ASSESSMENT OF GROUNDWATER QUALITY IN AND AROUND AREAS OF PANRUTI BLOCK IN CUDDALORE DISTRICT

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ABSTRACT-*The major and essential source of drinking water is groundwater, nearly 80% of our country's drinking water comes from groundwater and most of the agricultural, industrial and domestic water needs are fulfilled by groundwater, but the quality of groundwater nowadays remains questionable due to the development of industries and disposal of various kinds of waster into the ground. So this project deals with testing the groundwater based on several water parameters using water quality index (WQI) to find whether they are potable or not according to BIS and WHO standards and creating spatial distribution maps using ArcGIS software for clear representation and understanding of the presence of various groundwater quality parameters.*

KEYWORDS-*Groundwater quality, ArcbGIS, Spatial distribution, water quality index(WQI), BIS, WHO Standards.*

1. INTRODUCTION

The quantity and composition of the dissolved minerals in natural groundwater depends upon the type of environmental surrounding it has, which will often be changing due to the industrial or developmental activities in that particular region. Quality of groundwater may vary from one place to another place according to the outer environmental conditions which will be constantly altering due to man made changes. So it is essential to analyze the groundwater in an area with various tests to check the various quality of the groundwater which they should be possessing to attain the level of potable water. The experiments will be majorly concentrated on analyzing chemical characteristics of the water sample collected from certain towns and villages of Panruti block in Cuddalore district.

1.1 Objectives

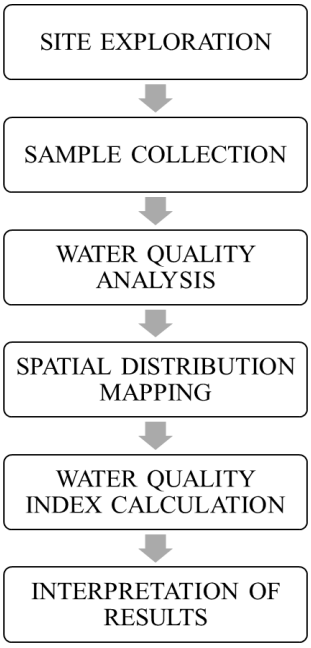
The main objectives of this project are,

- To evaluate the groundwater quality in and around blocks of Panruti.
- To compare the different values of various water quality parameters among the villages and towns in and around Panruti block
- To categorize parameters of the groundwater by mapping them with spatial variation method using GIS for giving out clear representation of the distinct components of water which deteriorates the quality of groundwater by being very less in its standard quantity or by being more than the needed appropriate quantity.
- To check the suitability of groundwater for drinking purposes using WQI method and BIS standards.

2. LITERATURE SUMMARY

- It is evident that the WQI index for the water sample obtained from industrial areas were greater than the normal water samples.
- Water parameters were slightly higher in the wet season than in the dry season. Artificial recharging of groundwater by recharge well will be a good action for the improvement of groundwater quality in urban region.
- So a pretreatment for sewage water coming from industrial area should be done before draining them into nearby water sources and polluted water should be treated with appropriate treatment technologies.

3. METHODOLOGY



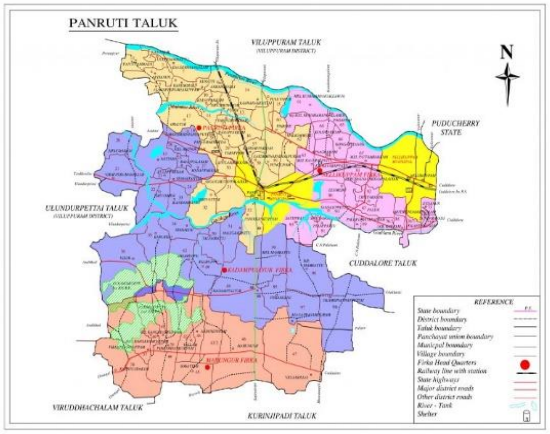


Fig. 1-Study area

Table 1- Parameters analysed

S.NO	PARAMETERS
1.	pH
2.	Electrical conductivity
3.	Bi-Carbonate
4.	Chloride
5.	Sulphate
6.	Calcium
7.	Magnesium
8.	Sodium
9.	Potassium
10.	Carbonate

4. SPATIAL DISTRIBUTION OF WATER QUALITY PARAMETERS

4.1. pH-It is basically the measure of acidity or basicity of the water, the range being 0 1o 14, water sample containing pH less than 7 will be considered acidic, above 7 will be considered basic and 7 will be neutral. Among these samples collected from villages, 42.5% of them are having acidic water while others are being with permissible limit. High pH level can cause skin to become dry, itchy and irritated. From these results it is seen that Melmambattu has highly acidic water (pH-5.2) and Meliruppu has neutral pH. The water system should be injected with Sodium Carbonate and Sodium Carbonate which will neutralize the effect of low pH and will increase it to the neutral level

