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Assessment of Water Quality of River Mahananda, West Bengal, India

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Abstract
The Mahananda River is a trans-boundary river, mainly fed by rainwater, originated from the Himalayas in the district of Darjeeling of West Bengal state. It flows through northern part of West Bengal, Bihar in India and Panchagarh district of Bangladesh. It again enters India in the Malda district of West Bengal. During summer or winter it has very low water level but during monsoon it carries large amount of rainwater often causing floods. One of the most important places by the side of this river is Siliguri, known as corridor of North-Eastern states and principal commercial, tourism, transportation, and educational center of Northern part in West Bengal, India. The People of Siliguri are highly dependent on this river water to meet their demand for drinking and other domestic activities on regular basis. But at present time being river Mahananda is facing a serious water pollution problem due to several reasons. The physico-chemical characteristics of Mahananda river water are continuously deteriorating due to discharge of untreated industrial and domestic wastewater and also agricultural runoff from its catchment areas. Bacteriological load in Mahananda river water is extensively high which indicates the unsuitability to use of raw water for any domestic activities by the people of Siliguri Municipal Corporation areas.

Keywords: Water Pollution, Bacteriological load, Waste Water, Effluents

Introduction
Amongst three basic required natural resources for sustaining any life, water is one of the prime natural resource as well as important constituent of life support system. It is indeed a wonderful chemical medium that has unique properties of dissolving and carrying in suspension a hug verification of chemicals. Thus it can get contaminated easily [4]. There are a number of causes responsible for polluting the water. Polluted water doesn't come from a single source [4]. Polluted water not only affects the life of present generation but it also affects the life of upcoming generations because its effect remains for long. In recent years, water pollution has become a serious problem across the country, mostly due to the presence of untreated effluents, chemicals and pesticides in it [2]. Rivers have always been the most important fresh water resources and most developmental activities are still dependent upon them. Rivers play a major role in assimilating or carrying industrial and municipal waste water, manure discharge and runoff water from agricultural field, road ways and streets which are responsible for river pollution [13]. The quality of water is of vital concern for mankind since it is directly linked with human welfare. The River Mahananda plays a significant role in human life of Siliguri Municipal Corporation areas located at the bank of it [7]. Now-a-days it has become polluted at some places due to small scale industrial activities and the confluence of sewage, domestic wastes and industrial effluents of many large, medium and small enterprises with various types of organic compounds and heavy metals which are deteriorating human health and aquatic organisms. Urban areas, farms, factories and individual households – all contribute to the contamination of this river [1]. Study of different physico-chemical parameter revealed that the intensity of pollution increased as river was subjected to sewage and industrial waste. This is a study to aware people how they have contaminated the Mahananda river water. In view of increased demand of water due to expanding needs it seems evitable to study surface water bodies particularly river for proper utilization and conservation. Having assessed the importance of good water quality of rivers of the country, Central Pollution Control Board (CPCB) in 1976, initiated a series of integrated river basin studies all over India. CPCB in collaboration with all State Pollution Control Boards (SPCB) established the Water Quality Monitoring (WQM) network in the country[12] and such information gathered has been considered in this investigation for a meaningful consideration of data freshly acquired/ available through the analyses of water of Mahananda river.

Methodology
For the present investigation water samples were collected from Nine (9) fixed locations of Mahananda river that have been clearly written in bellow of the table no-1 and physico-chemical parameters i.e. temperature, turbidity, pH, conductivity, alkalinity, hardness, total suspended solids, total dissolved solids, chloride, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, total coliform load and fecal coliform load of Mahananda river water measured on pre-monsoon period from the year of 2011 - 2014. Temperature was usually measured by thermometer using compansion-contraction principle of liquid water which had been collected in a plastic container. pH was measured by pH meter using a

glass electrode. Electrical conductivity of water samples was measured by the Conductivity meter. Total dissolved solids and total suspend solids were measured followed by weighing method. Chloride of water sample was estimated by titration method using K2Cr2O7 (indicator) and 0.02 (N) AgNO3.The measurement of total hardness of water Sample was also done by titration method using Erichrome black-T indicator and 0.01M EDTA solution. The amount of Dissolved oxygen was usually measured by Winkler's method, an old standard wet technique i.e., Winkler Dissolved Oxygen test. A BOD value measured by multiplication of dilution factor with the differentiation of initial and final DO of water sample. Chemical oxygen demand (COD) estimated by chemically oxidizing the organic matter in a water sample by strong oxidizing agent. The coliform test was based on the fact that E. Coli ferments lactose and the broth become cloudy with the liberation of gas. Placing a samll Durham tube upside down inside a large tube containing lactose broth can test the production of gas. After inoculation, the broth tubes are incubated at 37^0C for 48 hours. After incubation if gas is liberated, it will be collected in the Durham tube and which will be an indication of the presence of coliform organisms.

