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WATER QUALITY AND POLLUTION STATUS OF RAWASAN STREAM IN GARHWAL HIMALAYA, UTTARAKHAND, INDIA

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Abstract

To understand the water quality statuses of Rawasan stream, the physico-chemical characteristics of stream water was studied in five different selected sites for an interval of two years (Aug 2013 to July 015). Analysis observation reveals variation in the average value of air temperature (18.48 ± 1.07 °C to 34.96 ± 59 °C), water temperature (15.2 ± 0.46 °C to 27.6 ± 1.17 °C), water velocity (0.27 ± 0.06 m//sec to and 0.65 ± 0.0), DO mean value 8.9 ± 1.5 mg/l to 11.9 ± 1.14), turbidity (0.40 ± 0.07 NTU to 80.5 ± 1.95 NTU), pH value (7.4 ± 0.24 in to 8.4 ± 0.17), total alkalinity (31 ± 1.12 ppm in August 2013 to 67.6 ± 1.03 ppm), Hardness (46.2 ± 2.94 ppm to 85.2 ± 9.71 ppm) and average free carbon dioxide (0.02 ± 0.2 mg/l to 0.7 ± 0.27 mg/l). From the overall analysis it was observed that fluctuations in the value of different parameters season dependent. Rawasan stream was observed as conducive for aquatic biota.

INTRODUCTION:

The present study is carried out in an important tributary of River Ganga in District Pauri Garhwal. Geographically, the Rawasan stream is bounded by $29^{\circ}55'33.82''N$ and $78^{\circ}26'42.41''E$. This stream has its origin from the Kher-Pokhri Danda (1,130m asl). The study on Rawasan stream in different sites downstream (Narikatal (S1), Jarpani (S2), Seela (S3), Pupaldanga, Madhan (S5) extended up to 30 km from its upper tributary known as Sateri sot. Jarpani sot is another important sub-tributary of the Rawasan stream meeting it near Padyana. Below the junction of the Sateri and the Jarpani the stream is called Rawasan and flows toward Southwest throughout its course. The stream reaches in the Bhabar track near Laldhang and flows towards South and Southwest, meeting the Holy River Ganga at Tantwala in Amsot Block. The study is aimed to analyze the water quality as this is a highly productive stream and play an important role as breeding and nursery ground for many fish and other benthic communities. The regular and periodic change in the climate synchronized with season and anthropogenic activity ultimately influence the abiotic and biotic nature of the river water and directly or indirectly affect the productivity of that river.

Good quality of water resources depends upon on a large number of physico-chemical characteristics and the magnitude of the source of pollution. Many authors have studies the physico-chemical characteristic of water in Uttarakhand (Sharma 1984; Singh et al. 1994; Agarwal et al. 2003; Sharma et al. 2007; Khanna et al. 2010; Madan 2013; Kumar and Saini 2014; Balodi et al. 2014; Matta 2014; Kumar and Rani 2015; Balodi and Koshal 2015; Pramod and Shweta, 2015). Hence, the present study was conducted to study the physico-chemical characteristic to assess the water quality of Rawasan stream.

MATERIALS AND METHODS:

Water sample were collected in BOD bottles from the selected sites (from Aug 2013 to July2015). The monthly samples of subsurface water were collected during the first week of each month in the early hours of the day i.e. between 7 AM to 9 AM. Utmost care was taken to avoid spilling of water and air bubbling at the time of sample collection and brought to the laboratory for the analysis of various parameters. Temperature and pH was recorded on the site with the help of digital pen type temperature and pH meter and free carbon dioxide was also analysis on the spot by titrimetric method. DO was fixed on the sampling site with magnanous sulphate and alkali-iodiade-azide for further analysis in lab. The physico-chemical characteristics of water were analyzed according to the standard methods of Welch (1948) and APHA (2012).

