



ISSN: 0975-833X

RESEARCH ARTICLE

ANALYSIS OF WATER QUALITY USING PHYSICO-CHEMICAL PARAMETERS IN CUDDALORE DISTRICT, TAMILNADU, INDIA

*¹Mithra, J. and ²Bhaskaran, R.

¹Department of Geography, Guest Lecturer, K.N.G.A. College for Women (A), Thanjavur, Tamilnadu, India

²Department of Earth Sciences, H.O.D., Tamiluniversity, Thanjavur-613 010, Tamilnadu, India

ARTICLE INFO

Article History:

Received 15th June, 2015

Received in revised form

23rd July, 2015

Accepted 05th August, 2015

Published online 30th September, 2015

ABSTRACT

The paper presented to study of the Physico-chemical Parameters of Cuddalore District, Tamilnadu. Yearly-wise changes in physical and chemical. Parameters such as pH, EC, TDS, HCO₃⁻, F, Cl₂, SO₄, NO₃⁻, Na⁺, K⁺, Ca²⁺ and Mg²⁺ were analysed for a periods of year from 2009 – 2013. All Parameters were exceeds the permissible limit except Ca and SAR

Key words:

Cuddalore District, Physico-chemical parameters, Yearly Variations.

Copyright © 2015 Mithra and Bhaskaran. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Mithra, J. and Bhaskaran, R. 2015. "Analysis of water quality using physico-chemical parameters in Cuddalore district, Tamilnadu, India", *International Journal of Current Research*, 7, (9), 20794-20802.

INTRODUCTION

Water is a precious and most commonly used resource. Water is one of the most abundant chemical substances on earth, as it covers two third of the earth surface. Of the total amount of global water, only 2.4% is distributed on the main land, of which only a small portion can be utilized as fresh water. The available fresh water to man is hardly 0.3-0.5% of the total water available on the earth and therefore, its judicious use is imperative. Groundwater plays significant role in the living organisms that existing in this world. Groundwater has become a necessary resource over the past decades due to the increase in its usage for drinking, irrigation, industrial use etc. In the last few decades, there has been a tremendous increase in demand for fresh water due to rapid growth of population and the accelerated pace of industrialization. Human health is threatened by most of the agricultural development activities particularly in relation to excessive application of fertilizers and unsanitary conditions. Rapid urbanization, industrialization, especially in developing countries like India, has affected the availability and quality of groundwater due to its over exploitation and improper disposal in urban areas. The present study involves the analysis of Water Quality in Cuddalore district. It is located at Latitude – 11.7, Longitude – 79.7.

Cuddalore District occupies the area of approximately 3564 square kilometers (Fig. 1.1).

It is in the 9 meters to 10 meters elevation range. This District belongs to Southern India and it is a Coastal district. In India Still now several Researchers have done Study on Physicochemical and Biological characteristic of Standing and Running Water Resources

Aim

The aim of the study is to visualize the spatial variation of certain physico-chemical parameters of groundwater.

Objectives

The main objectives of this research work is to make a groundwater quality assessment using XL map based on the available physico-chemical data from 6 locations in Cuddalore district and evaluate its use and the causes of contamination.

MATERIALS AND METHODS

Secondary data were collected from the Groundwater Division Tharamani Chennai.

*Corresponding author: Mithra, J.

Department of Geography, Guest Lecturer, K.N.G.A. College for Women (A), Thanjavur, Tamilnadu, India.