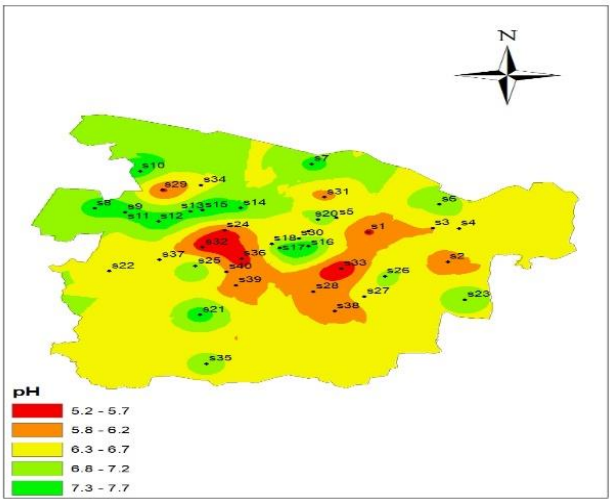


Fig.2-Spatial distribution of pH

4.2. Electrical Conductivity-Electrical conductivity of drinking water should be between 200-800 (µS/cm) Almost 82.5% the water samples from the villages are high in electrical conductivity and so the salt contamination will be more leading to high salinity and poor taste. Kadampuliyur has high EC (4000 µS/cm) and Sathipattu has low EC (380 µS/cm) High EC in water may be due to high amount of ions which will have adverse effect on drinking. Reverse osmosis system can be set up to reduce the excessive dissolved ions in the water.

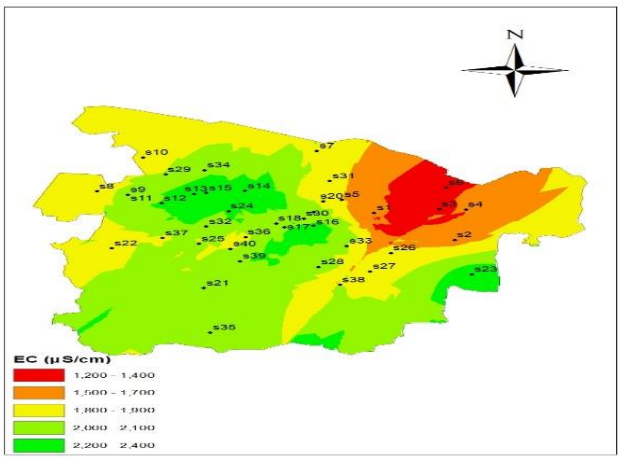


Fig. 3-Spatial distribution of Electrical Conductivity

4.3. Bi-Carbonates-Presence of excess Bi-Carbonate in drinking water will lead to alkalizing effect on water increasing the bitterness in water. All the water samples have limited bicarbonate concentration. The permissible limit of bicarbonate is 300-500 mg/l. A high level of bicarbonate in your blood are often from alkalosis, a condition that causes a pH increase in tissue. Alagappasamuthiram has less Bi-Carbonate content (17.08 mg/l) and Siruvathur has high Bi-Carbonate content (288.01 mg/l). Injection of slightly acidified water in the water system may help in reducing the Bi-

Carbonates, a non-harming amount of sulfuric acid or phosphoric acid can be injected in those cases.

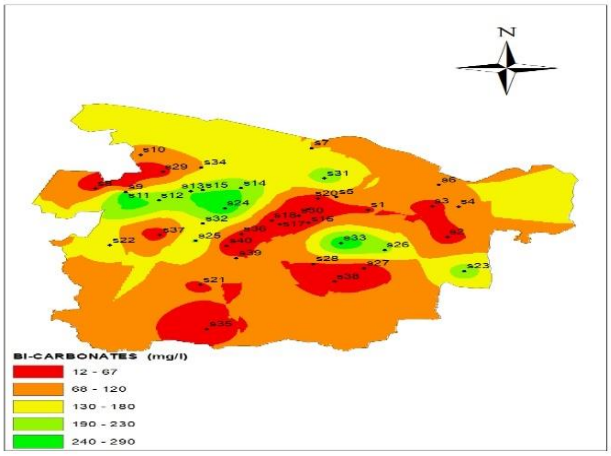


Fig. 4-patial distribution of Bi-Carbonate

4.4. Chloride-The permissible limit of Chloride in drinking water 250 mg/l. 67.5% of the water source tested are crossing the permissible limit of Chloride which may be causing heart ailments in people in taking them. Chloride reacts with metal ions to form soluble salts thus increasing levels of metals in drinking-water and giving unpleasant taste and odour. Palapattu (141.4 mg/l) has less Chloride content and Thideerkuppam has high Chloride content (918.1 mg/l). Excessive Chloride can be taken out of water with the help of reverse osmosis process or by a distiller.

