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ASSESSMENT OF WATER QUALITY OF BASANTAR RIVER IN SAMBA DISTRICT, INDIA

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ABSTRACT

In India, the quality of river water is deteriorating due to improper disposal of domestic and industrial waste. Basantar river also witnesses the same problem since it is located along the industrial town Samba and thus receives most of the untreated sewage and industrial effluents which adversely affect its water quality, its aquatic life and also affects the groundwater quality of the region. Therefore, it becomes important to evaluate its water quality. So, the present study focuses on the evaluation of important parameters such as pH, BOD, COD, turbidity, hardness etc. and then its comparison with the standard set by BIS (Bureau of Indian Standard) which determine the water quality of the river. For the present study, samples of water were collected from six different sampling sites and then brought to the laboratory for further analysis. The results indicated that the stretch of river from location 4 to location 5 is adversely affected due to its close proximity to the industrial units and dumping site.

KEY WORDS: Basantar river, Pollution, Water quality, Industrial waste

INTRODUCTION

One of the most serious crisis for developing countries in the today's world is river pollution as about 70% of their industrial waste and 80% of their domestic waste flow untreated into the rivers (Do *et al.,* 2016). Rivers are considered holy in India. They are central to Indian life and even worshipped as deities. This is disgusting to see that though they are deeply venerated in India but still are heavily polluted. More than half of India's rivers and other surface water bodies are polluted to a significant level ("India's Ganges and Yamuna rivers," 2017). The major sources of river pollution are sewage, untreated industrial waste and agricultural run-off which make river water unsuitable for many purposes such as drinking, bathing, irrigation, etc. River pollution in India has now reached a threshold point as shown by the report of National Environmental Engineering Research Institute (NEERI) that almost 70% of water is polluted in India (Dwivedi, 2017). Such high pollution imparts serious health effects on the population in both direct and indirect way. Direct exposure to river pollution may put the population's health at risk as it causes various infections, chronic diseases and premature mortality of children whereas this pollution also affect health in indirect way (i.e. far from polluted site) by contaminating ground water and food chains (Do *et al.,* 2016). River water quality also gets affected by increasing industrialization, urbanization and intensive agriculture or changes in land use pattern (Kumar *et al.,* 2016).

Due to unbalanced industrial growth in Samba region, Basantar river receives a major setback as its quality is getting deteriorated day by day due to untreated industrial effluents (Chandan *et al.,* 2017). Jammu and Kashmir State Industrial Development Corporation (SIDCO) also faces a fine of Rs. five crores from the National Green Tribunal (NGT) for discharge of effluents and dumping of waste in the Basantar river in Samba district. The water sample and ambient air quality exceeding the limits and sewer waste is exceeding the standard limits for majority of parameters. Delay in establishment of waste treatment plants resulted in the discharge of untreated sewage waste and industrial effluents in the river ("NGT slaps 5 cr penalty," 2018). Thus

there lies an urgency for assessment of water quality of Basantar river and identify the pollution prone sites so as to take immediate remedial measures.

Study Area

Samba is situated along the banks of river Basantar which is an important tributary of river Ravi. River Basantar originates at an altitude of 1300 meters above mean sea level from Shiwaliks near Kharai Dhar. On its course, it flows through southern slopes of Bani, passes through shallow gorges, forms asymmetrical valleys, makes a bend before entering flood plains in Samba and finally joins Ravi in Pakistan. It drains the major portion of Samba district of J&K. It has catchment area of about 630 sq. km. and maximum discharge is during monsoon. SIDCO has set up industrial complex in the proximity to the bank of river Basantar. There are nearly 250 industrial units which drain their waste into or near river (Sharma *et al.,* 2015).

Objectives

1. To assess the water quality based on the physico-chemical parameters of Basantar river.
2. To examine the spatial variations in the water quality of the river.

