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Toxicity of heavy metals in the water quality of Ganga River in Kanpur, Uttar Pradesh, India

Dr. Anupama Rai
Directorate of Education, Andaman and Nicobar Administration, Port Blair, Andaman and Nicobar, India

Abstract
A study to find the toxicity of heavy metals in the water quality of Ggana river in Kanpur, Uttar Pradesh, India area was carried out over a period of Jan. 2018 to Dec. 2018. Water samples from Kanpur (Shuklaganj New Ganges Bridge, Ordnagar, Baba Ghat, Bhairav Ghat and Khayora Kati) were analyzed for heavy metals like Cu, Cr, Fe, Mn, Zn, Cd and Pb. The pH of these water samples was found in alkaline range (7.21-8.18). The concentration of PB varies between 0.44±0.32 ppm and 0.33±0.31 ppm. Cd concentration was seen to range from 0.022±0.11ppm to 0.008±0.06 ppm. The content of Cr is from 0.054±0.56 to ppm 0.38±0.33ppm. Highest concentrations of heavy metals of Cu (0.173±0.283ppm) and PB (0.44±0.32ppm) were found in Ordnance town sample, Cr (0.054±0.56) in Khyora katari water sample, Cd (0.022±0.11ppm) in Baba ghat water sample, Fe (0.366±0.98ppm) in Khyora katari water sample.

Keywords: heavy metal; drinking water; water pollution; water quality

Introduction

Water is the most vital issue for life existence on earth. The extent and best of the world's water has been deterioting with exponential growth in human populace and its desires for industrial and agricultural activities. Metal infection in river water is an increasing number of turning into frequent in India. Toxicity caused through metals posing trouble for ecological, evolutionary, dietary and environmental areas. Presence of metals in river water in excesses may also purpose a giant hazard to human fitness and ecological systems.

The essential sources of heavy steel air pollution are mining, milling, plating and surface finishing industries that discharge a variety of poisonous metals such as Cr, Cu, Cd, Mn, Pb, Zn and Fe into the environment. Over the last few decades, the attention of these heavy metals in river water and sediments has extended rapidly. Consequently, concentrations of poisonous metals in grains and veggies grown in contaminated soils have accelerated at alarming rates. This poses a serious hazard to human beings and the environment due to the fact of its toxicity, non-biodegradability and bioaccumulation (Bahadir *et al.*, 2007; Perez-Marin *et al.*, 2008; Reddad *et al.*, 2003) [1-3].

River Ganga is one of the biggest and longest rivers in India and originates from Gangotri in the Himalayan Mountains. After flowing about 2,525 km the river meets the Bay of Bengal near Kolkata. The vital cities positioned at its banks are Rishikesh, Haridwar, Kanpur, Allahabad, Varanasi, Patna and Kolkata.

The river Ganga flows via Varanasi, a metropolis which has a prosperous cultural, religious and religious heritage. A wide variety of small industries like, metallic smelting, electroplating, fabrics dye, painting, electrical and batteries are going for walks in Kanpur. Effluent discharges of these industries contain increased stages of heavy metals like Cr, Cu, Pb, Cd, Zn and Mn etc. (Singh *et al.*, 2009). Heavy metals enriched untreated effluents are oftentimes being dumped off in the sewage system. In India 90% of the sewage generated stays non treated and are discharged in open water bodies. Thus the discharges of untreated sewage, industrial and agricultural effluents are the important source of these heavy metallic in Ganga water. The Ganga water in Varanasi is quite affected with the aid of heavy metals like Cr, Cu, Pb, Cd, Zn and Mn etc. The monitoring stations at Kanpur, Patna, West Bengal have indicated that industrial effluents are broadly speaking accountable for the pollution (Khwaja *et al.*, 2001, Parshuram and Singh, 2007 and Kar *et al.*, 2008) [4-6]. These heavy metals in water our bodies are nondegradable in nature, accumulate from one trophic degree to the subsequent and show their toxic consequences and finally detoriate the water quality. Eventually they have an effect on the aquatic surroundings as well as human being. Heavy metals contamination makes water unfit and non-potable for human health via direct and oblique way. It would no longer be out of vicinity to mention that human beings settled along the financial institution of Ganga in this historical city of Varanasi depend closely on its water for drinking as properly as for different domestic purposes. Some of the heavy metals like Cr, Cu, Zn, Mn and Fe are useful in trace amount as a nutrient for flora and microorganisms however at higher concentration it is hazardous (Marschner, 1995, Bruins *et al.*, 2000, Singh, and Sarma, 2005, Singh, *et al.* 2006, Singh, 2010) [7-11].

