The impact on industrial water pollution in Buriganga river, Bangladesh

BY

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This thesis report presented in partial Completion of the Requirement for the Degree of Bachelor

Of science (B.Sc.) in Environmental science and Disaster Management (ESDM)

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APPROVAL

This thesis report titled "the impact on industrial water pollution in **Buriganga river, Bangladesh",** submitted by Mahad Mohamud (ID: 181-30-187) to the Department of Environmental science and Disaster Management (ESDM), Daffodil international University (DIU) has been accepted as satisfactory for the partial completion of the requirement for the degree of Bachelor of science (B.Sc.) in Environmental science and Disaster Management (ESDM) and approved as to its style and contents. The presentation has been held on December 2021.

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DECLARATION

I hereby declare that this thesis submission is my work towards completion of the program of Batchelor degree of environmental science and disaster management under the supervisor of

Dr. A. B. M. Kamal Pasha, Ph. D, Associate professor and Head of the Department of Environmental Science and Disaster Management (ESDM) Daffodil International University (DIU). I also declare that neither this research project nor any part of this research project has been submitted elsewhere for the award any Degree.

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DEDICATION

To,

I dedicate this research work to my family and many friends. Special feelings of gratitude to my loving parents, **Mako Mohamed Ibrahim** and **Mohamud Mohamed Omer** whose inspiration and endless support pushed me to where I'm today nothing would have been possible to me without them their unconditional support. I'm also grateful to all my siblings for their immense support. I also dedicate this research to my faculty members and the students of ESDM for their unconditional support and encouragement.

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ABSTRACT

Buriyanga river is originated from Dhaleshweri and its referred as one of the most polluted River around Dhaka. On the last decade significant numbers of textile and tannery industries Have been established on the bank of rivers, part from the industries established a substantial amount of domestic waste has been dumping into the river water which dramatically the pollution increases of the river water. To investigate the quality of buriganga river water we analyses the status of 10 physical parameters including pH (potential hydrogen), EC (electrical conductivity), TDS (total dissolved solids), Do (dissolved oxygen), alkalinity, acidity, total hardness, free carbon dioxide, magnesium hardness and calcium hardness of Buriganga River, we collected 11 water samples from 11 different locations of Buriganga River which we further analyzed in laboratory using different tools and methods including pH meter, EC meter, TDS meter and titration method. Our result indicates that most of the parameters we analyzed exceed the limited standard set by WHO (world health organization) and DoE (department of environment) peoples republic of Bangladesh for healthy water. In addition to that our result highlighted a strong correlation between some parameters, this indicates that the parameters were corresponding to one another; we had found this correlation using correlation and linear regression methods. Our research has shown the deteriorating situation of Buriganga River and surrounding environment and suggested a strong recommendation to the concerned authorities however a wide scale research is needed to be conducted to further develop a realistic mechanism to cope the increasing pollution.

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LIST OF SYMBOLS AND ABBREVIATIONS

Symbol or Unit	Name of the Symbol or Uni
Km	Kilometer
CM	Centimeter
Mg/	Milligram per liter
Ppm	Parts per million
mS/	milli Siemens per centimeter
μ/cm	Millionth per centimeter

Abbreviation	Full-Form of the Abbreviation
Ph	Potential of hydrogen
DO	Dissolved oxygen
TDS	Total dissolved oxygen
Mg	Magnesium
Ca	Calcium
HCL	Hydro chloric acid
EBT	
NaoH	Sodium hydroxide
TSS	Total suspended solids
BOD	Biological oxygen demand
COD	Chemical oxygen demand
CO2	Carbon dioxide
DoE	Department of environment
WHO	World health organization

Chapter 1: Introduction

This introduction chapter provides the introductory information of the research study. Those include a discussion about the background, statement of the problem and objectives of the study. It will also provide a briefly explanation the overall structure of this research study report. This chapter will contain five major parts which are:

1.1. Background

Buriganga River is originated from Dhaleshweri and it is referred as one of the most polluted rivers around Dhaka. A significant number of industries has been established on the banks of river, apart from the industrial establishment a substantial amount of domestic waste has been dumping into the river water which dramatically contributed the pollution increase of the river water (Engineering, 2008).

In recent years the condition and quality of river water has changed considerably as a result of excessive pollution from industries around the river, many industries and factories including textile and tannery industries have been deliberately dumping untreated or partially treated effluents into the river water (Engineering, 2008). This has decreased the quality of the river water which has made it impossible for the river to be used for essential purposes such as drinking water or for daily needs.

Nonetheless The fast development of industrialization, the growth of population and communities living the surrounding areas of the river banks and other expansion activities that is going around the Buriganga river largely contributed the worsening situation of the river (Islam et al., 2019).

Moreover, River water has been used for many purposes including transportation, irrigation, drinking and fishing but unfortunately these activities had become an obstacle to maintaining water quality of the river and protecting the biodiversity of the river which has resulted in the river becoming a dumping ground. The use of water for drinking purposes has also disappeared and the prospect of aquatic life has been reduced which has resulted in the decrease of fishing in addition to that dumping plastic waste and small items in river water during travel has not been focused but was one of the main sources of the pollution.

1.2. Problem statement

The quality of Buriganga river water has changed over the last decade as a result of industrial growth, increased solid and liquid waste production, and a variety of river water uses such as transportation, agriculture, and fisheries. Texas was illegally dumping and discharging billions of microplastics, which all contributed to the deterioration of river water, both physically, biologically, and chemically.

Historically Buriganga River was one of the most important rivers in the country which was used by the people in many ways but the growth of the industries including textile and tannery factories has contributed the production of large amount of waste however this significant amount of waste was dumping into the river intentionally, these contaminants was consisted of chemicals and heavy metals that pose a threat to the environment and the quality of river water. As a result, in a short period of time, the river has become one of the most polluted rivers in the country, making it impossible to use the river at all in terms of domestic use. Moreover, there are many studies that point to the deteriorating state of the river, and some of these studies have indicated that in a short period of time the river could become biologically dead (Mowla, 2015)

1.3. justification

Many studies have been conducted to shed light on the deteriorating situation in the Buriganga river water; these studies focused on the impact of domestic waste, untreated industrial effluents, and heavy metals on water quality, both physically, chemically, and biologically; the existing literature highlighted the presence of significant pollution in the Buriganga river water.

However, in this study, we will focus on the status of physiochemical parameters and how the situation has changed since the covid19 pandemic.

1.4. Objectives

In this study, we will focus on three distinct objectives.

- to identify major causes of industrial water pollution in Buriganga river.
- To ensure the health status of society close the river.
- to Determine the industrial contribution products in the river. ⚬ to have look all the types of waste in the river.

1.5. Structure of the report

This research report has five major chapters:

Chapter 1: Introduction

This introduction chapter provides the introductory information of the research study. Those include a discussion about the background, statement of the problem and objectives of the study. It will also provide a briefly explanation the overall structure of this research study report.

Chapter 2: literature review

In this we will broadly discuss the existing literature; it will provide a brief discussion on Analyses of water quality by evaluating the physio-chemical parameters of Buriganga River and Heavy metal contamination.

Chapter 3: Methodology

This chapter provides a ground understanding of research area [study area], sampling technique and the methods and material used to analyze our samples. It will mainly contain four major parts.

Chapter 4: result and discussion

In this chapter we will explain the data analysis result and discussion on the result we found during our study, we will mainly emphasize on the analysis of water quality parameters with accordance of research question and objectives by providing a detailed description of all the parameters that we have analyzed during our study.

Chapter 5: Conclusion and discussion

In this final chapter of this research, we will try to summarize the study report from the literature review, data collection, data analysis, result and discussion. In addition to that we will also substantiate the objectives of the study and finally we will demonstrate the recommendation part

Chapter 2: Literature Review

Buriganga River is one of the most densely populated rivers we that Bangladesh — has plentiful water sources, but these sources are being polluted continuously. Both surface water and groundwater sources are contaminated with different contaminants like toxic trace metals, coliforms as well as other organic and inorganic pollutants. As most of the population uses these water sources, especially groundwater sources which contain an elevated amount of arsenic throughout the country; health risk regarding consuming water is very high. Death due to waterborne diseases is widespread in Bangladesh, particularly among children. Anthropogenic sources such as untreated industrial effluents, improper disposal of domestic waste, agricultural runoffs are the main contributors regarding water pollution. A total water pollution status of this country, as well as the sources of this severe condition, is crucial to evaluate public health risk. For this purpose, we reviewed hundreds of well recognized international and national journals, conference proceedings and other related documents to draw a complete picture of recent water pollution status and its impact on public health; also, the sources of water pollution are identified. In this chapter, we will conduct a chronological review of the existing literature, focusing on two major scenarios:

i. Analyses of water quality by evaluating the physio-chemical parameters of Buriganga river
ii. Heavy metal contamination iii.

In 2009 (Hasan et al., 2009) did a comparative study which they focused in two rural and urban rivers {Buriganga and Panguchiri river}, they analyzed several physiochemical and Biological water quality measures including BOD “biochemical oxygen demand”, COD” chemical oxygen demand”, TDS “total dissolved solids” alkalinity, pH and many other water quality parameters, they did found their initial study that the pH level of buriganga were between “6.92 – 7.52”, they also found that the level of TDS were “789 mg/L” though it may differ due to seasonal disparity but they did compare another studies which conducted in different season, they also found that the EC (electrical conductivity) were between “685.80 to 1093.47”. Moreover, they further analyzed total Hardness and alkalinity which they found respectively “56.68 to 74.79 mg/L” of hardness and “from 67.43 to 159.52 mg/L” of alkalinity level.