DATABASE AND METHODOLOGY

The study is purely based on the field survey. To achieve the above objectives, water samples were collected from 6 locations in previously sterile glass bottles, at a depth of about 12-15 cm from the surface. The locations have been selected, taking into consideration the human and industrial intervention along the longitudinal course of Basantar river. Three locations (L_1, L_2 and L_3) selected were situated 5 km, 3 km and 1.5 km upstream from mixing point respectively. These represent the location of least anthropogenic activities and no industrial intervention. One selected location (L_4) was situated at the mixing point where the industrial waste mixes with river water. While the other two locations (L_5 and L_6) were situated 2 km and 3 km downstream from mixing point respectively.

Water samples were collected carefully, labeled

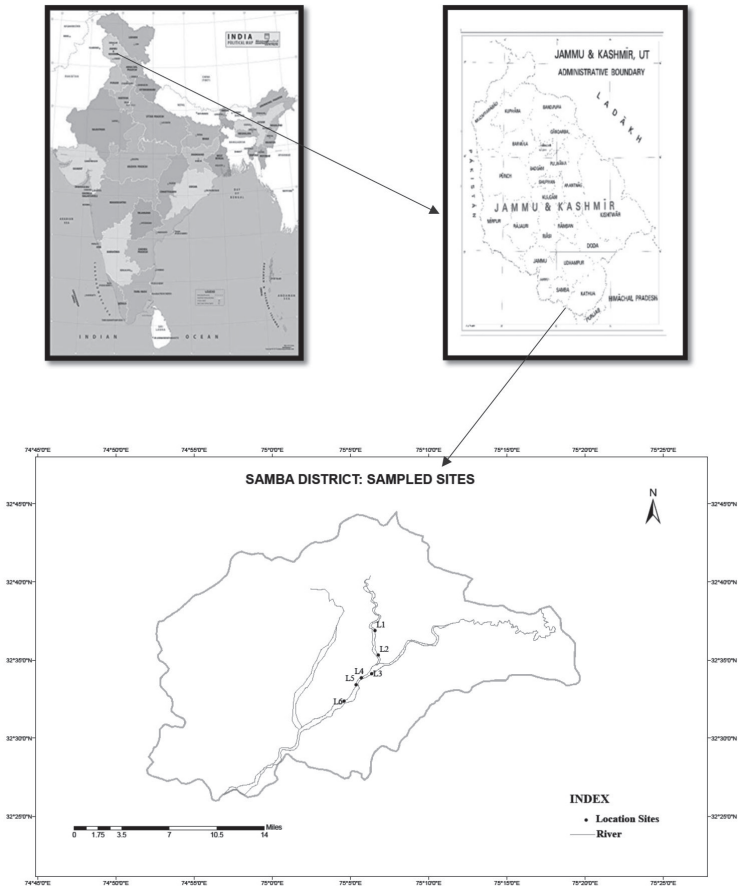

Fig. 1. Location map of study area

properly and then brought to the laboratory within 24 hrs for analysis of various parameters like BOD (Biological Oxygen Demand), COD (Chemical Oxygen Demand), TDS (Total Dissolved Solids), Turbidity, pH, Hardness, Nitrate, Chloride, Alkalinity, Calcium, Magnesium, Sulphate, Phosphate and *E. coli* bacteria. The observed values of these parameters are also compared with the water quality standard limits given by Bureau of Indian Standards (Bureau of Indian Standards, 1991).

RESULTS AND DISCUSSION

All the parameters that have been tested for the physico-chemical analysis of the river are discussed below.

BOD and COD

BOD is the amount of oxygen required by microbes to decompose organic matter present in the water. Increase in concentration of organic matter increases the oxygen demand i.e. concentration of organic matter is directly proportional to BOD. COD is the amount of oxygen required for the oxidation of chemicals present in the water. Thus both BOD and COD are the indicators of organic pollution in the surface water. The observed average value for BOD and COD in the Basantar river is 3.94 mg/L and 10.34 mg/L respectively. Values of BOD in all the sampling locations exceed the BIS permissible limit as shown in Table 1. Figure 2 depicts that both BOD and COD were found to be highest in L_4 due to discharge of industrial effluents as this sampling site is located along the banks of industries.

