# WATER QUALITY OF DND CANAL FROM THE PERSPECTIVE OF SAIDABAD WATER TREATMENT PLANT

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## ABSTRACT
Water quality is an important factor for public health and also for aquatic life. More and more water quality issues are becoming a significant concern due to the growth of population, urban expansion and development. Thus, assessment of surface water quality has become an important issue. Water Quality Index (WQI) is a single number which were calculated in this study. The water quality data obtained from 4 sampling stations during one year monitoring period at DND canal is one of the important drinking water sources of the capital city of Dhaka, Bangladesh. The analyses of 18 water quality parameters were done for all water samples in Water Analysis Laboratory. It was found that DO, BOD, phosphate, colour, turbidity, Electric conductivity, hardness, chloride, free chlorine, salinity, TDS, TSS, $NH_3$, $NO_2$, $NO_3$, sulphate values which exceed the limit values given in the water quality standards are the major pollutants that affect the water quality in this Canal. For easy interpretation of the data, three different WQI models were applied for the selected parameters. The suitability of these WQI models is discussed with respect to their applicability in similar studies. For this study it is concluded that our WQI in the lab would provide the best results.

Keywords: Biochemical oxygen demand; turbidity; electric conductivity; hardness

## INTRODUCTION
Fresh water resources are very limited in the world and preserving fresh water quality is important for public health and also for aquatic life. World health organization (WHO) reported that in developing countries over three million people die every year because of waterborne disease. Thus, proper assessment and reporting of surface water quality is an important issue. That is why our findings in this study revealed that the overall water quality in DND canal. Dhaka-Narayanganj-Demra (D.N.D) canal area is located between the cities of Dhaka & Narayanganj in Bangladesh and bounded by the Shitalakhya River. The main objectives of this study is to find out the reasons of polluting water, seasonal and spatial variations of water quality with selected parameters, environmental factors in the context of SWTP.

## METHODOLOGY
To obtain such data, eight different sampling locations were chosen from four cross sections of the DND canal. Water quality monitoring has been carried out through collection and analysis of water samples at 8 different times (covering both dry and wet seasons) during the period from July 2013 to February 2014. Water samples were collected at the first week of each month .The collected canal water samples have been analyzed for a total of 14 water quality parameters including Dissolved Oxygen (DO), pH, Electrical Conductivity (EC), Color, Conductivity, Chloride, Hardness, Biochemical Oxygen Demand ($BOD_5$), Ammonia($NH_3$-N), Total Dissolved solids (TDS) and Total Suspended Solids (TSS)and Nitrate ($NO_3$-N) for selected campaigns. These samples were analyzed by standard method in the Environmental Engineering laboratory.

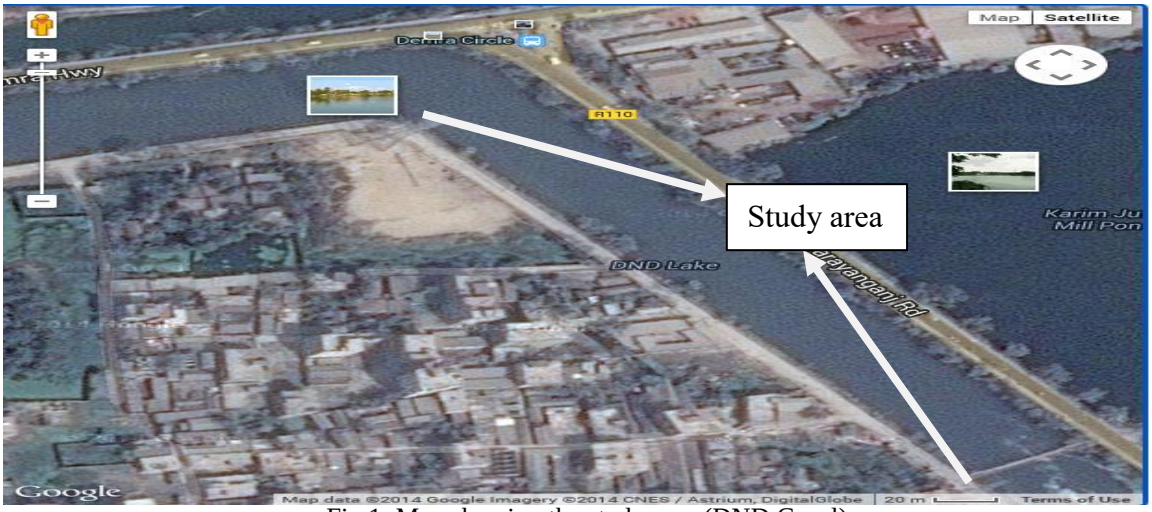

Fig.1: Map showing the study area (DND Canal)

