PATNA WOMEN'S COLLEGE 1940

Zoology
Explore–Journal of Research
ISSN 2278 – 0297 **(Print)**
ISSN 2278 – 6414 **(Online)**
UGC Approved List of Journals No. - 64404

http://www.patnawomenscollege.in/journal

Study of Water Quality of River Ganga at Patna

• **Pooja Kumari** • **Annu Priya** • **Radhika Sharma**
• **Shobha Shrivastava**

Received **:** November 2017
Accepted **:** March 2018
Corresponding Author : Shobha Shrivastava

Abstract: Water pollution is an acute problem in all major rivers of India. Rivers are heavily polluted due to the industrial, municipal, agricultural and domestic effluents. Over the years rivers have been indiscriminately polluted and misused. The anthropogenic activities have posed serious environmental problems which threaten human life and conservation of biodiversity. The present study deals with the water quality of the Ganga River at Patna. The water samples were collected from different sites (site I- Danapur, site II- Mandiri, site III- Kali Ghat, site IV- NIT Ghat) of Ganga River at Patna during the rainy season (August to September), 2017. Analysis of water quality was done by determining pH, TDS (Total Dissolved Solid), Conductivity, DO (Dissolved Oxygen) and BOD (Biological Oxygen Demand). The minimum pH, TDS and BOD were recorded at site I (Danapur) and minimum conductivity at site II (Mandiri), minimum DO was recorded at site III (Kali Ghat). The maximum pH, DO and BOD were recorded at site II (Mandiri) and maximum TDS and conductivity recorded at site III (Kali Ghat) .

The water quality of site II was poor as compared to site I , site III and site IV. The high value of BOD and DO suggests that the purification may be necessary for domestic consumption.

Keywords: Biological Oxygen Demand (BOD), Dissolved Oxygen(DO), Total Dissolved Solid (TDS).

Pooja Kumari
B.Sc. III year, Zoology (Hons.), Session: 2015-2018,
Patna Women's College, Patna University, Patna,
Bihar, India

Annu Priya
B.Sc. III year, Zoology (Hons.), Session: 2015-2018,
Patna Women's College, Patna University, Patna,
Bihar, India

Radhika Radhika
B.Sc. III year, Zoology (Hons.), Session: 2015-2018,
Patna Women's College, Patna University, Patna,
Bihar, India

Shobha Shrivastava
Assistant Professor, Deptt. of Zoology,
Patna Women's College, Bailey Road,
Patna–800 001, Bihar, India
E-mail : shrivastavashobha07@gmail.com

Introduction:

Water pollution is a global problem that does not respect national boundaries. The source of pollution may be domestic, agricultural or industrial. Water pollution is an acute problem in all major rivers of India. The small and large areas which fall in the way of the river, dump their waste in the river (Banerjee et al., 2016).

Ganga is the 13th largest river in the world, covering an area of 8,61,404 km^2 (Rehman, 2009). Its origin is in the western Himalaya ranges in the state of Uttarakhand. This river has also significant historical value. The river Ganga passes through Uttarakhand, Uttar Pradesh, Bihar, and West Bengal. The river supports abundant biological width, characterized by rich fisheries and faunal diversity. Due to copious availability of water throughout the year, it has a major

role in the growth of Indian civilization. The Ganga is the largest basin in India, constituting 26 percent of the country's landmass supporting 43 percent of its population. The Ganga Basin is heavily populated with an average density 520 person/km^2. The Ganga passes along 29 class I cities, 23 class II cities and approximately 50 towns because of which different types of waste, such as, industrial, sewage, etc, are released into the river (Agrawal et al., 2010 ; Biswas et al., 2015). All along this heavily populated stretch, fresh water intake from the river is increasing, but in exchange only waste is returned . Pollution threatens not only humans, but also more than 130 fish species, 83 amphibian species and the endangered Ganga River Dolphin.

Ganga River water is used routinely for drinking and outdoor bathing by millions of people who take a holy dip at least once a year throughout the course of the river from Gangotri to Ganga Sagar, owing to its socio-religious significance (Rehana et al., 1996) .

Research and assessment is necessary to formulate up-to-date policy about management of physico-chemical properties of river water to demonstrate change in water quality by combining the representative water quality characteristic of River Ganga as well as intended use of water and sanitation approach for better quality water.

Materials and Methods:

Study area: The present study was confined to the surrounding area of site I (Danapur), site II (Mandiri), site III (Kali Ghat) and site IV (NIT Ghat) of Patna, where a huge mass of devotees take holy dip, local people too perform bathing, washing of clothes and discharge of local wastes are done throughout the year.

