

# Environmental Impact Assessment Using Internet of Things (IoT) - Technical + Analysis on the Aspects of Groundwater in Karur

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**Abstract:** This study investigates characteristics of groundwater and surface water in the Amaravathi River Basin Tamil Nadu. The total area of Amaravathi River minor basin is 1460.41sq.Km. and the study area is limited to 320 sq. Km. covering a stretch of 40 Km from Chinnadarapuram. The research involved 50 sampling sites to analyse key parameters such as pH, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), hardness, calcium, magnesium, chloride, sulphate, nitrate, fluoride, alkalinity, and dissolved oxygen. Results were evaluated against BIS:10500-1991 standards, and the Water Quality Index (WQI) was computed to assess suitability for drinking and irrigation purposes. The study underscores the urgent need for effective wastewater management, enforcement of industrial regulations, and continuous monitoring to ensure sustainable utilization and protection of groundwater resources in the Amaravathi basin.

**Keywords:** Groundwater quality, Amaravathi River Basin, Karur District, Water Quality, Total Dissolved Solids, Total Suspended Solids, Industrial effluents, Municipal sewage, Drinking water standards, Sustainable water management, IOT

## 1. Introduction

### 1.1 General

Water is a natural resource that is essential for humans for drinking, irrigation and many other purposes. 97% of the water on Earth is saline, and only three percent is freshwater of this over two-thirds is are frozen in glaciers and polar ice caps. The remaining unfrozen freshwater is found mainly as groundwater, with only a small fraction available as surface water or atmospheric moisture. Natural sources of freshwater include glaciers, groundwater, rivers, lakes and subsurface flow under rivers. Humans rely on these water resources for agricultural, household and industrial activities.

Groundwater recharge takes place when water moves downward from surface water to groundwater level. Recharge is the primary method through which water enters an aquifer. This process usually occurs in the vadose zone (subsurface region extending from the land surface down to the top of the groundwater table.) below plant root zone and is often expressed as a flux to the water table surface. Recharge occurs both naturally and by anthropogenic processes i.e. artificial groundwater recharge methods.

India is the largest user of groundwater in the world, extracting an estimated 230 cubic kilometres per year. Groundwater supplies 85% of the country's drinking water.

### 1.2 Aim

To study ground water of Karur town.

### 1.3 Objective

To study the characteristics of groundwater and to assess the quality of water for usage in Karur town.

