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IMPACT OF POLLUTANTS ON WATER QUALITY OF BASANTAR RIVER WITH REFERENCE TO PHYSICO- CHEMICAL PARAMETERS OF DISTRICT SAMBA (J&K), INDIA

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Short Profile

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ABSTRACT:
To understand the complex biological interactions occurring within a lotic ecosystem, an assessment of its physicochemical conditions holds a key position. Any change encountered in its conditions has a direct bearing on the biota inhabiting in it. So, the present study was carried out to assess the water quality of Basantar river of Samba district during May 2013 to April 2014 in four different seasons viz. Summer (March to June), Monsoon (July- August), Post Monsoon (September to October) and Winter (November to February). Two study stations were identified on the basis of anthropogenic load viz. Station I & Station II. Water samples were analyzed for physicochemical parameters including: Air temperature, Water temperature, Transparency, pH, DO, FCO_2, BOD, Carbonates, Bicarbonates, total dissolved solids (TDS),Conductivity, Calcium, Magnesium, Nitrates, and Phosphate from these stations. The results revealed seasonal variations in the physico-chemical parameters and also recorded clear water at Station I while at Station II high values of BOD, nitrates, free CO_2, TDS but low value of DO & pH. The study further indicated that observations made on the basis of water quality parameters has high pollution load at station II due to location of industries in

its vicinity (SIDCO complex) and also significant amount of discharge from nearby Samba city. To maintain the healthy ecosystem of the river there is a need for proper management and monitoring of water quality of the river.

KEYWORDS

Seasonal variations, physicochemical parameters, Basantar river.

INTRODUCTION

Water on earth surface is imperative for life but water quality degradation due to various anthropogenic pollutants has resulted in loss of its natural quality. The lotic ecosystems are nowadays, strongly influenced by discharge of untreated domestic and industrial wastewaters, agricultural runoff, accidental spills and direct dumping of solid waste. This deteriorating quality of lotic ecosystem has resulted in a state of deviation from its pure condition and normal functioning and thus affecting its physicochemical parameters at large. One such important lotic ecosystem is river water ecosystem. But unfortunately today the World river system are being polluted by indiscriminate disposal of sewage, industrial waste and excess of human activities, which has made water not only unfit for human consumption but has also affected its physico-chemical characteristics and biota living therein.

Anthropogenic interventions from point and nonpoint sources of pollution (chemical contamination and agricultural runoff) are responsible for a broad-scale deterioration of lotic ecosystems (Chatzinikolaou *et al*., 2006) besides disturbing the physical characteristics of an aquatic ecosystem (habitat alteration and urban land use).The problems of river water quality are much more acute in densely populated areas. This has been supported by Bhatnagar *et al.*, (2012) who studied physico-chemical analysis of water samples in Rewa city (M.P.), India and indicated that water quality at Rewa region is not good and major cause of pollution is population density and obviously discharge of domestic sewage, domestic effluents and agricultural run-off in the area.

Earlier work on impact of pollutants on physico-chemical parameters of river water had been reported by Joshi and Bisht(1993), Chopra & Patrick(1994), Prasanakumari *et al*.,(2003), Kumar *et al*., (2004), Gandotra *et al*., (2008), Joshi *et al.*, (2009), Singh *et al*., (2010), Muniyan & Ambedkar (2011),Yadav & Srivastava(2011), Chaurasia & Tiwari (2011),Bhatnagar *et al*., (2012), Chauhan & Sagar (2013), Meghla *et al*., (2013), Dutta (2014), Sharma *et al.*, (2015).

In Samba district of Jammu region there are present a good number of widely distributed fresh water resources and there is a need for and concern over the protection and management of these fresh water resources. Considering the above aspects of water degradation, the present study was undertaken to investigate the possible impact of pollutants on the water quality of Basantar river.

MATERIAL AND METHODS

Study area

The study was conducted for a period of one year from May 2013 to April 2014 at the Basantar stream in Samba district of J&K. The Stream is an important tributary of the river Ravi.It originates near Kharai Dhar at an altitude of 1300 m above mean sea level from Siwalik range and flows through southern slopes of Bani and its catchment area is 630 sq. km with maximum discharge during monsoon season. The river makes a knee bend before and finally enters flood plains near Samba and ultimately joins the river Ravi in Pakistan. It is most important river that drains the major portion of Samba region and is also the sole source of drinking water to the inhabitants. Numerous anthropogenic activities such as sand mining, dredging, bathing, disposal of solid wastes and sewage from human colonies are the potential sources of river pollution. Besides these, Industrial area developed by State industrial development corporation (SIDCO) in vicinity of Samba city has almost 250 factories and most of which are dealing with hazardous chemicals are petro based. The waste of which is being dumped into the river. So for the present investigation, two sampling sites viz. Station 1(S_1) and Station 2 (S_2) have been set up along the longitudinal profile of Basantar River. Station 1 (S_1) is situated about 2 km upstream from Samba bridge where least human activity is present While Station 2 (S_2) is located 3km downstream from S_1 where SIDCO nullah joins the stream, bringing sewage, solid wastes and industrial effluents of Samba City and industries.

