

Original Research Article

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Studies on the Physicochemical and Biological parameters of River Vaigai, Madurai Dist, Tamilnadu, India

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ABSTRACT

Water is one of the major components of environmental resources. Water quality has become a major concern due to ever increasing human developmental activities that over exploit and pollute the water resources. A study on physicochemical and biological characters of river water and its suitability for drinking and irrigation purposes was carried out in Vaigai River of Tamilnadu. Qualitative and quantitative methods were used throughout the research. The overall purpose of this study is to find out some mitigating measures for improving water quality of Vaigai River. Specifically, the objectives of the study are included: to find out the physical parameters such as temperature, colour, turbidity, electrical conductivity, suspended solids, dissolved solids and total solids of the water in Vaigai River, to examine the pH, dissolved oxygen, biological and chemical oxygen demand, carbonate alkalinity, bicarbonate alkalinity of the water, to experiment and ascertain the dissolved nutrients of the water such as Calcium, Magnesium, iron, Sodium, Chloride, Sulphates, Silicates, Phosphates, Nitrates, Potassium and organic carbon. To know the biological parameters of the water such as Phytoplanktons, Zooplanktons, Primary productivity, Aquatic insects Benthos and Fishes. Representative of three samples were collected from Kunnur (Theni Dt), Vaigai Dam and Anaipatti. The samples were analyzed for Physical parameter like temperature, turbidity, electrical conductivity and total dissolved solids by temperature sensitive probe, turbidity tube method, electrometric method respectively. Chemical parameters such as pH, CO₂, alkalinity, Ca, Mg and Cl were analyzed using Titrimetric method, SO₄, NO₃, PO₄ and Fe were analyzed using Spectrophotometric method, Na was analyzed using Flame photometric method and DO was analyzed by Winkler's method following the guidelines of WHO and ISI. Biological parameters like Phytoplanktons and Zooplanktons were analyzed by Lackey's drop and Sedgwick Rafter cell methods respectively. Most of the parameters in Vaigai Dam and Kunnur lie within the permissible limits whereas in Anaipatti sampling point parameters such as temperature, electrical conductivity, suspended solids, total solids and magnesium were found to be higher than the WHO, BIS and APHA permissible limit. Hence it is therefore needful steps to be taken to ensure effective water resources management of Anaipatti sampling point of the River Vaigai. From this study, it is inferred that the river water is generally potable after the required water treatment.

Keywords

Physical parameters,
Chemical parameters,
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Zooplankton,
Primary productivity,
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Introduction

The Vaigai is a river situated in Madurai, the Southern state of Tamil Nadu, India. It originates in the Periyar Plateau of the Western Ghats range, and flows northeast through the Cambam Valley, which lies between the Palani Hills to the north and Varushanad Hills to the South. The river empties into the Palk Strait in Ramanathapuram District. The Vaigai is 258 kilometers (160mi) long, with a drainage basin 7,031 square kilometers (2,715 sq mi) large. It falls within the co-ordinates of Latitude 7°21'00'' N and Longitude 79°00'00''E. Vaigai Dam is built across the Vaigai River flowing through Madurai, Pollution of rivers in India has now reached to a point of crisis due to unplanned urbanization and rapid growth of industrialization (Saksena *et al.*, 2008). Many researchers have carried out research on water quality of rivers in different places and in each place it has received greater attention. For good and long life the good quality of water is very important. Present scenario Vaigai is mostly polluted by various pollutants and anthropogenic activities so with this aspect, this project focuses on the effect of pollutants in Vaigai river.

The main objectives of this study includes, to study the Vaigai River Ecosystem. Also, assessment of Water Quality in the Vaigai River. Effects of pollutants on the Biodiversity of Vaigai River. Then, Screening of pesticides Degrading Microorganisms Vaigai River.

Materials and Methods

Sample Collection

The water and sediment samples were collected from Vaigai River, Madurai, Tamil

Nadu, and India. Samples were collected for a period of one year with an interval of 30 days. Samples were collected in a fixed region of each sampling point. Every month sample was collected at the surface of the river at 11.30 to 12.30 pm in order to maintain uniformity. Samples were collected in clean white polythene containers (1Lit Plastic cans). Collected samples were brought to the laboratory and kept in the refrigerator for further analysis,

Samples were collected from five different study sites included Vaigai dam, Annaipatti solavanthan, Aarappalayam, Anna Nagar.

