Assessment of pollution status with respect to up and down stream influences of Gomti River in Jaunpur City, India

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ABSTRACT: River is important for every human being as well as flora and fauna. Over the last century, riverine ecosystems have suffered from intense human intervention resulting in habitat loss and degradation and as a consequence, many biotic species have become highly endangered, particularly in rivers where heavy demand is placed on freshwaters. This study was aimed to estimate the pollution status and their variation across the stretch of river Gomti flowing through the city of Jaunpur. The sampling is concerned from upstream to downstream regions of the river through the city. Four sampling sites namely, Gokul Ghat (upstream), Gular Ghat, Shastri Bridge and Gomti Barrage (downstream) were selected for sampling. The water samples were collected and analyzed for a period of one year during March 2016 to February 2017. For the study total 6 parameters such as Temperature, pH, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Nitrate (NO_3^-) and Phosphate (PO_4^{3-}) were detected with reference to the monsoonal variation (summer, monsoon and winter). The results indicate that Gomti River water was in polluted condition due to the city drainage systems, unplanned municipal wastes and industrial waste. Religious idol immersions are also found on the bank and in river water. On the other hand river was polluted mainly by local waste like daily garbage, faecal flow and plastic bags. It indicates that the unplanned urbanization is responsible for the deterioration of river water. To keep the river clean for the future, it is strongly recommended that urban effluents should not be over-looked before their discharge into the river and it is very necessary to assess the river water quality and subsequently, prepare the mitigation measures to reduced pollution level in Gomti River.

KEY WORDS: Ecosystem, Gomti River, Dissolved Oxygen, BOD, Urbanization.

1. 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. Water quality plays an important role in promoting agricultural production and standard of human health (Chaurasia et.al., 2013).

The total quantity of fresh water on 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). Riverine sediments play an important role as pollutants and they reflect the history of the river pollution (Jain, 2004). The main source of pollutants into the aquatic system are anthropogenic activities, whereby industrial and urban wastes are discharge into water bodies (Pardo et.al.,1990; Boughriet et.al., 1992; Yu et al., 2001; Klavins et.al., 2000; Mohan et.al., 2011). Numerous studies have demonstrated that the concentrations of pollutants in suspended and bed sediments can be sensitive indicators of contaminants in hydrological systems (Salomons and Forstner,1980; Luoma 1990). Most of the development activities are dependent upon rivers for cleaning as well as disposal purposes. Therefore, comprehensive river water quality monitoring program is becoming a necessity in order to safeguard public health and to protect the valuable and vulnerable fresh water resources (Kannel et.al., 2007). River water quality monitoring is necessary especially where the water serves as drinking water sources, are threatened by pollution resulting from various human activities along the river course (Ahmad et.Al., 2010). According to Srivastava et.Al., (2011) drains are the main source of water pollution especially for rivers flowing within the city carries industrial effluent, domestic waste sewage and medicinal waste results in pouring the water quality. Study of water quality of the river Gomti of Jaunpur city was carried out by Yadav et.al. (2012).The Gomti River, one of the major tributaries of Ganga River, originates from a natural reservoir in the swampy and densely forested area near Madho- Tanda (28˚ 34' N, 80˚ 07' E), 3km east of Pilibhit town in Uttar Pradesh (Mainkot, elevation of about 200 m) India, and is about 50 km south of the Himalayas foothills. The river flows in the great alluvial plain, which is of Pleistocene- Holocene origin, and redistributes the weathered sediments of the Gangatic alluvial plain derived from Himalaya (Kumar and Singh, 1978). The river flows through the districts of Pilibhit, Shahjahanpur, Sitapur, Lucknow, Barabanki, Sultanpur, Jaunpur and Ghazipur, covers a total distance of about 730 km before joining the Ganga River near Saidpur Kaithi in Ghazipur district about 30 km north of Varanasi city. The river drains a catchments area of about 25,800 earth could satisfy all needs of human population if it was evenly distributed and accessible. Fresh water resources are deteriorating day by day at a very fast rate. Now water quality has become a global problem (Mahananda et.al., 2005). The Gomti River, a major source of water carries a pollution load from industrial towns and agricultural areas of eastern Uttar Pradesh (Gupta and Subramanian, 1994). 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. Kathna, Sarayan, Reth, Luni, Kalyani, and Sai rivers are the tributaries of the Gomti River. The river collects large amounts of human- industrial pollutants as it flows through the highly populous areas (18 million approx) of Uttar Pradesh. High pollution levels in the river have negative effects on the ecosystem functioning, threatening to its aquatic life. Before reaching in Lucknow, Gomti River receives waste from sugar and distillery industries of Sitapur. Various industries namely, distillery, milk industry and vegetable oil, pours effluent directly into Gomti River. Besides this agricultural run-off from its vast catchment area directly or through its tributaries and about 45 wastewater drains, other pollution sources are washing of clothes and animals in the river water and cremation Ghats on the riverbanks are equally important. It bisects the city of Jaunpur in eastern region of Uttar Pradesh, 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 study reveals the pollution status of Gomti River flowing across the Jaunpur city (India) with respect to up and downstream influences.