RESULTS AND DISCUSSION:

The physico-chemical characteristics provide a fair idea of the water quality in any water body. These characteristics generally depend upon the environmental conditions and the composition of water as well as the pollution sources near the water. Figure 1 showing variations in different ecological parameters of Rawasan stream during different months (2013-15).

Air temperature (AT): In present study the air temperature fluctuated between (34.96 ± 0.59 to 18.48 ± 1.07) with maximum in July 2014 and minimum in December 2014. The fluctuation in air temperature followed a seasonal climatic pattern, as data revealed high temperature during summer months (May, June and July), moderate during monsoon months (August, September and October), while the lowest temperature recorded in winter months (December, January and February). Observation of air temperature were found in close proximity with the results of Kanwal and Pathani (2012) as they had recorded the air temperature range (13.5°C to 33.0°C) at Petsal and Sironia Garh of Suyal river of Kumaun Himalaya Uttarakhand.

Water temperature (WT): Like the air temperature water temperature also shows the same trend of fluctuation during the study. Maximum water temperature was recorded (27.6 ± 1.17) in July 2015 and minimum (15.2 ± 0.46) in the month of February 2014. A fluctuation in water temperature leads to the disturbance of biodiversity of aquatic ecosystem. Water temperature showed an upward trend of increase from January to July and followed by down ward trend of decrease from July onwards. A similar trend has been observed by Chakrabarty et al. (1959) in river Yamuna.

Water velocity (WV): In the present study the water velocity ranged from 0.27 ± 0.06 m/sec to 0.65 ± 0.0 m/sec), similar result was observed by Verma (2013). The high and low velocity may be correlated with steeper and horizontal slopes due to altitudinal variation, but maximum water velocity in our study was observed in rainy months as was also observed by Sharma et al. (2007) in hill stream Chandrabhaga from Garhwal Himalaya and Singh et al. (2012) at hill stream Sidzii, tributary of Doyangriver Manipur.

Dissolved oxygen (DO): In present study for Rawasan stream DO is fluctuated between ranges from 8.9 ± 1.5 mg/l to 11.9 ± 1.14 mg/l. Increase in dissolved oxygen value during winter and decrease in summer, are well known characteristic features of aquatic ecosystem.

