



## Effect of industrial effluents on the physico-chemical parameter of the receiving water bodies in India

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### Abstract

Industrialization is a measure of the development of rapid industrialization; however, population growth adversely affects it. India is in the problem of rising industrialization and the need to maintain the environmental status of the country. Industrialization in India since independence has seen a rapid development, creating a variety of medium and large-scale industries. However, the effluents from these industries have complex and diversified a wide array of pollutants leading to the pollution of aquatic bodies. This study measured physico-chemical parameters in order to measure the levels of pollution in the aquatic body; the parameters studied included PH, Electrical conductivity, Biochemical oxygen demand, chemical oxygen demand, total dissolved solids and Salinity. Through the above study, the researcher has noticed that agriculture areas such as Bichitrapur are less polluted, while the industrial areas such as Kharagpur and Midnapore are highly polluted. In this paper, subsequent effects of industrial pollutants discharge on India's aquatic bodies biological systems were discussed. Industrial waste should be treated properly and be allowed to be discharged into the environment; then, our tomorrow will be better.

**Keywords:** Industrial pollutants, aquatic pollution, dissolve oxygen, tds, electrical conductivity

### Introduction

Water, an inevitable element in the ecosystem, serves as a lifeline for all living organisms. However, the escalating trends of industrialization and urbanization in developing nations have precipitated a surge in aquatic pollution. Industrial effluents continuously infiltrate nearby aquatic bodies such as rivers, canals, ponds, and reservoirs, perpetuating a cycle of contamination that extends to both water and soil.

The repercussions of aquatic and soil pollution reverberate throughout the ecosystem, particularly influencing aquatic organisms and those dependent on them. The physico-chemical analysis of water emerges as a critical tool in evaluating its quality for diverse purposes, including drinking, domestic use, industrial processes, irrigation, and pisciculture [1]. Water quality testing not only underscores the practical significance of water but also informs decision-making across various spheres of daily life.

The convergence of sewage not only compromises water quality but also disrupts the delicate steadiness of the aquatic ecosystem. As pollution levels surge, the sustainability of ecosystems and the prosperity of communities reliant on these resources hang in the balance. Urgent measures are imperative to mitigate pollution, preserve water quality, and safeguard the integrity of our ecosystems for next generations.

In the contemporary context, the issue of heavy metal pollution in aquatic ecosystems has garnered significant recognition as a pressing concern. Various studies and enquiries have indicated that heavy metals are present in natural water bodies at concentrations below their thresholds for toxicity. Nevertheless, owing to their non-degradable characteristics, heavy metals tend to accumulate within numerous compartments throughout the food web [16]. This phenomenon of bioaccumulation poses a considerable threat to the overall health and stability of aquatic ecosystems.

Industrialization wave has carried the establishment of various industrial hubs in Paschim Medinipur district of West Bengal; India and the alarming part in that these

industries are in the vicinity of domestic area of the township. Two such site namely Kharagpur and Midnapore have been selected as test study area which have water body aligned to the industries. These water bodies are being used as a source of food and water for Domestic purpose. As a result, the likelihood of contaminants influencing life in the immediate vicinity is greatest.

### Methodology

#### 1. Study Area Selection

The selected area for this study were Bichitrapur (21.6047° N, 87.4151° E), Kharagpur (22°36'N & 87°36'E), and Midnapore (22°37' N & 87°28'E) due to the affluence of wetlands. We chose Bichitrapur as the control area because it had no industrial hub and was covered by agricultural fields. In contrast, large industrial hubs were located in the Midnapore and Kharagpur regions.

