



Water Quality characteristics of River Tons at District-Dehradun, Uttarakhand (India)

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Received: 14-03-2010

Accepted: 17-05-2010

Abstract

In the present research work an approach to assess the water quality status of Tons river at Dehradun (Uttarakhand) has been done during Jan 2008 to June 2008. The Tons is the largest tributary of the Yamuna and flows through Garhwal region in Uttarakhand, touching Himachal Pradesh. Its source lies in the 20,720 ft (6,315 meters) high Bandarpunch mountain, and is one of the most major perennial Indian Himalayan rivers. The parameters studied were temperature, velocity, TS, TDS, TSS, pH, free CO₂, DO, hardness, calcium, magnesium, BOD, COD, chloride and alkalinity. Except DO all the studied parameters showed higher range of values in summer period and lower values in winter period. On the other hand DO showed reversed pattern by revealing maximum values in winter which may be due to higher solubility of oxygen at lower ambient temperature. Water of river Tons is of alkaline in nature so far as pH is concerned. The average values of BOD, TS, hardness and alkalinity were observed beyond the standard limits. The presence of bacteria was clearly shown by the value of BOD which has gone beyond the standard limit that can affect public health by causing fatal diseases.

Keywords: BOD, Chloride, DO, Hardness, TDS

Introduction

The Tons is the largest tributary of the Yamuna and flows through Garhwal region in Uttarakhand, touching Himachal Pradesh. Its source lies in the 20,720 ft (6,315 meters) high Bandarpunch mountain, and is one of the most major perennial Indian Himalayan rivers. This river is mainly glacial fed having some tributaries named as Bhitral river, Kiarkuli river, Nalhota river, Noon river and Nimi river. In fact, it carries more water than the Yamuna itself. On its course, a large stretch of this River passes through the western part of Dehradun which is the capital of Uttarakhand state. Along its stretch in Dehradun there are situated Forest Research Institute Campus, Indian Military Academy Campus, cantonment area, a famous picnic spot named Robber's Cave and famous Tapkeshwar Mahadev temple. The Tons river merges into Yamuna river near Assan Barrage in Dehradun adjacent to the boundary of Uttarakhand and Himachal State. This

is an ultimate source of water for drinking and irrigation purpose for the people of near by Town and villages. Very few studies has been conducted to assess the water quality of Tons river till now. Due to the importance of river for the villagers and tourists this study has been conducted.

Materials and Method

Some of the physico-chemical parameters like TS, TDS, TSS, DO, BOD, COD, chloride, hardness, calcium, magnesium and alkalinity were observed in the laboratory. Temperature, velocity, pH, and free CO₂ were observed at the spot. Grab sampling collection method was adopted through out the study. Sampling preservation and analytical methods were adopted as per APHA (1998), Trivedi and Goel (1986), Khanna and Bhutiani (2004).

Results and Discussion

The average value of observed physico-chemical parameter of samples are given in Table-1 and 2 and shown in Fig. 1-8. The average values of temperature ranged between 11.50 ± 0.28 - 20.80 ± 0.23 . A more or less similar trend has been observed by Khanna and Bhutiani (2003) in the river Ganga at Haridwar and Khanna *et al.* (2008)

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in stream Nalhota at Dehradun. The value of velocity was observed between 0.99 ± 0.12 - 1.51 ± 0.05 m/s. Total solids, total dissolved solids and total suspended solids were found between 583.33 ± 109.71 - 1050.00 ± 200.23 mg/l, 186.66 ± 31.83 - 366.66 ± 28.86 mg/l and 350.00 ± 76.46 - 650.00 ± 150.17 mg/l respectively. Khanna and Bhutiani (2007) in River Suswa found same thing.

pH value fluctuated in between 7.50 ± 0.00 - 8.16 ± 0.16 . Singh *et al.* (2006) observed the same pattern in the River Ganges at Anupshahar, Bulandshar. The similar trend has been observed by Khanna *et al.* (2007) in Song. Dissolved oxygen and biochemical oxygen demand ranged between 10.12 ± 0.23 - 7.01 ± 0.75 mg/l and 2.15 ± 0.35 - 3.77 ± 0.35 mg/l respectively. Kulkarni *et al.* in Khushavati river at Quepem, Goa and Khaiwal *et al.* (2003) reported in the River Yamuna.

