Physio-Chemical Characteristics of Coleroon River Bank Shallow Aquifer in Komaratchi Block of Cuddalore District, Tamilnadu

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Abstract- The groundwater is a fundamental and important wellspring of water gracefully everywhere on the world. Water quality alludes to the physical, substance, natural attributes of water. The present study aims in determining the ground water quality in Coleroon (Kollidam) river regions of Komaratchi block in Cuddalore district, Tamilnadu. Water samples for the analysis are collected from hand pipe, bore well in the kollidam river region and are analysed for physio-chemical parameters like pH, Conductivity, Dissolved Oxygen, Oxidation Demand, Chemical Oxidation Demand, Total Hardness, Alkalinity and Chloride. Assembling different parameters into one single number leads to an easy interpretations of water quality. However, the WQI values in the present investigation varied from 91 to 321 indicating that the water is unfit for drinking and domestic purpose. Therefore, people should be made aware of the water quality importance on sanitation and economical water treatment methods to avoid waterborne diseases. Therefore; water quality is not up to the standard.

Indexed Terms- pH, Chemical Oxidation Demand, Alkalinity and Chloride

I. INTRODUCTION

Groundwater is significant wellspring of drinking water for both individual and creature on the planet. It is likewise extremely basic wellspring of water for the drinking, farming and the modern division. Being a noteworthy aspect of the hydrological cycle, water assets rely upon the precipitation and revive strategies. The appropriateness of groundwater for different uses significantly relies upon nature of groundwater. If the groundwater is contaminated, its quality cannot be return to its original quality, until stopping the pollutants from the sources. So more attention required to regularly monitor the groundwater quality and to device ways and means to protect it (Khalid Hameed Lateef 2011). Currently about 20% of the world's population lacks access to safe drinking water, and more than 5 million people die annually from illness associated with safe drinking water or inadequate sanitation. The purpose of assessment water quality is to turn multifaceted water quality data into simple information that is essential for the public (Packialakshmi et al., 2011). WQI is an important parameter for the analysis and management of groundwater. WQI is defined as a rating reflecting the composite influence of different quality of water parameters (Ramakrishnaiah et al., 2009). Hence protecting the quality of groundwater is a major concern in this study.

II. LITERATURE REVIEW

Patrick Debels et al. (2005) have determined Water Quality Index (WQI) in Chillan stream (focal Chile) utilizing nine physicochemical boundaries. The outcomes indicated that the upper and centre pieces of the watershed, water quality was acceptable however in downstream, because of impacts of the metropolitan wastewater release, water quality conditions were basic during the dry season. Yidana et al. (2009) examined Water Quality Index to represent the hydrochemistry of groundwater from the northern aspect of the Volta locale of Ghana. Result infers that topography affects the WQI of groundwater in the zone. A groundwater test shows higher WQI esteem than tests taken from surface water sources in the territory. Reza and Gurdeep (2010) evaluated groundwater quality through Water Quality Index strategy in Orissa, India. Result shows that water quality is poor during post rainstorm when contrasted with summer season because of more leakage and development of Ground water during post storm.

P.J.Puri et al. (2011) surveyed surface water (lake) nature of Nagpur city by utilizing WQI. Results indicated that the nature of water is reasonable in storm, which at that point changed to medium in winter and poor in summer. Chowdhury et al. (2012) assessed water quality record of water bodies along Faridpur-Barisal Street in Bangladesh and reasoned that the estimations of WQI at the most extreme stations are poor and exceptionally poor in condition. Not many of them alluded as great, and among all water stations just one of the stations contains amazing water quality boundary for human utilization and different employments. The results showed that WQI of the water bodies were beyond acceptable limit but would be used for domestic and household purpose after purification.

Lamare et al. (2014) surveyed the ground water nature of delved wells in west Jaintia slopes region, Meghalaya, India, utilizing water quality file and uncovered that in spite of the fact that burrowed well water tests were discovered acidic and wealthy in iron substance however fall under great water attributes thinking about different boundaries. Annapoorna et al. (2015) surveyed the suitability of ground water quality of 22 wells located the rural areas surrounding Ingaldhaldefunt copper mine in Chithradurga district of Karnataka state was assessed for drinking purpose based on the various water quality paramters by standard parameters showed that wealthy in iron substance and zones are classified based on GIS.

