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Statistical Analysis of Coliforms and Bod Levels in Hindon River at Meerut: A Pilot Study

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Abstract

Meerut is one of the important industrial towns of western Uttar Pradesh with several traditional and modern industries. Existing industries in the city include tyres, textile, transformer, sugar, distillery, chemical, engineering, paper, publishing, and sports goods manufacture. Hindon river flows through the district and is an important source of water supply to the region. Many industries dump their untreated waste directly into the river, which is a matter of great concern. Another major problem is the dumpage of sewage waste directly into the river resulting in high Fecal Coliforms. The aim of our study was to statistically analyse the data of water samples collected from April 2017 to April 2018, to find out the effect of seasonal variations of different parameters under study ie DO, BOD , Other forms of Coliforms, Fecal Coliform and their correlation. All parameters were analysed using standard methods as stated by APHA. No DO was reported in any season, levels of BOD, Fecal Coliforms and Other forms of coliforms were found too high, compared to the standards stated by UPPCB. Correlation Matrix and Regression Analysis found an approximately similar correlation between BOD and Fecal Coliform. Both summer and winter season showed a negative and weak correlation between BOD and coliforms, while rainy season showed a positive and strong correlation. Reason could be attributed to the fact that in rainy season river receives inflow of sewage and waste effluents from surrounding areas resulting in higher levels of coliforms compared to summer and winter months. Our study is one of the first approaches to judge the level of correlation between BOD and Coliforms for summer, rainy and winter season. The study highlights the major problem associated with industrial, sewage and other forms of waste being dumped in the river without any treatment which leads to oxygen depletion, a major requirement for survival of aquatic life in water. Since BOD levels partly reflect the degree of organic pollution associated with fecal sources in this river system, it is of great

significance to observe the relationships of coliforms and BOD levels. The study in itself suggests that faecal coliform and total coliform vs BOD can be used as pollution indicator for further research work on water pollution.

Keywords: Meerut, Hindon River, DO, BOD, fecal Coliform.

INTRODUCTION

As stated by the recent report of NITI (National Institution for Transforming India) Aayog India is facing one of the worst water crisis in history, The water crisis will get worse, as the country's water demand is projected to be twice the available supply by 2030.

Hindon river while flowing through Meerut is utilised by a wide range of industrial uses's along its length. Indeed, these industries both abstract large volumes of water from their manufacturing processes, and also discharge their industrial effluents often with no treatment, directly to the river.

Hindon river is the primary source for agricultural purposes in the locality. Agriculture is the dominant economy of Western Uttar Pradesh which is largely rural. The main crop grown is sugarcane, a crop that is well known for the large volumes of water required for a successful harvest.

Substantial quantities of water are therefore abstracted from the Hindon River for crop irrigation. Abstraction for irrigation reduces natural freshwater flows within the Hindon River, reducing the dilution potential of the river and concentrating the effects of other pollutants entering the river.

Use of the river for the disposal of untreated human sewage is a primary cause of poor water quality within the river. The river receives large volumes of untreated sewage and municipal wastes from all population centres within the catchment area. Untreated municipal wastes are known to contain a very high level of organic pollutants, disease causing bacteria as well as heavy metals which are not removed by conventional treatment. Aim of the present study was to investigate the relationship between these bacteria's and organic pollutants. The major problem associated with sewage are the production of odours and spread of disease , organic pollution which leads to oxygen depletion in receiving water

River Hindon originates in the lower Himalayas in Saharanpur district and flows 260km through 6 districts including Muzaffarnagar, Meerut, baghpat, Ghaziabad and Gautambudh Nagar, until its confluence with the Yamuna. Rivers in India are the major source of water but many research works are proving that their pollution level in all forms are increasing day by day. (Dwivedi and Anil 2017;Paul 2017).

Hindon river is a major source of water to the highly populated western Uttar Pradesh. Meerut being one of the important districts of Western Uttar Pradesh, it is home to many industries, important ones being tyres, textile, transformer, sugar, distillery, chemical, engineering, paper, publishing, and sports goods manufacture etc. Although several studies on the impact of industrialisation and urbanisation on river water

quality has been carried out in the past (Sharma 2001;Singh and Sharma 2015;Rizvi et al 2015;Raghav and Singh 2010)

Rapid industrialisation and disposal of sewage waste from nearby colonies is making the river unfit for not only drinking purposes but also vegetation, washing etc. The main aim of the study was to assess the impact of urban and industrial waste on river water during summer season, rainy season and winter season from April 2017 to April 2018.

