# Water Quality Assessment of Hindon River at Ghaziabad by Physico- Chemical Parameters Analysis

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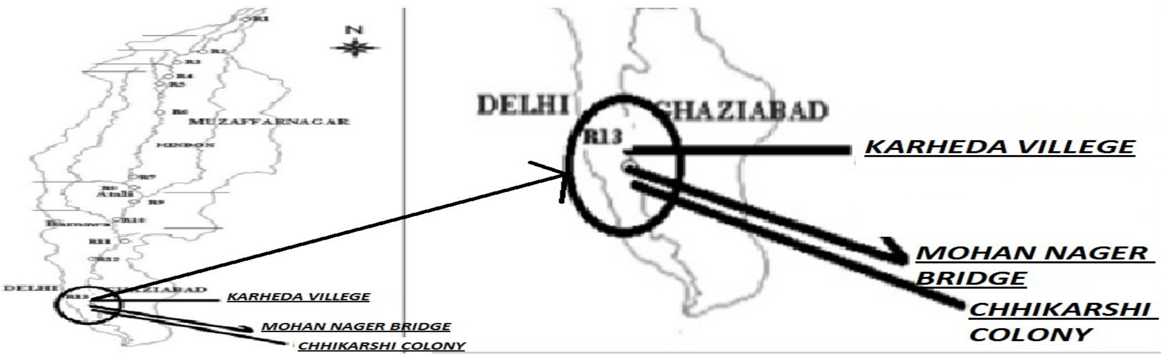
***Abstract: Present study deal with the assessment of physico- chemical parameters of the Hindon river at Ghaziabad. The river basin is characterized by the presence industrial activities owing to the rich occurrence of mineral resources and salts .Systematic calculation of correlation coefficient between water quality parameters has been done with the objective of minimizing the complexity and dimensionality of large set of data. The water samples were collected and analyzed for year 2013 from three sampling stations. The major objectives of the present study were, firstly to investigate the hydro chemical properties of the Hindon river & secondly to analyze the required data on the basis of statistical analysis .This study uses both quantitative and qualitative analysis to assess the water quality in several points along river The sampling and analysis are conducted in accordance Indian standards. It was found that the water quality at Chhijarshi colony, Karheda village, Mohan Nagar bridge were found to be critical parameters for the stretch these parameters are, BOD, DO,COD, pH, total and fecal Coliforms bacteria.***

***Keywords: DO, BOD, COD, Fecal Coli form bacteria, Correlation Coefficient, Regression Analysis.***

## 1. INTRODUCTION

*The hydrochemistry of a river basin reflects the geochemical and hydrological characteristics of the basin that maintain the flow of the river and dissolved chemical constituents. Urban settlements and growing industrial development, combined with rapidly increasing demand for water, are causing more and more water management problems. Ninety six percent of water pollution problems in India are due to indiscriminate discharge of municipal wastes[1]. These wastes are biodegradable and produce a series of directional but predictable changes in water bodies. Industrial effluents are responsible for pollution to a lesser extent but their effects may be more serious, as nature is often unable to degrade and assimilate them.* In spite of India's spectacular achievements in some areas of Science and Technology since independence, most of our rural areas and even many of urban areas do not have access to safe drinking water. Even now most of the towns do not have a pipelined water supply. Even if there is one, water is obtained from ponds and rivers [2]. This water is also used for domestic and agricultural purposes. The quality of water may be described according to its physico-chemical characteristics [3]. The quality of water is identified by its physical, chemical and biological properties; the particulate problem in case of water quality monitoring is the complexity associated with analysis of the large number of measured variables [4] the data sets contain large information about the behavior of the water body. The classification, modeling and interpretations of monitoring data are the most important steps in the assessment of water quality. Water quality parameters interact with each other. To define the resource water quality many researchers treated water quality parameters individually by describing the seasonal variability and their causes. It is a very difficult and laborious task to regularly monitor all the parameters even if adequate manpower and laboratory facilities are available. For this reason, in recent years an easier and simpler approach based on *statistical correlation*, has been developed *using mathematical relationship* for comparison of physicochemical parameters [5-8].The present study deals with the study of physico-chemical parameters of HINDON river water in Uttar Pradesh, India.




This study was performed at three stations starting from sampling station A (karheda village), sampling station B (Chhijarshi colony), Sampling station C (hindon river bridge). In present study various parameters (pH, bod, cod, do, fecal & total coliform) of eight water samples from different sites were analyzed.

