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PHOSPHATE CONTAMINATION AND TOXIC CYANOBACTERIAL BIOMASS IN THE EUTROPHICATED SURFACE WATER OF RIVER TAPI

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ABSTRACT

Background: Surat city in the western state of Gujarat in India completely relies on the supply of surface water from river Tapi. Tapi is heavily eutrophicated like many rivers of tropical region of the world. Presence of toxin producing cyanobacteria might be a concern for the public health using water supply from the river. **Materials and Methods:** Present study has analyzed presence and seasonal variation of phosphate as an indicator of nutrient contamination in river water. Diversity of cyanobacteria was studied by microscopy and chlorophyll-a was estimated spectrophotometric technique indicating cyanobacterial biomass. **Results and Discussion:** A seasonal increase in phosphate concentration (mg/dm^3) was observed in Tapi water that resulted in the increase of chlorophyll-a concentration indicating increase in cyanobacterial biomass. Cyanobacterial genera were identified by microscopy, possibly producing hepatotoxins. **Conclusion:** A strong positive proportionate correlation exists between increase in nutrients such as phosphate contamination and harmful cyanobacterial bloom in Tapi. Presence of toxin producing cyanobacteria in surface water is an important issue that requires further investigation.

KEYWORDS: Tapi River, Cyanobacteria, Phosphate, Chlorophyll-a, Hepatotoxins.

INTRODUCTION

The city of Surat is located on the banks of river Tapi in the western state of Gujarat in India. The city has a population of 4.66 million as per the Census, 2011. The Surat municipal

corporation operates four different water works with the cumulative capacity of 1300 M.L.D. to fulfill the demand of clean water. All these water works use surface water from river Tapi. Construction of a weir created a reservoir augmenting this source of surface water. Eutrophication is a common nuisance in tropical water bodies due to nutrient contamination.[1] Cyanobacteria producing hepatotoxins are a major apprehension related to river eutrophication.[2,3] Persistent presence of toxic species of cyanobacteria may pose a health hazard even in treated drinking water if it is acquired from such river water.

MATERIALS AND METHODS

Four specimen sites were selected near the intake wells of four major water works namely Rander (A), Katargam (B), Varachha (C) and Sarthana (D) in river Tapi of Surat city (Fig. 1).

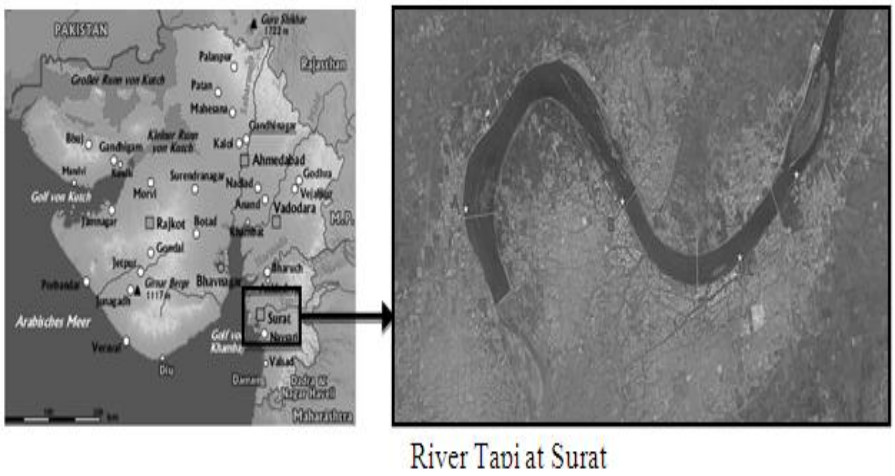

Fig. 1: Location of sampling sites across River Tapi

Samples were collected by WHO guidelines in prescribed containers by standard grab method.[4] Samples were analyzed within 2 hours for microscopic identification.

The diversity of cyanobacteria at the genus level was studied using standard bright field microscopy at the magnification of 400×. Identification was carried out with the help of Anagnostidis guidelines.[5] Orthophosphate content of samples was determined as a major nutrient contaminant of water using standard vanadomolybdophosphoric acid colorimetric method.[6]

Quantification methods for cyanobacteria are difficult to standardize due to the presence of filamentous and colony-forming species. Estimation of chlorophyll-a is a widely used and accepted indirect measure of cyanobacterial biomass despite of minute variation in pigment

content.[7] Spectrophotometric estimation of chlorophyll-a was carried out after organic solvent extraction as per ISO method.[8]

RESULTS AND DISCUSSION

Monthly samples were compared for their phosphate and cyanobacterial biomass content to assess seasonal variation in Tapi water. Results suggest that chlorophyll-a levels peak up in late summer and before monsoon season (Fig. 2), especially in April (Fig. 3). Further, out of the collected four water works samples, Varachha-the northeast part of the city (upstream river area) was found to have maximum values of chlorophyll-a (2.67 mg/m^3) (Fig. 2). The lower values of chlorophyll-a in the downstream region might be due to the estuarine region of river.

