Water Quality Analysis of Karnaphuli River Water near Industrial Areas

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Abstract

Due to the facilities of transporting raw materials and industrial products through the Bay of Bengal, the bank of the Karnaphuli river in Chittagong has been one of the busiest Industrial zone of Bangladesh. Various oil refining industries, garments and fertilizer industries have been established here which are throwing their industrial wastes in the Karnaphuli river and it is hindering availability of pure water near the bank of the river. As a result, the increasing rate of water pollution in the river Karnaphuli has been a matter of huge concern these days for the dwellers of Chittagong. The aim of this study is to assess the water quality in the Karnaphuli river. The water samples were taken from two points (upstream and downstream near the industrial zones of Patenga) in a difference of one week for three consecutive weeks and have been tested to assess the water quality indicating parameters such as pH, Dissolved Oxygen (DO), Total Dissolved Solid (TDS), Biological Oxygen Demand (BOD), salinity and conductivity. The results have been compared with that of the non-polluted standards of river water. And these findings prove that water of Karnaphuli river is being highly polluted due to the industrial waste from that specific region. This pollution is causing a direct impact in the human health and the lives of the organisms living in the water.

Introduction

Karnaphuli river is one of the largest rivers of Bangladesh and as it is geographically situated in the trading capital of Bangladesh, it has been one of the most important means of trade and commerce in Chittagong. As a result, many industries have been established on the bank of this river. For this study, we only focused on the industrial zone of Patenga area on the bank of Karnaphuli river. The study area of 1.5 kilometer was selected in a way that this 1.5 kilometer

area contains a lot of small and large industries. The study area of 1.5 kilometer has been marked in blue lines in Fig. 1. In our study area there are several oil refining industries, fertilizer and cement factories, textile industries and some other small industries. The water samples collected from this bank of the river were tested on the basis of several parameters such as Biological Oxygen Demand (BOD), Dissolved Oxygen (DO), Total Dissolved Solid (TDS), Salinity, Conductivity and pH.