III. STUDY AREA

The study area, Cuddalore district is located between 11û11' and 12û35' northern latitudes and 78û38' and 80û0' eastern longitudes with an area of 3678 sq km. It is bound on the east by the Bay of Bengal and on south by Nagappatinam and Ariyalur district. Villupuram district is in the north and Pearambalur and part of Villupuram is on the west. It is separated by Kollidam in the south (Sivaprakasam and Murugappan, 2010). There are five major seasonal water bodies namely; Kedilam, Thenpennaiyar, Kollidam, Vellar and Manimuthar. All these rivers cause floods only during the monsoon. Figure 3.1 shows the index map of the study area.

The soils of the district are classified as the black, red, ferruginous and arenacious. Major soil types, in Cuddalore district, includes the red soil in 367791 Ha, sandy clay loam in 128573 Ha, clay loam in 115565 Ha, sandy loam in 91679 Ha and sandy soil in 31974 Ha. In which Komaratchi block, includes Sandy loam in 1256 Ha, Sandy 31 in Ha, Clay loam in Ha 9862, Sandy clay loam in Ha 10126. This district receives the average rainfall of 1448 mm on an average. It includes rainfall from both the South West and the North East Monsoons (423 mm, 1025 mm). The minimum rainfall was 593 mm and the mean rainfall was 972 mm. The annual maximum temperature recorded in the district was 37.15ûC. The minimum and mean temperature recorded were 19.93ûC and 28.12ûC respectively. Paddy, Sugarcane, Maize, Black gram, green gram, and Groundnut are cultivated in Cuddalore district. Rice being the dominant crop of the study area, normally grows well under semi-aquatic situation and in uplands classified as highly suitable, moderately suitable, marginally suitable, and temporarily not suitable.

In Komaratchi, Groundwater Availability (M.Cu.m) 10092.92, Existing Gross Draft for Irrigation (M.Cu.m) 1934.82, Existing Gross Draft for Domestic and industrial water supply (M.Cu.m) 284.25, Existing Gross Draft for all uses (M.Cu.m) 2219.07, Allocation for Domestic and Industrial Requirement supply upto next 25 years (2029) (M.Cu.m) 296.08, Net groundwater Availability for future Irrigation Development (M.Cu.m) 7862.02 Stage of Groundwater Development 22%.

