Effect of land use on the water quality of the Turag River.

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Effect of land use on the water quality of the TuragRiver.

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APPROVAL

This is to certify that the thesis submitted by Md. RafiuZaman and Abu Saeed Md. Noman entitled as “Effect of land use on the water quality of the Turag River.” has been approved by the supervisor for the partial fulfillment of the requirement for the degree of Bachelor of Science in Civil & Environmental Engineering, Islamic University of Technology (IUT), Gazipur, Bangladesh in November 2015.

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DECLARATION

We hereby declare that the undergraduate project work reported in this thesis has been performed by us and this work has not been submitted elsewhere for any purpose (except for publication).

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ABSTRACT

Dhaka is one of the most densely populated cities in the world. The population of Dhaka is now more than 15 million (1). The population of Dhaka is increasing day by day. Same thing is happening in the northern part of the city i.e. in Uttara, Tongi, Gazipur the population is increasing rapidly due to urbanization and industrialization. The approximate population in the northern part of the city is almost two million (1). Turag River flows alongside the northern part of the city. Due to rapid urbanization and industrialization in the northern part the Turag River is being polluted in various ways. This pollution is mainly because of various types land use of those particular areas. Lands are used in various purposes but particularly for residential, industrial and agricultural purposes. Alongside the Turag River lands are mainly used mainly for these three purposes. As a result of pollutants from these sectors are Turag River is continuously being polluted and now-a-days this has become a major concern. The main concern of this research is to characterize the pollutants coming from residential, industrial and agricultural areas. This research is conducted to measure the quality and quantity of waste effluent in Turag River. That is, the main objective is to identify the amount of waste effluent in the river along with their probable effect on the quality on the water of Turag River.

To do so, water samples were collected particularly from five (5) different points of the Turag River based on type of land use around that point. The samples were being tested in the laboratory. Six (6) basic water quality parameters were considered for the tests. Those are pH, Colour, Turbidity, Total Suspended Solid (TSS), Total Dissolved Solid (TDS), and Biochemical Oxygen Demand (BOD). These tests were being done to determine the quality of water of Turag River due to waste effluent.

In order to determine the quantity of waste effluent in the Turag River a generalized survey was being done around the sample collection sites. The survey covered residential, industrialized and agricultural areas. From the survey various data related to quantity of waste effluent were determined. And from the survey a clear conception about the land use along the Turag River has been made.

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INTRODUCTION

1.1 General

The land use effect is very important on the quality of river water (Lee et al, 2009; Tran et al, 2010; Rothwell et al, 2010). Since the late of 1970s the influence of land use on water quality has been a main concern (Rime, Nissen & Reynolds, 1978; White, 1976). Researchers began to quantitavely analyze the correlation between land use and water quality, after the 90s (Johnson, Richards, Host & Arthur, 1997). Numerous problems related to water quality are caused by various kinds of land use and practices in a river, such as rapid urbanization, growth of population, industrial and agricultural activities (Ngoye and Machiwa, 2004). The relationship between land use patterns and water quality at a watershed scale explained variations of river water quality in a water resource conservation and watershed ecosystem management (Woli et al, 2004; Li et al, 2009). Water quality assessment techniques has made these studies much convenient than before (Griffith, 2002; Lerodiaconou et al, 2005; Rothwell et al, 2010).

Generally, agricultural land use has a strong command on the nutrient parameters in river water (Pieterse et al, 2003; Ngoye and Machiwa, 2004; Woli et al, 2004). Industrial and urban land uses are related with organic pollution, nutrients and heavy metals and other pollutants in the river water (Ferrier et al, 2001; Li et al, 2009; Kang et al, 2010).

Dhaka is one of the most densely populated cities of the world. The population of Dhaka is almost more than 15 million. In the northern side Turag River flows marking the edge of the city. Turag River is the water body receiving most of the agricultural, urban and industrial wastes as the northern part of the city consists of a number of industries located in Tongi. Recently, the northern part of Dhaka is expanding rapidly with industries being built by filling wetlands around the river. Turag river crosses the Tongi Bazar, Gazipur and Uttara of Dhaka. Shops and residential buildings together with small industries and hospitals almost cover the banks of the river to a great extent.

Over the last few decades, the river has undergone tremendous chemical and biological changes as a result of increasing human interferences. Currently the river ecosystem is in danger due to various deforestation, erosion, sedimentation and many other factors in the catchment area. There is also significant impact on various fish species due to water level reduction, pressure of growing population, and the connected impact of urbanization and industrialization. Degradation of Turag river water quality through open defecation and poor hygienic practice is caused by the increased number of floating people along river bank

Meanwhile, a significant number of industries have grown along the Turag River for the purpose of using surface water without much trouble and most of them without considering the environmental impact have selected Turag as a permanent disposal site of waste effluent. Another factor for the degradation of water quality is due to seepage of septic tank wastes and kitchen wastes from the closely situated Uttara residential area. Besides various hospital and medical wastes also contribute in the whole process of degradation.

Almost 80% of the annual average rainfall of 1854 millimeters (73.0 in) occurs during the monsoon season which lasts from May till the end of September. So the pollutants get diluted during rainy season. So our samples are being collected in the winter season to show a worse scenario than that for the rainy season.

1.2 Objectives

The thesis project has been performed based on some objectives. The objectives are fulfilled throughout the thesis project. The objectives are stated below:

- Assessment of the present water quality of Turag River in various points of the river.
- Studying the impact of various types of waste i.e. domestic, industrial and agricultural wastes on the water quality of Turag River.

- Studying the impact of land use along the bank of the Turag River on the water quality of Turag River.
- Comparison of various water quality parameters of Turag River with the existing standards

1.3 Scope of the study:

The samples of water were collected from different point of Turag River ranging from Nagda Bridge to Rustompur Bridge along Turag River. Several tests were run at different cycles for assessing the present water quality of the river. The experiment carried out in the laboratory will help out to determine the following.

- Health risk assessment.
- Assessment of present water quality in terms of selected parameter
- Land use assessment.
- Changing pattern of water quality parameters.

1.4 Limitations:

- Number of previous research works regarding the water quality of Turag is very limited.
- Lack of sufficient funding forced us to preserve the sample in the conventional method using ice thus refraining us from using chemicals to preserve the samples. Also, experiments on metal concentration measurement could not be done due to budget constrain.
- Since the sampling sites are far away (in terms of time), we could not sample more sites in a single day
- Due to the lack of transportation system we had to abandon one of our selected sites.
- As Turag River was filled with water hyacinths, moving along the river was a troublesome job.
- It takes 5 days to conduct a BOD_5 experiment. We had to co-ordinate with other groups for measuring BOD_5, since we have only one BOD track.

- Participants of the survey were not very co-operative.
- Information on industrial waste could not be collected since industries were reluctant not to share their waste production and disposal method.
- Lack of organized data on domestic waste and waste from the markets.

1.5 Outline of the thesis:

There has been many work carried out about the assessment of water quality of various rivers. The related works that have been carried out is discussed in chapter two. Effect of land use on water quality of rivers has also been discussed in the chapter of literature review. The introduction of parameters that are related with the study is given on chapter three. Chapter four includes the study area, sampling, testing procedure and overall methodology of the study carried out. The result that has been found after different test has been discussed in the chapter five. Chapter five also includes the comparison of the results with the existing standards. Lastly at chapter six the conclusions and recommendations has been made.

CHAPTER 2
LITERATURE REVIEW

2.1 General

Pasha et al (2012) performed a study to assess the water quality of Turag River and to study the impact of industrial and domestic wastes on water quality. They also made a comparison of various parameters on water quality based on the existing standards for water quality. They informed that residential areas around Turag River must have a well-defined and well maintained waste disposal system. So, a well-defined sanitary system should be developed in the Turag River adjacent to slum areas as they are significant source of fecal contamination & efficient solid waste management should be implemented in residential areas around Uttara and Tongi.

