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# Variations in Organic Pollution and Coliform Bacteria in River Ganga along Bithoor - Kanpur Ghats: A Socio-cultural dimension

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**Abstract—***The water quality of River Ganga has become an issue of serious concern in today's time, approximately 400 million people living in the catchment are heavily impacted by the pollution load that the river carries in the form of industrial effluents, agricultural waste, municipal sewage and domestic discharges. It has been tagged as one of the world's top ten rivers at risk by World Wide Fund for Nature (WWF). The present study has been carried out for pre - monsoon phase (2017-2018) to investigate the variations in the concentrations of organic pollution load and biological variables in the river in Bithoor-Kanpur region considering associated religious, cultural and social activities. The sampling sites included Dhruv ghat (S-I), Chatrapati Shivaji ghat (S-II), Ganga Barrage (S-III) and Rani Ghat (S-IV). Water quality parameters i.e. Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Coliform bacteria were analyzed using standard methods. The parameter values were found in the range of 3.6- 8.1 mg/L, 7-38 mg/L, 91-349 mg/L and 800-35000 MPN/100 ml, respectively. Water quality of Ganga in all the four Ghats was found to be of poor quality as the maximum permissible limits were crossed. However, maximum pollution was found in S-II and S-IV, which were the sites showing very high human activities including bathing, washing, religious offerings and others.*

**Keywords***: Pollution, Ganga, DO, BOD, COD, Total Coliform.*

## 1. INTRODUCTION

River Ganga is reckoned to be the most important river in India's rich cultural heritage and is believed to be the essence of Northern India. Despite its exemplary historical background associated with rich and varied customs, it is not only encountering daunting pollution pressures but also facing greater risks to environmental cohesiveness and biological diversity. The booming population and mass scale emigrations from rural to urbanized regions along with inefficiently planned urbanized and industrial sectors in the parts of Ganga basin ,construction of dams and barrages, discharge of untreated municipal and industrial wastes, floral offerings, cremation of dead bodies on river banks and others have deteriorated the quality of River water adversely. Major cities are located on unconfined or semi confined aquifers along the river banks that are hugely dependent upon the river and groundwater for their water supply and disposition of the liquid industrial effluents and solid wastes to the rivers and ground. There has also been an inescapable increment in waste production. The present treatment capacity for the 12000MLD waste generated in the river basin is just one –third of it. Thus, it has resulted in the choking of small natural channels and low lying areas in the basin. Studies were under taken to analyze the impact of sludge disposal from the sewage treatment plants (STPs) in Jajmau, Kanpur (5MLD) and Dinapur, Varanasi (80 MLD) [5].The river finds its geographical origin from its glacial source at Gangotri Glacier (Gaumukh) in Uttarakhand and passes through 5 states in northern plains before finally merging into the swirling waters of the Bay of Bengal. While traversing 2525 km of journey the river plays different roles .At some places it sustains the agriculture by providing water for irrigation, at other places it becomes the source of energy in the form of electricity, in few places it is supposed to be the sin purifier, whereas at the other places it opens the doors for many water sports showing its playful aspect. Thus, it sustains a list of towns and cities. Besides being an ecotourism spot and sacred place, River Ganges shores are shelter to many indigenous and migratory birds. It is one of the densely populated river basins in the world sheltering an area of about 1,000,000 sq. km. It houses approximately 40% population of India. The basin contributes to more than one-third of India's surface water, out of which 90 percent is being utilized for irrigation. The physicochemical characteristics of River Ganga water and its sediments are affected because of different types of wastes [4].Analysis of interrelated water quality parameters and their Correlations in Ganga at Kanpur and its nearby areas depicted that the water quality is not good[6,9]. The pollution of Ganga river basin is high not just in terms of high organic matter but also in the form of the enormous faecal content. The major city of Kanpur possesses more than 300 leather tanneries which make use of highly outdated chromium extraction processes. Ganga River in Kanpur to analyze the sediment

quality where effluents are discharged from tannery industries [2] .Studies have also been done on seasonal variation for physico–chemical parameters of ground water, surface water, and filtration plant treated water of Kanpur city [9]. Anthropogenic factors have been majorly responsible for severely deteriorating the water quality and the floodplain characteristics of rivers. The industrial pollution volume wise contributes to about 20 percent but it has a much greater impact as the industrial pollutants are not easily degraded and virulent in nature. In order to find out the amount of pollution in soil due to industrial waste studies were carried out around Jajmau (Kanpur) and Unnao[8].