Results and Discussion

In this present investigation the table no-1 showing current status of water quality of river Mahananda. In general preview it may be think that water quality of the river is a good source for drinking water and domestic purpose, but here remains a mystery. The coliform, both total coliform and fecal coliform are so high in content that raw water is totally unsuitable to use. Beside this particular parameter, other parameters remained in control by virtue of natural activities of river purification system [10].

Table: 1: Physico-Chemical Characteristics of Water Samples Collected in Pre-Monsoon Period From Mahananda River at Siliguri Municipal Corporation Areas in 2011- 2014.

Water Quality Parameters	Sampling Sites								
	A-E	A-M	A-W	B-E	B-M	B-W	C-1	C-2	C-3
Temperature ATM/ Water in ℃	28/25	28/25	28/25	28/26	28/26	28/26	31/27	31/27	31/27
pH	7.8	7.7	6.9	7.8	7.7	7.9	7.5	7.5	7.0
Conductivity in µ MHO	150.4	151.6	153.3	216.8	194.7	194.6	213.2	208.1	209.3
Total Dissolved Solids (TDS) in mg/liter	78.8	78.9	80.4	114	101	103	110	110	108
Total Suspended Solids (TSS) in mg/liter	11	21	17	18	21	29	19	49	51
Chloride in mg/liter	1.8	0.9	1.8	1.8	1.8	0.9	0.9	1.8	1.8
Alkalinity in mg/lit of CaCO3	45.08	40.08	45.13	48.96	49.57	57.37	51.91	50.49	52.02
Total Hardness in mg/lit of CaCO3	58	56	61	59	64	53	63	65	70
Dissolved Oxygen (DO) in mg/lit	7.7	4.5	4.2	5.3	5.2	4.4	4.0	3.4	4.6
Biological Oxygen Demand (BOD) in mg/lit	2.7	0.3	0.8	0.9	1.1	0.8	0.3	0.6	0.8
Chemical Oxygen Demand (COD) in mg/lit	38.4	19.2	38.4	38.4	57.6	38.4	19.2	76.8	38.4
Total Coliform MPN/100ml	48000	23000	20000	23000	93000	93000	48000	39000	9000
Fecal Coliform MPN/100ml	7000	9000	4000	9000	15000	15000	7000	7000	4000

A= Sample site at Champasari road bridge. E = Pune house side bank.
B= Sample site at Mahananda road bridge on Sevoke road. M = Air View hotel side bank
C= Sample site at Mahananda bridge (Fulbari) W= Opposite to location E

Water temperature is more or less almost same at every point but slightly increased at the water-sampling site near Mahananda Bridge at Fulbari which indicates that untreated hot water released to river directly from few small scale industries at that particular zone. The pH of water is ranging from 7.0 to 7.8 that totally remain in tolerance range of Class A, Class B, Class C, Class D and Class E surface water standard as per Bureau of Indian Standard (BIS). Conductivity is in control to every point of the sampling sites. Total dissolved solids (TDS), total suspended solids (TSS) and Chloride are in trace amount with respect to Bureau of Indian Standard (BIS). Chloride content of water samples are in range of 0.9 mg/lit to 1.8 mg /lit. The total hardness of Mahananda river water are ranging from 53 mg/ lit to 70 mg/ lit in terms of $CaCO_3$, where as Standard remain 300 mg/lit in terms of $CaCO_3$. So, from this observed results it is quite clear that Mahananda river water is not the hard water.

