

Original Research

A comparative hydrobiological study on Authoorangal channel and Srivaikuntam channel and their role as sustainable water resources

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ABSTRACT:

A hydrobiological study conducted in two different river channels of two different taluks of south Tamil Nadu showed that the concentrations of Physico-chemical parameters like turbidity, temperature, pH, dissolved oxygen, electrical conductivity, total dissolved solids, total hardness, total alkalinity, calcium, magnesium, sodium, potassium, chloride, sulphate, carbonate, bicarbonate, total coliform and faecal coliform were deteriorating water quality rapidly due to intense and excessive amounts of fertilizers, manures, pesticides and insecticides. In the present investigation among the two channels, maximum values of the physical parameters with a mean of turbidity 6.5 ± 0.070 NTU, temperature $33.9 \pm 0.707^\circ\text{C}$, pH 8.7 ± 0.707 , dissolved oxygen 7.9 ± 0.707 mg/l, electrical conductivity 3.08 ± 0.632 ds/m, total dissolved solids 15.7 ± 3.162 mg/l, total hardness 25.6 ± 6.324 mg/l, and total alkalinity 50.1 ± 1.140 mg/l was recorded. The maximum values of the chemical parameters with a mean of calcium 10.0 ± 1.702 mg/l, magnesium 11.6 ± 0.378 mg/l, sodium 8.48 ± 2.828 mg/l, potassium 0.23 ± 0.012 mg/l, chloride 16.1 ± 2.607 mg/l, sulphate 11.9 ± 3.224 mg/l, carbonate 0.3 ± 0.070 mg/l and bicarbonate 2.8 ± 0.050 mg/l was noticed. The maximum values of the coliform parameters with a mean of total coliform bacteria 390 ± 0.707 (MPN/100 ml) and faecal coliform 37 ± 0.707 (MPN/100 ml) was also recorded. The results of this study point out the fact that the water quality of both the channel waters are slowly deteriorating.

Keywords:

Physico-chemical and coliform parameters, Authoorangal and Srivaikuntam river channels

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INTRODUCTION

Fresh water is an important natural resource necessary for the survival of all ecosystems. In India, ponds, lakes, rivers and ground water are used for domestic and agricultural purposes (Hemant Pathak *et al.*, 2011). Agriculture is the chief source of livelihood for the use of agriculture a great effect on the flow of fresh water is necessary. The potable water should be free from infectious agents and chemical constituents, pleasant to taste, odour and usable for domestic purposes (Saini *et al.*, 2010). Physico-chemical parameters play a significant role in determining the distributional pattern and quantitative abundance of aquatic ecosystem (Sayeswara *et al.*, 2011). The physical and chemical properties of fresh water bodies are based upon the geomorphological and weathering processes (Sahni and Yadav, 2012).

The presence of safe and reliable drinking water is a significant prerequisite for a stable community (Sen *et al.*, 2011). Due to the growth of population and man-made activities, the quality of water is deteriorating everywhere. For this purpose, it is important to know about different physico-chemical characteristics of water. There has been no report on physico-chemical parameters assessment in the Authoorangal channel and Srivaikuntam channel. Hence, a periodical assessment is

essential in monitoring the physico-chemical parameters of Authoorangal channel and Srivaikuntam channel for the welfare of surrounding human settlements. The present study is an attempt to assess the water quality with the following objectives:

- Collection of baseline data on the structure and function of the Authoorangal channel and Srivaikuntam channel.
- Assessment of seasonal changes in physico-chemical parameters.
- Analysis of seasonal fluctuations in the microbes.

MATERIALS AND METHODS

Study area of Authoorangal Channel

The Authoorangal channel has thirteen channel inlets. It has the width of about 6m broad and 1.5m depth (Figure 1). The channel is getting water from Thamirabarani river. Further, it is passing through Authoor and Sethukavaithan villages. In about 460 acres, the water is utilized for agricultural purposes. It belongs to Tiruchendur taluk.

