Heavy Metal Play Important Role in Ganga River Pollution

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Abstract

River Ganga is considered sacred by people of India for providing life sustenance to environment and ecology. Anthropogenic activities have generated important transformations in aquatic environments during the last few decades. Advancement of human civilization has put serious questions to the safe use of river water for drinking and other purposes. The river water pollution due to heavy metals is one of the major concerns in most of the metropolitan cities of developing countries. These toxic heavy metals entering the environment may lead to bioaccumulation and biomagnifications. These heavy metals are not readily degradable in nature and accumulate in the animal as well as human bodies to a very high toxic amount leading to undesirable effects beyond a certain limit. Heavy metals in riverine environment represent an abiding threat to human health. Exposure to heavy metals has been linked to developmental retardation, kidney damage, various cancers, and even death in instances of very high exposure. The following review article presents the findings of the work carried out by the various researchers in the past on the heavy metal pollution of river Ganga.

KEYWORDS- RIVER , POLLUTION, CITIES, ENVIRONMENT, TOIXC, WATER.

Instroduction

Water is the most key resource required to sustain the life on this planet. The river Ganga is the most important river system in India. Due to the copious availability of water throughout the year, it has played a major role in the growth of Indian civilization and economy. It accounts for 25% of India's water resources. The Ganga is the thirtieth longest river in the world, covering a basin area of 861,404 kmsq. The Ganga basin is among the most heavily populated areas in the world with an average density of 520 persons/kmsq. The basin sustains more than 300 million people in India. The basin of river Ganga, which has very rich heritage, cultural and religious values, drains about 1,060,000 kmsq area and it is the fifth largest in the world. The river system drains about one-fourth of the Indian subcontinents. In India, the river Ganga passes along 29 class I cities, 23 class II cities and approximately 50 towns because of which different types wastes such as industrial, sewage etc are released into this mighty river eco-system.

The river Ganga originates from the Gangotri glacier at Gomukh (30°36′ N; 79°04′ E) in the Uttar Kashi district of Uttarakhand province in India, at an altitude of about 3800 m above mean sea level in the Garhwal Himalaya. The length of the main channel from the traditional source of the Gangotri glacier in India is about 2550 km. After flowing through the Sivalikhillsit enters plains at Haridwar. Then it flows southwards, passing through the plains of Uttar Pradesh. After leaving Uttar Pradesh, the Ganga enters Bihar in the Rohtas district. From Bihar, it enters West Bengal province and starts flowing south. Nearly 40 km below Farakka it is divided into two arms. The left arm flows eastwards into Bangladesh and the right arm, called Bhagirathi, continues to flow south through West Bengal. The Bhagirathi flowing west and south-west of Kolkata is known as Hooghly. After reaching Diamond Harbour, it attains a southward direction and is split into two streams before reaching the Bay of Bengal. The mean annual water discharge is the fifth highest in the earth with a mean of 18,700 m3/s. High variation in flow exists within the catchment area, to the extent that the mean maximum flow of the river Ganga is 468.7 × 109 m3 which is 25.2% of India's total water resources . The freshwater flow in the river system is mostly from the tributaries and therefore, the water availability greatly varies from 59,000 million m3 at Allahabad, before the confluence with the Yamuna, to 459,000 million m3 at Farakka in the lower stretch . The source of water is the melting of snow in the Himalayas and monsoon rains. The river system covers cool upland streams and warm water stretches, including deltaic habitats

.Ganga river water is used routinely for drinking and outdoor bathing by millions of people who take a holy dip at least once a year throughout the course of the river, from Gangotri to Ganga Sagar, owing to its socio-religious significance.

In present-day, river pollution is a serious and emerging problem in the majority of developing countries. Due to rapid industrialization, there has been an increase in the amount of effluent being disposed to natural water bodies. Industrial effluents and sewage entering the water bodies are one of the prime sources of environmental toxicity, which endangers aquatic biota and deteriorates water quality . The quality of water is a vital concern for mankind since it is directly linked with human welfare. Major pollutants found in water include volatile, biodegradable and recalcitrant organic compounds, toxic metals, plant nutrients, suspended solids, microbial pathogens and parasites. Among the pollutants, toxic metals are of serious concern because they accumulate through the food chain and create environmental problems. Higher concentrations of heavy metals can form harmful complex compounds, which critically effect different biological functions. The presence of heavy metals in the wastewater of industry is a potential risk to aquatic ecosystem, animal, and human. High concentrations of heavy metals often pose a serious threat to biota and the environment of any ecosystem. Heavy metal pollution can be a much more serious problem because they cannot be degraded by natural processes and persist in soil and sediment from where they are released gradually into water bodies as sink.

