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Comparison Studies of Three Freshwater Rivers (Cauvery, Bhavani and Noyyal) in Tamilnadu, India

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Abstract: Assessment of some physico chemical and microbial parameters of the water bodies of three rivers (Cauvery, Bhavani and Noyyal) which is suitable for human consumption have been carried out during the period of one year (September 2007 to August 2008). Analysis of some physico-chemical characteristics like water temperature, colour, electrical conductivity, transparency, total suspended solids, total dissolved solids, pÇ, dissolved oxygen, BOD, total alkalinity; total hardness has been done during the investigation period. Increases in temperature, turbidity, electrical conductivity, total solids, PH, bicarbonate, COD values were higher in Noyyal river followed by Cauvery river. The increase dissolved oxygen; BOD values were higher in Bhavani river. Study indicates the rivers were largely pollution by anthropogenic performance due to industrial effluents, municipal sewage, religious credence and subject to amend owed to seasons, climate and flows and influx of waters from various tributaries. In addition present study point out that the river Noyyal facing severe anthropogenic followed by Cauvery and Bhavani.

Key words: Electrical conductivity % BOD % COD % Effluents % Anthropogenic % pH

INTRODUCTION

Cauvery is a major river system of south India and river Bhavani and Noyyal are tributes to the river Cauvery. The Cauvery River rises at Talakavery in the Western Ghats in the State of Karnataka and passes through Mysore plateau and Tamilnadu plains before it mixes with the Bay of Bengal. The river flows generally south and east through Karnataka and the tributaries such as Harangi, Hemavathi, Lakshmanateerta, Lokapavani, Kabini,Suvarnavathi, Shimsa, Arkavathi, Noyyal, Bhavani, and Amaravathi are the major source of water for drinking, agricultural, and industrial desires in Karnataka and Tamilnadu states of India. The river covers a drainage area of nearly 87,000 km2 in the southern part of the Indian subcontinent and it flows through densely populated areas from Coorg (Karnataka) in the Western Ghats to Bay of Bengal [1]. The basin is characterized by a tropical climate with average annual rainfall of 900 mm [2], with 90% occurring during the south west monsoon. It serves as a major source of domestic, irrigation and industrial water supply. Subsequently, it receives untreated domestic waste water. The major land uses in the basin are agriculture (36%) and forests (32%), with the remaining areas being developed areas, wetlands. The sampling locations are spread throughout the study area.

River Bhavani is fresh water, perennial originates from Western Ghats, Nilgiri district and second largest river in Tamil Nadu, and passing through Mettupalayam and Sirumugai to the distance of 217 km before merging with the Cauvery. Long Perennial River fed mostly by the southwest monsoon season prevails during June to August while the North East monsoon season follows from September to December. The post monsoon season has a brief winter (January to February) and summer follows afterwards, characterized by warm humid conditions. Its watershed drains an area of 6,200 kmÂ² spread over Tamil Nadu (87%), Kerala (9%) and Karnataka (4%). The main river courses through entire of the North-Western Erode district of Tamil Nadu. About 90 per cent of the river's water is used for agriculture irrigation.

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12 major rivulets join Bhavani draining the southern Nilgiri slopes. Water accounting study conducted by the [3] for the lower Bhavani river basin shows that industrial water use (45 million cubic meter) is almost 2 per cent of total water use of 2341 Mm^3 of the basin and agriculture has the highest share more than 67 per cent or 1575 Mm^3. [4-7]. The total annual pollution load discharged by the units is estimated, based on TamilNadu pollution control borad data (TNPSC), to be 1,316 tonnes of Total Dissolved Solids (TDS), 94 tonnes of Total Suspended Solids (TSS), 169 tonnes of Chemical Oxygen Demand (COD), and 2 tonnes of oil and grease.In Sirumugai town, a major pulp and viscose rayon plant used to draw 54 mld water from the Bhavani river and discharge an equivalent amount of partially treated effluents into the river. Annual wastewater pollution load of Mettupalayam municipality constitutes 61 tonnes of TDS, 50 tonnes of TSS, 7 tonnes of BOD, 18 tonnes of COD, 19 tonnes of Chloride and 1 tonne of Sulphate , 494 tonnes/year of TDS, 22 tonnes/year of TSS and 24 tonnes/year of COD [8].