In 2011 (Ahmed et al., 2011) published a research paper which they extensively analyzed the physiochemical parameters of industrial effluents {textile and tannery effluents} of two rivers “Buriganga and Karnatoli river” including BOD, COD, TSS, TDS and some heavy metals including Fe, Zn, Cu, Ca, Na, etc. in three different seasons rainy, dry and summer in the years between 2006 – 2007. They did found that the all the parameters they analyzed were different depending on the season. The notable finding that the paper highlighted is that the BOD {biological oxygen demand} was very high in locations that's surrounded by tanneries and textile industries in dry seasons, according to the study the TDS {total dissolved solids} and TSS {total suspended solids} were roughly higher than the standard limit as DoE {department of environment} recommended.

In 2013 (Saifullah et al., 2013) published research that they have done in 2011 in two different seasons wet and dry season they evaluated the status of physio chemical parameters as previous studies, they initially institute that the color of water was different depending on the season, they point out that during wet season the color was "light blown" and "black to black" in dry season.

They figure out that the temperature, pH level, EC, Do and all other parameters was roughly different depending on the season In 2015 (Ahammed et al., 2015) had worked on water quality parameters in two different seasons the parameters they studied were included BOD, COD, Do, TDS, TURBIDITY and some heavy metals including nitrate and phosphate. They found that the Do were almost below the standard limit they point out that in some location the Do was ZERO which is an alarming. In addition to that they highlighted that the COD and BOD in some location were respectively higher than the standard limit.

In 2016 (Md. Galal Uddin, Md. Moniruzzaman, Muhammad Al-Amin Hoque & Md. Abu Hasan and Mala Khan, 2016) had published a comprehensive research paper which they had worked on two different seasons in between 2012-2013. They analyzed the same physiochemical parameters as previous studies, they investigated nine physiochemical parameters, the notable findings on their research is that they did found the pH level were more than 7 in both seasons which indicating that the water was considerably alkaline the paper also noted that the dissolved oxygen {Do] was higher in wet season compare to dry season moreover the paper underlined the higher number of COD compare to the BOD in both seasons which can be defined as an alarming standard.

In 2017 (Nath et al., 2017) did research which they analyzed on the level of pH, TDS and trace elements in buriganga river. Their core focus was to determine the trace elements and their effect
on both human health and the quality of the water, in addition to that they did measure pH and TDS parameters, the paper shows that pH level and TDS were below the required standard as world health organization and department of environment of people's republic of Bangladesh recommended.

In 2017 (Abdullah-Al-Mamun et al., 2017) had worked on the effect of climate on water quality, the paper focused on climate induced impact but they pointed out several physiochemical parameters including Do {dissolved oxygen}, BOD {biological oxygen demand} and COD {chemical oxygen demand} and some heavy metal concentration including nitrate and phosphate. They used a secondary data as their primary sources however they highlighted that the dissolved oxygen were high during wet season and relatively very low during dry season, they also pointed that both BOD and COD were respectively high and above the standard limit.

The same year 2017 (Akbor et al., 2017) had worked on the status of physiochemical parameters of Buriganga river they analyzed several parameters including TDS, TSS, BOD, COD etc. the study find that the value of Do {dissolved oxygen} in most sample points were below the required limit which indicating that there is a significant low amount of Do {dissolved oxygen}. The study also highlighted that EC {electrical conductivity} maximum and minimum values were between "1208µS/cm - 1171 µS/cm" according to their findings, this indicates that the EC level is higher than the recommended value. The study also shown that the level of pH were between "6.82 -7.8" according to the study but this can be said the water was roughly alkaline. COD and BOD were roughly above the standard limit more over the TDS and TSS values were similarly, above the recommended standard.

In 2018 (WATER QUALITY ASSESSMENT OF THE RIVER BURIGANGA, BANGLADESH Fatema, K., M. Begum, M. Al Zahid and M. E. Hossain 1 Department of Zoology, University of Dhaka, Dhaka-1000, Bangladesh; 1 Department of Soil, Water and Environment, University of Dhaka, Dhaka-1, 2018) analyzed the status of water quality by assessing the physiochemical parameters in two different seasons wet and dry season, the parameters they have studied include Do {dissolved oxygen}, temperature, EC {electrical conductivity}, pH together with some heavy metals phosphate, Fe {iron}, Pb {lead} and Cd {Cadmium}. The study found that temperature of all sampling location were between "22.80 31.40°C" though it was varies depending on the season this indicates a positive result as per DoE {Department of environment} recommended. The study highlighted the low amount of Dissolved oxygen, the study also pointed out that the mean pH level were between "7.61- 8.97" which is showing that the water is slightly alkaline. Regarding the heavy metal concentration, the study found that all the measured metals were either above or below the acceptable standards.

In 2018 (Engineering, 2018) studied several physio chemical parameters to evaluate the water quality of Buriganga river, they selected four different locations where they collected from their samples. The key physiochemical parameters they analyzed were included pH level, temperature and biological oxygen demand {BOD}, turbidity and alkalinity of Buriganga water, they also evaluated iron and chloride. The study result shown that the pH level of selected areas were between "6.8 to 7.3" which can be considered as a neutral compared to previous studies, the study similarly highlighted that the turbidity level was very high in some location in addition to that the study underlined iron level of selected areas was not exceed the permissible standard however the result of chloride was not positive as it was above the acceptable limit.

In 2019 (Islam et al., 2019) had worked on the status of the water quality of Buriganga river by analyzing various physiochemical parameters and some heavy metals, the study shown that the pH level was quite neutral as it is average value was "7.31", the study argues the presence of significant amount of waste water discharge in Buriganga river from industries due to the higher standard of EC {electrical conductivity}. The study also noted that the level of Ions {cation and anion} were both in acceptable limit. In 2020 (Saila, 2020) assed the pollution status of Buriganga river by evaluating physiochemical parameters including total hardness, BOD, COD, Do and alkalinity they also analyzed ammonia and nitrogen, they collected three samples which they were later analyzed. The study result shown that dissolved oxygen level were very low which indicating the presence of unchartered pollution similarly the pH level, electrical conductivity, biological oxygen demand and chemical oxygen demand were respectively either below or above the permissible limit. The study also emphasized the high level of nitrogen which has it is adverse effect on both human health and agricultural activities.

In 2016 (Mohiuddin et al., 2016) performed research which they evaluated the degree of heavy metal contamination including "Cr, Pb, Cd, Ni, Zn, Cu, F", they collected samples from 14 different locations which they analyzed by using various chemical based techniques and instrumental tools, the notable findings which the study highlighted was the huge variation of pH level, this can be as a result of presence of unwanted chemicals, they further noted presence of high chromium "173.3" the paper reflected this as result of untreated industrial effluents comes from both textile and tannery industries, they also emphasized that the Pb "lead", zinc and cu "copper" level were tremendous higher compare to the previous studies.

In 2019 (Hossain, 2019) carried out a comprehensive study which they examined status of heavy metals in Buriganga river, after analyzing a samples from various sites from the river the key finding of research was that a substantive amount of heavy metal contamination was found in the river's sediments compared to river water though their initial was to analyze sediments. While most of these researches had focused on the status of physiochemical parameters of Buriganga River and heavy metal contamination by analyzing exclusively some parameters this research will critically analyze approximately 19 water parameters we will identify their current status while addressing weather they met the standard limits set by WHO [world health organization] and DoE [Department of environment].

Chapter 3: Methodology

This chapter provides a ground understanding of research area [study area], sampling technique and the methods and material used to analyze our samples. It will mainly contain four major parts.

Study area

The Buriganga River one of the most important rivers in Dhaka (the capital city of Bangladesh) it flows past the southwest outskirts of Dhaka city. Its average depth is 7.6 meters (25 ft.) and its maximum depth is 18 meters {58 ft.} (Moniruzzaman et al., 1970).