Discharge of toxic wastes , suspended solids , coloured wastes, sewage , agricultural wastes , detergents being used for washing purposes , dairy waste water etc are also the major causes of worsening the river conditions (Suthar et. al 2009)

Draining of sewage waste in the river water is major cause of the BOD levels and coliforms specially fecal being too high. Pollution of river bodies with coliforms specially faecal is major cause of concern as it results in growing water born diseases in the area. Growing of public colonies near the river can be attributed as a cause of fecal coliforms being so high in the river. The high level of BOD can be attributed to discharge of industrial effluents from large number of pulp and paper mills, distilleries and sugar mills. The river does not have a perennial source at its origin leading to non availability of fresh water. That was also one of the major reason for DO (Dissolved Oxygen) levels being found nil in the river over a period of April 2017 to April 2018. The river receives the municipal sewage as well as industrial effluents from the township of Muzzaffar Nagar and adjoining areas. High fecal coliform (fecal bacteria that show presence of waterborne diseases) levels and low water quality for rivers increase the chance of waterborne diseases. Fecal coliform can lead to diseases such as typhoid fever, Traveler's diarrhea, and Asiatic cholera.(Dewan et. al 2013)

In addition the wastes from several small units such as textile factory, sugar factory , land dries etc also transfer their waste into hindon river. As a natural resource of water, rivers need to maintain low levels of fecal coliform and high water quality keeping public health in mind. After comprehensive literature review it has been found that no work has been reported on the application of multivariate techniques on water quality parameters of coliforms and BOD levels correlation in river Hindon. It was against this background that this study was conducted which can facilitate the relation between coliforms and BOD levels to judge water quality.

The increase in BOD levels in natural water bodies might greatly affect the populations and survival of indicator bacteria's. (Kagalou et.al 2009).

It is therefore of interest to observe the relationships of TCs(Total Coliforms), FCs,(Fecal Coliforms) and BOD (Biochemical Oxygen Demand) in the aquatic environment. Many researchers have noted a direct relationship between the TC population and BOD in polluted river and estuary waters(Schuettpelz 1969; Aisxi et. al 1984) but still detailed information available on this subject is limited specially for seasonal variations. Water pollution indicating parameters of Hindon river as per our study were manifold higher than the prescribed limit by the Uttar Pradesh Pollution Control Board (UPPCB). Municipal waste of Saharanpur, Meerut , Ghaziabad is being discharged into the river. 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. Because of this reason, statistical correlation was found to be an easier and simpler approach, this method has been developed using mathematical relationship for comparison of physicochemical parameters. The statistical analysis was performed using standard methods.

Statistical studies have been carried out by calculating correlation coefficients between different parameters BOD, TCs, and FCs applied for checking significance. The correlation among different parameters will be true when the value of correlation coefficient (r) is high and approaching one. Correlation, the relationship between two variables, is closely related to prediction. The value of correlation should lie between -1 and +1. The greater the association between variables, the more accurately we can predict the outcome of events.

The regression analysis was used to establish the nature of the relationships between the variables and thereby provides the mechanism for prediction or forecasting.

This is the first study in itself which highlights the interrelationship of human activities and river water quality making the study significant and interesting to assess the pollution load discharges in Hindon river at Meerut. In this study correlation matrix between BOD, Other forms of Coliforms and FC (Fecal Coliforms) was analysed. The aim of this study to statistically asses the following parameters DO, BOD, feacal coliform, other forms of coliform over a period on one year (April 2017 to April 2018) for summer season, rainy season and winter season. Surprisingly no DO was found even in one single month, BOD was highly unfit even for plantation work, and Coliforms especially faecal were found too high in fact an alarming level. The present study would be step towards understanding the nature of pollutants and their impact on the quality of water.

MATERIALS AND METHODS

Physiography

Meerut district lies between Latitude 29°16'48.00" and Longitude 77°28'12.00"East longitude in the Indo-Gangetic plains of India. It is bound on the north by Muzaffarnagar district, in the south by Bulandshahar district while Ghaziabad and Baghpat districts form the southern and western limits. The Hindon forms the western boundary and separates the district from Baghpat. The ground is not rocky and there are no mountains. The soil is composed of pleistocene and sub-recent alluvial sediments transported and deposited by river action from the Himalayan region.

