

Seasonal changes in water quality indices –a case study in chennai city and its surrounding districts

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ABSTRACT

The present study was carried out to assess the seasonal changes (pre and post monsoon) in water quality indices of Chennai, Kancheepuram and Tiruvallur districts in Tamil Nadu state, India. The water quality data for the year 2001 and 2010 were collected and studied for alkalinity, salinity hazard, sodium hazard, hardness and for specific ion toxicity. The spatio – temporal distribution of physico - chemical properties of water were plotted in Geographical Information System environment. The results will give the clear cut information about the water quality in the study zones.

Keywords: hazard, physic-chemical, pre and post monsoon spatio-temporal, water quality.

INTRODUCTION

Water is indispensable for the existence and survival of life on Earth. A country's economy depends mostly on its wealth of water resources. Groundwater is the gift given by nature. Nowadays the groundwater resources are overexploited due to industrialization, urbanization, and increasing population density etc., Groundwater has been extracted highly from the sub urban area (like Kancheepuram and Thiruvallur) to supply the water for drinking to overcome the demand for growing population in urban cities (Chennai). Sea water intrusion is a result of over exploitation of groundwater; due to this, the quality of water gets changed (Srikanthan L, 2013). Rapid urbanization has affected the groundwater quantity and over exploitation, improper waste disposal have affected the quality of water. If the quality of groundwater is once contaminated, it is not possible to restore its originality. Regular monitoring of groundwater is important to protect their quality from the pollution (Ramakrishnaiah, 2009). In this study, an attempt is made to evaluate the water quality indices such as alkalinity, salinity hazard, sodium hazard, hardness and specific ion toxicity in an urban (Chennai) and the sub urban (Kancheepuram and Thiruvallur) areas. This will help the people to know more about the status of water quality and it's important.

STUDY AREA

Chennai, Kancheepuram and Thiruvallur are the areas chosen for the study. Chennai city is the capital of the state Tamil Nadu. Kancheepuram and Thiruvallur are the adjacent districts of Chennai city. Figure 1 shows the location map of study area. Nowadays, the districts having number of small to large scale industries, Information technology park, auto mobile companies, refineries, treatment plants, dumping yards. In such cases obviously, the quality and quantity of water resources are getting reduced. Chennai district have an area of about 174km². Table 1 represents the geographical area, location, administrative information and climatic conditions of the other two districts.

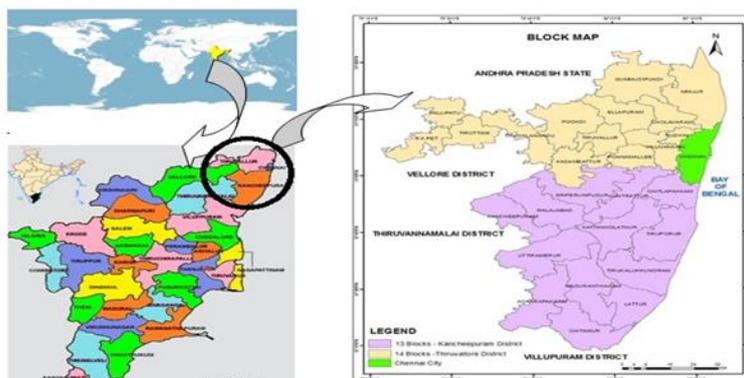


Fig. 1. Location map of study area

MATERIALS AND METHODS

For the physico chemical analysis, the monthly water quality data such as pH, Electrical Conductivity(EC), total dissolved solids (TDS), chloride (Cl⁻), total hardness (TH), sodium adsorption ratio (SAR) (Abdullahi A.S et.al., 2010, Rupal M et.al., 2012, Govindarajan M and Senthilnathan T, 2014, Nag S.K and Das S, 2014, Shobana R et.al., 2014, Upadhyay A and Chandrakala M, 2014) for the year 2001 and 2010 were collected. For the year 2001, the 92 pre monsoon data and 115 post monsoon data were used and for the year 2010, around

250 well data were used for both the seasons. From the pH value, the alkalinity and the acidity were identified. The salinity hazard was identified using EC and TDS. Sodium hazard was identified from SAR value. The spatial distribution of each physico-chemical properties of water was plotted in the GIS environment using ArcGIS 10 package. Based on the data availability, they are classified into three or four categories with the equal interval. Then the results were compared with standard values.

