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# Water Quality Assessment of Turag River Using Selected Parameters

Saquib Ahmad Khan[1], Shaikh Sayed Ahammed[2], K. Ayaz Rabbani[3], Md. Abdul Khaleque[4]

*[1,2,3,4] Department of Environmental Science, School of Environmental Science and Management, Independent University, Bangladesh, Plot-16, Block-B, Aftabuddin Ahmed Road, Bashundhara R/A, Dhaka-1212*

***Abstract:*** *The Turag is a very important river of Dhaka city, specially to its northern inhabitants. While other rivers around Dhaka have received considerable attention, there have not been any recent, reliable studies on the water quality of Turag using standard methods. This study looks at some water quality parameters in the Turag and classifies sections of the river under a water quality index (WQI). Water quality index provides a single number to express overall water quality of a certain location based on selected water quality parameters. The parameters used to calculate WQI in this study are pH, conductivity (µS), temperature (°C), dissolved oxygen (mg/L) and total dissolved solids(mg/L). Present study shows that Turag has higher WQI in the northern part, with the highest WQI value of 84.04 obtained at Rupnagar Pump House. Comparatively the southern sections of the river have lower WQI values with the lowest WQI value of 40.17 at PalparaGhat location.*

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## I. Introduction

Like many major megacities in developing countries, Dhaka, the capital of Bangladesh, has crippling environmental problems which is compounded by Dhaka's high population density (Siegel, 2019; Rahman and Rabbani, 2007). The pollution of the rivers around Dhaka are of particular concern because of the significant health and economic cost to the residents of Dhaka (Real et al., 2017; Asaduzzaman et al., 2016). Dhaka is unique in that the city is surrounded by rivers - Turag, Buriganga, Dhaleshwari, Balu and Shitalakhya are the major rivers around Dhaka with the Buriganga being considered the most important (Fig 1). Pollution of Buriganga has been given a lot of attention because the river was the primary economic pathway of Dhaka since the 17th century and the river has suffered 400 years of environmental stress due to unregulated growth of settlements on its banks, unregulated discharge of effluents and solid waste into its waters and critical flow constrictions from land grabbing and infilling which has led to some researchers calling Buriganga a "dead river" (Uddin et al., 2016; Reza and Yousuf, 2016; Ahammed et al., 2016). There are reports onBuriganga having high levels of COD, BOD and heavy metals like chromium; most of the parts of the river that pass through the city has dissolved oxygen levels of less than 0.5 (Uddin et al., 2016; Ahammed et al., 2016).

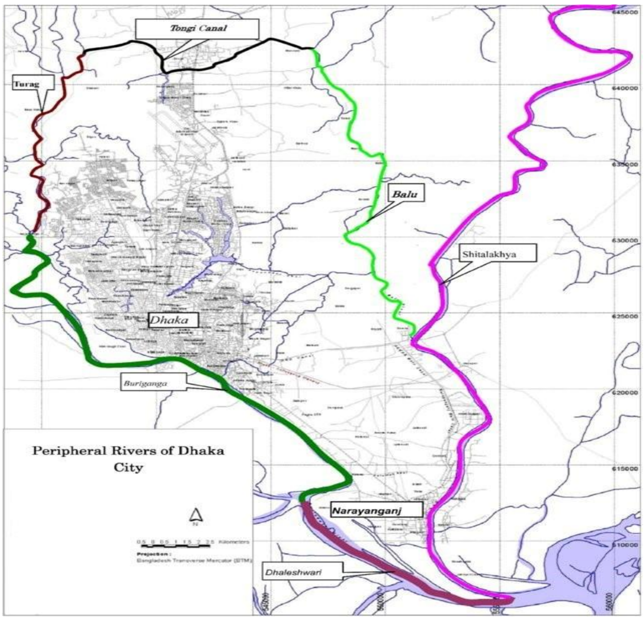


**Figure no 1**Modified from (*Banu et al., 2013*). Available via license CC BY 4.0

The Turag, however, is also important to the residents of Dhaka as it serves as the primary waterway of the north-eastern part of the city transporting people, commodities and agricultural products. Turag originated from the Bangshi River, an important tributary of the Dhaleshwari River, flows through Gazipur, area situated next to Dhaka in north-eastern side and joins the Buriganga which is in the south of Dhaka. In addition to the approved establishments, the banks of Turag consist of a large number of unplanned, illegal and semi legal establishments, ranging from residential houses to commercial buildings to industries of varying sizes and scales. There are also extensive agricultural lands along sections of Turag's banks and the Bangladesh National Zoo is located along the river. The second largest annual international gathering of Muslims (BiswaIjtema) takes place on the banks of the Turag which adds to the pollution as well entering the river. What is of immediate concern from a pollution perspective is that along the length of the river, especially as it enters Dhaka from the north, there is heavy residential, commercial and industrial effluent discharge into Turag. Many major textiles, pharmaceutical and other industries are located in areas like the Tongi industrial area which is the northern part of the city. There are also very densely populated and unplanned residential complexes around these industrial areas in the north which releases significant wastewater or sewage into the river. Due to the environmental stress on this river and the cultural and economic significance, the Turag has been declared as an ecologically critical area (ECA) by the Department of Environment, Government of Bangladesh on September 2009 (*Colls et al., 2009*).

