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PHYSICOCHEMICAL CHARACTERIZATION OF LOTIC SYSTEMS OF KASHMIR: A CASE STUDY OF RIVER JHELUM

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ABSTRACT
Water is a finite resource that is very essential for the human existence, agriculture, industry etc. Without any doubt, inadequate quantity and quality of water have serious impact on sustainable development. Present investigation was carried out to assess the physico-chemical characteristics pH, Total alkalinity, Hardness, DO, BOD, COD TDS, Nitrate Nitrogen etc. of River Jhelum which is under tremendous anthropogenic intervention. The observations reveal that the values of all these parameters indicate deterioration in water quality towards the downstream side due to additional discharge of sewage at successive downstream points.

KEY WORDS: physiochemical analysis, DO, BOD, TDS, pH.

INTRODUCTION

The River Jhelum originating from Pir Panjal range in the south is the longest River of Kashmir and one of the most important tributaries of the Indus drainage system. Like any other lotic system, River Jhelum from the days of yore has been used for irrigation, drinking, washing, bathing besides sport fishing, dumping of sewage and municipal wastes, sand mining etc. Subsequently the water quality of river Jhelum has deteriorated at an alarming rate. Anthropogenic intervention induces changes in hydrological cycle besides disturbing the physical characteristics of an aquatic ecosystem (habitat alteration and urban land use) and point and nonpoint sources of pollution (chemical contamination, surface runoff and intensive agriculture) are responsible for a broad-scale deterioration of lotic ecosystems (Chatzinikolaou *et al*., 2006; Subramanyam, 2006 and Sathware *et al*., 2007). Water quality assessment has thus gained magnanimous dimensions because of the potential hazards associated with the use of contaminated water supplies (Ali *et al*., 2007). WHO (1997) has reported 80% of all sickness and diseases in third world is due to consumption of contaminated water. Polluted water is the major cause for the spread of many epidemics and some serious diseases like cholera, tuberculosis, typhoid, diarrhea etc. Although several attempts have been made by a number of researchers (Harrison, 1958; Lenat and Crawford, 1994; Biggs, 1995; Gergel *et al*., 1999; Caraco *et al*., 2003; Donohue *et al*., 2006) to study various aspects of water quality and the factors responsible for its degradation in order to formulate a significant control strategy all over the globe yet the problem is on rise. The problems of surface water quality are much more acute in the areas which are densely populated. The rapid growth of urban areas has further affected groundwater quality due to overexploitation of resources and improper waste disposal practices. Hence, there is always a need for and concern over the protection and management of surface water and groundwater quality reported by Patil *et al*. (2001), Patil *et al*. (2010), Murhekar (2011). Considering the above aspects of water contamination, the present study was undertaken to investigate the possible impact of the surface water quality. In Kashmir, most of the population is dependent on surface water as the only source of drinking water supply Thus, in this paper an attempt has been made to assess the physical and chemical properties of surface water of the River Jhelum, India.

MATERIALS & METHODS

River Jhelum popularly addressed as the 'Vyeth' in local parlance, is located at latitude 32° 05-N to 35° 06-N and longitude 73° 24-E to 75° 35-E. With total geographical area of 37,775 Sq. Kms., Jhelum basin includes the flood tracts spreading from Khanabal (District Anantnag) in the south east of the Kashmir valley up to Baramulla in the North West. The river Jhelum originates from a magnificent spring in South Kashmir called "Verinag Spring" situated at the foot hills of Banihal Pass. Most cities along the Jhelum River do not have sewage treatment plants and consequently lakhs of tons of untreated sewage, municipal wastes, soaps, detergents etc are dumped into the river annually. The river is also polluted by human and animal faces besides the run-off from the agricultural fields. The water quality of the river has deteriorated at an alarming rate and consequently those feeding on the river water are suffering from the water borne diseases. Extensive and integrated work is being conducted in various laboratories of the Jammu and Kashmir state to assess the extent of pollution on Jhelum River. In order to determine the level of pollution and its impact on the water

quality, four sampling sites/study stations were selected along the banks of river Jhelum.

Water samples of the river were collected at monthly intervals in the first week of each month from March 2011 to July 2011. Five replicates, each of two litre were collected at a time in bottles between 8 a.m. to 10 a.m. from each of the sampling sites. The samples of the river water were collected and brought to the laboratory and analysed for pH, acidity, alkalinity, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD) and Total Dissolved Solids (TDS). Temperature and pH were also recorded on the spot, at the time of sampling. Sample analysis for the different physico-chemical parameters was done as per standard methods for the examination of Water and Waste Water (APHA, 1985).

RESULTS

The physico-chemical characteristics of River Jhelum as recorded in 2010-11 reveal that the abiotic parameters have recorded a remarkable decline and the same is reflected by the tables (1-6). pH a measure of the acidity of the water, recorded remarkable decreasing trend from Khanabal in South to Sopore in North. At all the study stations the values of pH were higher in May (Table 1). pH recorded a tilt from alkaline to acidic side as the river progressed from south to north. At all the sites the water has been observed to be highly alkaline. However the values of alkalinity recorded maxima at Khanabal in July (Table 2) followed by a decrease in the downstream stations. The BOD values of river Jhelum estimated during the present study recorded slight variability from March to July. BOD values recorded increasing trend from Khanabal to Sopore while recording maxima at Sopore station (Table 3). At all the sites COD values were higher than that of the Khanabal. Like BOD, a sharp increase in COD values was observed from Khanabal to Sopore where it reached maxima. At each of these sites, the values of COD kept on increasing with an increase in temperature (Table 4). Total Dissolved Solids recorded an increasing trend in the downstream sections while recording maxima at Sopore. TDS at each of the study stations increasing trend from March to July (Table 5). The values of NO_3-N concentration found in the water of river Jhelum reveals an increasing trend in the downstream sections. Maximum values were observed at Sopore but NO_3-N concentration increased with an increase in temperature (Table 6).