2. The Study Area

The city of Jaunpur (25˚ 44’ to 25˚ 45’ North latitude and 82˚ 42' to 82˚ 43' East longitude) stands on either side of the river Gomati in India. It is situated at a distance of 260 km from Lucknow in the south – east, 57 km from Varanasi in the nort –west and 97 km from Allahabad in the northeast.

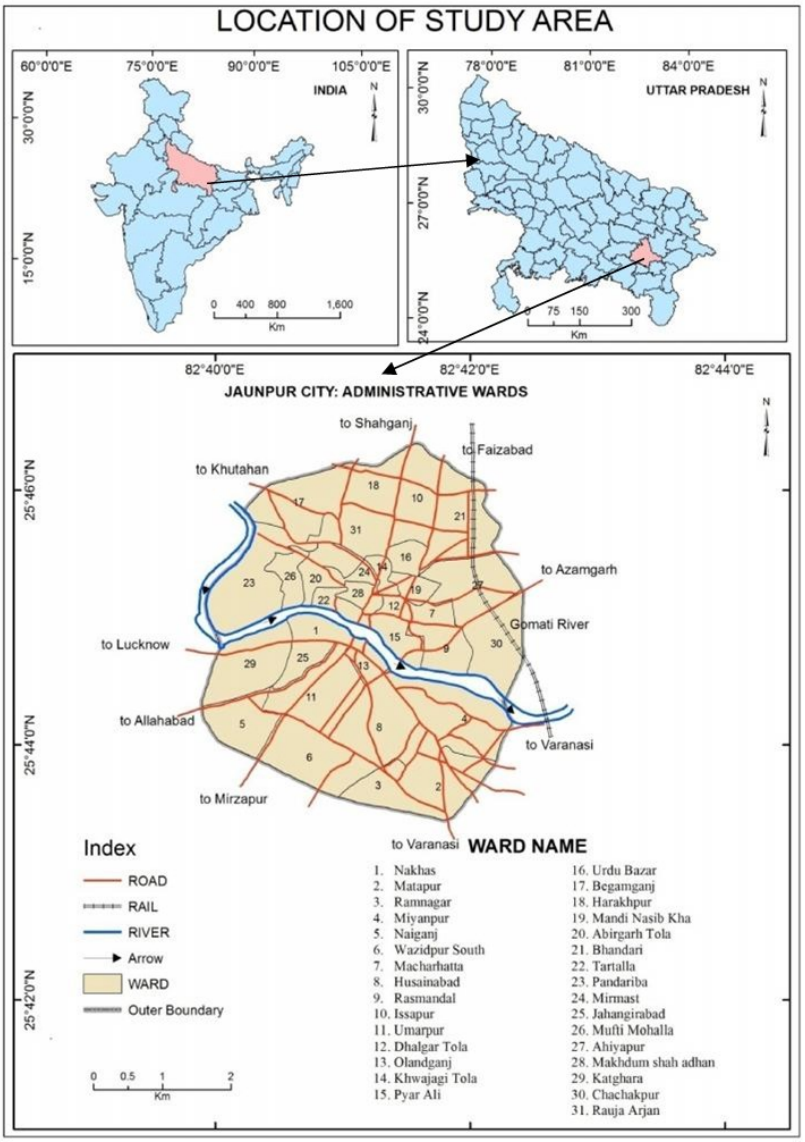

Figure 1 Location of the study area.

Thus, it enjoys a central position in the eastern Uttar Pradesh. It occupies a natural defensive site in the meander loop of the river Gomati. Jaunpur city is very well connected by railway and roads from other parts of the country. For administrative convenience of civic the city has been divided into 31 wards As per 2011 Census, Jaunpur city has a total population 346580 of which 179248 are males and 167332 are females. It recordeda decadal growth rate of 91.47 percent in its population. About 71percent of the population of city is literate of which 75.19 percent are males and 66.66 percent females. The sex ratio of the city is found to 925 females/1000 males.

3. Data Base and Methodology

3.1. Sampling and Analysis

Sampling sites were selected on the basis of upstream and downstream influences of Gomti River at Jaunpur city. Climatic condition of the study area is tropical with distinct seasonality. April to June is summer, July to late September is rainy season and November to February is winter with March and October are transition period. Soil of the study area is alluvial. Annual rainfall is near about 999.9 mm. with highest in rainy season. Four sampling sites were selected namely Gokul Ghat (upstream), Gular Ghat, Shatri Bridge and Gomti Barrage (dowmstream). Sampling was done on seasonal basis that is summer, Monsoon and winter. The studywas conducted over a period of one year during March 2016 to February 2017. The study area was divided into four sites based on the similarity of the physical habitat and distance coverage and each site was represented by four sampling locations.Samples were collected in triplicate from the mid stream directly below the surface of 6 cm depthin pre washed plastic bottle. Physical parameter such as temperature and pH were measured at sampling sites immediately. Samples were brought to the laboratory and preserved for further analysis. All analysis were done within one week of sampling and each parameters were estimated according to the methods in APHA (2005) and compared with standard values of BIS (1991) and WHO (1993).