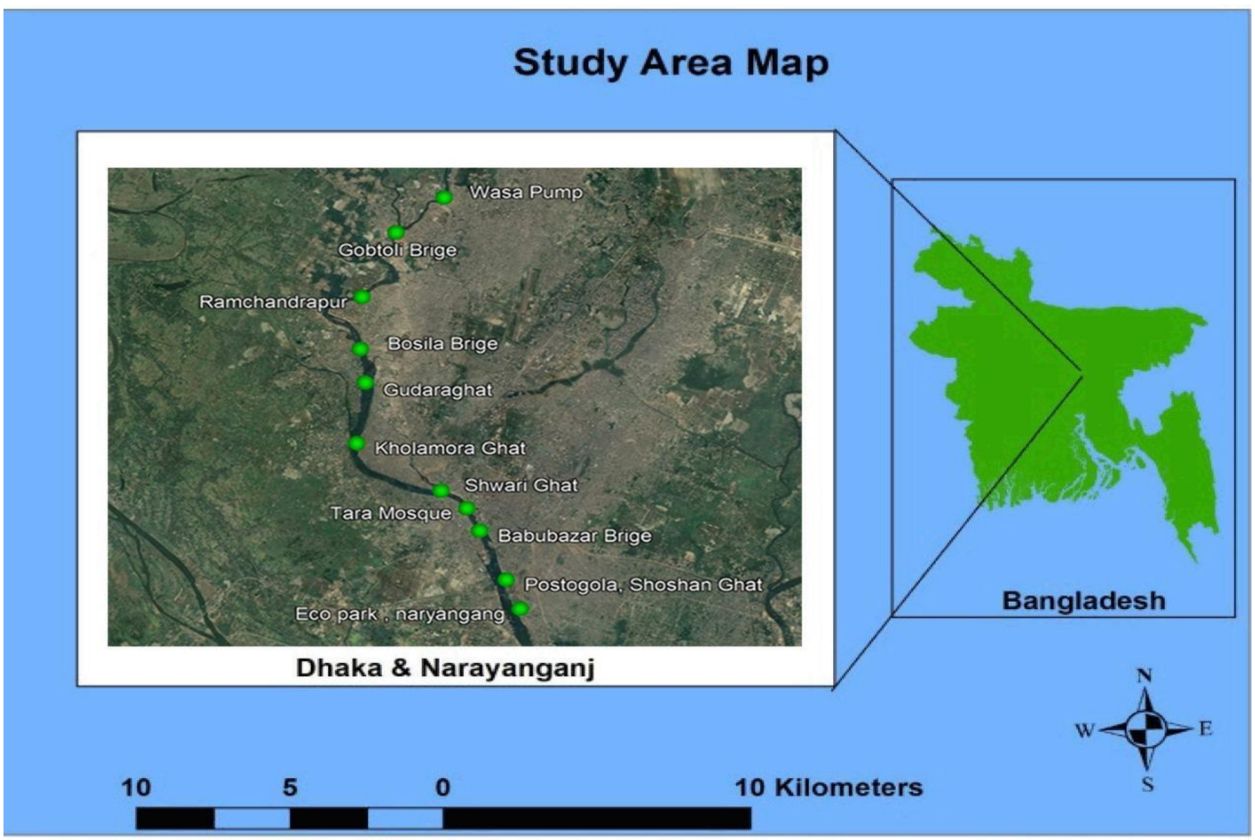

Figure 3.1 (Map of study area}

Sample collection

A study area of 18 km was covered, 11 samples of water were collected, and the distance was calculated. A study area of 18 km was covered, 11 samples of water were collected, and the distance between each two sample point locations was 2 km; we chose this 2 km distance to cover the most area possible. To avoid any unwanted contamination, plastic bottles were carefully cleaned with distilled water**.** Due to the covid19 pandemic situation we tried to collect all samples in one day while maintaining all necessary precautions and covid19 guidelines by ensuring wearing mask, gloves and maintaining social distancing**.**

Sample No.	Sample locations name	Latitude	Longitude
01.	Wasa Pump	23°48'3.44"N	90°20'34.06"E
02.	Gobtoli Brige	23°47'2.23"N	90°20'7.78"E
03.	Ramchandrapur	23°45'34.69"N	90°20'14.17"E
04.	Bosila Brige	23°44'36.43"N	90°20'44.93"E
05.	Gudaraghat	23°44'1.77"N	90°21'10.62"E
06.	Kholamora ghat	23°42'51.19"N	90°21'39.67"E
07.	Shwari Gha	23°42'38.19"N	90°23'32.60"E
08.	Tara Mosque	23°42'30.99"N	90°24'8.86"E
09.	Babubazar Brige	23°42'12.44"N	90°24'35.32"E
10.	Shoshan Ghat Postogola	23°41'31.28"N	90°25'31.27"E
11.	Eco Park, naryangang	23°41'6.04"N	90°26'2.68"E

Table 3.1 (sample collection sites)   Assessment of physio – chemical parameters pH

pH is a scale used to determine the acidity and basicity of any solution. Many processes including physiochemical and biochemical can affect the scale of pH (Boman et al., 2012).

To measure the pH level of our selected study area we used pH meter.

Apparatus we required to measure the pH level

I. Two glass beakers cleaned by distilled water [one for sample water and one for cleaning the pH reader after it is used]
II. Sample water of 50 ml
III. pH meter

to get accurate data we put the pH level in the breaker of sample water carefully, we waited until the pH meter stabilized by itself then we recorded the result.\

EC [electrical conductivity]

Electrical conductivity of water can be defined as the capacity of water to conduct electrical current of a given solution (Boman et al., 2012). The presence of inorganic substance in the water can have impact on the conductivity of the water. To detect the electrical conductivity of our selected areas we used EC meter which his model was HI98304.

Apparatus we required to measure electrical conductivity of the sample water.

I. Two glass **breakers** cleaned with distilled water [one for sample water and one for cleaning the EC reader after it is used]
II. Sample water of 50 ml
III. EC meter

We carefully put the EC meter in the sample water, we wait till the EC meter stabilize itself then we recorded the result based on EC meter.

TDS [total dissolved solids]

Total dissolved solids (TDS) can be described as all inorganic and organic elements that comprised in a specific water (Boman et al., 2012). In order to detect the TDS [total dissolved solids] level of our sample water we used this apparatus.

I. Two glass **breakers** cleaned with distilled water
II. Sample water of 50 ml
III. TDS meter We recorded the result based on TDS meter (HI) reading.

Acidity

Acidity can be defined as the degree or amount of acid in given water. In our analyses we used one re-agents, one indicator and a known concentration of sodium hydro oxide to detect the acidity level of our sample water, the procedure was as following.

Re-agent: 2 drops of phenolphthalein.
Indicator: 2 drops of methyl orange

A known concentration of 0.02N sodium hydro oxide [NaOH].

One conical flask, two glass beakers, 250ml burette cleaned by distilled water and two dropper, one pipette filter also have been used.

We put sample water of 25ml into beaker, we added two drop of phenolphthalein, 2 drops of methyl orange and 0.02 of sodium hydro oxide then mixed it carefully until the color changed from yellow to pink. We recorded from the initial to final point where the color is fully changed.

After finishing the experiments, we used the following equation to calculate the Acidity in the water samples:

Acidity= $A * N * 50{,}000 \div vol\ of\ sample$

Where

A= volume of NaoH.
N= normality of NaoH.

Alkalinity

Alkalinity is mainly determined by the existence of bicarbonates carbonates (CO_3 -), and hydroxides (OH^-) in water. Alkalinity is a measure of the capacity of water to neutralize acids (Boman et al., 2012). In our analyses we used one re-agents, one indicator and a known concentration of hydrochloric acid to detect the alkalinity level of our sample water, the procedure was as following.

Re-agent: 2 drops of phenolphthalein.
Indicator: 2 drops of methyl red

A known concentration of 0.02N hydrochloric acid [HCL].

We put sample water of 25ml into beaker, we added two drop of phenolphthalein, 2 drops of methyl red and 0.02 of hydrochloric acid then mixed it carefully until the color changed to pinl. We recorded from the initial to final point where the color is fully changed.
After finishing the experiments, we used the following equation to calculate the Acidity in the water samples:

Alkalinity= $V * 1000 \div vol\ of\ sample$

Where V= volume of acid used

Total hardness

In general water hardness can be described the amount of dissolved calcium and magnesium that is available in water in other words water can be refer hard when the amount of minerals in the water is approximately high (Boman et al., 2012). To measure the total hardness of the sample water we used re-agent, indicator, sodium sulfate, buffer solution, and known concentration of EDTA.

Re-agent: 2 drops of phenolphthalein.

Indicator: 1 drop of EBTA.

Solution: 0.1 of sodium sulfate [Na_2So_4]/buffer solution.

A known concentration of 0.01 of EBTA.

We put sample water of 25ml into beaker, we added two drop of phenolphthalein we then we added to one drop of EBTA then mixed it again then we added 0.01 of sodium sulfate/ buffer solution then we mixed it again finally recorded when the color changed from purple to blue.

After finishing the experiments, we used the following equation to calculate the Acidity in the water samples:
Total hardness= $vol\ of\ EDTA * N * 100 * 1000 \div vol\ of\ sample$

Where
N= normality of EDTA

Calcium hardness

Calcium hardness is the amount of calcium and magnesium that are dissolved in water. The terms "hard water", "soft water" and overall "total hardness" refer to the level of calcium hardness and other minerals that are present or available in a given water (Zieneldien, 2018). Hardness of water can be referred when the available dissolved minerals is high while soft water is referred when the amount minerals that are available in the water is low. To measure the calcium hardness of the sample water we used indicator, sodium hydroxide, known concentration of EDTA.

Indicator: 1 drop of murex ide.

Solution: 2ml of sodium hydroxide [NaoH].

A known concentration of 0.01 of EBTA.

We put sample water of 25ml into beaker, we added one drop of murex ide, we mixed it then we added to 2ml of sodium hydroxide then mixed it again then we added a known concentration of EDTA O.O1N then we mixed it again finally recorded when the color changed from pink to light burble.

After finishing the experiments, we used the following equation to calculate the Acidity in the water samples:

Calcium hardness= $vol\ of\ EDTA * N * 50 * 1000 \div vol\ of\ sample$

Where

N=normality of EDTA

Free carbon dioxide [co2]

Free carbon dioxide is carbon dioxide that available in the water. It is present in water in the form of a dissolved gas. To detect the free carbon dioxide that is available in the sample water we used a re-agent of phenolphthalein and a known concentration of sodium hydroxide.

