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Analysis of Physico-Chemical Parameters and Bacterial Population in Kaveri River of Tamilnadu

Authors:
Gladin Pitty Star D[1], Christudhas Williams B[1] and Mary Sujin R[2].

Institution:
1. Department of Botany and Research Centre, Scott Christian College (Autonomous), Nagercoil-629 003, Tamilnadu, India.

2. Department of Zoology, Sadakathullah Appa College (Autonomous), Tirunelveli-627 011, Tamilnadu, India.

Corresponding author:
Christudhas Williams B.

ABSTRACT:

The evaluation of Physico-chemical parameters and bacterial populations of Kaveri River from five stations of Dharmapuri District of Tamil Nadu were studied. The pH of the water samples from five stations were varied from 6.2 to 8.7. The TDS of the water samples was ranged from 321.25±11.8 to 519.25±20.8 in different stations. The temperature, rainfall, turbidity, TA, Cl, TH, Conductivity, Ca, Mg, So_4, Po_4 and F were also varied at different stations. The maximum (20.25×10^7 CFU ml^{-1}) bacterial population was found in the station-Pili kundu and the minimum (61.7×10^5 CFU ml^{-1}) was recorded in station-Ootamalai. The statistical analysis, Correlation coefficient, multiple regression analysis and multiple linear regression analysis for bacterial population were compared with variables showed at 0.01 and 0.05 level significant. The quality of water was determined by the environmental conditions and physiochemical parameters.

Keywords:

Pollution, bacterial population, physicochemical parameters, River Kaveri.

Email:
d.gladdy@gmail.com
wilrescen@yahoo.com

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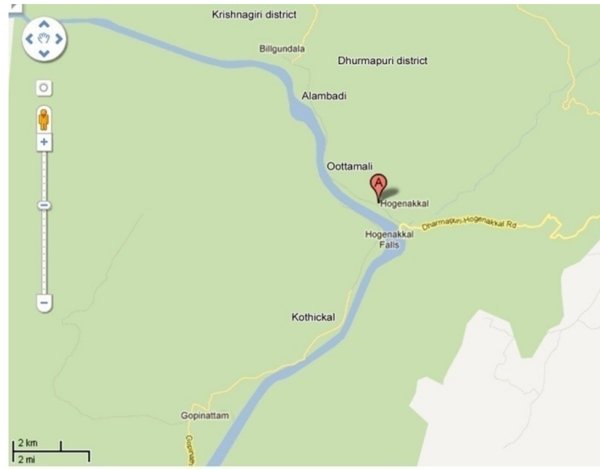
INTRODUCTION

Water is essential for the survival of all living organisms though its accessibility is extremely low of the 1.370 million km^3 of all the water existing in the plant only 98,000 km^3 are suitable for human consumption. The improper management of water systems may cause serious problems in availability and quality of water. Water may be contaminated by various means, chemically or biologically and may become unfit for drinking and other uses (Raja *et al.,* 2008). The influx of inadequately treated municipal wastes along a river causes distinct and predictable changes in the microbial community and available oxygen (Prescott *et al.,* 1996).

The quality of water is usually determined by its physicochemical characteristics. It is a well established fact that domestic-sewage and industrial effluent discharged into natural water result in deterioration of water quality and cultural eutrophication (Shaw *et al.,* 1991). The other important sources of water pollution include mass bathing, disposal of dead bodies, rural and urban waste matter, agricultural run-off and solid waste disposal (Tiwana, 1992).

The water qualities of the Indian rivers have been deteriorating due to continuous discharge of industrial wastes and domestic sewage (Smitha *et al.,* 2007). Kaveri River in India has been contaminated by increasing hazards of domestic and industrial pollution, agricultural pesticides and insecticides. Scientists envisage a rapid degradation of water quality unless concrete steps are taken immediately to abate pollution (Singh and Singh, 1995). To provide safe drinking water and sanitation to the entire country by using cost effective tools to eliminate all water borne diseases as a single problem. Health education to disseminate the knowledge and practice of hygiene is equally important to prevent the water borne diseases (Dhanapaul, 2006). The higher CFU count is attributed to the discharge of municipal sewage and domestic waste water in the river Kaveri (Raja *et al.,* 2008).