***Pollution Aspects of DND Canal:***

The Pollution of the Lakhya River to a large extent comes from urban sewage which is leaking from the heavily polluted Norai Khal into the Balu River and further into the Lakhya River shortly upstream of the Sarulia intake pump station. Finally the polluted water enter DND canal from Shitolakhya River. The DND canal to some extent works as a treatment reactor. During the wet season there is most likely sedimentation of solids along the canal and in the dry season there is a growth of algae, which removes parts of the pollution in the water, but which also negatively influence the treatment process at the SWTP. However, this removal is to some extent counterbalance by a certain pollution coming from the human activity (bathing, washing etc) along the canal. Besides These some other problems are responsible for pollution as: ammonia, scarcity of DO (less than 5.0mg/l), turbidity, grater BOD, TDS, EC, hardness, sulphate, nitrate, presence of metal in water.

***Sampling and Test of water:***

Water quality refers to the chemical, physical and biological characteristics of water. It is most frequently used by reference to a set of standards against which compliance can be assessed. For assessment of water quality the sample of DND canal was monitored from July 2013 to Feb 2014, among the several sampling campaigns three were carried out during monsoon and four were dry season.

***Selection of sampling point:***

The number of sampling sites in a water body during any study depends on a number of factors such as possible spatial variation of pollutants, detection of pollutants, detection of pollutants peaks and frequency of sample collection and physical limitations of laboratory facilities. To assess the DND water quality numerous sampling areas are required but vast investigation was not feasible in this study due to time limitations. So, four cross-sections along the DND canal were selected for sampling locations for this study are Konapara, Basherpool, Loherpool & Staff quarter.

***Laboratory work:***

In Lab, waste water characterization studies were conducted to determine Dissolved Oxygen (DO), pH, Electrical Conductivity (EC), Color, Conductivity, Chloride, Hardness, Biochemical Oxygen Demand ($BOD_5$), Ammonia($NH_3$-N), Total Dissolved solids (TDS) and Total Suspended Solids (TSS), Nitrate ($NO_3$-N), Nitrite ($NO_2$-N) and sulfate ($SO_4^{--}$) by the standard method.
In the lab the following instruments are used for measuring the water quality parameters-

Table 1: Instruments used in the laboratory

| Parameters | Instruments |
|---|---|
| pH | Platinum Series pH Electrode , Model No-51910-88, HACH Instrument and Sension 156 Portable Multiparameter, Model No-54650-18, HACH |
| Electric Conductivity (EC) | Sension 156 Portable Multiparameter, Model No-54650-18, HACH |
| Salinity | Sension 156 Portable Multiparameter, Model No-5460-18, HACH |
| Dissolve Oxygen (DO) | Sension 156 Portable Multiparameter, Model No-5460-18, HACH |
| TDS (Total Dissolve Solid) | Sension 156 Portable Multiparameter, Model No-5460-18, HACH |
| Turbidity | Digital Turbidity Meter. Model No-331E, EI Instrument |
| Chloride | Digital Titrator, Cat. No- 16900-01, HACH Instrument |
| Color | Spectrophotometer, Model No-DR2800$^{TM}$, HACH Instrument |
| $BOD_5$ | BOD Trak $^{TM}$ II, Model No-DOCO22.53.90072, HACH Instrument |

## RESULTS AND DISCUSSIONS

This section describes the water quality characteristics of DND canal based on analysis of test results and for better understanding sample locations like Konapara, Basherpull, Loharpull, and Staff-quarter are expressed as numerical number 1,2 for konapara cross-section ; 3,4 for Basher pull cross-section ; 5,6 for Lohar pull cross-section and 7,8 for staff quarter cross-section respectively.

### *pH*

pH is one of the most important factors, serving as an index for pollution. The resulting graphs show the variations along with collection points and time. Also represent the spatial variation and seasonal variations.

