



STUDY OF RATE OF DETERIORATION OF WATER QUALITY OF RIVER GANGA AT PATNA, BIHAR

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ABSTRACT

Water quality of a water body is characterized by its physico-chemical and biological features. All these features reflect on the pristine nature of the river. Due to unplanned urbanization, rapid growth of industrialization and other anthropogenic activities such as dispersal of dead bodies, discharge of industrial and sewage wastes, the quality of a Ganga river body is deteriorated day by day.

The present study is an attempt to demonstrate the rate of deterioration of the water quality of river Ganga at Patna, Bihar and its effects on the primary productivity of the river. For this, various physico-chemical and biological parameters i.e pH, DO, BOD, total coliform and faecal coliform, were studied for one year from April 2018 to March 2019 and noticed the changes on these parameters due to urbanization, agricultural runoff and other anthropogenic activities. The result conclude that such as pH, DO and BOD parameters are well within the limit, but total coliform and faecal coliform found beyond the prescribed standard limits in the present investigation hence water quality of this Ganga river water is deteriorated at Patna. Water quality of this river is also not suitable of growth of phytoplanktons, bathing and domestic purpose.

Keyword: Water quality, Physico-chemical parameters, total coliform and faecal coliform, , Ganga river, phytoplanktons, Patna.

INTRODUCTION

The Ganges is a lifeline to millions who live along its course.^{[1][2]} It is a sacred river and worshipped as the goddess Ganga in Hinduism.^{[3][4]} It has been important historically; many former provincial or imperial capitals (such as Prayagraj, Dhaka, Baharampur, Bikrampur, Kampilya, Kannauj,^[8] Kashi, Kolkata, Murshidabad, Munger, Patliputra^[5] and Sonargaon) have been located on its banks.

The Ganges is threatened by severe pollution. This poses a danger not only to humans but also to animals; the Ganges is home to approximately 140 species of fish and 90 species of amphibians. The river also contains reptiles and mammals, including critically endangered species such as the Gharial and South Asian river dolphin.^[6] The levels of faecal coliform bacteria from human waste in the river near Varanasi are more than a hundred times the Indian government's official limit.^[6] The Ganga Action Plan, an environmental initiative to clean up the river, has been considered a failure^{[7][8][9]} which is variously attributed to corruption, a lack of will in the government, poor technical expertise,^[10] environmental planning^[11] and a lack of support from the native religious authorities.^[12]

Water is a priceless gift of nature and takes the first priority of life on earth, which serves as a basic fundamental necessity for all living creatures. The water of river plays an important role in development of country. The river serves as a source of water supply to meet our domestic, industrial, agricultural, fisheries and power generation needs. But, pollutants from domestic disposal, agricultural runoff, industrial wastes, washing, bathing and cattle wallowing leads to water pollution which affects its biological values beyond desirable limits.

Materials and Methods

Study Area

The study area lies between Ganga River water at Danapur near Pipapul Patna, Ganga River at U/S Patna Kurji Patna, Ganga River at Gandhi Ghat NIT Patna, Ganga River at Gulbi Ghat Patna, Ganga River at D/S Patna Gaighat Patna, in the state of Bihar in India.



Sample collection map of river Ganga in Patna District

Sample Collection and Analysis

Samples were collected in different containers at each point to add necessary preservatives as per standard procedure. The samples were preserved in icebox and transported to laboratory within three hours from the time of collection and analyses.

Sample collection from the different sites were carried out for twelve months and physico-chemical and microbiological parameter were analysed as per Standard methods for the examination of water and waste water.^[13] The results obtained were compared with the drinking water standards as specified by World Health Organisation (WHO)^[14] and Bureau of Indian Standards (BIS).^[15]

Microbiological Analyses

For microbiological analysis, 100 ml water samples were collected from five study sites of the river stations. The samples were subjected to serial dilution in nutrient water containing potassium dihydrogen phosphate and magnesium chloride and inoculated in multiple tubes as per the maximum probable number method. The tubes contained 10 ml of lauryl tryptose broth for the detection of total coliform and faecal coliform, were incubated at $35 \pm 0.5^\circ\text{C}$ for three hour in A1 broth. For faecal coliform, the tubes were inoculated serially and were incubated for three hour at $35 \pm 0.5^\circ\text{C}$ and transferred to a water bath at $44.5 \pm 0.2^\circ\text{C}$ and incubated for an additional 21 ± 2 hour. Production of an acidic reaction or gas production in any A-1 broth culture within 24 hours or less is a positive reaction indicating the presence of faecal coliform [13].