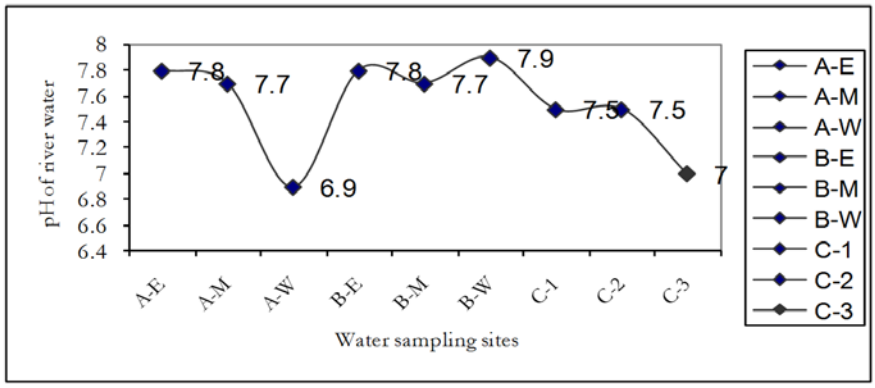

Fig 1: Graphical representation of pH of Mahananda river water at different sampling sites.

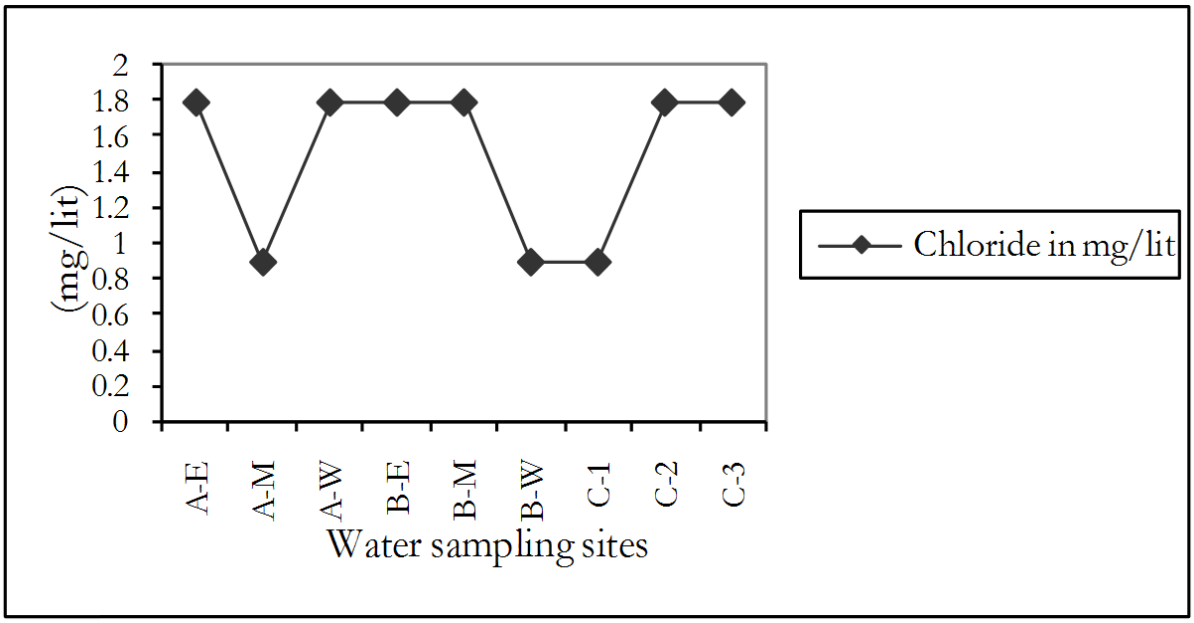

Fig 2: Graphical representation of Chloride content of Mahananda river water at different sampling sites.

But a very special attention will be given to bacteriological parameters i.e. presence of coliform in the Mahananda river water. It is a great concern that range of Dissolved Oxygen (DO) and Biological Oxygen Demands (BOD) are conflicting indication of presence of bacteriological parameters in river water. The DO values are in a range of 3.4 mg/lit to 7.7 mg/lit. Lower value of respective range, not taken into consideration but higher value will be given a special importance because it is beyond the range of surface water quality prescribed by Bureau of Indian Standard (BIS). Higher DO value obtained from the sample collected at site of Champasari Road Bridge. At that same sampling site BOD value i.e. 2.7 mg/lit is also beyond the Standard and both the total coliform and fecal coliform are very high.

