



Characterization of Water and Sediment quality of River Ahiran in Korba Chhattisgarh, India

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Abstract

Both water and sediment are the valuable natural resources for aquatic organisms whose quality change in a minor range can be very harmful. Growing population, urbanization, increasing living standard and other activities have brought severe changes in the quality of both water and sediment. River Ahiran is a small tributary of the River Hasdeo. River Hasdeo is the largest fresh water resources of Korba city, Chhattisgarh, India. The present study was taken on River Ahiran; it is an important water source of Katghora block and its surrounding villages. River Ahiran was greatly influenced by effluents of small scale industries and domestic wastes. The study revealed that the total solids, total dissolved solids, total suspended solids, ammonia, nitrite, phosphate and chemical oxygen demand of water of this area was found higher. Biological oxygen demand was found under the limit and dissolved Oxygen was found lower than the standard limit. The sediment of the sampling points of River Ahiran contains higher concentration of lead and cadmium than the permissible limit recommended by Indian Standards and World Health Organization. The study highlights the pollution load on River Ahiran due to mixing of industrial and domestic wastes.

Keywords: River Ahiran, surface water, sediment, industrial effluents and Pb and Cd.

Introduction

Korba is the fully revenue district and power capital of the state Chhattisgarh, India. It is situated on the banks of the confluence River Hasdeo and Ahiran the major sources of fresh water and located 22°01 to 23°01 latitude and 82°08 to 83°09 longitude¹. Environment is described as the calnative and other geographical setup of a region, where all animals live. It consists of biotic and abiotic components and includes the aquatic, terrestrial, and atmospheric habitats. Water and sediment being the essence of life, any deterioration in these can create great harm to human beings as well as to the environment. The quality of both water and sediment is affected by industrial and urban development. As every industrial process along with the population uses same quantity of water and discharge it after use. This makes the study of water and sediment quality an internal part of the environment study. Both water and sediment are important for aquatic organisms. There are numerous power plants and industries are established. Its waste products are directly or indirectly discharged on rivers, it contains important trace and toxic elements. When the effluents of industrial unit's mixes with the River Ahiran, they flow with water either in dissolved state or settle down over the surface of sediment, and makes harmful for aquatic organisms. The continuous emanation of treated and untreated wastes from various activities has changed quality of water and sediment of this region. As we know that the heavy metals are non-biodegradable and they remain stable in our environment and harmful for all the living beings. River Ahiran join with the

River Hasdeo below the Darri reservoir. The main problems created by wastes of industrial and domestic even at low concentration in both water and sediment; they can lead to major damage to aquatic organisms. The aim of the investigation was to assess the quality of water and sediment of River Ahiran.

Material and Methods

Method for sampling of water and preservation²⁻⁴: The sampling was made from the year July 2008 to year June 2011. The sampling was done once in the middle of every season. 2.5 liter of water and sediment samples were collected in a clean washed plastic jerry-cane and 2 ml conc. nitric acid added to the prevent biodegradation, hydrolysis and precipitation.

Method for sampling of Sediment and analysis: Sediment samples were collected in hard plastic container. Sediment samples were collected in 10 x 10 x 3 cm. Sample was homogeneously mixed. The sediment was spread to dry, on a tray. The tray was commonly about 60x50x2.5 cm made from hard plastic. The sediment was allowed to dry in the air. After sieving stone pieces, parts of plant and other packable substances, sediment were dried at 100 to 105°C for 4-5 hours and cooled it in desiccators. Dried samples were grinded by rolling gently with a Mortar and converted into fine powder. By weight 1 gm of sediment was digested with mixture of conc. H₂O₂, HCl and HNO₃ and then added 10 ml of distilled water and filtered it by using whatman filter paper no. 41 in a 100 ml

volumetric flask made-up to the marks. Samples were analyzed by standard method adopted by APHA 21st edition Washington D.C. 2005 and N. Manivasakam, Pragati Prakashan Meerut India 2008-09.

