Post-Monsoon Assessment of Physicochemical Parameters of IB River Odisha

Pratik P. Meshram[1] Dr. D. R. Saxena[2]
[1]Student [2]Professor
[1,2]Department of Zoology
[1]2118 18A Gopal Nagar Parsodi Corner Swawlambi Nagar Road Nagpur Maharashtra India
[2]Kamla Nehru Mahavidhyala Sakkardhara Nagpur, Maharashtra, India

Abstract— The present study was carried out to determine the water quality assessment status of IB River which is tributary of Mahanadhi River in Jharsuguda district, Odisha state, north east central India. In the present study, physiochemical parameters of water samples were compared with the water quality standard of Bureau of Indian Standard and the State Pollution control board. Water sample were collected from IB River in post monsoon period of month August 2016 to January 2017. The Parameters studied were, temperature, pH, total alkalinity, dissolved oxygen, biochemical oxygen demand, fluoride, phosphates, iron, and lead. Water quality index was calculated by using National Sanitation Foundation Water Quality Index / Statistical Method. The temperature of the water samples was in the range of 25°C to 28.7°C and pH 7.0 to 7.8 after physiochemical analysis, Water Quality Index was established for various physiochemical parameters by following statistical methods. The results proved to be useful mean for rapid monitoring of water quality with the help of systematic calculation of water parameters analysis. The calculated water quality index indicated that the quality of water was good and hence it is fit domestic use and other purposes.

Key words: IB River, Physicochemical Analysis, Water Quality Index, Saprobian System

I. INTRODUCTION

This paper was intended to analyze the different parameters to assess water quality of IB River, Odisha.

Water is the one of the most abundant 70% of water of these compound of the ecosystem and plays a vital role for the existence of human beings and all living organism of the ecosystem.

Fresh water Rivers holds 0.9% of total freshwater reserves, out of this fresh water wetlands alone supports 27% biodiversity in India. Around 11500 species of fishes inhabits freshwater.

Water is mainly used for domestic, industrial and agricultural purposes, due to population explosion pollution of water has become an environmental problem globally. According to the World Health Organization about 75% of all diseases in human beings are caused by contaminated or polluted water. Contaminated water bodies are unsuitable for aquaculture. Several physicochemical or biological factor could act as stressor and adversely affect fish growth and reproduction. Hence, regular monitoring of physicochemical and biological water quality parameter is essential to determine status of river or lakes with reference to fish culture (World watch institute 1999), it determines the physiological lifecycle of plants, and health of animals and human beings. Filtration of river water is necessary to removes microbes and toxic substances to make water potable. Development of the region is related with quality of water, it also has bearing on population and economic progress of the country.

Effluents from mining and other related industries is increasing water pollution day by day and it alters the physical, chemical and biological nature of the receiving water bodies. Coal mines and related industries spread over major urban and suburban area of the IB region has a significant contribution to the economic growth and human welfare. The impact of effluent discharge (liquid and solids) from the mines of Mahanadi Coal Limited, aluminum smelter, NTPC' power plants, IB thermal plant, etc. was assessed by scientific experimental models. According to D. R. Saxena and A. N. Lonkar, 1988 orange coloring of shell of molluscs V. bengalensis, indicate pollution of water by the element selenium. Animal act as biological indicators of pollution. They can be used to monitor water quality.

II. MATERIALS AND METHODS

A. Materials

The water sample were analyzed for physicochemical parameters like temperature, pH, total alkalinity, biochemical oxygen demand, fluoride, phosphates, and metals iron and lead, during the post monsoon period extending form August 2016 to January 2017. The temperature of water sample was measured by thermometer and pH was measured by pH strips at the site of sampling and in laboratory by digital microprocessor based pocket pH meter. Biochemical Oxygen Dissolved is estimated by difference between dissolved oxygen of first day and dissolved oxygen after 5 days. All these methods were followed by standard procedure methodology of American Public Health Association (APHA 1998).

Physical parameters include, temperature, chemical parameters include, pH, total alkalinity, dissolved oxygen, biochemical oxygen demand, fluoride, phosphates, heavy metals include iron and lead.

Water samples were normally collected in the afternoon in a bottles of 2.0 litter's capacity. Immediately after sampling, preservatives were added and the bottles were re-capped and sealed by the application of hot molten wax. The sealed water glass bottles were put in a thermo-cool box and stored at 4°C till it was carried for laboratory analysis. Sodium thiosulphate preservative were used for sampling in tablet forms.

