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ASSESSMENT OF HEAVY METALS CONTAMINATION OF DIFFRENT RIVER WATER OF CHHTTISGARH, INDIA

Environmental Science

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ABSTRACT

The concentrations of heavy metals (Cu, Cr, Zn, Pb, Mn, As, Cd, Co, Ni, Sn, and Fe) in water samples for the Industrial (Kharun and Shivnath river) and Non-Industrial (Doodhnadi and Mahanadi river) site of different river are three season monsoon, winter, and summer in Chhattisgarh, India were evaluated to assess the pollution level. Four river sites (Industrial and Non-Industrial site of different river) were selected along the study area and sampled during 2017 to 2018 monsoon, winter, and summer season using Atomic Absorption spectrometer (Thermo scientific ICE 3000 series AAS). The concentration of heavy metals in different river water shows the concentration in manner like summer > monsoon > winter. The study reveals that the concentration of the specific metals was higher than the permitted value for aquatic life as well as for drinking purpose indicating that the water is not safe for the above purpose. This study demonstrates the usefulness of water quality assessment identification of pollution sources factors and understanding temporal/spatial variations in water quality for effective surface water quality management.

KEYWORDS

Industrial and Non-Industrial heavy metals, Concentration, Pollution.

INTRODUCATION:

Water is one of the very most valuable substances on the earth, it is very essential for the existence and survival of the life and water is store by aquatic bodies like river, lack, ocean, and they maintain ground level for the earth. Water is the most important factor in the water board; it is located in 0.8 parts of the Earth. The total volume of water in the hydrosphere is 1.4 billion cubic kilometres. In it, 97.5 percent of the water is in the sea, which is unusable for humans. Only 2.5% of fresh water is available in the form. Recently, metal contamination in the aquatic bodies has of great concern because of its toxicity for environment and human beings, non-degradable, persistence and ability to be accumulated in food chains (Emad A. Mohammed Salah et al. 2015; Armitage et al. 2007; Wang et al. 2013; Sun et al. 2015).

The primary sources of metal pollution include the burning of fossils fuels, mining and smelting of metal ores, municipal wastes, fertilizers, pesticides, and waste water irrigation. The heavy metals are difficult to clear away from the natural environment, or even form a secondary pollution (Wu Pan et al. 2002). Contamination of groundwater and soil by heavy metals leads to major environmental and human health problems discharge of industrial and domestic effluent Anthropogenic activities like mining, disposal of treated and untreated toxic waste, and metal chelates from different industries resulted in worsening of water quality rendering serious environmental problems(J. O. Idoko et al. 2016).Wastes are complex in nature depending on the sources of generation and its environmental fate once generated of all the classification of wastes available, industrial wastes is the most occurring source of water pollution (Deepak Kumar et al. 2017; Oyediranfan et al.1997). Heavy metals thus discharged persist in the aquatic bodies and bio accumulates along the food chain. Metals present in the environment in minute quantities become part of various food chains through bio magnification and their concentration increases to such a level that may prove to be toxic to both humans and other living organisms (Aradhna Gupta etal. 2008).

Due to runoff rain water river that flow in highly populated and industrialized areas, contents of toxic elements including suspended organic loads by soil erosion, urban and hospital effluents and lactates from the numerous waste dumps located along the rivers (Mubedi et al. 2013). The Heavy metal pollution can be a much more serious problem because they are very toxic in nature and cannot be degraded by natural processes and persist in soil and sediment from where they are released gradually into water bodies as sink (S.N. Sinha et al. 2014).Water quality monitoring it's regularly of the water resources is absolutely necessary to measure the quality of water for ecosystem health, hygiene, industrial use, agricultural use and domestic use because the water quality evaluation may be a complicated practice in compound parameters causing numerous anxieties in general quality of water (Mohamed E. Goher et al. 2014).Variation of heavy metal concentration in river water depended on present environment like industrial and non-industrial site urban and rural site agriculture and forest site in river. The presence of heavy metals (i.e., lead, cadmium, iron, copper, zinc, chromium, tin, nickel, cobalt, manganese, arsenic) in marine, groundwater, and industrial wastewater is of great concern due to the associated negative health effects such as cancer (Su etal.2015).

