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RESEARCH ARTICLE

Studies on Physico-Chemical and Biological parameters of Kamla River Water

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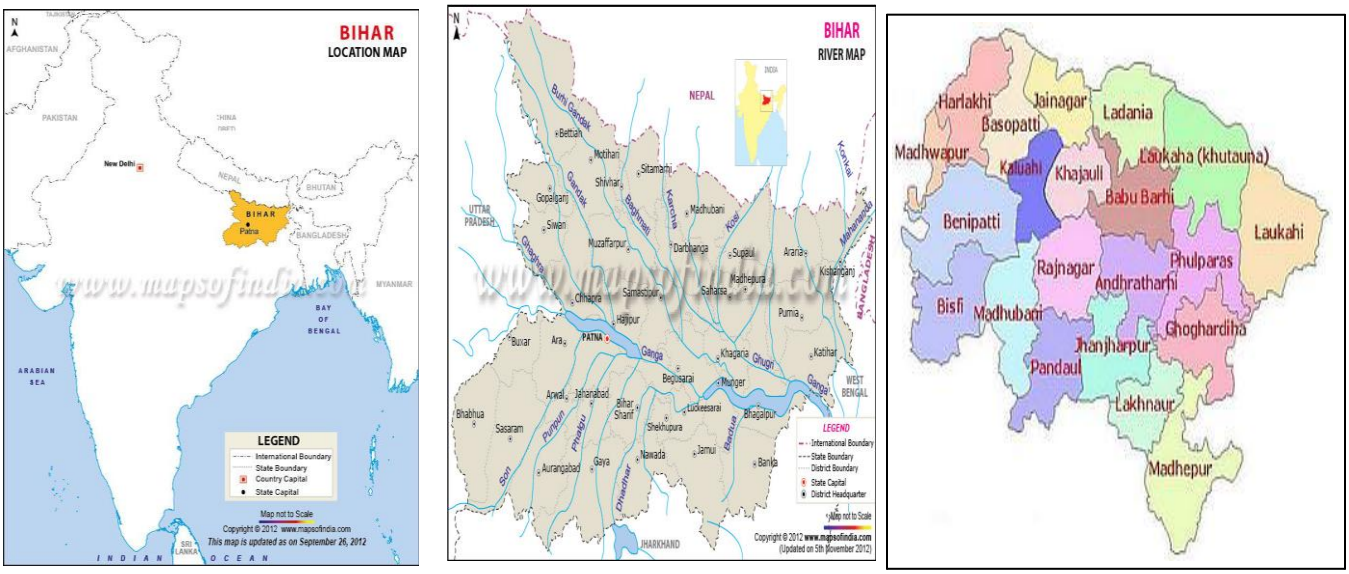
Abstract

Biological water characteristics are used to describe the presence of microbiological organisms. In the present investigation water samples were collected from Jaynagar to Jhanjharpur during Feb-2013 to Jan-2014. The biological parameters were Faecal coliform count and phytoplanktons. Seasonal variation of some physico-chemical parameters was observed that influenced the rate of biological parameters i.e. temperature, pH, turbidity, iron, calcium, total dissolved solids, dissolved oxygen and biological oxygen demand. The Faecal Coiform ranges from 650 to 2050 MPN/100ml, TDS 950 to 1230 mg/l, dissolved oxygen 4.4 to 7.3 mg/l, BOD 4.8 to 10.9 mg/l and Turbidity 17 to 27 NTU. The investigation suggested that the quality of water of river Kamla become deteriorated at some stations because of sewage discharged and unhygienic personal practices.

INTRODUCTION

The river Kamla originates from Mahabharat range of hills in Nepal near Sindhuliagarhi at an elevation of **1200 metres (3900 ft.)** at the latitude **$27^0 15' N$** and longitude **$85^0 57' E$**. It enters Indian territory in the district of Madhubani in Bihar, 3.5 Km upstream of Jaynagar town. A barrage known as Kamla barrage has been constructed by the state Government near Jaynagar. It joins the river Kareh (Bagmati) at Badlaghat in Khagaria district and the combined stream flows into the nearby Koshi. While one of its branches leads to the Bagmati another leads to the Kosi. In the lower reaches it follows the course of the Balan and is therefore also known as **Kamala-Balan**. The total length of the river Kamla – Balan is **328 Km** of which **208 Km** is in Nepal and the remaining **120 Km is in India**. The river Kamla – Balan drains a total catchment area of **7232 Sq Km.** Out of this **4488 Sq Km** lies in Bihar state of India and the remaining **2744 Sq Km** in Nepal.

