Poll Res. 39 (November Suppl. Issue) : S50-S54 (2020)

ISSN 0257–8050

ASSESSMENT OF WATER QUALITY OF GANGA RIVER STRETCH FROM KANPUR TO DEORI GHAT

AJIT KUMAR VIDYARTHI*, FIROZ AHMAD, PRABHAT RANJAN, CHITRANSH DUA AND SUNITI PARASHAR

Central Pollution Control Board (CPCB), Ministry of Environment, Forest and Climate Change, Parivesh Bhawan, East Arjun Nagar, Shahdara, Delhi 110 032, India

(Received 5 January, 2020; accepted 18 February, 2020)

ABSTRACT

The present study highlights the Impact of point sources pollution load impact on river water quality of Ganga from Bithoor to Deori ghat. Ten samples have been taken along River Ganga covering most of the impact zone throughout the stretch like industrial and domestic sources, drains, tributaries etc. The results show that pH and DO were complying throughout the stretch in terms of bathing standard. BOD was found complying from D/s Kanpur barrage to D/s Shuklaganj and FC was found complying at U/s of Bithoor and U/s Shuklaganj. The correlation plot shows a high positive correlation of BOD with COD; BOD with NH3-N; COD with TSS and turbidity; and TC with FC. The upper part of the stretchshows the impact of tributaries, and lower stretch showsimpact of drains.

KEY WORDS : Water quality, River pollution, Ganga River

INTRODUCTION

Kanpur is the commercial capital and one of the major cities in the state of Uttar Pradesh, India situated on the right bank of River Ganga. It has a high migratory population in search of employment, in terms of the population it is 12th most populous city with a high literacy rate of 83.98% (Census of India 2011). It is the largest producer of textile and leather making it commercial capital of the state. For the present study 10 samples have been taken from River Ganga and analysed for various physio-chemical and biological parameters. Out of these 10 locations, 07 locations were National Water Monitoring Programme (NWMP) Stations whereas 03 locations were non-NWMP stations. The present study describes the process and factors affecting the water quality of river Ganga as well as shows the impact of the point source pollution loads (Industrial and Domestic) along the river stretch (Chaudhary, Mishra and Kumar, 2017).

Study Area

Kanpur apart from being largest producer of textile and leather,it is also a production centre for chemicals, fertilizers, soaps, Pan Masala, two wheelers, engineering industries and hosiery which leads to high industrial pollution load in river Ganga (Ansari, Singh, and Tobschall 1999; Paul 2017).

Stretch of River Ganga in Kannauj; Kanpur and Fatehpur region (Fig. 1) is joined by three major tributaries rivers, Ramganga ~75 km U/s of Old Bithoor; River Garra – 10 km D/s of confluence point of river Ramganga and River Kali East – confluence with River Ganga at Mehndipur ghat which is around 15 km D/s of confluence point of river Garra. The distance of Mehndipur ghat (district Kannauj) is around 55 km U/s to the Old Bithoor location which is the reference point for present study. River Pandu passes through Kanpur city, which receives discharge from five major drains of Kanpur city.

MATERIALS AND METHODS

The River Ganga stretch at Kanpur was monitored during 9th-11th April, 2019 from Old Bithoor (Kanpur U/s) to Deori Ghat (Kanpur D/s). The samples of River Ganga were taken at 10 locations (Table 1). Grab-samples were collected for physico-chemical (temperature, colour, pH, DO, BOD, and COD) and biological (total and faecal coliform) properties of river water. The DO was measured on-site during the sampling only. Other parameters were stored andanalysed at labs of CPCB (Head Office, Delhi and Regional Directorate, Lucknow) following standard method (APHA 2017).

RESULTS AND DISCUSSION

Upstream Bithoor at Murdaha Ghat (Old Bithoor)

Murdaha Ghat, Old Bithoor is located at the upstream of NWMP sampling location before discharge of Kalwari Ghat drain and Laxman Ghat drain. River water sample analysis result indicates high value of total coliform and low faecal contamination at this location. Total coliform values at upstream Old Bithoor makes the water not fit for drinking water quality. The high values of BOD may be caused due to pollution impact of three polluted tributaries - Ramganga, Garra and river Kali East which have their confluence points near Kannauj/Hardoi at a distance of around 55-60 km from Old Bithoor. The Higher D.O. value of 8.9 mg/L at this location may be attributed to algal growth in river Ganga (Picot *et al.,* 1992) indicating better diversity of aquatic fauna and acts an indicator of the effect of waste discharge into the river(Haritash, Gaur, and Garg, 2016; Naubi *et al.,* 2016; Rabee, Abdul-Kareem, and Al-Dhamin, 2011).