METHODOLOGY

The water samples were collected from both the stations established on Basantar river from May 2013 to April 2014 for four seasons viz. Summer (March to June), Monsoon (July to August),Post Monsoon (September to October) and Winter (November to February). Utmost care was taken to avoid spilling of water and air bubbling at the time of sample collection. Some of the physico-chemical parameters including air temperature, water temperature, transparency, pH, Dissolved oxygen (DO), free carbon dioxide (FCO_2), calcium and magnesium were determined on spot. While other parameters including Conductivity, Total dissolved solids (TSS), Nitrates, Phosphates, Biological oxygen demand, were analyzed in the laboratory within five to six hours of collection. The physico-chemical parameters of water were analyzed according to standard methodology (APHA, 2005) and their results were analyzed and compared with various drinking water standards (WHO, CPCB and ICMR).

STATISTICAL ANALYSIS

The collected data were analyzed by using MS EXCEL 2007, where the mean and standard deviation were calculated while Pearson correlation coefficient among physico-chemical properties of water was computed using SPSS 18.0.

Figure 1: Location of Study Sites within Basantar River

RESULTS AND DISCUSSION

The results of physicochemical parameters observed during different seasons at Station I and II of Basantar river are given in table I & table II respectively.

The minimum and maximum air temperature of station I range from 24.1- 40.8^{0}C,while that of Station II ranges from 24.6-41.2^{0}C. Similarly the minimum and maximum water temperature of Station I range from 15.2-28.3^{0}C. While that of Station II ranges from 15.8-29.2^{0}C. Temperature remained high during March-June followed by a decline thereafter. Air and water temperature remained very low during winters viz. November-February. High air temperature noticed during the summer season may be attributed to the increased photoperiod and longer day length while lowest during the winter season may be due to shorter photoperiod and shorter day length. Further water temperature closely followed air temperature there by indicating that the samples collected from shallow zone have direct relevance with air temperature as also demonstrated by Welch (1951) that shallow water reacts quickly with changes in atmospheric temperature.

Transparency has direct bearing on the light penetration of water and depends upon suspended matter and dissolved colored substances. During the present study period, the transparency value recorded ranges from 86.4 to 171.3 cm at Station I while that of Station II ranges from 72.4 to 112.4 cm. The higher values recorded during summer and winter season were due to settled silt, clay and less suspended matter, whereas lower values were found in monsoon season due to mud and silt brought by rain water in the river, anthropogenic activities such as deforestation in the catchment area and sand collection from the river. Similar results were observed by Lendhe and Yeragi (2004) in Tansa River, Thane during monsoon season.

pH is the indicator of acidic or alkaline condition of water status and provides information about various geochemical equilibrium. It is important in determining the corrosive nature of water. Lower the pH value, higher is the corrosive nature of water. During the present study period, pH showed a narrow annual variation at both the stations. An inverse relationship of pH with free CO_2 (Welch, 1951; Hutchinson, 1957; Schwoerbell, 1970; Cole, 1975; Reid and Wood, 1976; Jhingram, 1991 and Wetzel 2000) may explain low pH recorded during March to June along with high free carbon dioxide. pH of water remains alkaline throughout the year at station I and it ranged between 7.2-8.6.While at station II pH value ranged from 5.9-7.1 which was slightly acidic because of anthropogenic load from the nearby localities. Krishnaram *et al.*, (2007) documented that pH range of 6.7 to 8.4 is considered to be safe for aquatic life to maintain productivity and pH below 4.0 and above 9.6 found hazardous to life.

