ORIGINAL RESEARCH PAPER

Chemistry

AN ASSESSMENT OF RELEASED INDUSTRIAL EFFLUENT AND ITS IMPACT ON WATER QUALITY PARAMETER IN ALIGARH

KEY WORDS: Industrial Effluent, PH, TDS, Conductivity, Composition, Ganga River, Water Quality, Physicochemical Properties of Water.

Yogendra Singh Research Scholar, Department Of Chemistry, Mangalayantan University, Aligarh

Sandhya Chaudhary* Associate Professor, Department Of Chemistry, Nrec College, Khurja-bulandshar *Corresponding Author

Ravi Kant Professor, Department Of Chemistry, Mangalayantan University, Aligarh

ABSTRACT

This study assessed the Ganga River's water quality in the Aligarh District in relation to industrial wastes. Between May and June 2024, data were gathered from six sample stations that included upstream, downstream, and midstream areas. Ex situ examinations (of absolute phosphorus [TP], substance oxygen request [COD], complete nitrogen [TN], organic oxygen request [BOD] and all out disintegrated solids [TDS]), and were done notwithstanding in situ perceptions (of all out suspended solids [TSS], electrical conductivity [EC], temperature and pH,). The whole water quality was assessed using the weighted math water quality index (WQI). Massive contrasts in the water quality indicators between the sampling locales were tracked down by measurable analysis. Notably, pH values at two sites were higher than what the MoEF, and WHO considered to be acceptable. The river water was classified as "unsuitable for consumption" by the WQI results. Significant pollution is evident from the observed fluctuations in indices like COD, BOD, TN, TP, and TSS, which are mostly caused by industrial emissions. These results emphasize how urgently better pollution control and wastewater management strategies are needed. The study offers the municipal administration of Aligarh useful information for creating plans for efficiently managing and preserving the Ganga River, guaranteeing its sustainability and preserving public health.

INTRODUCTION

All life requires water, which makes up 50-97% of plants and animals and 70% of humans. Agriculture, manufacturing, transportation, and other human activities require it. Although vital, water is one of the worst managed resources worldwide. Ground and surface waters can be contaminated by many things. Fertilizer use in agriculture pollutes water. Industrial effluents and other garbage improperly disposed of in cities impair water quality. A study on industrial effluents on the Ganga River in Aligarh found that chemical parameters typically exceeded limits and accumulated downstream. Aligarh's rapid industrial expansion has strained water resources. Many urban people utilize piped water, but others use river water and boreholes.

Urban rivers in developing regions sometimes get industrial effluents. These effluents can damage groundwater if not properly handled and managed. Thus, afflicted boreholes and rivers have low water quality. Untreated water from these sources can cause cholera, bilharzia, and diarrhea outbreaks. Environmental conservation becomes harder in Aligarh and other rapidly industrializing places. Insufficient political will and the industrial sector's desire to shift pollution control to the government limit the successful implementation of environmental protection and resource management regulations. Unsustainable and wasteful resource use causes wildlife decline, land degradation, and unmanaged commercial, industrial, and domestic garbage disposal. A major river flows through an industrial sector in Aligarh into the Ganga River, which is long. Multiple companies discharge effluents into this river, and inhabitants near industrial zones use it for drinking. However, there is little data on the effluents and river water quality for human consumption. Authorities need such data to control pollution and protect public health. This study examines industrial effluent-induced Ganga River contamination.

Iloms, E. (2020) examined the connection between weighty metal contamination and industry area and metropolitan WWTP productivity. pH, Body, DO, COD, TDS, and EC differed transiently and spatially, with industrial examples having more prominent qualities. ICP-OES data indicate more noteworthy degrees of aluminum, copper, lead, and zinc in industrial effluents ($p < 0.05$), with just Zn and Al showing occasional variety. Measurable relationship study showed an unfortunate relationship between physicochemical elements and wastewater HMs composition. Notwithstanding, WWTP wastewater included destructive HMs (Zn, Cu, and Pb) above limits. The WWTP maintained most wastewater measurements within South African Green drop Norms, yet its final effluent had more noteworthy Cu, Zn, Pb, and COD, which stressed Vaal river wellbeing and organic variety. Consequently, we advocate ongoing WWTP infrastructure monitoring and fix in the exploration area.[1]