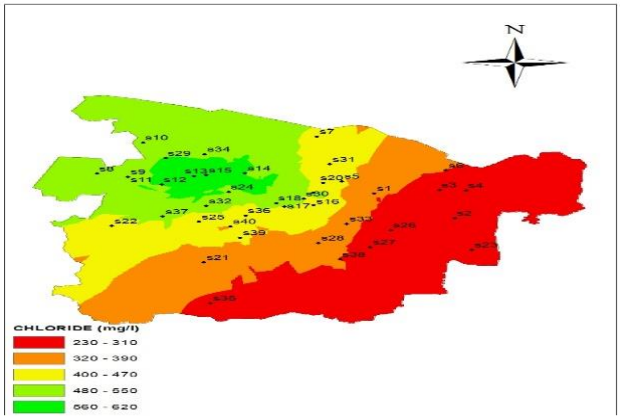


Fig. 5-Spatial distribution of Chloride

4.5. Sulphate-The permissible limit of Sulphate in water is 200 mg/l. Over **42.5%** of the water samples are high in Sulphate concentration. Excess of Sulphate in water can cause bad odour in water. Higher amount of sulphate will cause diarrhoea and dehydration. Palapattu has high Sulphate contamination (49.4 mg/l) in water and Poongunam has less Sulphate content (367.4 mg/l). Reverse osmosis system can be set up to reduce the excessive Sulphate ions in the water.

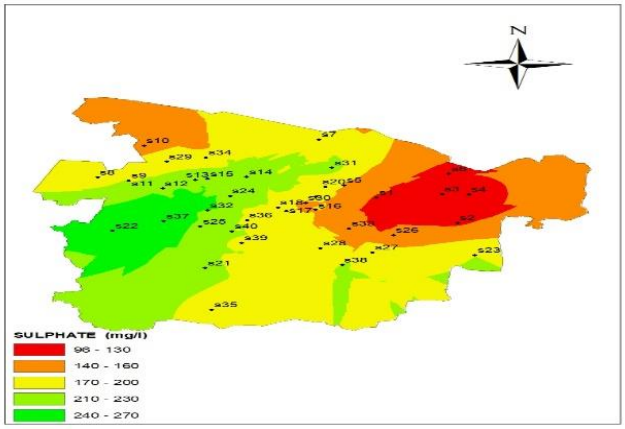


Fig. 6-Spatial distribution of Sulphate

4.6. Calcium-Permissible limit of Calcium in water 75 mg/l. **15%** of the water samples have higher Calcium content than the acceptable limit. Excess of Calcium content deteriorates the quality of water and will cause formation of kidney stones in consumers. Alagappasamuthiram groundwater has less Calcium content (18.83 mg/l) and Keeliruppu has high Calcium content (252.1 mg/l). Addition of Sodium Carbonate in the water system will break the excess Calcium and Magnesium present in water

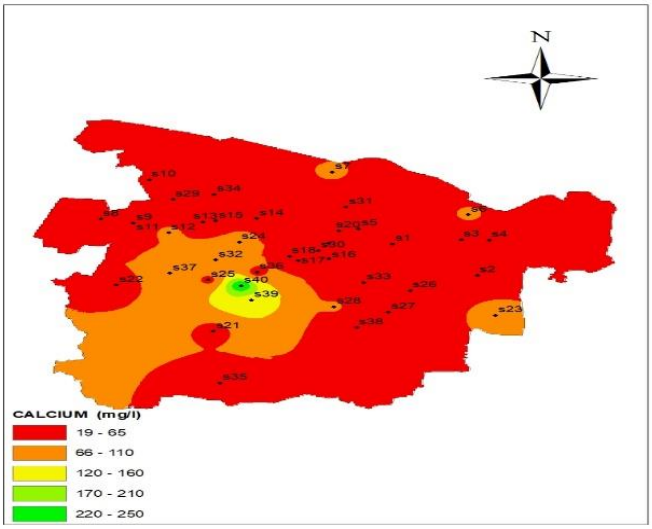


Fig. 7-Spatial distribution of Calcium

4.7. Magnesium-The permissible limit of Magnesium in drinking water is 30 mg/l. about **30%** of the collected samples were exceeding the acceptable limit of Magnesium. People who intakes high Magnesium contaminated water could have high blood pressure and heart ailments. Palapattu has less Magnesium level (1.944 mg/l) and Marungur has high Magnesium level (95.7 mg/l). Excess Magnesium is treated by water softener where Sodium or Potassium ions will be replacing the Magnesium ions

