

Assessment of Water Quality and Sources of Pollution in Downstream of Ukai, Tapi River (Gujarat)

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ABSTRACT

In the present paper an attempt has been made to study of physico-chemical parameters of downstream in Ukai, Tapi River (Gujarat). For this study the water samples were collected at monthly interval during December 2012 to November 2013 and important water quality parameters were analyzed. Study revealed that temperature, pH, conductivity, dissolved oxygen, chemical oxygen demand, nitrate-n, total hardness, fluoride, chloride, total alkalinity and sodium were within the permissible limits whereas turbidity, biological oxygen demand, nitrite-n ammonia, phosphate and potassium were beyond the permissible limits of state, national and international authorities like GPCB, CPCB WHO and USEPA. These result depicted that water body was polluted in the form of nutrient enrichment which is due to agricultural activities and its runoff in and around catchment area of downstream.

Key words: Downstream, Ukai, Tapi River, Water quality and Pollution sources.

INTRODUCTION

The quality of water is a sensitive issue and it is affected by natural as well as anthropogenic processes. Increasing consumption and natural processes such as changes in precipitation inputs, erosion and weathering of crustal materials degrade surface water and impair their uses for drinking, industrial, agricultural and other purposes¹. The river water is contributed directly or indirectly for human welfare and aquatic ecosystem² it is highly vulnerable to pollution and now reached to point of crisis due to unplanned urbanization and rapid growth of industrialization. Therefore, it is important to assess the water quality and monitor the water pollution in rivers³ which help to control and conserve the aquatic resources. The water quality parameters were studied in Cauvery river (Karnataka)⁴, river Devaha (Uttara Pradesh)⁵, Chambal river (Rajasthan)⁶, Arasalar river (Tamil Nadu)⁷, Kolong river (Assam)⁸, Satluj river (Punjab)⁹, Yamuna river¹⁰ and in Tapi river¹¹ and reported the pollution status. The objective

of the present study is to assessment of the water quality and source of pollution in downstream of Ukai, Tapi River (Gujarat).

MATHODOLOGY

Study area

This study was carried out at downstream of Ukai, Tapi River (Fig. 1) which is situated on 21° 16' 21.93" N Latitude and 73° 21' 21.553" E Longitude on the southern bank of Tapi River, which is about 90 km from Surat city in the southern region of Gujarat State.

Sample analysis

The water samples were collected from downstream of Ukai, Tapi River (Fig. 1) during December 2012 to November 2013 and these water samples were subjected to filter for analysis. Although, water quality parameters including temperature, pH and dissolved oxygen were analysed *in situ* whereas for remaining parameters

(turbidity, conductivity, BOD, COD, nitrate-N, nitrite-N, ammonia, total hardness, fluoride, chloride, total alkalinity, phosphate, sodium and potassium) water samples were preserved and transported to Research Laboratory, Department of Aquatic Biology, Veer Narmad South Gujarat University, Surat. For the preservation and analysis of the water samples the standard methods^{12,13} were followed.

RESULT AND DISCUSSION

Water quality provide the primary assessment of the pollution status and it can be determined through assessment of water quality parameters. The results of present study on water quality parameters are described in table 1.

Temperature may less important in pure water because of the wide range of temperature tolerance in aquatic life while in polluted water it can effects on dissolution of gases and biological process in aquatic ecosystem. In present study, it was minimum 18.000 °C during January and maximum 25.000 °C during June while it was average 21.417 ± 0.633 °C during the study and it was very low than the maximum permissible limit of WHO¹⁵. The river temperature generally depends on the season, geographic location, sampling time and effluents entering the stream^{11,14}.

Turbidity of water is caused by suspended material such as sand, silt, clay, phytoplankton, microorganism or organic material which influences

the light penetration. In downstream of Ukai of Tapi River turbidity was observed (15.000 - 41.500 NTU) with average 23.842 ± 2.380 NTU. These results were compared with maximum prescribed limits (10 NTU) of WHO¹⁵ and found significantly high that indicate of presence of pollution in studied area¹⁰.

pH is an important factor that determines the suitability of water for various purposes. In the present study, it was found faintly alkaline (7.700 - 8.610) with average value 8.269 ± 0.078 was low than maximum permissible limit of WHO¹⁵. Similar finding describe that fluctuation in pH due to microbial activity and increase in primary productivity¹⁶.