STUDY SITE:

The studies of heavy metal concentration in river water are proposed to begin with identification of Industrial and Non-Industrial site four river of sampling sites for river water sample collections which have given below:

1. Kharun River, District- Raipur, Chhattisgarh (Industrial area)
2. Shivnath River, District- Durg, Chhattisgarh (Industrial area)
3. Mahanadi River, District- Dhamtari, Chhattisgarh (Non-Industrial area)
4. DoodhNadi, District- Kanker, Chhattisgarh (Non-Industrial area)

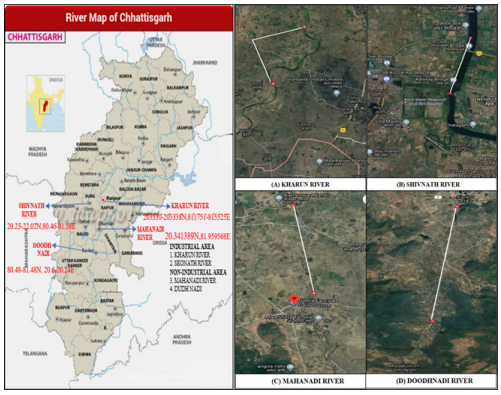

Fig. 1. Locations of river water sampling sites in (A) Kharun River (B) Shivanath River (C) Mahanadi River (D) Doodhnadi River.

COLLECTION OF WATER SAMPLE:

Hold of sampling process is used for sample collection. Polythene bottle 500ml capacity were used for water sample collection. The bottles were cleaned by HNO3 with sampling station water and after this they were filled and sealed. During the testing procedure sample were kept in normal room temperature.

MATERIALS AND METHODS:

For total metal analysis, water samples were digested using acid mixture (10-mL HNO3 + 5mL HClO4). Acid digestion of water was carried out in following way:

Water sample: 100ml of water sample was added with 20 ml acid mixture. The digested samples were then filtered through Whatman filters paper No. 42 and made up to 25 ml with deionized water and stored at 40C. The metals in water samples were analysed using Atomic Absorption Spectrometer (Thermo scientific ICE 3000 series AAS). The quantification of metals was based upon calibration curves of standard solutions of metals (Surindra Suthar et. al.2010)

RESULTS AND DISCUSSION:

Average concentration of heavy metals of monsoon, winter, and summer season, in vicinity of selected Industrial river site and Non-Industrial river site of are shown in Table 1 & 2. It is apparent from the results that the average concentrations of metal ions vary significantly in different Industrial river sites and Non-Industrial river site.

Table 1. Average Concentration (mg/L) of heavy metal in Industrial site of river.

Heavy Metal parameters (mg/L)	Kharun river			Shivnath river			WHO
	Monsoon	Winter	Summer	Monsoon	Winter	Summer	Permissible limits (mg/L)
Cu	0.2335	0.2208	0.2608	0.3236	0.2441	0.3243	1.0
Cr	0.7520	0.7989	0.8108	0.7753	0.7712	0.7816	0.1
Zn	1.2361	1.0384	1.3028	1.2165	1.2418	1.2508	5.0
Pb	0.1715	0.1925	0.1914	0.1900	0.1814	0.1857	0.05
Mn	0.0746	0.0760	0.0719	0.0768	0.0755	0.0739	0.1
As	0.3908	0.4067	0.3429	0.4487	0.4600	0.4487	0.05
Cd	0.2251	0.2254	0.2286	0.2250	0.2276	0.2316	0.005
Co	0.1744	0.1755	0.1781	0.1723	0.1766	0.1749	0.04
Ni	0.1658	0.1642	0.1719	0.1650	0.1654	0.1693	0.02
Sn	0.5894	0.3472	0.5943	0.5094	0.4981	0.6424	0.1
Fe	0.0736	0.0654	0.0981	0.4306	0.0694	0.0571	0.3

The Industrial site selected in two river Kharun River of Raipur area and Shivnath River of Durg area. The seasonal average consecration of heavy metal Industrial site of Kharun river water sample decreased in the order of Zn > Cr > Sn > As > Cu > Cd > Pb > Co > Ni > Fe > Mn, and same order of heavy metal concentration in Shivnath river. The concentration of Zn in river water sample higher the other heavy metal in all three season but concentration of Zn both river under the permissible limit (5mg/l) and concentration of Mn lower the other heavy metal in all three season and concentration of Mn both river under the permissible limit (0.1mg/l) . The concentration of Cr, Cu, and Fe, is below the permissible limit (0.1 mg/l, 1mg/l, 0.3mg/l respectively) all the three season in both river site. But the concentration of Pb, As, Cd, Co, Ni and Sn, higher the permissible limit (0.05mg/l, 0.05mg/l, 0.005mg/l, 0.04mg/l, 0.02mg/l, and 0.1mg/l respectively) all the three season in both river site. The Sn concentration is more than of non-industrial site and other element may be same concentration of Non-Industrial site. This metal are highly toxic metal not known to have any beneficial effects for plants and animals and mainly enters the environment through anthropogenic activity like municipals waste water, vehicle fume, Industrial activities and natural activity like soil corrosion. Heavy metal concentration are higher industrial river water site also effected plants, human health and other living organism. Human health and environmental quality are undergoing degradation by the increasing amount of pollutant.