Dissolved Oxygen(DO) is one of the important parameters in water quality assessment. Its presence is essential to maintain variety of forms of life in the water and the effect of waste discharge in a water body are largely determined by the oxygen balance of the system. It is a critical water quality parameter for characterizing the health of an aquatic ecosystem and reflects the physical, chemical and biological processes prevailing in water (Dirican *et al*., 2009). Its correlation with water body gives direct and indirect information e.g. bacterial activity, photosynthesis, availability of nutrients, stratification etc. (Premlata & Vikal, 2009). In the present study the value of DO ranges from 8.2 to 9.9 mg l-1at station I and for station II it ranges from 3.8 to 5.2 mg l-1. DO showed highest records during winters and lowest during summers. Higher values of DO can be attributed to low temperature which has higher oxygen retention capacity and also increase solubility of gases in water. While rise in temperature lowers the oxygen retention capacity of water and thereby results in low value of DO during summer. Further, it increases the rate of decomposition of organic matter involving the rapid utilization of oxygen. The results are in agreement with Jameel (1998).

Carbon dioxide is the end product of organic carbon degradation in almost all aquatic environments and its variation is often a measure of net ecosystem metabolism (Smith 1997, Hopkinson 1985). The amount of Free CO_2 of water depends upon the water temperature, rate of respiration, decomposition of organic matter and geographical features of the terrain surrounding the water body. An inverse relationship between DO and FCO_2 was recorded at both stations I & II. The FCO_2 value ranges from 3.6 to 5.4 mg l^{-1} at Station I and from 16.30 to 22.10 mg l^{-1} at Station II. High values of FCO_2 were found in summer season which may be due to the increased microbial decomposition of dead organic matter at high water temperature utilizing dissolved oxygen and liberating carbon dioxide and reduced spring water discharge.

Carbonates and bicarbonates contributes to alkalinity of water body i.e. act as buffering capacity of a river water to resist changes in pH. pH has direct relationship with alkalinity as reported by Bharadwaj and Sharma, (1999). Carbonates were found to be absent at both the stations. While Bicarbonates were recorded in higher concentrations at station II and low at station I. The value of bicarbonates at station I ranged from 83.40 to158.0 mg l-1 while at Station II ranged from 116.4 to 148.6 mg l^{-1}. High values of bicarbonates were found in monsoon and summer season due to decomposition and oxidation of anthropogenic pollutants and to some extent weathering of underlying rocks by river.

Further, this is in conformity with the findings of Sankar *et al*., (2002) who explained that during summer increased concentration of salts in water was due to evaporation.

Calcium and magnesium dissolved in water are the two most common minerals that contribute to the hardness of water (Shrivastava and Patil, 2002). In the present study, low value of calcium was recorded at station 1 and found to fluctuate between 25.2 to 47.0 mg l^{-1} while high values of calcium was recorded at station II and ranged between 42.40 to 57.60 mg l-. High values of calcium at station II is due to discharge of domestic sewage from nearby localities, washing, dumping of waste material from adjoining industrial houses.

The range of Magnesium at station I & II was found to vary between 16.25 to 24.35 mg l^{-1} and 32.6 to 48.4 mg l^{-1} respectively. High value of magnesium was recorded at Station II which is probably due to regular addition of large quantities of sewage and detergent into river from the nearby industrial localities and residential area nearby the site. Similar observation was made by Kaur *et al.*, (1996).

Nitrates are formed in water due to oxidation of ammonia by bacterial action and their presence indicates that nitrogenous organic matter is under nitrification. The observed range of nitrate for station I was found between 0.75-2.48 mg l^{-1} while for station II the observed range was 3.45-6.50 mg l^{-1}. The high values of nitrate at station II was due to excessive agricultural runoff, domestic effluents, sewage disposal and industrial discharges. These results are in conformity with Makhijani and Manoharan, (1999).

Biochemical Oxygen Demand (BOD) is an index of organic pollution to measure the amount of DO required by microbial community in decomposing the organic matter present in a water sample by aerobic biochemical action. Presence of variable amount of sewage and biodegradable dead organic matter during different seasons may explain a wide annual variation in BOD. In the present study The BOD value ranges between 3.24- 4.52 mg l^{-1} and 9.85 -16.80 mg l^{-1} at Station I and Station II respectively and an inverse relationship between DO and BOD was recorded at the both stations I &II. Decreased oxygen solubility at high temperature and high microbial activity during summer season may explain high observation of BOD at both the stations. On the other hand, increased oxygen solubility at low temperature and reduced microbial activity during winter may explain low observation of BOD at both stations. Tiwari *et al*., (2005) observed high level of BOD in river Ganga at Bihar due to sewage contamination.