Study area of North main channel (Srivaikuntam)

The North main channel (Srivaikuntam) is spread over a distance of 87 sq.km and 82 acres (Figure 2). The channel has the width of 30 feet and 6 feet depth. It consists of two channel inlets namely Mukoot and



Figure 1: Sampling Site – Authoorangal



Figure 2: Sampling Site – Srivaikuntam

Table 1: Monthly variations of physical parameters of Authoorangal channel in the year of 2011

YEAR-2011 Month	PHYSICAL PARAMETERS							
	Turbidity (NTU)	Temperature °C	pH	DO (mg/l)	EC (ds/m)	TDS (mg/l)	TH (mg/l)	TA (mg/l)
January	4.0±0.252	21.1±0.935	7.3±0.196	7.9±0.326	1.2±0.078	11.0±0.465	10.1±0.345	22.2±0.677
February	4.4±0.307	22.4±0.196	7.9±0.183	7.1±0.111	3.0±0.058	11.1±0.160	15.5±0.316	25.7±0.080
March	4.1±0.040	23.5±0.223	7.7±0.066	7.3±0.094	0.49±0.029	11.5±0.353	4.3±0.050	28.0±0.948
April	4.0±0.707	23.7±0.241	7.7±0.230	6.6±0.215	0.49±0.010	11.3±0.330	3.3±0.134	26.2±0.322
May	3.9±0.037	25.9±0.583	8.5±0.612	5.6±0.168	0.31±0.005	12.0±0.400	6.6±0.276	33.3±0.583
June	4.0±0.316	25.7±0.241	7.8±0.193	5.5±0.067	1.27±0.013	12.3±0.083	4.1±0.031	29.8±0.083
July	4.3±0.221	24.5±0.223	7.4±0.126	5.8±0.126	0.27±0.023	13.1±0.333	3.0±0.707	30.3±0.377
August	3.4±0.141	24.8±1.414	7.4±0.126	6.3±0.134	0.30±0.044	13.2±3.049	16.2±3.391	33.2±1.140
September	3.4±0.178	24.9±0.707	7.3±2.302	5.7±2.024	0.21±0.032	12.3±1.898	13.0±1.140	40.2±6.324
October	4.5±1.414	23.7±6.324	7.9±0.707	7.6±0.707	3.08±0.632	14.9±0.707	25.6±6.324	45.5±12.747
November	5.9±1.303	22.2±3.224	7.7±1.140	7.9±1.140	2.02±0.707	15.7±3.162	23.9±3.178	50.1±1.140
December	6.2±0.317	21.1±1.000	8.0±0.707	7.2±0.707	0.21±0.010	14.3±1.303	3.1±1.000	30.4±0.100

Thamiraparani river. Further, the water is passing cleaned polythene two liter bottles without any air bubbles through Varadharajapuram, Appankoil and Kaspas and after rinsing it with the sample water in morning hours villages. It belongs to Srivaikuntam taluk.

Water analysis

The two channels have been selected for investigation on the basis of geographical locations. Samplings were made at monthly intervals from January 2011 to December 2011. Samples were collected in

between 8 am to 10 am. The temperature was recorded on the spot by mercury thermometer. The turbidity was measured on spot by Nephelometer. The other parameters such as pH, Dissolved Oxygen (DO), Electrical Conductivity (EC), Total Dissolved Solids (TDS), Total Hardness (TH), Total Alkalinity (TA), calcium,

Table 2: Seasonal variations of chemical and coliform parameters of Authoorangal channel in the year