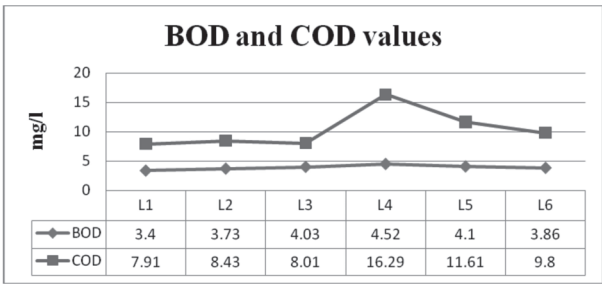

Fig. 2. Variation of BOD and COD values at different locations

TDS

TDS ranges from 385 mg/L to 588 mg/L in the Basantar river which is well within the BIS permissible limit but exceed for desirable limit as shown in Table 1. It is clear from the Figure 3 that only two locations i.e. L_4 and L_5 exceed the desirable limit. High value of total dissolved solids in these two locations is due to the discharge of industrial and domestic waste into the river as L_4 site is located near industrial area and L_5 is located downstream to L_4 and also near solid waste dumping site. Increase in TDS reduces water potability, i.e. its utility decreases for drinking, irrigation and industrial purposes.

Table 1. Physico-chemical and biological parameters at different sampled locations and their comparison with the values of Bureau of Indian Standards (BIS)

Quality Parameters	Units of Measurement	BIS Permissible Limit	BIS Desirable Limit	Actual Level						Mean
				L_1	L_2	L_3	L_4	L_5	L_6	
BOD	mg/L	3	3	3.40	3.73	4.03	4.52	4.10	3.86	3.94
COD	mg/L	20	20	7.91	8.43	8.01	16.29	11.61	9.80	10.34
TDS	mg/L	2000	500	395	385	404	588	515	487	462.33
Turbidity	NTU	5	1	58.25	50.65	70.18	131.89	142.12	109.34	93.74
pH	pH	8.5	6.5	7.78	7.81	8.42	8.9	8.01	8.52	8.24
Hardness	mg/L	600	200	152.84	158.01	169.81	182.21	176.36	177.81	169.51
Nitrate	mg/L	45	45	11.8	7.3	9.8	22.69	25.8	8.18	14.26
Phosphate	mg/L	0.5 to 3	0.5 to 3	0.03	0.09	0.7	0.68	0.8	0.13	0.41
Chloride	mg/L	1000	250	24.12	24.56	25.81	29.84	28.18	26.04	26.43
Alkalinity	mg/L	600	200	125.89	170.64	195.58	213.65	248.41	170.89	187.51
Calcium	mg/L	200	75	143.68	160.54	163.01	295.58	278.42	250.52	215.29
Magnesium	mg/L	100	30	30.24	25.18	33.92	42.41	47.89	40.56	36.7
Sulphate	mg/v	400	200	11.56	11.01	15.63	21.18	19.81	19.03	16.37
E. coli	MPN/100 mL	0	0	-	+	+	+	+	+	

- Absent & + present

Hardness

Hardness is one of the important water quality parameter for domestic and industrial uses. It shows the summation of concentration of calcium and magnesium salts in the water. In the Basantar river, observed average of hardness is 169.51 mg/L which is within the desirable limit of 200 mg/L according to BIS standards. Spatial variation in values of hardness in all sampling locations is shown in Figure 3. Hardness has no direct health impact but can cause scaling of pipes.