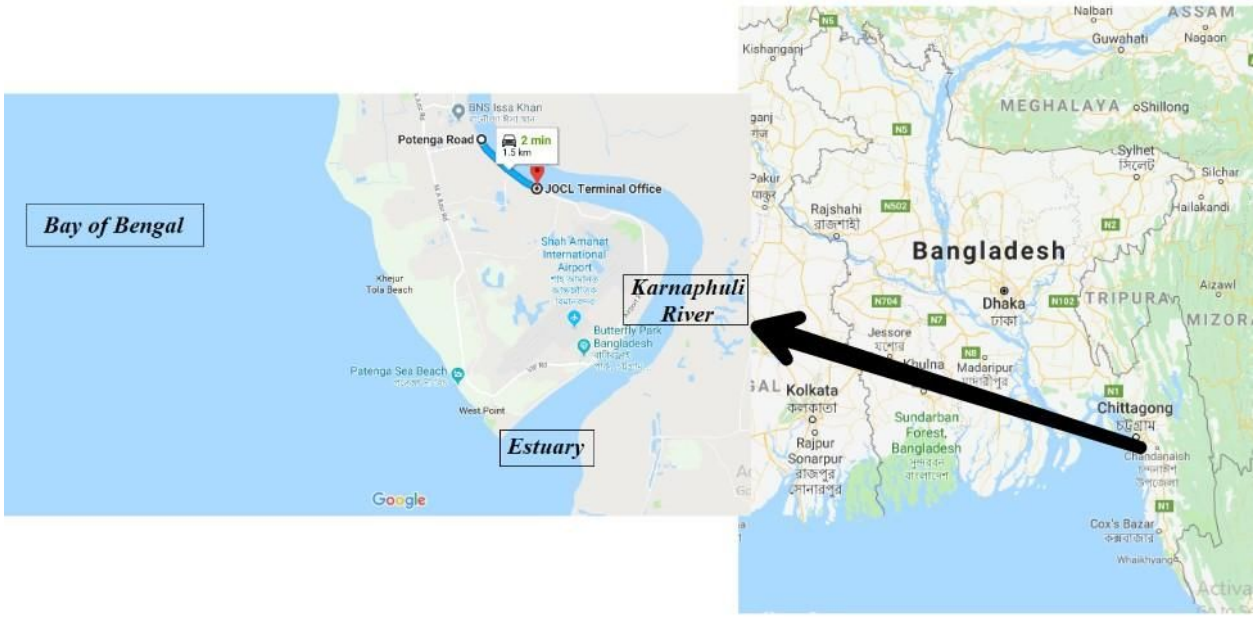


Fig. 1 : Location of collecting samples

Because of ongoing industrialization process and having inadequate waste water treatment plants in the industries, the Karnaphuli river water is a disposal place of several industrial pollutants. Water quality of Karnaphuli is degrading mainly due to disposal of chemical waste in it and it was supported after comparing the experimental values of water quality with the standards of Water Quality Index (WQI) (Dey et al., 2017). The industries are the major source of chemical

waste disposal. Due to this pollution the standard of living of the residents of nearby areas are not degrading only; the aquatic ecosystem are also losing diversity and difficulties to survive. In this regard, in another article "The Bangladesh Floodplain Fisheries", the authors mentioned how and why increasing contamination of river water is threatening the lives of the fisheries in Karnaphuli river (Craig et al., 2004). So, realizing the dangerous impacts of industrial pollutants in Karnaphuli river, it is urgent to take initiatives to control this. The article "Preliminary Assessment of Heavy Metals in Water and Sediment of Karnaphuli River, Bangladesh" contains assessment of exposure of heavy metal in the Karnaphuli river and there the authors suggested to monitor industrial effluent and domestic waste to prevent the Karnaphuli river from point sources of water contamination after their experiment on heavy metal contamination in Karnaphuli river (Ali et al., 2016). This is why, adapting measurements to protect the river Karnaphyli from industrial pollutants is necessary.

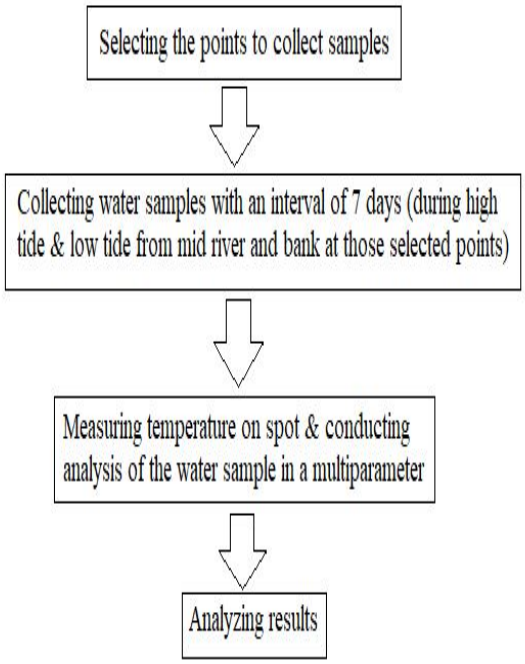
Different organizations such as WHO, EPA, World Bank, Water Aid etc. have set different standard valuesfor several parameters of river water. So, in this study we also compared our findings with those parameters to determine if the water quality is truly degrading or not and if it is degrading how is the current condition based of the previously mentioned physical and chemical parameters.

Materials & Methods

In this experiment, we used bottles, ice box to collect and preserve thewater samples. To analyze the sample we used laboratory thermometer, pH meter and a multiparameter.

At first, we selected two points near the estuary of Karnaphuli River and in between these two points there is 1.5 km distance. There are almost 45 small and big industries in this 1.5 km

distance. And these industries dispose all of their industrial waste in the Karnaphuli River. We collected water samples twice a day for three days with an interval of 7 days in between. We collected samples on the same days during high tide and low tide from the bank and mid river at those previously selected points. This is how we had eight samples per day which were stored in an ice box and preserved in the refrigerator later for lab test. The temperature of water has been measured at the time of collecting samples on spot and the other tests were done in laboratory. We measured pH of the sample in a pH meter and other parameters such as salinity, conductivity, BOD, TDS and DO in a multiparameter. A flow chart of our methodology during this experiment has been given below.



