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Chapter

Heavy Metal Contamination

Soni Kumari and Amarnath Mishra

Abstract

In the era of industrialization, pollution has totally deteriorated the quality and diversity of life. Heavy metal contaminations are the major causes of environment deteriorations. The basic reasons are natural as well as anthropogenic. Chief sources of heavy metal contamination are air pollution, river sediments, sewage sludge, town waste composts, agricultural chemicals like fertilizers and pesticides, and industrial waste like factories releasing chemicals, anthropogenic activities, etc. Agricultural soils in many parts of the world are generally contaminated by heavy metal toxicity such as Cd, Cu, Zn, Ni, Co, Pb, Hg, As, etc. These are due to the long-term use of phosphate fertilizers, sewage sludge, dust from smelters, industrial waste, etc. Heavy metals in soils are detected with some specific instruments like atomic absorption spectroscopy, inductively coupled plasma, inductively coupled plasma-mass spectroscopy, and X-ray fluorescence and spectroscopy. Among all these instruments, atomic absorption spectroscopy (AAS) is the best because it gives the precise quantitative determination. AAS is a method applied for measuring the quantity of the trace elements present in the soil or any other samples.

Keywords: environmental forensics, heavy metals, soil, water, air, public health

1. Introduction

Heavy metals are principally referred as the metals which have high densities and atomic weights or atomic numbers.

Or

In metallurgy, heavy metals are defined on the basis of densities, and in Physics, it is defined on the basis of atomic number while in chemistry on the basis of chemical behaviour. In biochemistry, heavy metals are defined whether it is Lewis's acid (electron pair acceptor) performance of the ions in the aqueous solutions [1].

Some examples of heavy metals are iron (Fe), copper (Cu), tin (Sn), and other elements metals such as silver (Ag), gold (Au), and platinum which are precious; these were the earliest known metals. Other heavy metals are moreover essential nutrient, for example, iron, cobalt, and zinc some comparatively less dangerous such as ruthenium, silver, and indium; but can be toxic in the larger amounts or in their definite form [2]. Then a number of the certain heavy metals which are such as cadmium, mercury, and lead are highly poisonous.

Heavy metals contamination can be observed in soil, water (rivers), air (atmosphere), etc. The composition and physical properties and chemical structure of each of the heavy metals are different. No doubt that the heavy metals are toxic

as well as hazardous. They have harmful effects. Heavy metals are needed to be handled with care. Some heavy metals tend to be less reactive, whereas some are very reactive. These are thought to be toxic or highly destructive to the environment. Heavy metals mortify air, water, and soil quality and consequently cause health issues in plants, animals, people, etc. Some toxic elements are also regarded as beneficial, but only in small quantities for human health. These elements are vanadium, manganese, cupper, iron, zinc, strontium, selenium, molybdenum etc. The deficiency of these metals is harmful and may increase susceptibility to heavy metal poisoning. Chronic level ingestion of heavy metals toxic or heavy metals has dangerous effects on human body, and the impacts are observable only after several years of exposure [2].

According to their toxicity to living organisms, the heavy metals are arranged in the following order: Hg > Cu > Zn > Ni > Pb > Cd > Cr > Sn > Fe > Mn > Al [3].

1.1 Properties of heavy metal

- Heavy metals are less reactive than the other lighter metals.
- Heavy metals are relatively scarce in the Earth crust, means concentration of heavy metals are less.
- Heavy metals have usually higher density than the light metals.
- These metals are quite hard whereas soft metals are easy and tend to cut easily.
- Thermal expansively of heavy metals is lower than the light metals.
- Melting point of heavy metals varies from low to high whereas light metals have low melting point.
- Tensile strength of heavy metals is mostly higher.
- Heavy metals are less abundant in earth crust.
- These are extremely insoluble in sulphides.
- These are generally insoluble in hydroxides.
- Heavy metals form coloured solutions in water.
- Complexes of heavy metals are mostly coloured.
- Heavy metals are the micronutrients, required in small concentrations whereas light metals are the macronutrients required in larger concentrations.