Bithoor

This sampling site is located at Bithoor, Pariyar bridge, near Laxman Ghat. The higher values BOD, COD and pH at the above locations are in non-confirmation to bathing and drinking water quality. The high BOD value of 4.3 mg/L at Bithoor may be because of impact of three polluted tributaries of river Ganga and two drains discharging into river Ganga at Bithoor U/s to this location.

Kanpur Barrage

All the major drains from the Kanpur city discharges into river Ganga at downstream of this location. Permiya drain discharges into river Ganga just downstream to this location near Atal Ghat followed by partially tapped Ranighat drain. The analysis results indicate BOD - 2.7 mg/L and DO - 8.3 mg/L which is well within the limit required for bathing water. The total coliform and faecal coliform values are higher than the prescribed limit for drinking and bathing water quality criteria as well as not fit for drinking after conventional treatment. Higher values of coliform at this location may be attributed to untreated sewage discharge coming to river Ganga from Bithoor and nearby areas as well as population upstream to Luv Kush Barrage (Kanpur Barrage) (Matta *et al.,* 2017). The D.O. value of 8.3 mg/L at this location may be because of high algal growth in the downstream of river and turbulence in the water rushing from barrage gate.

Bhairoghat Bathing Ghat

Permiya drain and Ranighat drain discharges into Ganga at U/s location of Bhairoghat. The analysis results indicate BOD as 2.7 mg/L and DO as 7.8 mg/L which is well within the limit required for bathing water. The total coliform and faecal coliform values were 33000 MPN/100 mL and 23000 MPN/100 mL, respectively, which is higher than the prescribed limit for drinking and bathing water quality criteria.

Upstream Shuklaganj

The location at upstream of Shuklaganj is situated at right bank of Ganga (opposite Kanpur city) U/s of Ganga Vishnu Ghat and before discharge points of five drains from Shuklaganj town. The analysis results of samples collected from this location indicates BOD - 2.8 mg/L and DO - 6.9 mg/l which is well within the limit required for bathing water. The total coliform and faecal coliform values were found at 2000 MPN/100 mL and <1.8 MPN/100 mL respectively which is higher for total coliform than the prescribed limit for drinking and bathing as per water quality criteria.

Bathing Ghat (Golaghat)

The analysis results indicate BOD - 2.82 mg/L and DO - 8.2 mg/L which is well within the limit required for bathing water criteria. However, total coliform and faecal coliform values were found at 17000 MPN/100 mL and 13000 MPN/100 mL respectively which is not meeting criteria prescribed for drinking and bathing as per water quality criteria. Ammonical nitrogen was found as Below

Detection Level (BDL) at this location. The higher values of coliform at this location is possibly because of discharge of untreated sewage from the drains discharging upstream to this location (Matta *et al.*, 2017).

D/s Shukla Ganj

The sampling point is located at downstream of Shuklaganj after discharge points of five drains from Shuklaganj town. The analysis results indicate BOD - 2.78 mg/L and DO as 7.6 mg/L which is well within the limit required for bathing water criteria. However, total coliform and faecal coliform values were found at 33000 MPN/100 mL and 4500 MPN/100 mL respectively which is not meeting criteria prescribed for drinking and bathing as per water quality criteria. pH value at this location was found at 8.8 which is slightly higher than the limit for drinking and bathing.

Bathing Ghat (Jajmau bridge)

This location is situated on the lower half of Kanpur city and almost in the middle of tannery hub of Jajmau and nearby industrial pockets. Large quantity of industrial effluent as well as sewage is generated upstream and downstream to this location. The CETP and STP of Jajmau is situated downstream to this location. Several small drains from populated nearby areas of Jajmau was observed directly discharging into river Ganga d/s of Jajmau bridge

The analysis results indicate BOD as 3.98 mg/L and DO as 7.5 mg/L which indicates. The higher BOD values may be linked to discharges from industrial drains upstream to this location and non-points sources of discharge in the tannery area upstream to this location. The total coliform and faecal coliform values were found at 280000 MPN/100 mL and 220000 MPN/100 mL respectively indicating untreated wastewater discharge into river Ganga upstream to this location.

Kanpur Downstream (Jajmau Pumping Station) Jana village

This location is situated after discharge points of three drains situated downstream of Jajmau bridge. While all the three drains of this stretch were reported to be tapped, intermittent overflows from theses drains were reported.