Results and Discussion

PARAMETER	EXPERIMENTAL VALUES		STANDARDS				
	CONDITION	VALUE	Department of Environment	Department of Fisheries	Drinking	Domestic Use	Irrigation
pH	High Tide-Mid	7.92	7.25	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
	Low Tide-Mid	7.45					
	High Tide-Bank	7.95					
	Low Tide-Bank	7.34					
Dissolved Oxygen (DO)	High Tide-Mid	5.97 ppm	6.5 ppm	4.0 - 6.0 ppm	N/A	4.0 – 6.0 ppm	N/A
	Low Tide-Mid	10.93 ppm					
	High Tide-Bank	16.00 ppm					
	Low Tide-Bank	10.48 ppm					
Biological Oxygen Demand (BOD)	High Tide-Mid	3.54 ppm	5.0 ppm	(-) or below 2 ppm	N/A	N/A	N/A
	Low Tide-Mid	8.80 ppm					
	High Tide-Bank	11.46 ppm					
	Low Tide-Bank	7.7 ppm					
Total Dissolved Solid (TDS)	High Tide-Mid	2.18 ppt	0.165 ppt	0.5 ppt	0.5 ppt	1 ppt	<0.450 ppt
	Low Tide-Mid	0.062 ppt					
	High Tide-Bank	1.91 ppt					
	Low Tide-Bank	0.05 ppt					
Salinity	High Tide-Mid	2.3 g/kg	-	-	-	-	-
	Low Tide-Mid	0.05 g/kg					
	High Tide-Bank	2.03 g/kg					
	Low Tide-Bank	0.04 g/kg					
Conductivity	High Tide-Mid	4352.1 S/m	300 S/m	800 -1000 S/m	N/A	N/A	750 S/m
	Low Tide-Mid	53.3 S/m					
	High Tide-Bank	3838.1 S/m					
	Low Tide-Bank	100.33 S/m					

Table 1: Comparison the physical parameters of Jamuna River water during dry and wet season (Uddin et. al., 2014)

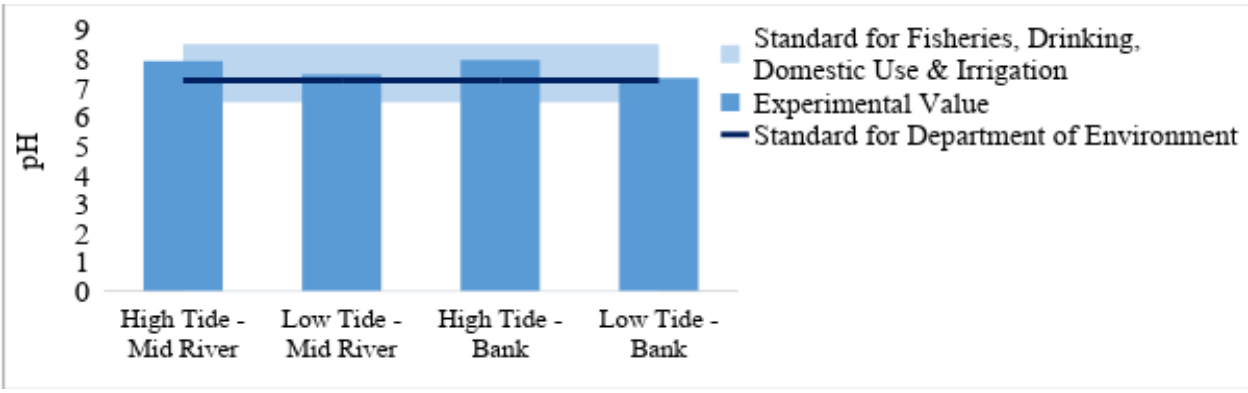


Figure: pH

Here we can see that the pH is close to the standard value given by DOE, DOF and domestic standards. This means that there is less expulsion of acidic or basic pollutants. However, while taking the water samples we have noticed that there were oil layers on the surface of the water. Besides we have also seen that the drains from the industries which expelled acids opened into the river. From this we can analyze that due to equal amount of expulsion of acids and bases in the water the pH was balanced out. Due to this it did not vary a lot from the standards. But this does not mean that there was no pollution. We can verify the pollution level through other parameters.