Statistical Analysis

The data obtained on the physico-chemical and microbiological parameters of the surface water has subjected to correlation analysis. The correlation have carried on statistical formula.

Water quality status of river Ganga water and its Tributaries during the Year (April 2018 to March 2019) Excluding rainy season (August to October)

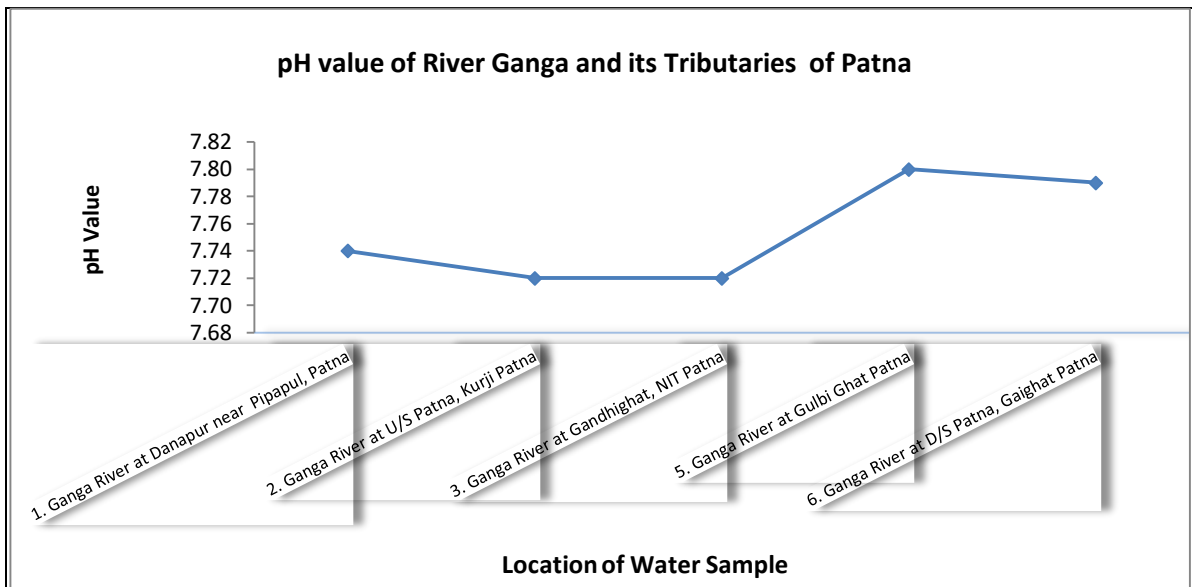
Table - 1

| Sl No. | Water sample point and Location name | Latitude | Longitude | Parameter | pH | DO | BOD | Total Coliform (TC) | Faecal Coliform (FC) |
|--------|---|-----------|-----------|--------------------------|-------------|------------|------------|---------------------|----------------------|
| | | | | Unit | -- | mg/L | mg/L | MPN/ 100 ml | MPN/ 100 ml |
| | | | | Standard / Water Quality | 6.0 - 8.5 | > 4.0 | < 3.0 | < 5000 | < 2500 |
| 1 | Ganga River at Danapur near Pipapul Patna | 25.653166 | 85.047728 | Minimum | 7.44 | 7.5 | 1.3 | 5500 | 2600 |
| | | | | Maximum | 8.30 | 9.4 | 2.4 | 15000 | 7000 |
| | | | | Average | 7.74 | 8.3 | 1.8 | 8355 | 4077 |
| 2 | Ganga River at U/S Patna, Kurji Patna | 25.653472 | 85.093824 | Minimum | 7.21 | 7.2 | 1.5 | 5800 | 2600 |
| | | | | Maximum | 8.20 | 9.5 | 2.5 | 14000 | 7900 |
| | | | | Average | 7.72 | 8.2 | 1.9 | 8922 | 4288 |
| 3 | Ganga River at Gandhi Ghat, NIT, Patna | 25.622054 | 85.171803 | Minimum | 7.08 | 7.0 | 1.9 | 11000 | 4000 |
| | | | | Maximum | 8.21 | 8.8 | 2.6 | 35000 | 26000 |
| | | | | Average | 7.72 | 7.9 | 2.3 | 21222 | 10244 |
| 4 | Ganga River at Gulbi Ghat, Patna | 25.620311 | 85.180451 | Minimum | 7.31 | 6.7 | 2.2 | 6800 | 3100 |
| | | | | Maximum | 8.25 | 8.5 | 2.7 | 29000 | 21000 |
| | | | | Average | 7.80 | 7.8 | 2.5 | 15088 | 7955 |
| 5 | Ganga River at D/S Patna, Gaighat Patna | 25.613638 | 85.204381 | Minimum | 7.42 | 6.6 | 2.0 | 11000 | 4000 |
| | | | | Maximum | 8.20 | 8.8 | 2.8 | 29000 | 21000 |
| | | | | Average | 7.79 | 7.9 | 2.4 | 18666 | 11700 |

