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Seasonal variation of heavy metal contamination of surface water in Beehar River, Rewa, Madhya Pradesh

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Abstract
The study was carried out to determine the concentration of heavy metal ions in and around this area. Four surface water samples were collected from in and around Beehar river, Rewa during summer, rainy and winter season during the year of 2015-17. The concentration of trace metals such as arsenic, chromium, cadmium, copper, iron, manganese and zinc were determined using atomic absorption spectrophotometer and the results were compared with the World Health Organization (WHO) and Bureau Indian standard (BIS) values. They are extremely dangerous for the health of fish. Most of these metals are characterized by being accumulated in tissues, and lead to the poisoning of fish. These metals can effectively influence the vital operations and reproduction of fish; weaken the immune system, and induce pathological changes. As such, fish are used as bio-indictors, playing an important role in monitoring heavy metals pollution.

Keywords: surface water, heavy metals, irrigation, WHO

1. Introduction
India is a blessed with fresh water resources in the form of numerous rivers and lakes. It is often referred to as the "Land of Rivers". It has 14 major, 55 minor and numerous small rivers. In fact riverbanks first hosted human civilizations in India as elsewhere in the world. The spiritual reverence for rivers in India still remains intact. But the physical well-being of the rivers is increasingly been challenged by the rapid growth in industrialization to support the country's growing population and economy. According to the scientists of National Environmental Engineering Research Institute, Nagpur, India, about 70% of the available water in India is polluted (Pani, 1986) [1]. Studies showed that domestic and industrial sewage, agricultural wastes etc. have polluted almost all of Indian rivers. Most of these rivers have turned into sewage carrying drains. It is estimated that community waste from human activities accounts for four times as much wastewater as industrial effluents, most of which is discharged untreated/partially treated into the water courses in India (Sahu, 1993) [2].

Surface runoff from urbanized territories carries a broad spectrum of pollutants. It is well known that urbanized areas are important pathways for the transfer of heavy metals (HM) into the environment (Buzier *et al.* 2011) [3]. Due to their dispersion, HM can be observed in different environments (Drozdova *et al.* 2015) [4]. Polluted surface runoff may represent a shortterm problem when dissolved pollutants enter a receiving system with pulses, and a long-term problem when toxicants accumulate in the sediments (Hatch & Burton 2000; Göbel *et al.* 2007) [5-6].

Sediments in untreated runoff from direct discharge storm water systems are one of the most important contributors to urban waterway pollution, and are considered to be a dominant stressor in urban aquatic ecosystems (Marshall *et al.* 2010) [7]. Excess suspended sediments can affect the aquatic ecosystem through depositional effects such as the reduction in the exchange capacity between benthic and water column zones, reduced food quality and smothering of biota, as well as through suspended effects such as respiratory damage, light attenuation and transport of other pollutants such as HM (Ryan 1991; Pekey 2006; Clapcott *et al.* 2011) [8-10].

2. Material and Methods
2.1 Description of the study site
Rewa region has a saucer shaped structure. The flat central part is composed of sedimentary rocks derived from the denuded material of the hills surrounding the basin. The sloping margin of the saucer are composed of older rocks which contrastingly occupy a higher level than the younger. Sedimentary rocks of the central flat zone. The saucer was once a sea in which sediment from the coastal hills deposited during Precambrian period. Decapitation of the surrounding hills exposed the older rocks at the coast line of the original Synclinal tatnys. A profile of this vast hilly tract running south to north would clearly make out the physiographic feature of the Rewa, and its comparative position the elevation scale.

The physiography of Rewa is very rough and hilly. The area is cylinderical in share and the drainage pattern is of centripetal type. The rivers are mostly originating from the South and running towards north. Structure confirm earth surface behaviour and geodynamic process such as silting and erosion, consequently, tend to produce marked local climate or micro climate. The saucer shaped structure of this area clearly accounts for the scanty vegetation. Owing to its centripetal drainage pattern the area is subjected to quick and continuous.

Site description

1. Rajghat Sangam (S-1): This sampling point was established near Rajghat Sangam. PHED pumping station is the characteristics of the site.
2. Nipania bridge (S-2): This sampling point was established near Nipania bridge intensive humann activities are the taking place at this site.
3. Vikram bridge (S-3): This sampling point was marked near Vikram bridge, a cloth washing by Dhobis and other human activities are the characteristics of the area.
4. Jayantikunj (S-4): This sampling station was established behind forest range office which characteristics the river moving out of the town.

The analysis/measurements of heavy metal concentration were carried out with an Atomic Absorption Spectrophotometer (AAS) and the results were compared with WHO standard values. All concentrations were determined using the absorbance made with airacetylene flame. Eight working solutions were prepared from the stock solutions for each of the metals by successive serial dilution and each of the standard solutions was then aspirated into the flame of AAS and the absorbance recorded in each case. A plot of the concentration against the corresponding absorbance gives the calibration curve of each metal. The samples, after aspirated into the flame and the absorbance obtained were then extrapolated from the calibration plot to obtain the corresponding concentration.

3. Results and Discussion

The obtained results of heavy metals are tabulated in Table 1. The results are discussed and compared with standard values.

Table 1: Concentrations of heavy metal ions in surface water samples during 2015-17 year of the Beehar River.