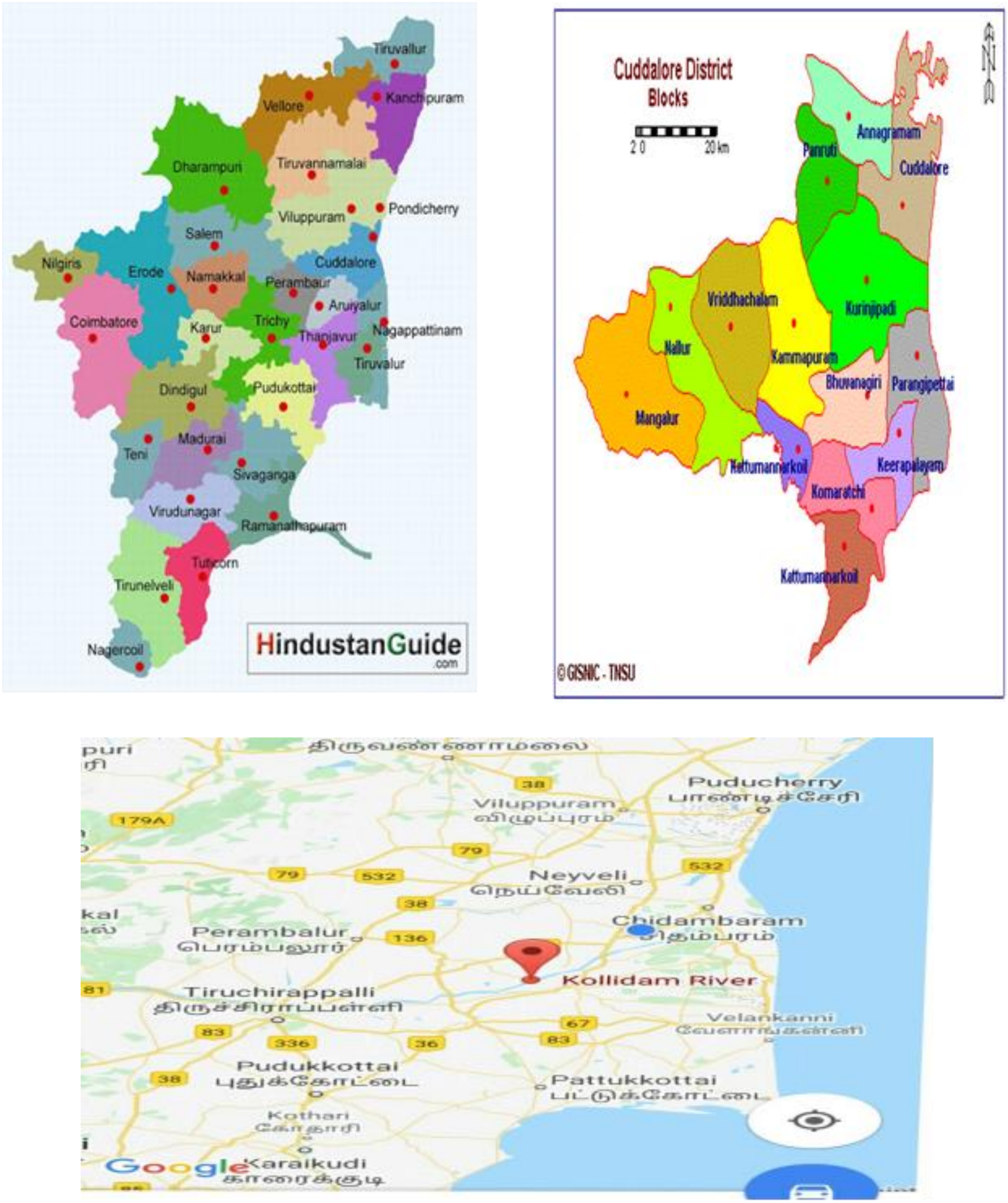
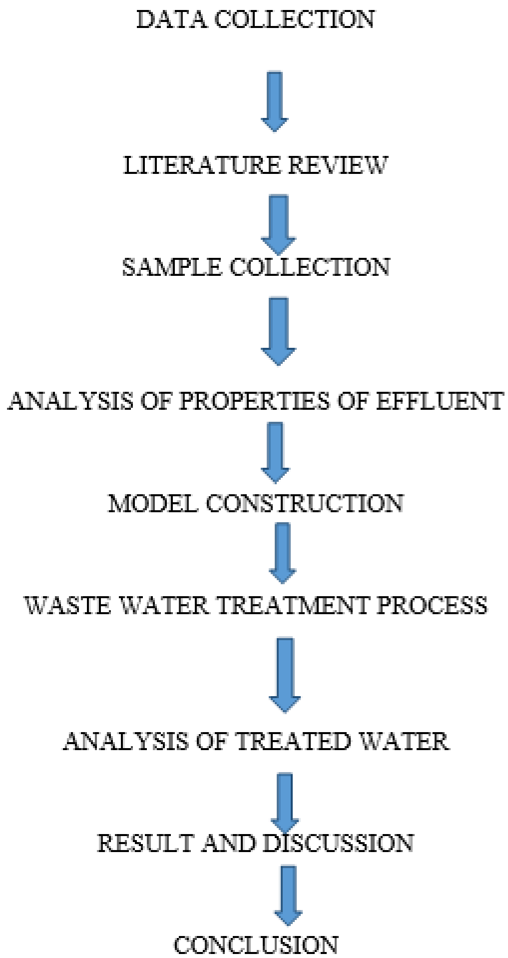


FIG. 1 LOCATION MAP

IV. METHODOLOGY



FLOW CHART

- Sample Collection

A total of SEVEN water samples was collected from komaratchi block regions. The water samples were gathered according to the standard strategy recommended for examining. Examining was completed without including any additive. The details of inspecting areas are given in Table 3.

Table 1 Details of Sampling Locations

Sample No.	Sample Station	Type of Source	Latitude N	Longitude E
1	Therkkumangudi	Hand Well	11.330578	79.695823
2	Karuppur	Hand Well	11.319249	79.685726
3	Nalamputhur	Hand Well	11.318756	79.666312
4	Nalamputhur	Hand Well	11.318740	79.666293
5	Mullankudi	Hand Well	11.311529	79.657911
6	Vadakkumangudi	Hand Well	11.353170	79.699491
7	saliyanthoppu	Hand Well	11.338867	79.708186

V. RESULTS AND DISCUSSION

- TEMPERATURE:

Greatest temperature was recorded in May and least temperature was recorded in December, yet the variation was never more than 4 to 5 degrees for any sample during the examination time frame. Temperature was found to increment with the depth of the source. Open well water had lower temperature than bore well water.