Table.1.Details about the study area.

Minutiae	Kancheepuram	Thiruvallur
Geographical Area (km ²)	4433	3422
Latitude	11° 00' to 12° 00'	12°15'to 13°15'
Longitude	77° 28' to 78° 50'	79°15' to 80°20'
Number of Blocks	13	14
Number of Revenue Villages	1214	820
Productivity for vegetables (t/ha)	19.49	16.87
Average Rainfall (mm)	1213	1104
Average Temperature in summer (C)	36.6	37.9
Average Temperature in winter (C)	19.8	18.5

RESULTS

Alkalinity or Acidity: The pH of ground water in the study area lies between 6.5 to 9.1. The larger area is affected by alkalinity than acidity. During the year 2001 74% of well data in pre monsoon and 97% in post monsoon fall within permissible limit. In 2010, 78% in pre monsoon and 90% in post monsoon fall within the limit. Figure 2 depicts the graphical representation of spatio-temporal variation of pH during the pre and post monsoon in the year 2001 and 2010. From the figure it is observed that during pre monsoon, the alkalinity in Kancheepuram district is higher than the other two districts. The alkalinity problem gets reduced during post monsoon than pre monsoon.

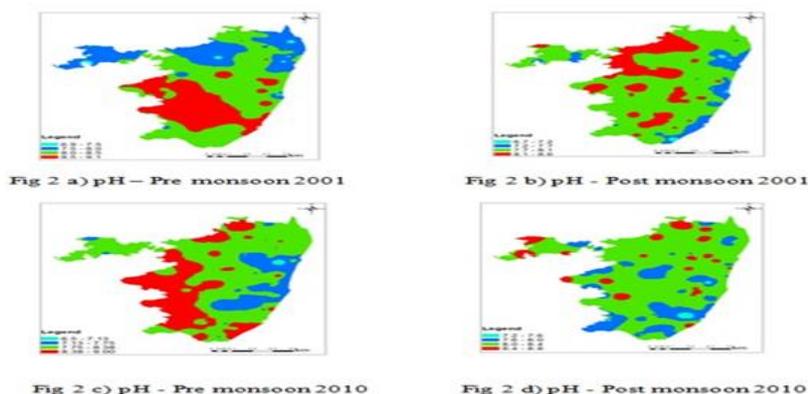


Fig.2.Spatial distribution of pH 2001 and 2010

Salinity Hazard: Salinity hazard was identified from EC and TDS values.

1. ECzIO: The unit used for EC in the study is S/cm. From the analysis it is observed that the EC values exceed the permissible limits (300S/cm) for drinking purpose. Below 750S/cm can only be used for irrigation purpose. In 2010, the EC values varied between 320 and 4460S/cm for pre monsoon and 280 and 5570S/cm for post monsoon. Figure 3 depicts the variation in EC values between the year 2001 and 2010.

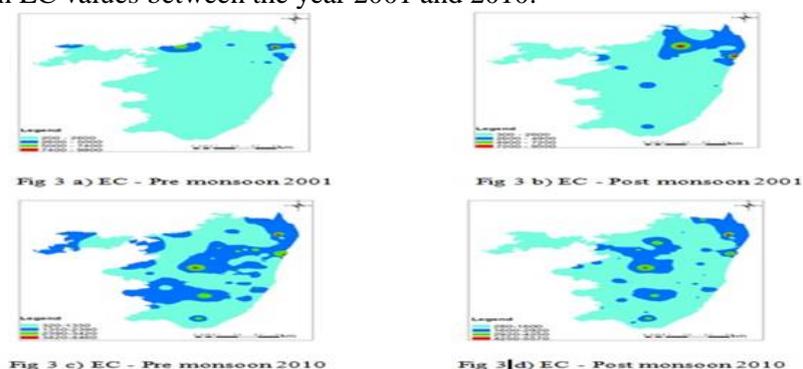


Fig.3.Spatial distribution of EC 2001 and 2010

2. TDS: Figure 4 depicts the changes in the TDS level between the year 2001 and 2010. From the map, the ground water available in the area where the TDS level lies under the first category (< 500mg/l) only can be used for drinking purpose. In the study area, the larger portions fall under the not suitable (> 500mg/l) category.