## 2. MATERIALS & METHODS

Experimental -*River water samples were collected various locations on a monthly basis using a Hydro-Bios standard water sampler. All the samples were collected from the upper 15 cm of the water surface and stored in polyethylene bottles fitted with screw caps. Samples taken were preserved by adding an appropriate reagent and brought to the laboratory in sampling kits maintained at 4oC for detailed chemical analysis. The physio-chemical analysis was performed following standard methods [9-10]. The accuracy of the methods is greater than ± 10%. All the glass wares were washed and cleaned with distilled water so that to obtained the accurate values and for less no of errors.*

A total of 8 water samples were collected from three different spots during different seasons (winter, summer and rainy) over a period of 8 months (January 2013 to August 2013).Water samples were collected. All the glassware used was of corning grade, manufactured by Borosil India Ltd. The statistical analysis performed using standard methods[11-19]

Statistical studies have been carried out by calculating correlation coefficients between different pairs of parameters applied for checking significance.

Coefficient of correlation (r):

$$r = \sqrt{\frac{\Sigma(x-\overline{x})(y-\overline{y})}{\Sigma(x-x)^2\,\Sigma(y-y)^2}} \qquad (1)$$

Where, x = Individual reading of 1st parameter
($\bar{x}$)=Mean of Σ x
y = Individual reading of 2nd parameter
Bar of y = Mean of Σ y

The correlation among the different parameters will be true when the value of correlation coefficient (r) is high and approaching to one. *Correlation*, the relationship between two variables, is closely related to Prediction. The value of correlation should lie between -1 to 1.The greater the association between variables, the more accurately we can predict the outcome of events.

The *regression analysis* was used to estimate two water quality parameters to describe realistic ground water situations. In addition this analysis attempts to establish the nature of the relationship between the variables & thereby provides the mechanism for prediction or forecasting [20-22].To find the relationship between two physicochemical parameters X & Y, the Karl Pearson's correlation coefficient, r is used in equation (1) is discussed above.

To evaluate the straight-line by linear regression, the following equation of straight line can be used:

$Y= aX + b$ (2)

where, Y= Dependent variable; X= independent variable; a= slope of line; b= intercept on y-axis

$a = n\Sigma xy - (\Sigma x.\ \Sigma y)$ (3)

$n\Sigma x^2 - (\Sigma x^2)$

where, x = arithmetic mean of all value of x; y = arithmetic mean of all value of y.
for good correlation, value of r should be between $-1<r<1$.

## 3. RESULTS AND DISCUSSION

*B.O.D.* is defined as the amount of oxygen required by the bacteria while stabilizing decomposable organic matter under aerobic conditions. BOD values ranging from 77±20.87 at karheda village to 79.875±21.79 at Mohan nagar bridge to 88.5±23.4 at chijrashi village. The mean value of BOD range from 77 at karheda village, 79.875 at Mohan Nagar bridge and 88.5 at Chijrashi Village. The maximum value of BOD is 155 and minimum value is 13 with and standard error of 20.87 at karheda village from jan to aug 2013. Thus we can conclude that the range of BOD is 142. The maximum value of BOD is 165 and minimum value is 11 with an standard error of 21.79 at Mohan Nagar bridge from Jan to Aug 2013. Thus we can conclude that the range of BOD is 154. The maximum value of BOD is 185 and minimum value is 17 with a standard error of 23.418 at Chhijarshi village from Jan to Aug 2013. Thus we can conclude that the range of BOD is 168.A *negative* relationship has been observed between B.O.D. and D.O (r= -0.4379), which shows that if BOD is high then DO is less in water. Higher values of BOD indicate a higher consumption of oxygen and a higher pollution load.

*D.O* is defined as relative measure of amount of oxygen that is dissolved or carried in a given medium. DO values ranging from 1±.35 at Karheda village to 1.2±0.42 at Mohan Nagar bridge to 0.8±.28 at Chijrashi village. The mean value of DO range from 1 at Karheda village,0.8 at Mohan Nagar bridge and 1.2 at Chijrashi village.The maximum value of DO is 1 and minimum value is 1 with and standard error of 0.35 at Karheda village from Jan to Aug 2013. Thus we can conclude that the range of DO is 0. The maximum value of DO is 1.2 and minimum value is 1.2 with an standard error of 0.42 at Mohan Nagar bridge from Jan to Aug 2013. Thus we can conclude that the range of DO is 0. The maximum value of DO is 0.8 and minimum value is 0.8 with an standard error of 0.28 at Chhijarshi village from Jan to Aug 2013. Thus we can conclude that the range of DO is 0.The relationship observed between PH and PH is negative (r=-.24667). This shows that if PH of water increases then PH level decreases.