Jun Zhao et al (2015) conducted a study on the influence of land use on water quality in a reticular river network area particularly in Shanghai, China. The study included a clear distribution of water quality along an urban-to-rural gradient was identified in Shanghai. Also all land uses and hydrological variables explained more than 50% of the variation of water quality. The study also showed that the urban and industrial land uses had determinant impact on water quality and lastly the urban affected water quality at larger scale but the industrial only showed impact at riparian zone.

Hongmei Bu et al (2014) showed relationship between land use patterns and water quality in the Taizi River basin, China. The results of this study demonstrate the relationship between land use patterns and river water quality during dry and rainy season in various zones of the Taizi River basin. During dry season, buid up land rather than agricultural land use significantly influences the concentrations of Cl, SO4, and more nutrient variables, which indicates possible point source pollution. Durn the rainy season, agriculturaland built-up land uses have significant effects on most water quality variables, showing mixed pollution of agricultural, domestic, and industrial sources. Additionally, the degraded water quality during both seasons is positively associated with landscape metrics of SHDI, PD, and ED, and negatively related to SHMN, CONTAG, LPI, ENNMN, and COHE. Finally, factor scores in FA recognize zones 9–11 as highly polluted regions associated with point and non-point pollution sources, such as agricultural runoff, domestic waste, and industrial discharge.

S. Shrestha & F. Kazama (2007) conducted a study on the surface water quality using multivariate statistical techniques on Fuji River basin, Japan. In this case study, different multivariate statistical techniques were used to evaluate spatial and temporal variations in surface water quality of the Fuji river basin. Hierarchical cluster analysis grouped 13 sampling sites into three clusters of similar water quality characteristics. Based on obtained information, it is possible to design a future, optimal sampling strategy, which could reduce the number of sampling stations and associated costs. Although the factor analysis/principle component analysis did not result in a significant data reduction, it helped extract and identify the factors/sources responsible for variations in river water quality at three different sampling sites. Varifactors obtained from factor analysis indicate that the parameters responsible for water quality variations are mainly related to discharge and temperature (natural), organic pollution (point source: domestic wastewater) in relatively less polluted areas, organic pollution (point source: domestic wastewater) and nutrients (non-point sources: agriculture and orchard plantations) in medium polluted areas, and organic pollution and nutrients (point sources: domestic wastewater, wastewater treatment plants and industries) in highly polluted areas in the basin. Discriminate analysis gave the best results both spatially and temporally. For three different sampling sites of the basin, it yielded an important data reduction, as it used only six parameters (discharge, temperature, dissolved oxygen, biochemical oxygen demand, electrical conductivity and nitrate nitrogen) affording more than 85% correct assignations in temporal analysis, and seven parameters (discharge, temperature, biochemical oxygen demand, pH, electrical conductivity, nitrate nitrogen and ammonical nitrogen) affording more than 81% correct assignations in spatial analysis. Therefore, DA allowed a reduction in the dimensionality of the large data set, delineating a few indicator parameters responsible for large variations in water quality. Thus, this study illustrates the usefulness of multivariate statistical techniques for analysis and interpretation of complex data sets, and in water quality assessment, identification of pollution sources/factors and understanding temporal/spatial variations in water quality for effective River water quality management.

Siyue Li et al (2009) established a paper on Water quality in the upper Han River basin, China and the impacts of land use in the riparian buffer zone. It is said there that the basin has a relative better water quality in dry season. Major ion compositions are controlled by geology and ecological background with lower concentrations in high flows because of dilution of precipitation. Water variables, especially the main pollutants have high concentrations in the urban and agricultural production areas. Water conservation effort should concentrate in the reservoir region, Hanzhong and Ankang Plains. Major ion compositions are significantly correlated with riparian land use/land cover. Nitrogen could be predicted by landscape setting in buffer strip, thus, restoration of riparian ecosystems should be a high priority for water resource conservation in particular along the shorelines of the Danjingkou Reservoir and the two plains where there are intensive agricultural activities.

Songyan Yu et al(2015), in their publication i.e. Effect of land use types on stream water quality under seasonal variation and topographic characteristics in the Wei River basin, China. The results of this study demonstrate the relationship between land use types and stream water quality during both dry and rainy seasons in 44 sub-basins of the Wei River basin, China. In rainy seasons, water quality variables were significantly correlated with agricultural area, forest area, and grassland area as well as with urban and barren areas at a significance level of >0.95. During dry seasons, the statistical analysis presented different correlation patterns from those in rainy seasons, showing that water quality variables were more influenced by all types of land uses. Therefore, seasonal variation was observed, indicating that the land use type had a more significant correlation in dry seasons than that in rainy seasons on both water quantity and quality. The topographic characteristics of land use, such as the average slope and proximity of land use to stream water, were found to be important factors affecting the contribution of land use to stream water quality. Further analysis showed that seasonal variation also occurred in the complex relationship, and steeper land generally had a stronger influence on the stream water quality than flatter land. This study does not only considered the relationship between land use and water quality, but also the relationship between land use and seasonal variations on the one hand, and land use and topographic characteristics on the other hand. Thus, the results of this study support the recommendation that water quality can be improved by better land use management.

R.M. Monaghan et al (2007) Linkages between land management activities and water quality in an intensively farmed catchment in southern New Zealand also gave us idea about our project. Monthly monitoring of the Bog Burn stream shows that concentrations of nutrients (N and P), sediment and faecal bacteria regularly exceeded guidelines recommended for surface waters. Comparison of Bog Burn median water quality with other dairy catchment studies, however, shows it to be broadly similar in terms of fecal indicators, nutrients and turbidity. Measured specific yields of N and P discharged from the catchment compared reasonably well with modeled estimates that were derived using a spatially explicit export coefficient model. Field measurements, farm management surveys and farm systems modeling identified some resource features and land management practices that appear to be key sources of many of these pollutants. Their analysis suggests that the implementation of targeted best management practices on dairy farms in the catchment could achieve significant reductions in catchment losses of N and, to a lesser extent, P. These include covered wintering systems for controlling N losses, the use of nitrification inhibitors, deferred and low rate effluent application to mole–pipe drained soils within the catchment and limiting soil Olsen P to economically optimum levels.

M.S. Islam et al (2012) Effects on solid waste and industrial effluents on water quality of Turag River at Konabari industrial Area, Gazipur, Bangladesh have established some thoughts in their paper. The results of the study showed that the upstream water was neutral with comparatively high dissolved oxygen, but low values of other parameters. Although the upstream water contained pollutants, the water quality was comparatively good than the water after receiving the solid waste and industrial effluents which was slightly alkaline pH with higher concentration of other parameters, especially downstream point. The results suggested that the solid waste and industrial effluents being discharged into the river have considerable negative effects on the water quality of the river water and as such, the water was not good for human purposes and for other uses. In such conditions, only feasible options that could be followed such as appropriate distance from the surrounding water body should be maintained for waste dumping and dumping site should be properly managed; the industries should be installed effluent treatment plant (ETP) for all the industrial wastes so that they are treated before being dumped into the environment; and appropriate laws and legislations on dumping of industrial waste into the river should be established.

2.2 Selection of sites

For the execution of the research the main challenge was the selection of potential sites. At first 10 sites were primarily chosen from maps based on the assumption of probable dumping zone of domestic and industrial waste. After 3 rounds of reconnaissance 5 sites were finally selected based on odour and visible properties of the water of Turag River. The research area extends from Pubail to Rustompur Bridge. Tongi Bridge is the base point of the research area. The sites are given in the table below with their corresponding latitudes and longitudes

Table 2(a): Location of the sites

Name of Location	Longitude	Latitude	Sample / Site No.