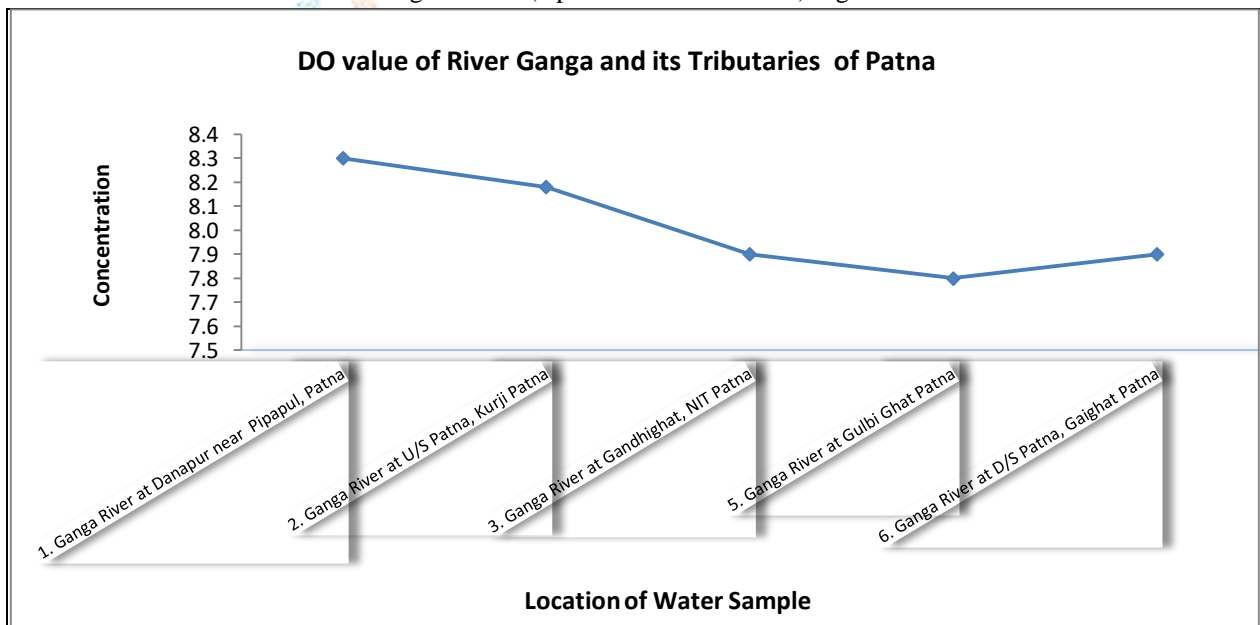
Annual average concentration of river Ganga water and its Tributaries during the Year (April 2018 to March 2019) Excluding rainy season (August to October)

