

# Spatial Variation of Groundwater Quality from Porur to Poonamallee: A Case Study in Tamil Nadu, India

T. K. Padmini\* and K. Parameswari

Department of Civil Engineering, Sathyabama University, Chennai - 600119, Tamil Nadu, India;  
padminitk@gmail.com, param.rm@gmail.com

## Abstract

Ground water contamination is nearly always the result of human activity. In areas where population density is high and human use of land is intensive, ground water is vulnerable. Virtually any activity where by chemicals or wastes may be released to the environment, either intentionally or accidentally, has the potential to pollute the ground water. When ground water contaminated, it is difficult and expensive to clean up. Also drinking contaminated groundwater can have serious health effects. Diseases such as hepatitis and dysentery may be caused by contamination from septic tank waste. Poisoning may be caused by toxins that have leached into water supplies. Other long term effects such as certain types of cancer may also result from exposure to polluted water. The present study aims to understand the spatial variation of groundwater quality from Porur to Poonamallee. The samples were collected from Porur, Iyyappanthangal and Poonamallee and tested for the physio-chemical parameters. The test results were compared with the WHO and Indian Standard water quality standards. The spatial variation map for various physio-chemical parameters was digitized using Arc GIS. From the study it is observed that the groundwater quality is good in Porur, moderate in Iyyappanthangal and not desirable in few parts of Poonamallee. Also, it is observed in particular that the iron content is more than the permissible limit.

**Keywords:** Contamination and Groundwater Quality, Groundwater

## 1. Introduction

Water is a prime natural resource. Due to rapid urbanization in India, the availability and quality of groundwater have been affected. Ground water quality, especially in areas that immediately surround industrial zones are of increasing interest of residential zones. The quality of ground water is of great importance in determining the suitability of particular ground water for a certain use (public water supply, irrigation, industrial applications, power generation etc). The quality of ground water varies with location, depth of water table, season and by the extent and composition of dissolved solid. This project is an important report on the ground water quality in and around Poonamallee area of Tamil Nadu, India. Industries located in industrial area of Poonamallee dispose their effluents on land and as a result the nearby

shallow open wells get polluted and also the salt content of soil has started building up slowly. An estimated of around 580 people in India die of water pollution related sickness everyday some 90% of Chinas cities suffer from some degree water pollution and nearly 500 million people lake access to safe drinking water.

A study was attempted in Gulbarga City, Karnataka, India. The ground water quality map is determined and spatial parameters distribution is generated<sup>1</sup>. In Ranchi Municipal Corporation (RMC) Area Deterioration of ground water quality in RMC is not very serious problem except few areas. For a better groundwater quality management, spatial distribution analyses of groundwater quality parameters in the regions were carried out<sup>2</sup>. In a study conducted in an industrial area Maraimalai Nagar, Kanchipuram District it is determined that both ground water and the soil contains high amount of salt<sup>3</sup>. In a study

\*Author for correspondence

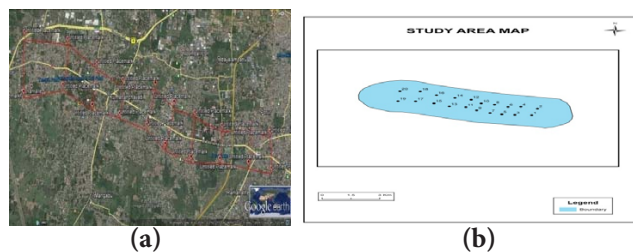
conducted in Pettyjohns Cave, Northwest Georgia, USA it is identified that the dominant ions are calcium and bicarbonate. Magnesium, Sulphate, Chloride, Sodium, Silica and Potassium are also present above detection limits in most waters. Surface waters being much lower in TDI concentrations than cave waters are also deficient in calcium, magnesium and bicarbonate<sup>4</sup>. The pH value of the ground water in the Gangavalli Taluk, Salem district, Tamil Nadu, area is determined to be slightly alkaline and this is because of  $\text{HCO}_3^-$  ions in the ground water aquifer, which is due to percolation of rain<sup>5</sup>.