1.2 Uses of heavy metals

If heavy metals are toxic, they are useful or beneficial also. Its regular uses depend on the general characteristics of heavy metals such as electrical conductivity and reflectivity or some other general characteristics such as its density, its strength, and its durability. Other uses depend on the quality of the particular

element, such as their biological role as nutrients or poisons or some other specific atomic properties. Some examples of the atomic properties include partially filled d or f orbital that enables the formation of coloured complexes. Other uses are in sport, mechanical engineering, military ordnance, and nuclear science, which take the advantage of their relatively high density. In mechanical engineering heavy metals are used as ballast in boats, aeroplanes, and other motor vehicles or in balance weights on wheels and gyroscope and propellers and centrifugal clutches, in situation requiring maximum weight in minimum space. In military ordnance, tungsten and uranium are used in armour plating and armour piercing projectiles, as well as in nuclear weapons to increase the efficiency. Also, denser materials absorbs more radioactive emissions than the lighter ones, so heavy metals are useful for radiation shielding and to focus radiation beams in linear accelerators and radiotherapy applications [3].

2. Heavy metals contamination in soil

Soil is an essential constituent of an ecosystem. Soil has the absorbing and emitting capabilities, which is vulnerable to contamination by a wide variety of sources. The continuous development of the urbanisation leads to constructions, agriculture farming, cemetery, and traffic emission. Soil, where we live, where we do our agriculture, is not safe from these metals. Heavy metals reached into the soils as from the parent materials (lithosphere) and from different human activities. There are some factors which affects the presence and division of the these metals in the earth; they are the composition of the parent rocks, the extent of weathering and the chemical, physical and, biological features of the soil, and it also depends on the climatic conditions. Human activities are the major cause and are gradually increasing day by day which results in the deterioration of environment [4].

2.1 Sources of heavy metal

These metals in soil reach through many sources which include atmospheric deposition, improper disposal of the industrial solid and liquid waste, mining activities, sewage, and using of pesticide and fertilisers. These metals in the environment are released mainly from the gas, dirt, and dust produced by the transportation, energy, metallurgy, and during building. Heavy metal basically reaches into the air in the form of aerosol and finally deposit in the soil through natural sedimentation and rainfall process.

Automobile transport causes some serious heavy metal contamination. Also, heavy metals are brought into soil by irrigative sewage, sanitary sewage, chemical waste water, and industrial mining. Industries release a lot of harmful chemical which are directly released to river or an open area. Also, people nowadays use a lot of fertilisers, pesticides, for agricultural purposes. The long-term extreme application has resulted in the degradation of the soil. Heavy metals are the largely reported pollutant inside the fertilisers. Phosphoric fertilisers generally contain high amount of toxic heavy metals, whereas nitrogen and potash fertilisers contain considerably low amount of heavy metals.

An increased concentration of certain elements is found particularly in vegetables grown in the nearby of industrial plants and busy roads, as well as in crops exposed to municipal and agricultural wastewater [4]. This may result in disrupted balance of these elements, and in turn significantly affect their bioavailability and interaction with other food ingredients as well as other metals. Different branches

of industry as well as road traffic have a significant impact on the environmental pollution with the heavy metals such as the following chrome from metallurgical, paint, and tanning industries, nickel mainly from the steel industries and burning of coal and liquid fuel, cadmium from metal smelters, while along reads another sources of contamination with this element may be grease used in motor vehicles and lead from paints industries, metallurgical, and glass industries. The main sources of lead contamination in soils, air, and plants are the exhaust gases releasing from [4].

2.2 Impact of heavy metals contamination of soil

Microbial activity and the enzymatic activity gradually decrease because of heavy metals. Microbial activities are inhibited. Different metals in soil have different effects on it. Low concentration of heavy metals indicates high microbial activity and growth and thus high microbial biomass and high quantity of the metals in the soil indicates very low microbial growth and thus results in low microbial biomass. A significant role in process of organic matter decomposition and nutrient cycling are played by the enzymes. So due to excess heavy metals in soil reduces its enzymatic activity. These degrade the quality and quantity of the soil which are not good for fertilisation. The soil loses its fertility and it is completely degraded. So, the degraded soil is of no use; it will only be considered as barren land.