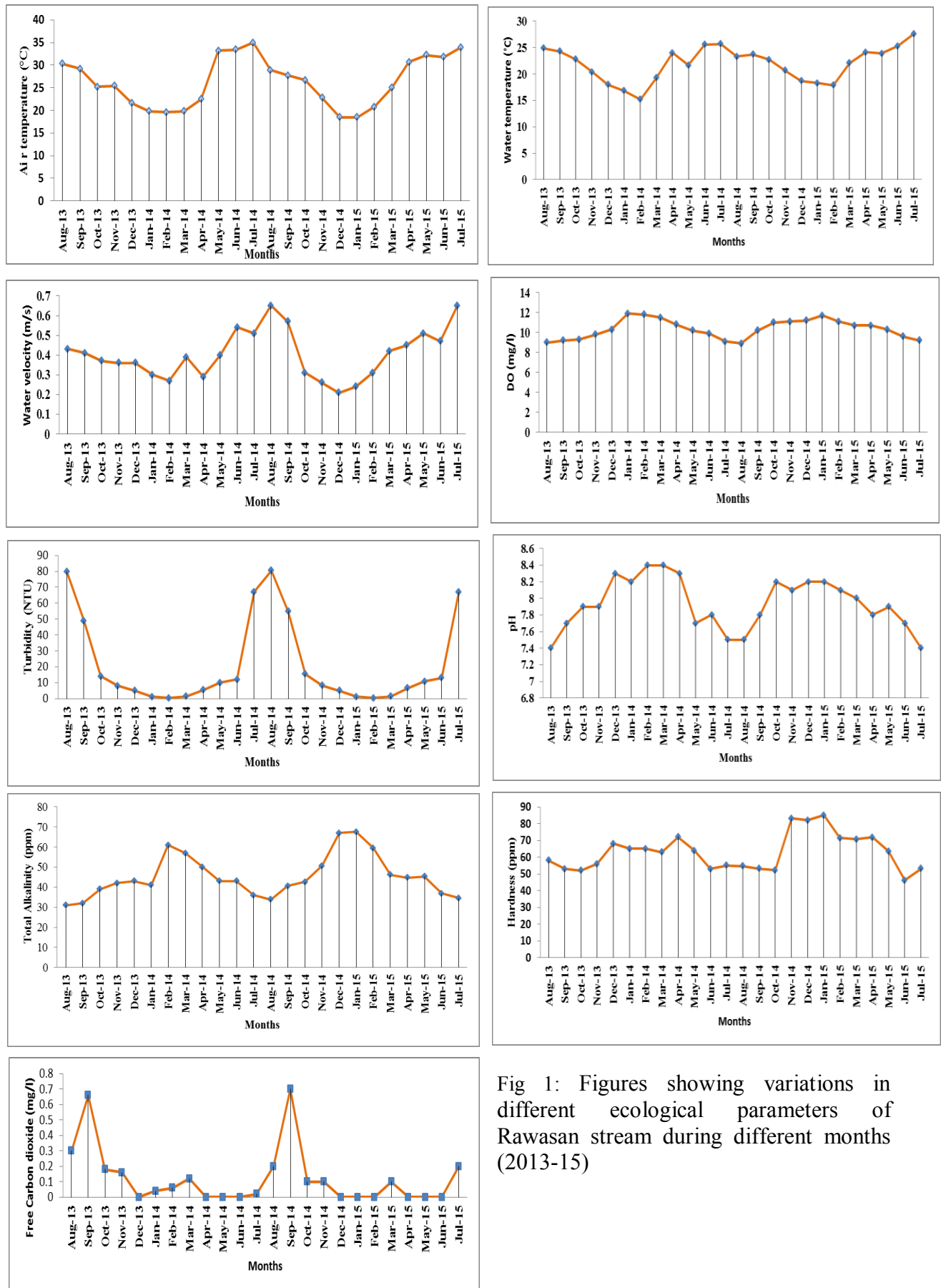


Fig 1: Figures showing variations in different ecological parameters of Rawasan stream during different months (2013-15)

Similar observation for DO was recorded by Sharma et al. (2007) in the stream Chandrabhaga from Garhwal Himalaya. Same trend of fluctuations of dissolved oxygen i.e maximum in winter months and minimum in summer months was observed in Nambol river by Devi et al. (2005). The maximum DO during the winter is due to the phytoplankton enrichment and photosynthesis.

Turbidity (T): During present study the turbidity ranges from 0.40 ± 0.07 NTU to 80.5 ± 1.95 NTU was recorded. Maximum turbidity observed in August was due to the rain fall and flash flood. Our observations was well supported by Bhatt et al. (1984), who observed that turbidity increases to a maximum value in monsoon due to suspended solids in the flooded water. Our results for high turbidity in August (monsoon) and low or negligible during January and February (winter) were also in accordance with the results of Verma (2013) for Western Ramganga river in Kumaun Himalaya.

pH: The value of pH was found to vary between (7.4 ± 0.24 to 8.4 ± 0.17) in Rawasan stream. This is in conformity with the work of Malik et al., (2012), as they recorded pH value of 7.09 to 8.03 in Asan reservoir. The pH was recorded minimum in July 2014 and maximum in March 2014. However the data obtained from the study showed that the water of Rawasan stream was alkaline in nature during study.

Total Alkalinity (AL): Alkalinity was recorded in the range of 31 ± 1.12 ppm to 67.6 ± 1.03 ppm during the study and similar observation was recorded by Gangwar et al. (2012) and Selakoti and Rao, (2015). Our result for total alkalinity range is much less than the observations made by Kumar et al. (2010) who report the alkalinity range of (32 mg/l to 118 mg/l) from rivers of Uttarakhand.