YEAR-2011 Month	CHEMICAL PARAMETERS								COLIFORM PARAMETERS	
	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)	Cl (mg/l)	SO ₄ (mg/l)	CO ₃ (mg/l)	HCO ₃ (mg/l)	Total Col (MPN/100ml)	Faecal Col (MPN/100ml)
January	8.2±0.31	5.5±0.37	6.4500±0.14	0.210±0.01	13.5±0.50	4.2±0.09	0.00±0.00	2.5±0.29	240±8.94	21±0.58
February	9.9±0.36	11.6±0.18	8.1000±0.20	0.230±0.01	16.0±0.15	0.0±0.00	0.24±0.05	2.7±0.13	220±3.53	20±0.67
March	2.9±0.04	1.3±0.08	0.6956±0.00	0.025±0.00	2.3±0.13	0.0±0.00	0.00±0.00	2.6±0.16	230±2.02	22±1.14
April	2.6±0.15	1.2±0.18	0.5952±0.00	0.220±0.03	2.2±0.32	0.0±0.00	0.00±0.00	2.5±0.15	240±6.51	25±0.53
May	1.8±0.37	0.6±0.07	0.6521±0.13	0.051±0.00	1.4±0.18	0.0±0.00	0.20±0.03	1.5±0.20	250±7.07	23±0.66
June	2.9±0.07	45±1.58	0.6623±0.00	0.052±0.00	2.3±0.03	3.0±0.31	0.00±0.00	2.8±0.05	270±7.07	25±2.23
July	0.9±0.08	1.3±0.09	0.5217±0.00	0.025±0.00	1.0±0.07	0.0±0.00	0.00±0.00	1.7±0.17	264±3.40	24±2.28
August	2.8±0.70	1.5±0.35	0.6856±0.00	0.027±0.00	2.2±0.31	2.5±0.70	0.20±0.07	2.6±0.32	277±1.14	29±3.11
September	2.8±0.70	1.3±0.32	0.5621±0.03	0.230±0.03	2.3±0.32	2.6±0.33	0.00±0.00	2.6±0.33	276±31.63	26±3.30
October	10.0±1.7	11.6±3.16	8.4800±2.82	0.210±0.03	16.1±2.60	11.9±3.22	0.20±0.07	2.7±0.70	270±31.62	27±3.22
November	9.80±1.0	10.2±0.7	7.3100±0.70	0.200±0.07	14.2±0.70	5.5±0.63	0.00±0.00	2.6±0.33	261±0.70	21±3.17
December	2.0±0.70	3.0±0.70	0.5650±0.00	0.028±0.00	2.5±0.07	0.0±0.00	0.20±0.07	2.8±0.31	256±0.70	260±1.00

magnesium, sodium, potassium and chloride, were analyzed in the laboratory as per the standard methods described by APHA (2005). Microbial studies were analyzed by MPN method described by Papen and Van Berg (1998).

Statistical analysis

Results obtained were subjected to statistical analysis using SPSS (11.5).

RESULTS AND DISCUSSION

Turbidity

The present study indicated that the highest value of turbidity was 6.2 ± 0.317 NTU in the month of December 2011 in the Authoorangal channel; Similarly the lowest value of turbidity was reported as 3.4 ± 0.141 NTU in the months of both August and September 2011. In the Srivaikuntam channel, the highest value of turbidity was reported as 6.5 ± 0.070 NTU in the month of August 2011. On the other hand, the lowest value of turbidity was showed as 2.9 ± 0.316 NTU in the month of September 2011 (Table 3). The present investigations reported the highest concentration of turbidity was due to the interaction of agricultural fertilizers, manures, insecticides and pesticides from the nearby banana field.

Water Temperature

The sun is the source of heat that warms most water and its effect depends on the angle at which it strikes the surface. There may also be a direct exchange of heat between air and water and between substratum and water (Macan, 1974). In the present investigation, the temperature values in the station Authoorangal channel from January to December 2011 were recorded. The maximum value of water temperature was recorded as $25.9 \pm 0.583^\circ\text{C}$ in the month of May 2011. The minimum value was recorded as $21.1 \pm 1.00^\circ\text{C}$ in the months of December and January (Table 1). In the station Srivaikuntam channel, the maximum value was recorded as $33.9 \pm 0.707^\circ\text{C}$ in the month of May. The minimum value was recorded as $10.1 \pm 0.707^\circ\text{C}$ in the

month of December (Table 3). In this investigation, the temperature values were maximum during summer and minimum during winter. Sonawane (2011) reported that the maximum value was recorded as $21.07 \pm 1.49^\circ\text{C}$ during summer; the minimum value was recorded as $12.15 \pm 2.95^\circ\text{C}$ during winter. In the present study, the maximum value recorded during summer may be due to low water level, more solar radiation and more evaporation. The minimum value recorded during winter may be due to high water level, less solar radiation and less evaporation.