2.3 Impact of heavy metals contamination of plants

Heavy metals in soil mean heavy metals in plants too. The prime reaction of plants is production of reactive oxygen species (ROS) on the exposure to high level of heavy metals. Through soil it reaches the plants and water. In water, heavy metals reach not only through water but from the environment too. The aerosol particles are present in the atmosphere; these reach the water, soil, from soil to plants and water. These all are related, and all are affected by one another. And high concentration of heavy metals in soil means high concentrations in environment and the surrounding which is a global threat. The heavy metals they are not easy to remove but they get incorporated easily. Exposure to heavy metals is toxic is a serious problem the motor vehicles [5].

The risk of heavy metal presence in vegetables cultivated near old industrial areas is significant. Industrial and municipal sewage is also an important source of heavy metals. Also, wastewater irrigation is an important approach for irrigation in agriculture which is treated biologically. Wastewater irrigation has changed physical and chemical properties of the soil and led to the heavy metals' uptake by plants, mostly vegetables as vegetables are grown mostly. And vegetables grown in such soils has high amount of heavy metals accumulated in them. Also, concentration of heavy metals in the soil also depends on amount of fertilisers and pesticides being used in the soil. The higher we use fertilisers and pesticides in the soil for the plants to grow better and to protect them from the insects and the weeds the higher the chemicals will reach the soil and will be absorbed by the plants or vegetable being grown in that particular soil. So, the amount of fertilisers and pesticides doses also influence the amount of heavy metals in the soil. Also, some other sources of heavy metals are used as plant protectors' products. The dynamics of the heavy metals in the soil and their uptake by plants depend on the soil properties, which play a key role in the bioavailability of these metals. The level and amounts of these heavy metals accumulation in plants depends on among others, soil types, pH, humidity, and micronutrients content as well as the time of crop harvesting. Among these, the acidic pH is considered to be the

most important factor influencing the increased in absorption of heavy metals by vegetation. Whereas in alkaline soils, a risk of heavy metal leaching and their bioavailability to plants are lower and the presence of organic matter can inhibit metals uptake from the soil solution. By changing these following soil properties that determine metal solubility in the soil, heavy metals are transferred in its solid phase. Metal mobility and bioavailability may be influenced by addition of organic and inorganic matter [6].

A basic treatment restricting metal mobility is soil de-acidification by liming. Some studies revealed that phosphate stabilises Pb by reducing its availability in the soil. But this effect depends on the soil type. The addition of phosphate increases soil permeability, thus contributing to arsenic migration deeper into soil profile and entering groundwater. Adding materials which are rich in organic compounds such as compost, tree bark, sawdust, or granulated or powdered lignite, are generally recommended to reduce mortality and bioavailability of metals. Some studies also show that regular addition of organic matter in large quantities may inhibit metal uptake from the soil solution. Also, organic matter stabilises trace elements in the soil, and addition of compost may lead to increase in accumulation of metals in cultivated plants. Other studies show that lead and arsenic levels in vegetables were strongly correlated with a total content of these meals in the soil, and not with organic matter content in the soil or a level of compost addition. Some researchers also proved that the soil age also plays a crucial role in modulation of metal bioavailability in plants. Higher content of heavy metals is found in old flat wetlands due to long term discharges of municipal and industrial wastewater. Some analysis shows that bed rock is a source of Fe and Mn, while copper, zinc, cadmium, chromium, nickel, and lead are of anthropogenic origin. After comparing wet ditches and reclaimed wetlands, levels of some heavy metals such as lead, cadmium, and zinc are found in excess or in higher amount in wetlands because the wetlands are richer in mangrove soils. Apart from the soil factors which influence the presence and concentration of heavy metals in soil absorption of metals differ in different types of soils and plants. An important variation in metal concentrations was also seen being depending on the location in plant tissue, species also on the varieties of the same species. Such as concentrations of nickel, chromium, and cadmium were highest in plants roots, while leaves have highest level of lead accumulation. There are differences in the concentrations of heavy metals in edible parts of different plants and vegetables and concentration also varies. Cadmium and zinc are accumulated to a higher extent in lettuce and spinach, and lead was highly accumulated in lettuce and onions. Also, vegetables of the same species accumulated different amount and concentration of the heavy metals depending on the cultivar [6].

Legumes vegetables < melon vegetables < alliums vegetables < root vegetables < solanaceous vegetables < leafy vegetables.

