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RESEARCH ARTICLE

SUITABILITY ASSESSMENT OF THE RIVER YAMUNA IN UPPER STRETCH FOR BATHING PURPOSES

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ABSTRACT

Present investigation has been carried out for assessment of the suitability of the river Yamuna in the upper stretch for bathing purpose. Accordingly, ten sampling locations were selected, two in Uttarakhand, one in Himachal Pradesh, six in Haryana and one in outskirts of Delhi. Sampling was done in the month of November, 2011. A total of five parameters, namely, pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), Total Coliforms and Faecal Coliforms were studied. Results of this study were compared with the water quality standards prescribed by the Central Pollution Control Board (CPCB) for designated best-use. The sampling sites of Uttarakhand (Dakpathar U/S and Dakpathar D/S) showed physico-chemical and biological parameter within the prescribed limits of water quality standards and the quality of water was good and fit for bathing purpose. All other sampling stations were found to harbour coliform organisms in numbers greater than the required CPCB standards for outdoor bathing and hence are not suitable for bathing.

INTRODUCTION

The holy river Yamuna is of glacial origin forming into a stream at the foot of the Yamunotri glacier. A host of tributaries from the Himalayas, Sivaliks, Aravalis and Vindhyas join her along its 1,376 km length before it commingles with the Ganga at Prayag, the pious confluence of the Ganga, Yamuna and the now invisible Saraswati at Allahabad.[1] It has been acclaimed as a holy river in Indian mythology and various pilgrimage centers e.g. Yamunotri (Uttaranchal), Poanta Sahib (Himachal Pradesh), Mathura Vrindavan, Bateshwar & Allahabad (all in Uttar Pradesh) are located at the banks of this river [2]. River bathing is one of the most important uses of river water in the country. The Hindu culture and the other cultures of Indian origin are generally considered as river oriented. Bathing is an essential part of various Hindu rituals. On religious and cultural occasions millions of people take bath especially near religious towns in a congested stretch of the river within the span of a few hours [2]. Mythology and traditions pertaining to the Yamuna River are immense and many are still in practice. Many religious and historical sites are close to the river. Water from the river is taken by people and temples to perform multiple pujas, or acts of worship. Rituals are common with Yamuna River water which is an integral part of too many people's daily routine. The present paper aims at finding whether the river Yamuna in the upper stretch is suitable for bathing purpose or not. The study was conducted during the post-monsoon season, in the month of November 2011 and a total of ten study sites were selected from Dakpathar to Palla. For management of water quality of a water body, one has to define the water quality requirements or water quality goal. In India, the Central Pollution Control Board (CPCB) has developed the concept of "designated best use". According to which, out of several uses a particular water body is put to, the use which demands highest quality of water is called its "designated best use" and consequently the water body is designated. The CPCB has identified 5 such "designated best uses". All those water bodies, which are used for drinking without any treatment, but with disinfection (chlorination), are termed as "A" Class Water, those which are used for outdoor bathing are termed as "B" Class Water, those which are used for drinking after conventional treatment are termed as "C" Class Water, those which are used for propagation of wildlife and fisheries are termed as "D" Class Water and those which are used for irrigation, cooling and controlled waste disposal are termed as "E" Class Water. For each of these five "designated best uses, the CPCB has identified water quality requirements in terms of few chemical characteristics, known as primary water quality criteria. The "designated best uses" along with respective water quality criteria is given in Table 1. [3]

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MATERIALS AND METHODS

A stretch of about 276 km of the Yamuna river in upper stretch was surveyed from Dakpathar upstream in the north to Palla in the south. In this stretch of the river, sampling stations were selected at ten locations, namely (i) Dakpathar U/S, Uttarakhand (30°30'42"N, 77°49'57"E), (ii) Dakpathar D/S, Uttarakhand (30°30'06"N, 77°47'39"E), (iii) Poanta Sahib, Himachal Pradesh (30°26'03" N, 77°37'26"E), (iv) Tajewala U/S, Haryana (30°17'52"N, 77°33'47"E), (v) Tajewala D/S, Haryana (30°17'46"N, 77°33'42"E),(vi) Yamunanagar, Haryana (30°04'06"N, 77°21'14"E), (vii) Mawi bridge, Haryana (29°23'01"N, 77°00'.559"E), (viii) Khojkipur, Haryana (29°15'56"N, 77°07'38"E), (ix) Sonipat, Haryana (28°59'10"N, 77°11'51"E) and (x) Palla, Delhi (28°59'13"N 77°12'30"E). The samples were collected during post-monsoon season of November 2011 and were subjected to analytical procedures for various physico-chemical and biological characteristics including dissolved oxygen, (DO) which was carried out at the sites itself by Winklers method, bio-chemical oxygen demand (BOD), pH (pH meter), total coliforms and faecal coliforms by membrane filtration technique. The procedure adopted for the water analysis for these factors were adopted from the book "Standard Methods For the Examination of Water and Wastewater" [4]