Nagda Bridge, Pubail	23.917112	90.467734	A / Site 1
Tongi Bridge, Tongi	23.882053	90.404182	B / Site 2
Gudara Ghat, Tongi	23.897993	90.385506	C / Site 3
Diabari, Uttara	23.883274	90.357300	D / Site 4
Rustompur Bridge, Savar	23.878545	90.352000	E / Site 5

Below there is the graphical representation of all the 5 sites on the map. The Star mark is the base point. Point A is the upstream and point E is the downstream point.

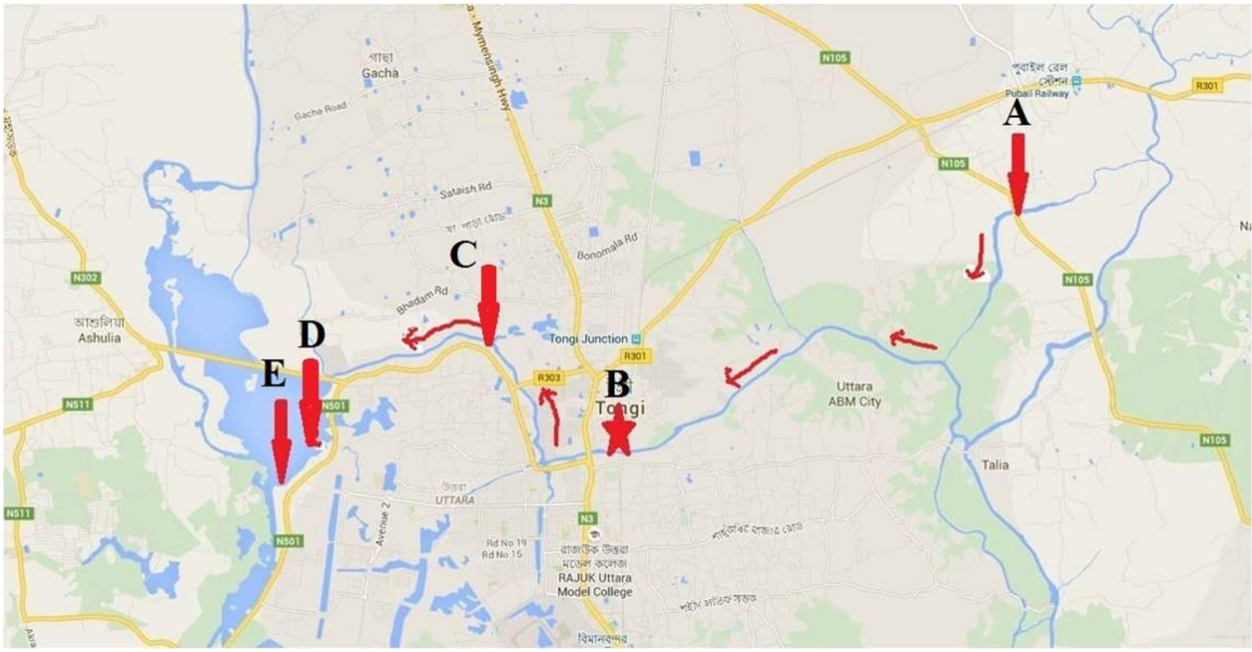


Figure 2.1: Sites on Map

Figure 2.2: Pictures of the Site

2.3 Existing Standards

We will now discuss about the Standards of Water quality. These standards are there to check the water quality of a particular area. We make a comparison of the test results with the existing standards and thus we can have a clear idea about the existing water quality of the particular area below in the table is given the standards for water quality both in Bangladesh and over the whole world. We will compare our results with these standards to get an idea about the water quality of Turag River.

Table 2(b): Standards for water quality

Name of the experiment	Existing Standards	Bangladesh Standards
pH	6.5-8.5	6.5-8.5
Turbidity (FTU)	5	5
Color (PtCo)	15	15
TDS (mg/L)	1000	1000
BOD5 (mg/L)	30	30

Chapter 3
Materials & Methodologies

3.1 Brief description of the Parameters

There are 5 parameters used for determination of the water quality of the Turag river. The parameters are described below with their environmental significance.

pH:

pH is a measure of the acidic or alkaline condition of water. It may be expressed as the hydrogen ion concentration, or more precisely the hydrogen ion activity. pH may be defined as follows:

pH= -log $[H^+]$; H^+ = concentration of hydrogen ion in moles per liter.

In pure water, water molecules dissociate into equal amounts of hydrogen & hydroxyl ions (10^{-7} moles/L). From the law of mass action, it can be shown that, for pure water at about 25^0C:

$K_w = [H^+][OH^-]/ [H_2O]$; K_w= Equilibrium constant.

$$K_w = [H^+][OH^-] = 10^{-14}$$

$[H_2O]$ considered as constant and its activity is taken as 1, because it diminished very little by the slight degree of ionization.

Environmental significance:

A controlled value of pH is desired in water supplies, sewage treatment and chemical process plants. In water supply pH is important for coagulation, disinfection, water softening and corrosion control. In biological treatment of waste water, pH is an important parameter, since organisms involved in treatment plants are operative within a certain pH range.

The pH of the soil is very important for a proper crop yield. Salts such as carbonates, bicarbonates, phosphates, and organic acids render the soils acidic or basic. Farmers and gardeners need to know how acidic or basic the soil is so that they know which plants to grow. The choice of fertilizers also depends upon pH of the soil.

When rain falls through polluted air, it comes across chemicals such as gaseous oxides of sulphur (SO_x), oxides of nitrogen (NO_x), mists of acids such as hydrochloric and phosphoric acid, released from automobile exhausts industrial plants, electric power plants etc. These substances dissolve in falling rain making it more acidic than normal with pH range between 5.6 -3.5. In some cases the pH even gets lower to two. This leads to acid rain.

Turbidity:

The term ‘Turbid’ is applied to water containing suspended matter that interferes with passage of light through the water. Turbidity is a measure of water clarity.Material that causes water to become turbid includes:

- Clay
- Silt
- Finely dissolved organic & inorganic material
- Microorganism such as bacteria and viruses.

A turbidity test will measure the decrease in the passage of light through a water sample based on the amount of floating materials in the water. Turbidity is caused by suspended materials which absorb and scatter light. These colloidal and finely dispersed turbidity-causing materials do not settle under quiescent conditions and are difficult to remove by sedimentation. Turbidity is a key parameter in water supply engineering, because turbidity will both cause water to be aesthetically unpleasant and cause problems in water treatment processes, such as filtration and disinfection. Turbidity is also often used as indicative evidence of the possibility of bacteria being present.

Environmental Significance:

Turbidity is a useful indicator of groundwater quality changes. Groundwater, especially if under a more or less direct influence of surface water, will experience rapid movements during recharge periods or after rain events. This will displace sediment and turbidity can be an indicator of such changes. Turbidity in groundwater does not indicate pathogen presence but provides information on general water quality and is an indicator of surface influence on groundwater quality.

Turbidity is important for water supply engineers as turbid water is not aesthetically acceptable to people. There is always a fear among the people that turbid water may cause diseases. For filtration, turbid water is not suitable as it cause quick clogging of filter bed which means the use of pre-treatment plant is necessary. Turbidity is also an important parameter in disinfection process. Disinfection is usually accomplished by means of chlorination, ozone treatment, distillation, aeration etc. To be effective, there must be contact between the agent and the organisms to be killed. However, in case in which turbidity is caused by municipal wastewater solids, many of the pathogen organisms may be encased in the particles and protected from the disinfectant. Turbidity can provide food and shelter for pathogens. If not removed, turbidity can promote re-growth of pathogens in the distribution system, leading to waterborne diseases.

