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Water quality assessment of three tributaries of Beas drainage system in Himachal Pradesh in upper reaches of Himalayan region

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ABSTRACT : Himachal Pradesh is a hill state in Western Himalayas, located between 30°22 to 33°12 North latitude and 75°47 to 79°4 East longitudes. Beas is one of important river of Himachal Pradesh which originates at an elevation of 14,308 feet (4361m) in the Rohtang glacier at Beas Kund (Lahul-Spiti). River Beas comprises a stretch of 923 Kms including 297 Kms main river and 623 Kms of its tributaries. Recent reviews indicates that land degradation, forest loss, biodiversity and habitat degradation and pollution of fresh water are increasing hence this limnobiological study of three tributaries of Beas drainage system is an integrated approach to assess the water quality of tributaries of River Beas in Palampur. The present investigations consist of the analysis of important water quality parameters. Samples were collected between 9am -10am from site I, site II and site III (Poon, Awa, Mole) fortnightly and subjected for analysis in the laboratory by Following the Standard Methods for Examination of Water & Waste Water (APHA, 1995) It is suggested that, water of all three tributaries viz. site I (Poon), Site II (Awa) and Site III (Mole) was found suitable for drinking purpose and will be helpful to solve the problem of drinking water in metropolitan cities. This can be supplied as drinking water after primary treatment at national level.

Keywords : Land degradation, Forest loss, Biodiversity and Phytoplankton

INTRODUCTION

In aquatic ecosystems the phytoplankton constitutes a vital link in the food chain. The planktons are essential organisms to understand the basic nature and economy of the fresh water bodies. Changes in season influence the physio-chemical condition of aquatic bodies which in turn influence the phytoplankton dynamics (Sarkar and Sen, 1975; Moitra and Mukharjee, 1972; Bhoumik, 1993).Though a plenty of work has been done on the seasonal variation of plankton by a number of Indian workers (Ganapati, 1942; George, 1961; Saha *et. al.*, 1971; Khan and Saddique, 1974; Kohli *et. al.*, 1982; Sarkar *et al.*,1985; Bhoumik, 1987 and Wishard *et. al.*, 1988). Hitherto, nothing about planktons from these tributaries of river Beas in Palampur of Himachal Pradesh is known till date. Himachal Pradesh is a hill state in Western Himalayas, located between 30°22 to 33°12 North latitude and 75°47 to 79°4 East longitudes. It has varied type of water resources like glacier fed rivers, snow fed tributaries, natural lakes, man made reservoirs and many other seasonal water bodies. Beas is one of important river of Himachal Pradesh which originates at an elevation of 14,308 feet (4361m) in the Rohtang glacier at Beas Kund (Lahul-Spiti). River Beas along with its tributaries comprises a stretch of 923 Kms. including 297 Kms. main river and 623 Kms. of its tributaries. Study of some tributaries of river Beas has been done by Dhanze and Dhanze (2002); Chauhan (2002). Recent reviews indicates that land degradation, forest loss, biodiversity and habitat degradation, scarcity and pollution of fresh water are increasing hence this limnobiological study of three tributaries of Beas drainage system is an integrated approach to assess the water quality of River Beas. The investigations have been made to know the ecological condition of the fresh water tributaries of River Beas.

Fig.1. Study site I (Poon Tributary).

Fig.2. Study site II (Awa Tributary).

Fig.3. Study site III (Mole Tributary).

MATERIAL AND METHODS

The present investigations consist of the analysis of important water quality parameters which include Water temperature, Air temp., D.O., Conductivity, Free CO_2, Alkalinity, Chloride, Magnesium hardness, Calcium hardness, Water velocity, Silicates and TDS. Samples were collected between 9am -10am from site I, site II & site III (Poon, Awa, Mole) fortnightly and subjected for analysis in the laboratory by following the Standard Methods for Examination of Water and Waste Water (APHA, 1995). pH measured by using electronic pH analyzer, D.O., Free CO_2, Carbonates, Calcium, Magnesium and chloride measured by titration calorimetric methods and TDS by water analyzer Kit.