Hence attempt was made to evaluate the water quality in view of bacterial population, environment and physicochemical characteristics of the five stations in river Kaveri. The present investigation is a further step to monitor the water quality of Kaveri river.

MATERIALS AND METHODS

The five study area such as Biligundu (A1), of Kaveri river of Krishnagiri District Alambadi (A2), Ootamalai (A3), Hogenakkal (A4) and Kothickal (A5), of Dharmapuri District of Tamil Nadu, India were selected and evaluated for the study of bacterial population and correlated with environment and physicochemical parameters for a period of one year.

Physicochemical parameters

The water samples were collected in triplicate, from each station in sterile plastic cans (3 liter) and refrigerated in laboratory at 4°C. The environmental parameter (Rainfall), physicochemical parameters such as pH, temperature, turbidity, TDS (Total dissolved salt), TA (Total alkalinity), Cl, TH (Total hardness), conductivity, Ca, Mg, So_4, Po_4 and F were analyzed. The estimation of parameters was made by the following methods described in (APHA, 1998). WQI were evaluated according to and (Tiwari and Manzoor, 1988).

Total bacterial population

To determine the total bacterial population, the samples were collected in sterile plastic can and

Table 1 The Environment, physical and chemical parameters of river Kaveri

Parameters	A1	A2	A3	A4	A5
pH	07.07-008.4	06.02- 8.4	07.4-08.3	07.5-8.1	07.2 - 8.5
Temperature	34.00±002.9	33.50±2.5	33.0 ± 2.2	32.0±2.2	31.75±2.0
Rainfall	876.00±168.6	865.0±160	709.0 ± 135	704.2±133.5	788.7±144.8
Turbidity	2.50±000.5	1.50±00.5	1.25±0.5	2.00±0.81	2.75±0.5
TDS	321.25±011.8	315.25±06.19	519.25±20.82	510.75±20.81	511.50±19.79
T. Alkalinity	198.50±005.9	208.75±16.5	270.00±11.37	281.25±11.93	226.25±2.5
Chlorides	92.25±028.1	91.75±27.8	106.50±2.38	106.00±0.0	105.50±0.57
T. Hardness	181.00±030.5	187.50±32.01	252.50±12.52	225.00±64.03	217.50±15.0
Conductivity	498.75±013.14	511.25±06.29	679.50±32.172	681.25±28.042	632.50±12.038
Calcium	29.25±003.59	28.00±07.48	38.50±11.93	39.50±11.35	33.05±01.93
Magnesium	23.50±002.08	23.50±02.08	22.00±1.5	64.00±29.83	60.25±21.85
Sulphate	15.25±004.99	21.25±05.50	62.25±5.152	84.50±4.856	62.25±5.113
Phosphate	0.475±000.04	0.32±00.38	0.125±0.005	0.0268±0.028	0.0155±0.003
Flouride	0.1075±0.0095	0.1025±0.005	0.1125±0.01	0.1075±0.005	0.1250±0.005

A1 - Biligundu; A2 -Alambadi; A3 -Ootamalai; A4 - Hogenakkal; A5 - Kothickal

immediately transported to the laboratory. Bacteria were enumerated as Colony Forming Units (CFU) employing the standard pour plate technique described in (APHA, 2005). Plate count agar medium was used for enumeration purposes and the agar medium was autoclaved prior to use. The collected samples were serially diluted using sterile distilled water and inoculated into sterile Petri dishes. Plating was done by employing pour plate techniques and the plates were incubated at 30°C in an incubator. After 24 h of incubation, colony counts were made using a colony counter.

Statistical analysis

Statistical analysis, correlation coefficient analysis, multiple regression and multiple linear regression models for different variables were carried out using SPSS software package.