Color:

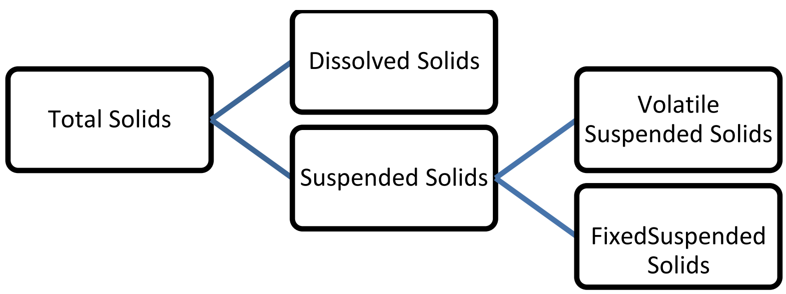
Pure water should not possess any color. Most water available to us are colored to some extent due to the presence of various impurities i.e., iron and manganese in association with organic matter from decaying vegetation. Many surface waters are colored, due primarily to decomposition of organics, metallic salts or colored clays. This color is considered as "apparent color" as it is seen in the presence of suspended matter, whereas "true color" is derived only from dissolved inorganic and organic matters.

Environmental Significance:

Colored water is not always harmful to man, but in most cases it is. Even if the water is not harmful, people for aesthetic reasons do not prefer it. Also, disinfection by chlorination of waters containing natural organics (which produces color) results in the formation of chloroform, other tri-halomethanes, and a range of other chlorinated organics, leading to problems which are a major concern in water treatment. So it is important to limit the color of water for domestic supplies.

Total Dissolved Solid:

Environmental engineering is concerned with the solid material in a wide range of natural waters and wastewaters. The usual definition of solids (referred to as "total solids") is the matter that remains as residue upon evaporation at 103~105°C. The various components of "total solids" can be simplified as follows:



Total Solids (TS) are the total of all solids in a water sample. They include the total suspended solids and total dissolved solids. Total Suspended Solids (TSS) is the amount of solids in a water sample retained by a filter. Samples are filtered through a glass fiber filter. The filters are dried and weighed to determine the amount of total suspended solids in mg/l of sample. Total Dissolved Solids (TDS) are those solids that pass through a filter with a pore size of 2.0 micron or smaller. They are said to be non-filterable. After filtration the filtrate (liquid) is dried and the remaining residue is weighed and calculated as mg/l of Total Dissolved Solids. Fixed Solids are the inorganic mater present in the sample water and the Volatile Solids are the organic matter present in the sample.

Environmental Significance:

Total solids measurement can be useful as an indicator of the effects of runoff from construction, agricultural practices, logging activities, sewage treatment plant discharges and other sources. Water with total solids generally is of inferior palatability and may include an unfavorable condition. It may be esthetically unsatisfactory for purposes such as bathing, washing etc. The amount of solids in waste water is frequently used to describe the strength of the water. If the solids in wastewater are mostly organic, the impact on a treatment plant is greater than if the solids are mostly inorganic.

The most important aspect of TDS with respect to drinking water quality is its effect on taste. The palatability of drinking water with a TDS level less than 600 mg/L is generally considered to be good. Drinking water supplies with TDS levels greater than 1200 mg/L are unpalatable to most consumers. An aesthetic objective of 500 mg/L should ensure palatability and prevent excessive scaling. However, it should be noted that at low levels TDS contributes to the palatability of drinking water. High TDS levels generally indicate hard water, which can cause scale buildup in pipes, valves, and filters, reducing performance and adding to system maintenance costs. These effects can be seen in aquariums, spas, swimming pools, and reverse osmosis water treatment systems. Typically, in these applications, total dissolved solids are tested frequently, and filtration membranes are checked in order to prevent adverse effects.

Suspended solids can make surface waters turbid (cloudy) and cause an increase in stream temperature. As levels of TSS increase, a water body begins to lose its ability to support a diversity of aquatic life. Suspended solids absorb heat from sunlight, which increases water temperature and subsequently decreases levels of dissolved oxygen (warmer water holds less oxygen than cooler water). In the realm of municipal wastewater, suspended solids analysis is by far the most important gravimetric method. It is used to evaluate the strength of the raw wastewater as well as the overall efficiency of treatment. Furthermore, most WWTP's have effluent standards of 10 to 30 mg/L suspended solids which may be legally enforceable. As was the case with municipal wastewater, suspended solids analysis is useful as a means of assessing the strength of industrial wastewaters and the efficiency of industrial wastewater treatment

Biochemical Oxygen Demand (BOD_5):

When biodegradable organic matter/waste is released into a water body, microorganisms feed on the wastes, breaking it down to simpler organic and inorganic substances. When this decomposition takes place in an aerobic environment it produces non-objectionable, stable end products (e.g., CO_2, SO_4, PO_4, NO_3) and the process draws down the dissolve oxygen (DO) content of water.

Organic matter + O_2 =CO_2 + H_2O + new cells + stable products

(Bacteria)

When insufficient oxygen is available or when oxygen is exhausted by the aerobic decomposition of wastes, different set of microorganisms carry out the decomposition anaerobically producing high objectionable products including H_2S, NH_3 and CH_4.

Organic matter = CO_2+ CH_4 + new cells + unstable products

(Bacteria)

The biochemical oxygen demand determination is a chemical procedure for determining the amount of dissolved organic matter to occur under standard condition at a standardized time and temperature. Usually, the time is taken as 5 days and the temperature is 20^0C.

The test measures the molecular oxygen utilized during a specified incubation period for biochemical degradation of organic material (carbonaceous demand) and the oxygen used to oxidize inorganic material such as sulfides and ferrous ion. It also may measure the amount of oxygen used to oxidize reduce forms of nitrogen (nitrogenous demand).

Environmental Significance:

BOD is the principle test to give an idea of the biodegradability of any sample and strength of the waste. Hence the amount of pollution can be easily measured by it.

Efficiency of any treatment plant can be judged by considering influent BOD and the effluent BOD and so also the organic loading on the unit.

Application of the test to organic waste discharges allows calculation of the effect of the discharges on the oxygen resources of the receiving water. Data from BOD tests are used for the development of engineering criteria for the design of wastewater treatment plants.

Ordinary domestic sewage may have a BOD of 200 mg/L. Any effluent to be discharged into natural bodies of water should have BOD less than 30 mg/L.

This is important parameter to assess the pollution of surface waters and ground waters where contamination occurred due to disposal of domestic of domestic and industrial effluents.

Drinking water usually has a BOD of less than 1 mg/L. But, when BOD value reaches 5 mg/L, the water is doubtful in purity.

The determination of BOD is used in studies to measure the self-purification capacity of streams and serves regulatory authorities as a means of checking on the quality of effluents discharged to stream waters.

The determination of the BOD of wastes is useful in the design of treatment facilities.

It is the only parameter, to give an idea of the biodegradability of any sample and self purification capacity of rivers and streams.

The BOD test is among the most important method in sanitary analysis to determine the polluting power, or strength of sewage, industrial wastes or polluted water.

It serves as a measure of the amount of clean diluting water required for the successful disposal of sewage by dilution.

3.2 Sample Collection and Preservation:

- Samples were collected from 5 selected sites.
- Sample bottles were washed with distill water prior to collection.
- Samples were collected from the middle of the river.
- Samples were collected on 25th of March and 22nd of April.
- On 25th of March sample A, B and C were collected.
- On 22nd of April sample D and E were collected.
- Samples were collected from approximately 1-1.5 feet below the surface of the water.
- A survey was conducted near the selected points to get some hand to hand data on the land uses around the selected points.