Cd and Pb are no longer required for any physiological activity. Their presence in water reasons problems associated to muscular, reproductive, behavioural, neurological and gastrointestinal systems (Abbasi *et al.*, 1998 and Tsuji and Karatzides, 2001) [12-13]. Therefore, detection of these heavy metals in Ganga water samples is integral to consider the Ganga water quality with recognize to consuming and agricultural irrigation purposes.

The water of all these rivers works as a primary source for ingesting and irrigation in the place of Kanpur. Therefore, in order to restoration the nice of existence and water nice of all these rivers, appropriate water useful resource planning application be developed.

2. Study site

The latitude of Kanpur, Uttar Pradesh, India is 26.449923, and the longitude is 80.331871. Kanpur, Uttar Pradesh, India is located at India country in the *Cities* place category with the gps coordinates of 26°26' 59.7228" N and 80° 19' 54.7356" E. Kanpur elevation is 133 meters height, that is equal to 436 feet.

Fig 1: Map showing location of Ganga river at Kanpur.

Kanpur is situated on the banks of river Ganga and its area is approximately 1040 sq km and it is 126 meters above sea level. In 78 km. on the distance between Kannauj and Kanpur Barrage, there are agricultural activities at the bottom of the river, mainly Cucurbitaceous Crops are known as "plazas". There is a great decline in the quality of river water. The second distance of 7.5 km from Kanpur There is widespread floods in Shuklaganj and due to domestic and industrial waste and dumping of solid waste, there is widespread impact on the quality of river water, the most important in case of pollution load of 5.5 km from Shuklaganj to Jajmou. Kanpur has about 5500 industries with 75 medium and large industries such as compost, detergent, chemical and paint factories. Of these, 350 heterogeneous leather industries are allowed to flow in the Ganges in an area called Jajmau along the Ganges river. The river is known to move to Kanpur through time.

3. Materials and Methods

According to the standard quality (Rai, 2019) [14] in National Institute of Hydrology, Roorkee Laboratory (an ISO 9001-2008 certified) BIS [26], the quality of water was analyzed. These samples were treated with 2%HNO_3 for preservation of metals in water samples and to avoid precipitation. The pH of water samples were determined with pH meter having electronic glass electrodes. For determination of heavy metals, 100ml water samples were digested with 2.5 ml HNO_3 and $HClO_4$ (10:1) ratio on hot water plate (Eaton *et al.*, 1995) [15]. Later it was filtered with whatman No.42 filter paper. Samples were analyzed for the presence of heavy metals in Atomic Absorption Spectrophotometer at different wavelength. Sampling location map software of Ganga river is prepared using USED-Arc GIS 9.3 and Surfer 9.

4. Result and Discussions

All the five surface water samples of River Ganga had been analyzed for Cr, Cu, Cd, Mn, Pb, Zn and Fe (Table 1). The Fe content material was observed to be extra than the permissible restrict in all the water samples. Maximum Fe (0.366ppm) attention was discovered in water samples of Khyora katari. Cu used to be analysed more than permissible restriction in 5 water samples. Highest awareness of Cu (0.173ppm) was once found in water samples of Ordnance town. Highest attention of Cr (0.054ppm) used to be discovered in water samples of Khyora katari. Pb content material used to be found in maximum concentration (0.44ppm) was once discovered in water samples of Ordnance town. Cd used to be determined in fourteen water samples and most attention (0.022 ppm) used to be discovered in Baba ghat water samples.

Some of the heavy metals like Fe, Cu, Zn, Cr and Mn are imperative as micronutrient for plants, microbes and humanbeings (Singh and sarma, 2005; Singh *et al.*, 2006) [9-10]. The range of concentration of essential metals in Ganga water is as follows: Fe>Zn>Cu>Cr>Mn>Pb>Cd (Fig. 2). Lead (Pb) is the reasons of extreme health issues like convulsions, coma, and renal failure and at higher concentration demise can also occur. It creates neurotoxic consequences on growing foetuses (US Agency 1999) [16]. It has been mentioned that lead saved in the maternal bone are mobilized at excessive rate mainly throughout being pregnant and lactation (Gulson *et al.*, 1997) [17] period. It affects foetus delivery weight, boom charge and mental improvement (Gonzalez-Cossio *et al.*, 1997) [18]. Cadmium is a danger component for human fitness because it creates testicular degeneration (Benoff *et al*., 2000) [19] and prostate cancer (Ye *et al.*, 2000) [20]. Moreover, it damages the proximal tubules of each nephron of the kidney. The affected character suffers via leakage of low molecular weight proteins and crucial ions like Ca into urine and eventually kidney failure (Satarug *et al.*, 2000) [21]. Due to Cd exposure, the humans suffer thru vulnerable bone due to loss of Ca (Staessen *et al.*, 1999) [22]. Use of higher heavy metals (Cr, Cd and Pb) containing Ganga water for ingesting motive has reason of carcinoma of gall bladder in the people of jap Uttar Pradesh and Western Bihar of India (Shukla *et al.*, 1998; Strobel *et al.*, 2001; Namasivayam and Rangnathan, 1995) [23-25].

