Quality Analysis of Ground Water in Avadi, Chennai, Tamil Nadu

Sowmiya.K, Vinodh.K.R

Abstract*: *The estimation of water quality is very important to know its suitability for various purposes. Water is very important and it is also used for various activities. This study was carried out to evaluate the groundwater quality in Avadi area. To find its suitability various testes like physico-chemical parameters and trace metals have been analyzed. From the study area various water samples were collected and analyzed. The results showed that from residential areas most of the water quality is above the permissible limits of BIS and WHO. In an average more amount of sample is above the permissible limit, which is very harmful for our health hence they are not used as a drinking water. Thus treatment of water should be done before it is used as a drinking water.

Keywords: Physico-chemical parameters, trace metals, BIS, water quality, groundwater.

I. INTRODUCTION

Groundwater is mostly used as a drinking water; and it is also essential for various other activities. Water covers about 70% of the surface of the Earth. Water is an important resource for the people and the environment. Polluted water is hazardous to human beings and also it is dangerous for many other activities and it is very important to identify the quality of water.

II. STUDY AREA

Avadi is an area which is located in western part of metropolitan city of Chennai Tamil Nadu. As of 2011, the town had a population of 345,996.Avadi is located at 13°07'N 80°06'E / 13.12°N 80.1°E. The Areal extent of the selected study area is 46.25sq.km. The rainfall in that area is about 1108 mm in that district. The weather is good at the time of collection of water samples. The yearly average temperature is 25.3° and 32.9°C respectively.
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Fig.1 Map showing Avadi

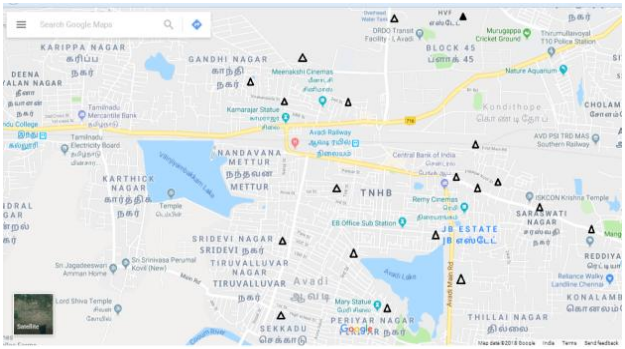

Fig. 2 Study area map

III. METHODS AND MATERIAL

Selection of monitoring wells in order to collect the groundwater samples is important for assessing the groundwater quality.
Twenty sampling points were selected using Google Earth for the collection of water samples. Samples are taken in bottles of 2 liters capacity and analyzed for their physico-chemical parameters and metal content. The water is taken from the post monsoon of January 18, 2018. Samples were tested and test results were tabulated. The parameters are pH, chloride, nitrate, nitrite, phosphate, ammonia, fluoride, residual chlorine, TDS, TH and total alkalinity. These results were compared with World Health Organization Standards (WHO) limits. The test results are analyzed to find the quality and suitability of water sample. And also the selected trace metals Ni, Mn, Cu, Co, Fe, Cr and Zn are tested by using Atomic Absorption Spectrometer (AAS).Software package Arc GIS 9.3 is used for image processing application and GIS applications respectively

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Sowmiya.K, PG student, Department of Civil Engineering, Jerusalem college of Engineering, Chennai, Tamil Nadu, India.
Vinodh.K.R, Assistant Professor, Department of Civil Engineering, Jerusalem college of Engineering, Chennai, Tamil Nadu, India.

IV. RESULTS AND DISCUSSION

Groundwater quality maps are used find the usability of the water for different purposes. The spatial database generated to analyze the parameters like pH, alkalinity, Total Dissolved Solids, hardness, ammonia; Fluoride, chloride, nitrite, nitrate, phosphate and residual chlorine of the samples were analyzed. Also the trace metals namely Nickel, Cobalt, Copper, Iron, Manganese, Chromium and Zinc of the samples were found.