#### 2. Water Quality Parameters

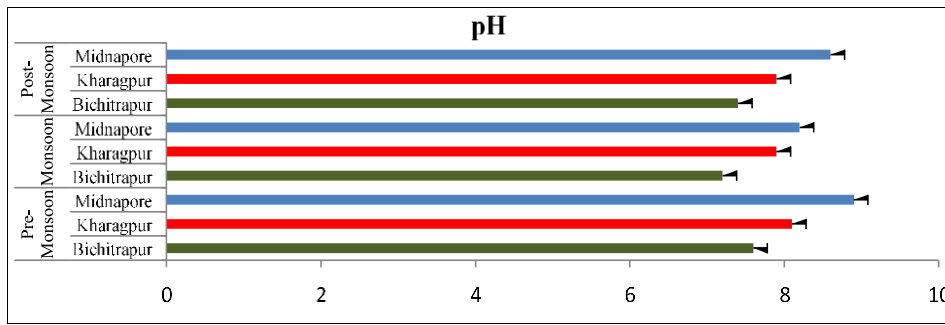
Water samples were collected from the reservoirs of various study areas in sterilized plastic containers. The closed bottles were submerged into the reservoir water, after which the caps were opened, allowing the water to fill up the bottles completely. Subsequently, the caps were closed, and the bottles were removed from the water. The methods used to analyse different physicochemical parameters followed the procedures described in the APHA 1998, 20th edition. [3]. The physico-chemical parameters were analysed by-

- a. **pH:** pH meter
- b. **Temp:** thermometer
- c. **Electrical conductivity at 26°C:** Conductometer
- d. **Salinity:** water analyser refractometer
- e. **Dissolve O<sub>2</sub>:** Winkler method
- f. **COD:** Open condensation and digestion
- g. **BOD:** Open condensation and digestion
- h. **Hardness:** using EDTA complexometric
- i. **Turbidity:** by Nephello Turbid Meter
- j. **Heavy Metal (Fe, Pb, As, Cd, Hg):** test method- IS: 3025 (part- 41,49,47,37,53)

**Results & Discussion**

**1. Physico-chemical parameter of the Water**

**1.1 pH**

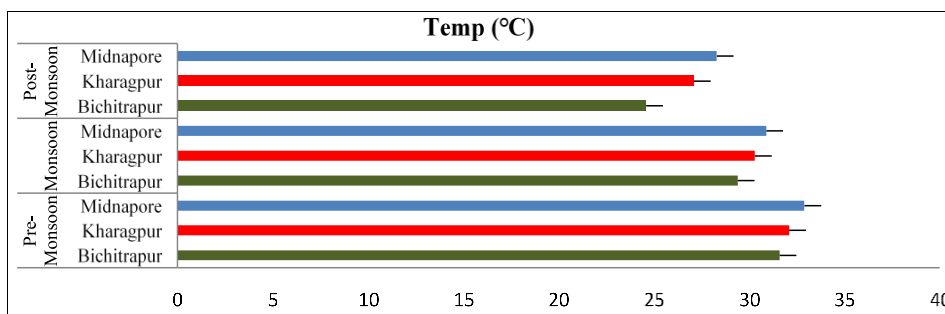


**Fig 5:** Graphical presentation shows the different value of pH at different study area

The survival and growth of aquatic animals are also depending on pH of water. The pH of water can fluctuate considerably by season. It has been observed that a pH range of 6 to 7.5 is ideal for improved snail and fish production (12). In recent study pH value recorded from 7.3 to 9. The highest of pH value was recorded at Midnapore

region (T2) during pre-monsoon seasons and the lowest was recorded at Bichitrapur region (C) during monsoon seasons. The low value during the monsoon may be caused by the dilution of rain water. The Values are also within the ICMR limit.

