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MICROBIAL STATUS IN RIVER COOUM POLLUTION, CHENNAI, INDIA

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ABSTRACT

The main goal of this study was to access the microbiological quality of water in River Cooum within Chennai city. Microbiological water analysis is mainly based on the concept of fecal indicator bacteria. River water samples were collected from 11 locations among which 10 samples were within Chennai city, during summer season for the year 2011 to access the level of pollution by the discharge of sewage/effluent in the River Cooum. The water samples were analyzed for the bacteriological quality by testing the total bacterial count (TBC) and fecal coliform count (FCC) and also the amount of biologically active nutrients such as nitrogen and phosphorous and their spatial as well as temporal distribution and variability patterns were also evaluated. The report clearly indicates the presence of heavy bacterial load up to 18 x 10^{10} CFU/100ml. This reading fluctuated between the different locations.

Keywords: Microbiological quality, Water Pollution, Cooum River, River Pollution, Nutrient Enrichment.

INTRODUCTION

Water plays a vital role in human life. Providing safe water for drinking and other use, free of pathogens and toxic substances is closely related to the biological and bacteriological quality of water. Fecal contamination of potable water supplies is possible due to entering of untreated or inadequately treated sewage effluent into lakes, rivers or groundwater. The consequence of urbanization and industrialization leads to contaminate the water. Environmental problems are mainly caused due to the deterioration of water quality in the waterways [1]. Due to rapid industrialization and subsequent contamination of surface and ground water sources, water conservation and water quality management has nowadays assumed a very complex shape [2]. Biological monitoring of river quality has grown in importance over the past few decades due to the recognition of important advantages over chemical monitoring [3]. Similar reports have identified eutrophication due to nutrient enrichment as a priority environmental issue in waterways.

The characteristics required for an indicator organism chosen to indicate faecal pollution are easy to detect ability, origin exclusively in human faeces, abundance in excreta exceeding that of the pathogens, no possibility of multiplication in the water environment, greater resistance to treatment (disinfection) than the pathogens. The indicator organisms most commonly used belong to coliform group of bacteria.

Cooum River originates from Cooum tank which is situated about 65 km west of Chennai City and runs through the heart of the Chennai city for a length of 17.98 Km and joins Bay of Bengal. Cooum River enters in City limit near Padikuppam causeway and runs up to sea mouth below Napier Bridge for a length of 18 Km. The Cooum River serves as drainage and sewerage carrier within the Chennai city limit. The river once a source of drinking water gets polluted due the domestic sewage and industrial outfalls into the river. Due to rapid growth of Chennai city and its suburbs and also due to population growth the river is highly deteriorated in every aspect. Industries discharge variety of pollutants like heavy metals, organic toxins, oil, nutrients and solids.

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MATERIALS AND METHODS

Study area

The length of the river is about 65 km, of which 18 km; fall within the Chennai city limits. The study area lies between latitude 13°4′5.18″ north and longitude 80°17′9.06″ east. Eleven stations were chosen for the collection of water samples within the City limit. Experiments were carried out for the water samples collected during the summer season for the year 2011. A study area map comprising the points of sampling location is given in Figure 1 with the sampling stations in Table 1.

Sampling Method

One liter of water samples were collected using acid washed polypropylene containers from the centre of the bridge in the river and preserved as per the standard methods prescribed by APHA (1989).The water samples were analyzed for microbiological parameters and the nutrients such as Nitrogen and phosphates based on the procedures described in APHA, AWWA and WPCF (1998) and other literatures collected for this study.

RESULTS AND DISCUSSION

Microbial quality

Total coliform counts of the water samples showed values ranging from $9.68x10^{7}$and $5.84x10^{10}$ CFU/100ml, and the fecal coliforms were found in the range of $6.85x10^{7}$and $1.08x10^{10}$ CFU/100ml, wherein the prescribed limit is Nil [4].