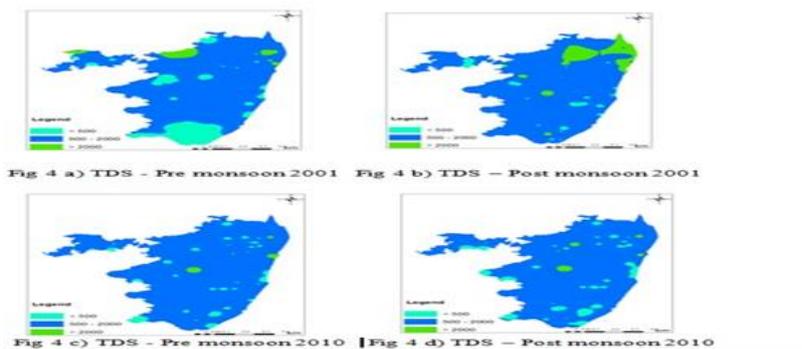


Fig.4.Spatial distribution of TDS 2001 and 2010

Sodium Hazard: Sodium adsorption ratio is the key indicator of identifying the sodium hazard zones. Figure 5 shows the spatial distribution of SAR in the study area. Table 2 represents the groundwater classification for irrigation based on SAR value. From the figure 5, in almost all the area, the water quality falls under excellent and good category (Aghazadeh N and Mogaddam A A,2010). SAR value is <math>< 20</math>-Excellent for irrigation, 20 to 40 – Good, 40 to 60 – Permissible. Hence, the whole study area falls under the excellent category (Ghislain, 2012).

Table.2.Classification of Ground water for Irrigation based on SAR

Quality of Water	Sodium Adsorption Ratio (SAR)
Excellent	<math>< 10</math>
Good	10-18
Doubtful	18-26
Unsuitable	>26

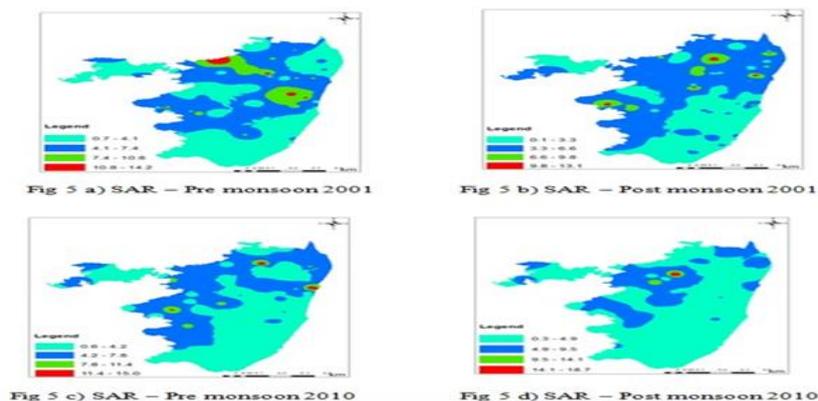


Fig.5.Spatial distribution of SAR 2001 and 2010

Specific Ion Toxicity: In this study, Chloride was taken as an indicator for determining the specific ion toxicity. In 2010, the chloride content in the study area ranged between 11 - 1300 mg/l in pre monsoon and 21 – 1600mg/l in post monsoon. In the year 2001, it ranged between 21- 2500mg/l in both the seasons. From the figure 8, it is observed that the water having less than 250ml/l of chloride fall under the suitable category for drinking purpose. From the analysis it was identified that, in 2001 the drinking water quality is very poor in Thiruvallur district but the quality is quite improved in 2010. In both the year the ground water quality in Chennai district are not suitable for drinking. More than 300ml/l leads to severe ion hazard.