MAP OF INDIA **MAP OF BIHAR** **MAP OF MADHUBANI DISTRICT**



MAP SHOWING KAMLA RIVER (STUDY AREA)

↑ **(NORTH)**

↓ Kamla river

FIGURE-1 STUDY AREA LOCATION MAP

Kamla river water pollution is increasing steadily and the problem of water quality deterioration is mainly due to human activities such as disposal of dead bodies, discharge of sewage wastes and agricultural runoff which are major cause of ecological damage and pose serious health hazards. River pollution in India has now reached to a critical point. It is estimated that community waste from human activities accounts for four times as much wastewater as industrial effluents (Sahu *et al*., 1993).

Various factors which play an important role for the growth of flora and fauna in water body viz. temperature, turbidity, nutrient, hardness, alkalinity dissolved oxygen and biological oxygen demand indicates the pollution level of the water body (Kamal *et al*., 2007).

MATERIALS AND METHODS

Midstream surface water samples were collected for analysis from six sampling stations. The samples were collected in wide mouthed polythene bottles and stored in ice box for further analysis after determining temperature and pH. The samples were analyzed for following physic-chemical parameters viz., **Temperature** (by mercury thermometer), **pH** (by using pH meter), **Turbidity** (Nephelometric Method), **Calcium** (EDTA Titrimetric), **Iron** (Phenanthroline spectrophotometric), **Dissolved oxygen** (Winkler method with acidic modification), **Biochemical Oxygen Demand** (by incubating diluted sewage samples at 25`c for 5 days in dark)**, Total dissolved solids** (Gravimetric after filtration) & **Faecal Coliform**(Elevated Temperature Fermentation). Most of the physico-chemical parameters were determined by standard methods prescribed by **APHA (2005)**.

RESULTS AND DISCUSSION

Physico-chemical and biological properties of river Kamla in different seasons and at different stations are as follows -

TEMPERATURE

Temperature is the important factor which influences the chemical, biochemical and biological characteristic of the aquatic system **(Kumar R. et al, 2005)**. In an established system the water temperature controls the rate of all chemical reactions, and affects fish growth, reproduction and immunity. Drastic temperature changes can be fatal to aquatic flora and fauna. The temperature profile of river varies significantly ($P < 0.05$) and ranged from 20.6 to 31.8°C. 25 °C is the recommended limit for no risk according to the FEPA water quality guidelines for domestic use (DWAF, 1995).

The present investigation reveals that the temperature varied from minimum 20.6°C in winter near NH-104 bridge (SS-1), Jaynagar and Kuarpatti (SS-5) to maximum 31.8°C in summer near Kali Mandir (SS-2) and old Durga Mandir (SS-3), Jaynagar. The temperature values were significantly higher in summer.

pH

Hydrogen in concentration (pH) is one of the most important chemical parameters used in water quality assessment. It is numerical expression that indicates the degree to which a water is acidic or alkaline and is an operational parameter. The adverse affect of most of the acids appear below pH 5 and of alkalis above the pH 9 **(Kriest & Oschlies, 2013)**. High pH value are undesirable since they may impart a bitter taste to the water and also depress the effectiveness of disinfection by chlorination, thereby requiring the use of additional chlorine or longer contact times. However, pH alone does not provide a full picture of the characteristics or limitation with the water supply.

The pH of various water samples ranged from 7.5 to 8.6. Thus, it was moderately alkaline in most of the water samples analysed. The pH values were significantly higher from end of the summer to beginning of the winter with the highest value 8.6 in winter near old Durga Mandir (SS-3) and Navtoli (SS-4) and lowest value 7.5 in summer near old Durga Mandir (SS-3), Jaynagar. Water of lower pH value are not suitable for other domestic uses, due to increased corrosive action.

TURBIDITY

Turbidity is caused due to the presence of suspended matters, clay, silt, colloidal organic particles, plankton and other microscopic organisms. It is an expression of certain light scattering and light absorbing properties of water. It has significant effect and indicates microbiological quality of irrigation water. The probability of presence of pathogenic organisms is also increased in turbid water (**Kumar & Chopra, 2012)**.

