Faculty of Engineering
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Health condition of Textile workers: A study in Gazipur Industrial zone

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Submitted by
Md. Zahid Murad Shuva
ID: 0242220014123015

Submitted to

Mr. Tanvir Ahmed Chowdhury
Assistant Professor
Department of Textile Engineering

A project submitted in partial fulfillment of the requirements for the degree of **Master of Science in Textile Engineering**

Declaration

I hereby declare that this thesis entitled **"Health condition of Textile workers: A study in Gazipur Industrial zone"** under the supervision of **Tanvir Ahmed Chowdhury**, Assistant Professor, Department of Textile Engineering, Faculty of Engineering, Daffodil International University. I have produced this thesis based on industry generated research findings and from references that has been published before as literature. To my best of knowledge and concern no part of this thesis or information has been published in any journal or website. I also certify that no plagiarism has been adopted to produce this paper.

Md. Zahid Murad Shuva
ID No: 0242220014123015
Department of Textile Engineering
Daffodil International University

Letter of Approval

This is to certify that the thesis titled, **"Health condition of Textile workers: A study in Gazipur Industrial zone"** has been solely prepared by Md. Zahid Murad Shuva, (ID No: 0242220014123015 as a partial requirement for the M.Sc. in Textile Engineering at Daffodil international University. This research has been conducted under my supervision and guidance. I confirm that no part of this thesis has been submitted previously for the award of any other degree, fellowship or similar academic recognition. Furthermore, this work has not been published in any journal or magazine

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Mr. Tanvir Ahmed Chowdhury

Assistant Professor

Department of Textile Engineering

Daffodil International University

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Abstract

Environmental elements air, water, soil, more other things are vital and integral resources for the environment. Water is an essential component of the environment, another name for this water is life. The existence of life without water cannot be imagined. In our daily life, we use water for various purposes; we use a lot of water for various household chores as well as industrial works. Directly and indirectly, water resources are playing an important role in our economic and social development. One of the biggest water consumable industry in Bangladesh is Textile industry. “The industrial sectors of Bangladesh (e.g. textile, tannery, steel, paper, etc.) consume about 9,500,000 m3 of groundwater (about 98% of water supply) daily where the textile sector consume 4,013,000 m3 of groundwater”.

The textile industry is one of the main driving forces of Bangladesh's economy. The textile industry contributes greatly to the growth of Bangladesh's GDP. But economic development alone cannot be called the overall development of a state or a country. In addition to economic development, the overall development of the people and the environment is essential. Different types of chemicals are used in different processes of the textile industry, from which different waste products are produced; Part of which is made reusable and part is released into the environment following the standards of the Department of Environment. The standards of the Department of Environment have been set in such a way that they do not pose any obstacle to the ecology of the environment. Textile industries of Bangladesh start business with clearance from Department of Environment and many other concerned ministries. If the textile industries were managed properly according to the rules of the Department of Environment, then we would not have to worry so much about the environmental situation today. At present, the ecosystem of certain regions of Bangladesh is being severely disrupted. One of these areas is Gazipur district. There are about 1773 small and big different types of factories in this district out of which about 1024 are textile and garments industry. It is almost 57.75% of total number industry in Gazipur district.

These textile industries are upsetting the balance of the environment by releasing different types of chemicals into the environment. But the owners of the textile

industries say they are following the rules of the Environment Department. So the question is how the balance of the environment is being destroyed? We have tried to know this matter here and also I have tried to know the consequences on the nearby water bodies. We hope Bangladesh government and people will benefit from this research.

Key words: Environmental issue, Textile industry, Ecological development, Human health, Effluent Treatment Plant, Health and Wealth Status, Ready-Made Garments.

Contents

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List of Abbreviation:

Abbreviation	Full Name
RMG	Ready-Made Garment
GDP	Gross Domestic Production
ETP	Effluent Treatment Plant
DPHE	Department of Public Health Engineering
DO	Dissolved Oxygen
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
TDS	Total Dissolved Solid
TSS	Total Suspended Solid
P^H	Potential of Hydrogen
WQI	Water Quality Index
HR	Heart Rate
SBP	Systolic Blood Pressure
DBP	Diastolic Blood Pressure
ECA	Environment Conservation act
ECC	Environmental Clearance Certificate
DOE	Department of Environment

Chapter 01

Introduction

Chapter 01: Introduction

1.1 Background

Environmental elements air, water, soil, more other things are vital and integral resources for the environment. Water is an essential component of the environment, another name for this water is life. The existence of life without water cannot be imagined. In our daily life, we use water for various purposes; we use a lot of water for various household chores as well as industrial works. Directly and indirectly, water resources are playing an important role in our economic and social development. One of the biggest water consumable industries in Bangladesh is Textile industry. “The industrial sectors of Bangladesh (e.g. textile, tannery, steel, paper, etc.) consume about 9,500,000 m3 of groundwater (about 98% of water supply) daily where the textile sector consumes 4,013,000 m3 of groundwater”. [1]

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industries say they are following the rules of the Environment Department. So the question is how the balance of the environment is being destroyed? We have tried to know this matter here and also I have tried to know the consequences on the nearby water bodies. We hope Bangladesh government and people will benefit from this research.

Most of the development and damage that mankind has done on earth is due to the actions of man himself. The wheel of Bangladesh's economy and development has been dependent on the textile industry for the past 20 years. A review of the economic prosperity and development of the past 20 years shows that the textile sector has contributed the most to the economic development of Bangladesh. [3]

In addition to economic development, in the last twenty years, polluted waste from the textile industries has caused severe damage to our environment. Today our environment is on the verge of ecological destruction due to lack of proper management and law enforcement.

1.2 Overviews of Bangladesh Textile Industry:

The contribution of the textile industry behind the socio-economic development of Bangladesh is undeniable. This industry contributes more than 12% of our country's national income, and more than 80% of total foreign earnings come from this sector. At present 95% factory owners are citizens of our country. About 4.4 million people depend on this industry for their livelihood, 80% of whom are women. [4], [5]

Value in Million USD

Table 1 : Export performance of Bangladesh RMG sector.

Year	Value of RMG export	Total Export of Bangladesh	Share % of RMG to total Export
2000-01	4859.83	6467.30	75.14
2001-02	4583.75	5986.09	76.57
2002-03	4912.09	6548.00	75.01
2003-04	5686.09	7602.99	74.79
2004-05	6417.67	8654.52	74.15
2005-06	7900.80	10526.16	75.06
2006-07	9211.23	12177.86	75.64
2007-08	10699.80	14110.80	75.83
2008-09	12347.77	15565.19	79.33
2009-10	12496.72	16204.65	77.12

2010-11	17914.46	22924.38	78.15
2011-12	19079.73	24301.90	78.55
2012-13	21515.73	27027.36	79.61
2013-14	24491.88	30186.62	81.13
2014-15	25491.40	31208.94	81.68
2015-16	28094.16	34257.18	82.01
2016-17	28149.84	34655.90	81.23
2017-18	30614.76	36668.17	83.49
2018-19	34133.27	40535.04	84.21
2019-20	27949.19	33674.09	83.00
2020-21	31456.73	38758.31	81.16
2021-22	42613.15	52082.66	81.82

[6] From the above chart we can identify the contribution and progress of Bangladesh RMG sector. Right now this sector is the backbone of the economy of Bangladesh.