Hydrogen Ion Concentration (pH)

The acidity of water is gauged by its pH, which is a measure of the concentration of the hydrogen ion (H^+). During the study period January – December 2011, the maximum value of pH was recorded as 8.5 ± 0.612 during summer in the month of May 2011 in the Authoorangal channel whereas the minimum value was recorded as 7.3 ± 0.196 in the months of January and September 2011 (Table 1). The maximum pH value of Srivaikuntam channel was recorded as 8.7 ± 0.707 in the month of February 2011. The minimum value was recorded as 7.3 ± 0.707 in the months of January and September 2011 (Table 3). The present study revealed that the pH was alkaline during summer season in Authoorangal channel, on the other hand pH was alkaline during winter season in Srivaikuntam channel. In the present investigation, higher values may be due to accumulation of ions owing to evaporation and pesticides, insecticides from the nearby banana field. Pathak *et al.* (2012) reported that the higher values may be due to accumulation of ions owing to evaporation, biological turnover and interaction with sediments.

Dissolved Oxygen (DO)

Dissolved oxygen is essential to the respiratory metabolism of most aquatic organisms. Natural sources of dissolved oxygen are derived from the atmosphere or through photosynthetic production by aquatic plants. In the analysis of dissolved oxygen during the study period,

the maximum value was recorded as 7.9 ± 0.326 mg/l in the Authoorangal channel during the months of January and November (Table 1). The minimum value was recorded as 5.5 ± 0.067 mg/l in the month of June. In the Srivaikuntam channel, the maximum value was recorded as 7.9 ± 0.707 mg/l during the months of August and November. The minimum value was recorded as 5.9 ± 0.707 mg/l in the month of May (Table 3). The present investigation indicated the dissolved oxygen level concentration was high during rainy season. High concentration of DO was due to the photosynthetic activity of algal flora. Bhuiyan and Gupta (2007) reported that the dissolved oxygen is mainly regulated by photosynthetic activity of algal flora. The minimum concentration level of DO was due to the depletion of water and abundance of nutrients in the Authoorangal channel and Srivaikuntam channel. Sonawane (2011) reported that minimum concentration is probably due to the decomposition of organic matter.

Electrical Conductivity (EC)

In the analysis of electrical conductivity during the period of January to December 2011, the maximum value was 3.08 ± 0.632 ds/m in the Authoorangal channel during the month of October. The minimum value was recorded as 0.2 ± 0.032 ds/m in the months of September and December. In the Srivaikuntam channel, the maximum value was recorded as 0.41 ± 0.007 ds/m in the months of February and May. The minimum value was recorded as 0.2 ± 0.031 ds/m in the month of November (Table 3). This study reported that the electrical conductivity was high due to the surface run – off during the rainy season in the Authoorangal channel. The study indicated that the EC was high during the months of May and February in the Srivaikuntam channel which may be due to the greater content of ions in the water and dissolved solids. Dutta and Chowhan (2009) reported that water of higher conductivity may be used with suitable amendments and precautions, but under normal conditions, they are harmful to the soil structure and their

continuous use will result in salinity hazard, with ultimate effect on plant growth.

Total Dissolved Solids (TDS)

In this investigation, the maximum value of TDS was noticed as 15.7 ± 3.162 mg/l in the Authoorangal channel in the month of November, whereas the minimum value was noticed as 11.0 ± 0.465 mg/l in the month of January. The analysis of Srivaikuntam channel revealed the maximum value of TDS as 14.0 ± 1.000 mg/l in the month of May. The minimum value of TDS was 9.1 ± 0.707 mg/l in the month of February (Table 3). The present study revealed the highest concentration of total dissolved solids which may be due to the surface run off and agricultural run off from the nearby banana field. Sonawane (2011) reported that the higher concentration of total dissolved solids ranged between 502 mg/l and 8626.25 mg/l. The ground water chemistry changes when the water flows through the subsurface geological environment having overall change in the major ions and dissolved solids.

