Qualitative Assessment of river Gomti in Lucknow emphasizing the trace metal: A report of winter season

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Abstract

Gomti river receives industrial as well as domestic wastes from various drains of Lucknow city. In the process the water of the river Gomti get contaminated with heavy metals and other pollutants. A study was made for water quality assessment of Gomti river(Lucknow city stretch) at five sampling stations viz. Gau ghat**,** Pakka pul, Daliganj bridge, Nishatganj bridge , Pipra ghat. Eight physico-chemical parameters along with eight heavy metals were analysed to assess the impact of effluents on water quality. Among the metal studied Cd, Cr, Cu, Fe, Mn, Ni, Pb and Zn showed the lower concentration, which was below the permissible limit for drinking water prescribed by Bureau of Indian standards (BIS). Result of present study are indicative of deteriorating life sustaining quality of river water as well as its non suitability for domestic consumption. Possible effects of water quality on aquatic life as well as possible remedial measures have also been discussed.

Key words: trace metal, River Gomti, Pollution

Introduction

The natural water analysis for physical, chemical properties including trace metal element content are very important for public health studies. These studies are also a main part of pollution studies in the environment (Reza and Singh,2010, Nair et.al.,2011). Also, investigation of the quality of river water samples have been continuously performed by researches around the world. Water quality degradation by various sources becomes an important issue now a days. Soil salinization and increase in the use of agricultural fertilizers, common pesticides use erosion have become problems threatening natural water sources (Vinit Kumar et.al., 2011). River pollution is not a new problem. Rivers have long been used for a variety of purpose by man. River water is used for domestic water supply in different part of the world and therefore the analysis of toxic pollutant

in river water has received great attention. Gaur et.al. (2005) noticed heavy metal distribution in river Gomti and Singh (2012) also studied the heavy metal in Gomti river.

Heavy metal contamination in river Gomti is one of the major issues in many growing cities, because maintenance of water quality did not increased along with population and urbanization growth (Akan et.al., 2010, Sharma et.al.,1992, Ahmed et.al., 2010).Heavy metals are also known to have serious health implications including carcinogenesis induced tumor promotion (Schwartz, 1994). Heavy metals are non biodegradable and they persist in the environment and may become concentrated up the food chain (Eja et.al.,2003).

In view of the above , an extensive study of river through the city was conducted to determine the amount of pollution. The aim of this study is to assess the level of heavy metals and present status of physicochemical parameters in river water in winter season arid to assess the pollution status of river .

Material and Methods:

River Gomti is a tributary of river Ganga arising from foothills of pilibhit and join Ganga near Jaunpur covering 940 Km stretch. Sampling sites were selected near Lucknow (U.P.) India (N 26^0 52' 30") and E (80^0 52' 31") in about 10 km. strech and samples were fixed from upstream (Gaughat) to down stream (Pipra Ghat). Five sampling sites are selected viz. A .Gau Ghat, B.Pakka Pul ,C. Daliganj Bridge,D. Nishatganj Bridge ,E.Pipra Ghat. The water samples were collected from all the sampling sites from gaughat to pipraghat . The collected samples were kept in polythene bottles with addition of 2 ml conc. HNO_3/litre. Samples were stores at 4^0C. Samples were filtered through Whatman No.42 paper, digested with nitric acid and metal concentration was estimated with an Inductive couple plasma emission spectrophotometer (ICP)-Philips Model # 1231 with the help of Central Institute of Medicinal and Aromatic plants (CIMAP), Lucknow(U.P.) India. For physicochemical analysis water samples of 2 litres were collected with the help of fisherman between 7.00 am to 10.00 am. Samples were brought to laboratory with care and precaution and analysed for various physic-chemical parameters viz. pH, temperature, dissolved oxygen, CO2, alkalinity, acidity , hardness and chloride according to guidelines of APHA (1998) and method described in Trivedi and Goel (1986). Results obtained in replicates were subjected to statistical analysis with minitab software on P.C.

