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ASSESSMENT OF WATER QUALITY OF KIM RIVER, GUJARAT, INDIA

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ABSTRACT

Availability of fresh water is a challenge in the current world and with increase in pollution, erratic climatic conditions has worsened the situation. Gujarat being a semi arid state of India has fresh water resources in form of rivers, ponds, lakes, that is in pressure due to industrialization and urbanizations. To understand the level of water degradation, the present paper deals with physico-chemical analysis of Kim River of Gujarat. The standard methods were followed for the quantification of various physical and chemical characteristics of the water. The paper discusses the behavior of the river is two seasons viz., summer and winters. The results indicate that the quality of river water is in good condition in winter as compared to summers with high TDS, DO, BOD levels. Reduced fresh water flow during summers accompanied with discharge of industrial effluents lead to poor water quality during summers.

KEYWORDS-Biological oxygen demand, Correlation, Dissolved oxygen, Kim River, Nitrogen

1. INTRODUCTION

Water is very essential for every human and industrial development. Hydrological cycle, the natural process is depending on the water resources[1] and is disturbed by virtue of extraordinary development activities[2]. The health of pond, rivers and their biological diversity are directly related to health of almost every component of the ecosystem[2].Khatoon[3] have assess the water quality parameter of Ganga River, Kanpur, India using Pearson's correlation coefficient (r) value which determined using correlation matrix to identify the highly correlated and interrelated water quality parameters. According to Assessments of

quality of water gives management strategies for large rivers of India like Gagan River at Moradabad[4&5].

India is facing problems related water scarcity due to demand from high population, pollution of water resources, presence of less water harvesting systems and lack of awareness on judicious use of water. The problem is grave in the western part of India with low rainfall and arid condition. Gujarat is one such state facing the crisis of water resource and allocation. Added to problem, surface waters are most vulnerable to pollution due to their easy accessibility for disposal of wastewaters[6]. Regular monitoring is done in the major rivers of the State like Sabarmati, Mahi and Tapti by Central Pollution Control Board, but is becomes essential to study the water quality of lesser-known rivers, yet sustain large population on its banks. Proper management of available water resources is essential for the survival of human[7].

Present study deals with the Kim River of and aim to provide suggestions and management strategies to the lawmakers. The river originates from Satpuda hill ranges and meets the Gulf of Khambhat near village Kantiajal after flowing southwest direction for a distance of 107 km. The major tributaries are Amravati, Ghanta and Tokri. The important towns along the course of the river are Rajpipla, Valia, Hansot, Mangrol, Kosamba and Kim. There are 77 MSME units and Birla Cellulose is major industry located at Kharaj, Kosamba that releases treated effluent directly into the Kim River. To understand the quality of water the study was undertaken on various physico-chemical parameters with seasonal fluctuation.

2. STUDY AREA

Figure: 1 Location Map Of Study Area

Four stations selected in the riverine stretch based on the presence of major industries or urban cluster on its banks. Station 1 (Kambodiya) is located at the upstream point of the river after it enters to Gujarat. Station 2 (Dehli) is located below the below the upstream point and there is a barrage in-between the two points and used for domestic activities like washing clothes. Station 3 (Amandera) is located at the junction where the tributary of Kim River meets and the flow of river is steady. The farmers undertake lift irrigation from the river to cultivate. Station 4 (Borasara) is located below the station 3 with discharges from industries, domestic sewage from urban centers and also agriculture runoff. There is a small stream joining at this point from mining areas brining in pollution load.

3. MATERIAL AND METHODOLOGY

Standard method was adopted for sample collection from the stations and three samples per location were considered. Air temperature and water temperature was noted on site and water samples were collected in standard 2 lts. bottles for further analyses. Based on the flow of the river, three samples was collected viz., two samples from either side of the bank and one from the midstream. pH measured directly at the site using pH meter instrument. The DO and BOD was determined by using the azide modification of Winkler method using sodium thiosulphate and Starch solution as an indicator. Chlorinity/Salinity was determined by Mohr's method using Silver nitrate (AgNO3) and Potassium dichromate as an indicator. Total Suspended Solids (TSS) and Total Dissolved Solids (TDS) were determined by Gravimetric method. Nitrite (NO_2^--N) estimated by colorimetric method. Nitrates and Total Nitrogen estimated using Cadmium reduction method. Total Phosphate and Phosphate-Phosphorus estimated following Ascorbic acid method. Silicates estimated by using Molybdosilicate method. Sulphates estimated by Turbidimetric method. Chemical Oxygen Demand (COD) estimated by volumetric titration with standard Ferrous Ammonium Sulphate using Ferroin indicator as an indicator. Flouride estimated by SPANDS method. Total Hardness estimated by complexometric titration (EDTA method) using Eriocrome Black-T as an indicator. Alkalinity estimated by using titrimetric method. Statistical analysis carried out using the Statistical package (SPSS Version 20). Pearson's co-relations of the all physico-chemical parameter performed to see the inter-relationship of the parameter and to know the effects of the water on ecology of the river.