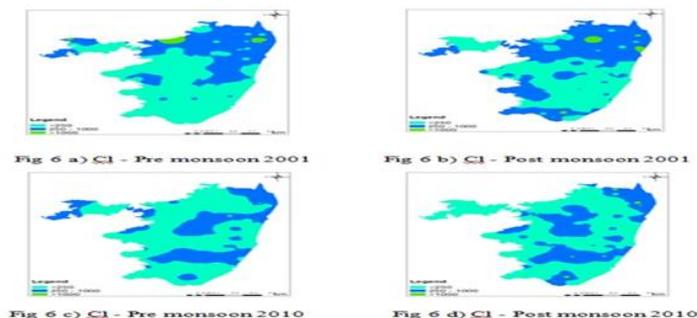


Fig.6.Spatial distribution of Cl- 2001 and 2010

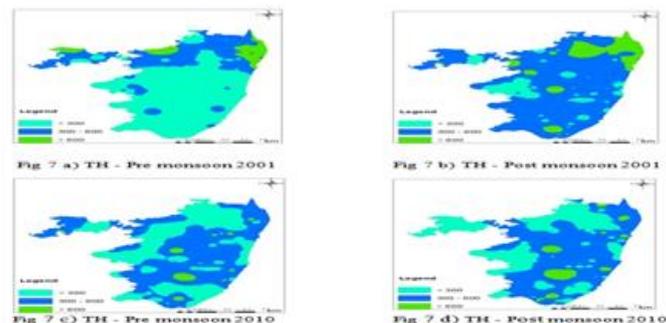


Fig.7.Spatial distribution of TH 2001 and 2010

Total Hardness: The classification of groundwater based on total hardness (Table 3) shows that in 2001 pre monsoon 50% of water samples fall in the hard water category and 36% fall in the very hard category. In 2010 pre

monsoon 43% of water samples fall in the hard water category and 45% fall in the very hard category. In the figure 7, the soft to very hard water fall under the first category.

Table 3 Suitability of groundwater based on hardness.

Total hardness as CaCO ₃ (mg/l)	Water class
< 75	Soft
75 - 150	Moderately hard
150-300	Hard
>300	Very hard

CONCLUSION

During pre and post monsoon, the groundwater quality of the study area for drinking is poor in terms of EC, TDS and TH and for irrigation it is good in terms of SAR. In the year 2010, there is no much variation in the seasonal water quality indices. The concentration of chloride ion is good for in the whole study area. The pH is good for drinking in the larger part of the study area. In overall, the whole study area is affected by salinity hazard than the other hazards. Therefore, the remedial measures such as reverse osmosis, distillation and deionization have to be taken to improve the water quality by reducing the salinity in all the three districts.

REFERENCES

- Abdullahi A.S, Isa F.I, Ayodele A.S, Peter Z and Muhammad D.B.B, Investigation of Groundwater quality for Domestic and Irrigation purposes around Gubrunde and Environs, northeastern Nigeria, *Journal of Aerican Science*, 6(12), 2010, 664-672
- Aghazadeh N and Mogaddam A.A, Assessment of GroundWater Quality and its suitability for Drinking and Agricultural Uses in the Oshnavieh Area, Northwest of Iran, *Journal of Environmental Protection*, 1, 2010, 30-40
- Ghislain T.Y.J, Roger F, Joseph W, Emmanuel E.G and Ghislain D.M, Evaluation of Groundwater Suitability for Domestic and Irrigational Purpose: A Case Study from Mingoa River Basin, Yaounde, Cameroon, *Journal of Water Resource and Protection*, 4, 2012, 285-293.
- Govindarajan M and Senthilnathan T, Ground water quality and its health impact analysis in an industrial area, *International Journal of Current Microbiology and Applied Sciences*, 3(7), 2014, 1028-1034
- Nag S.K and Das S, Quality Assessment of Groundwater with special Emphasis on Irrigation and Domestic Suitability in Suri I &II Blocks, Birbhum District, West Bengal, India”, *American Journal of Water Resources*, 2(4), 2014, 81-98.
- Rupal M, Tanushree B and Sukalyan C, Quality Characterization of Groundwater using Water Quality Index in Surat city, Gujarat, India, *International Research Journal of Environment Sciences*, 1(4), 2012, 14-23.
- Shobana R,Suriyakala K, Sahayaraj P.A, Dharmalingam V and Soruba R, Evaluation of water quality of sriperumpudur in Kancheepuram District in Tamilnadu, *Pelagia Research Library*, 5(5), 2014, 91-97.
- Srikanthan L, Jayaseelan J, Narendran D, Manikandan I and Sing S.H, Determination of ground water quality using water quality index in part of Chennai city, Tamilnadu, *Indian Journal of Science*,3 (8), 2013, 81-84.
- Upadhyay A and Chandrakala M, Pre-Monsoon Study of Physico-Chemical Parameters of Hemavathi River, Turuvekere, Karnataka, India, *International Journal of Innovative Research in Sciences, Engineering and Technology*, 3 (9), 2014, 15986-15990.