Table 1: GPS location and description of sampling site of Hindon River

Sampling Station	GPS Location	Description
Meerut (India)	**Lat. 29°16'48.00" Long. 77°28'12.00"**	**Meerut: Bagpat Sardana Budhan Road Gram Baparasi**

Climate

Meerut has a monsoon influenced humid subtropical climate characterised by hot summers and cooler winters. Summers last from early April to late June during and are extremely hot, with temperatures reaching 49 °C (120 °F). The monsoon arrives in late June and continues till the middle of September. Temperatures drop slightly, with plenty of cloud cover but with higher humidity. Temperatures rise again in October and the city then has a mild, dry winter season from late October to the middle of March. Rainfall is about 845 millimetres (33 in) per annum, which is suitable for growing crops. Most of the rainfall is received during the monsoon. Humidity varies from 30 to 100%. The city receives no snow.

Sample Collection :

Sampling was done from April 2017 to April 2018 from Meerut, Baghpat Sardhana Budhan Road Gram Baparasi. The water samples were collected in sterile capped containers by following method as described by APHA (American Public Health Association (APHA) 2000). To avoid contaminations disposable gloves washed with HCl 1N were worn during sampling. The water samples were preserved by acidifying with concentrated nitric acid to pH < 2 and stored in polythene bottles. Sampling bottles were kept in airtight large plastic ice cold containers at 4^0C and were transported to laboratory within 6hrs of their collection for the further processing. Based on the reconnaissance survey, keeping in view the objective of the study, easy approachability in all seasons, mixing and other physical characteristics of the water body, confluence of tributaries and pollution load from important towns and industries near Meerut were noted.

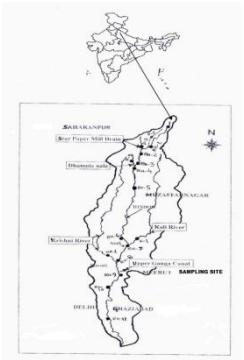

Figure 1: Location Map of Sampling Site

ANALYSIS:

Water samples were analysed for DO (Dissolved Oxygen), BOD (Biochemical Oxygen Demand), Feacal Coliform(FC) and Total Coliform (TC) by following the methods as described by APHA (1998). Detailed methodologies are given in Table 2. DO was fixed at site and air and water temperatures were also recorded.

Table 2: Water quality parameters, units and analytical methods used for Hindon River

Parameters	Abbreviations	Units	Analytical Methods	Instruments
Dissolved Oxygen	DO	mg/lt	Titrimetric	Titration Assembly
Biochemical Oxygen Demand	BOD	mg/lt	5 – day incubation, 20^0C	BOD incubator and titration assembly
Fecal Coliform	FC	mpn/100 ml	Multiple Tube Fermentation technique	Tubes
Other Coliform	OC	mpn/100 ml	Multiple Tube Fermentation technique	Tubes

Table 3: Primary Water Quality Criteria for Designated – Best Use Classes

Prescribed by Uttar Pradesh Pollution Control Board

Classification	Category	Tolerance Limit
Drinking Water Source without conventional treatment but after disinfections	A	1. Total Coliform Organism MPN/100 ml shall be 50 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 6mg/l or more 4. Biochemical oxygen demand 5 days 20^oC 2mg/l or less
Outdoor Bathing (Organized)	B	1. Total Coliforms Organism MPN/100 ml shall be 500 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 5mg/l or more 4. Biochemical Oxygen Demand 5 days 20^oC 3mg/l or less

Drinking Water source after conventional treatment and disinfections	C	1. Total Coliforms Organism MPN/100 ml shall be 5000 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 4mg/l or more 4. Biochemical Oxygen Demand 5 days 20^{o}C 3mg/l or less
Propagation of Wild Life and Fisheries	D	1. pH between 6.5 and 8.5 2. Dissolved Oxygen 4mg/l or more 3. Free Ammonia (as N)1.2 mg/l or less
Irrigation Industrial Cooling, Controlled waste disposal	E	1. pH between 6.0 and 8.5 2. Electrical Conductivity at 25^{o}C micro mhos/cm Max. 2250 3. Sodium absorption ratio Max. 26 4. Boron Max. 2 mg/l

Source : http://www.uppcb.com/river_quality.htm

Statistical Analysis: Correlation matrix was done between BOD and OCs and FCs for different seasons of the year summer, rainy and winter. Regression analysis was done and regression plots were plotted showing the relation between BOD and fecal coliform.