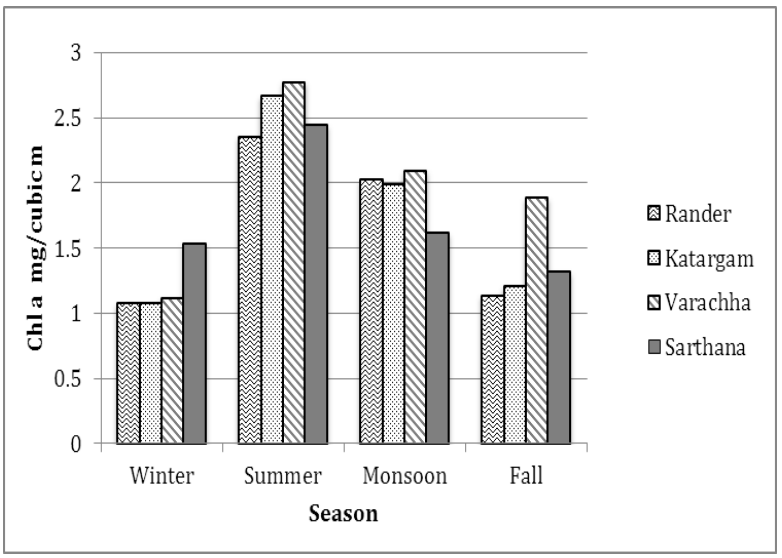

Fig. 2: Seasonal variation in Chlorophyll-a concentration

On microscopy of samples, it was observed that four genera *Oscillatoria*, *Microcystis*, *Planktothrix* and *Cylindrospermopsis* predominated the phototrophic diversity of river water. These cyanobacteria were known to produce hepatotoxins.

As observed in Fig. 3, phosphate contamination in water is the major cause for formation of cyanobacterial blooms. There is a strong correlation between seasonal variation in the concentrations of phosphate and chlorophyll-a.

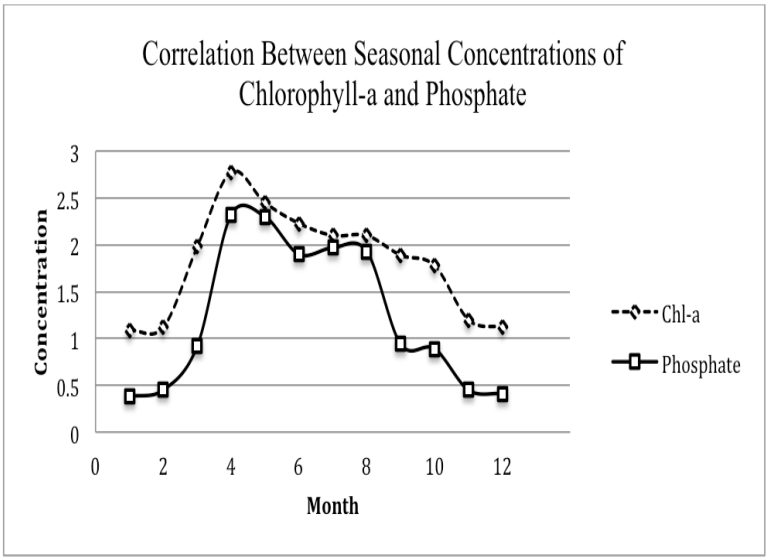

Fig. 3 Correlation between seasonal concentrations of Phosphate and Chlorophyll-a

It is clearly evident that season and ambient temperature have stimulatory effect on the cyanobacterial biomass (Fig. 3). The cyanobacterial biomass as measured in terms of chlorophyll-a increased to maximum in the month of April (month 4) and remained considerably high up to June (month 6). With advance of monsoon, it gradually decreases due to mixing with estuarine water and dilution. At the onset of winter, a major reduction in chlorophyll-a concentration is observed. These results were analogous with other similar studies on the global tropical water bodies.[9,10,11]

CONCLUSION

Monthly study of phosphate and chlorophyll-a concentrations establish a strong correlation between nutrient contamination and resulting eutrophication in the river. Both of these values peak late in summer before monsoon. Microscopic identification of cyanobacteria suggests presence of previously known hepatotoxin-producing species in river that may pose public health hazard. Being heavily reliant on the surface water as a source of domestic water supply, presence of cyanobacterial toxins is a major concern for Surat city. This demands further studies on cyanobacterial toxins in the river water.

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