Definitely the importance of textile industry behind the socio-economic development of Bangladesh is undeniable, but now this concept becomes contradictory due to the careless activity of factory owner and of the legislative society also. They don't care about environmental damages by their wastes, they think just only for money. This is true that some textile business man take care of their surrounding environment, but the number of this kind of factory is very few. That is our concern.

1.3 Objectives of this study:

This study aims to:

- To review the current status of water pollution by textile factories.
- Identify the current ETP situation of Textile Industry of Bangladesh.
- To find out the comparative difference between the result of factory-laboratory and out site laboratory.
- To assess the overall environmental damage caused by water pollution by Textile Industry.
- Finding a way out of the current situation of environmental damages.
- Reviewing the health risks to people in the vicinity.

Chapter 02
Literature Review

Chapter 02: Literature Review:

2.1 Assessment of Textile water pollution:

Various types of research have been done on environmental disasters in the world, some of them are personal research and some are institutional research. After studying various research papers, one thing is clear to me that due to lack of sufficient information, corruption tendency of those who are responsible for environmental disaster, reluctance to provide information. The correct reality is not being presented in Bangladesh. The main objective of my research is to bring out the actual reality despite the symbolism.

In this research I have taken help from three types of papers, books and journals. Firstly health concern related that means the bad effect of industrial waste on nearby people, secondly environmental effect related which is loss of environmental ecosystem related and last one is ETP related

Gazipur district is one of the biggest textile hub in Bangladesh. It has been started since 1990, still this industry playing an important role to develop the economic solvency and as well as the development of environmental pollution especially in the context of water pollution of this district, because most of the factories are located near water bodies or rivers. Research conducted by 'Water Integrity Network' in 2018, they found that Textile Industries are using approximately 200 to 250 liters of water to produce per kilogram of fabric, and approximately300 ton water consumes to produce 1 ton of fabric. About 80 to 85 %

Figure 1: Industrial waste water impact on nearby water bodies:

water discharge as west water. [7] As a result eco-system of this area are unbalancing day by day, those people who are living on the natural water resources by fishing or farming are suffering tremendously.

Figure 01

2.1.1 Impact on human health:

An industrial cluster zone of Gazipur named Konabari is generating 53,000 m^3 wastewater daily and major portion of this water comes from Textile industries and approximately 1000 acres of farming land have been damaged by this effluent, as a result more than 1000 families are affected who are living on the water resources of this area. [8]

The dyes and chemicals are associated with Textile and other industry are not only damaging the water but also affecting the human body. Azo Dye is one of most useable color component in Textile industry. A research has done on the impact of Textile Dyes on human health and environment in 2020, the researchers have found that azo dyes have some responsibility for causing of cancer disease. [9]

Apart from this, those who are directly working with dyes and chemicals they suffer from different types of skin disturbances, nose blockage, sniffling sore eyes and so on. [10]

2.2 Economic development of Gazipur city:

Gazipur district is one of the biggest hub of textile industry in Bangladesh. According to the "Labor force survey 2017", about 55% of Labor force are working in Dhaka and Chittagong division, and the most people work in Gazipur district compeer to the other districts of these two division, and also mentioned that one out of every two people in Gazipur earns a living through garment work. According to this report 48% people are involved with textile sector in Gazipur area. [11]

According to the opinion of Gazipur Industrial Police super Siddiqur Rahman, the total number of licensed factories in Gazipur district is 2165, the number of garment factories is 1187. Apart from this there are many unlicensed factories. In total, there are 5000 small and big factories, most of which are garment factories. [12]

So, Textile sector of Gazipur is playing a vital role behind the economic and social development of Gazipur district.

2.2.1 Mobility of Society:

Textile industries have been playing an important role behind the socio-economic development of Gazipur district. Textile industry has been developed in a planned manner in certain areas of this district. The increase in the number of industries provided employment to people and increased purchasing power. Earlier, most of the roads were 8 to 10 feet, but now all those roads have been widened to 20 feet and 30 to 60 feet.

Table 2: Industrial development changes the socio-economic situation of Gazipur district:

Years of Interval	**Population of Gazipur District**	**Literacy %**
2001	20,31,891	56.4
2011	34,03,912	62.6
2022	34,45,439 (approximate)	85.5 (approximate)

This table shows the improvement of literacy of the people of Gazipur district.

2.3 Ecological damages of Gazipur city:

The actual situation of environmental disaster is very dire. We know maybe 20% to 25% of the damage. The rest remains outside of our vision. Here I have included some pictures which will describe the worst effect of industrial waste water on environment. At present the water quality index of Turag River shows that 'WQI

Figure 2: Openly discharging the industrial wastes and household garbage into the river.

Value is 50.96' and average water quality is very poor. Not only Turag but also other rivers as well. [15]

2.3.1 Destructing the Eco-system:

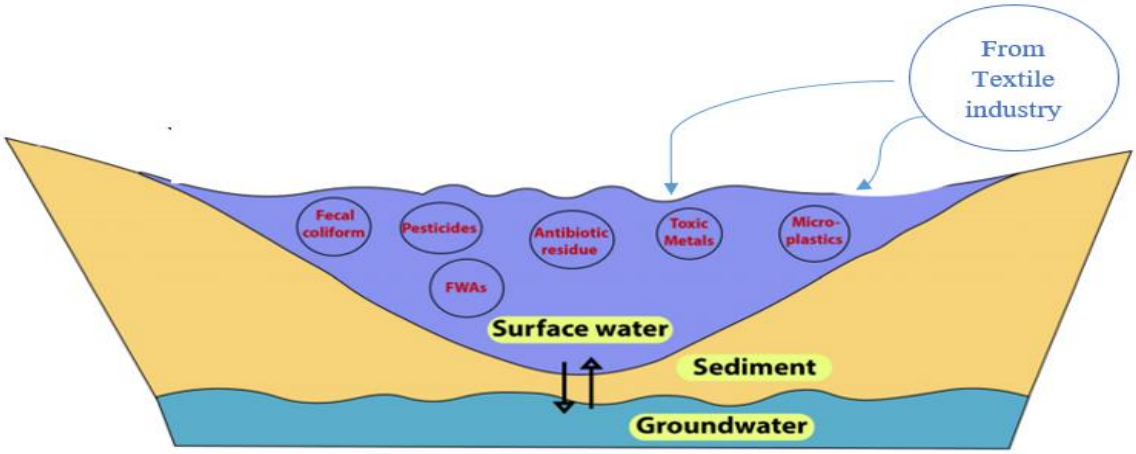

Figure 3 : Water contamination from textile industry.

Different types of chemicals are used in the textile industries of Bangladesh, among them are different types of inorganic dyes, acids, and different types of enzymes very much, chemical reaction with water and destroy the water quality as a result living organisms can survive into their eco-system. Important. All these substances carry various heavy metals

2.3.2 Response of Human Health:

In this study I have taken interview of local people and as well as factory people also. Because their lives extremely connected with the environment of this area.

Talking to150 people during my research, I have learned some very important things. Of those 150, 60 are factory workers and 20 of them are living in the factory area, the remaining 90 are local public. Here I have included the information which I found during the survey. According to the below chart I have taken the data of 'Heart rate and Blood Pressure' of people in the industrial area.

2.4 Importance of ETP:

ETP is an industrial wastewater treatment system designed for reuse the water or safe disposal to the environment. Industrial west water or effluent contains different types of hazards chemicals and materials; it depends on the type of factory. This type of water very harmful for animals and environment as well.