Re-agent: 2 drop of phenolphthalein.

A known concentration of sodium hydroxide o.o5N.

We mixed the sample water with 2 drop of phenolphthalein if the color change as the result of phenolphthalein reaction then we recognize that the sample has zero free carbon dioxide but if the color does not change as a result of phenolphthalein reaction we understand the presence of free carbon dioxide, we continued our experiment by adding a known concentration of sodium hydroxide. Finally we recorded the initial and final points.

Free co2= $V * N * 44000 \div vol\ of\ sample$

Where

V= volume of NaoH.

N= normality of NaoH.

Physical observation of study area

Apart from our data collection [sample collection] we went on a field trip to the study area to find out and observe the general situation, we observed social interaction between the river and the communities living the surrounding areas, industrial activity and movement of people using river water for transportation. During the observation, we took general pictures using our phones and also we used note to gather information that we considered important or that may help us. However unfortunately we did not get much opportunity to talk to local people because of covid19 pandemic but we managed to precisely observe the situation through both physical and visual observation.

Visual observation of study area

The development of technology have helped human to conceptualize and understand how they interact their environment and this has encouraged us to develop visual observation that reflects how the river has changed over the last five years. Though our main objective was to analyze the

water parameters we realized the importance of providing an effective observation in our research. With this in mind we have used the "sentimental hub" website which is a free platform that can help you to develop a visual observation in any area based on your interest by using all the available land sets, in our case due to the lack of effective physical observation because of the pandemic we observe our study area [Buriganga river] by visual analyses in addition to that this has also helped us and made it easier for us to find out the general situation and how the landscape and the interaction of the surrounding communities have changed over the last five years as the evidence showing. We used the theme of "monitoring Earth from space" in L2A in true color based on BANDS 4,3,2,1 we have focused on in the last 5 years by building timelapse from 2017 to 2021 as shown the following time-lapse pictures.

Chapter 4: Result and Discussion

In this chapter we will explain the data analysis result and discussion on the result we found during our study, we will mainly emphasize on the analysis of water quality parameters with accordance of research question and objectives by providing a detailed description of all the parameters that we have analyzed during our study.

4.1 Study finding

In this section, we tried to demonstrate all our findings and results that we examined from the beginning of our research to the end of our selected study area. We tried to concentrate the status of pH, EC, TDS, Alkalinity, Acidity, Total hardness, Calcium hardness, Free Co2, Dissolved oxygen, Magnesium hardness, BOD, COD and TSS and the correlation between these parameters.

4.1.1 pH

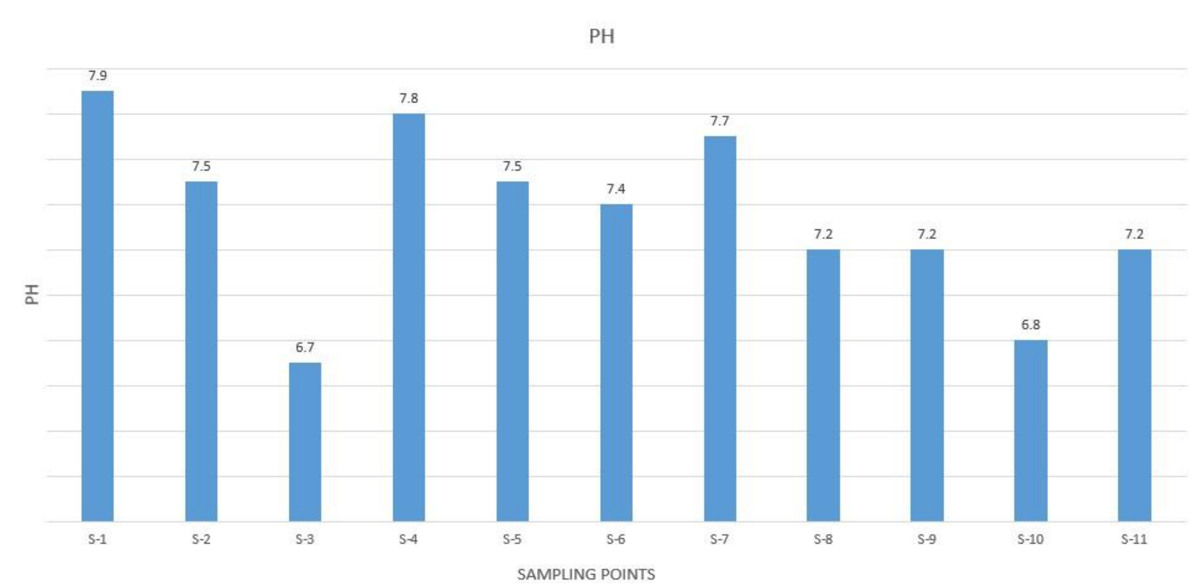

Figure 4.1.1 (status of pH of buriganga river water)

The pH is important indicator of the quality of water, in our analyses we recorded the highest pH level in sample 1 were the pH was lowest in sample 3, this demonstrate that the pH level of sample 4 was quietly acidic. As we observed in the area, we found that due to the presence of industrial effluents the pH of sample 3 was low compared to the all-other samples.

However, the standard of pH level in all samples was in permissible limit, there was no substantial dissimilarity between all 11 sample locations.

4.1.2 EC (electrical conductivity)

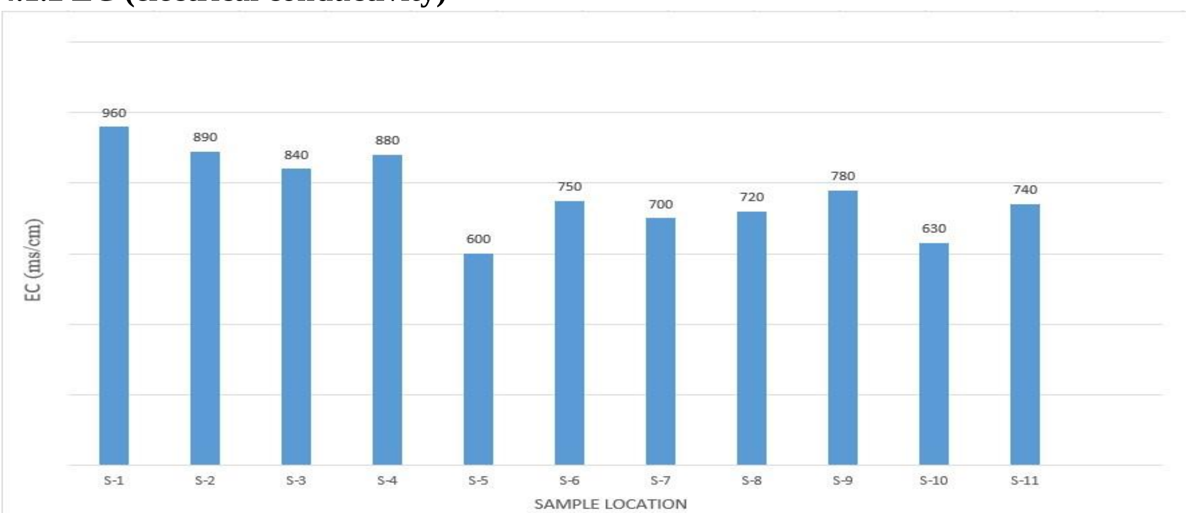

Figure 4.1.2 (status of EC in buriganga river water).

EC is an important indicator of the capacity of water in conducting an electrical current. In our analyses the highest values was recorded in sample 1 were the lowest was recorded in sample 5. This demonstrate that the presence of impurities in sample locations.

4.1.3 TDS (total dissolved solid)

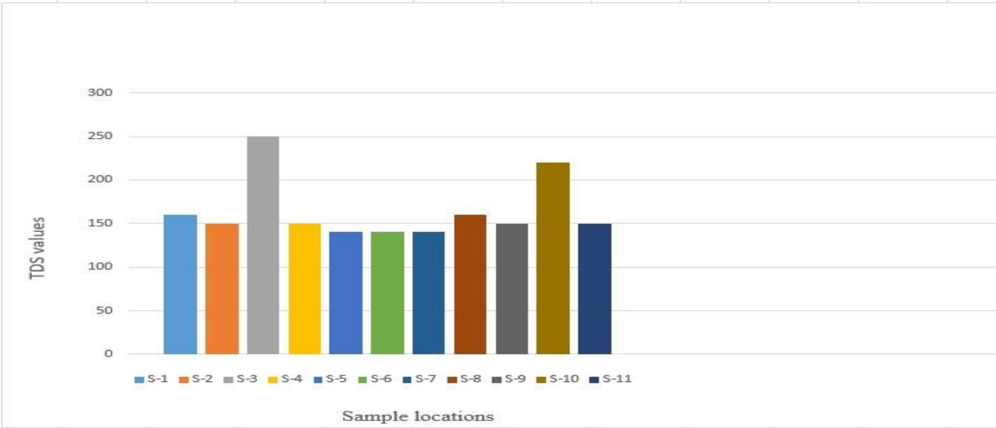

Figure 4.1.3 (status of TDS in Buriganga river water)

Total dissolved solids can be described as the amount of solids that are present in a given water (Md. Galal Uddin, Md. Moniruzzaman, Muhammad Al-Amin Hoque and Md. Abu Hasan and Mala Khan 2016). In our analyses we observed that the highest level of total dissolved solids was found in sample 3 and the lowest was found in sample 5 and sample 10 respectively. The result of all sample analysis shown a significant presence of TDS in Buriganga river water however except from sample 3, the rest shown that the TDS level was within the permissible limit set by department of environment of peoples republic of Bangladesh which is 100mg/l (Tareq et al. 2013). Nonetheless the presence of this huge amount of TDS is because of the intentional waste dumping from households and industrial activity.