Collection of samples: Water samples were collected during the monsoon season from August to September, 2017, from selected sites of the Ganga. The sampling was done between 1:00 pm and 6:00 pm. The surface water was collected from each site in plastic containers (500 ml). For Dissolved Oxygen (DO) the water samples were collected in BOD bottles (250 ml). Manganese sulphate and Alkali iodide azide were added in BOD bottles at the site of sampling. All the collected samples were stored in an ice box and taken to the laboratory for determination of pH, Total Dissolved Solids (TDS) and conductivity.

Three samples were collected from each site. DO content of water samples were measured by Modified Winkler's method. This method is a titrimetric procedure based on Oxidizing property of Oxygen dissolved in water. The average values of three consecutive readings of water sample were taken for determination of DO. For the estimation of BOD of water samples average value of initial and final DO contents of water samples were determined just after collection of sample and after 5 days' incubation at 20^{0}C in BOD incubator, respectively. TDS was measured by TDS meter and pH was measured by pH meter. Conductivity was measured by Conductivity meter.

Results and Discussion:

The quality of river water is determined by physical and chemical constituents. The contamination level in water bodies changes according to season and concentration of pollutants in water. The samples only indicate the condition at the time of sampling.

Table 1. The study results at various sites of Patna

Parameters	Standards	Site I	Site II	Site III	Site IV	SD
Ph	*7.0 – 8.5*	*8.31*	*8.95*	*8.57*	*8.50*	*0.23*
TDS(mg/l)	*500*	*91.4*	*152*	*153*	*142*	*25.31*
Conductivity(µs/cm)	–	*285*	*143.4*	*289*	*256*	*873.04*
DO (mg/l)	*5.0*	*8.2*	*9.2*	*6.3*	*7.0*	*1.11*
$(DO)_5$(mg/l)	–	*2.8*	*2.6*	*1.2*	*0.2*	*1.06*
BOD (mg/l)	*6.0*	*27*	*33*	*28*	*31*	*2.38*

pH: The maximum pH recorded at site II (Mandiri) was 8.95 and minimum at site I (Danapur) was 8.31 (Table -1).The slightly higher pH were recorded in all sites during rainy season. The slightly alkaline pH of water during rainy season was attributed due to leaching of rock material. (Tiwari et al., 2016) reported that the mean pH values were 8.2 at Kanpur, 7.6 at Allahabad and 7.7 at Varanasi. The pH values were recorded 8.8, 8.2, 8.5 during summer, monsoon and winter, respectively, at Allahabad. The pH values were recorded 8.2, 7.7, 7.9 during summer, monsoon and winter, respectively, at Varanasi. The pH values were recorded 8.2, 7.7, 8.0 during summer, monsoon and winter at Kanpur. Rai et al., (2011)reported pH ranges from 8.1 to 8.4 in pre-monsoon and 7.3 to 8.2 in post-monsoon at site I (Pahalwan Ghat and Bans Ghat) and at site II (Krishna Ghat and Gandhi Ghat) pH ranges from 8.4 to 8.7 in pre-monsoon and 6.8 to 7.3 in post-monsoon.

Kar et al., (2008) reported average value of pH 7.80 from lower stretch of Ganga River at Kolkata. The pH value of the Ganga River falls between slightly acidic to slightly alkaline and has relationship with accumulation of heavy metal in river water as well as sediments.

Total Dissolved Solids: The average value of Total Dissolved Solids recorded was 134.6mg/l. The maximum TDS was recorded from site III (Kali Ghat) was 153 mg/l and minimum from site I (Danapur) was 91.4 mg/l (Table -1).

Tiwari et al., (2016) reported that the mean TDS values were 403.33 ± 141.20 mg/l at Kanpur, 398.67 ± 141.14 mg/l at Allahabad and 405.33 ± 20.1 mg/l at Varanasi. The TDS values were recorded as 412,540, 258 mg during the seasons of summer, monsoon and winter, respectively, at Kanpur. The TDS values were recorded as 406, 536, 254mg/l during summer, monsoon and winter at Allahabad. The TDS values were recorded as 406, 425, 254 mg/l during summer, monsoon and winter at Varanasi. Rai et al., (2011) reported that the TDS value ranges from 817-943 mg/l in pre-monsoon and 615 -672 mg/l in post-monsoon at site I (Pahalwan Ghat and Bans Ghat) and at site II (Krishna Ghat and Gandhi Ghat) TDS value ranges from 947 – 976 mg/l in pre monsoon and 598 – 621 mg/l in post monsoon. This was attributed to soil erosion in the nearby catchment area and massive contribution of suspended solids from domestic effluents or local sewage.