The turbidity value ranged from minimum of 17 NTU in winter near Kuarpatti to maximum of 27 NTU in rainy near Kali Mandir and Old Durga Mandir, Jaynagar. The turbidity values in samples varied from 17 to 23 NTU in winter, 19 to 24 NTU in summer, 20 to 27 NTU in rainy season and 18 to 22 NTU in spring season. The water near old Durga Mandir and Kali Mandir, Jaynagar is most turbid throughout the study period due to low discharge of water.

IRON

Iron is found in variable amounts in natural water. The various water samples contained iron in very negligible amount. The presence of iron in groundwater is due to processes involved during rock formation. When the groundwater with higher concentration of iron is tapped, it quickly oxidizes to ferric state in the form of insoluble ferric hydroxide, a brown substance.

The iron values ranges from 0.50 to 1.1 mg/l. The iron value shows variation with a range of 0.50 mg/l in winter near NH-57 bridge, Jhanjharpur to 1.1 mg/l in summer near old Durga Mandir, Jaynagar. The iron values remain higher in summer season. The iron content was moderately high. Therefore, the water of river Kamla is unsuitable for domestic and other purposes.

CALCIUM

Calcium is one of the most abundant substance found in natural water in higher quantities in the rocks. It has no hazardous effects on human health. Higher level of calcium is not desirable in washing, bathing and laundering, while small concentration of calcium is beneficial in reducing the corrosion.

The calcium values ranges from 32.4 to 82.3 mg/l. The calcium value shows variation with a range of 32.4 mg/l in spring near NH-57 bridge, Jhanjharpur to 82.3 mg/l in rainy near old Durga Mandir, Jaynagar. The calcium values remain higher in rainy season. The calcium content was moderately low. Therefore, the water of river Kamla is suitable for domestic and other purposes.

Table : Physico-chemical and biological properties (from Feb 2013 to Jan 2014) of River Kamla in between Jaynagar to Jhanjharpur .

S.No.	Stations	Seasons	Parameters								
			Temp. (°c)	pH	Turbidity (NTU)	Calcium (mg/l)	Iron (mg/l)	D.O. (mg/l)	BOD (mg/l)	TDS mg/l	Faecal Coliform (MPN/100 ml.)
01	Near NH-104 Bridge Jaynagar	Summer	31.6	7.7	23	56.2	0.78	4.6	10.4	1050	920
		Rainy	26.6	8.1	25	68.5	0.65	5.7	8.4	1210	1640
		Winter	20.6	8.2	21	48.7	0.54	6.2	7.2	1000	655
		Spring	26.4	8.0	21	34.6	0.62	5.9	7.8	1070	710
02	Near Kali Mandir Jaynagar	Summer	31.8	7.6	24	60.4	1.0	4.5	10.9	1060	1040
		Rainy	26.8	8.3	27	75.5	0.90	5.5	8.9	1230	1970
		Winter	21.1	8.4	22	53.8	0.70	6.0	7.9	1005	700
		Spring	26.6	8.2	22	42.3	0.80	5.7	8.2	1085	850
03	Near Old Durga Mandir Jaynagar	Summer	31.8	7.5	23	64.8	1.1	4.4	10.5	1025	1080
		Rainy	26.8	8.4	27	82.3	0.95	5.4	8.9	1145	2050
		Winter	21.4	8.6	23	56.2	0.76	6.1	7.6	995	720
		Spring	26.9	8.5	22	45.6	0.85	5.8	7.9	1060	875
04	Near Navtoli	Summer	31.7	7.8	19	58.2	0.85	6.6	7.3	960	970
		Rainy	25.7	8.2	22	72.0	0.76	6.9	6.9	1055	1800
		Winter	21.2	8.6	18	50.4	0.68	6.0	7.6	890	680
		Spring	26.5	8.2	18	38.0	0.72	7.1	5.4	980	760
05	Near Kuarpatti	Summer	31.2	7.8	19	57.3	0.76	6.2	7.1	970	940
		Rainy	25.4	8.0	21	69.6	0.65	7.0	5.6	1050	1710
		Winter	20.6	8.5	17	49.9	0.57	6.5	6.8	885	660
		Spring	25.9	8.1	18	35.2	0.64	7.2	4.9	990	715
06	Near NH-57 Jhanjhar-pur	Summer	30.8	7.7	19	55.8	0.70	5.9	7.8	950	915
		Rainy	25.2	7.9	20	68.2	0.62	7.1	5.8	1040	1630
		Winter	20.8	8.5	18	47.5	0.50	6.4	6.4	870	650
		Spring	25.8	8.0	18	32.4	0.55	7.3	4.8	980	680

