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# Assessing the Impact of a few Anthropogenic Activities on Water Quality of River Ganga

***Anushka and Dr. Surinder Deswal***

*Department of Civil Engineering,*
*NIT, Kurukshetra, (Haryana), INDIA*

*(Corresponding author: Anushka)*
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**ABSTRACT: Flora and fauna is directly dependent on water and hence water is a crucial asset for every developing country particularly the watercourse water which is prime source of potable water. The ganges, one among the most important watercourse system of Indian landmass is being severely polluted by mass bathing, sewage treatment plants, manufacturing plant effluents, and numerous alternative anthropogenic activities and this is all because of the unplanned and un-managed environmental system. This study is oriented around the assessment of water quality of river Ganga at Narora region of Uttar Pradesh state, India. Specifically, the river water was tested to assess the impact of mass bathing and other religious activities on the basis of various physico-chemical and biological parameters. It was observed that a few parameters were in the permissible range and a few were not however it was additionally ascertained that the water is not fit for drinking purpose. The parameters were compared to the bis specifications (2012).**

**Keywords**: Mass bathing, bathing site, Water Quality, River Ganga

## I. INTRODUCTION

In today's world, the water resources (with special concern of holy rivers) are in catastrophic condition and struggling owing to the speedy increase in pollution and contamination because of rapid industrialization, rising population pressure, urbanization, trendy agricultural activities and various other anthropogenic activities(Hatcher & McGillivary, 1979; Hutley, 1990; Agarwal *et al.,* 2006 and Singh et al., 2007 ). However, these alone cannot be goddamned for wrecking the aquatic systems, 'Mass bathing' which is an age old ritual in India, has conjointly an enormous hand in it. According to Hindu mythology, dip in the holy rivers at particular occasions such as *amavasya*, *poornima* etc. is considered an exculpated event. Millions of pilgrims and devotees take a dip in holiest river Ganga at various religious occasions. Ritualistic activities such as mass bathing in river Ganga increases the organic matter in the water body, apart from impurities like soaps, detergents and a lot of clothes offered by the devotees in the water body (Bhatnagar and sangwan, 2009).

**Narora** is located on the banks of river Ganges, in district Bulandshahar, Uttar Pradesh. Narora has several bathing locations or platforms (Ghats) for holy dip in the Ganges namely Rajghat, Karnvaas, Narvar, Kalakatti, Ramghat etc. Thousands of pilgrims visit Narora at various holy occasions to take a dip in river Ganga. As a ramification, the accessible places are used as toilets or as bathing sites such as fields, grounds and riparian town forest areas. The 4-5 Km Ganga River and canal bank are used as bathing places and source of holy water collection, too. Plenty of offerings in the form of flowers, old icons of Gods and Goddess and clothes are brought by a large number of pilgrims. People also dispose off the last remains (ashes) of their loved-ones in the river Ganga, at Narora. Many a times Polythene bags are used to carry such offerings. The polythene bags are dropped in to the river in absence of proper disposal system. Aquatic life is threatened because of the polythene bags and other non-biodegradable materials which remain either floating on the water surface or cover the river bed substratum (Bhadula and Joshi, 2014). Such activities can definitely deteriorate the water quality of the river. Mass bathing remains one of the main causes of decay of the water quality of river as a result of which some pilgrims also carry skin and alternative diseases, so there is a risk of cholera, typhoid, rashes and more, that affect human health (Shrinithivihahshini *et al*., 2014).

Keeping all these facts in mind, this paper focuses on the changes in the water quality status of river ganga owing to mass bathing at narora province.