- pH:

The pH value for all the examples were practically uniform consistently aside from a periodic variation in a couple of cases. This might be credited to the carbonate-bicarbonate buffer plentifully found in the soil. pH of all the samples was found to be within the BIS range of 6.5 to 8.5. samples were generally basic. The pH was seldom discovered to be around 7.0. As far as possible for drinking water is 7.5 to 9.0. Greater part of the samples most of the time showed less than 7.5 pH.

- ELECTRICAL CONDUCTIVITY:

Electrical Conductivity (EC) of water is controlled by the concentration of ions present in it. The more the concentration of ions in the sample the more is its conductivity. All the examples had more prominent than 1000µS conductance albeit 500µS is the admissible worth suggested by Central Ground Water Board. Higher EC is the purpose for the issue of scale formation in the study area.

- TOTAL HARDNESS:

Ca and Mg primarily cause hardness in water despite the fact that Fe and Mg likewise add to real hardness. Absolute hardness (carbonate and non-carbonate) is expressed as mg/l of $CaCO_3$. It is a proportion of the limit of water to encourage cleanser. Hardness in water brings about inordinate utilization of cleanser and wastage of fuel. All out hardness of the apparent multitude of tests was discovered to be higher during rainstorm when contrasted with different occasions. Normal complete hardness of the vast majority of the samples in the study area was found to be higher than 300mg/l demonstrating that the water is very hard water. Total hardness in most cases is always higher than 300mg/l which is the permissible limit both by BIS as well as WHO standards.

- TOTAL ALKALINITY:

Alkalinity is the capacity of water to neutralise acid. It is a measure of bicarbonates, carbonates and hydroxides present in water. Alkalinity was found to be maximum in winter season and minimum in summer season. Total alkalinity of all the samples was found to be higher than permissible value (200mg/l (P) & 600mg/l (E)) suggested by BIS as well as WHO at all times.

- TDS:

EC of water is likewise an aberrant proportion of the total dissolved solids in the sample. A direct relationship was found to exist between electrical conductivity and total dissolved solids (TDS). TDS levels are likewise discovered to be higher than permissible limits. High levels of TDS is the reason for tastefully disappointing shading, taste and scent of the groundwater in the study area.

- CHLORIDE:

Chloride is one of the major inorganic anions found in ground water. It begins in ground water from both common and anthropogenic sources. High chloride content demonstrates heavy pollution. Chlorides in drinking water impart characteristic taste to it. Normal chloride concentrations of all the samples were never found to exceed the permissible limit of 250mg/l (BIS & WHO) in the study area.

- DISSOLVED OXYGEN:

Dissolved oxygen (DO) levels indicate the ability of water to purify itself through biochemical processes. DO levels were found to decrease with an increase in the temperature of the sample. DO levels were maximum during monsoon and minimum in summer. The permissible level of DO according to BIS as well as WHO standards is 4.6-6.0. DO of the samples was never less than the permissible levels except for one or two rare cases.

- BOD:

BIS just as WHO have not referenced the permissible levels for BOD in this manner demonstrating that it ought not be available in water. Drinking water ought to be free from BOD/COD. Some of the samples have shown a definite BOD value (≈5-6mg/l) at all times, thus indicating that the ground water in the study area is inhabited and moderately contaminated by microbial population at all times.

- CALCIUM and MAGNESIUM:

Calcium is plentiful in groundwater due to the presence of its minerals in the earth outside. Magnesium is moderately less bountiful in groundwater yet is broadly found in seawater. Both Ca and Mg cause hardness to water. Normal calcium and magnesium focus as a rule are discovered to be higher than as far as possible both by BIS just as WHO (Ca-75 and Mg-30) guidelines The normal proportion of Ca to Mg is constantly discovered to be > 1 thus ruling out salt-water contamination in the aquifers under study.

- SODIUM:

Permissible limit of Sodium in the groundwater as per WHO as well as BIS standards is 100mg/l. All the samples showed high concentrations of Na but within the permissible limit except three (Sample No. 4, 8 and 10). Several scientists have attributed excessive levels of Na (>150 mg/l) to sea water intrusion in the coastal belt. However, none of the samples showed such high values for Na.