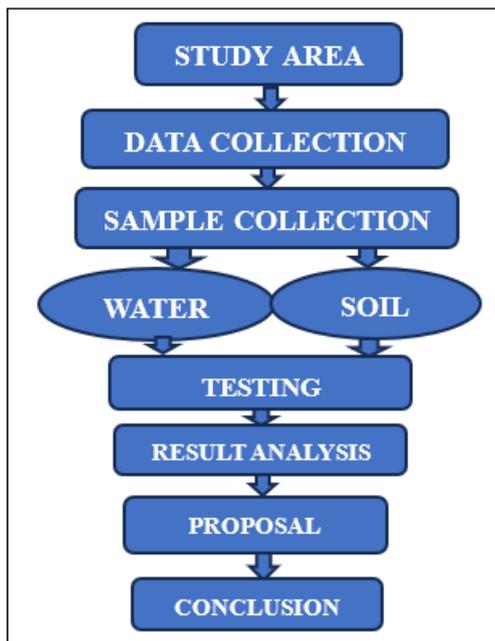


Figure 1: Karur town map



Figure 1.1: Amaravathi basin map

## 2. Methodology



### 3. Study Area

Amaravathi river basin originates from 10°21'2" N Latitude 77°14'14" E Longitude, in Kerala and Tamil Nadu State border. It then passes through Coimbatore, Tirupur, Erode and Karur districts and joins river Cauvery. The river flow is in the southwest to northeast direction with a total length of 175 Km. The tributaries Shanmuganadhi, Nankanchi and Kodaganaru join Amaravathi at 20, 40 and 60 Km respectively upstream of the Karur town. The river thereafter joins river Cauvery near Kattali village, located 10 Km downstream of the Karur town. Amaravathi river is the main source of water for domestic, irrigation and industrial uses in Karur taluk. The total area of the river's minor basin is 1460.41sq.Km. The river has a seasonal flow, due the rains brought in by the northeast and southwest monsoons. In the present investigation, the study area is limited to 320 sq.Km., covering a stretch of 40 Km length from Chinnadarapuram this includes the expanse of Amaravathi River basin of only the Karur district, where there is severe impact on the river as well as on groundwater quality. The study zone comprises the part from where the river enters into Karur district, upto Kattalai where the river joins with Cauvery River and width of 8 Km (4Km on either side of Amaravathi River). 13 monitoring wells were selected in designated zone and three locations were chosen as the river sampling points. Analysis of the river water shows that it is severely polluted within a 7Km stretch. The reason for such high degree of pollution can be attributed to discharge of partly treated effluents from bleaching and dyeing units. Also, sewage from Karur is let into the river despite the establishment and commissioning of a 15 MLD capacity sewage treatment plant for the town's municipality in December 2006.

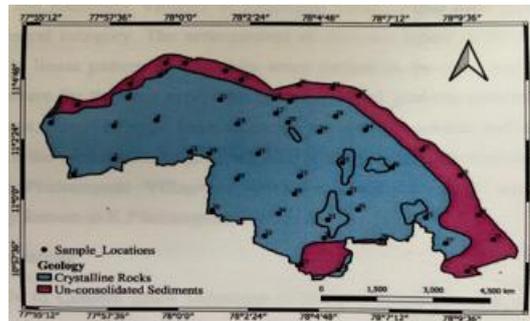


Figure 2: Amaravathi River basin-based GIS map

### 4. Data Collection

#### Soil:

Soil deposition is important for agricultural production and recharge of groundwater. a geological formation has different types of soil. The soil map of Karur district, based on the survey by the Tamil Nadu Agricultural Department, indicates four different types of soils viz., Red Soil, Thin Red Soil, Red Loam and River Alluvium Soil.

#### Wells

The district of Karur is mainly drained by the Cauvery River and its tributaries- Amaravathi, Kodavanar, and Pungar- with a dendritic, seasonal drainage pattern. Irrigation is dominated by dug wells (59.97%), followed by canals (29.45%) and tube wells (9.48%), while tank irrigation is minimal. Well irrigation is maximum in Thogamalai block, and use of canal irrigation is highest in Kulithalai block.

#### Testing

Following tests has been done with collected samples:

#### 1) Total Dissolved Solids:

TDS was calculated by using the formula:  
 Total Dissolved Solids, mg/L =  $\frac{(A-B) \times 10^6}{V}$

Where,

A = Weight of dried residue + dish, g

B = Weight of the dish, g

V = Sample volume, ml

#### 2) Total Suspended Solids:

Total Suspended Solids (TSS) is measured by filtering a known volume of water through a pre-weighed filter, drying the residue at 103–105°C, and weighing it again. The increase in weight represents the amount of suspended solids in the sample.

#### 3) Total Hardness:

EDTA (EthyleneDiamineTetraAcetic)  
 Concentration of EDTA, moles/L =  $\frac{V \times M}{(A-B)}$

Where:

A = Volume of EDTA solution consumed for calcium solution, ml.

B = Volume of EDTA solution consumed for reagent blank, ml

V = Volume of calcium solution, ml

M = Concentration of calcium solution, moles.

**4) Estimation of Calcium:**

Calcium in water is estimated by EDTA (ethylenediaminetetraacetic) titration method, where calcium ions react with EDTA using murexide indicator at a pH of 12–13. The endpoint is indicated by a color change from pink to purple.