The river Noyyal originates from Vellingiri hill rocks of a Western Ghats. The Noyyal river is a tributary of the Cauvery, a large interstate river which cuts through the States of Karnataka and Tamilnadu and enters the Bay of Bengal and it flows through the districts of Coimbatore, Tirupur, Erode and Karur, in western Tamilnadu the total length of river is170 km from its origin to mix with Cauvery at Koodhamandi in Erode district. The Noyyal river basin covers a total area of 3510 km2 and is located between north latitude 10056' and 11019' and east longitude 76041' and 77056'.The Noyyal is a seasonal river which has good flow only for short periods during the North-East and South-West monsoons. 6,000 acres of cultivable land in Coimbatore district are irrigated using the river water. The average width of the basin is 25 km. The basin is widest in the central part with a width of 35 km.The entire area of the basin is situated in the state of Tamilnadu, in parts of Coimbatore, Erode and Karur districts. The Noyyal confluences with the Cauvery River at Noyyal village. The upper reaches of the basin receive high rainfall of more than 3000 mm annually, while the eastern part receives only 600 mm. The pre-monsoon season period produces about 100 mm to 300 mm of rain and most of it is received during the months of April and May. The River carries the effluents to downstream areas especially to the system tanks and the Orathapalayam reservoir.

After reaching Tirupur town the Noyyal receives the town sewage and untreated effluents from dyeing and bleaching industries. Tirupur has about 3000 units of hosiery and knitwear. The units are spread over about 750 are engaged in dying and bleaching work. It estimated to full capacity about 1, 00, 000m^3 of water is required per day. The effluents approximately 75,000 m^3 are discharged into the river Noyyal and into various sewage systems [9]. For the present study evaluate the physico chemical characteristics and the quality of water was determined by three different stations.

MATERIALS AND METHODS

For the present study water samples were collected from the surface of three stations such as Cauvery, Bhavani and Noyyal for the period of one year (September 2007 to August 2008) with the interval of 30 days. In each river sampling spot were fixed for the collection of water sample at the time of 11 am to 12 noon in order to maintain uniformity. For the present study water samples were collected form the surface at three stations.

River Cauvery- Mixing point of river Bhavani and Cauvery at Kodanthurai.

River Bhavani-Mixing effluent near South India Viscose (SIV) effluent at Koothamandi near Bhavanisagar reservoir.

River Noyyal- 10 km from Tirupur town (Kasipalayam near Muthalipalayam) where receives all the industrial effluents.For the physico chemical examination, different methods adopted the standard procedures [10]. The instruments were used of precise accuracy and chemicals were used AR grade.

RESULTS AND DISCUSSION

Data of the seasonal variations in the physico chemical parameters of the river Cauvery and Bhavani and Noyyal for a period of one year (September 2007 to August 2008) are presented in the Table 1, 2 and 3. The range and mean of values of physico chemical parameters are listed in the Table 4. The water temperature was ranging from 25°C to33°C during the study period. The lowest temperature of 25°C was recorded in the river Cauvery. A steady increase in the water temperature was noticed in the river Bhavani. The highest temperature of 33°C was observed in the river Noyyal. There was an increase in water temperature after the discharge of the effluents into the rivers was recorded. The mean value of temperature in Cauvery 28.0°C and Bhavani 29.25 °C and Noyyal 30.17°C.

Table 1: Physico-chemical characteristics of the river Cauvery for one year (September 2007 to August 2008)

Month	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug
Temperature (°C)	27	27	27	26	25	26	30	30	31	30	29	28
Colour	C	C	B	B	C	C	C	C	LB	LB	B	B
Turbidity (N.T.U)	12	13	15	16	15	13	12	16	19	19	17	14
Electrical Cond (mMho)	1920	1890	1930	2080	2050	1880	1750	2010	2430	2100	1860	1650
Suspended Solids (Mg/l)	110	120	140	160	140	110	100	110	140	130	110	90
Dissolved Solids (Mg/l)	950	870	930	1020	950	880	830	1020	1130	980	960	930
Total Solids (Mg/l)	1060	990	1070	1180	1090	990	1030	1130	1270	1110	1070	1020
Ph	7.7	7.8	7.6	7.5	7.5	7.5	7.5	7.6	7.5	7.4	7.4	7.4
D.O (Mg/l)	4.1	4.2	4.4	4.7	4.8	5.0	4.9	4.5	4.6	4.6	4.5	4.4
BOD (Mg/l)	85	90	80	85	92	75	82	90	94	80	78	70
BCO3 (Mg/l)	9.0	9.5	8.0	9.0	8.5	8.0	9.5	9.0	10.1	9.5	8.5	8.0
COD (Mg/l)	150	130	125	110	120	115	120	110	100	100	100	90