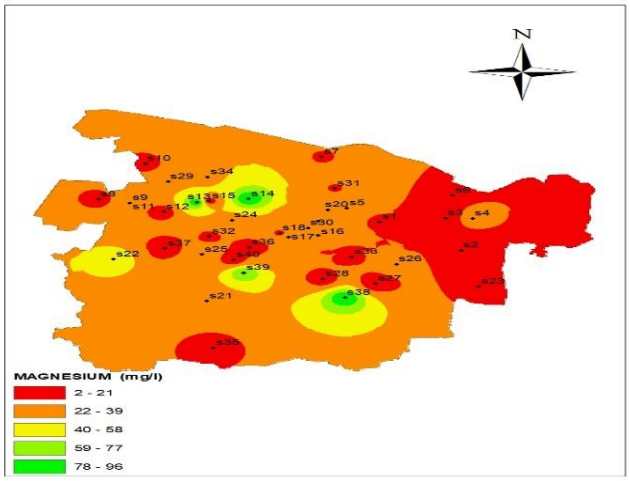


Fig. 8-Spatial distribution of Magnesium

4.8. Sodium-Permissible limit of Sodium in drinking water is 200 mg/l. nearly **45%** of the obtained samples are exceeding the acceptable limit of the parameter.High Sodium content will give poor salty taste to the water and can cause musc exchange or distillation systems.

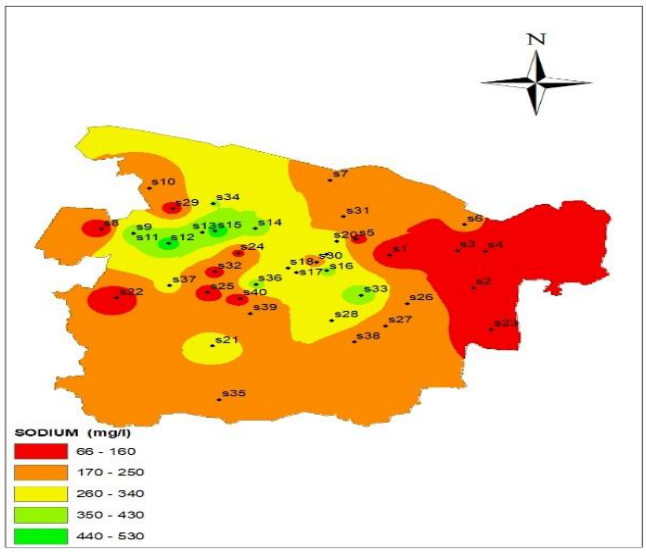


Fig. 9-Spatial distribution of Sodium

4.9. Potassium-Permissible limit of Potassium is 50 mg/l. **72.5%** of the samples obtained are exceeded the acceptable limit according to BIS. High amount of Potassium may lead to Muscle, fatigue, Weakness, Paralysis, Abnormal heart rhythms (arrhythmias). Reverse osmosis is usually used in getting rid of excess Potassium ions in the drinking water. Vallam groundwater has less Potassium content and Keelmambattu has high Potassium content.

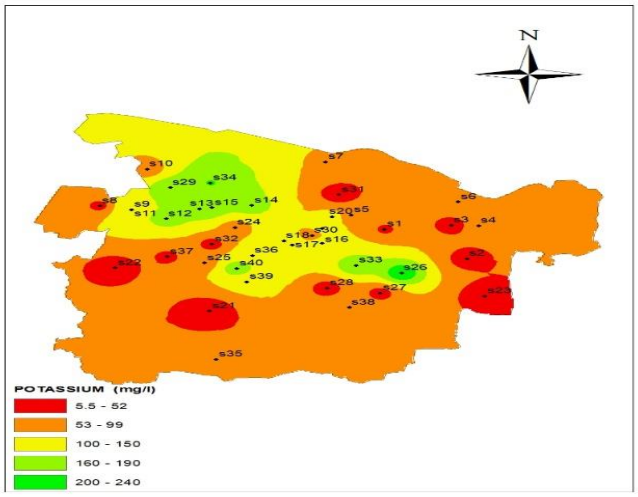


Fig. 10-Spatial distribution of Potassium

4.10. Carbonate-Carbonate content is negligible in all the water samples collected from the villages. The permissible limit for Carbonate is 60-120 mg/l. Excess of Calcium Carbonate will increase the hardness of water.

