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ASSESSMENT OF PHYSICO-CHEMICAL PARAMETERS OF RIVER GANGA AND ITS TRIBUTARIES IN UTTARAKHAND

Nidhi Singh Chauhan

ABSTRACT **Water quality assessment conducted in the tributaries of Ganga River in the year 2012 and 2013 identified human activities as the main sources of pollution. For the study three**

study three tributaries of river Ganga in Uttarakhand were ***chosen i.e. Alaknanda (A), Bhagirathi (B) and Ganga (G). Water samples were collected from five sampling stations on river Alaknanda viz. Devprayag (A1), Rudraprayag (A2), Karnaprayag (A3), Chamoli (A4) and Vishnuprayag (A5), only one sampling station on Bhagirathi near residential area at Devprayag (B), two sampling station on river Ganga viz. Har ki pauri (G1) and Rishikesh (G2). The samples were analysed for physical and chemical parameters using standard methods. The sample temperatures ranged from 7.7 –18.3 0C. Summer maxima and winter minima were observed at all the sites of sampling stations (A, B and G). pH ranged from 7.4 - 8.2, DO ranged from 7 – 8.61 mg/l and BOD ranged from 0.2 – 1.9 mg/l. All samples showed permissible limit except samples from Harki pauri and Rishikesh on river Ganga.***

KEYWORDS :

INTRODUCTION

Rivers have been used by man since the dawn of civilization as a source of water, for food, for transport, as a defensive barrier, as a source of power to drive machinery, and as a means of dis- posing of waste. Rivers water finds multiple uses in every sec- tor of development like agricultural, industry, transportation, aquaculture, public water supply etc. The growing problem of degradation of our river ecosystem has necessitated the moni- toring of water quality of various rivers all over the country to evaluate their production capacity, utility potential and to plan restorative measures (Datar and Vashistha, 1992; Das and Sinha,1993). Many rivers in India, including the river Ganga, are pol- luted by indiscriminate discharge of wastewater. Domestic ef- fluents mostly carry organic wastes, which are biodegradable and require oxygen. High levels of sewage consume most of the dissolved oxygen leaving little for other aquatic organisms. At extremely low oxygen levels, fishes begin to die off. The disease causing agents, organic plant derivative, industrial waste, chemi- cals and radioactive substances are the usual river pollutants. The river Ganga might have all these pollutants. But the unique pollutants of the river Ganga are religious and fertility mater in- cluding dead bodies of ghats.The assessment of water quality lies on carefully examining the delicate interface between Physics, Chemistry and Biol- ogy. The most common physical assessment of water quality is the measurement of temperature. Temperature impacts both the chemical and biological characteristics of surface water. Another important aspect to check quality of water is pH. The pH is measure of the intensity of acidity or alkalinity and the concentration of hydrogen ion in water. The pH has no direct adverse effects on health, however, higher values of pH reduce germicidal potential of chloride. High pH induces the formation of trihalomethanes which are toxic (Kumar and Chandel,2010). According to FWPCA report published in 1968 regarding water quality criteria, the pH affects the dissolved oxygen level in the water, photosynthesis of aquatic plants, metabolic rates of aquatic organisms and the sensitivity of these organisms to pollution, parasites and disease. Most rivers have a neutral to slightly basic pH of 6.5 to 8.5. If stream water has a pH less than 5.5, it may be too acidic for fish to survive in, while stream water with a pH greater than 8.6 may be too basic. A change in stream water pH can also affect aquatic life indirectly by altering other aspects of water chemistry e.g. low pH levels can increase the solubility of certain heavy metals. This allows the metals to be more easily absorbed by aquatic organisms (Schlesinger, 1991).Since all natural waterways contain bacteria and nutrients, al- most any waste compounds introduced into such waterways willinitiate biochemical reactions. These biochemical reactions are measured as BOD and COD in laboratory (Tchobanoglous et al.,2003). Both the BOD and COD tests are a measure of the rela- tive oxygen-depletion effect of a waste contaminant. Both have been widely adopted as a measure of pollution effect. The BOD test measures the oxygen demand of biodegradable pollutants whereas the COD test measures the oxygen demand of oxidiz- able pollutants. It is expressed in milligrams per litre (mg/l), which indicates the mass of oxygen consumed per litre of solu- tion (Clair and Sawyer, 2003)

STUDY AREA

For the present study three rivers of Uttarakhand was chosen for the study of physiochemical analysis of the water samples taken in different seasons such as summer, post monsoon and winter from different spots. The three rivers for study were Alaknanda (A), Bhagirathi (B) and Ganges (G). Five spots for water sampling were chosen on River Alaknanda namely Devprayag, Rudrapray- ag, Karnaprayag, Chamoli, and Vishnuprayag and were tagged as A1, A2, A3, A4 and A5 respectively. Only one sampling station was chosen to collect the water sample from River Bhagrathi near the residential area at Devprayag and coded as sample B. Two sampling spots namely Harki Pauri and Rishikesh were cho- sen as sampling spots on the River Ganga and coded as G1 and G2 respectively as shown in the figure:1.