For dissolved oxygen (DO), and biological oxygen demand (BOD) samples are collected on glass bottle of 300ml capacity. The manganese sulphate and alkali Iodide azide reagent were added immediately at the collection site to fix the sample for analysis of dissolved oxygen. Soon after collection of sample the Temperature of the sample is taken by using digital thermometer and pH has been measured by

using pH strip paper and in laboratory it is measured by digital microprocessor pocket based pH meter.

B. Methods

The temperature of water sample was measured by using standard mercury thermometer. The temperature of the sample was measured twice time, firstly at the site of water sampling and secondly at the time of the sampling received at the laboratory procedures. The pH of water was measured by using pH paper strips at the time of water sampling and at laboratory during the analysis of the water sample through by the digital microprocessor pocket pH meter. Total alkalinity of water sample was measured of ability of water to neutralize the acids through by titration method.

Oxygen dissolved in water is very important parameter in water analysis as it serves as an indicator of the physical, chemical and biological activities of the water body. The two main sources of dissolved oxygen are diffusion of oxygen from the air and photosynthetic activity. Oxygen is considered to be major limiting factor in water bodies with organic material. Dissolved oxygen is used as an indicator of the health of a water body, where higher dissolved oxygen concentrations are correlated with high productivity and little pollution.

The Winkler method was a technique used to measure dissolved oxygen in freshwater systems.

Biological oxygen demand (BOD) was the amount of oxygen required by micro-organism for stabilizing biologically decomposable organic matter in water under Aerobic Conditions. The test is used to determine the pollution load of wastewater the degree of pollution and the efficiency of waste water treatment methods. BOD value was measured by measuring the difference of dissolved oxygen of the same water sample in 5 days. DO present in sample was calculated. Biological oxygen demand was estimated by titration method.

Fluoride are found in certain industrial processes resulting in fluoride rich wastewater. Fluoride was estimated by sodium 2 (para-sulpho-phenyl-azo) -1, 8-dihydroxy-3, 6-naphthalene di-sulphonate (SPADNS) colorimetric method. The method is based on reaction between fluoride and a zirconium dye lake.

Phosphate occurs in natural water almost solely in the form of various type of phosphates. Their presence in water was due to detergents, fertilizers, boiler wastages, and biological processes. They occurs in solution in particles or as detritus. They are essential for the growth of organisms and a nutrient that limits the primary productivity of the water body. Inorganic phosphorus plays a dynamic role in aquatic ecosystem, when present in low concentration is one of the most important nutrient, but in excess along with nitrates and potassium causes algal blooms. These may occurs in the soluble form, in particles of detritus or in the bodies of aquatic organism. Phosphate was estimated by stannous chloride method.

Iron is the abundant element of the earth crust, but exists generally in minor concentration in natural system Iron occurs in minerals as hematite, taconite and pyrite. Iron in water sample was detected by phenanthroline method.

Lead is relatively a minor element in the earth's crust but is widely distributed in low concentrations in uncontaminated soils and rocks. Lead concentration in freshwater is generally much high. High concentration of Lead results from atmospheric input of lead originating from its use in the leaded gasoline or from smelting process. Industrial processes such as printing and dyeing, paint manufacturing, explosives, photography and mine, or smelters operations may contain relatively high values in lead. Lead is toxic to aquatic organisms. Lead was estimated by dithiazone method.

III. Observations

Table shows post-monsoon monthly variations in some physicochemical parameters in the IB River Odisha extending from August 2016 – January 2017.

S. No	Parameters	Aug	Sept	Oct	Nov	Dec	Jan
Physical parameters							
1	Temperature at °C	27.20	25.40	24.20	23.10	25.30	25.50
Chemical parameters							
2	pH	7.5	7.7	7.3	7.4	7.3	7.9
3	Total Alkalinity mg/l	39.66	37.43	32.66	35.43	40.44	42.31
4	Dissolved Oxygen mg/l	5.25	5.71	6.72	5.84	6.38	6.26
5	Biological Oxygen Demand mg/l	7.26	9.87	4.58	9.84	3.51	5.10
6	Fluoride F mg/l	0.326	0.338	0.321	0.337	0.324	0.328
7	Phosphate PO_4 mg/l	1.74	1.83	1.62	1.35	1.17	1.26
Heavy metals							
8	Iron mg/l	1.54	2.38	1.68	1.38	1.47	1.81
9	Lead mg/l	0.006	0.008	0.007	0.006	0.006	0.008

