PRELIMINARY PHYSICO-CHEMICAL STUDY ON THE POLLUTION POTENTIAL OF RIVER LONGAI AT KARIMGANJ, ASSAM (INDIA)

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Abstract: In this study water quality of river Longai in stretch of 5 km at Karimganj was investigated for pollution potential by determining various water quality parameter. A total number of fifteen water samples were collected during the summer season. A uniform distance between the collection sites was maintained during the collection of the samples. Analysis was done for the quantitative determination of the concentration of Fe, Mn, Cu, Cr, Cd and As and also for the qualitative determination of physical parameters like pH, EC,TSS,TDS,TS and total hardness of the collected water samples. The concentrations of Mn, Cr, Fe, Cd and As obtained were higher than the permissible limit declared by WHO. pH and electrical conductance of the water samples lies between 6.56 to 7.47 and 6.65 to 10.2 $mscm^{-1}$ respectively. TSS, TDS,TS and total hardness were found to be within the permissible limit declared by WHO.

Keywords*:* preliminary; physico-chemical; pollution; potential; quantitative; WHO

1. Introduction:

Rivers are vital and vulnerable freshwater systems and are essential for the sustenance of all living things. River is one of the major water resources which can satisfy the demand of water necessary for domestic, industrial and agricultural purposes. Currently water pollution is an acute problem in all the major rivers of India[1,6]. Kar et al. has studied the contamination of river Ganga by inorganic contaminants as well as by heavy metals[7]. Though some metals like Cu, Fe, Mn, Ni, Zn are essential for life, many other metals like Cd, Cr, Pb have very detrimental effects if present beyond a certain limit[8]. Rajkumar et.al has analyzed 43 ground water samples and 7 surface water samples from waste dumping sites at Erode city, Tamilnadu and found that the analysed water samples are unsuitable for drinking due to contamination from leachates[9]. It was in 2012, we have reported about the water quality of Naughty Khal, a canal connecting the Longai and Kushiara river of Karimganj District which reflects the presence high concentration of heavy metals in the water samples collected from areas under study[10] . Water quality assessment of the river water is one of the prime concern and a major challenge in all over the world as the health factors is directly related to the quality of water. The maintenance of healthy aquatic ecosystem is depended on the physico-chemical properties and biological diversity. A regular monitoring of water bodies with required number of parameters with reference to the quality of water not only prevents the outbreak of diseases and occurrence of hazards but checks the water from further deterioration. By analysing water samples of a river over a period of time, the changes in the quality of the water and the impact of pollution on it can be realised.

It was felt worthwhile to go for an investigation of the water quality of the river Longai because residents on the bank of the Longai river dump their domestic waste materials in the river, there by causing water pollutions in such an extent that it is offering threat even to the survival of aquatic flora and fauna.

2. Materials and method

2.1. Study area

Karimganj town is the district head quarter of Karimganj district of Assam, a state in the north eastern region of India. The district is situated just on the Bangladesh border with the river Kushiara flowing in between. It is located approximately along 240 52/ N latitude and 920 49/ E longitude and has the area about 6.9 Km^2. According to the 2011 census report the total population of the district is 52,613. The river under study passes

aside the Karimganj town. It is originated from Jampui Hills, Tripura and in downstream it enter Bangladesh flowing over Karimganj town.

2.2. Collection of sample

In order to determine the water quality index fifteen stations were chosen for sample collection form the river longai during August 2013. Midstream surface water samples were collected The description of sampling sites are given in the table 1. The samples were collected from a depth of 1ft below the surface and kept in 1liter prewashed polythene containers. Half part of the water samples were analysed for the physicochemical parameters like pH, EC, TS, TDS, TSS and total hardness with in 24 hours of collection and the other half part has been kept in refrigerator at ~4^0C with 1 ml concentrated HNO_3 per 500 ml in order to preserve the metals and also to avoid precipitation which are used for the estimation of the metals by AAS.