RESULTS AND DISCUSSION

Dissolved oxygen (DO) is a key indicator of water quality parameters used for assessing the quality of the water for survival of the aquatic life. Main sources of dissolved oxygen are diffusion from the atmosphere and water at the surface, aeration as water flows over rocks and uneven surfaces, aeration through churning action of wind and waves, photosynthesis from aquatic plants. None of the three seasons showed any Dissolved Oxygen (DO) throughout the year, major reason being Hindon river lacking free flowing water. The quality of the water in terms of DO content is always of primary importance because at the waste discharge points in river, the DO is required for aerobic oxidation of the wastes (Raj et. al 2007).Because the river 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. In fact the situation now is that DO levels are being reported nil throughout all seasons. The discharge of high biochemical oxygen demand (BOD) sewage is harmful for survival of aquatic life in a water body. The

high BOD load becomes responsible for lowering the DO levels in a water body. In fact the DO levels being nil shows complete anaerobic condition in river water making it impossible for survival of aquatic life. This indicates that the wastewater generated from the industries is only flowing in the river.

Decaying organic matter in water decomposition releases heat, warming water and decreasing dissolved oxygen capacity. The faster the water moves and churns the greater the amount of oxygen is dissolved. Human activities removal of shade or the release of warm water used in industrial processes can cause an increase in water temperature, resulting in lower dissolved oxygen capacity.(research.net/waterqualindex)

Biochemical oxygen demand (BOD): is the measure of the amount of oxygen required by micro organisms to degrade organic matter and is the indicative of organic pollutants in the water. Naturally bacteria utilize organic matter during respiration and remove oxygen from the water (Kirchman 2010).

Rainy season shows the lowest BOD value of 62mg/lt in July 2017, while summer season shows the highest value of 74mg/lt in April 2018.The BOD levels are very high compared to that prescribed by UPPCB for survival of aquatic life. The BOD results show that Hindon River water is not suitable for even drinking, washing or agricultural purposes.

Such high levels of BOD at Meerut could be because of dumping of municipal wastes from near by colonies. High value of BOD suggests that oxygen present in the water is consumed by the aerobic bacteria which makes fish and other aquatic species difficult to survive.

River Hindon water quality in terms of BOD seem to be quite inferior. The high B.O.D values are good indicators 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. The more organic matter there is (e.g., in sewage and polluted bodies of water), the greater the BOD; the lower the amount of dissolved oxygen available for aquatic life. The BOD is therefore a reliable gauge of the organic pollution of a body of water. One of the main reasons for treating wastewater prior to its discharge into a water resource is to lower its BOD—i.e., reduce its need of oxygen and thereby lessen its demand from the streams, lakes, rivers, or estuaries into which it is released.

Feacal Coliform: A fecal coliform is a facultative anaerobic, rod-shaped, gram-negative, non-sporulating bacterium. 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. The coliform bacteria have the following advantages for use as an indicator organism coliforms are constantly found in the human intestine in large numbers, the coliform organism is easy to isolate and enumerate in the laboratory, and coliforms are

normally not pathogenic and are easy to handle. d. Most researchers have concluded that fecal coliforms rather than total coliforms are more realistic indicators of sewage pollution. (Schuettpelz 1969)

Fecal coliforms may enter surface water by a number of ways, from contaminated soil runoff from storm water, from vegetation, washing water from cities, or from direct sewage pollution by man or animals. Fecal coliform bacteria are not naturally present in the intestinal tracts of fish, but may be there due to ingestion of polluted waters. Therefore, because coliforms and pathogens exist in similar environments, it may be possible for fish to carry pathogenic bacteria to unpolluted waters. Summer season saw the highest recorded coliform in the month of April 2017 of 15,0000mpn/100ml, while rainy season saw the lowest recorded in the month of July 2017 of 79,000mpn/100ml.

No doubt the levels are alarmingly high. Giving proof of dump age of human waste through sewage in the river. Efforts should be made that instead of dumping the sewage waste directly in the river some sort of treatment plant should be there which reduces the waste before it gets dumped. Also, a simpler way out could be the use of chlorine and other disinfectant chemicals. Such materials to some extent help in killing the fecal coliform and disease bacteria. Also these materials are cheap and easily available .Such high levels of fecal coliforms require higher levels of chlorine, because they are a great threat to aquatic life and growth of disease causing bacteria.