Conductivity: The maximum conductivity recorded from site III (Kali Ghat) was 289 µs/cm and minimum conductivity recorded from site II (Mandiri) was 143.4 µs/cm (Table1).

Tiwari et al., (2016) reported that the mean Conductivity values were 512.67 ± 126.12 mhos/cm at Kanpur, 505.00 ± 120.16 mhos/cm at Allahabad and 674.33± 20.1 mhos/cm at Varanasi. The Conductivity values recorded were 628, 378, 532 mhos/cm during summer, monsoon and winter, respectively, at Kanpur. The Conductivity values recorded were 612, 375, 528 mhos/cm during summer, monsoon and winter at Allahabad. The Conductivity values recorded were 695, 640, 688 mhos/cm during summer, monsoon and winter at Varanasi Chandra et al.,(2011)reported 222 mg/l from the Ganga River at Kashi and 215 mg/l in Gomti River at Lucknow (Rai et al., 2011) reported Conductivity ranges from 431– 453 µmho/cm in pre monsoon and 416 – 427 µmho/cm in post monsoon at site I (Pahalwan Ghat and Bans Ghat). And at site II (Krishna Ghat and Gandhi Ghat) Conductivity ranges from 505 – 532 µmho/cm in pre-monsoon and 497 – 514 µmho/cm in post-monsoon.

Dissolved Oxygen: The maximum DO recorded from site II (Mandiri) was 9.2mg/l and minimum at site III (Kali Ghat) was 6.3mg/l.

Tiwari et al.,(2016) reported that the mean DO values were 3.93 ± 0.90 mg/l at Kanpur, 5.00 ± 1 mg/l at Allahabad and 4.17 ±0.76mg/l at Varanasi. The DO values recorded were 4,3,4.8 mg/l during summer, monsoon and winter, respectively, at Kanpur. The DO values recorded were 5, 4, 6 mg/lduring summer, monsoon and winter at Allahabad. The DO values recorded were 4,3.3, 5mg/l during summer, monsoon and winter at Varanasi [Rai et al.,(2011)] reported DO ranges from 7.1 – 7.5 mg/l in pre-monsoon and 7.7 – 8.8 mg/l in post-monsoon at site I (Pahalwan Ghat and Bans Ghat) and at site II (Krishna Ghat and Gandhi Ghat) DO ranges from 6.8 – 7.2 mg/l in pre-monsoon and 7.2 – 7.7 mg/l in post-monsoon.

Biological Oxygen Demand (BOD): The maximum BOD value recorded from site II (Mandiri) was 33mg/l and minimum recorded at site I(Danapur) was 27mg/l.

Tiwari et al.,(2016) reported that the mean BOD values were 38.67 ± 8.33 mg/l at Kanpur, 34.00± 11.14 mg/l at Allahabad and 31.00 ± 6.56 mg/l at Varanasi. The BOD values recorded were 36, 48, 42 mg/l during summer, monsoon and winter, respectively, at Kanpur. The BOD values were recorded 36, 44, 22 mg/l during summer, monsoon and winter at Allahabad. The BOD value were recorded 30, 38, 25 mg/l during summer, monsoon and winter at Varanasi. Singh (2010) observed that the BOD ranged from 66.2 ± 3.4 to 87.5 ± 2.9 mg/l at Rajghat (Varanasi) while Rai et al.,(2010)reported BOD range was from 97 ± 41 mg/l to 265 ± 78 mg/l in the year 2005 from same site. Chavan et al.,(2006) reported 3.9mg/l BOD from the Ganga River at Kashi and 2.1 mg/l at Lucknow in Gomti River. Rai et al.,(2011) reported that the BOD ranges from 6.1 – 6.6 mg/l in pre-monsoon and 4.7 – 4.9 mg/l in post-monsoon at site I (Pahalwan Ghat and Bans Ghat) and at site II (Krishna Ghat and Gandhi Ghat) BOD ranges from 5.8 – 6.3 mg/l in pre-monsoon and 5.2– 5.7 mg/l in post monsoon. According to recent estimate of Central Pollution Control Board (CPCB), Seth (2013) fecal coliform, an indicator of pathogenic contamination, is well above the stipulated level considered safe for bathing in the main stem (2,525 km from Gangotri to Diamond Harbour). But there are

worrying signs as increasing trends are recorded in Rudraprayag and Devprayag and suggesting untreated sewage discharge reduces flow in these highly oxygenated stretches for dilution.