4.1.4 Do (Dissolved Oxygen)

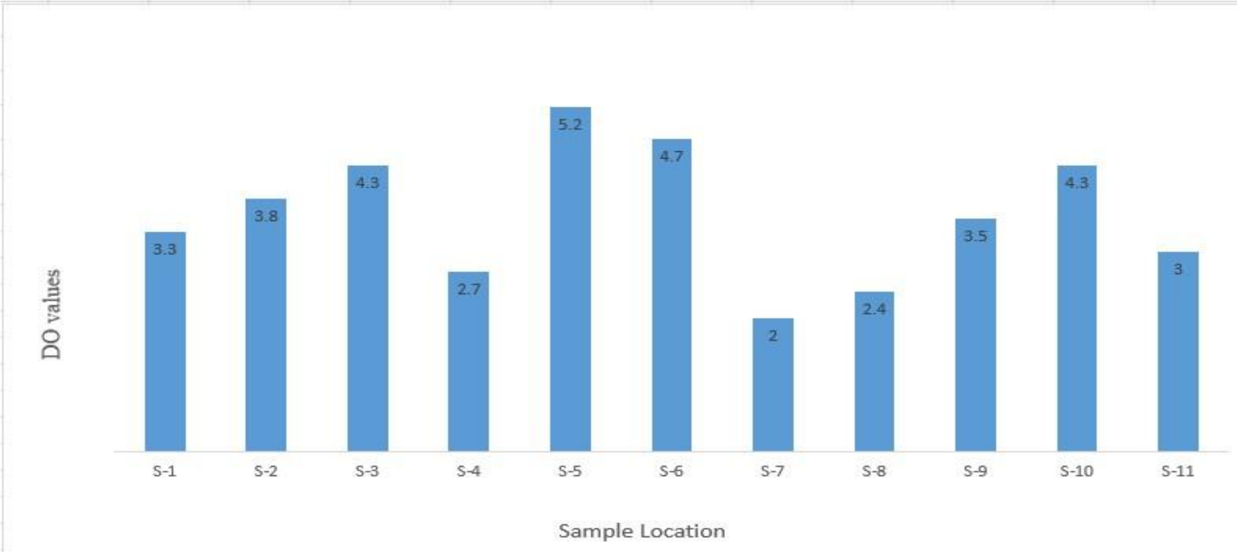

Figure 4.1.4 (status of dissolved oxygen in buriganga river water)

Dissolved oxygen is an important indicator of the quality of suitable water. In our assessment we found that the highest level of Do was found in sample 5 were the lowest was found in sample 7. According to the guideline set by DoE (department of environment) the level of Do has to be 5mg/l for the ideal maintenance of the health of aquatic species in water (Md. Galal Uddin, Md. Moniruzzaman, Muhammad Al-Amin Hoque and Md. Abu Hasan and Mala Khan 2016) however, any values less than five can be referred as an alarming. Our study highlighted that the do value was significantly low in all 11 sample analyses.

4.1.5 Alkalinity

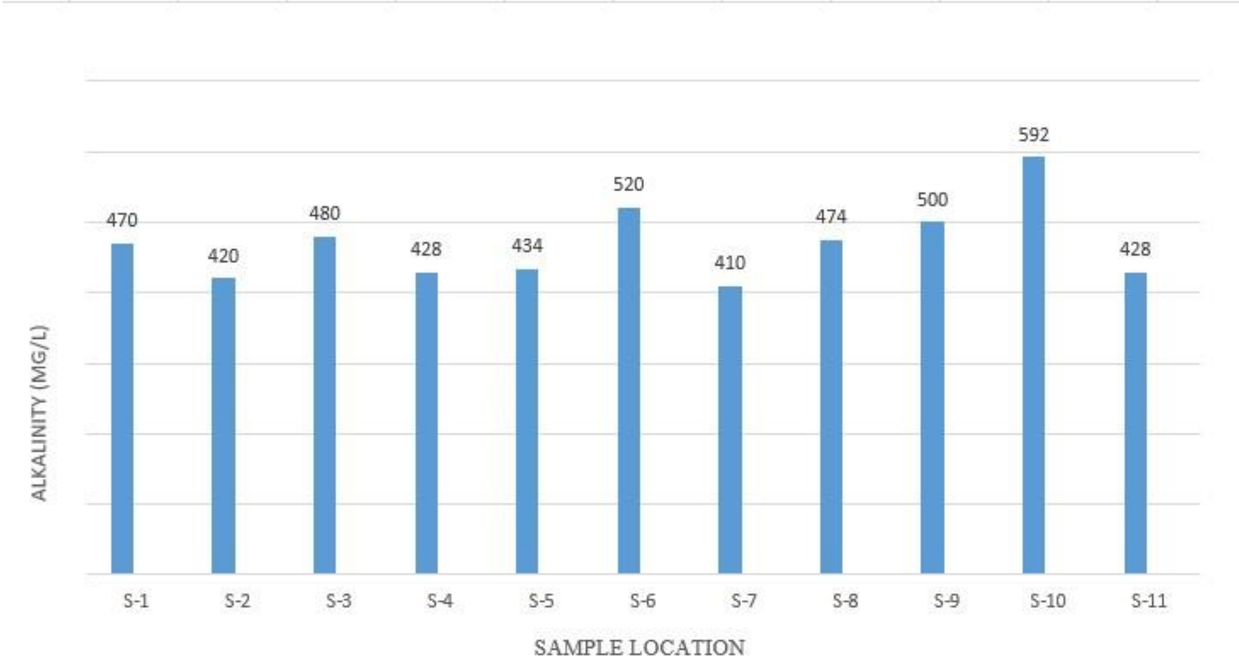

Figure 4.1.5 (status of alkalinity in buriganga river water)

In general water can be highly alkaline due to the presence of weak acid and significant amount of base (Islam and Majumder 2020). After analyses of 11 water samples collected from our study area using titration method the highest alkaline water was found in sample 10 and the lowest was found in sample 7. The study highlighted that the alkalinity level of Buriganga river is considerably high and beyond the standard limit set by WHO (world health organization). After critical evaluation we concluded that the alkalinity is high because of the unstable changes of pH which can directly influence the status of alkalinity in water. Moreover the dumping of sewage.

from households as it is contained chemicals from cleaning agents in addition to that the presence of untreated industrial effluents has contributed the increase of alkalinity level in Buriganga river water.

4.1.6 Acidity

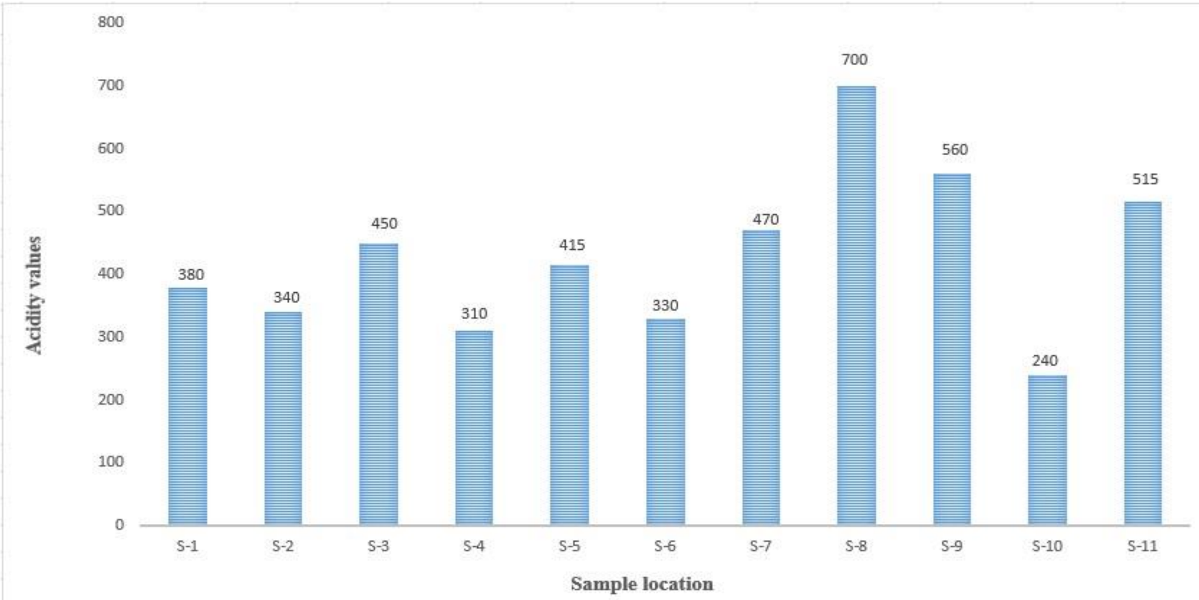

Figure 4.1.6 (status of acidity in Buriganga river water)

Acidity can be described as the ability of water to neutralize bases. We analyzed the level of acidity of 11 samples collected from Buriganga river water by using titration method, the result of our analyses shows that the highest value was found in sample 8 and lowest value was found in sample 9. This highlighted that the acidity level was substantially high in all sample location which indicating the presence of highly contaminated water.