## 2. Study Area

Porur is located at 13.03° N and 80.16° E, and 52 feet (15 metres) above sea level. It is bounded on the east and south-east by the Pallavaram Hills. It is located 18 km south-west of Chennai city limits on the Guindy-Poonamallee road which eventually merges into the Chennai-Bangalore highway. Iyyapanthangal is a town (Panchayat Village) in the Sriperumbudur taluk in the Kancheepuram District of Tamil Nadu, India. It is located 19 kilometres (12 mi) from Fort St George on the Mount-Poonamallee Road and is a suburb of Chennai. Poonamallee is a town in the Poonamallee taluk of the Thiruvallur district in the Indian state of Tamil Nadu. The area is presently considered to be a suburb of Chennai. The study area map is shown in Figure 1.

## 3. Data Collection and Methodology

20 water samples were collected from the study area: Porur, Iyyapanthangal, and Poonamallee. From Porur 8 samples and 6 samples each from Iyyapanthangal and Poonamallee were collected to check for physical and chemical parameters such as Alkalinity, pH, Turbidity,



**Figure 1.** (a) and (b) Study Area Map.

Iron, Total Dissolved solids, Total hardness and Chlorine using APHA method.

## 4. Results and Discussion

### 4.1 Alkalinity

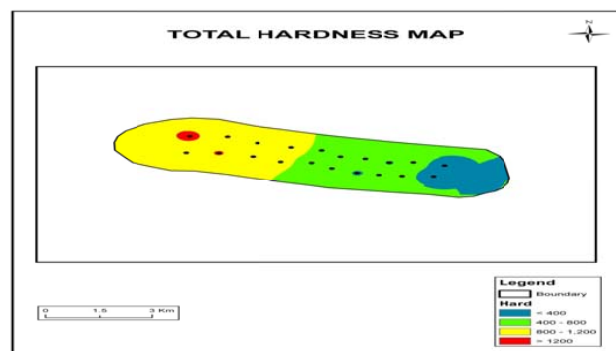
The test result shows that the alkalinity present in Porur, Iyyapanthangal, and Poonamallee is more than the desirable limit ( $> 200\text{mg/l}$ ). Moreover in Iyyapanthangal and Poonamallee it's more than permissible limit i.e.  $600\text{mg/l}$ . From the result it is determined that the water sample is not desirable as well as not meeting the bureau of INDIAN STANDARDS FOR WATER.

### 4.2 Total Hardness Test

The test result shows that the hardness present in Porur is more than the desired limit. i.e.  $300\text{mg/l}$ . Moreover in Iyyapanthangal and Poonamallee is more than the permissible limit i.e.  $600\text{mg/l}$ . From the result it is determined that the watersample is not desirable as well as not meeting the bureau of INDIAN STANDARDS FOR WATER. The spatial variation is shown in Figure 2.

### 4.3 Chloride

The test sample shows that the chloride present in Porur, Iyyapanthangal and Poonamallee is greater than the permissible limit i.e.  $1000\text{mg/l}$ . From the result it is determined that the water sample is not desirable as well as not meeting the bureau of INDIAN STANDARDS FOR WATER. The spatial variation is shown in Figure 3.



**Figure 2.** Spatial Variation of Total Hardness.

#### 4.4 pH

The test result shows that the pH present in Porur is more than the desired limit. i.e. 6.5. Moreover in Iyyapanthangal and Poonamallee it is more than the permissible limit i.e. 8.5. From the result it is determined that the water sample is not desirable as well as not meeting the bureau of INDIAN STANDARDS FOR WATER. The spatial variation is shown in Figure 4.

#### 4.5 Turbidity

The test result shows that turbidity of the present in Porur is more than the desired limit. I.e. 5 mg/l. Moreover in Iyyapanthangal and Poonamallee is more than the permissible limit i.e. 10 mg/l. From the result it is determined that the water sample is not desirable as well as not meeting the bureau of INDIAN STANDARDS FOR WATER. The spatial variation is shown in Figure 5.