Table 2 Bacterial population colony counting in the River Kaveri

Station	Total colony count CFU/ ml
A1	20×10^7
A2	12×10^5
A3	61×10^5
A4	41×10^5
A5	30×10^5

A1 - Biligundu; A2 - Alambadi; A3 - Ootamalai; A4 - Hogenakkal; A5 -Kothickal

RESULTS

Physical and chemical parameters

In the present study pH showed a wide range from 6.2 to 8.5 within the permissible limit of ICMR standards (7.0-8.5) except in Alambadi station-2 showed slightly acidic pH 6.2. The temperature varied from 31.75°C in station- 5 Kothickal to 34°C in Biligundu station-1. Rainfall showed the maximum of 876.0 mm in Biligundu station-1 and the minimum of 704.2 mm in station-4. Turbidity showed the minimum of 1.25 NTU in Ootamalai station-3 and maximum 2.75 NTU in station-5 Kothickal was within the limit of ICMR (5 NTU) (Table 1).

The total dissolved solids varied from the minimum of 315.25±6.1 mg L^{-1} in station-2 (Alambadi) to the maximum of 519.25±20.82 mgL^{-1} in station-3 (Ootamalai). Station 1 and 2 showed the permissible limit except Stations 3, 4 and 5. The permissible limit given by CPHEEO (Central Public Health Environmental Engineering Organization) for total dissolved is 500 mgL^{-1} solids. The total alkalinity varied from the minimum of 198.50±5.9 mgL^{-1} in station-1 (Biligundu) and to the maximum of 281.25±11.93 mgL^{-1} in station-4, (Hogenakkal), all the stations exhibited beyond the limit of permissible limit of total alkalinity 120 mgL^{-1}.

Table 3 Correlation coefficient of bacterial population compared with Variables

Station	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A_1	-0.57	-0.79	0.59	-0.009	0.35	-0.68	0.55	0.61	0.31	0.41	0.01	0.86*	0.99**	0.30
A_2	-0.19	-0.21	0.87*	0.90*	0.81	0.07	-0.18	-0.02	-0.21	-0.27	0.08	0.52	-0.60	0.87*
A_3	-0.77	-0.68	1.0**	1.0**	0.38	-0.41	-0.42	-0.28	-0.33	-0.36	-0.57	-0.49	-0.35	0.33
A_4	-0.20	-0.82	0-.35	-0.82	0.75	0.99**	0	0.99**	0.99**	0.96*	0.21	0.39	-0.28	0.30
A_5	-0.66	0.072	0-.57	0.58	0.01	-0.58	0.003	-0.58	-0.88*	-0.33	-0.35	-0.14	0.17	1.0**

***0.05 level significant; **0.01 level significant; A_1 - Biligundu; A_2 - Alambadi; A_3 - Ootamalai; A_4 -Hogenakkal; A_5 - Kothickal; 1-pH; 2 Temperature; 3-Rainfall; 4-Turbidity; 5-TDS; 6-Total Alkalinity; 7-chlorides; 8-Total hardness; 9-Conductivity; 10-Ca; 11-Mg; 12-$S0_4$; 13-Po_4; 14-Flouride**

Polluted station of Kaveri river was highly alkaline reported by (Somasekhar, 1988). Pre-monsoon showed the peak values of total alkalinity followed by post-monsoon and monsoon in lower Anicut of river Kaveri (Jerald, 1994) and it was stated that the value of total alkalinity also within the limits of national and International standards.

The chloride content is high 106.50±2.38 mgL^{-1} in station-3 (Ootamalai) and station-4, (Hogenakkal) however in station-2 (Alambadi) it showed a minimum of 91.75±27.8 mgL^{-1}. The total hardness varied from the minimum of 181.00±30.5 mgL^{-1} in station-1 (Biligundu) and to the maximum of 252.50±12.52 mgL^{-1} in station-3 Ootamalai (Table 1).