Materials used for collection of samples

- Standard 500ml sample bottle
- Cooling box
- Ice

Methods of Collection & Preservation of samples

- Conventional method was used for sample collection & preservation.
- That means sample was collected manually.
- Samples were preserved by using ice and then refrigeration system.
- No chemicals were used for preservation of samples.

3.3 Methodologies/Equipments Used for Tests:

There is a table below listing all the tests being done and the type of method/equipment used for the test:

Table 3(a): Name of the tests and equipments used.

Test	Method/Equipment
pH	HACK pH Meter
Turbidity	HANNA turbidity meter
Color	HACH Spectrophotometer
TDS	Filtration & Oven Drying
BOD5	HACH BOD Trak

3.4 Questionnaire for the Survey :

A survey was conducted near the selected points to get some hand to hand data on the land uses around the selected points. We have three kinds of waste. Agricultural, industrial and domestic land use generates these wastes. Questions were selected for Agricultural, Industrial and Domestic wastes separately. The survey was being conducted in several places near the river.

For agricultural waste questions were designed to get information about area of cultivation, number of seasonal crops, quality and quantity of fertilizers and pesticides.

The questions were:

- How much area is cultivated?
- How many crops are grown in one year?
- What kind of fertilizer is used?

- To what extent these fertilizers are used?
- What kind of pesticides is used?
- To what extent these pesticides are used?
- What percentage of the fertilizers and the pesticides leeches into ground?
- What percentage of the fertilizers and the pesticides washes into Turag?

For industrial waste questions were aimed to get answers for purpose of the industry, area of the industry, type of the waste, amount of waste produced and whether this effluent was dumped in Turag or not. The questions were:

- What is the basic purpose of the industry?
- What is the area of the industry?
- What is the type of the waste?
- Do the solid wastes reach Turag? If yes, then, in what amount?
- What is the amount of waste produced on a given time?

For Domestic waste questions were selected to get answers for the type of waste, amount of waste produce and whether this effluent was dumped in Turag or not. We contacted an organization named AVIJAN to conduct the survey. They manage the domestic waste near Turag River. The questions were:

- What is the type of the waste?
- Do the wastes reach Turag? If yes, then, in what amount?
- What is the amount of waste produced on a given time?

CHAPTER 4
RESULTS AND ANALYSIS

4.1 Results from Test

pH:

pH is the measure of acidity or alkalinity of the water. It has no unit. The standard value of pH for drinking water is 6.5-8.5. For preserving aquatic life it is 5-8. The values of pH from different sites are given below in the table:

Table 4(a): Value of pH at the selected sites

Site	Value
A	7.66
B	7.49
C	7.91
D	7.04
E	7.10

The results of pH that are found from the tests in the laboratory are plotted in the actual map to get the idea of variation of pH.

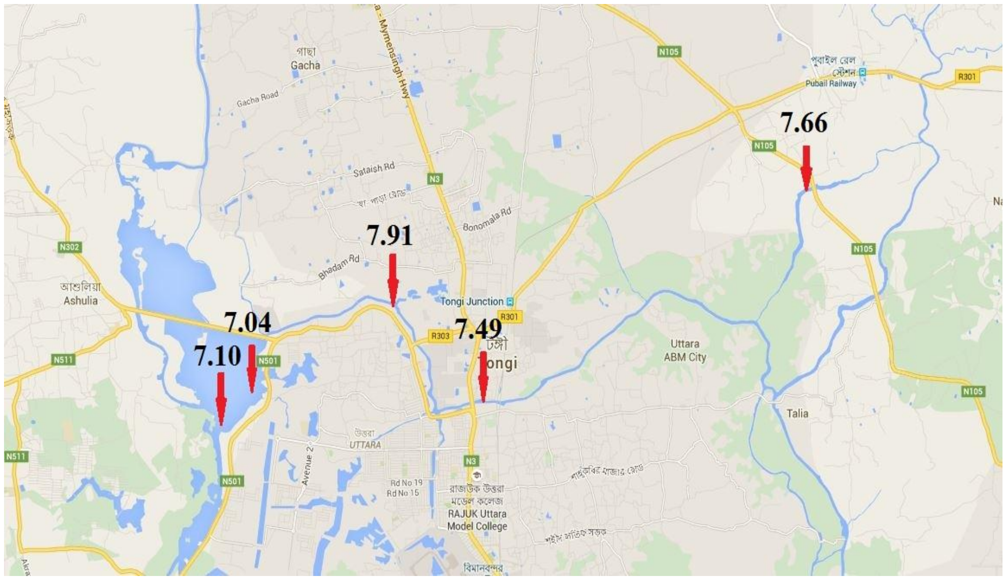


Figure 4.1: Values of pH from experiments on map

Turbidity:

Turbity is measured in terms of FTU. The highest value is 112 FTU and the lowest value is 33.7 FTU. The standard value of pH for drinking water is 5 FTU. For convenience the values are shown in a table.

Table 4(b): Value of Turbidity at the selected sites

Site	Value(FTU)
A	112
B	110
C	97
D	41.3
E	33.7

The results of turbidity that are found from the tests in the laboratory are plotted in the actual map to get the idea of variation of turbidity.

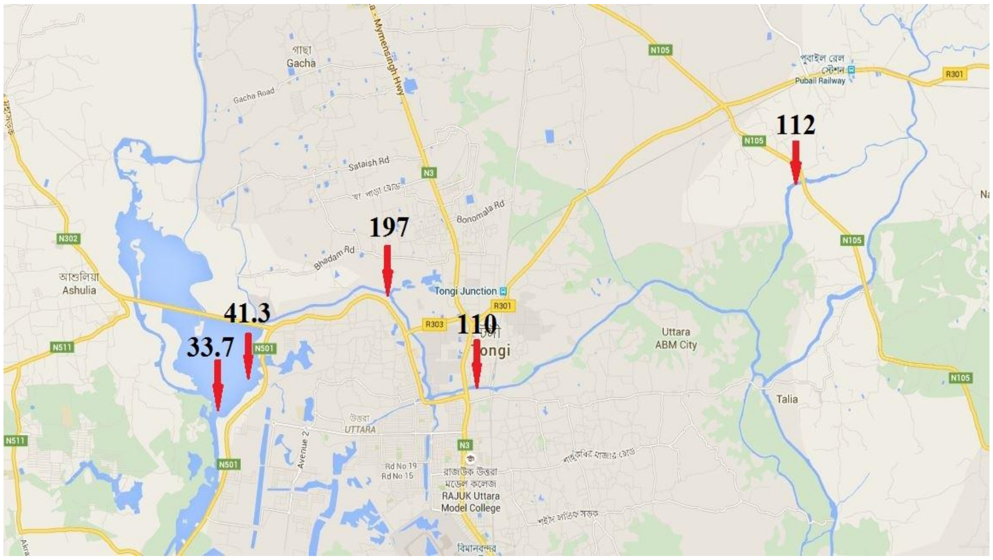


Figure 4.2: Values of turbidity from experiments on map

Color:

Color is measured in terms of platinum-cobalt unit i.e. PtCo. The highest value is 496 PtCo and the lowest value is 251 PtCo. The standard value of pH for drinking water is 15 PtCo.