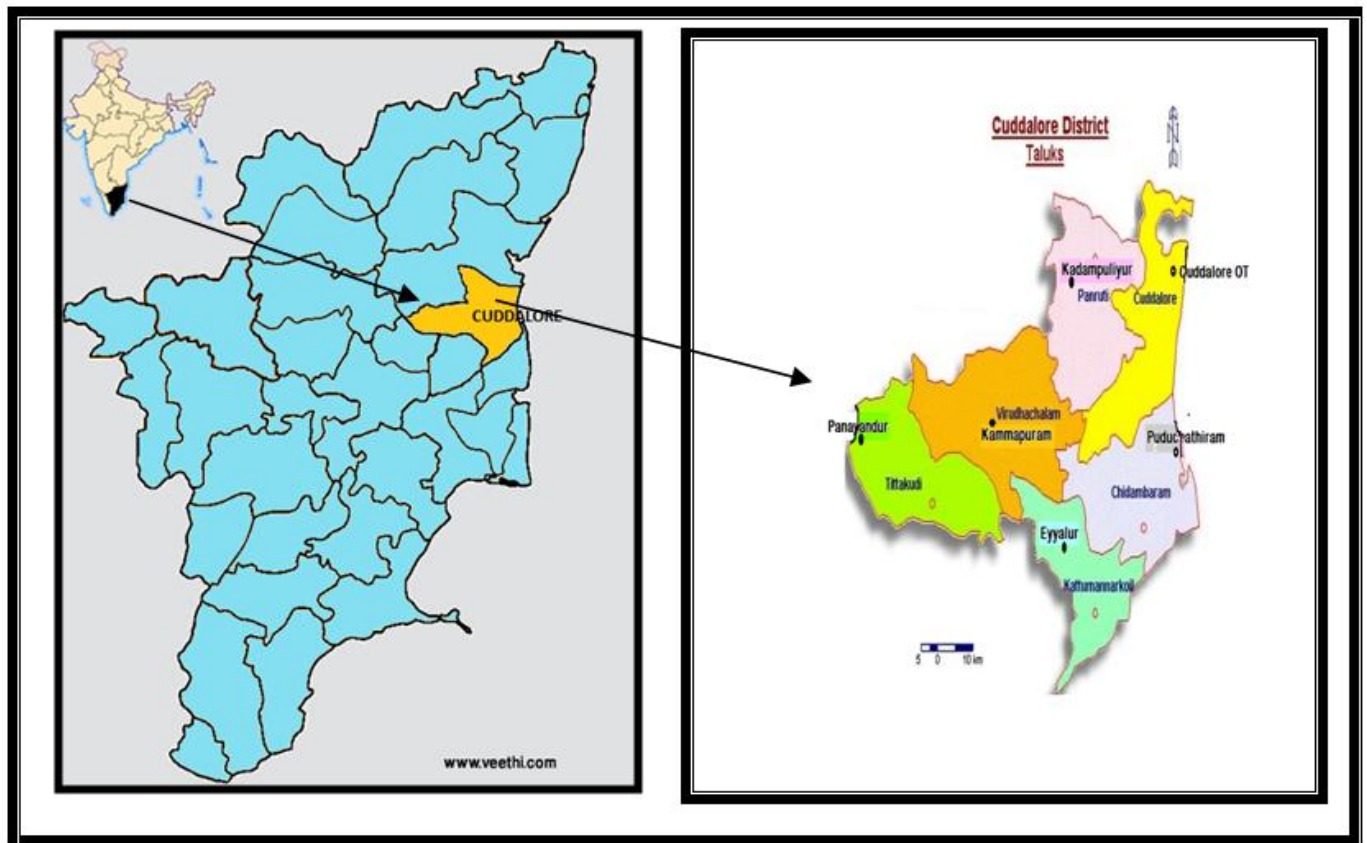


Fig. 1.1. Location map of the study area

RESULTS AND DISCUSSION

EC

In Cuddalore OT, Panayanthur, Kammapuram and Eyyalore the EC values were beyond the maximum allowable limit as recommended by WHO in all the five years between 2009 and 2013 but the values were within the prescribed limit in Kadampuliyur and Puthuchathiram during that period.

pH

The pH values were beyond the maximum allowable limit in Puthuchathiram location in all the five years between 2009 and 2013 but Panyanthur and Eyyalore the pH values were within the permissible limit in all the five years. In the years 2011 and 2012 the pH values were in the maximum allowable limit in Kammapuram and Kadampuliyur locations respectively. In the year 2012 and 2013 alone the pH value is higher than the prescribed limit in Cuddalore- OT location and the remaining years it was stable.

Ca

All the years between 2009 and 2013 the samples were almost within the allowable limit.

Mg

The Mg values were beyond the maximum allowable limit in Cuddalore- OT location only in the years of 2009 and 2010,

but remaining locations were within the permissible limit in all the five years.

Sodium (Na)

Data shows that in Cuddalore- OT and Panyanthur locations the 'Na' values were beyond the maximum allowable limit between 2009 and 2012. It is high in the year 2010, 2011 and 2012 in the Kammapuram location. In the Eyyalore location the values were beyond the maximum allowable limit in the year of 2009 and 2012 but the Na values were within the permissible limit in Kadampuliyur location for all the five years. In Puthuchathiram location all the years the values were exceeded the maximum allowable limit except 2009.

Pottassium (K)

The K values were beyond the maximum allowable limit in Cuddalore OT and Panyanthur- locations during the years of 2009 to 2013. In Kammapuram location all the values were within the permissible limit. In Eyyalur location in the year 2011, Puthuchathiram location in the years 2011 and 2012 and also Kadampuliyur location in the years 2012 and 2013 the values were beyond the maximum allowable limit by recommended Standards.

So₄

In Panyanthur, Kadampuliyur and Puduchathiramm locations So₄ values were within the permissible limit by recommended Standards. The So₄ values were beyond the maximum

allowable limit in Cuddalore OT location only in the years of 2009 and 2010. In the year 2011 and 2012 the values were beyond the maximum allowable limit in Kammapuram location and in the Eyyalur location for the year 2012 only, the values were beyond the maximum allowable limit.

Cl₂

In Cuddalore –OT location in the years 2009, 2010 and 2011 and in Panayandur location in the year 2011 the Cl₂ values were beyond the maximum allowable limit recommended by WHO. Kammapuram, Pudhychathiram and Eyyalur locations are within the permissible limit.

No₃

Only in the Panayandur location in the years of 2009, 2011, 2012 and 2013 values were beyond the maximum allowable limit and remaining locations were under the safe position.

TDS

In all the years from 2009 to 2013 the cuddalore OT and in the year of 2009 to 2011 the Panayanthur locations values were beyond the maximum allowable limit. Remaining locations were safe position.

Fluoride (F)

The level of F prescribed by Indian Standard 1.0 to 1.5, all the samples are within the permissible limit recommended by IS and WHO standards.

HCO₃

All the years between 2009 and 2013 the values were exceeded the maximum allowable limit.

