Jr. of Industrial Pollution Control 27(1)(2011) pp 15-18

GROUND WATER QUALITY IN THE SINGANALLUR SUB-BASIN OF COIMBATORE CITY

K.L. PRIYA*, NALINI JEBASTINA AND G. PRINCE ARULRAJ

School Of Civil Engineering, Karunya University, Coimbatore 641 114, Tamil Nadu, India

Key words : Ground water quality, Water resources, Water Quality Index, Statistical analysis.

ABSTRACT

The city of Coimbatore has been facing from water scarcity due to the degradation of water resources. The main cause of degradation of quality of water in the city is due to unscientific practices of agriculture and disposal of domestic and industrial waste into water bodies. This has in turn degraded the ground water. Unless continuous monitoring of quality of ground water is practiced, the entire city will be in severe water crisis. The Noyyal river of Cauvery basin, which is feeding the different tanks is polluted by domestic and industrial sewage. Of the different tanks, Singanallur tank is the biggest and most polluted one. In the present study, the ground water quality of the Singanallur sub-basin have been analysed to check its suitability for drinking, irrigation as well as domestic usage. The results were compared with the BIS/ICMR standards for ascertaining its suitability for drinking purposes.

INTRODUCTION

The metropolitan city of Coimbatore, called as the Manchester of South India, is one of the important industrial towns. It has a geographical area of 140 km^2 with an average altitude of 470 m. Situated at $11^{o}00'$ N latitude and $77^{o}00'$ E longitude, the Coimbatore district is flanked on the northwest and south by steeply raising mountains of Western Ghats. Of these, the Nilgiris on the north west and Anamalai on the south are the important ranges, which attain a height of over 2500 m above mean sea level. The city is situated near the banks of Noyyal river, which emerges in the Vellingiri hills of Western Ghats and flows over a distance of 180 km in an area of 3510 sq.km to join the river Cauvery at Karur district. The city has a number of tanks (around 18) which are the main source of water for agricultural, fishery and domestic activities. The river Noyyal is a seasonal river and hence there will be flow only during rainy season. The city has no proper drainage or sewerage system and hence the sewage is discharged into the river. Thus the polluted water reaches the different tanks which form the part of the Noyyal river system. Of the different tanks of the Noyyal river system, Singanallur tank is one of the biggest tanks having a catchment area of the tank is 11.776 sq.km. The registered ayacut is 845 acres. The full tank level is 4.25 m. The maximum flood level is 5.17 m and the water spread area is 1.153 sq.km.

METHODOLOGY

Selection of sampling stations

***Address for correspondence - Email :** piya_kl@yahoo.co.in

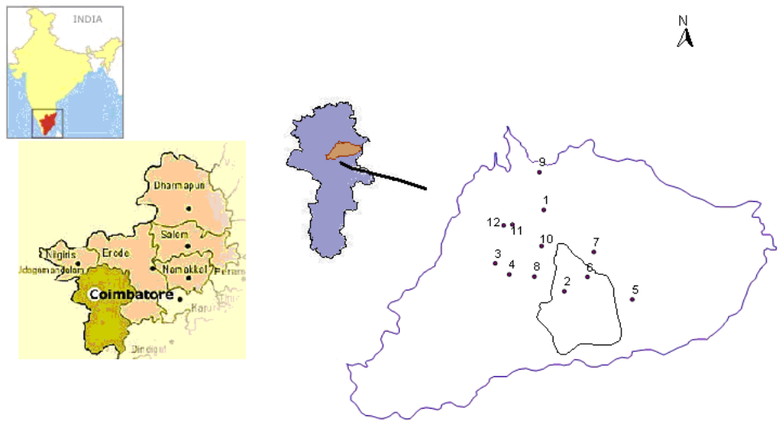

Figure 1 Sample Locations

Survey of India (SOI) toposheets on 1:50,000 scales were used to prepare the base map of the study area. The sub-basin of the tank was prepared from the contour and drainage map using AUTOCAD 2007. The northern part of the tank was selected for the study, which was highly residential area. Some part of the study area comprised of even agricultural land. Total ten ground water samples were collected from nearby wells. Water from the Singanallur tank water was also collected for finding the quality of water (Figure 1).