Table 4(c): Value of color at the selected sites

Site	Value(PtCo)
A	496
B	403
C	251
D	324
E	387

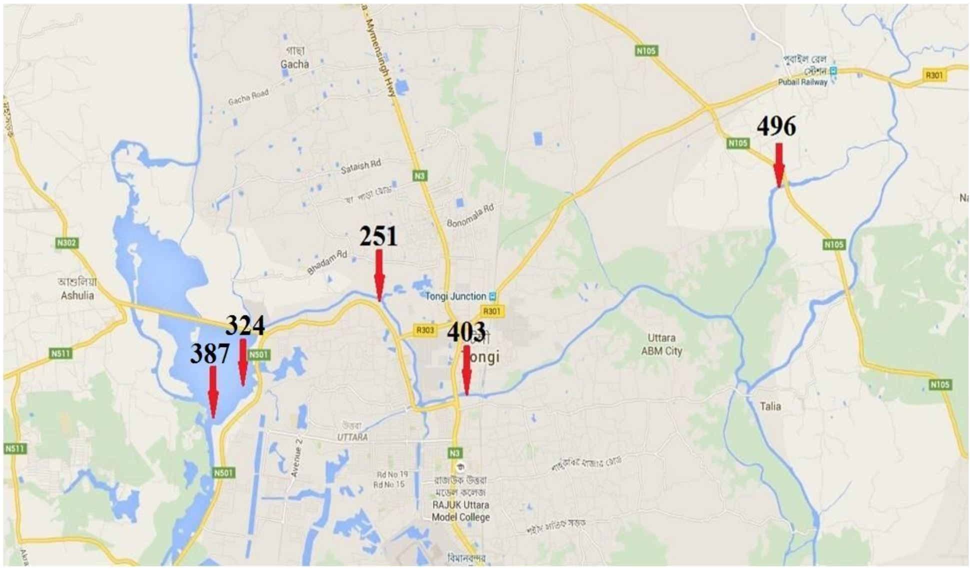


Figure 4.3: Values of color from experiments on map

Total Dissolved Solid (TDS):

Total Dissolved Solid is measure in terms of mg/L. The values are provided in the box below. The highest value is 1600 mg/L and the lowest value is 629 mg/L. The standard value of TDS for drinking water is 1000 mg/L.

Table 4(d): Value of TDS at the selected sites

Site	Value(mg/L)
A	1150
B	872.5
C	1600
D	629
E	746

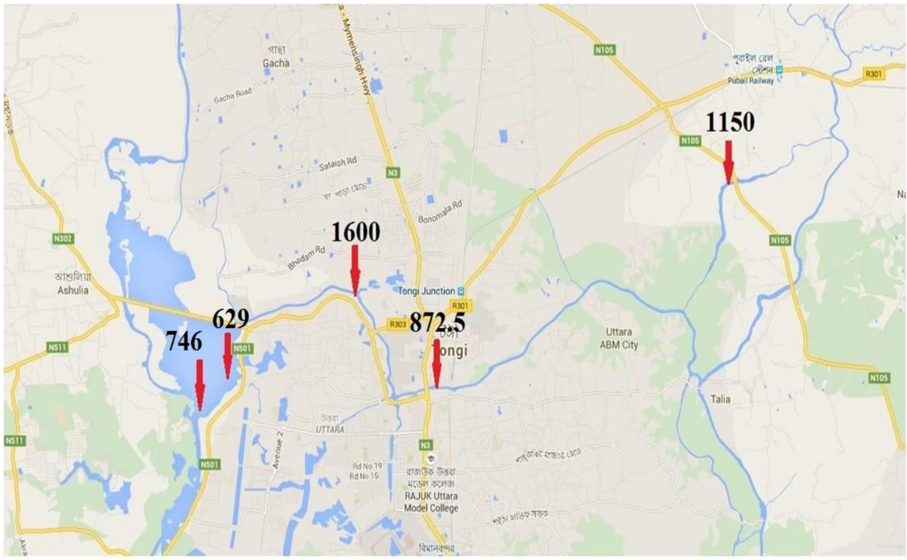


Figure 4.4: Values of TDS from experiments on map

BOD_5:

Biochemical Oxygen Demand is a measure in terms of mg/L. The values are provided in the box below. The highest value is 31 mg/L and the lowest value is 17 mg/L. The standard value of BOD_5 for drinking water is 30 mg/L.

Table 4(e): Value of BOD_5 at the selected sites

Site	Value(mg/L)
A	23
B	24
C	31
D	19
E	17

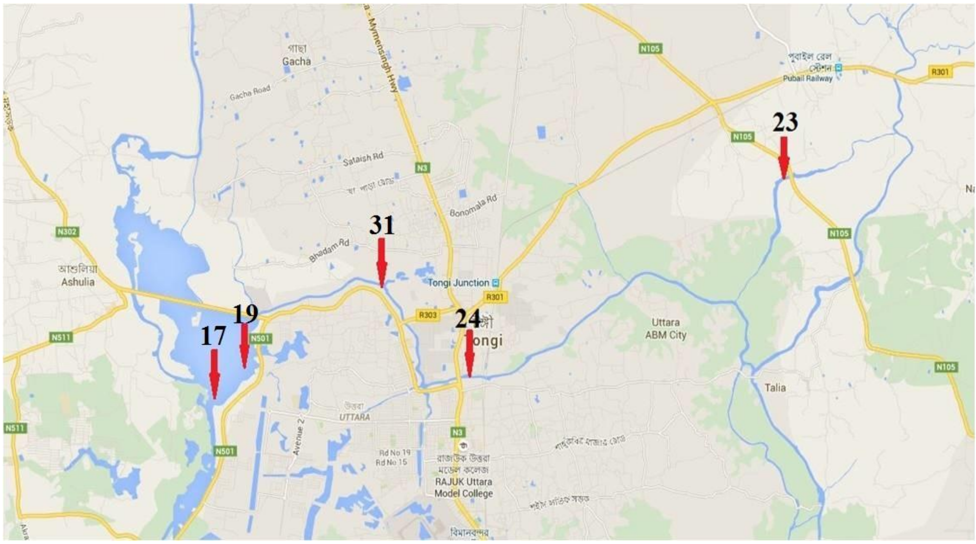


Figure 4.5: Values of BOD_5 from experiments on map

4.2 Results from Survey:

- Prior to site A, approximately 5, 00,000 m^2 area is under cultivation for only four months. 10-20 kilograms of fertilizer is used in 3643 m^2 land thrice in this time.
- Around 6 tons of fertilizers are used. And these fields are just beside the river.
- The main ingredients of these fertilizers are Nitrogen (N), Potassium (K), Zinc (Zn) and Gypsum ($CaSO_4.2H_2O$).
- There is a market at site B occupying 180000 m^2 areas. Waste produced in this market is dumped in Turag.
- Around 5,000 m^3 domestic waste is dumped in site C.
- 8 vans each approximately of 1.7344069 m^3 volume dump waste at site C all the year round.
- There are at least two markets, three hospitals, two steel/ aluminum mills, threepharmaceutical companies in the study area who contribute in the waste dumped in Turag.
- There are many small industries growing on daily basis that also contributes to the wastes dumped in Turag River.
- Moreover wastes are also carried from upstream that is also added to the wastes of the studied area.

