



## **ASSESSMENT OF THE MICROBIOLOGICAL QUALITY OF THE RIVER GOMATI AT JAUNPUR (U.P.) INDIA**

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### **ABSTRACT**

The Gomati river in Jaunpur was investigated for its pollution status over a period of one year during June 2009 and May 2010. The sampling is concerned from upstream to downstream regions of the river through the city. Five sampling sites namely : Kalichabad Ghat (Control Site), Gular Ghat (Site I), Hanuman Ghat (Site II), Baluwa Ghat (Site III) and Miyanpur Ghat (Site IV) were selected for sampling. The bacteriological analysis of the river water samples included bacteriological parameters like Total Coliform Count (TC), Faecal Coliform Count (FC) and Faecal Streptococcal Count (FS). Total Coliform Count of river was observed lower at control site than that of the other sites. MPN values ranged from a minimum  $875/100$  mL at the control site in the month of February and March to a maximum  $98 \times 10^3/100$  mL at site-I in the month of July. Total Coliform bacterial count at all the sites, except the control, was beyond the prescribed limit indicating polluted condition of river Gomati. Faecal Coliform and Faecal Streptococci counts were recorded lower at the control site and higher at other experimental sites. This indicates the higher discharge of faecal organic content of the experimental sites.

**KEY WORDS :** Bacteriological analysis, Total Coliform Count, Faecal Coliform Count, Faecal Streptococci Count, River Gomati.

### **INTRODUCTION**

The history of water pollution is considerably older and goes parallel with the development of human civilization on this earth. Water constitutes one of the most essential elements supporting the life of innumerable animals, plants and human beings. The total quantity of fresh water on earth could satisfy all needs of the human population if it were evenly distributed and accessible. Fresh water resources are deteriorating day by day at a very faster rate. Now water quality has become a global problem (Mahananda et.al., 2005). Pollution of surface and ground water is largely a problem due to rapid urbanization and industrialization. The large scale urban growth due to increase in population or migration of people from rural areas to urban areas has increased domestic effluents while industrial development has resulted in a generation of copious

volume of industrial effluents. Thus, gradual deterioration of water quality is as a result of increase in human population and urbanization (HO and Hui, 2001). Polluted water is also an important vehicle for the spread of diseases. In developing countries 1.8 million people, mostly children die every year as a result of water-related diseases (WHO, 2004). The examination of microbiological river water quality according to technical standards is obligatory for use-related aspects such as for drinking water, irrigation or recreation. Higher levels of faecal-indicator bacteria can be indicated by the presence of pathogenic microorganisms present in water body. Cholera, dysentery, typhoid fever, hepatitis are some of the common water-borne diseases that spread through contaminated water. Contaminated water can cause eye, ear, nose and throat infections also. Faecal

indicator bacteria like total coliforms, faecal coliforms (thermotolerant coliforms). *E. coli* and Faecal Streptococci (intestinal enterococci) are excreted by human and warm-blooded animals, pass sewage treatment plants to a great amount and survive for a certain time in the aquatic environment (Kavka and Poetsch, 2002). Faecal Coli and Faecal Streptococci are most widely used indicator bacteria (Kistemann et.al., 2002). Bacterial pollution in the river Gomati is increasing day by day due to discharge of organic wastes, human excreta, sewage waste, municipal garbage and toxic discharge from factories. River Gomati an important tributary of river Ganga rises near Mainkot in Gomat Tal about 3 Km east of Pilibhit town in the district of Pilibhit situated in the North-West U.P. at an elevation of 200 m above MSL at latitude 28°34' North and longitude 80°17' East. It bisects the city of Jaunpur in eastern region of U.P., which is located at 25°44' to 25°45' North latitude and 82°42' to 82°43' East longitude. At Jaunpur, the river is being polluted by a number of small and large drains, carrying municipal sewage of adjoining areas. The present investigation reveals the bacteriological characteristics and their monthly variation in the river water during the year 2009 and 2010. The aim of the study is to determine the bacteriological characteristics of the river water of the whole stretch of river Gomati flowing across the city of Jaunpur.