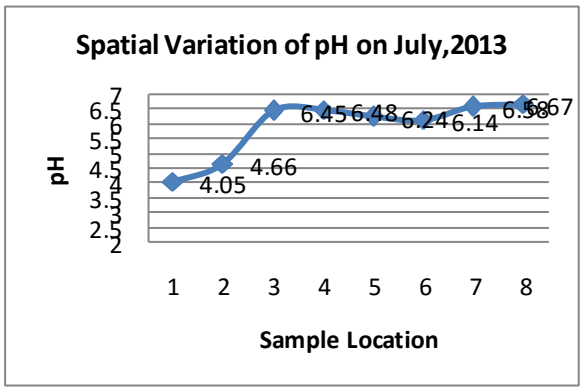


Fig. 2: Spatial variation of pH

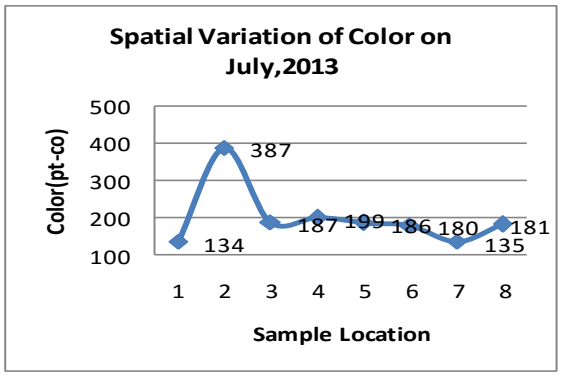


Fig. 3: Spatial variation of color

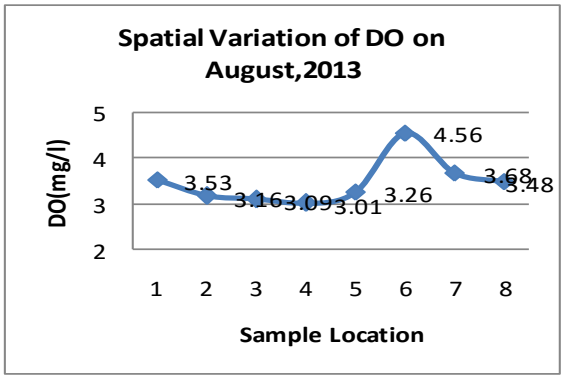


Fig. 4: Spatial variation of DO

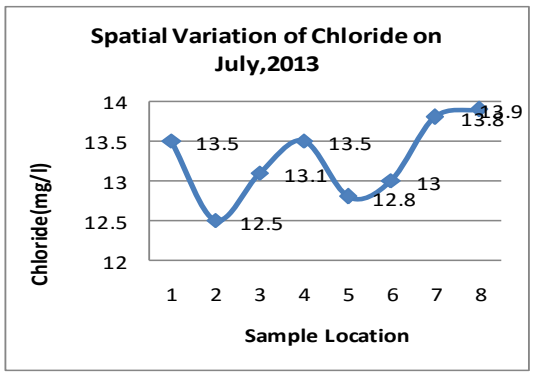


Fig. 5: Spatial variation of chloride

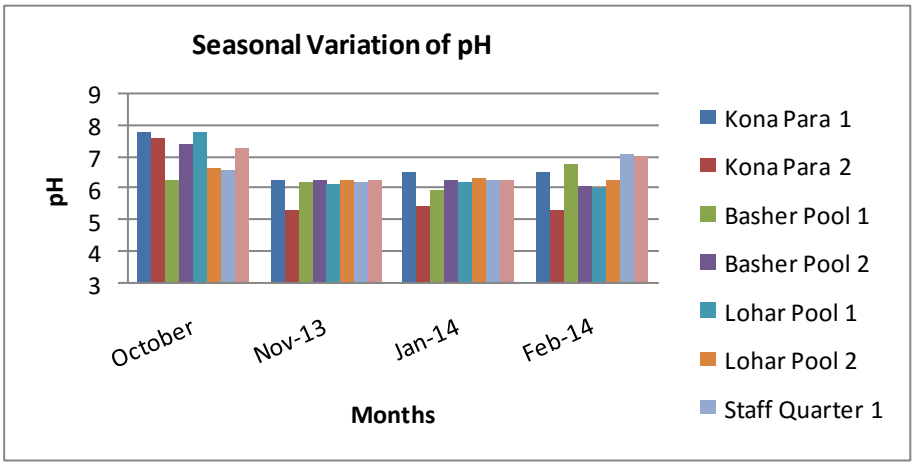


Fig. 6: Seasonal Variation of pH from October 2013 to February 2014

***Color***

During the study period, color has been recorded as a physical parameter at the sampling location. It has been seen that color of the river water undergoes darker with the advancement of dry season and in the wet season. In general the trend was observed like the value of color varies middle four points (Lohar Pool and Basher Pool). Color showed spatially varies significantly from upstream to downstream. The minimum color value is 3 pt-co in October 2013 and maximum color value is 387pt-co in July 2013.