**1.2 Temperature**

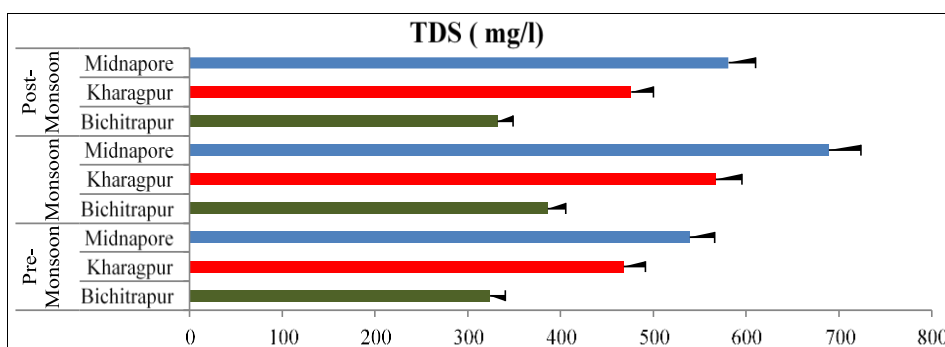


**Fig 6:** Graphical presentation shows the different value of Temperature (°C) at different study area

Temperature also plays a crucial role in physicochemical and biological properties of water that have direct impacts on the aquatic habitat. Water temperature is dependent on the temperature of its environment. The temperature changes affect the metabolism and physiology of aquatic animals, as well as their productivity. The results obtained from this work showed temperature value ranging from 24.6

°C to 32.1 °C. The temperature was recorded maximum during Pre-monsoon in Midnapore (T2) region and minimum during post monsoon in Bichitrapur (C) region. According to Dinesh *et al.*, water temperature may depend on the seasonal variation, geographical location and sampling time [13]. The results were compared with the ICMR standards.

**1.3 Total Dissolved Solids (TDS)**



**Fig 7:** Graphical presentation shows the different value of TDS (mg/l) at different study

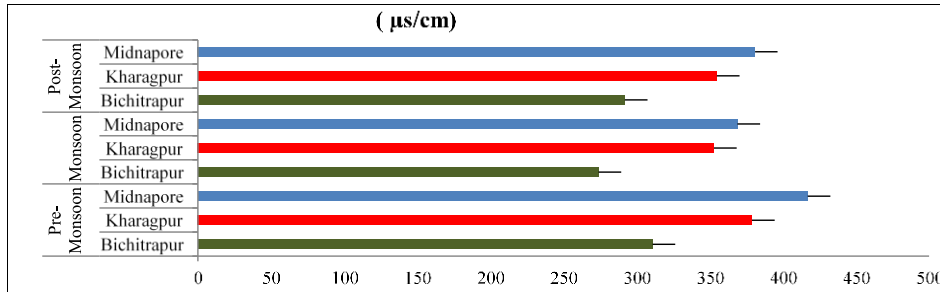
The amount of total dissolve solid present in water is also depending upon the amount of domestic and industrial West water is discharged into the water bodies. A total dissolve

solid is measured for analysis the quantity of solid materials (inorganic and organic) mixed in water (14). TDS value changes with seasonal variation shown in Fig-7. The total

dissolved solid analysis represents that the total dissolves ions but does not report that type of ion interaction (7). The increase in TDS raises the apparent watercolour temperature and also diminished the rate of photosynthesis. It also regulates the in and out flow of water from the aquatic cell also controls osmotic pressure of aquatic biota. Analysis of

TDS observed that the lowest concentration 324 mg/litre during pre-monsoon and the highest concentration 689 mg/litre during monsoon. The highest concentration values are greater than ICMR standard value which exerted adverse effect on aquatic life.

**1.4 Electrical conductivity**

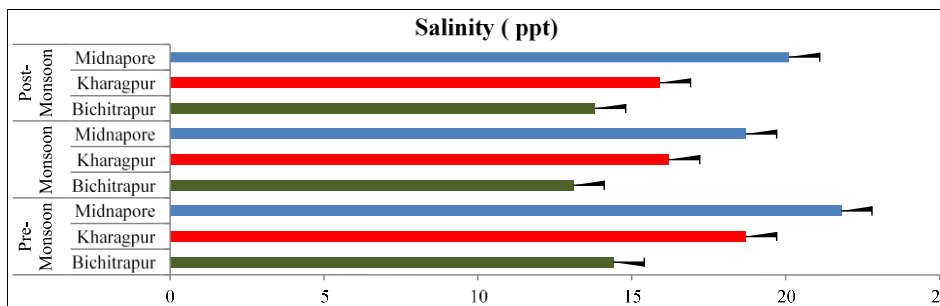


**Fig 8:** Graphical presentation shows the different value of Electrical conductivity at 27°C (µs/cm) at different study area