## MATERIALS AND METHODS

To assess the bacteriological pollution in river Gomati, five sampling sites in the city of Jaunpur were selected. These are the Kalichabad Ghat-control site, Gular Ghat-site-I, Hanuman Ghat-site-II, Baluwa Ghat-site-III and Miyanpur Ghat-site-IV. Sampling was carried out at monthly intervals during the first week of each month from June 2009 to May 2010. Triplicate samples of surface water were collected in sterile glass bottles and immediately transported to the laboratory in an ice bucket at 4 °C for analysis. Bacteriological analysis such as Total Coliform Density (TC), Faecal Coliform group Density (FC) and Faecal Streptococcal Density (FC) were performed. Methods recommended by Cruickshank (1965) and APHA (1998) were employed for the bacteriological analysis of water samples.

### **Total Coliform Density**

Measured amount of diluted water samples inoculated in MacConkey's broth tubes of different strength (single and double strength) containing acidity indicator and Durham's tube was incubated at 37 °C for 24 hours. These tubes were then examined for acid and gas formation. This is regarded as 'Presumptive positive' since the gas indicates the possible presence of coliforms. The tubes, which were not showing any of acid or gas formation were further incubated for another 24 hours. Those, which were positive were counted as positive and read together with the previous findings. In the confirmatory test, inocula from positive presumptive tubes were transferred to tubes of Brilliant Green Lactose bile (BGLB) broth. Gas production after incubation at 24 or 48 hours at 37 °C constitutes a positive confirmed test for total coliform. The enumeration of coliform organisms was done with the help of a McCrady probability table.

### **Faecal Coliform Group Density**

Determination of Faecal Coliform was performed by modified Eijkman test (McCrady, 1943).

### **Faecal Streptococcal Density**

For Faecal Streptococci, inoculation was made in the same way as for total coliform counting in the Hannary and Norton Sodium Azide medium and incubated at 44 °C for 48 hours. From positive tubes, inoculations were made on MacConkey's agar plates and incubated at 37 °C for 48 hours. The number of Faecal Streptococci was found from the table used for Total Coliform counting.

## RESULTS AND DISCUSSION

### **Total Coliform Group Density**

The variation in the MPN index per 100 mL with respect to five different sites at 37 °C is presented in Table-1. Monthly variation in Total Coliform counts reveal higher values during rainy season at all sites. Maximum counts were observed in the month of July at all the sites except at control site where maximum value was observed in the month of August. Minimum values at all the sites were obtained during winter months. During summer season, coliform densities were recorded higher than those in winter months. The control site showed a range of 875/100 mL (natural

logarithmic value; n.l.v. – 6.7742) in February to  $34 \times 10^2/100$  mL (n.l.v. – 8.1315) in the month of September. Minimum value as  $17 \times 10^2/100$  mL (n.l.v. – 7.4384) in the month of January and maximum as  $91 \times 10^3/100$  mL (n.l.v. – 11.4186) in the month of July was observed at site-I. Values ranged in between a minimum  $25 \times 10^2/100$  mL (n.l.v. – 7.407) in January/ May and maximum  $95 \times 10^3/100$  mL (n.l.v. – 11.4616) in the month of July at site-II. At site-III, minimum value was obtained in the month of February ( $23 \times 10^2/100$  mL, n.l.v. – 7.407) and maximum in the month of July ( $97 \times 10^3/100$  mL (n.l.v. – 11.4825). site-IV exhibited a range of minimum and maximum as  $21 \times 10^2/100$  mL with n.l.v. – 7.6487 and  $98 \times 10^3/100$  mL with n.l.v. – 11.4927 in the month of December and July respectively.

### **Faecal Coliform Group Density**

Feacal Coliform Density of river Gomati in different months is shown in fig-1. It is quite evident from the figure that values were found higher in rainy month, where it was found maximum in the month of July at all the sites ( $87 \times 10^3/100$  mL, n.l.v. – 11.3737 at site-I,  $89 \times 10^3/100$  mL, n.l.v. – 11.3964 at site-II,  $95 \times 10^3/100$  mL, n.l.v. – 11.4616 at site-III and  $96 \times 10^3/100$  mL, n.l.v. – 11.4721 at site-IV). However, the maximum value at control site ( $13 \times 10^2/100$  mL, n.l.v. – 7.1007) was observed in September. Their percentage in Total Coliform was found lower at control site (38.2% of Total Coliform),

which increased fairly at other sites (95.6% of Total Coliform at site-I, 89.8% of Total Coliform at site-II, 97.93% of TC at site-III and 97.95% of TC at site-IV). Minimum values for most of the sites were observed in May as  $11 \times 10^2/100$  mL with n.l.v. – 7.0031 (44.0% of TC) at site-III and in the month of January as  $14 \times 10^2/100$  mL with n.l.v. – 7.2442 (48.27% of TC) at site-IV.