S. No.	Parameters	WHO[11]/BIS[12] limit (ppm) (min.-max.)	Seasons			
			Summer	rainy	winter	Avg.
1.	Arsenic (ppm.)	0.01-No relaxation	0.030	0.051	0.027	0.036
2.	Chromium (ppm.)	0.05-No relaxation	0.030	0.006	0.044	0.027
3.	Cadmium (ppm.)	0.01- No relaxation	0.004	0.006	0.006	0.005
4.	Copper (ppm.)	0.05-1.5	0.038	0.058	0.005	0.034
5.	Iron (ppm.)	0.3-1.0	0.047	0.062	0.070	0.059
6.	Manganese (ppm.)	0.1-0.3	0.027	0.054	0.076	0.052
7.	Zinc (ppm.)	5-15	0.025	0.052	0.060	0.046

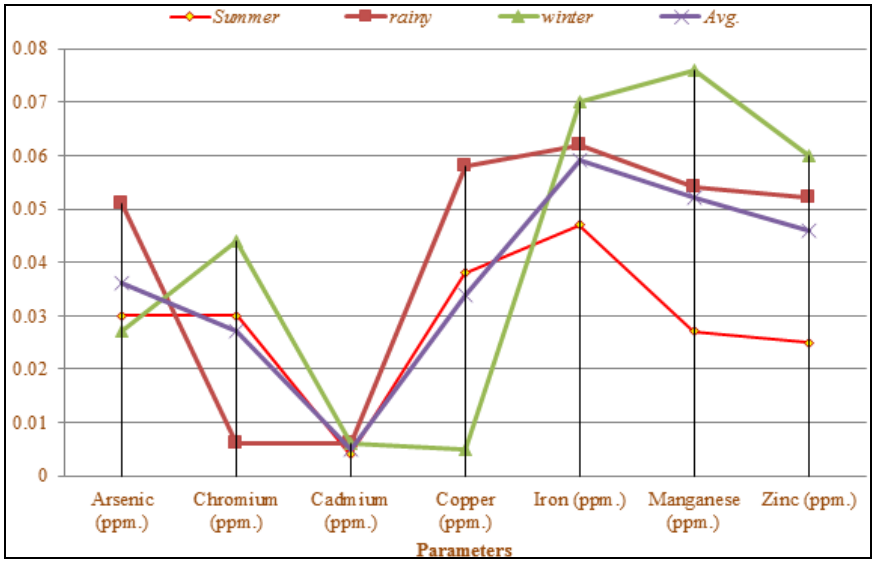

Fig 1: Graphics analysis of Concentrations of heavy metal ions in surface water samples during 2015-17 year of the Beehar River

It is produced as a result of metal refining processes. As it is stored in skeleton muscles followed by skeleton, liver, blood, lungs, kidney and feathers. As exists as trivalent and pentavalent forms Trivalent form of as is much more toxic than pentavalent form. Clinical signs of acute poisoning are vomiting, diarrhea, marked depression and dermatitis (Jarup, 2003) [13]. The present study the Arsenic seasonal variations 0.030 (ppm) summer season, 0.051 (ppm) rainy season and 0.027 (ppm) winter seasons.

It is also responsible for chrome ulcer and kidney damage. The maximum concentration of Cr (VI) permitted in domestic water supplies is 0.054 ppm. Other sources of contamination of chromium in the environment are Chlor-alkali, electroplating, leather textiles, pigments, dyes, metal finishing and mining (Manivasakam, 1996) [14]. Cr content of the present study lies within the prescribed standards except winter season.

Exposure to cadmium is commonly determined by measuring cadmium levels in blood or urine. Blood cadmium reflects recent cadmium exposure (from smoking, for example). Cadmium in urine (usually adjusted for dilution by calculating the cadmium/creatinine ratio) indicates accumulation, or

kidney burden of cadmium (Jarup *et al.* 1998, Wittman and Hu, 2002) [15-16]. The present study the Cadmium seasonal variations 0.004 (ppm)-0.006 (ppm).

Copper is widely distributed and is an essential metal required by all living organisms in some of enzyme systems, but at higher concentration it acts as pollutant. Higher concentrations of Cu cause fishy, fatty and oily taste (Sharma & Kaur, 1997) [17]. The present study values are ranged between (0.005-0.038 ppm).

Iron is one of the most abundant metals in the earth crust and is essential for human beings. But excess iron in drinking water produces inky taste and muddy smelling (Sharma & Kaur, 1997) [17]. In the present study iron content varies between 0.047 to 0.070 ppm.

It is one of the most important trace elements essential for organisms. Shortage of Mn causes fatness, Glucose intolerance. Manganese effects occur mainly in the respiratory tract and in the brains. Manganese can also cause Parkinson and lung embolism (Barik *et al.* 2005) [18]. Chronic Manganese poisoning may result from prolonged inhalation of dust and fume. The central nervous system is the chief site of damage from the disease, which may result in permanent disability. Symptoms include languor, sleepiness, weakness, emotional disturbances, recurring leg cramps, and paralysis. Mn is found to vary between 0.027 and 0.076 ppm.

The major sources of water contamination of Zn are from industrial wastes, deterioration of galvanized iron and dezincification of brass etc. Zinc sulphates containing fertilizers are also responsible for higher values of Zn in water (Wu *et al.* 2008) [19]. In the present study Zn content varied between 0.025ppm and 0.060ppm.

4. Conclusions

Water is one of the abundantly available substances in nature and also called an elixir of life. The study assessed the evolution of water quality in surface water and open well water of Beehar river, Rewa district. The water samples were subjected to the concentrations of heavy metal ions. Such as arsenic, chromium, cadmium, copper, iron, manganese and zinc were found to be within the limits. In aquatic ecosystem, heavy metals are considered as the most important pollutants, since they are present throughout the ecosystem and are detectable in critical amounts.

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