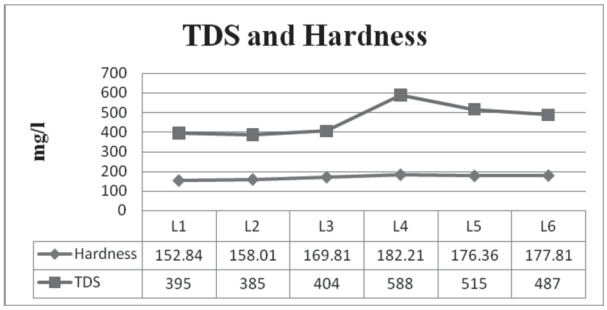

Fig. 3. Variation of TDS and Hardness values at sampled locations

Turbidity

Turbidity is the measure of clarity of water and is due to the suspended solids in the water such as clay, silt, colloidal organic matter, etc. The observed values of turbidity for all the sampling locations exceed BIS permissible limit as shown in Fig. 4. L_5 shows the highest value of turbidity, i.e. 142.12 NTU as it receives waste from both industries and households which increases the concentration of suspended solids whereas L_2 shows the lowest turbidity, i.e. 50.65 NTU because it is located upstream from highway and has less human interference than L_5. Water with high turbidity is harmful for aquatic life as it affects the penetration of light into water.

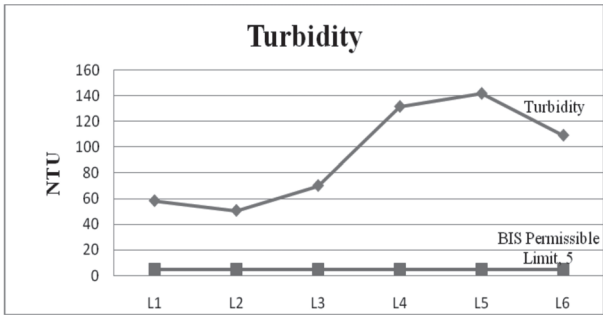

Fig. 4. Variation in the values of Turbidity at different locations

pH

pH is the indicator of acidic or alkaline condition of water. The range of pH of the Basantar river was found between 7.78 and 8.9 whereas its average value is 8.24 i.e. it shows alkaline nature. Average value of pH of the river is in the permissible limit given by BIS. Only one sampling site i.e. L_4 exceed the BIS permissible limit as shown in Figure 5. Such high pH is not good for aquatic life as suitable pH range for aquatic population is 6.5-8. Also, lower pH makes water corrosive and higher pH leads to skin problems.

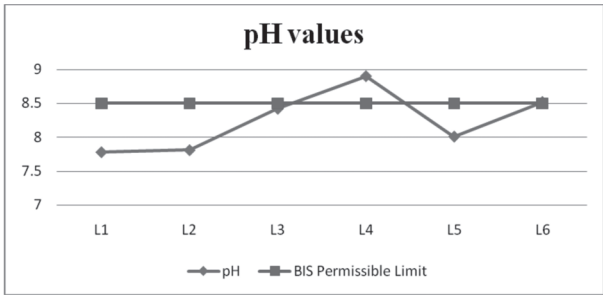

Fig. 5. Variation of pH values at sampled locations

Nitrate and Sulphate

Nitrates are formed due to oxidation of ammonia by nitrifying bacteria in the water. Nitrate reduces to nitrite when there is decrease in Dissolved Oxygen in the water. Nitrite, even in small amount, is considered to be indicator of beginning of pollution. Nitrate concentration in the Basantar river ranges from 7.3 mg/L to 25.8 mg/L with average concentration of 14.26 mg/L which is within the BIS limits of 45 mg/L. It has been clear from the Figure 6 that nitrate concentration is maximum at L_5. This is because of industrial pollution and also due to agricultural run-off as fertilizers have nitrate content. Sulphate concentration in water is due to contamination from soil and industrial effluents. Observed average concentration of sulphate in the river is 16.37 mg/L. Thus river water is not much contaminated due to sulphate as its concentration is well within the BIS desirable limit. Figure 6 is showing the sulphate concentration at all sampled locations. The presence of sulphate in water causes many health problems such as diarrhea, bowel problems, etc.