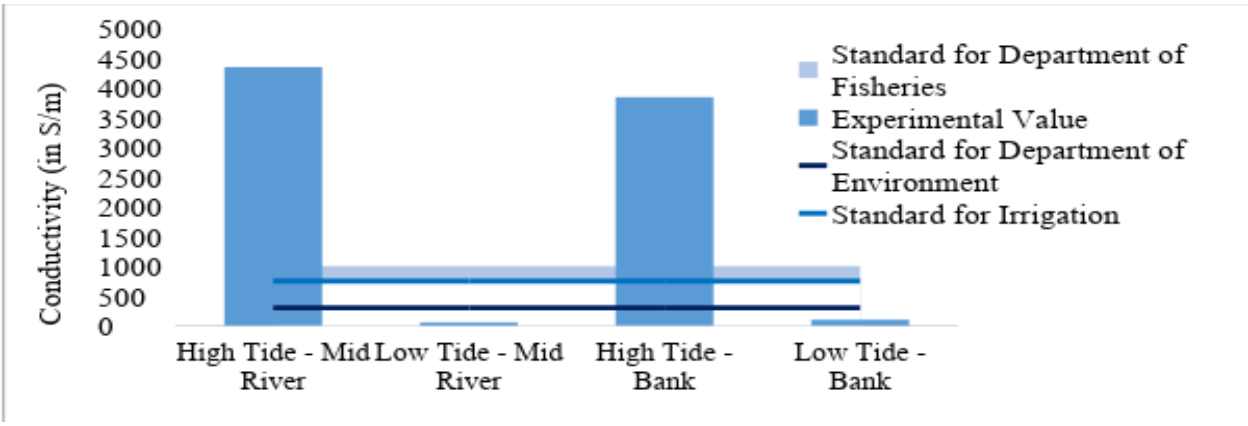


Fig: Conductivity

Conductivity is very high. It means more concentration of ions are more. More alkali or salt ions are present. More conductivity means more salinity

