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# Assessment of Water Quality of Surma River and Its Impacts on Urban Residents: The Case of Sylhet City Corporation

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### Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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## ABSTRACT

This study intends to assess the current water quality of the Surma River alongside Sylhet City and its impacts on urban residents. The water quality has been assessed by laboratory analysis considering a total of seven water quality parameters, viz. pH, DO, BOD, COD, TS, TSS and TDS and water samples were collected from four stations. The impacts of water quality on human health, fishing, the soil, agriculture and the surrounding environment are analyzed based on primary data collected through questionnaire survey covering a total of 200 respondents who resides at the bank of the river. The average values of parameters are DO 11.15 mg/l, BOD 1.77 mg/l, COD 25.27 mg/l, pH 7.2, TSS 131.5 mg/l, TDS 26.47 mg/l and TS 158 mg/l. Among of them only pH is within standard value. Respondent of the study area opined that they have no waste dumping station where they can put their waste. For that reason they compelled to dump waste into the river. Inadequate waste management system and lack of proper waste management initiatives accelerating the pollution exponentially. The scenario can be improved by implementing the recommendations made by the study, which can have the positive changes in the human and aquatic life, environment and ecosystem of the river area.

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## 1. INTRODUCTION

The water quality of this river is gradually deteriorating by direct and indirect waste disposal of municipal waste. Many point and non-point sources are responsible for this deterioration which not only affects the physical environment, but also the socioeconomic condition of people living near the river. The rapid urbanization has brought about increasing growth of urban water use, especially domestic water consumption, giving rise to tension in urban water supply and demand [1]. At present, the water supply authority of Sylhet City Corporation (SCC) is mainly dependent on ground water, which fulfills only 40% of the demand of its total population and the rest of the people are deprived of the water facilities of the City Corporation and they mainly depend on hand pump tube wells [2]. The urbanization has different environmental impacts such as water supply problem, solid waste management, disposing waste system, water logging problem, traffic congestion and sound pollution [3,4]. The scarcity of public water supply is mainly occurring due to shortage of production [5], presence of leakage and other faults in the pipeline and also due to unauthorized connection and unplanned urbanization [6]. The chorus (natural channels) is responsible for surface runoff conveyance from its urban catchments to the receiving Surma river [7]. A total of 180 to 200 tons of solid waste is generated in Sylhet city and only 140 to 160 tons are collected (Amin and Baquee, 2005). Same River is a very important concern to the water utilities to be used as an alternative source of water supply for a Sylhet City Corporation. But the water of Surma River is contaminated day by day due to the direct and indirect disposal of the solid wastes, domestic and municipal sewage and agricultural run-off to the river [8,9].

In this circumstance, this study aims to fulfill the following objectives:

1. Assessment of Physico-chemical parameters of water.
2. To identify the major causes of river pollution.
3. To find out the socioeconomic problems people are facing due to river water pollution.
4. Find out the probable solution of problems.

## 2. STUDY AREA

Sylhet City is situated by the side of the Surma river- at the northeast region of the country and situated at 28.85° latitude and 98.80° longitude. [From its source in the Manipur Hills near Mao Songsang, the river is known as the Barak River. At the border with Bangladesh, the river divides with the northern branch being called the Surma River and the southern the Kushiya River.

Seven mahallas (a small part of the city) from seven wards alongside the river course has been selected randomly to conduct household survey in order to investigate the social impact of water pollution. In Addition, four stations have been selected for collecting water sample for laboratory analysis (Table 1 and Fig. 2). The selected wards and mahallas are shown in Fig. 1.

