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WATER QUALITY OF SAI RIVER AT UNNAO DISTRICT OF U.P.

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Research Paper

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ABSTRACT

The present study aimed to evaluate the impact of municipal and industrial waste water on river Sai at Unnao district of U.P. The untreated or partially treated municipal and industrial waste water discharged in the river caused a significant alteration in pollution indicating parameters of river water. The physico-chemical parameters such as Temperature, pH, DO, FCO_2, Alkalinity, Hardness, TDS, BOD, COD, Chloride, Nitrate and Sulphate of river water showed seasonal variations. Most of the parameters of the Sai River at Unnao are within the permissible limit and suitable for aquatic life but some pollution indicating parameters especially TDS, BOD and COD were found much higher than the tolerance limit recommended by WHO.

Keywords: Physico-chemical parameters, Sai River, Unnao.

INTRODUCTION

Water is fundamental to life on earth, but this precious resource is increasingly in demand and under threat. The earth's surface contain about 70% water including rivers, beels, lakes, streams, seas, oceans, ground water and all these forms are very important in life cycle (Arimieari *et al*., 2014). Of the waters occupying 70% of the earth's surface, only 3% is considered fresh water and approximately 5% of this fresh water or 0.15% of the entire global water is used for beneficial purposes (Usharani *et al*., 2010).

Industrial and municipal waste water discharges and e-wastes have been a major cause fresh water pollution and hazardous contamination to soil and surface as well as ground water thereby affecting the public health (Prakash and Verma, 2020a). In developing countries surface water may be affected by severe pollution and unsustainable agriculture due to its easy accessibility for disposal of wastewater (Ashok, 2018). The disposal of untreated wastewater of various small scales industries, domestic sewage waste water and agrochemical wastes may reach into river.

The increasing pollution of rivers and streams and other anthropogenic activities have attracted the attention of many scientific and administrative authorities globally (Sugumaran *et al.*, 2020; Prakash and Verma, 2022). Due to rapid industrialization, many rivers in India are facing the problems of chemical pollution as these rivers act as temporary reservoirs for drainage of water and industrial effluent and often are highly contaminated with anthropogenic materials. Fresh water resources are important but are being contaminated uncontrollably through industrial effluent and anthropogenic activities (Bhagde *et al*., 2020). However, the Sai river has grown contaminated as a result of industrial, domestic, and municipal discharge of waste water as well as extensive

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anthropogenic activity. In this study, an attempt was made to examine the water quality of Sai river at Unnao district of U.P.

MATERIALS AND METHODS

Study area: The popularly known as Sai, the river mentioned as 'Adi Ganga' (ancient Ganga) in Tulsidas' Ramcharitmanas, is originated from a water table in Parsai, a village of Hardoi district of U.P. After Hardoi, Unnao and Lucknow, the Sai flows through Rae Bareli, Pratapgarh and Jaunpur covering some 500 villages over a distance of 715 km before finally merging into the Gomti river at Jaunpur, U.P. As it passes through six districts of UP, the Sai gets progressively polluted by the untreated municipal and industrial wastes it receives from the 200 drains along its course.

Fig. 1: The Sai river near bridge on Unnao Lucknow road.

Three sites were selected in Unnao district to collect the water samples of the Sai river. Surface water was collected in the middle of the river at each sampling point and stored in clean polyethylene bottles. Because of their unstable nature, water temperature, pH, and dissolved oxygen were measured on the spot. The collected water samples were transported immediately to the laboratory for the estimation of physico-chemical properties of sample water. The collected samples were analyzed for Biological Oxygen Demand (BOD), Chemical Oxygen demand (COD), Free CO_2 and TDS, DO, BOD, COD, Nitrate, Sulphate and chloride by following standard methods given by APHA (2005).

RESULTS AND DISCUSSION

The monthly samples collected from three sites of river Sai at Unnao district of U.P. and were subjected to physicochemical analysis for parameters such as Temperature, pH, DO, FCO_2, TSS, TDS, BOD, COD, nitrate, sulphate and chloride as per standard methods. The results of the various physico-chemical properties of Sai river of three seasons (Summer, monsoon and winter) from April, 2021- to March,2022 are summarized in Table-1. The result of the present study shows wide variations were observed in measured parameters at all stations.

The water temperature varied with variation of season as lowest in winter and highest in summer, these finding is supported by the finding of (Singh and Gupta, 2004) in Yamuna river. Water temperature directly or indirectly influences many abiotic and biotic components of aquatic ecosystem. It also reflects to the dynamics of the living organism such as metabolic and physiological behaviour of aquatic ecosystem (Singh, 2014). In the present study average temperature was ranging 16.73-30.16^{0}C of which maximum average temperature (30.16^{0}C) was noticed in summer season and the minimum average temperature (16.73^{0}C) in winter season. Many workers observed similar trends while working on different water bodies (Prakash *et al*., 2015; Verma, 2020; Verma and Prakash, 2020b). As fishes require moderate temperature for growth and reproduction, the temperatures were found suitable for the survival and growth of fish fauna (Ansari and Prakash, 1999 & 2000).