Mukate, S. (2018) overviewed the impacts of industrial effluents, open poop, and untreated sewage discharge on groundwater and surface water in Chincholi industrial region. Kondi, Pakni, and Chincholi have 7000 occupants, and 81% poo directly. Businesses dump sewage in pits and surface water tanks without treatment, while tenants drink from hurt springs. An amount of 55 water tests were gathered pre-and post-storm in 2015. At many example areas, the BIS tracked down TH, Ca, Na, Cl, NO3, and TDS over the breaking point. Pre-and post-rainstorm flautist plots show alkaline earth dwarfs' soluble bases major areas of strength for and over frail corrosive. Post-storm nitrate and chloride levels are higher because of wastewater, agrarian waste, and recharging water permeation. The bunch analysis shows three groups, indicating anthropogenic contamination from the high sure connection between Cl, NO3, and TDS.[2]

Mmonwuba, N. C. (2024) evaluated the effect of wastewater discharges on the Otamiri River's quality in Nigeria's Imo state. At the locations where the industries discharge their wastewater and the abattoir, six water samples were taken. Using normal protocols, samples taken both upstream and downstream were evaluated in the lab and in the field. The Otamiri River's quality is impacted by the effluent discharges from industrial and abattoir activities, which are the source of pollution. Therefore, in its current state, the River cannot be used for residential purposes without any treatments. It is recommended that cost-effective production technology be implemented, such as on-site waste separation and reduction and effluent recycling processes, and that the river be frequently monitored.[3]

Islam, S. M. D. (2016) examined the Shitalakhya River's water quality, the variety and wealth of phytoplankton, the effect of contaminants on phytoplankton, and the essential efficiency. Basically alkaline (7.01-8.2), the water tests exhibited huge changes in DO (0.92-2.7 mg/L), EC (1171-2700 S/cm), BOD (12.03-28.38 mg/L), TDS (576-1345 mg/L), free-CO_2 (15-31 mg/L), and COD (101.2-109.2 mg/L). There were 62 species found in all, with 9 belonging to the Chlorophyceae, 11 to the Cyanophyceae, 14 to the Euglenophyceae, and 28 to the Bacillariophyceae families. The fact that Bacillariophyceae ranked lowest among Chlorophyceae and was shown to be dominant among all other members suggests that this group is more vulnerable to the toxins that the sector releases.[4]

The goal of this work to determine the Ganga River's water quality in the Aligarh District. To assess the level of contamination by contrasting measures related to water quality with accepted norms at selected six sites.

Methodology
All collected samples were analysed, using the various techniques in the present study.

Description Of The Study Area
From Fig.1, the Ganga River in Uttar Pradesh, India, which flows close to the city of Aligarh, was the subject of the study. The research area's precise coordinates are roughly 27.8974° N latitude and 78.0880° E longitude.

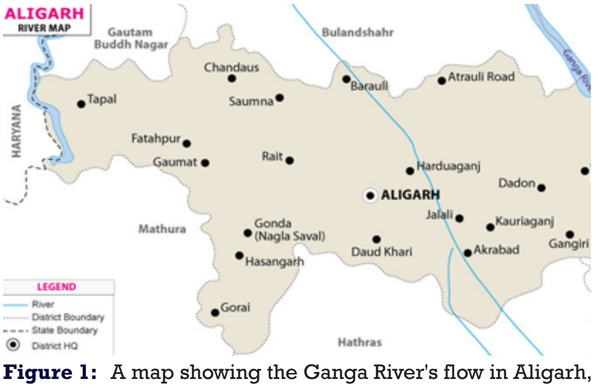

Figure 1: A map showing the Ganga River's flow in Aligarh, Uttar Pradesh, India.

Study of Sampling Sites
The Ganga River's test locations were specifically chosen to evaluate the effects of nearby activities and possible wastewater discharge on the river's water quality in Aligarh. For the study, six sampling sites were considered. According to Table 1, the locations were categorized as being upstream, downstream, or midstream of the river.

Table 1: An explanation of the water sampling stations' sampling sites

Abbreviation	Test Sites	X-Coordinate	Y-Coordinate	Altitude	Brief Portrayal of the Site
UPWS1 (Understanding Pollutant Water Sources 1)	Site 1	0780860	2784450	190	Upper stream, relatively unpolluted area.
GS2 (Geospatial Analysis Study 2)	Site 2	0780925	2784350	188	Near a residential area, subject to domestic waste.
IPS3 (Industrial Pollutant Sampling 3)	Site 3	0780970	2784200	186	Effluent release point from a local industry.
IPS4 (Industrial Pollutant Sampling 4)	Site 4	0780995	2784175	185	Outside the compound of the treatment plant.
WWJSS (Waste Water Joint Sampling Study)	Site 5	0781050	2784100	183	Effluent joining point from the industry to the river.
DSS6 (Data Sampling Study 6)	Site 6	0781100	2784000	180	Downstream site where wastewater is used for irrigation.

