ASSESSING THE TRACE METAL STATUS IN THE SEDIMENT OF AMBRAMPALAYAM RIVER, POLLACHI TALUK, TAMILNADU, INDIA

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ABSTRACT: Pollution, the introduction of contaminants by natural disaster and by human activities into the environment has a detrimental effect on any living organism in an that environment and making it virtually impossible to sustain life. Of these, heavy metals are regarded as one of the most serious pollutants of the aquatic environment because of their persistence and tendency to accumulate in aquatic organisms and in aquatic components. While, apart from water, sediments are one of the possible mediums in aquatic monitoring as they are known to capture hydrophobic chemicals pollutants entering water bodies. Thus, following standard Sediment Analysis Method the Ambarampalayam river sediment is monitored for the trace metals. The order of heavy metal is Fe>Zn>Mn>CU> Cd>Cr>Pb>Hg recorded respectively. Since long term exposure of such metals will bring about health and physiological problems in aquatic organisms which later on intake through food and water will bring deleterious health issue for consumers. According to the results, some management and conservation schemes to save rivers should be framed to enable the effective monitoring of both environmental quality and the health of the organisms inhabiting the riverine ecosystem.

Keywords: Seasonal variations, Trace metals, Fresh water ecosystem, Pollutants

I.INTRODUCTION

One of the possible medias in aquatic monitoring are sediments, which apart from water, are also responsible for nutrients and pollutant transportation in aquatic ecosystems. Hollert *et al*., 2003; McCready *et al*., 2006 in their scientific work stated that sediments are important sinks for heavy metals that capture hydrophobic chemicals pollutants entering water bodies. Such toxins/pollutants are directly discharged by industrial plants, municipal sewage treatment plants and from polluted runoff in urban and agricultural area. Once these non-biodegradable trace metals get discharged into water bodies like rivers, lakes, and oceans they can either be adsorbed on sediment particles or accumulated in aquatic organisms. But these heavy metals are not constantly present in the sediments also because they are released back to the water as a secondary source of water pollution by changes in environmental conditions which will disrupt natural biological communities (Cheung *et al*., 2003; Venugopal *et al*., 2009).

Workers like Staley *et al*., 2015., Nguyen *et al*., 2016; Patil and Kaushik, 2016 reported that heavy metal pollution in natural waterbodies like rivers is primarily caused due to industries such as - textiles industries, diaries, recycle facilities, fertilizer industries, coir industries located besides the river catchment are the primary causes for heavy metal pollution. Wright and Mason, 1999 stated that sediment act as food source for most fresh water invertebrates leading to bioaccumulation of toxic metals causing potential threat to the health of many species at top of the food chain, especially fish and humans. So, the escalation of metals in sediments will have the significant environmental implications for local communities, as well as for river water quality. In the aquatic environment, sediment has a high storage capacity for contaminants i.e. more than 99.9% remaining 0.1% is noted to be in the hydrological cycle, especially heavy metals (Karbassi *et al*., 2007; Pradit *et al*., 2009). So, they act as carriers and possible sources of pollution.

Therefore, it is important to measure the concentrations of heavy metals in sediments of any riverine ecosystem as it is an indispensable tool to assess the risk of an aquatic environment. So, in the present study Ambarampalayam natural river basin ecosystem of Pollachi Taluk is selected to assess the industrial impacts and risks posed by waste discharge, agricultural runoff which contain heavy metal on sediments.

II. MATERIALS AND METHODS

2.1 Sampling Area: Ambarampalayam village is located in Pollachi Tehsil, southern part of Coimbatore district in Tamil Nadu, India. It is geographically located at latitude 10 ° 38′0" and longitude 10 ° 38′0". The study area lies around 40 kilometres from downtown Coimbatore and is situated 8km away from sub-district headquarter Pollachi. Owing to the proximity to the Western Ghats, Ambarampalayam village has a pleasant climate throughout the year. Water from topslip hills and aliyar dam flow in this river. The total geographical area of village is 426.18 hectares. Ambarampalayam has a total population of 3,794 peoples. There are about 1,052 houses in Ambarampalayam village.

2.2 Sediment Sample Collection and preservation: The sediment sample were collected seasonally using sediment grab and placed in properly labelled polyethylene bags which were previously treated with 5% nitric acid and rinsed with distilled water.