Qualitative Analysis

Samples collected were analysed for various physio-chemical parameters as per APHA (American Public Health Association) standard methods. The parameters selected include chlorides (cl), Total Dissolved Solids (TDS), Total Hardness (TH), Calcium Hardness (Ca), Magnesium Hardness (Mg), Dissolved Oxygen (DO), Sulphates (Sulp).

Water Quality Index

Water Quality Index for the sampling stations were calculated by using the formula,

$WQI = \text{antilog } \Sigma^{n}_{i=1} W_i \log 10\ q_i$,

where W_i is the weightage for each parameter and q_i is the quality rating. Weightage is calculated as,

$W_i = K / \Sigma S_i$,

where K is the proportionality constant given by

$K = 1 / \Sigma^{n}_{i=1} (1 / \Sigma S_i)$,

S_i is the standard value as per WHO / BIS / ICMR for each parameter. The quality rating,

$q_i = 100 * \{(V_{actual} - V_{ideal}) / (V_{standard} - V_{ideal})\}$,

where V_{actual} and V_{ideal} are the observed value and ideal value for each parameter respectively and $V_{standard}$ is the standard value for each parameter as per BIS/ICMR standards. V_{ideal} for pH is taken as 7 and that for DO is taken as 14.6 mg/L for all other parameters, its value is 0.

The standard values as per BIS / ICMR standards for drinking water and the weightages for each parameter are given in Table 1. Based on the water quality index (WQI) water was classified as given in Table 2.

Statistical Analysis

The correlation between various parameters were determined using,

$r = \Sigma xy / (\Sigma x^2 * \Sigma y^2)$

where, $x = X - X_1$, $y = Y - Y_1$, X and Y represents two different parameters and X_1 represents mean of X and Y_1 represents mean of Y.

RESULTS AND DISCUSSION

The results of qualitative analysis are given in Table 3. The Water Quality Indices of different locations are given in Table 4.

The results of the analysis show that the ground water is highly saline due to the geological formation of the area. The hydrogeological studies reveal that the soil is high in bicarbonate and chlorides which resulted in a high TDS and hardness. The pH value of water shows that the water is slightly alkaline in some areas; the highest pH reported being 7.24 due to bicarbonates. The percolation of agricultural waste as well as domestic waste into the ground water also

Table 1. Standard values as per BIS/ICMR and weightages

Sr.No.	Parameter	Standard value	Weightage
1.	Chlorides	250 mg/L	0.010426
2.	Total Dissolved Solids	500 mg/L	0.005213
3.	Total Hardness	300 mg/L	0.008689
4.	Calcium	75 mg/L	0.034754
5.	Magnesium	30 mg/L	0.086885
6.	Dissolved Oxygen	4 –6 mg/L	0.521312
7.	pH	6.5–8.5	0.306654
8.	Alkalinity	200 mg/L	0.013033
9.	Sulphates	200 mg/L	0.013033

Table 2. Classification of water based on WQI

WQI Rating	0 - 20 Highly desirable (HD)	21 - 40 Desirable (D)	41 - 60 Moderately suitable (MS)	61 - 80 Poorly suitable (PS)	81 - 100 Very Poor (VP)	>100 Unfit for drinking (UFD)
Ranking of WQI	1	2	3	4	5	6

Table 3. Results of qualitative analysis

Parameter	maximum	minimum	mean	Standard Deviation
Chlorides	2793.1	180.2	1097.04	798.47
Total Dissolved Solids	8800	800	3200	2320
Electrical conductivity	7.54	1.22	4.38	2.69
Total Hardness	2120	320	840	547.88
Calcium hardness	800	60	255.8	224.44
Magnesium hardness	1320	240	584.2	331.95
Dissolved Oxygen	6.9	0.9	5.14	1.86
pH	7.24	6.4	6.84	0.26
Alkalinity	740	290	540	121.51
Sulphates	430	95	197.1	108.11

Note: All parameters except pH are in mg/L.