4.1.7 Total hardness

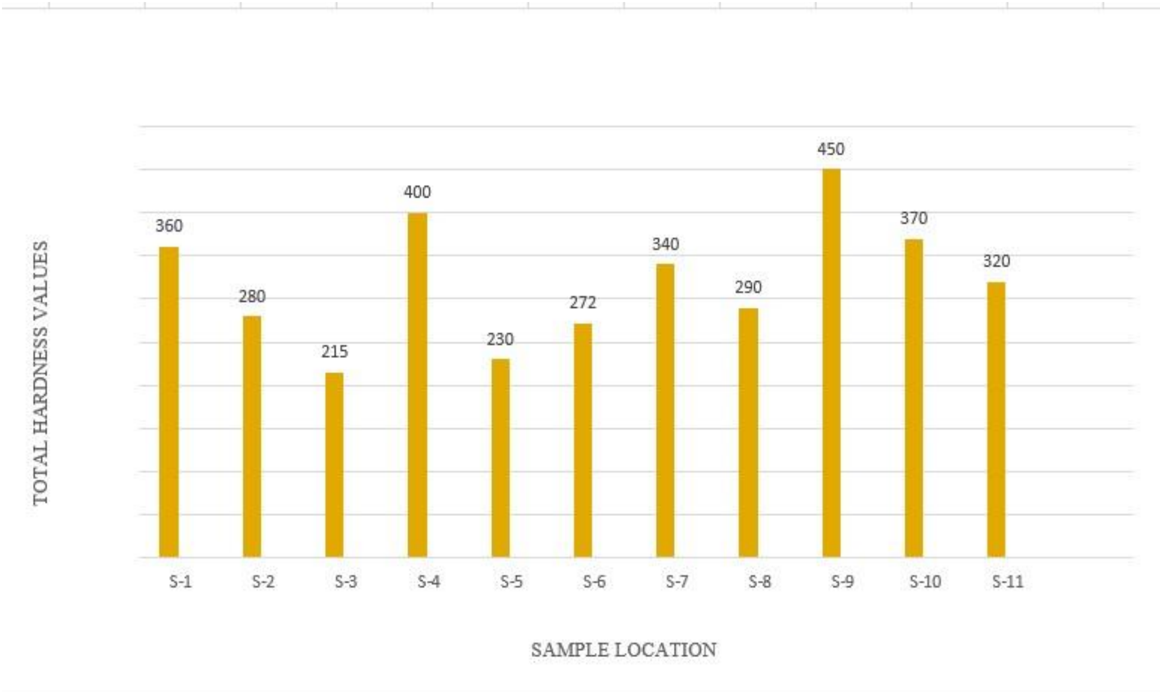

Figure 4.1.7 (status of total hardness in buriganga river water)

Water hardness can be described the ability of water to react soap in other word water hardness is the amount of minerals especially calcium and magnesium that are available in water. Hard water contains significant amount of dissolved minerals while soft water has less dissolved minerals (Takahashi and Imaizumi 1988). In our study we found the highest value in sample 9 and the lowest value was found in sample 3.

4.1.8 Free carbon dioxide

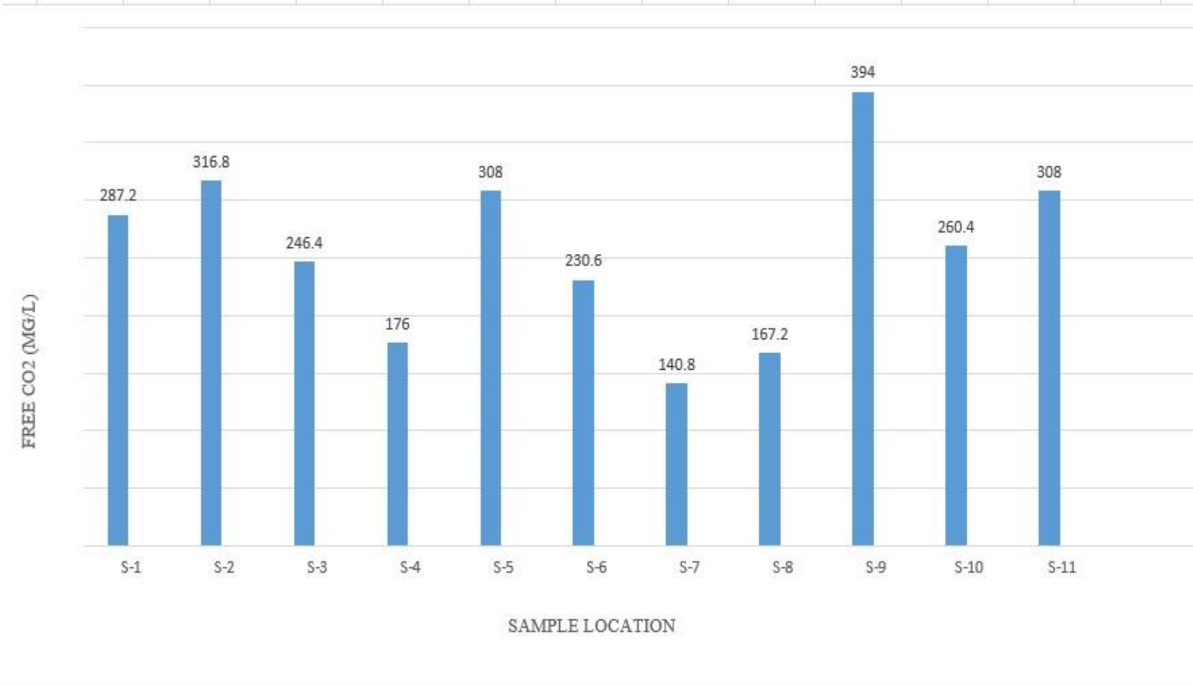

Figure 4.1.8 (status of free carbon dioxide in buriganga river water)

Carbon dioxide can be found in water as a form of dissolved gases. In our study we examined free carbon dioxide using titration method. The highest value of free carbon dioxide was found in sample 9 and the lowest was found in sample 7.

4.1.9 Calcium Hardness

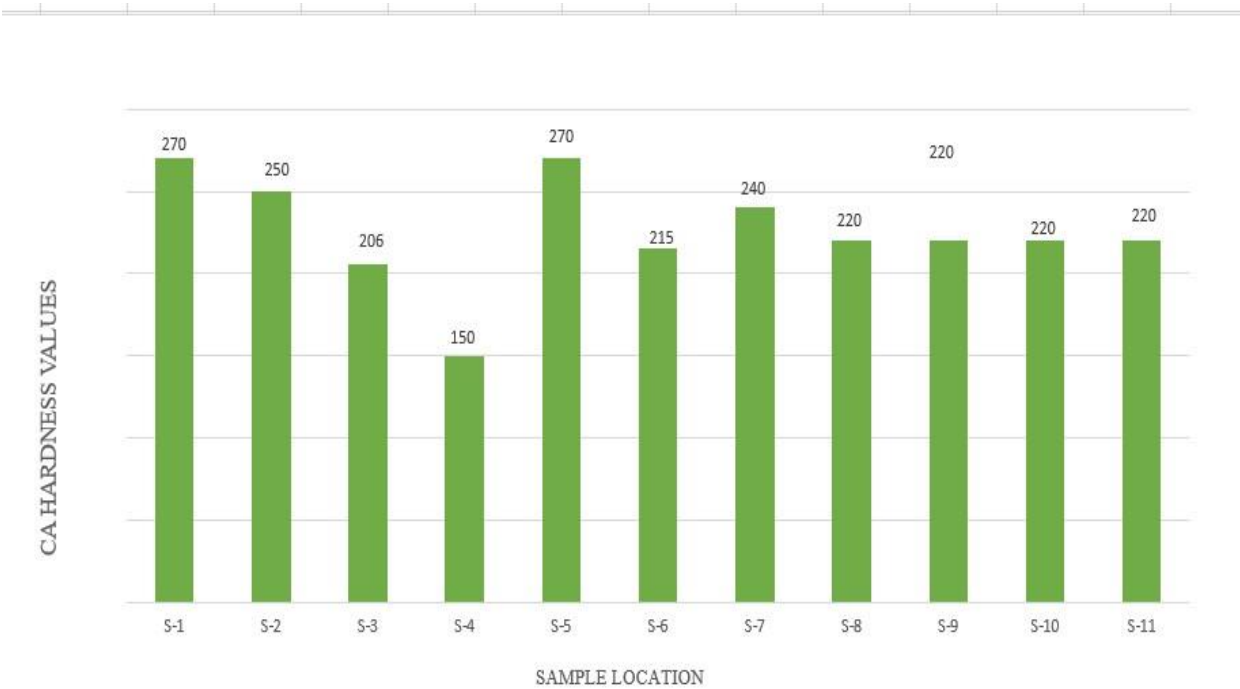

Figure 4.1.9 (status of calcium Hardness in Buriganga river water)

11 sample water was analyzed to detect the calcium hardness of the study area, it is noteworthy that the highest was found on sample 1 while the lowest value was found on sample 4.