## II. MATERIALS AND METHODS

The Narora city lies between the coordinates 28.1968° N and 78.3814° E in the north eastern part of Uttar Pradesh state of India approximately 174m above sea level (Available at the link: given as reference 4). River Ganga flowing through the Narora city is usually used for mass bathing and other ritualistic events. In the current study, a scientific study was made to assess the impact of mass bathing on the standard of river Ganga water. Three bathing ghats particularly ramghat (Site-1), rajghat (Site-2) and narvar ghat (Site-3) were selected as the study and sapmling sites. Ramghat is the least disturbed site during any festive occasion or on any special mass bathing day. Water samples were collected on the day of *kartik poornima* (full moon day) from the chosen sites for physico-chemical and biological analysis. The three sites were distinguished on the basis of number of devotees taking bath in the river. Site-1 is referred to the place where minimum bathing takes place, Site-2: where maximum bathing takes place and Site-3: where intermediate bathing takes place. Some hand-picked physicochemical parameters are Temperature, pH, Conductivity, TDS, DO, Turbidity, BOD, Nitrate, Hardness were analyzed. Total coliform as MPN (most probable number) was also reported. Out of these parameters, Temperature, pH, TDS, Conductivity and Turbidity were analyzed on site at the time of sampling using Deluxe water and soil analysis kit Model 191 E. While DO, BOD, Nitrates, Hardness, and total coliform were determined in the Research laboratory using given method of APHA (Sharma et al., 2012).

## III. RESULTS AND DISCUSSION

*A. Results*

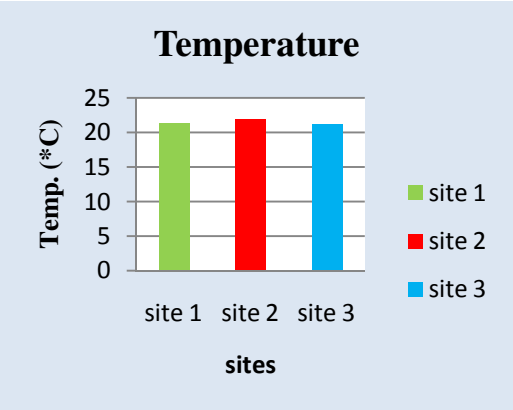


**Fig. 1.** Temperature variation.

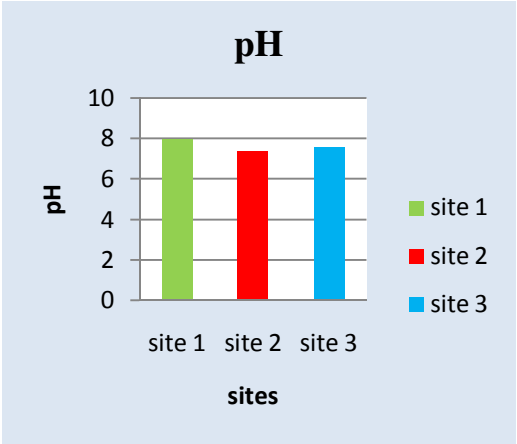


**Fig. 2.** pH variation.

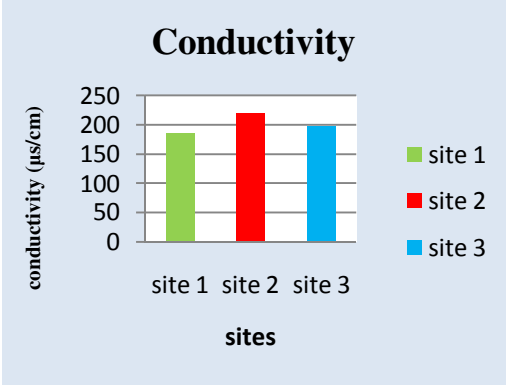


**Fig. 3.** Conductivity variations .

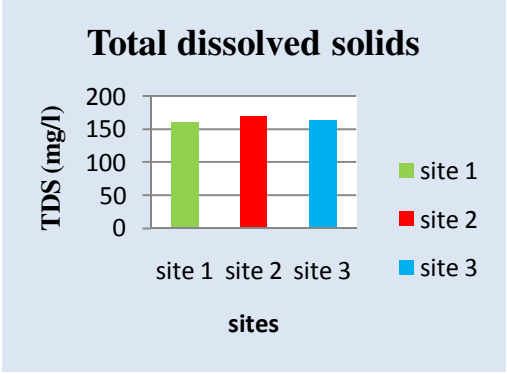


**Fig. 4.** TDS variations.

The results of the selected physico-chemical parameters are discussed below and also recapitulated as Table-1 and conjointly graphically represented.

