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A Review on Textile Wastewater Characterization in Bangladesh

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Abstract The textile and apparel industries in Bangladesh are playing an utmost important role offering tremendous opportunities for the economy of Bangladesh. But, hasty and unplanned clustered growth of industries leads to adverse environmental consequence in an alarming way. This work is aimed at giving emphasis on the present pollution scenario in Bangladesh due to textile effluent. The liquid effluents from industries are causing major havoc to the environment, ecology, agriculture, aquaculture and public health since the development of textile industries in the country. In this paper, effluent characterization results of last ten years (2005-2014) are focused. We found physicochemical parameters of Textile effluents in Bangladesh as, Temperature (25-65°C), pH (3.9-14), TDS (90.7 – 5980 mg/L), DO (0-7 mg/L), COD (41-2430 mg/L), BOD (10 – 786 mg/L), TSS (24.9 – 3950 mg/L) and EC (250-63750μS/cm) from 2005 to 2014. From the available data originated from the study depicts the present pollution scenario in Bangladesh with tremendous violation of laws to meet requirement of waste discharge quality standards. Now it has become a prerequisite to set up ETP in each industrial establishment, particularly at dyeing industries that were discharging huge amount of liquid waste to the rivers every day.

Keywords Textile Wastewater, pH, TDS, COD, BOD

1. Introduction

The textile industry is a significant contributor to many national economies, encompassing both small and large-scale operations worldwide. In terms of its output or production and employment, the textile industry is one of the largest industries in the world [1a].

Bangladesh Textile industries have been the backbone of her economy for years. The industry is providing 45% of industrial manpower with employment. More than 4 million people of the country's total population of which more are the women, are attached to these industries. The textile industries of Bangladesh are a combination of small and large scale public and private companies. Bangladesh Textile Industries can be divided into three sectors, the Government sector, the hand loom sector and the organized private sector. The role of the hand loom sector is significant because of employment opportunity of a large number of people of our country. Bangladesh is exporting her about 750 Textile Products in China's market under Asia Pacific Trade Agreement with nominal duty. The textile products of Bangladesh have also, developed its demand in Japan too. Besides, Bangladesh is exporting readymade garments to USA and Europe also.

Bangladesh garment industries are exporting significant number of cloths to the global market. Its exporting incomes were US $ 17.9 billion in the year 2010-11, US $ 19.0 billion in the year 2011-12 and US $ 21.5 billion in the year 2012-13 [1b], the share of textile sector is almost 80%. Bangladesh has achieved 2nd position in case of exporting global readymade garment products.

According to the Organization of Garments Manufacturers and Exports of Bangladesh, the need of textile sector is 3 billion yard fabric, which nearly from 85-90% is imported from neighboring countries such as China, India, Taiwan, Thailand and Singapore and its demand of this raw material is increasing 20% annually.

Although, the textile sector is the largest and the flourishing sector of Bangladesh but the most important problem is the non-availability of the raw material to the needs of these industries. In spite of it, these industries are gaining its place at global level. Owing to the easy and cheaper manpower, this industry is fully availing itself of the relative advantage [2].

Bangladesh has earned "Brand Bangladesh" in readymade garment products exporting in the world, gratitude goes to the Multi-Fiber Agreement (MFA), and the Generalized System of Preferences (GSP) of the European Union, that conferred significant quota benefits to the country. The garment sector now contributes about 77% of the country's foreign exchange earnings, and 50% of its industrial work force [3].

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1.1. Use of Natural Resources and Its Discharge Condition

The textile manufacturing process is characterized by the high consumption of resources like water, fuel and a variety of chemicals in a long process sequence that generates a significant amount of waste. The common practices of low process efficiency result in substantial wastage of resources and a severe damage to the environment. The main environmental problems associated with textile industry are typically those associated with water body pollution caused by the discharge of untreated effluents. Other environmental issues of equal importance are air emission, notably Volatile Organic Compounds (VOC)'s and excessive noise or odor as well as workspace safety [1].

In the age of industrialization, environmental pollution is a matter of great concern. Surface water pollution is one of the elements of this pollution. Surface water is the water we find in the river, canals, cultivation field and other water bodies on the earth. Severe pollution of this water is causing serious health hazard in the neighborhood, damaging fertility of the land, killing fishes and aquatic lives. Being land of rivers Bangladesh is largely dependent on this surface water. We must keep this water safe for better environment and good health of the people. Many issues are responsible for surface water pollution. Chemical processing industries especially textile processing industries are claimed to produce huge effluent to discharge in our river and other water bodies [4].

Rapid growth in the industrial sector is playing a vital role in the economy of Bangladesh. Mainly the growth has been concentrated in garments which are export oriented industries. To support garments a large number of other textile industries have been established & more are growing to be set up shortly. These rapid growth of textile industries create environmental pollution, mainly pollution in water bodies. The reason of water pollution is lack of appropriate environmental management in textiles in Bangladesh. There are several environmental management options in textiles. Among various options most popular and effective option is establishment of perfect wastewater treatment plant which is conventionally known as effluent treatment plant (ETP) & appropriate treatment of waste water regularly [5].

The textile industries are distinguished by the use of raw materials which determines the volume of water required for the process as well as wastewater generated. The major industries in Bangladesh are mainly raw cotton-based. In this type of production, slashing, bleaching, mercerizing, and dyeing are the major water consumption activities as well as wastewater generation processes.

During each stage different type of chemicals are used such as strong acids, strong alkalis, inorganic chlorinated compounds, hypochlorite of sodium, organic compound such as dye stuff, bleaching agent, finishing chemicals, starch, thickening agent, surface active chemicals, wetting and dispensing agents and salts of metals. Various dyes are used during dyeing stage for coloring purposes; multi color are used to improve best of products. The processing steps involved and associated pollutants parameter are shown in figure 1 [6].

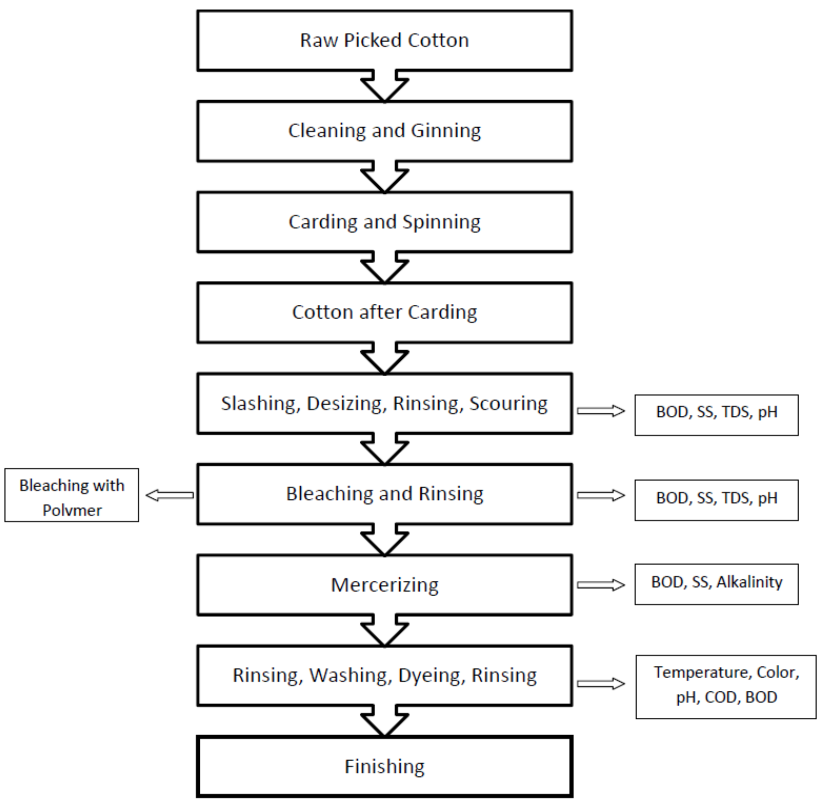


Figure 1. Cotton Fabric Production and Associated Parameters

Export oriented garments are playing vital role in the economy of Bangladesh. The wet processing factories have been established to support these garments. As a result a large number of wastewater creates serious water pollution by discharging untreated wastewater to water bodies. A large quantity of water is used for dyeing and washing purposes. Generally 30-40% of water is used for major chemical or dyeing operation. The remaining 60-70% water is used in the washing stage. The specific water consumptions for cellulosic fabric are 100-120 L/Kg. In 1994 it was quantified that 40,000 m^3/day wastewater was discharged from 502 textile industries which created 26,000 kg/day BOD load. According to another report individual small scale dyers discharge 8m^3/day wastewater and the corresponding value for large scale dyers is 70-400 m^3/day [5]. It was quantified recently that 1,28,700 m^3/day waste water produced for 1430 tons/day knit processing products [7a]. From another source it has been estimated that 2 millionm^3 effluents are discharged every day from Textile sector in Bangladesh [7b].

The source of water pollution contributed by textiles is wet processing steps. It includes sizing, desizing, scouring, bleaching, mercerizing, dyeing, printing and finishing. We know that water is used in wet processing and commonly 1kg fabric needs 120L water for complete textile processing. It is estimated that (12-65) L of water is required for processing one meter of cloth. So it is easily understood that what a large volume of waste water generates daily from different textile mills.

Table 1. Water Consumption and Corresponding Effluent Generation in Various Processes of Textiles

Production of mill (m/day)	Water Consumption (KL/day)	Volume of effluent (KL/day)
2,20,000	13,870	8,000
1,90,000	2,300	1,900
80,000	3,500	3,400
45,000	1,830	1,750
35,000	1,050	800

1.2. Comparative Study with Neighboring Countries

1.2.1. Textile Industry in China [8, 9b]

China holds an impassive place in Textile Industry and is leading global production without any impediment. On an intensive study at the end of 2009 which tells that in spite of the negative impacts of global financial crises, China still holds an attractive position in the World Textile Industry (China's competitiveness index for this industry was evaluated at 102.8 in 2009). China retains 1st position in US market with 36% share of US total textile imports and again at the top table in European market with a share of 29% of European Union total textile imports in the world.

In the first 10 months of 2010, China's exports had been more than US $ 62 billion which were higher than the same period during 2009. However China Textile is changing rapidly. For the past few decades foreign investment and the modern technology have linked themselves to this sector. As a result of this, China has stepped forward in world's production of more civilized and value added products.

Huge amount of foreign investment, low cost labor force, advanced technology and depreciated exchange rates are the most important factors of China's towering status in Textile Industry.

1.2.2. Textile Industry in India

India Textile Industry is the oldest and biggest industry of India. Rather it is the biggest industry after China in the world. The industry contributes 14% of industrial production in the country. This industry earns 17% of her total exports also. Textile Industry of India provides employment opportunities to 35 million people of the country.

India is the biggest country of the world in Jute production, 2nd in Silk production, 3rd in cotton production while 5th big country in Synthetic fiber production [2].

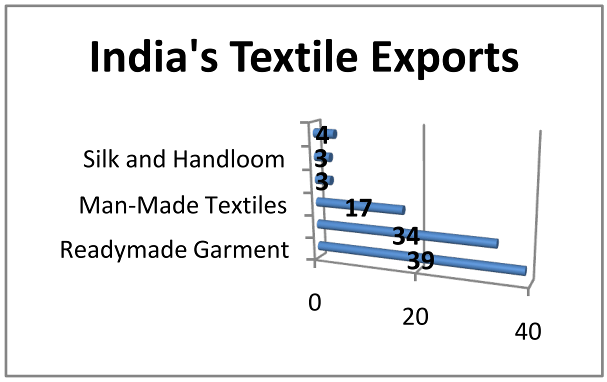


Figure 2. India's Textile Exports [19]

India's Textile Industry can be classified into two big sectors.

1. An organized mill sector.
2. An unorganized decentralized sector.

India is the biggest exporter of Yarn in international market and has a share of 25% in the World Yarn Export Market and has a share of 12% in Yarn and Textile Fiber production in the world. India has the highest capacity of loom and has a share of 61% in the world loom age.

Low cost skilled manpower, availability of cheap raw material, availability of numerous varieties in cotton fiber, a big and potential national and international market and independent textile industry are the factors which make India outshine in Textile Industry.

1.2.3. Textile Industry in Pakistan

The role of Textile Industry of Pakistan in the gross economic activities has been very positive and distinctive. More than 40% of manpower of industrial sector link to this sector whereas the contribution of the textile industry towards the total export of Pakistan is approximately 63%. Pakistan is the 8th large country in Asia in terms of textile production. But its contribution towards World Textile Trade is even less than 1%.

Pakistan is the 4th big country in the world in cotton production. Pakistan is in the 3rd position after China and India in the capacity of spinning and provides 5% of spinning capacity in the world. The total share of this sector in GDP of Pakistan is nearly 9.5% during the fiscal year 2010.

The growth of Pakistan Textile Industry is marred by gas and electricity crises, an increase in yarn prices, increase in the minimum wages of industrial laborers, political instability, mal-transportation system and tariff and trade contracts are incessant obstruction [2].

Changes in factor endowment along with changes in trade policies may have provided necessary stimulation to boost up Bangladesh's clothing industry. Despite the global recession, demand for Bangladeshi cheap clothing did not fall. Bangladesh is obviously in a better position regarding the price competitiveness of clothing sector compared to other major Asian clothing exporters. The RCA (Revealed Comparative Advantage) of Bangladesh's clothing [Table 2] maintains its increasing trend even though there were global economic downturns in years 1999, 2008-9 etc. and even after the removal of quota restrictions in 2005. However, countries like China and India show a decreasing trend in their respective RCA indices, specially, in the later years probably due to the global economic recession. Comparing RCAs among the top Asian clothing exporters, it can be clearly indicated that export based RCA of Bangladesh is continuously increasing compared to the other Asian competitors [Figure 3].

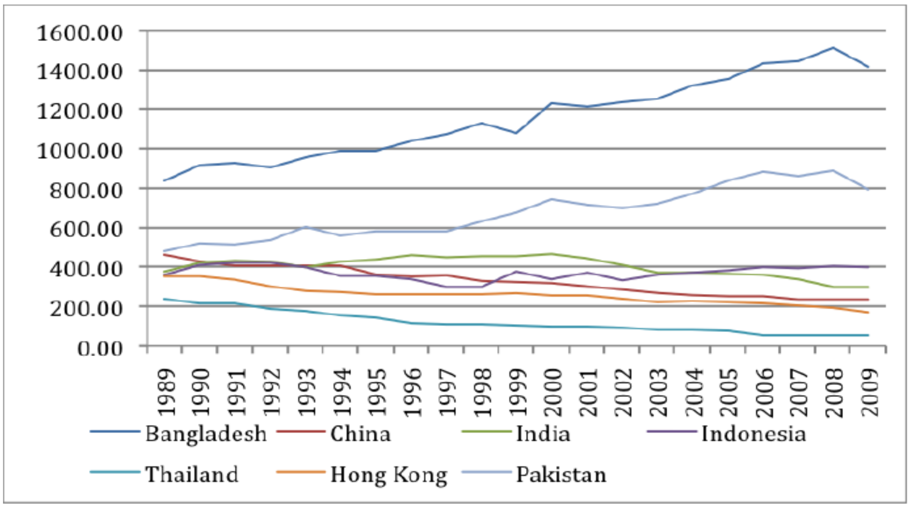


Figure 3. Comparisons of RCA among Asian CT exporters

Table 2. World's Leading Clothing and Textile (CT) Exports

Leading Clothing Exporters	Share in World Export (%)				Leading Textile Exporters	Share in World Export (%)			
	1980	1990	2000	2009		1980	1990	2000	2009
China	4.0	8.9	18.2	34	EU (27)	49.4	48.7	36.0	29.5
EU (27)	42.0	37.0	26.9	30.7	China	4.6	6.9	10.3	28.3
Hong Kong, China	12.3	14.2	12.2	10.2	Hong Kong, China	3.3	7.9	8.5	6.4
Turkey	0.3	3.1	3.3	3.8	United States	6.8	4.8	7.0	4.7
India	1.7	2.3	3.1	3.6	Korea Republic	4.0	5.8	8.1	4.3
Bangladesh	0	0.6	2.6	3.4	India	2.4	2.1	3.5	4.3
Vietnam	-	-	0.9	2.7	Taipei, Chinese	3.2	5.9	7.6	3.7
Indonesia	0.2	1.5	2.4	1.9	Turkey	0.6	1.4	2.3	3.7
United States	3.1	2.4	4.4	1.3	Pakistan	1.6	2.6	2.9	3.1
Mexico	0	0.5	4.4	1.3	Japan	9.3	5.6	4.5	2.9
Thailand	0.7	2.6	1.9	1.2	Indonesia	0.1	1.2	2.2	1.5
Pakistan	0.3	0.9	1.1	1.1	Thailand	0.6	0.9	1.2	1.4

Table 3. Revealed Comparative Advantage among the Asian Competitors

Year	Bangladesh	China	India	Hong Kong	Indonesia	Pakistan	Vietnam	Thailand
1989	837.81	462.39	379.30	353.27	361.39	480.70	365.10	238.24
1990	919.69	428.90	423.17	351.39	409.89	519.28	365.32	217.47
1991	927.96	408.08	430.81	333.88	418.97	513.02	354.73	215.27
1992	903.95	405.41	426.06	301.56	421.75	536.34	347.44	185.98
1993	955.53	404.92	397.73	281.59	396.89	603.42	357.59	174.27
1994	991.22	406.15	428.39	274.35	352.59	560.81	369.13	156.69
1995	990.75	363.56	436.83	261.44	352.11	578.58	452.98	145.43
1996	1042.65	352.72	458.44	261.56	339.67	578.89	454.28	113.59
1997	1073.89	353.94	450.49	261.30	312.25	583.35	438.77	108.09
1998	1129.57	328.21	454.88	265.30	299.66	632.82	421.39	110.49
1999	1081.30	322.71	454.30	270.83	379.05	673.41	419.73	103.06
2000	1230.65	314.55	466.19	259.14	339.54	743.28	489.68	96.39
2001	1212.71	298.74	443.66	258.17	373.36	716.61	498.26	97.85
2002	1236.06	280.53	412.25	240.45	333.51	697.77	468.99	89.90
2003	1253.35	268.56	370.32	227.06	357.69	721.56	451.17	81.21
2004	1318.14	254.93	372.43	228.54	373.03	770.54	472.56	79.32
2005	1354.07	248.81	362.74	222.19	380.62	836.87	498.98	73.90
2006	1432.16	250.85	359.51	216.43	401.55	884.59	470.01	67.36
2007	1445.29	244.53	335.66	206.29	394.15	863.04	458.44	56.64
2008	1511.03	236.24	299.08	195.39	403.84	888.85	549.65	56.47
2009	1415.68	235.65	303.94	170.62	401.22	792.39	513.28	54.01

It is also good to check whether RCA of clothing industry of Bangladesh is complementary or competing with her major trade partners. The highest correlation coefficient value of Pakistan, Indonesia and India indicates their strong rivalry towards our CT in world market. Relatively lower values of the correlation coefficient with China and Thailand postulate a gradual declining competitiveness with Bangladesh.