Sodium Adsorption Ratio (SAR)

The sodium hazard in irrigated waters is expressed by determining the sodium adsorption ratio (SAR) which is given by the relation; (Karanth 1997).

$$SAR = \frac{Na^+}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}}$$

(Where all the concentrations are expressed in meq/l)

| SAR | Water class |
|-------|-------------|
| 0-10 | Excellent |
| 10-18 | Good |
| 18-26 | Fair |
| >26 | Poor |

SAR Standard Value

| Village | 2009 | 2010 | 2011 | 2012 | 2013 |
|---------------|-----------|-----------|-----------|-----------|-----------|
| Cuddalore OT | Excellent | Excellent | Excellent | Excellent | Excellent |
| Panayandur | Good | Good | Good | Good | Excellent |
| Kammapuram | Good | Good | Excellent | Good | Good |
| Kadampuliyur | Good | Good | Good | Good | Good |
| Puduchathiram | Good | Good | Good | Good | Good |
| Eyyalur | Good | Good | Good | Excellent | Good |

Suitability of groundwater for irrigation based on SAR

The water samples value were in excellent quality during the years 2009, 2010, 2011, 2012 and 2013 in the study area.

Residual Sodium Carbonate (RSC)

This excess is denoted by Residual Sodium Carbonate (RSC) and is determined by the formula (Richards (Ed.), 1954):

$$RSC = (HCO_3^- + CO_3^{--}) - (Ca^{++} + Mg^{++})$$

(Where all the concentrations are expressed in meq/l)

| RSC(meq/l) | Water Category |
|------------|----------------|
| <1.25 | Safe |
| 1.25 – 2.5 | Marginally |
| >2.5 | Unsuitable |

| Village | 2009 | 2010 | 2011 | 2012 | 2013 |
|---------------|------------|------------|------------|------------|------------|
| Cuddalore OT | Safe | Safe | Unsuitable | Unsuitable | Unsuitable |
| Panayandur | Marginally | Marginally | Safe | Unsuitable | Unsuitable |
| Kammapuram | Safe | Unsuitable | Unsuitable | Safe | Safe |
| Kadampuliyur | Safe | Safe | Safe | Safe | Safe |
| Puduchathiram | Unsuitable | Marginally | Unsuitable | Unsuitable | Unsuitable |
| Eyyalur | Marginally | Safe | Safe | Unsuitable | Safe |

Suitability of groundwater for irrigation based on RSC

During the study period the water samples were unsuitable for irrigation except Kadampuliyur.

Percentage of sodium (NA%)

In all natural waters, percent of sodium content is a common parameter to assess its suitability for agricultural purposes (Wilcox 1948). Sodium combined with carbonate can lead to the formation of alkaline soils, while sodium combined with chloride forms saline soils. Both these soils do not help plant growth. NA% was calculated using the following equation:

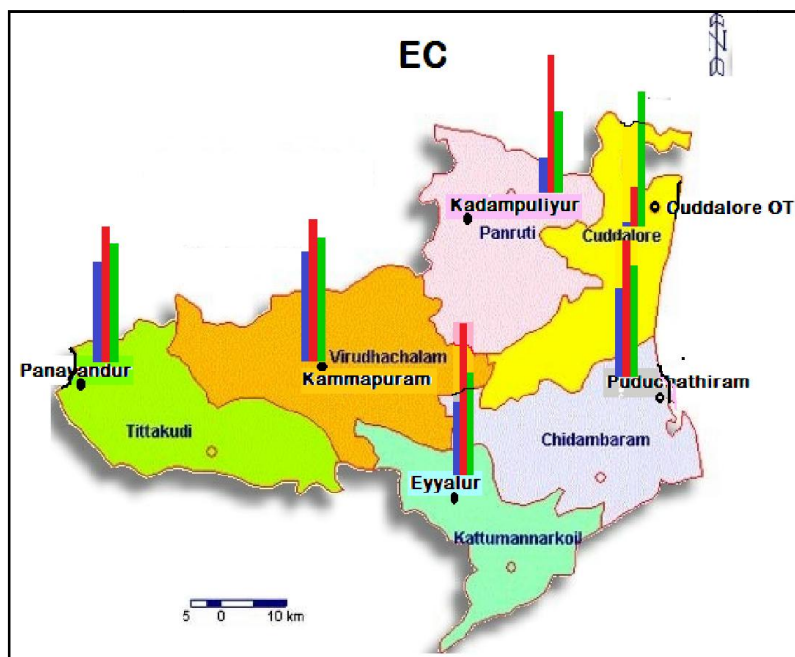
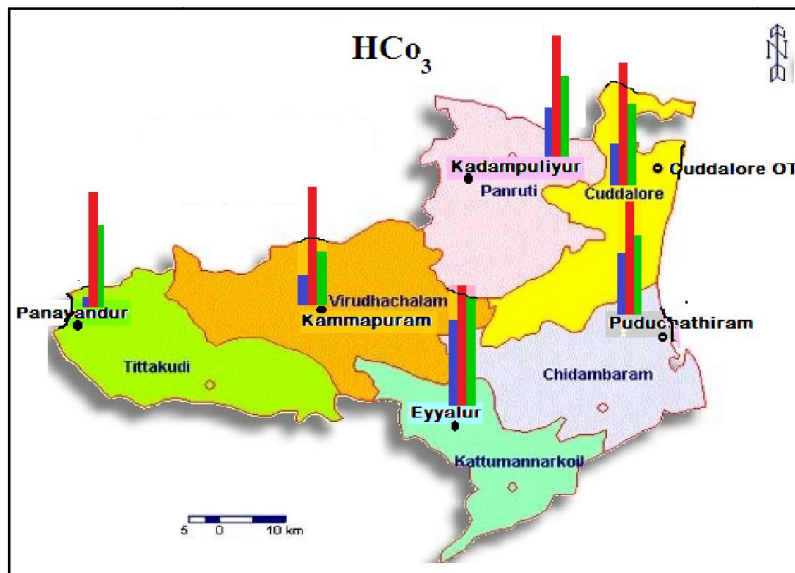
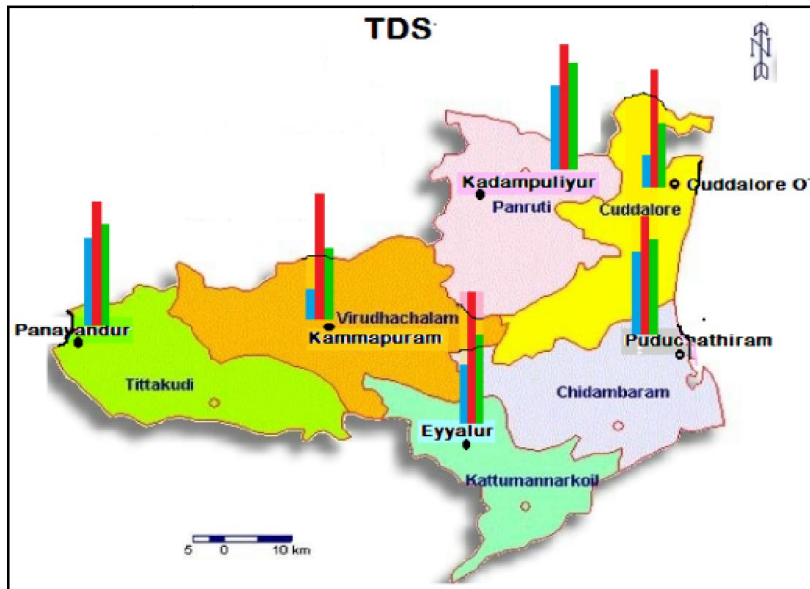
$$Na\% = \frac{Na \times 100}{Ca + Mg + Na + K}$$