Sources of heavy metal

“Heavy metals” is a collective term, which applies to the group of metals and metalloids with an atomic density greater than 4 g/cm3, or 5 times or more, greater than water. Heavy-metal contamination is not a modern problem arising out of industrialization – it began when humans started processing ores. Since then the use of metals and their impacts on the environment have accelerated, with a major increase during the 19th and 20th centuries. Generally, most of the heavy metals enter the in river from different sources, it be can be either natural by erosion and weathering and or anthropogenic. In view of the intense human activity, natural sources of heavy metals from leaching and weathering of rocks in the environment, are usually of little importance. The presence of heavy metals in sediments is due to precipitation of their carbonates, hydroxides, and sulfides, which settle down and form the part of sediments. The most important anthropogenic sources of heavy metal are various industries and domestic sewage. The practice of discharging waste from industries and untreated domestic sewage into the aquatic ecosystem is continually going on that leads to the increase in the concentration of heavy metals in river water.

The industries which attribute heavy metals in river water are generally metal industries, paints, pigment, varnishes, pulp and paper, tannery, distillery, rayon, cotton textiles, rubber, thermal power plant, steel plant, galvanization of iron products and mining industries as well as unsystematic use of heavy metal-containing pesticides and fertilizer in agricultural fields. These heavy metals have accumulative effect at the low level in drinking water and ground water.

Heavy metals and its effects

The most important heavy metals from the point of view of water pollution are Zn, As, Cu, Pb, Cd, Hg, Ni, and Cr. Some of these metals (e.g. Cu, Fe, Mn, Ni, and Zn) are required as nutrients in trace amount for life processes in plants and micro-organisms but become toxic at higher concentrations. Other such as Pb, Cr, and Cd has no known biological function, but are toxic elements. These heavy metals are not readily degradable in nature and accumulate in the animal as well as human bodies to a very high toxic amount leading to undesirable effects beyond a certain limit. The fatal diseases such as eyelid edema, nephritis, renal tumour, extensive lesions in the kidneys, anuria, nasal mucous membranes and pharynx congestion, increase blood pressure and cardiovascular diseases, osteoporosis, cancer, headache and malfunctions of different systems of the body caused by heavy metals have been reported by several authors. They are also known to interfere with synthesis and metabolism of the hormones.

Status of heavy metal in river Ganga water and sediments

Many studies have been carried out by several researcher on heavy metal pollution of river Ganga. Ajmal et al. studied the concentrations of cadmium, cobalt, chromium, copper, iron, manganese, nickel, lead and zinc in the water and sediments of the river Ganga in Uttar Pradesh and reported that there was considerable variation in the elements from one sampling station to the other.alsoanalyzed the temporal and spatial variations in the heavy metals distributions in the river Ganga sediment. A similar study was also conducted in upper Ganga by Saikia et al. Heavy metals distribution in the sediments and sewer-river confluence points of river Ganga in Varanasi-Mirzapur region. Sharma studied the heavy metal pollution of River Ganga in the Mirzapur region and came to the conclusion that the river was polluted. A similar study was also conducted at Kanpur by several researchers are determined the concentrations of Al, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Sn and Zn in sediments of the river Ganga in the Kanpur-Unnao industrial region. According to them about 90% of the contents of Cd, Cr, and Sn; 50–75% of organic carbon, Cu and Zn; and 25% of Co, Ni and Pb in sediments are derived from the anthropogenic input in relation to the natural background values.

The role of monsoon rain on concentrations and dispersion patterns of metal pollutants in sediments of the river Ganga in the Kanpur-Unnao industrial region and reported that the monsoon rain reduces the contents of Co, Cr, Fe, and Ni, and enhances the contents of Cd, Sn and Zn in sediments of post-monsoon period. Ganga river water and sediments pollution due to tannery industries at Kanpur.studied the heavy metals in freshly deposited stream sediments of rivers associated with urbanization of the Ganga Plain in Lucknow, Kanpur, Delhi, and Agra urban centers and classified by the proposed Sediment Pollution Index as highly polluted to dangerous sediments.thegeogenic distribution and baseline concentration of heavy metals (Cr, Mn Fe, Co, Ni, Cu, Zn, Cd, and Pb) in the sediments of the Ganga river.assessed the impact of lead on water quality of river Ganga in West Bengal.