Table 1: Seasonal Variation in Physico-chemical Parameters of Sai river at Unnao district (During Summer April, 2021-June, 2021; Monsoon July 2021- Oct., 2021; Winter Nov., 2021-March,-2022).

Parameters	Season	Site-1	Site-2	Site-3	Average
Temp^{0}C	Summer	28.7±0.73	31.40±0.21	30.4±0.23	30.16
	Monsoon	25.4±0.32	27.5±0.43	26.5±0.56	26.47
	Winter	15.2±0.44	18.5±0.31	16.5±0.33	16.73
pH	Summer	8.12±0.08	7.17±0.07	7.87±0.06	7.72
	Monsoon	8.14±0.03	7.35±0.03	7.85±0.03	7.78
	Winter	7.77±0.05	7.19±0.08	7.69±0.07	7.55
DO	Summer	7.20±0.13	6.35±0.18	6.60±0.23	6.72
	Monsoon	6.95±0.13	6.70±0.19	6.65±0.11	6.76
	Winter	8.52±0.12	7.45±0.12	8.45±0.13	8.14
FCO_2	Summer	52.8±0.54	60.4±0.33	59.4±0.43	57.53
	Monsoon	42.4±0.54	42.7±0.29	44.7±0.34	43.26
	Winter	38.4±0.52	37.7±0.23	38.7±0.22	38.26
Alkalinity	Summer	215.5±1.23	195.3±1.02	205.3±1.33	205.37
	Monsoon	202.4±1.22	191.3±1.11	198.3±1.25	197.33
	Winter	138.6±1.11	149.2±1.23	109.2±1.42	132.33
Hardness	Summer	121.0±1,50	112.0±1.13	124.0±1.25	119.00
	Monsoon	85.5±1.40	98.5±1.29	88.5±1.32	90.83
	Winter	105.5±1.12	117.8±1.12	107.8±1.22	110.36
TDS	Summer	465.0±1.50	455.5±1.71	475.5±1.82	465.33
	Monsoon	615.0±1.50	618.5±1.51	638.5±1.71	624.00
	Winter	465.0±1.4	472.5±1.68	482.5±1.81	473.33
BOD	Summer	8.0±1.4	8.1±1.53	8.6±15.61	8.23
	Monsoon	5.5±1.2	5.9±1.37	6.5±1.42	6.00
	Winter	5.5±1.4	6.2±1.46	6.4±1.53	6.03
COD	Summer	21.0±1.0	22.0±1.46	23.0±1.51	22.0
	Monsoon	10.50±1.4	12.50±1.51	13.50±1.52	12.16
	Winter	17.5±1.2	19.5±1.22	20.5±1.12	19.16
Chloride	Summer	28.5±1.5	32.5±1.31	34.5±1.41	31.83
	Monsoon	14.5±1.2	16.5±1.42	17.5±1.54	16.16
	Winter	15.50±1.5	17.50±1.31	17.00±1.41	16.66
Nitrate	Summer	0.68±0.11	0.85±1.21	0.95±0.122	0.82
	Monsoon	0.45±0.12	0.67±1.22	0.68±0.143	0.60
	Winter	0.55±0.15	0.65±0.123	0.70±0.131	0.63
Sulphate	Summer	24.50±1.4	24.60±1.02	24.80±1.42	24.63
	Monsoon	14.50±1.6	17.00±1.21	18.00±1.65	16.50
	Winter	17.50±1.5	20.50±1.52	21.50±1.51	19.83

Notes: All values are in mg/L except water temp. and pH.

The pH of water is the most important parameter that impacts its appropriateness for many applications. Because most aquatic organisms are accustomed to an average pH, water pH is vital for biotic communities. During the summer, monsoon, and winter seasons, the average pH values were 7.72, 7.78, and 7.55, respectively. Due to extensive rainfall throughout the winter months, the lowest pH value was observed. The pH range observed in this study, indicated that water of river was slightly alkaline, which is a favourable sign for the survival of aquatic animal including fishes (Ashok, 2016; Prakash, 2001).

Dissolved oxygen is also most important parameter in assessing the quality of water which directly affecting survival and distributing of flora and fauna in an aquatic ecosystem. Average value of recorded DO for the observation period was ranged between 6.72-8.14 mg/L. This average DO is positive for a healthy growth of aquatic animals. In the present study dissolved oxygen was recorded maximum in winter and minimum in summer, may be due to the low solubility at high temperature and high degradation of organic substances by Rajagopal *et al*. (2010), this result supported by the finding of Ansari and Prakash (1999). The quantity of D.O. in water is directly or indirectly dependent on water temperature, partial pressure of air etc. Similar result were observed by Kamal *et al*., 2007 in Mouri river. This result is corroborated by the findings of Ansari and Prakash (1999), because fish require at least 5 mg/l dissolved oxygen, river water is adequate for their development and growth.