*LB Light brownish, B-Brownish, C-Colourless

Table 2: Physico-chemical characteristics of the river Bhavani for one year (September 2007 to August 2008)

Month	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug
Temperature (°C)	30	29	29	28	28	28	29	30	32	31	30	27
Colour	LB	LB	B	B	B	B	B	B	C	C	C	C
Turbidity (N.T.U)	25	20	21	15	16	17	18	20	21	20	19	18
Electrical Cond (mMho)	900	690	650	630	680	750	700	850	800	600	600	720
Suspended Solids (Mg/l)	700	610	700	720	750	740	600	610	620	630	640	630
Dissolved Solids (Mg/l)	1200	910	1000	1050	950	900	1200	1150	1010	900	850	800
Total Solids (Mg/l)	1900	1520	1700	1770	1700	1640	1800	1760	1630	1530	1490	1430
pH	7.7	7.7	7.8	7.9	7.8	7.7	8.0	7.9	8.1	7.9	7.7	7.6
D.O (Mg/l)	5.8	5.8	5.9	6.0	6.5	6.2	5.4	5.5	5.3	5.5	5.6	5.7
BOD (Mg/l)	1.7	1.8	1.9	2.1	2.4	3.4	3.5	4.0	5.1	4.6	3.8	3.2
BCO3 (Mg/l)	3.5	4.0	5.0	5.5	4.5	4.0	3.5	5.0	7.5	6.0	2.5	2.0
COD (Mg/l)	110	90	70	78	80	86	98	100	105	95	90	65

*LB Light brownish, B-Brownish, C-Colourless

Table 3: Chemical characteristics of the river Noyyal s for one year (September 2007 to August 2008)

Month	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug
Temperature (°C)	29	30	29	28	28	28	32	32	33	32	31	30
Colour	DB	DB	DB	DB	DB	DB	DB	B	DB	DB	DB	DB
Turbidity (N.T.U)	26	26	27	27	28	28	30	32	31	28	27	25
Electrical Cond (mMho)	6500	6100	5210	6800	6700	6900	6700	6800	7700	6250	6950	6320
Suspended Solids (Mg/l)	850	950	1000	1010	980	990	990	1000	1010	1020	1040	980
DissolvedSolids (Mg/l)	4900	4850	4500	4550	4560	5050	5150	5750	5900	5750	4800	5200
Total Solids (Mg/l)	5750	5800	5500	5560	5540	6040	6140	6750	6910	6770	5840	6180
pH	7.7	7.6	7.4	7.4	7.5	7.6	7.7	8.0	8.1	8.0	7.6	7.8
D.O (Mg/l)	1.3	1.4	1.5	1.6	1.6	1.7	1.0	1.2	1.2	1.9	1.8	1.9
BOD (Mg/l)	320	300	265	260	295	320	350	330	360	328	300	300
BCO3 (Mg/l)	320	345	336	365	360	370	395	410	450	435	395	360
COD (Mg/l)	285	261	230	290	342	360	374	410	430	408	390	360

*DB- Dark brownish

Table 4: Physico-chemical characteristics of three rivers (Cauvery, Bhavani, Noyyal) at three stations (mean values for one year September 2007 to August 2008)