Table 1: Average value of physical parameters of Tons River from January 2008 to June 2008

Month Parameter	January	February	March	April	May	June	Average
Temperature (°C)	11.50 ± 0.28	12.60 ± 0.20	14.90 ± 0.14	17.70 ± 0.43	18.90 ± 0.14	20.80 ± 0.23	16.30 ± 4.05
Velocity (m/s)	0.99 ± 0.12	1.02 ± 0.09	1.16 ± 0.07	1.37 ± 0.01	1.42 ± 0.02	1.51 ± 0.05	1.24 ± 0.21
Total solid (mg/l)	583.33 ± 109.71	650.00 ± 100.11	716.66 ± 92.90	750.00 ± 173.20	786.66 ± 131.84	1050.00 ± 200.23	756.10 ± 161.25
TDS (mg/l)	186.66 ± 31.83	233.33 ± 33.36	266.66 ± 16.68	266.66 ± 16.68	283.33 ± 33.36	366.66 ± 28.86	267.21 ± 59.64
TSS (mg/l)	350.00 ± 76.46	400.00 ± 100.11	446.66 ± 92.90	500.00 ± 76.46	566.66 ± 92.90	650.00 ± 150.17	485.55 ± 110.48

Table 2: Average value of chemical parameters of Tons river from January 2008 to June 2008

Month Parameters	January	February	March	April	May	June	Average
pH	7.50 ± 0.00	7.83 ± 0.16	8.00 ± 0.00	8.00 ± 0.00	8.16 ± 0.16	8.16 ± 0.16	7.94 ± 0.09
Free CO ₂ (mg/l)	0.88 ± 0.25	1.00 ± 0.14	1.17 ± 0.14	1.46 ± 0.14	1.61 ± 0.25	1.90 ± 0.14	1.33 ± 0.38
DO (mg/l)	10.12 ± 0.23	9.58 ± 0.35	9.30 ± 0.39	8.77 ± 0.95	8.09 ± 0.61	7.01 ± 0.75	8.81 ± 1.12
Hardness (mg/l)	381.33 ± 8.11	385.33 ± 6.75	397.33 ± 4.37	400.00 ± 3.71	406.66 ± 5.03	409.33 ± 2.90	396.66 ± 11.27
Calcium (mg/l)	118.89 ± 2.91	122.24 ± 2.31	126.24 ± 2.00	127.58 ± 4.17	130.29 ± 4.05	132.26 ± 2.31	126.24 ± 4.98
Magnesium (mg/l)	45.00 ± 1.53	46.40 ± 0.69	46.97 ± 0.19	48.02 ± 0.20	48.71 ± 0.19	48.83 ± 0.10	47.32 ± 1.48
BOD (mg/l)	2.15 ± 0.35	2.83 ± 0.23	2.97 ± 0.35	3.17 ± 0.52	3.47 ± 0.61	3.77 ± 0.35	3.06 ± 0.56
COD (mg/l)	3.36 ± 0.09	3.52 ± 0.09	3.68 ± 0.18	4.16 ± 0.18	4.21 ± 0.13	4.42 ± 0.10	3.89 ± 0.42
Chloride (mg/l)	30.76 ± 31.71	31.71 ± 0.46	35.66 ± 1.78	37.49 ± 2.15	41.65 ± 1.24	43.54 ± 1.24	36.80 ± 5.15
Alkalinity (mg/l)	220.00 ± 7.64	228.33 ± 6.01	240.00 ± 7.64	241.66 ± 7.27	245.00 ± 8.67	250.00 ± 8.67	237.49 ± 11.19

The sample showed Chemical oxygen demand value in between 3.36 ± 0.09 - 4.42 ± 0.10 mg/l. Hardness, calcium and magnesium varied between 381.33 ± 8.11 - 409.33 ± 2.90 mg/l, 118.89 ± 2.91 - 132.26 ± 2.31 and 45.00 ± 1.53 - 48.83 ± 0.10 mg/l respectively. A similar trend has been found by Bhandari and Nayal. (2006) in the River Kosi in

Uttarkhand. Free CO₂ ranged between 0.88 ± 0.25 - 1.90 ± 0.14 mg/l. A similar trend has been found by Khanna *et al.* (2006) in river Suswa and Khanna *et al.* (2008) in stream Nalhota at Dehradun. Chloride was found between 30.76 ± 31.71 - 43.54 ± 1.24 mg/l. Alkalinity varied between 220.00 ± 7.64 - 250.00 ± 8.67 mg/l.



Khanna and Singh (2000) found similar trend in River Suswa in Raiwala. Except DO all the studied parameters showed higher range of values in summer period and lower values in winter period. On the other hand DO showed reversed pattern by revealing maximum values in winter which may be due to higher solubility of oxygen at lower ambient temperature. Water of river Tons is of alkaline so far as pH is concerned. . The average value of pH, DO, COD and Chloride were obtained with in the prescribed tolerance limits of drinking purpose (BIS-1991) where the average values of BOD, TS, hardness and Alkalinity were observed beyond the standard limits. The presence of bacteria was clearly shown by the value of BOD which has gone beyond the standard limit that can affect public health by causing fatal diseases. Indian standards of drinking water (BIS-1991) are given in table-3.