The Conductivity varied from the minimum of 498.75±13.14 mgL^{-1} in station-1 (Billgundu) to the maximum of 681.25±28.042 mgL^{-1} in station-3 (Ootamalai). The Ca level in water sample varied from the minimum of 28.00±7.48 mgL^{-1} in station-2 (Alambadi) to the maximum of 39.50±11.35 mgL^{-1} in station-4 (Hogenakkal). The level of magnesium in water sample varied from the minimum of 22.00±1.5 mgL^{-1} in station-3 (Ootamalai) to the maximum of 64.00±29.83 mgL^{-1} in station-4 (Hogenakkal). The level of sulphate in water samples varied from the minimum of 15.25±4.99 mgL^{-1} in station-1 (Biligundu) to the maximum of 84.50±4.856 mgL^{-1} in station-4 (Hogenakkal). The phosphate level varied from the

Table 4 Multiple regression analysis for bacterial population

Station	R^2 value
A1	0.4314
A2	1.0709
A3	0.3549
A4	0.505
A5	0.4384

A1 - Biligundu; A2 -Alambadi; A3 - Ootamalai; A4 - Hogenakkal; A5 - Kothickal

Table 5 Multiple linear regression analysis for bacterial population

Station	Multiple regression analysis
A1	Y= -19.4682 X_1+ -7.980; X_2+2995.0 X_3+ -2070.0; X_4+2.176; X_5+318.4; X_6+192.3; X_7+129.1; X_8+220.2; X_9+494.3; X_{10}+38.53; X_{11}+25.10; X_{12}+20.1; X_{13}+0.099; X_{14}+0.114
A2	Y= -3.3484; X_1+9.262; X_2+37.23; X_3+ -19.79; X_4+0.576; X_5+413.4; X_6+397.3; X_7+109.4; X_8+262.3; X_9+904.1; X_{10}+54.98; X_{11}+6.983; X_{12}+14.20; X_{13}+0.075; X_{14}+0.110
A3	Y= 2.9784; X_1+8.066; X_2+34.45; X_3+ -246.1; X_4+0.896; X_5+464.3; X_6+304.3; X_7+107.2; X_8+278.6; X_9+751.3; X_{10}+41.75; X_{11}+21.54; X_{12}+79.84; X_{13}+0.013; X_{14}+0.106
A4	Y= 0.5765; X_1+8.151; X_2+27.867; X_3+1568.0; X_4+0.032; X_5+300.7; X_6+109.7; X_7+109.4; X_8+133.6; X_9+283.3; X_{10}+23.63; X_{11}+56.63; X_{12}+57.35; X_{13}+0.038; X_{14}+0.116
A5	Y= 0.4485; X_1+8.547; X_2+35.02; X_3+37.52; X_4+1.604; X_5+299.4; X_6+239.0; X_7+104.9; X_8+249.5; X_9+551.4; X_{10}+38.46; X_{11}+66.79; X_{12}+26.93; X_{13}+0.014; X_{14}+0.116

A1 - Biligundu; A2 - Alambadi; A3 - Ootamalai; A4 - Hogenakkal; A5 -Kothickal

minimum of 0.0155±0.003 mgL^{-1} in station-5 (Kothickal) to the maximum of 0.475±0.04 mgL^{-1} in station-1 (Biligundu). The fluoride content in water samples varied from the minimum of 0.1025±0.005 mgL^{-1} in station-2 (Alambadi) to the maximum of 0.1250±0.005 mgL^{-1} in station-5 (Kothickal) (Table1).

Bacterial population

In the present study, bacterial population varied from 20×10^7 CFU ml^{-1} in station-1 (Biligundu) to 12×10^5 CFU ml^{-1} station-2 (Alambadi) and it was observed as 61×10^5 CFU ml^{-1} at (Ootamalai), 41×10^5 CFU ml^{-1} at (Hogenakkal) and 30×10^5 CFU ml^{-1} at (Kothickal) (Table 2).

The correlation coefficient of bacterial populations was compared with the different variables of physicochemical parameters. Station-1 (Biligundu) showed the positive correlation of Sulphate (0.86) at 0.05 level of significant and phosphate (0.99) at 0.01 level of significant.