Carbon dioxide is the most important component of the photosynthetic process in plants. CO_2 reacts with water in water bodies to generate carbonic acid, which quickly dissociates into carbonates and bicarbonates, changing the pH of the water (Prakash, 2001; Verma, 2019). CO_2 behaved differently in different seasons in all four sampling sites, which was surprising. In the current investigation, average free CO_2 levels ranged from 38.26 to 57.53 mg/L in different seasons and locations. The lowest levels of free CO_2 (38.26 mg/L) were found in the winter, while the greatest levels (57.53 mg/L) were found in the summer. The increase in CO_2 levels during the summer months could be attributable to organic matter degradation and decomposition, as well as the addition of industrial waste (Joshi *et al.*, 1995).

Water's alkalinity is its ability to neutralise strong acids, which is primarily determined by carbonate, bicarbonate, and hydroxide content and is created when CO_2 is dissolved in water. In this study, average alkalinity values ranged from 132.33 to 205.37 mg/L in all three seasons, with the highest value (205.37 mg/L) in the summer and the lowest value (132.33 mg/L) in the winter. Some researchers (Sahni and Yadav, 2012; Verma, 2019 & 2020) discovered a similar tendency of alkalinity changes in river water. Decomposition of bottom sediments, resulting in the conversion of insoluble carbonates to soluble bicarbonates (Prakash *et al*., 2015). The alkalinity range of river water indicates that photosynthetic activity has taken precedence over biota respiration activity (Ansari and Prakash, 2000). According to Alikunhi (1957), the alkalinity in highly productive water should be greater than 100 mg/L.

Total hardness of the river water ranged from 99.83 to 119.0 mg/L, with the highest value in summer and the lowest value in monsoon season. The hardness increases in summer season due to decrease in water volume and an increase in the rate of evaporation at high temperatures, high loading organic compounds, detergent, chloride, and other pollutants, as well as high loading organic substances, detergent, chloride, and other pollutants (Prakash *et al*., 2015). Water with a hardness of up to 75 mg/L is categorised as soft, 76-150 mg/L as moderately soft, 151-300 mg/L as hard, and more than 300 mg/L as very hard, according to various classifications (Saravanakumar and Kumar, 2011). The selected water samples from the Sai River can be classified as soft based on classification.

High TDS affects the osmo regulation of freshwater organisms, reduces solubility of gases (like oxygen) and utility of water for drinking, irrigational, and industrial purposes. Waters can be classified based on the concentration of TDS as, desirable for drinking (up to 500 mg/L), permissible for drinking (up to 1,000 mg/L), useful for irrigation (up to 2,000 mg/L), not useful for drinking and irrigation (above 3,000 mg/L) (Lokhande *et al.*, 2011.). In the present study the average total dissolved salts (TDS) was ranged between 465.33 mg/L (in winter) to 624.0 mg/L (in Summer) which was higher than the desirable limit of drinking water.

The biological oxygen demand (BOD) of Sai river water varies from 6.00 mg/L to 8.23 mg/L on an average. According to the Department of Energy (1997), BOD levels of drinking water was upto to 0.2 mg/L, for the fish growth was up to 6 mg/L, and for irrigation purposes up to 10 mg/L. The chemical oxygen demand (COD) of Sai river water ranged from 12.16 mg/L to 22.00 mg/L. Both organic and inorganic chemicals generated by the influx of industrial and municipal wastes containing high amounts of organic pollutants results in excessive BOD and COD (Owusu-Ansah *et al.*, 2015).

In the present study the average chlorides content of river water varies from 16.16 to 31.83 mg/L, with the highest value during summer and lowest value during the winter season. Other researchers noticed reduced chloride concentrations in freshwater bodies throughout the winter season (Shiddamallaya and Pratima, 2008). According to the findings of Venkatesharaju *et al*. (2010), higher chloride concentrations in the summer may be attributable

to increased warmth, low water levels, and sewage mixing. The higher chloride concentration at site 3 is thought to be a sign of increased pollution from sewage outflow.

In the present study the average nitrates concentration was ranged from 0.60 mg/L (in winter) to 0.83 mg/L (in Summer). The nitrate is relatively nontoxic for fish health, except when the concentration of nitrate exceeds 90 mg/L in water. Sulphate levels in the Sai river ranged from 16.50 mg/L (in winter) to 24.63 mg/L (in summer). These values when compared to EPA value of 2.0 mg/L showed that sulphate level of Sai river was not suitable for the growth of aquatic animals.

CONCLUSIONS

The purpose of the present investigation was to evaluate the physicochemical properties of water of the Sai river at Unnao district of U.P. The result of this study revealed that various physicochemical parameters, like as temperature, pH, DO, FCO_2, alkalinity, and hardness, were within permissible limits in India, whereas TDS, BOD, and COD concentrations were significantly higher than national and international standards.

The rate at which industrial wastewaters are released into river is high so there is the need to check their quality before releasing them into the environment. The result of the present study provides baseline information for aware the people and government to take action for the conservation of aquatic biodiversity.

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