Figure 4: Bio-chemical Effluent Treatment Plant

At present there are about 4000 textile industries in Bangladesh and textile industries use the most amount of water among the industries in Bangladesh. As a result textile industries generate the largest amount of industrial waste containing various harmful chemicals used in different process like dyeing, printing, washing etc.

It is very alarming that till now there are many uncertified Textile factories are doing their operations without arranging any kind of treatment plant for their Textile west, beside this they dispose directly to the source of our surface water. Those who have stablished ETP are not using properly, because they think that it is not profitable and it is a loss project. Ultimately, they don’t care about environmental damages.

According to the law of Bangladesh government, under section 12 of the Bangladesh Environment Conservation act 1995 (ECA 1995) no industrial unit or Project can be established or undertaken without obtaining an Environmental Clearance Certificate (ECC) from the Department of Environment (DOE).

Figure 5: Biological Effluent Treatment Plant

2.4.1 Benefits of ETP:

There are several benefits of ETP and here I have listed some top of them:

- It will help you to comply with the rules of the Department of Environment (DoE).
- It will purify the wastewater produced by your industry and make it suitable for reuse, thereby preventing water wastage and reducing the use of groundwater.
- Keeping your industry clean it will make the working environment beautiful and healthy.
- It protects the environment from pollution and helps to maintain the ecology of the environment.

- Proper use of ETP will benefit your industry economically in the long run.

2.4.2 Types of ETP:

ETP can be classified in several ways. We will differentiate here based on mechanisms of ETP.

1. Biological ETP: Sometimes it called as Secondary treatment Process. It used to treat the wastewater coming from the industry or from residential area. According to the process it can be classified into two:
   -Biological Anaerobic Treatment (In absence of oxygen)
   -Biological Aerobic Treatment (In presence of oxygen)
2. Chemical ETP.
3. Physical ETP.
4. Physicochemical ETP.
5. Biochemical/hybrid ETP.
6. Chlorine ETP.
7. Electrochemical ETP.

Here are some important manufacturing sectors which must need ETP to purify their wastewater.

- Dairy and Beverage Industry.
- Food Manufacturing Industry.
- Automobile Industry.
- Pharmaceuticals and Chemicals Industry.
- Paper Industry.
- Textile and Dyeing Industry.

For treatment of Textile waste-water above-mentioned ETPs are more suitable in the context of Bangladesh. Because maximum textile production of Bangladesh are ready-made garments which contains maximum wet processes like dyeing, finishing and so on. These type of wet processes require huge amount of water.

2.5 Treatment Level and Processes of ETP:

In general Effluent Treatment Plant of Textile Industry can be operated with the assist of four different levels. Those treatment levels are: Preliminary. Primary. Secondary. Tertiary.

Table 3: Basic operational description of ETP:

The individual process component and operations are described below:		
Level of treatment	Operations Involved	Name of the mechanisms:
Preliminary Treatment	1.Bar Screen: *To remove large suspended solid materials* 2.Equalization Tank: *Balancing the effluent comes from different sections.*	Physical
Primary Treatment	1.Flash mixture/reaction tank 2.Chamical dosing tanks 3.Flocculation tank 4.Primary clarifier/Tube settler/Lamellar clarifier	Physicochemical
Secondary Treatment	1.Aeration Tank 2.Secondary Tube settler/Secondary clarifier: *To separate the bio-sludge.* 3. Treated effluent collection tank.	Bio-chemical
Tertiary Treatment	1.Disinfectent like Chlorine, Ozone, UV-Light : *For removing any undesirable microbes.*	Physical, Chemical, Biological.

2.5.1 Parameters to be checked for a standard ETP:

Table 4: Checking Parameters for an ETP according to government policy.

Step	Parameters	Values
01	Production Per Day	Kg/day
02	Water Consumption Per Day	m^3/day
03	Effluent Generation Per Day	m^3/day
04	Capacity of ETP Per Day	m^3/day
05	Specific Water Consumption In Different Process	L/kg
06	Inlet and Outlet Flow Meter reading Per Hour	m^3/hour
07	Treated Effluent Characteristics.	According to DOE

Table 5: Discharge Quality Standard for Textile industry

Parameter	Limit (mg/L)
Total Suspended Solid (TSS)	100
BOD 20℃	*150
Oil & Grease	10
Total Dissolve Solid (TDS)	2100
West water Flow	100 L/kg of fabric processing
P^H	6.5-9
Special parameters based on the classification of dyes use	
Total Chromium (as Cr molecules)	2
Sulfide (as S molecules)	2
Phenol Compound (C_6H_5OH)	5

*BOD Limit of 150 mg/L will be applicable only for physio-chemical processing method. [22]

Chapter 03

Methodology

Chapter 03: Methodology

3.1 Procedure:

This research was completed in three steps. In the first part, data and samples were collected from the field level. Five organized textile factories were visited, some of which were very helpful. Certain factories were particularly sincere in providing information; however, due to confidentiality, their names will not be disclosed. Sincere gratitude is extended to them. While information was being gathered at the field level, efforts were made to understand the environment around the factories as well as the physical and economic conditions of the local people.

In the second part, the samples collected from the field were tested at the Department of Public Health and Engineering (DPHE), and data were extracted in the laboratory. My years of working experience with textile water quality has provided extensive knowledge of water testing according to international water testing methods. Additionally, some information was gathered from authentic websites and journals.

In the third step, the data collected in the first and second steps were compared, and conclusions were drawn. The focus was mainly on the following parameters: pH level of water, hardness of water, DO (Dissolved Oxygen), and TDS/TSS (Total Dissolved Solids/Total Suspended Solids).

The research was conducted in Gazipur Industrial zone, one of Bangladesh's largest textile & Apparel manufacturing hubs. The zone was selected for the following reason:

- High concentration of textile & Apparel factories
- Diverse workforce & demography
- Frequent cases of occupational health issues

A stratified random sampling method has been adopted to ensure representation across factory sizes and job roles. Factories those are of large capacity and produce huge amounts of effluents. Workers were randomly elected based on age, gender, living status etc.

The target population comprised male and female textile workers aged 18 years and above who had been employed in the industry for at least six months. The inclusion criteria ensured that participants had enough experience in the factory environment to provide relevant insights into job-related health conditions.

Limitations of the methodology:

Despite efforts to ensure reliability and validity, the study faced some limitations:

- As a cross-sectional study, it cannot establish casual relationships and positive/negative correlation
- Self-reported data may be influenced by recall bias or social desirability.
- Due to time limitations, the sample size was limited and findings may not be generalizable to all textile workers across Bangladesh.

3.2 Data Collecting Method:

During the visit, different types of data were collected from the Textile industry. The collected data are described below. Data were gathered from various sources within the factory, although the actual data were not willingly disclosed. Initially, discussions were held with the management and Compliance department. Then, the dyeing section has been visited, followed by discussions with the ETP department. Finally, the maintenance department was visited, and a conversation was held with the Chief Engineer.

Figure 6: Sample Collection from ETP plant of a Textile Industry in Gazipur

After collecting data, it were compared all data to each other, and finally got the result with huge difference.