Table 1. Sampling location and physio-chemical parameter of River Ganga

S.	Location	Lat	Long	pH	DO	Temp.	Colour	BOD	COD	TC	FC	TDS	TSS	Turbidity	NO_3-N	NH_3-N	PO_4-P	K^+	Cl^-
1.	R. Ganga u/s of old Bithoor	26°37'32.39"N	80°16'9.17"E	8.40	8.9	30	10	3.7	15.1	2.0×10^3	<1.8	173	78.6	38	1.78	0.594	0.050	4.73	10.4
2.	R. Ganga Bithoor	26°37'1.27"N	80°16'27.41"E	8.47	8.6	30	10	4.3	15.2	4.9×10^4	7.8×10^3	175	70.5	34	2.45	0.838	0.046	4.62	10.6
3.	R. Ganga u/s of Ranighat (d/s of Ganga Barrage)	26°30'25.24"N	80°19'5.38"E	8.56	8.3	30	10	2.7	12.7	2.4×10^3	4.9×10^4	184	26.2	18	3.16	0.279	0.057	4.78	8.65
4.	R. Ganga Bhairoghat	26°29'40.70"N	80°19'37.31"E	8.38	7.8	29	10	2.7	14.3	3.3×10^4	2.3×10^4	185	34.6	19	2.38	0.264	0.100	5.07	10.6
5.	R. Ganga u/s of Shuklaganj	26°28'49.91"N	80°22'18.23"E	8.33	6.9	30	5	2.8	12.8	2.0×10^3	<1.8	166	40.6	16	2.40	0.181	0.045	4.85	10.6
6.	R. Ganga d/s of Shuklaganj	26°28'5.64"N	80°23'11.21"E	8.39	7.6	32	5	2.78	11.2	3.3×10^4	4.5×10^3	171	31.3	17	1.72	0.109	0.052	4.73	9.61
7.	R. Ganga at Golaghat, Kanpur	26°27'58.28"N	80°22'34.18"E	8.30	8.2	31	5	2.82	14.1	1.7×10^4	1.3×10^4	175	24.5	18	1.84	BDL	0.099	5.03	10.6
8.	R. Ganga at Jajmau Bridge, Kanpur	26°26'5.50"N	80°24'31.72"E	8.22	7.5	31	10	3.98	13.7	2.8×10^3	2.2×10^3	179	37	17	1.66	BDL	0.089	4.99	12.5
9.	R. Ganga at Ju Vill. Kanpur	26°24'19.86"N	80°27'8.48"E	8.28	7.2	31	10	5.30	16.5	4.9×10^4	2.0×10^3	179	53.4	20	1.24	BDL	0.062	4.73	11
10.	R. Ganga at Jane Dhondhi ghat	26°22'40.60"N	80°29'25.97"E	8.35	7.9	31	5	3.47	16.0	1.4×10^4	4.5×10^3	175	67	27	1.34	BDL	0.055	4.52	9.86

However, no overflow was observed by the visiting team.

The analysis result indicates BOD - 5.30 mg/L, DO - 7.2 mg/L and COD - 16.5 mg/L indicates sudden increase in BOD and COD values at this location compared to previous upstream location at Jajmau Bridge. The total coliform and faecal coliform values were found at 49000 MPN/100 mL and 2000 MPN/100 mL respectively indicating lesser contamination from household sewage and higher BOD level at the location, which can be because of higher quantity of untreated industrial effluent discharge into river Ganga upstream to this location from point/non-point sources. The higher values of BOD, COD and coliform makes the water unfit for drinking and bathing and indicating industrial waste/sewage contaminations upstream to this location.

Deori Ghat (Downstream of Kanpur)

Samples were collected from river Ganga near temple at Deori Ghat. Drain from Rooma industrial area joins river Ganga just downstream to this location. Analysis result shows BOD - 3.47 mg/L, DO - 7.9 mg/L and COD - 16 mg/L which indicates high level of pollution due to higher BOD and COD. The higher BOD values at Deori Ghat may be linked to cumulative effect of all the discharges from industrial drains and non-points sources of discharge in the Kanpur city. The total coliform and faecal coliform values were found at 14000 MPN/100 mL and 4500 MPN/100 mL respectively indicating contamination from household sewage and industrial effluent from Kanpur city (Haritash, Gaur, and Garg, 2016; Naubi *et al.*, 2016; Rabee, Abdul-Kareem, and Al-Dhamin, 2011).

Correlation

Correlation is a statistical tool to study inter-relationship between variables. In the correlation plot (Table 2) high positive correlation were found between BOD and COD (0.71); TSS (0.57) and NH_3-N (0.96); COD and TSS (0.68); Turbidity and NH_4-N (0.85); high positive correlation is also seen between TC and FC (0.84) and TSS and turbidity (0.9) respectively, it suggests that these pollutant have common industrial/wastewater source in River Ganga.