Table-3: Standard limits of drinking water in terms of physico-chemical parameters

Parameters	Desirable limit
pH	6.5-8.5
TS (mg/l)	500
DO (mg/l)	>6.0
BOD	2.0
Hardness (mg/l)	300.0
Calcium hardness (mg/l)	75.0-200.0
Magnesium hardness (mg/l)	30.0-100.0
Alkalinity (mg/l)	<200.0
Chloride (mg/l)	250.0

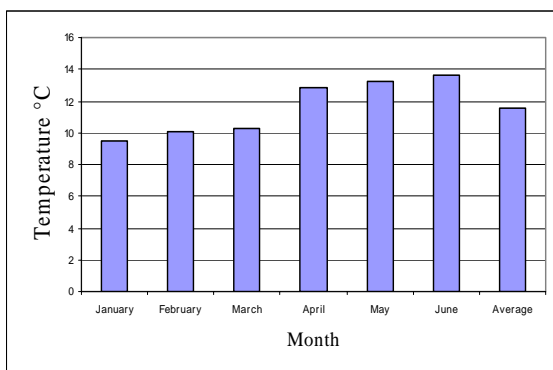


Fig. 1: Monthly fluctuation in Temperature °C

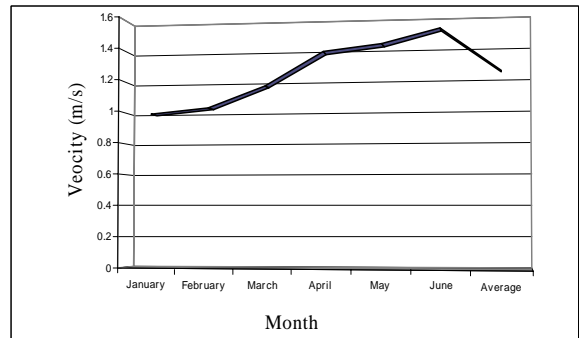


Fig. 2: Monthly fluctuation in Velocity (m/s)

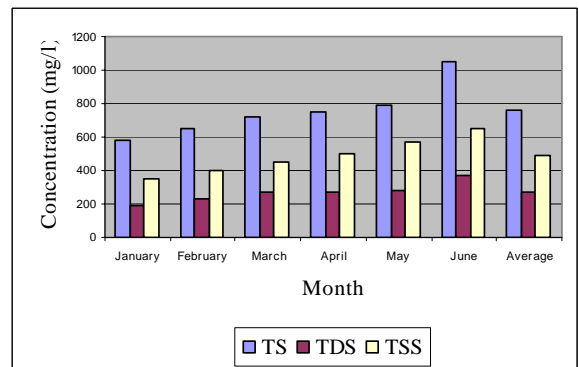


Fig 3: Monthly fluctuation in Total solid, TDS and TSS (mg/l)

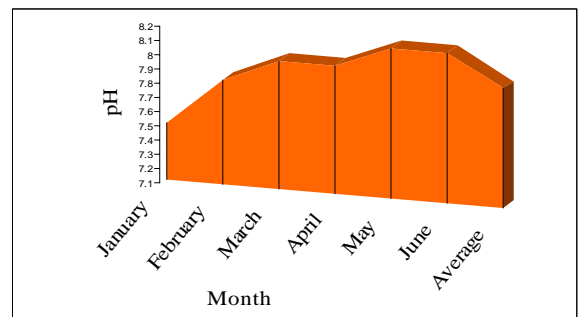


Fig. 4: Monthly fluctuation in pH

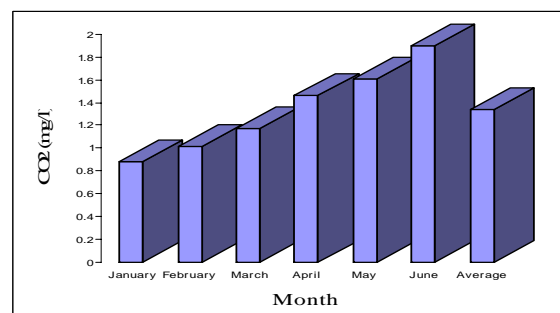


Fig. 5: Monthly fluctuation in Free CO₂ (mg/l)



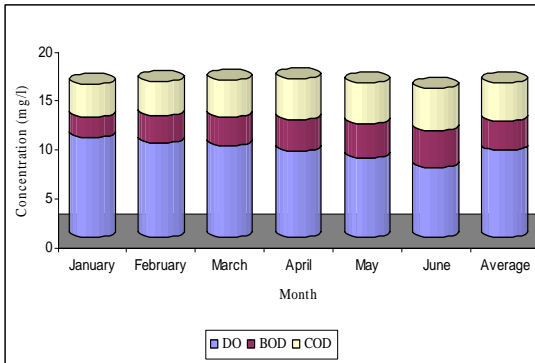


Fig. 6: Monthly fluctuation in DO, BOD and COD (mg/l)