Bacterial population in station-2 showed the positive correlation with rain fall, turbidity and fluoride (0.87, 0.90, 0.87 respectively) at 0.05 level of significant. In station-3 the rain fall and turbidity showed 1.0 at 0.1 levels of significant. Station-4 (Hogenakkal) showed the positive correlation of total alkalinity 0.99, total hardness 0.99 and conductivity 0.99 at 0.01 level of significance and calcium showed the positive correlation of 0.96 at 0.05 level of significance. Conductivity showed negative correlation of -0.88 at 0.05 level of significance and fluoride showed positive correlation (1.0) at 0.01 levels (Table 3).

Multiple regression analysis for bacterial population showed the degree of relation, whether the variables are independent or dependent among the bacterial populations and the variables. The R^2 value shows 1.0709 at station-2 (Alambadi) is more population compared to S-1, 3, 4 and 5 (Table 4). The multiple linear regression for bacterial population compared with chemical parameters showed variation (Table 5). The model equations were obtained based on computer analysis of data using SPSS package for bacterial population with physical and chemical parameters, in each station.

DISCUSSION

Present results are in good accord with the above observations. It has been reported that most water are alkaline in nature particularly from India (Davis, 1964) which is supported by the work of (Saxena *et al.,* 1996). (Managayarkarasi, 1996) has observed that the pH value fall in a narrow range in river Kaveri. The salinity of the water is variable and is governed by contribution from rock sources of the water in atmospheric precipitation and fall out, and balances between evaporation and precipitation (Wetzel, 1979).

(Murthikrishna and Bharati, 1997) reported increased chloride concentration in river Kali near Dandeli, Karnataka and attributed it to the discharge of domestic and industrial wastes. Moreover, the increase in chloride was accompanied by an increase in ammoniacal nitrogen and organic matter at all the sampling stations. Evidences supporting the above observations are reported in the river kaveri (Mangayarkarasi, 1996). Higher values of chloride can be accounted for the basis of high solubility of chloride through the run-off from catchments area, high rates of evaporation coupled with low level of river water. This has also been supported by other investigators (Rao, 1971; Prasad and Qayyam, 1976).

The reason for low content of sulphate recorded in the present study could be due to the absence of any industrial pollution in the sampling station. Some authors have suggested that the higher sulphate content in the rivers and attributed it to the flushing of these ions into the river from surface runoff. (Qadri *et al.,* 1981). (Somasekhar, 1988) recorded B.O.D values ranging from 1.71 to 38.18 mgL^{-1} in headwater of Kaveri river. Similar studies were also made in other Indian river (Agarwal *et al.,* 1983; Tiwari and Manorama, 1985; Sinha, 1988).

(Mangayarkarasi, 1996) has observed lowest BOD level in the river Kaveri and it has been largely attributed to the discharge of sewage water which in turn accounted for higher amounts of organic matter in domestic sewage. Similar observations have been advanced by other investigators (Paramasivam and Sreenivasan, 1981; Somasekhar, 1985). The above observation reinforces the view of several investigators (Bagde and Verma, 1985; Sengar *et al.,* 1985) and it has been reported that the increase in BOD and bacterial levels has been considered as indicator of increasing pollution which has been further supported by (Sinha, 1988) in his study on river Damodar (Bihar).

CONCLUSION

Increasing pollutants in water is clearly exceeds the permissible limit of chemicals in Kaveri river. Understanding the bacterial population in river water which is helps to improvement of water quality. The river is polluted as it is used as a sewer disposal site, but is also under going self- purification and has potential for significant improvement in water quality if discharges are ameliorated. Regular monitoring of river and taking suitable remedial measures like collection of domestic sewage and setting of the common treatment plant; before discharge of sewage into river system, it should be treated. This will control pollution and prevent the depletion of the quality of river waters.

REFERENCES:

Agarwal JC, Bais VS and Shukla SN. 1983. Organic Carbon: total Nitrogen and Organic Carbon total Phosphorus ratio as the indicator of sewage pollution in the sediment of sagar lake. Poll. Res., 12(3):165-168.

APHA. 1998. Standard methods for the examination of water and waste water American Public Health Association, 20th edn. DC, New York.

APHA. 2005. Standard methods for the examination of water and wastewater analysis 21st Edn; washington. D.C.

Bagde VS and Verma AK. 1985. Proc. Nat. Symp. Pure and Appl Limnology. Adoni(ed). Bull. Bot. soc., 32:16.