4.3 Discussion on Test Results:

We will observe the variation of each of the parameter in the selected sites from the standard value. Thus we can compare the obtained test values with the standard value and come to a conclusion about the current water quality of the Turag river.

pH:

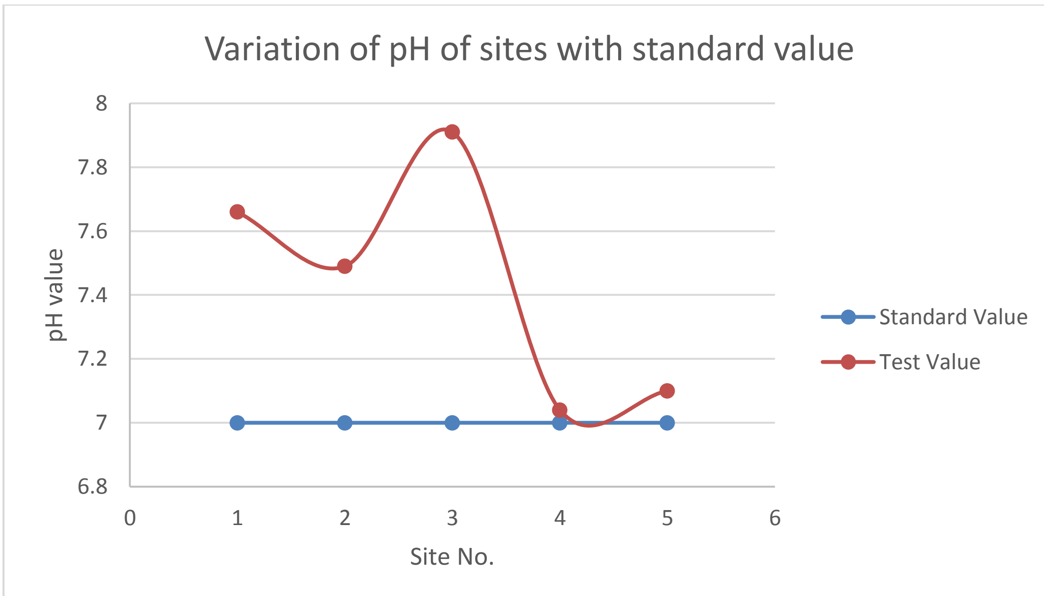


Figure 4.6: pH variation

From the graph we can see that the test values of pH are much higher than the standard value in site A, B and C. And in D and E the values are close to the standard value. All the values of pH test are higher than standard value. That means the water of the selected sites are somewhat basic in nature. The value of pH is maximum in site C and minimum in site D.

Turbidity:

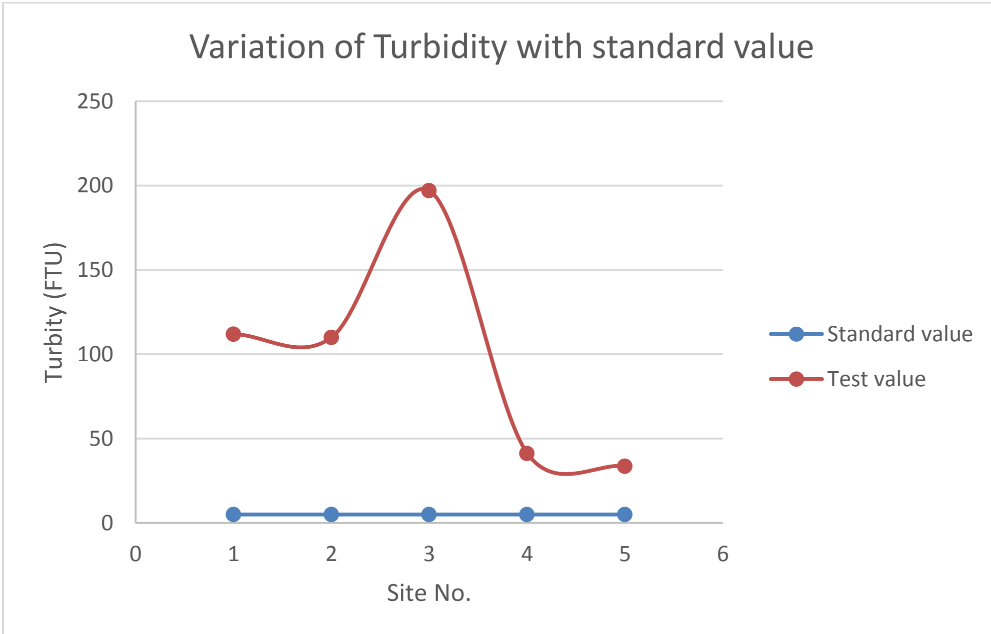


Figure 4.7: Turbidity variation

From the graph we can see that the test values of Turbidity are much higher than the standard value in site A, B and C. And in D and E the values are close to the standard value. All the values of turbidity test are higher than standard value. The value of turbidity is maximum in site C and minimum in site E.

Color:

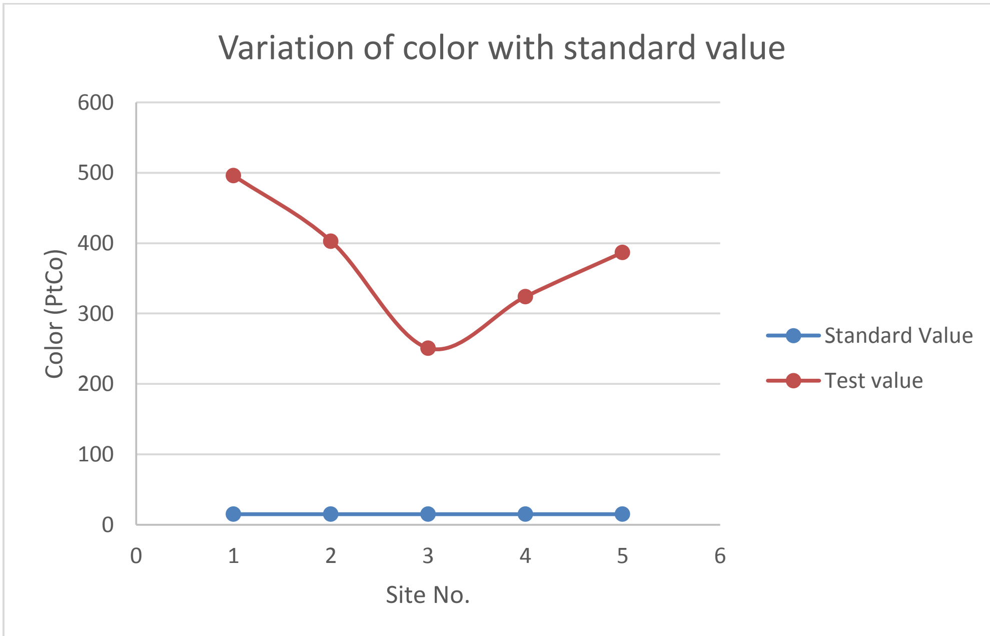


Figure 4.8: Color variation

From the graph we can see that the test values of Color are much higher than the standard value in site A, B, C and E. And in D the value are close to the standard value. All the values of turbidity test are higher than standard value. The value of Color is maximum in site A and minimum in site C.

TDS:

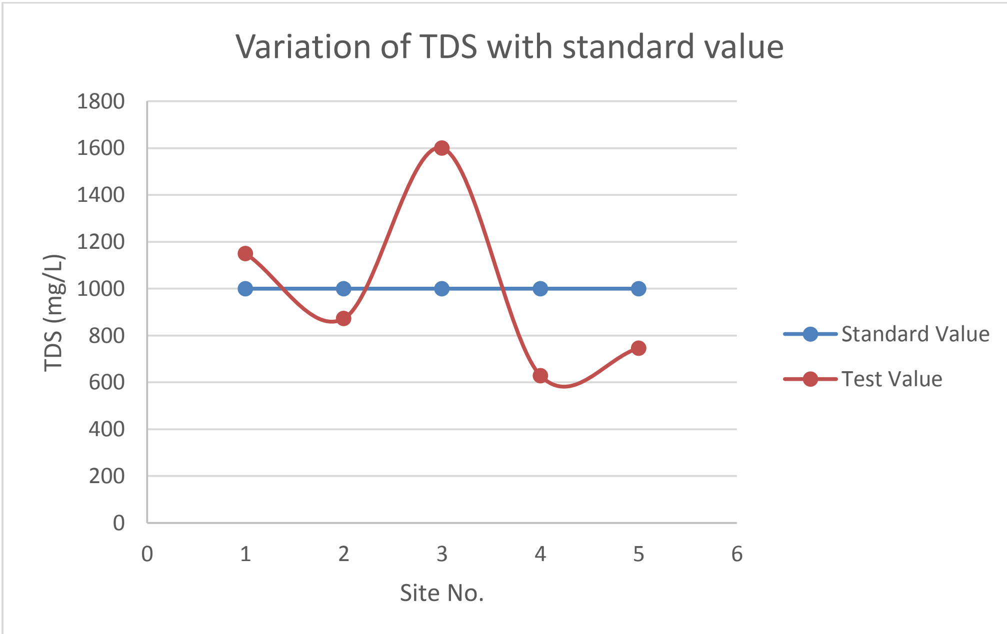


Figure 4.9: TDS variation

From the graph we can see that the test values of TDS are somewhat variable than the standard value in sites. The values are closer to the standard value. The values of TDS test are higher than standard value at point A and C and the values of TDS are lower than standard value at point B,D and E. The value of TDS is maximum in site C and minimum in site D.