- POTASSIUM:

The likely sources of potassium in ground water are silicate minerals and igneous and metamorphic rocks. Permissible limit of K concentration in the groundwater as per WHO as well as BIS standards is 10mg/l. All the samples showed K in excess of the permissible limit except two (Sample No. 2and 5). Main reason for increase in potassium levels in groundwater is agricultural work. But since the study area is urban and is nowhere near an agricultural field that reason can be ruled out. Water softeners that regenerate using potassium chloride can also raise the level of potassium in water significantly.

Water Quality Index (WQI) is a single number which can be calculated easily and used for overall description of the quality of water bodies. It provides a quick and simple methodology to identify the quality of water by only looking at a single aggregate value and the corresponding scale.

Step 1: Collect value of physico- chemical water quality parameters.
Step 2: Calculate Proportionality constant “K” value using formula, $K=1/(\sum 1/Sn)$
Where "Si" is standard permissible for nth parameter.
Step 3: calculate quality rating for nth parameter (Qn) where there are n parameters.
This is calculated using formula $Qn=100\{(Vn - V0)/(Sn- Vo)\}$.
Whereas, Vn = Estimated value of the nth parameter of the given sampling station.
Vo= Ideal value of nth parameter in pure water.
And Sn=Standard permissible value of the nth parameter.
Step 4: Calculate unit weight for the nth parameters, $Wn= (K/Sn)$.
Step 5: Calculate Water Quality Index (WQI) using formula, $WQI = ((\Sigma W n^* Qn)/\Sigma Wn)$

Table 2 WATER QUALITY INDEX RANGE AND WATER QUALITY TYPE

WQI Range	TYPE OF WATER
≤50	Excellent
50.1 - 100	Good
100.1 - 200	Poor
200.1 - 300	Very Poor
>300	Unfit for drinking

Table 3 STANDARD PERMISSIBLE VALUE OF WATER QUALITY PARAMETERS

PARAMETERS	BIS	WHO
pH	6.5 - 8.5	7.0 - 8.5
Conductivity	500	500
Total Hardness	300	300
Total Alkalinity	200 - 600	200 - 600
TDS	500 - 1500	500 - 1500
Chloride	250	250
Dissolved Oxygen	4.6 - 6.0	4.6 - 6.0
BOD	-	-
Calcium	75	30
Magnesium	75	50

Sodium	100	100
Potassium	10	10

Table 4 GROUNDWATER QUALITY PARAMETERS OF THE STUDY AREA

PARAMETERS	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5	SITE 6	SITE 7
pH	7	7.11	7	7.2	6.1	7.6	7.24
Conductivity	1720	1430	1145	1110	645	1130	2910
Total Hardness	520	260	460	460	260	360	560
Total Alkalinity	594	313.5	330	379.5	148.5	396	940.5
TDS	1100.8	915.2	732.8	710.4	412.8	723.2	1862.4
Chloride	95.85	159.75	181.05	69.225	53.25	90.525	250.275
Dissolved Oxygen	7.2	7.0	6.0	7.0	5.1	4.0	6.0
BOD	5.5	2.5	3.0	6.0	1.5	4.0	4.0
Calcium	120	64	112	96	56	80	120
Magnesium	52.8	24	43.2	52.8	28.8	38.4	62.4
Sodium	69.4	19.4	30.8	100.2	12.2	27.8	44.6
Potassium	13.7	3.3	35.7	27	10.8	23	30
WQI	176.9274	170.1743	148.3581	148.3592	91.35259	147.3317	321.9817