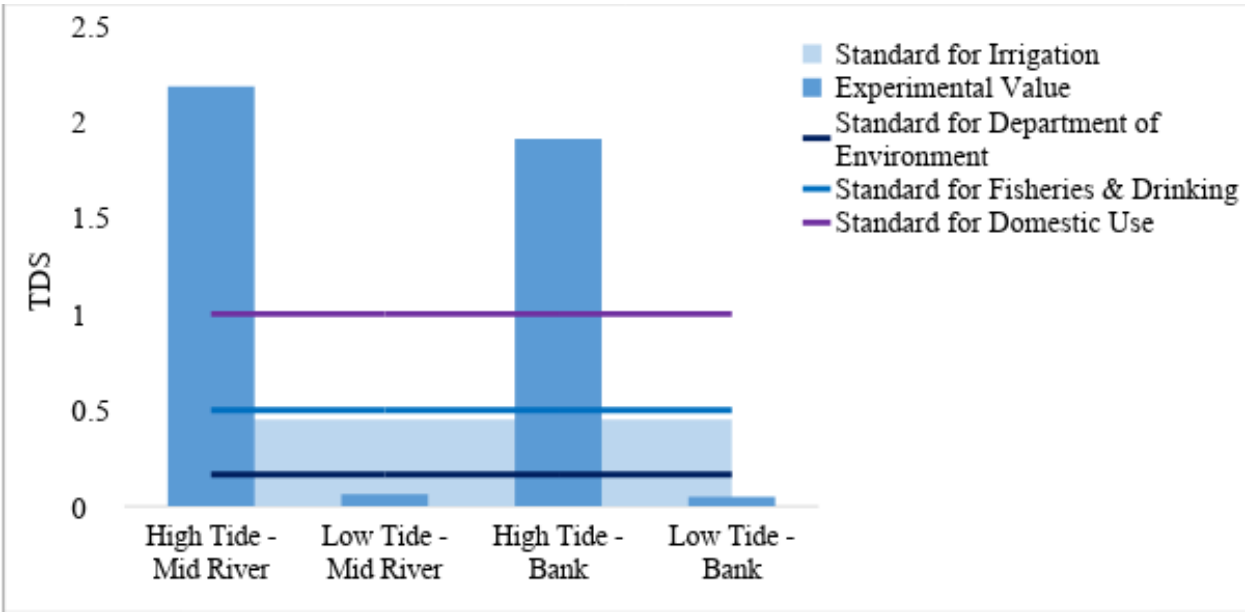


Figure: TDS

During low tide the TDS level is very low and during the High tide the TDS level is very high. During High tide the TDS level has a huge deviation from the standards. And even during the low tide there was not a very big deviation. So we can infer that the TDS level is more in the water comparing to the standards. Thus it is not suitable for drinking, domestic use and it gradually being harmful for fisheries

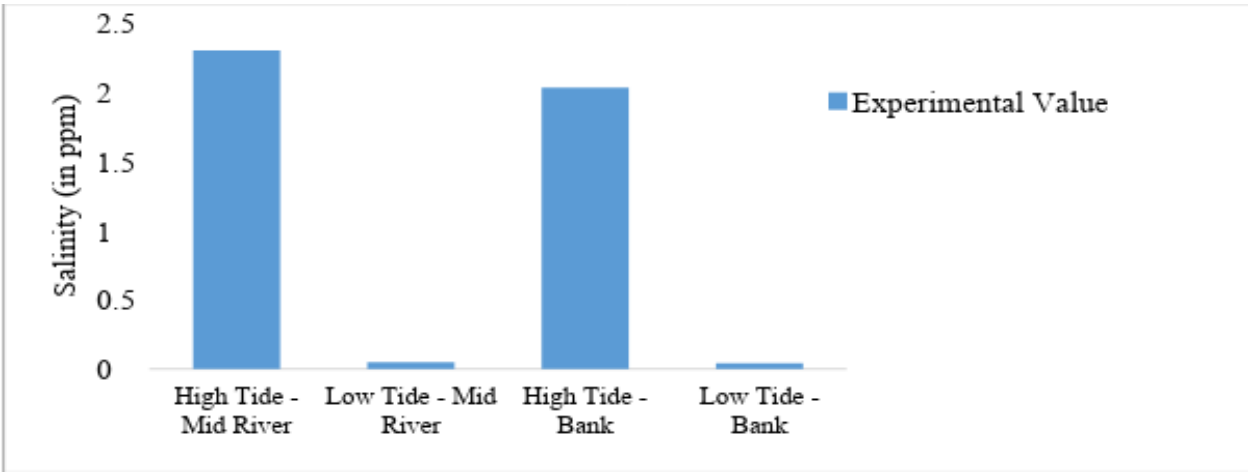


Figure: Salinity

We found out a huge difference in between the salinity during high tide and low tide. It is because, the salt water of the Bay of Bengal enters into the river during high tide causing an increase in salinity and during low tide, the saline water returns into the Bay of Bengal and thus salinity decreases during low tide. Besides, it has been found that salinity in mid river is little higher than salinity in the bank of the river.