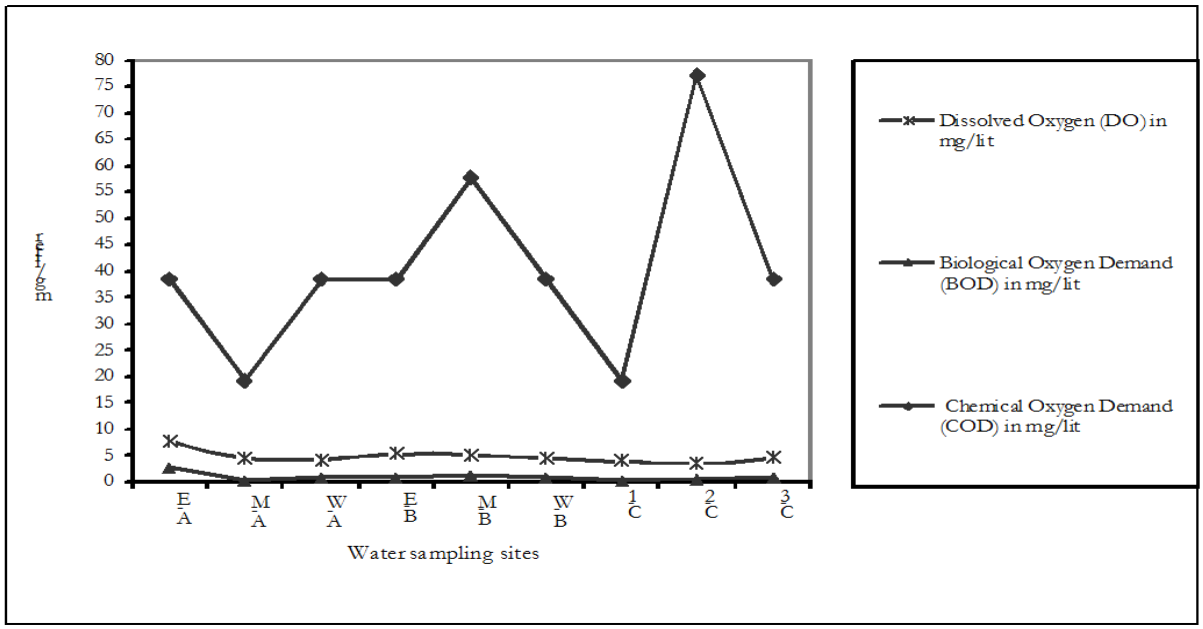

Fig 3: Graphical representation of DO, BOD and COD in Mahananda river water at different sampling sites

So, a rapid action should be taken for that area because a very higher tendency is laying to becoming a highly polluted by biological contaminants in very near future. Besides this, Mahananda riverbank site and Air View hotel side bank-sampling site will be taken into consideration where the bacteriological pollutants are very high. Depending upon Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), total coliform and fecal coliform it is quite clear that, food processing industries, chemical industries and some hotel industries are situated at/near Champasari road (Siliguri Municipal corporation ward number 46) which are releasing untreated waste water and food waste to river with high

biological waste/organic matter. Besides these, slum dwellers of that areas having poor sanitation system and ignorance of them is an added advantage to grow bacteriological load in the river water. The unsanitary conditions of inhabitants of that ward and release of untreated domestic wastewater into river are other causes to increase coliform load in river water. The sampling site near Sevoke road, river water quality deteriorated because untreated waste water released from chemical industries, automobile industries food processing industries are also added to Mahananda river water.