Davis SN. 1964. Silica in streams and Groundwater. Amer J. Sci., 870.

Dhanapaul S. 2006. Water borne diseases. Proc. Nat. con. water and waste water management. J.J.Ccollege of Engineering and Technology, Trichy. 31.

Jerald IJA. 1994. Studies on the Limno-Ichthyology of lower Anicut reservoir, Tamil Nadu, South India and Some aspects of biology of minor Carp Puntius Sarana (Hamilton). Ph.D thesis, Bharathidasan University.

Managayarkarasi K. 1996. Kaveri water pollution: A physico-chemical aspect. Ph.D thesis, Baharathidasan University, Tamil Nadu, India.

Murthikrishna and Bharati SG. 1997. A study on concentration of Chloride of the river Kali near Dandeli, Karnataka (India). J.Environ. Poll., 4(1):9-15.

Paramasivam M and Sreenivasan A. 1981. Changes in algal flora due to pollution in Cauvery river. Indian J. Environ Hlth., 23:222.

Prasad DV and Qayyam MA. 1976. Water quality of Cauvery river basin in Tirichirappalli. India. Indian J. Zool., 4:35.

Prescott LM, Harley JP and klevin DA. 1996. Marine and freshwater environments. ENBI 1 Textbook: Microbiology, 3rd edition.

Qadri MY, Showkat AN, Mustafa G and Yosuf AR. 1981. Limnology of two trout stream of Kashmir. J. Indian Inst. Sci., 63:137-141.

Raja P, Muhindhar Amarnath A, Elangovan R and Palanivel M. 2008. Evaluation of physical and chemical parameters of river Kaveri, Tiruchirappalli, Tamil Nadu, India. J. Environ Biol., 29(5):765-768.

Rao VS. 1971. An ecological study of three freshwater ponds of Hyderabad, India. I- The environment. Hydrobio., 38:213-223.

Saxena Kl, Chakrabarthy RN, Khan AQ, Chattopadya SN and Chandra H. 1996. Environ. Hlth., 8:270.

Sengar SS, Joshi DC and Johri SB. 1985. Effect of feeding different levels of protein on nutrient utilization and growth in male buffalo calves. Indian J. Anim. Nutri., 2:27-30.

Shaw BP, Sahu A and Panigrahi AK. 1991. Water quality of the Rushikulya river estuary in relation to waste water discharge from a chloraikate plant. Pollut. Res., 10:139-149.

Singh RK and Singh SP. 1995. Physico-chemical conditions of the river S one at Dalmilanagar (Bihar). J. Fresh water boil., 7:93-98.

Sinha MP. 1988. Effect of waste disposal on water quality of river Damodar in Bihar. Acad. Sci. (Anim. Sci.) 95(3):353-363.

Smitha PG, Smitha K. Byrappa and Ramaswamy SN. 2007. Physico-chemical characteristic of water samples of Bantwal Taluk, South-western Karnataka, India. J.Environ. Biol., 28:591-595.

Somasekhar RK. 1985. Studies on water pollution of river Kaveri. Proc. Nat. symp. Pure and Appl. Liomnology. Bull Bot. Soc. Sagar 32:145-149.

Somasekhar RK. 1988. Ecological studies on the major rivers Karnataka. In: Trivedy, R.K. (ed): Ecology and pollution of Indian rivers. A shish Publishing House. New Delhi. 39-53.

Tiwana AJ. 1992. Water resource manament quality and quality aspects. Proc. Int Con, Rural works and sanitation in developing countries, IWWA, Nagpur, India 6 -17.

Tiwari TN and Manzoor A. 1988. River Pollution in Kathmandu Valley (Nepal) suitability of river water for irrigation. Ind. J. Environ. Protect 8(4):269-274.

Tiwari TN and Monorama M. 1985. A preliminary assignment of water quality Index to major Indian rivers. Ind. J. Environ. Protect, 5:376-279.

Wetzel GR. 1979. In: Gene E. Lickens. (ed.): Limnology analysis: 95W.B. Saunders company.