Electric conductivity is a useful parameter to evaluate the purity of water (8). A total load of salt in water body is directly related to its conductivity (6). It has reported that high values of conductivity are an indicator of pollution (4). The range of electric conductivity in the present study was 274 to 417 µs. The electrical conductivity was recorded maximum during pre-monsoon at Midnapore and minimum during monsoon at Bichitrapur (C). It was also observed that

at the same season the EC value of Midnapore and Kharagpur is greater than the EC value of Bichitrapur (C). It is because Bichitrapur (C) is agriculture area and Midnapore and Kharagpur are industrial area. The value of electrical conductivity at Bichitrapur (C) fall under the ICMR limit but electrical value at Midnapore (T2) and Kharagpur (T1) exceed the ICMR limit which indicates water pollution.

**1.5 Salinity**

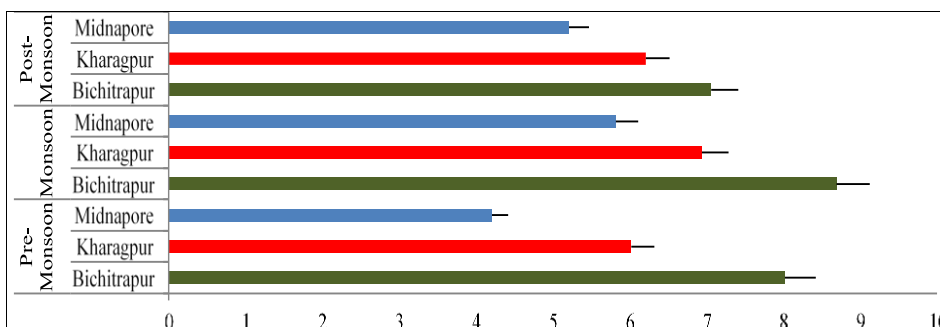


**Fig 9:** Graphical presentation shows the different value of Salinity (ppt)at different study area

Salinity tip place and important role in metabolic and extinction of aquatic organism through osmoregulation. It acts as a vital ecological factor controlling the phytoplankton population of freshwater. During the present study the salinity range 13.1 to 21.8. The maximum value

for salinity was recorded in the monsoon at Midnapore and minimum in monsoon at Bichitrapur (C). High salinity concentration was associated with fungi and bacteria diversity of phytoplankton population (17).

**1.6 Dissolve O2 (mg/l)**

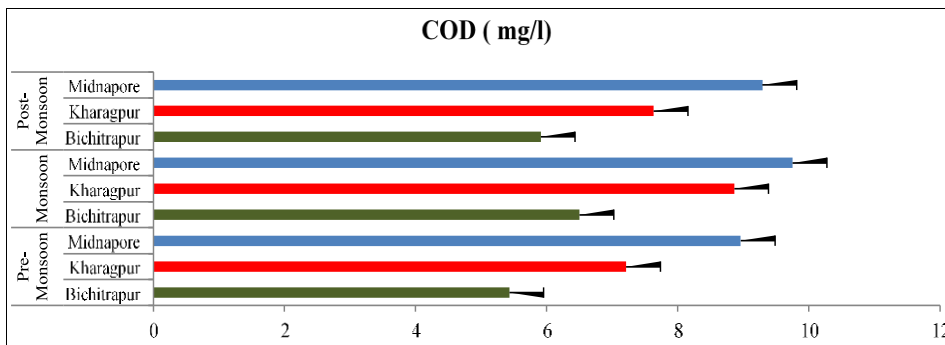


**Fig 10:** Graphical presentation shows the different value of Dissolve Oxygen (mg/ml) at different study area

One of the most crucial indicators of the water quality in streams, rivers, and lakes is dissolved oxygen, or DO. It is an important water contamination test. (10). O<sub>2</sub> is needed by aquatic organism for their respiration. Level up the job

oxygen changes during seasonal variation. The dissolve oxygen obtained from the study was reached between 4.1 to diesel oxygen was recorded maximum in monsoon period and minimum during pre-monsoon period.