The *chemical oxygen demand* (COD) test is commonly used to indirectly measure the amount of organic compounds in water. It is expressed in milligrams per liter (mg/L) also referred to as ppm (parts per million), which indicates the mass of oxygen consumed per liter of solution. COD values ranging from353.875±99 at Karheda village to 360.192± 94.03 at Mohan Nagar bridge to 365.5±91.3 at Chijrashi village. The mean value of COD range from 353.875 at Karheda village, 360 at Mohan Nagar bridge and 365.5 at Chijrashi village. The maximum value of COD is 670 and minimum value is 44 with and standard error of 95 at Karheda village from Jan to Aug 2013. Thus we can conclude that the range of COD is 626.76The maximum value of COD is 760 and minimum value is 38 with an standard error of 94.03 at Mohan Nagar bridge from Jan to Aug 2013. Thus we can conclude that the range of COD is 722. The maximum value of COD is 760 and minimum value is 56 with a standard error of 91.3 at Chhijarshi village from Jan to Aug 2013. Thus we can conclude that the range of COD is 704. The correlation observed between COD and PH is positive its value is (r=0.972517122).

A *fecal coliform* is a facultative anaerobic, rod-shaped, gram-negative, non-sporulating bacterium. The relationship observed between *Fecal coliform* and PH is positive (r= 0.779286),amount of PH will be increased if *fecal coliform* is present in high amount. The presence of Fecal Coliform in well water may indicate recent contamination of the groundwater by human sewage or animal droppings which could contain other bacteria, viruses, or disease causing organisms.

*Standard value of fecal coliform* by WHO is 1000 MPN per 100ml of water.

Most of the chemical and biochemical reactions are influenced by the *pH*, it is of great practical importance. The adverse effects of most of the acids appear below PH 5 and of alkalis above PH 9.5. The PH of drainage waste was slightly alkaline, ranging from 7.10±0.121 at karheda village to 7.16 ±.077 at mohan nager nager bridge to 7.235±.198 at chijrashi village. The mean value of PH range from 7.1 at karheda village, 7.16 at mohan nager bridge and 7.235 at chijrashi village. The maximum value of pH is 7.9 and minimum value is 6.8 with and standard error of 0.121 at karheda village from jan to aug 2013. Thus we can conclude that the range of pH is 1.2. The maximum value of pH is 7.6 and minimum value is 7.0 with and standared error of 0.077 at mohan nagar bridge from jan to aug 2013. Thus we can conclude that the range of pH is 0.6. The maximum value of pH is 7.6 and minimum value is 5.9 with and standared error of 0.198 at chijrashi village from jan to aug 2013. Thus we can conclude that the range of pH is 1.7.

B.O.D tests only measure biodegradable fraction of total potential D.O. consumption of a water sample while C.O.D. measures the oxygen demand created by toxic organic and inorganic compounds as well as biodegradable substances [23]. Oxygen that is available in the water is being consumed by the bacteria leading to the inability of fish and the other aquatic organisms to survive in the river. Hence D.O. can be measured by using regression analysis is BOD = -73.14D.O. +86.1 of Kareheda village, BOD = -65.595 DO+ 89.71 of Hindon river bridge & BOD = -96.78DO + 94.42 of chijrashi village can be used to estimate the value of B.O.D & D.O. This will ease the calculations B.O.D/D.O. ratios in order to predict the biodegradability of water since high B.O.D/D.O. indicates that water is polluted & is relatively biodegradable. The high value of B.O.D suggest that oxygen present in the water is consumed by the aerobic bacteria which makes fish & other aquatic species to find it difficult to survive from January to August 2013 .

C.O.D can be measured by using regression analysis is BOD= .214COD + 1.344 of Kareheda village, BOD = .2241 COD -0.813 of Hindon river bridge & BOD = 0.244 COD + 2.565 of chijrashi village can be used to estimate the value of B.O.D & C.O.D. This will ease the calculations B.O.D/C.O.D. ratios in order to predict the biodegradability of water since high B.O.D/C.O.D indicates that water is polluted & is relatively biodegradable. The high B.O.D value are good indicator of organic pollution level in the water organic pollutants such as sewage & food wastes have a high nutrient loading. These nutrients attract bacteria & other microbes. As these microbes digest the nutrients & digest oxygen within the water column. This reduces the level of oxygen available for other aquatic micro organisms.

