 to 2014.

Observation Well Locations	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Coimbatore north	25.54	26.86	16.69	17.02	22.27	31.29	31.80	17.13	14.16	16.30
P.N.Palayam	22.37	18.12	17.33	17.10	19.30	22.84	24.08	23.45	31.07	31.47
Anakatti	11.46	6.44	7.65	8.92	10.84	16.05	16.46	6.85	7.03	11.74
Sugunapuram	14.95	14.60	12.72	11.27	10.41	15.05	14.46	14.07	12.88	15.64
Kuruchi	11.01	10.44	8.95	9.19	7.78	8.76	7.00	7.05	8.70	10.07
Pichanur	8.32	5.59	5.20	4.76	3.71	4.10	2.94	3.36	5.06	5.93
Natchipalayam	28.28	29.12	27.01	28.07	27.08	27.22	30.56	27.72	32.10	35.89

Table-2: Observation well data in m bgl (2004 to 2014).

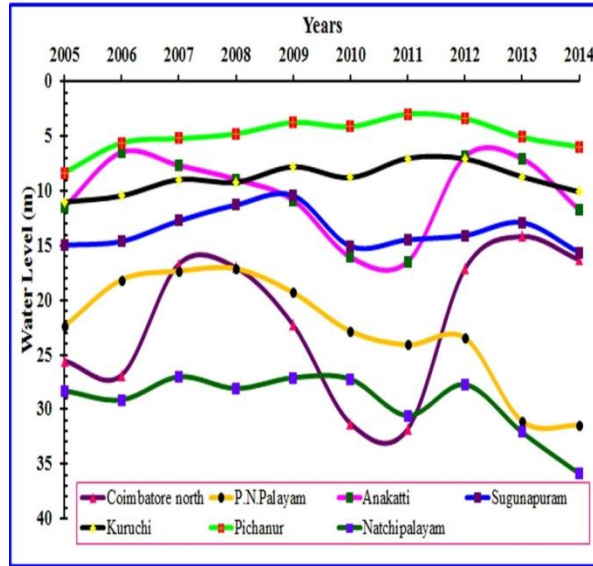


Figure-4: Observation Well Location graph in m bgl (2004 to 2014)
Seasonal water level Analysis

The water level data are segregated and formulated on season wise viz, winter, summer, southwest and northeast and annual average was calculated. The inference on this analysis is shown in table-3 & figure-4. That the water table level moves on increasing trend during the northeast monsoon and extends upto winter season because of the rainfall impact. On other hand, the water table level turned down in southwest and summer season since the water demand was more during this season.

Observation Well Locations	Winter	Summer	Southwest	Northeast	Annual Average
Coimbatore north	22.46	21.66	22.45	21.06	21.91
P.N.Palayam	19.54	22.62	24.63	22.36	22.29
Anakatti	8.77	9.44	11.88	10.26	10.09
Sugunapuram	13.00	14.53	14.11	12.42	13.51
Kuruchi	7.87	9.85	9.26	8.14	8.78
Pichanur	4.25	4.86	5.34	4.77	4.81
Natchipalayam	28.47	29.17	29.89	29.22	29.19

Table-3: Seasonal water table data for Observation well in m bgl

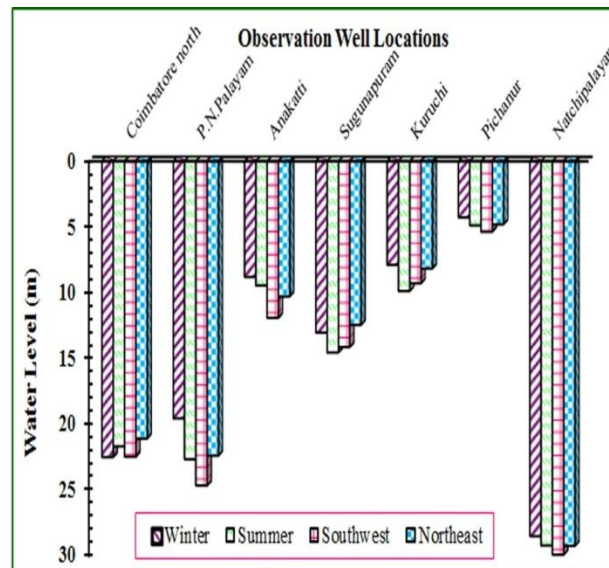


Figure-3: Seasonal water table graph for Observation well in m bgl.

4 Spatial Distribution Study

The spatial distribution map is used to understand the groundwater level in the study region. The seasonal variation of groundwater level is also studied using this map; it provides an idea about the depth of water table level available in the study boundary. If the depth of water is too deep, the artificial recharge sites can be introduced to replenish the groundwater resources. The seasonal changes viz., pre-monsoon and post-monsoon in groundwater level is also studied by using the spatial distribution map.