Table 1: Description of sampling sites

Sample	Site description
S_1	Near kathakal bridge
S_2	350 meter upstream from the kathakal bridge
S_3	Near the ISKON temple
S_4	350 meter upstream from the ISKON temple
S_5	Near the Shiv bari
S_6	350 meter upstream from Shiv bari
S_7	Near the mosque
S_8	Near the longai police out post
S_9	Near the longai bridge
S_{10}	Near PHE water Pump station
S_{11}	350 meter upstream of pump station
S_{12}	700 meter upstream from the pump stream
S_{13}	500m to dhorokona village
S_{14}	Near the dhorokona Village
S_{15}	Near the dhorkona LP school

2.3. Physico chemical parameters:

2.3.1 pH and conductivity:

pH of the collected samples were determined by Elico pH meter and conductivity was determined by Weiber conductivity bridge.

2.3.2. TS:

Ts of the samples of water was determined by obeying standard literature. In which 250 ml of each water sample is taken in a pre weighed clean beaker. The beakers are then covered with watch glass and placed inside an oven to dry it slowly by maintaining temperature at 60^0C . The beaker with the substance was weighed again.The increase in the beaker weight represent the total solid in water sample.

TS (mg/l) = (A-B) x 10^6 / V

Where, A= Final weight of the beaker and residue in g.

B= Initial weight of the beaker in g.

V= Volume of the sample.

2.3.3. TSS:

Pre weighed dry and clean sintered glass crucible is used to filter 100 ml of each water sample and dried in the oven at ~60^{0}C. The sintered crucible with the substance was weighed again. The increase in the crucible weight represents the total suspended solid in water sample.

TSS (mg/l) = (A-B) x 10^6 / V

Where, A= Final weight of the crucible and residue in g.

B= Initial weight of the crucible in g.

V= Volume of the sample.

2.3.4. TDS:

The filtrate remaining after the determination of TSS was taken in pre weighed beakers. The beakers are then covered with watch glass and placed inside an oven at ~60^{0}C till dryness. The increase in the beaker weight represents the total dissolved solid in water sample.

TS (mg/l) = (A-B) x 10^6 / V

Where, A= Final weight of the beaker and residue in g.

B= Initial weight of the beaker in g.

V= Volume of the sample.

2.3.5. Total hardness:

Ca-hardness (Ca-H) and Mg hardness (Mg-H) were determined with the help of usual EDTA complexometric method found in the literature.

2.3.6. Metal analysis:

100 ml of each acid digested water sample was taken in beaker and the beaker was then kept in a oven at 70^{0}C to reduce the volume up to 50 ml. Mn, Fe, Cd, As, Cu and Cr were analyzed by Atomic Absorption Spectrometer (AAS) by using three standards calibration curve. AAS required an acid digestion step prior to analysis by treating the samples with concentrated HNO_3. Digestion of samples is performed essentially as described in standard method in American Public Health Association (APHA, 1989)[11].All trace metal determinations by AAS used a Perkin-Elmer Model 200 instrument, for which settings were determined from the recommendations in the instruction manual (IO).

3. Result and Discussion:

The values of physico-chemical parameters are given in Table 2 and the metal contents are given in Table 3. Detailed discussion is as follows:

3.1. pH and Conductivity

The variation of pH and electrical conductance values of fifteen different water samples are reflected by the bar diagram as shown in figure 1.

The pH of the analysed water samples were found to vary from 6.56 to 7.47.. Except the samples S_7, S_8, S_9 and S_{11}, pH of all other samples are found to be slightly alkaline.

In the present study the electrical (EC) found to vary from 6.65 ms/cm to 10.2 ms/cm .High Electrical conductivity indicates a larger quantity of dissolved mineral salts[12] thereby making it sour and unsuitable for drinking [13,14].