5. WATER QUALITY INDEX

The water quality index (WQI) is a significant tool to find the drinking water quality in urban, rural and industrial area. There are three major steps to find water quality index.

STEP 1-Certain weights should be assigned to the chosen parameter according to their relative importance in the overall quality of water for drinking purposes which may be ranging from 1 to 5.

STEP 2-Relative weight of the parameter should be found out using the following formula

$$W_i = w_i / \sum w_i \ (i = 1 \text{ to } n)$$

Where, Wi-Relative weight, wi-is the weight of every parameter and n-number of parameter

STEP 3-This step deals with assigning of quality rating scale for each and every parameter.

$$q_i = (C_i / S_i) .100$$

Where, qi - the quality rating, Ci - concentration of each chemical parameter in each water sample in mg/l, and Si- guideline value/desirable limit as given in Indian drinking water standard.

For calculating WQI, the sub index (SI) should be found for each chemical parameter, which is then used to find the WQI as per this equation below,

$$SI_i = W_i . q_i$$

$$WQI = \Sigma SI_i$$

Table 2-Water quality index and Corresponding class

S.NO	WATER QUALITY INDEX VALUE	WATER QUALITY CLASSES
1	<50	Excellent
2	50-100	Good Water
3	100-200	Poor Water
4	200-300	Very Poor Water
5	>300	Water Unsuitable for drinking

5.1. ASSESSMENT OF WATER QUALITY INDEX VALUES FOR STUDY AREA

The values of examined parameters of groundwater quality data and BIS water quality standards were used for calculating water quality indices. Quality range is assigned on the basis of calculated values of water quality indices.

Table 3-Groundwater parameter and corresponding relative weight

S.NO	PARAMETERS	STANDARD VALUE	ASSIGNED WEIGHTAGE (W_I)	RELATIVE WEIGHT(W_I)
1	pH	6.5-8.5	4	0.153846154
2	Chloride	250	5	0.192307692
3	Sulphate	200	3	0.115384615
4	Calcium	75	4	0.153846154
5	Magnesium	30	3	0.115384615
6	Sodium	200	5	0.192307692
7	Potassium	50	2	0.076923077

Table 4-WQI Values of the collected water samples

S.NO	SAMPLING LOCATION	WQI
1	SATHIPATTU	61
2	PALAPATTU	46
3	NARIMEDU	50
4	PALUR	89
5	THIRUVADHIGAI	92
6	KEEZHKAVARAPATTU	102
7	RASAPALAYAM	113
8	VEERAPERUMANALLUR	56
9	KUDUMIYANKUPPAM	90
10	SIRUGRAMAM	81
11	THIDEERKUPPAM	215
12	THIRUVAMUR	181
13	KOLAPPAKAM	201
14	ELANDHAMPATTU	201
15	SEMAKOTTAI	178
16	PANIKKANKUPPAM	156
17	PILLAYARPALAYAM	139
18	MALIGAMPATTU	126
19	P.ANDIKUPPAM	131
20	PANRUTI	145
21	VALLAM	110
22	VISUR	110
23	SILAMBINADHANPETTAI	91
24	SIRUVATHUR	99
25	MELIRUPPU	86
26	KEEZHMAMBATTU	112
27	ALAGAPPASAMUTHIRAM	76
28	KADAMPULIYUR	104
29	NATHAM	149
30	PANIKKANKUPPAM	91
31	POONGUNAM	92
32	SEMMEDU	95
33	MELMAMBATTU	115
34	RAYARPURAM	128
35	SORATHUR	81
36	THALAMPATTU	157
37	KARUKKAI	137
38	MARUNGUR	118
39	PERIYAKAATUPALAYAM	131
40	KEELIRIUPPU	143

CONCLUSION

As a result of the tests and analysis it is found that over 57.5% of the villages are having highly contaminated groundwater and three of them are severely polluted which is too dangerous for the people using them for domestic purposes and those water source having improper water quality index are unfit for drinking. So it is suggested to follow the above given treatment methods for every polluted water source before letting them to public usage. From the water quality analysis it is found that most of the villages are having deteriorated water quality which has to be treated properly to neglect the health effects arising from them. On the other hand some villages have water quality ranging from excellent to good, according to the water quality index calculations and BIS standards. As a whole electrical conductivity, Chloride and Potassium are the dominant chemical parameters which are exceeding beyond the permissible limits in the sampling areas. Reverse osmosis is found to be the appropriate treatment for most of the water quality problems

regarding the crossing of permissible limit as it can neutralize those chemical parameters.

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