1.3. Objective

This review article has been prepared to compile all present data on Textile wastewater characterization of Bangladesh. This paper includes a comprehensive discussion on wastewater characterization of Bangladesh as well as a comparative study of Textile growth and pollution level by this sector between Textile dominating countries.

2. Characterization of Textile Wastes in Bangladesh

Until the middle of the 19^{th} century, all colorants applied were from natural origin. Inorganic pigments such as soot, manganese oxide, hematite and ochre have been utilized within living memory. Organic natural colorants have also a timeless history of application, especially as textile dyes. These dyes are all aromatic compounds, originating usually from plants (e.g. the red dye alizarin from madder and indigo).

Synthetic dye manufacturing was started commercially in 1856, when the English chemist W.H. Perkin, in an attempt to synthesize quinine, obtained it, instead of a bluish substance with excellent dyeing properties that later on became known as aniline purple, Tyrant purple or mauveine. Perkin, an 18-year old boy, patented his invention and set up a production line for mass production. Consequently, in the beginning of 20th century, synthetic dyestuffs almost completely supplanted the natural dyes.

Key environmental issues associated with textile manufacture are use of water, its treatment and disposal of effluent. The risk factors are primarily associated with the wet processes, such as, desizing, scouring, bleaching, mercerizing, dyeing and finishing. Desizing, scouring and bleaching processes produce large quantity of wastewater. Treatment for color removal can increase the risk of pollution. For instance, treating azo-dyes results in production of amines which could be a greater environmental risk than the dye itself. It is reported that textile effluent is very low in terms of LC50 and exhibit very high toxicity with acute toxicity unit (ATU) levels between 22 and 960.

Dyes are contributing to overall toxicity at all processing stages. Also, dye baths could have high level of BOD, COD, color, toxicity, surfactants, fibers, turbidity, and contain heavy metals [8c]. They generally constitute a small fraction of total liquid effluent, but may contribute a high proportion of total contaminants. It is to be note that textile effluents are highly colored and saline that contain non-biodegradable compounds, and are high in Biochemical and Chemical Oxygen Demand (BOD and COD). It is reported that the presence of metals and other dye compounds inhibit microbial activity and some cases may cause failure of biological treatment system. USEPA reported that the pollution parameters in textile effluents are suspended solids, BOD, COD, nitrogen, phosphate, temperature, toxic chemicals (phenol), chromium and other heavy metals, pH-value, alkalinity and acidity, oils and grease, sulphide, and coliform bacteria. The Department of Environment of Bangladesh has supported these and demands for their proper monitoring in the textile effluents in the country. Textile effluents are high in BOD due to fiber residues and suspended solids [8c]. They can contaminate water with oil & grease, and waxes, while some may contain heavy metals, such as, chromium, lead, copper, zinc and mercury. Dyeing process usually contributes chromium, lead, zinc and copper to wastewater. Copper is toxic to aquatic plants at concentrations below 1.0 mg/L while concentrations near this level can be toxic to some fishes [8d].

There are a lot of different kinds of industries in Bangladesh. All these industries have different waste problems. A grading of index of the level of pollution is made and given in Table 4 [6].

Table 4. Water pollution source and their ranking in Bangladesh

Industry	Water Pollution	Pollution Product	Ranking
Agriculture	Moderate	1.08	3
Textile	Big	3.35	1
Transport	Small	0.02	6
Construction	Small	0.14	5
Paper	Very big	0.67	4
Leather	Extreme	1.88	2
Sugar	Extreme	1.72	2

Textile manufacturing sector is the major industrial water users. A lot of chemicals are added to the process for cleaning and dyeing purposes. Obviously, the wastewater effluents from textile mills contain considerable amounts of hazardous pollutants, where heavy metals are very common. Most of the effluents from the textile industries are discharged untreated into rivers, as a result, a considerable portion of the available water is being polluted by the textile effluents and about two thirds of diseases are related to water-borne diseases in Bangladesh. The textiles mill actually represents a range of industries with operations and processes as diverse as its products. Industrial pollution is one of the problems presently facing Bangladesh and several efforts are being vigorously pursued to control it in various industries to see that people live in a disease free environment. Effluent generated by the textile industries is one of the important sources of pollution increasingly stringent effluent discharge permit limitations have been put into effect. The textile industry generally has difficulty in meeting wastewater discharge limits, particularly with regard to dissolved solids, pH, BOD, COD, sometimes, heavy metals and color of effluent [9b, c].

Some of the main parameters listed in the water quality discharge standards are briefly discussed here to give a working knowledge of what they are and why they are important?

Color

Although color is not included in the Environment Conservation Rules (1997), it is an issue in dye house effluent because unlike other pollutants it is so visible. Reducing color is therefore important for the public perception of a factory. Consequently, international textile buyers are increasingly setting discharge standards for color. However, as a health and environmental issue color is less of a concern than many of the other parameters.

BOD and COD

Measurement of the oxidisable organic matter in wastewater is usually achieved through determining the 5-day biological oxygen demand (BOD_5), the chemical oxygen demand (COD) and total organic carbon (TOC).

BOD_5 is a measure of the quantity of dissolved oxygen used by microorganisms in the biochemical oxidation of the organic matter in the wastewater over a 5-day period at 20^{o}C. The test has its limitations but it still used extensively and is useful for determining approximately how much oxygen will be removed from water by an effluent or how much may be required for treatment and is therefore important when estimating the size of the ETP needed.

COD is often used as a substitute for BOD as it only takes a few hours not five days to determine. COD is a measure of the oxygen equivalent of the organic material chemically oxidised in the reaction and is determined by adding dichromate in an acid solution of the wastewater.

DO (Dissolved Oxygen)

Dissolved oxygen analysis measures the amount of gaseous oxygen (O_2) dissolved in an aqueous solution. Oxygen gets into water by diffusion from the surrounding air, by aeration (rapid movement), and as a waste product of photosynthesis.

When performing the dissolved oxygen test, only grab samples should be used, and the analysis should be performed immediately. Therefore, this is a field test that should be performed on site.

TDS and TSS

Wastewater can be analysed for total suspended solids (TSS) and total dissolved solids (TDS) after removal of coarse solids such as rags and grit. A sample of wastewater is filtered through a standard filter and the mass of the residue is used to calculate TSS. Total solids (TS) is found by evaporating the water at a specified temperature. TDS is then calculated by subtracting TSS from TS. Currently TDS and TSS are measured by pocked sized meters [9c].

Metals

A number of metals are listed in the national environmental quality standards for industrial wastewater, including cadmium, chromium, copper, iron, lead, mercury, nickel and zinc. Many metals, which are usually only available naturally in trace quantities in the environment, can be toxic to humans, plants, fish and other aquatic life.

Table 5. National Standards - Waste Discharge Quality Standards for Industrial Units and Projects (quality standard at discharge point)

Parameter	Unit	Inland Surface Water	Public Sewer secondary treatment plant	Irrigated Land
Ammonical Nitrogen (N molecule)	mg/L	50	75	75
Ammonia (free ammonia)	mg/L	5	5	15
Arsenic	mg/L	0.2	0.5	0.2
BOD_5, 20℃	mg/L	50	250	100
Boron (B)	mg/L	2	2	2
Cadmium (Cd)	mg/l	0.05	0.5	0.5
Chloride (Cl^-)	mg/L	600	600	600
Chromium (total Cr)	mg/L	0.5	1	1
COD	mg/L	200	400	400
Chromium (hexavalent Cr)	mg/L	0.1	1	1
Copper (Cu)	mg/L	0.5	3	3
Dissolved Oxygen (DO)	mg/L	4.5-8	4.5-8	4.5-8
Electrical Conductivity	micro mho/cm	1200	1200	1200
Total Dissolved Solids (TDS)	mg/L	2100	2100	2100
Fluoride (F)	mg/L	7	15	10
Sulfide (S)	mg/L	1	2	2
Iron (Fe)	mg/L	2	2	2
Total Kjeldahl Nitrogen (N)	mg/L	100	100	100
Lead (Pb)	mg/L	0.1	0.1	0.1
Manganese (Mn)	mg/L	5	5	5
Mercury (Hg)	mg/L	0.01	0.01	0.01
Nickel (Ni)	mg/L	1	1	1
Nitrate (N molecule)	mg/L	10	Undetermined	10
Oil & Grease	mg/L	10	20	10
Phenol Compounds (C6H5OH)	mg/L	1	5	1
Dissolved Phosphorus (P)	mg/L	8	8	10
Radioactive materials:	As determined by Bangladesh Atomic Energy Commission			
pH		6-9	6-9	6-9
Selenium (Se)	mg/L	0.05	0.05	0.05
Zn (Zn)	mg/L	5	10	10
Temperature				
Summer	°C	40	40	40
Winter	°C	45	45	45
Total Suspended Solid (TSS)	mg/L	150	500	200
Cyanide (CN)	mg/L	0.1	2	0.2

Phosphorus, Total Nitrogen, Nitrate and Ammonia

These parameters are all used as a measure of the nutrients present in the wastewater, as a high nutrient content can result in excessive plant growth in receiving water bodies, subsequent oxygen removal and the death of aquatic life.

pH

pH is a measure of the negative logarithm of hydrogen ion concentration in the wastewater and gives an indication of how acid or alkaline the wastewater is. This parameter is important because aquatic life such as most fish can only survive in a narrow pH range between roughly pH 6-9.

Sulphur and Sulphide

Textile dyeing uses large quantities of sodium sulphate and some other sulphur containing chemicals. Textile wastewaters will therefore contain various sulphur compounds and once in the environment sulphate is easily converted to sulphide when oxygen has been removed by the BOD of the effluents. This is a problem because hydrogen sulphide can be formed which is a very poisonous gas, it also has an unpleasant smell of rotten eggs. The presence of sulphides in effluents can interfere with biological treatment processes.

Oil and Grease

This includes all oils, fats and waxes, such as kerosene and lubricating oils. Oil and grease cause unpleasant films on open water bodies and negatively affect aquatic life. They can also interfere with biological treatment processes and cause maintenance problems as they coat the surfaces of components of ETPs [9a].

EC (Electrical Conductivity)

The electrical conductivity of water estimates the total amount of solids dissolved in water -TDS, which stands for Total Dissolved Solids. TDS is measured in ppm (parts per million) or in mg/l. Since the electrical conductivity is a measure to the capacity of water to conduct electrical current, it is directly related to the concentration of salts dissolved in water, and therefore to the Total Dissolved Solids (TDS).

The electrical conductivity of the water depends on the water temperature: the higher the temperature, the higher the electrical conductivity would be. The electrical conductivity of water increases by 2-3% for an increase of 1 degree Celsius of water temperature. Many EC meters nowadays automatically standardize the readings to 25℃.

The commonly used units for measuring electrical conductivity of water are: µS/cm (micro Siemens/cm) or mS/cm (milli-Siemens), where: 1 mS = 1000 µS [21a].

Strong influence on the potential impacts associated with textile manufacturing operations due to the different characteristics associated with the effluents is shown in Table 2.3. Specific water use varies from 60-400 L/kg of fabric, depending on the type of fabric [8c].

3. Textile Wastewater Characterization in Bangladesh (2005-2014)

Physicochemical parameters of Textile wastewater of Bangladesh have been summarized. The review has been done based on literature of last ten years (2005-2014).

3.1. Measurement and Method

A significant number of experiment and research have done on Textile wastewater Characterization of different textile industrial zones in Bangladesh. The samples were analyzed for various physicochemical parameters like, TDS, pH, EC, Temperature, BOD, COD and TSS according to standardized method. In those experiments, the researchers used a standard method for sampling (ISO5667-02:1996 E).

4. Results and Discussion

Table 6. Effluent Characteristics of Textile Industry Processes

Process	Effluent Composition	Pollutant Nature
Sizing	Starch, waxes, Carboxymethyl Cellulose (CMC), Polyvinyl Alcohol (PVA), wetting agents.	High in BOD, COD
Desizing	Starch, CMC, PVA, fats, waxes, pectins	High in BOD, COD, SS, dissolved solids (DS)
Bleaching	Sodium Hypochlorite, Cl_2, NaOH, H_2O_2, acids, Surfactants, $NaSiO_3$, Sodium Phosphate, short cotton fibre	High alkalinity, high SS
Mercerizing	Sodium Hydroxide, cotton wax	High pH, low BOD, high DS
Dyeing	Dyestuffs Urea, reducing agents, oxidizing agents, Acetic acid, detergents, wetting agents.	strongly colored, high BOD, DS, low SS, heavy metals
Printing	Pastes, urea, starches, gums, oils, binders, acids, Thickeners, cross-linkers, reducing agents, alkali	Highly colored, high BOD Oily, appearance, SS, slightly alkaline

Table 7. Physicochemical Parameters of Textile Effluent Collected From Different Areas of Bangladesh

AREA	CONDITION	COLOR	ODOR	Temp. (°C)	pH	TDS (mg/L)	DO (mg/L)	COD (mg/L)	BOD5 (mg/L)	TSS (mg/L)	EC(μs/cm)	YEARS	Ref.
Savar (DEPZ)		Deeply Colored	Pungent	37-65	8.7-11	460-5981	0-5.65		90-460.6	24.9-524	250-7950	2005	15
Dhaka (Shavar)	Outlet					984--1148			46.9-58.5	872.85-1282.4		2006-2007	16
Savar	Outlet: Drain			41.2	9.8	3392	0.11	2304	151.24	278	4820	2007	14
Savar (DEPZ)				28-65	8.7-11.2	1740-5981	0-6	118-1497	60-461	24.9-524	1300-7950 (MS/cm)	2007	15
Savar	Outlet: Drain			40.5-43	9.6-11.2	1856-4356	0.23-0.5	652.8-800	299.1	100-336	2210-6020	2008	14
Savar (Karnapara)	Treated Effluent				4.98-5.22						1.91-2.04 (mS/cm)	2009	17
Savar	Raw wastewater from inside the factory	Blue	Pungent & Odorless		10.4-10.5	2136-2386						2010	11
Savar	Outlet: Drain	Blue	Odorless		10.4-10.7	2560-3226						2010	11
Savar					10.4-10.7	2136-3226						2010	7
Savar					7.3-11	764-1125		487-768	140-320		1108-1547	2013	13
Savar (Dhaka EPZ)	main drain				10	3380		680	230		1503	2013	13
Ashulia	Wastewater from outlet cannel discharged to Turag river water	Pale Blue	Pungent		6.9-7.2	490-498						2010	11
Ashulia					6.9-7.2	490-498						2010	7
Ashulia					11	3552		1240	340		1232	2013	13
Dhamrai					6.7-6.9	518-524						2010	7
Dhamrai	Wastewater from outlet cannel discharged to Bongshi river water .	Pale Blue	Pungent		6.7-6.9	518-538						2010	11
Gazipur	Inside treated wastewater	Grey	Odorless		7.1-7.3	1010-1177						2010	11
	Outside treated water	Grey	Foul odor		9.1	892							
	Wastewater from drain	Pale blue	Foul odor		7.5	665							
	From river	Yellowish	Odorless		7.8-8.8	501-830							
	From plane land	Pale blue	Foul odor		8.7-9.6	798-3304							
	From drain	Pale blue & Pink	Foul odor		9.2-9.8	1107-2808							
Gazipur					7.1-9.8	501-3304						2010	7
Gazipur				34.7-46.3	7.75-13.61	1056-7130	1.2-7.0	238-2430	117-786	49-471		2011	6
Gazipur	Discharge	Black	Odorless	27.5-32	7.2-7.8	2218-2360	2.8-5.81	41-140	28-10			2012	12
	Pond	Black,Bluish & Greenish	Foul & Pungent	27-35	9.2-10.9	2509-2818	2.1-5.4	308	108				
	Canal	Black,Reddish,Bluish & Greenish	Foul & Pungent	27-32.5	9.5-11.3	2374-3012	1.95-4.32	301-323	98-126				
	Open area	Black,Bluish & Greenish	Foul & Pungent	28.5-33.5	8.9-10.7	2308-2983	3.24-5.41						
	Paddy field	Greenish	Foul	28.5	10.8	2503	2.03						
Gazipur					8.9-10	531-1006		560-965	190-410		0.888-1701	2013	13
Narshindi					5.0-14	127-2676						2010	7
Narshindi	Inside treated wastewater	Grey	Foul odor		5.9	261						2010	11
	Treated wastewater	Grey	Foul odor		5.0-5.5	260-262							
	Raw wastewater	Black	Foul odor		14	2676							
	From river	Pale pink/ Pale green	Pungent		6.1-9	288-593							
	From plane land	Pale pink/ Yellowish	Pungent		9.8-14	127-1638							
	From drain	Pale green	Pungent		10-10.7	390-456							
Narayangonj (Fatullah)		Deeply Colored	Pungent	30-40.56	6.5-10	260-5990	0.17-6.5		80-405	980-3950	4875-63750	2007	15
Narayangonj	Discharge drain of factory and Raw wastewater	Blue, Black and Pink	Pungent and Foul	25-45	5-10.3	803-3260						2011	10
Narayangonj					6.8-11	152-1011		268-1275	60-450		592-1696	2013	13
Dhaka (Karnatoli River)	surface water					90.7-457			24.5-48.3	78.35-303.4		2006-2007	16
Dhaka (Tejgaon)	Outlet & Main drain of Tejgaon I/A				7.7-12	843-1730		224-954	90-480		1017-1417	2013	13
Kashimpur	Outlet & turag River				8.9-9.2	685-1338		585-1120	260-420		1223-1907	2013	13
Hazaribagh	Main drain & Drain near river				3.9-4.5	4271-5240		1675-1850	560-620		448-485	2013	13
Chittagong	Discharge drain of factory and Dumping point of Kornofuli river	Blue, Pink, Violet and Gray	Pungent and Foul	25-55	7.1-11.1	411-1483						2011	10
Chittagong					8.9-11	685-1338		487-1120	140-420		1108-1907	2013	18
Pabna					6.8-11	152-1011		268-1275	60-450		592-1696	2013	18
Sylhet					3.9-4.5	4271-5240		1675-1850	560-620		448-485	2013	18