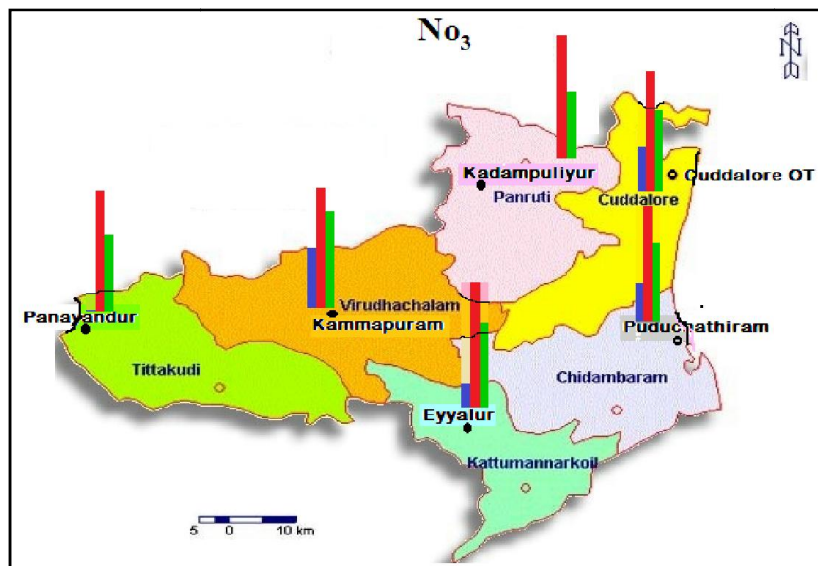
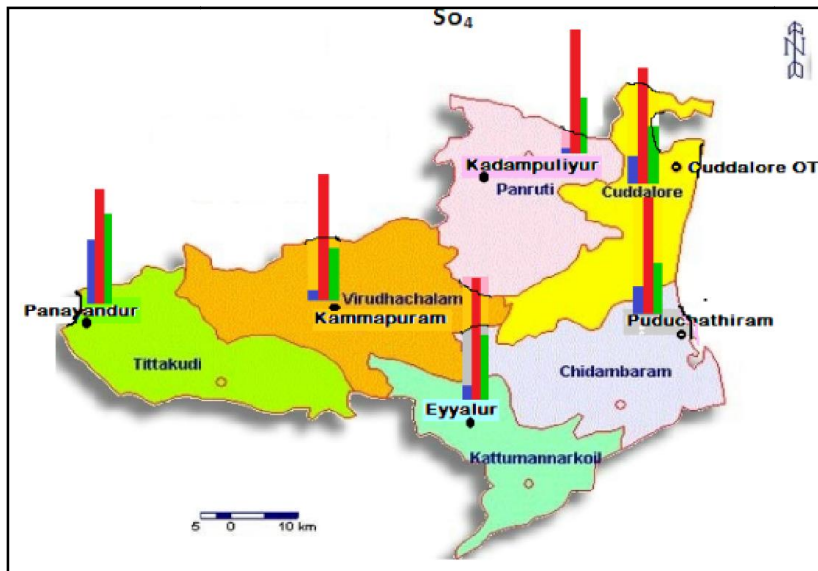
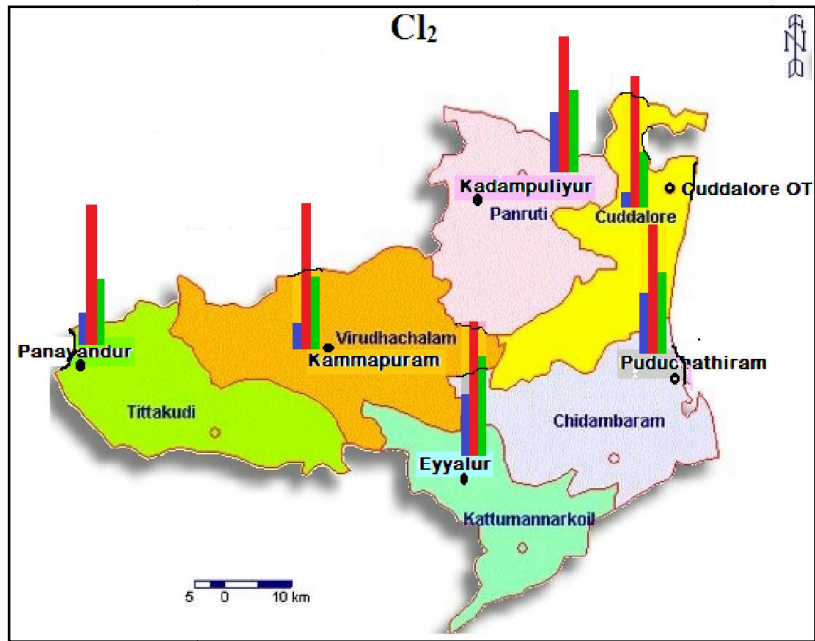
The NA% were in doubtful category and unsuitable for irrigation in the entire study region except Kadampuliyur.

