

# Ground Water Quality Assessment using Geo Spatial Technology in Part of Lower Vaigai Basin, Madurai District, Tamil Nadu

Naveen Raj T<sup>1</sup>, Sam Moses S<sup>2</sup>, Pradeep Kumar B<sup>2</sup>, Nagendra Prasad N<sup>2</sup>, Hariharasudhan S<sup>2</sup>

<sup>1</sup> Assistant Professor, Civil Engineering, Velammal College of Engineering and Technology, Tamilnadu, India

<sup>2</sup> Former Student, Civil Engineering, Velammal College of Engineering and Technology, Tamilnadu, India

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**Abstract** - *Hydro-geochemistry of groundwater in lower Vaigai river basin was used to assess the quality of groundwater for determining its suitability for drinking and agricultural purposes. It was observed that the basin water had more amount of Nitrate that results in large number of people suffering from health problems related to the kidney. The maximum value of Nitrate, viz. 4800 mg/l was observed during 2006. Various maps are drawn based on their parameter and are compared so as to obtain the difference in rates of compounds from their previous decade. The water level and its parameter have been analysed and causes have been identified and remedial solutions are suggested. The sample water is taken from 10 areas in Southern part of Vaigai Basin and tested in laboratory for the parameters such as Electrical Conductivity, pH, Nitrate, Sulphate, Chloride, Total Dissolved Solids are obtained. These parameters are compared from their previous decade and are analysed.*

**Key Words:** Groundwater, GIS, Water Quality

## 1. INTRODUCTION

All freshwater bodies are inter-connected, from the atmosphere to the sea, via the hydrological cycle. Thus water constitutes a continuum, with different stages ranging from rainwater to marine salt waters. The parts of the hydro-logical cycle which are considered in this book are the inland freshwaters which appear in the form of rivers, lakes or groundwater. These are closely inter-connected and may influence each other directly, or through intermediate stages. Each of the three principal types of water body has distinctly different hydrodynamic properties as described below. Rivers are characterized by uni-directional current with a relatively high, average flow velocity ranging from 0.1 to 1 m/s. The river flow is highly variable in time, depending on the climatic situation and the drainage pattern. In general, thorough and continuous vertical mixing is achieved in rivers due to the prevailing

currents and turbulence. Lateral mixing may take place only over considerable distances downstream of major confluences.

The chemical quality of the aquatic environment varies according to local geology, the climate, the distance from the ocean and the amount of soil cover, etc. If surface waters were totally unaffected by human activities, up to 90-99 per cent of global freshwaters, depending on the variable of interest, would have natural chemical concentrations suitable for aquatic life and most human uses. Rare (between 1 and 10 per cent and between 90 and 99 per cent of the global distribution) and very rare (< 1 per cent and > 99 per cent of the global distribution) chemical conditions in freshwaters, such as occur in salt lakes, hydrothermal waters, acid volcanic lakes, peat bogs, etc., usually make the water unsuitable for human use. Nonetheless, a range of aquatic organisms have adapted to these extreme environments. In many regions groundwater concentrations of total dissolved salts, fluoride, arsenic, etc., may also naturally exceed maximum allowable concentrations (MAC). Particulate matter (PM) is a key factor in water quality, regulating adsorption-desorption processes.

## 2. AIM AND OBJECTIVES

To study the Hydro-geochemistry of the basin.

- To identify optimized locations for different usages in the present study area.
- To study the water quality trends in the basin.
- To develop an integrated groundwater quality map of lower vaigai river basin using GIS.

## 3. METHODOLOGY

- Base map was prepared using the toposheet of the research area (in Arc GIS 9.3).
- Water samples were collected from 10 different locations across the research area which includes, Potappalayam, Kosavapatti, Valayankulam, Avaniyapuram, Thoppur, Kappalur, Perungudi, Thenpazhanji, Saamanatham & Vadivelkarai.
- The collected samples were sent for testing in the local PWD office and the results were obtained. The following tests were carried out from the obtained

water samples viz., Chloride, Fluoride, pH, Nitrate, TDS, Electrical conductivity.

- Various spatial distribution map and the final Water Quality map was prepared using Arc GIS 9.3

#### 4. RESEARCH AREA

The geographical area of Avaniyapuram town Panchayat is 28.21 Sq.km covering 21 wards and it holds the total population of about 53,006 (census 2001) with 18,375 Households. The study area include ten villages namely Potappalayam, Kosavapatti, Valayankulam, Avaniyapuram, Thoppur, Kappalur, Perungudi, Then Pazhani, Saamanatham & Vadivelkarai. The town panchayat is situated at the fringe of Madurai city and important National Highway passes through the study area Trichy – Tuticorin Highway (NH 45B) and on the NH 7 (Varanasi Kanniyakumari). The latitude and longitude extension of the study area is 9°49'43" to 9 o 54'25" N latitude and 78°04' 32" to 78 o 08' 09" E longitude respectively and is altitude is about 131.00 m above MSL.