Table - 2

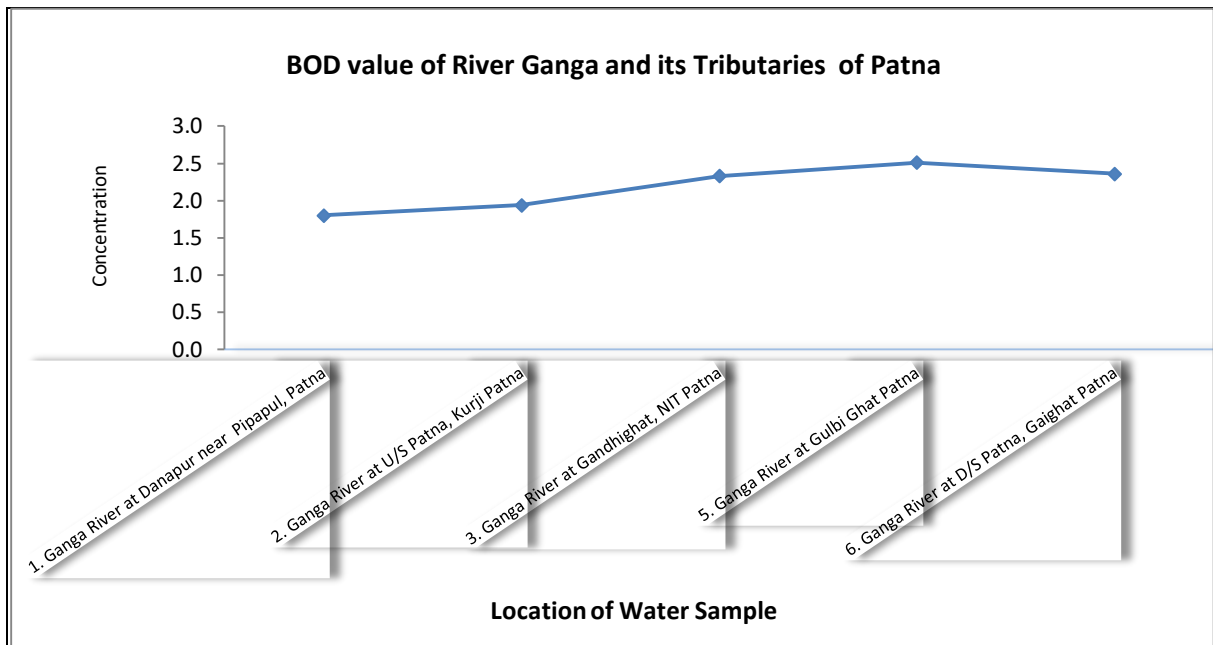
| Sl No. | Location of water sample | pH | DO | BOD | T.C | F.C |
|----------------|---|-------------|-------------|------------|-----------------|-----------------|
| | Unit | -- | mg/L | mg/L | MPN/ 100 ml | MPN/ 100 ml |
| | Water quality / Criteria | 6.0-8.5 | > 4.0 | < 3.0 | < 5000 | < 2500 |
| | Parameters | pH | DO | BOD | T.C | F.C |
| 1 | 1. Ganga River at Danapur near Pipapul, Patna | 7.74 | 8.3 | 1.8 | 8355 | 4077 |
| 2 | 2. Ganga River at U/S Patna, Kurji Patna | 7.72 | 8.2 | 1.9 | 8922 | 4288 |
| 3 | 3. Ganga River at Gandhighat, NIT Patna | 7.72 | 7.9 | 2.3 | 21222 | 10244 |
| 4 | 5. Ganga River at Gulbi Ghat Patna | 7.80 | 7.8 | 2.5 | 15088 | 7955 |
| 5 | 6. Ganga River at D/S Patna, Gaighat Patna | 7.79 | 7.9 | 2.4 | 18666 | 11700 |
| Average | | 7.75 | 8.0 | 2.2 | 14450.6 | 7652.8 |
| Minimum | | 7.72 | 7.80 | 1.8 | 8355.00 | 4077.00 |
| Maximum | | 7.80 | 8.30 | 2.5 | 21222.00 | 11700.00 |