4. RESULTS AND DISCUSSION

The water temperature is very important physical characteristics of aquatic ecosystem, as it affects the aquatic organisms. This is also supported by Parasar[8] that water temperature affects a number of other water quality parameters for environmental, domestic, industrial and agricultural applications. In present study, the average values of water temperature during the summer was 25.25± 1.89 °C mg/l and in winter 29.50± 0.58 °C mg/l.

The pH levels showed slightly basic in nature with values of 8.18 ± 0.12 mg/l and 8.12 ± 0.16 mg/l in both the seasons respectively and these values were within permissible limits of CPCB. The basic character of the water quality could be due to the addition of water from irrigation system and excess use of alkaline detergents in residential zones and alkaline material from tannery effluent[9]. Another parameter, alkalinity in the present study showed presence of high bicarbonate ion during both seasons. The higher value was recorded in summer (150.25± 35.08 mg/l) as against winter (41.50± 6.91 mg/l) is attributed to the mineralization as the water flow from the mountain and high temperature lead to dissolution of minerals. Higher concentration of alkalinity may cause eye irritation in humans[3].

The total dissolved solid is the important parameter to check the water quality for its portability. The TDS values recorded was 1055.00 ± 491.16 mg/l during summer and 957.25± 215.71 mg/l in winter. Slight low TDS value during winter may be due to presence of fresh water flow and TDS values tend to get diluted by surface runoff in most rivers[6]. Moreover, water with high total dissolved solid (TDS) is unusable and unhealthy[10]. Chloride ions contribute to the TDS value[11] and in the present study high salinity was recorded during summers as compared to winters. Total suspended solid (TSS) showed significant positive correlation with Sodium ($r=976$, $P<0.05$) in summer and with Ammonical nitrogen ($r=1.00$, $P<0.01$) during winter.

In the present study the TSS values recorded was 13.25± 5.44 mg/l and 16.25± 12.04 mg/l respectively in both the seasons. Rocky/sandy nature of river and vegetation along the bank lead to low TSS.

Total hardness reported was more in summer 2.85± 0.69 mg/l as compared to winter 2.11 ± 0.17 mg/l. This is due to reduced fresh water flow during summer. Total hardness showed significant negative correlations with Salinity ($r= 980$, $P<0.05$) in winter. In the present study bicarbonates showed positive correlation with alkalinity ($r=996$, $P<0.01$) in winter and ($r=1.00$, $P<0.01$) summer. Bicarbonates is part of alkanity, henceforth the strong correlation. In the Cauvery waters also similar results were reported and the reduce inflow of the water was the major causative factor [12].

Dissolved oxygen (DO) is very important role for maintaining aquatic life and is susceptible to slight environment changes and important for sustenance of the aquatic organisms[13] .The recorded mean values of Kim River were 6.93 ± 1.62 mg/l in summer and 4.58 ± 0.74 mg/l in winter. Seasonal difference in DO values is linked to temperature and biological process[14]. BOD is an important factor for indicating the health of freshwater bodies [15]. In present study, the biological oxygen demand (BOD) recorded was higher in summer (61.03 ± 25.39 mg/l) and low (4.58 ± 0.21 mg/l) in winter. Higher BOD level indicate the presence of stress condition in the water largely due to release of effluents[16]. BOD (r= 984, P<0.05) showed significant negative correlation with Salinity and positive correlation with total hardness (r= 990, P< 0.01) in winter, while in it showed positive correlation with total phosphorus(r=992, P<0.01).

Sodium and Potassium are the most vital minerals, which are occurring naturally in water. The mean values of sodium reported high in summer 10.00± 7.39 mg/ l and low in winter 5.50± 1.29 mg/l. The mean values of potassium were reported as 2.25± 0.96 mg/l (summer) and 1.50± 0.58 mg/l (winter). The values of Sodium and Potassium were found within the permissible limit (50 mg/l) of WHO[17]. Presence of effluents and other waste results in higher sodium and potassium values[18].