Heavy metals concentration is higher than in potato, carrot, tomato, kohlrabi, and green bean seeds. After some studies, it is concluded that edible parts have highest heavy metal concentration in leafy vegetables, lower in root vegetables, and minimum or lowest in fruit vegetables. Root vegetables in plants are particularly susceptible to cadmium accumulation. Uptake of cadmium is extremely easy, both by the root and the leaves system, generally in proportion to its concentration in the environment, despite of the soil properties. However, acidic soil is considered to be most important factor influencing its increased phyto assimilation. Cadmium is characterised by a high bioaccumulation index up to 10 and its content in plants is commonly directly proportional to its content in the soil [7].

Cultivation of vegetables in regions is characterised by high density of the industrial and factorial, or nearby the busy roads like has traffic 24 hours result in significant contamination of crops with heavy metals. On the other hands, irrigation of agricultural fields with the wastewater results in the considerable contamination with the heavy metals and thereby to the accumulation of metals in vegetables cultured there. It is also important to maintain rational approach to fertilising and the use of plants protection products because they also increase accumulation of these metals in plants. They should be used in a reasonable amount so that could be beneficial for the plants or vegetables as well as the soil. Also if the concentration of heavy metals in the soil and the plants are in limit, they could be taken care off or if they reach into the body of any human being through plants or vegetables; they are in little amount or they can be cured but if once the concentration of heavy metals exceeds its reasonable limit, they then become very difficult to be cure and also causes difficulties in identifying. Leafy vegetables and root vegetables have the metals that have the greatest ability to accumulate the heavy metals absorb from the soil. Therefore, they should not be grown in such types of soil or the soil should be experimented or it should be examined properly before growing of the vegetables. Or they should not be grown at all. Once the plants or animals or human being are contaminated with the heavy metals, it is very difficult to cure them. Some causes damage to the internal organs like damage to the respiratory system, cardiovascular system, excretory system, neuromuscular system, and some other causes damage to the functioning of brain activity, heart, lungs, and kidney activity. In extreme cases, it can lead to paralysis or even death. So, one must take care of themselves. As soil is not the only one factor or way through which heavy metals reach the human body in fact there are many other ways such as through water, through air, and many other ways [7].

2.4 Toxic affects

Soil contaminated with zinc due to fertilisers, urban compost, emission from municipal waste incinerators, and other anthropogenic activities. Also, zinc is as essential nutrient for living organisms while cadmium is non-essential and potentially toxic for higher plants, animals, and also for the humans. Excess concentration of zinc leads to phytotoxicity, limits in its growth of both roots and shoots, senescence, chlorosis in younger leaves, and later extends to older leaves. Copper is a micronutrient for plants and its role is in CO_2 assimilation and ATP synthesis. It reaches to soil through industrial activities and human activities like mining and smelting of Cu containing ores. Excess of Cu in soil leads to growth of plants and its reduction. Mercury reaches the soil mainly in the solid phase through adsorption. It accumulates in the higher aquatic plants. It induces physiological disorder. Chromium is heavy metal and is a serious threat for the environment contamination of soil. Its toxicity is seen in many plants. Its toxicity leads to alterations in the growth of roots, stems, and leaves, deleterious effects on the plants physiological process such as photosynthesis, water relations, and mineral nutrition. Cobalt, this naturally occurs in the earth crust as cobaltite, erythrite, and smaltite. Excess of Ni2+ in soil causes various physiological alterations and diverse toxicity symptoms such as chlorosis and necrosis according to different species, shows impairment of nutrient balance, and resulted in disorder of cell membrane functions. Other symptoms are changes in water balance, etc. Lead accumulations are gradually decreasing in the plants and the nearby highway and roads as when the law came up with using of lead-free petrol. Properties of soil include its texture, capability to absorb water, Ph value, and ion exchange capacity. Lead, mercury, and chromium

are usually tightly fixed in soils, and cadmium and zinc are readily absorbed by the plant roots. The heavy metals are absorbed by the plants through soil. These metals are absorbed by plants roots and get accumulated in the softer tissue of plants. These metals are not metabolised by the tissues, so it gets accumulated. From plants, it reaches human body. Human being consumes the plants containing the heavy metals, and the metabolization in humans too is not proper and thus it gets accumulated there. This further becomes toxic for the human and they face the consequences in form of the diseases.