3.2.1 Questionaries for industry:

The following checklist have been used for evaluating the ETP in this study:

- Name and address of the factory.
- Number of total employees.
- Number of working shift.
- Name of raw materials.
- Production Capacity per day.
- The capacity of ETP per day.
- Water consumption per day.
- Discharged effluent volumes of treated water per day.

- Time intervals of checking the parameters.
- Sources of water
- Disposal method
- Treated Effluent Characteristic
- P^h.
- TDS/TSS
- BOD
- COD
- DO
- The number of stuff observing and monitoring ETP

3.2.2 Questionaries' for local people:

- Name.
- Age.
- Profession.
- Asset.
- Bank savings.
- Farming lands.
- Food condition
- About diseases.
- Blood pressure.

3.3 Study area location:

I have done this research based on various textile industries of Gazipur district. Because according to statistics, most people of this area are involved in textile industry. Five factories have been randomly selected which have their own ETP. Basically I have discussed about the industrial disposal area, and the impact of wastes on the nearby local area and on the health of local people.

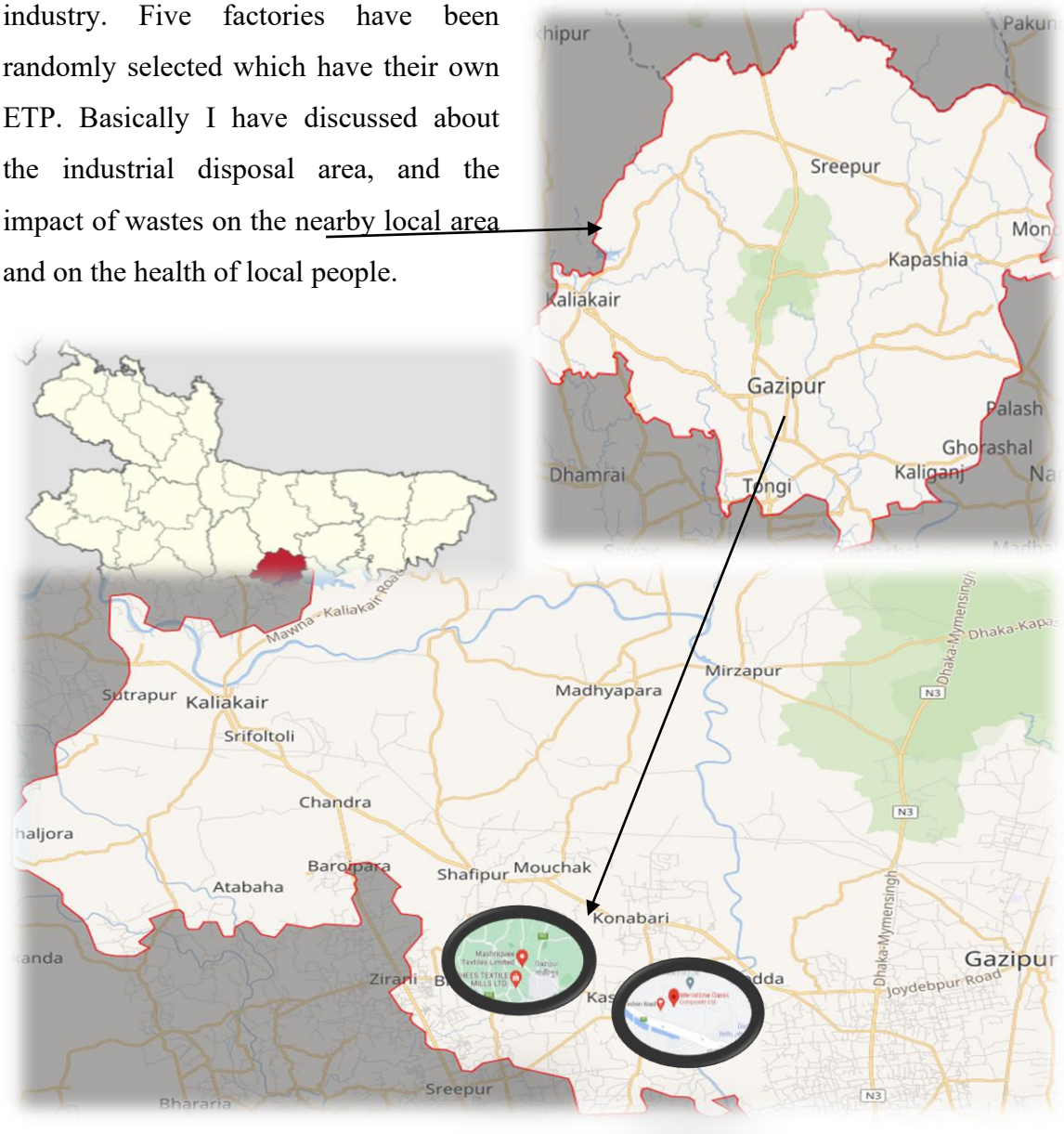

Figure 7: Map of Study Area

3.3.1 Heart Rate (HR) by age and gender:

Table 6: Age wise heart rate condition for man and a women:

Man						
Age Group	Poor	Very good	Above Average	Average	Below average	Poor
20-39	<55	55-60	61-68	69-75	73-83	84-94
40-59	<55	55-60	61-67	68-76	77-84	85-94
60-79	<54	54-59	60-66	67-74	75-83	84-97
Women						
Age Group	Poor	Very good	Above Average	Average	Below average	Poor
20-39	<60	60-65	66-73	74-81	82-88	89-98
40-59	<59	59-63	64-70	71-78	79-85	86-96
60-79	<59	59-63	64-69	70-77	78-85	86-95

3.3.2 Blood pressure range by age group:

Table 7: Age group wise blood pressure range:

Age Group	Blood Pressure type	Range		
		Minimum	Maximum	Average
15-19	Systolic Blood Pressure (SBP)	105	117	120
	Diastolic Blood Pressure (DBP)	73	77	81
20-24	Systolic Blood Pressure	108	120	132
	Diastolic Blood Pressure	85	79	83
25-29	Systolic Blood Pressure	109	121	133
	Diastolic Blood Pressure	76	80	84
30-34	Systolic Blood Pressure	110	122	134
	Diastolic Blood Pressure	77	81	85
35-39	Systolic Blood Pressure	111	123	135
	Diastolic Blood Pressure	78	82	86
40-44	Systolic Blood Pressure	112	125	137
	Diastolic Blood Pressure	79	83	87

45-49	Systolic Blood Pressure	115	127	139
	Diastolic Blood Pressure	80	84	88
50-54	Systolic Blood Pressure	116	129	142
	Diastolic Blood Pressure	81	85	89
55-59	Systolic Blood Pressure	118	131	144
	Diastolic Blood Pressure	82	86	90
60-64	Systolic Blood Pressure	121	134	147
	Diastolic Blood Pressure	83	87	91

3.3.3 Indicators to understand the overall condition of local people of the industrial area:

Table 8: Human health and wealth indicators:

Health and Wealth status				
1 Excellent	**2** Good	**3** Moderate	**4** Average	**5** Poor
BP minimum HR Very good	BP Minimum HR Above average	BP Maximum HR Average	BP average HR Below Average	BP Average HR Poor
No diseases	Headache	Headache, Skin diseases,	Respiratory (Symptoms Cough, Phlegm, wheezing Shortness of breath) Chronic Bronchitis, Arsenicosis Byssinosis (Symptoms fever, muscle and joint pain, tiredness, a dry cough)	Skin diseases Headache. Diarrheas. Vomiting Kidney damage
Can manage three meals per day. Rich food once per week (fish, meat). Fruits	Can manage three meals per day. Rich food once in a week (fish, meat). Fruits	Can manage three meal per day. Rich food (once or twice within month fish, meat).	Can manage three meals per day. Rich food (Once or twice within two or three month eat Fish, meat).	Can manage three meals per day. Rich food (Once or twice within a year eat meat and