Table 2. Average Concentration (mg/L) of heavy metal in Non-Industrial site of river.

Heavy Metal parameters (mg/L)	Mahanadi river			Doodhnadi river			WHO
	Monsoon	Winter	Summer	Monsoon	Winter	Summer	Permissible limits (mg/L)
Cu	0.2530	0.2057	0.3353	0.2629	0.1925	0.2933	1.0
Cr	0.7884	0.8230	0.7950	0.7631	0.7740	0.7746	0.1
Zn	1.2745	1.2518	1.3531	1.2397	1.2544	1.2417	5.0
Pb	0.1853	0.1860	0.1941	0.1761	0.1736	0.1770	0.05
Mn	0.0671	0.0646	0.0756	0.0722	0.0748	0.0784	0.1
As	0.2271	0.3471	0.4386	0.2999	0.4156	0.4578	0.05
Cd	0.2263	0.2271	0.2191	0.2254	0.2254	0.2248	0.005
Co	0.1780	0.1797	0.1803	0.1793	0.1718	0.1720	0.04
Ni	0.1728	0.1706	0.1778	0.1701	0.1699	0.1771	0.02
Sn	0.3464	0.4121	0.4186	0.4538	0.4306	0.4922	0.1
Fe	0.0932	0.0513	0.0950	0.6310	0.0612	0.6651	0.3

In this studies Non-Industrial site selected in two river Mahanadi River of dhamtari area and Doodhnadi River of Kanker area. The seasonal average consecration of heavy metal non-Industrial site of Mahanadi river water sample decreased in the order of Zn > Cr > Sn > As > Cu > Cd > Pb > Co > Ni > Fe > Mn, and order of heavy metal concentration in Doodhnadi river Zn > Cr > Fe > Sn > As > Cu > Cd > Pb > Co > Ni > Mn. The concentration of Zn in river water sample higher the other heavy metal in all three season but concentration of Zn both river under the permissible limit (5mg/l) and concentration of Mn lower the other heavy metal in all three season and concentration of Mn both river under the permissible limit (0.1mg/l) . The concentration of Cr, Cu, and Fe, is below the permissible limit (0.1 mg/l, 1mg/l, 0.3mg/l respectively) all the three season in Mahanadi river site and the Doodhnadi river water concentration of Cr, Cu, below the permissible limit but concentration of Fe is higher the permissible limit and the concentration of Pb, As, Cd, Co, Ni and Sn, higher the permissible limit (0.05mg/l, 0.05mg/l, 0.005mg/l, 0.04mg/l, 0.02mg/l, and 0.1mg/l respectively) all the three season in both river site. This metal are highly toxic metal not known to have any beneficial effects for plants and animals and mainly enters the environment through anthropogenic activity like house waste water, vehicle fume, agricultural activities and natural activity like soil corrosion. Heavy metal concentration are higher in Non-Industrial river water site also effected plants, human health and other living organism.

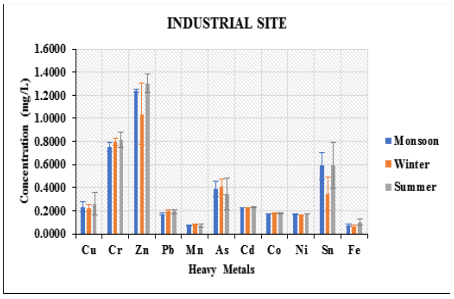

Fig. 1. Seasonal variation in concentration in heavy metals Kharun River site.

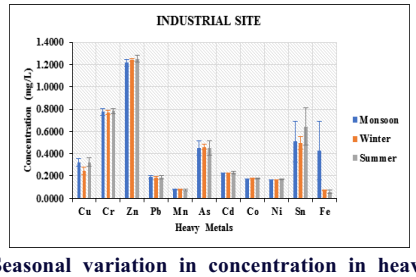

Fig. 2. Seasonal variation in concentration in heavy metals Shivnath River site.