DISSOLVED OXYGEN

Dissolved Oxygen is one of the important parameter in water quality assessment. Its correlation with water body gives direct and indirect information e.g. bacterial activity, photosynthesis, availability of nutrients, stratification etc. (**Premlata Vikal, 2009**). Its presence is essential to maintain variety of forms of life in the water and the effect of waste discharge in a water body are largely determined by the oxygen balance of the system. It can be rapidly removed from the Waste waters by discharge of the oxygen demanding waste.

The DO values ranges from 4.4 to 7.3 mg/l. The DO value shows variation with a range of 4.4 mg/l in Summer near old Durga Mandir, Jaynagar to 7.3 mg/l in Spring near NH-57 bridge, Jhanjharpur. The DO values remain higher in Summer season. The DO content was moderately high. Therefore, the water of river Kamla is suitable for agriculture and other purposes.

BIOCHEMICAL OXYGEN DEMAND

Biochemical Oxygen Demand (BOD) is used as a measure of the amount of organic matter in an aquatic system which ultimately supports the growth of microorganisms. Biochemical Oxygen Demand refers to the amount of oxygen that would be consumed if all the organic matter present in water were oxidized by bacteria and other micro-organisms which are present in water. The demand for oxygen is proportional to the amount of organic waste to be degraded aerobically. Hence BOD approximates the amount of oxidizable organic matter present in the sample. When the BOD is high, the dissolved oxygen becomes low. Hence greater the BOD, greater is the pollution.

The BOD values ranges from 4.8 to 10.9 mg/l. The BOD values range from 4.8 mg/l in spring near NH-57 Jhanjharpur to a maximum of 10.9 mg/l in summer near Kali Mandir, Jaynagar. Usually higher BOD values in summer and lower in the spring season were recorded. Although the values of BOD in river water is moderately soft and is suitable for aquatic life. Therefore, the water of river Kamla is suitable for domestic purposes and agricultural activities.

TOTAL DISSOLVED SOLIDS

Total Dissolved Solids may be considered as salinity indicator for classification of river water. The TDS in river water is due to the presence of Calcium, Magnesium, Sodium, Potassium, Bicarbonate, Chloride and Sulphate ions. Total dissolved Solids (TDS) analysis has great implications in the control of biological and physical waste water treatment processes. The largest amount of total solids adds to the high turbidity and electrical conductivity. Total Dissolved solids determination is particularly useful in the analysis of sewage and other waste waters and is as significant as BOD determination. It is used to evaluate the strength of domestic wastewaters and efficiency of treatment units. Total Dissolved solids are objectionable in river for many reasons. Total Dissolved Solids containing much organic matter may cause putrefaction and consequently the river may be devoid of dissolved oxygen (**Kumar & Chopra, 2012)**.

The TDS values ranges from 870 to 1230 mg/l. The Total dissolved Solids (TDS) determined in these studies ranged between 870 to 1070 mg/l in winter, 950 to 1060 mg/l in summer, 1040 to 1230 mg/l in rainy season and 980 to 1085 mg/l in spring season. The minimum TDS values of 870 mg/l were found in winter near NH-57 bridge, Jhanjharpur and maximum of 1230 mg/l in rainy near Kali Mandir, Jaynagar. The TDS values were higher near Kali Mandir, Jaynagar throughout the year. Although the values of TDS in river water is slightly saline and is suitable for aquatic flora and fauna. Therefore, the water of river Kamla is suitable for domestic purposes and agricultural activities.

