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Effect of Heavy Metal Contamination on Fishes In River Yamuna

Chemistry

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ABSTRACT

Heavy metals like Mn, Ag, Hg, Pb, Hl, Zn, Ni, Se, Sb and As are very hazardous for aquatic as well as human lives. These heavy metals mix in river through the waste material of factories or industries and are consumed by fishes though water or algae growing there. By the process of bioaccumulation these heavy metals are deposited into the body of fishes and cause different diseases. As we know fishes are the main sources of food for most of the population. So these infected fishes are consumed by humans and bioaccumulation occurs and cause severe disease such as Lung cancer, Anemia, Hyperkeratosis, Stomatitis, Hepatitis B etc because these metals cannot be digested by us. Thus we can say that we should stop such type of water pollution to save aquatic as well as human lives.

INTRODUCTION

The River Yamuna originates from the Himalayan glacier. Being the largest tributary of River Ganga and with a total basin area of 366,223 km^2 , Yamuna geographically covers parts of the states of Uttaranchal, Uttar Pradesh, Himachal Pradesh, Haryana, Rajasthan, Madhya Pradesh and NCT–Delhi. The river crosses several states like Uttarakhand, Himachal Pradesh and Haryana then reaches Delhi. It enters Delhi near Wazirabad (Delhi) and covers a 48 km stretch in Delhi before entering into the state of Uttar Pradesh. Two other major cities Yamuna Nagar and Panipat of Haryana state are located close to the river prior to its entering Delhi. Though the river Yamuna has its origin in Himalayan glacier Yamunotri which is located at 6,387 meters of the uppermost parts of the lower Himalayas and is a perennial river, however during the non-monsoon period in Delhi the Yamuna cannot be designated as a perennial river because during this period it segregates into four independent segments due to the presence of three barrages from where almost the entire water is being diverted for various socio-economic activities thus resulting in the absence of the good quality fresh water in the river which is essential to maintain its assimilation capacity.

Although the Yamuna is polluted almost throughout its entire length in the plains, but the maximum of the pollution occurs during its journey through the NCT. In addition, twenty eight major drain outfalls into Yamuna[1]. The organic pollution level increase significantly at Delhi and the Biochemical Oxygen Demand (BOD) level do not confirm to the stipulated standard form. The same stretch of the river shows fluctuations in Dissolved Oxygen (DO) level from Nil to well above the saturation level. This reflects the presence of organic pollution load and prevalence of eutrophic conditions. Bacteriological contamination is significantly high in the entire Yamuna River stretch[2]. In addition to these pollutants, heavy metal level is also found more in comparison to the normal limits.

'Heavy metal' is a term used for the metals having high density and toxicity. Few metals are important for lives but in trace amount and if this amount increases in any form it causes toxicity which is harmful for lives. Now-a-days pollution is the biggest and rapidly increasing problem for us. Increasing use of chemical fertilizers and industrialization is responsible for this. There are many more reasons but pollution caused by industries and factories is the leading cause of heavy metal contamination. As we know the waste effluent of factories and industries goes and mix in water of rivers and ponds. Fishes live in that polluted water get infected by these metals as they consume infected algae and water and they live in that water so the bioaccumulation process occurs and these heavy metals start to cause hazard in fishes. Bioaccumulation is a process in which the amount of consumption is greater than the amount of lost substance. So these heavy metals accumulate in fishes and make them diseased. Heavy metal contamination in fishes results in the damage of gills and lungs. All heavy metals exhibit their toxic effects via metabolic interference and mutagenesis. Death in aquatic animals may occur due to nutrient pollutions (e.g., nitrogen, phosphates, etc.) present in the toxic algae.

Fishes are the main source of food for a large population in the world for humans and for many animals too. Fishes infected by heavy metals are consumed by humans and cause diseases in humans too. And so fishes are being a major source of methyl mercury exposure, and dental amalgam, Long term exposure to these heavy metals cause cancers, hyperkeratosis, and pigmentation changes. There are a lot of diseases caused in humans due to heavy metal contamination. Lung cancer and hepatitis are the main and most dangerous of them.

USES OF YAMUNA WATER -

Even today, water stands as one of the most essential requirements of life. We cannot think our livelihood without water. Yamuna waters contribute a lot to sustaining our lives in every manner. Some of the uses of its waters are as follows:

Areas like Delhi, Mathura, Agra and Allahabad use the Yamuna water for domestic water supplies. In Delhi, at a specific location i.e. Wazirabad, the entire water is diverted specifically for domestic supplies. Almost 93% of Yamuna water is used for the purpose of irrigation with the help of four irrigation canals which are Western Yamuna canal, Eastern Yamuna canal, Agra canal & Gurgaon canal.

The Yamuna basin also has huge potential to generate hydropower & currently almost 400 MW of hydropower is being channeled through this basin.

River Yamuna provides a large scope of farming for fish and other aquatic animals.

Waters of Yamuna are also used for bathing as depicted by Hindu mythology and also for washing clothes and utensils by nearby community.

Moreover, it is estimated that about 70% of the total cattle population in the Yamuna basin uses flowing water of river and canals for bathing.

With such a high dependence on its waters, this river surely is one of the biggest areas of concern as far as environmental impacts are concerned. The river is one of the most polluted rivers in the world.