CONCLUSION

All sampling point were found complying DO w.r.t. bathing norms, BOD was found non-complying at U/s Bithoor (Murdaghat), Bithoor, D/s Kanpur Barrage, Bharioghat, Golaghat, D/s Shuklaganj, Jajmau Bridge, D/s Jajmau pumping and Deori Ghat and FC was found non-complying at Bithoor, D/s Kanpur Barrage, Bharioghat, Golaghat, D/s Shuklaganj, Jajmau Bridge, D/s Jajmau pumping and Deori Ghat. In the River Ganga stretch from U/s Bithoor (Murdahaghat) to D/s Kanpur Barrage shows high pollution due to the pollution contribution from three major tributaries, Ramganga, Garra and Kali East. In the stretch from d/s Kanpur barrage to d/s Shuklaganj shows better quality of River water as compared to upper sampling locations. In the lower stretch discharge from Kanpur city and Shuklaganj city contribute to

Table 2. Pearson Correlation Plot of River Ganga Water Quality Parameters

	pH	DO1	Temp.	Colour	BOD	COD	TC	FC	TDS	TSS	Turbidity	NO_3^- N	NH_3^- N	PO_4^- P	K^+	Cl^-
pH	1.00															
DO	0.57	1.00														
Temp.	-0.39	-0.26	1.00													
Colour	0.23	0.33	-0.51	1.00												
BOD	-0.32	-0.05	0.17	0.48	1.00											
COD	-0.23	0.20	-0.19	0.34	0.71	1.00										
TC	0.06	-0.03	0.04	0.47	0.05	-0.26	1.00									
FC	-0.38	-0.08	0.09	0.41	0.13	-0.13	0.84	1.00								
TDS	0.22	0.20	-0.36	0.66	0.07	0.21	0.53	0.31	1.00							
TSS	0.07	0.41	-0.15	0.24	0.57	0.68	-0.38	-0.23	-0.26	1.00						
Turbidity	0.31	0.75	-0.25	0.32	0.37	0.55	-0.34	-0.27	-0.14	0.90	1.00					
NO_3-N	0.75	0.25	-0.63	0.25	-0.52	-0.45	0.30	-0.06	0.26	-0.33	-0.10	1.00				
NH_3-N	0.31	0.77	-0.31	0.64	0.96	0.85	-0.11	-0.06	0.04	0.86	0.90	0.00	1.00			
PO_4-P	-0.44	-0.07	-0.11	-0.19	0.03	0.22	0.22	0.41	0.55	-0.54	-0.43	-0.09	-0.27	1.00		
K^+	-0.36	-0.22	-0.27	0.11	-0.37	-0.31	0.24	0.40	0.31	-0.68	-0.56	0.20	-0.55	0.83	1.00	
Cl^-	-0.80	-0.28	0.04	0.25	0.49	0.31	0.15	0.61	-0.05	0.14	-0.01	-0.46	0.40	0.41	0.41	1.00

pollution load and further deterioration in river water quality is observed due to discharges from drains and industries located at Jajma.

REFERENCES

Ansari, A. A., Singh, I. B. and Tobschall, H. J. 1999. Status of Anthropogenically Induced Metal Pollution in the Kanpur-Unnao Industrial Region of the Ganga Plain, India. *Environmental Geology*. 38(1): 25-33.

Census of India, 2011. censusindia.gov.in *Census of India 2011*. http://censusindia.gov.in/2011-prov-results/data_files/india/paper_contentsetc.pdf (June 1, 2020).

Chaudhary, Mohit, Saurabh Mishra and Arun Kumar, 2017. Estimation of Water Pollution and Probability of Health Risk Due to Imbalanced Nutrients in River Ganga, India. *International Journal of River Basin Management*. 15 (1) : 53-60.

Haritash, A. K., Shalini Gaur and Sakshi Garg, 2016. Assessment of Water Quality and Suitability Analysis of River Ganga in Rishikesh, India. *Applied Water Science*. 6 (4) : 383-392.

Matta, Gagan, Sachin Srivastava, R. R. Pandey and Saini, K. K. 2017. Assessment of Physicochemical Characteristics of Ganga Canal Water Quality in Uttarakhand. *Environment, Development and Sustainability*. 19(2) : 419-31.

Naubi, Irena, 2016. Effectiveness of Water Quality Index for Monitoring Malaysian River Water Quality. *Polish Journal of Environmental Studies*. 25 (1) : 231-239.

Paul, Dipak, 2017. Research on Heavy Metal Pollution of River Ganga: A Review. *Annals of Agrarian Science*. 15 (2) : 278-86. https://www.sciencedirect.com/science/article/pii/S1512188716301142 (May 31, 2020).

Picot, B. 1992. Comparison of the Purifying Efficiency of High Rate Algal Pond with Stabilization Pond. In *Water Science and Technology*. 197-206. https://iwaponline.com/wst/article-pdf/25/12/197/14744/197.pdf (May 31, 2020).

Rabee, Adel Mashaan, Bahaa Malik Abdul-Kareem and Ahmed Saad Al-Dhamin, 2011. Seasonal Variations of Some Ecological Parameters in Tigris River Water at Baghdad Region, Iraq. *Journal of Water Resource and Protection*. 03(04): 262-67.