Plants uptake the heavy metals that are present in soluble components in soil solution or those which can be easily solubilised. Some heavy metals are essential for the plants for their growth and upkeep, but in excess amount, these metals become toxic for the plants and even for the humans too. Plants growing in the soils containing heavy metals show reduction in growth, yield, and performance too. Growth reduction because of changes in physiological and biological process in plants growing on heavy metals polluted soil is seen. Continued growth in the size of plants leads to decrease in the yields which eventually lead to food insecurity. Soil properties affect metal availability in many ways. Like pH is the main factor affecting metal availability in soil. Other factors like density and type of charge in soil colloids the degree of complexation with ligands and the soils relative surface area.

Heavy metals reach the soil through the air\atmosphere and absorb by the roots of the plants and get accumulated in the softer tissues of plants. Plants experience oxidative stress on exposure to the heavy metal that finally leads to the cellular damage. Also, plants accumulate metal ions that destroy the cellular ionic homeostasis. To overcome the hazardous effects of heavy metal exposure and their accumulation, plants have developed detoxification method. These mechanisms are mainly based on chelation and sub cellular compartmentalisation [8].

2.5 Impact of heavy metal contamination on humans

Heavy metals reach human body through intake of plants containing it. Heavy metals turn out to be venomous, when not metabolised via the body and thus they accumulate or gather in the softer tissues. Chronic level ingestion of heavy metals toxic or heavy metals has hazardous effects on human body, and the impacts are noticeable only after several years of exposure. Heavy metals enter plants, animals, and human tissue through air (inhalation), diet (humans consuming both plants and animals or animal consuming plants and in turn humans consuming animals). These metals not only cause hazardous effects to humans only but are harmful for soil too. Toxic metals are a threat for both terrestrial and aquatic ecosystem. Heavy metals contaminate water bodies, soils, and sediments, after releasing from both natural or anthropogenic or human activities. Heavy metals are importunate, so they accumulate or deposit in the ground waters. Contamination also occurs when these metals are released into air through volcanic activities and from different industrial emission which ultimately return to the land.

Cadmium toxicity has been identified in the liver, brain, kidney, lungs, placenta, and bones. It causes muscular weakness, vomiting, abdominal cramps, and nausea. In Japan, Itai-Itai diseases brought dangers of cadmium into attention. Zinc is considered nontoxic, however, if taken in excess amount causes vomiting, impairment of growth, diarrhoea, bloody urine, reproductive issues, liver and kidney failure and anaemia. Cupper, exposure to high levels causes hepatic and renal damage, severe gastrointestinal irritation, skin irritation, etc. Heavy metals are detected in soil with some specific instruments like Atomic Absorption Spectroscopy (AAS), Inductively Coupled Plasma (ICP), Inductively Coupled

Plasma-Mass Spectroscopy (ICP-MS), and X-ray Fluorescence and Spectroscopy are used. Among all these instruments, atomic absorption spectroscopy gives the precise quantitative determination. The research basically focuses on the study to find out the presence of heavy metal, and quantity or amount of heavy metals or what the heavy metals are [9].

2.6 Forensic significance

Soil is like the fingerprint because as there are different patterns of fingerprint, the same way soil has its unique characteristics and properties that serve as its identification. Soils can be used as a profitable proof to establish the link between the suspect and the crime scene. Soil is a common blend of chemical, biological, and physical properties. If any heavy metals detected in soil, then it is used to geo-tag any particular location. Atomic Absorption Spectroscopy (AAS) is an apparatus for identification of the metals from the sample (soil, blood, serum, etc.) While investigating a various crimes, soils from different regions like sites of rivers, urban regions, industrial regions, and institutional regions etc. are used. Suppose we found a soil sample from the crime scene, it was sent further to laboratories tor its analysis. Whatever the result is like present of any heavy metals or ay normal or general metals will help to geo tag the location. By tallying both the question soil samples and the reference soil samples conclusions can be drawn [10, 11].