**1.7 Chemical Oxygen Demand (mg/l)**

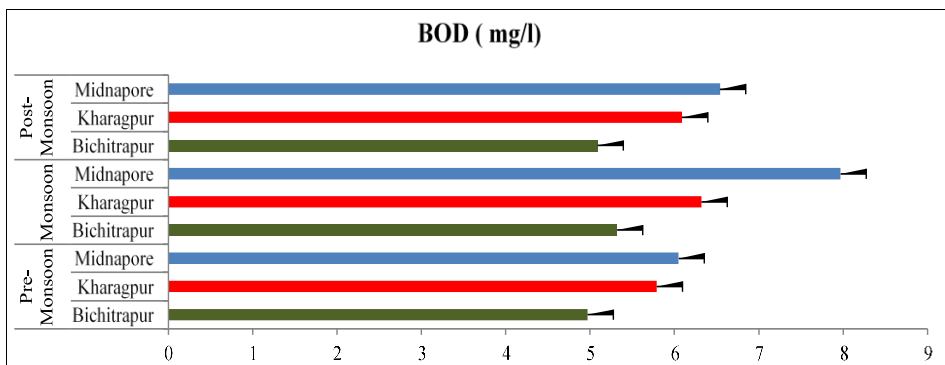


**Fig 11:** Graphical presentation shows the different value of Chemical Oxygen Demand (mg/ml) at different study area

It is important for establishing of the quality of water. It is determining the amount of O<sub>2</sub> required for chemical oxidation of organic and inorganic matter (5). The high COD values indicate that nonbiodegradable O<sub>2</sub> demanding

pollutants present in water. It was observed that through this study COD level was ranged 5.43 to 9.75 mg/lit. Maximum value of during Monsoon at Midnapore (T2) and minimum value observed during Pre-monsoon at Bichitrapur (C).

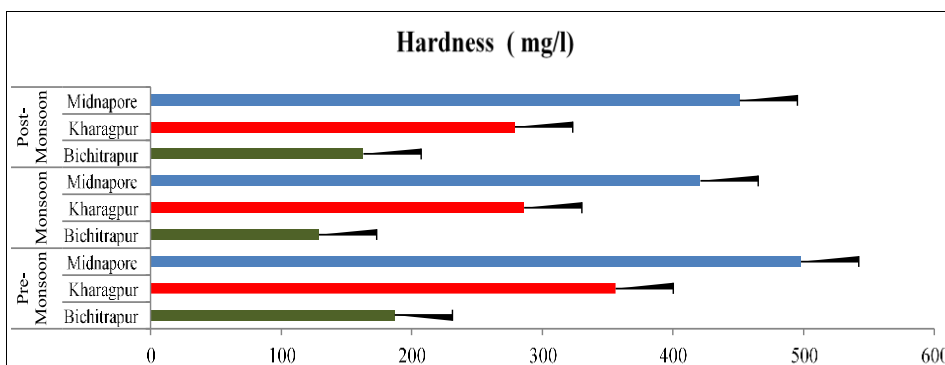
**1.8 Bio Chemical Oxygen Demand (mg/l)**



**Fig 12:** Graphical presentation shows the different value of Biological Oxygen Demand (mg/ml) at different study area

temperature that extent of biological activity, the concentration of organic matter and microbial populations such as bacteria and fungi (2). The maximum bod level was recorded 7.97 mg per litre during monsoon period and minimum value was recorded 4.97 mg per litre during tri monsoon period this bod values are there for within the ICMR limit.