The categorization of groundwater is inculcated by quartile statistical method. The four groups of groundwater is classified as, shallow groundwater depth, moderate groundwater depth, deeper depth and very deeper depth. The maps are prepared, based on the seasonal changes and annual water level data.

Winter season groundwater level

In the winter season spatial distribution map shows that the water is moving towards northwest to southeast direction. The southern region of the study receives the shallow water table level less than 10 over an area of 24.9sq.km in view of fact that, the majority of surface water bodies are located in southern part. The figure-4 shows that the contour level falls from north zone to south zone. It represents that the southern region has more shallow groundwater table compare to northern region.

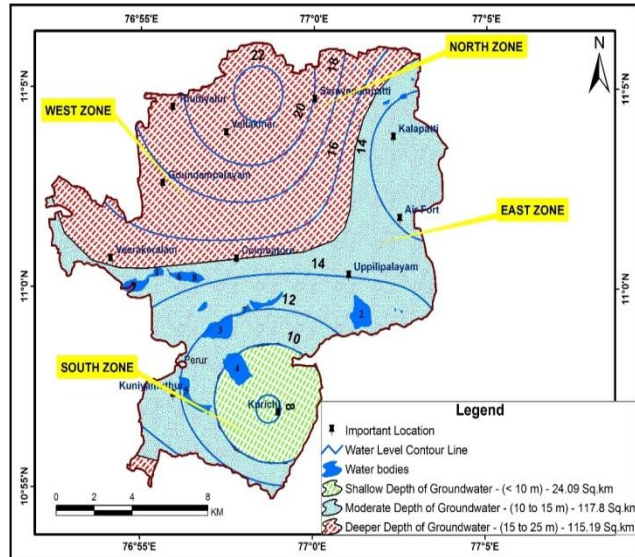


Figure-4: Winter season water level map

Summer season groundwater level

The spatial distribution for summer season map shows that the major study falls under the deeper groundwater level that occupies an area of 168.67sq.km and moderate groundwater table level falls under an area of 86.67sq.km. The shallow water table level falls only in meager quantity. The map infers that the water demand is high in summer season and less downpour. The figure-5 shows the spatial distribution map for summer season.

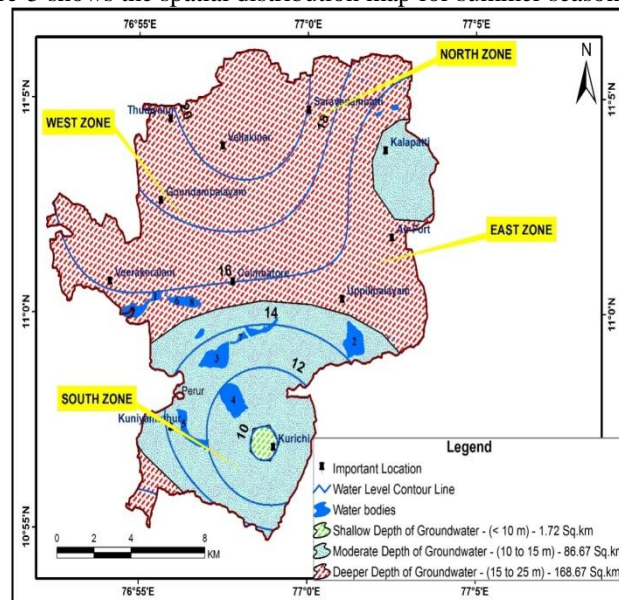


Figure-5: Summer season water level map

Southwest Monsoon season groundwater level

This thematic map reveals that, the shallow depth of groundwater table level occupies an area of 7.86 sq.km and moderate depth of groundwater table covers an area of 82.09 sq.km. The figure-6 shows that the spatial map for southwest monsoon season.

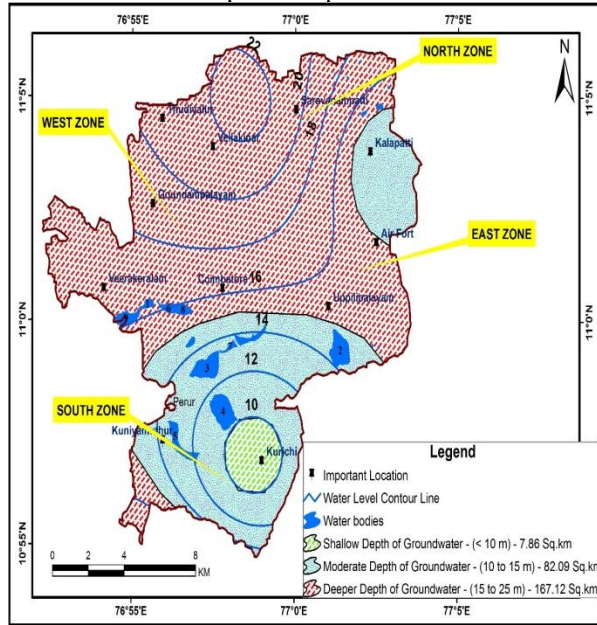


Figure-6: Southwest monsoon season water level map

Northeast Monsoon season groundwater level

The spatial distribution map reveals that the shallow water table depth occupies an area 21.44 sq.km the figure-7 shows that the shallow water table region falls in the southern region because of two water tanks located in this region. The moderate groundwater depth region extends from south east to north east direction.