**5) Estimation of Magnesium:**

Magnesium was calculated as Mg mg/l by using the formula:

$$\text{Amount of Mg, mg/L} = \frac{[(A-B)-(C-D)] \times M \times V}{24000}$$

Where

A = Volume of EDTA consumed for the sample with EBT indicator, ml,

B = Volume of EDTA consumed for the blank with EBT indicator, ml

C = Volume of EDTA consumed for the sample with murexide indicator, ml

D = Volume of EDTA consumed for the blank with murexide indicator, ml

M = Concentration of EDTA, moles/l

V = Volume of the sample, ml

**6) Alkalinity:**

$$\text{Concentration of hydrochloric acid, moles/L} = \frac{2 \times M \times V}{(A-B)}$$

Where

M = Concentration of standard sodium carbonate solution, moles/l

V = Volume of standard sodium carbonate solution, ml

A = Volume of hydrochloric acid consumed for standard sodium carbonate solution, ml

B = Volume of hydrochloric acid for reagent blank, ml

**7) Determination of Chloride:**

Chloride in water is determined by argentometric titration, where the sample is titrated with silver nitrate ( $\text{AgNO}_3$ ) using potassium chromate ( $\text{K}_2\text{CrO}_4$ ) as an indicator. The endpoint is marked by the formation of a reddish-brown silver chromate precipitate.

**8) Determination of Sulphate**

Sulphate in water is determined by the turbidimetric method, where sulphate ions react with barium chloride ( $\text{BaCl}_2$ ) to form barium sulphate ( $\text{BaSO}_4$ ) turbidity. The intensity of turbidity is then measured using a nephelometer or spectrophotometer.

**9) Determination of Nitrate**

Nitrate in water is determined by the UV spectrophotometric method, where the sample's absorbance is measured at 220 nm wavelength. The nitrate concentration is calculated by comparing the absorbance with a standard calibration curve.

**10) Determination of Fluoride:**

Fluoride in water is determined by the SPADNS colorimetric method (a widely used, EPA-approved technique for determining fluoride concentration in drinking water, surface water, and wastewater.), where fluoride reacts with a zirconium–SPADNS dye complex to produce a colour change. The decrease in colour intensity is measured using a spectrophotometer at 570 nm.

**11) Determination of Dissolved Oxygen (DO):**

Dissolved Oxygen (DO) in water is determined by the Winkler titration method, where oxygen oxidizes manganous ions to form manganic hydroxide, which reacts with iodide to release iodine. The liberated iodine is then titrated with sodium thiosulphate to determine DO concentration.

**12) Water Quality Index:**

$$\text{WQI} = \sum W_i Q_i / \sum W_i$$

$$W_i = K / S_n$$

$$K = 1 / \sum (1 / S_n)$$

Quality Rating

$$Q_i = 100[(V_o - V_i) / (S_n - V_i)]$$

If,  $Q_i = 0$  -absence of contaminants

$0 < Q_i < 100$  - contaminants are within the prescribed standard.

$Q_i > 100$  contaminants are above the standards.

( $W_i$ ) - The unit weight of the various water quality parameters.

$Q_i$  = quality rating (sub-index) of the  $i$  the water quality parameter

$S_n$  – BIS standards

$V_o$  - Ideal value

$V_n$  - Mean con. Value (Testing Report Value)

Groundwater samples can be categorized into 4: good, moderate, poor and very poor. The major part of the study region is of moderate quality of water and few places are of poor category. Of the total sample sites, 33% (4 out of 12 sites) had good-quality drinking water (WQI value <100) and the majority (67%) had poor-quality drinking water (WQI value > 100). Quality of drinking water was found to be very poor in the centre part of the study area, where water was categorized as unsuitable for drinking only. Assessment of drinking water quality is a necessary and timely requirement in the context of emerging public health problems, especially where availability of safe water is increasingly at risk due to both natural processes and man-made activities.