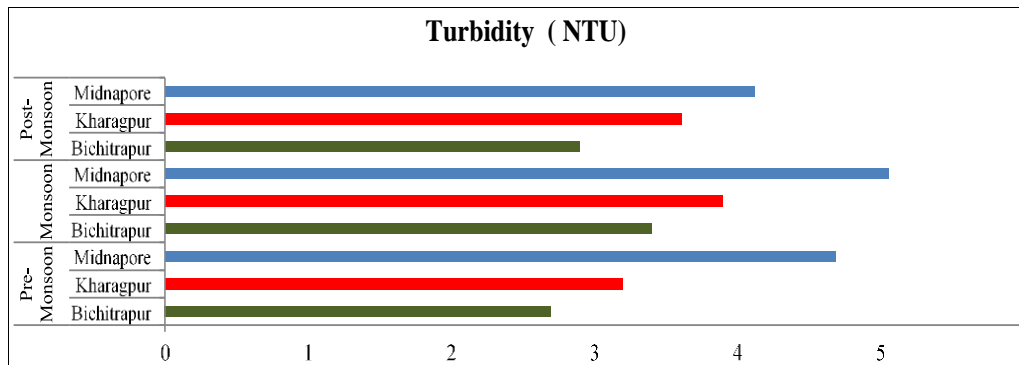
**1.9 Hardness (mg/l)**



**Fig 13:** Graphical presentation shows the different value of Hardness (mg/l) at different study area

Calcium and magnesium are essential for bone and scale formation of aquatic animal (1). Maximum value 498 mg per litre was observed during pre-monsoon and minimum value 129 mg per litre was determined during monsoon period. Hardness value obtained during pre-monsoon can be attributed to lower water level and high rate of water evaporation.

### 1.10 Turbidity (NTU)



**Fig 14:** Graphical presentation shows the different value of Hardness (mg/l) at different study area

Turbidity measures the ability of water to transmit the light that restrict light penetration and control photosynthesis (15). Turbidity usually affected by factor such as clay particles dispersion of plankton organism etc. Turbidity watches recorded maximum during monsoon 5.06 NTU and minimum in pre-monsoon 2.7 NTU. Minimum values are also within the ICMR limit but maximum value exceeds slightly the ICMR value.

### Conclusion

India, a rising nation, is rapidly industrializing, which is a key engine of its economic growth. However, this boom in industrial activity has resulted in a significant increase in waste output, notably in the automotive, leather, textile, and metal industries. Unfortunately, industrial effluents are sometimes disposed of without sufficient treatment, with serious effects for neighbouring wetlands and ecosystems. In light of this, it is critical to perform extensive water quality monitoring to determine the amount of environmental contamination. The evaluation of numerous characteristics including as pH, temperature, color, electrical conductivity (EC), biochemical oxygen demand (BOD), chemical oxygen demand (COD), dissolved oxygen (DO), and turbidity gives essential information on the health of aquatic ecosystems. Notably, the study found large differences in water quality among locations. The results show that pH, temperature, and hardness levels are significantly greater in the Midnapore and Kharagpur regions than in Bichitrapur. In contrast, Bichitrapur has greater dissolved oxygen levels, suggesting lower pollution levels according to Indian Council of Medical Research (ICMR) guidelines. These findings demonstrate the significant influence of industrial effluents on water quality measures. The striking contrast between Bichitrapur reasonably clean water bodies and the extremely polluted ones in the Midnapore district serves as a harsh reminder of the environmental consequences of unregulated industrial growth. Finally, this study emphasizes the crucial necessity for strict measures to reduce industrial pollution and promote sustainable development. By tackling the core causes of pollution and implementing efficient waste management measures, India can protect its valuable water resources and ecosystem integrity for future generations.

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### Conflict of Interest

The authors declare that there is not any conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/ or falsification, double publication and/ or submission, and redundancy has been completely observed by the authors.

### Life Science Reporting

No life science threat was practiced in this research.

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