The stream sediment quality is heavily impacted due to urbanization in the Ganga plain [7]. Studies have been undertaken to assess the water quality of the Ganga River by comparing the pre and post Ganga Action Plan scenarios [3]. Due to massive industrial contaminants loads, substantial discharge of municipal sewage, religious and human wastes, over-exploitation of the resource in the lean season, increment in water needs, choking of the channels in the main trunk and tributaries have affected the overall state of the river. Therefore the present study is proposed to analyze Organic Pollution and Coliform Bacteria in River Ganga along Bithoor - Kanpur Ghats with an objective to assess the changes taking place due to anthropogenic factors depicting the ecosystem health.

## 2. MATERIALS AND METHODS.

### 2.1 Study area

The study area includes four sites from Bithoor to Kanpur region i.e. (Dhruv Ghat, Chatrapati Shivaji Ghat, Ganga Barrage and Rani Ghat).The study sites have been depicted in the table 1 shown below along with their GPS locations.

**Table 1: Bithoor-Kanpur stretch: GPS locations**

| S. No. | Site Name | Latitude | Longitude | Elevation |
|---|---|---|---|---|
| 1. | Dhruv Ghat | 26.61759° | 80.27345° | 103m |
| 2. | Chatrapati Shivaji Ghat | 26.61606° | 80.27440° | 95m |
| 3. | Ganga Barrage | 26.50622° | 80.31801° | 84m |
| 4. | Rani Ghat | 26.49666° | 80.32472° | 92m |

### 2.2 Sample collection

Before sample collection, the bottles were rinsed with dilute nitric acid followed by distilled water and were dried in an oven.

Water samples were collected in triplicates at each sampling location and the bottles were rinsed thoroughly with the sample water three to four times. Grab sampling procedure was carried out for water quality analysis as per standard methods (APHA, 2012[1]. The water samples were collected in polyethylene bottles from four sites viz. Dhruv Ghat, Chatrapati Shivaji Ghat, Ganga Barrage and Rani Ghat during pre monsoon season for the year 2017-2018 from Bithoor to Kanpur region.

Water samples for DO determination were collected in BOD bottles of 300 ml capacity. The parameters such as dissolved oxygen (DO) were estimated on the spot immediately to prevent unpredictable changes whereas analysis related to other chemical parameters was carried out in the laboratory.

### 2.3 Physico-chemical analysis

The analysis of BOD, COD and coliform bacteria was carried out by 5-Day BOD test, Open reflux method and multiple tube fermentation technique respectively, for the water samples that were brought to the laboratory in insulated ice boxes.

The methods used for the analysis of various parameters have been shown in Table 2 below:

**Table 2: Methods used for water quality parameters analysis**

| ***Parameter*** | ***Units*** | ***Instrumentation/Technique used*** |
|---|---|---|
| **Dissolved Oxygen(D.O)** | mg/L | Winkler's method |
| **Biochemical Oxygen Demand(B.O.D)** | mg/L | 5-Day BOD test |
| **Chemical Oxygen Demand(C.O.D)** | mg/L | Open reflux method |
| **Total coliform(T.C)** | MPN/100 ml | Multiple tube fermentation technique |

## 3. RESULTS AND DISCUSSION.

The physicochemical characteristics of four sites of Middle Ganga viz: (Dhruv Ghat, Chatrapati Shivaji Ghat, Ganga Barrage and Rani Ghat) from Bithoor to Kanpur region are shown in table 3 below.