Results & Discussion:

Results of analysis of various physico-chemical parameters of river Gomti at different sampling sites during winter season,2014 are shown in Table-1. These characteristics were examined according to guidelines of APHA (1998) and in reference to IS:10500 standards as prescribed by BIS(1991). The concentration of trace metals obtained during winter season along five sampling sites are summarized in table-2.

Temperature: Water temperature of studied sites was between 16.2^0 C to 20^0C. Maximum temperature was observed at site-A (20^0C) and minimum at site-E (16.2^0). These observation are in agreement with Mahananda et al., 2010, Srivastava et al, 2009). Influence of temperature may be due to different seasonal climatic variation (Parshar et.al., 2008). Temperature influences the bacterial growth responsible for the decomposition of organic matter for nutrient recycling (Mohamed and Korium, 2009). The desirable pH range for drinking water is from 7.23-8.74. Deviation of this range indicate the entry of acidic and basic medium causing lot of health problem. Similar observation were made by Patra et.al. (2010), Mahananda et al.(2010). During the present investigation a pattern of pH change was noticed. Maximum value of pH, which indicate the alkaline nature of water might be due to high temperature that reduce the solubility of CO_2. The average value of dissolved oxygen 8.45 mg/l is indicative of average life sustaining quality of river (APHA, 2005).Variation in dissolved oxygen value of Gomti river ranged between 8.41 mg/l- 9.51mg/l at different sampling site from upstream to downstream. Maximum value of D.O. was observed at site-A (9.51 mg/l) at Gaughat while minimum value was observed at Site-C (8.41 mg/l) at Daliganj bridge. Water at gaughat site may be considered negligibly polluted, can be used for various household purpose but not for drinking without proper treatment. The depletion of DO at site –C may be due to stagnant condition and chemical impurities and sewage discharge of the city leading to microbial growth, algal blooms etc. (Murugesan et.al, 2007). CO_2 concentration was observed maximum 52.6 mg/l at site-C and mimimum 38.3 mg/l at site-B. The increase at site-C as well as poor dissolved oxygen value represent poor river condition due to influx of sewage and industrial effluents. The concentration of acidity was observed maximum at site-A (55.3 mg/l) and minimum at (34.3 mg/l). The value of acidity provide an idea of material salt present in water. The concentration of alkalinity were observed maximum 213 mg/l at site-A and minimum at site-D (120 mg/l). It was lower than maximum permissible limit (600 mg/l) as per BIS recommendation (BIS, 1991). Ahmed et.al. (2010) reported the water quality assessment of river Gomti at Lucknow. Alkalinity is an estimate of the ability of water to resist change in pH upon addition of acid. The variation in total hardness ranged between 155-196 mg/l. It was lower than maximum permissible

limit (600 mg/l). Although hardness has no known adverse effect on health. It is undesirable due to formation of heat retarding insulating scales in the boilers and other heat exchange equipment. For hardness and alkalinity almost similar results were obtained by Singh (2002). Alkalinity and hardness are closely related (Tripathi, 2006). The concentration of trace metals during winter season along five sampling sites are summarized in table-2. Cadmium concentration was observed in between 0.001- 0.002 mg/l at different sampling sites. The analytical data of Cd was below the permissible limit of 0.01 mg/l in river. Cd is extremely toxic and primary use of water high in Cd cause adverse health effect, such as renal disease and cancer (Friberg et.al.,1986). Cd is absorbed strongly to sediment and organic matter (Sanders et.al.,1999). The possible source of contamination of Cd might be due to runoff from agricultural soil. Zn concentration was noticed in between the range of 0.01-0.02 mg/l at all sites. It may also be because of coloured clay statues thrown in the river during the many festival. Chromium was noticed in between the range of 0.002-0.004 mg/l. At site-A it was found below detection limit. Concentration of Cr also permissible limit by WHO i.e. 0.05 to 1 mg/l. This may be due to waste water coming from cottage industries situated in the chowk area. Reza and Singh (2010) reported the Cr concentration was less than 3mg/l in winter season in river water. Copper concentration was found in between the range of 0.003-0.006 mg/l. This is due to automobile repair shops, electroplating unites, utensil manufacture situated in the area surrounding the river corridor. Wu et al. (2008) reported Cu concentration in river water and concluded that it may be due to sewage and run off from extensive farmed area. Fe concentration 0.003-0.008 mg/l at five different sites.