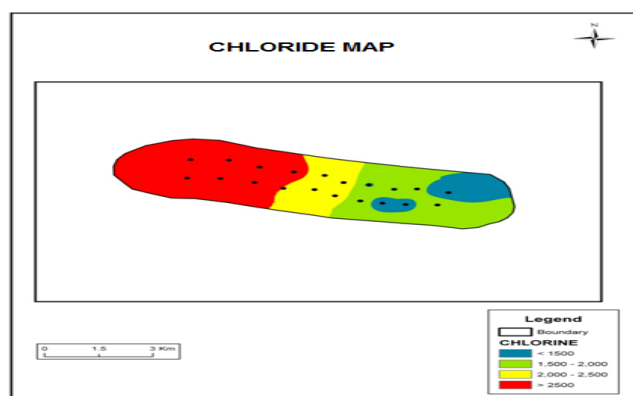


Figure 3. Spatial Variation of Chloride.

#### 4.6 Total Dissolved Solid

The test result shows that the total dissolved solids present in Porur are more than the desired limit. I.e. 500 mg/l. Moreover in Iyyapanthangal and Poonamallee is more than the permissible limit i.e. 1500 mg/l. From the result it is determined that the water sample is not desirable as well as not meeting the bureau of INDIAN STANDARDS FOR WATER. The spatial variation is shown in Figure 6.

#### 4.7 Iron

The test result shows that the iron present in Porur is more than the desired limit. i.e. 0.3 mg/l. Moreover in Iyyapanthangal and Poonamallee is more than the permissible limit i.e. 1 mg/l. From the result it is determined that the water sample is not desirable as well as not meeting the bureau of INDIAN STANDARDS FOR WATER. The spatial variation is shown in Figure 7.

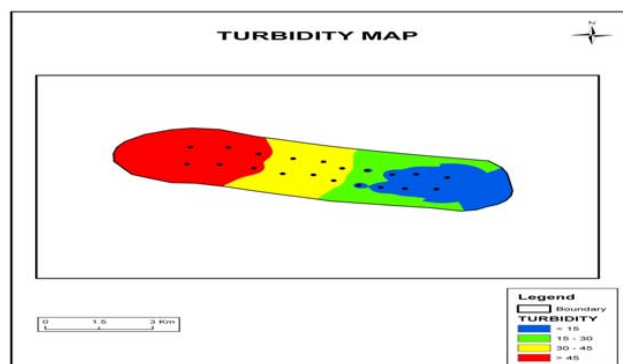


Figure 5. Spatial Variation of Turbidity.

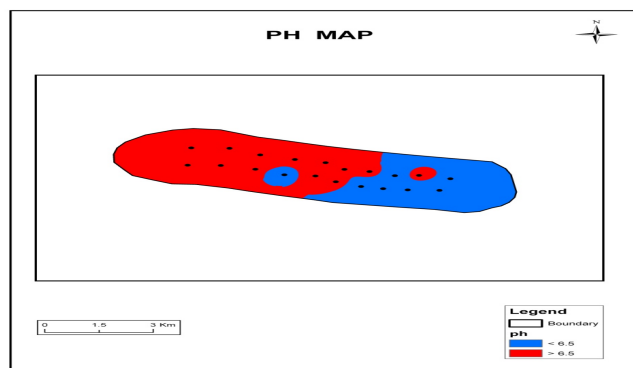


Figure 4. Spatial Variation of pH.

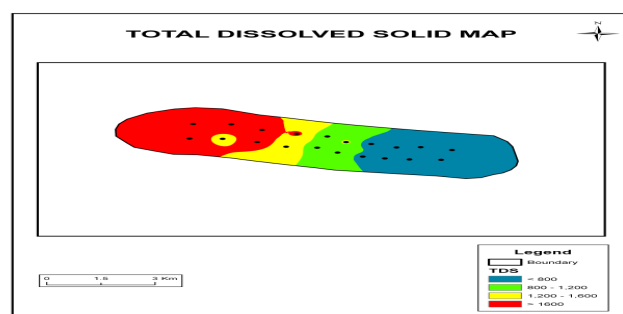
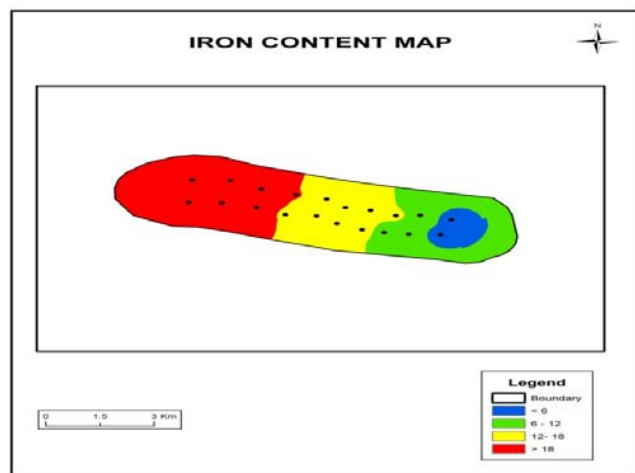