RESULTS AND DISCUSSION

In order to find out the suitability of the water for outdoor bathing purpose, "Class B" according to the "designated best use" given by CPCB, the samples were compared with the primary water quality criteria including pH, DO, BOD and total coliforms. The results of various physico-chemical and biological parameters are given in Table 2 and Figure (1-5). River water quality can be assessed by the analysis of nutrients, chemistry and biology. The criteria for bathing river are that it should contain at least 5 mg/L of Dissolved Oxygen and about 3 mg/L of Biochemical Oxygen Demand. Further the Pathogens (disease causing bacteria's) represented by the Faecal Coliforms counts should not exceed 500 per 100 mL of water.

pH : The pH recorded during the present study (8.22-8.42) was indicative of alkaline nature of water. The minimum value of 8.2 was recorded at Poanta sahib and a maximum value of 8.42 at Khojkipur. All the values were found to be within the prescribed limit of 6.5-8.5 required for "B Class" water quality Figure (1).

Dissolved Oxygen (DO): Dissolved oxygen is an important parameter in water quality assessment and reflects the physical

Table 1: Use based classification of surface waters in India

Designated-Best-Use	Class of water	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	1. Total Coliforms Organism MPN/100ml shall be 50 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 6mg/l or more 4. Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organised)	B	1. Total Coliforms Organism MPN/100ml shall be 500 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 5mg/l or more 4. Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	1. Total Coliforms Organism MPN/100ml shall be 5000 or less 2. pH between 6 to 9 3. Dissolved Oxygen 4mg/l or more 4. Biochemical Oxygen Demand 5 days 20oC 3mg/l or less
Propagation of Wild life and Fisheries	D	1. pH between 6.5 to 8.5 2. Dissolved Oxygen 4mg/l or more 3. Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	1. pH between 6.0 to 8.5 2. Electrical Conductivity at 25oC micro mhos/cm Max.2250 3. Sodium absorption Ratio Max. 26 4. Boron Max. 2mg/l

Source: CPCB, 2008

Table 2: Physico-chemical and biological parameters of Samples

Sites	Date of Sampling	Elevation (m)	Latitude	Longitude	pH	DO (mg/l)	BOD (mg/L)	Total Coliforms (No.)/100mL	Faecal Coliforms (No.)/100mL
Dakpathar Upstream	22/11/2011	461	30°30'42"N	77°49.898'E	8.4	9.4	0.3	490	130
Dakpathar Downstream	22/11/2011	422	30°30'06"N	77°47.660'E	8.26	8.8	1.02	130	78
Poanta Sahib	22/11/2011	240	30°26'03" N	77°21.025'E	8.22	9.8	0.97	1300	200
Tajewala Upstream	22/11/2011	305	30°17'52"N	77°33.897'E	8.27	9.2	1.03	1100	680
Tajewala Downstream	22/11/2011	309	30°17'46" N	77°33.719'E	8.28	8.7	0.91	28000	1100
Yamuna Nagar	21/11/2011	243	30°04'06"N	77°21.025'E	8.25	8.3	0.82	35000	7900
Mawi Bridge,	21/11/2011	245	29°23'01"N	77°09.297'E	8.37	8.6	0.87	14000	4900
Khojkipur,	21/11/2011	203	29°15'56"N	77°07.528'E	8.42	7.2	1.89	7000	2300
Sonipat	20/11/2011	194	28°59'10"N	77°11.860'E	8.32	9.7	2	35000	13000
Palla	20/11/2011	196	28°59'13"N	77°13.174'E	8.3	8.1	1.5	3900	1400