Higher concentration of Fe was also reported by Singh (2001 and 2002). During the entire study the Cd, Zn, Cr, Cu ,Ni and Pb content were well within the BIS permissible values among all the stations. Similar observation have been made by Pandey et.al. (2010) in Ganga river in west Bengal. The concentration of Pb was noticed in between the range (0.004-0.053 mg/l) at different sites. Water contamination due to Pb could be from sewage effluent discharge and also from waste in accordance with the studies done by Haque et.al.(2005) in the surface water of river Ganga. Ni was detected minimum at site-B i.e. 0.004 mg/l and maximum i.e. 0.017 mg/l . Similar observation have been made by Singh (2002) in Gomti river. This may be because of the closure of some cottage industries generating Ni in their effluents. Mn concentration was detected in between the range of 0.001- 0.003 mg/l. This kind of pattern indicate the accumulation of heavy metal concentration during low flow condition of river. The previous studies has been ensure that the atmospheric precipitation and sediment adsorbation is very much responsible for metal concentration in surface water (Lohani et.al., 2008, Ahmed et.al.,2010).

Table 1: Physico-chemical characteristic of water of river Gomti sampled at various sites in winter season during-2015

S.No.	Parameters	Site-A	Site-B	Site-C	Site-D	Site-E
1	Temperature	20 ± 0.05	16.8± 0.23	18.3± 0.05	17.2± 0.36	16.2± 0.28
2	pH	7.23± 0.01	7.32±0.04	8.74±0.04	7.56±0.02	8.41±0.01
3	Dissloved Oxygen	9.51±0.07	8.71±0.10	8.41±0.02	8.45±0.08	9.41±0.04
4	Free CO_2	42.3±0.18	38.3±0.69	52.6±0.96	44.1±0.16	48.6±0.68
5	Acidity	55.3±2.18	42±.57	41.3±0.02	34.3±2.02	24.5±0.24
6	Alkalinity	213±3.78	184±2.08	136±2.72	120±1.85	123±2.08
7	Hardness	174±2.17	155±1.52	196±1.86	189±0.87	167±2.72
8	Chloride	16.4±0.4	18.5±0.31	24.1±0.49	20±0.24	17.4±21

Note: All parameters are in mg/l except temperature ^{0}C and pH

Table-2 : The concentrations of trace metal ions in Gomti river water samples during winter season- 2015

S.No.	Sites	Concentration mg/litre							
		Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn
1	Site-A	0.001	BDL	0.005	0.003	0.002	0.008	0.053	0.011
2	Site-B	BDL	0.002	0.003	0.003	0.002	0.004	0.004	0.011
3	Site-C	0.001	0.004	0.006	0.008	0.001	0.008	0.034	0.019
4	Site-D	0.001	0.003	0.006	0.007	0.003	0.008	0.037	0.012
5	Site-E	0.001	0.004	0.005	0.008	0.002	0.017	0.037	0.020

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References

Ahmed MK, Islam S., Rahman S.,Haque MR and Islam MM (2010). Heavy metal in water, sediments and some fishes of Buriganga river Bangladesh, Int.J. Environ. Res.,4(2): 321-332.

Akan J.C., Abdulrahman FI, Sodipo OA, Ochanya AE and Askira YK (2010).Heavy metals in sediments from river Ngada, Maiduguri Metropolis,Borno state,Nigeria. Journal of Environment Chemistry and Ecotoxicology.Vol.2(9),pp.131-140.

Eja CE, Ogri OR, Arikpo GE (2003). Bioconcentration of heavy metals in surface sediments from the Great Kwa river estury, Calabar, Southeast Nigeria. J.Nig. Environ.Socia.,1:247-256.

Friberg,L., Elinder,C.G., Kjellstroem,T. and Nordberg,GF (1986). Cadmium and health. A toxicological and epidemiological appraisal. Effect and response CRC press,Boca,Roton,Florida 11:1.