**Table 1: WQI Rating**

WQI	Rating
0- 25	Excellent
25- 50	Good
50- 75	Poor
75- 100	Very Poor
>100	Unsuitable for drinking

Table 2: Permissible Limits and Disorders as per Drinking Water IS:10500 - 1991

S. No	Parameters	Permissible Limit (BIS/WHO)	S9	S35	S45	Diseases Caused If Exceeds The Limit
1	pH value	6.5 to 8.5	-	-	-	
2	Total Dissolved Solids	500-2000 mg/l	950	875	400	*Gastrointestinal irritation and digestive disorders. *Kidney stones and urinary problems. *Laxative effects.
3	Total Suspended Solids	500-2000 mg/l	-	-	-	
4	Total Hardness	300-600 mg/ml	80	690	410	* Kidney stones and urinary tract problems. *Digestive discomfort and constipation. * Dry skin and hair damage when used for bathing.
5	Magnesium	30-100 mg/l	35	120	130	* Diarrhoea and laxative effects. * Abdominal discomfort and nausea. * Kidney dysfunction and electrolyte imbalance.
6	Calcium	75-200 mg/l	210	80	80	*Kidney stones. * Constipation and digestive discomfort. * Heart problems
7	Chloride	250-1000 mg/l	-	-	-	
8	Sulphate	200-400 mg/l	50	150	175	* Diarrhoea and dehydration. *Gastrointestinal irritation and abdominal pain.
9	Nitrate	45 mg/l - No relaxation	30	55	65	*Methemoglobinemia (blue baby syndrome). *Gastrointestinal disorders
10	Fluoride	1-1.2 mg/l	0.8	1.2	1.1	*Dental fluorosis. *Skeletal fluorosis and bone deformities. * Neurological and kidney damage
11	Conductivity	1400 U	500	2300	1750	*Gastrointestinal irritation and digestive problems. *Kidney stress or stones. * High blood pressure.

S9 – Thottakuruchi;  
S35 – Sindayur;  
S45 – Chinna Kaalipalayam

5. Result Analysis

Total no of samples taken: 50  
No of samples exceed permissible limit in:

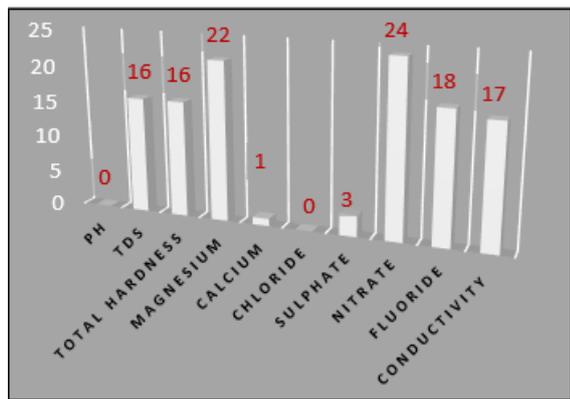


Figure 3: Sample Result

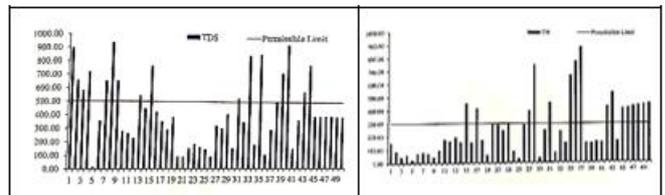


Figure 6: TDS results

Figure 7: TH results

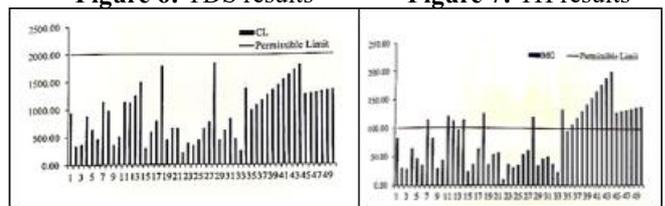


Figure 8: Cl results

Figure 9: Ca results

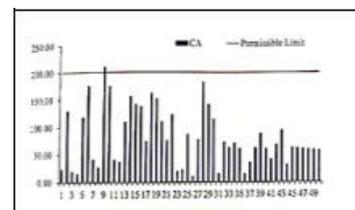


Figure 10: Mg results

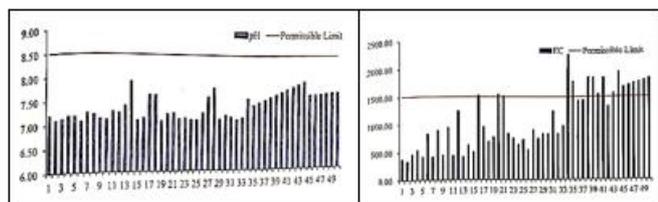


Figure 4: pH results

Figure 5: EC results

6. Proposal

- 1) Awareness campaigns on prevention of water pollution, community clean-up drives, and school programs can encourage responsible behaviour.