3. Heavy metals contamination of water

Water pollution includes contamination in liquid forms. Water pollution is of both marine pollution and river pollution. Industrial, factorial and consumer waste, fertilisers and pesticides, and acid rain which fall in the soils and finally reache these heavy metals into streams, rivers, lakes, and ground water. Heavy metals tend to bio accumulate and thus they are dangerous. It is well said that because of water, life exists in biosphere. And water is a universal solvent. Various inorganic chemicals and organic chemicals are dissolved in water, and the environment impurities are also dissolved in water. Both aquatic ecosystems be it fresh water or marine all are affected because of pollution. Water contamination is a serious environmental issue and which has direct impact on animals, plants, and human beings. Heavy metals are tremendously lethal to aquatic life even at small concentrations. Histopathological modification in the tissues of aquatic organisms such as fish, insects, and other aquatic life are seen because of the toxicity of the water. As these metals do not decompose, they accumulate in the soft tissues of the aquatic animals as well as in plants too. Contamination by heavy metals from many other various sources is major threat to the water and its organism. One source is effluents which released from the factories and industries [12].

3.1 Sources of heavy metals in water

Environmental pollution from dangerous metals and minerals can appear from natural as well as human activities sources. Natural sources such as leakage from rocks into water, volcanic action, forest fires, etc. With quick industrialisation and changing in lifestyle supply of environment pollution has increased. Chromium through mining and industrial coolants; lead through lead acid batteries, E-wastes, and bangle industry; mercury through fluorescent lamps, hospital waste, and

electrical appliances; arsenic through natural process, fuel, and thermal power plants; copper and nickel through mining and electroplating; cadmium is released through waste batteries, e-waste, paints sludge, incinerators, and fuel combustions; zinc through smelting and electroplating [13].

3.2 Impact of heavy metal contamination of water

It releases toxic substances which are harmful for the aquatic life. Heavy metals tend to bio accumulate and thus they are dangerous for all the living organisms. Bio accumulates mean to boost concentration of any chemical in any living organism eventually. Increase in water pollution leads to release of toxic substance, pathogenic germs which requires more oxygen to decompose, for radioactivity, etc. Example: Eutrophication is a condition in which lack of oxygen in a water body is seen which is caused by unnecessary algae growth since it has enrichments of pollutants. It kills all the aquatic plants, small fishes (which in turn feds on the aquatic plants), large fishes (which feeds on the small fishes), and the human beings. And finally degrade the environment. The quality of water everywhere is degrading day by day. It is becoming less suitable for any work, and for drinking purpose, it is completely unfit. But still some people have no choice, they filter the water and then they consume it. And the animals, they have no idea whether is suitable for drinking purpose or not, and after grazing, they come to the river, ponds, or small lakes to drink water. Along with the water, they take the toxic metals in them. And slowly this toxic metal affects their system and makes them ill and finally leads to their death [13].

3.3 Impact of heavy metal contamination on human

Animals graze on the plants which are contaminated with the heavy metals and then gulp the same water. The marine lives that breed in heavy metals contaminated water; both such metals form a mass in their tissue and milk. In short, every single living organism is dependent on each other for their survival. And when humans consume these plants and animals, they eat the toxic substances along with them. Specific metals have specific toxicity. And toxicity also depends on the concentration of the metals consumed. Cadmium is poisonous at a low level [10]. In humans, it leads to renal dysfunction, bone defects, osteoporosis, increases blood pressure, and myocardial dysfunctions. Lead is very harmful and mostly captivated by ingestion with food and water and through inhalation. One of the serious effects is teratogenic effect. Poisoning of lead also causes cessation of the production of haemoglobin, kidney dysfunction, and unceasing damage to central nervous system. Zinc has same effects as lead. Its excessive concentration causes improper growth and reproduction, diarrhoea, bloody urine, vomiting, kidney failure, and anaemia. Mercury is toxic as it causes spontaneous abortion, gastric intestinal disorder, etc. Many health-related issues occur because of protein deficiency including reduction of chondroblastic or osteoblastic activity. In this condition, normal growth and formation of bones and cartilage gets manipulated, which finally results in irreparable body deformities in the growing child and in adults. Fishes are an important and staple food in the coastal regions of many parts of India. Hence, it is very important to know the correct amount of heavy metals present in the coastal amounts to protest both the aquatic and terrestrial life. Terrestrial life suffers damage to liver, kidney, heart, and body joints. The liver and kidney produce metallothioneins causing toxicity which is very hazardous for the human life [14]. In **Figure 1**, there is presentation of bioaccumulation and biomagnification.