Table 1: Post-monsoon monthly variations

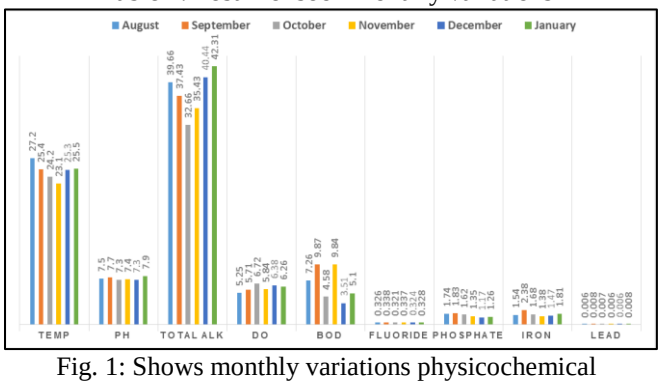

Fig. 1: Shows monthly variations physicochemical parameters in the IB River Odisha extending from August 2016 – January 2017.

IV. Results and Discussion

A. Results

The various physicochemical parameters of IB River have been graphically summarized. Analytical results revealed

physicochemical characteristics of water samples of the study area done in August 2016 to January 2107. In the present study the parameters among the study site showed little variations during all the seasons. (See table 1 and graph 1.)

Parameters	Investigating Months of Year 2016 – 2017.						Statistical Analysis.			
	August	September	October	November	December	January	Max	Min	Range	Mean
Temperature	27.20	25.40	24.20	23.14	25.30	25.50	27.20	23.10	4.1	25.11
pH	7.5	7.7	7.3	7.4	7.3	7.9	7.9	7.3	0.6	7.5
T. Alkalinity	39.66	37.43	32.66	35.43	40.44	42.31	40.44	32.66	7.78	37.98
D. Oxygen	5.25	5.71	6.72	5.87	6.38	6.26	6.72	5.25	1.47	6.02
B.O.D	7.26	9.87	4.58	9.84	3.51	5.10	9.87	3.51	6.36	6.69
Fluoride F^-	0.326	0.338	0.321	0.337	0.324	0.328	0.338	0.321	0.017	0.329
Phosphate	1.74	1.83	1.62	1.35	1.17	1.26	1.83	1.26	0.57	1.495
Iron Fe	1.54	2.38	1.68	1.38	1.47	1.81	2.38	1.38	1	1.71
Lead Pb.	0.006	0.008	0.007	0.006	0.006	0.008	0.008	0.006	0.002	0.0068

Note: All Parameters are in mg/l except pH, Temperature in °C,

Table 2: Statistical analysis of water samples.

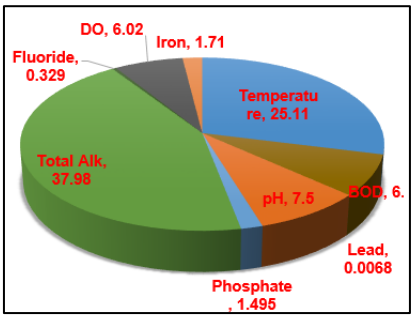

Fig. 2: Statistical analysis of water samples.

V. Discussion

Color of the river water was clear but in monsoon it may be turbid due to flood in Mahanadhi River. The water was odorless having pleasant taste and was refreshing. Temperature of the river water was found 23.14 to 27.20 with an average of 25.11 which is within the limit of National Sanitation Foundation water quality index. The difference in temperature is due to seasonal variation in solar radiation.

The pH of the river water is found 7.3 to 7.9 with an average of 7.5 indicates that the alkaline nature of the water. The pH values are well within the range as compared to permissible limit of pH drinking water which is within the 6.9 to 8.5 as per drinking water quality standard IS: 10500 and National Sanitation Foundation water quality index a criteria used to classify the quality of water. Slightly high pH was due to algal growth and reduced microbial activity (Chetana and Somashekar, 1997), slightly low pH was due to input of raw sewage into the river water.