The average seasonal variation of heavy metal concentration in Kharun River and Shivnath River at Industrial site. The concentration of Cu, Cr, Zn, Pb, Mn, As, Cd, Co, Ni, Sn, and Fe in monsoon winter and summer season in Kharun river water (Fig1). The maximum concentration of Cu, Zn, Sn, Ni, and Fe in summer season and minimum concentration of winter season, concentration of maximum is Co, Cd, and Cr in summer season and minimum concentration is monsoon season the concentration of Pb, Mn, and As is maximum in winter season and minimum is summer season. The concentration of Cu, Cr, Zn, Pb, Mn, As, Cd, Co, Ni, Sn, and Fe in monsoon, winter and summer season in Shivanath river water (Fig2). The maximum concentration of Cu, Zn, Ni, and Cd in summer season and minimum concentration in monsoon season, concentration of maximum is Sn,

and Cr in summer season and minimum concentration is winter season, the concentration of Mn and Fe is maximum in monsoon season and minimum is summer season and concentration of As is maximum in summer and equal as monsoon and minimum is winter season, and concentration of Co maximum in monsoon and minimum is winter season, concentration is Pb maximum in monsoon season and minimum is summer season, and concentration is Co maximum in winter season and minimum is monsoon season.

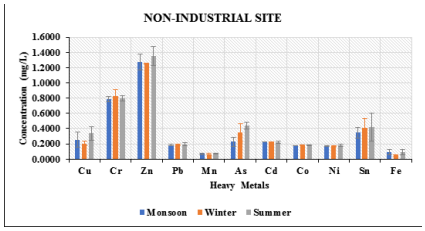

Fig. 3. Seasonal variation in concentration in heavy metals of Mahanadi river site.

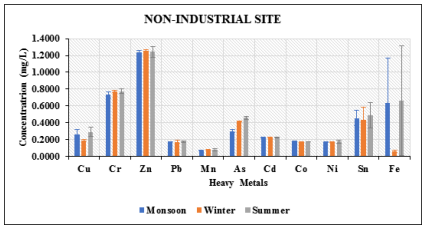

Fig. 4. Seasonal variation in concentration in heavy metals of Doodhnadi river site.

The average seasonal variation of heavy metal concentration in Mahanadi River and Doodhnadi River at Non-Industrial site. The concentration of Cu, Cr, Zn, Pb, Mn, As, Cd, Co, Ni, Sn, and Fe in monsoon winter and summer season in Mahanadi river water (Fig3). The maximum concentration of Cu, Zn, Mn, Ni, and Fe in summer season and minimum concentration of winter season, concentration of maximum in Pb, As, Co, and Sn in summer season and minimum concentration is monsoon season the concentration of Cr is maximum in winter season and minimum is monsoon season and concentration of Cd is maximum is winter and minimum is summer season. The concentration of Cu, Cr, Zn, Pb, Mn, As, Cd, Co, Ni, Sn, and Fe in monsoon winter and summer season in Doodhnadi river water (Fig4). The maximum concentration of Cu, Pb, Mn, Sn, As, and Fe in summer season and minimum concentration of winter season, concentration of maximum in Ni and Cr in summer season and minimum concentration is monsoon season the concentration of Zn is maximum in winter season and minimum is monsoon season and concentration of Cd is maximum winter season and equal as monsoon season and minimum is summer season, and concentration of Co maximum in monsoon and minimum is winter season.

CONCLUSION:

In this above study it is concluded that rapid Industrialization and urban development results in deterioration of water quality over the years. Selected four river site is found more polluted because of Industrial density resulted in discharge of huge effluent and discharge of untreated sewage. Stretch of river Kharun River and Shivanath River passing through city and Industrial aria, but Mahanadi and Doodhnadi passing through small town and villages but they have not present any Industries. Due to very few urbanization and Industrial activities along the river concentration of pollutant in increases. However, from the results obtained in present study it's recommended to frame a strict policy for waste water treatment in Industries. Regulatory Authorities have to ensure implementation of the existing rules and suggest a way forward in achieving effluent discharge standards in the industries. Also there is a need to establish sewage treatment plants in major human settlements so that untreated sewage couldn't contaminate the water bodies.

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