Table 2: Values of Physico-chemical parameters

Sample	pH	EC(ms/cm)	TSS(mg/l)	TDS(mg/l)	TS(mg/l)	Total hardness(mg/l)
S_1	7.47	6.87	42	621	643	56
S_2	7.34	7.12	54	610	664	67.4
S_3	7.40	7.45	70	564	634	72

S_4	7.32	7.2	50	571	621	56
S_5	7.21	8.3	89	621	710	45
S_6	7.12	9.44	85	598	683	52.3
S_7	6.93	10.2	121	630	751	83
S_8	6.67	10.11	90	623	713	67
S_9	6.56	9.04	75	590	665	76
S_{10}	7.02	9.98	84	603	687	59
S_{11}	6.87	8.54	67	576	643	64
S_{12}	7.34	7.16	73	567	640	49
S_{13}	7.42	7.63	58	561	619	52
S_{14}	7.2	6.54	45	597	642	43
S_{15}	7.31	6.67	44	580	624	44

EC: Electrical Conductance, TSS: Total Suspended Solid, TDS: Total Dissolved Solid, TS: Total Solid

Table 3: Metal contents for the water samples

Sample	Mn(mg/l)	Cu(mg/l)	Cr(mg/l)	Cd(mg/l)	Fe(mg/l)	As(mg/l)
S_1	0.446	0.069	0.729	0.008	1.503	0.01042
S_2	0.461	0.102	0.347	0.073	0.867	0.01269
S_3	0.492	0.113	0.521	0.003	3.170	0.02012
S_4	0.502	0.177	0.462	0.002	2.172	0.02006
S_5	0.469	0.142	0.469	0.029	3.1683	0.01007
S_6	0.512	0.187	0.672	0.004	3.209	0.0316
S_7	0.506	0.202	0.873	0.012	3.007	0.04012
S_8	0.498	0.214	0.925	0.006	4.043	0.04004
S_9	0.523	0.174	0.931	0.007	2.056	0.02106
S_{10}	0.481	0.156	0.764	0.054	3.065	0.01804
S_{11}	0.467	0.187	0.465	0.023	3.453	0.02116
S_{12}	0.432	0.121	0.421	0.005	2.356	0.01001
S_{13}	0.451	0.094	0.496	0.011	1.423	0.00967
S_{14}	0.458	0.063	0.436	0.023	1.053	0.00576
S_{15}	0.476	0.079	0.367	0.003	0.697	0.1009

3.2. Total Hardness, TSS, TDS and TS:

The graphical variation of Total Hardness, TDS, TSS and TS of water samples have been shown in the figure.1. In our study the total hardness are found in the range 44mg/l to 83mg/l which are well below the desirable level depending on pH value[13]. TDS of the water samples are found in the range 561 to 630 mg/l which are slightly above the Bureau of Indian Standards permissible limit (500 mg/l). Total solid (TS) of the water samples obtained in this study range between 619 to 751 mg/l . The water samples S_7 and S_8 show relatively high TS value as the water collected from the sites are near the meeting point of the river with Naughty Khal which is connected to the municipality dumping sites . Total solids analysis has great importance in the control of biological and physical waste water treatment processes[14,15]. Among the fifteen water samples analysed, the TSS value of the Samples S_5 to S_{10} falls in relatively higher range.

3.3. Heavy metals:

Graphical variations of the concentration of the heavy metals present in the fifteen water samples are shown in the figure 2-4.