4. Results & Dicussion

The physical chemical characteristics of total 6 variables are presented here in form of table and graph. The seasonal variation in water temperature is distinct. The water temperature varied with season. The water temperature ranged between 18.61 - 30.10 $^{\circ}$C, higher temperature ranges were found in summer season at all sampling sites followed by monsoon and winter (Table 1 & Fig.2).The pH of the lotic water body is an important determinant of the water quality and the extent of the pollution. BIS and WHO guidelines suggested that the pH range 6.5 – 8.5 is good for freshwater ecosystem. In the present study the pH ranges were found from 7.57 – 8.29 which qualified for BIS and WHO norms (Table 2 & Fig.3).

Dissolved Oxygen (DO) is an important indicator of water quality. The Dissolved Oxygen is very necessary for the well being and survival of the aquatic ecosystem. Dissolved Oxygen depends on the temperature of the water body, an increase in temperature leads to decrease in Dissolved Oxygen. Our finding showed that Dissolved Oxygen range from 6.21 – 8.81 mg/liter with highest in winter season followed by monsoon and summer (Table 3 & Fig.4). A slight decrease in Dissolved oxygen was found in downstream of the river, this is due to comparatively more pollution as upstream. Biological Oxygen Demand (BOD) indicates the oxidation of organic matter with the help of microbes. High Biological Oxygen Demand indicates the high oxygen demands for the

breakdown of organic matters. High Biological Oxygen Demands also indicates high pollution level in water bodies. In our study BOD ranged between 1.54 – 2.68 mg/litre with highest in summer. The high concentration of BOD in summer season is due to low flow and high temperature. BOD also increase towards downstream, this is due to addition of untreated sewage from the city containing high organic load (Table 4 & Fig.5).

