ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 9, Issue, 5(J), pp. 27187-27190, May, 2018

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

ESTIMATION OF WATER QUALITY OF IMPHAL RIVER, MANIPUR, INDIA

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DOI: http://dx.doi.org/10.24327/ijrsr.2018.0905.2206

ARTICLE INFO

Article History:
Received 12th February, 2018
Received in revised form 9th March, 2018
Accepted 26th April, 2018
Published online 28th May, 2018

Key Words:
Imphal River, parameters, physico-chemical, toxaemia, Manipur.

ABSTRACT

The current study was conducted on water quality of Imphal River, Manipur. The aim of the study is to analyse physico-chemical properties of water of Imphal River. Imphal River is one of the main sources of water for the people of Manipur. The study was conducted from Oct. 2014 to Dec. 2015. The water samples were analysed using APHA standard methods. The physico-chemical parameters like water temperature, P^H, dissolved oxygen, Free Carbondioxide, total alkalinity, turbidity, total hardness, calcium, magnesium, sodium, potassium and chloride were evaluated. The value of water temperature recorded between 16.5°C- 27.9°C, pH ranged between6.3-7.9, dissolved oxygen between 5.8-19.3 mg/l, Free CO_2 between 0.5-7 mg/l, alkalinity ranged 10-84 mg/l, turbidity between 0-480 mg/l, total hardness between 32-52 mg/l, calcium between 8.46-16 mg/l, magnesium between 2.73-9.95 mg/l, sodium between 3.46-6.02 mg/l, potassium between 1-3.32 mg/l. The river water is contaminated in the city areas due to human activities and there is a need to monitor regularly to conserve the water system. So, the State Government should make proper policy programme to prevent further degradation of the river since many people depend on the river for drinking and other livelihood like fishery activities.

INTRODUCTION

Water is the elixir of life. Most of the livelihood activities depend on water. The quality of water depends on physico-chemical properties of water. Oceans, lakes, rivers, ponds, tanks etc. are the main sources of water. In which, river water is one of the important sources of daily activities for surrounding living beings. Many aquatic organisms exist in water. The physical and chemical properties of water must be monitored regularly. As due to industrialization and development water system is getting unfit of uses. Human health is threatened by most of the agricultural development activities particularly in relation to excessive application of fertilizers and unsanitary conditions [1].

Manipur is endowed with many rivers and streams in which Imphal River is the important river of Manipur. Imphal River originated from Henbung of Kangpokpi areas as SekmaiRiver and from Sana Lokchao of Leimakhong areas as Leimakhong river of Senapati District and both the river joint at KhonghampatIrong of Imphal West district and named Imphal River. It is the tributary of Manipur River, joining it in Thoubal district and flows to Loktak Lake. Imphal River water quality is deteriorated by the sewage disposal, pesticides, dumping of solid waste, agricultural fertilizers and other human activities like washing cloth and utensil, bathing etc,[2].

The water quality of the Indian rivers has been polluted due to continuous industrial waste and domestic sewage [3]. The wastes may contain many contaminants like petroleum hydrocarbon, chlorinated hydrocarbon and heavy metals, various acids, alkalis, dyes and other chemicals which highly affect the water bodies. All these chemicals are highly harmful and become toxic to fishes [4]. Rapid growth of population, industrialization and using of river and other water bodies as waste disposal may extremely disturbed and changes the physico-chemical properties of water [5]. Water quality not only depend on natural processes like erosion, precipitation, weathering of rocks etc. but also on anthropogenic influences like urban, industrial and agricultural activities [6].

MATERIAL AND METHODS

The current study of the Imphal River was conducted from Oct. 2014 to Dec. 2015. The water samples were collected from five different sites i.e. KhuraiShalanthong (Site I), HaptaMinuthong (Site II), Mahaballi (Site III), SingjameiKshetrileikai (Site IV) and Ningomthong (Site V) respectively are given in the fig: 1.The water samples were collected every month. The water

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temperature was measured by using digital thermometer on the spots pH was determined by portable pH meter (systronic), turbidity measured by using turbidity meter. Free CO_2, alkalinity, total hardness, calcium, magnesium, Chloride is estimated by titration methods and dissolved oxygen by Winkler's method with azide modification [7]. The nutrients content like sodium and potassium were measured by using flame photometer. The nutrients like calcium, magnesium, chloride, sodium, potassium and total hardness were measured every three month.