Phosphate is considered to be a significant nutrient responsible for eutrophication of the water body and high concentration of it is an indication of eutrophy. In the present study, the amount of phosphate recorded ranges between 0.10 to 0.28 mg l^{-1} at Station I and between 1.86 to 4.63 mg l^{-1} at Station II. The minimum amount was recorded during winter season and maximum amount during summer season. High values during summer may be due to influx of sewage effluents, detergents, human waste and decomposed organic matter. This is further supported by the findings of Kannan and Job (1979) and Mishra *et al*., (2008).

Electrical conductivity is a measure of capacity of a solution to conduct electrical current through it and depends on the concentration of ions. The conductivity serves as a good and rapid measure of the total dissolved solids in water. Higher the value of dissolved solids, greater is the amount of ions in water (Bhatt *et al,* 1999). The values of Electrical conductivity range between 122.4-158.25µS.cm^{-1} for station I and between 312.2- 435.25 µS.cm^{-1} for station II. In the present study lowest value of conductivity was found in post monsoon season and highest in monsoon season. Low conductivity value at station I may be due to absence of anthropogenic stress. Similar result was observed by Prasad (2005) in a canal of Krishna river near delta region.

Water with high total dissolved solids (TDS) indicated more ionic concentration which is of inferior palatability and can induce unfavorable physicochemical reactions. High content of dissolved solids elevate density of water, influence osmoregulation and reduce gas solubility and utility of water for drinking, irrigation and industries as reported by Edmondson (1959). In the present study total dissolved solids (TDS) values ranges between 106.30- 214.25 mgl^{-1} at station I slightly while at Station II these values ranges between 385.10-475.10 $mgl^{-1}$and. High levels of suspended solids were observed due to pouring of sewage in the river at Station II from nearby industrial area.

Table I: Physico-chemical parameters observed from May 2013 to April 2014 (Station I)

S.No	Parameters	Units	Seasons				Range	Mean ± S.D
			Summer	Monsoon	Post Monsoon	Winter		
1.	Air temp	^0C	40.8	36.7	35.3	24.1	24.1-40.8	34.23 ±7.14
2.	Water temp	^0C	28.3	23.2	24.7	15.2	15.2-28.3	22.85±5.53
3.	Transparency	cm	153.4	86.4	122.7	171.3	86.4-171.3	133.45± 37.23
4.	pH	-	7.5	7.9	7.2	8.6	7.2-8.6	7.8 ± 0.60
5.	DO	mg l^{-1}	8.5	8.7	8.2	9.9	8.2-9.9	8.8 ± 0.74
6.	FCO_2	mg l^{-1}	5.4	3.2	3.6	3.1	3.6-5.4	3.82 ± 1.07
7.	Conductivity	µS.cm^{-1}	132.4	158.25	122.4	138.6	122.4-158.25	137.91 ± 15.11
8.	Carbonates	mg l^{-1}	-	-	-	-	-	-
9.	Bicarbonates	mg l^{-1}	101.7	158.0	87.2	83.40	83.40 -158.0	107.57 ± 34.53
10.	Magnesium	mg l^{-1}	16.25	18.40	24.35	21.60	16.25- 24.35	20.15 ± 3.56
11.	Calcium	mg l^{-1}	29.50	47.0	32.15	25.2	25.2- 47.0	33.46 ± 9.47
12.	Phosphates	mg l^{-1}	0.28	0.16	0.10	0.17	0.10-0.28	0.18 ± 0.07
13.	Nitrates	mg l^{-1}	0.85	0.75	1.27	2.48	0.75-2.48	1.33 ± 0.79
14.	BOD	mg l^{-1}	4.52	3.82	4.10	3.24	3.24- 4.52	3.92 ± 0.54
15.	TDS	mg l^{-1}	167.4	214.25	137.8	106.30	106.30- 214.25	156.43 ± 45.91

Table II: Physico-chemical parameters observed from May2013 to April 2014 (Station II)