## 3. METHODOLOGY

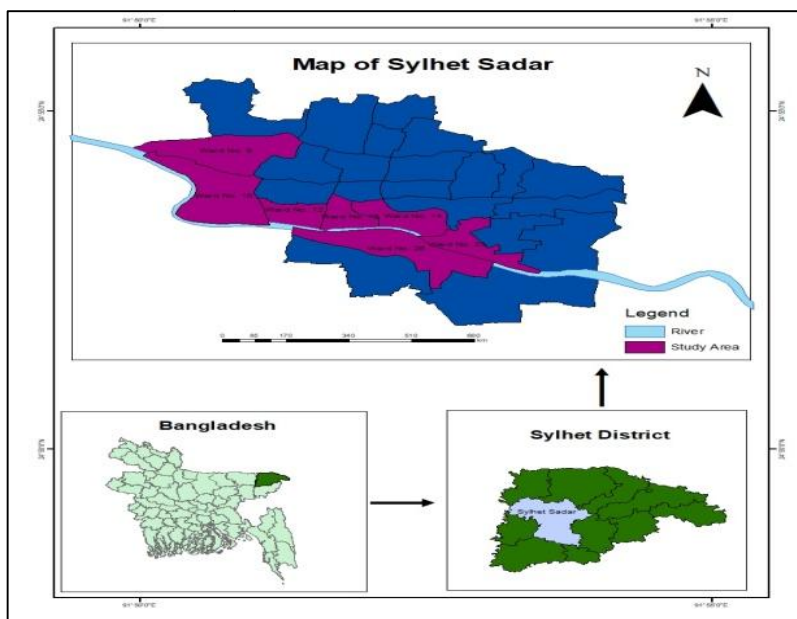
Primary data were collected from direct field observation through questionnaire survey and water samples collected with the help of instrument four water samples were taken from four different stations varying with their geographic location. Sampling locations were geographically identified using Global Positioning System (GPS) device.

Sampling for socioeconomic impact assessment was conducted at 7 mahallas from 7 words taken randomly with non-probability sampling procedure where about 200 respondents participated directly. A water sample was collected from four different stations of the Surma River through composite sampling method into the water sampling bottle for DO: Dissolve oxygen, BOD5: Biological Oxygen Demand(5days), COD:Chemical Oxygen Demand, TS: Total Solid, TDS: Total Dissolve Solid, TSS: Total Suspended Solid, pH : Puissance of analysis.

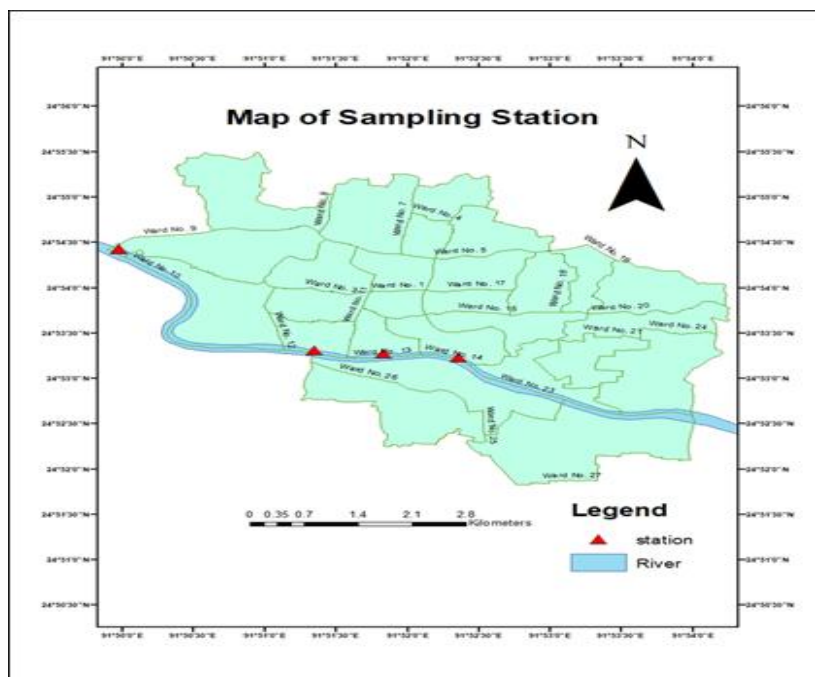
Model PHS-25 (pH meter) is used to measure the pH of water. Titrametric method is used to measure the DO and BOD<sub>5</sub>.APHA 1993 formula is used to get the COD, TDS, TSS and TS.