Study sites

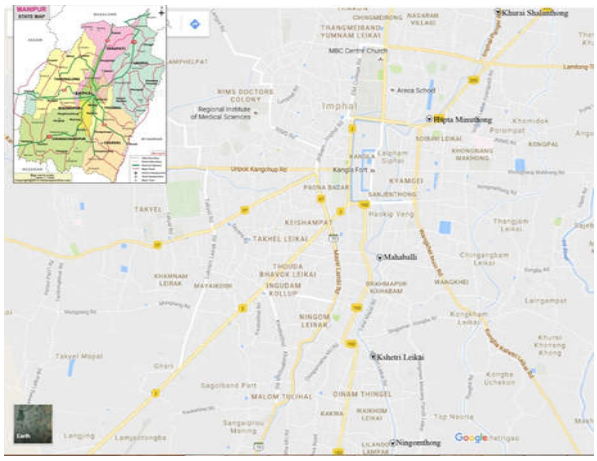

Fig 1 Sampling Sites of Imphal River

RESULT AND DISCUSSION

The sampling sites are in given in the Figure 1 and the results of physico-chemical parameters and nutrients content of the Imphal River are given in the Table No. 1. The value of water temperature recorded between 16.5°C- 27.9°C, pH ranged between6.3-7.9, dissolved oxygen between 5.8-19.3 mg/l, Free CO2 between 0.5-7 mg/l, alkalinity ranged 10-84 mg/l, turbidity between 0-480 mg/l, total hardness between 32-52 mg/l, calcium between 8.46-16 mg/l, magnesium between 2.73-9.95 mg/l, sodium between 3.46-6.02 mg/l, potassium between 1-3.32 mg/l..

Table1. Physico-chemical parameters of five different site of Imphal River.

Sl. No	Physico-chemical parameters	STUDY AREAS					
		SITE I	SITE II	SITE III	SITE IV	SITE V	WHO limits
1	Temperature °C	16.5-26.7	17.7-27.8	17.2-27.9	17.5-26.6	17.7-27.8	30-35
2	p H	6.5-7.8	6.8-7.9	6.8-7.8	6.8-7.8	6.8-7.9	6.5-8.5
3	Free Carbon dioxide (mg/l)	1-6	1-7	1-4	0.5-4	1-4	22
4	Dissolved Oxygen (ppm)	16.4-19.3	7.5-12.8	5.8-11.8	7.6-11.8	6.3-14.6	5.00-7.00
5	Alkalinity (mg/l)	11-73	10-84	10-78	10-72	10-76	120
6	Turbidity (mg/l)	Nil-357	Nil-388	Nil-398	Nil-388	Nil-380	5
7	Total Hardness (mg/l)	32-52	26-50	32-52	20-50	34-46	300
8	Calcium (mg/l)	9.6-12	8.4-10.4	10.2-11.2	8.8-12	9.6-12.6	100
9	Magnesium (mg/l)	5.4-9.6	3.8-9.95	5.07-9.95	2.73-9.27	5.66-8.88	150
10	Sodium (mg/l)	3.26-5.6	4.36-5.86	3.46-5	3.38-6	4.24-6.02	200
11	Potassium (mg/l)	1-2.6	1.86-3.32	1-3.2	1-2.24	1-2.62	50
12	Chloride (mg/l)	Nil-7.10	Nil-8.52	Nil-7.10	Nil-22.72	Nil-19.88	250

Water temperature: Water temperature is an important physical parameter. The intensity and seasonal variations of water temperature directly affect the productivity of river [8, 9]. In Indian sub-continent the water temperature ranges from 7.8°C- 38.5 °C [10]. The water temperature during the study period was recorded between 16.5°C to 27°C. The minimum value was recorded at Site I in Dec. 2015 which may be due to decrease in metabolic activities of aquatic plants and animals in winter season. The maximum value was reported at Site III in August 2015.

Dissolved oxygen*:* The DO content in the water body indicates the physical and biological processes prevailing in the water and is very important because it directly affect the survival and distribution of flora and fauna in an ecosystem. The increase and decrease of DO is correlated with photosynthetic activity. The higher concentration of DO recorded during winter season might be due to low turbidity and increase in photosynthetic activity. The dissolved oxygen value during investigation period was recorded between 5.8 to 19.3 ppm. The minimum value was recorded at Site III during March 2015 and the maximum value was recorded at Site I during July 2015. The highest value may be due to heavy rainfall. However, during rainy season the river water is contaminated with domestic sewage, agricultural waste and soil erosion [11].

Free Carbondioxide*:* The Free CO_2 in water is accumulated due to microbial activity and respiration of organisms. Water content less than 5 mg/l of free CO_2 concentration and more than 15 mg/l detrimental to aquatic biota. The high range of free CO_2 is present in polluted water. During investigation period the free CO_2 value ranged between 0.5-7 mg/l. The minimum value was recorded at Site IV in April and the maximum value was recorded at Site II in July during rainy season. Photosynthesis requires the presence of CO_2 and CO_2 is released during biological mineralization of organic matter [12]. The maximum value may be decrease in photosynthetic activity and high rate of respiration by aquatic organisms and addition of drainage [13,14].

Alkalinity*:* The total alkalinity of water neutralized a strong acid which may be due to presence of carbonates, hydroxide and bicarbonates. Alkalinity above 50 mg/l in water body is considered as high productivity Alkalinity is influenced with the carbonate and bicarbonate and other ions. The amount of alkalinity determines the pH of water. Water with low alkalinity has low pH value (high acid) in the bicarbonate form and high alkalinity has high pH value in carbonate form [15]. The value of alkalinity during the study period was ranged between 10-84 mg/l. The maximum value was recorded at Site II in Nov. 2015 may be due to sewage decomposition and use of detergent by the surrounding. The minimum value was recorded at Site II itself in Oct. 2014 which is highly acidic, may be due to low level of water volume and excess use of soap and detergent by surrounding people.