Figure 6. Spatial Variation of Total Dissolved Solid.



**Figure 7.** Spatial Variation of Iron.

## 5. Conclusion

The chloride concentration in the groundwater surrounding the Porur area is 1850 mg/l, Iyyapanthangal area is 2650 mg/l and Poonamallee is 2800 mg/l which is not desirable as it is not meeting the permissible limit of 1000 mg/l and desirable limit of 250 mg/l. The alkalinity concentration in the groundwater surrounding the Porur area is 275 mg/l, Iyyapanthangal area is 620 mg/l and Poonamallee is 640 mg/l which is not desirable as it is not meeting the permissible limit of 600 mg/l and desirable limit of 200 mg/l. The total dissolved solid concentration in the groundwater surrounding the study area is Porur area is 750 mg/l, Iyyapanthangal area is 1650 mg/l and Poonamallee is 1875 mg/l which is not desirable as it is not meeting the permissible limit of 2000 mg/l and desirable limit of 500 mg/l. The hardness concentration in the groundwater surrounding the Porur area is 448.5 mg/l, Iyyapanthangal area is 925.41 mg/l and Poonamallee is 1235.40 mg/l area is mg/l which is not desirable as it is not meeting the permissible limit of 600 mg/l and desirable limit of 300 mg/l. The pH

concentration in the groundwater surrounding the Porur area is 6.7, Iyyapanthangal area is 6.8 and Poonamallee is 6.9 which are not desirable as it is not meeting the permissible limit of 6.5 and desirable limit of 8.5. The iron concentration in the groundwater surrounding the Porur area is 13.2 mg/l, Iyyapanthangal area is 18.1 mg/l and Poonamallee area is 23.6 mg/l which is not desirable as it is not meeting the permissible limit of 1.0 mg/l and desirable limit of 0.3 mg/l. The turbidity concentration in the groundwater surrounding the Porur area is 13.7 mg/l, Iyyapanthangal area is 40.9 mg/l and Poonamallee area is 48.4 mg/l which is not desirable as it is not meeting the permissible limit of 1500 mg/l and desirable limit of less than 1000 mg/l. Thus the groundwater is considered contaminated and it is not good for people to drink or for domestic use.

## 6. References

1. Balakrishnan P, Saleem A, Mallikarjun D. Groundwater quality mapping using Geographic Information System (GIS): A case study of Gulbarga City, Karnataka, India. *African Journals of International Science and Technology*. 2011; 5(12):1096–84.
2. Gorai AK, Kumar S. Spatial Distribution Analysis of Groundwater Quality Index Using GIS: A Case Study of Ranchi Municipal Corporation (RMC) Area. 2013. doi: <http://dx.doi.org/10.4172/2327-4581.1000105>.
3. Govindarajan M, Senthilnathan T. Ground water quality and its health impact analysis in an industrial area. *International Journal of Current Microbiology and Applied Science*. 2014; 3(7):1028–34. ISSN: 2319-7706
4. Mayer J. Spatial and temporal variation of groundwater chemistry in pettyjohns cave, northwest Georgia, USA. *Journal of Cave and Karst Studies*. 1999; 61(3):131–8.
5. Lilly Florence P. Ground water quality assessment of Gangavalli Taluk Salem District, Tamil Nadu, India using multivariate statistical techniques. *IRACST – Engineering Science and Technology: An International Journal (ESTIJ)*. 2013; 3(1). ISSN: 2250-3498.