***3.1.1 Temperature***: The range of temperature was observed between 21.2°C to 22°C. The lowest value (21.2°C) of temperature was observed at site-3 whereas maximum value of temperature was recorded 22.0°C at Rajghat i.e site-2 (as shown in Fig.1) where maximum bathing activity occurred.

***3.1.2 pH***: pH values ranged between 7.4 to 8.0 pH. Fig.2 shows that the value of pH was highest at Ramghat site (site-1) i.e 8.0 while it was recorded 7.4 at Rajghat bathing site. The permissible limit of pH is 6.5-8.5 pH.

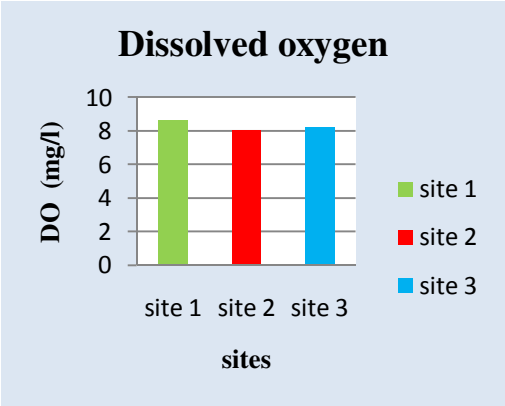


**Fig. 5.** DO variations.

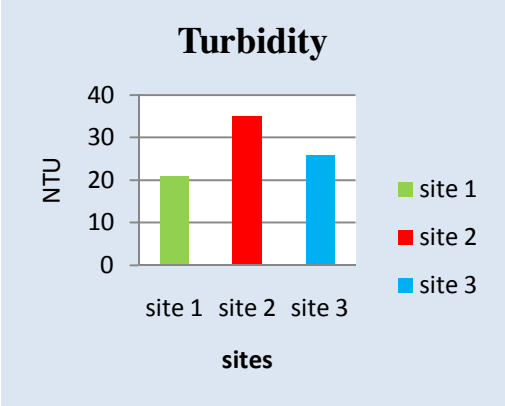


**Fig. 6.** Turbidity variations.

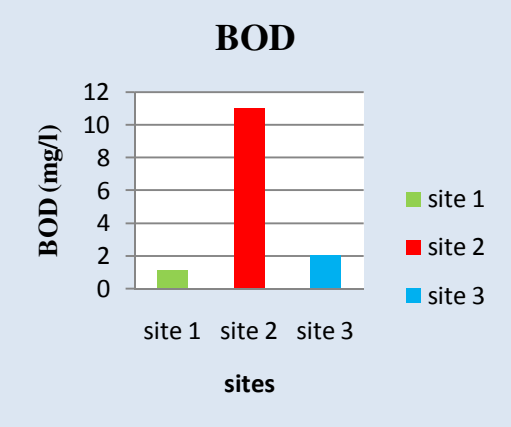


**Fig. 7.** BOD variations.

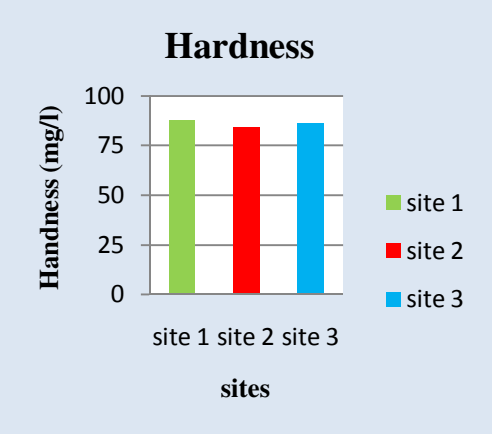


**Fig. 8.** Hardness variations.

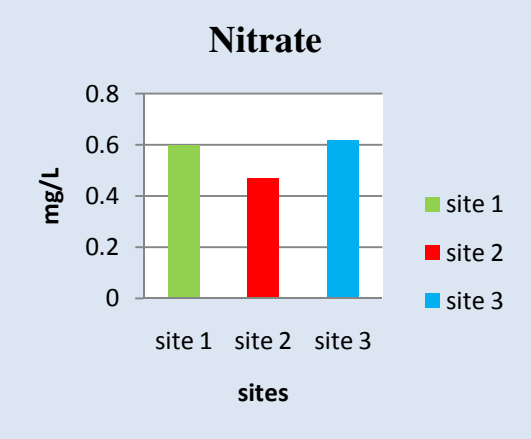


**Fig. 9.** Nitrate variations.

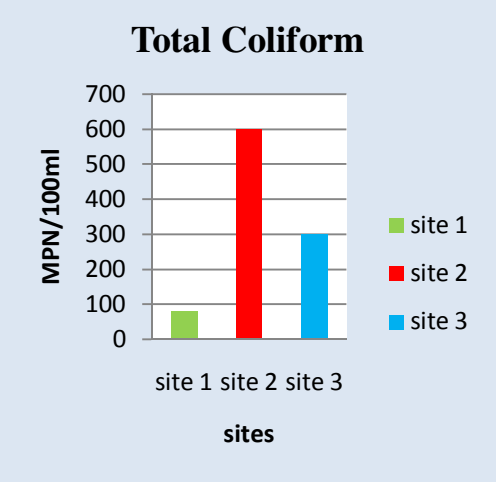


**Fig. 10.** Total coliform variations.

**Table 1: Values of chosen parameters at different selected sites.**

| S. No. | Parameters Analyzed | Unit | Sites (Bathing Ghat) | | |
|---|---|---|---|---|---|
| | | | 1 | 2 | 3 |
| 1 | Temperature | $^oC$ | 21.4 | 22 | 21.2 |
| 2 | pH | - | 8.0 | 7.4 | 7.6 |