A. Water quality index

The WQI is compared with the water quality parameters. The calculation is done and it is then compared with (BIS) and (ICMR) and weighted index method to find whether this water can be used for the drinking purposes. In this study WQI is found by using the following formulae.

A.1 Water quality index calculation

By using Horton's method the calculation of WQI was carried out. The WQI is calculated by using the following Equation.

$$WQI = \sum qnWn / \sum Wn \quad (1)$$

Where,

q_n = Quality rating of nth water quality parameter.

W_n= Unit weight of nth water quality parameter.

A.2 Quality rating (q_n)

The calculated of quality rating (qn) is done using

$$q_n = [(V_n - V_{id}) / (S_n - V_{id})] \times 100 \quad (2)$$

Where,

V_n = Estimated value of nth water quality parameter at a given sample location.

V_{id} = Ideal value for nth parameter in pure water.

(V_{id} for pH = 7 and 0 for all other parameters)

S_n= Standard permissible value of nth water quality parameter.

A.3 Unit weight

The unit weight (W_n) is calculated using

$W_n = k/S_n$ Where,

Sn = Standard permissible value of n the water quality parameter.

k = Constant of proportionality and it is calculated by using k

$$= [1(\sum 1/ Sn = 1,2,..n)] \quad (3)$$

B. Water quality index and status

The WQI and their possible uses are shown in the table.1

Table.1 WQI and corresponding water quality status (IJERT, Volume 07, Issue 05 (May 2018))

NO	WQI Status	Possible usages
1	0 – 25	Excellent Drinking, Irrigation and Industrial
2	25 – 50	Good Domestic, Irrigation and Industrial
3	51 -75	Fair Irrigation and Industrial
4	76 – 100	Poor Irrigation
5	Above 150	Unfit for Drinking Proper treatment required before use.

C. Standard values of water quality parameters

The parameters for the various water qualities are selected. The parameters are then compared with, (ICMR) and (ISI).The calculation of the study area for WQI has been done. The values are found high above the permissible limits in some of the samples. The higher values will increase WQI value.

Table.2 Standard values of water quality parameters and their corresponding ideal values

Parameters	S_n (mg/L)	Recommending Agency for S_n	Ideal Value (V_{id})	K value
pH	8.5	BIS	7	0.109
Alkalinity	200	BIS	0	0.109
Hardness	200	BIS	0	0.109
Chlorides	250	BIS	0	0.109
TDS	500	BIS	0	0.109
Fluoride	1	BIS	0	0.109
Ammonia	0.5	BIS	0	0.109
Nitrate	45	BIS	0	0.109
R.Chlorine	0.2	BIS	0	0.109
Phosphate	1	BIS	0	0.109

D. Water quality index of the study area

Based on the permissible limits the chemical parameters are compared. The calculation is done to find the WQI.

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Table.3 WQI values of samples

Sample ID	WQI
1	49.5
2	22.3
3	27.8
4	22.7
5	28.2
6	23.0
7	17.3
8	50.5
9	61.0
10	76.7
11	99.7
12	17.0
13	76.0
14	77.1
15	88.9
16	94.5
17	50.7
18	76.7
19	38.5
20	33.5

Table.4 WQI of the samples

WQI	Status	Representing samples
0 – 25	Excellent	S2, S4, S6, S7, S12
25 – 50	Good	S1, S3, S5, S19, S20
51 -75	Fair	S8, S9, S17
76 – 100	Poor	S10, S11, S13, S14, S15, S16, S18
Above 150	Unfit for drinking	Nil

The WQI of the sample has 25% samples are excellent, 25% are good, 15% are fair and 35% are poor (IJERT, Volume 07, Issue 05 (May 2018)).