Medicine Entertainment	Medicine	Fruits		can afford fish once within a month).
Home With Farming land Bank Savings.	Only home. Bank Savings.	Home With Farming land	Only Farming Land Bank Savings.	Only home Or Land or Nothing of those

Area 01: Pagar, Tongi. (For confidentiality I are not going to disclose the factory name)

Table 9: Score of samples 01 in health and wealth status:

Sample No 01:					
Name, Age, Profession.	Physical Condition	Kinds of sufferings due to pollution	Land property and economical Condition	Food Menu	Total Score
-**Anowar** -45 years old -Textile Finishing	SBP:124 DBP:82 HR: 68	Skin diseases Headache. Diarrheas.	Home With Farming land	Can manage three meal per day. Rich food (Once or twice within two or three month eat Fish, meat).	
	3	3	3	4	13

Table 10: Score of samples 02 in health and wealth status:

Sample No 02:					
Name, Age, Profession.	Physical Condition	Kinds of sufferings due to pollution	Land property and economical Condition	Food Manu	Total Score
-**Jamal** Miya -33 years old -Shop kipper	SBP:130 DBP:82 HR: 70	Skin diseases Headache. Diarrheas. Vomiting	Only home. Bank Savings	Can manage three meal per day. Rich food (Once or twice within two or three month eat Fish, meat).	
	3	5	2	4	14

Table 11: Score of samples 03 in health and wealth status:

Sample No 03:					
Name, Age, Profession.	Physical Condition	Kinds of sufferings due to pollution	Land property and economical Condition	Food Manu	Total Score
-**Boshir Shorker** -31 years old -Auto Driver	SBP:140 DBP:90 HR: 68	Arsenicosis Byssinosis (Symptoms fever, muscle and joint pain, tiredness, a dry cough)	Nothing of those	Can manage three meal per day. Rich food (Once or twice within two or three month eat Fish, meat).	
	4	4	5	4	17

Table 12: Score of samples 04 in health and wealth status:

Sample No 04					
Name, Age, Profession.	Physical Condition	Kinds of sufferings due to pollution	Land property and economical Condition	Food Manu	Total Score
- Anika Ghoshal -25 years old -Garment Worker	SBP:135 DBP:84 HR: 54	Arsenicosis, Byssinosis (Symptoms fever, muscle and joint pain, tiredness, a dry cough) Skin diseases Headache.	Only Home	Can manage three meal per day. Rich food (Once or twice within two or three month eat Fish, meat).	
	5	5	5	4	19

Table 13: Score of samples 05 in health and wealth status:

Sample no 05:					
Name, Age, Profession.	Physical Condition	Kinds of sufferings due to pollution	Land property and economical Condition	Food Manu	Total Score
- **Gulzer** -32 years old -Garment officer	SBP:121 DBP:68 HR: 67	Headache.	Home With Farming land Bank Savings.	Can manage three meal per day. Rich food once in a week (fish, meat). Fruits Medicine	
	2	2	1	2	7

Table 14: Score of samples 06 in health and wealth status:

Sample no 06:					
Name, Age, Profession.	Physical Condition	Kinds of sufferings due to pollution	Land property and economical Condition	Food Manu	Total Score
- **Tori Akter** -20 years old -Garment worker	SBP:108 DBP:82 HR: 70	Skin diseases Headache Byssinosis (Symptoms fever, muscle and joint pain, tiredness, a dry cough)	Home With Farming land	Can manage three meal per day. Rich food (Once or twice within two or three month eat Fish, meat).	
	5	5	3	4	17

Table 15: Score of samples 07 in health and wealth status:

Sample no 07:					
Name, Age, Profession.	Physical Condition	Kinds of sufferings due to pollution	Land property and economical Condition	Food Manu	Total Score
- **Akhi Begum** -30 years old -Garment worker	SBP:110 DBP:77 HR: 58	Skin diseases Headache Byssinosis (Symptoms fever, muscle and joint pain, tiredness, a dry cough)	Farming land, Bank Savings	Can manage three meal per day. Rich food (Once or twice within two or three month eat Fish, meat).	
	5	5	4	4	18

Table 16: Score of sample 08 in health and wealth status:

Sample no 08:					
Name, Age, Profession.	Physical Condition	Kinds of sufferings due to pollution	Land property and economical Condition	Food Manu	Total Score
- **Jorina Begum** -29years old -Garment worker	SBP:115 DBP:80 HR: 59	Headache Byssinosis (Symptoms fever, muscle and joint pain, tiredness, a dry cough)	Home with Farming land.	Can manage three meal per day. Rich food (Once or twice within two or three month eat Fish, meat).	
	5	5	3	4	17

Table 17: Score of sample 09 in health and wealth status:

Sample no 09:					
Name, Age, Profession.	Physical Condition	Kinds of sufferings due to pollution	Land property and economical Condition	Food Manu	Total Score
- **Mojibor** -26 years old -Garment worker	SBP:125 DBP:80 HR: 59	Respiratory (Symptoms Cough, Phlegm, wheezing Shortness of breath) Chronic Bronchitis, Arsenicosis Byssinosis (Symptoms fever, muscle and joint pain, tiredness, a dry cough)	Home with Farming land. Bank Savings	Can manage three meal per day. Rich food (Once or twice within two or three month eat Fish, meat).	
	4	4	4	4	16

Table 18: Score of sample 10 in health and wealth status:

Sample no 10:					
Name, Age, Profession.	Physical Condition	Kinds of sufferings due to pollution	Land property and economical Condition	Food Manu	Total Score
- **Hasina** -23 years old -Garment worker	SBP:132 DBP:83 HR: 56	Arsenicosis Byssinosis (Symptoms fever, muscle and joint pain, tiredness, a dry cough) Skin diseases Headache. Diarrheas. Vomiting	Only Home	Can manage three meal per day. Rich food (Once or twice within two or three month eat Fish, meat).	
	5	5	5	4	19

Chapter 04

Result & Discussion

Chapter 04: Result & Discussion

Interviews were conducted with 150 individuals from the industrial area . To prevent unnecessary volume the collected data will be summarized and presented through the graph chart below.