**Table 1. Lat and long value of study area**

Station No.	Station name	Latitude	Longitude
Station no 1	Kinbridge	24°53'14"N	91°52'5"E
Station no 2	Kazirbazar	24°53'20" N	91°51'30" E
Station no 3	Shekhghat	24°53'21" N	91°51'29"E
Station no 4	Kanishail	24°53'58" N	91°50'28" E



**Fig. 1. Study area**



**Fig. 2. Sampling stations in the study area**

A Systematic Correlation between pairs of physico-chemical parameters were carried out. Because each parameter has a specific role in aquatic eco-system [10]. The correlation analysis helps to understand the interdependent of different water quality parameters.

#### 4. RESULTS AND DISCUSSION

##### 4.1 pH of Water

The value 7.3 found at kinbridge, second highest at Kazirbazar. It implies that puissance of Hydroxide ion is greater than Hydrogen ion. The industrial water directly and indirectly dumping on kinbridge and if we slightly move from this point the pH decreased and near about neutral in kanishail where the average value of pH is 7.20. That means the water is slightly more alkaline than slightly acidic. All the values of the selected stations are within the standard range (6.5-8.5). No stations have found excess high or the excess low value of pH. pH concentrations of the study area have been satisfied the allowable limits for surface water. So the pH value of Surma is good for irrigation and domestic purposes.

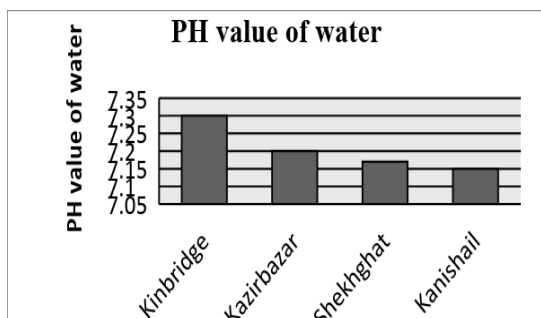


Fig. 3. P<sup>H</sup> value of water

##### 4.2 DO of Water

In this study dissolve oxygen level of Surma river has found at a fluctuating rate at selected stations. It has been seen that the highest value is 13.8 mg/l in Station 4 (Kanishail) and lowest value 7.4 mg/l has seen in station 1 (Kin Bridge) where the standard value is 6 mg/l. The average value is 11.15 mg/l. That means the DO value is extraordinary good according to WHO. The presence of dissolved oxygen is a good sign for Surma river water. It is suitable for industrial purpose. According to DO value the quality of water is satisfactory for fishing, agriculture, irrigation and industrial purpose.

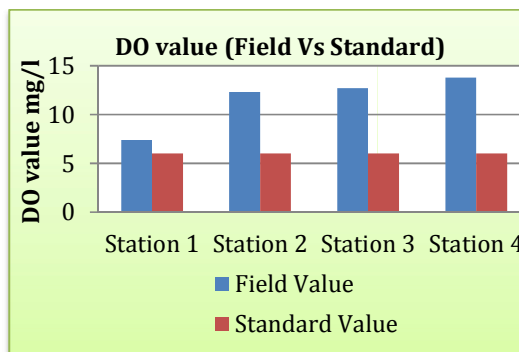


Fig. 4. DO value of water

##### 4.3 BOD<sub>5</sub> of Water

From this study it is seen that the average BOD level of Surma river is 1.77 mg/l. From above figure it is seen that the highest BOD value is found in station 1 3.2 mg/l, which is above of drinking water quality standard (.2 mg/l). 2<sup>nd</sup> highest value is found Kazirbazar at station 2 1.7 mg/l and 1.5 mg/l, .7 mg/l, respectively in station 3 and 4. The highest value is found kinbridge because here point source is directly discharged into river water. Although all the values are quite higher than .2 mg/l, the Surma river water is quite satisfactory according to BOD value.