Table 8. Summary of the effluent discharging condition in different areas of Bangladesh

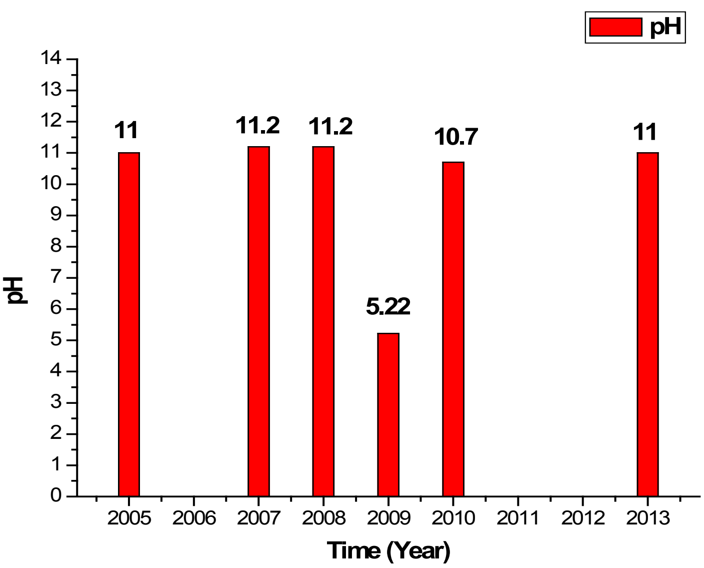
	Parameters	pH	TDS	DO	COD	BOD_5	TSS	EC
Areas								
Savar	Exceed Limit %	83.3	83.3	66.7	100	100	100	100
	Within Limit %	16.7	16.7	33.3	0	0	0	0
Ashulia	Exceed Limit %	50	50	-	-	-	-	-
	Within Limit %	50	50	-	-	-	-	-
Gazipur	Exceed Limit %	100	75	0	100	100	-	-
	Within Limit %	0	25	100	0	0	-	-
Narayangonj	Exceed Limit %	100	66.7	-	-	100	-	100
	Within Limit %	0	33.3	-	-	0	-	0
Dhaka	Exceed Limit %	-	0	-	-	50	-	-
	Within Limit %	-	100	-	-	50	-	-
Chittagong	Exceed Limit %	100	0	-	-	-	-	-
	Within Limit %	0	100	-	-	-	-	-

Color, odor, temperature, pH, Total dissolved solids (TDS), Dissolved oxygen (DO), Chemical oxygen demand (COD), Biochemical oxygen demand (COD) and Electrical conductance (EC) are major characterizing physicochemical parameters of Textile effluents. There are different textile industrial zones in Bangladesh. These are Savar, Ashulia, Dhamrai, Gazipur, Narayangonj and Chittagong. The textile wastewater characterization results have been summarized with respect to area and year based on available literature in local and international journals in Table 8. As per the results in Table 7, we can state that wastewater samples were collected from various sources, such as drain, open areas, raw wastewater, treated wastewater etc. to get actual picture of pollution level of Bangladesh. Various colors such as blue, green, yellow, pink, gray, black etc. reported in the Table. Pungent and foul odorwere found in most of the wastewater samples. We can summarize results as temperature (25-65℃), pH (3.9-14), TDS (90.7-5980 mg/L), DO (0-7 mg/L), COD (41-2430 mg/L), BOD (10-620 mg/L), TSS (24.9-3950 mg/L) and EC (250-63750)µS/cm [Table 7]. Most of these values are above the standards [Table 5].

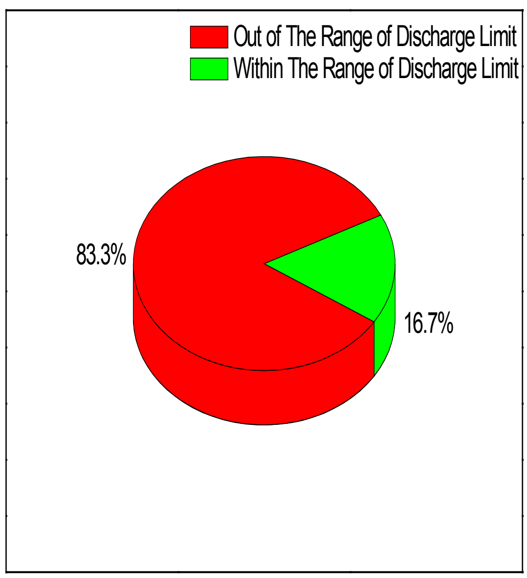
4.1. Year Wise Variation

The available data in Table 7 have been treated to get bar and pie charts for easy and clear understanding of readers.

I. SAVAR



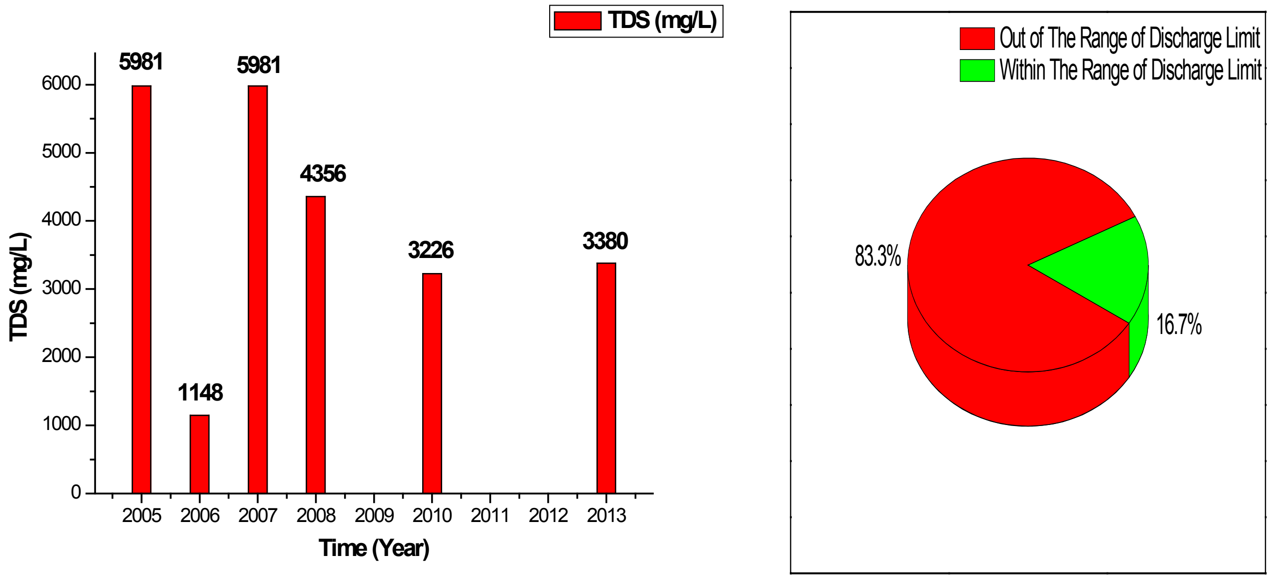
(a)



(b)

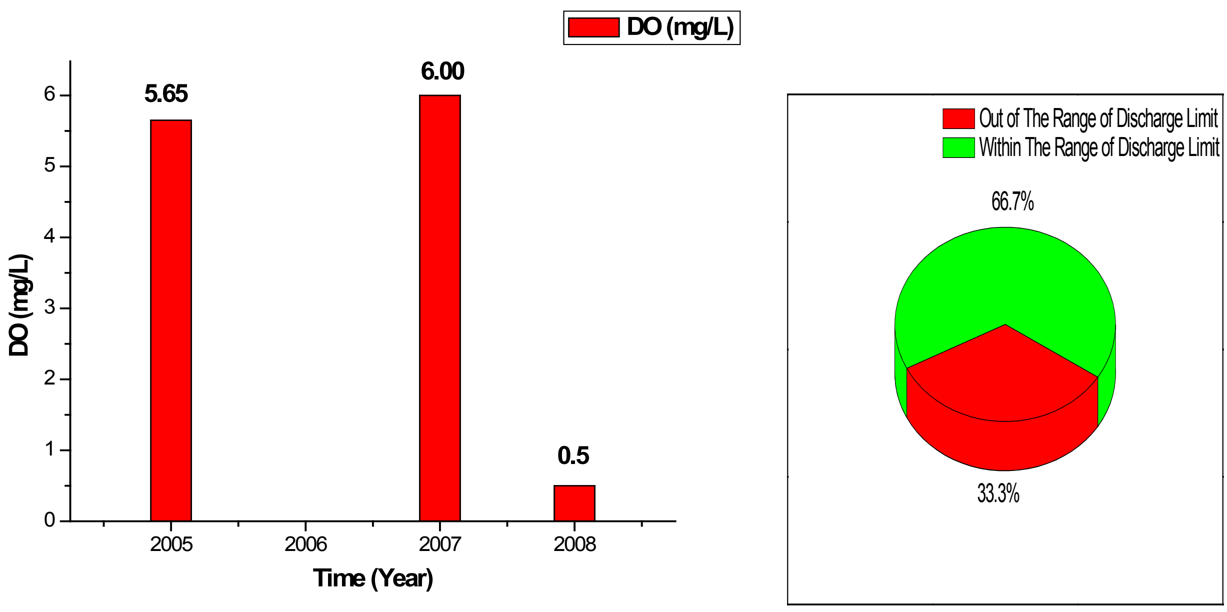
Figure 4. (a) A bar chart of year wise variation in pH at Savar. (b) Apie chart of pH discharging condition with reference to the discharge limit

The bar chart for pH*vs.* year of Savar area has been shown in Figure 4 (a). The bar chart shows pH values of Textile wastewater at different years. For example pH is 11 in 2005 and remained same in 2013. The corresponding pie chart (Figure 4 b) indicates that 83.3 % wastewater samples were out of the range of discharge limit (6-9). Similarly the bar chart TDS (mg/L) vs. year (Figure 5a) indicates corresponding TDS values of Textile wastewater samples at different years. The corresponding pie chart (Figure 5b) has been generated based on national discharge limit of TDS (2100 mg/L) [Table 5]. The other parameters, DO, COD, BOD, TSS and EC are shown in bar & pie charts in Figures 6a-10b.



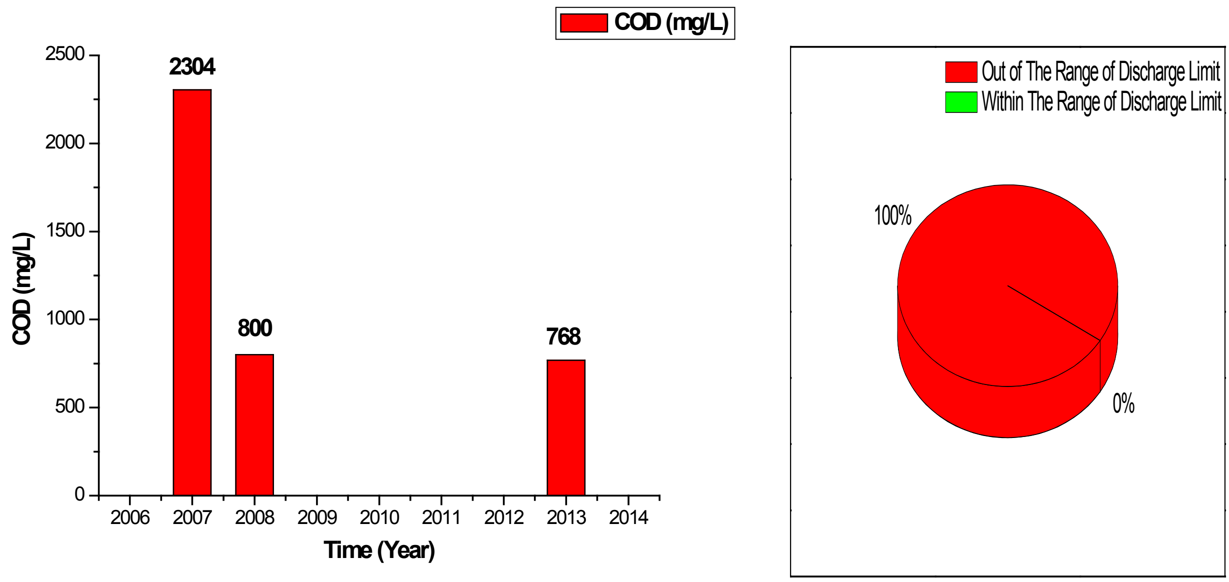
(a) (b)

Figure 5. (a) A bar chart of year wise variation in TDS at Savar. (b) A pie chart of TDS discharging condition with reference to the discharge limit



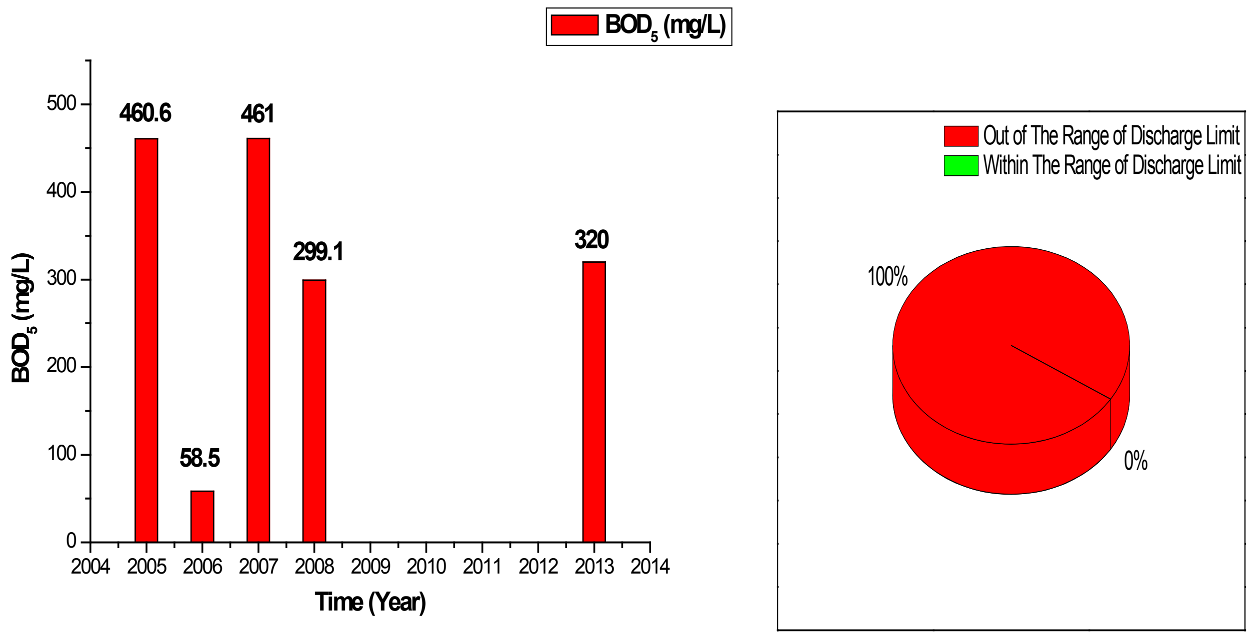
(a) (b)

Figure 6. (a) A bar chart of year wise variation in DO at Savar. (b) A pie chart of DO discharging condition with reference to the discharge limit