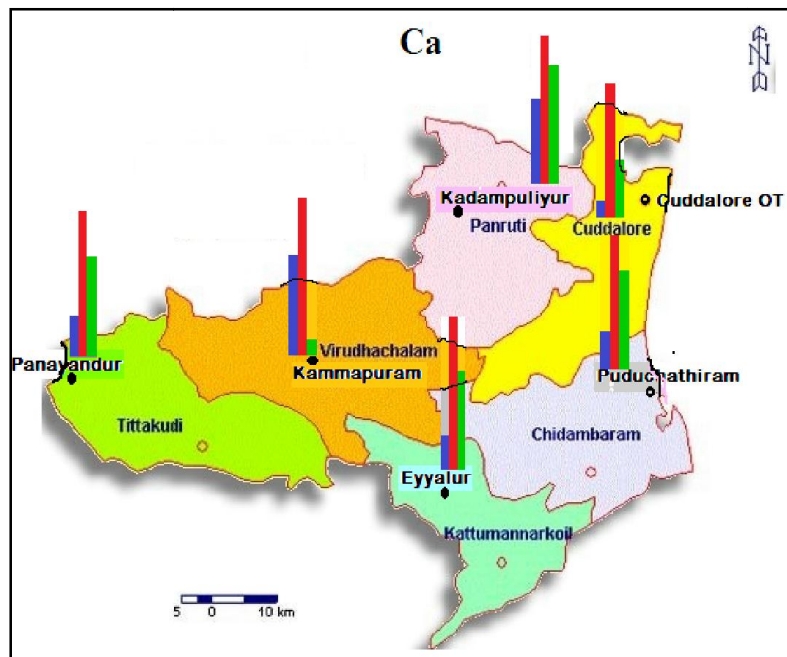
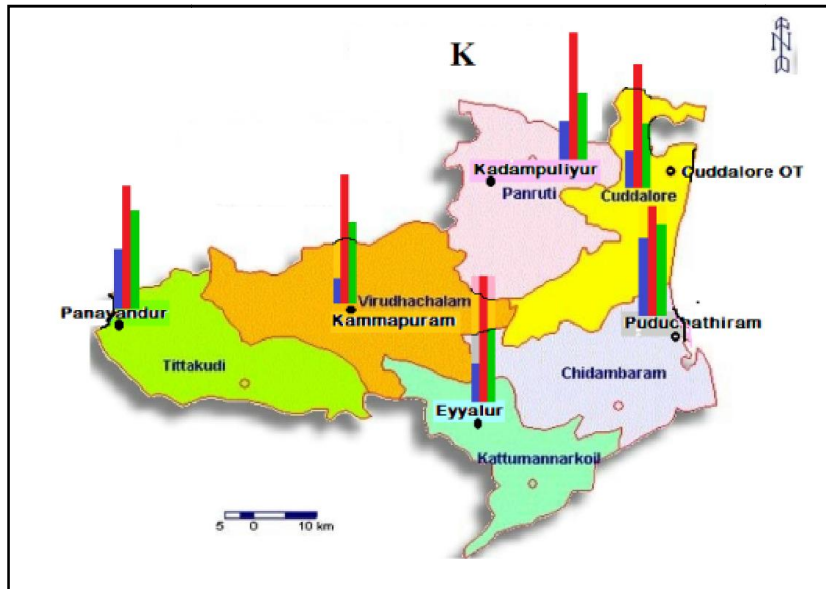
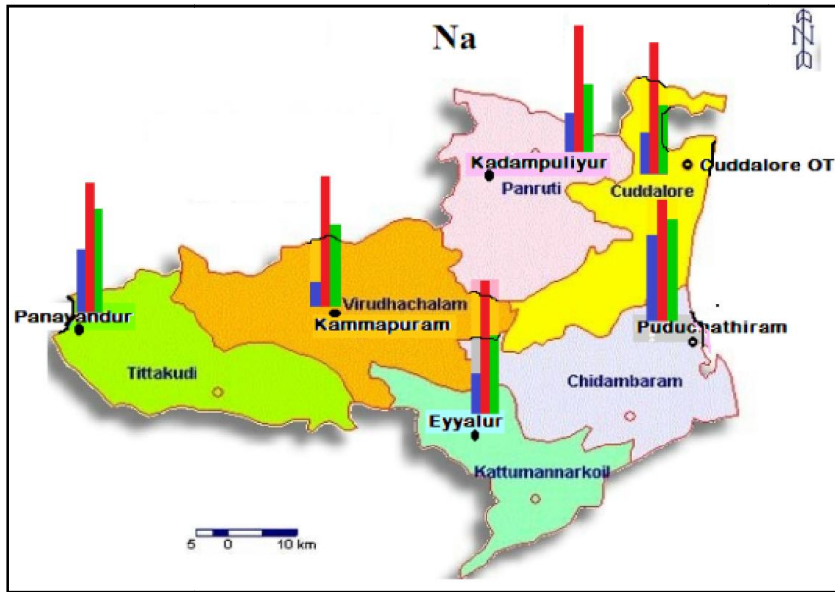
| Village | 2009 | 2010 | 2011 | 2012 | 2013 |
|---------------|-------------|-------------|-------------|------------|-------------|
| Cuddalore OT | Permissible | Doubtful | Doubtful | Doubtful | Doubtful |
| Panayandur | Doubtful | Doubtful | Doubtful | Doubtful | Unsuitable |
| Kammapuram | Permissible | Permissible | Doubtful | Doubtful | Permissible |
| Kadampuliyur | Good | Good | Good | Good | Good |
| Puduchathiram | Doubtful | Doubtful | Doubtful | Doubtful | Doubtful |
| Eyyalur | Doubtful | Doubtful | Permissible | Unsuitable | Permissible |