Conductivity is a measure of the ability to carry an electric current of an aqueous solution. High values of electrical conductance are the products of decomposition and mineralization of organic materials¹⁷. In the present investigation it was range (0.200 - 0.800 ms) with the average value (0.292 ± 0.050) ms was comparatively low maximum permissible limit of WHO¹⁵. The results of present investigation were also verified from the results of Cauvery river (Karnataka)⁴.

Dissolved oxygen (DO) is one of the most important water quality factors of aquatic environment health and its depletion is directly affects the river ecosystem. During the present investigation it fluctuated from 1.20 to 7.20 mg/l with the average value of 4.950 ± 0.494 which were comparatively low than maximum prescribed limits



Fig. 1: Map of study area

of WHO¹⁵. The natural turbulence and higher primary productivity which produces O₂ by photosynthesis and active utilization in bacterial decomposition of organic matter¹⁸.

Biological oxygen demand (BOD) is the measurement of oxygen in water which required by the aerobic organisms. Biodegradation of organic matters exerts oxygen tension in the water and increases the biochemical oxygen demand¹⁷. The BOD was ranged 2.00 to 7.20 mg/l with the mean value 5.450±0.389 mg/l was observed in present study. The results of current study were compared to maximum permissible limits (2.000 mg/l) of CPCB¹⁹ and found high which is sign of pollution in aquatic ecosystem⁹.

Chemical oxygen demand (COD) is used to measure the amount of organic compounds in water and it is used as indicator of pollution in surface water^{20,21}. The low value (16.000 mg/l) of COD noted in the Month of December and high value (232.000 mg/l) in September which show the variation in COD throughout the study period and the average value of COD was 79.500±20.791 mg/l which was very

than limits of GPCB²⁵ The of present investigation was evidenced in Kolong river⁸.

Nitrate-N is an essential plant nutrient and also a good indicator of contamination by natural and human activities. It was observed 0.019 to 1.360 mg/l with mean value of 0.529 ±0.146 mg/l were observed comparatively low than the limits of USEPA²⁶ and similar finding were also reported Ganga river (Ghazipur)²².

Nitrite-N is the intermediate in the conversion of ammonia in to nitrates through the process of nitrification and de-nitrification by bacteria. The result shows that nitrite contents were varied from 0.00 to 0.932 mg/l with average value 0.330±0.095 mg/l were observed comparatively low than the limits of USEPA²⁶ and result were supported by the study conducted in Moirang rivar²³.

Ammonia is produced by ammonification of organic matter. The occurrence of ammonia in the waters can be accepted as the chemical evidence of organic pollution¹². The range of ammonia was observed 0.00-1.676mg/l with average 0.611±0.129

Table 1: Water quality parameters at downstream of Ukai, Tapi River

S.N.	Parameters	Units	MPL	Minimum	Maximum	Mean ± SE
1.	Temperature	°C	35 ¹⁵	18.000	25.000	21.417±0.633
2.	Turbidity	NTU	10 ¹⁵	15.000	41.500	23.842±2.380
3.	pH		8.5 ¹⁵	7.700	8.610	8.269±0.078
4.	Conductivity	ms	1 ¹⁵	0.200	0.800	0.292±0.050
5.	Dissolve Oxygen	mg/l	7 ¹⁵	1.200	7.200	4.950±0.494
6.	BOD	mg/l	2 ¹⁹	2.000	7.200	5.450±0.389
7.	COD	mg/l	250 ²⁶	16.000	232.000	79.500±20.791
8.	Nitrate-n	mg/l	9 ²⁷	0.019	1.360	0.529±0.146
9.	Nitrite-n	mg/l	0.3 ²⁷	0.000	0.932	0.330±0.095
10.	Ammonia	mg/l	0.1 ¹⁵	0.000	1.676	0.611±0.129
11.	Total Hardness	mg/l	500 ¹⁵	100.000	202.000	137.667±10.562
12.	Fluoride	mg/l	1.5 ¹⁵	0.010	0.030	0.019±0.002
13.	Chloride	mg/l	250 ¹⁵	22.999	64.998	36.082±4.040
14.	Total alkalinity	mg/l	600 ¹⁵	28.000	112.000	77.667±5.757
15.	Phosphate	mg/l	0.1 ¹⁵	0.000	0.966	0.674±0.075
16.	Sodium	mg/l	200 ¹⁵	8.800	50.000	20.588±3.476
17.	Potassium	mg/l	50 ¹⁵	39.000	98.000	56.500±5.171