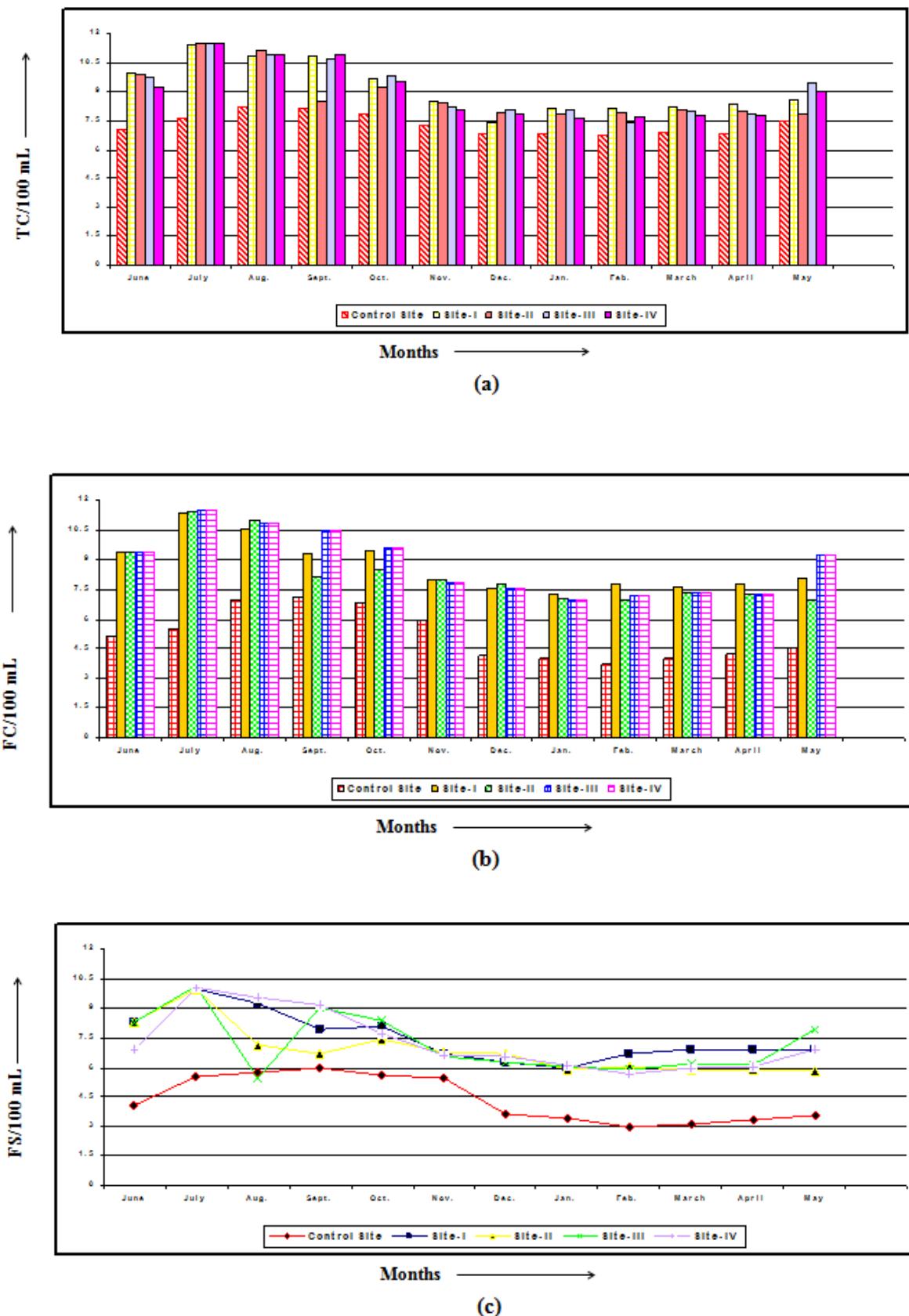
### **Faecal Streptococci Density**

Monthly variation in Faecal Streptococci density is shown in figure-1. Higher densities were observed in rainy season months at all the sites and lower during the winter season. Lowest values were recorded at control site. At control site, values ranged between a minimum  $20/100$  mL, n.l.v. – 2.9957 in February and maximum  $400/100$  mL, n.l.v. – 5.9915 in the month of September. Maximum values at all other sites were recorded in the month of July ( $21 \times 10^3/100$  mL, n.l.v. – 9.9523 at site-I;  $22 \times 10^3/100$  mL, n.l.v. – 9.9988 at site-II;  $24 \times 10^3/100$  mL, n.l.v. – 10.085 at site-III and  $23 \times 10^3/100$  mL, n.l.v. – 10.0432 at site-IV). Minimum value  $400/100$  mL, n.l.v. – 5.9915 for site-I and  $350/100$  mL, n.l.v. – 5.8579 for site-II was observed in January, March and April. However, the minimum value  $350/100$  mL, n.l.v. – 5.8579 was observed in the months of February for site-III and  $300/100$  mL with n.l.v. – 5.7038 was observed in the month of February for site-IV.

**Table 1**

*Monthly Variation in the Bacteriological parameters of River Gomati at Jaunpur from June 2009 to May 2010*

Parameters	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May
<b>1. Total Coliform</b>												
Control Site	$11 \times 10^2$	$21 \times 10^2$	$38 \times 10^2$	$34 \times 10^2$	$26 \times 10^2$	$14 \times 10^2$	936	922	875	965	937	$18 \times 10^2$
Site-I	$21 \times 10^3$	$91 \times 10^3$	$52 \times 10^3$	$49 \times 10^3$	$15 \times 10^3$	$51 \times 10^2$	$17 \times 10^2$	$36 \times 10^2$	$35 \times 10^2$	$36 \times 10^2$	$43 \times 10^2$	$51 \times 10^2$
Site-II	$19 \times 10^3$	$95 \times 10^3$	$69 \times 10^3$	$50 \times 10^3$	$10 \times 10^3$	$47 \times 10^2$	$27 \times 10^2$	$25 \times 10^2$	$27 \times 10^2$	$31 \times 10^2$	$29 \times 10^2$	$25 \times 10^2$