##### 4.4 COD of Water

The concentration of Chemical Oxygen demand fluctuating from 44 to 10 mg/l. The highest COD value found in station1 (Kin Bridge) 44.40 mg/l and 2<sup>nd</sup> highest value found in station 2 (kazirbazar). This means that extensive treatment required for us because people frequently dump their waste material along river and gradually mixed with water and polluted this stations. The value of 3<sup>rd</sup> and 4<sup>th</sup> stations means river water need conventional treatment and it can use recreational purpose like bathing, swimming, etc.

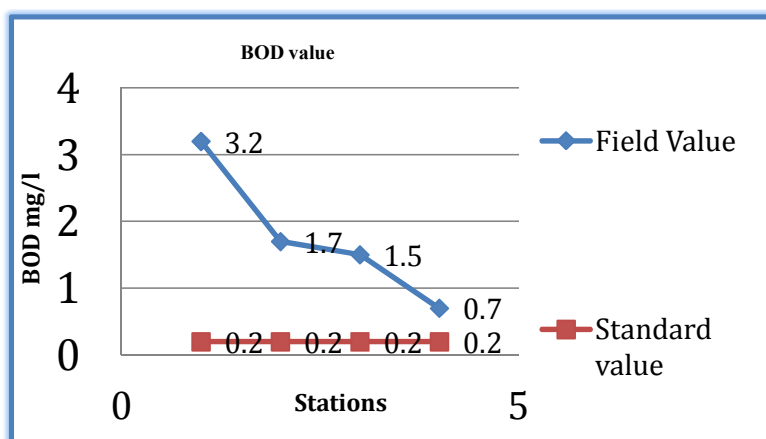
##### 4.5 TS of Water

All the stations total solid value found within the range of standard limit. High levels of total solids will residue the clarity of the water. Although the total solid value found within standard limits, but station 1 & 2 this value can exceed the standard limit in future if pollution is going on and cause harmful for aquatic life.

**Table 2. Value of water parameters in four station of study area**

Parameters	Standard value for surface water (FAO,WHO and DOE)	Sampling stations			
		ST-A	ST-B	ST-C	ST-D
pH	6.5-8	7.30	7.20	7.17	7.15
DO	6 mg/l	7.4	12.3	12.7	13.8
BOD	.2 mg/l	3.2	1.7	1.5	.7
COD	4 mg/l	44.43	33.33	13.33	10
TSS	10 mg/l	220	179	79	48
TDS	500-10 <sup>3</sup> mg/l	50	7.5	40.6	7.8
TS	20-50 mg/l	270	186.5	119.7	55.8

Source: Laboratory test, Environmental lab, December-2018



**Fig. 5. BOD value of water**

	pH	DO	BOD	COD	TSS	TDS	TS
PH	1						
DO	-0.99122	1					
BOD	0.980979	-0.97954	1				
COD	0.926741	-0.86994	0.90309	1			
TSS	0.899307	-0.83791	0.891088	0.994844	1		
TDS	0.649207	-0.73224	0.739938	0.381278	0.371311	1	
TS	-0.5261	0.604961	-0.65651	-0.29768	-0.31175	-0.96919	1

**Fig. 6. Correlation matrix**

#### 4.6 TDS of Water

Maximum dissolves solid 50 mg/l is found at station 1 and minimum dissolve solid 7.5 mg/l found in station 2. Expected levels of TDS values according to WHO drinking water will tend to be 25 to 500 mg/l. From above discussion, it is found that dissolve solid value of Surma river follow the standard limit. But it has probability to increase dissolve solid value because of waste dump nearby river area.

#### 4.7 TSS of Water

The value found in kinbridge is high because it is one of the populated areas of Sylhet City Corporation where population density is high, beside the bridge many temporary shops has been situated, rice mills, poultry farm and other industrial wastes directly dump in the river and near the side of the river. Drainage system also directly discharges into the river. The standard limit of Total suspended solid is 10 mg/l according to WHO. The value of Station 1 and

Station 3 exceed the standard value. This station water is only usable for irrigation purpose. The TSS value is high in sampling station, which is not a good sign for water quality.

