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Assessment of Water Quality of River Mandakini during Amawashya in Chitrakoot, India

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Abstract

The rivers in India have been considered sacred from ancient times. People take holy dip in river with the faith that the water washes away their sin. Most of the festival associated with bathing in rivers. Chitrakoot is a religious place and lacks of floating population take bath in river Mandakini during every Amawashya day. The main objective of present study was undertaken to investigate water quality changes due to mass bathing during Amawashya. The effect caused by mass bathing was assessed and discussed. It was observed that fecal coliform, DO, BOD and COD had significant changes due to mass bathing. The fecal coliform MPN was higher in Amawashya as well as in normal days. The quality of water indicated that river seemed much polluted from Arogyadham to Ramghat. Increased pollution load deteriorating the water quality of river Mandakini day by day. Higher fecal coliform values indicating that river water is not safe for pilgrim's health point of view.

Keywords: Pollution, Physico-chemical, Quality, Coliform.

Introduction

The river Mandakini originates from the hills of Khillora near Pindra village, Majhagawan block (25° 09'24.8" N, 80° 52' 55.3"E), Satna district, M.P. at an elevation of 156 m above mean sea level in the state of Madhya Pradesh of northern India. Whole watershed area is 1956.3 sq. km. The river shared between M.P. and U.P. portions. Sati Anusuiya is a perennial reach of Mandakini River where a large number of small springs feed the river.

Rivers in India regarded as sacred from times immemorial. A dip in a holy river is believed to wash all sins. Being obsessed by such faith, people take bath in these rivers, especially on auspicious occasions, such as Deepawali, Somwati Amawashya, Sanichari Amawashya, Purnima etc. This obviously causes significant impact on the quality of this tiny river[1].

The present study was undertaken to investigate water quality changes arising from mass bathing with particular reference to faecal coliform contamination during Amawashya.

Material and Methods

On the stretch of river (3 km approximate) three sampling station were selected that are Arogyadham, Pramodvan and Ramghat station. The water quality was studied for one year on every Amawashya for various physico-chemical and biological parameters. Sample were collected from all the station twice a day (7 A.M. when peak bathing activity takes place and 3 P.M. when least bathing activities takes place) and brought to laboratories immediately and analyzed for pH, DO, BOD, COD and fecal coliform. DO sample were fixed at the site and brought to laboratory. For fecal coliform analysis samples were separately collected in sterilized bottles and brought to laboratory and immediately inoculated. All the analysis was done as per APHA AWWA WPCF 2005[2].

Results and Discussion

Results are given in table-1 to 11. All parameters expressed are expressed in mg/l except pH and F.Coliform (MPN).

Dissolved oxygen is an important water quality parameter for various purposes. DO levels in surface water body indicate the ability to support aquatic life? DO range between 3.98-9.76 mg/l. Low level is DO was again indicative of polluted nature of water body. Low level value was found in afternoon at Ramghat in August. Higher value of DO observed in forenoon at Arogyadham in May when temperature was lowest in morning, might be due to the fact that the solubility of oxygen in water increase with decrease temperature[3].

Chemical oxygen demand is measure of the oxidation of reduced chemical in water. It is commonly used to indirectly measure the amount of organic compounds in water[4]. The measure of COD determines the quantity of organic matter found in water. This makes COD useful as an indicator of organic pollution in surface water. It was observed lower (32.65 mg/l) in forenoon at Arogyadham in May and higher (62.60 mg/l) in afternoon at Ramghat in August.

Table-1
Average physico-chemical characteristics of river Mandakini during Deepawali Amawashya date 2, 3and 4 Nov., 2013

S.N.	Parameter	Forenoon			Afternoon		
		S1	S2	S3	S1	S2	S3
1.	pH	8.19	8.24	8.91	8.16	8.22	8.93
2.	DO	6.98	6.04	4.08	7.26	6.66	4.69
3.	BOD	18.23	22.37	28.61	16.96	21.05	28.82
4.	COD	48.87	58.76	60.42	47.68	57.60	60.02
5.	F. Coliform	1300.45	1450.07	3200.21	13312.67	1430.85	3500.78