In the case of Cooum River the city entry point Koyambed itself was loaded with heavy coliform counts, this may due to the illegal discharge of waste water and untreated sewage water and the other reason may be due to open defecations in the two sides of the river bank. It was found to be maximum in the College Road Bridge and minimum in the Napier Bridge, which may be due to the sea water intrusion in the Cooum River mouth. The variation of total coliform and fecal coliform is shown in the figure 3.

Nutrients

The major forms of the nitrogen occurring in river water are the nitrate, nitrite and ammonium. As the river passes through the city and with the increasing sewage outfalls and other industrial effluents, the nitrite content in the river increases [5].

The mean value of nitrate and the ammonium concentrations varied between 2 and 12.36: 5.92 and 36.01 respectively. The concentration of Ammoniacal Nitrogen was high throughout the river course. The sewage disposal into the river contributing to the nitrate is higher near the Napier Bridge. The corresponding ammonium concentration in these regions was also found to be high. Among the nutrients, the ammonium concentration was found to be high, which is the most reduced form of nitrogen indicating the reducing conditions that exist in the surface waters.

Figure 1. Geographical Study Area

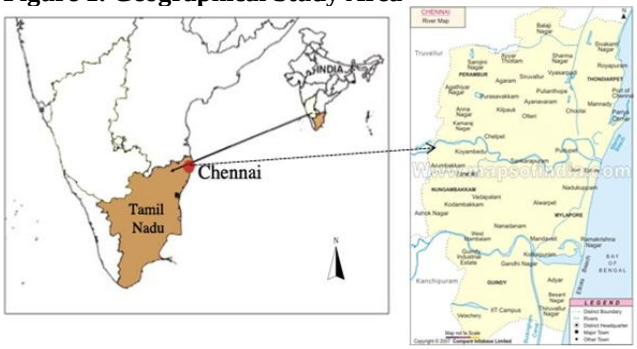

Figure 2. Map highlighting the sampling locations within Chennai city

Figure 3. Variation of Total coliforms and Fecal coliforms in Cooum River water

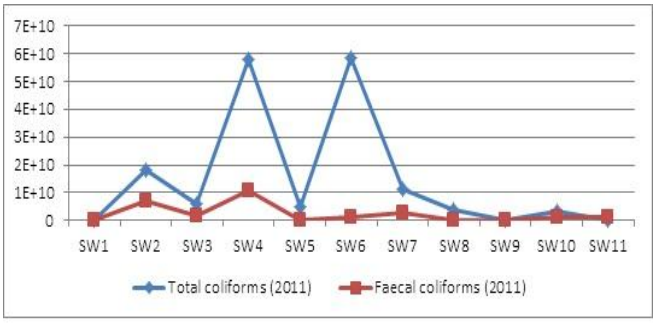

Figure 4. Variation of Nutrients in the Cooum river water

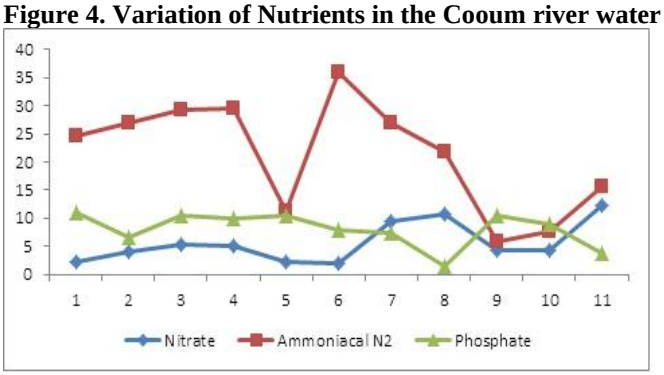

Figure 5. Spatial Variation of Ammoniacal Nitrogen in the Cooum river water

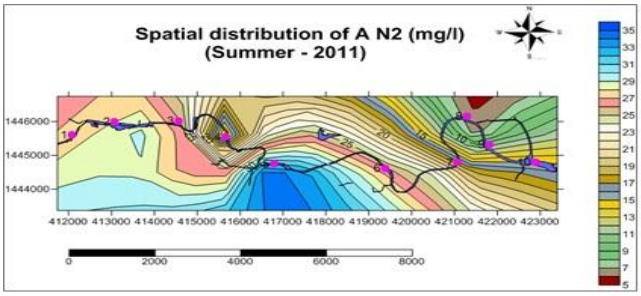

Figure 6. Spatial Variation of Nitrate in the Cooum river water

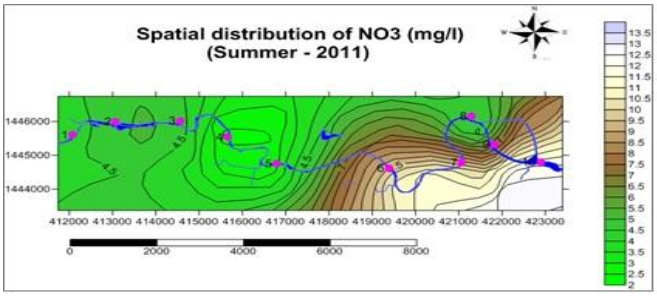

Figure 7. Spatial Variation of Phosphate in the Cooum river water