Total Coliform: 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. If coliform bacteria are present in drinking water, the risk of contracting a water-borne illness is increased. Although total coliforms can come from sources other than fecal matter, a positive total coliform sample should be considered an indication of pollution. At site under study the total coliforms range summer season recorded the highest value of in the month of April 2018 of 26,0000mpn/ml and lowest value was observed in winter season January 2018 of 91,000mpn/ml. Once again a very alarming figure there by showing that not only is Meerut site having sewage waste dumped in high quantity but also other form forms of bacterial waste which are origin of many diseases being dumped in the river.

Water Quality Index WQI indicates the overall quality of water based on the values of various parameters. The mean WQI values obtained from our study indicated that Hindon river water quality is highly unsatisfactory throughout the year. The results indicate that the water is unfit for human consumption and steps must be taken to reduce pollution. The parameters used in our study are the most common ones and thus the WQI values reflect the level of pollution to a great extent.

STATISTICAL RESULTS:

Correlation matrix between different parameters for different seasons of the year is presented in Table 5 (Summer Season), Table 7 (Rainy season), Table 9 (Winter Season).

In summer season, a negative correlation was observed between BOD and fecal coliform (16%) while negative correlation was observed between BOD and other forms of coliforms (68%) .

Rainy season showed a positive and very strong correlation between BOD and other forms of coliforms (75%) while BOD and fecal coliform showed a 100% correlation. Winter season showed a negative correlation between BOD and other forms of coliforms (19%) while correlation between BOD and fecal coliform though positive was very weak (24%).

The **regession analysis** also shows approximately same results R^2 is a statistical measure of how close the data are to the fitted regression line. It is also known as coefficient of determination. A high R^2 of 80% and above indicates the values a good correlated.

REGRESSION PLOTS:

The regression analysis plots for BOD and fecal coliforms along with their R^2 values showed the following results.

Summer season Figure 2 showed a weak regression coefficient with $R^2 = 0.027$, while the rainy season Figure 3 showed a good value of $R^2 = 1$, and winter season Figure 4 again showed a value of $R^2 = 0.061$. After analysing the above results conclusion that can be drawn is that during rainy season river receives inflow of sewage and waste effluents from surrounding areas resulting in higher dumpage of sewage waste, pollutants etc leading to higher levels of BOD.

Table 4. Data (Summer Season)

Month	Year	DO mg/lt	BOD mg/lt	Other forms of Coliform (mpn/100ml)	Feacal Coliform (mpn/100ml)	Total Coliform (mpn/ml)
April	2017	0	68	60000	150000	210000
May	2017	0	70	76000	94000	170000
June	2017	0	65	100000	110000	210000
April	2018	0	74	140000	120000	260000
	Mean	0	67.66667	78666.67	118000	196666.7
	Standard Deviation	0	2.516611	20132.89	28844.41	23094.01

Table 5. Correlation Matrix (Summer Season)

	BOD mg/lt	*Other forms of Coliform(mpn/100ml)*	*Feacal Coliform (mpn/100ml)*	*Total Coliform (mpn/ml)*
BOD mg/lt	1			
Other forms of Coliform(mpn/100ml)	-0.684211	1		
Feacal Coliform (mpn/100ml)	-0.165312	-0.6061426	1	
Total Coliform (mpn/ml)	-0.802955	0.11470787	0.72057669	1