Nitrate and Phosphate are the most important nutrient for the Phytoplanktons. Nitrate – N concentration ranged from 6.81 - 10.77 mg/litre with distinct seasonality (Table 5 & Fig.6). Higher concentration was found in summer season and lowest in monsoon. The higher concentration in summer is due to low flow and addition of sewage. Phosphate concentration varied between 1.03 – 2.01 mg/litre with highest in summer (Table 6 & Fig.7). Phosphate mainly comes from the sewage, domestic wastes and agricultural runoff. The highest concentration of phosphate was found in summer season at all sampling sites. This is due to addition of sewage and low flow condition of the river. Our finding shows that the all parameters are in their permissible limit. If this condition will persist for longer term then it will cause harmful effect on river water. River water is important for both flora and fauna, humans are directly depends on river water. Sustainable use and well management of river water is very essential for the sustainable use of water. Untreated sewage should not be flows directly into the river. Religious idols which contain harmful metal and dyes should not be flow into the river. Cremation should be far from river banks. Soap bathing should be prohibited along river bank. All this measures should be strictly regulated for the effective management of river body. Water is supply from river to city through pump; if the water will be more polluted then it will directly affect the health of city population. Polluted water may cause Water-Borne diseases such as Cholera, Dysentery etc. so, before supply to the city treatment is required to reduce the pollutants.

Table 1 Seasonal Temperature of Four Sampling Sites.

Sampling Sites	Summer	Monsoon	Winter
Gokul Ghat	29.81	27.51	18.61
Gular Ghat	29.95	27.75	18.61
Shastri Bridge	30.01	27.82	18.65
Gomti Barrage	30.10	27.93	18.87

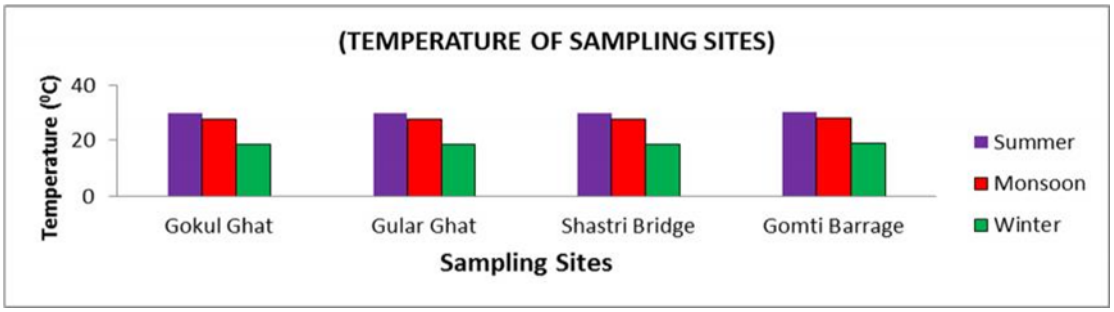

Figure 2 Temperature of sampling sites.

Table 2 Seasonal pH of Four Sampling Sites.

Sampling Sites	Summer	Monsoon	Winter
Gokul Ghat	8.29	7.88	7.76
Gular Ghat	8.21	7.74	7.69
Shastri Bridge	8.15	7.63	7.62
Gomti Barrage	8.08	7.58	7.57