Chloride

Chloride concentration in the river water is the indicator of pollution due to organic waste of animal

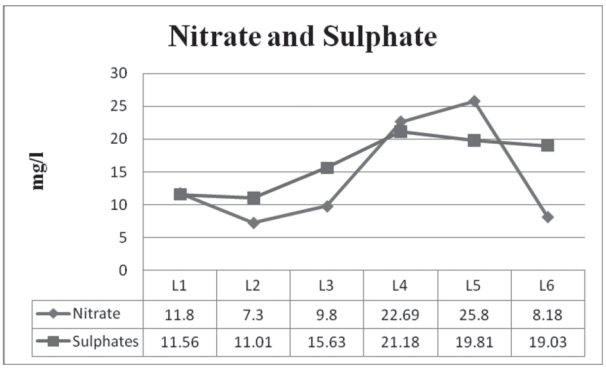

Fig. 6. Graph showing variation in the values of nitrate and sulphate at sampled locations

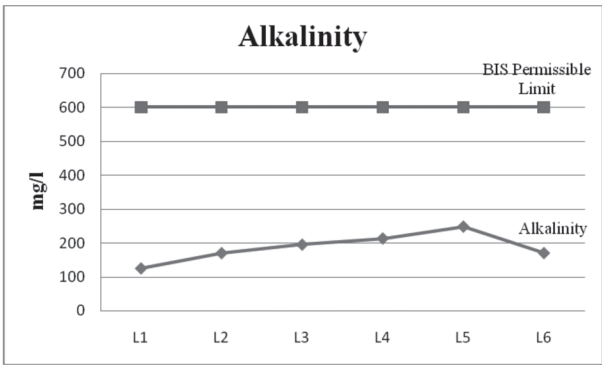

Fig. 8. Graph showing variation in the values of alkalinity at different locations

and industrial origin. In the Basantar river, concentration of chloride ranges from 24.12 mg/L to 29.84 mg/L which is within the permissible limit of BIS as shown in Figure 7. High concentration of chloride in the water is not good for irrigation, aquatic life and also creates health problems to humans.

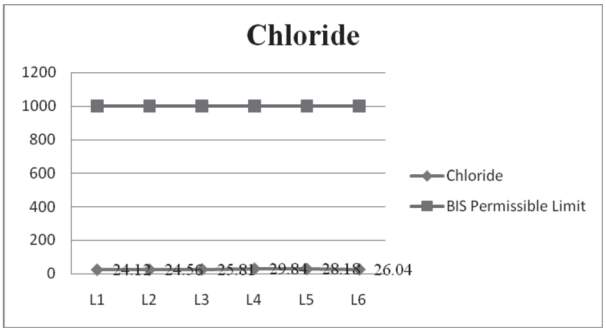

Fig. 7. Variation of chloride values at sampled locations

Alkalinity

Alkalinity refers to the ability of water to neutralize acids in the water. High alkalinity of water is harmful for irrigation and hence destroys crops. Figure 8 depicts that L_4 and L_5 record highest alkalinities which are more than 200 mg/L, i.e. exceeding the BIS desirable limit. This is due to agricultural and domestic waste discharges. But the alkalinity in all sampled locations is well within the BIS permissible limits as shown in Figure 8.

Calcium and Magnesium

Calcium and magnesium dissolved in water are the two common minerals that contribute to the hardness of water. Figure 9 shows the concentration of calcium and magnesium in all sampling locations. Calcium and magnesium concentration are maximum in L_4 and L_5 respectively. This is due to domestic waste from nearby localities and industrial waste from nearby industrial area. Three locations L_4, L_5 and L_6 have calcium concentration more than 200 mg/L i.e. exceeding the BIS permissible limit.