Monitoring of river water quality of Turag is important if we want to prevent it from progressing into a similar environmentally distressed state as Buriganga. The quality of water in Turag has been monitored before but there is no consistency in the choice of water quality parameter that is measured making it difficult to compare studies (Rahman et al., 2012; Islam et al., 2012; Mobin et al., 2014; Meghla et al., 2013; Mokaddes et al., 2012; Khondker and Abed, 2013). Sometimes the water quality that needs to be measured (e.g. nitrates, metals, organic compounds) requires the use of expensive equipment and specialized analytical chemistry laboratories. Processing a large number of water quality variables is not easily understood which makes it difficult to quickly convey the health of a river to the general public (Katyal, 2011; Akoteyon et al., 2011). Water Quality Index (WQI) has been touted as a simple index that embodies the aggregate influence of different water quality parameters of a river (Lumb et al., 2011). It has the capability to reduce the bulk of the information into a single value to express the data in a simplified and logical form which can be communicated easily to the public and legislative decision makers (Semiromi et al., 2011; Tyagi et al., 2013). There are many examples in the literature of using the concept of WQI in rivers (Şener et al., 2017; Bhargava, 1983; Kumar and Dua, 2009; Karbassi et al., 2011; Dojlido et al., 1994). This study looked at the WQI of several significant points along the Turag to investigate the overall quality of the river and try to establish if WQI is an adequate measure for river health by comparing it to the visible sources of pollution at each sampling point. The WQI being used here will also serve as a baseline for future studies on the Turag.

## II. Methodology

Field measurements of water quality parameters were conducted in eleven locations along the Turag in a single day on June, 2018 (Figure 2). The GPS coordinates of each location was determined with the aid of a handheld GPS (GPS60, Garmin, USA). Surface water from each locations were collected on spot and analyzed for five water quality parameters (pH, conductivity, temperature, dissolved oxygen, total dissolved solids) as per standard methods (Federation and Association, 2005). All water quality parameters were measured on site by using a calibrated hand held multimeter analyzer (HQ40d Multimeter, Hach, USA). The Water Quality Index (WQI) was calculated using the formula (*Tyagi et al., 2013*):

$$\mathrm{WQI} = \frac{\sum \mathrm{QiWi}}{\sum \mathrm{Wi}}$$

Where, Qi (water quality rating) = 100 × (Va-Vi)/ (Vs-Vi); Va is the actual value present in the water sample; Vi is the ideal value (0 for all parameters except pH and DO which are 7.0 and 14.6 mg/ L respectively) and Vs is the standard value (pH = 8.50 (ref), Temp = 25$^{o}$C (Ref: WHO,2004), Conductivity = 1200 (Ref: Water Quality Report, 2014, DoE), TDS = 1000 (Ref: ECR, 1997) & DO = 6.00 (Ref: ECR.,1997). Qi = 0 signifies complete absence of pollutants, while Qi> 100 implies that the pollutants are above the standards.