Table-2
Average physico-chemical characteristics river Mandakini during Somwati Amawashya dated 1, 2 and 3 Dec, 2013

S.N.	Parameter	Forenoon			Afternoon		
		S1	S2	S3	S1	S2	S3
1.	pH	7.92	8.16	8.28	8.00	8.40	8.60
2.	DO	7.01	6.98	5.02	7.82	7.02	5.28
3.	BOD	16.23	20.84	30.64	16.02	21.98	29.28
4.	COD	40.23	50.92	59.67	41.69	52.64	60.6
5.	F. Coliform	1198.46	1436.76	2800.87	1287.87	1412.00	2900.00

Table-3
Average physico-chemical characteristics river Mandakini during Maghi Amawashya date 29, 30 and 31 Jan, 2014

S.N.	Parameter	Forenoon			Afternoon		
		S1	S2	S3	S1	S2	S3
1.	pH	7.92	8.02	8.19	8.00	8.05	8.18
2.	DO	7.94	7.02	6.62	7.94	7.60	6.89
3.	BOD	10.29	13.32	22.6	10.12	13.28	20.78
4.	COD	38.76	42.69	56.34	40.39	41.89	52.45
5.	F. Coliform	1196.06	1398.09	2400.34	1290.09	1390.45	2498.00

Table-4
Average physico-chemical characteristics river Mandakini during Amawashya dated 29, 30 and 31 March, 2014

S.N.	Parameter	Forenoon			Afternoon		
		S1	S2	S3	S1	S2	S3
1.	pH	7.08	7.94	8.00	7.00	8.00	8.42
2.	DO	8.24	7.99	5.90	8.01	7.62	5.56
3.	BOD	11.20	14.76	19.67	11.46	14.65	19.89
4.	COD	32.70	40.82	52.49	33.66	41.05	51.74
5.	F. Coliform	1009.76	1298.09	2398.87	1097.76	1299.98	2470.54

Table-5
Average physico-chemical characteristics river Mandakini during Somwati Amawashya dated 27, 28 and 29 April, 2014

S.N.	Parameter	Forenoon			Afternoon		
		S1	S2	S3	S1	S2	S3
1.	pH	8.00	8.34	8.91	8.06	8.42	8.93
2.	DO	7.90	6.47	5.23	7.21	6.29	5.08
3.	BOD	12.28	14.93	21.61	12.99	14.87	20.89
4.	COD	40.67	44.81	57.40	40.98	43.68	56.69
5.	F. Coliform	1400.98	1534.81	2842.45	1456.23	1543.45	2926.67

Table-6
Average physico-chemical characteristics river Mandakini during Amawashya dated 27, 28 and 29 May, 2014

S.N.	Parameter	Forenoon			Afternoon		
		S1	S2	S3	S1	S2	S3
1.	pH	7.06	7.87	8.12	7.0	7.86	8.11
2.	DO	9.76	8.67	6.02	9.73	8.12	5.93
3.	BOD	10.12	11.43	17.86	10.19	11.50	17.94
4.	COD	32.65	38.81	48.45	33.87	39.63	48.80
5.	F. Coliform	1023.23	1100.32	1556.23	1089.24	1178.24	1627.24

Table-7
Average physico-chemical characteristics river Mandakini during Amawashya dated 26, 27 and 28 June, 2014

S.N.	Parameter	Forenoon			Afternoon		
		S1	S2	S3	S1	S2	S3
1.	pH	7.76	8.00	8.43	7.78	8.12	8.48
2.	DO	7.53	7.00	5.02	7.22	6.28	4.98
3.	BOD	12.12	14.67	19.56	13.56	15.54	19.94
4.	COD	40.33	47.45	50.45	41.45	45.78	54.00
5.	F. Coliform	1229.56	1480.89	2056.23	1298.24	1497.87	2112.23

Table-8
Average physico-chemical characteristics river Mandakini during Amawashya dated 25, 26 and 27 July, 2014