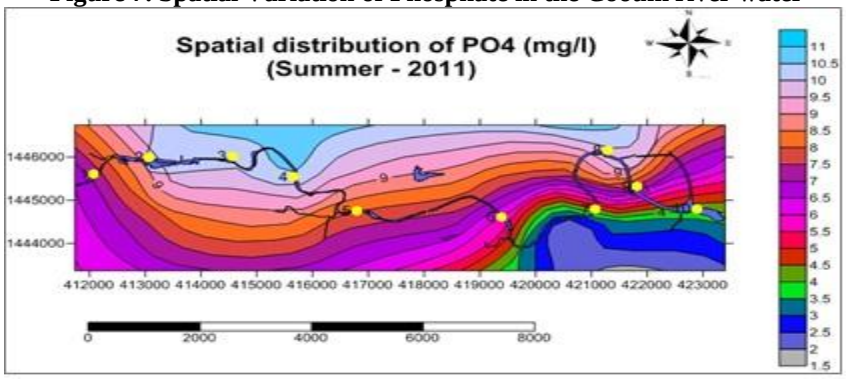

Table 1. Details of the sampling stations

Sample ID	Sampling location
SW1	Perambakkam bridge
SW2	Koyambed bridge
SW3	Anna Nagar bridge
SW4	Aminjikarai bridge
SW5	Choolaimedu bridge
SW6	College road bridge
SW7	Harries bridge
SW8	Coolaws bridge
SW9	Periar bridge
SW10	Quaid-E-Millath bridge
SW11	Napier bridge

CONCLUSION

The bacteriological examination for the river water clearly reveals that there is a high bacterial pollution. This may lead to the water born disease if the water is used for the human consumption. In total the water is very salty and also contains faecal streptococci and the coliform bacterial population [6,7].The people living on the banks of the river are more prone to infectious diseases. The eutrophication inside the river leads to the spreading of disease causing mosquitoes and other pathogens. All the values illustrated varying degrees of nutrient enrichment beyond guideline values. These were generally related to increasingly intensive land use effects, and were illustrated by increased nitrogen concentrations, phosphorus concentrations or both. The degradation arises from both point sources and non-point sources. The results show that the bacteriological quality of the Cooum river water posed an increasing risk of infectious disease transmission to the communities. The river water quality is decreasing due to industrialization, sewage system malfunctions, overcrowding and poor sanitation. The faecal contamination of the river needs to be continually monitored and tested.The counts fluctuating trend in the Total coliform counts was also observed in the faecal coliform**.** Mean faecal and total coliform counts throughout the study period were generally very high. According to the standard guidelines, the bacteriological quality of Cooum river water posed an increased risk of infectious disease transmission to the communities living along the banks of the river.

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