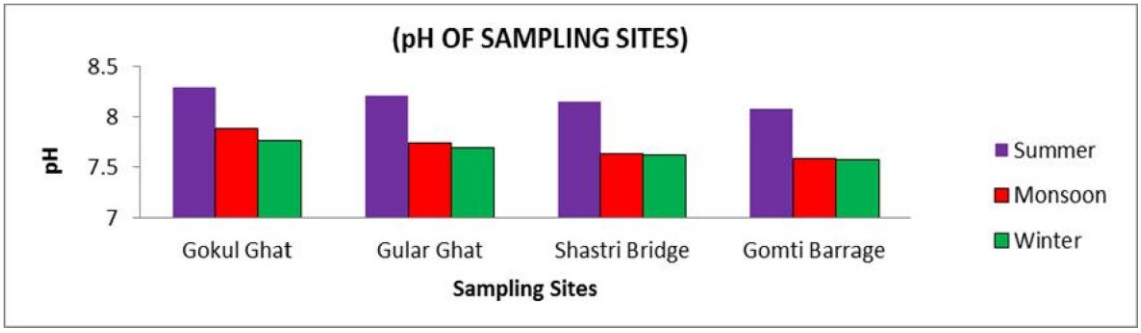

Figure 3 pH values of sampling sites.

Table 3 Seasonal Dissolved Oxygen (DO) of Four Sampling Sites.

Sampling Sites	Summer	Monsoon	Winter
Gokul Ghat	6.51	7.61	8.81
Gular Ghat	6.44	7.53	8.69
Shastri Bridge	6.32	7.41	8.53
Gomti Barrage	6.21	7.37	8.45

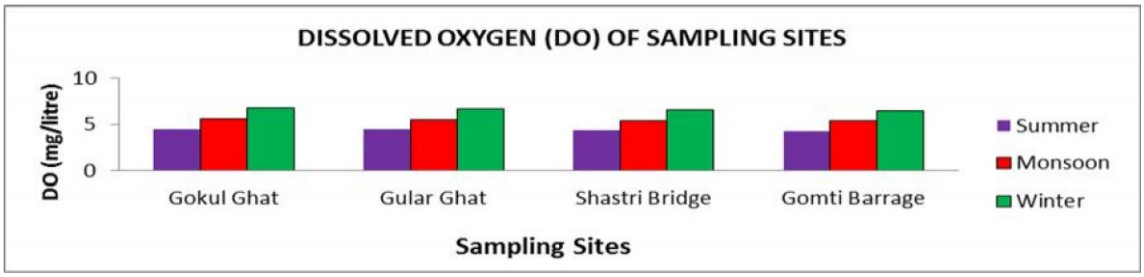

Figure 4 DO of sampling sites.

Table 4 Seasonal Biological Oxygen Demand (BOD) of Four Sampling Sites.

Sampling Sites	Summer	Monsoon	Winter
Gokul Ghat	2.32	1.86	1.54
Gular Ghat	2.45	1.93	1.62
Shastri Bridge	2.59	2.01	1.73
Gomti Barrage	2.68	2.09	1.77

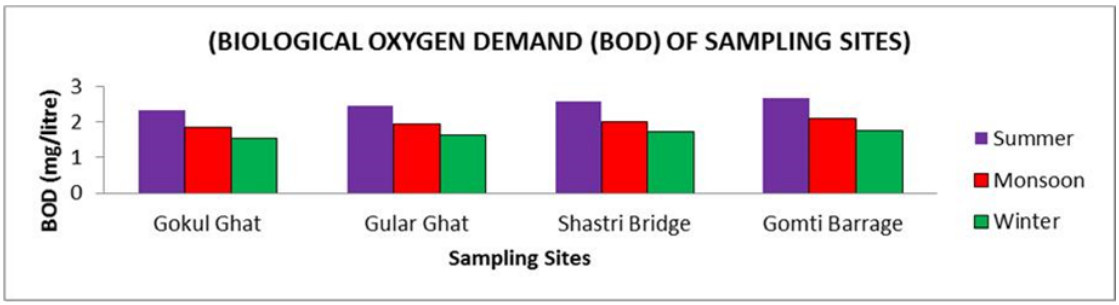

Figure 5 BOD of sampling sites.