SOURCES OF HEAVY METALS IN YAMUNA RIVER -

As a result of ecological stress created by humans on the aquatic environment, the pollution levels have significantly increased. Numerous studies have been conducted for testing the presence of heavy metals in the river Yamuna. In a study for determination of heavy metals in fish species[3], characterization of heavy metals in fish elucidated that the concentrations of Ca, K, Mg, Na and P were too high as compared with other metal and were not in the maximum permissible level set by World Health Organization (WHO). Industrial discharge, release of organic material into water, domestic waste etc. have caused a reduction in oxygen level and are a major reason for eutrophication. Another research conducted by TERI, showed moderate levels of toxic metals in the water at several locations. The samples were taken across various locations around Yamuna in Delhi and Haryana. The study also emphasized on the effect of heavy metals on the vegetables growing on the river banks as well as on the population dependent on river water. Extensive study of heavy metal contamination of heavy metals in water and soil was carried out in the Delhi segment of Yamuna basin (from Wazirabad barrage till the Okhla barrage, 13 sites were chosen)[4]. The key findings of the study were: Average heavy metal concentration at different locations in the river water varied in the order of Fe > Cr > Mn > Zn > Pb > Cu > NI > Hg > As > Cd The average heavy metal concentration at different locations in soil varied in the order of Fe > Mn > Zn > Cr > Pb > Ni>Hg>Cu>As>Cd Free Ammonia levels of 1.4-6.6 mg/l was present at Okhla Barrage were found to be unfit for propagation of wildlife and fisheries. Flamingos have been observed in thousand in the lake formed at Okhla Barrage where they come to feed on fish, insect, seeds and roots of marsh plants. They make their nests in a mound of mud, which look like a depression. There is an urgent requirement to restore the water quality for conservation of habitat of rare and endangered Flamingos at Okhla Barrage. The pollution of the aquatic environment with heavy metals has become a worldwide problem during recent years, because they are indestructible and most of them have toxic effects on organisms. Among environmental pollutants, metals are of particular concern, due to their potential toxic effect and ability to bioaccumulate in aquatic ecosystems[5,6]. Heavy metals are considered the most important form of pollution of the aquatic environment because of their toxicity and accumulation by marine organisms[2,7]. The concentration of heavy metals in the fish from the River water has shown that the metal concentration found in the fish samples were higher than the range of maximum acceptable limits as per WHO. The various industrial outlets which drain into the river is a probable source of the heavy metals in the Yamuna, leading to severe deleterious effecst in humans, fish and plants[3]. Various national and international agencies (CPCB, WHO) have determined the recommended range of heavy metals permissible to human health[8].

IMPACT OF HEAVY METALS ON AQUATIC LIFE-

(i) <u>IMPACT OF MERCURY (Hg) ON AQUATIC ECOSYSTEM-</u>

Mercury is a neurotoxic metal. It inhibits the activity of enzymes in brain of human. And it also effect on aquatic life due to methylation. Mercury enters into water through chemical industry which use mercuric oxide as a catalyst and release mercury from industry. The best example of mercury contamination is the minimata disease in Japan caused by water and its syndrome is *Hunter Russel*. Mercury level is high in food chain than in water. The standard water quality of metal in drinking water is 1 and in aquatic life protection is 0.1. Fish are only source by which Hg enter in human body.

(ii) IMPACT OF LEAD (Pb) ON AQUATIC LIFE-

Pb comes from both natural and anthropogenic in environment. It is resistant to corrosion and decoloration. It used in drinking water pipes, collection of pipes and food storage container. It can be exposure via drinking water, food, air, soil, and dust from oil paint. The high level of Pb shows toxic effect in human and also impact on synthesis of hemoglobin, kidney, gastrointestinal tract, acute chronic damage to nervous system. In human, calcium- deficient diet assembles lead in bones which shows toxicity. The best example of lead contamination is anemia. In algae, the higher concentration of lead is impact on enzymes of photosynthetic but in fishes, they effect on function of gills.

(iii) IMPACT OF ZINC (Zn) ON AQUATIC ECOSYSTEM-

Zinc is present in water in dissolve form and suspended particulates. Zn^{+2} is present in water which is very toxic or fishes. Zinc metal is essential for aquatic and terrestrial life in trace amount.

(iv) IMPACT OF NICKEL (Ni) ON AQUATIC ECOSYSTEM-

Nickel is very toxic and carcinogenic metal. Nickel is essential for growth of microorganism. Nickel enters in water via smelting, refining, alloy processing, fossil fuel combustion. It causes disease like acute pneumonitis, central nervous system, skin infection, cancer of lungs and nasal activity.

(v) IMPACT OF SELENIUM (Se) ON AQUATIC ECOSYSTEM-

Selenium is bioaccumulative pollutant. it enters into water via irrigation drinking water, release from metallic ore mining and smelting. The trace amount of selenium is effective on growth, survival of juvenile stage of fish and also effect on larva of adult fish. It causes skeletal deformities.

(vi) IMPACT OF ANTIMONY (Sb) ON AQUATIC ECOSYSTEM -

Antimony enters in water through natural expose of rocks, municipal and industrial waste. Antimony is carcinogenic metal for animals and aquatic lives.

(vii) IMPACT OF SILVER (AG) ON AQUATIC ECOSYSTEM -

Fishes are not sensitive to silver concentration. Silver is toxic to human which effect on lung, skin, pancreas, skin, bone marrow, walls of blood vessels. Silver is toxic to other aquatic mammals.

(viii) IMPACT OF MANGANESE (MN) ON AQUATIC ECOSYSTEM-

Manganese is a natural substance which is present in water. It is use to protect the aquatic mammals.

<u>CONCLUSION -</u>

Thus we can see heavy metal contamination is very harmful for aquatic as well as human lives directly or indirectly. The main reason is pollution. So we should make efforts to stop the pollution to avoid such problems. Heavy metal contamination is increasing day by day in water resources. So industries should not mix their waste and toxic effluent in water resources.

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