Figure1 River Map of Uttarakhand showing sampling points

Name of Sampling Station	Season	
	Winter	Post-monsoon
Devprayag (A1)	15.4	17.2
Rudraprayag (A2)	15.7	15.8
Karnaprayag (A3)	15.6	13.8
Chamoli (A4)	10.4	12.3
Vishnuprayag (A5)	7.7	8.4
Devprayag (B)	14.6	15.7

17.6

	Ganga (G1)	14.9		15.9		
	Ganga (G2)	14.3		16.2		

Table 1 Table showing the recor
temperature (in OC) of water samples of different sampling stations on Alaknanda River in different seasons (2012-2013)
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Dissolved oxygen of the water samples from different sampling spots were measured in different seasons during 2012-13 and tabulated in the table 3. The mean of DO on the sampling spots is graphically represented in the Figure 4.

Name of Sampling Station	Season	
	Winter	Post-monsoon
Devprayag (A1)	7.92	7.55
Rudraprayag (A2)	7.80	7.39
Karnaprayag (A3)	7.94	7.55
Chamoli (A4)	8.28	7.80
Vishnuprayag (A5)	8.61	8.11
Devprayag (B)	7.97	8.04
Ganga (G1)	7.9	7.5
Ganga (G2)	7.5	8

Table 3 Seasonal variation of Dissolved Oxygen (mg/l) measured from water samples from different sampling station in the year 2012-13

Figure 2 Comparative study of the recorded temperature of the water samples from different sampling spots on the Alaknanda River during the season of winter, post monsoon and summer (2012-2013)

Figure 4 Mean of DO variation of water samples from different sampling stations during study period 2012-2013

pH of water was analysed in order to observe the condition of water

of River Alaknanda, Bhagirathi and Ganges. It was ob- served that the pH of drinking water was in the range 6.5-8.5 as fixed by World Health Organization (WHO) standard (WSC2004). The pH of the tributaries are found tabulated in the table2 and The mean of pH on the sampling spots is graphically rep- resented in the Figure 3.

Table 2 pH of water at different sampling spots on the river Alaknanda in different season during study period 2012-2013Biological Oxygen Demand of the water samples from different sampling spots were measured in different seasons during 2012-13 and tabulated in the table 4. The mean of BOD on the sam- pling spots is graphically represented in the Figure 5.

Table 4 Seasonal variation of BOD (mg/l) measured from water samples from different sampling station in the year

Name of Sampling Station	Season	
	Winter	Post-monsoon
Devprayag (A1)	0.90	0.70
Rudraprayag (A2)	0.70	0.76
Karnaprayag (A3)	0.52	0.48
Chamoli (A4)	0.44	0.36
Vishnuprayag (A5)	0.34	0.31
Devprayag (B)	0.86	0.65
Ganga (G1)	1.8	1.6
Ganga (G2)	1.7	1.6

2012-13	Station	Season	
		Pos	Sus
		t-monsoon	
	8.0	7.6	7.7
	8.2	7.7	7.9
	8.1	7.9	7.7
	8.1	7.6	7.6
	7.9	7.6	7.4
	7.9	7.5	7.6
	8.3	7.5	7.6
	7.3	7.4	7.8

Figure 3 Mean of pH variation of water samples from differ- ent sampling stations during study period 2012-2013

Figure 5 Mean of BOD variation of water samples from dif- ferent sampling stations during study period 2012-2013

CONCLUSION

During the investigation, the maximum temperature was found at sampling station Deoprayag i.e 18.3oC and minimum tempera- ture was found at sampling station Vishnuprayag i.e. 7.7oC. The pH value of water samples at different selected sites were within the acceptable range of 7.4-8.2 at all the sampling station on the Alaknanda river and 7.2 – 7.9 for sampling station on Ganga riv- er. The pH lied between 7.5-7.9 for Bhagirathi river at Devprayag. Dissolved Oxygen varies from 7-8.61 mg/l. In observation maxi- mum dissolved oxygen was recorded 8.61 mg/l at Vishnuprayag on the River Alaknanda during winter season. The minimum val- ue of dissolved oxygen 7.10 mg/l was observed in summer sea- son at Chamoli. The value of dissolved oxygen ranged between 7.32 mg/lto 8.04 mg/l in the water samples from the river Bhagi- rathi whereas the value of DO was observed ranged between 7.0 mg/l to 8.0 at both the sampling station on the river Ganges. The range of Biochemical Oxygen Demand (BOD) was observed be- tween 0.34 mg/l to 0.90 mg/l for the water sample at all the sam- pling stations on the river Alaknanda. The value of BOD ranged between 0.20 mg/l to 0.86 mg/l for the river Bhagirathi. The minimum BOD of water sample from River Ganges was record- ed i.e. 1.0 mg/l

in winter season at Rsishikesh and Maximum at Haridwar i.e.1.9 in summer. Highest annual average value of bio-chemical oxygen demand at Haridwar may be due to drainage of several sewage drains into the river. A negative relationship has been observed between BOD and DO contents.

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