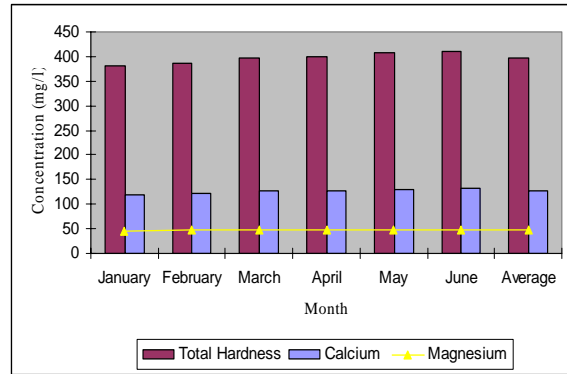


Fig. 7: Monthly fluctuation in Total Hardness, Calcium and Magnesium (mg/l)

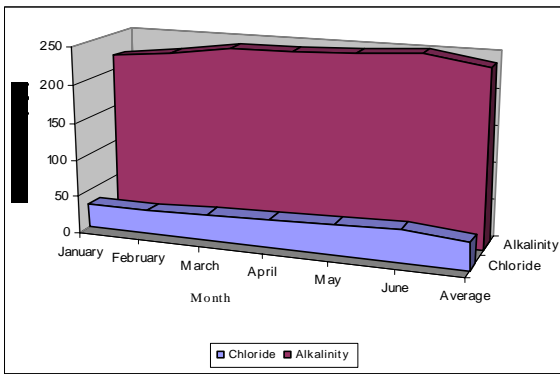


Fig. 8: Monthly fluctuation in Chloride and Alkalinity (mg/l)

The correlation coefficients among the different parameters are presented in Table 4. The analysis show the high degree positive correlation of temperature with other parameters except DO. Besides this the high degree positive correlation was also found between velocity and TSS, velocity and CO₂, velocity and hardness, velocity and calcium, velocity and BOD, velocity and COD, velocity and chloride, velocity and alkalinity, TS and TSS, TS and TDS, TS and CO₂, TS and Chloride, TDS and TSS, TDS and CO₂, TDS and hardness, TDS and calcium, TDS and BOD, TDS and chloride, TDS and alkalinity, TSS and CO₂,

Table 4- Correlation coefficient among the different Parameters

	Temperature	Velocity	TS	TDS	TSS	pH	CO ₂	DO	Hardness	Calcium	Magnesium	BOD	COD	Chloride	Alkalinity
Temperature	00.00	0.99	0.90	0.92	0.98	0.92	0.99	-0.96	0.99	0.99	0.96	0.95	0.99	0.98	0.98
Velocity		00.00	0.87	0.87	0.96	0.86	0.98	-0.94	0.96	0.96	0.45	0.92	0.99	0.92	0.93
TS			00.00	0.98	0.95	0.77	0.93	-0.96	0.86	0.88	0.82	0.89	0.87	0.90	0.86
TDS				00.00	0.95	0.86	0.93	-0.96	0.90	0.93	0.88	0.94	0.88	0.91	0.92
TSS					00.00	0.88	0.99	-0.99	0.97	0.44	0.96	0.96	0.92	0.92	0.93
pH						00.00	0.86	-0.85	0.94	0.96	0.45	0.96	0.87	0.84	0.96
CO ₂							00.00	-0.98	0.95	0.96	0.94	0.94	0.98	0.98	0.93
DO								00.00	-0.92	-0.94	-0.42	-0.94	-0.94	-0.90	-0.90
Hardness									00.00	0.99	0.96	0.94	0.95	0.98	0.98
Calcium										00.00	0.98	0.97	0.95	0.97	0.99
Magnesium											00.00	0.48	0.45	0.71	0.45
BOD												00.0	0.93	0.89	0.96
COD													00.00	0.90	0.92
Chloride														00.00	0.88
Alkalinity															00.00

TSS and hardness, TSS and calcium, TSS and BOD, TSS and COD, TSS and chloride, TSS and alkalinity, pH and hardness, pH and calcium, pH

and BOD, pH and alkalinity, Free CO₂ and hardness, Free CO₂ and Calcium, Free CO₂ and magnesium, Free CO₂ and BOD, Free CO₂ and COD, Free CO₂ and chloride, Free CO₂ and



alkalinity, hardness and calcium, hardness and magnesium, hardness and BOD, hardness and COD, hardness and chloride, hardness and alkalinity, calcium and magnesium, calcium and BOD, calcium and COD, calcium and chloride, calcium and alkalinity, BOD and COD, BOD and alkalinity, COD and chloride, COD and alkalinity. The analysis shows the high degree negative correlation of DO with all other parameters. The statistical analysis of present study shows the correlation coefficient among the parameters was negative 14 times and positive 91 times. This study indicated the dominancy of positive correlation.

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