**Table 3: Water quality parameter values at various sampling stations at Middle Ganga (Bithoor-Kanpur) stretch**

| **Sampling site** | **D.O (mg/ L)** | **B.O.D (mg/ L)** | **C.O.D (mg/ L)** | **Total Coliform (MPN/100 ml)** |
|---|---|---|---|---|
| Dhruv Ghat | 3.6 | 7 | 91 | 800 |
| Chatrapati Shivaji Ghat | 6.2 | 38 | 349 | 4600 |
| Ganga Barrage | 8.1 | 16 | 141 | 1300 |
| Rani Ghat | 6.4 | 28 | 336 | 35000 |

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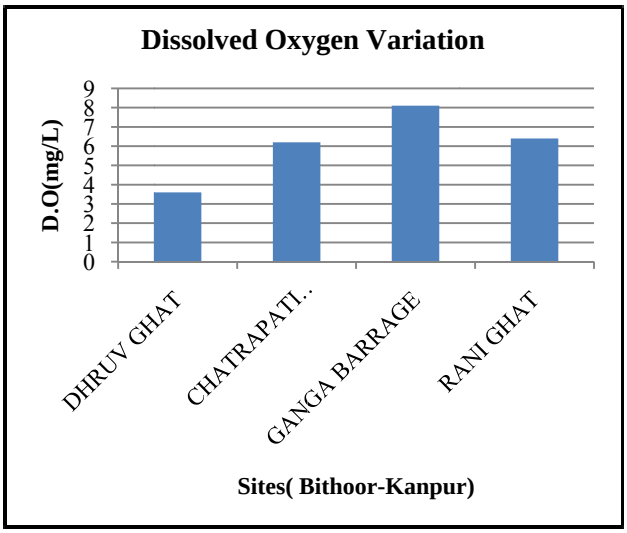


