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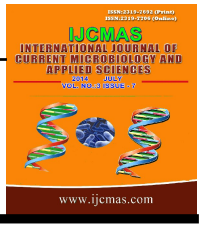

Original Research Article

Seasonal Variation of heavy metal concentration in water of River Yamuna, Allahabad, Uttar Pradesh, India

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A B S T R A C T

Keywords

WHO, heavy metals, Copper, Lead, Arsenic

Heavy metals (Lead, Copper & Arsenic) concentrations were determined in water from River Yamuna, at Allahabad. Water and fish samples were collected from three sites (Upstream, Midstream and Downstream). Heavy metal concentrations in water and fish were analysed using an Atomic Absorption Spectrophotometer. On comparison of these heavy metals concentration in water it was found that Pb and Cu were higher than the permissible limits of WHO, that gives an indication of hazardous risk to human health. Whereas Arsenic was detected lower than the permissible limit.

Introduction

The environmental contaminations by the toxic substances are growing that cause major concern to the local users. A wide range of contaminants are continuously introduced into the aquatic environment mainly due to increased industrialization, technological development, growing human population and exploitation of natural resources, agricultural and domestic wastes run-off. Among these contaminants, heavy metals constitute one of the most dangerous groups because of their persistent nature, toxicity, tendency to accumulate in organisms and undergo food chain amplification and more still, they are non-degradable.

Heavy metals with adverse health effects in human metabolism (including lead, copper, cadmium and arsenic) present obvious concerns due to their persistence in the environment and documented potential for serious health consequences. Acute heavy metal intoxications may damage central nervous function, the cardiovascular and gastro intestinal (GI) systems, lungs, kidneys, liver, endocrine glands, and bones. It is not possible to completely avoid exposure to toxic metals. Even people who are not occupationally exposed carry certain metals in their body as a result of exposure from other sources, such as food, beverages, or air. It is, however, possible to reduce metal toxicity risk through lifestyle choices

that diminish the probability of harmful heavy metal uptake, such as dietary measures that may promote the safe metabolism or excretion of ingested heavy metals.

Heavy metals are commonly found in natural waters and some are essential to living organisms, yet they may become highly toxic when present in high concentrations. These metals also gain access into ecosystem through anthropogenic source and get distributed in the water body, suspended solids and sediments during the course of their mobility. The rate of bioaccumulation of heavy metals in aquatic organisms depends on the ability of the organisms to digest the metals and the concentration of such metal in the River. Heavy metals concentrations in aquatic ecosystems are usually monitored by measuring their concentrations in water, sediments and biota. The aim of this study is to determine the concentration of heavy metals (Lead, Copper & Arsenic) in water of Holy River, Yamuna and to study the seasonal variations of these toxic elements in Year 2010. Contamination of water body with pollutants are directly or indirectly discharged through sewage effluents into water bodies without adequate treatment affects aquatic plants, organisms of water bodies. Water pollution is a global problem and requires ongoing evaluation and revision of water resource policy at all levels. It has been suggested that it is the leading worldwide cause of deaths and diseases and that it accounts for more than 14,000 people affected daily**.** An estimated of 580 people in India die of water pollution related sickness every day.

Materials and Methods

Samples Collection

The water samples were collected from the four different bathing Ghats of Yamuna River such as Arail Ghat (Site 1), Baluwa Ghat (Site 2), New Yamuna Bridge (Site 3) and Gau Ghat (Site 4).

The all sampling sites were used for bathing and considered to be more polluted due to human activities.

These Ghats are situated southern part of Allahabad city where, River Yamuna flows towards east to last destination, Sangam, (the final confluence point with Ganga). Baluwa Ghat is the first bathing Ghat then Gau Ghat and New Yamuna Bridge that is called as "Saraswati ghat". These prominent Ghats are being used by pilgrims for their religious rituals. The Arail ghat is across Allahabad city and nearest to confluence point of Sangam. During Kumbh or every year Magh Mela these Ghats are used maximum by bathers. These sites were purposely selected, where human activities are greater and many people come in contact with water in River Yamuna.

20 Water samples were collected for analysis from each Ghat. All samples were collected in 1.5 litre, polyethylene bottles, which were pre-washed with 10% nitric acid and de-ionized water. Before sampling, the bottles were rinsed at least three times with water from the sampling site. The bottles were immersed to about 20 cm below the water surface to prevent contamination of heavy metals from air. All water samples were immediately brought to the laboratory where they filtered through Whatman No.41 (0.45 µm pore size) filter paper. The samples were acidified with 2 ml concentrated Nitric acid to prevent precipitation of metals, reduce adsorption of the analytes onto the walls of containers and to avoid microbial activity, then water samples were stored at 4°C until the analyses.

The analytical technique used to determine heavy metal levels in all samples was Spectra AA 220G, by Atomic Absorption Spectroscopy (Varian-GTA-110). It is a standard laboratory analytical tool for metal analysis and is based on the absorption of electromagnetic radiation by atoms.