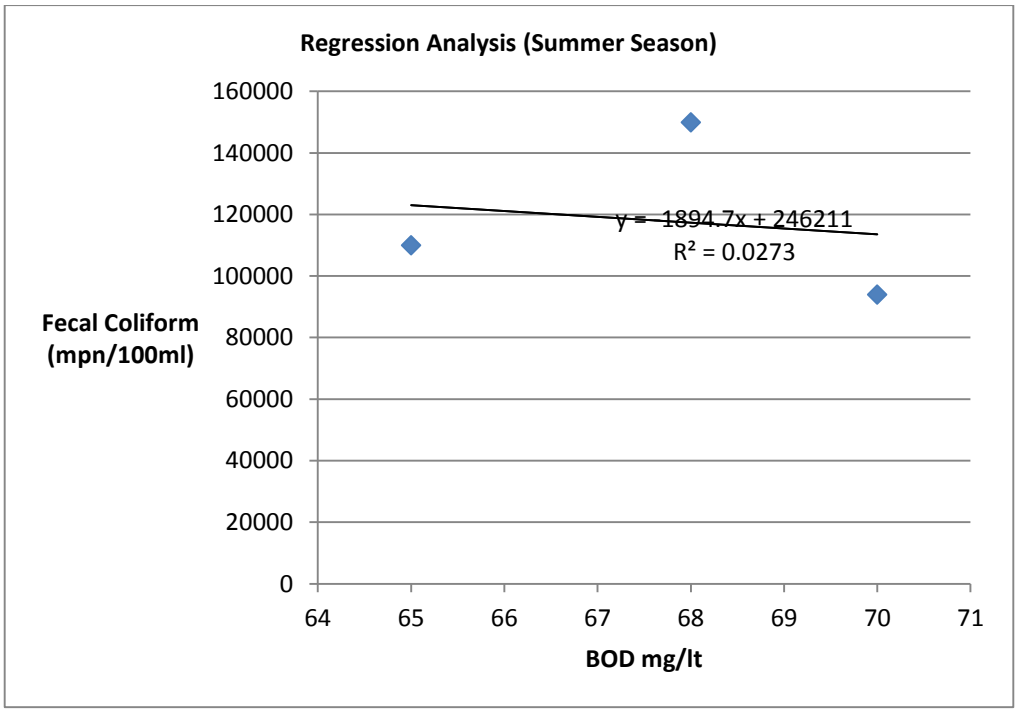

Figure 2. Regression Plot (Summer Season)

Table 6. Data (Rainy Season)

Month	Year	DO mg/lt	BOD mg/lt	Other forms of Coliform (mpn/100ml)	Feacal Coliform (mpn/100ml)	Total Coliform (mpn/ml)
July	2017	0	62	31000	79000	110000
August	2017	0	64	56000	84000	140000
September	2017	0	68	56000	94000	150000
	Mean	0	64.66667	47666.67	85666.67	133333.3
	Standard Deviation	0	3.05505	14433.76	7637.626	20816.66

Table 7 Correlation Matrix (Rainy Season)

	BOD mg/lt	*Other forms of Coliform(mpn/100ml)*	*Feacal Coliform (mpn/100ml)*	*Total Coliform (mpn/ml)*
BOD mg/lt	1			
Other forms of Coliform(mpn/100ml)	0.7559289	1		
Feacal Coliform (mpn/100ml)	1	0.75592895	1	
Total Coliform (mpn/ml)	**0.8910421**	0.97072534	0.89104211	1

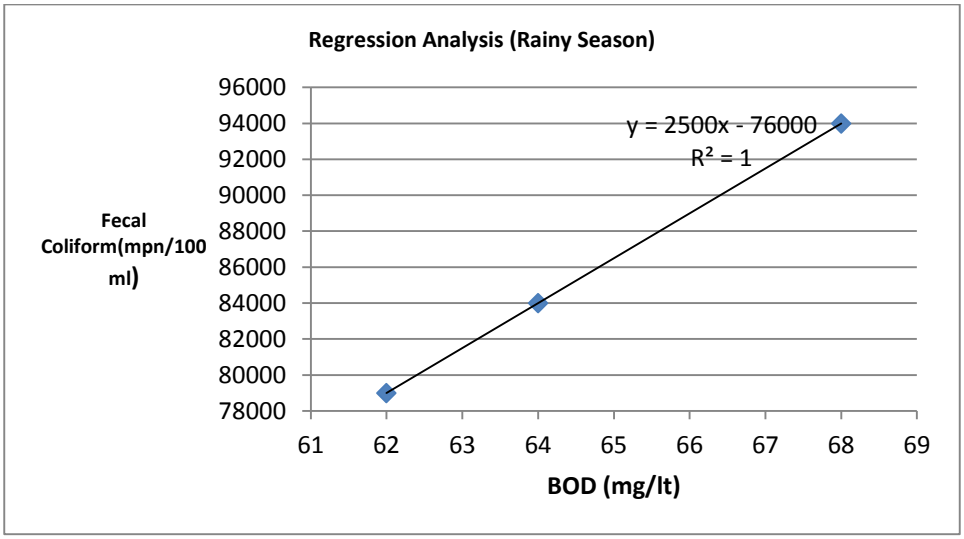

Figure 3. (Regression Plot Rainy season)

