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Rapid assessment of quality of ganga river water at kanpur uttar pradesh

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ABSTRACT

The present investigation is an attempt to study the effect of sewage discharge into river Ganges and to record the qualitative change in water. Water samples were collected from Kanpur sampling station on the Ganga river within Kanpur city in the year 2012 (April) -2013 (March) and analyzed for 14 water quality variables (physico- chemical) parameters, the data obtained were standardized and subjected to principal components analysis (PCA) to define the parameters responsible for the main variability in water quality variance for Ganga River within Kanpur city. Results reveal that total dissolved solids, total alkalinity, total hardness were the parameters that are most important in assessing variations of water quality in October, November, December, January, February, March, April (post monsoon season) in the river. Results also reveal turbidity, suspended solid were the parameters that are most important in assessing variations of water quality in June, July , August and September in the river (monsoon season). This study suggests that PCA technique is useful tool for identification of important river water quality monitoring months and parameters. Ca^{+2}, Cl^{-}, SO_4^{-2}, temperature, Flouride, pH, Fe, Oxygen consumption (O.C), Cl^{-}, Mg^{+2} are found to be non principal water quality parameters.

1. Introduction

The Ganga is a major river of the Indian subcontinent rising in the himalaya mountains and flowing about 2,510 km (1,560 miles) generally eastward through a vast plain to the bay of Bengal. Ganga flows southeast through the Indian states of Uttar Pradesh, Bihar, and West Bengal. In central Bangladesh it is joined by the Brahmaputra and Meghna rivers. Their combined waters (called the Padma River) empty into the Bay of Bengal and form a delta 220 miles (354 km) wide, which are shared by India and Bangladesh. It's plain is one of the most fertile and densely populated regions in the world[1]. In the Uttarakhand himalayas, where glacial water flowing from a cave at Gaumukh, is the origin of the Bhagirathi River. Gaumukh has been described as a desolate place at an altitude of about 4,000 meters (13,000 feet). Twenty-three kilometres from Gaumukh, the river reaches Gangotri, the first town on its path. Thousands of visitors come to Gangotri each year, from every part of the world[2]. The river which joins the Alaknanda river at Devaprayag, also in the Uttarakhand Himalayas, to form the Ganga. The Ganga then flows through the Himalayan valleys and emerges into the north Indian plain at the town of Haridwar[3]. After flowing 250 kilometres (160 mi) through its narrow Himalayan valley, the Ganges emerges from the mountains at Rishikesh, then debouches onto the Gangetic Plain at the pilgrimage town of Haridwar. At Haridwar, a dam diverts some of its waters into the Ganges Canal, which irrigates the Doab region of Uttar Pradesh, whereas the river, whose course has been roughly southwest until this point, now begins to flow southeast through the plains of northern India.

The discharge of the Ganges also differs by source. Frequently, discharge is described for the mouth of the Meghna River, thus combining the Ganges with the Brahmaputra and Meghna[4]. This results in a total average annual discharge of about 38,000 m^3/s (1,300,000 cu ft/s), or 42,470 m^3/s (1,500,000 cu ft/s). In other cases the average annual discharges of the Ganges, Brahmaputra, and Meghna are given separately, at about 16,650 m^3/s (588,000 cu ft/s) for the Ganges, about 19,820 m^3/s (700,000 cu ft/s) for the Brahmaputra, and about 5,100 m^3/s (180,000 cu ft/s) for the Meghna.

2. Experimental

Physiochemical analysis of water sample

Water has some specific physical, chemical and biological parameters. All these properties make water as a source of life existence. Physical properties can be assessed by nacked eye whereas chemical and biological properties assessed only by analysis. These parameter shows water is fit for drinking or not. Water having many physical properties[5] of its own such as it should be colourless, odourless, tasteless and transparent if all these properties altered it means water is not fit for drinking purposes. The given table **(Table 1)** shows some physicochemical parameters which were analysed and results shows the total suspended solids found in the sample which alters its transparency and indicate this is not fit for drinking purposes. The pH of Ganga river is high it is greater than normal drinking standard. pH above 7 means their salt concentration is high in to the water. In given table sulphate, nitrate and magnesium concentration is limited concentration of these are under Indian drinking standard, whereas concentration of chloride is greater

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than drinking standard given by Indian standard. Dissolved oxygen of river water is also under limit it means there are biological activities carried by different microorganism.