RESULTS AND DISCUSSIONS

The productivity of a water body largely governed by physical and chemical parameters viz. water current, temperature, TDS, Free CO_2, DO, Silicates, Magnesium, Calcium and Total hardness, Chloride and Conductivity. All these parameters were observed for post monsoon and winter (Aug., Sept. and Nov.). Air temperature varied from 13°C to 29°C in all three sites; out of which minima was observed at site III and maxima at site II. Temperature is one of the important and changing environmental factors directly influences some of aquatic reaction in aquatic ecosystem and thus becomes an important physical parameter which regulates the self purification capacity of river and reservoir. Minimum water temperature was recorded 11°C at site III in November and maximum 24°C at site I and II during August which shows that temperature was high when day length was longer. The air temperature always found to be 2°C-4°C higher than that of water temperature. Hydrogen ion concentration (acidic) and hydroxyl ion concentration (alkaline) results from ionization of water. Change in hydrogen ion concentration brings change in hydroxyl ion concentration and vice versa. In pure water both hydrogen and hydroxyl ion are in equal concentration hence pure water is neither acidic nor basic. For natural water pH value ranges 4 to 9 depending upon the concentration of carbonates, bicarbonates and hydroxyl ion. Hence pH is used in the alkalinity and CO_2 measurement and in acid base equilibrium. pH was found maximum at site I and II *i.e.*, 8 and minimum was recorded at site III *i.e.*, 6. Alkalinity was also recorded maximum at site I it clearly indicates that as the pH value increases the alkalinity also increases. TDS is the measure of the amount of all kinds of solids (suspended, dissolved, volatile etc.) the concentration of TDS content usually ranges from 20mg/l to 100mg/l. In fresh water total dissolved solids are mainly composed of carbonates, bicarbonates, chlorides, nitrate, sulphate, phosphate, Ca, Mg, Na, Fe and Mn. As a rule hardness of water increases with increase in level of TDS. It is clear from the table I, II and III that the minimum TDS (32.1µmhos) was observed at site III and maximum (42µmhos) was observed at site I and II. Value of TDS was more in winter season than rainy season as the dissolved solids becomes more concentrated in winter due to evaporation and non-replacement of water. Conductivity is the measure of capacity of a substance to conduct the electric current and is reciprocal to resistance and is rapid method to measure TDS and is related to dissolve solids. Bhatt *et. al.*, (1999) stated that higher the value of TDS higher will be the value of Conductivity. Minimum conductivity was recorded at site III and maximum at site I *i.e.*, 20.8 and 27.36 µmhos. It clearly indicates that more ions are present in water of site I than site II and III. Alkalinity in natural water is formed due to dissolution of CO_2 in water or HCO_3 produced by the action of ground water on lime stone or chalk; measured value may also include contribution from borates, silicates, phosphates and other bases. The maximum alkalinity was observed at site I (36mg/l in Aug.) and minimum at site III (14mg/l in Aug). It gives indication that site I is more productive than rest of two sites. The alkalinity was maxim during rainy season (August) due to deposition of allachthonus material from nearby area. Alkalinity is directly proportional to pH. Dissolved Oxygen is a single limnological parameter speaks about the health of tropic status and productivity of a biotic system, it was maximum at site I(7.7mg/l), medium at site II(6.8mg/l) and minimum at site III(6.4mg/l). This indicates that why Mahseer is well flourishing at site I and II in comparison to site III. Free CO_2 is necessary to retain Ca in solution form of calcium bicarbonate. CO_2 is not appreciably toxic to fish; most species can survive for several days in water containing 60mg/l, provided DO should be in plenty. Maximum CO_2 was recorded at site I *i.e.*, 8.1mg/l and minimum was recorded at site II & III (3.92 and 4mg/l). It indicates that free CO_2 helps in photosynthesis in plants as the algae and aquatic plants were more at site I in comparison to II^{nd} and III^{rd} site. CO_2 is inversely proportional to temperature. Cl^- conc. beyond certain limit may cause osmoregulatory problems to aquatic organisms especially in fishes. Further its high concentration causes cardio vascular problem to organisms and gives bitter taste of water. Maxima of Cl^- was recorded at site I(9.3mg/l) and minima at site III(4.2mg/l) but the water of site I doesn't gives bitter taste as the Cl^- ion is dominated by Ca and Mg. Maximum (14.2mg/l) hardness was reported at site I and minimum (10mg/l) at site III. It also indicates that Ca and Mg both were also recorded max. in site I and II. Calcium is very important factor influencing metabolism and growth. Ca conc. up to 1800mg/l have been found not to impair any physiological reaction in man. Ca conc. in all three sites was in limit. Principle source of Mg in natural water is various kinds of rocks, sewage and industrial waste. The maxima recorded at site II and Minimum at I & III (2.77, 1.4 and 1.6mg/l.).