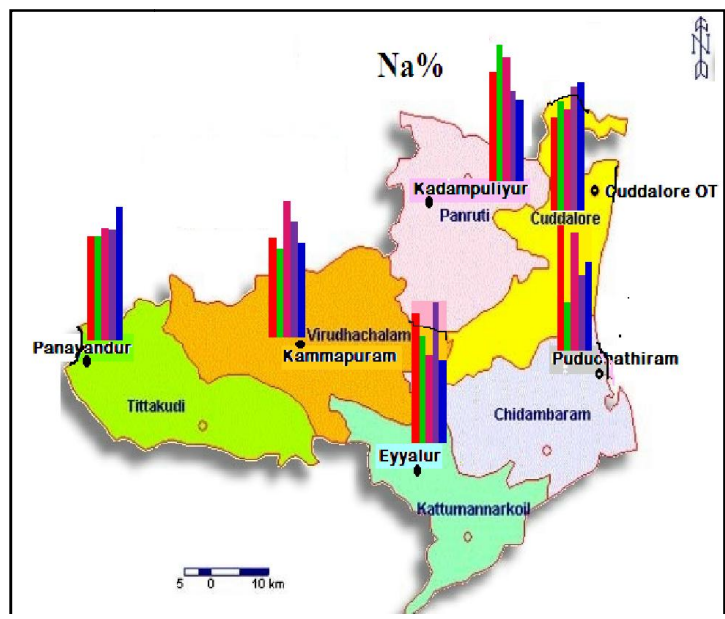
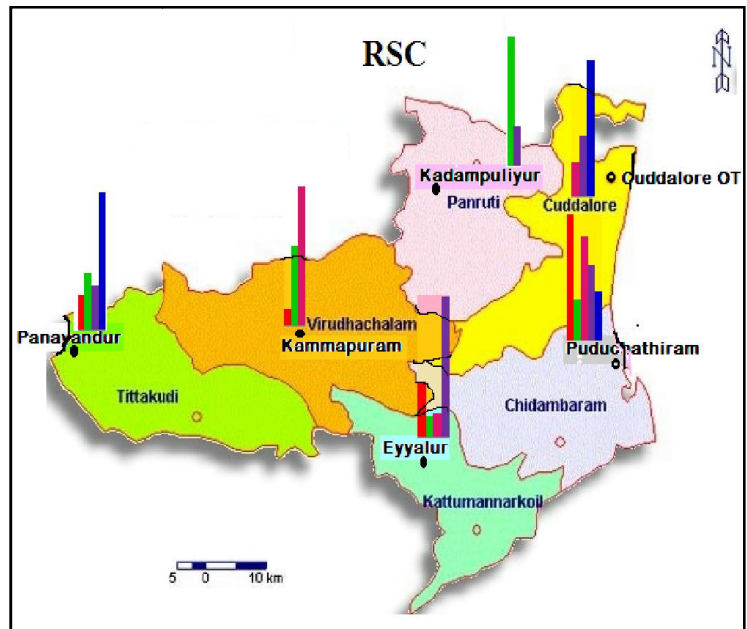
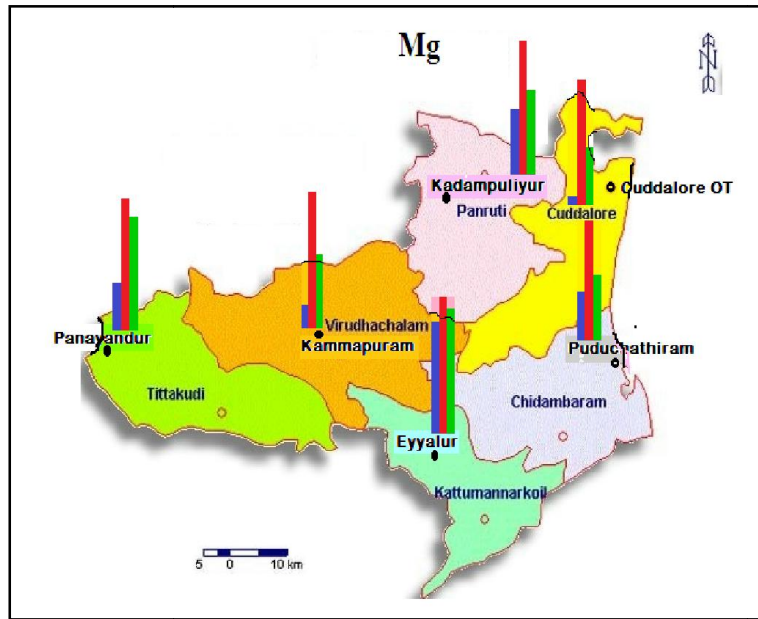
Suitability of groundwater for irrigation based on NA%