Method of Data Collection
In situ and ex situ water quality evaluations were finished. In May and June 2024, Aligarh's six Ganga River sampling points (Figure: 1) assembled water tests from upstream, halfway, and downstream regions. This period was picked for data gathering because it denotes India's dry-wet change. The investigations covered nine water quality boundaries. For water quality evaluation, pH, water temperature, electrical conductivity (EC), and total suspended solids (TSS) were estimated in situ, while COD, TN, TP, TDS, and Body were estimated ex situ. On location boundaries were taken with a versatile instrument. Water tests from the three locales were collected and broke down in the lab using ordinary techniques for ex situ estimations (Table 2).[5-11] Here is the table adjusted for the Ganga River study in Aligarh:

Table 2: Water Quality Parameters and Analysis Techniques

Parameters	Water Quality Technique/Strategy Utilized for Analysis
Temp. (°C)	Thermometer
TN (mg/L)	HACH-DR6000 UV VIS—Spectrophotometer
EC (μS/cm)	EC meter
COD (mg/L)	HACH-DR6000 UV VIS—Spectrophotometer
pH	pH meter
TP (mg/L)	HACH-DR3900 UV Spectrophotometer
TSS (mg/L)	Gravimetric method
BOD (mg/L)	Standard method
TDS (mg/L)	EC meter

Data Analysis
Clear measurements and fundamental factual measurements for the examined water quality indicators were included in the data analysis. Clear insights and a one-way analysis of fluctuation were utilized to affirm the changes made to the proportions of water quality accumulated. With an importance edge of $p < 0.05$, it was feasible to distinguish a huge distinction in the water quality boundaries between the example locales. The data were subjected to a factual analysis utilizing SPSS programming, variant 25.0.

RESULTS AND DISCUSSION
Water quality monitoring is crucial for river management and public health. From the Table: 3 collected water samples on several locales showed pH levels of 7.88–8.90, indicating somewhat alkaline water. Higher electrical conductivity (EC) measurements at some sites indicate higher dissolved salt levels (range: 262.69 μS/cm to 649.00 μS/cm). Different degrees of organic contamination were indicated by BOD, which ranged from 7.52 to 27.01 mg/L. Oxidable matter was estimated by chemical oxygen demand (COD) between 105.65 and 146.55 mg/L. Nitrogen (TN) and phosphorus (TP) levels varied site-specifically from 15.05 to 31.35 mg/L and 3.90 to 5.37 mg/L, respectively. TSS was highest at Site 6 (169

mg/L), while TDS ranged from 155.28 to 390.50 mg/L. Water temperature ranged from 14.69°C to 16.67°C. Different locales have different pollution and water quality levels.[6-9]

Table 3: Analyzing water sample data for physicochemical properties (mean ± SD)

Parameters of Water Quality	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
pH	7.88 ± 0.55	8.18 ± 0.04	8.86 ± 0.25	8.90 ± 0.15	8.23 ± 0.20	8.33 ± 0.15
EC (μS/cm)	262.69 ± 3.75	574.00 ± 66.99	649.00 ± 6.59	644.35 ± 18.40	437.15± 125.14	569.85 ± 65.75
BOD (mg/L)	8.02 ± 8.50	15.48 ± 19.10	27.01 ± 32.09	7.52 ± 7.80	22.49 ± 17.70	21.49 ± 2.10
COD (mg/L)	146.55 ± 37.03	132.85 ± 3.52	139.15 ± 13.90	112.52 ± 12.00	105.65 ± 4.25	121.36 ± 3.29
TN (mg/L)	31.35 ± 2.85	21.50 ± 8.25	15.68 ± 0.05	15.05 ± 0.05	17.30 ± 8.25	15.80 ± 0.80
TP (mg/L)	4.25 ± 0.30	4.00 ± 0.10	4.72 ± 1.20	3.90 ± 0.15	3.97 ± 0.30	5.37 ± 0.19
TSS (mg/L)	25.48 ± 34.68	31.48 ± 14.87	13.48 ± 4.97	13.52 ± 10.60	50.48 ± 0.69	169 ± 147.80
TDS (mg/L)	155.28 ± 0.83	345.00 ± 40.58	389.65 ± 8.50	390.50 ± 9.20	332.30 ± 22.65	336.69 ± 43.87
Temp. (°C)	15.28 ± 4.15	14.69 ± 4.25	15.47 ± 4.19	16.48 ± 2.74	15.27 ± 4.47	16.67 ± 1.65