E. Physico-chemical and Trace metal analyzed

The samples were collected and both the physico-chemical parameters and trace metal were compared with the permissible

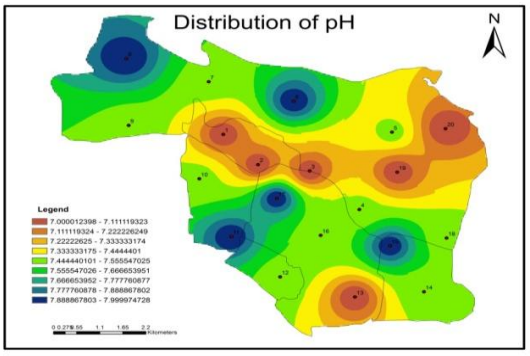
Table.5 & 6 Showing the Physico-chemical and Trace metal of the water sample

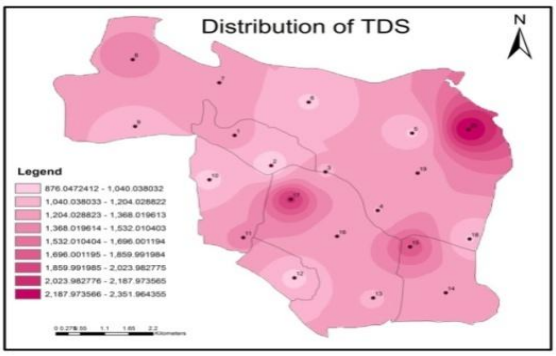
pH	Alkalinity	Hardness	Cl	F	NH_3	NO_2	NO_3	PO^3_4	TDS	R.cl
7	290	460	290	1.5	0.5	0	20	1	1248	0
7	270	370	90	1.5	0	0	20	0.5	876	0
7	390	290	310	1.5	0	0	45	1	1188	0
7.5	380	270	350	1.5	0	0	45	0.5	1200	0
7.5	220	270	360	2	0	0	45	0.5	1020	0
8	280	290	280	1.5	0	0	20	0.5	1020	0
7.5	380	210	280	1	0	0	20	0.5	1320	0
8	400	440	350	1.5	0.5	0	20	0.5	1428	0
7.5	320	340	300	1	1	0	45	0.5	1152	0
7.5	310	240	280	0.5	0.5	0.5	10	2	996	0
8	400	470	290	1.5	0.5	0	45	1	1392	0
7.5	310	280	240	0.5	0	0	45	0.5	996	0
7	350	400	240	2	0	0	45	0.5	1188	0
7.5	400	350	300	1.5	0	0	45	0.5	1260	0
8	340	280	890	1.5	0.5	0	45	0.5	1812	0
7.5	350	300	380	0.5	3	2	15	2	1236	0
8	380	990	350	2	1	0.2	45	0.5	2064	0
7.5	310	290	260	2	0.5	0	45	0.5	1032	0
7	390	300	380	3	0	0	20	0.5	1284	0
7	240	720	850	1	1	0	45	0	2352	0
7.4	333.	398	365	1.7	0.5	0.2	49	07	1331	0