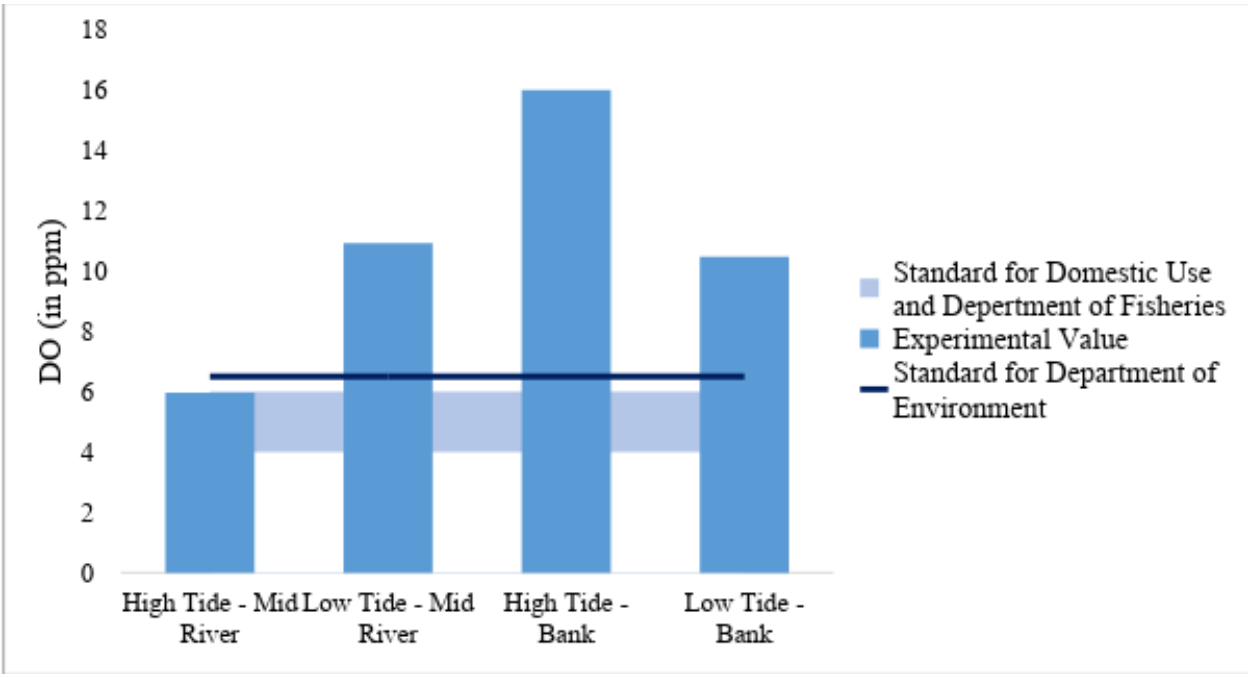


Figure: DO

DO didn't vary a lot in our experimental values. Unfortunately, we couldn't test the DO right at the moment of collecting samples and therefore, there might have decreased little in our experimental value, as the microorganisms of the water samples consumed some oxygen during the interval of collecting sample and testing the DO. Comparison of our experimentally found DO with the standards of department of fisheries, department of environment and with the standard of domestic use illustrates that the average DO of the four water samples was close enough with the standards.