Results and Discussion

The Concentration of Copper, Lead and Arsenic concentration in Water during the Year 2010 was detected and compared with the permissible limits as set by the World Heath Organisation and Environmental Protection Agency. The concentration of Copper, Lead and Arsenic in all Water samples at all four different Sites of Yamuna River during Year 2010 in summer, monsoon, and winter seasons was detected and the results are discussed below.

Concentration of Copper

In summer season the average values of Copper vary 2.13847mg/l at Site 1, 2.571 mg/l at Site 2, 1.792 mg/l at Site 3 and 2.548 mg/l at Site 4. In monsoon season the average value of Copper vary between 1.1757 mg/l at Site 1, 1.2517 mg/l at Site 2, 1.0474 at Site 3 and 1.2282 mg/l at Site 4. The concentration of Copper in Water was detected in winter season. The average value of Copper varies from 1.6775 mg/l at Site 1, 1.9570 mg/l at Site 2, 1.4767 mg/l at Site 3 and 1.6855 mg/l at Site 4. The copper concentration at study areas was found highly deposited which may result in severe toxicity of Copper in human being as well as in animals.

Concentration of Lead

The average value of Lead was detected as 0.00514 mg/l at Site 1, 0.00626 mg/l at Site 2, 0.01565 mg/l at Site 3, and 0.0208 mg/l at Site 4 in Year 2010. The average value of Lead varies from 0.00216 mg/l at Site 1, from 0.00596 mg/l at Site 2, from 0.0034 mg/l at Site 3 and 0.0119 mg/l at Site 4 in Year 2010 in Monsoon Season. The average value of Lead in winter season is 0.00411 mg/l at Site 1, from 0.00881 mg/l at Site 2, 0.0062 mg/l at Site 3 and 0.01645 mg/l at Site 4 in Year 2010.

Figure.1 Concentration of Copper in Water in Winter Season during 2010 at four different Sites

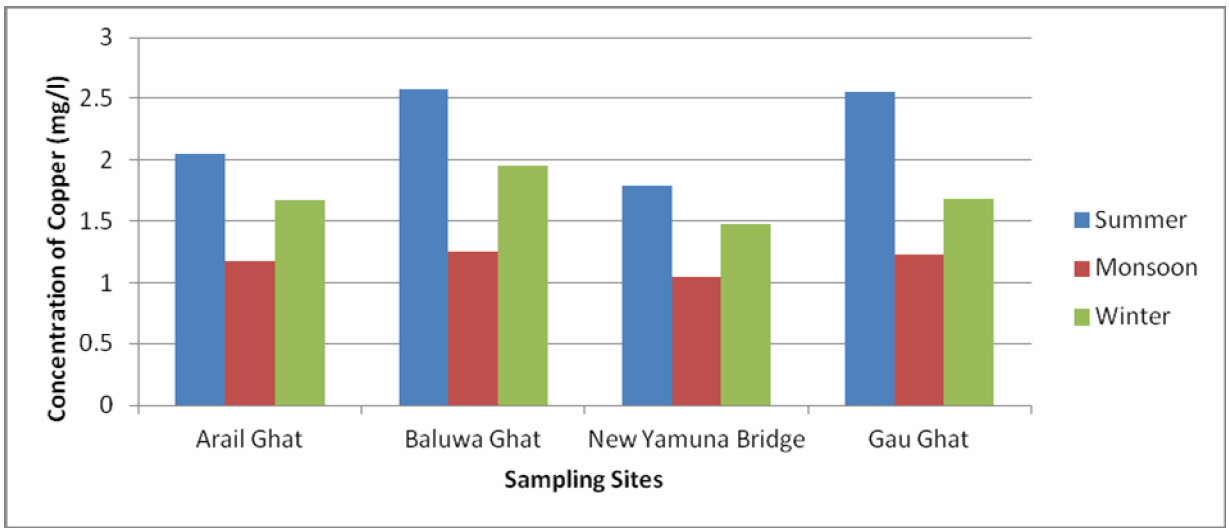


Figure.2 Concentration of Lead in Water in Winter Season during 2010 at four different Sites