***Chloride***

In July 2013 to February 2014, the most significant trend was observed that minimum chloride value is 12.5 mg/l in July 2013 and maximum chloride value is 16.9 mg/l in November 2013.It can be said that in dry season the value was much higher than wet season.

***Electric Conductivity (EC)***

Electrical Conductivity is an indirect measure of dissolved ions in water.

***Dissolved Oxygen (DO)***

The amount of dissolved oxygen (DO) in water is one of the most commonly used indicators of a canal`s health. As DO drops below 4 or 5 mg/l, the forms of life that can survive begin to be reduced. In the extreme case, when anaerobic conditions exist, higher forms of life are killed or driven off. Noxious conditions then prevail, including floating sludge, bubbling, odorous gases and slimy fungal growth. In general, the DO value of wet season (July, August and September) was high and DO value of dry season was low.

***Hardness***

In general the trend was observed like the value of hardness varies spatially in all locations. The value increases from upstream to downstream respectively. Also it is observed that the seasonal variation of free chlorine of different months in selected sample areas. In general, the hardness value of wet season (July, August and September) was low and hardness value of dry season (October, November, January and February) was high.

***$BOD_5$***

Normally, the $BOD_5$ value of wet season (July, August and September) is low. The $BOD_5$ value of dry season (October, November, January and February) is high. Normally the trend was observed like the value of $BOD_5$ varies spatially middle four points (Lohar Pool and Basher Pool). In November the value of $BOD_5$ shows low value because of sudden rainfall. The minimum $BOD_5$ value is 12mg/l in November 2013 and maximum $BOD_5$ value is 40.2 mg/l in October 2013.

***Total Dissolved Solid (TDS)***

Total Dissolved Solids is the concentration of all substances dissolved in water (solids remaining evaporation of a water sample) called total filterable residue. In general the trend was observed like the value of TDS increases in location 2 and 3 (Lohar Pool and Basher Pool). The minimum TDS value is 69.6 mg/l in August 2013 and maximum TDS value is 95.3 mg/l in November 2013. TDS

value of wet season (July, August and September) was low and TDS value of dry season was high. Dilution of rainwater was most likely responsible for relatively low TDS values during wet season.

***Total Suspended Solid (TSS)***

In the month of August the TSS value was maximum and in October was minimum value. The minimum TSS value is 4 mg/l in October 2013 and maximum TSS value is 40 mg/l in August 2014. TSS value of wet season (July, August and September) was high and TSS value of dry season was slightly low.

***Turbidity***

Turbidity is the cloudiness or haziness of a fluid caused by individual particles (suspended solids) that are generally invisible to the naked eyes. In general the trend was observed like the value of turbidity increases from upstream to downstream. The value of turbidity is low in Location 2,3,4 every time because there was an outfall. The minimum turbidity value 4.02 JTU in October 2013 and maximum turbidity value is 79.01 JTU in August 2013. Here turbidity value of wet season (July, August and September) and turbidity value of dry season was mostly same.

***Ammonia ($NH_3$-N)***

Ammonia or ($NH_3$-N) is a compound of nitrogen and hydrogen with the formula $NH_3$. It is colourless gas with a characteristic pungent smell .Natural factors that can affect the concentration of ammonia include: algal growth, decay of plant or animal material and faecal matter. Other aspects of nitrogen cycling can also affect the amount of ammonia present. Ammonia can also come from domestic, industrial or agricultural pollution, primarily from fertilizers, organic matter or faecal matter. The ammonia concentrations of the four cross-sections along the DND canal varies from 1.2 mg/L to 0.15 mg/L . The high concentration of ammonia prevents efficient disinfection both in pre-chlorination and post-chlorination stages and thus makes it difficult to ensure the hygienic quality of water. The standard value of $NH_3$-N for Bangladesh standard for drinking water (ECR 97) is 0.5 mg/l & WHO guideline 1.5 mg/l. It was found the seasonal variation of $NH_3$-N of different months in selected samples areas. In general in wet season (July, August, & September) the $NH_3$-N values vary from 1.2 mg/L to 0.15 mg/L. It is significantly observed that except Konapara cross-section the other rest three cross-sections the values varies from 0.23 mg/L to 0.15 mg/L. In dry season $NH_3$-N value varies from 0.85 mg/L to 0.2 mg/L.