Total Hardness (TH)

The hardness of water is generally due to the presence of calcium and Magnesium in the water. The study recorded the maximum value of total hardness in the Authoorangal channel as 25.6 ± 6.324 mg/l in the month of October 2011. Similarly, the minimum value of hardness was 3.0 ± 0.707 mg/l in the month of July 2011 (Table 1). But in the Srivaikuntam channel, the maximum value of hardness was revealed as 13.9 ± 0.707 mg/l in the month of November 2011. The minimum value of total hardness was noticed as 3.0 ± 0.707 mg/l in the month of July 2011 (Table 3). The present investigation noticed the highest concentration of total hardness reflected by the nature of the agricultural fertilizers, manures, insecticides and pesticides. Saini *et al.* (2010) reported that the hardness of water reflects the nature of the geological formation with which it has been contacted.

Total Alkalinity (TA)

The present study indicated the highest concentration of TA in the Authoorangal channel as 50.1 ± 1.140 mg/l in the month of November 2011, whereas the lowest concentration of TA was 22.2 ± 0.677 mg/l in the month of January 2011. The analysis of Srivaikuntam channel showed the highest concentration of TA as 45.1 ± 0.317 mg/l in the month of November 2011 and the lowest concentration of TA as 20.2 ± 0.707 mg/l in the month of January (Table 3). The present study showed the presence of the highest concentration of total alkalinity which was due to the surface run off from banana field which contains the highest concentration of calcium, carbonates and bicarbonates ions during rainy season. Sahni and Silotia (2011) reported that the alkalinity values correlate positively with the pattern of rainfall and this implies surface run off from the Mansagar lake.

Calcium

Waters that emerge from the earth are highly charged with calcium bicarbonate and flow away as streams which may deposit calcium carbonate (Macan,

1974). The values of calcium ions were given in Table 2 for Authoorangal channel which represented the highest value of 10.0 ± 1.702 mg/l in the month of October 2011. Similarly, the lowest value was 0.9 ± 0.086 mg/l in the month of July 2011. Considering the Srivaikuntam channel, the analysis of calcium ions was recorded as 3.6 ± 0.633 mg/l in the month of March 2011 as the highest value. The lowest value was recorded as 0.8 ± 0.031 mg/l in the month of May 2011. The precipitation of agricultural pesticides, fertilizers and manures from the banana field represented the highest calcium concentration. Samson and Elangovan (2011) reported that water more or less in equilibrium with the materials in the drainage basin is characterized by higher concentration of calcium.

Magnesium

The magnesium ion in the Authoorangal channel was recorded as 11.6 ± 0.378 mg/l in the months of February and October 2011 is the highest value. Similarly, the lowest value was 0.6 ± 0.070 mg/l in the month of May 2011 (Table 2). In the Srivaikuntam channel, the highest value of magnesium ion was

Table 3: Monthly variations of physical parameters of Srivaikuntam channel in the year of 2011