Minimum, Maximum & Average concentrations of the study area (2009 – 2013)









Minimum, Maximum & Average concentrations in groundwater in the Study area 2009 - 2013

| Water quality parameters | Village Name | 2009 - 2013 | | |
|-------------------------------|----------------|-------------|--------|----------|
| | | Min | Max | Mean |
| TDS | Cuddalore OT | 1793 | 6497 | 3483.2 |
| | Panayandur | 1220 | 1731 | 1406.6 |
| | Kammapuram | 334 | 1371 | 788.6 |
| | Kadampuliyur | 181 | 268 | 229 |
| | Pudhuchathiram | 481 | 692 | 555 |
| EC | Eyyalur | 479 | 1073 | 731.8 |
| | Cuddalore OT | 2710 | 10120 | 5448 |
| | Panayandur | 1960 | 2640 | 2300 |
| | Kammapuram | 580 | 290 | 1346 |
| | Kadampuliyur | 330 | 430 | 370 |
| PH | Pudhuchathiram | 760 | 1180 | 964 |
| | Eyyalur | 920 | 1870 | 1268 |
| | Cuddalore OT | 8 | 9 | 8.42 |
| | Panayandur | 8.3 | 8.7 | 8.5 |
| | Kammapuram | 8.1 | 8.6 | 8.28 |
| CO ₃ | Kadampuliyur | 7.6 | 8.6 | 8.14 |
| | Pudhuchathiram | 8.6 | 8.9 | 8.78 |
| | Eyyalur | 7.9 | 8.8 | 8.36 |
| | Cuddalore OT | 0 | 180 | 69.6 |
| | Panayandur | 0 | 168 | 36.6 |
| Alkalinity(HCO ₃) | Kammapuram | 0 | 36 | 10.2 |
| | Kadampuliyur | 0 | 30 | 8.7 |
| | Pudhuchathiram | 9 | 42 | 27.9 |
| | Eyyalur | 0 | 72 | 29.1 |
| | Cuddalore OT | 317.2 | 921 | 613.64 |
| Ca ²⁺ | Panayandur | 49 | 561 | 400.2 |
| | Kammapuram | 171 | 665 | 297.3 |
| | Kadampuliyur | 79 | 188 | 124.6 |
| | Pudhuchathiram | 250 | 458 | 311.7265 |
| | Eyyalur | 220 | 323 | 280.8194 |
| Mg ²⁺ | Cuddalore OT | 28 | 100 | 86.4 |
| | Panayandur | 16 | 56 | 38.4 |
| | Kammapuram | 30 | 48 | 5 |
| | Kadampuliyur | 26 | 44 | 43.8 |
| | Pudhuchathiram | 10 | 34 | 25.2 |
| Na ⁺ | Eyyalur | 12 | 54 | 34.8 |
| | Cuddalore OT | 24 | 328 | 151.064 |
| | Panayandur | 24.3 | 73 | 58.838 |
| | Kammapuram | 13 | 72 | 39.769 |
| | Kadampuliyur | 9 | 18.225 | 11.475 |
| K ⁺ | Pudhuchathiram | 4.86 | 22 | 11.959 |
| | Eyyalur | 27 | 33 | 30.15 |
| | Cuddalore OT | 541 | 1730 | 898.8 |
| | Panayandur | 210 | 430 | 342.8 |
| | Kammapuram | 78 | 400 | 249 |
| NO ₃ ⁻ | Kadampuliyur | 25 | 83 | 43 |
| | Pudhuchathiram | 145 | 207 | 172.6 |
| | Eyyalur | 104 | 253 | 195.6 |
| | Cuddalore OT | 34 | 160 | 115.6 |
| | Panayandur | 11 | 43 | 27.8 |
| Cl ₂ | Kammapuram | 0.1 | 11 | 4.22 |
| | Kadampuliyur | 2 | 18 | 7.8 |
| | Pudhuchathiram | 0.1 | 20 | 9.22 |
| | Eyyalur | 0.1 | 15 | 5.62 |
| | Cuddalore OT | 3 | 8 | 5.4 |
| SO ₄ | Panayandur | 1 | 81 | 51.4 |
| | Kammapuram | 1 | 2 | 1.6 |
| | Kadampuliyur | 0 | 4 | 2.2 |
| | Pudhuchathiram | 1 | 3 | 2 |
| | Eyyalur | 0 | 8 | 3.4 |
| F | Cuddalore OT | 298 | 2552 | 1081.8 |
| | Panayandur | 163 | 663 | 311.4 |
| | Kammapuram | 46 | 255 | 126.8 |
| | Kadampuliyur | 25 | 71 | 43.4 |
| | Pudhuchathiram | 50 | 110 | 67.4 |
| | Eyyalur | 89 | 195 | 144 |
| | Cuddalore OT | 355 | 1488 | 749.2 |
| | Panayandur | 110 | 197 | 156 |
| | Kammapuram | 34 | 427 | 180.6 |
| | Kadampuliyur | 1 | 30 | 13.6 |
| | Pudhuchathiram | 30 | 154 | 67 |
| | Eyyalur | 30 | 242 | 130.4 |
| | Cuddalore OT | 0.01 | 1.3 | 0.566 |
| | Panayandur | 0.4 | 1 | 0.606 |
| | Kammapuram | 0.2 | 1 | 0.656 |
| | Kadampuliyur | 0.35 | 0.8 | 0.59 |
| | Pudhuchathiram | 0.1 | 1.3 | 1.004 |
| | Eyyalur | 0.03 | 0.9 | 0.364 |