Methods for Physicochemical and Biological Analysis in Water and Sediments

Temperature, color, Turbidity, Electrical conductivity, Suspended Solids, Dissolved Solids and Total solids. pH, Dissolved oxygen, Biological Oxygen Demand, Carbonate alkalinity, Bicarbonate alkalinity, Chemical Oxygen Demand. Phytoplanktons, Zooplanktons, Micro flora, Micro fauna, Primary productivity, Aquatic insects Benthos and Fishes.

Result and Discussion

Physico Chemical Parameters of Study Sites (January to December 2014)

Temperature

During the study period the water temperature was in range between 25°C to 32°C. The lowest temperature recorded in the sampling point Vaigai Dam was 25 °C. Study increase in water temperature was noticed in the River Vaigai from origin to Anaipatti. There might be increase in water temperature after discharge of effluents into the sampling points includes Anaipatti

solavanthan, Arapalayam , Anna Nagar was recorded.

Color

The water flow in the river was found to be brownish in color during rainy season. In the sampling point Vaigai Dam it was found to be colorless in most of the months. In Anaipatti solavanthan, Arapalayam , Anna Nagar it was brownish in most of the months in water.

Turbidity

The turbidity value was in range between 14 - 22 N.T.U (Nephelometric Turbidity Unit) at Solavanthan. In the Vaigai Dam it ranges from 11 - 20 N.T.U. In Anaipatti, solavanthan, Arapalayam and Anna Nagar it was ranging from 25 to 32 N.T.U. The minimum turbidity value of (11 N.T.U) was recorded in Vaigai Dam. Whereas the maximum value of (32 N.T.U) was recorded in Arapalayam and Anna Nagar.

Electrical Conductivity

In the Solavanthan sampling unit electrical conductivity value of the water ranging from 180 to 270 μ Mho. The electrical conductivity value of the Sampling point Vaigai Dam was ranging from 250 to 329 μ Mho. In Arapalayam, Anna Nagar the electrical conductivity values were ranging from 950 to 2900 μ Mho. The minimum electrical conductivity value (180 μ Mho) was recorded at the sampling point Solavanthan and maximum electrical conductivity value of (2900 μ Mho) was recorded in the Arapalayam and Anna Nagar.

The value of total solids (suspended and dissolved) in Vaigai Dam, Anaipatti, Solavanthan, Arapalayam and Anna Nagar was ranging from 135 to 310, 135 to 2815,

338 to 2965, 350 to 2965 and 365 to 2965 mg/l respectively. The lowest value (135 mg/l) was observed in Vaigai Dam and the highest value (2965 mg/l) was obtained from solavanthan, Arapalayam and Anna Nagar.

pH

The pH value of the sampling point Annaipatti solavanthan, Arapalayam, Anna Nagar was ranging from 7.5 to 8.1. In the sampling point Vaigai Dam the pH value was ranging from 7.1 to 7.8. The minimum pH value was recorded as 7.1 in the sampling points Vaigai Dam. The maximum pH was recorded at the sampling point Annaipatti solavanthan, Arapalayam, Anna Nagar. All the three sampling points showed an alkaline condition throughout the study period.

Dissolved Oxygen

The dissolved oxygen values were found to be ranging from 1.1 to 2.9 mg/l in the unit Arapalayam , Anna Nagar. In the Vaigai Dam sampling point the dissolved oxygen values were ranging from 4.1 to 6.4 mg/l. In the sampling point Annaipatti solavanthan, ,, the dissolved oxygen values were ranging from 3.0 to 3.8 mg/l. The minimum value (0.3 mg/l) was recorded at the sampling point Annaipatti solavanthan, Arapalayam , Anna Nagar, . Maximum value of (6.4 mg/l) was recorded in the sampling Vaigai Dam.

Biological Oxygen Demand

BOD values were ranging from 53 to 300 mg/l in the sampling point Annaipatti solavanthan, Arapalayam , Anna Nagar. In the Vaigai Dam the BOD values were ranging from 9.5 to 16.8 mg/l. In the sampling unit Annaipatti solavanthan, Arapalayam, Anna Nagar, the BOD. Values were ranging from 96 to 338 mg/l. The minimum BOD.