Role of tributaries of river Ganga in heavy metal pollution

The Ganga river has a vast number of tributaries; many of these are of Himalayan origin with considerably large water wealth. The major tributaries within India are Kali, Ramganga, Yamuna, Gomti, Ghaghara, Gandak, Mahananda, Damodar, Kosi, Tamsa, Son and Punpun. The tributaries of the Ganga account for 60% of the total water of the river. About 20% of Ganga water is fed by Ghaghara as against 16% by Yamuna. The tributaries of Ganga have an important role in pollution of river Ganga because it transports considerable amounts of pollutants as well as heavy metals into the Ganga. All the tributaries join the river Ganga and drain their pollutant input load adding to the already polluted Ganga river. The Yamuna river, however a tributary of the river Ganga, is almost a river by itself. There are vast numbers of industries, draining the huge amount of untreated effluent water in the Yamuna existing in the cities like Delhi, Agra, Faridabad, and Mathura. Central Pollution Control Board (CPCB) had estimated that there were nearly 359 industries, which directly or indirectly discharge their effluents in Yamuna. Kali is a highly polluted river. Levels of pollutants including heavy metals have reached alarming amount in the river Kali. The water quality of Gomtiriver has also been found quite unsafe at Lucknow and Jaunpur. The concentration of various heavy metals in different tributaries of river Ganga.

Strategies to improve the heavy metal pollution of river Ganga

The heavy metal pollution of the river Ganga has drawn the attention of the scientists and others concerned with the endangerment of the environment. Regulatory standards for emission and discharges from different industries should be strict. Recycling of wastewater containing heavy metals needs to be given greater importance not only from environmental and health concerns but also as a resource conservation initiative. Monitoring of wastewater from toxic heavy metal processing units of the different industries needs to be executing more vigorously. The government should outline a plan or strategy to comprehensively survey the Ganga in order to identify and specify the sources of the pollution.

In India, many states and departments of central Government are dealing with the matter of decreasing pollution in the major rivers of the country. In 1986, the Ganga Action Plan (GAP) was launched by Prime Minister of India to follow the policies of Central Ganga Authority (CGA). The key objective of the GAP was to improve the water quality by decreasing the pollution load before it reached to the flowing river Ganga. It is very much crucial that the GAP ensures that the river water quality is brought upto the standards as specified by the CPCB. Ganga Action Plan, however, have had little success in meeting proposed objectives. An over-dependence on conventional methods, designed and executed by the central Government without the involvement of local stakeholders, has provided to the GAP's shortcoming. A survey of CPCB, showed that 317 major industrial units are operating all along the bank of river Ganga and its tributaries. Only 37% of these units followed some controlled measures and the remaining ones pose pollution hazards, and none of them has any treatment facilities. In the year 2008, the Prime Minister of India announced Ganga a National River and set up the National Ganga River Basin Project (NGRBP) for its clean up. The NGRBP will be the first basin-level initiative in India to manage an inter-state river for water quality and environmental protection.

The effect of heavy metals present in water and sediments of river Ganga on the biotic community were studied only to a limited extent. From the published research articles of many authors it is revealed that the presence of heavy metal in the river may cause of the reduction in growth, size, and survival of fish population or may also cause extinction of some fish species and river dolphins. Daphnia and Cyclops are most sensitive to heavy metals. Presence of such heavy metal pollutants in water course not only creates unfavourable environment but also causes paucity of the fish organisms. The occurrence of very large amount of heavy metal pollutants into surface water and sediment can affect the self-purifying nature of the river. As soon as the river loses its self-purifying nature, it results in the growth of high level of pathogenic bacteria. The regular and systematic monitoring and strict law implementation are required to achieve sustainable way for enhancing the water quality. At last, awareness should be raised among the common people. The information obtained from this review could be helpful for environmental organizations to monitor river Ganga system and finally to the management of human health practices.

Conclusion

The current situation of heavy metal pollution in the river Ganga has become a cause for concern. Several studies of heavy metal pollution show that the levels of various heavy metals in the river Ganga water and sediment are far above the acceptable concentrations. The metals enter the environment through aquatic life systems and plants and animals surrounding the river. The hazard of bioaccumulation and biomagnification of the heavy metals make them a big risk to human health and welfare. Hence, it is necessary that steps be taken to minimize the metallurgical effluent load deposited into the river Ganga. This review suggested that various sources of heavy metals in the water and sediments of the river Ganga should be closely monitored; improvement of conditions and industrial effluent and domestic sewage discharge should be reduced.

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