ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 10, Issue, 04(F), pp. 32000-32003, April, 2019

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

BACTERIOLOGICAL AND PHYSICO-CHEMICAL ASSESSMENT OF TAPI RIVER, SURAT, GUJARAT

Kinjal Sangani* and Kapila Manoj

Department of Aquatic Biology, Veer Narmad South Gujarat University, Surat, Gujarat, India

DOI: http://dx.doi.org/10.24327/ijrsr.2019.1004.3379

ARTICLE INFO

Article History:
Received 06th January, 2019
Received in revised form 14th February, 2019
Accepted 23rd March, 2019
Published online 28th April, 2019

Key Words:

Water quality, bacteriological, physico-chemical, pathogens, Tapi River

ABSTRACT

Bacteriological and physico-chemical quality of Tapi River was assessed in order to determine seasonal and spatial variations. Samples collected from three different sampling sites along the Tapi River bank were analyzed for physico-chemical parameters viz., Temperature, pH, DO, BOD, Nitrate, Phosphate, Ammonia and Bacteriological parameters viz., Total Viable Count and presence of selected pathogens. Moderate temperature, alkaline pH, decreased DO and increased BOD and other nutrients as well as higher bacterial load at downstream sites were the common observations throughout the study period. Seasonal variations in all the parameters were observed. Water quality was found poor during summer comparatively. Frequent presence of potential pathogens at all three sites indicates the risk of infection and health issues and therefore it is a matter of concern.

INTRODUCTION

Rivers in urban areas are normally used to provide people with freshwater (Zhang *et al*, 2012). They are also the main source of water for agricultural and industrial purposes (Kenzaka *et al*, 2001). However, Surface waters in urban areas are exposed to high concentrations of nutrients, particularly as a result of anthropogenic activities, sewage and domestic discharge as well as industrial discharges. Nitrogen and phosphorus are the nutrients that show the greatest enrichment of concentrations and have excessive concentrations of nitrogen and phosphorous leading to extensive eutrophication and poor water quality respectively (Cherry *et al*, 2008). Many authors have reported that Indian river systems are polluted mainly because of human interference ((Borade, *et al*, 2014; Shanmugam, *et al*, 2016; Sangani and Manoj, 2017). Deliberating the importance and vulnaribility of ecosystems, regular monitoring of the quality of water and pollution status of water bodies is esential.

Tapi River has considerable importance in economic growth and development of Surat city. Tapi river when passes through surat city, various anthropogenic activities affects the water quality and puts pressure on ecology and shape the microbiology of the river ecosystem. Moreover, seasonal as well as spatial variations affect the quality of water. So the main aim of the study was to monitor the physico-chemical and bacteriological parameters of Tapi river water.

MATERIAL AND METHODS

The water samples were collected from three different sites along the stretch of Tapi River at Surat, Gujarat during March'2016 to February'2017 at monthly intervals. Sampling sites were selected based on the sources of pollution. Galteshwar was selected as reference site (Freshwater Zone, up-stream, less disturbances) and Utran (Freshwater Zone, Inlet of domestic sewage, anthropogenic pollution) and Ashwanikumar (Freshwater Zone, Inlet of domestic sewage, Anthropogenic pollution and cremation ground drainage) were selected as test sites (Figure-1).

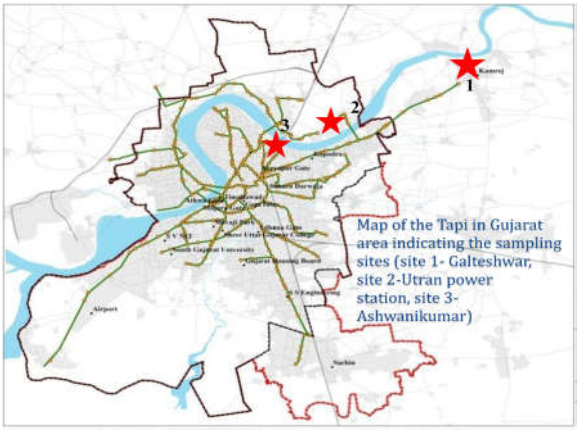


Figure 1 Map of Tapi River indicating Sampling Sites

Corresponding author:* **Kinjal Sangani
Department of Aquatic Biology, Veer Narmad South Gujarat University, Surat, Gujarat, India