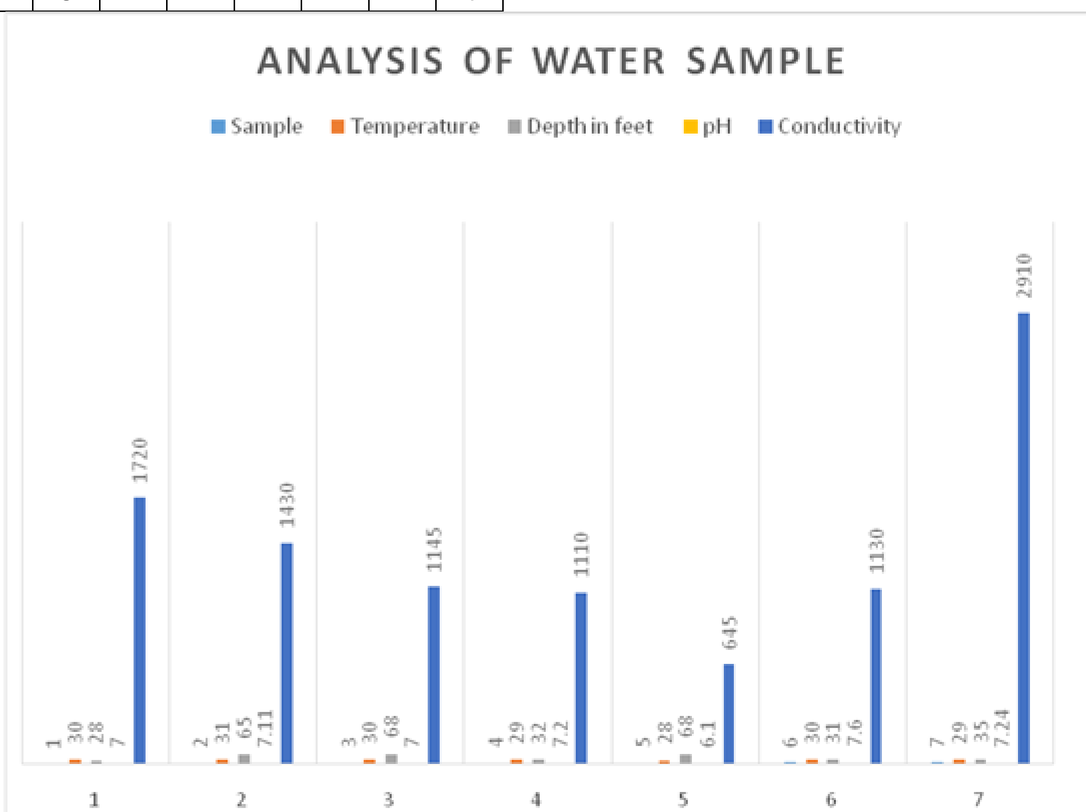


FIG 2 ANALYSIS OF WATER SAMPLE

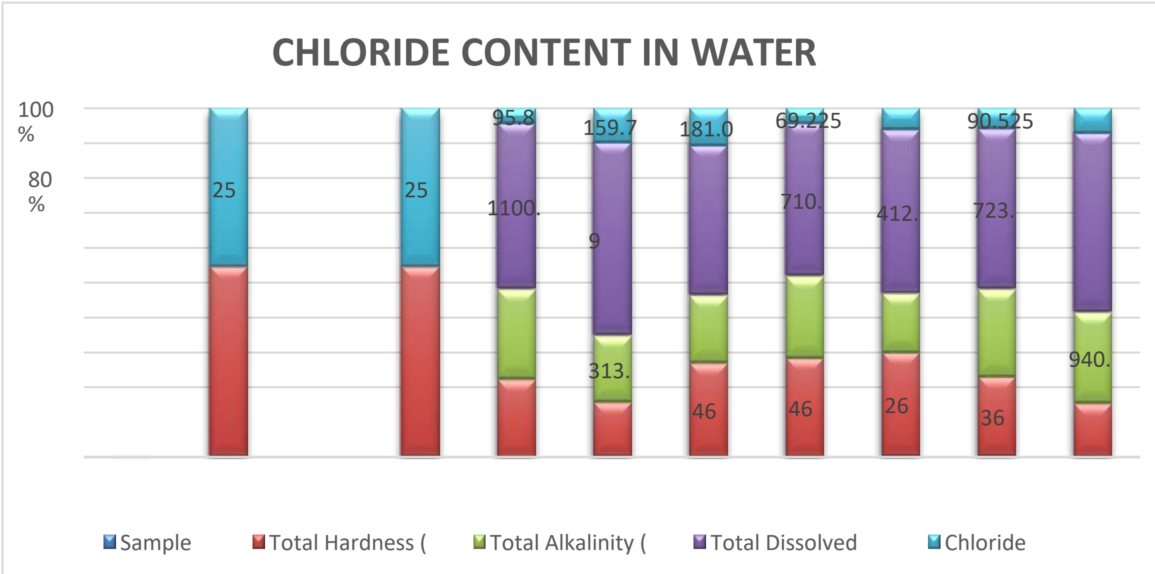


FIG 3 CHLORIDE CONTENT IN WATER SAMPLE

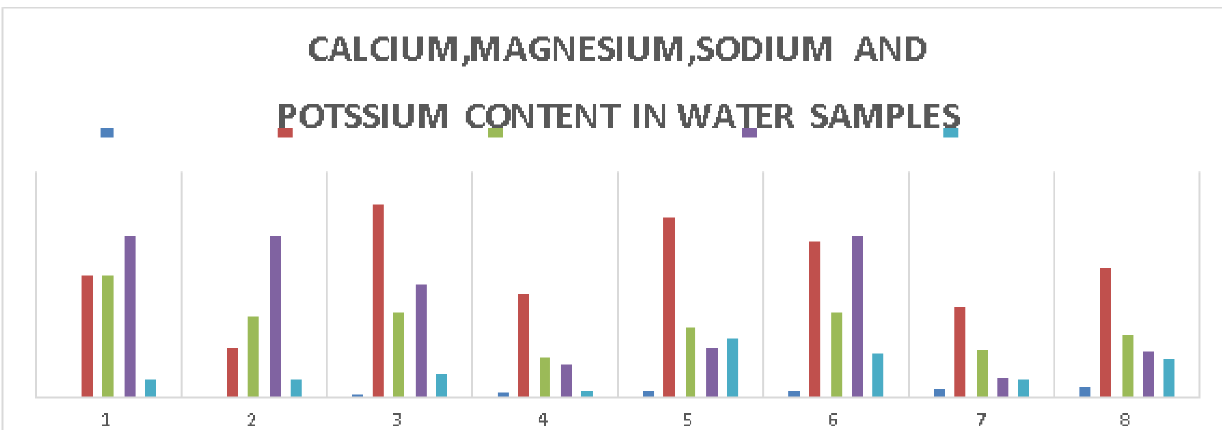


FIG 4 CALCIUM, MAGNESIUM, SODIUM AND POTASSIUM COINTENT IN WATER SAMPLES

CONCLUSION

- The groundwater samples were collected from seven different places of komaratchi block of Cuddalore District. The samples were subject to physio-chemical analysis.
- The results were showed most of the physio-chemical parameters like pH, TH, TDS, COD, BOD, EC and Cl are above the permissible limit set by BIS and WHO. In this study, the application of Water Quality Index Technique is used for the determination of groundwater quality in and around komaratchi block.
- Assembling different parameters in to one single number leads an easy interpretation of water quality. However, the WQI values in the present investigation varied from 91 to 321 indicating that the water is unfit for drinking and domestic purpose.
- Therefore, people should be made aware of the water quality importance on sanitation and economical water treatment methods to avoid waterborne diseases.
- The remedial measure must be taken immediately to safeguard and conserve the precious water resources from pollution for future generation.