Table 8. Data (Winter Season)

Month	Year	DO mg/lt	BOD mg/lt	Other forms of Coliform (mpn/100ml)	Feacal Coliform (mpn/100ml)	Total Coliform (mpn/ml)
October	2017	0	64	36000	84000	120000
November	2017	0	68	60000	110000	170000
December	2017	0	64	110000	120000	110000
January	2018	0	66	91000	100000	91000
	Mean	0	65.5	74250	103500	122750
	Standard Deviation	0	1.91	32785.92	15351.44	33718.19

Table 9. Correlation Matrix (Winter Season)

	BOD mg/lt	*Other forms of Coliform(mpn/100ml)*	*Feacal Coliform (mpn/100ml)*	*Total Coliform (mpn/ml)*
BOD mg/lt	1			
Other forms of Coliform(mpn/100ml)	-0.198804	1		
Feacal Coliform (mpn/100ml)	0.2485479	0.89987306	1	
Total Coliform (mpn/ml)	**0.9878292**	-0.3488221	0.09486111	1

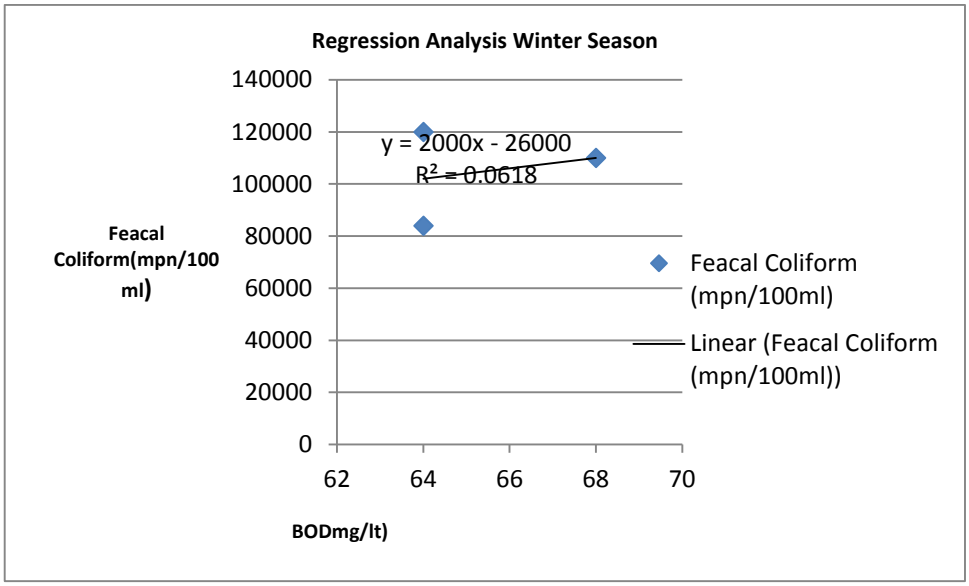

Figure 4. (Regression Plot Winter season)

CONCLUSION

The river is sluggish except during high flow period this is indicated with DO being reported nil in all three seasons. It shows that the oxygen available in the water is being consumed by bacteria leading to the inability of fish and other aquatic organisms to survive in the river. The high value of BOD suggest that oxygen present in the water is consumed by the aerobic bacteria which makes fish and other aquatic species difficult to survive. The results clearly indicate that during rainy season high inflow of sewage waste from nearby surroundings takes place, this waste is coming directly in the river. It clearly points to the fact that in rainy season some effective measures should be taken to see that sewage waste from surroundings does not flow in the river.

Attempts to increase sewage treatment provision within the catchment area is necessary, such treatment does not remove industrial or pesticide contamination from drinking water. This highlights the need to control such discharges at source, as post discharge treatment is not a viable option.