Table 1. Physico-chemical analysis of water

SN	Parameter	Industrial area		Commercial area		Indian standard for drinking water
		A1	B1	A2	B2	
1	Taste	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless
2	Colour	Colourless	Colourless	Colourless	Colourless	Colourless
3	Odour	Odourless	Odourless	Odourless	Odourless	Odourless
4	Turbid	Excess	Excess	Normal	Normal	Transparent
5	pH	7.5	7.8	6.1	7.2	6.5
6	SO_4^{2-}	110 (mg/l)	115(mg/l)	20(mg/l)	40(mg/l)	200(mg/l)
7	NO_3^-	1(mg/l)	1.1(mg/l)	0.7(mg/l)	0.5(mg/l)	45(mg/l)
8	Cl^-	78(mg/l)	82(mg/l)	60(mg/l)	65(mg/l)	250(mg/l)
9	Mg^{2+}	10(mg/l)	12(mg/l)	1(mg/l)	1.2(mg/l)	30 (mg/l)
10	DO	2.8	2.9	3.7	4	2-6 (ppm)

Heavy metal detection

Heavy Metal was detected from all the samples after the sample were digested by Concentrated HNO_3 and then Metals Detected by AAS (Atomic Absorption Spectrophotometer). **Table 2** shows the concentration of heavy metals in Ganga river in Kanpur (U.P. India). The above data also helps to show the difference in concentration of heavy metals from mid stream to river bank of water, there is small difference in mid stream and river bank sample of same sampling site but there is a great fluctuation assessed from the sampling site near industrial area and the sampling site apart from industrial area. This result may be shown because of the waste discharge from the industries is untreated and this may alter the quality of river water. Heavy metals released from industries and other place of Kanpur is dumped in to Ganga directly which alters the water quality of Ganga River. Heavy metals in water affect metabolic processes of living organism. The water quality of any place is also dependent upon the fertilizers used just near that water resource.

In the sample we found Zn, Cr, Pb and Cd heavy metals which affects directly or indirectly the human being. High concentration of heavy metal was found from industrial area sampling site. It means industries used such kind of raw materials which carried heavy metals and they do not treat their waste properly before discharge.

The **tables 2** show the heavy metal extracted from Samples collected in Industrial area (River bank and mid stream) and commercial area (River bank and mid stream) and the sample previously treated by first plant that is Lotus for 20 days. It is very effective in Lead extraction. The Concentration of lead is reduced from 690 microgram to 650 microgram by Lotus and further absorbed and reduced to 600 microgram in presence of EDTA. Lotus and EDTA also helps in extraction of some other metals such as Zinc, Cadmium, Copper etc. but it most effective on lead. Lotus plant also capable to remove other heavy metals, it absorbs around 10 microgram Zinc alone and around 20 microgram with EDTA, In same way it absorbs Cd and Cu also. It removes around 6 to 10 microgram Cd from sample and around 20 to 30 microgram Copper from water sample.

The concentration of heavy metal present in samples taken from Indusrial area of Kanpur and Commercial area of Kanpur and both samples are treated by *Nelumbo nucifera* (Lotus) for 20 days in first step which shows a great response in absorption of heavy metals. Lotus is an ornamental plant and also used for the worship of god but it shows a great response in absorption of lead from the water sample. The performance of lotus is also increased when it is applied with a chemical that is EDTA for 20 days again. The above data shows how EDTA helps to increase the rate of absorption reaction. The results show that EDTA with plant increases the rate of absorption reaction. This is a positive response for the waste water treatment process.

The results show that Eichornea is more effective for extraction of Heavy metals but lotus also give a response in absorption and Extraction of heavy metals. The Comparison of Metal absorption by the plants Eichornea and the lotus in commercial area and the shows Eichornea is more effective than lotus in heavy metal absorption alone as well as with EDTA. Although Eichornea is more effective in heavy metal absorption but lotus also plays a great role for extraction of heavy metals from water sample.

Table 2. Heavy Metal Concentration (microgram/l)

SN	Heavy Metal	Before Absorption(microgram/l)			
		Industrial area		Commercial area	
		A1	B1	A2	B2
1	Zn	210	225	55	60
2	Pb	690	700	100	102
3	Cd	32	36	18	20
4	Cu	110	115	50	51

3. Results and discussion

Hina Kousar and E.T. Puttaiah in 2009 worked on Application of Trapa bipinosa for the treatment of pulp and paper industry effluent[6] and got result that the ability of aquatic plants to absorb, translocate and concentrate metals has led to the development of various plant-based treatment systems. The potential to accumulate metals like iron, nickel, manganese and copper by Trapa bipinosa was assessed by subjecting them to different effluent concentrations of pulp and paper industry under laboratory conditions. Trapa showed the ability to accumulate substantial amounts of the metals during a short span of one week. Similar Response has been found in present Experiment where plants (Eichornea and Lotus) both are able to remove Heavy metals in few days and after that reaction formed saturation level.