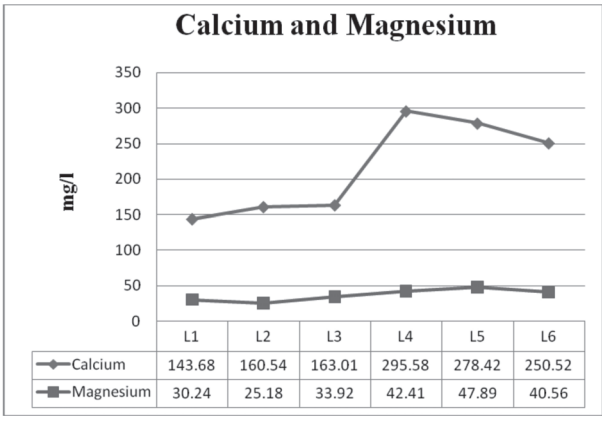

Fig. 9. Graph showing variation in the values of calcium and magnesium at sampled locations

Phosphate

Phosphate concentration ranges from 0.03 to 0.8 mg/L in the Basantar river as shown in below figure. High level of phosphate is harmful for aquatic life as phosphorus along with nitrogen cause eutrophication i.e. high vegetative growth especially algae.

E. coli

The presence of *E. coli* in the water shows that water is contaminated with bacteria. Table 1 show that *E.coli* are present in five sampling locations except in L_1. This is due to discharge of domestic sewage and industrial waste in the river.

CONCLUSION

It has been concluded from the present study that

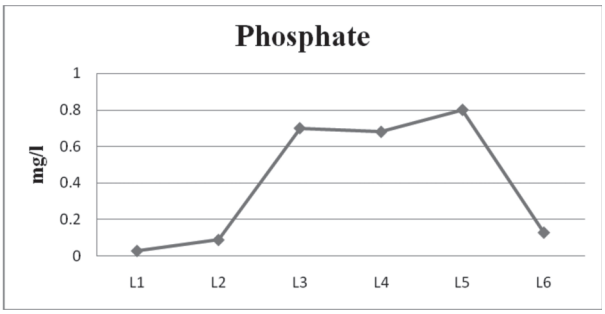

Fig. 10. Variation in the values of phosphate at different sampled location

the sampled locations L_1, L_2 and L_3 show better results in terms of water quality parameters due to least anthropogenic activities and no industrial impact. On the other side, the stretch between location 4 and location 5 is more polluted than rest of the river. Physico-chemical parameters like BOD, TDS, Turbidity, Alkalinity, Calcium and Magnesium are exceeding the BIS permissible limits in these 2 locations (L_4 and L_5). Only the large industries in Samba have treatment plants beside the guidelines of National Green Tribunal whereas small industries discharge their maximum waste untreated into the Basantar river. The close proximity of dumping site from location L_5 has also adverse impact on the health of the river. Thus, the present study indicates that the water of the river is unfit for direct drinking purposes. So, before supplying it to general public, it has to be treated well. Even, the high value of TDS (>450 mg/L) and alkalinity make it unsuitable for irrigational purposes as well. The polluted stretch of river is also affecting the people's health by contaminating the ground water which is mostly used by people for drinking without treatment. Terrestrial animals and aquatic life also get affected by this pollution.

SUGGESTIONS

Result of water quality parameters of Basantar river indicates that the river is getting polluted day by day. Thus, it is the need of hour to take immediate steps so as to prevent the river from worst consequences of pollution. The following suggestions will be helpful-

1. All the industries in the region must follow the guidelines of National Green Tribunal to have their treatment plants.
2. The Samba dumping site located close to the Basantar river should be placed away from the river.
3. State and Central Government must intervene for regulating the industries and factories according to the law and ordinance.
4. The domestic sewage should not be directly thrown in the river.
5. Both fine and imprisonment should be imposed on those industries and factories that don't follow the guidelines of National Green Tribunal.
6. Regular inspection by govt. authorities is necessary to put pressure on the industries to abide the rules and regulations.

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