Results and Discussion

Physical parameters: Temperature of this water body has increased due to mixing of hot wastewater coming from industrial units; its value was recorded between the ranges of 16.8°C to 26°C. The higher value of temperature was recorded in summer. pH was recorded between the ranges of 7.69 to 8.96, water of the study points was found basic in summer season. Higher pH is not safe for aquatic organisms especially for fishes⁵. The electrical conductivity of the study area was recorded higher than the limit. The conductivity of the sampling points was recorded between the ranges of 788 micro mhos /cm to 1770 micro mhos/cm. Turbidity was recorded between the ranges of 13 NTU to 21 NTU. The higher value of turbidity may be due to mixing of water soluble wastes discharged by motor vehicle and industrial units. TS, TDS and TSS of this water

body were found higher to the limits. Which makes it unfit for irrigation, higher total dissolved solids indicate the salinity behaviour of water and contains higher quantity of minerals^{6,7}. WHO and IS provided guidelines for TDS not to exceed more than 250 mg/L.

Demand parameters: Dissolved oxygen is one of the most important parameters is assessing water quality and reflects the physical and biological processes prevailing in the water. Dissolved oxygen of the sampling points was found lower in summer season while higher in winter, its values was recorded between the ranges of 6.4 mg/L to 9.9 mg/L. Biological oxygen demand indicates microbial pollution in water, the results was recorded between the ranges of 2.9 mg/L to 5.8 mg/L. Chemical oxygen demand of the sampling points was recorded 4 mg/L to 11 mg/L⁸⁻¹⁰. Its values were not in dangerous zone.

The various physicochemical parameters were estimated from the collected water and sediment samples at sampling sites S1 and S2 are given in table 1 and 2.

Table-1
Physicochemical parameters at sampling sites S1 and S2

Parameter	Year 2008-2009			Year 2009-2010			Year 2010-2011		
	M	W	S	M	W	S	M	W	S
Temperature	19.8	16.8	24	19	17.9	27	18	18.6	24
pH	7.70	7.69	8.46	7.70	7.69	8.94	7.74	7.90	8.96
Conductivity in Micro mhos/cm	879	998	1668	887	1106	1171	788	1198	1770
Turbidity in NTU	21	13	20	20	15	19	19	21	18
TS	1108	1434	2065	1186	1665	1867	1054	1347	2178
TDS	789	965	1569	687	1005	1069	658	1050	1654
TSS	391	469	496	499	500	798	396	297	524
DO	8.6	9.8	7.8	8.9	9.3	7.2	9.8	9.8	7.9
BOD	2.9	3.7	5.8	2.9	4	5.3	3.1	3	5
COD	4	7	9	5	7	10	5	7	11
Hardness	270	279	296	235	268	300	240	246	265
Sulfate	39	62	112	36	45	104	34	56	123
Fluoride	0.2	0.4	0.5	0.1	0.5	0.7	0.2	0.6	0.6
Chloride	24	36	75	32	42	78	19	19	45
Nitrate	0.3	1.1	1.6	0.4	1.0	1.5	0.4	0.9	1.4
Nitrite	0.05	0.07	0.15	0.03	0.05	0.16	0.04	0.07	0.14
Ammonia	0.01	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.02
Phosphate	0.3	0.4	2.0	0.5	0.6	2.1	0.4	0.5	1.6
Acidity	23	39	42	23	39	42	21	41	42
Alkalinity	71	81	93	65	81	91	65	70	89
Pb in water	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.01	0.02
Pb in sediment	0.07	0.25	0.29	0.05	0.20	0.29	0.03	0.23	0.25
Cd in water	0.02	0.001	0.01	0.001	0.01	0.001	0.001	0.001	0.01
Cd in sediment	0.06	0.16	0.20	0.05	0.15	0.22	0.09	0.23	0.29