The river Hindon is also subjected to a varying degree of pollution caused by numerous untreated and/or partially treated waste inputs of municipal and industrial effluents as well as non point sources. Therefore, the water quality modelling is necessary to estimate downstream DO deficit in fact nil in different stretches. The human settlement and waste disposal along the route of hindon river and its tributary has been affecting the self purification of the river system. It is suggested that systematic monitoring of aquatic ecosystems must include bacteriological parameters together with chemical indices of water assessing their quality from point of view of health

The assessment of the water quality of river Hindon indicates that the river is not meeting the criteria with respect to Dissolved Oxygen, BOD, Total Coliform and Faecal Coliform for any purpose be it drinking, agricultural, washing etc. The high level of BOD can be attributed to discharge of industrial effluents from number of electroplating and tannery units. River Hindon receives the municipal a well as industrial effluents from the township of Saharanpur, Muzaffarnagar, Shamli, Meerut and Baghpat and Gautam Buddhnagar. The water is not fit even for irrigation purposes as the source water is grossly polluted.

The purpose of this study was to assess the DO, BOD levels and its correlation with faecal coliforms in Hindon river at Meerut city, India. Results indicated relatively higher levels of BOD, and coliforms. It indicates that the river is highly polluted with sewage discharge waste.

Effluent treatment water plants should be installed by all the industries discharging their effluents directly into the river without any treatment. Also watersheds can be used.

The present study would be a step towards understanding the nature of pollutants and their impact on the quality of water. Further studies on the relationships between river water quality and various bacteria's present in coliform's specially fecal are needed to make the study more useful from disease point of view.

Conflict of interest

No conflict of interest influenced in this research.

Authors Contribution

Author collected the data, after understanding the statistical analysis attending workshops on same, analysed the data and discussed the results with experts of the field.

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REFERENCES

[1] American Public Health Association (APHA), (2000). "Standard Methods for the Examination of Water and Wastewater". 19th Edition, American Public Health Association, Washington, D.C.

[2] Aisxi A.H, Zuaki A Horie Susumu (1984) Bulletin of the Japanese Society of Scientific Fisheries . Relationships of Total Coliform, Fecal Coliform, and Organic Pollution Levels in the Tamagawa River . 6, 991-997.

[3] Dewan M .A, Corner R, Hashizume M (2013). Typhoid Fever and Its Association with Environmental Factors in the Dhaka Metropolitan Area of Bangladesh. Neglected Tropical Diseases. 10, 1371-76.

[4] Dwivedi . K, Anil (2017) Researchers In water Pollution : A Review.International Research Journal of Natural and Applied Sciences Vol. 4, 2349-4077.

[5] Kirchman L D, (2010) Degradation of Organic Materials. Processes in Microbial Ecology . Chapter 5 .Oxford University Press.

[6] Kagalou, Tsimarakis G et.al. (2009) Inter-relationships between Bacteriological and Chemical Variations in Lake Pamvotis. Microbial Ecology in Health and Disease. 1651-2235.

[7] Paul Dipak (2017) Research on heavy metal pollution of river Ganga: A review. Annals of Agrarian Science.16, 278-286.

[8] Rizvi N, Deeksha K , Joshi V (2015) Assesment Of Water Quality Of Hindon River In Ghaziabad and Noida, India . International Knowledge Press 3. 80 – 90.

[9] Raghav P, Singh B.P. Water Quality Assessment of Hindon River at Ghaziabad by Physico-Chemical Parameters Analysis . Strategic Technologies of Complex Environmental Issues – A Sustainable Approach 978-93.

[10] Raj S. S, Chary S, Bindu H, et. Al (2007) Aerobic Oxidation of Common Effluent Treatment Plant Wastewaters and Sludge Characterisation Studies. International Journal Of Environmental Studies . 61. 99 – 111.

[11] Site :www.water-research.net/watrqualindex/index.htm

[12] Suthar S, Nema K A, Gupta K S. (2009) Assessment of metals in water and sediments of Hindon River, India: Impact of industrial and urban discharges Journal of Hazardous Materials 171 , 1088–1095.

[13] Schuettpelz H. D,(1969) Fecal And Total Coliform Tests in Water Quality Evaluation. Research Report

[14] Sharma, M.K., 2001. "Studies of Hindon River System with Reference to Heavy Metals", Ph.D Thesis, IIT, Roorkee, India

[15] Singh O, Sharma M.K (2015) Measurement Of Dissolved Oxygen And Biochemical Oxygen Demand For The Hindon River, India. Journal of Indian Water Resources Society, Vol 35, No.1.

[16] Schuettpelz D H, (1969) Feacal and Total Coliform Tests in Water Quality Evaluation-Research Report . Department of Natural Resources Madison.