N. Khellaf, M. Zerdaoui in 2008 used duckweed Lemna minor for assessment of Growth response of the Plant to Heavy Metal Pollution and got result that the aquatic plants were exposed to different concentrations of copper (Cu), nickel (Ni), cadmium (Cd) and zinc (Zn). Copper at 0.2 mg/L and nickel at 0.5 mg/L promoted the growth of Lemna fronds. At higher concentrations, Cu and Ni inhibited the growth of duckweed. Here, the present Experiment also shows that Eichornea and lotus both are efficient to exposed different concentration of heavy metals specially Eichornea is very efficient to remove Zn and Cd as Lemna minor and concentration of heavy metal to a limit do not hamper their growth but promotes the growth. The anchored hydrophyte, *Hydrocotyle umbellata* L. was employed by Sheza Khilji and firdaus E Bareen in 2008 for the removal of toxic metals from tannery sludge concentrations from a tanneries wastewater treatment plant. The accumulation of toxic metals in the plants was significantly increased, with increasing time of plants. A higher amount was accumulated in the roots than in the shoots. The bioconcentration factor of Cr was higher than that of Zn and Cu at the same exposure time, indicating a higher accumulation potential of Cr by H. Umbellate. *Hydrocotyle umbellate* is a hydrophyte. Eichornea is also an anchored hydrophyte and its roots are also very effective in heavy metal absorption. The Characters indicated by Sheza Khilji in his paper is near to similar with Eichornea and both are Effective for Metlal accumulation from waste water.

Firdaus E. Bareen and Sheza Khilji in 2008 shows result byexperiment on Bioaccumulation of metals from tannery sludge by *Typha angustifolia* L. The metal bioaccumulation capability of a common anchored hydrophyte, *Typha angustifolia* L. was studied in a green house trial. The plants could absorb significant amounts of the heavy metals like chromium, copper and zinc from tannery sludge. The bioaccumulation potential of T. angustifolia was greater for the heavy metals especially for Cr. Different Hydrophytes shows different metal accumulation. In present experiment Eichornea specially absorbes Zn and Lotus is more effective on absorption of Pb. Abdolkarim Chehregani and Behrouz E. Malayeri in 2007 assessed the removal of Heavy Metals by Native Accumulator. Plants growing in some area including *Euphorbia cheiradenia, Scariola orientals, Centaurea virgata, Gundelia tournefortii* and *Eleagnum angustifolia* could accumulate heavy metals in different organs. E. cheiradenia belonging to Euphorbiacea was more effective accumulator with effectively accumulating Pb, Zn, Cu, Ni and Cd. It is recommended by them that E. cheiradenia may be introduced as an effective plant for soil detoxification and phytoremediation in heavy metals polluted soils. Based on our study we can say that since in India Eichornea and lotus are easily available in different places therefor it can be effectively used in absorption of Heavy metals from waste water.

4. Conclusion

A large number of factors and geological conditions influence the parameters of water samples. From the present study we conclude that Ganga water is most probably not fit for drinking and it needs to be treated to reduce the contaminations especially heavy metals. Above result shows the industries lying in Kanpur is very much responsible for the heavy metal concentration found in Ganga river water. There is also difference found in concentration of metal from river bank to mid stream but this is not very substantial. This assessed difference is very nominal. Heavy metals in water cause many serious biochemical problems in human being.

This experiment was done for the better extraction of heavy metals by the help of plant in the water. Also, here the result shows ornamental plants have great capability of metal extraction from the waste water. Some chemicals are used as a chelating agent who increase the rate of reaction. EDTA is one of them. It works just as a chelating agent and also increases the rate of absorption of heavy metals in waste water. Thus, with the help of this research we conclude that ornamental plants have great efficiency for heavy metal extraction. If industries plant such kind of plants in their waste disposal sites, its very effective for the extraction, of heavy metals from the waste released from the industries as well as it gives a great look to the industries. Here the Ornamental plant was used lotus. Lotus is an aquatic plant mostly used in the worship and have a bushy character. The bushes of lotus have spaces and these spaces help plant for transportation of material such as food and water.

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