FAECAL COLIFORM

Bacteriological contamination is one of the major water quality problems of rivers in the state and it is more so in their lower reaches. Discharge of untreated sewage into rivers results in faecal contamination of rivers. River water is not free from microorganisms. The factors that determine the type of bacteria and the number of bacteria in water are; temperature, light, organic matter, acidity, salinity, protozoa, rainfall and storage conditions. The presence of the Escherichia coli is an indication of contamination of water supplies. E.coli indicates faecal contamination of drinking water. E.coli being pathogenic bacteria causes four types of clinical syndromes namely, urinary tract infection, diarrhoea or gastroenteritis, pyogenic infections and septicaemia. Hence, it becomes necessary to ensure that the river water is free from bacteriological contamination. E. coli in the study area varied from 650 – 2050 /100ml and the mean concentration is found to be 920/100ml with 44.87% of the samples exceeding the acceptable limit of BIS. This can be attributed to the unhygienic conditions (human and animal excreta, Households sewage containing waste materials) on the bank of the river, which serve for the growth of microorganisms.

The Faecal coliform values ranges from 650 to 2050/100ml. Faecal coliform determined in these studies ranged between 650 to 720/100ml in winter, 915 to 720/100ml in summer , 1630 to 2050/100ml in rainy season and 680 to 875/100ml in spring season. The minimum Faecal coliform values of 650/100ml were found in winter near NH-57 bridge, Jhanjharpur and maximum of 2050/100ml in rainy near old Durga Mandir, Jaynagar. The Faecal coliform values were higher in rainy season. Although the values of Faecal coliform in river water is very high and is unsuitable for domestic and agricultural purposes.

CONCLUSION

Analysis of the water samples collected in Kamla river revealed that, in general various parameters are not within the range of standard values prescribed by various agencies. The water is polluted at all the stations during the course of study and it is unfit for consumption, domestic and irrigation purposes. It can be concluded that near Kali Mandir and old Durga Mandir, Jaynagar, river water is more polluted whereas, all the other four stations are found less polluted.

RECOMMENDATIONS

Periodical monitoring of river water is necessary to protect our natural water system. Human contaminants such as fecal matter, sewage and agricultural wastes should be kept away from water resources. Results of present study showed that with increase in distance from effluent discharge and unhygienic personal practices the load of pollutants decreased, so we should avoid using water from these areas. There is a great increase of microbial load in summer as comparison to winter, so special care should be taken during summer. Public awareness is required to save our natural water resources.

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REFERENCES

[01] Giri S & Singh AK (2014). Risk assessment, statistical source identification and seasonal fluctuation of dissolved metals in the Subarnarekha River, plateau. Environmental Monitoring and Assessment, 147(1-3): 83-92.
[02] Kriest I & Oschlies A (2013). Swept under the carpet organic matter burial decreases global ocean biogeochemical model sensitivity to remineralization length scale. Biogeosciences, 10: 8401-8422.
[03] Komala, H.P, et al (2013). An assessment of Plankton diversity and abundance of Arka- vathi River with reference to pollution. Advances in Applied Science Research, 4(2): 320-324.
[04] Kumar V & Chopra AK ,2012. Monitoring of physicochemical and microbial characteristics of municipal wastewater at treatment plant, Haridwar city (Uttarakhand) India. Journal of Environmental Science and Technology, 5(2): 109-118.
[05] Rai AK, et al (2012). A study of the sewage disposal on water quality of Harmu River in Ranchi city Jharkhand, India. International Journal of plan, animal and env.. Sci.2 (1): 102-106.
[06] Simpi, B. et al (2011), Analysis of Water Quality Using Physico-Chemical Parameters Hosahalli Tank in Shimoga District, Karnataka, India, Global Journal of Science Frontier, Research, 1(3), pp 31-34.
[07] **Kumar, N. & Sinha, D. K. (2010),** Drinking water quality management through correlation studies among various physicochemical parameters: A case study, International Journal of Environmental Sciences, 1(2), pp 253-259.
[08] Gupta, D. et al (2009), Physiochemical Analysis of Ground Water of Selected Area of Kaithal City (Haryana) India, Researcher, 1(2), pp 1-5.
[09] Premlata, V. (2009), Multivariant analysis of drinking water quality parameters of lake Pichhola in Udaipur, India. Biological Forum, Biological Forum- An International Journal, 1(2),pp 97-102.
[10] APHA (2005), "Standard methods for the examination of water and waste water", American Public Health Association, Washington D.C.
[11] Kumar R. et al (2005), Water Resources of India, Current Science, 89(5): 794- 811.