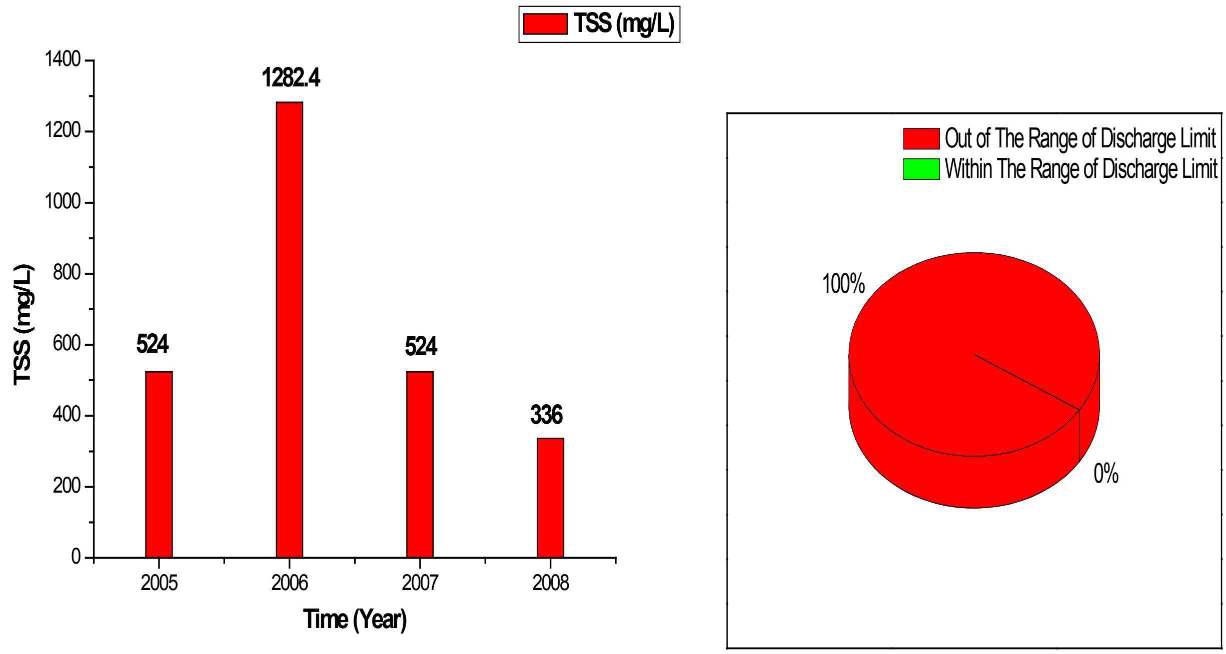
(a) (b)

Figure 7. (a) A bar chart of year wise variation in COD at Savar. (b) A pie chart of COD discharging condition with reference to the discharge limit



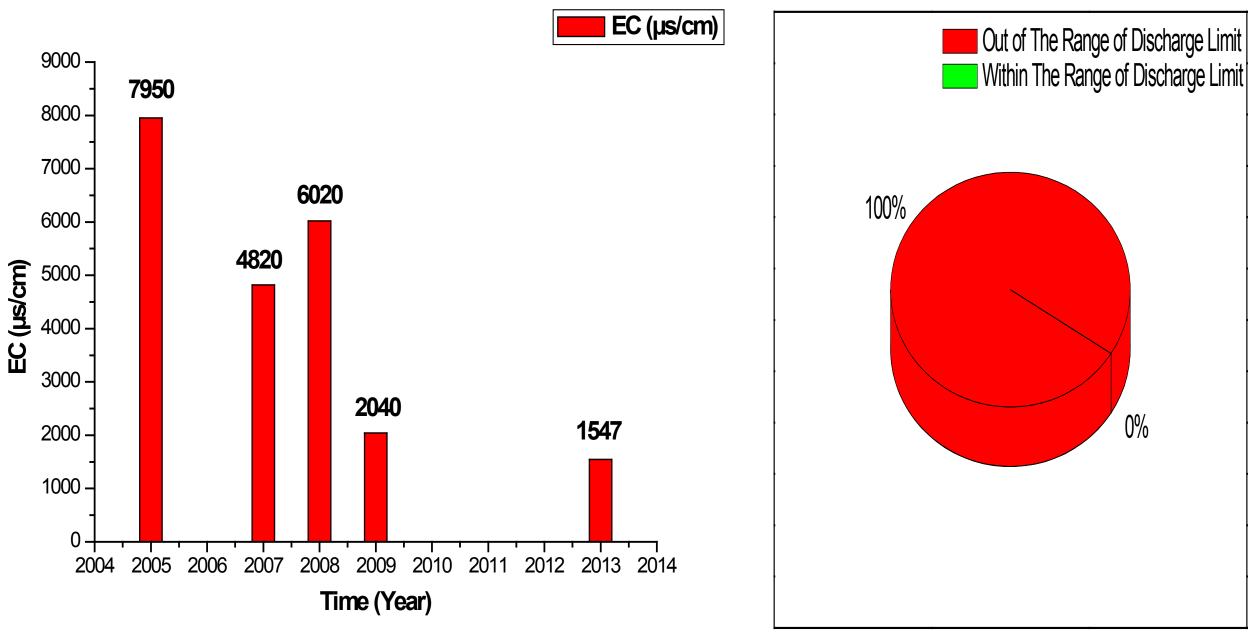
(a) (b)

Figure 8. (a) A bar chart of year wise variation in BOD at Savar. (b) A pie chart of BOD discharging condition with reference to the discharge limit



(a) (b)

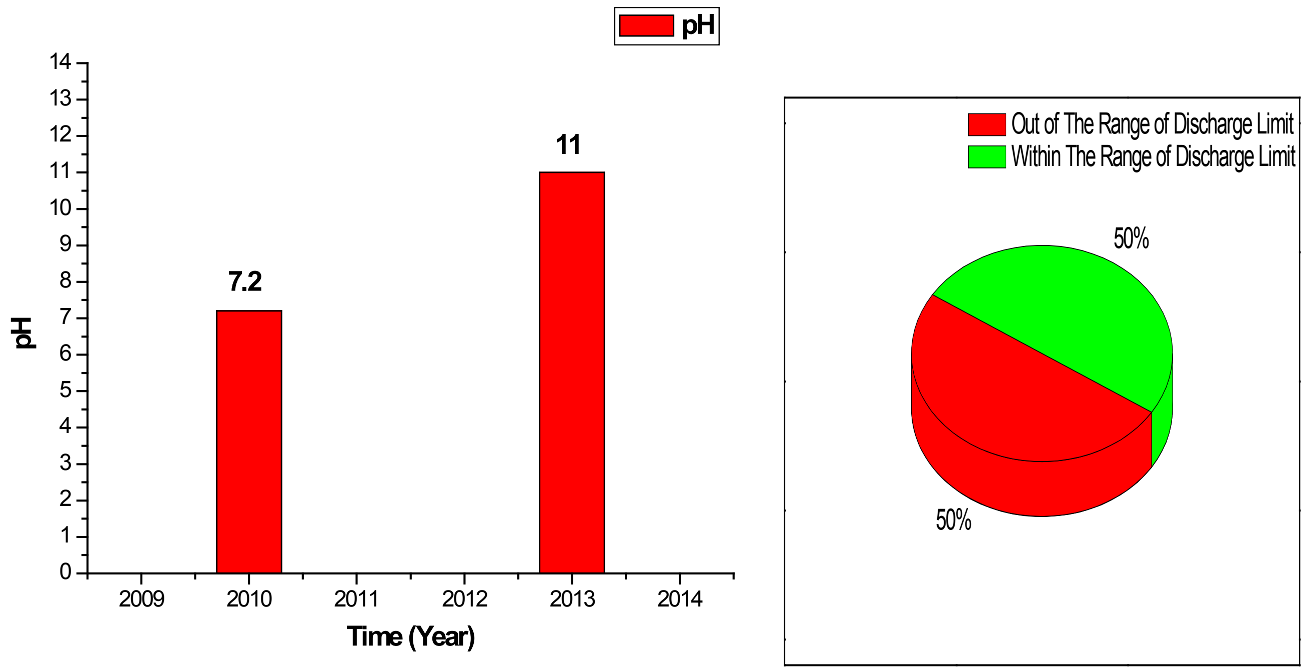
Figure 9. (a) A bar chart of year wise variation in TSS at Savar. (b) A pie chart of TSS discharging condition with reference to the discharge limit



(a) (b)

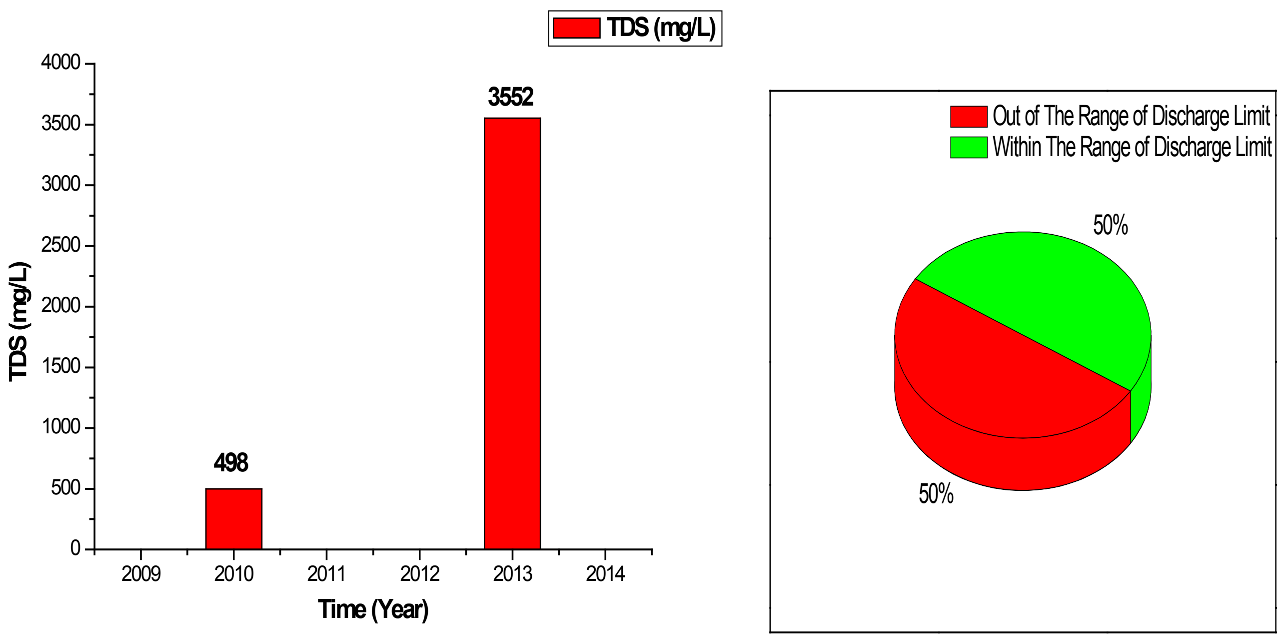
Figure 10. (a) A bar chart of year wise variation in EC at Savar. (b) A pie chart of EC discharging condition with reference to the discharge limit

II. ASHULIA



(a) (b)

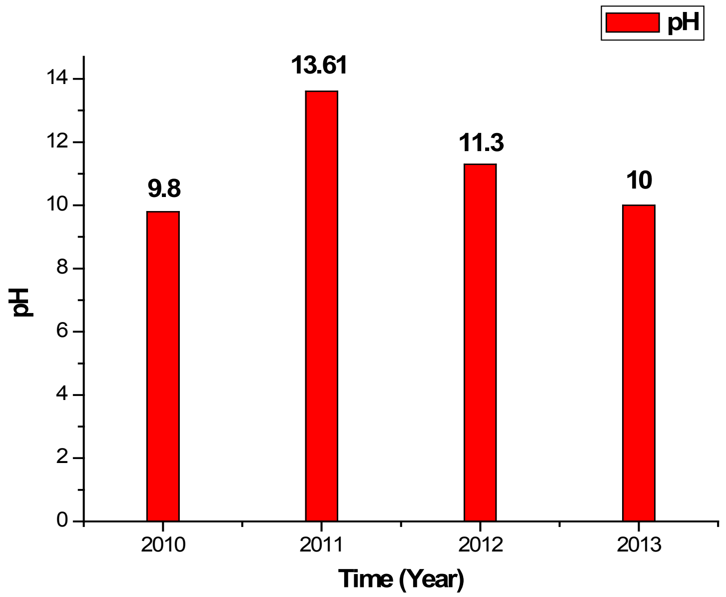
Figure 11. (a) A bar chart of year wise variation in pH at Ashulia. (b) A pie chart of pH discharging condition with reference to the discharge limit



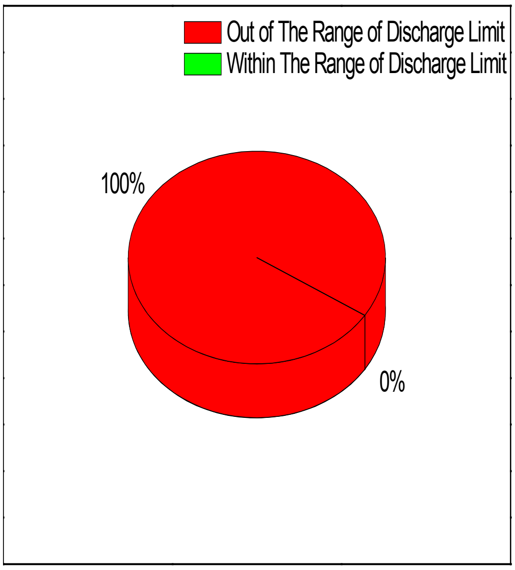
(a) (b)

Figure 12. (a) A bar chart of year wise variation in TDS at Ashulia. (b) A Pie chart of TDS discharging condition referring to the discharge limit

III. GAZIPUR

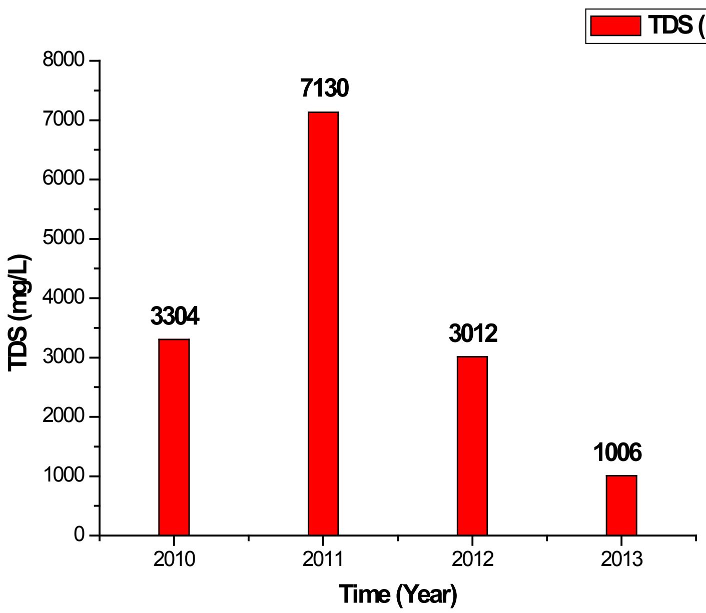


(a)

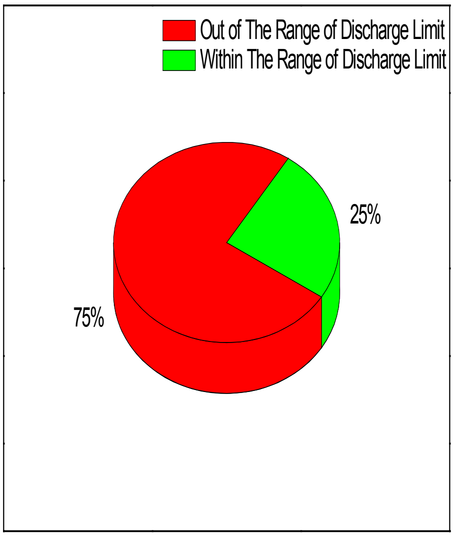


(b)

Figure 13. (a) A bar chart of year wise variation in pHat Gazipur. (b) A pie chart of pH discharging condition with reference to the discharge limit

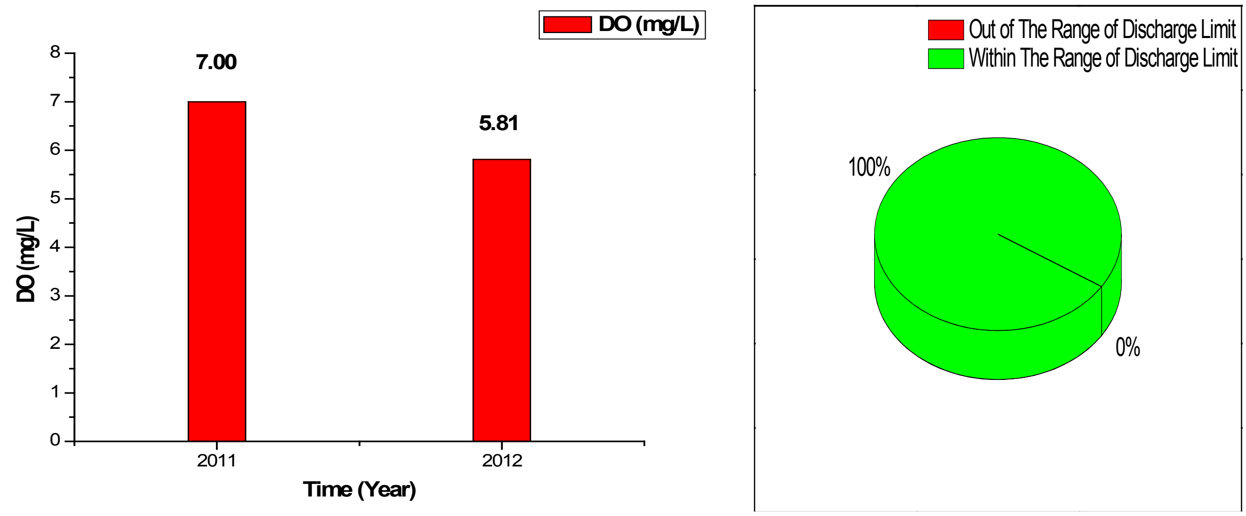


(a)