Before launching GAP (Ganga Action Plan) the DO value was recorded well over 4mg/l and ranged between 6.8-7.2 in most stretches.

According to 2009 status, as per CPCB data, the Biological Oxygen Demand (BOD), a key parameter to gauge organic pollution, is well beyond safe limits for bathing downstream of Haridwar, Kannauj and Kanpur after receiving the flush of the city of Varanasi. In the 25 years of monitoring water quality, the station downstream of Kanpur has recorded the highest value in the basin. But in all stretches a trend has emerged that pollution load steadily increases.

The CPCB assessment of 2012 makes public the fact that sewage accounts for 85% of all waste water, the rest being industrial waste.

Conclusion:

The findings of the present study revealed that pH values during the rainy season were higher. The pH of water at site II (Mandiri) had highest pH, signifying that the water of site II is more alkaline than other sites.

The TDS was recorded highest at site III (Kali Ghat) of all sites, but they are under permissible limits of drinking water quality standards. The high value of dissolved oxygen and BOD recorded from site II (Mandiri) shows that water of Mandiri is more polluted than other sites of the Ganga. The high value suggests that purification is necessary for domestic consumption. A proper monitoring will pave the need for development of conservation strategies to clean the Ganga water and thereby minimize the impact of water borne diseases in humans.

Acknowledgement:

We are grateful to UGC for providing financial support to this research project. We express our sincere gratitude to our respected Principal, Dr. Sister Marie Jessie A.C., for giving us this wonderful opportunity to undertake the project.

References :

Agrawal A, Pandey R.S and Sharma B (2010) : Water pollution with special reference to pesticide contamination in India. J. ***Water Resource***. Prot, 2:432 - 448.

Banerjee S, Kumar A, Maiti S.K and Choudhary A(2016): Seasonal variation in heavy metals contamination in water and sediment of Jamshedpur stretch of Subarnarekha river,India. ***Environ***, Earth science ,75:1-12.

Biwas K, Paul D and Sinha S.N (2015): Prevalence of multiple antibiotic resistance coliform bacteria in the water of river. ***Front.Environ***.Microbiology, 1: 44-46.

Chandra S, Singh A. Tomar P.K. and Kumar A (2011): Evaluation of Physiochemical characterstics of various river in India. ***E Journal of Chem***, 8:1546-1555.

Chavan A.W ,Dhamani A.A and Murkute V.B (2006): Physico-chemical parameters of river Wainangar near Brahamapuri, Dist Chandrapur. Vidh. Inter***. Interd. Res***.J,1:28-35.

Kar D, Surr P, Mandal S.K., Saha Tand Kole R.K (2008): Assessment of heavy metal pollution in surface water. ***International Journal of Environmental Science and Technology***, 5:119 -124.

Pandey, Ruby, Raghuvanshi Divya and Shukla D.N (2014): Assessment of physiochemical parameter of River Ganga at Allahabad with respect to WQI. Int. ***J.Innov. Res. In BC., Eng. And Tech, 3 (9):16339-1634***

Rai A.K. Paul B, Mudra L and Kishore N (2011): Studies of Selected Water Quality Parameters of River Ganga at Patna, Bihar ***Journal of advanced laboratory research in biology***, 2(4) :0976- 7614.

Rai P.K. Mishra A and Tripathi B.D (2010): Heavy metal and microbial pollution of the river Ganga: a case study of water at Varanasi, India. ***Aquatic Ecosystem and Health Management***, 13:352-361.

Rehana Z, Malik A and Ahmad M (1996): Genocity of the Ganga water at Narora, India. ***Mutation***, Genet.Toxicol, 367:187 -193.

Rehman M.M (2009): Principles of transboundry water resources management and Ganga treaties: an analysis, ***Water Resources .Dev***, 25:159-175.

Seth B.L (2013): Deputy Programme Manager Status paper for River Ganga, Past failures and current challenges. Central River Action Plan (CRAP).

Singh N (2010): Physio- chemical properties of polluted water of river Ganga at Varanasi. ***International Journal of Energy and Environment,*** 1:823-832.

Tiwari A, Diwedi A.C and Mayank P(2016): Time Scale Changes in the Water Quality of the Ganga River, India and Estimation of suitability for Exotic and Hardy Fishes. ***Hydrol Current Res,*** 7:254.2157-7587.