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Comparative Analysis for Estimation of Groundwater Potential A-Case Study for Hosur Block, Krishnagiri District , Tamil Nadu

Dr . L.Yeshodha[1] Professor Adhiyamaan College of Engineerig, Hosur
Dr. T.Meenambal[2] Professor Govt. College of Technology, Coimbatore
Dr.G.Ranganna[3] Emiretus Professor University Visweswariah College of Engineering, Bangalore.

Abstract

In view of increasing demand of water for various uses like agricultural, domestic industrial etc., a greater emphasis is being laid for a planned and optimal utilization of water resources. Among the two major water resources, surface and groundwater, it is the ground water resource, which needs to be managed carefully. The hydro-geological features such as sub-soil structure, rock formation, lithology and location of water play a crucial role in determining the potential of water storage in groundwater reservoirs. To assess the groundwater potential, a suitable and accurate technique is required for a meaningful and objective analysis. In this paper, an attempt is made to study the different methods of estimating the groundwater potential and compared to arrive at the most suitable technique for practical utility., In this study, groundwater recharge was estimated by three methods viz, Yearly water level fluctuation, Fluctuation in monsoon season and Ten year average water level fluctuation as recommended GEC (1997). From the study it was observed that Ten year average water level fluctuation method is suitable for our study area based on the observed maximum recharge. The results of this study helps in accurate prediction of groundwater availability, which in turn may avoid groundwater over exploitation and can also suggest suitable artificial recharge structure to store water in the study area.

Key Words: **Groundwater , Water level fluctuation, Groundwater potential**

Introduction

Water contained in the voids of the geological materials that comprise the crust of the earth is the groundwater. It exists at a pressure equal to or greater than the atmospheric pressure. Groundwater recharge is the process by which water percolates down the soil and reaches the water table, either by natural or artificial methods. Quantification of the rate of natural ground water recharge is a pre-requisite for efficient groundwater resource management. The important hydrogeological parameters such as porosity and hydraulic conductivity of the geological stratum determine the performance of the aquifer. Added to this is the length of data considered for predicting the groundwater recharge. The rate of aquifer recharge is one of the most difficult factors to measure in the evaluation of ground water resources. Estimation of recharge, by any method is normally subject to large uncertainties and errors. This paper presents the methods for estimation groundwater recharge of Hosur block, Krishnagiri district, Tamilnadu. The approach accounts for different time periods for the recharge potential of the aquifer. A comparative evaluation is made on these method.

Study Area

The Hosur block of Krishnagiri district in Tamilnadu, located about 45 km from Bangalore city. It lies between a latitude of 12 ˚7'-12˚44'N and longitude of 77˚30'-78˚27'E occupying an area of about 275 sq.km. The study area receives an average rainfall of 822.3 mm per annum, with maximum rainfall of around 900 mm and minimum rainfall is around 700 mm. The geological formations consist of hard rock's of granite or gneiss formation. Groundwater generally occurs under phreatic conditions in the weathered mantle and under semi-confined conditions in the fractured zones at deeper levels. The thickness of weathered zones in the block ranges from less than 0 meter to more than 15 m. The aquifer existing in the study area is unconfined type. The yield of well in the block ranges from 100 lpm to 500 lpm. The depth of groundwater level ranged between 2.0 m to 9.9 m below ground level. The study area map is shown in Fig No 1.0

Field Data's Collected

Monthly rainfall data for a period of ten years during 2001-2010 was collected from Hosur Taluk office, Hosur, Monthly groundwater level data for seven observation wells in the block was collected from PWD, Groundwater division, Dharmapuri district, Tamil Nadu. The details of the locations of the seven observation wells are shown Table 1.0 and the groundwater level data of the observation well are shown in Table 2.0

Methodology

The commonly used method for estimation of groundwater storage available annually as recommended by GEC (1997) is, Q =Area influencing the well x depth of fluctuation in groundwater table x specific yield (1)

Area influencing the well is obtained by Theissan polygon method using ARC GIS Software. The Specific yield values were considered as per the recommendation of GEC 1997.

Estimation of Groundwater Recharge

Estimation of groundwater recharge was analysed by three methods viz, Yearly Water level fluctuation, Water level fluctuation in monsoon season and Average water level difference between highest and lowest water level for ten years.