YEAR-2011 Month	PHYSICAL PARAMETERS							
	Turbidity (NTU)	Temperature °C	pH	DO (mg/l)	EC (ds/m)	TDS (mg/l)	TH (mg/l)	TA (mg/l)
January	3.0 ± 0.707	13.1 ± 1.000	7.3 ± 0.707	7.1 ± 0.707	0.26 ± 0.007	9.2 ± 0.707	6.1 ± 0.317	20.2 ± 0.707
February	3.0 ± 0.707	12.4 ± 0.707	8.7 ± 0.707	7.3 ± 0.633	0.41 ± 0.007	9.1 ± 0.707	5.5 ± 1.000	22.7 ± 0.707
March	4.1 ± 0.707	15.0 ± 1.000	7.8 ± 0.707	7.6 ± 0.707	0.35 ± 0.007	10.5 ± 0.707	4.3 ± 0.707	23.0 ± 0.707
April	4.0 ± 0.707	23.7 ± 0.070	7.7 ± 0.070	6.6 ± 0.317	0.31 ± 0.007	10.3 ± 0.635	3.3 ± 0.707	21.2 ± 0.707
May	3.6 ± 0.317	33.9 ± 0.707	8.4 ± 0.707	5.9 ± 0.707	0.41 ± 0.007	14.0 ± 1.000	6.6 ± 0.317	23.3 ± 0.317
June	3.1 ± 0.707	33.7 ± 0.070	7.7 ± 0.633	6.5 ± 0.707	0.27 ± 0.007	12.3 ± 0.322	4.1 ± 0.707	22.8 ± 0.317
July	3.5 ± 0.707	29.5 ± 0.633	7.6 ± 0.707	6.8 ± 0.707	0.27 ± 0.007	13.1 ± 0.317	3.0 ± 0.707	31.3 ± 0.317
August	6.5 ± 0.070	27.8 ± 0.633	7.4 ± 0.707	7.9 ± 0.707	0.39 ± 0.007	13.2 ± 0.317	4.2 ± 0.707	30.2 ± 0.707
September	2.9 ± 0.316	26.8 ± 0.707	7.3 ± 0.707	7.7 ± 0.317	0.21 ± 0.007	12.7 ± 0.317	6.0 ± 0.707	39.2 ± 0.317
October	3.3 ± 0.317	17.0 ± 0.707	7.9 ± 0.707	7.6 ± 0.317	0.28 ± 0.010	13.9 ± 0.707	8.6 ± 0.317	37.5 ± 0.317
November	3.2 ± 0.317	15.2 ± 0.317	7.7 ± 0.317	7.9 ± 0.707	0.2 ± 0.031	10.7 ± 0.633	13.9 ± 0.707	45.1 ± 0.317
December	3.6 ± 0.317	10.1 ± 0.707	7.6 ± 0.317	7.2 ± 0.317	0.29 ± 0.007	12.3 ± 0.317	13.1 ± 0.707	23.4 ± 0.317

1.6±0.317 mg/l in the month of October 2011. Similarly, the lowest value of magnesium ion was 0.05±0.007 mg/l in the month of December 2011. The present study revealed the highest magnesium concentration due to leachates from the banana field during rainy season. Sonawane (2011) reported that the main source of magnesium concentration is obtained from the leachates of rocks in the catchments.

Sodium

The present analysis of sodium ion revealed the highest value as 8.48±2.828mg/l in the month of October 2011. The lowest value of sodium ion 0.52±0.007mg/l in the month of July 2011 was recorded in the Authoorangal channel (Table 2). Similar results were reported in the Srivaikutam channel (Table 4). The highest concentration of sodium ion in both channels represented the agricultural fertilizers, manures and the detergents used by the humans for bathing and washing clothes. Mary Kensa (2011) reported that the main source of sodium is obtained from soaps and detergents, used by the local residents for bathing and washing purposes.

Potassium

The present study recorded the highest value of potassium ion in the Authoorangal channel as (0.23±0.012 mg/l) in the months of February and September 2011 (Table 2). Likewise, the lowest value of potassium ion was (0.025±0.0009 mg/l) in the months of March and July 2011 (Table 1). In proportion to Srivaikuntam channel, the highest value of potassium ion (0.23± 0.007 mg/l) was recorded in the month of September 2011. The lowest value of potassium ion was recorded as 0.022± 0.007 mg/l in the month of April 2011. The present investigations reported that the highest concentration of potassium may be due to wash out of slurry from the agriculture fields and sewage run off. Gopalkrushna (2011) reported that the major source of potassium in natural fresh water is due to weathering of rocks but the quantities increase in the polluted water due

to the disposal of waste water.

Chloride

Chloride is one of the most widely used disinfectants. The highest concentration of chloride in the Authoorangal channel was 16.1±2.607 mg/l during October 2011. Likewise, the lowest value was recorded as 10±0.070 mg/l in the month of July 2011 (Table 2). With reference to the Srivaikuntam channel, the highest concentration of chloride analyzed was 1.9±0.318 mg/l in the month of March 2011. Similarly, the lowest concentration of chloride was analyzed as 1.0±0.00 mg/l in the months of July and December 2011. The present study depicted that the highest concentration of chloride (16.1±2.607 mg/l) may be due to the water sources that come from organic wastes and refuse of leachates. Prabakaran *et al.* (2013) reported that the high concentration of chloride may be due to anthropogenic activities, sewage contamination and decomposition of organic wastes.