The samples collected in sterile containers were transported to laboratory for analysis/estimation of physico-chemical parameters viz. Dissolved Oxygen, BOD, Nitrate, Phosphate and Ammonia using standard methods of APHA (2005) and Trivedy and Goel, (1986). pH and Temperature were recorded and dissolved oxygen was fixed at the site itself. Bacteriological analysis in term of Total Viable count and presence of pathogenic bacteria was carried out using standard methods of APHA (2005) and *Bergey's Manual of Determinative Bacteriology* (Holt *et al*, 1994). Water samples were screened for presence of pathogens namely *E.coli, Salmonella typhi, Salmonella paratyphi, Shigella sp., Vibrio cholerae* and *Klebsiella pneumonniae.*

RESULTS AND DISCUSSION

Monthly variations in Physico-chemical and bacteriological parameters are graphically represented. The seasonal averages of physico-chemical and microbiological parameters is tabulated in Table-1. Water samples were checked for presence of pathogens and seasonal distribution of them is furnished in Table-2.

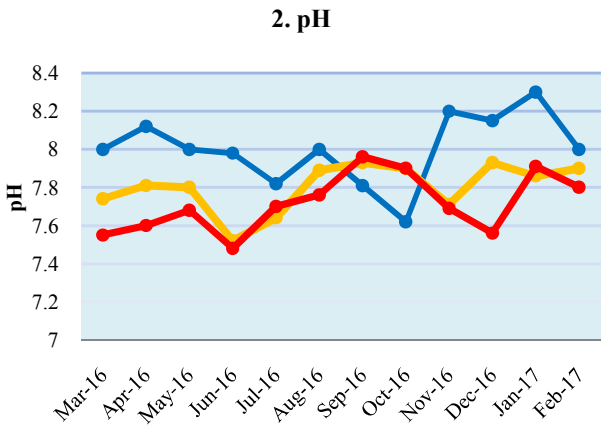
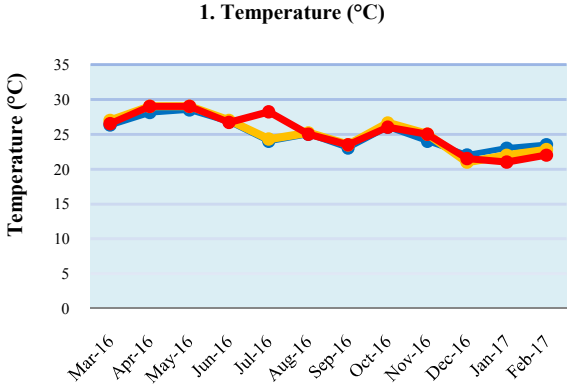


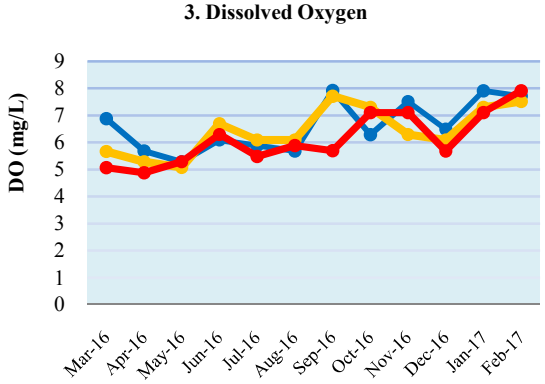
Table 1 Seasonal Averages of water quality parameters of Tapi River at different Sites