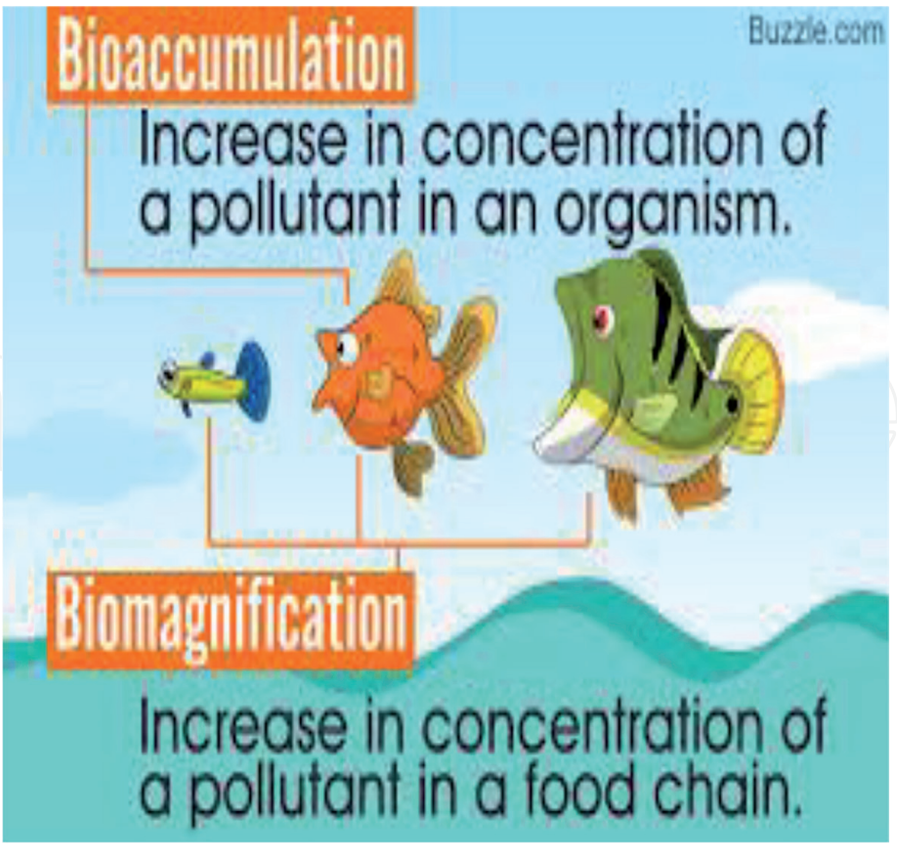

Figure 1.
Bioaccumulation and bio magnification [15].

3.4 Impact of heavy metal contamination on fish

Heavy metals are continuously being released in aquatic environment from natural and anthropogenic activities such as industrial, factories and domestic sewage discharges, mining, farming, electronic waste, anthropic accidents, etc., and metals are easily dissolved in water and are subsequently absorbed by the aquatic organisms such as small and large fishes and invertebrate, including a wide range of biological effects from being important or essential to being lethal. In spite of the fact that some metals are essential at low concentration, at higher concentration, they could be inducing toxic and lethargic effects in organisms, disturbing its growth, metabolism or reproduction [16].

Micronutrients are such as copper, zinc, ferric, manganese, cobalt, molybdenum, chromium and selenium, and macronutrients such as calcium, magnesium, sodium, phosphorous and sulphur. Apart from the essential elements, the non-essential elements such as lead, cadmium, nickel, arsenic, and mercury show its toxic effects at a very low concentration. High levels of metals in the surrounding could be hazardous for the functioning of the natural ecosystem and human health, due to their toxic effects, long persistence, bio accumulative properties, and bio magnifications in the food chain. Due to the possibility that the aquatic biota can accumulate various chemicals, are used to measure the effects of metals on aquatic organism as an essential indicator of water quality [17].