## III. Results And Discussion

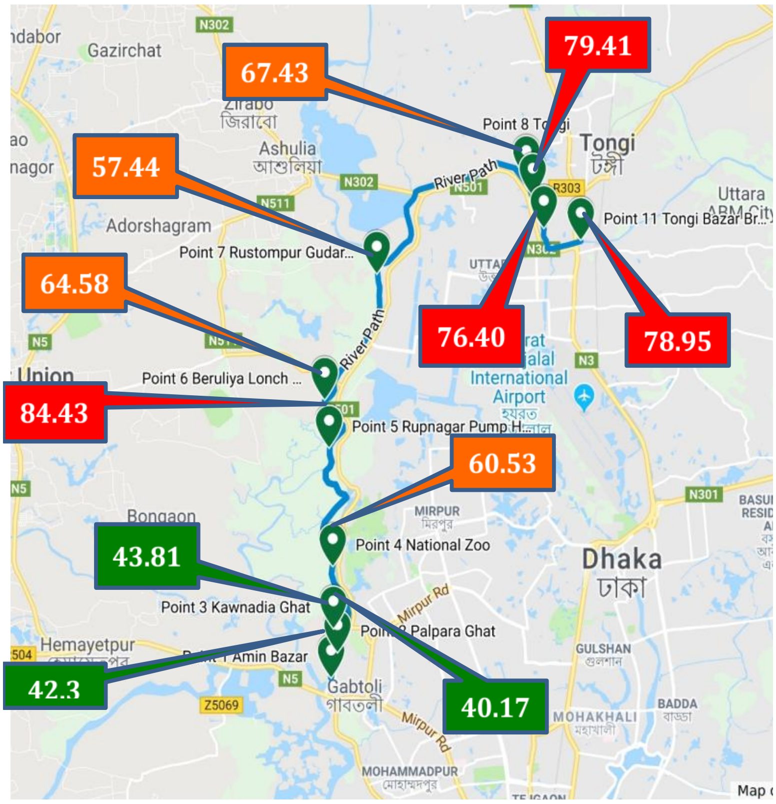


**Figure no 2** WQI at different points of Turag on base map modified from (*Google, n.d.-c*)

The value of the water quality parameters measured at different locations are given in Table 1. WQI calculated in the eleven points of Turag are given in Fig. 2. The health of the river at particular points were classified as Excellent, Good, Poor, Very poor or Unsuitable according to the WQI value given in Table 2. Name of each location, its GPS coordinates, the WQI and the classification is given in Table 3.

**Table no1** Water Quality Parameters of different points on Turag

| | **pH** | **Conductivity** (μS) | **Temp (°C)** | **DO (mg/L)** | **TDS (mg/L)** |
|---|---|---|---|---|---|
| Sampling Point 1 | 5.43 | 1110 | 30.3°c | 3.75 | 710 |
| Sampling Point 2 | 5.37 | 1096 | 29.7°c | 3.77 | 701 |
| Sampling Point 3 | 5.24 | 1097 | 29.8°c | 2.64 | 702 |
| Sampling Point 4 | 6.29 | 1109 | 30.2°c | 4.11 | 710 |
| Sampling Point 5 | 6.57 | 1119 | 30.8°c | 1.27 | 716 |
| Sampling Point 6 | 6.74 | 1106 | 30.1°c | 5.24 | 708 |
| Sampling Point 7 | 6.49 | 1105 | 30.1°c | 5.43 | 707 |
| Sampling Point 8 | 6.61 | 1124 | 31.0°c | 4.31 | 719 |
| Sampling Point 9 | 6.84 | 1106 | 30.1°c | 3.15 | 708 |
| Sampling Point 10 | 6.94 | 1105 | 30.1°c | 4.06 | 707 |
| Sampling Point 11 | 7.03 | 1102 | 29.9°c | 3.98 | 705 |

**Table no 2** Rating scale used for WQI values

| **WQI value** | **Rating of Water Quality** |
|---|---|
| 0-25 | Excellent |
| 26-50 | Good |
| 51-75 | Poor |
| 76-100 | Very Poor |
| >100 | Unsuitable |

**Table no 3** Location and WQI of points on Turag

| **Location** | **No.** | **WQI** | **Rating** |
|---|---|---|---|
| Amin Bazar | P1 | 42.03 | Good |
| PalparaGhat | P2 | 40.17 | Good |
| KawnadiaGhat | P3 | 43.81 | Good |

| | | | |
|---|---|---|---|
| National Zoo | P4 | 60.53 | Poor |
| Rupnagar Pump House | P5 | 84.04 | Very Poor |
| Beruliya Launch Ghat | P6 | 64.58 | Poor |
| RustompurGudaraGhat | P7 | 57.44 | Poor |
| Tongi | P8 | 67.43 | Poor |
| AbdulapurKamarpara Bridge | P9 | 79.41 | Very Poor |
| TongiEstemaMoydan | P10 | 76.40 | Very Poor |
| Tongi Bazar Bridge | P11 | 78.95 | Very Poor |

The average WQI of the Turag was 63.20 which makes the rating of the river as being poor overall. However, the overall distribution of WQI clearly shows that the north of the city (P9, P10, P11) has a worse WQI compared to the south of the city (P1, P2, P3). There is a progression of the health of the river from very poor to good as we move from north to south of the river with an exception at sampling point 5 (P5). The reasons for the very poor WQI in the northern part of the city is due to the discharge of effluents from dyeing and other textile industries located near the sampling points and direct waste disposal from dense, unplanned and semi-permanent settlements on the eastern banks of the river (Fig. 3). The reason for good WQI in the southern part of the city is because there is comparatively less industries and settlements with effluent discharge. The sampling spots are also close to the confluence of Turag and the Karnatali river, which provides large volume of freshwater which may have also contributed to the low WQI at these points. The highest WQI was at P5 which seems to be an isolated case which does not follow the trend of north to south decrease in water quality. The reason is that this point is because it is close to an untreated municipal sewerage discharge point and this point source makes a huge change in this specific location.