From table: 4 and Fig.2, showed the temperature of the water influences the limits of water quality and is basic for land and water proficient life. It is a critical real mark of water quality that influences the water's split up oxygen content (DO). The DO grouping of contaminated water can be significantly influenced by its temperature. The Ganga River receives wastewater from a number of sources, which could cause the river system to leak warm water and raise the water's temperature. During the wet season, mean water temperatures were measured as low as 14.20°C at GS2 and as high as 16.45°C at IPS4. The water temperature at each sampling location did not differ significantly (p = 0.99) despite this variation.

Table 4: Temperature readings (C°) at the riverside sampling locations

Sampling Sites	Temperature Measured (C°)
UPWS1	15.22
GS2	14.20
IPS3	15.48
IPS4	16.45
WWJSS	15.30
DSS6	16.20

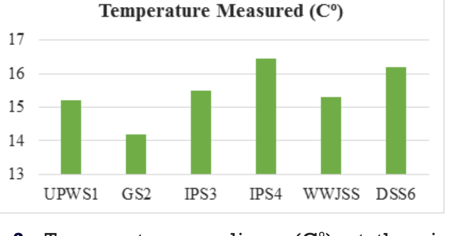

Figure 2: Temperature readings (C°) at the riverside sampling locations

The existence of ionic particles in an answer determines its electrical conductivity (EC), which indicates the quantity of salts and carbonates in water. EC, as TDS, addresses river water salinity and is affected by inorganic broke down solids such sulfates, iron, nitrates, phosphates, calcium, magnesium, chlorides, aluminum and sodium particles. Higher particle fixations increase conductivity, indicating river contamination. High turbidity levels dissipate and impede light because of suspended molecule matter like mud, green growth, garbage, and feces, affecting daylight infiltration and sea-going life. Unexpected conductivity changes can indicate contamination. The table:5 and Fig.3 showed the portrays EC, TDS, and TSS for six Aligarh Ganga River test stations: UPWS1, GS2, IPS3, IPS4, WWJSS, and DSS6. The most minimal EC was at UPWS1, suggesting minor contamination, while the most noteworthy was at IPS3, indicating industrial release.

Table 5: Compositions of EC, TDS, and TSS at six distinct sampling sites

Sampling Sites	EC	TDS	TSS
UPWS1	270	150	15
GS2	560	325	20
IPS3	650	400	5
IPS4	648	395	5
WWJSS	425	320	60
DSS6	550	350	180

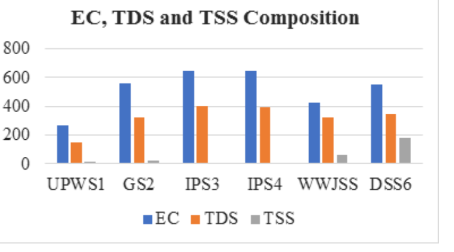

Figure 3: Compositions of EC, TDS, and TSS at six distinct sampling sites

The investigation found a mean EC of 270-650 μS/cm. UPWS1 had the lowest mean EC and IPS3 the highest. Industrial and residential waste may explain this difference. High river turbidity and suspended particles limit vision and cleanliness, compromising safety and attractiveness. Analysis demonstrated substantial sampling site EC differences (p = 0.01). MoEF drinking water guidelines (2500 μS/cm at 20 °C), FAO water system water norms (700-3000 μS/cm), and WHO standard (400 μS/cm) were met by our normal Fisheries-supporting water ought to have 0.15-0.50 mS/cm, per the MoEF. Conductivity values infer hydroponics agreeable water.[10-15]

CONCLUSION

Water quality parametres evaluation is essential to water resource management because it provides empirical evidence for assessing water quality degradation and minimizing pollution impacts. This study examined how local industrial activity affected Ganga River water quality in Aligarh, Uttar Pradesh, India. Dissecting nine water quality boundaries and deciding the Water Quality Record (WQI) of test destinations on a piece of the river inspected what industrial and homegrown releases mean for water quality. To assess river health, water quality metrics were compared to CPCB and WHO criteria. This study found that upstream sample sites had worse water quality characteristics than downstream sites. Some river sites had pH levels above CPCB and WHO drinking water guidelines. The WHO norms for Complete Suspended Solids (TSS) were not met at different locales, and the TN and TP values were above biological system rules. This shows that industry and homegrown effluents have definitely debased river water quality. The WQI evaluation says the river's water quality is basic. To protect Aligarh's river assets, the city's administration ought to focus on water quality. The Focal Contamination Control Board (CPCB) and the Neighborhood River Security and Advancement Office need this study's discoveries to create powerful Ganga River conservation procedures. This analysis can also help regulate industrial operations in Aligarh and conserve other vulnerable rivers in India.