Conclusion and Recommendation

The physio-chemical based results suggest that the groundwater suitability for drinking usage and agriculture purpose which were evaluated under WHO standards for the periods between 2009 and 2013, all Parameters were maximum allowable limit except Ca and SAR. The results indicate that the 6 locations were polluted and cannot be used for Domestic, Irrigation and Pisciculture. Maximum polluted location is Cuddalore -OT. Integrated groundwater suitability map for drinking purposes are created using TDS, EC, TH, pH, Na, K, Ca, Mg, Cl₂, SO₄, PO₄, Fluoride and NO₃ values based on a concept that if the groundwater sample exceeds the recommended limit of any one of these parameters, it is not suitable for drinking usage.

The discharge of effluents by the Industries into the surroundings which ooze through the ground caused the pollution. With monsoon approaching, the problem of effluents water getting mixed up with ground water. To solve the problem TWAD Board has to adopted severe maintenance systems properly in the study area. Tamil Nadu Pollution Control Board and District Administration prevent the discharge of untreated effluents into water ways and initiate stern action against those polluting the Environment. Laws should be framed to check over exploitation of ground water by private agencies supplying water in bulk.

REFERENCES

- Durfer C.N. and Baker, F, 1964. Public water supplies of the 10 larger city in the U.S. Geo. Survey. *Water Supply*, 1812, pp.364.
- Garg, V.K., Deepshikha, D., Sudhir and Chaudhary 1998. A Ground water quality in rural areas of Jind district in Haryana. *J. of Envnt. And Poll.*, 5(4), 285- 290.
- Hari Haran. A.V.L.N.S.H. 2002. Evaluation of drinking water quality a Jalaripeta village of Visakhapatanam distict, Andhra Pradesh. *Nat. Envnt. and Poll. Tech.*, 1 (4), pp. 407-410.
- Hem. J.D 1985. Study and interpretation of the chemical characteristics of Natural water, U.S. Geol. Survey, water supply paper – 2254, 264p.
- Karanth, K.R. 1987. Ground water assessment, development and management, Tata Mc Graw Hill publishing company Ltd., NewDelhi 720 p.
- Karunakaran, K., Thamilarasu, P. and Sharmila, R. 2009 Statistical Study on Physiochemical Characteristics of Groundwater in and around Namakkal, Tamilnadu, India. *E- Journal of Chemistry*, 6(3), pp. 909-914.
- Munawar M. 1970. Limnological studies on fresh water ponds of Hyderabad, India-II, *J. Hydrobiologia.*, 35: pp. 127-162
- Ramakrishna 1998. Groundwater handbook, India
- Ranjana, B., Das, P. K. and Bhattacharyya, K.G. 2001. Studies on interaction between surface and ground waters at Guwahati, Assam, *India Jour of Envnt. and Poll.*, 8(4) pp. 361 – 369.
- World Health Organization, (WHO) 1991 Guidelines for drinking water quality, recommendations (2 nd edition) Geneva: WHO.