Recharge by Yearly water level fluctuation

In this method, fluctuation of groundwater is taken as the difference of highest (of the second season) and the lowest (of the first season) in the year is used in equation (1) and the recharge value is estimated for all the seven observation wells for the period of 2001-2010.

Recharge by water level fluctuation in Monsoon season

In this method, groundwater recharge is estimated by taking the difference between highest and the lowest water levels during the monsoon season (June to September). is used in equation (1) recharge value is estimated for all the seven observation wells for the period of 2001-2010.

Recharge by Average water level difference over ten year

The estimation is worked out for an average fluctuation over ten years. The difference between the highest and the lowest fluctuations for every year is taken and an average over ten years is calculated. This is done for all observation wells and the quantity of recharge is calculated.

Result and Discussions

The groundwater fluctuation over the entire study period was analyzed and the estimated values of recharge for a period of ten years from 2001-2010 by three different methods are shown in Table 3.0, 4.0 and 5.0 and the comparison of the recharge potential by the three methods are shown in Table 6.0. From Yearly water level fluctuation method it was observed that the maximum recharge as occurred in Hosur Tank location and the minimum has occurred in Agaram. It is because of the fact that the surrounding area consists of many of lakes and ponds near Hosur Tank. From the recharge estimation by Water level fluctuation during the Monsoon season it was observed that the maximum recharge of 56457 cu.m occurred in the Bagalur location and minimum of 9045 cu.m, has occurred in Agaram. It is due to the fact that the runoff in this region is less and infiltration is more. From the recharge estimated by the Average water level fluctuation over ten years it is observed that the maximum recharge of 63837 cu.m has occurred in Bagalur and minimum of 13770 cu.m in Agaram observation well. Agaram location shows less recharge since that location is the hard rock region and percolation is very low. As per the groundwater estimation committee norms, the results obtained by the three methods are close to the assessment made by the Groundwater board which can be used for planning of water resources for Hosur block. In particular the first method is more conservative and the third method is best suited for the estimation of groundwater recharge.

Table 1.0 Details of Observation Well of Study area

Well No	Observation well Location	Mean Sea Level (m)
53031	Kamaraj Colony	845.325
53032	Hosur near tank	840.124
53029	Perandapalli	812.135
53030	Bagalur	829.255
53045	Mathigiri	826.190
53076	Kaganur	856.970
17093	Agaram	836.241

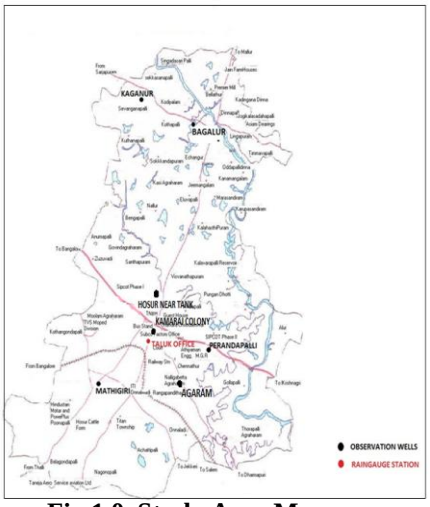

Fig 1.0 Study Area Map

Table 2.0 Variation in Groundwater Level Fluctuation

	Kamaraj colony		Hosur Tank		Perandapalli		Bagalur		Mathigiri		Kaganur		Agaram	
Year	Rise	Fall	Rise	Fall	Rise	Fall	Rise	Fall	Rise	Fall	Rise	Fall	Rise	Fall
2001	3.18	1.4	0.78	0.51	0.73	0.38	1.82	0.91	0.43	0.39	1.09	0.67	0.67	0.53
2002	1.58	1.05	1.28	0.66	0.29	0.41	0.89	0.56	1.2	1.31	0.99	0.5	0.71	0.47
2003	0.31	1.5	0.81	0.99	0.89	0.51	0.99	0.8	1.55	0.72	0.77	0.68	0.46	0.59
2004	3.3	1.7	2.82	3.35	0.63	0.46	0.47	0.41	1.13	0.53	0.7	0.55	0.64	0.75
2005	1.92	0.73	1.46	0.85	1.72	0.5	0.41	0.46	1.83	1.09	0.68	0.65	0.77	0.33
2006	0.85	1.58	1.18	0.83	0.46	0.66	0.62	0.52	0.05	0.58	0.82	0.64	0.43	0.44
2007	2.56	0.76	2.85	0.72	1.1	0.47	1.25	1.08	0.38	0.17	0.71	0.5	0.51	0.48
2008	1.97	1.12	1.98	1.23	0.89	0.62	0.9	1.59	1.09	0.56	0.49	0.7	0.47	0.47
2009	0.33	0.56	1.35	1.56	0.93	0.6	0.53	1.1	0.86	0.61	0.49	0.9	0.65	1.25
2010	0.5	0.59	1.4	1.06	1.25	0.8	1.34	0.6	0.41	0.46	0.66	0.54	0.66	0.67