Table-2
Physicochemical parameters at sampling sites S1 and S2

Parameter	Year 2008-2009			Year 2009-2010			Year 2010-2011		
	M	W	S	M	W	S	M	W	S
Temperature	19.6	17	27	18	18.2	25	17.9	17	26
pH	7.80	7.89	8.70	7.80	7.89	8.96	7.83	7.10	8.99
Conductivity in Micro mhos/cm	878	999	1623	896	998	1299	798	1470	1534
Turbidity in NTU	14	15	21	15	17	20	17	19	21
TS	1184	1256	1943	1196	1326	1954	986	1754	2198
TDS	768	876	1450	756	898	1168	678	1320	1479
TSS	416	380	493	440	428	786	308	434	719
DO	8.2	9.6	6.4	8.8	8.8	6.9	9.9	9.2	7.0
BOD	3.0	3.5	5.6	3	3.8	4.2	3.2	3.2	5.2
COD	5	6	8	6	5	11	6	8	10
Hardness	215	285	298	254	280	296	236	231	263
Sulfate	31	63	102	31	41	105	36	52	109
Fluoride	0.3	0.5	0.6	0.2	0.4	0.6	0.3	0.5	0.7
Chloride	26	39	70	23	45	71	23	26	42
Nitrate	0.3	1.2	1.5	0.5	1.1	1.3	0.3	0.8	1.8
Nitrite	0.04	0.06	0.17	0.04	0.06	0.13	0.04	0.0	0.15
Ammonia	0.01	0.02	0.01	0.01	0.01	0.05	0.02	0.01	0.01
Phosphate	0.4	0.9	2.7	0.4	0.6	2.2	0.3	0.4	1.1
Acidity	21	32	39	21	32	39	20	43	39
Alkalinity	69	77	88	61	84	84	56	69	84
Pb in water	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.005	0.01
Pb in sediment	0.08	0.22	0.28	0.02	0.23	0.25	0.04	0.21	0.32
Cd in water	0.01	0.001	0.002	0.001	0.001	0.01	0.001	0.001	0.002
Cd in sediment	0.04	0.12	0.21	0.06	0.14	0.20	0.03	0.22	0.26

Note: - All results in Mg/L except temperature, pH, conductivity and turbidity. M= Monsoon, W= Winter, S= Summer

Mineral parameters: The hardness of the sampling points was recorded above the limit. Its value was recorded between 215 mg/L to 300 mg/L. The concentration of sulphate was recorded between the ranges of 34 mg/L to 123 mg/L. The problems caused by sulfate gives a bitter taste to water if it exceeds the concentration of 250 mg/L^{11,12}. Fluoride concentration was recorded between the ranges of 0.1 mg/L to 0.7 mg/L¹³. The little amount of chlorine if present in water is harmful for aquatic organisms. Its concentration was recorded between the ranges of 19 mg/L to 78 mg/L. The concentration of chloride in water is not exceeding 250 mg/L. Acidity of the sampling points was recorded under the limits and the alkalinity of the sampling points was recorded minimum 61 mg/L and maximum 93 mg/L. The cause of alkalinity of this water body was due to presence of various basic substances.

Nutrient parameters: Nitrate is a form of nitrogen and a vital nutrient for growth, reproduction etc. Nitrate nitrogen of the sampling points was recorded within the limit. However its small quantity reacts with various compounds present in our body and forms carcinogenic compounds. WHO, IS and OATA provided guidelines for ammonia not to exceed 0.02 mg/L in water. It was found higher than the limit and was recorded between the range of 0.04 mg/L to 0.08 mg/L. Nitrite nitrogen

of the sampling points was found higher than limits, it was recorded between the ranges of 0.03 mg/L to 0.16 mg/L^{14, 15}. There are various sources of phosphate in rivers, such as rock erosion, decomposition of dead plants and interaction between the water and sediment. Phosphate increases the growth rate of blue green algae causing the water unsuitable for bathing and reduces dissolved oxygen levels in water¹⁶. Its concentration was recorded between the ranges of 0.3 mg/L to 2.7 mg/L; its concentration should not exceed 0.1mg/L in water.

Metals: During the study years the concentration of the lead and cadmium was recorded higher in sediment. The higher value of lead and cadmium in sediment may be due to deposition of industrial and auto-mobile wastes. The concentration of Lead and Cadmium of the sampling points was recorded between the ranges of 0.001 mg/L to 0.05 mg/L and 0.001 mg/L to 0.02 mg/L respectively in water and sediment 0.03 to 0.29 mg/L of Lead and cadmium was also recorded between the ranges of 0.03 to 0.29 mg/L in sediments¹⁷⁻²⁸.

Conclusion

The sediment of the study points was recorded more polluted than water. The sediment of the study area is not fit for farming

purpose. Hence, it is necessary to determine heavy metals pollution in sediment and periodical assessment of both water and sediment is beneficial to avoid pollution load on River Ahiran and it will help the farmers in selecting the River points for the farming of cucumber, watermelon and other vegetable on Ahiran.

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