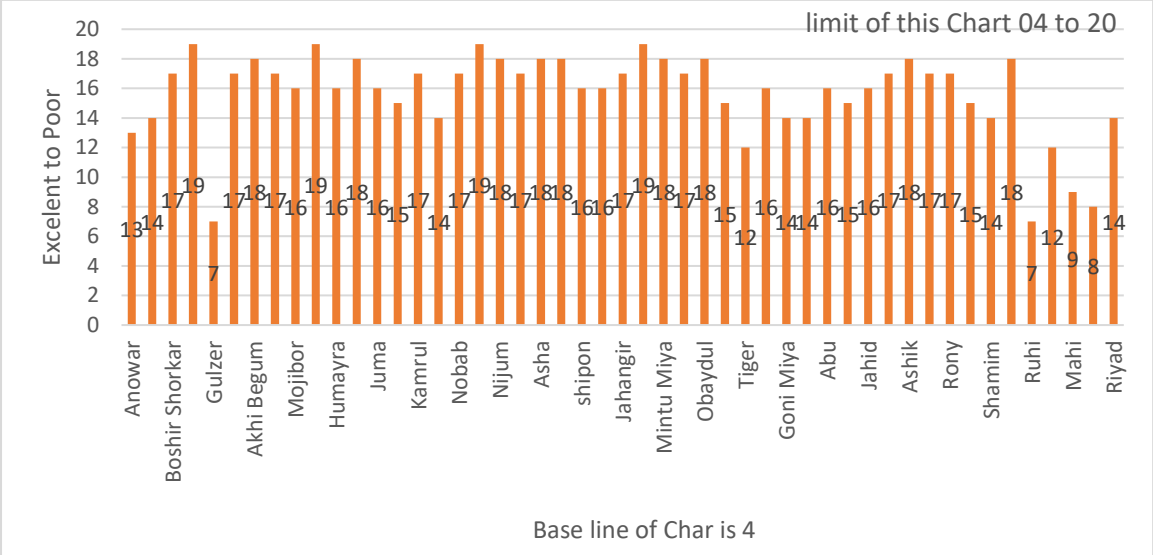

Figure 8: Graph chart 01 for describing the overall health and wealth status:

Here the status will consider following the order of the table below:

Table 19: Measuring scale for health and wealth status of chart 01

Score	Excellent 4-6	Good 7-9	Moderate 10-13	Average 14-16	Poor 17-20
Number of people	0	4	3	18	24

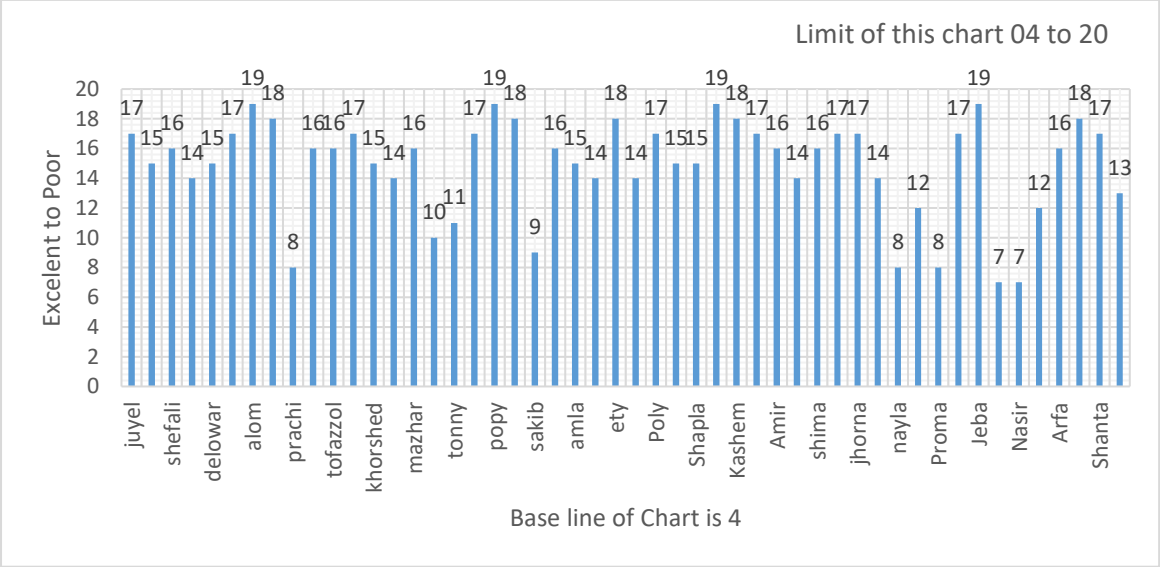

Figure 9: Graph chart 02 for describing the overall health and wealth status:

Table 20: Measuring scale for health and wealth status of chart 02

Score	Excellent 4-6	Good 7-9	Moderate 10-13	Average 14-16	Poor 17-20
Number of people	0	6	5	20	19

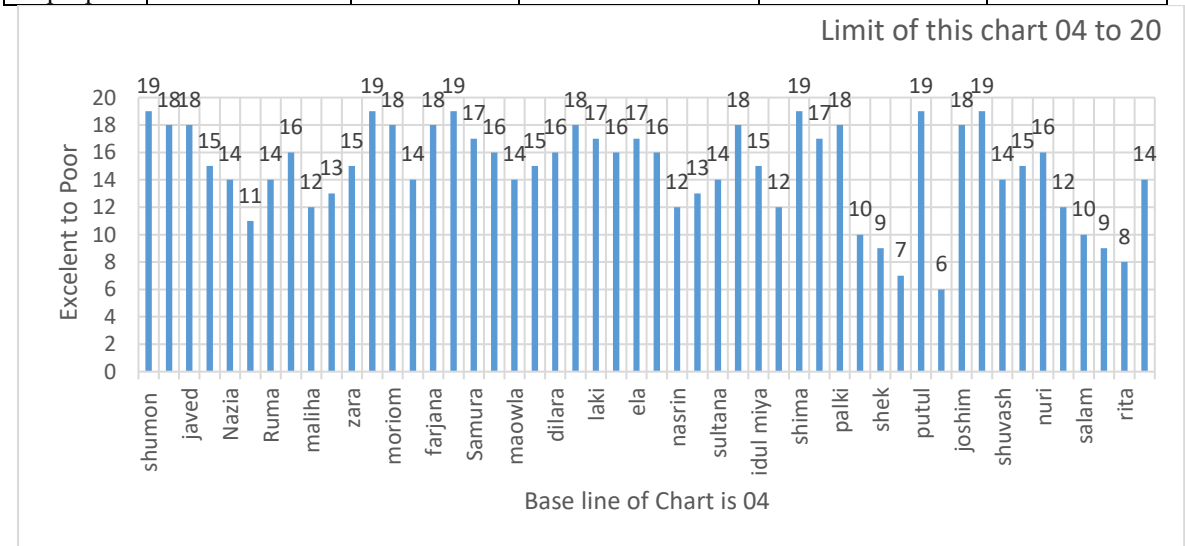

Figure 10: Graph chart 03 for describing the overall health and wealth status:

Table 21: Measuring scale for health and wealth status of chart 03

Score	Excellent 4-6	Good 7-9	Moderate 10-13	Average 14-16	Poor 17-20
Number of people	1	4	9	16	18

From the chart we can identify that maximum people of the industrial area are living in very worst condition.

4.1 Enforcement of Law:

The Environment Department of Bangladesh promulgated the Environment Conservation Act in 1995, and in 2010 designated some areas as ecologically critical areas. Which included the Turagh River and its surrounding area. Nine important statements were made in this Act. Two important statement of those are:

- Establishment of soil, water, air and noise polluting plants is prohibited in the said area.
- All activities that may destroy the natural features of land and water are prohibited. [19]

The Government of Bangladesh announced the National Environment Policy in 2018. Water resource management is discussed in Section 3.2 of this policy.

Sub-section 3.2.7 states that the annual recharge of ground water should be determined based on the carrying capacity of the ground water table in large industrial and commercial establishments. In order to increase productivity against per unit water consumption, water audit and pricing and recycling in specific areas should be made mandatory.