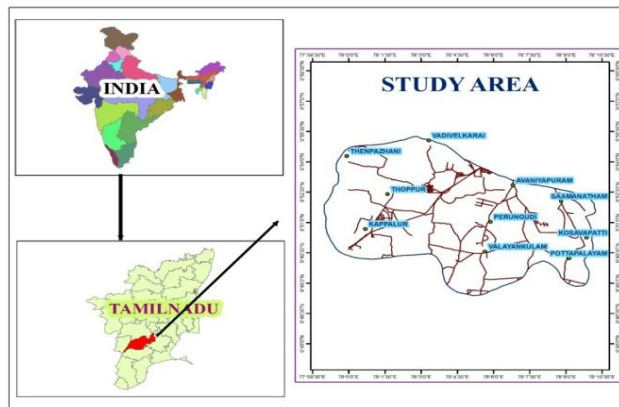


Fig -1: Base Map of the Study Area

#### 5. RESULT AND DISCUSSION

The quality of groundwater in part of Vaigai Basin is good and moderate in most of the observations wells. Saline pockets are observed in certain areas like Avaniyapuram, Kosavapaati, Valayankulam.. The main reason for the presence of larger amount of dissolved solids may be due to geological formation or seepage from fertilizers or local contamination. This may cause high salinity.

Generally the pH of the water has a small variation due to buffering action of water with Carbon-di-oxide. Regarding the Southern Vaigai basin the pH value range lies within the permissible limit except in few places. The higher pH observed in this basin is found to be above 7.5 in Avaniyapuram, Vadivelkarai, Thoppur, Kappalur, Saamanatham. This may be due to Calcium carbonate bearing rock formations

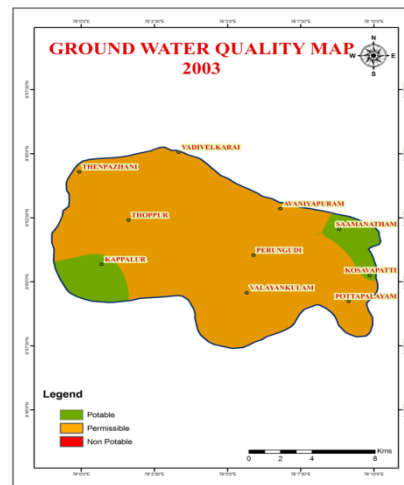


Fig -2: Ground Water Quality Map 2003

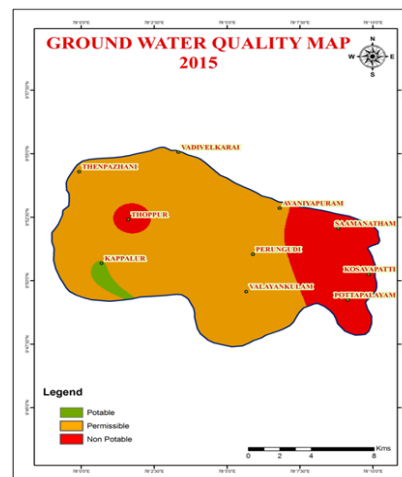


Fig -3: Ground Water Quality Map 2015

The Chloride concentrations in all the wells of this basin are found to be within the maximum limit except in few wells. When the salt concentration is increased, it is difficult for plants to extract water. Chlorides are more toxic to some plants.

The concentrations of Nitrate in most of the wells are within the maximum acceptable limit in some places like Vadivelkarai, Kappalur, Kosavapatti. The other areas are non potable water.

The increased concentration of Nitrate may be due to excessive application of nitrogen fertilizers or decay of plants and animals' residue or disposal of industrial wastewater or sewage or by increased cultivation of leguminous plants.

The concentration of Fluoride is found to be within the permissible limit in most of the areas. When the intake of

Fluoride is above the permissible limit, it leads to skeletal and dental fluorosis.

The Fluoride contamination in these pockets may be due to the presence of fluoride rich minerals like fluorite and apatite.

The groundwater of Saamanatham & Kappalur is identified as the most polluted in both the seasons. Basin authority may give priority to these places while implementing groundwater improvement measures. Based on the present study, Valayankulam is identified as a potable source for the entire year. Hence the developmental activities in terms of agriculture or water resources development can be carried out in the above places.

**Table -1:** Comparative Water Quality Analysis for the year 2003 and 2013

Year	Potable (sq.km)	Moderate (sq.km)	Non-potable (sq.km)	Total area (sq.km)
2003	10.55	1.71	0	12.3
2015	2.91	1.47	7.92	12.3

### 3. CONCLUSIONS

It may be concluded that Southern Vaigai basin is not yet polluted with industrial effluents compared to nearby river basins. The primary factors contributing to the present situation are presence of small number of industries and migration of population from this river basin to urban areas. Similarly, the sewage plant situated in the region alone comprises 3.22% of the total area and it causes major environmental issue like deterioration of ground water. It is identified that 68% of the available ground water is found to be clear but salty and the remaining is found to be turbid and unfit for domestic purpose.

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### BIOGRAPHIES



Dr.T.Naveen Raj M.Sc., M.Tech., P.hD working as Assistant Professor in Civil Engineering at Velammal College of Engineering and Technology, Madurai. His area of research work is Geology and Remote Sensing.  
Email :naveengeoster@gmail.com