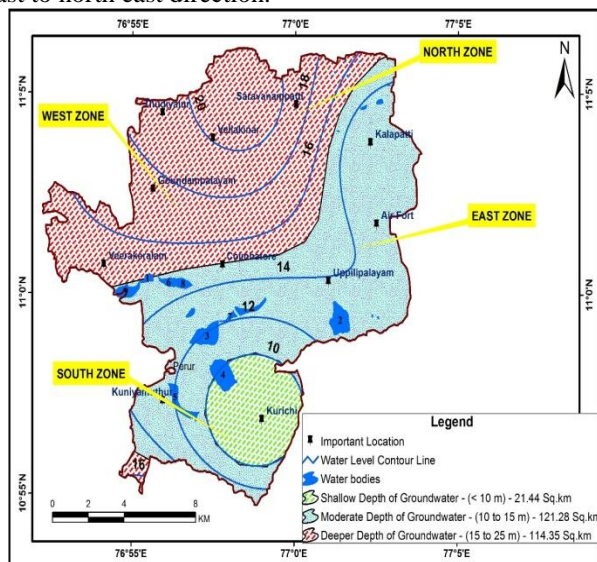


Figure-7: Northeast monsoon season water level map

Annual Mean Groundwater level

The annual mean groundwater level map discloses that the shallow groundwater table level less than 10m covers an area of 14.03 sq.km and the moderate groundwater table level 10m to 15m extends an area of 108.92 sq.km. The southern, southeast portions and Northeast portions possess the moderate to shallow groundwater table level. The figure-8 shows the mean water table level spatial distribution map in that southern area has shallow groundwater table level. The water resources utilization can be done effectively in this region whereas the northern region has deeper water table level, so water rejuvenation structures can be installed to augment the groundwater table level.

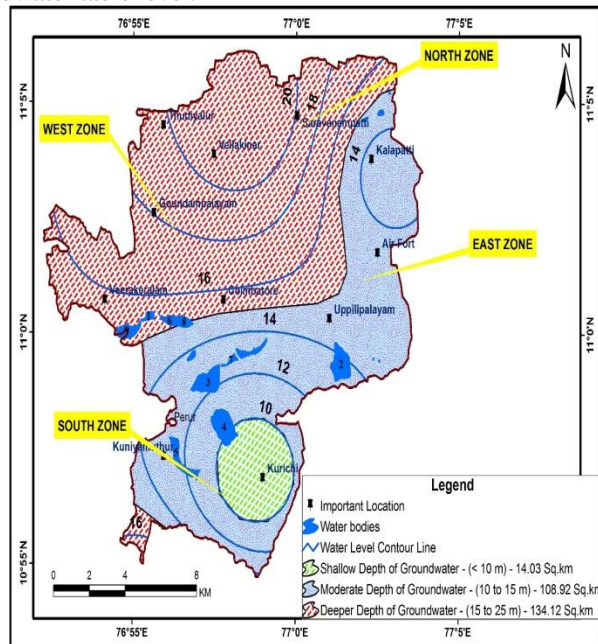


Figure-8: Annual mean water level map

Inference on Shallow Groundwater table

The seasonal spatial distribution map reveals that southern region of study area receives the shallow water table level less than 10m. This is due to the presence of two water tanks in this region namely kurichi and kuniymuthur lake, there will be possibility of water percolation in this region, so it will replenish the groundwater, and also precipitation will have very good interaction with the water table. This statement is exemplified here, during the winter season the shallow water table covers an area of 24.09 sq.km whereas in summer season the shallow groundwater table area shrinks to 1.72 sq.km. This is because of water demand is very high in this season, next season follows the southwest and northeast monsoon. In this the northeast monsoon season receives the more rainfall, therefore the groundwater table is increased rapidly and covers an area of 21.44 sq.km. This shows that the groundwater table depends upon the rainfall.

5 Results and Discussions

The analysis on groundwater table is observed and studied with the help of seven open wells in and around the study area, also by the seasonal spatial distribution maps. In the winter season the shallow groundwater table level covers only 9.3 % in the southern region whereas, others fall in moderate to deeper groundwater table, 55% of the study area encompasses the shallow to moderate depth of groundwater table level. The rainfall phenomenon will also be responsible for the increasing trend of groundwater table; this was confirmed in rainfall analysis. It reveals that in 2011 the rainfall is higher than other years therefore the groundwater table significantly increased in the year 2012. The overall study shows that the southern region has very good groundwater table level, when compared to other zones in the study area, so groundwater pumping and utilization can be beneficially done in this region.

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