Table 1: Heavy metals concentration in water samples of river Ganga in Kanpur, Uttarpradesh.

S No.	Parameters	Study sites				
		Shuklaganj New Ganga bridge	Ordnance town	Baba ghat	Bhairav ghat	Khyora katari
1.	Cr	0.043±0.040	0.049±0.42	0.38±0.33	0.045±0.39	0.054±0.56
2.	Cu	0.057±0.023	0.173±0.283	0.168±0.032	0.102±0.052	0.110±±0.090
3.	Cd	0.012±0.010	0.018±0.12	0.022±0.11	0.008±0.06	0.016±0.12
4.	Mn	0.039±0.028	0.068±0.046	0.049±0.033	0.034±0.028	0.044±0.036
5.	Pb	0.35±0.22	0.44±0.32	0.33±0.31	0.36±0.24	0.42±0.38
6.	Zn	0.175±0.088	0.182±0.090	0.167±0.66	0.188±0.98	0.182±0.84

7.	Fe	0.342±0.98	0.336±0.88	0.332±0.90	0.354±0.87	0.366±0.98

Permissible limit (PL) of heavy metals Cu (PL)=0.05 ppm, Mn (PL) = 0.1 ppm, Cr (PL)=0.05 ppm, Zn (PL) = 5 ppm, Fe (PL)=0.3 ppm Pb (PL) = 0.05 ppm Cd(PL)=0.01 ppm; Below Detection Limit (BDL)

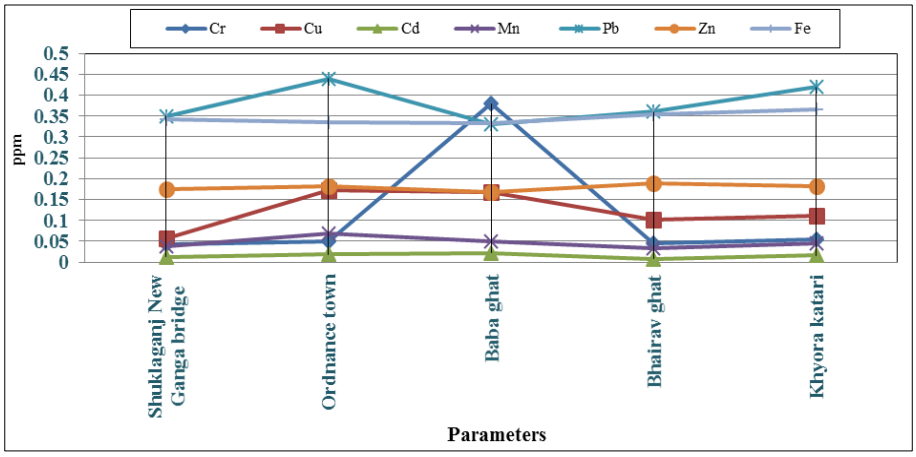

Fig 2: Heavy metals concentration in water samples of river Ganga in Kanpur, Uttarpradesh.

5. Conclusion

Stormwater runoff from urbanized areas is a significant source of metal pollution in the receiving water streams. Metal composition of urban runoff water is dependent on many factors, such as city planning, traffic, road construction, land use, and the physical characteristics and climatology of the watershed

All the samples have proven Fe concentration greater than permissible limit. Cu awareness is extra than permissible limit in all the water samples except one website online (Ordnance town) where it varies between 0.173±0.283 ppm and 0.057±0.023 ppm. In general, the concentration of heavy metals in industrial effluents is much greater than their prescribed permissible limits in the aqueous solutions, so there is an urgent need to treat the metal containing effluents before they are discharged into the aquatic bodies. Metals and their concentrations in industrial waste discharges specifically depend on the profile of that particular industry.

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