The value of the total alkalinity was found to be 40.44mg/l to 42.31mg/l with an average of 37.98mg/l. Alkalinity was estimate of the ability of water to resist change in pH upon addition of acid through by sewage. There was slightly seasonal variation was found in the alkalinity of the water. Decomposition of plants during the flood plays significant role in rise of alkalinity of water mostly seen the post monsoon (Mishra et at 1995, Senapati and Sahu 1996; Panda et al., 2006)

The value of dissolved oxygen in the study site was found to be 5.25mg/l to 6.72mg/l with an average value of 6.02mg/L. Significant difference in DO of water sample are found but all the values of DO was found to be permissible limit as per IS: 2296 & IS: 10500. Dissolved oxygen increases due to the dissolved oxygen during the period of photosynthesis. The lowest DO values indicates unhealthy condition of water. High atmospheric temperature, addition of sewage and other waste form industrial and mines are responsible for variation in DO values. Significant changes of DO were observed due to aeration, organic matter decomposition and algal activities. As DO levels falls; undesirable odors, tastes and colors reduce the acceptability and potability of water (Priyadarshni, N, 1998, 2004)

The values of biological oxygen demand in the study area was found to be 3.51mg/L to 9.87mg/L with an average of 6.69mg/L. BOD values are observed high in monsoon period. All the values of BOD are found to be permissible limit as per IS: 10500. The higher values of BOD are during rainy days was due to input of organic wastes and enhance the bacterial activity. High BOD decreases level of dissolved oxygen (B)

The values of fluorides in the study area was found to be 0.321mg/l to 0.338mg/l with an average of 0.329mg/L are in within the permissible limit as per IS: 10500 which is 1.0mg/L. Fluoride level of water sample in monsoon season show slightly variation. Surface water generally contain less than 0.5mg/l, if present in much greater concentration it becomes a pollutant. Fluoride content was found as significant in river water but seasonal variation shows no significant differences.

High concentration of fluoride causes serious health problems, hence it is necessary to regularly monitor of fluoride level in river water. (Bagde and Verma 1986; Palharya and Malvial 1998)

The values of phosphate in the study area was recorded to be 1.26mg/l to 1.83mg/l with an average of 1.495mg/l. All the values of phosphate in water sample are found within permissible limit as per IS: 10500. Significant variations are observed during the sample periods. Phosphate occurs in natural water in low quantity, as many aquatic plants absorb and store phosphorous many times their actual immediate needs. The maximum value may be due to the solar radiation, which might have encouraged the biological degradation of the organic matter. Continuous entry of domestic sewage was responsible for increase of phosphate. The high value of phosphate in monsoon are mainly due to rain, surface water runoff, agriculture runoff, coal washer. (Dixit et al., 2013)

The value of iron in the study area was found to be 1.38mg/l to 2.38mg/l with an average of 1.71mg/l. The permissible limit of Iron in water was 1.0mg/L as per IS: 10500. Iron is the abundant elements of earth's crust, but exist in various concentration in water system. In the study area

iron concentration in water sample was found to slightly high due to presence of coal mines. The IB River is surrounded by IB river coal valley and contain coal washeries. The soil contains large number of deposited iron and is a sink for discharge of waste water of thermal power plant. Hence the iron level of the water sample was found to slightly high. (Mishra and Ram 2007)

The value of lead in the study area was found to be 0.006mg/l to 0.008mg/l with an average of 0.0068mg/l. Almost negligible limit of Lead was found in river water. Lead in a water supply may come from industrial, smelter discharges and mines. Industries and smelter follow standard water treatment before discharge of water directly into the river. (Girija et al., 2007). The permissible limit of lead in water is 0.015mg/l as per American Standard of the river water & IS: 10500.

VI. Conclusion

The present study assessed the water quality of IB River Water. In this study, different physicochemical parameters was successfully applied and compared with the respective standards to monitor the water quality of Mahanadi River delta. Water analysis of pH, temperature, dissolved oxygen, biological oxygen demand, phosphates, fluorides, iron and lead, and are the most important parameters represents the pollution status of the IB River Water. The pollutants from several sources causes significant changes in the quality of water and pose some deleterious effect to the aquatic as well as surrounding ecosystems. Data were compared with Surface Water Quality Standards IS 2296, and Drinking Water Quality Standard IS 10500 and National Sanitation Foundation (NSF) Water Quality Index in order to classify the quality of water. The parameter did not exceed the maximum permissible limit. The physicochemical data indicates that the river water is clean fit for drinking by using proper filtration and chlorination. All natural waters clear their pollution load that depends on physical chemical and biological (microbes) factors saprobian system is constituted by microbes (fungi and bacteria). The IB river region has Medium Quality Drinking Water as per the National Sanitation Foundation Water Quality Index.

Acknowledgement

The present investigation study was supported by the Department of Zoology of Kamla Nehru Mahavaidhyala Sakkardhara Nagpur, Maharashtra India, affiliated to Rashtrasant Tukadoji Maharaj Nagpur University. The Author are thankful to all staff of Post Graduated Department of Zoology for extending all possible and timely co-operation for completion of the Research work project.