10. Magnesium Hardness

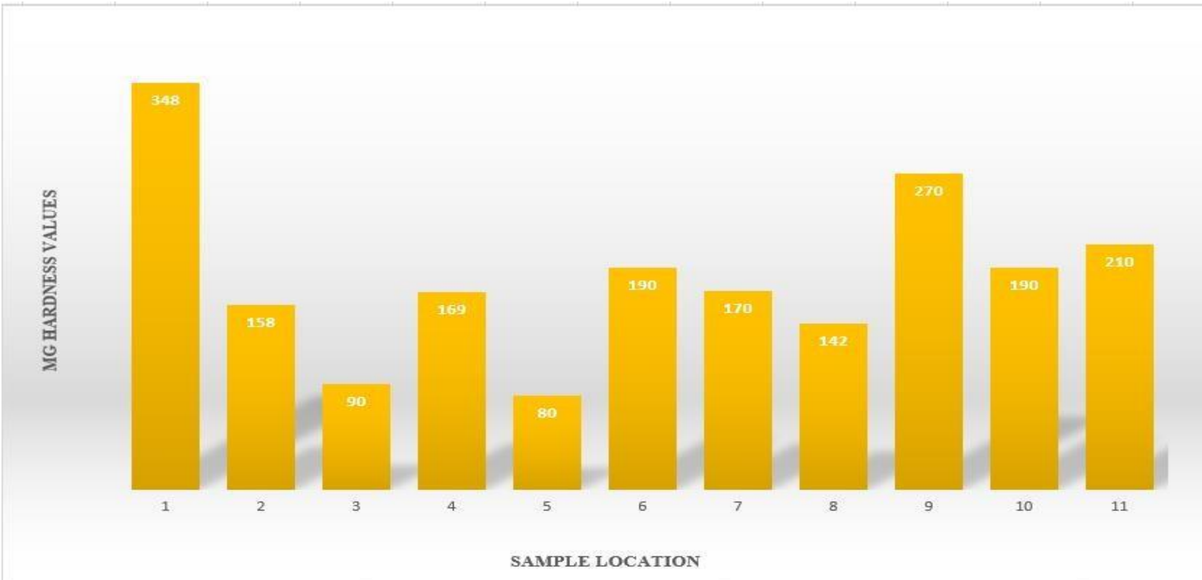

Figure 4.1.10 (status of Magnesium Hardness in Buriganga river water)

Due to relation between total hardness, calcium hardness and magnesium hardness we have analyzed the value of magnesium hardness by calculation.

4.2 Correlation between the analyzed parameters

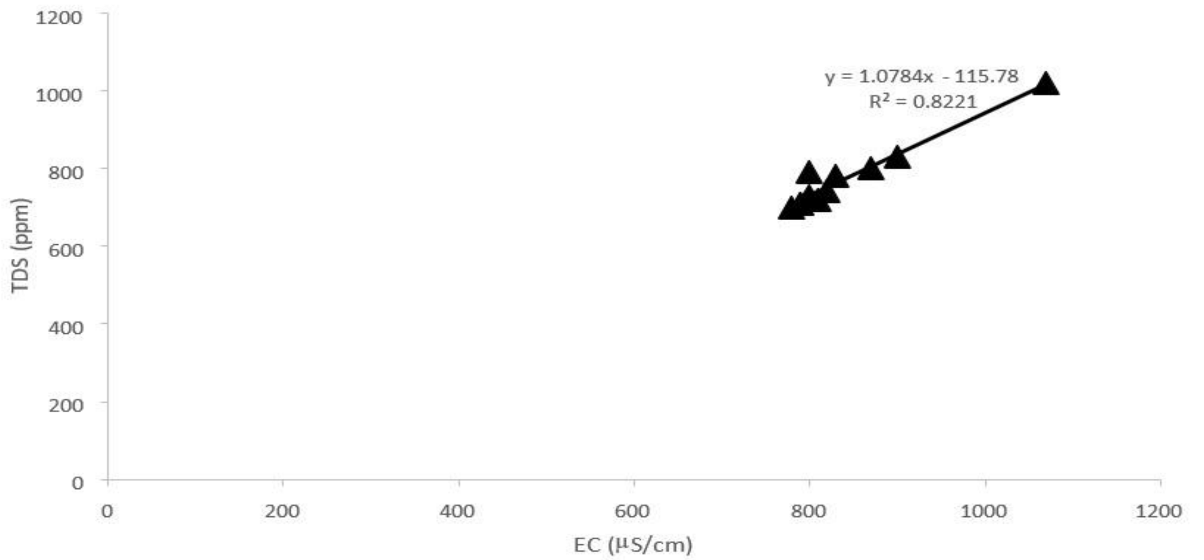

Figure 4.2.1 (correlation between TDS and EC)

In our analyses our result shown a correlation between TDS and EC of the sample waters which signifies that the value of TDS is increasing with the increase of EC value, which is a positive relationship where the value of R is = 0.906697, representing (strong positive relationship) while regression equation is y = 1.0784x – 115.78

4.2.2 Correlation between pH and Do

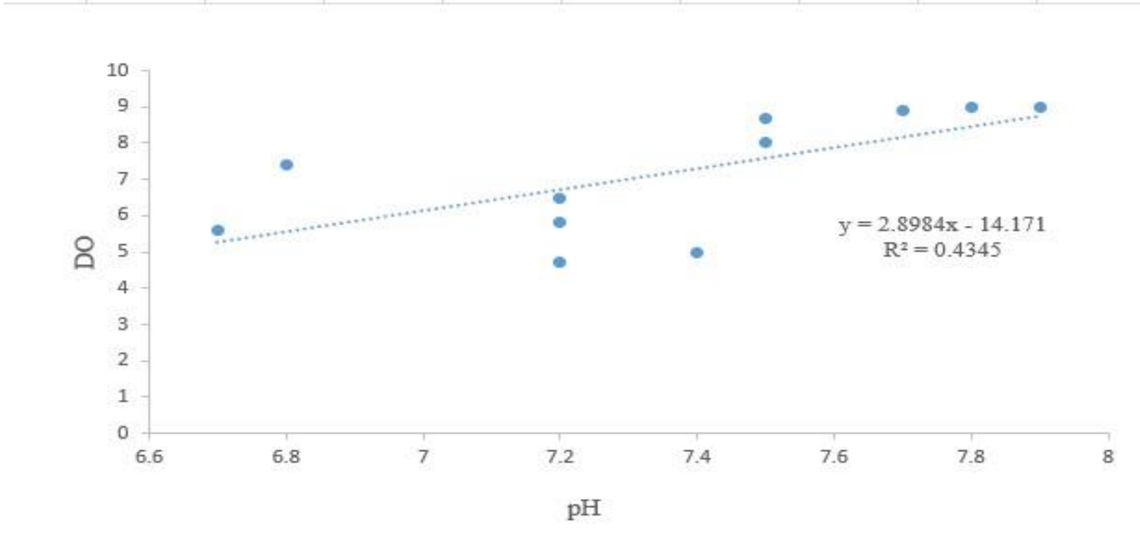

Figure 4.2.2 (correlation between pH and Do)

In our analyses our result shown a correlation between pH and Do of the sample waters which signifies that the value of pH is increasing with the increase of Do value, which is a positive relationship where the value of R is = 0.659166139, representing (strong positive relationship) while regression equation is y = 2.8984 x – 14.171.

4.2.4 Correlation between Ph and TDS

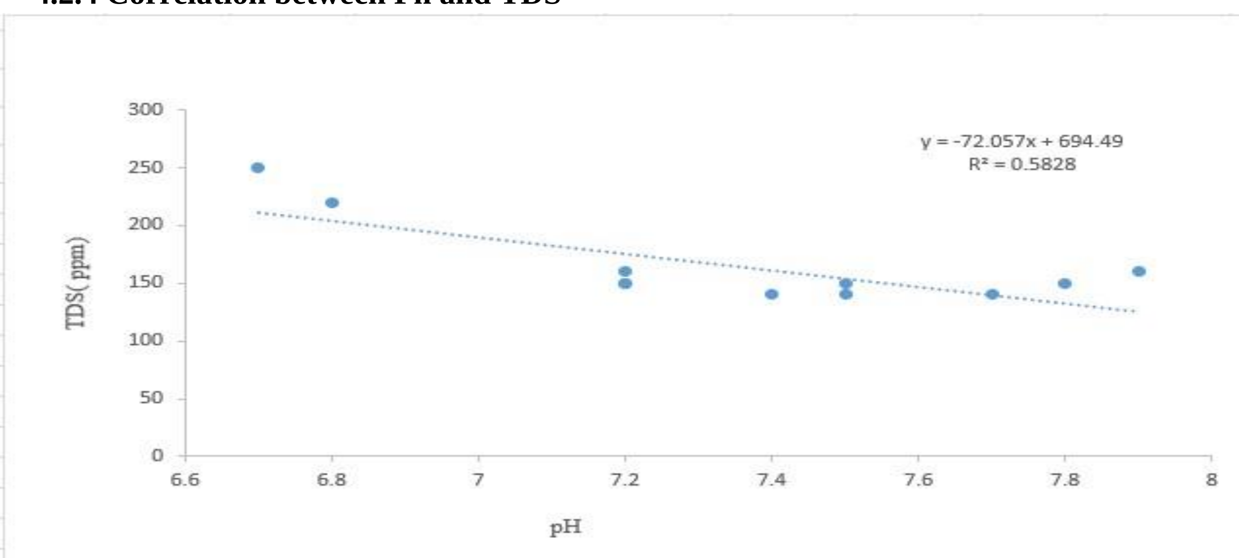

Figure 4.2.4 (correlation between Ph and TDS)