- 2) Media and social platforms can spread messages efficient waste disposal strategies such as segregation, recycling, and reducing plastic use.
- 3) Involving local authorities and NGOs in the drive against water pollution can strengthen participation and enforcement.
- 4) Implementing zero discharge technique.

Ensuring proper disposal and management of solid waste is essential to prevent pollution of rivers, lakes, and groundwater.

- Uncollected or poorly managed waste often ends up in drains and water bodies, causing blockages and contaminating the water with harmful chemicals and plastics.
- Implementing efficient waste collection systems, segregation at source, and promoting recycling can greatly reduce this risk.
- Local authorities should establish proper landfill sites, composting units, and waste-to-energy conversion plants to handle waste sustainably.
- Public participation and strict enforcement of waste management rules are also key to keeping our water bodies clean and healthy.

- 1) Promote the use of eco – friendly agricultural practices to reduce runoff of pesticides and fertilizers which in turn can naturally clean up polluted river systems.
- 2) Encourage the use of bioremediation techniques to gradually reduce river pollution.
- 3) Imposing Strict regulations on industries to treat effluents by any of the following methods.
  - a) Physical Treatment Methods like removing suspended solids, oils, and larger impurities.
  - b) Chemical Treatment Methods such as i) Coagulation and Flocculation, ii) Neutralization, iii) Oxidation and Reduction, iv) Precipitation, v) Ion Exchange
  - c) Biological Treatment Methods where in organic matter degradation is carried by using microorganisms.
  - d) Advanced Technology Treatment Methods Activated Carbon Adsorption, Reverse Osmosis (RO), Ultrafiltration & Nanofiltration, Electrochemical Treatment, UV/Ozone Disinfection
  - e) Reuse & Resource Recovery
- 4) Monitoring of water quality of river should be carried out by the Public Works Department (PWD) or by Tamil Nadu Pollution Control Board (TNPCB) through systematic collection, analysis of important water quality parameters, and regular updating on water quality status.
- 5) Increasing public awareness about clean and responsible waste disposal is vital for protecting water resources and public health.

## 7. Conclusion

This study reveals that when water is properly treated and regularly maintained by municipal authorities, its overall quality improves significantly, making it suitable for both drinking and irrigation purposes. Treated water retains an optimal balance of essential minerals and micronutrients that are vital for human health and plant growth. Clean and safe

water supports agricultural productivity, ensures healthy crop yields, and provides nourishment to communities.

However, if there is poor maintenance or lack of proper treatment in water bodies and groundwater sources, the consequences can be severe. Contaminated water can lead to numerous health issues such as gastrointestinal infections, diarrhoea, and various gut-related problems. It can also cause skin irritation, rashes, and chronic skin diseases. Long-term exposure to polluted water may result in respiratory problems, fatigue, weakness, and even bone-related disorders due to harmful chemical accumulation. In extreme cases, untreated water with high nitrate content can cause blue baby syndrome in infants and may also contribute to thyroid disorders and neurological issues.

Therefore, continuous water quality management, regular monitoring, and public awareness are essential to safeguard both human health and the environment.

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## Author Profile

**M. Vignesh** obtained her bachelor's and master's degrees in urban planning from Karpagam Academy of Higher Education. Academic training equipped her with a sound understanding of the principles of urban planning, land use regulations, and the need to balance urban development with environmental and heritage conservation. This report is based on the academic work completed by Subiksha as a reference for this research study.

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