Physical characters	Cauvery	Bhavani	Noyyal
Temperature (°C)	28.0(25.0-31.0)	29.25(27.0 -32.0)	30.17(28.0-33.0)
Turbidity (N.T.U)	15.08(12.0-19.0)	19.17(15.0-25.0)	27.92(25.0-31.0)
Electrical Cont (mMho)	1962.5(1620-2340)	714.17(600-900)	6577.5(5210-7700)
Suspended Solids (Mg/l)	121.67(90-160)	662.5(600-750)	1069.17(850-1040)
Dissolved Solids (Mg/l)	962.50(870-1130)	993.33(800-1200)	5080.0(500-590)
Total Solids (Mg/l)	1145(970-1280)	1655.83(1430-1900)	6065(5500-6910)
pH	7.55(7.4-7.8)	7.82(7.6-8.1)	7.7(7.4-8.1)
D.O (Mg/l)	4.56(4.1-5.0)	5.77(5.4-6.5)	1.5(1.0-1.9)
BOD (Mg/l)	83.42(70-94)	3.13(1.7-5.1)	310.66(260-360)
BCO3 (Mg/l	8.88(8.0-10.0)	4.42(2.0-7.5)	378(320-450)
COD (Mg/l)	115.8(90-150)	88.91(65-110)	345(230-430)

Map 1: Showing the sampling points of three different rivers not scaled

Temperature is an important biologically significant factor, which plays an important role in the metabolic activities of the organism. Water sample s collected in the river Cauvery showed lower temperature in the monsoon season. In the summer season it was found to be maximum. In the river Bhavani the temperature was found more when compare to the river Cauvery. This may be due to mixing of the effluent from the factories situated in the banks of thee river Bhavani at Sirumugai. Previous the south India viscose factory has pulping unit using the Sulphite process which is most polluting river Bhavani at Koothamandi near Sirumugai.The highest temperature of the river was noticed in this, region due to the cooking of the wood to make wood pulp to extract cellulose and also due to the mixing of the concentrated Sulphuric acid for digestion of the wood .in the river Noyyal at Kasipalayam the temperature was found to be maximum. This may be due to the discharge of the effluent from the textile and dying industries in the Tirupur. Most of the textile and dying units in Tirupur have discharged the treated and untreated effluents into the river Noyyal.

The river was found brownish in colour during rainy season in the river Cauvery it was found to colorless in most of the months, this may be due to the less rain fall. In the river Bhavani it was brownish in most of the months this may be due to the mixing of the effluent from the South India Viscos Factory. In the river Noyyal it was always dark brown in colour. This might be due to mixing of the effluent from the textile and dying units and there was no water flow in the river Noyyal. The turbidity value

was ranging from 12 N.T.U to 19 N.T.U in the river Cauvery. In the river Bhavani it was ranging from 15 N.T.U to 25 N.T.U. In the river Noyyal it was ranging from 25 to 31. The minimum turbidity value of 12 N.T.U was recorded in the river Cauvery, whereas the maximum value of 31 N.T.U was recorded in the river Noyyal. The maximum turbitituy value was recorded in the river Noyyal when compare to river Cauvery and river Bhavani. The mean value of turbidity in Cauvery 15.08 N.T.U and bhavani19.17 N.T.U and Noyyal 27.92 N.T.U. This might be due discharge of the effluents and also due to stagnation of the effluents in the check dam of Kasipalayam.

The electrical conductivity value of the water was ranging from 1620 mMho to 2430 mMho in the river Cauvery. The electrical conductivity value of the river Bhavani was ranging from 600 mMho to 900 mMho. In the river Noyyal the electrical conductivity value of the water was ranging from 5210 mMho to 7700 mMho. The minimum electrical conductivity value of 600 mMho was recorded in the river Bhavani and maximum electrical conductivity value of 7700 mMho was recorded in the river Noyyal. The value of electrical conductivity was maximum in the river Noyyal due to more concentration of the effluents. The mean value of electrical conductivity in Cauvery 1962.5 mMho and Bhavani 714.17 mMho and Noyyal 6577 mMho. The reason for decrease in the values of the electrical conductivity of the river Cauvery and river Bhavani due to the dilution of the effluents and municipal sewage. The value of total solids (suspended and dissolved) in Cauvery was ranging from 970 mg/l to 1280 mg/l. in the river Bhavani value of total solids1430 mg/l to 1900 mg/l. In the river Noyyal the value of total solids was ranging from 5500 mg/l to 6910 mg/l. the minimum value of (70 mg/l) of total solids was recorded in the river Bhavani and maximum value of total solids 6910 mg/l was recorded in the river Noyyal. The mean value of total solids in Cauvery 1145 mg/l and bhavani1655 mg/l and Noyyal 6065 mg/l. This may be due to the more turbid condition of the river due to the mixing of the effluents. The reason for the minimum total solids in the river Cauvery due to the dilution of the sewage and effluents and also the water flow is more when compare to the river Bhavani and Noyyal.