Table 4. Water Quality Indices

Sample	Location	Details	WQI	Rating
1	Uppilipalayam	BW	134.66	UFD
2	Tank (West)	T	67.32	PS
3	Central studio	BW	63.79	PS
4	LCC	OW	58.12	MS
5	Vellalore road	OW	81.44	VP
6	Tank (North)	T	81.15	VP
7	LC road	OW	54.25	MS
8	Kallimadai	BW	35.99	D
9	Lakshmipuram	BW	52.66	MS
10	Kasturinagar Thottam	OW	77.63	PS
11	Rajiv Nagar	BW	101.32	UFD
12	Periyathottam	OW	96.62	VP

Note : BW – bore well, OW – open well, T – tank

Table 5. Correlation matrix

	cl	TDS	EC	TH	Ca	Mg	DO	pH	alk	Sulp
Cl	1	0.9853	0.9848	0.8683	0.8241	0.8759	0.265	-0.8716	-0.0125	0.9176
TDS		1	0.9919	0.8199	0.7906	0.8188	0.2576	-0.8424	0.0181	0.9315
EC			1	0.8456	0.8081	0.8493	0.2818	-0.8869	0.1060	0.9393
TH				1	0.9774	0.9897	0.0595	-0.8703	-0.0874	0.8709
Ca					1	0.9370	-0.0056	-0.8264	-0.114	0.8612
DO						1	0.1020	-0.8777	-0.0672	0.8552
Mg							1	-0.2865	0.1799	0.0388
pH								1	-0.3048	-0.8207
Alk									1	0.0827
Sulp										1

increased the dissolved solids content. The tank water was reported having a less DO in location 2, where a domestic sewage disposal site was noted. The area comprised of highly thick residential area. The tank water flows from north west to south east, so there was a marginal increase of DO at location 6. In many areas, the soil is rich in $Cacl_2$ and $Mgcl_2$. of the ten ground water samples, Kallimadai locations scored the best with a WQI of 36, indicating that the water can be used for drinking purposes. The sample locations 4, 7 and 9 have been classified as moderately suitable and the water can be used for other domestic purposes such as flushing toilets. The area enclosing sample locations 1, 11 and 12 a local pollution from agricultural area is suspected because the area comprises of agricultural land. The agricultural wastes get percolated and have contaminated ground water. The other locations showed high WQI and the main contribution to high TDS, chlorides and hardness is the geological formation of the soil.

In order to understand the relationship of different parameters, statistical studies were conducted for the parameters. Table 5 shows the correlation matrix for the parameters.

The correlations between different parameters show that a good correlation exists between TDS with EC, and hardness with Ca and Mg. Sulphates also showed a good correlation with chlorides, TDS and EC. pH had a negative correlation with all the parameters.

CONCLUSION

The study resulted in the qualitative classification of ground water of the Singanallur sub-basin.The areas such as Uppilipalayam, Rajiv Nagar and periyathottam was suspected to be affected with local pollution from agricultural source. The areas such as Kallimadai, LCC, LC road and Lakshmipuram showed better results where the water can be used for domestic purposes. The water from Kallimadai can even be used for drinking purposes. The tank water was of bad quality because of the discharge of domestic sewage. Steps have to be taken to improve the quality of tank water by implementing pollution prevention measures such as keeping standards for sewage discharge into water bodies, implementing scientific agricultural practices so that water resources can be used effectively.

REFERENCES

Americal Public Health Association, (APHA), 1998. *Standard Methods for the Examination of Water and Waste Water,* 18th edition. MWWA&WPCF, Washington.

Asadi, S. S., Padmaja Vuppala and Anji Reddy, M. 2007. Remote sensing and GIS techniques for evaluation of groundwater quality in municipal corporation of Hyderabad (Zone-V), India. *Int. J. Environ. Res. Public Health*. 4 (1) : 45-52.

BIS: 10500, 1991. Specifications for drinking water, Indian Standard Institutions (Indian Bureau of Standards), New Delhi.

Mishra, B.B., Chaturvedi, G.B. and Tewari, D.D. 2008. Water quality index and suitability of water of Kohargaddi dam at district Balrampur, India. *Poll Res*. 27 (3) : 497-500.

Rao, K.R., Krishnan, R., Chakraborthy, A.K. and Deekshatulu, B.L. 1980. Correlation of water quality parameters and products of exotech radiometer bands. *Jr.Photo-Int.& Remote Sensing*. 8 (2).

Shyamala, R., Shanthi, M. and Lalitha, P. 2008. Physicochemical Analysis of borewell water samples of Telungupalayam area in Coimbatore district, T.N., India. *E-Journal of Chemistry.* 5 (4) : 924-929.