REFERENCES

[1] Patil V. T. and Patil V. R. Current World Environ. 2. 2007.77.

[2] Patrick Debels et al. (2005). Environmental Monitoring Assessment vol 110, 301-322.

[3] Reza and Gurdeep et al. (2010) current world environment An International Research Journal of Environmental Science ISSN: 0973-4929

[4] Brian Oram P. G. Water Research Centre: Primary and Secondary Drinking Water Standards. 2010.

[5] P.J.Puri et al. (2011) Rasayan Journal of Chemistry 4(1):43-48.

[6] Eugene Lamare R et al. (2014) International Journal of Environmental Sciences Volume 5 No.3, 545.

[7] Srinivasa Rao G. and Nageswara Rao G. J. Environ Sci. Eng. 52. 2010.137.

[8] R.G.Choudhary, Chemical Der Sinica journal, Pelagia Research lib. 2015, 6(2) 11-19

[9] Annapoorna, H, Janardhana, M. R. (2015) Aquatic procediavol 4. 02.088

[10] Central Ground Water Board, GOI. Ground Water Quality in Shallow Aquifers of India. 6. 2010

[11] WHO Guidelines for Drinking Water Quality, Recommendations, World Health Organisation, Geneva, Vol.1, 1984,130.

[12] Standard Methods Book for the Examination of Water a Waste Water, 18th edition, American Public Health Association, Washington DC,1992.