Table.1 Physico Chemical Parameters

Physico Chemical Parameters									
Sample Sites	Temperature	pH	Alkalinity	Color	Turbidity	Electrical Conductivity	DO	BOD	COD
Vaigai Dam	25-28	7.1-7.8	4.1-6.4	Colourless	14-22	108-270	4.1-6.4	9.5-16.8	12-62
Anaipatti	26-30	7.5-7.8	2.0-3.8	Brown colour	16-25	250-329	3.0-3.8	96-338	110-150
Solavandhan	28-30	7.3-7.9	3.0-3.9	Brown colour	21-30	280-2000	2.0-3.8	110-338	100-150
Arapalaiyam	25-32	7.3-8.1	1.1-2	Brown colour	26-32	850-2900	0.3-0.2	53-300	160-250
Anna Nagar	30-32	7.5-8.1	1.1-2.9	Brown colour	29-32	950-2900	0.3-0.2	45-300	173-299

Table.2 Micro organisms Isolated from Various Sites

S. No	Sampling Location	Nature of sample	Microorganism Isolates
1	Annaipatti	Water & Sediment	V1 ,V2, V3 ,V4 ,V5,V 6,V7, V8, V9, V10, V11 ,V12, V13, V14, V15, V16 ,V17 ,V18, V19
2	Vaigai dam	Water& Sediment	V20, V21, V22, V23, V24, V25, V26, V27,V28, V29 ,V30
3	Sholavanthan	Water & Sediment	V31, V32 , V33, V34, V35 , V36, V37, V38, V39, V40, V41, V42, V43, V44, V45, V46, V47, V48, V49,
4	Arapalayam	Water & Sediment	V50, V51, V52 ,V53 ,V54, V55, V56, V57, V58, V59, V60, V61, V62 , V63, V64 ,V65, V66, V67, V68, V69, V70, V71 , V72, V73, V74, V75, V76, V77, V78, V79
5	Anna nagar	Water & Sediment	V80, V81, V82, V83, V84, V85, V86, V87, V88, V89, V90, V91, V92, V93, V94, V94, V95, V96, V97, V98, V99, V100, V101 , V102, V103, V104, V105.

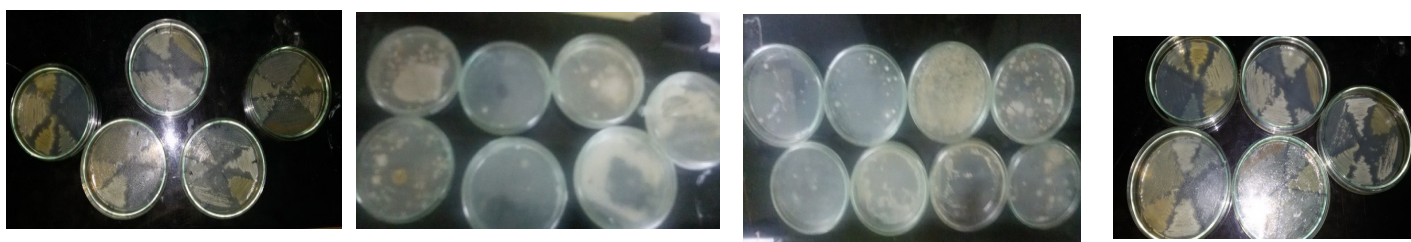
Table.3

Site ID	Sites	Latitude	Longitude
1	Vaigai Dam	10.05 ° N	77.58°E
2	Anaipatti	9.8° N	77.30°E
3	Solavanthan	9.9° N	78.11°E
4	Arapalayam	9.9° N	78.11°E
5	Anna Nagar	9.2° N	78.14°E

Table.4

Parameters	Method of Study
Physical:	
Turbidity, NTU	Turbidity tube method
Colour	Eye Visualization
Water temperature, °C	EuTech Pc Tester35 Electrode Method
EC, m S/cm	
TDS, mg/L	
Chemical:	
pH	EuTech Pc Tester35 Electrode Method
DO	Winkler's iodometric method
BOD	
COD	
Total alkalinity, mg/L	Titrimetric method

Plate.1 Isolation of Bacteria from Water Samples Collected in Vaigai River



The value of (9.5 mg/l) was recorded at the sampling point Vaigai Dam and the maximum BOD. The value of (338 mg/l) was recorded in the Arapalayam, Anna Nagar.