A pair of parameters having value  $r \geq \pm 0.5$  bears significant linear correlation between them [11,12]. The value  $r \geq \pm 0.8$  indicates very strong linear correlation between the two parameters [13]. In this study Almost all values show the correlation coefficient greater than 0.5 this means parameters are strongly correlated. TDS and TS does not show the correlation coefficient greater than 0.5 this means these are poorly correlated.

## **5. IMPACTS ON SOCIOECONOMIC CONDITION**

### **5.1 Inadequate Water Supply in Sylhet City Corporation**

The existing water pumps of Sylhet City Corporation cannot supply adequate water for all. In the city area about 20 percent water supply coverage is found from the data of the City Corporation. Among the 27 wards, five wards are still not provided with public water supply. In the slum areas, water supply is not available and new city areas. The consumption of water is higher than the quantity of supply because of the high population growth rate. There is an only one water purification center among 8 wards Which is not satisfactory. A huge amount of people in my study area said that they are a victim of inadequate water supply.

### **5.2 Respondents Perception of Access to Water Supply**

From the inhabitant's perception about water supply in the study area, it could be said that the water supply in the Kanishail colony is highly inadequate because only 30% of the inhabitants have a satisfactory water supply while 69% are believed to have an unsatisfactory water supply. Majorities of the inhabitants live near the river are highly unsatisfied with the water supply to the area and 80% of the inhabitants tend to have a fair supply of water.

### **5.3 Usage of Surma River Water**

River water is used by industries, household chores, bathing, agriculture and others. Most respondents said that the river water is the only

source of water for them because they have no alternative source. In kanishail respondent said that they use tube well, which belongs to the owner and they patch water from 7 A.M to 5 P.M. They do not get water at any time when needed. They are compelled to drink river water. In Topkhana slum area people have no tube well and other alternative source of water without the river.

### **5.4 Causes of Water Pollution in the Study Area**

Among 200 respondent 70% of respondent said that dumping of household waste is the major cause of water pollution, 60% of said that Industrial waste causes water pollution. Sewage and waste water is also reasonable cause for water pollution [5]. Animal waste and chemical fertilizer is not so much effective cause of water pollution according to the respondent.

### **5.5 Satisfaction over Waste Deposing System**

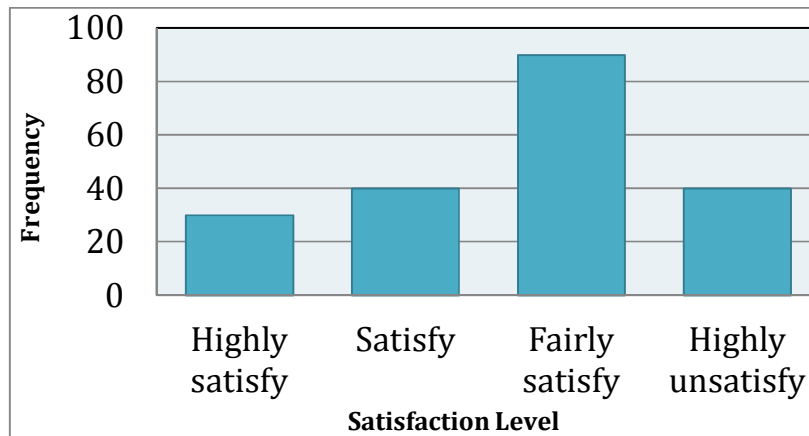
63 percent respondents said that they are satisfied over disposing waste management in Sylhet city, but 87 percent respondents said, they are not satisfied over disposing waste management. People who live in a slum area in Topkhana and Kanishail said they have no waste depositing system and they are compelled to dump waste into the river.

### **5.6 Improper Drainage System**

The existing drainage system of this municipality is not well-developed. During the rainy season dirty water from the drain flows out on the road which bears various germs and diseases. Besides, service holders, school and college going students, rickshaw pullers, auto, and bus drivers face a great problem. At this time, the roads look like a canal and men and children catch fish on the road. It happens because the drains are not so deep, wide and clean and resulting that a lot of rubbish and messy things are amassed in the drain which fill the drain and create odor pollution.