Gaur,VK, Gupta SK,Panday SD, Gopal K and Misra V (2005). Distribution of heavy metal in sediments and water of river Gomti. Enviromental Monitoring and assessment,102,419-433.

Haque ,M.R.,Ahmad, J.U., Chowdhury,M.D.A.,Ahmad, M.K., Rahman,M.S. (2005). Seasonal variation of heavy metal concentration in surface water of river and estuaries of Sundarban mangrove forest. Pollution Res.,24: 463-472.

Lohani, M.B., Singh,S., Rupainwar,D.C. and Dhar,D.N. (2008). Seasonal variation of heavy metal contamination of river Gomti at Lucknow city region.Environ. Monitor. Assess. 147 (1-3): 253-263.

Mahananda MR, Mohanty BP, Behera NR (2010). Physico-chemical analysis of surface and ground water of Bargarh district,Orissa,India. IJRRAS 2 (3),March.

Mohamed,A.F., Toufeek and M.A.Korium (2009). Physico-chemical characteristic of water quality in Lake Nasser water. Global journal of Enviromental Reasearch, 3(3): 141-148.

Murugesan,A.G.,Perumal,C.M. and Ruby ,J.(2007). Physico-chemical of biological study of the river Chittar at Courtallam, Tamilnadu (India). J.Environ.Sci. Engg.,49(2):121-126.

Nair Indu V.,Singh K., Arumugam M.,Clarson D. (2011). Monitoring of trace metal pollution in Meenachil River at Kottayam, Kerala (India). E-Journal of Chemistry,8(1),257-263.

Pandey,J., Shubhashish,K., and Pandey, R. (2010). Heavy metal contamination of Ganga river at Varanasi in relation to atmospheric deposition. Tropical Ecology,51(25): 365-373.

Parashar C,Verma N., Dixit S., and Srivastava R. (2008). Multivariate analysis of drinking water quality parameter in Bhopal,India.Environ.Monitt Assess.,140:119-122.

Patra,A.P.,Patra J.E., Mahapatra ,N.K. ,Das,S. and Bwain, G.C.(2010). Seasonal variation in physic-chemical parameter of Chilka Lake after opening of new mouth near Gabakunda,Orissa,India. World journal of fish and Marine Sciences,2(2):109-117.

Reza R., Singh G.(2010). Heavy metal contamination and its indexing approach for river water. Int.J.Environ.Sci. Tech.,7(4),785-792.

Sanders, M.J., Preez, HH and Van vuran JHJ (1999). Monitoring Cd and Zn contamination in fresh water system with the use of the fresh water crab.Potamanautius warrenii Water SA 25(1):91-98.

Schwartz J (1994). Air pollution and daily mortality: A review and metal analysis. Enviromental Research,64: 26-35.

Sharma YC,Prasad G and Rupainwar DC (1992). Heavy metal pollution of river Ganga in Mirzapur,India. International J.of Enviromental Studies, Vol.40,pp.41-53.

Singh K.P. (2002). Report on monitoring and assessment of the Gomti river quality. Industrial Toxicology Research centre, Lucknow.

Singh KP (2002 and 2001). Report on monitoring an assessment of the Gomti river quality. Industrial Toxicology Research Centre, Lucknow.

Singh P (2012). Monitoring of trace metals in river Gomti (U.P.),India: A report of winter season. J. Natcon 24(2): 175-180.

Srivastav,N, Harit,G and Srivastava R (2009). A study of physicochemical characteristic of lakes around Jaipur,India. Journal of Enviromental Biology,30(5):889-894.

Tripathi,C.P., Singh,N.K. and Bhargava,D.S. (2006). Qualitative assessment of river Gomti in Lucknow emphasizing the trace metals.

Vinit Kumar, Arya S., Sonkar P.,Minakshi, Dhaka A and Chanchal (2011). Water quality status of historical Antiya tall at Jhansi city as a primary data for sustainable approach. Recent research in Science and Technology,3(8): 52-55.

Wu,Y.F., Liu,C.Q.,Tu, C.L. (2008). Atmospheric deposition of metals in TSP of Guiyang; PR China. Bull Enviromental Contain. Toxicol., 80(5): 465-468.