Table 5 Seasonal Nitrate Concentration of Four Sampling Sites.

Sampling Sites	Summer	Monsoon	Winter
Gokul Ghat	10.23	6.81	8.51
Gular Ghat	10.29	6.87	8.54
Shastri Bridge	10.40	6.91	8.68
Gomti Barrage	10.77	7.23	8.85

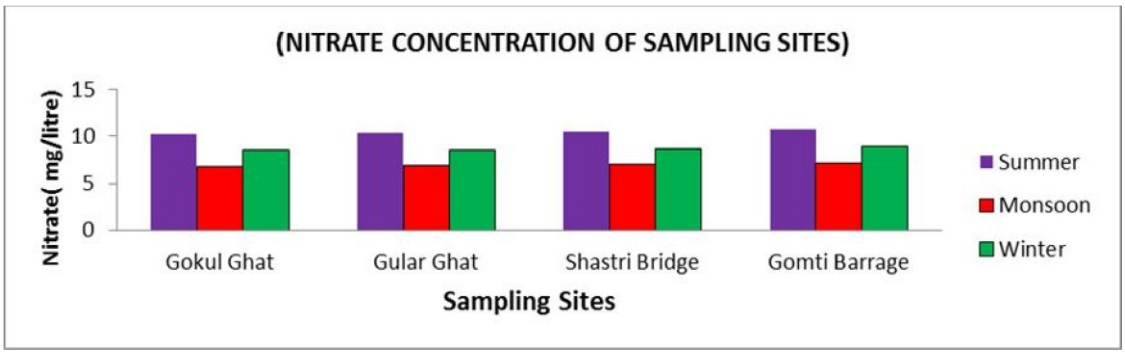

Figure 6 Nitrate Concentration of sampling sites.

Table 6 Seasonal Phosphate Concentration of Four Sampling Sites.

Sampling Sites	Summer	Monsoon	Winter
Gokul Ghat	1.56	1.03	1.22
Gular Ghat	1.58	1.11	1.33
Shastri Bridge	1.71	1.25	1.41
Gomti Barrage	2.01	1.42	1.56

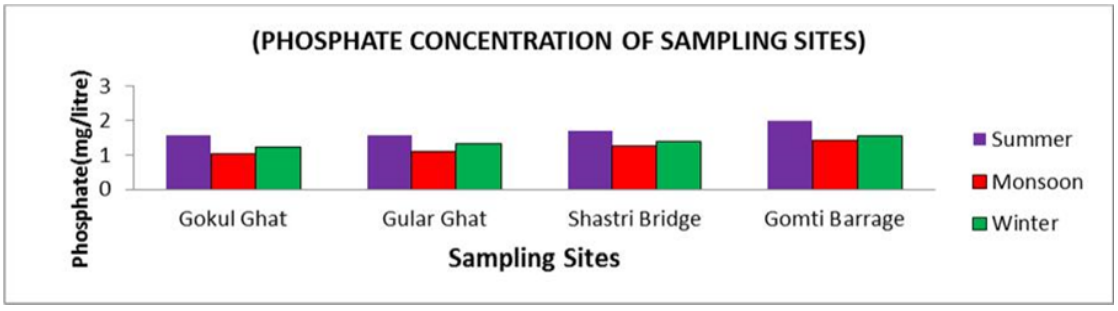

Figure 7 Phosphate concentration of sampling sites.

5. Conclusions

From the above investigation it may be concluded that the physicochemical characteristics of Gomti River at Jaunpur city, total six parameters have considered for the study. The data shows that all the six variables such as temperature, pH, DO, BOD, Nitrate and Phosphate are in their ranges of aquatic ecosystem. But if it will persist for longer time then it will be harmful. Therefore in order to prevent the river water from pollution all the city sewage must be treated before its discharge into the river. Besides this, there should be continuous monitoring of the pollution level is necessary and immediate action is required for its better management.

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