Hardness (HD): The value of hardness was in the range of maximum (85.2 ± 9.71 ppm) in January 2015 and minimum (46.2 ± 2.94 ppm) in June 2015. Productive water should have hardness above 20 mg/l (Das and Das 1997). As per the statement of Das and Das (1997), the Rawasan stream is rightly observed as productive.

Free carbon dioxide (CO): During the present study the maximum value of CO_2 was calculated as (0.7 ± 0.27 mg/l) in September 2014 and minimum (0.02 ± 0.2 mg/l) in July 2015, and no carbon dioxide was observed in December, April, May and June month during the study periods. Comparatively higher values of free carbon dioxide were observed during September. These could be due to the decay of organic matter and respiratory activities of organisms, resulting in the addition of large quantities of CO_2 to the water. The results of the present findings are in agreement with the finding of Nath and Srivastava, (2001) and Gurumayum et al. (2000) who have also reported higher values of free CO_2 during summer and monsoon months.

RELATIONSHIP BETWEEN PHYSICO-CHEMICAL PARAMETERS:

The statistical correlation between the physico-chemical parameters is presented in table 1 in the stream Rawasan at Pauri Garhwal. Most of the parameters were found to bear statistically significant correlation with each other indicating close association of these parameters with each other at different levels of significance as shown in table 1. The positive correlation coefficient (r) was noticed in between water temperature and air temperature (WT-AT), water temperature and water velocity (WT-WV), DO with alkalinity and pH (DO-AL, DO-pH) and negative correlation coefficient (r) was noticed between pH with turbidity and air temperature (pH-AT, pH-T) during study, but air temperature and water temperature showed a highly positive correlation ($r=0.96$, $df=8$, $p<0.001$) and water velocity and pH showed strong negative correlation ($r= -0.93$, $df=8$, $P<0.001$) was noticed from the Rawasan stream water.

CONCLUSION:

On the basis of various parameters studied Rawasan stream study area can be placed under oligosaprobic. When various water parameters of our study are compared with that of Indian standard (IS-1055, 1991)

for public, fish culture and irrigation purposes, it was revealed that all such parameters are well within the limits. The water characteristic considered for the study indicates that the Rawasan stream water is pollution free and can serve as a good habitat for many aquatic organisms.

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Table 1 Correlation matrix of Rawasan stream water analysis

	AT (°C)	WT (°C)	DO (mg/l)	WV (m/s)	T (NTU)	pH	AL (ppm)	HD (ppm)	CO (mg/l)
2013-2014									
AT (°C)	1								
WT (°C)	0.800***	1							
DO (mg/l)	-0.763**	-0.799***	1						
WV (m/s)	0.840***	0.730**	-0.656*	1					
T (NTU)	0.639*	0.657*	-0.740***	0.553	1				
pH	-0.897****	-0.753	0.853***	-0.710*	-0.827***	1			
AL (ppm)	-0.628	-0.621	0.808***	-0.503	-0.726**	0.827***	1		
HD (ppm)	-0.591	-0.536	0.700*	-0.671*	-0.488	0.679*	0.568	1	
CO (mg/l)	0.130	0.275	-0.449	0.086	0.497	-0.373	-0.494	-0.501	1
2014-2015									
AT (°C)	1								
WT (°C)	0.960****	1							
DO (mg/l)	-0.786***	-0.793***	1						
WV (m/s)	0.834***	0.823***	-0.915****	1					
T (NTU)	0.505	0.577	-0.820***	0.814	1				
pH	-0.804***	-0.821***	0.947****	-0.935****	-0.798***	1			
AL (ppm)	-0.891****	-0.900****	0.855***	-0.851***	-0.673	0.806***	1		
HD (ppm)	-0.768***	-0.767***	0.773***	-0.735**	-0.607	0.658*	0.850***	1	
CO (mg/l)	0.202	0.310	-0.331	0.495	0.638	-0.335	-0.408	-0.416	1

(df= 8, level of significance * 0.05 %, **0.025%, *** 0.01%, ****0.001%), df=degree of freedom

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