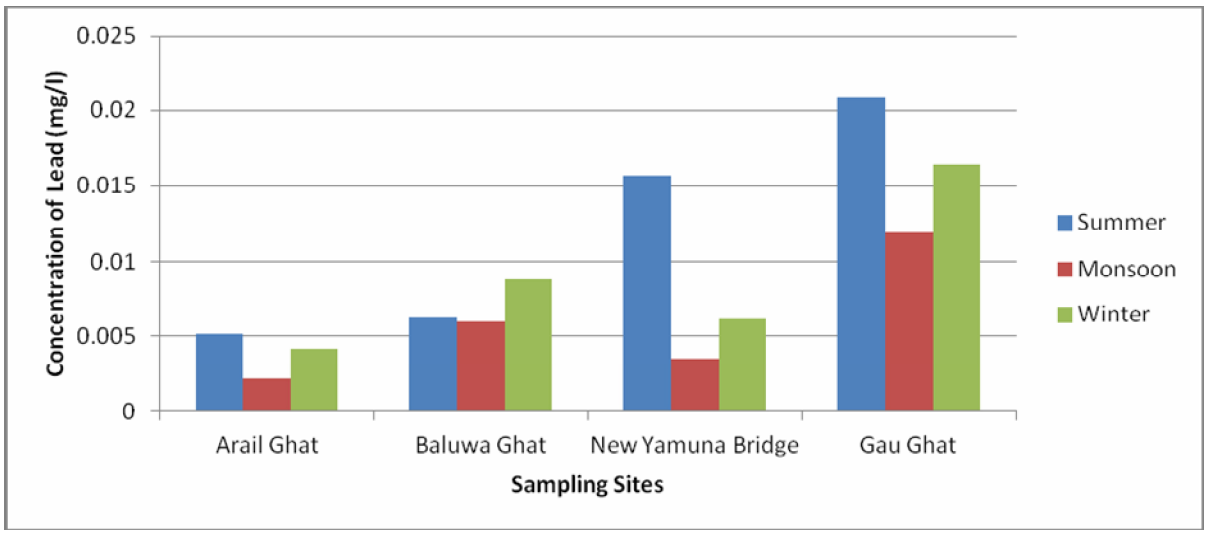
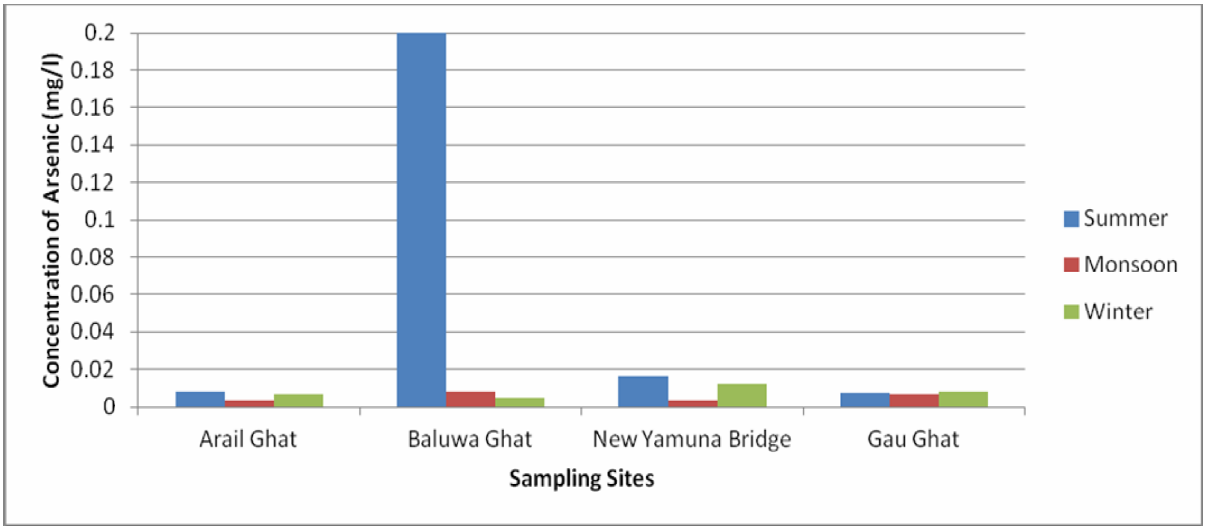


Figure.3 Arsenic concentration in Water in Winter Season during 2010 at four different Sites



Concentration of Arsenic

The average values of Arsenic varied from 0.008 mg/l at Site 1, from 0.2056 mg/l at Site 2, from 0.01652 mg/l at Site 3, from 0.00727 mg/l at Site 4 in Year 2010. The average value of Arsenic varied from 0.00352 mg/l at Site 1, from 0.00765 mg/l at Site 2, from 0.0036 mg/l at Site 3, from 0.00694 mg/l at Site 4 in Year 2010. The average value of Arsenic varied from 0.0066 mg/l at Site 1, from 0.0049 mg/l at Site 2, from 0.01234 mg/l at Site 3, 0.00809 mg/l at Site 4 in Year 2010.

The WHO guidelines for maximum permissible limit of Copper and lead were 0.05mg/l and 0.01mg/l respectively. As the range of Copper and lead is higher than the permissible limit, it may cause an

adverse affect on consumption. The Water is not suitable for drinking and for other domestic purposes, whereas it is safe to use for irrigation as Copper is not expected to cause any problem in crops. The maximum permissible limit of Arsenic as per WHO guidelines is 0.01 mg/l which is more than the detected limit, so adverse effects on consumption are not expected. The water may be suitable for drinking and for other domestic purposes and are safe to use this water for irrigation.

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