Again, according to section 3.2.31 water recycling should be ensured in all cases including industries. In section 3.2.34 it is said that the owner of the visible industrial factory shall take measures to purify the concerned visible water bodies. [20]

So it can be said that in Bangladesh, a conscious policy has been made to protect the environment. But due to the lack of proper implementation of this law, this pathetic condition of our environment has been created.

Table 22: National Standard Quality of disposal area: [21]

Parameter	**Unit**	**Location of Final Disposal**	
		Inland Surface water	Irrigation Land
Ammonia (Free Ammonia)	mg/L	5	15
Arsenic (As)	mg/L	0.2	0.2
BOD 20℃	mg/L	50	100
Boron (Br)	mg/L	2	2
Cadmium (Cd)	mg/L	0.05	0.5
Chromium (Total Cr)	mg/L	0.5	1.0
Chloride (Cl)	mg/L	600	600
COD	mg/L	200	400
Copper (Cu)	mg/L	0.5	3.0
Cyanide (Cn)	mg/L	0.1	0.2
Dissolve Oxygen	mg/L	4.5-8	4.5-8
Dissolve Phosphorus	mg/L	8	10
Fluoride	mg/L	7	10
Iron	mg/L	2	2
Lead (Pb)	mg/L	0.1	0.1
Mercury (Hg)	mg/L	0.01	0.01
Manganese (Mn)	mg/L	5	5
Nickel (Ni)	mg/L	1.0	1.0
Nitrate (N molecule)	mg/L	10	10
Oil and Grease	mg/L	10	10
P^H	mg/L	6-9	6-9
Phenols Compound (C_6H_5OH)	mg/L	1.0	1
Radio Active Materials as Determined by Bangladesh Atomic Energy Commission			
Selenium (Se)	mg/L	0.05	0.05
Sulfide (S)	mg/L	1	2
Temperature Summer	mg/L	40	40
Temperature Winter	mg/L	45	45
Total Dissolved Solids (TDS)	mg/L	2100	2100
Total Suspended Solid (TSS)	mg/L	150	200
Zink (Zn)	mg/L	5.0	10.0

4.2 Water Quality Test and Obtained Results

In this research I have visited five Textile factories. Due to some confidential issue I am not mentioning the name of those factories. But I can mention the location .Two factories among those are not willing to share any kind of data. That's why I have included here of three areas.

Table 23: List of Factory Location

List of the factory location those I have visited	
Area Number	Location
1	Naojor, Konabari
2	Pagar. Tongi
3	Bisic, Gazipur. Konabari
4	Hriken, Gasa
5	Sign-board ,Gasa

4.2.1 Area No 01:

Table 24: Data collection for area number one during field survey:

Factory Name	**C C**
Factory Type	**Knit Dyeing**
Total Number of Employee	**4000**
Location	**Naojor, Gazipur**
Shift Per day	**3**
Production capacity per day	**11500kg**
Types of E.T.P and effluent treat-ment facilities	**Bio-Chemical**
The capa-city of E.T.P per day	**50m^3**
Types of chemi-cals and mate-rials used	**HCL,Lime,Polymer,$FeSO_4$,De-color Agent ,Finishing auxiliaries (TF-275)**
Water consumption per day	**1035m^3**
Discharged effluent volumes of treated water per day	**1100m^3**
Time interval of checking the parameters	**3-month interval**

ph.	**8.2-8.5**
TDS/TSS	**17mg/l**
BOD	**9mg/l**
COD	**32mg/l**
DO	**6.7mg/l**
The number of staff supervising and operating ETP	**9**

4.2.2 Water calculation:

Table 25: Water calculation for area number one

Annual Water Calculation according to Factory						
Total ground Water Extraction (m^3)	Domestic Water use (m^3)	Boiler Water use(m^3)	Water use for Back wash and Cleansing(m^3)	Water use for Generator (m^3)	Total water consumption (m^3)	ETP Outlet(m^3)
665210.00	443942.0	51361.0	240900.00	584.00	649066.00	312863.00

Water for drink:

Drinking water for 4000 employees: each person drinks average 2 liter water. So, 4000 employee drink: 4000*2= 8000 Litter = 8 m^3 per day in the factory.

Now, Yearly drinking water required= Total working day*8m^3 = 250 *8m^3 = 2000m^3.

Hence, Water Discrepancy = Total Ground water Extraction- (ETP Outlet+ Boiler Water use+ Water use for generator+ Yearly drinking water required)

= 665210.00-(312863.00+ 51361.00+ 584.00+2000.00) m^3

=665210.00- 3176808.00 m^3

=2511598.00 m^3 Water.

Findings:

This industry 2511598.00 m^3 water discharge into the environment without any treatment of their factory waste water in every year.

4.2.3 Sample collection and test result comparison:

Table 26: water test report of area number one:

SL	Factory	Testing Parameters					
		pH	Hardness	TSS	BOD	COD	DO
01	Factory test result	8.3	-	17mg/L	9mg/L	32mg/L	6.7mg/L
	DPHE test result	7.5	210mg/L	2mg/L	-	108mg/L	3.15mg/L
	BD Standard	6.5-9	200-500 mg/L	100mg/L	50-100 mg//L	200-400 mg/L	4.5-8 mg/L

4.3 Area No 02:

Table 27: Data collection for area number two during field survey:

Factory	**ZZ**
Factory Type	**Woven Dyeing**
Total Number of Employee	**9200**
Location	**Pagar, Tongi**
Shift Per day	**3**
Production capacity per day	**1020000 meter**
Types of E.T.P and efflux-ent treat-ment facilities	**Biological ETP**
The capacity of ETP per day	**16,200 m^3**
Types of chemical and materials used	**Sulfuric Acid**
Water consumption per day	**12,000 m^3**
Discharged effluent volumes of treated water per day	**10,000 m^3**
Time interval of checking the parameters	
ph.	**7.6**
TDS/TSS	**1630mg/l And 19mg/l**
BOD	**19mg/l**
COD	**93mg/l**
DO	**5.31mg/l**
The number of staff supervising and operating ETP	**30+**

4.3.1 Water calculation:

Table 28: Water calculation for area number two:

Annual Water Calculation according to Factory ZZ						
Total ground Water Extraction (m^3)	Domestic Water use (m^3)	Boiler Water use(m^3)	Water re-use from boiler (m^3)	Water use for Generator (m^3)	Total water consumption (m^3)	ETP Outlet (m^3)
3720000.00	19500.00	540000.0	64800.00	1605.50	1862616.00	2143716.00

Note: There is no Back Wash for Biological ETP.

Water for drink:

Drinking water for 9200 employees: each person drinks average 2 liter water. So, 9200 employee drink: 9200*2= 18,400 Litter = 18.4 m^3 per day in the factory.
Now, Yearly drinking water required= Total working day*18.4m^3 = 310 *18.4m^3 = 5704m^3.

Water for extra use:

Extra Use for others utilities (Gardening, Hand Washing in outside area) about 1 m^3 per day. So, Extra water required = Total working day*1 m3 =310 m^3.
Hence, Water Discrepancy per year= (Total Ground water Extraction per year+ Water re-use from boiler)- (ETP Outlet+ Boiler Water use+ Water use for generator+ Yearly drinking water required+ Extra Water required)

= (3720000+64800.0)-
(2143716.0+540000.0+1605.50+5704.0+310.0)

= (3784800-2691335.5) m^3

=1093464.5 m^3 Water.