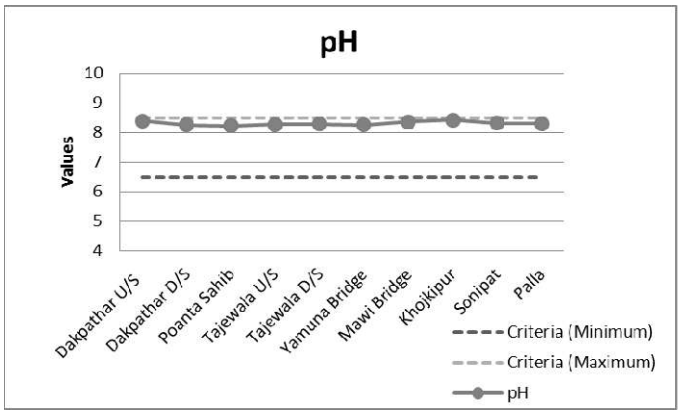

Fig. 1: pH values at various study sites

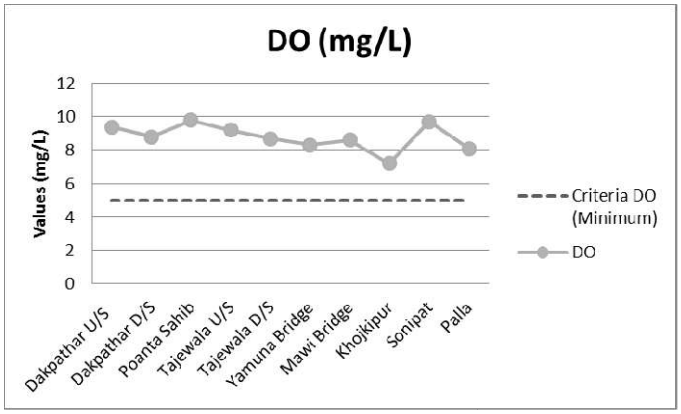

Fig. 2: Dissolved Oxygen at various study sites

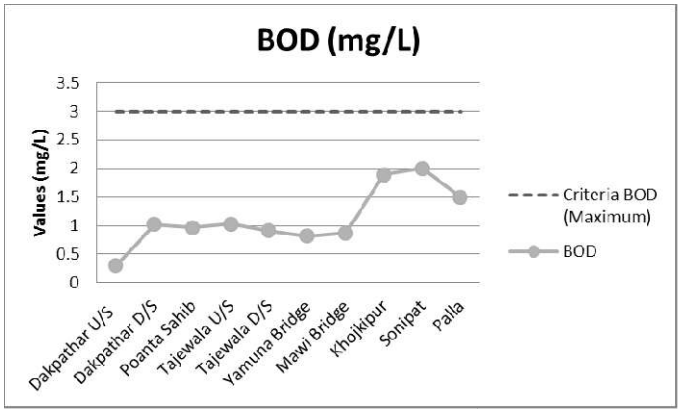

Fig. 3: Biochemical Oxygen Demand at various study sites

5.00 mg/L. The concentration of DO in the upper stretch of the Yamuna was found to be in the range of 7.2 -9.8 mg/L as shown in figure (2). Minimum value was found at Khojkipur while maximum value exists at Poanta Sahib. All the sites had dissolved oxygen above the prescribed limit of 5 mg/L

Biochemical Oxygen Demand (BOD): The Biochemical Oxygen demand represents the amount of oxygen that microbes need to stabilize biologically oxidizable matter. BOD range varies from 0.3-1.89 mg/L (figure 3) in the studied river samples. The same trend has earlier been reported by