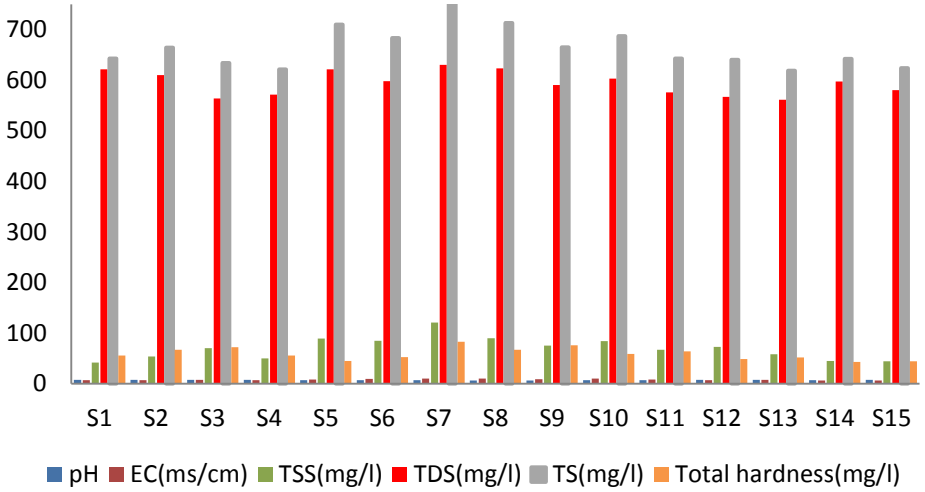

Figure 1: Graphical variation of physical parameters

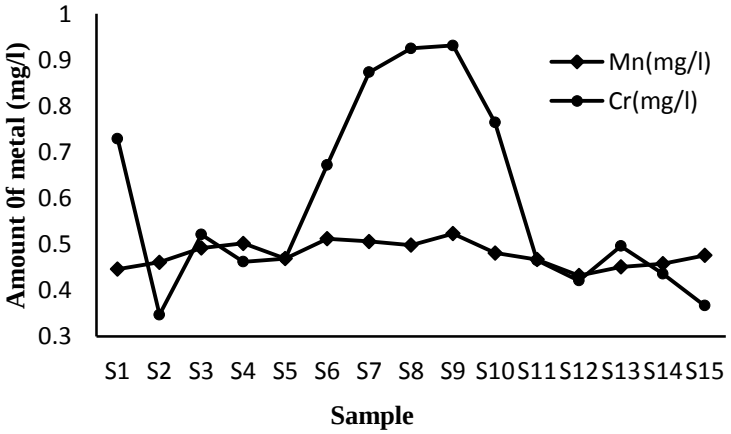

Figure 2: Graphical variation of the concentration of Mn and Cr.

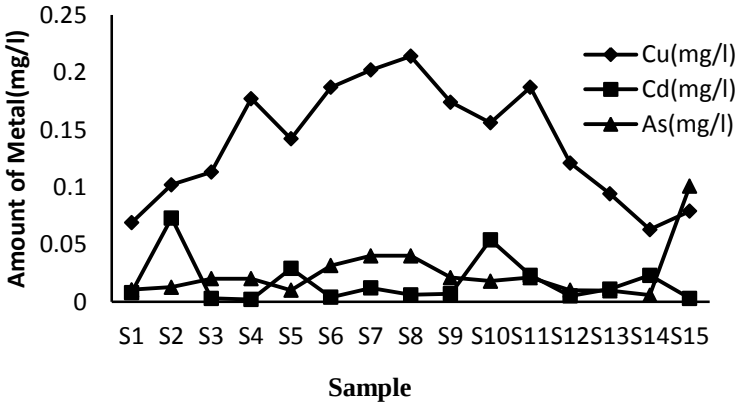

Figure 3: Graphical variation of the concentration of Cu,Cr and As

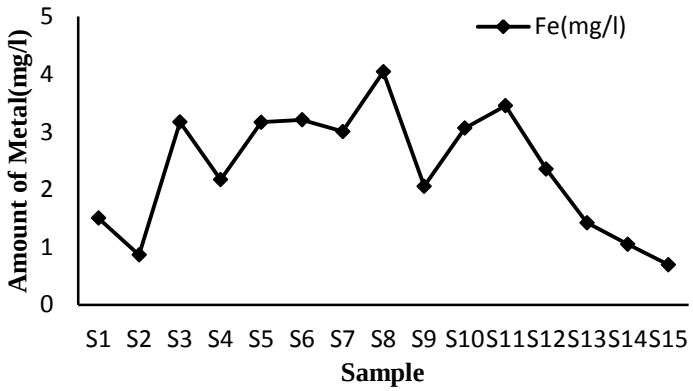

Figure 4: Graphical variation of the concentration of Fe

Result of the metal analysis of the water sample established that out of the six heavy metal analysed for, Mn, Cr, Cd, As and Fe were present in large excess as compared with the permissible limit declared by WHO[16]. The presence of heavy metal poses high risk factor for the people of the Karimganj town as the water of longai river is the only source of drinking water. Again the Longai river is the major water resource which is widely used by the villagers of the surrounding areas for drinking as well as other domestic purposes including cultivation, cattle washing, bathing purposes etc. without proper treatment because of their ignorance about the presence of heavy metals in water and also its adverse health effect . The concentration Mn is highest in S_6(0.512 mg/l) and lowest in S_{12}(0.432 mg/l) both are far above the maximum allowable limit (<0.1mg/l) for drinking water.