Sulphate

Sulphate occurs in certain igneous rock minerals of the field spathoid group, but the most extensive and important occurrences are in the evaporate sediments. The highest concentration of sulphate in the Authoorangal channel was found as 11.9±3.224 mg/l in the month of October 2011 (Table 2). While comparing with the Srivaikuntam channel, the highest concentration of sulphate was reported as 11.9±0.707 mg/l during October 2011 which is similar to the Authoorangal channel. The highest concentration of sulphate in the present investigation revealed the deposition of agricultural fertilizers which are drained into the water body from the catchment area. Suresh *et al.* (2013) reported that sulphate enter into the water body from the catchment area through surface run off. Since the study area is bordered by agricultural lands where sulphate fertilizers are used in plenty, relatively higher concentrations of sulphate observed could be attributed to the run off from these agricultural lands.

Carbonate

The present study investigated the highest concentration of carbonate in the Authoorangal channel as 0.2 ± 0.050 mg/l (Table 2) and was uniformly distributed over the month of February, May, August, October and December 2011. The Srivaikuntam channel revealed the highest concentration of carbonate as 0.3 ± 0.070 mg/l in the months of February and April 2011. The present investigation manifested the highest concentration of carbonate which was due to the surface run off from the agricultural fertilizers, manures and pesticides as precipitation to where it exits the watershed. Vasanthy and Velmurugan (2009) reported the presence of temporary (carbonates and bicarbonates of Ca and Mg) and also permanent hardness (sulphates, phosphates, nitrates, chlorides of Ca and Mg). This may be attributed to the geological reasons and surface run-off.

Bicarbonate

The highest concentration of bicarbonate in the

Authoorangal channel was found as 2.8 ± 0.050 mg/l in the months of June and December 2011 (Table 2) but the lowest concentration was 1.5 ± 0.203 mg/l in the month of May 2011. With reference to the Srivaikuntam channel, the highest concentration of bicarbonate was recorded as 2.2 ± 0.633 mg/l in the months of January, April, August, September, November and December 2011 whereas the lowest concentration of bicarbonate recorded was 1.5 ± 0.317 mg/l in the month of May 2011. The present findings revealed the highest concentration of bicarbonate which may be due to the leachates from the agricultural run off and human activities. Sonawane (2011) reported that the highest concentration of bicarbonates may be attributed to the rate of organic decomposition during which CO_2 is liberated, which reacts with water to form HCO_3 .

Total Coliform Bacteria

The analysis of total coliform bacteria revealed the highest count as 277 ± 1.140 (MPN / 100ml) in the

Table 4: Seasonal variations of chemical and coliform parameters of Srivaikuntam channel in the year of

YEAR- 2011 Month	CHEMICAL PARAMETERS								COLIFORM PARAMETERS	
	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)	Cl (mg/l)	SO ₄ (mg/l)	Co ₃ (mg/l)	Hco ₃ (mg/l)	Total Col (MPN /100ml)	Faecal Col (MPN/ 100ml)
January	2.2±0.31	1.5±0.31	6.45±0.31	0.1±0.00	1.5±0.31	4.2±0.63	0.000±0.00	2.2±0.63	259±0.70	21±0.70
February	2.9±0.70	0.70±0.07	8.10±0.70	0.10±0.00	1.6±0.31	0.000±0.00	0.3±0.37	2.1±0.70	255±1.00	20±1.00
March	3.6±0.63	0.00±0.00	0.69±0.00	0.02±0.00	1.9±0.31	0.000±0.00	0.000±0.00	2.1±0.70	257±0.70	27±0.70
April	2.6±0.31	1.2±0.31	0.59±0.00	0.02±0.00	1.2±0.31	0.000±0.00	0.3±0.07	2.2±0.07	257±0.70	25±0.70
May	0.8±0.03	0.6±0.07	0.65±0.00	0.05±0.00	1.7±0.32	0.000±0.00	0.000±0.00	1.5±0.31	300±0.70	23±0.70
June	2.9±0.70	1.5±0.31	0.66±0.00	0.05±0.00	1.3±0.31	3.0±0.70	0.000±0.00	2.1±0.70	259±1.14	29±1.14
July	1.3±0.31	1.3±0.07	0.52±0.00	0.07±0.00	1.0±0.00	0.000±0.00	0.000±0.00	1.7±0.07	255±0.70	23±0.70
August	2.8±0.31	1.5±0.31	0.68±0.00	0.02±0.00	1.2±0.31	2.5±0.31	0.2±0.03	2.2±0.31	253±0.70	27±0.70
September	2.8±0.31	1.3±0.31	0.56±0.00	0.23±0.00	1.3±0.31	2.6±0.31	0.000±0.00	2.2±0.31	255±1.00	25±1.00
October	3.0±0.70	1.6±0.31	8.48±0.31	0.21±0.00	1.1±0.31	11.9±0.70	0.2±0.03	2.1±0.31	350±0.70	30±0.70
November	2.8±0.31	1.2±0.31	7.31±0.31	0.20±0.03	1.2±0.31	5.5±0.31	0.000±0.00	2.2±0.31	390±0.70	37±0.70
December	2.0±0.70	0.05±0.00	0.56±0.00	0.05±0.00	1.0±0.00	0.000±0.00	0.000±0.00	2.2±0.31	300±0.70	29±1.14