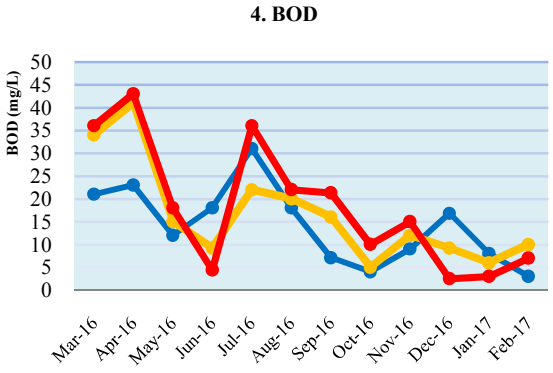
Parameters	G			U			AK		
	summer	Monsoon	Winter	summer	Monsoon	winter	Summer	monsoon	winter
Temperature (ºC)	27.425	24.5	23.125	28	24.9	22.7	27.8	25.675	22.375
pH	8.025	7.8125	8.1625	7.7175	7.84	7.85	7.5775	7.83	7.74
DO (mg/L)	5.9725	6.4325	7.395	5.665	6.7875	6.7875	5.365	6.0275	6.9375
BOD(mg/L)	18.5	15.025	9.2	24.8	15.75	9.3	25.35	22.325	6.875
Nitrate(mg/L)	2.2185	1.317	2.0935	3.15275	3.397	3.21725	2.609	4.17375	4.991
Ammonia(mg/L)	0.28875	0.04225	0.01525	0.7795	0.547	0.83825	0.662	0.18125	0.6355
Phosphate(mg/L)	0.10425	0.07525	0.04475	0.177	0.162	0.435	0.16875	0.2445	0.2915
TVC (cfu/ml)	4.6×10^5	3.1×10^5	3.6×10^5	7.3×10^5	7.0×10^5	6.9×10^5	10.4×10^5	8.1×10^5	9.3×10^5

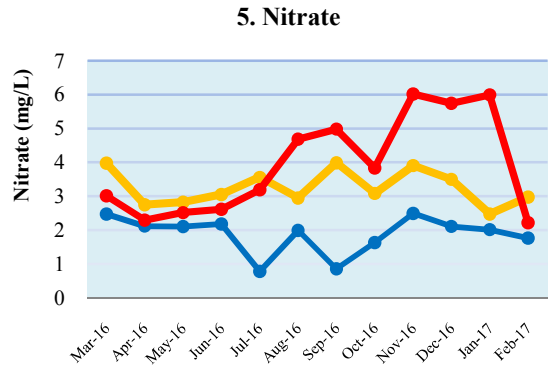
G: Galteshwer, U: Utran, AK: Ashwanikumar

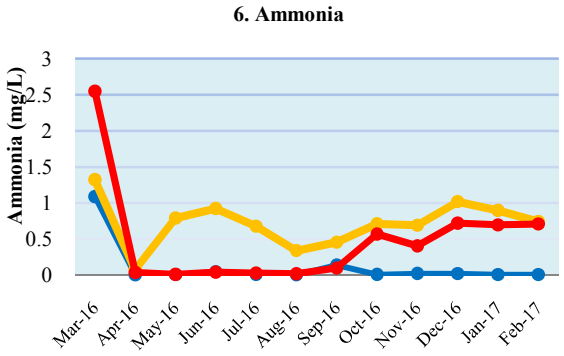
Slightly alkaline pH and moderate temperature were recorded during study period. Seasonal fluctuations in temperature were observed. Little variations in pH indicates high buffering capacity of river ecosystem. Dissolved Oxygen was recorded lowest during summer period and highest during winter at all three sites. Concentration of DO was decreased at downstream site as compared to upstream. BOD was observed to be increase at downstream with higher BOD in summer and lowest in winter season. Concentration of nutrients was recorded higher in summer which indicates poor water quality.