BOD_5:

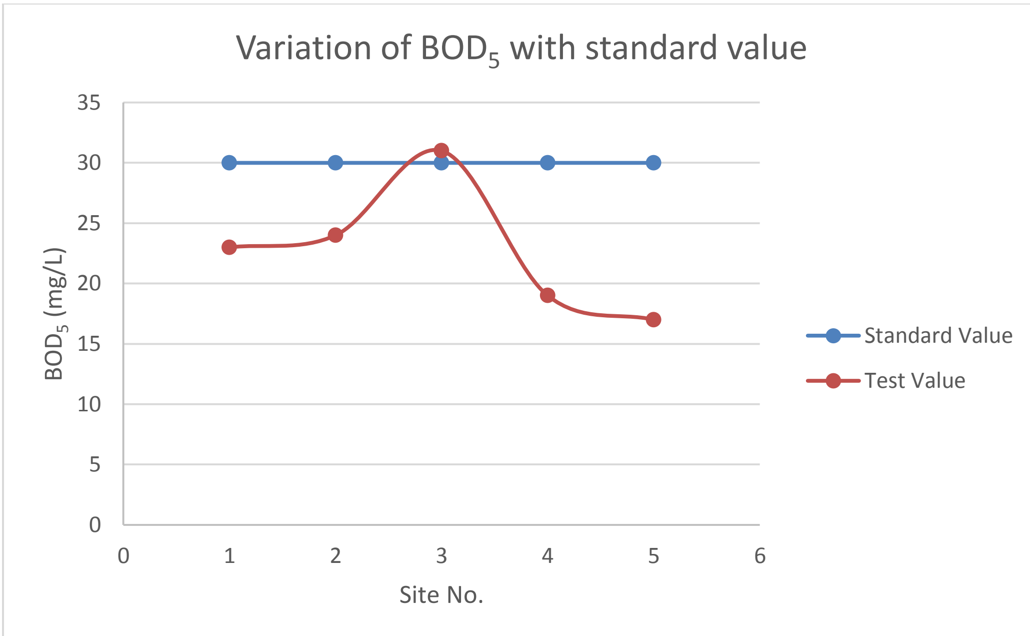


Figure 4.10: BOD_5 variation

From the graph we can see that the test values of BOD_5 are somewhat variable than the standard value in sites. The values are closer to the standard value. The values of BOD_5 test are higher than standard value at point C and the values of BOD_5 are lower than standard value at the rest of the points. The value of BOD_5 is maximum in site C and minimum in site E.

4.4 Discussions on Survey Results:

Prior to site of Nagda Bridge waste is mainly agricultural. The reason to say that is because the area around site A is under cultivation of rice mainly.

In site of Tongi Bridge waste is mostly industrial and domestic (organic). Water at this site has less pH than Nagda Bridge Site probably because of the acidic nature of the main ingredients of the fertilizers. Though Potassium (K) is also applied, its quantity is very less.

Values of environmental parameters at site of Gudara Ghat has topped in every experiment except one. This is mainly due to the type of waste present there as well as the waste brought by the stream. At Gudara Ghat, waste is a mix of agricultural, industrial and domestic. There are a university, a hospital, and two big and several other small slums, various kinds of industries in the adjacent area of Turag between Tongi Bridge & Gudara Ghat.

Diabari & Rustompur Bridge sites mainly contains the flow from upstream which combines with another flow of Turag in a marshland. A very small area is cultivated only in the dry season which remains under water for the most part of the year. The waste dumped at Diabari & Rustompur Bridge sites is mainly industrial. There are dredgers kept parallel to the Mirpur Bypass road up to and past these sites to keep navigable depth in Turag, at the same time filling low lands on the other side of the road. They use petroleum, which if leaked can have an effect on the water quality also

CHAPTER 5
CONCLUSION

5.1 General

Freshwater systems are vitally important to our society today. Aquatic ecosystems not only provide food and water for human consumption, they maintain and improve water quality by filtering out, storing and converting contaminants, provide transportation, support habitats for wildlife, and provide recreation. The Turag River is a vital resource to approximately 2 million people. However, a very few study of the river's water quality had been undertaken to date.

Being a watershed dominated by agriculture, industrial & domestic it was clear that this land use had the potential to affect the water quality of the Turag River. This study attempted to quantify that effect. The data presented in this thesis could aid in developing guidelines for the Turag River watershed. The municipal point source of pollution had a great effect on the water quality. It became apparent during the course of this study that climatic variability can potentially affect water quality. Wet or dry years can have an influence on nutrient concentrations in the river. In wetter years, there could be more fluctuations in nutrient concentrations and differences between sites can be more difficult to determine. Drier years could see longer residence times for nutrients.

A further recommendation for this watershed is the organization of educational programs to provide information to people in the local area about the benefits of waste water management and soil conservation methods. Educational programs are inexpensive and often an effective tool in addressing nonpoint source pollution. Some work has begun in these areas, especially in terms of wastewater management, but there is much work to be done in encouraging the use of nutrient and land management practices in the areas near Turag River It is also recommended in the future that a monitoring program be set up to track changes in water quality and to monitor the progress of remedial measures. The data presented in this thesis represents benchmark data for the Turag River. This data can now provide a base for future water quality monitoring of the Turag River. The Turag

River is an important resource to many users and the current health of the river could certainly be improved. Local organizations and residents, and provincial and federal departments all need to become involved in the restoration of the Turag River ecosystem. The Turag River is a vital resource to many people. The health of this ecosystem is essential to the well being of the communities in the adjacent area. Thetime has come to take a more intensive look into the water quality of the river, to safeguard people's health, and to protect these important ecosystems.

Only a few of the test results are fitting in the existing standards while the others are way off the chart. It seems from the value from the test and survey results and observation that quality water deteriorates with the increase and density of land use. And land use is increasing rapidly every year. Fertility of cultivable land as well as species and amount of fish is decreasing. Sedimentation is increasing. These are only a few of the problems faced by the people in the study area. Land use is a major variable of development of the socio economic condition of a society. But it is taking its toll on the water quality of Turag in case of Gazipur. So, we suggest that any future land use should be planned and monitored by proper authority.

5.2 Future scope

For the future work, we suggest the followings:

1. Several samples from the same location i.e. we have taken one sample from each location. But for better results we should take several samples from same location

2. Sampling at different occasions, i.e. to avoid unforeseen events that might happen suddenly and strongly to influence sampled water. Also, natural fluctuations are covered by sequential sampling.

3. Analyzing river sediment from different depths and trying to identify areas influenced by industrial activities.

4. Biological analysis, such as bacteria, because of its role in human health.

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