| 3 | Conductivity | µS/cm | 185 | 220 | 197.3 |
| 4 | Total dissolved solids (TDS) | mg/l | 160 | 170 | 163 |
| 5 | Dissolved Oxygen (DO) | mg/l | 8.65 | 8.0 | 8.25 |
| 6 | Turbidity | NTU | 21 | 35 | 26 |
| 7 | Biochemical oxygen demand (BOD) | mg/l | 1.1 | 11 | 2.0 |
| 8 | Total Hardness (as $CaCO_3$) | mg/l | 88 | 84 | 86 |
| 9 | Nitrate (as $NO_3$) | mg/l | 0.6 | 0.47 | 0.62 |
| 10 | Total coliform (as MPN) | MPN/100ml | 80 | 600 | 300 |

***3.1.3 Conductvity***: Conductivity ranged from 185 µS/cm to 220 µS/cm. From Fig.3 it was observed maximum at Ramghat bathing site and minimum at site-1 i.e. Rajghat. Permissible limit for conductivity is 5 µS/cm to 50 µS/cm (Pathak et al., 2015). Conductivity was observed maximum at the most disturbed site i.e. Rajghat where maximum anthropogenic activities takes place.

***3.1.4 Total dissolved solids***: TDS ranges from 160 mg/l to 170 mg/l. From Fig.4 Maximum value (170mg/l) of TDS is observed at site-2 and minimum (160mg/l) at site-1.

***3.1.5 Dissolved oxygen***: DO from Fig. 5 is observed between the range from 8.0 mg/l to 8.65 mg/l. DO has the permissible limit of 5 mg/l. Maximum value of DO is observed at the most used site for bathing and other rituals i.e. Rajghat bathing site.