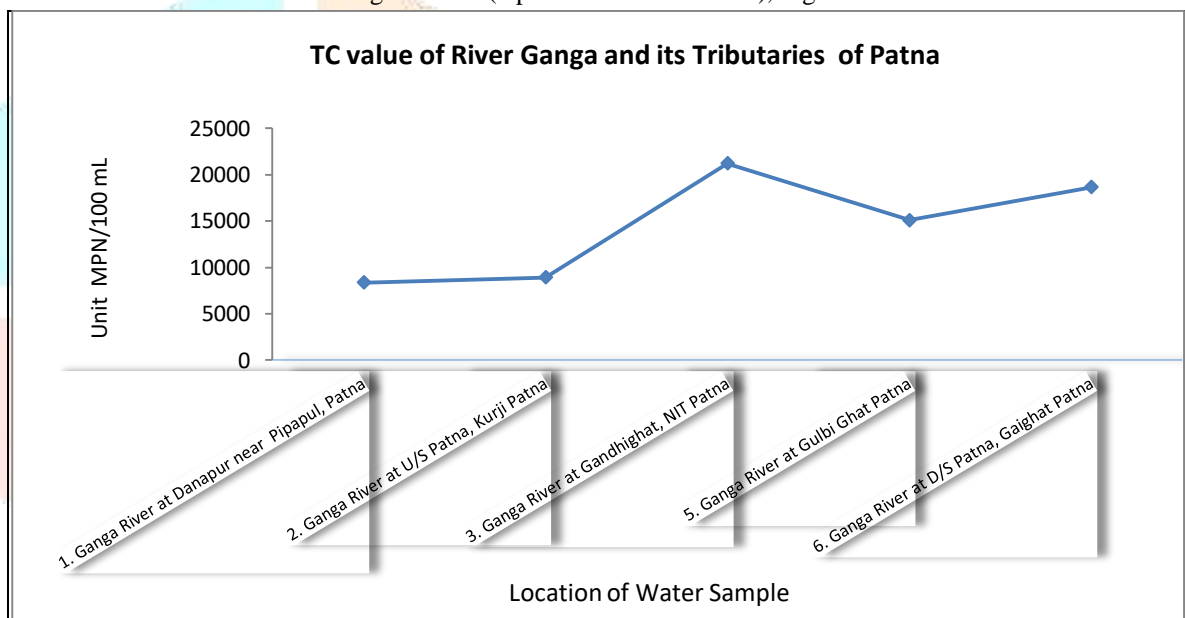
Annual average pH value of River Ganga and its Tributaries of Patna during the Year (April 2018- March 2019) Figure - 1



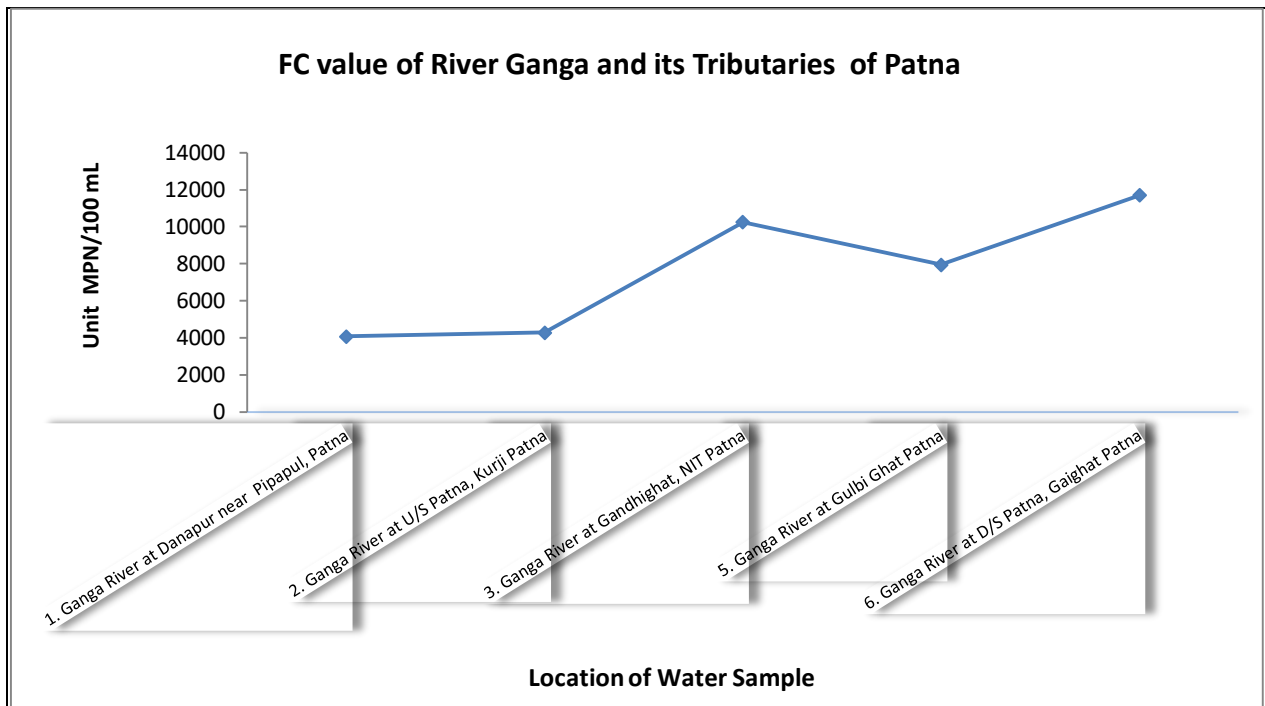
Annual average Dissolved Oxygen (DO) Concentration of River Ganga and its Tributaries of Patna during the Year (April 2018- March 2019), Figure – 2