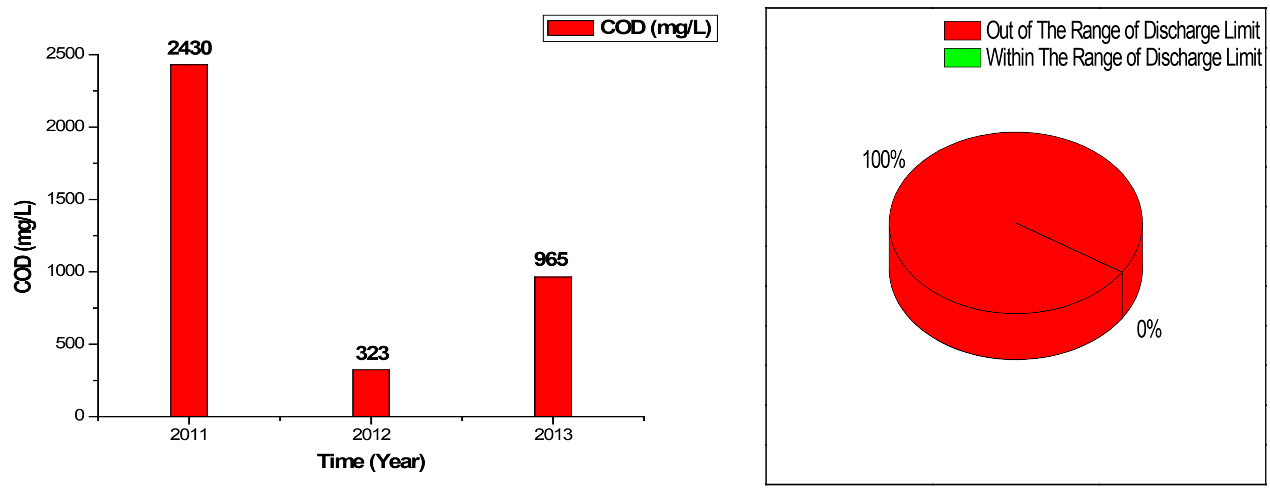
(b)

Figure 14. (a) A bar chart of year wise variation in TDS with time to time at Gazipur. (b) A pie chart of TDS discharging condition with reference to the discharge limit



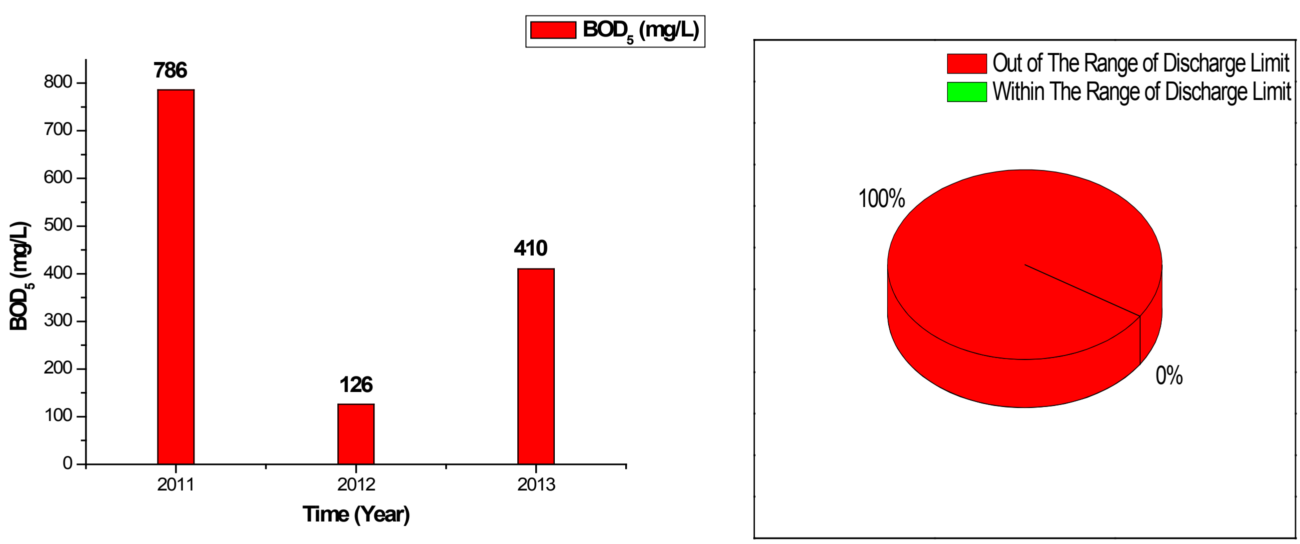
(a) (b)

Figure 15. (a) A bar chart of year wise variation in DO at Gazipur. (b) A pie chart of DO discharging condition with reference to the discharge limit



(a) (b)

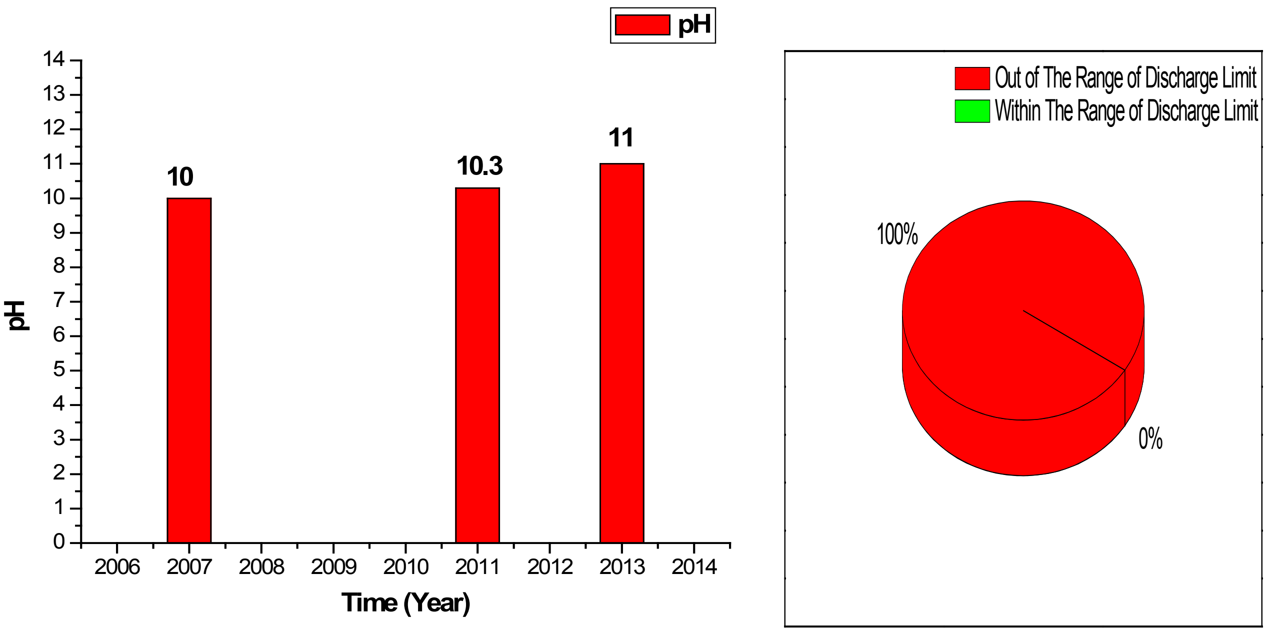
Figure 16. (a) A bar chart of year wise variation in COD at Gazipur. (b) A pie chart of COD discharging condition with reference to the discharge limit



(a) (b)

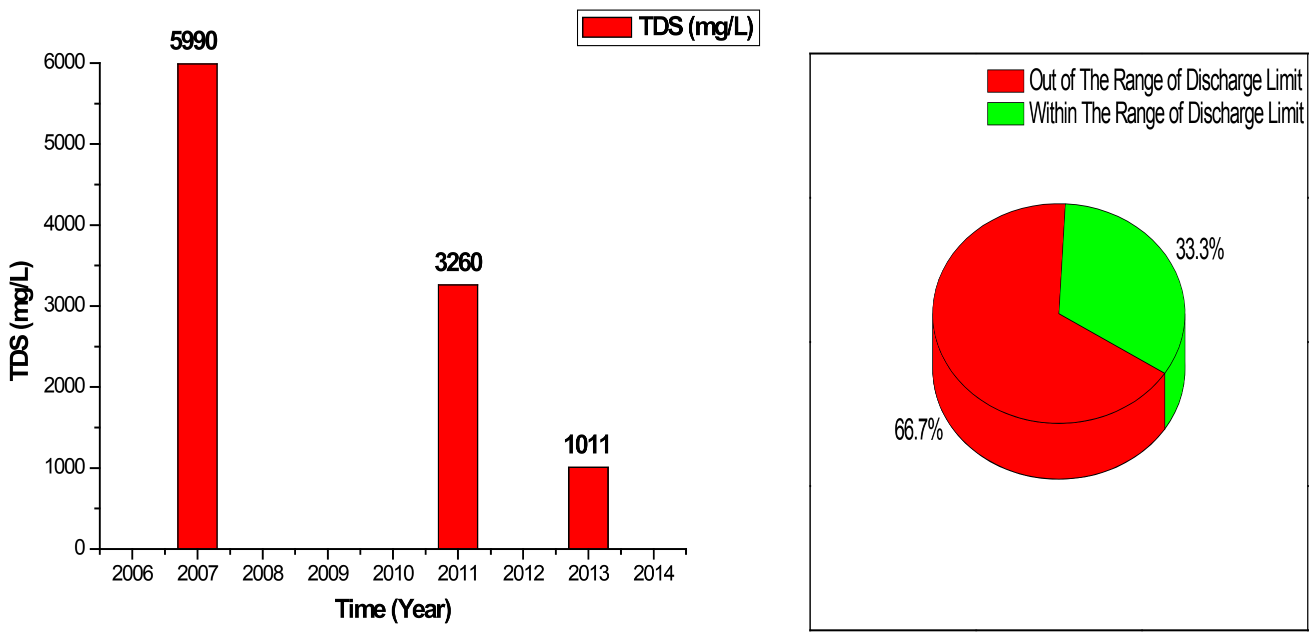
Figure 17. (a) A bar chart of year wise variation in BOD_5 at Gazipur. (b) A pie chart of BOD_5 discharging condition with reference to the discharge limit

IV. NARAYANGONJ



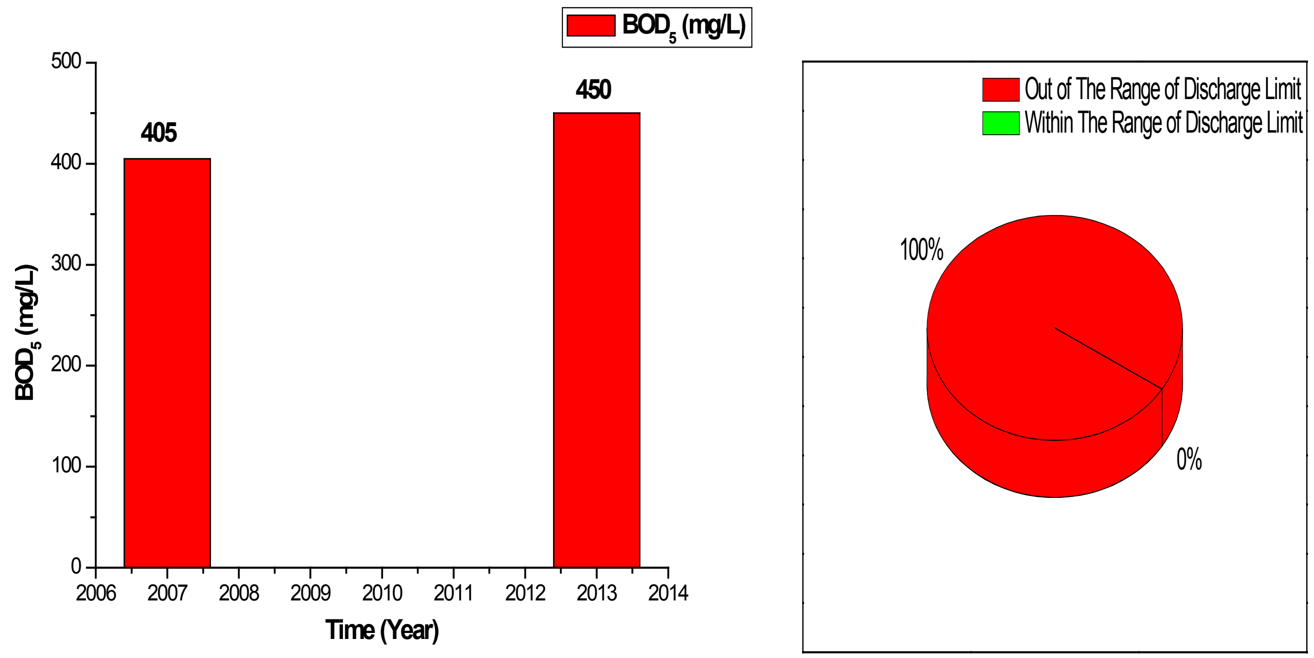
(a) (b)

Figure 18. (a) A bar chart of year wise variation in pH at Narayangonj. (b) A pie chart of pH discharging condition with reference to the discharge limit



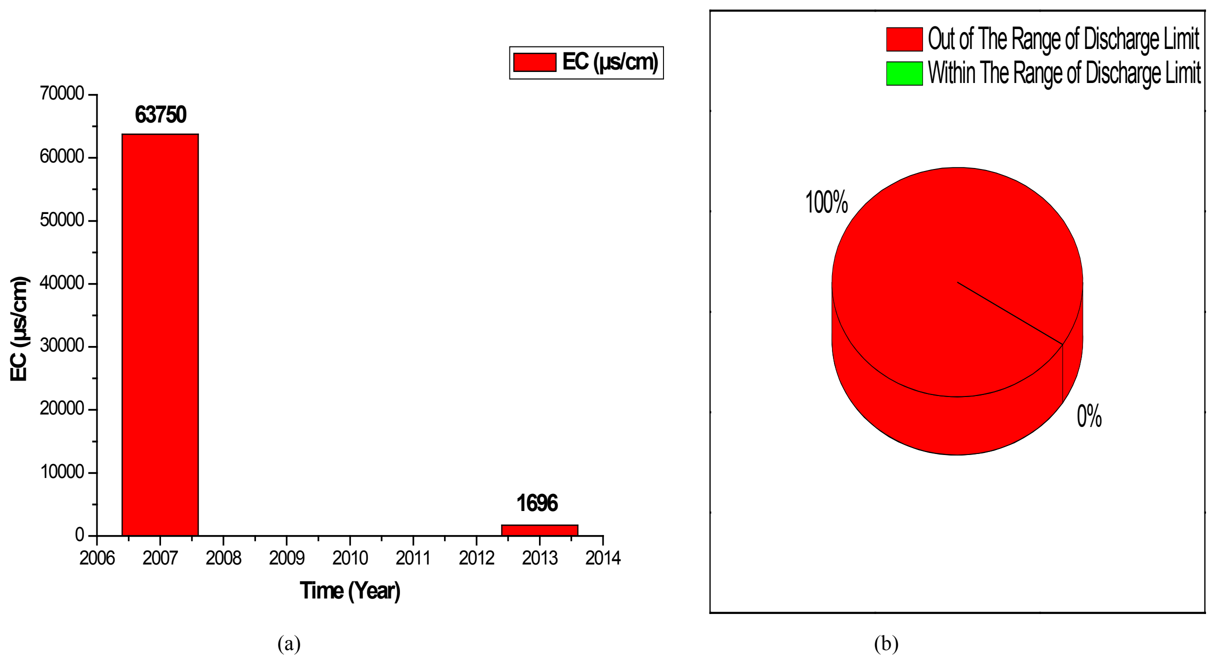
(a) (b)

Figure 19. (a) A bar chart of variation in TDS with time to time at Narayangonj. (b) A pie chart of TDS discharging condition with reference to the discharge limit



(a) (b)