References

[1] Caldwell, D.H. &R.B Adams, (1946) Colourimetric Determination of Iron in Water with O-Phenanthroline. J. Amer Water Works Association. 38:727.
[2] Chahuan, R. and Ramanathan, A.L., "Evaluation of Water Quality of Bhitarakaika Mangroove Ecosystem, Odisha, East Coast of India, "Indian Journal of Marine Science 37. 153-171 2008
[3] Das J, Das SN, Sahoo RK 1997. Semidiurnal Variation of Some Physicochemical parameter in the Mahanadi Estuary East Coal of India. Indian J Mar Sci, 26: 323-336.
[4] Dr. D. R. Saxena and A. N. Lonkar (1988), Preliminary observation on the toxicity of selenium dioxide to Vivipora bengalensis. Section VII. Proceeding NSCA 233 PP 127.
[5] Drinking Water Analysis Manual Publish by Central Pollution Control Board (CBCB). A Govt. of India Organization Ministry of Environment and Forest.
[6] Drinking Water Quality Assessment of Nagpur City, Soni Chaubey and Moahn Kumar Patil, Senior Environment Professional En Carp Solutions, Nagpur Maharashtra.
[7] Kamble, S.M., Kamble, A.H. and Narke, S.Y. (2009), Study of Physicochemical Parameters of Ruti Dam, Tq. Ashti, Dist. Beed, Maharashtra. Jouranl of Aquatic Biology 24, 86-95.
[8] Mahananda, M.R., Mohanty, B.P and Behera, N.R. (2010) Physicochemical Analysis of Ground and Surface Water IJRRAS, 2, 272-294.
[9] Methods for the Examination of Water & Associated Materials – General Principle of Sampling and Accuracy of Results 1980. Her Majesty's Stationery Office., London England.
[10] NEERI: Manual on Water and Waste Water Analysis, National Environmental Engineering Research Institute Nagpur (1986)
[11] Panda, U.C., Sundaray Rath, S.K, Nayak, P and Bhatta, D (2006) Application of Factors and Cluster Analysis for Characterization of River and Estuarine Water System – A Case Study.
[12] Sandell, L.J., (1947) Improved Dithizone method for determination of Lead Mixed Colour Method at high pH Anal. Chem 19:684.
[13] Scientific Research Physiochemical Analysis of Surface and Ground water around Talcher Coal Field District Angul Odisha.
[14] Standard Methods for the Examination of Water & Wastewater, American Water Works Association (AWWA-1964), American Public Health Association (APHA - 1998) 21st Edition 2005.
[15] Singh, G. (2004) Study of Water Quality in Coal Mining Environment – A case Study in the Jharia Coal Field Journal of Industrial Pollution, Control, 6, 67-70.
[16] Water Quality Monitoring Programme Guide – A Guide Protocols to Design and Implementation of Fresh Water Quality Studies and Monitoring Proreammes.
[17] Water Quality Analysis Guide Manual – Edited by Dr. Reeta Kori, Mrs. Suniti Parashar under guidance of Dr. D.D. Basu, Scientist "E" & Sh. J.S. Kamyotra, Member Secretary CPCB.
[18] World health Organisation 1984, Guidliness for Drinking Water Quality Vol 1, Health Criteria and Other Supporting Information Geneva WHO.
[19] Physico Chemical Properties of Water Sample collection from Mangroove Ecosystem of Mahanadi River Delta Odisha by B.C Behera, R.R Mishra, J.K Patra, S.K. Dutta, H.N Thatoi – Department of Biotechnology College of Engineering & Technology Biju Pattnaik University of Technology, Bhubaneswar Odisha.
[20] Drinking Water Quality Analysis of Surrounding Rivers in Bhubaneshwar Odisha – K.Mohapatra, S.K. Biswal,

G. Nayak. Asst Professor Deparment of Chemistry GITA. Bhubaneshwar Odisha.
[21] American Journal of Marine Science, 2014 2 (1) pp.19-24. DOI: 10. 12691/marine-2-1-3
[22] State Pollution Control Board Report (SPCB) "Water Quality of Major Rivers of Odisha" 2007.
[23] Bureau of Indian Standard for Drinking Water (BIS) IS: 10500, New Delhi 1991.
[24] Subarnarekaha River in Balasore Region Odisha Karim A.A Panda R.B Assessment of Water Quality of Subarnarekha River in Balsore Region, Odisha.
[25] Mahanadi River (India) Journal of Hydrology 331, 434-456.