MPL= maximum permissible limits, SE = standard error, 15= WHO, 19= CPCB and 26= GPCB, 27= USEPA

mg/l which is comparatively high than the MPL (0.1 mg/l) of CPCB¹⁵ and results were supported by Annalakshmi and Amsath⁷.

Total hardness of water is an important consideration for suitability of water for domestic and industrial uses. In the present study, the mean value of total hardness was 137.667 ± 10.562 mg/l and it was minimum (100.00 mg/l) during May due to reduced inflow and higher evaporation while it was maximum (202.00 mg/l) during the month of August that may be due to increasing inflow and dilution at rainy season¹¹.

Fluoride concentration is directly not indicating the pollution while human health and aquatic life is adversely affected by the presence of it. In the present investigation fluoride concentration was minimum (0.01 mg/l) in July and maximum 0.03 mg/l was in January with average value of 0.019 ± 0.002 mg/l. which is within the permissible limit 1.5 mg/l of WHO¹⁵.

Chlorides occur naturally in all waters and its high concentration considered as the indicator of pollution which troublesome in irrigation water and harmful to aquatic life²⁴. In present observation chloride content was fluctuated from 22.999 to 64.998 mg/l with the mean value of 36.082 ± 4.040 mg/l which was significantly very low than limits of WHO¹⁵ and results were referred by the findings of Chambal river⁶.

Total Alkalinity itself not harmful for human beings¹² moreover the value of alkalinity provides idea of natural salts present in water²⁵. In this study period minimum (28.000 mg/l) were recorded during September and maximum (112.000 mg/l) in June with the mean value 77.667 ± 5.757 mg/l and comparatively it was not exceed the MPL of the WHO¹⁵.

Phosphate occurs most commonly either as orthophosphates or as polyphosphates.

Orthophosphate is form that immediately available to aquatic biota. The result shows that it was ranged from 0.000 to 0.966 mg/l and the average value was 0.674 ± 0.075 mg/l during the study which is significantly high than recommendations of WHO¹⁵. It might be due to over use of fertilizer in agricultural field as described in Cauvery river⁴.

Sodium and potassium are the most important minerals occurring naturally. In present study, sodium and potassium concentration was varied from 8.80 to 50.00 mg/l and 39.00 - 98.00 mg/l respectively. The average value of sodium (20.588 ± 3.476 mg/l) and potassium (56.500 ± 5.171 mg/l) were also calculated. The potassium contents were found comparatively high than the maximum permissible limits (50.00 mg/l) of WHO¹⁵ and results was verified from the findings of river Devaha (UP)⁵.

CONCLUSION

The present study conclude that physico-chemical parameters temperature, pH, conductivity, dissolved oxygen, chemical oxygen demand, nitrate-n, total hardness, fluoride, chloride, total alkalinity and sodium were within the permissible limits whereas turbidity, biological oxygen demand, nitrite-n ammonia, phosphate and potassium were beyond the permissible limits of state, national and international authorities like Gujarat Pollution Control Board, Central Pollution Control Board, World Health Organisation and United States Environmental Protection Agency.

The result revealed that water of downstream of Ukai, Tapi River is polluted due to presence of plant nutrient like N, P and K that might be accumulated from agricultural activities and its runoff in and around catchment area of downstream of Ukai, Tapi River.

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