Table 1 : Various limnological parameters recorded at site I.

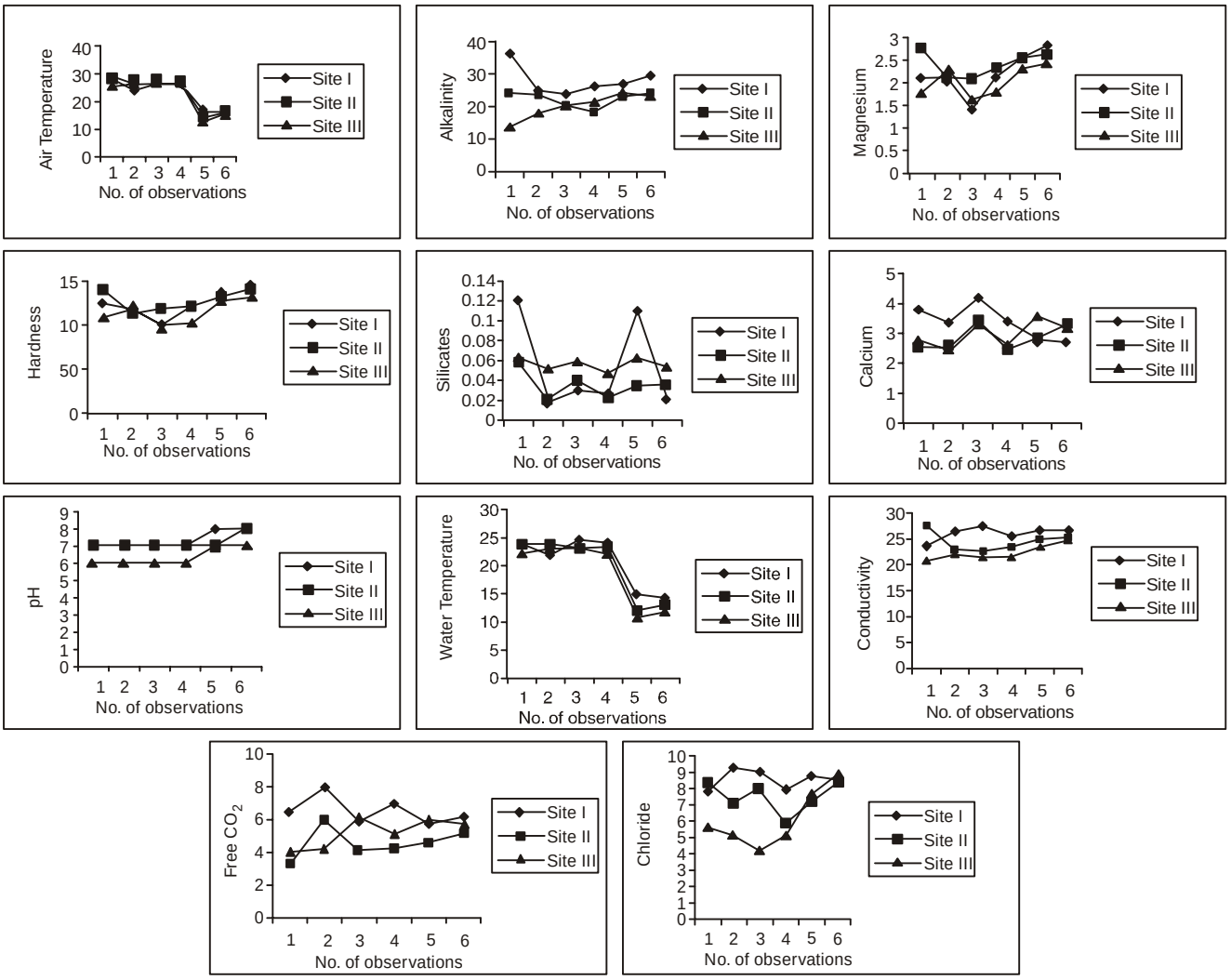
S.No.	Parameter	August		September		November		Min.	Max.	Mean
		I	II	I	II	I	II			
1	Water Temperature	24	22	24.5	24	15	14	14	24	20.5
2	Dissolved Oxygen	7.6	7.7	7.92	7.2	6.8	6.17	6.8	7.92	7.2
3	Air Temperature	28	24	27	27	16	16	16	28	23
4	pH	7	7	7	7	8	8	7	8	7.3
5	Conductivity	23.52	26.19	27.36	25.48	26.65	26.39	23.53	27.36	25.9
6	Free CO_2	6.40	8	6	7	5.8	6.1	5.8	8.1	6.66
7	Alkalinity	36	24.6	24	26	29.1	29.0	24.3	36	28.2
8	Chloride	8.0	9.3	9	8	8.7	8.5	8.0	9.3	8.6
9	Magnesium	2.09	2.05	1.4	2.09	2.54	2.76	1.4	2.052	2.15
10	Calcium	3.78	3.36	4.2	3.36	2.81	2.74	2.81	4.2	3.37
11	Total Hardness	12.40	11.8	10	12	13.29	14.12	10	14.12	12.26
12	Silica	0.220	0.020	0.031	0.026	0.110	0.021	0.020	0.220	0.071
13	Total Dissolved Solids	36.2	40.3	42.1	39.2	41	40.6	36.2	42.1	39.9