Findings:

This industry per year 1093464.5 m^3 water discharge into the environment without any treatment of their factory waste water.

4.3.2 Sample collection and test result comparison:

Table 29: water test report of area number two:

SL	Factory	Testing Parameters						
01		pH	Hardness	TDS	TSS	BOD	COD	DO
	Factory test result	7.6	-	1630 mg/L	19 mg/L	19 mg/L	93 mg/L	5.31mg/L
	DPHE test result	7.7	370 mg/L	605 mg/L	8 mg/L	-	56 mg/L	4.50mg/L
	BD Standard	6.5-9	200-500 mg/L	2100 mg/L	100 mg/L	50-100 mg/L	200-400 mg/L	4.5-8 mg/l

4.4 Area no 03:

Table 30: Data collection for area number three during field survey:

Factory	**MT**
Factory Type	**Knit Dyeing**
Total Number of Employee	**1022**
Location	**Bisic. Konabari, Gazipur**
Shift Per day	**3**
Production capacity per day	**5 Ton**
Types of E.T.P and effluent treat-ment facilities	**Chemical ETP**
The capacity of ETP per day	**20m^3**
Types of chemi-cals and mate-rials used	**Acid, Decolor, Polymer, Urea, DAP**
Water consumption per day	**14 m^3**
Discharged effluent volumes of treated water per day	**10 m^3**
Time interval of checking the parameters	**3**
ph.	**7.6**
TDS/TSS	**1750mg/l**
BOD	**-**
COD	**-**
DO	**5.8mg/l**
Operating staffs at ETP	**30+**

4.4.1 Water calculation:

Table 31: Water calculation for area number three:

Annual Water Calculation according to Factory MT						
Total ground Water Extraction (m^3)	Domestic Water use (m^3)	Boiler Water use (m^3)	Water use for Back wash and Cleansing(m^3)	Water use for Generator (m^3)	Total water consumption (m^3)	ETP Outlet (m^3)
413333.33	2166.2	22330.87	96360.0	253.9	195000.00	2600.00

Water for drink:

Drinking water for 1022 employee: each person drinks average 2 liter water. So, 1022employee drink: 1022*2=2044 Litter = 2.044 m3 per day in the factory.

Now, Yearly drinking water required= Total working day*2.044m3 = 260 *2.044m3 = 531.4m3.

Hence, Water Discrepancy = Total Ground water Extraction- (ETP Outlet+ Boiler Water use+ Water use for generator+ Yearly drinking water required)

= 413333.33-(2600.00+ 22330.87+ 253.9+531.4) m3

=413333.33- 25716.17 m3

=387617.16 m3 Water.

Findings:

This industry 387617.16 m^3 water discharge into the environment without any treatment of their factory waste water annually.

4.4.2 Sample collection and test result comparison:

Table 32: Water test report of area number Three:

SL	Factory	Testing Parameters						
		pH	Hardness	TDS	TSS	BOD	COD	DO
01	Factory test result	7.6	-	1730 mg/L	-			5.81 mg/L
	Lab test result	7.9	700 mg/L	305 mg/L	11 mg/L	-	424mg/L	2.60 mg/L
	BD Standard	6.5-9	200-500 mg/L	2100 mg/L	100 mg/L	50-100 mg/L	200-400 mg/L	4.5-8 mg/L

4.5 Final Result:

From this study we have identified four major findings, which was the main objective of this study.

Findings 01*:* Though at present textile sector is the key of economy of Bangladesh, it damaging our environment severely. Eco-system of the nearby water bodies is getting destroy enormously.

Findings 02*:* Health Hazards of local people are increasing day by day. Through the interview of 150 people, we have found that, 40.67% people are living in poor condition and 36% are in average condition. On the other hand, 11.33% people are surviving moderately and very small amount of people are staying in good condition. So, it is very alarming that day by day peoples living condition going downward.

Table 33: Health and wealth status calculation chart:

Chart 01					
Score	Excellent 4-6	Good 7-9	Moderate 10-13	Average 14-16	Poor 17-20
Number of people	0	4	3	18	24
Chart 02					
Score	Excellent 4-6	Good 7-9	Moderate 10-13	Average 14-16	Poor 17-20
Number of people	0	6	5	20	19
Chart 03					
Score	Excellent 4-6	Good 7-9	Moderate 10-13	Average 14-16	Poor 17-20
Number of people	1	4	9	16	18

So.

- Percentage of poor Condition = $\frac{(24+19+18)*100}{150}$ = 40.67%.
- Percentage of average living condition = $\frac{(20+16+18)*100}{150}$ = 36.0%
- Percentage of Moderate Condition = $\frac{(3+5+9)*100}{150}$ = 11.33%.
- Percentage of Good Condition = $\frac{(4+6+4)*100}{150}$ = 9.3%.

Findings 03*:* Untreated waste water discharging into the surface water. Here we have proved calculating the data provided by the factories that, huge amount water extruding through hidden drain or pipe.

Factory of area no 01:

This industry 2511598.00 m^3 water discharge into the environment without any treatment of their factory waste water per year.

Factory of area no 02:

This industry per year 1093464.5 m3 water discharge into the environment without any treatment of their factory waste water.

Factory of area no 03:

This industry 387617.16 m3 water discharge into the environment without any treatment of their factory waste water annually.

Findings no 04:

According to DPHE lab report it is clear that, factories are not using ETP properly, or the capacity of ETP is very low in compare of production. Because through the lab report we can identify that factory owners are not caring about the environment and this is the main reason of ecological damages.

Limitations and Strength:

It is natural for every human made thing to have weaknesses. The acceptability of this paper could have been increased had it not been for these issues.

If the number of samples was 1500 instead of 150, then its accuracy would be more acceptable. If I could visit 50 industries then the calculation of waste hiding would be more accurate. Apart from this, I faced some difficulties while interviewing people, I had to face different types of questions.

In this research I have tried to collect necessary data from authentic sources. I have taken help from the Department of Environment of Bangladesh, and also I have get test my simples from Department of Public Health and Engineering (DPHE) which are government organization. Sample ID: CEN2022080258, CEN20220802559, CEN2022080260.

Recommendation:

Willingness and honesty are two big factors to overcome from this situation of the environment. A big role should be played by the government. Water footprint tax can be applied to control the disposal of waste water.

Increase the awareness of using Biological ETP, Government should allocate subsidy behind the establishment of Biological ETP. And should monitor in regular intervals.

Chapter 05
Conclusion

Chapter 05: Conclusion:

The findings of this research highlight the severe environment and human health implications of water pollution caused by the textile industry in the Gazipur industrial zone. Despite the alarming data available in various sources there remains a concerning lack of strong regulatory action against polluters, allowing harmful practices to persist unchecked. Additionally, the reliability of environmental reporting is often compromised, which obscures the true scale of the crisis. This study has maintained an objective perspective, striving to present an unbiased representation of the issue. The analysis of human health impacts and socio-economic conditions will serve as a valuable resource for future researchers while the waste water assessment provides concrete evidence that can aid policymakers and regulatory bodies in addressing industrial malpractices. Urgent intervention is necessary to ensure sustainable industrial practices that safeguard both the environment and public wellbeing. Without decisive action the ecological damage and health risks will continue to escalate.

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