2.3 Sediment Analysis Method: Collected sediment sample were sealed in polyethylene bags embedded in ice during transportation to the laboratory. They were then air dried and passed through a 1mm size sieve to separate the unwanted materials. Later the soil was then ground into powder of particle size less than 100 meshes (sieve size = 0.152 mm) using a mortar and a pestle from which half a gram tissue samples were taken into digestion tube, 4 ml of HNO_3 (Analar grade, BDH) was added to the samples and left for overnight. Then samples were heated at 120º C in heating digester as recommended by Yilmaz *et al*.,2007; Adhikari *et al*.,2009 for 1 hr, cooled, then following Tan,2005, 0.4 ml of H_2O_2 (Analar grade) was added and placed back in heating digester until it becomes colorless.

2.4 Statistical analysis: The mean and standard deviation of water with regard to heavy metals was calculated using SPSS statistical package-Version-12.

III. RESULTS AND DISCUSSION

Rivers play significant role in sustaining life form on this earth, as they are not only life originating but also life sustaining ecosystem. Furhan Iqbal *et al*., 2004; Adakole *et al*., 2008 reported that rivers are very important part of our natural heritage that have widely been utilized by mankind over centuries. But, in the present scenario many rivers disappeared and others are on the verge of extinction due to lack of consciousness and environmental awareness. In specific, in India the available fresh water resources are depleting rapidly due to increased demand of water in different sectors leading to water scarcity and also due to lack of knowledge on the availability of water and its judicious use. As we know that water is very essential for sustenance of life and the report of WHO,2017 say that approximately 40% of urban and 70% of rural Indian were without access to safe drinking water. This present condition to the natural freshwater bodies in the last few decades is due to the rapid growth of industrialization and urbanization which has created negative impacts on the water resources due to influx of industrial, municipal and agriculture wastes containing pesticides, insecticides, fertilizers residues and heavy metals. Moreover, these wastes may contain hazardous chemicals and metals which on discharge get mixed in the river medium and are found distributed in water, sediments and biota of river system.

Among the aquatic waterbody components, the essential and dynamic part of the riverine aquatic ecosystems are sediments which are more prone to pollutants. According to Abdel-Ghani and Elchaghaby,2007; Mohiuddin *et al.*,2010 the principal comportment of metals is a function of the suspended sediment composition which may undergo frequent changes due to dissolution, precipitation and sorption and this statement was in accordance with Nouri *et al.*,2011 who too stated that due to the above activities their bioavailability and performance will affect the water quality of aquatic environments. Radhika *et al.*,2004 stated that in any freshwater ecosystems the water quality is a significance factor because any change in it will have a direct impact on biotic composition abundance stability and productivity of aquatic organism. So, knowing the prime importance of water quality characteristic the Ambarampalayam river, the lifeline

river which flows through many villages of Pollachi Taluk and provide water for various regular activities and irrigation was analysed for trace metals seasonally in sediment samples.

Table: 1 showing the heavy metals analyzed in the collected sediment samples during the study period collected Ambrapalayam river during the study periodJuly-Dec-2017.

Samples	Sediments		Permissible Limits			
Seasons			BIS limit	ICMR limit	WHO limit	USEPA limit
Heavy metals	Pre-monsoon	Post-monsoon				
Iron	4.16±0.04	4.26±0.02	0.3	0.3	0.3	0.3
Zinc	2.48±0.06	2.59±0.05	5	.1	3	5
Manganese	1.26±0.04	1.58±0.36	0.1	.1	0.4	0.05
Copper	1.23±0.07	1.36±0.04	.05	.05	2	1.3
Cadmium	1.03±0.06	1.05±0.07	.01	.01	.003	.005
Chromium	0.03±0.04	0.07±0.04	0.05	0.05	0.03	-
Lead	0.02±0.043	0.03±0.058	.05	.05	.01	.015
Mercury	ND	ND	0.001	0.001	0.001	-

*Values are expressed in µg/g dry weight of sediment sample and as mean ± SD where, n = 3.

On sediment analysis the results of heavy metals value recorded from the selected study site Ambarampalayam river during pre-monsoon were iron- 4.16± 0.04 µg/g; zinc – 2.48 ± 0.06 µg/g; manganese 1.26 ± 0.04 µg/g; copper – 1.23 ± 0.07 µg/g and post-monsoon were iron – 4.26 ± 0.02 µg/g ; zinc- 2.59± 0.05 µg/g; manganese – 1.58 ± 0.36 µg/g, copper – 1.36 ± 0.04 µg/g (Table.1).

