CCME WATER QUALITY INDEX IN RIVER CAUVERY BASIN AT TALAKADU, SOUTHINDIA

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ABSTRACT: Cauvery a sacred river of South India which is considered as "Dakshina Ganga" for Hindu devotees is also an important source for agriculture and hydropower. The study was carried out to know the Water Quality Index (WQI) of river Cauvery, at Talakadu in Karnataka during Panchalingadarshana festival. WQI was assessed based on physico-chemical parameters using Canadian Council of Ministers of the Environment. WQI was found to be 48.49 which indicated "marginal" value, i.e., frequently impaired and conditions departed from desirable level.Biological Parameters such as Total bacterial count and MPN were found to be higher than normal value. H_2S test was positive indicating fecal contamination. Presence of planktons such as *Synedra ulna*, *Fragillaria biceps* and *Oscillatoria* species confirmed the polluted state of water. The study provided the status of river quality and this can help us to preserve precious water resources by planning and executing for protection, management and/or making lifestyle adaptations for the benefit of the environment.
Key words: Cauvery, CCME, Water quality index

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INTRODUCTION

Rivers are of immense importance geologically, biologically, historically and culturally. They are the source of water, food, transport, and hydropower; but unfortunately now they are the source of deaths due to pollutants and water borne diseases. By dumping millions of tons of sewage, agricultural and industrial wastes, rivers have been encroached, and the crisis for water has resulted. The day is not far for a war on sharing water resources among the countries. In India Rivers are worshipped, religious dips and pooja are performed with a thought of attaining punya and removing karma. Cauvery is one such sacred river of South India and is considered as "Dakshina Ganga" for Hindu devotees. The river is known to take its origin at Talakaveri, Kodagu, in the Western Ghats in Karnataka. Several studies have been reported on the evaluation of physico-chemical parameters, seasonal variations and pathogenic pollutants of Cauvery at different basins [1,2,3,4].

Water Quality Index (WQI) tells us the quality of water based on physical, chemical and biological parameters. Physical parameters include temperature, suspended sediments, turbidity, color, odor; Chemical parameters are pH, dissolved oxygen, biological oxygen demand (BOD), and chemical oxygen demand; Biological constituents include coliforms. Here an attempt was made to study the WQI of Cauvery river basin during religious festival "Panchalingadarshan" in Talakadu, Mysore district, Karnataka. The Canadian Council of Ministers of the Environment (CCME) was used to calculate WQI. CCME in a convenient way summarizes the overall water quality. The index takes the complex scientific information and produces a single number between zero and 100, by normalizing the observed values to subjective rating curves [5,6].

Study area: Talakadu is a small town situated in amidst of sand dunes on the bank of river Cauvery in T. Narasipura taluk, Mysore district, Karnataka. Being known as "Dakshina Kasi" of South, several pilgrims visit during Panchalingadarshan and take a holy dip in the river. Devotees construct "Linga- an idol of Lord Shiva" using sand on the banks and perform pooja. The place being a historic site and an archeological importance attracts several tourists and has become picnic spot. River Cauvery is the source for an extensive irrigation system and for hydroelectric power in this region.

METHODOLOGY

In this study the water sample was collected from the river, prior, during and after the festival for 4 days, with an interval of two days during November 2013. A wide mouthed plastic bottle of one liter size was used for collecting the sample. Water sample was analyzed for physicochemical and biological parameters using standard methods [7, 8]. Biological parameters such as total bacterial count, most probable number (MPN) and H_2S tests were also performed. The latter two tests were carried to detect the presence of coliforms [9] which indicate fecal contamination.Temporary slides were prepared to examine the planktons. The WQI was calculated using CCME index (Table1) based on nine important physicochemical parameters which were tabulated (Table 2).

CCME Water Quality Index

CCME WQI [10] consists of three measures of variance. The "Scope (F1)" represents the extent of water quality guideline noncompliance over the time period of interest. The "Frequency (F2)" represents the percentage of individual tests that do not meet the objectives. The "Amplitude (F3)" represents the amount by which failed tests do not meet their objectives. These three factors combine to produce a value between 0 and 100 that represents the overall water quality (Table 1).

$$F_1 = \left(\frac{\text{Number of failed variables}}{\text{Total number of variables}} \right) \times 100 \quad F_2 = \left(\frac{\text{Number of failed tests}}{\text{Total number of tests}} \right) \times 100$$

Calculation of Excursion: Excursion is the number of times by which an individual concentration is greater than (or less than, when the objective is a minimum) the objective.

$$\text{excursion}_i = \left(\frac{\text{Failed Test Value}_i}{\text{Objective}_j} \right) - 1 \quad \text{excursion}_i = \left(\frac{\text{Objective}_j}{\text{Failed Test Value}_i} \right) - 1$$

Calculation of Normalized Sum of Excursions- 'nse': It is the collective amount by which individual tests are out of compliance. It is calculated by summing the excursions of individual tests from their objectives and dividing by the total number of tests (both those meeting objectives and those not meeting objectives).

$$nse = \frac{\sum_{i=1}^{n} \text{excursion}_i}{\text{Number of tests}} \quad F_3 = \left(\frac{nse}{0.01 nse + 0.01} \right)$$

The WQI is then calculated as:

$$WQI = 100 - \left(\frac{\sqrt{F_1^2 + F_2^2 + F_3^2}}{1.732} \right)$$

The score was then ranked into one of the following five categories represented in Table 1.