Table 3.0 Recharge by yearly fluctuation method

Observation well	Well No	Area influencing the well x10^6sq.m	Depth of fluctuation (m)	Specific Yield	Recharge cu.m
Kamaraj Colony	53031	0.52	1.64	0.03	25584
Hosur Tank	53032	1.02	1.6	0.03	48960
Perandapalli	53029	0.62	1	0.03	18600
Bagalur	53030	1.23	1.02	0.03	37638
Mathigiri	53045	0.85	0.94	0.03	23970
Kaganur	53076	1.3	0.76	0.03	29640
Agaram	17093	0.45	0.62	0.03	8370
				Average	**27537**

Table 4.0 Recharge by water level fluctuation in Monsoon season

Observation well	Well No	Area influencing the well x10^6sq.m	Depth of fluctuation (m)	Specific Yield	Recharge cu.m
Kamaraj Colony	53031	0.52	1.01	0.03	15756
Hosur Tank	53032	1.02	1.54	0.03	47124
Perandapalli	53029	0.62	1.06	0.03	19716
Bagalur	53030	1.23	1.53	0.03	56457
Mathigiri	53045	0.85	0.67	0.03	17085
Kaganur	53076	1.3	1.15	0.03	44850
Agaram	17093	0.45	0.67	0.03	9045
				Average	**30,004**

Table 5.0 Recharge by average water level difference over ten years

Observation well	Well No	Area influencing the well x10^6sq.m	Depth of fluctuation (m)	Specific Yield	Recharge cu.m
Kamaraj Colony	53031	0.52	1.21	0.03	18876
Hosur Tank	53032	1.02	1.70	0.03	52020
Perandapalli	53029	0.62	1.93	0.03	35898
Bagalur	53030	1.23	1.73	0.03	63837
Mathigiri	53045	0.85	0.94	0.03	23970
Kaganur	53076	1.3	1.35	0.03	52650
Agaram	17093	0.45	1.02	0.03	13770
				Average	**37288**

Table 6.0 Comparison of Recharge Estimated by Three methods

Observation well	Yearly Water level fluctuation cu.m	Monsoon water level fluctuation cu.m	Average water level over ten years fluctuation cu.m
Kamaraj Colony	25584	15756	18876
Hosur Tank	48960	47124	52020
Perandapalli	18600	19716	35898
Bagalur	37638	56457	63837
Mathigiri	23970	17085	23970
Kaganur	29640	44850	52650
Agaram	8370	9045	13770
Total Average Recharge	**27537**	**30004**	**37288**

Conclusions

In this work, the optimum average recoverable groundwater reserve that can be exploited from the aquifer was found out using different time scale for the depth of fluctuation. Among the three methods, the recharge obtained by the first method is more conservative and the results obtained from the third method are best suited for recharge of groundwater in Hosur region. Further it shows that , Bagalur region can store bulk of recharge from the precipitation received and hence a suitable site can be suggested to construct an artificial recharge structure like percolation tank in this region to conserve water.

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Biography

Dr.L.YESHODHA received the B.E degree in Civil (Transportaion) Engineering from Bangalore university, Bangalore, Karnataka in 1988.The M.E degree in Water Resources Engineering from Bangalore university, Bangalore, Karnataka in 1997 and the Ph.D degree in Civil Engineering from Anna University, Chennai, Tamilnadu. Currently is a professor of Civil Engineering department at Adhiyamaan College of Engineering, Hosur, Tamilnadu. Her teaching and research area includes Hydraulics, Water Resources Engineering and Transportation Systems. **Dr.L.YESHODHA,** Professor may be reached at yesocivil123@yahoo.co.in