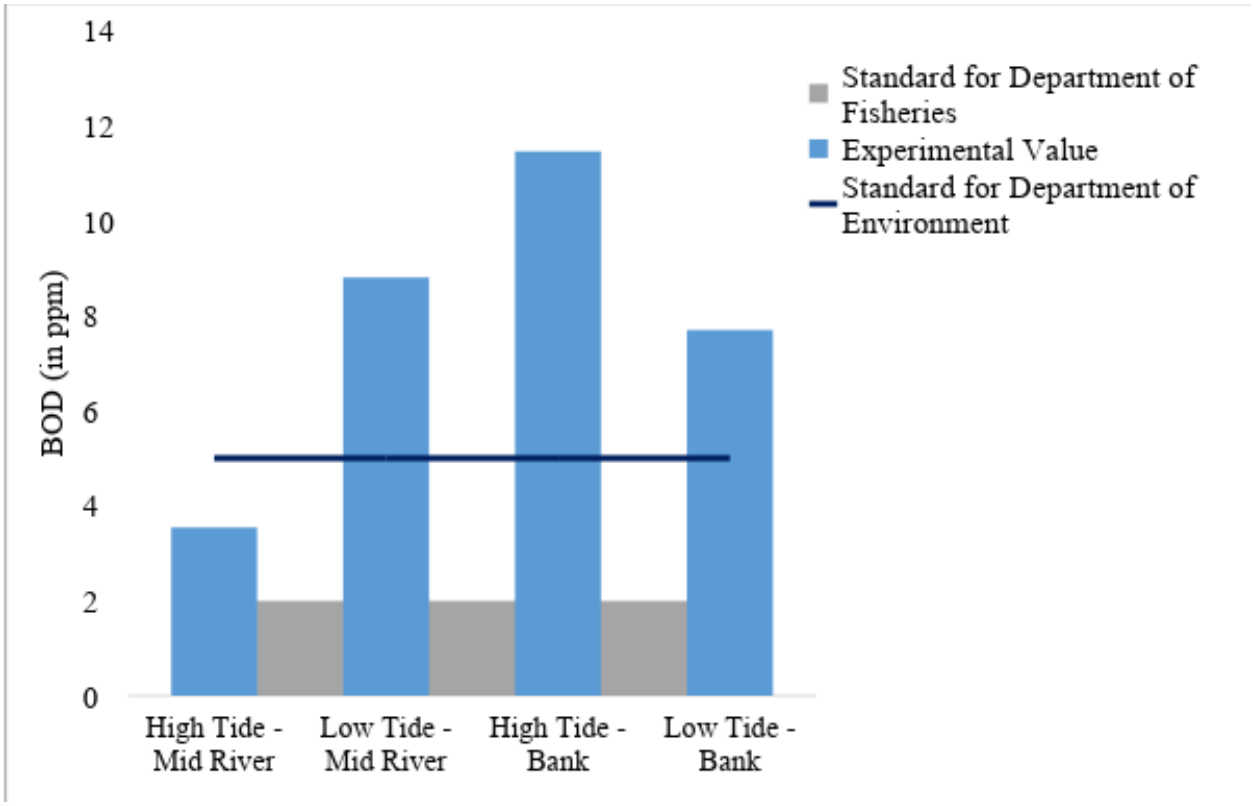


Figure: BOD

BOD denotes the demand of Oxygen by the biological bodies present in the sample. We calculated BOD from DO using the below mentioned formula.

$$\text{BOD} = \frac{Initial\ DO - Final\ DO}{Volume}$$

By comparing our experimentally found values of BOD with the standards of department of environment and department of fisheries, we found out that except the water samples during High Tide from middle river, other samples had a BOD higher than the standards. It also denotes that in most of the cases, the water samples contained more biological bodies than the established standard.

Possible Impacts

Water pollution is very harmful for human health. It can cause several diseases and in extreme cases it can also take human life. Every year about 1 billion people gets ill by intaking polluted water and most of them are the ones living around the water source (Denchak, 2018). Diseases like cholera, typhoid breakout due to untreated water. Besides the toxic elements also gets transferred to human bodies and cause cancer or hormone disruption (Denchak, 2018).

The toxicity of the water also impacts the organisms living in the water. The change in the oxygen content of the water makes respiration difficult for the organisms. Besides, the harmful organic pollutants accumulate in the organism's bodies and harm their life cycle, sometimes kill them too.

Conclusion

Water pollution results when contaminants are brought into the regular habitat. For instance, discharging insufficiently treated wastewater into regular water bodies can prompt corruption of aquatic ecosystems. In turn, this can lead to public health problems for individuals living downstream. They may utilize the equivalent contaminated stream water for drinking or washing or water system. Water pollution is the main overall reason for death and disease.

Contamination is the consequence of the aggregate impact after some time. All plants and organisms living in or being presented to contaminated water bodies can be affected. The impacts can harm individual species and affect the natural biological communities they are part of. Industries are contributing towards water pollution in a larger scale so it is necessary to take steps towards proper water and waste management. Environmental policy maker and government

should be involved and play an important role in controlling the impacts of water pollution in the environment.

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