S.No	Parameters	Units	Seasons				Range	Mean ± S.D
			Summer	Monsoon	Post Monsoon	Winter		
1.	Air temp	^0C	41.2	36.8	35.7	24.6	24.6-41.2	34.57 ± 7.06
2.	Water temp	^0C	29.2	23.5	24.6	15.8	15.8-29.2	23.27 ±5.56
3.	Transparency	cm	118.4	72.4	102.2	112.4	72.4-112.4	101.35 ± 20.42
4.	pH	-	5.2	5.8	5.9	7.1	5.9-7.1	6.0 ± 0.80
5.	DO	mg l^{-1}	4.7	4.1	3.8	5.2	3.8-5.2	4.45 ± 0.62
6.	FCO_2	mg l^{-1}	22.10	17.30	16.75	16.30	16.30-22.10	18.11 ±2.69
7.	Conductivity	µS.cm^{-1}	356.40	435.25	312.20	322.10	312.2- 435.25	356.49 ± 55.82
8.	Carbonates	mg l^{-1}	-	-	-	-	--	-
9.	Bicarbonates	mg l^{-1}	132.4	148.6	126.2	116.4	116.4-148.6	130.9 ± 13.51
10.	Magnesium	mg l^{-1}	32.6	33.3	48.4	40.6	32.6- 48.4	38.72 ± 7.40
11.	Calcium	mg l^{-1}	43.25	57.60	49.20	42.40	42.40- 57.60	48.11 ± 7.01
12.	Phosphates	mg l^{-1}	4.63	3.24	2.60	1.86	1.86-4.63	3.08 ± 1.17
13.	Nitrates	mg l^{-1}	4.20	5.75	3.45	6.50	3.45-6.50	4.97 ± 1.40
14.	BOD	mg l^{-1}	16.80	14.42	11.20	9.85	9.85 -16.80	13.06 ± 3.14
15.	TDS	mg l^{-1}	404.20	475.10	385.10	395.50	385.10-475.10	414.97 ± 40.84

Significant correlation(Table 3&4) among various parameters at Station 1 revealed that there is a positive correlation between air temperature and water temperature, Transparency and pH, Transparency and D.O., FCO_2 and Water temperature, FCO_2 and Transparency, Bicarbonates and Water temperature, B.O.D and Transparency, B.O.D and pH and B.O.D &D.O. while negative correlation is found between air temperature and Transparency, water temperature and Transparency, pH and Water temperature, D.O and Water temperature, FCO_2 and pH, FCO_2 and D.O., B.O.D and FCO_2, B.O.D and Water temperature. Similarly at Station II positive correlation is found between water temperature and air temperature, transparency and water temperature, pH and Transparency, D.O and pH, D.O and Transparency, FCO_2 and water temperature, FCO_2 and D.O., Electrical conductivity and pH, B.O.D. and Electrical conductivity while negative correlation is found between Transparency and air temperature, pH and water temperature, D.O and water temperature, FCO_2 and pH, Electrical conductivity and FCO2, B.O.D and pH and between B.O.D and D.O. respectively.

Table III: Correlation coefficient among different physico-chemical parameters at Station I of Basantar River

Parameters	AT	WT	TRA	pH	D.O	FCo_2	EC	Co_3^{2-}	HCo_3^-	Mg^{2+}	Ca^{2+}	Po_4^{3-}	No_3^-	BOD	TDS
AT	1														
WT	.980*	1													
TRA	-.476	-.352	1												
pH	-.681	-.676	.781	1											
D.O	-.877	-.905	.562	.916	1										
FCo_2	.693	.759	.299	-.051	-.447	1									
EC	-.311	-.216	-.144	-.421	-.185	-.536	1								
Co_3^{2-}	a	a	a	a	a	a	a	a							
HCo_3^-	.310	.141	-.941	-.526	-.285	-.403	-.063	a	1						
Mg^{2+}	-.526	-.426	.036	-.189	.053	-.615	.970*	a	-.186	1					
Ca^{2+}	.442	.280	-.959*	-.598	-.400	-.276	-.106	a	.990*	-.254	1				
Po_4^{3-}	.388	.375	.408	.411	.055	.810	-.904	a	-.300	-.881	-.225	1			
No_3^-	-.958*	-.890	.697	.750	.846	-.475	.284	a	-.570	.507	-.681	-.241	1		
BOD	-.921	-.898	.199	.342	.638	-.859	.623	a	-.121	.777	-.253	-.715	.831	1	
TDS	.549	.423	-.996**	-.790	-.603	-.214	.076	a	.934	-.112	.963*	-.329	-.758	-.287	1

** Correlation is significant at the 0.01 level (2-tailed) * Correlation is significant at the 0.05 level (2-tailed) a- cannot be computed because at least one of the variable is constant. AT=air temperature, WT = water temperature, TRA= transparency, D.O = dissolved oxygen, FCO_2= free carbon dioxide, Co_3^{2-}= carbonate, HCo_3-= bicarbonate, Ca^{2+}= calcium, Mg^{2+}= magnesium, Cl- = chloride, BOD=biological oxygen demand, Po_4^{3-} = phosphate, So_4^{2-} = sulphate, No_3- = nitrate, TDS = total dissolved solids, EC =electrical conductivity and TSS = total suspended solids.