Site-III	$17 \times 10^3$	$97 \times 10^3$	$56 \times 10^3$	$43 \times 10^3$	$18 \times 10^3$	$36 \times 10^2$	$31 \times 10^2$	$31 \times 10^2$	$23 \times 10^2$	$29 \times 10^2$	$26 \times 10^2$	$12 \times 10^2$
Site-IV	$10 \times 10^3$	$98 \times 10^3$	$53 \times 10^3$	$53 \times 10^3$	$14 \times 10^3$	$32 \times 10^2$	$25 \times 10^2$	$21 \times 10^2$	$23 \times 10^2$	$23 \times 10^2$	$23 \times 10^2$	$85 \times 10^2$
<b>2. Faecal Coliform</b>												
Control Site	160	245	$11 \times 10^2$	$13 \times 10^2$	944	390	65	52	42	52	68	90
Site-I	$12 \times 10^3$	$87 \times 10^3$	$38 \times 10^3$	$11 \times 10^3$	$13 \times 10^3$	$30 \times 10^2$	$19 \times 10^2$	$14 \times 10^2$	$23 \times 10^2$	$21 \times 10^2$	$24 \times 10^2$	$31 \times 10^2$
Site-II	$12 \times 10^3$	$89 \times 10^3$	$58 \times 10^3$	$34 \times 10^2$	$50 \times 10^2$	$29 \times 10^2$	$24 \times 10^2$	$12 \times 10^2$	$11 \times 10^2$	$15 \times 10^2$	$14 \times 10^2$	$11 \times 10^2$
Site-III	$12 \times 10^3$	$95 \times 10^3$	$51 \times 10^3$	$35 \times 10^3$	$15 \times 10^3$	$26 \times 10^2$	$20 \times 10^2$	$11 \times 10^2$	$13 \times 10^2$	$15 \times 10^2$	$14 \times 10^2$	$10 \times 10^3$
Site-IV	$35 \times 10^2$	$96 \times 10^3$	$47 \times 10^3$	$42 \times 10^3$	$81 \times 10^2$	$25 \times 10^2$	$24 \times 10^2$	935	$11 \times 10^2$	$13 \times 10^2$	$13 \times 10^2$	$30 \times 10^2$
<b>3. Faecal Streptococci</b>												
Control Site	58	254	303	400	275	240	38	30	20	23	28	34
Site-I	$40 \times 10^2$	$21 \times 10^3$	$99 \times 10^2$	$28 \times 10^2$	$32 \times 10^2$	798	536	400	797	$10 \times 10^2$	$10 \times 10^2$	990
Site-II	$39 \times 10^2$	$22 \times 10^3$	$12 \times 10^2$	824	$17 \times 10^2$	839	788	350	427	350	350	327
Site-III	$39 \times 10^2$	$24 \times 10^3$	$13 \times 10^3$	$82 \times 10^2$	$44 \times 10^2$	676	518	405	350	500	445	$28 \times 10^2$
Site-IV	982	$23 \times 10^3$	$14 \times 10^3$	$97 \times 10^2$	$22 \times 10^2$	748	671	434	300	381	410	969