Turbidity: High turbidity or low value of transparency disturbed the normal exchange of oxygen and carbondioxide and consequently inhabiting in photosynthesis of phytoplankton [13]. The turbidity during the study period was ranged Nil to 480 mg/l. The maximum value was recorded at Site V in July 2015, which may be due to heavy rainfall. During rainy season silt clay and other suspended solid particles contributes turbidity value of water. Minimum value of turbidity was recorded during winter season on almost all the study sites which may be due to settling down of suspended particles.

P^H: P^H of water determined the intensity of the acid or alkaline condition. Due to presence of carbonates and bicarbonates most of the water is alkaline. The higher range of pH indicates

higher productivity of water [16]. P^H of a water body is considered an important chemical parameter that determines the water quality and important for the aquatic organisms. P^H of water affects the water chemical reaction such as solubility and metal toxicity [17]. P^H during study period ranged from 6.8 to 7.9. The maximum value of 7.9 was recorded in the Site IV, and V during the month of March 2015 and Site II during January 2015. The value recorded is within WHO standard and which was alkaline in nature [18]. The minimum value of 6.8 recorded at Site I in January 2015 and Site V in November 2014. The pH value ranges from 6.5 – 8.5 are prescribed for drinking and pH ranges from 6.5 – 9.0 are most suitable for fish production as proposed by ISI, [19].

Total hardness: Total hardness of water is generally caused by the nutrients like calcium and magnesium ions present in water. The high value of total hardness might be due to the solubilised of salts along the river course and also may be due to anthropogenic activities such as farming [2]. During study period the total hardness of water was estimated between 32-52 mg/l. The minimum value was recorded at Site I during the month of Jan-Mar and Site V during Jul-Sep 2015. The maximum was recorded at Site I during Oct-Dec 2014. The value was non-uniform throughout the season. This is suitable for fish culture and drinking [20].

Calcium: Calcium in water is normally due to leaching out of rock present in river and domestic sewage drained into river. The value varied between 8.46-16 mg/l while study period. The minimum value was recorded at Site II during Jul-Sep 2015 and the maximum at Site IV during Jan-Mar. The present finding shows that the highest and lowest values were recorded in winter and rainy season respectively. High value of Ca may be due to evaporation of water and liberation of Ca due to decomposition of death and decaying macrophytes. Similar trends were also reported by [21].

Magnesium: Magnesium is highly related with hardness of water. Mg during investigation period was ranged between 2.73-9.95 mg/l which is between WHO permissible limit. The maximum was recorded at Site II during Oct- Dec 2014, this may be due to domestic sewage, drainage from the surrounding environment. The concentration of Mg may be due to concentration of nutrients [22].

Sodium: High quantity of sodium makes the salty taste of water making unfit for human consumption. According to National Academy of Science, the high concentrations of sodium can be related to cardiovascular diseases and in women toxaemia associated with pregnancy. Sodium in water mainly occurs due to weathering of rocks. High quality of sodium makes the water salty taste and unfit for human consumption and unhealthy for fresh water fishes. During investigation period it was recorded between 3.46-6.02 mg/l. All the sampling sites were within the permissible limit of WHO and ISI.

Potassium: The potassium content in water is mainly due to use of potash fertilizer and is abundant in animal waste. The higher value of potassium in the late winter and in the early summer may be due to decomposition and rapid turnover of the potassium through nutrients cycle. Potassium value ranges between 1-3.32 mg/l during study period. The value of potassium was high during summer season at Site II and low during winter season. Similar observations were also reported by [23].

Chloride: The Chloride occurs naturally in all types of water and waste water forming a major inorganic anion. The discharge of sewage waste in water may increase the chloride content. It is harmless upto1500mg/l concentration but produces a salty taste at 250-500mg/l level [24].Chloride in river water is mainly due to attribution of evaporation from surface water leaving the high content of chloride. The value of chloride during estimation period ranged between 0-22.7 mg/l. Chloride in water also act as an indicator of pollution by sewage. Higher value of chloride was recorded in Site IV during rainy season, which may be due to high domestic sewage discharge at river water.

CONCLUSION

The result of Imphal River is within the permissible limit which clearly reveals that the water quality is suitable for drinking and aquacultures activities. Even though the water quality is manageable for fish culture, the quality of the water is degrading gradually due to the anthropogenic activities of the human population. There is need to monitor periodically in-order to maintain the changes in the water system as the anthropogenic activities is increasing day by day. So, the State Government and other NGOs must address the issue in time to prevent further degradation of the river.

Acknowledgment

The author is very thankful to Research and Development Centre, Bharathiar University, Coimbatore for allowing to do research work and Dr.Kh. Rajmani Singh to guide the research work.

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How to cite this article:

Suraj, D. W and Rajmani, S. Kh.2018, Estimation of Water Quality of Imphal River, Manipur, India. *Int J Recent Sci Res.* 9(5), pp. 27187-27190. DOI: http://dx.doi.org/10.24327/ijrsr.2018.0905.2206

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