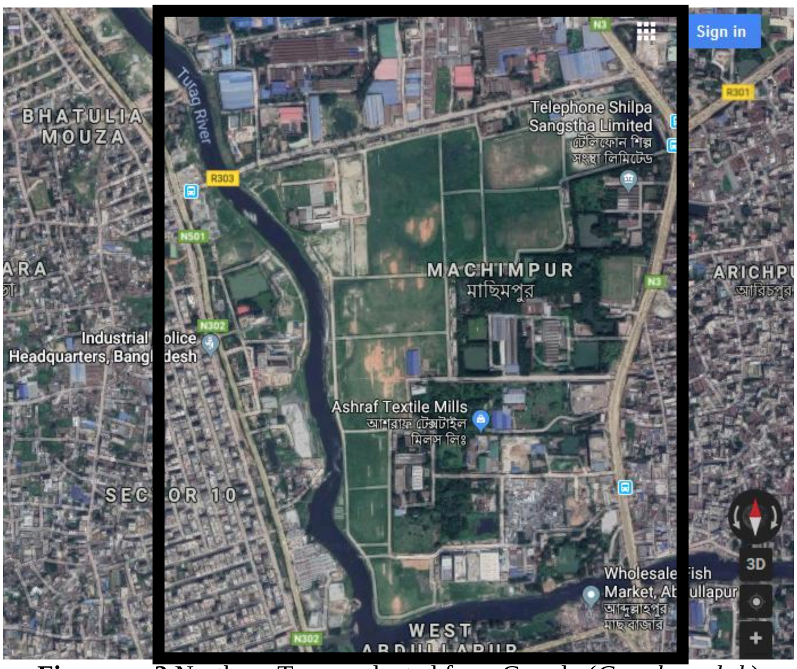


**Figure no 3** Northern Turag, adapted from Google (*Google, n.d.-b*)

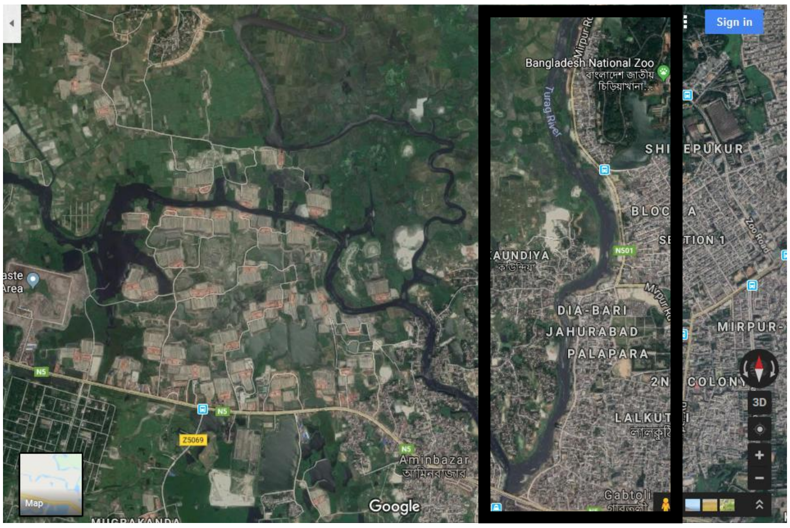


**Figure no 4** Southern Turag, adapted from Google maps (*Google, n.d.-a*)

It is clear from this study that water from the northern part of the study area was of worse quality than the southern part of the river. The use of WQI and the convenient rating of the water quality gives a quick and easily understandable measure of the health of the river. Even though only five parameters were measured using a single device, this methodology gives a useful representation of the health of the Turag. WQI can now be used, not only by policy makers, but can also to raise public awareness among the residents on the banks of the river Turag. However, it is important to note that WQI is not the final say on river pollution, but it is a useful index. If the same parameters are used, then WQI can provides basis for comparison within the river system (intra-river comparison) and also between rivers (inter-river comparison).

## IV. Conclusion

The study was conducted to calculate the WQI of Turag River using water quality parameters collected from 11 different sampling locations along the river. Five water quality parameters were used to calculate the WQI. It was found the upstream Turag has very poor water quality >76 and <100 due to congested, dense and unplanned growth of housing and industries who use the river as extensively dumping grounds. When moving toward midstream the WQI improves slightly to poor >50 and <75 due to decrease in industries, factories and residences and increase in agricultural lands leading to less pollutant discharge into the water. Finally, the best water quality index values in this study came from the downstream locations, where the WQI was determined to be good i.e. >25 and <50 because of confluence of rivers Turag and Karnatali that leads to turbulent mix of huge quantity of freshwater diluting pollution and improving Water Quality. The limitation of the study lies in the fact that it only used 5 water quality parameters namely pH, temperature, TDS, EC and DO were used while there are other important ones like nitrate, phosphates, COD etc. that could also be included for more comprehensive and inclusive WQI values. Overall, the study isable to achieve its aim of calculating the WQI of various points along Turag River and providing explanation for the WQI values obtained.

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