S.N.	Parameter	Forenoon			Afternoon		
		S1	S2	S3	S1	S2	S3
1.	pH	8.00	8.54	8.91	8.03	8.56	8.93
2.	DO	8.27	7.79	5.67	8.12	7.31	5.11
3.	BOD	9.27	10.37	18.65	9.47	10.02	17.02
4.	COD	37.72	41.82	46.41	37.97	42.03	48.23
5.	F. Coliform	1034.12	1121.14	1600.42	1134.14	1276.45	1842.89

Table-9
Average physico-chemical characteristics river Mandakini during Somwati Amawashya dated 24, 25 and 26 Aug., 2014

S.N.	Parameter	Forenoon			Afternoon		
		S1	S2	S3	S1	S2	S3
1.	pH	8.19	8.34	8.97	8.23	8.35	8.99
2.	DO	6.20	5.94	4.00	6.00	5.43	3.98
3.	BOD	18.29	20.37	29.61	19.79	22.45	32.82
4.	COD	42.07	48.82	60.42	43.65	49.62	62.60
4.	F. Coliform	1889.56	2056.00	2924.08	1898.45	1213.09	3400.09

Table-10
Average physico-chemical characteristics river Mandakini during Pitramoksha Amawashya dated 22, 23 and 24 Sept., 2014

S.N.	Parameter	Forenoon			Afternoon		
		S1	S2	S3	S1	S2	S3
1.	pH	8.12	8.24	8.96	8.16	8.28	8.98
2.	DO	7.22	6.78	5.00	6.01	6.11	4.97
3.	BOD	13.21	15.32	22.67	14.99	16.87	24.81
4.	COD	30.71	36.82	48.40	31.62	37.62	50.63
5.	F. Coliform	1634.56	1894.23	2689.04	1756.09	1908.98	2634.00

Table-11
Physico-chemical results

S.N.	Parameter	Min.	Station	Month	F/A	Max	Station	Month	F/A
1.	pH	7.00	S1	May	A	8.99	S3	Aug.	A
2.	DO	3.98	S3	Aug	A	9.76	S1	May	F
3.	BOD	9.27	S1	May	F	32.82	S3	Aug.	A
4.	COD	32.65	S1	May	F	62.60	S3	Aug	A
5.	F. Coliform	111.06	S1	March	F	3500.78	S3	Nov.	A

Table-12
WHO standard for drinking water

S.No.	Parameters	Standard
1.	pH	7.0-8.0
2.	Dissolved Oxygen (mg/l)	5.0
3.	Biochemical Oxygen Demand (mg/l)	6.0
4.	Chemical Oxygen Demand (mg/l)	10
5.	Fecal coliform MPN/100ml (CPCB)	500 MPN/100ml.

Biochemical oxygen demand is a measure of the oxygen in the water that is required by the aerobic organisms. The biodegradation of organic materials exert oxygen tension in the water and increases the biochemical oxygen demand[5]. BOD has been fair measure of cleanliness of any water on the basis that value less than 1-2 mg/l are considered clean, 3mg/l fairly clean, 5 mg/l doubt fall and 10 mg/l definitely[6]. The lower BOD value was observed forenoon at Arogyadham in May and higher value was observed in Afternoon at Ramghat in August.

pH of the aquatic system is an important indicator of the water quality and extent pollution in the watershed area. pH was observed 7.00-8.99. It has been monitored that the increasing. pH appear to be associated with increasing use of alkaline detergent.

Being of public health concern, this is the most critical parameter. The fecal coliform MPN at all stations and at all times was considerably higher than the CPCB limit (500/100 ml). The fecal coliform was ranged 111.06-3500.78.

In any case Mandakini water would be unsafe for bathing and should be regarded a health risk if well-accepted fecal coliform criteria were to be adopted[7].

Conclusion

Water samples were collected in River Mandakini, evident physico-chemical parameters examined. In general all parameters were not within the range of standard values prescribed by WHO. The water of River Mandakini is highly contaminated at all the stations during the study and it is unfit for consumption, domestic and irrigation purposes. Hence, requires proper treatment of river water than may be supplied for drinking and domestics uses. Water quality analysis should be carried out from time to time, in order to monitor the rate and the contamination type. The present study recommends to continue the monitoring that is useful for the sustainable development through planning and for the implementation of remediation methods in the future, in order to mitigate the adverse effects of the poor quality of water on human health.

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