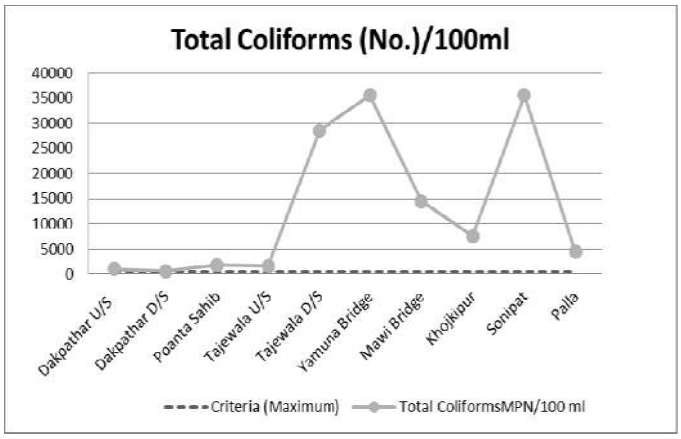

Fig. 4: Total Coliforms (No.) /100 mL at various study sites

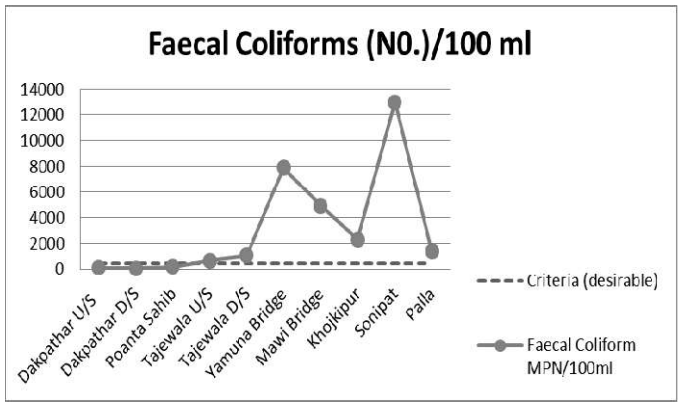

Fig. 5: Faecal Coliforms (No.) /100 mL at various study sites

CPCB [3]. BOD demand below 3 mg/L is required for the best use. The minimum value of 0.3 mg/L was recorded at Dakpathar U/S and maximum value of 1.89 mg/L at Khojkipur.

Table 3. Correlation Matrix

		pH	DO (mg/L)	BOD (mg/L)	Total Coliforms (No.)/100mL	Faecal Coliforms (No.)/100mL
Correlation	pH	1.000				
	DO (mg/L)	-.398	1.000			
	BOD (mg/L)	.151	-.313	1.000		
	Total Coliforms (No.)/100mL	-.115	-.009	.231	1.000	
	Faecal Coliforms (No.)/100mL	.058	.104	.470	.812	1.000

and biological processes prevailing in the water. The DO values indicate the degree of pollution in water bodies. According to CPCB (Central Pollution Control Board) the standard of DO for bathing purpose should be atleast equal to

Total and Faecal Coliforms: The analytical data related with Total and Faecal Coliforms are depicted in figure 4 and 5. In general Total Coliform numbers were not meeting the designated best use criteria for outdoor bathing i.e., 500 nos.

/100 mL. Total coliform numbers was below the prescribed limits at just two sites namely Dakpathar U/S and Dakpathar D/S while Faecal coliforms at three sites that is Dakpathar U/S, Dakpathar D/S and Poanta Sahib. As depicted in figure 4 and 5, there is a gradual increase in the numbers of both TC and FC from Dakpathar to Palla. Two peaks of very high values one at Yamuna Nagar and another at Sonipat stretch of total and faecal coliforms were observed. The total Coliform count per 100 ml and faecal coliform count per 100 ml varied from 130 to 35000 nos. /100mL and 78 to 13000 nos. /100 mL respectively. The minimum number of total coliforms count/100 mL and faecal coliforms count/100 mL was recorded at the same site, i.e., Dakpathar D/S. The maximum number of Total Coliforms nos. /100 mL was recorded at two sites, Yamuna Nagar and Sonipat and a maximum value of and Faecal Coliform nos. /100 mL was recorded at Sonipat. Thus at most of the sites, the values were above the maximum permissible level. Furthermore the correlation between these parameters is shown in Table 3. The highest positive correlation (0.812) was found between faecal coliforms and total coliforms followed by faecal coliforms vs. BOD (0.470). The lowest positive correlation (0.058) was found between faecal coliforms and pH. While as the highest negative correlation (-.398) was found between DO and pH.

Conclusion

The present investigations has concluded that the quality of the River Yamuna in the upper stretch was fit for bathing purpose at only two upper most sites i.e., Dakpathar U/S and Dakpathar D/S as all the primary water quality criteria were being fulfilled. All other sites were acceptable from physico-chemical parameters while total coliform count was above the prescribed limit at the remaining downstream eight sites and faecal coliforms also exceeded the desirable limits at seven sites, and hence are unfit for bathing purpose. The river Yamuna was most polluted at Sonipat and Yamunanagar. DO and pH showed the negative correlation indicating the presence of low DO in highly alkaline water. The highest correlation was found between the parameters of faecal coliforms and total coliforms which indicates the presence of higher faecal coliforms in the water samples exhibiting a higher total coliforms.

REFERENCES

[1] Peace Institute Charitable Trust, 2009. A report on "Reviving River Yamuna, An Actionable Blue Print for a Blue River".

[2] CPCB, 2006. "Water Quality Status of Yamuna River (1999-2005), Assessment and development of River Basin series: ADSOPBS/41/2006-07". Central Pollution Control Board.

[3] CPCB, 2008. "Guidelines for Water Quality Management". Central Pollution Control Board.

[4] A.P.H.A. 2001. "Standard Methods for the Examination of Water and Waste Water" 20th Edition. Am.Public. Health Association, Washington, DC.

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