The organic chemical can be metabolised by the organisms easily, but the majority of metals cannot be easily metabolised because of its non-biodegradability. Once they get introduced in the aquatic environment, the metals get redistributed throughout the water column, gets accumulated in sediments, or consumed by biota. Metal residues in contaminated habitats have the ability to bio accumulate in aquatic environment like aquatic flora and fauna, which in turn gets consumed by

the human beings or animals as food and enters the human food chain and finally results into health problems. Metal accumulation in sediments occurs through the process of precipitation of certain compounds. Some factors that control the bioavailability of metals are such as size or age, sediments, suspended matter and metal speciation, physical and chemical factors such as temperature, salinity, pH, ionic strength, concentration of the dissolved organic carbon, etc. [18].

The metals are up taken from the permeable epidermis if metals are in dissolved forms or through food ingestion if metals are in particulate forms. The ingestion uptake mainly depends on many factors. The suspended solid particles accumulate the insoluble metal compounds but under certain conditions, the metals reach the interstitial water being dissolved.

4. Discussion

Toxic metals are a threat for both terrestrial and aquatic ecosystem. Heavy metals contaminate water bodies, air, soils, and sediments, after releasing from natural or anthropogenic or human activities. Heavy metals are unrelenting or indestructible, so they both accumulate or deposit in the ground waters. Heavy metals reach water through the industrial, factorial, and consumer waste, through fertilisers and pesticides and also the from acid rain falling down in the earth which releases the heavy metals in the lakes, rivers, streams, and ground water. The release of factories and industrial effluents or waste is the chief source of water pollution as they are released directly into the rivers without being treated, which is a major threat to the aquatic life. Pollution of the rivers and water is a global problem because of its perseverance, bioaccumulation, and biomagnifications in the food chains and toxicity of the heavy metals. Atmosphere pollution is mainly in the gaseous state of the heavy metals and dust emitted by the transport, energy, metallurgy, and during building. Heavy metal principally goes in the atmosphere in the form of atomizer and gets deposited in the soil in the course of the natural sedimentation and rainfall process. Automobile transport causes some serious heavy metal contamination. Also, heavy metal is brought into soil by irrigative sewage, sanitary sewage, chemical wastewater, and industrial mining. Industries release a lot of harmful chemical which are directly released to river or an open area. Also, people nowadays use a lot of fertilisers and pesticides, for agricultural purposes. Factories and industrial outlets in the form of smoke, automobiles emissions and release of variety of compounds and chemical are followed by increase by man's some unwanted pollutants, which are serious threats and problem risking for the environment and for the man himself. Lead, mercury, and cadmium are the common air pollutants.

5. Conclusion

From the description of heavy metals, it can be concluded that these are toxic for all living beings. But the difference is in its concentration. If the concentration is low, the toxicity is also low but if it is high, it could be fatal. Heavy metals are present everywhere. These are present in soil, deposited in water, and present in the atmosphere too. These pollute the environment as well as human's life. Through soil, it is absorbed by plants further by the herbivorous animals which in turn are eaten by the carnivorous animals as well as by the humans. These metals do not go off easily from the plants and animals instead it gets accumulated in the soft tissues of plants and animals and further reaches to humans. The heavy metals which are in the water degrade the quality of water and makes it unfit for drinking for all the

living beings and even for other purposes. It is a threat for the aquatic life. Because of this, the amount of dissolve oxygen decreases and thus the life which are under aquatic do not get sufficient oxygen to breathe, which could lead to death of the fishes, aquatic insects, animals, and plants. Heavy metals are present in the atmosphere in the form of aerosols, air, etc. which directly goes into our lungs and then slowly to all our body parts through breathing. These heavy metals reached into the environment through the anthropogenic activities or human activities. By the industrial effluents, discharge of industrial and hospital waste directly into water without being treated, similarly the sewages are also released unto water without being treated, through vehicular emission.

We should control our activities and start thinking about the future. Already a lot of damage has been done to the environment and now it is time to take preventive measures. That includes a forestation, sewage waste should be treated before releasing into rivers, non-biodegradable waste should not be dumped here and there, instead recycle it and then again use it, heavy and radioactive metals should be properly incinerated.

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