River Cauvery is one of the major river in Tamilnadu, whereas the river Bhavani and river Noyyal are tributaries of the river Cauvery. All the three rivers showed the alkaline condition throughout the study period. Usually the effluents from the factory showed acidic pH and once it was mixed with rivers the acidic condition changed into alkaline. The pH value of river Cauvery was ranging from7.4 to 7.8. In the river Bhavani the pH value of ranging from 7.6 to 8.1. In the river Noyyal the pH value of was ranging from 7.4 to 8.1. The minimum pH value was recorded as 7.4 in the river Cauvery. Maximum value of pH 8.1 was recorded in the river Noyyal. The mean value of pH in Cauvery 7.55 and Bhavani 7.82 and Noyyal 7.7. All these three rivers showed alkaline condition throughout the study period.

The dissolved oxygen value of river Cauvery was ranging from4.1 mg/l to 5.0 mg/l. in the river Bhavani the dissolved oxygen value of ranging from 5.4 mg/l to 6.5 mg/l. In the river Noyyal the dissolved oxygen value of was ranging from 1.0 mg/l to1.9 mg/l. the minimum dissolved oxygen value was recorded as 1.0 in the river Noyyal. Maximum value of dissolved oxygen 6.5 mg/l was recorded in the river Bhavani. The mean value of dissolved oxygen in Cauvery 4.56 and Bhavani 5.77 and Noyyal 1.5. The oxygen concentration of the river Noyyal never reaches saturated condition. Whereas [11] reported that under natural condition the running water typically contains a relatively high concentration of dissolved oxygen tending towards saturation. In the present study a reverse condition was observed. This might be due to mixing of the effluents.

The value of BOD and COD were increased with increase in the pollution load. [12] Pointed out that the minimum dissolved oxygen content in water for maintaining fish life in healthy condition in 5 in the present study amount of dissolve. The maximum value of carbonate and bicarbonate were recorded dint the river Noyyal. The higher amount of carbonate and bicarbonate might be due to the combination of excess carbon dioxide with monocarbobnate forming bicarbonate has also observed by [13]. The decrease of alkalinity values of the river cauvery and river Bhavani may be due to dilution of the effluents in the river. The B.O.D value of river Cauvery was ranging from70 mg/l to 94 mg/l. in the river Bhavani the B.O.D value of ranging from 1.7 to 5.1. Mg/l in the river Noyyal the B.O.D value of was ranging from 260-mg/l to 360 mg/l. the minimum B.O.D value was recorded as 1.7 mg/l in the river Bhavani. Maximum value of B.O.D 360 was recorded in the river Noyyal. The mean value of B.O.D in Cauvery 83.42 mg/l and Bhavani 3.13mg/l and Noyyal 310.66 mg/l.

The bicarbonate alkalinity value of river Cauvery was ranging from8.0 mg/l to 10.0 mg/l. In the river Bhavani the bicarbonate alkalinity value of ranging from 2.0 mg/l to 7.5 mg/l. In the river Noyyal the bicarbonate alkalinity value of was ranging from 320-mg/l to 450 mg/l. The minimum

bicarbonate alkalinity value was recorded as 2 mg/l in the river Bhavani. Maximum value of bicarbonate alkalinity 450 mg/l was recorded in the river Noyyal. The mean value of bicarbonate in Cauvery 8.88mg/l and Bhavani 4.42 mg/l and Noyyal 378mg/l. The COD value of river Cauvery was ranging from90 mg/l to 150 mg/l. in the river Bhavani the C.O.D value of ranging from 65 mg/l to 110 mg/l. In the river Noyyal the C.O.D value of was ranging from 230 mg/l to430 mg/l. The minimum C.O.D value was recorded as 65 mg/l in the river Bhavani. Maximum C.O.D value of 430 mg/l was recorded in the river Noyyal. The mean value of C.O.D in Cauvery 115.8 mg/l and Bhavani 88.91 mg/l and Noyyal 345 mg/l.

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