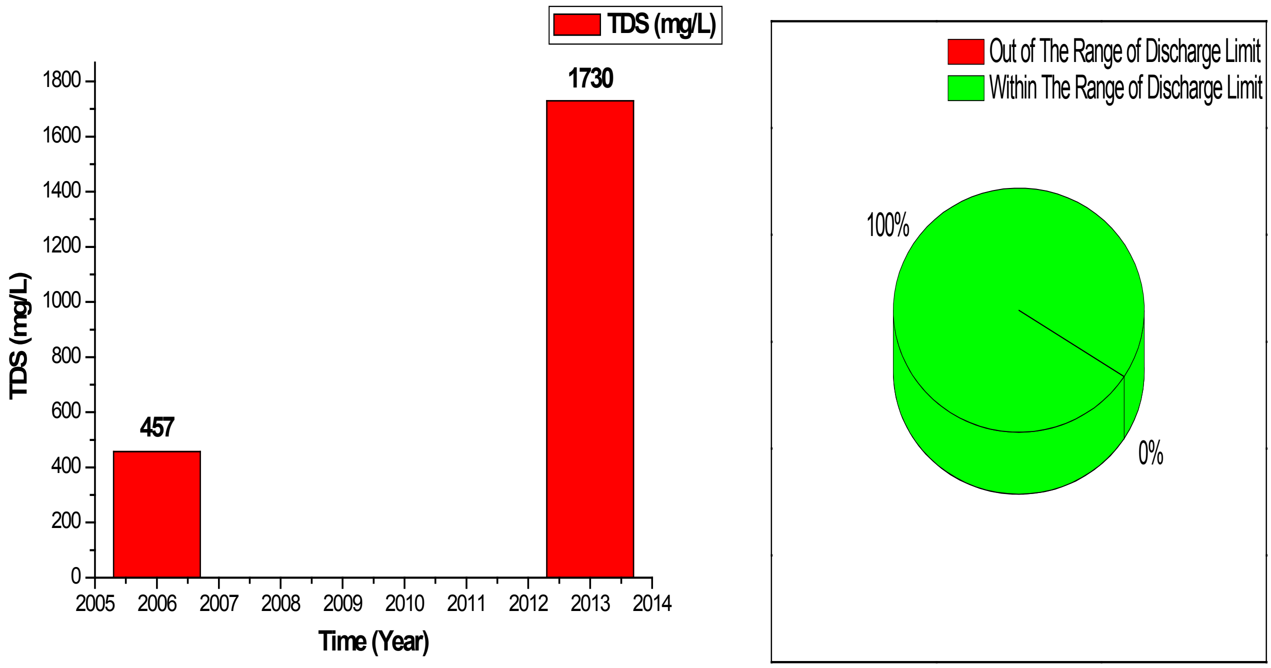
Figure 20. (a) A bar chart of year wise variation in BOD_5at Narayangonj. (b) A pie chart of BOD_5 discharging condition with reference to the discharge limit



(a) (b)

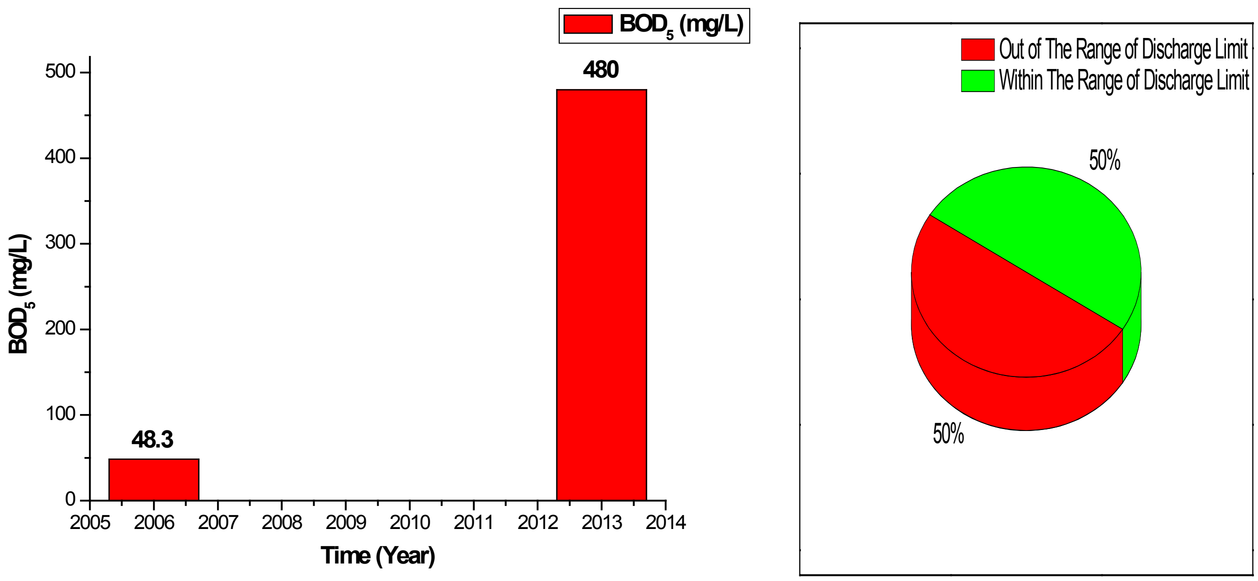
Figure 21. (a) A bar chart of year wise variation in EC at Narayangonj. (b) A pie chart of EC discharging condition with reference to the discharge limit

V. DHAKA



(a) (b)

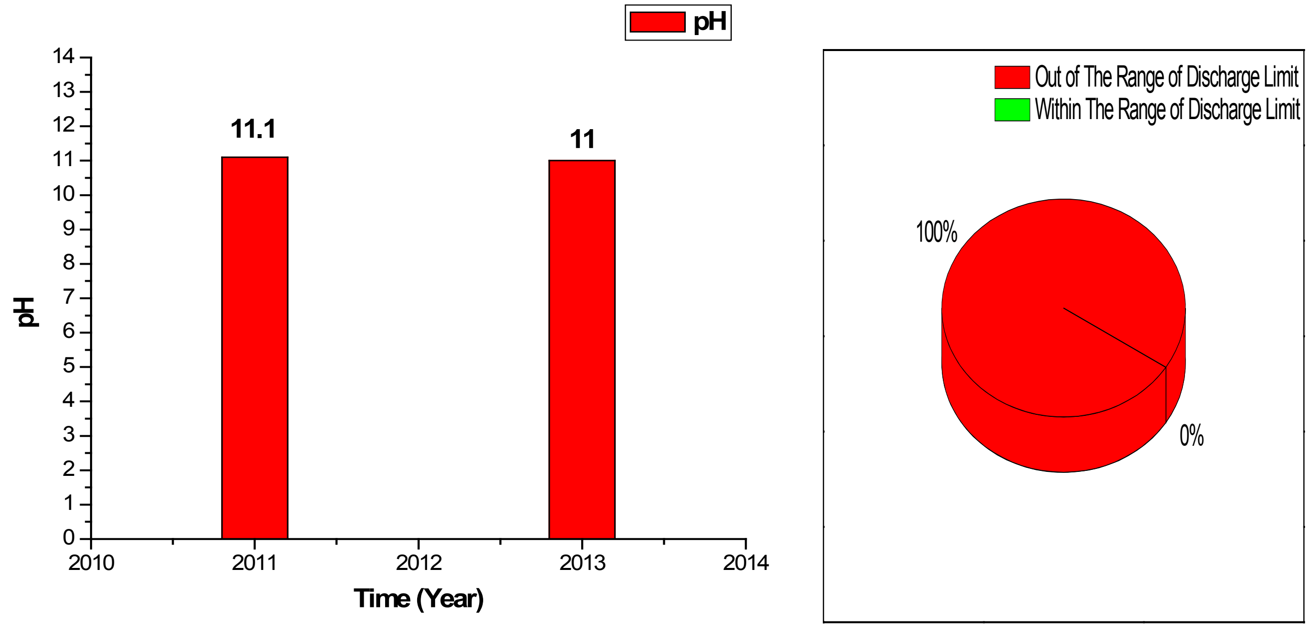
Figure 22. (a) A bar chart of year wise variation in TDS at Dhaka. (b) A pie chart of TDS discharging condition with reference to the discharge limit



(a) (b)

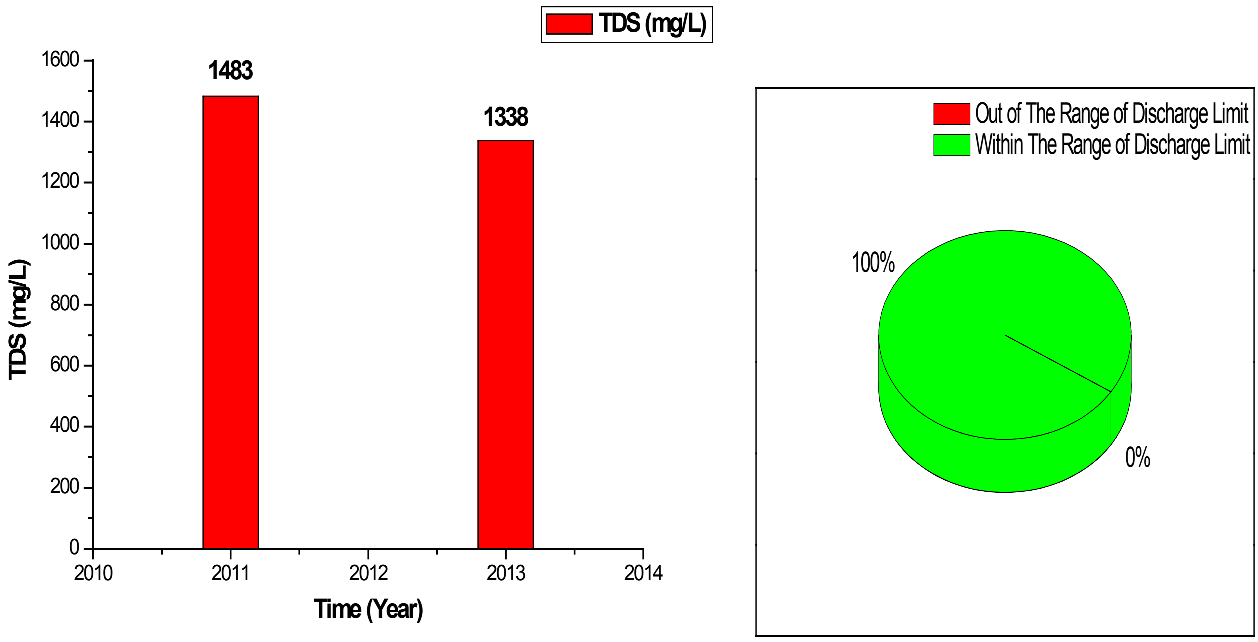
Figure 23. (a) A bar chart of variation in BOD_5 at Dhaka. (b) Apie chart of BOD_5 discharging condition referring to the discharge limit

VI. CHITTAGONG



(a) (b)

Figure 24. (a) A bar chart of year wise variation in pH at Chittagong. (b) A pie chart of pH discharging condition with reference to the discharge limit



(a) (b)

Figure 25. (a) A bar chart of year wise variation in TDS at Chittagong. (b) A pie chart of TDS discharging condition with reference to the discharge limit

The bar & pie charts (Figures 11 a – 25 b) show status of physicochemical parameters of Ashulia, Gazipur, Narayangonj and Chittagong areas of Bangladesh.

Observing the bar and pie chart, it has come to clear that almost all of the industrial areas are in poor condition due to the improper discharge of the Textile effluent. Among them Savar, Narayangonj and Gazipur are extremely affected through the Textile Effluent. As a result it is creating or will create a tremendous affect not only to our environment but also on our lively hood also, for example: insufficient water for drink, for irrigational uses, for future textile processing etc. Since Bangladesh is a land of many rivers, so the toxicity spreads rapidly through water, which is a threat to human and animal health. A large portion of our food supply i.e. fish is facing this threat due to improper effluent discharge.

4.2. Area Wise Variation

The bar charts (Figures 26-43) explain year wise Textile wastewater characterization of different areas of Bangladesh. The maximum pH (14) was found in 2010 in Narshindi area. The maximum TDS (5990 mg/L) was found in 2007. On the other hand, the maximum BOD (620 mg/L) was recorded in 2013.