***3.1.6 Turbidity***: Turbidity ranged from 21 NTU to 35 NTU. The permissible limit of turbidity is 5 NTU. Fig.6 shows that the maximum turbidity (35 NTU) was recorded at Rajghat (site-2). The values of turbidity were higher than the permissible limit because of the bathing activities occurring at the sites.

***3.1.7 Biochemical oxygen demand***: BOD was recorded between the range of 1.1 mg/l to 11 mg/l. From Fig.7 it can be observed that the value of BOD is maximum at site-2 (Rajghat) which is the most disturbed site in reference to a few anthropogenic activities. BOD should not exceed 3 mg/l as mentioned in BIS (2012).

***3.1.8 Total hardness***: From Fig.8 the total hardness was observed to be in the range of 84 mg/l as $CaCO_3$ to 88 mg/l $CaCO_3$. The desirable range of total hardness is from 200 to 600 mg/l as $CaCO_3$. The maximum value of hardness was observed at Ramghat i.e. site-1. Because of the use of soaps, detergents and offerings in the water, the value of hardness is comparatively lower.

***3.1.9 Nitrate***: Nitrate ranged between 0.47 mg/l to 0.62 mg/l. Fig.9 shows that site-3 has the highest value of nitrate.

***3.1.10 Total coliform as MPN***: MPN was recorded between the range of 80 mg/l to 600 mg/l. The permissible limit of total coliform is 50 per 100 ml for drinking water and 500 per 100 ml for outdoor organised bathing. From Fig.10 it can be observed that site-2 has the maximum value for the count of total coliform.

*B. Discussion*

This study exhibits the assessment of a few physico-chemical and biological parameters of river Ganga's water.

**Table 2: BIS specifications/CPCB limits for different characteristics of water.**

(Singh and Nath, 2015 and Gorde *et al.,* 2013)

| Parameters | BIS specification/CPCB limits |
|---|---|
| Temperature | Not mentioned |
| pH | 6.5-8.5 |
| Conductivity | Not mentioned |
| Total dissolved solids (TDS) | 500 mg/l |
| Dissolved Oxygen (DO) | 5 mg/l |
| Turbidity | 5 NTU |
| Biochemical oxygen demand (BOD) | 3 mg/l |
| Total Hardness (as $CaCO_3$) | 300 mg/l |
| Nitrate (as $NO_3$) | Not mentioned |
| Total coliform (as MPN) | 500/100 ml |

Three samples taken from three different sites/bathing ghats were tested for assessing the impact of mass bathing and other religious rituals. The results of the study evidently portray that the quality of river water is deteriorated because of the mass bathing taking place at the banks of the river. Mass bathing tends to muddle the fluvial ecology of river Ganga by decreasing DO and rising BOD, turbidity, conductivity and total coliforms in comparison to the BIS specifications (Table 2). Temperature, pH, nitrate showed some minor fluctuations whereas other parameters were observed below or above the prescribed standards. It was observed that site-2 i.e Rajghat was sorely affected because it was the most disturbed site by a large number of pilgrims or devotees. An increase in MPN index of total coliform population was conjointly recorded at the Rajghat bathing site. This disparity occurred because of the various factors such as the offering of ashes, urination, body sweat, bacterias, soaps, detergents etc.

## IV. CONCLUSION

The study undoubtedly rendered that the mass bathing during the festive occasion, tends to deteriorate the water quality of river Ganga. And this is concluded by the significant fluctuations in various physico-chemical and biological parameters. BOD, turbidity and total coliforms in the water were found to be increased during the day of *kartik poornima* which ultimately exerts a bad impact on the quality of river water. It was also spotted that during such festive occasion, the aesthetic conditions are exacerbated notably, creating a dreadful scenario of littered solid waste which attracts stray dogs and spreads unpleasant environmental conditions. Hence, the study concludes that there is a need of regular monitoring and appropriate measures should be taken to reduce the severity of the picture. There ought to be a better management of resources and provision of basic facilities may minimize the elevated levels of water pollution.

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