Acknowledgements

I am highly thankful to Department of Chemistry, Mangalayatan University, Aligarh for providing the necessary facilities and support.

REFERENCES

1. Iloms, E., Ololade, O. O., Ogola, H. J., & Selvarajan, R. (2020). Investigating industrial effluent impact on municipal wastewater treatment plant in Vaal, South Africa. International journal of environmental research and public health, 17(3), 1096.
2. Mukate, S., Panaskar, D., Wagh, V., Muley, A., Jangam, C., & Pawar, R. (2018). Impact of anthropogenic inputs on water quality in Chincholi industrial area of Solapur, Maharashtra, India. Groundwater for Sustainable Development, 7, 359-371.
3. Mmonwuba, N. C., Mmaduabuchi, A., Azubuike, O., Nzube Theophilus, N., & Chukwuemelie, C. (2024). The Effect of Industrial Waste Effluent on Waterquality: A Case Study of Otamiri River, Owerri, Imo State. Journal of Engineering Research and Reports, 24(4), 15-25.
4. Islam, S. M. D., & Huda, M. E. (2016). Water Pollution by Industrial Effluent and Phytoplankton Diversity of Shitalakhya River, Bangladesh. Journal of Scientific Research, 8(2).
5. Berehanu, B., Lemma, B., & Tekle-Giorgis, Y. (2015). Chemical composition of industrial effluents and their effect on the survival of fish and eutrophication of lake Hawassa, Southern Ethiopia. Journal of Environmental Protection, 6(08), 792.
6. Bharti, P. K., Kumar, P., & Singh, V. (2013). Impact of industrial effluents on ground water and soil quality in the vicinity of industrial area of Panipat city, India. Journal of Applied and Natural Science, 5(1), 132-136.
7. Chakravorty, P. P., Sinha, M., and Chakraborty, S. K. (2014). Impact of industrial effluent on water quality and benthic macro invertebrate diversity in fresh water ponds in Midnapore district of west Bengal, India. Journal of Entomology and zoology studies, 2(3), 93-101.
8. De Melo Gurgel, P., Navoni, J. A., de Morais Ferreira, D., & do Amaral, V. S. (2016). Ecotoxicological water assessment of an estuarine river from the Brazilian Northeast, potentially affected by industrial wastewater discharge. Science of the Total Environment, 572, 324-332.
9. Faisal, B. M. R., Majumder, R. K., Uddin, M. J., & Halim, M. A. (2014). Studies on heavy metals in industrial effluent, river and groundwater of Savar industrial area, Bangladesh by principal component analysis. Int J Geomat Geosci, 5(1), 182-191.
10. Gbarakoro, S. L., Gbarakoro, T. N., & Eebu, W. L. (2020). Impact of industrial effluent discharge on the physico-chemical properties of Aleto Stream, Eleme, Rivers State, Nigeria. Annual Research & Review in Biology, 35(1), 79-89.
11. Islam, M. S., Tusher, T. R., Mustafa, M., & Mahmud, S. (2012). Effects of solid waste and industrial effluents on water quality of Turag River at Konabari industrial area, Gazipur, Bangladesh. Journal of environmental science and natural resources, 5(2), 213-218.
12. Kanu, I., & Achi, O. K. (2011). Industrial effluents and their impact on water quality of receiving rivers in Nigeria. Journal of applied technology in environmental sanitation, 1(1), 75-86.
13. Kumar, D. S., and Srikantaswamy, S. (2015). Evaluation of effluent quality of a sugar industry by using physico-chemical parameters. International Journal of Advanced Research in Engineering and Applied Sciences, 4(1), 16-25.
14. Ogundiran, M. A., & Fawole, O. O. (2014). Assessment of the impacts of industrial effluent discharges on the water quality of Asa River, Ilorin, Nigeria. Journal of Environmental Science, Toxicology and Food Technology, 8(7), 80-98.
15. Osibanjo, O., Daso, A. P., & Gbadebo, A. M. (2011). The impact of industries on surface water quality of River Ona and River Alaro in Oluyole Industrial Estate, Ibadan, Nigeria. African Journal of Biotechnology, 10(4), 696-702.