Annual average Biochemical Oxygen Demand (BOD) Concentration of River Ganga and its Tributaries of Patna during the Year (April 2018- March 2019), Figure - 3



Annual average Total Coliform (TC) Concentration of River Ganga and its Tributaries of Patna during the Year (April 2018- March 2019), Figure - 4



Annual average Faecal Coliform (FC) Concentration of River Ganga and its Tributaries of Patna during the Year (April 2018- March 2019), Figure - 5

RESULT AND DISCUSSION

The result as presented in the table - 2 and Figure 1-5 shows a annual concentration variation in physico-chemical and microbiological parameters. The range of pH of Ganga water was recorded from 7.72 to 7.80, minimum pH was recorded in the Ganga river at U/S Kurji Patna and Ganga river at Gandhi Ghat NIT Patna while maximum pH was in the Ganga River at Gulbi Ghat Patna, observed the annual average value which was under the prescribed limit as shown in figure -1. The DO content showed a range of 7.80 mg/l to 8.30 mg/l, minimum DO content was recorded in the Ganga River at Gulbi Ghat Patna while maximum DO was in the Ganga River at Danapur near Pipapul Patna, observed the annual average concentration 8.0 mg/L which indicates healthy river water, but the water quality has slightly deteriorated as shown in figure-2. The BOD values as presented in the table varied between 1.8 mg/L to 2.5 mg/L, the minimum concentration of BOD was recorded in the Ganga river at Danapur near Pipapul Patna, while maximum concentration 2.5 mg/L Gulbi Ghat Patna, the annual average concentration was found to be 2.2 which were under the prescribed limit as shown in Figure-3. The total coliform (TC) concentration was varied from 8355.0 MPN/100 ml to 21222.0 MPN/100 ml, minimum total coliform was recorded in the Ganga River at Danapur near Pipapul Patna while maximum total coliform was in the Ganga river at Gandhi Ghat NIT Patna, while observed annual average concentration 14450.6, which was beyond the prescribed limit as shown in figure -4. The range of annual average faecal coliform of Ganga water was recorded from 4077.0 to 11700.0 MPN/100 ml the minimum faecal coliform was recorded in the Ganga river at Danapur near Pipapul Patna, while maximum faecal Coliform was in the Ganga river at D/S Patna Gaighat Patna, the observed annual average concentration 7652.8 which was beyond the prescribed limit as shown in figure-5. The above observation shows that the quality of the Ganges river body is deteriorating day by day.

The different physico-chemical features of river Ganga were found to be within the permissible limits. As per standard findings, the desirable pH of drinking water is 7.0 to 8.5 (WHO,1984), for aquatic life 6.5 to 9.0 (USEPA,1975), for irrigation purpose 5.5 to 9.0 and for domestic uses, it is 7.0 to 9.0 (ICMR,1975). In the present study the annual average pH value is within the limit. The permissible DO content for living organism as per European Economic Community is 5.0 mg/l to 8.2 mg/l, the permissible BOD content for living organism as per WHO is < 3 mg/l, the three parameters pH, DO and BOD was found within the prescribed standard limits in the present investigation but total coliform and faecal coliform found beyond the prescribed standard limits in the present investigation.

CONCLUSION

The present study confirms that the pH, DO and BOD parameters from Danapur near Pipapal Patna to Gaighat D/S Patna have slightly deteriorated but was within the prescribed standard limits. The concentration of total coliform (TC) was found to be 4.24 times higher at Ganga river at Gandhi Ghat NIT Patna and the concentration of faecal Coliform was found to be 7.68 times higher the prescribed standard limits at Ganga River at D/S Gaighat Patna.

The values of different parameters in the present paper suggests that the sites of investigation which stretches to a distance of 20 km covering the entire length of river passing through Ganga river at Danapur near Pipapal Patna to with the Ganga river at D/S Gaighat Patna, is perfectly not suitable for human uses as well as this water body is not appropriate for fish culture. The water quality of this river is also not suitable for the phytoplanktons, bathing and domestic purpose.

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