***Nitrates ($NO_3$-N)***

Nitrate is a tasteless, colorless and odorless compound that cannot detect unless water is chemically analyzed. According to the Guidelines for Bangladesh Drinking Water Quality, drinking water is safe if it has less than: (a) 45 mg/L nitrate or 10 mg/L of nitrate-nitrogen (Nitrate N),(b) 3.2 mg/L nitrite or 1 mg/L nitrite-nitrogen (Nitrite N).Nitrate does not interfere with the chlorination process, but high nitrate levels ( above 12 mg $NO_3$) violate the WHO guidelines for Drinking Water Quality being potentially harmful for human beings for long time exposure and nitrate is a nutrient for algal at an equivalent level of ammonia. From analysis, it's represented that the quantity of $NO_3$-N in DND canal along the four cross-sections varied from 1.2 mg/L to 0.4 mg/L.

***Nitrites ($NO_2$-N)***

EPA (Environmental Protection Agency) strongly encourages people to learn more about their drinking water, and to support local efforts to protect the supply of safe drinking water and upgrade the community water system. EPA requires all community water systems to prepare and deliver an annual consumer confidence report (CCR) (sometimes called a water quality report) for their customers by July 1 of each year. The major sources of nitrite in drinking water are runoff from fertilizer use; leaching from septic tanks, sewage; and erosion of natural deposits. Bangladesh standard for drinking water (ECR97) of $NO_2$-N value is less than 1mg/l besides WHO guideline 3 mg/l. Graph represents the seasonal variation of $NO_2$-N from the month of July 2013 to September 2013. Only in wet season NO2-N value is high its nearly 3 mg/l. Otherwise in dry season the range of value is low.

***Sulfate ($SO_4$)***

Sulfate is a substance that occurs naturally in drinking water. Of particular concerns are groups within the general population that may be at greater risk from the laxative effects of sulfate when they experience an abrupt change from drinking water with low sulfate concentrations to drinking water with high sulfate concentrations. Sulfate in drinking water currently has a secondary maximum

contaminant level (SMCL) of 250 milligrams per liter (mg/L), based on aesthetic effects (i.e., taste and odor). EPA estimates that about 3% of the public drinking water systems in the country may have sulfate levels of 250 mg/L or greater. In Bangladesh standard for drinking water (ECR 97) of sulfate ($SO_4$) is 400 mg/l. From this analysis it was seen that wet & dry season sulfate ($SO_4$) value is nearly same. The average value 10mg/l, which is very low from standard value.

## CONCLUSIONS:

The present study focuses on the assessment of the present water quality of DND canal, including seasonal and spatial variation and identification of pollution sources with wastewater out falls in the study area. DND canal water is used as drinking water source and treated in SWTP. The raw water is pumped from the Shitolakhya River into DND canal and from end of the DND canal the water is led by gravity through a closed culvert some meter to the inlet pump station of the SWTP. The pollution of the Lakhya River to a large extent comes from urban sewage which is leaking from the heavily polluted Norai Khal into the Balu River and further into the Lakhya River shortly upstream of the Sarulia intake pump station. Finally the polluted water enter DND canal from Shitolakhya River. If pollution rate of DND canal is reduced significantly then the water treatment efficiency would be much higher therefore, the treatment cost will be significantly reduced. So the study is created awareness regarding the environmental issues in DND canal through the actual determination of the water quality of DND canal in the context of SWTP. And some reasonable steps to be highlighted as given below:

(a). Existing land use pattern around DND canal should be changed.
(b). Illegal wastewater outlets and slums have to be removed from the bank of the canal.
(c). Prevent to discharge untreated sewage and other industrial waste water into canal.
(d). Avoid using canal banks as bathing & washing clothes.
(e). Moreover, existing laws and regulation should be implemented properly & suitable policy should make to raise the public awareness.
(f). There is an urgent need for introducing a pre-treatment for the water at Saidabad I and II as soon as possible and if possible optimize the operation of that plant to yield a better water quality during the dry season.

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