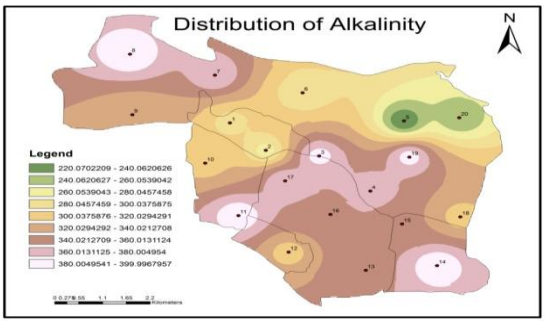
S.No	Co	Ni	Cu	Mn	Fe	Cr	Zn
1	0.15	0.058	0.061	0.055	0.235	0.29	0.023
2	0.036	0.09	0.072	0.032	0.239	0.3	0.022
3	0.049	0.045	0.043	0.023	0.101	0.447	0.305
4	0.012	0.262	0.028	0.028	0.05	0.322	0.071
5	0.104	0.211	0.025	0.031	0.036	0.452	0.018
6	0.036	0.143	0.029	0.041	0.229	0.093	0.043
7	0.048	0.084	0.021	0.067	0.259	0.033	0.07
8	0.099	0.239	0.009	0.001	0.047	0.229	0.033
9	0.032	0.232	0.06	0.05	0.211	0.23	0.031
10	0.002	0.223	0.022	0.023	0.223	0.381	0.022
11	0.089	0.219	0.013	0.028	0.212	0.376	0.018
12	0.035	0.21	0.031	0.012	0.336	0.233	0.33
13	0.092	0.238	0.043	0.058	0.201	0.24	0.037
14	0.016	0.165	0.052	0.164	0.204	0.023	0.113
15	0.021	0.18	0.024	0.032	0.17	0.035	0.007
16	0.101	0.123	0.022	0.08	0.017	0.45	0.014
17	0.051	0.18	0.032	0.092	0.042	0.31	0.08
18	0.002	0.009	0.014	0.085	0.098	0.904	0.61
19	0.029	0.135	0.019	0.133	0.144	0.208	0.235
20	0.13	0.267	0.024	0.175	0.122	0.018	0.016
Avg	1.134	0.1656	0.0322	0.0606	0.1588	0.2787	0.104905

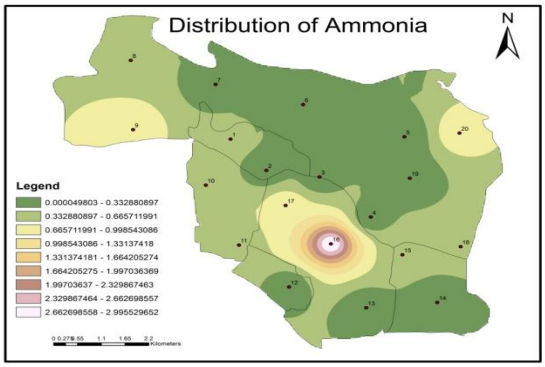
F. GIS spatial distribution of water quality parameters and trace metal

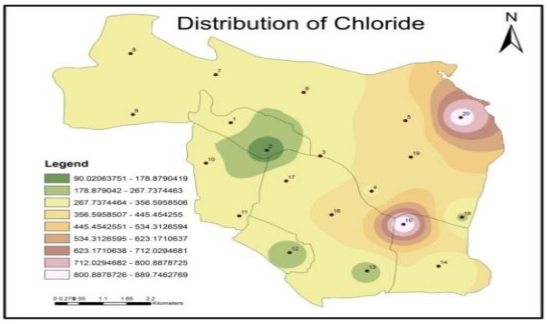
GIS is software which is used to assess the quality of water, determining water availability, preventing flooding, to know about the natural environment, water resources on a local regional scale.