Among the nutrients, Nitrate-N is an important for plant and a good indicator of pollution. In the present study, the mean values of Nitrate-N were low; 0.05± 0.01 mg/l in summer and 0.03± 0.00 mg/l in winter. Nitrate showed significant positive (r=957, P<0.05) correlation with salinity in summer. Yadav and Srivastava[19] reported similar finding at Kazipur station in Ganga River. Nitrite-N is the result of conversion of ammonia into nitrates through the process of nitrification by bacteria. The mean values of Nitrite-N were 0.01± 0.00 mg/l in summer and 0.04± 0.02 mg/l in winter. Nitrite showed significant positive (r=980, P<0.05) correlation with Total hardness in winter. Kosygin[20] reported similar result in Moirang river of Manipur. Ammonical nitrogen value was 0.07± 0.01 mg/l in summer and 0.13± 0.05 mg/l in winter, due to the disposal of sewage and the agricultural runoff [21].

The value of Phosphate was reported maximum 0.90 ± 0.54 mg/ l in summer and minimum 0.17± 0.04 mg/l in winter. Phosphate showed significant positive (r=950, P<0.05) correlation with Nitrite in summer and significant negative correlation with alkalinity (r=986, P<0.05) in winter. This indicates presence of agricultural runoff in the river during summers. The source of phosphates is use of fertilizers in agricultural fields[12&22]. The observed mean value of Silicate was reported low during both the season. This indicates no silicate pollution in the river.

Sulphate content of natural water is an important for determining their suitability for domestic and industrial provisions[12]. In present study, the value of sulphate was reported 1.21± 0.22 mg/l in summer and 1.46± 0.26 mg/l in winter. Sulphate showed significant positive (r=992, P<0.01) correlation with salinity and negative correlation (r=954, P<0.05) with silicate in summer.

Seasonally, the COD values were higher in summer season (160.00 ± 172.82 mg/l) followed by winter season (125.25± 36.53 mg/l). The values were within the permissible limit prescribed by CPCB (250mg/l). COD showed significant negative (r=987, P<0.05) correlation with Dissolved oxygen (DO) in summer, Sodium (r=960, P<0.05) and Potassium (r=967, P< 0.05) in winter.

Table 1: Descriptive Statistics Of Water Quality Parameter Of Kim River

Parameters	Summer		Winter	
	Mean	Std. deviation	Mean	Std. deviation
Water Temperature	25.25	1.89	29.50	0.58
pH	8.18	0.12	8.12	0.16
Alkalinity	152.25	37.56	41.50	6.19
Bicarbonates	150.25	35.08	41.50	6.19
TDS	1055.00	491.16	957.25	215.71
TSS	13.25	5.44	16.25	12.04
DO	6.93	1.62	4.58	0.74
BOD	61.03	25.39	4.58	0.21
Salinity	1.76	1.26	0.23	0.09
Total Hardness	2.85	0.69	2.11	0.17
Sodium	10.00	7.39	5.50	1.29
Potassium	2.25	0.96	1.50	0.58
Nitrate	0.05	0.01	0.03	0.00
Nitrite	0.01	0.00	0.04	0.02
Phosphate	0.12	0.05	0.24	0.04
Ammonical Nitrogen	0.07	0.01	0.13	0.05
Total Phosphorus	0.90	0.54	0.17	0.04
Silicates	0.03	0.00	0.01	0.00
Sulphate	1.21	0.22	1.46	0.26
COD	160.00	172.82	125.25	36.53

Based on the CPCB Standard for the designated use of the water, the following table was prepared using the various parameters. All the parameters showed that the river quality is designated as class A, where the river can be used as source of water without convectional treatment but after disinfection.

Table 2: Designated Use Of Water

Parameters	Class		Designated use	
	Summer	Winter		
pH,DO,BOD	A	A	Drinking Water Source without conventional treatment but after disinfection	
TDS	C	A	Drinking Water Source after conventional treatment and disinfection	Drinking Water Source without conventional treatment but after disinfection
Total Hardness	A	A	Drinking Water Source without conventional treatment but after disinfection	
Sulphate	A	A	Drinking Water Source without conventional treatment but after disinfection	

(Source: CPCB)

5. CONCLUSION

Overall the water quality is good and not under severe stress condition. There is a seasonal variation affecting the water quality due to formation of small pockets of water scare zones in summers resultant of low water flow. During winters, due to inflow of fresh water from the catchment there is improvement in the water quality. This also indicates the river basin has forested catchment area.

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