**Total coliforms** include bacteria that are found in the soil, in water that has been influenced by surface water, and in human or animal waste. Total coliforms can be measured by using regression analysis is of BOD = 0.001 TC + 163.4 Kareheda village, BOD = 0.001 T.COLIFORM– 161.1of Hindon river bridge & BOD = -0.001TOTAL COLI – 110.8 of Chijrashi village can be used to estimate the value of B.O.D & C.O.D. This will ease the calculations Total coliforms. If coliform bacteria are present in your drinking water, your risk of contracting a water-borne illness is increased. Although total coli forms can come from sources other than fecal matter, a positive total coliform sample should be considered an indication of pollution in your well. Positive fecal coliform results, especially positive E. Coli results, should be considered indication of fecal pollution in your well.

**Fecal coliforms** are the group of the total coliforms that are considered to be present specifically in the gut and feces of warm-blooded animals. Because the origins of fecal coliforms are more specific than the origins of the more general total coliform group of bacteria, fecal coliforms are considered a more accurate indication of animal or human waste than the total coliforms. Fecal coliform can be measured by using regression analysis is BOD= 0.000FC +139.9of Kareheda village, BOD = 0.001 FECAL– 98.79 of Hindon river bridge & BOD = -4E.05FECAL+ 93.771 of chijrashi village can be used to estimate the value of fecal coliform. It indicates the Untreated organic matter that contains fecal coliform can be harmful to the environment. Aerobic decomposition of this material can reduce dissolved oxygen levels if discharged into rivers or waterways. This may reduce the oxygen level enough to kill fish and other aquatic life. Reduction of fecal coliform in wastewater may require the use of chlorine and other disinfectant chemicals. Such materials may kill the fecal coliform and disease bacteria. They also kill bacteria essential to the proper balance of the aquatic environment, endangering the survival of species dependent on those bacteria. So higher levels of fecal coliform require higher levels of chlorine, threatening those aquatic organisms.

## 4. CONCLUSION

The assessment clearly shown that the quality of Hindon River in Karheda Village, Hindon river Bridge & chijrashi village is totally degraded according to WHO and Bureau of Indian standards. Because the Hindon flows through the sugarcane belt of western Uttar Pradesh and many factories allegedly dump the untreated chemical effluents into the river. Not only do the effluents directly affect the biodiversity within the rivers, but also leads to lowered levels of dissolved oxygen. The pollution load generated from Saharanpur, muzaffarnagar & Ghaziabad region is mainly responsible for the water quality degradation in the upper part of the hindon river. In the intermediate part water quality shows a steady improvement due to reaeration & photosynthesis. The Hindon river water is mainly the mixture of effluent from pulp & paper factory & distillery waste. As a major tributary of the Yamuna River, it is essential that remediation of Hindon River contamination is included as a priority within the existing Yamuna River Action Plan. Such remediation needs to allocate sufficient fund and be implemented within a clearly defined and appropriate timescale.

**TABLE 1 Regression Analysis with different parameters**

| Regression Analysis from JANUARY TO AUGUST 2013 | | |
|---|---|---|
| KARHEDA VILLAGE | | |
| R-EQUATION | 1- VAR | $R^2$ |
| BOD= -70.61pH + 578.8 | Ph | 0.167 |
| BOD= .214COD + 1.344 | COD | 0.943 |
| BOD= 0.000FC +139.9 | FECAL COLI. | 0.694 |
| BOD = -73.14D.O. +86.1 | D.O. | 0.191 |
| BOD = 0.001 TC + 163.4 | TOTAL COLI. | 0.675 |
| HINDON RIVER BRIDGE | | |
| R-EQUATION | 1- VAR | $R^2$ |
| BOD = -94.28 pH + 754.1 | pH | 0.111 |
| BOD = .2241 COD -0.813 | COD | 0.934 |
| BOD = 0.001 FECAL– 98.79 | FECAL COLI. | 0.620 |
| BOD = -65.595 DO+ 89.71 | D.O. | 0.203 |
| BOD = 0.001 T.COLIFORM– 161.1 | TOTAL COLI. | 0.685 |
| CHIJRASHI VILLAGE | | |
| R-EQUATION | 1- VAR | $R^2$ |
| BOD = -48.85pH+ 438.3 | pH | 0.111 |
| - BOD = 0.244 COD + 2.565 | COD | 0.904 |
| BOD = -4E.05FECAL+ 93.771 | FECAL COLI. | 0.032 |
| BOD = -96.78DO + 94.42 | D.O. | 0.201 |
| BOD = -0.001TOTAL COLI – 110.8 | TOTAL COLI. | 0.110 |

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