In our analyses our result shown a correlation between pH and TDS of the sample waters which signifies that the value of pH is increasing with the increase of TDS value, which is a positive relationship where the value of R is = 0.76341338, representing (strong positive relationship) while regression equation is y = -72.057x +694.49

4.2.4 Correlation between FREE CO2 (MG/L) and Ca Hardness

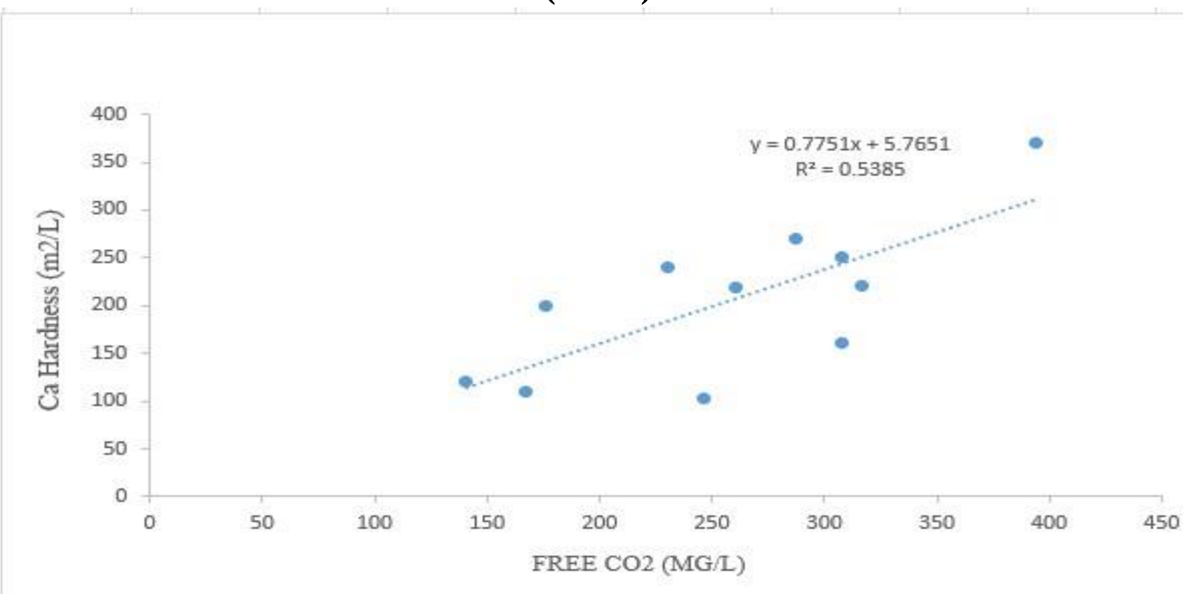

Figure 4.2.4 (correlation between FREE CO2 (MG/L) and Ca Hardness (m2/L)

Our analyses shown another correlation between Free CO2 (MG/L) and Ca Hardness (m2/L) of the sample waters which signifies that the increasing value of FREE CO2 (MG/L) has an impact on Total Ca Hardness, we described this correlation as a (strong correlation) where the value of R= 733825592, while regression equation is y = 0.7751 x + 5.7651.

4.2.5. Correlation between Mg hardness and Total hardness

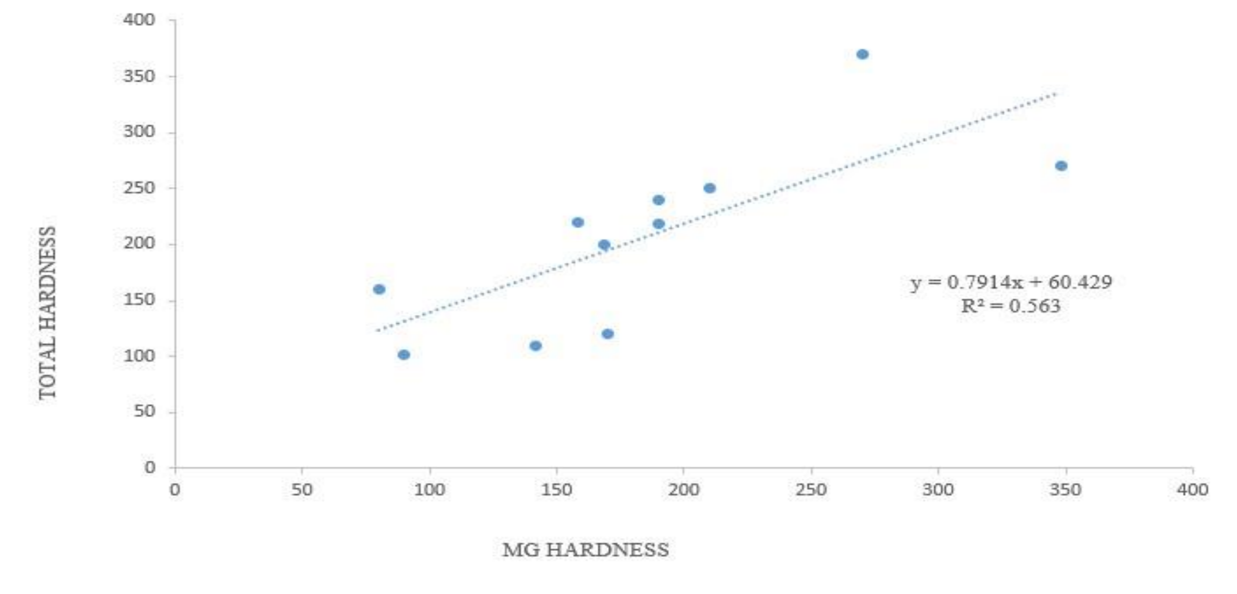

Figure 4.2.5(correlation between mg hardness and total hardness)

Our analyses shown another correlation between Magnesium hardness and Total hardness of the sample waters which signifies that the increasing value of Mg has an impact on Total hardness, we described this correlation as a (strong correlation) where the value of R= 0.750333259, while regression equation is y = 0.7914x + 260.429.

Chapter 5: Conclusion and Recommendation

I will attempt to summarize in this final chapter of this research study report from the literature review, data collection, data analysis, result and discussion. In addition to that we will also substantiate the objectives of the study and finally we will demonstrate the recommendation part.

5.1. Recommendation

The Buriganga River's impact on industrial water pollution has recently increased dramatically, resulting in a number of issues, including the risk of drinking contaminated river water and fishing disruption, both of which have harmed the livelihoods of those who live in the area. Furthermore, the river is in danger of becoming completely biologically dead, which would have disastrous consequences for the river's environment and biodiversity. To protect the river, which is critical, we suggest the following steps that can assist us in saving the Buriganga River.

The government and other relevant authorities must develop policies, rules, and regulations that:

- Control unauthorized vessels from industries along the river. ○ Set specific chemical standards and limits for the textile and tannery industries.
- Monitor contaminated water from textile and tannery factories and ensure that initial and secondary waste water treatment is performed before disposal.
- Control unauthorized waste disposal from textile and tannery industries
- Have look the release of hazardous chemicals and compounds into water, rendering it unfit for drinking and other uses. ○ enhance the quality and safety of river water
- Examine the previous policies and regulations established by the DoE (Department of the Environment).

- Control the number of industries surround the river to reduce the waste contribution of water river.

5.2. Conclusion

According to our study report, some physiochemical parameters of the Buriganga river exceeded the limited standard set by WHO (World Health Organization) and DoE (Department of Environment) for healthy and pollution-free water. The study found that dissolved oxygen was significantly law in some locations. The study also found unstable acidity and alkalinity levels; in some locations, the acidity level was within the permissible limit, while in others, it was significantly law. Furthermore, our study revealed a high level of TDS in our study area, as well as a significant hardness in our sample water. Furthermore, we have discovered that the location near the industrial zones have the most polluted water compared to the other locations.

Using correlation and linear regression equation we had found a correlation between the analyzed parameters. We observed a strong correlation between Total dissolved solids and electrical conductivity, and strong relation between pH and Do, a fairly strong positive relation between Ph and TDS, a strong positive relation between Free CO_2 (MG/L) and Ca Hardness (m2/L) eventually strong correlation between Magnesium hardness and Total hardness.

However, after conducting our analyses and reviewing the existing literature in order to find supporting evidence on the rise in pollution levels, we discovered that our study was shown to be positive when compared to the existing literature. In this case, we came to the conclusion that due to the covid19 pandemic The activities that were taking place in the surrounding environment, including the industrial and agricultural activities of the river, which were the main sources of pollution, were reduced, which resulted in a reduction in waste generation from the textile and tannery industries.

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Appendix

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Sample water analysis in ESDM department laboratory ©Daffodil International University