I. 2013

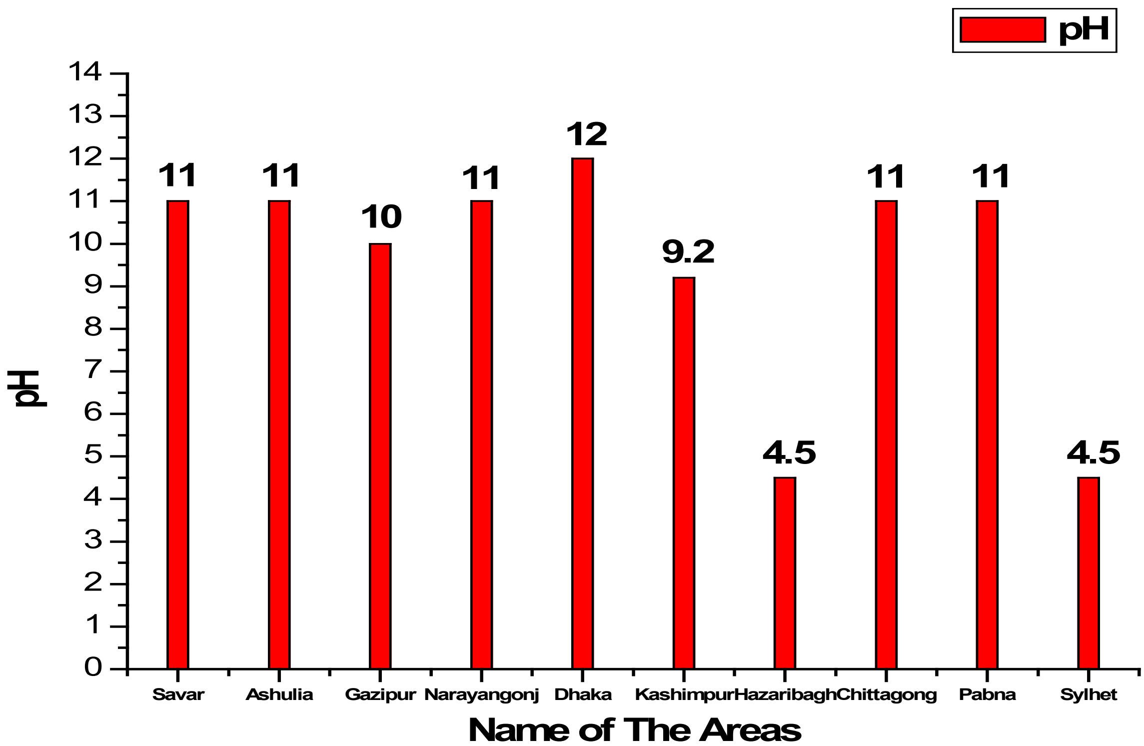


Figure 26. A bar chart of variation in pH among different areas in 2013

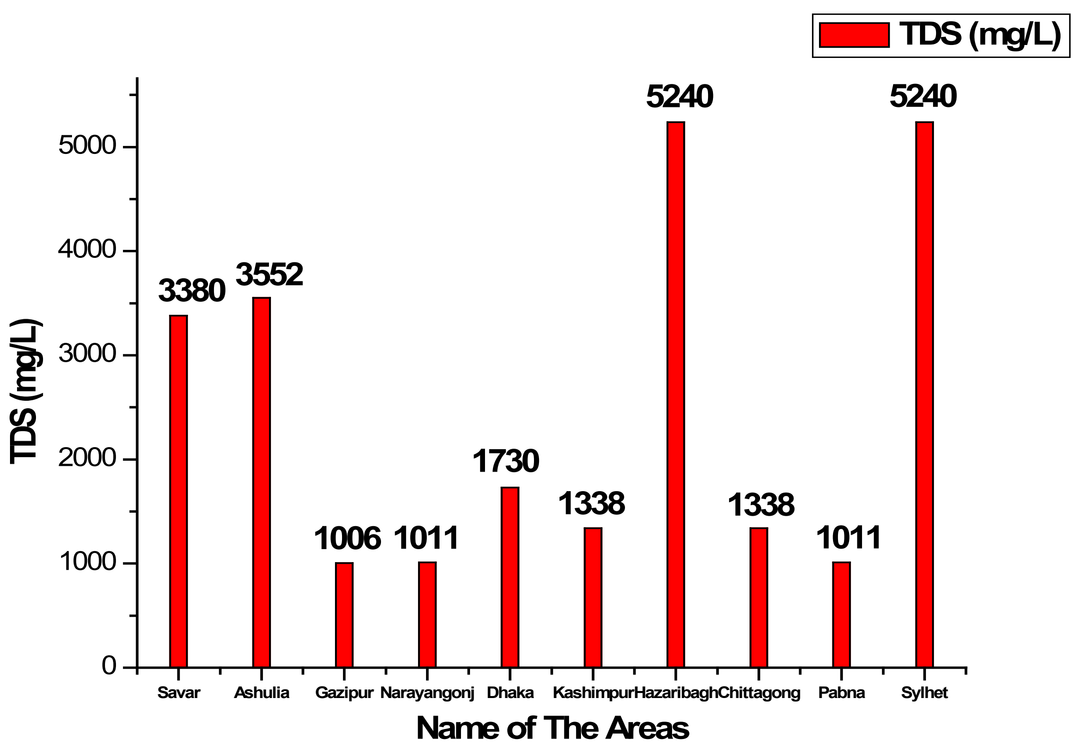


Figure 27. A bar chart of variation in TDS among different areas in 2013

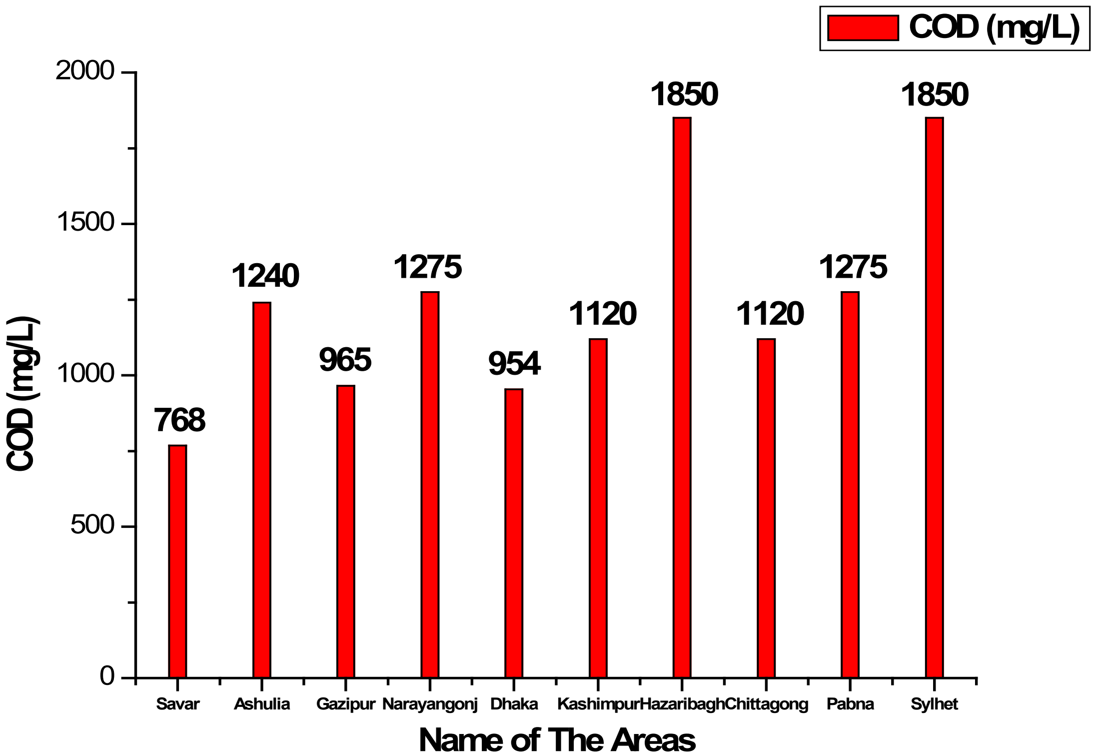


Figure 28. A bar chart of variation in COD among different areas in 2013

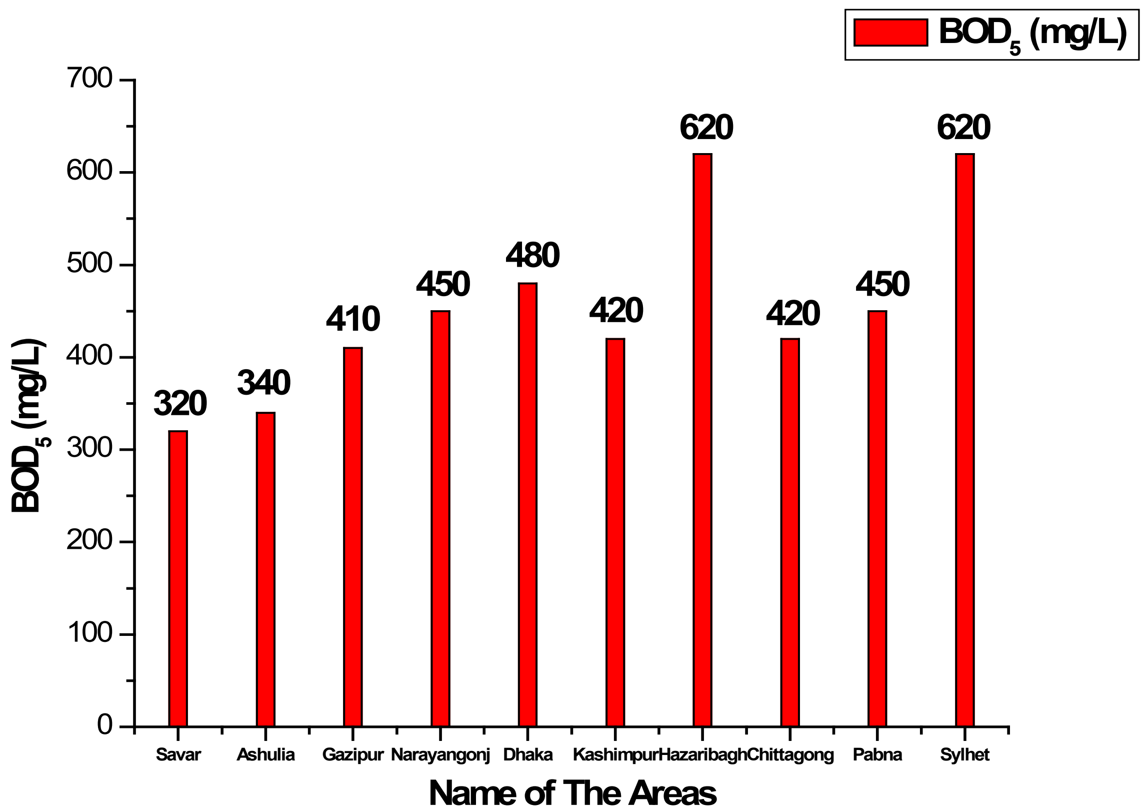


Figure 29. A bar chart of variation in BOD_5 among different areas in 2013

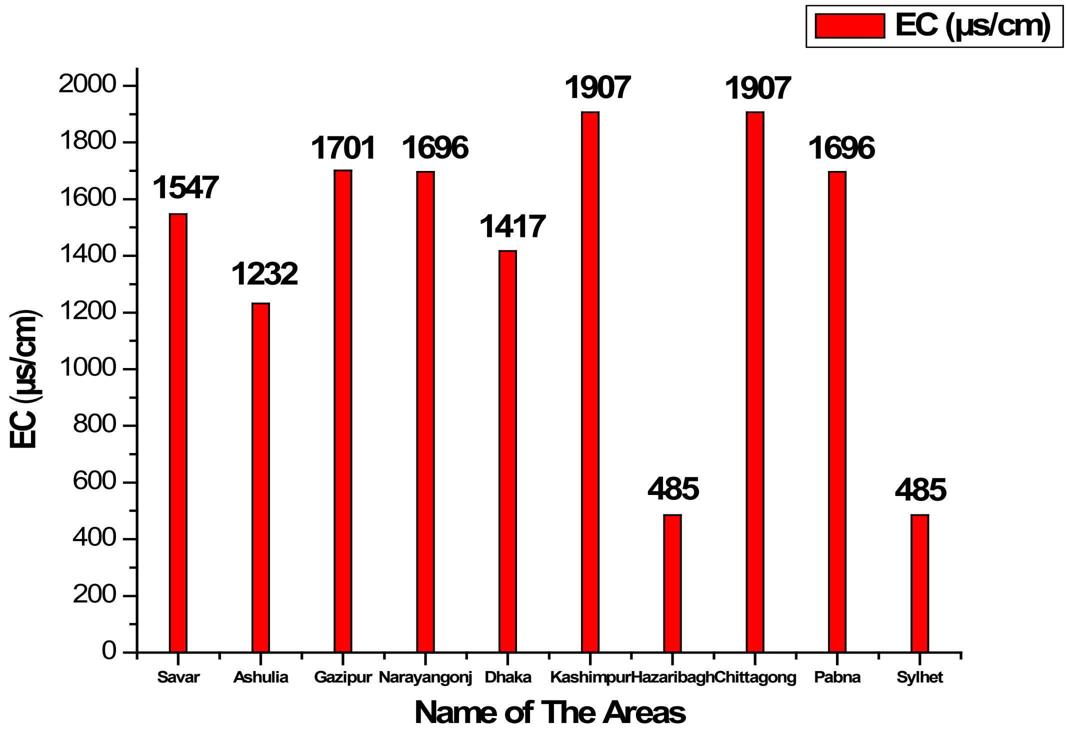


Figure 30. A column diagram of variation in EC among different areas at the year of 2013