The concentration of Cr in the water samples analysed ranges from 0.347 mg/l to 0.931 mg/l which are also well above the permissible level (<0.05 mg/l). The concentration of Cr is highest in the sample S_9(0.931mg/l). The presence of the high concentration of Chromium is of great concern as Cr(IV) is well established carcinogen for rat when absorbed orally. Amount of Cd in most of the water samples are above the permissible level (<0.005mg/l). Only few samples have Cd below the permissible level.

Fe was found to be present well above the allowable limit (0.3mg/l) in all the fifteen water samples and its value ranges from 0.697-4.043mg/l. This indicates that water of Longai river are not suitable for industrial use. Because of the presence of high concentration of Fe which develop undesirable smell, such water is also not suitable for human consumption.

One of the important finding of our investigation is the detection of high amount of Arsenic in the water of Longai river. Arsenic concentration in the water samples analysed ranges from 0.00576 mg/l to 0.1009 mg/l. Except S_{13} and S_{14}, all other sample contain Arsenic well above the permissible level(<0.01mg/l) declared by WHO.

4. Conclusion:

This study shown that water quality of the Longai river at Karimganj is not suitable for human consumption due to the presence of excess amount of heavy metals particularly Cd, Cr,Fe , Mn etc. In some water samples, concentration of Arsenic and iron is almost four and ten times respectively than the permissible limit for drinking water, which is very alarming and demands continuous monitoring of water quality to know the extent of water pollution and simultaneously its impact on the society if happens really.

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References:

[1] M.R. Singh , A. Gupta and K.H. Beeteswari, J. Appl. Sci. Environ. Manage., 14(4), 85 – 89, 2010.

[2] A.M. Ahmed, Pak. J. Biol. Sci., 7(11), 1865-1869, 2004.
[3] Y. Bahadur and R. Chandra, 15(1),31-33, 1996.
[4] D. Kamal , A. N. Khan , M.A. Rahman and F. Ahamed, Pak J. Biol. Sci., 10(5), 710-717, 2007.
[5] N. T. Meghla, Md. S. Islam, Md. A. Ali, S. Sultana and N. Sultana, Int. J. Curr. Microbial. App. Sci., 2(5), 110-122, 2013.
[6] N. Haloi and H.P.Sarma, Int. J. Chem.Tech Res., 3(3), 1302-1308. 2011.
[7] D. Kar, P. Sur, S. K. Mandal, T. Saha and R.K. Kole, Int. J. Enviro. Sci. Tech., 5(1), 119-124, 2008.
[8] V.K. Jain, I. Bot. Conf. JIBS, pp 57-84, 1978.
[9] N. Rajkumar, T. Subramani and L. Elango , Intl. J. Env. Sci., 1, 39 – 54, 2010.
[10] D.Deb, S.P. Purkayastha and K.G.Bhattacharcharyya, International Journal of Environmental Science, 2(3), 1408-1416, 2012 .
[11] American Public Health Association, Standard Methods for the Examination of Water and Waste water, 17th edition, Washington, DC.,1989.
[12] R.K. Trivedy and P.K. Goyal, Enviro-Media Karad,pp:. 3-96, : 1986.
[13] R.K. Srivastava and A.K. Sinha, Envtal. Toxi. Water Quality, 11(1), 1-5, 1996.
[14] A. Kumar and Y. Bahadur, W. J. Agri. Sci., 5 (1),1-4, 2009.
[15] M.Tabata, A. Ghaffar, Y. Eto, J. Nishimoto and K. Yamamoto, E-Water, 5, 1-24, 2007.
[16] Guidelines for drinking-water quality [electronic resource] : first addendum to third edition, World Health Organization. Vol. 1, Recommendations , pp. 317-400, 2006.