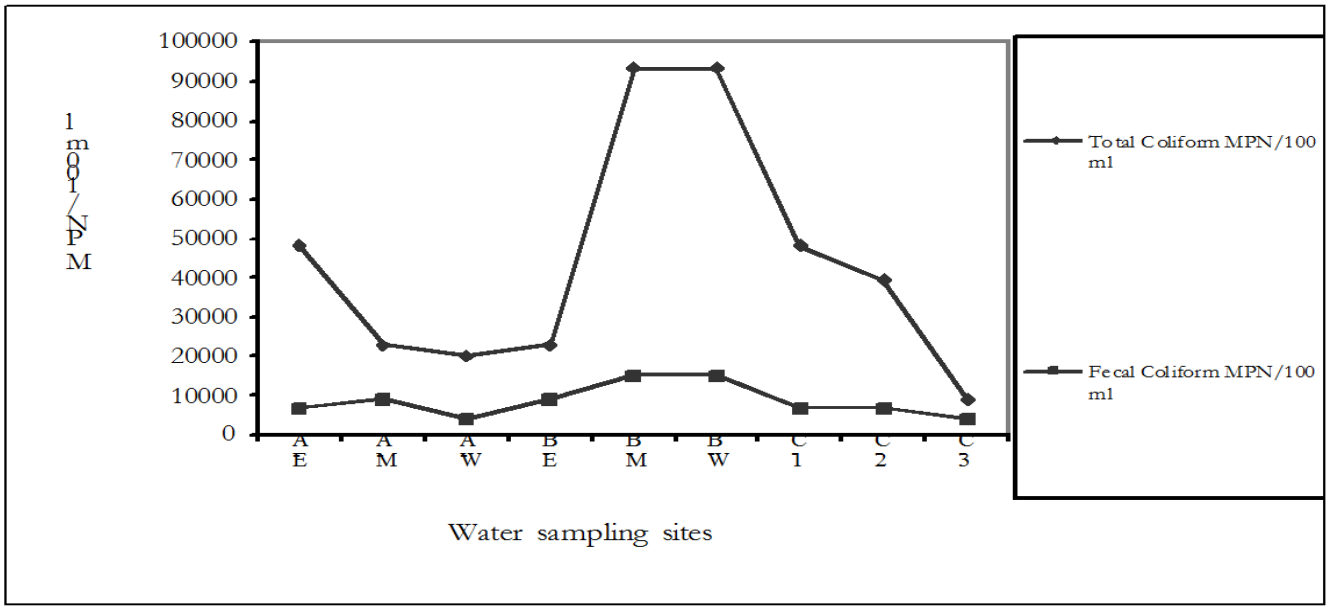

Fig 4: Graphical representation of total coliform and fecal coliform in Mahananda river water at different sampling sites.

The other sources of water pollution came from various situations that tend to occur in urban areas such as soil particles from construction and demolition sites, and also oil and toxic chemicals from car maintenance workshops, automobile manufacturing and servicing industries and runoffs from road surfaces [6] are also the cause of water pollution. In addition, land in urban cities is covered with 'buildings, asphalt, and concrete', which brought a large amount of quick runoff, contributing to water pollution [3, 9]. Such an urban lifestyle of Slilguri and an urban design are also factors contributing to water pollution. Domestic wastewater from ward numbers of 4, 10, 11, 13, 14, 42, 43 and 44 of Siliguri town is another source of bacteriological load into river water. The sampling site near Mahananda bridge at Fulbari bacteriological load are so high that, this side should consider with a prime concern because from that particular point water supply system is maintained for the domestic purpose to the population of Siliguri Municipal Corporation area.

Conclusion

The physico-chemical characteristics of Mahananda river water gradually deteriorating due to discharge of untreated industrial and domestic wastewater and also agricultural runoff. We find from results of this present investigation that deterioration of water quality in Mahananda River may seriously affect the local inhabitants. In fact water pollution of Mahananda river is due to human activities. Of all human activities, the main sources of water pollution are domestic and industrial wastewaters. Domestic wastewater comes from 'residential sources including toilets, sinks, bathing, and laundry' and industrial wastewater is 'discharged by manufacturing processes and commercial enterprises [11]. Even when compared the same physico-chemical parameters, it is evident that river water of *Mahananda* is more polluted as compared to the Bureau of Indian Standard (BIS). In order to manage the pollution load of River Mahananda that pass through Siliguri Municipal Corporation area, it is recommended that various methods of sewage industrial waste treatment should be used before disposal of effluents [5].

It is further interesting to note the fact that every human being of Siliguri Municipal Corporation area should be aware, conscious and knowledgeable about his or her role on water resources. There is almost an unbalanced relationship between the knowledge of population and water resource and it will be checked as soon as possible. Environmental education and knowledge for sustainable use of water resource may be able to take appropriate decisions concerning the solution and prevention of river water pollution of Siliguri Municipal Corporation Area.

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