Table 1: CCME Water index values

WQI Value	Score	Rank
Excellent	95-100	Water quality is protected with a virtual absence of impairment; conditions are very close to pristine levels
Very Good	89-94	Water quality is protected with a slight presence of impairment; conditions are close to pristine levels
Good	80-88	Water quality is protected with only a minor degree of impairment; conditions rarely depart from desirable levels
Fair	65-79	Water quality is usually protected but occasionally impaired; conditions sometimes depart from desirable levels
Marginal	45-64	Water quality is frequently impaired; conditions often depart from desirable levels
Poor	0-44	Water quality is almost always impaired; conditions usually depart from desirable levels

RESULTS

In the study, Water Quality Index was obtained for parameters (Table 2) such as Total Dissolved Solids, pH, Electrical conductivity, Total Hardness, Total alkalinity, Temperature, Turbidity, Biological Oxygen Demand and Chloride so that the suitability of water quality can be understood well. The WQI was 48.49 i.e., the values range from 45 to 64 and therefore, can be categorized as "marginal". This indicated the water quality was frequently impaired and conditions departed from desirable level.

Total bacterial count was found to be more than 40×10^4. MPN was 110/ml prior to the festival and had exceeded more than 1600 during the festival and 540 MPN/100ml at the end of the festival. H_2S test showed positive, indicating the presence of coliforms and fecal contamination. The common species of phytoplankton which were observed during and immediately after the festival were *Synedra ulna, Fragillaribiceps* and *Oscillatoria*.

Table 2: Physicochemical parameters of Cauvery River at Talakadu.

S. No	Parameters	1st day	2nd day	3rd day	4th day	Objective
1	pH	8.59	7.7	6.63	7.9	8.5
2	Total dissolved solids	173	170	162	142	500
3	Electrical conductivity	359	364	339	350	3000
4	Total hardness	160	140	150	150	600
5	Chloride	28	30	26	28	250
6	Total alkalinity	6.0	5.28	10.16	20	200
7	Biological Oxygen Demand	2.03	2.86	2.04	2.86	5.0
8	Temperature	26	25	26	26	25
9	Turbidity	5.0	3.4	4.2	4.9	5.0

DISCUSSION

The Cauvery river basin has been facing severe anthropogenic activities, mostly due to religious belief, dense population, municipal sewage and industrial waste confluences etc. A huge bacterial gene pool was obtained after the study indicating immense bacterial diversity [11]. As per Sandhya Shrivastava [12] the status of water quality report in India 2009, the water quality of Cauvery River varied widely with respect to DO, BOD, Total Coliform (TC) and Fecal Coliform (FC). Highest BOD of 17mg/l, DO of 1.5mg/l, more than 9200 total coliforms and 5400 of fecal coliforms (MPN/100ml) were observed. Other parameter values were temperature (20-34), pH (6.5-8.9) and conductivity (65-81800). As per water quality criteria for drinking water, water source without conventional treatment but after disinfection, TC- MPN/100ml should be 50 or less, pH 6.5-8.5, DO 6mg/l or more, BOD of 5 days 20° C is 2mg/l or less; on conventional treatment and disinfection TC shall be 500 or less, pH 6.5-8.5, DO 5mg/l or more, BOD 3mg/l or less.

The study indicated BOD, which is one of the prominent indicators of water pollution, was found within the permissible level in the river and coliforms load exceeded than normal value. The presence of *Synedraulna, Fragillaria biceps* and *Oscillatoria* species which are pollution tolerant confirmed the polluted state of water [13].

CONCLUSION

The CCME WQI of Cauvery - 48.49 indicated water level as marginal. The famous holy river Ganga due to spirituality, entertainment, dispenses of agricultural and industrial wastes has deteriorated the water to dangerous levels and has become a major problem for the government to manage and purify. If such condition should not occur in river Cauvery then precautions should be taken to monitor water bodies by anthropogenic activities, agricultural runoff and discharge of untreated municipal sewage. Extra care should be taken to prevent water getting focally polluted during festivals since they can be the source of bacterial diseases. CCME WQI provides information on the quality of water and helps in planning and executing for protection, management and/or making lifestyle adaptations for the benefit of the environment and to preserve the precious water resource.

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