**Figure - 1**  
*Graphical analysis of results of bacteriological parameters.*

## DISCUSSION

The Total Coliform group density values during the present study was beyond the permissible limits (WHO, 1985) at all the experimental sites. The increased coliform counts can be attributed to the unrestricted inflow of domestic as well as industrial effluents, livestock waste run-offs and open defecation along the river bank. Maximum count of Total Coliform Density was observed at site-I followed by II, II and IV in that order. At control site, Total Coliform (TC) values were within the prescribed limit for most of the months except during the rainy season when probably due to surface run-off from nearby fields, TC values exceeds the prescribed value. Similar observation was reported by Tripathi (1982). Faecal coliform bacteria are found in the intestines and faeces of humans and other warm blooded animals. The Faecal Coliform density values are mostly higher than the prescribed values, with maximum values at site-I followed by III, II and IV in that order in most of the months. In the present findings, the percentage of faecal coliform in total coliform is quite low at control site except in rainy season when it becomes as high as 38.23% in September. Maximum contribution of faecal coliform to total coliform is observed at site-I in most of the months followed by that at site-III and sites-II and IV. This finding indicates the gradual decrease in the level of faecal contamination. Faecal Streptococcal Density has been used as a reliable indicator of water quality by a number of workers (Copper, 1955; Geldreich, 1964, 1970; Mallman, 1962). Ciaccio (1971) states that this group comprises a standard test that is a useful supplement to the Total Coliform and Faecal Coliform tests, when a more precise assessment of the origin of faecal pollution is required. In the current study, it is observed that the control site demonstrates very low densities of Faecal Streptococci in winter and summer months, never exceeding prescribed limit. However, in rainy season it increases significantly and exceeds the recommended limit. At other experimental sites, it is always higher than 100/100 mL in all the months.

Table-1 showed that Total Coli (TC), Faecal Coli (FC) and Faecal Streptococci (FS) were found to be higher in monsoon season months than the respective level found in pre-monsoon and post-monsoon months. Higher bacterial population during monsoon is mainly due to increased land run-off and higher faecal inputs into the river from various sources. Thus, it is clear from the results that at all the experimental sites, in all the months, Total Coli, Faecal Coli and Faecal Streptococci of river water were beyond the permissible limit and was unfit for drinking purpose without pre-treatment.

## CONCLUSION

The present study revealed that river Gomati enters into the city of Jaunpur with least pollution load. However, the pollution load increases within the city limit due to incorporation of untreated city sewage from cis and trans river sides. The incorporation of huge amounts of untreated city sewage is the most responsible factor for the higher population of various forms of bacteria. Study also reveals that most of the organic content, released in the form of sewage is the faecal origin which is obvious with the higher population record of faecal coliform bacteria at all the sites except control. The high values of sewage pollution indicator bacteria detected revealed that the microbiological quality of water of river Gomati was very poor unsafe and not acceptable for drinking purpose. Therefore, in order to prevent the river water from bacterial pollution all the city sewage must be treated before its discharge into the river.

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