TABLE 1: Monthly value of pH in River Jhelum at different locations

Parameter	Khanabal	Sangam	Panthachowk	Sopore
March	7.4	7.1	7.0	6.4
April	7.4	7.3	7.0	6.7
May	7.8	7.5	7.2	6.8
June	7.7	7.2	6.5	6.3
July	7.5	7.0	6.3	6.0
Range	7.4 – 7.8	7.0-7.5	6.3-7.2	6.0-6.8
Average	7.5	7.2	6.8	6.4

TABLE 2: Monthly value of Alkalinity in River Jhelum at different locations

Parameter	Khanabal	Sangam	Panthachowk	Sopore
March	100.00	85.33	82.75	79.00
April	110.00	93.30	87.40	84.35
May	112.00	105.40	104.00	109.25
June	133.10	116.60	120.45	102.46
July	175.30	157.58	153.28	132.33
Range	100.0 – 175.3	85.3-157.5	82.7-153.2	79.0-132.3
Average	126.0	111.6	109.5	101.4

TABLE 3: Monthly value of Biological oxygen Demand in River Jhelum at different locations

Parameter	Khanabal	Sangam	Panthachowk	Sopore
March	4.00	4.61	4.65	4.72
April	4.38	4.91	4.95	4.98
May	4.98	5.12	5.40	5.65
June	5.10	5.65	5.75	5.80
July	5.15	5.75	5.82	6.05
Range	4.0-5.1	4.61-5.75	4.6-5.8	4.7-6.5
Average	4.7	5.2	5.3	5.4

TABLE 4: Monthly value of Chemical oxygen Demand in River Jhelum at different locations

Parameter	Khanabal	Sangam	Panthachowk	Sopore
15 March	30.90	34.60	35.90	37.65
15 April	30.70	36.40	37.80	40.20
15 May	34.90	39.68	40.65	42.50
15 June	38.63	42.10	45.30	46.25
15 July	42.83	45.38	46.70	49.95
Range	30.9-42.8	34.6-45.3	35.9-46.7	37.6-49.9
Average	35.5	39.6	41.2	43.3

TABLE 5: Monthly value of Total Dissolved Solids in River Jhelum at different locations

Parameter	Khanabal	Sangam	Panthachowk	Sopore
15 March	142.10	165.10	172.00	187.65
15 April	161.70	185.24	197.45	206.75
15 May	180.24	215.10	220.25	223.63
15 June	200.10	245.15	272.58	289.00
15 July	220.85	270.96	290.00	298.75
Range	142.1-220.8	165.1-270.9	172.0-290.0	187.6-298.7
Average	180.9	216.3	230.4	241.1

TABLE 6: Monthly value of Nitrate Nitrogen in River Jhelum at different locations

Parameter	Khanabal	Sangam	Panthachowk	Sopore
15 March	0.06	0.15	0.20	0.23
15 April	0.08	0.18	0.21	0.24
15 May	0.10	0.22	0.25	0.27
15 June	0.14	0.22	0.29	0.30
15 July	0.16	0.25	0.28	0.32
Range	0.06-0.16	0.15-0.25	0.20-0.29	0.23-0.32
Average	0.1	0.2	0.2	0.2

DISCUSSION

Present investigation reveals that the water of River Jhelum at Khanabal is alkaline but it turns acidic at Sopore and the same could be due to the fact that as the water of the river runs downstream, it receives influx of untreated sewage and other organic and inorganic wastes. However in May, the pH of the water becomes alkaline in comparison to other months as with an increase in ambient temperature there is increase in the rate of photosynthesis. But during June and July the pH values start falling as rate of decomposition also increases. Likewise alkalinity values decreased in the downstream sections which could be attributed to the fact that due to influx of sewage and other suspended matter the water of the river Jhelum is turbid which does not allow decomposition rate to surpass compensation point although there is an increase in temperature in summer. Hence the alkalinity values recorded an increase at Khanabal where there is less turbidity and hence greater decomposition rate and enhanced alkalinity. Since Kashmir is annually being visited by enormous number of visitors/tourists hence especially summer there is greater generation of wastes which are directly or indirectly being dumped into the river hence the BOD values show enhanced values in the downstream sections of the river. Like other parameters, COD also recorded an increase from Khanabal to Sopore which could be due to enhanced consumption of oxygen for decomposition purposes and enhanced waste load discharged into the river. As mining and other developmental are in full swing along the basin of Jhelum, hence there is an increase in total dissolved solid content of the river water. The values of nitrate increased in the downstream portions of the river and the same could be due to allochthonous supply of nitrate rich materials and enhanced decomposition rate. The sensitive stretches of the Jhelum river can be identified for the purpose of quality improvements with respect to the various beneficial uses. Upstream sites were amongst the least polluted and were excellent for all the beneficial uses. Thus a general progressive decline in the quality of river water along the downstream indicated an increase in pollution pressure due to additional discharge of sewage and bathing activities at successive sampling sites. The situation, therefore, poses a serious threat to public health and warrants very stringent pollution control measures in this stretch of the river. Since the greatest degradation of the river takes place at Sopore where the bulk of the sewage is discharged, efforts should mainly concentrate on improving the quality of the river. It is therefore necessary that the discharge of untreated sewage should be subjected to immediate appropriate treatment employing the latest technologies, before final disposal into the river.

In order to achieve successful management plan for any water body it is imperative to involve the communities directly related/dependent on these resources. Their involvement will take care of both cause and effect and will also reduce the risk of loosing the resource.

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