Bicarbonate Alkalinity

Bicarbonate alkalinity value was ranging from 154 to 355mg/l in the sampling point Anna Nagar. In Arapalayam sampling point the bicarbonate alkalinity value was ranging from 150 to 400mg/l. In the sampling point Vaigai Dam the bicarbonate alkalinity value was ranging from 80 to 280mg/l. In Anaipatti sampling point the bicarbonate alkalinity value was ranging from 175 to 479mg/l. In solavanthan sampling point the bicarbonate alkalinity value was ranging from 160 to 290mg/l.

The minimum bicarbonate alkalinity value of (80mg/l) was recorded in the sampling unit Vaigai Dam and the maximum bicarbonate value of (479mg/l) was recorded in the Annaipatti solavanthan, Arapalayam Anna Nagar.

Chemical Oxygen Demand

Chemical oxygen demand value was ranging from 173 to 299 mg/l in the sampling point Anna Nagar. In the Arapalayam COD value was ranging from 160 to 250 mg/l. In the sampling point Vaigai Dam the COD value was ranging from 12 to 62 mg/l. In the Annaipatti solavanthan, the value of COD was ranging from 110 to 150 mg/l. The minimum COD value of (12 mg/l) was recorded in the sampling unit Vaigai Dam and the maximum COD value of (426 mg/l)

was recorded in the. Annaipatti solavanthan Arapalayam Anna Nagar.

Fish

Puntius vittatus, *Aplocheilus lineatus*, *Danio aequipinnatus*, *Etrplus suratensis*, *Loach leptocephalus thermalis*, *Labeo calbasu*.

Monitoring of Selected Microorganism in Vaigai River

Sample Collection River water and sediments were dumping through the River' sampling port for 2-3 minutes prior to collection in sterile 1 liter wide-mouthed polypropylene bottles. Samples were placed on ice and returned to the laboratory for processing within 1-2 hours of collection.

Isolation of Bacterial Species from Water and Sediments Samples

The collected samples were serially diluted and the samples were spread plate for the growth of isolated colonies on LB agar. Then the plates were incubated at 37 °C for 24 hrs. After 24 hrs the colonies grown on the plates were examined and the colonies were used for grams staining.

Biochemical characterization

Isolated bacterial colonies were used for biochemical tests like Indole, Methyl Red, Voges Proskauer, Citrate Utilization, Coagulase, Catalase and Oxidase (above the Table). These biochemical characterizations results were used for identification of bacteria in genus level and species level characterization will be studied using 16s rRNA sequence.

Isolation of Pesticide Degrading Bacteria

The procedure to isolate bacteria consisted of the addition of 0.1 g of ground to a flask containing 50 ml of MSM medium, with

200mg_l⁻¹ of Monochrotophos 36% SL pesticide model and as an insect inhibitor. Cultures were incubated at 30 °C and shaken at 100 rpm for 7 days. Two milliliters were then transferred to a fresh MSM medium containing 200mg_l⁻¹ of PCNB and incubated under the same conditions. Cultures from the fifth transfer were plated on nutrient agar and incubated for 24 h at 30 °C. Colonies were isolated on the basis of morphological, culture, and biochemical characteristics using BBL Crystal GP System (Becton, Dickinson and Co., 2005). Bacterial isolates were plated separately on MSM medium containing 50ppm Monochrotophos 36% SL, Cultures that were able to grow in all pesticides tested were used for further studies.

In conclusion, the results for the present study on Vaigai River indicate the need for comprehensive monitoring of this river. Proper management, decisions have to be taken for the restoration of River Vaigai at Arapalayam and Anna Nagar sampling unit, which had been threatened ecologically due to various anthropogenic activities. Concerned authorities of the Tamil Nadu Water Supply and Sewage Board have to take appropriate action by controlling the sewage and industrial effluent let into the Vaigai River of Arapalayam and Anna Nagar. Letting in treated water would maintain the water quality that will improve the aquatic biota. The Arapalayam and Anna Nagar sampling point needs immediate remedial actions against shoreline degradation.

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