**Figure 1: Variations in Dissolved Oxygen across different Ghats.**

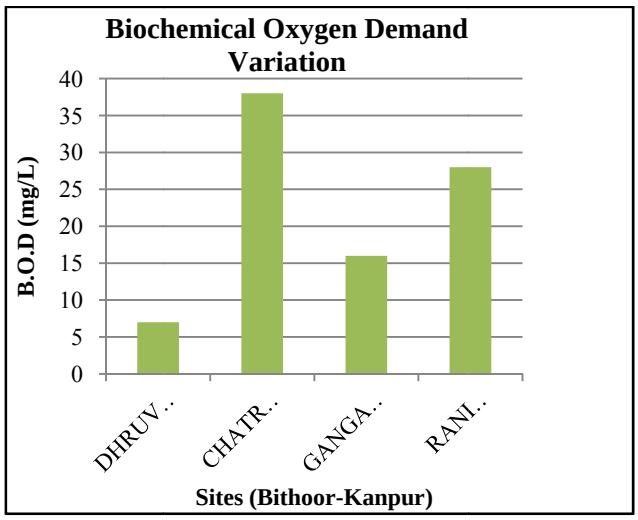


**Figure2: Variations in Biochemical Oxygen Demand across different Ghats.**

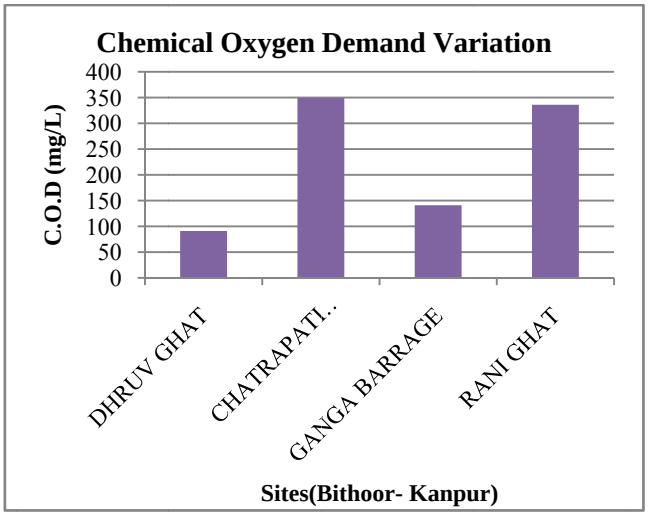


**Figure 3: Variations in Chemical Oxygen Demand across different Ghats.**

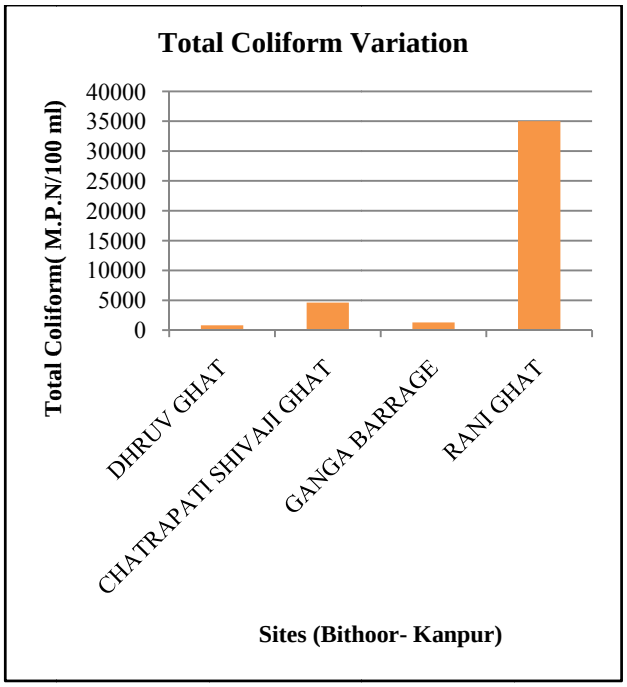


**Figure 4: Variations in Total coliform across different Ghats.**

Ganga water known to remain ever pure has been analyzed with high numbers of coliform bacteria surpassing the range of 15,000 per 100 ml at many locations depicting imprudent contamination with sewage discharge. Ganga, once called the repository of oxygen is now showcasing a sharp decline in oxygen level.The DO value is found to be the lowest for Dhruv Ghat (3.6 mg/L) and the highest for Ganga Barrage (8.1 mg/L). The lowest value at Dhruv Ghat can be attributed to the over enrichment of nutrients in the river at this site leading to eutrophication as well as sedimentation, increased municipal discharges, unregulated run offs and substantial introduction of detergents at this site can be considered as the possible reasons. Constructing barrages in the river reaches alters the water quality of rivers and its thermal regime. It has positive impacts on DO concentrations and air entrained at the downstream side. The BOD and COD are found to be lowest at Dhruv ghat (7 mg/L) and (91 mg/L) respectively. The BOD and COD are found the highest at Chatrapati shivaji ghat (38 mg/L, 349 mg/L). This condition can be due to high levels of organic pollution in the river as dumping of wastes, religious activities and washing of the clothes are the part of the anthropogenic activities at this ghat. Besides this, poorly treated waste water is discharged into the river and the septic systems are poorly functional at this site. The total coliform is found to be the highest for Rani Ghat (35000 MPN/100 ml) and the lowest for Dhruv ghat. The higher values can be attributed to dumping of human wastes, animal wastes and decaying organic mass. The reasons for more organic and industrial pollution load can be due to the fact that numerous industries discharge the wastes into the river. The industries in the Kanpur region are the tanneries, Chemical industries,

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fertilizer industries, dying, textile, and pulp and paper industries.

## 4. CONCLUSION

It may be concluded that the water quality parameter values were found to be exceeding the maximum permissible limits at all the sites as per designated best use classes of surface water by CPCB. The water quality characteristics have shown slight improvement when compared to previous reports of Central Pollution Control board but still the water is not found suitable for drinking and bathing purposes. River Ganga is tarnished by the perpetual outpouring of sewage, domestic waste and large amounts of industrial effluents and agricultural runoffs that are churned out of the anthropogenic activities along the River banks and have far-reaching effects on human and aquatic health due to their toxic nature. Piles of unsettled garbage add to the extensive pollution due to inefficient solid waste management systems at some sites. Strong environmental governance is needed to manage these extreme pollution pressures and if the deterioration persists, it will be a difficult task to drag River Ganga out from the bounds of pollution. Crucial preventive measures are needed to stop further degradation of the Ganga River water quality. Strong Initiatives need to be taken to spread awareness, not only among the poor people but also amidst those who are truly culpable for the poor condition of the River Ganga. Practical environmental education should be brought into practice compulsorily. Our individual contributions on small scale can pave way for enormous changes in future.

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