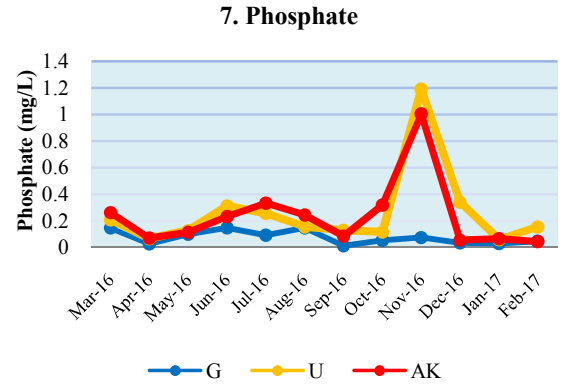


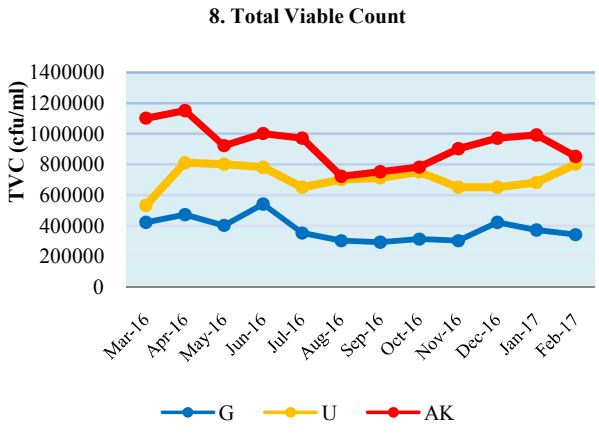












Graph 1-8 shows monthly variations in physico-chemical and bacterial parameters of River water (1-Temperature, 2-pH, 3-DO, 4-BOD, 5-Nitrate, 6-Ammonia, 7-Phosphate, 8-TVC)

Values of TVC indicates higher bacterial load at downstream sites. Water samples at Ashwanikumar site observed to have highest bacterial load (Table-1) which attributes to the number of human activities as well as rituals take place on the bank of river, domestic sewage discharge etc. similar results were observed by Sangani and Manoj (2015) where pre-monsoon, monsoon and post-monsoon variations in water quality of Tapi river were studied. Highest bacterial load at all three sites was recorded during summer whereas lowest during monsoon which can be due to dilution of river water by rain as well as increased water flow. Higher concentration of Phosphate and Nitrate at the downstream stretch may be responsible for the higher bacterial load.

Table 2 Seasonal distribution of Bacterial Pathogens

Pathogens	Summer			Monsoon			Winter		
	G	U	AK	G	U	AK	G	U	AK
Escherichia coli	++++	++++	++++	++	+++	++++	+++	+++	++++
Shigella sp.	+++	++	+++	++	++	++	+++	++	+++
Salmonella typhi	++	++	++	+	+	+	AB	++	AB
Salmonella paratyphi	+	++	+	+++	+++	+++	AB	AB	AB
Vibrio cholerae	+++	++	+++	AB	+++ +	++	++	++	+++
Klebsiella pneumonniae	+	++	+	++	+	++	AB	+	AB

Presence of pathogens in river water makes the water unsuitable for drinking purpose and domestic use. It can also affect the fishes and other faunal communities and ultimately affects the health of those rural communities which depend upon river for food and water. While most strains of *E. coli* inhabiting human and animal intestines are harmless, commensally bacteria, a small percentage can cause disease in humans. Shigellosis cause by *Shigella sp.* remains a common gastrointestinal disease in developing and industrialized countries (Mead *et al*, 1999). *Salmonella sp.* is of concern due to its pathogenicity which is of global importance and transmitted mainly through water and food. *V. cholerae* is the most important to study in concern of public health as it is the causal agent of cholera and infection of *V. cholerae* causes watery diarrhea and vomiting, which combine to cause potentially lethal rapid and severe dehydration (Percival *et al*, 2004). Outbreak of such pathogens can affect the large urban communities. Considering this, continuous monitoring and maintenance of water quality is recommended.

CONCLUSION

Higher bacterial load, pollution and human interference affect the water quality at downstream sites of Tapi River. Frequent distribution of pathogens is a matter of concern and further studies on water treatment methods, technology development are need to be developed in such a way that they can be widely approachable to public.

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How to cite this article:

Kinjal Sangani and Kapila Manoj., 2019,Bacteriological and Physico-Chemical Assessment of Tapi river, Surat, Gujarat. *Int J Recent Sci Res.* 10(04), pp. 32000-32003. DOI: http://dx.doi.org/10.24327/ijrsr.2019.1004.3379

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