month of August 2011 in the Authoorangal channel. The lowest counts of total coliform bacteria was recorded as 220 ± 3.535 (MPN/ 100ml) in the month of February 2011 (Table 2). In the Srivaikuntam channel, the highest counts of total coliform bacteria was recorded as 390 ± 0.707 (MPN/ 100ml) in the month of November 2011 (Table 4). Similarly, the lowest counts revealed as 253 ± 0.707 (MPN/100ml) in the month of August 2011. The present study revealed the highest counts of total coliform which may be due to physico-chemical parameters along with the agricultural decomposition of organic matter from the catchment area. Sharma *et al.* (2013) reported that all physico-chemical parameters of sediments showed significant relationship with bacterial count. Dark brown color of sediments, organic carbon (1.62%) and high organic matter (2.79%) showed high content of organic waste in the bottom sediments. pH of the sediment sample showed alkaline nature (8.1) and most of the isolated bacteria grow at slight pollution and helped in the growth of pollution indicator bacteria such as *Escherichia coli*, *Pseudomonas sp.*, *Enterobacter sp.* etc.

Faecal Coliform Bacteria

During the study, the highest counts of fecal coliform bacteria was shown to be 29 ± 3.114 (MPN/ 100ml) in the month of August 2011, in the station namely Authoorangal channel (Table 2). The lowest count of faecal coliform bacteria was found to be 20 ± 0.678 (MPN/ 100ml) in the month of February 2011. The Table 4 represented the highest counts of fecal coliform bacteria as 37 ± 0.707 (MPN/ 100ml) in the srivaikuntam channel in the month of November 2011. The lowest count of faecal coliform bacteria was found to be 20 ± 1.0 (MPN / 100ml) in the month of February 2011 (Table 4). The present study indicated the highest counts of fecal coliform bacteria owing to contamination of humic and animal matter from where the bacteria can be transported by surface run off. Adriana *et al.* (2012) reported that in Serra do Cipo, the sites of PEI1 and PEI2

showed the highest counts (500 to 700 MPN 100 mL⁻¹) of fecal coliforms during the rainy season in 2000. These sites receive large amounts of organic matter from non-treated effluents from the farms and small towns surrounding the region.

CONCLUSION

From the above investigations, it may be concluded that most of the physico-chemical parameters viz. turbidity, temperature, pH, dissolved oxygen, electrical conductivity, total dissolved solids, total hardness, total alkalinity, calcium, magnesium, sodium, potassium, chloride, sulphate, carbonate, bicarbonate, total coliform and faecal coliform were found within the World Health Organization limits in the Authoorangal channel and Srivaikuntam channel. The findings clearly indicated that both the channel water bodies are slowly deteriorating due to discharge of agricultural fertilizers, manures, pesticides and insecticides from the nearby banana field. The manifested results calls for the need to conserve manage and restore the water bodies. Intensive efforts such as regular monitoring, systematic assessment can save the human health and provide sustainable environment. There is a need for awareness among the people to maintain the significance of highest quality and purity levels of both Authoorangal and Srivaikuntam channel water bodies.

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