Table 2 : Various limnological parameters recorded at site II.

S.No.	Parameter	August		September		November		Min.	Max.	Mean
		I	II	I	II	I	II			
1	Water Temperature	24	24	23	23	12	13	12	24	19.83
2	Dissolved Oxygen	6.8	6.24	6.8	6.4	6.2	5.9	5.9	6.8	6.39
3	Air Temperature	29	27	27	27	15	16	15	29	23.5
4	pH	7	7	7	7	7	8	7	8	7.16
5	Conductivity	27.3	22.75	22.1	23.4	24.8	24.9	22.1	27.3	24.3
6	Free CO_2	3.29	6	4	4.2	4.6	5.1	3.92	6	4.03
7	Alkalinity	24	24	20	18	23	24	18	24	22.1
8	Chloride	8.2	7.1	8.0	5.8	7.1	8.4	5.8	8.4	7.4
9	Magnesium	2.77	2.10	2.05	2.30	2.55	2.62	2.05	2.77	2.39
10	Calcium	2.60	2.52	3.36	2.52	2.82	3.20	2.52	3.36	2.83
11	Total Hardness	14.0	11.2	11.8	12	13.2	14.0	11.2	14	12.7
12	Silica	.061	0.02	0.040	0.023	0.034	0.03	0.02	0.061	0.035
13	Total Dissolved Solids	42	35	34	36	38.02	38.4	34	42	37.2

Table 3 : Various limnological parameters recorded at site III.

S.No.	Parameter	August		September		November		Min.	Max.	Mean
		I	II	I	II	I	II			
1	Water Temperature	22	23	23	22	11	13	11	23	19
2	Dissolved Oxygen	5	6.4	6	6.2	5.0	6.3	5	6.4	5.8
3	Air Temperature	26	27	27	27	13.0	16	13	27	22.6
4	pH	6	6	6	6	7	7	6	7	6.3
5	Conductivity	20.8	22.1	21.58	21.45	23.4	24.7	20.8	24.7	22.3
6	Free CO_2	4	4.2	6.2	5.1	6.0	5.8	4	6.2	5.2
7	Alkalinity	14	18	20	21	24	23	14	24	20
8	Chloride	5.6	5.2	4.2	5.1	7.8	9.0	4.2	9.0	4.98
9	Magnesium	1.74	2.30	1.61	1.8	2.32	2.45	1.6	2.45	2.03
10	Calcium	2.8	2.52	3.36	2.62	3.56	3.21	2.52	3.56	3.01
11	Total Hardness	10.8	12	10	10.3	13.11	13.30	10	13.30	11.58
12	Silica	0.062	0.051	0.060	0.046	0.063	0.053	0.046	0.063	0.14
13	Total Dissolved Solids	32.1	34.0	33.2	33.0	36.0	38.12	38.12	32.1	34.4



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