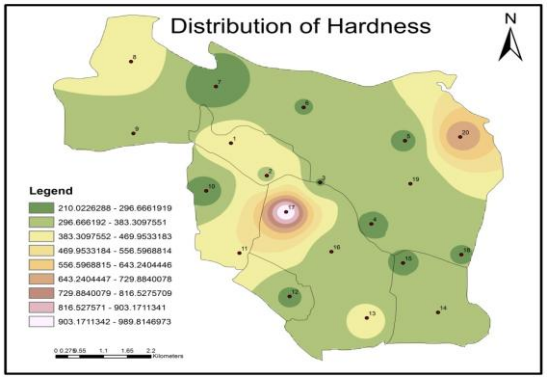


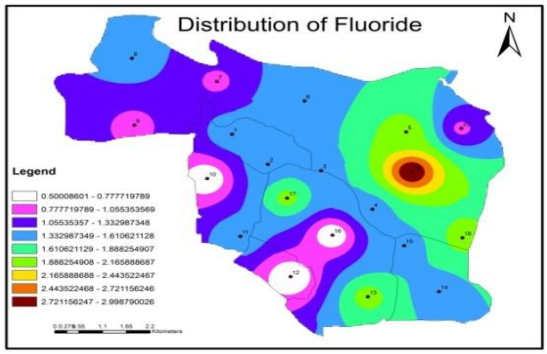


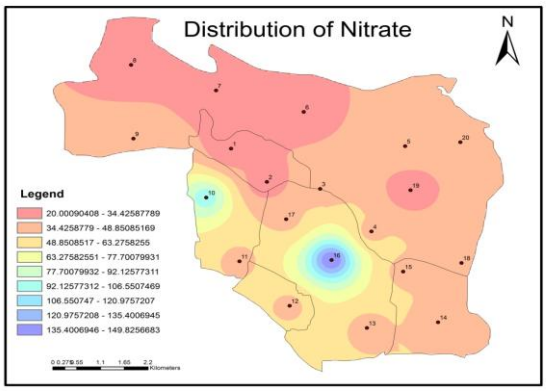


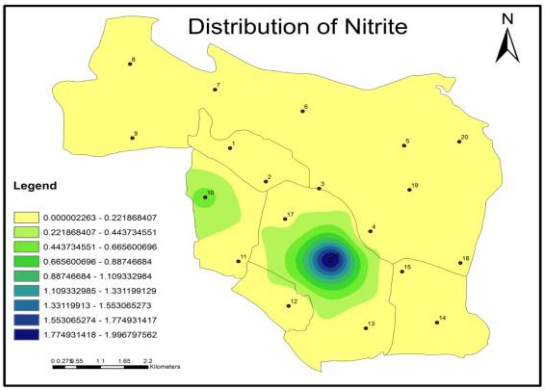


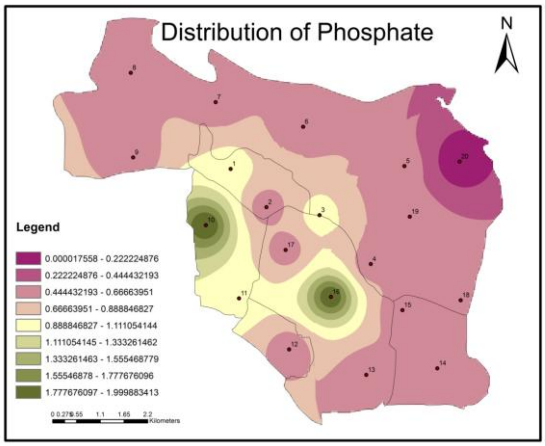












V. CONCLUSION

In this study the GIS combined with laboratory analysis and mapping of groundwater quality has been done.

In conclusion, the major ions concentrations in the ground water samples from the Avadi area were more than the BIS and WHO standards.

This study shows that the water quality in that area is poor. Therefore, the water in that area is not used as a drinking water. To maintain the quality of groundwater, monitoring of physicochemical parameters should be done. On this basis proper treatment should be done to make the water fit for using. From these results it is clear that the quality of water in Avadi region is unfit for both drinking and also for the domestic uses in absence of other sources.

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AUTHORS PROFILE

Ms.K.SOWMIYA, has obtained B.E., (CIVIL) Degree from Sathyabama Institute of Science and Technology, Chennai, Tamil Nadu. Currently pursuing M.E (CEM) in the Department of Civil Engineering, Jerusalem College of Engineering under Anna University, Chennai, and Tamil Nadu.

Mr.K.R.VINODH, currently pursuing Ph.D in the Department of Civil Engineering, Jerusalem College of Engineering under Anna University, Chennai. At present he is working as an Assistant Professor in the Department of Civil Engineering at Jerusalem College of Engineering, Chennai, Tamil Nadu and he has five years of teaching experience. He has published several papers in International Conferences and Journals. His research interests include Lean Construction, Construction Engineering and Management.