Table IV: Correlation coefficient among different physico-chemical parameters at Station II of Basantar River

Parameters	AT	WT	TRA	pH	D.O	FCo_2	EC	Co_3^{2-}	HCo_3^-	Mg^{2+}	Ca^{2+}	Po_4^{3-}	No_3^-	BOD	TDS
AT	1														
WT	.983*	1													
TRA	-.140	.038	1												
pH	-.998**	-.990*	.087	1											
D.O	-.554	-.486	.578	.510	1										
FCo_2	.722	.784	.427	-.761	.160	1									
EC	-.200	-.117	.223	.213	-.424	-.462	1								
Co_3^{2-}	a	a	a	a	a	a	a	a							
HCo_3^-	.659	.510	-.786	-.627	-.539	.223	-.532	a	1						
Mg^{2+}	-.386	-.314	.180	.401	-.326	-.613	.979*	a	-.593	1					
Ca^{2+}	.317	.149	-.977*	-.263	-.725	-.322	-.142	a	.839	-.141	1				
Po_4^{3-}	.893	.903	.110	-.914	-.123	.940	-.498	a	.527	-.663	.017	1			
No_3^-	-.687	-.765	-.235	.688	.638	-.391	-.547	a	-.042	-.366	.026	-.448	1		
BOD	.405	.348	-.537	-.359	-.982*	-.308	.568	a	.395	.490	.671	-.049	-.616	1	
TDS	-.727	-.426	.069	.686	-.817	-.657	.985	a	-.641	.998*	.002	-.806	-.681	.873	1

** Correlation is significant at the 0.01 level (2-tailed) * Correlation is significant at the 0.05 level (2-tailed) a- cannot be computed because at least one of the variable is constant. AT=air temperature, WT = water temperature, TRA= transparency, D.O = dissolved oxygen, FCO_2= free carbon dioxide, Co_3^2-= carbonate, HCo_3-= bicarbonate, Ca^{2+}= calcium, Mg^{2+}= magnesium, Cl- = chloride, BOD=biological oxygen demand, Po_4^{3-} = phosphate, So_4^{2-} = sulphate, No_3- = nitrate, TDS = total dissolved solids, EC =electrical conductivity and TSS = total suspended solids.

Table V: Summary analyzed parameters and guideline values as per WHO BIS & ICMR standard

S.no	Parameters	Units	Variation of Range		WHO Limits	Desirable Limits of BIS	Desirable Limits of ICMR
			Station 1 (S_1)	Station 2 (S_2)			
1.	Air temp	^0C	24.1-40.8	24.6-41.2	-	-	-
2.	Water temp	^0C	15.2-28.3	15.8-29.2	-	-	-
3.	Transparency	cm	86.4-171.3	72.4-112.4	-	-	-
4.	pH	-	7.2-8.6	5.9-7.1	6.5-8.5	6.5-8.5	6.5-9.2
5.	DO	mg l^{-1}	8.2-9.9	3.8-5.2	4.0	6.0	5.0
6.	FCO_2	mg l^{-1}	3.6-5.4	16.30-22.10	-	-	-
7.	Conductivity	µS.cm^{-1}	122.4-158.25	312.2- 435.25	750	-	300
8.	Total Hardness	mg l^{-1}	83.40-158.0	126.4-148.6	300	300	200
9.	Magnesium	mg l^{-1}	16.25- 24.35	32.6- 48.4	50	30	50
10.	Calcium	mg l^{-1}	25.2- 47.0	42.40- 57.60	100	75	75
11.	Phosphates	mg l^{-1}	0.10-0.28	2.86-4.63	> 0.5	-	-
12.	Nitrates	mg l^{-1}	0.75-2.48	13.45-17.50	10-45	45	20
13.	BOD	mg l^{-1}	3.24- 4.52	11.20-16.80	6	2.0	5
14.	TDS	mg l^{-1}	106.30- 214.25	395.50-475.10	600	-	500

The water quality of Basantar River when compared with national and international standards of drinking water quality (Table V) clearly reveals that parameters viz. pH, DO, BOD and Magnesium are not within the permissible levels of drinking water standards whereas other water quality parameters show narrow range with standard limits at station II. This reveals that Site II has anthropogenic stress as evidenced by water quality deterioration and its water has become unfit for human consumption, fisheries and irrigation purposes. To protect this river ecosystem there should be a proper management and regulation of industrial wastes (SIDCO complex) and nearby domestic discharge.

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