### **5.7 Impact of Water on Agriculture**

Most of the respondents uttered that agriculture is not hampered by river water. The water of Surmariver still worthy of agriculture. People near the kanishail use the water in paddy field and vegetable garden. The production of crops is as



**Fig. 7. Satisfaction level for sanitary condition**

same before. It indicates that there is a tiny impact on agriculture. From lab analysis the average pH value of water is 7.2, the average DO value is 13.33, The BOD<sub>5</sub> and COD value respectively .5 and 7.4. That value indicates that the water is good and eligible for agriculture and irrigation. There is still no negative impact of water in agriculture.

### **5.8 Impact of Water on Fishes and Fishing**

55% of the respondent say that there is an impact on fishes due to pollution. 10% of respondent caught fish about 15-20 years ago. Due to pollution most of fishes are not capable of breeding in this water and as a consequence the amount of fishes lessens than before. In rainy season most of people engaged in fishing. The pH value, DO value, BOD<sub>5</sub> and COD value is good for fish, but in the dry season the value is changed which is not fit for fishing at all. So, most of the people in the study area do not engage with the fishing because in the dry season they become jobless.

### **5.9 The Health Condition of the Study Area**

About 86% of respondents in my study area use the river water and they are victims of some waterborne diseases like diarrhea, Bilharzias and skin infection on foot but the quantity of victims is a tiny amount. In Ghasitula a patient of skin infectious said that in the dry season when the amount of water lessen in the river the pollutants become increased the black stain in the foot become rise due to using the polluted water. In

kanisail some of them are facing arsenicosis and in Seikhghat they have faced diarrhea in several times.

### **5.10 Impact of Water on Health and Sanitation**

86% of respondents in the study area use the river water and they are victims of some waterborne diseases like diarrhea, Bilharzias and skin infection on foot but the quantity of victims is a tiny amount. In Ghasitula a patient of skin infectious said that “in dry season when the amount of water lessen in the river the pollutants become increased the black stain in the foot become rise due to using the polluted water”. In kanisail some of them are facing arsenicosis and in Seikhghat they have faced diarrhea in several times.

It is indicated in the table that only 40% of the inhabitants of SCC are highly satisfied with the sanitary condition of their surrounding environment, 40% of the inhabitants are satisfied with the sanitary condition of their surrounding environment, 90% of the inhabitants are fairly satisfied with the sanitary condition of their surrounding environment, while 40% are highly unsatisfied with the sanitary condition of their surrounding environment. This indicates that the sanitary condition of SCC neighborhood is rapidly deteriorating and this could lead to outbreaks of disease epidemics such as cholera, typhoid and diarrhea. This calls for urgent attention by the state government and the state environmental agency to look into the problems of sanitation before it deteriorates finally.

## 6. CONCLUSION

In conclusion, it can be said that, because of urbanization, population is increasing in Sylhet city. Sufficient pure water cannot be provided in the city being population more in proportion to its area. The drainage of waste and dump pollutes the environment in the city. The majority of the people do not dispose waste in the dustbin. Because of insufficient manpower and vehicle problem, waste and dumps are not disposed timely. These problems are increasing steadily. By this research, negative effects of urbanization in Sylhet city are appearing. So it can be said clearly that, these problems are not only for Sylhet city, but a common phenomenon for all cities of Bangladesh. So, to resolve the effect of urbanization, the citizens should be conscious and as well as the government should take proper initiatives.

## 7. RECOMMENDATION

1. Existing laws and regulations should be implemented properly by SCC and enforcement should be adopted if required.
2. Illegal residential buildings and slums in Kanishail and Shekhghat have to be removed from the bank of the river.
3. To continue the flow of the river, dredging is required.
4. To control the pollution from industrial discharge, establishment and efficient operation of Effluent Treatment Plant (ETP) is crying need in Sylhet city.
5. To avoid any kinds of pollution, consciousness is the best policy, so public awareness is necessary.
6. Government agencies like (DOE, WDB, and DWASA etc.) and Non-Government agencies should be more active to reduce the pollution of the Surma.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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