During the present analysis trace metal iron was observed to fluctuate between 4.16 ± 0.04 µg/g during pre –monsoon and 4.26 ± 0.02 µg/g during post–monsoon at Ambarampalayam river. The higher iron concentrations recorded was during post-monsoon could be caused as a result of higher dissolved oxygen concentration which can oxidize dissolved iron into insoluble forms. Similar, results were found in Tam and Wong, 2000; Tabinda *et al*.,2013 who reported that iron in sediments were recorded significantly large amount due to high surface area and due to high humic contents due to movement of aquatic organisms. In all the analysed soil samples concentration of iron was above the permissible limit set by WHO, 2017.

The higher value of zinc concentration 2.59 ± 0.05 p µg/g was recorded during post -monsoon and the lowest 2.48 ± 0.06 µg/g during pre – monsoon. The elevation in zinc level during post –monsoon season in sediment when compared to that of water was similar to the Samir and Ibrahim,2008; Ahmed *et al*.,2010 who also recorded a higher value of heavy metal in sediment compared to the water medium. The presence of maximum zinc in the sediment may be due to the leeching of metals from vehicle washings.

The maximum value 1.58 ± 0.36 µg/g of manganese concentration in the sediment was recorded during post-monsoon and minimum value occurred during pre –monsoon 1.26 ± 0.04 µg/g at Ambarampalayam river. The fluctuation in manganese levels may be due to the variable amount of effluent wastes which reached to the sampling sites. Higher concertation of copper 1.36 ± 0.04 µg/g was recorded in post-monsoon season which might be attributed by domestic sewage and effluents discharged by small scale industries located on the bunds of the river.

The concentrations of Cd, Cr, Pb, and Hg in sediment ranged from 1.05 ± 0.07 µg/g, 0.07 ± 0.04 µg/g, 0.03 ± 0.058 µg/g during post-monsoon and lowest minimum concentration of Cd, Cr, Pb, and Hg in sediment ranged from 1.03 ± 0.06 µg/g, 0.03 ± 0.04 µg/g, 0.02 ± 0.043 µg/g and Hg was Not Detected (ND) respectively (Table.1).

Sediment samples collected from Ambarampalayam river area containing significantly high amounts of Cd, Cr, Pb, and Hg. The order of heavy metal is Cd>Cr>Pb>Hg recorded respectively. Maximum concentration of lead recorded in sediment during study season in the study site which might be due to increased human activity since these are township areas. Cadmium concentration in sediment was higher than the chromium, lead, and mercury.

The concentration of Cd was 1.03 ± 0.06 µg/g in pre-monsoon and maximum level of cadmium was found during post-monsoon 1.05 ± 0.07 µg/g which might be due to the differences in water capacity of the where low water in pre-monsoon resulted the precipitation of Cd in sediment there by rising its concentration (Islam *et al*.,2014).

Chromium concentration in sediment was higher than the lead and mercury which is as a consequence of direct discharging of untreated wastes from fertilizers and industry wastes (Facetti *et al.*,1998; Islam *et al.*,2014). High level of Cr (0.03 ± 0.04 µg/g) and (0.07 ± 0.04 µg/g) indicates its higher input which might be originated from the urban and industrial wastes (Mohiuddin *et al*.,2012; Tabinda *et al*.,2013) due to the presence of high sediment surface area and content of humic substances.

From the analysed results all the recorded heavy metals were above the permissible limits (Table.1). This high level of selected essential heavy metals in the sediment is attributed to the fact that sediment is the sink of heavy metal which enters the water body from runoffs during the rainy season. High level of metal pollution during post monsoon season may be attributed to the increasing amount of industrial, agricultural and domestic wastes at the sampling areas with high flow of water levels and leaching of fertilizers residues in addition to the increasing of organic matter in sediment at the sampling stations.

Moreover, in the present study the metals concentration in the sediment showed clear seasonal variations in all metals (although the seasonal variation of this metals was not regular) due to different discharge rate of water in rivers. The concentrations of heavy metals in sediments varied according to the rate of water discharge, the rate of particle sedimentation, the rate of heavy metals deposition, the particle size and the presence or absence of organic matter in the sediments (Saloman and Forstner,1984).The sources for the presence of these heavy metals in the selected riverine system includes discharging of irrigation water, rich in fertilizers, to the river and discharging untreated municipal heavy water to the river without treatment from adjacent and nearby villages.

IV. CONCLUSION

The mean concentrations of the selected metals were found to fluctuate considerably between seasons and exceed the guideline values implying the exposure of water body for prolonged metal pollution. This obvious sign of highly polluted water emphasis a need for the enforcement of stricter methods of disposal of waste (domestic, agricultural and industrial), and for regular monitoring of trace metal in the fresh water fragile environments for fresh water bodies conservation, effective management of aquatic systems, environmental safety and local inhabitant's health safety.

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