II. 2011

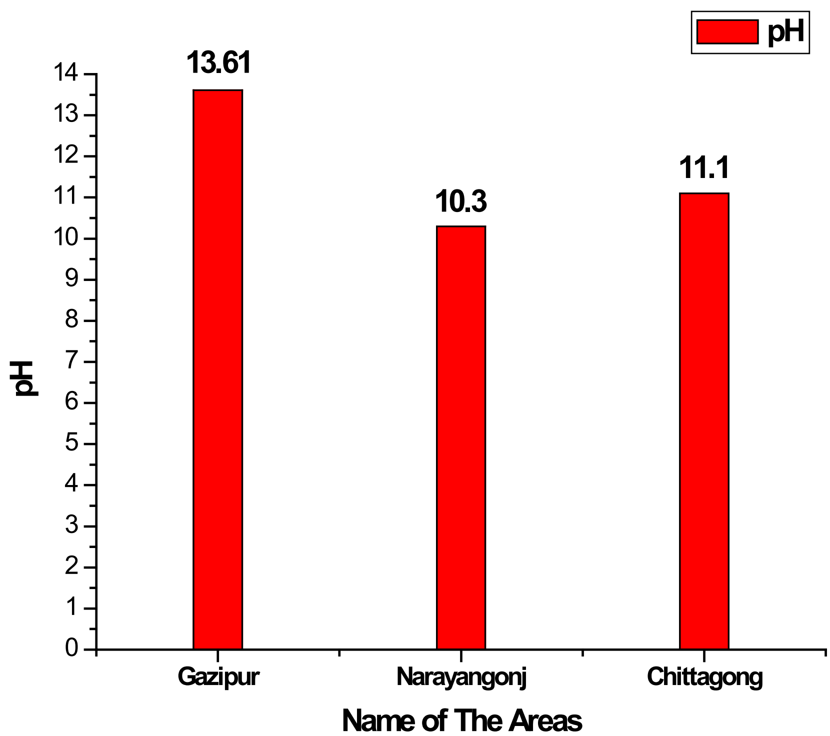


Figure 31. A bar chart of variation in pH among different areas in 2011

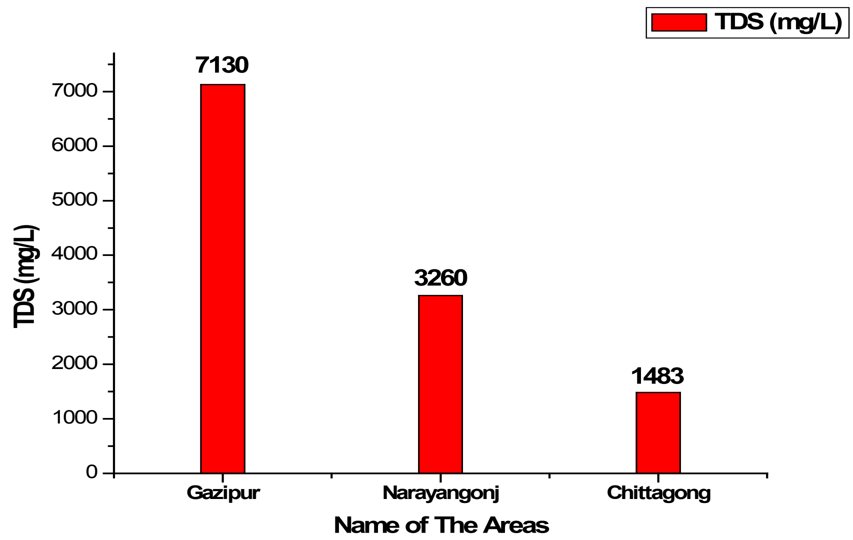


Figure 32. A bar chart of variation in TDS among different areas in 2011

III. 2010

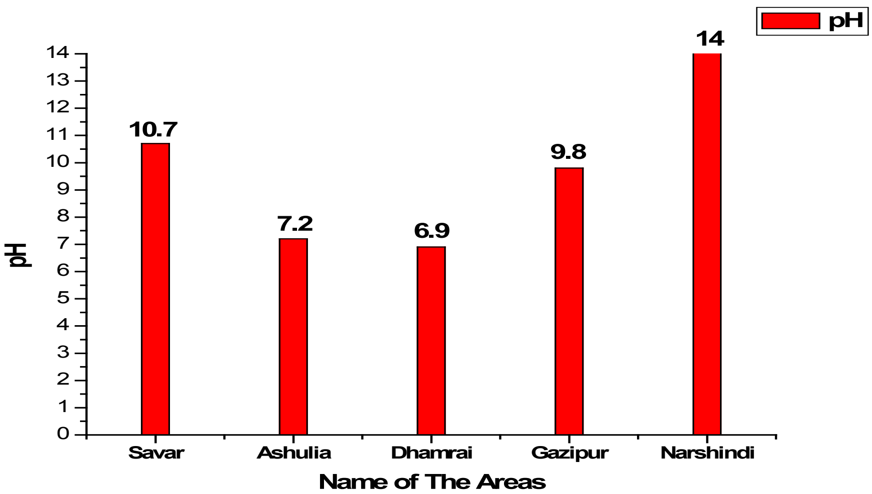


Figure 33. A bar chart of variation in pH among different areas in 2010

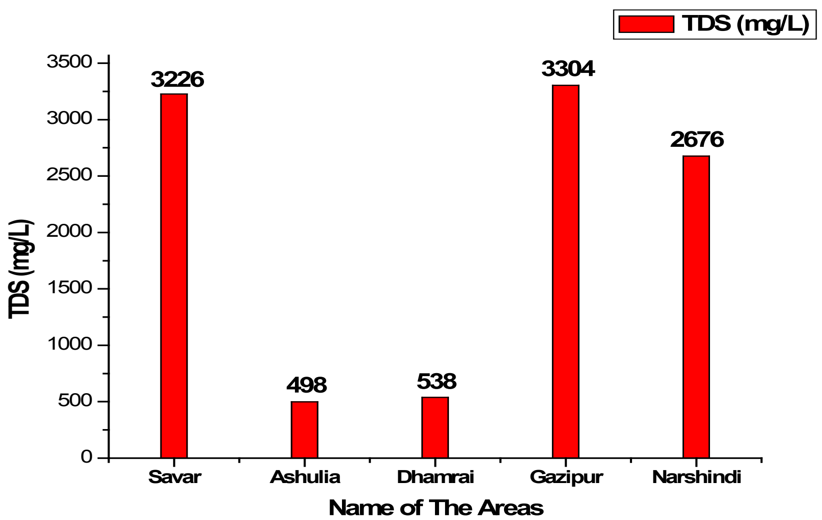


Figure 34. A bar chart of variation in TDS among different areas in 2010

IV. 2007

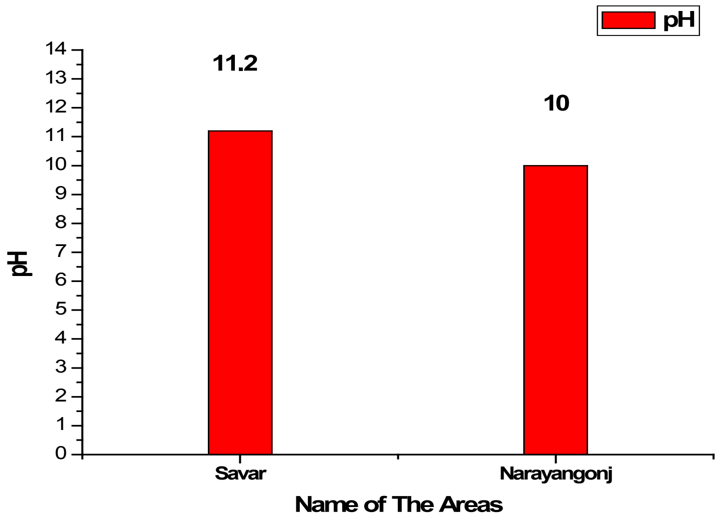


Figure 35. A bar chart of variation in pH among different areas in 2007

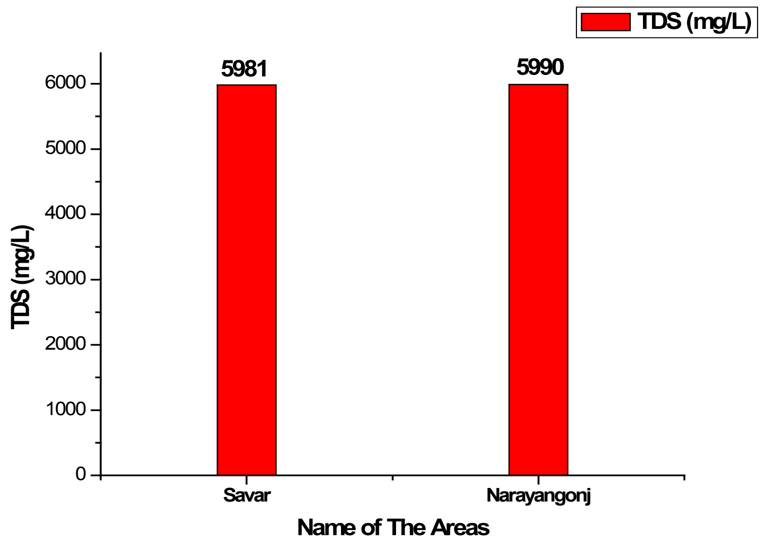


Figure 36. A bar chart of variation in TDS among different areas in 2007

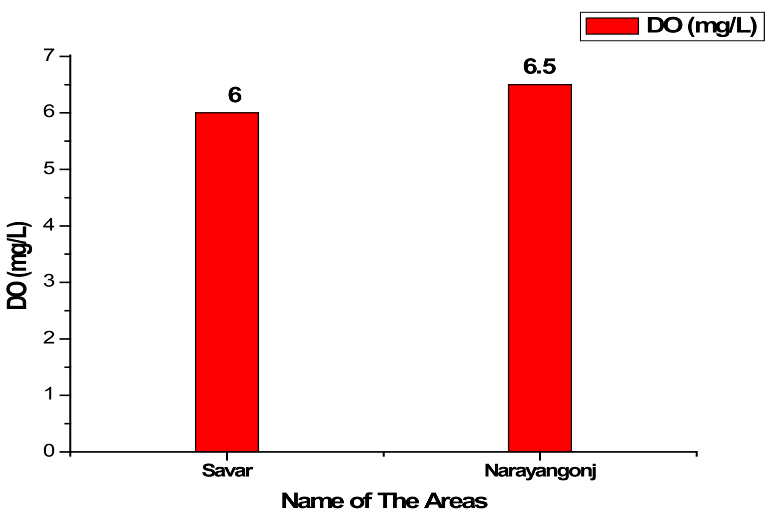


Figure 37. A bar chart of variation in DO among different areas in 2007

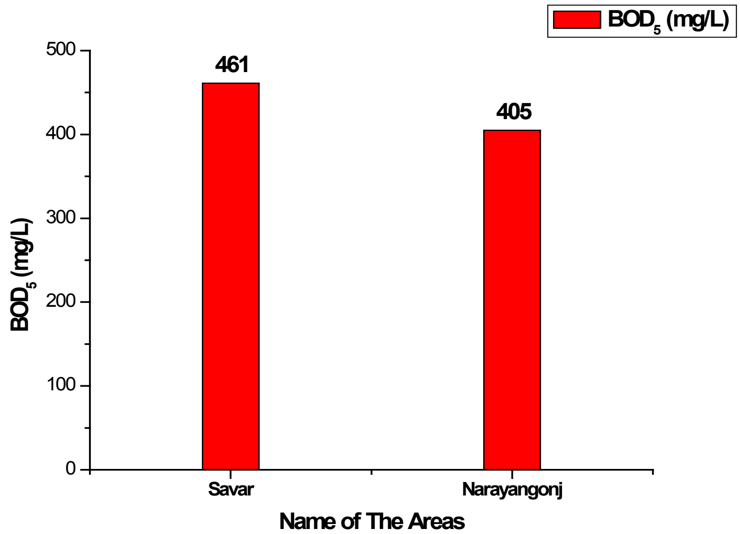


Figure 38. A bar chart of variation in BOD_5 among different areas in 2007

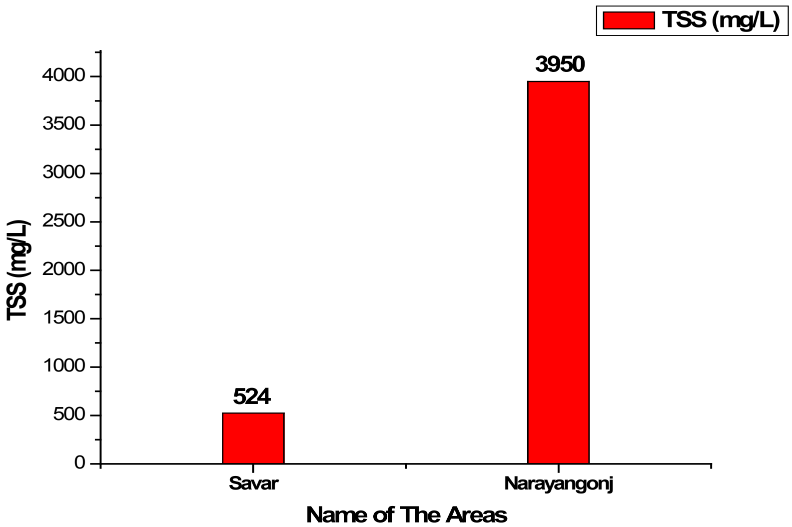


Figure 39. A bar chart of variation in TSS among different areas in 2007

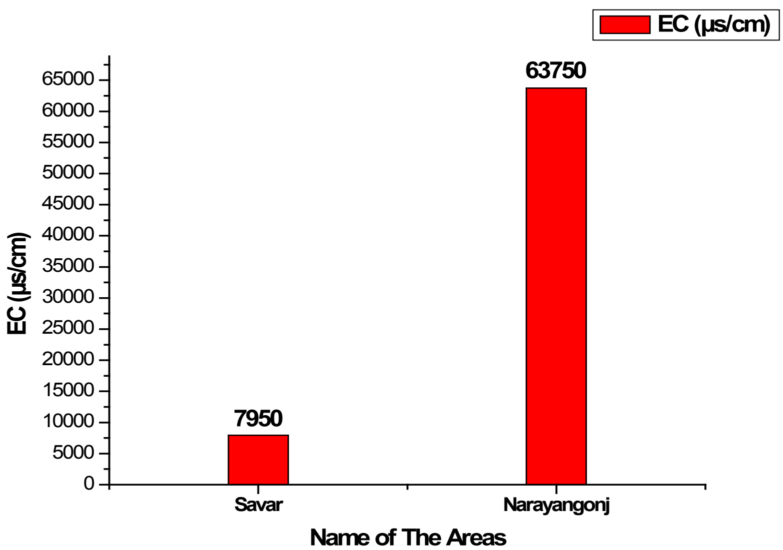


Figure 40. A bar chart of variation in EC among different areas in 2007

V. 2006-2007

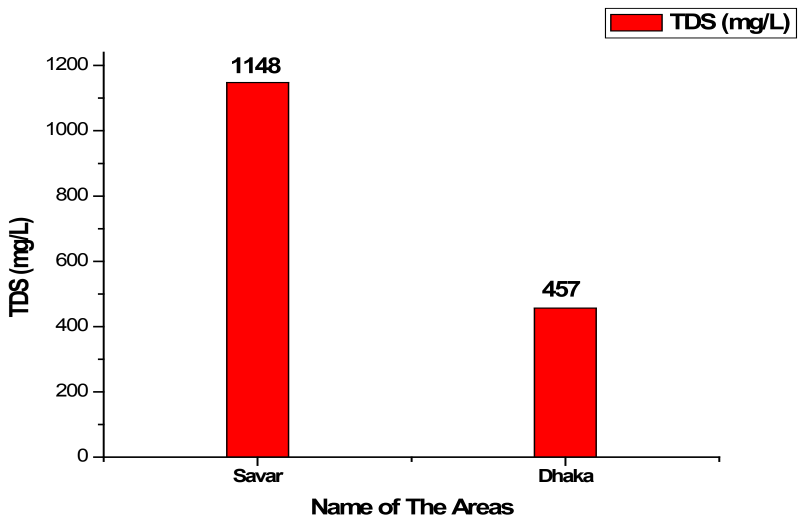


Figure 41. A bar chart of variation in TDS among different areas in 2006-2007

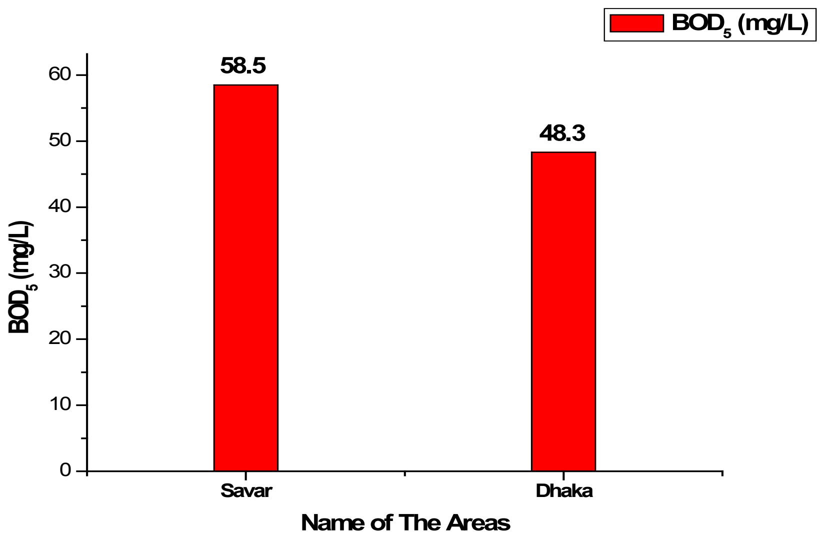


Figure 42. A bar chart of variation in BOD_5 among different areas in 2006-2007

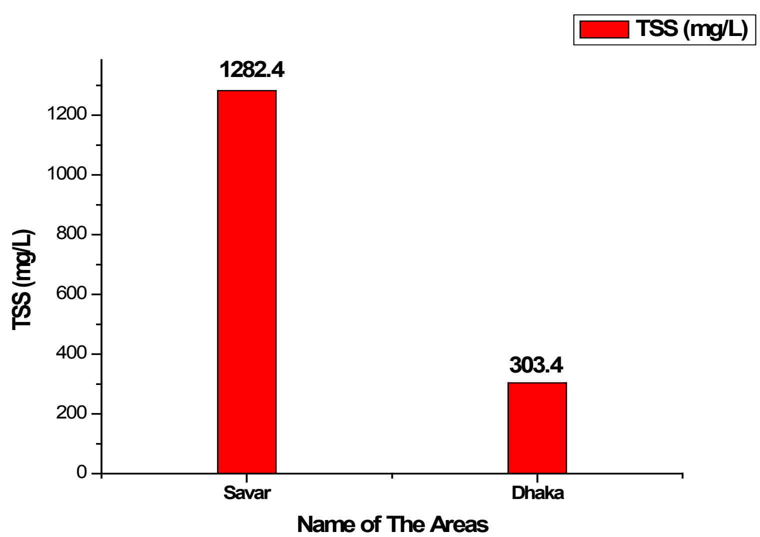


Figure 43. A bar chart of variation in TSS among different areas in 2006-2007

In Bangladesh, industrial units are mostly located at riversides. A complex mixture of hazardous chemicals, both organic and inorganic, is discharged into the water bodies from all these industries, usually without treatment. Disposal of these large amounts of wastewater with highly toxic compounds to water body and irrigable land is extensively threatening to the ecosystem and aquatic life and it also enters in our food chains. These lead to diminish the fisheries and agricultural economy day by day. In general, pH of the effluent is found to above 11, which become lethal to all species of fish. The textile effluent contains high amounts of agents causing damage to the environment and human health including suspended and dissolved solid, biological oxygen demand (BOD), chemical oxygen demand (COD), chemicals, odor and color.

We can interpret findings, in this paper, the year wise and area wise variations of various physicochemical parameters of textile effluent of six major industrial zones are focused. Observing the bar and pie charts, it has come to clear that almost all of the industrial areas are in alarming condition due to improper discharge of the Textile Effluent. On the basis of last ten years (2005-2014) reviewed data on effluent characterization it is found that the major three textile oriented industrial areas like Savar, Narayangonj, Gazipur among all of the industrial areas are extremely affected by textile effluent. The physicochemical parameters like pH, TDS, DO, COD, BOD_5, TSS and EC all are in beyond the national standard limit. For example, at Savar the pH varies 7.3-11.2,TDS 460-5981 mg/L, DO 0-6 mg/L, COD 118-2304 mg/L and BOD60-461mg/L whereas our national standard is for pH 6-9, TDS 2100 mg/L, DO 4.5-8 mg/L, COD 200 mg/L and BOD5 50 mg/L respectively. Not only in Savar but also the scenario of the effluent characteristics in greater Dhaka are almost same. Only one report found in literature in 2014 as per our literature survey. In that paper, Farjana et al. [21b], reported the characterization of untreated Textile effluent as, BOD_5 96-242 mg/L, COD 225-800 mg/L, TDS 228-2040 mg/L, TSS 15-110 mg/L and color 382-205 (Pt-Co Unit).

The textile industry is considered to be one of the biggest threats to the environment and phase it out gradually to protect the river system. Now it is the time to take necessary steps against the threat. ETP is the unique solution. At present, big textile mills are constructed well within the rule of environmental compliance. Small and medium factories are the exceptions and don't have the financial ability to set up full-capacity ETPs. Few good textile industries are found to have their own ETPs, but hardly run their ETPs up to the mark and also the factory authority does not pay due attention to it. Another reason behind is the unwillingness of factory owners to operate their ETPs due to operating and maintenance expenses, which is a gross violation of national laws. Many industries are running without ETPs, most of which don't have land as a provision for ETP installation. So, land requirement for ETP installation is a critical issue. This land requirement problem associated with ETP establishment can be greatly mitigated by installation of Central Effluent Treatment (CETP).

There is another problem in handling sludge out of ETPs. Sludge is the semisolid waste produced in ETPs and should be treated or disposed of safely. Textile sludge management is a vital issue in Bangladesh. Recently a sustainable eco-friendly method of Textile sludge management has been developed in Bangladesh, biogas generation from textile sludge [22a].

A comparison of Textile wastewater characterization of different countries is necessary to understand the Textile wastewater quality of Bangladesh. A comparison is focused in Table 9. The data compiled based on literature in Table 9 include experimental values of important parameters pH, COD, BOD and SS of Textile effluents of China, India, Pakistan and Bangladesh. The maximum pH (14) obtained in wastewater samples of Pakistan and Bangladesh. The largest COD (2430 mg/L) also found in Pakistan and Bangladesh. The maximum BOD (1842 mg/L) found in Indian Textile wastewater sample. On the other hand, very high SS value 3950 mg/L found in wastewater sample of Bangladesh. From the available data it is clearly understood that pollution level by Textile wastewater in Bangladesh is very high. So appropriate remedy is essential in Bangladesh. Discharge standards of Textile wastewater of different countries have been given in Table 10.

Table 9. A comparison of Physicochemical Parameters of Textile Wastewater Between China, India, Pakistan and Bangladesh

Parameter	China [22b]	India [22c]	Pakistan [22d]	Bangladesh [6, 7, 11, 12, 15, 18]
pH	9-13	4.8-9.3	8-14	3.9-14
COD (mg/L)	1800-2000	725-2080	182-2430	41-2430
BOD (mg/L)	400-500	243-1842	117-786	10-786
SS (mg/L)	250-350	270	49-471	24.9-3950

Table 10. Discharge Standards of Textile Effluents of China, India, Pakistan and Bangladesh

Parameter	China [22 b]	India [22 c]	Pakistan [22 d]	Bangladesh [22 e]
pH	6-9	6-9	6-10	6-9
COD (mg/L)	100	156-400	150	200
BOD (mg/L)	25	80-250	80	50
SS (mg/L)	70	200	150	150

5. Impacts on Environment

When the effluents are discharged into the river, the heavy metals present are absorbed in the river's soil and sediments during the dry season, and water evaporation could expose them to the environment. High TSS and TDS detected could be attributed to the high color (from the various dyestuffs being used in the textile mills) and they are the major sources of heavy metals. Increased heavy metal concentrations in river sediments increases suspended solids concentrations. During the dry season, the occasional dust re-suspension introduces these metals into the atmosphere along with the particulates.

The products of reactions between some of the chemicals present in the effluents [23] that may be toxic to the environment. Removal of the pollutants from these effluents is the only sure way of safer environment and this can be achieved by proper treatment of effluents to the required level.

The most important measure of water quality is the dissolved oxygen (DO) [24]. The low level of DO recorded could result in the non-maintenance of conditions favorable to the aerobic organisms. This could lead to anaerobic organisms taking over with the resultant creation of conditions making the water body uninhabitable to gill-breathing aquatic organisms.

Hydrogen sulphide is formed under conditions of deficient oxygen in the presence of organic materials and sulphate. This could be a possible reason for the high sulphide measured in the effluents analyzed. Hydrogen sulphide is formed under conditions of deficient oxygen in the presence of organic materials and sulphate [25]. This is the reason for high sulphide measured in the effluents under analysis. High alkalinity increases with wastewater strength. It shows the capacity of waste waters to neutralize acids, but it is undesirable. Heavy metals in the wastewaters could be of negative impact to the environment, trace heavy metal contamination of an area to industrial effluent. The negative impacts from textile mills effluents could be felt as far as all the regions covered by the River basin, the main receptor of these effluents. High heavy metal concentration has been found in these rivers attributed this to industries. The textile industry generally faces difficulty in meeting wastewater discharge limits, particularly, with regard to dissolved solids, pH, BOD, COD, sometimes, heavy metals and color of effluent [9b]. Effluents from textile industries contain different types of dyes, which because of high molecular weight and complex chemical structures, that show low level of biodegradability.

Direct deposition of effluents into sewage networks, produce disturbances in biological treatment processes. Industrial emission and waste effluent generated from factories are associated with heavy disease burden and this could be part of the reasons for the current shorter life expectancy, 61.4 years both for male and female in the country [25] when compared to the developed nations. Some heavy metals contained in these effluents (either in free form in the effluents or adsorbed in the suspended solids) from the industries have been found to be carcinogenic [26] while other chemicals equally present are poisonous depending on the dose and exposure duration.

These chemicals are not only poisonous to humans but also found toxic to aquatic life and potential sources of food contamination.

Ammonia is harmful to fish or other aquatic organisms at free (un-ionized) concentration of 10- 50 μg/L or higher pH value and the sulphide in the effluent are of environmental concern because they can lead to poor air quality of an area if not properly taken care of thus becoming threat to humans, vegetation, and materials. The same is applicable to pH that has been identified to raise health issues if water available for due to the nature of their operations which requires high volume of water that eventually results in high wastewater generation. They are one of the largest water users and polluters [6].

6. Conclusions

Textile industry is one of the major industries in the world that provide employment with no required special skills and play a major role in the economy of many countries like Bangladesh. The Textile industry utilizes various chemicals and large amount of water during the production process. The water is mainly used for application of chemicals onto fibers and rinsing of the final products. The waste water produced during this process contains large amount of dyes and chemicals containing traces of metals such as Cr, Cu and Zn which are capable of harming the environment and human health. The textile waste water can cause hemorrhage, ulceration of skin, nausea, skin irritation and dermatitis. The chemicals present in the water block the sunlight and increase the biological oxygen demand thereby inhibiting photosynthesis and reoxygenation.

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