

EVALUATION OF HEAVY METAL CONTAMINATION IN THE ESTUARIES OF CHENNAI

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ABSTRACT

Chennai, the fourth largest metropolitan city in India has undergone rapid urbanization and industrial developments in recent years. This has resulted in the accumulation of hazardous pollutants and toxic metals in the aquatic ecosystems. The present study is carried out to study contamination of Cr, Pb, As and Cd in Ennore, Pulicat and Muttukadu estuaries surrounding Chennai. Among the metals analyzed, Cr was found to be deposited in higher concentration. This was followed by Pb, As and Cd. The concentration of all the metals was found to remarkably very high in the Ennore estuary

KEY WORDS: Ennore, Pulicat, Mutukadu, heavy metals, contamination

INTRODUCTION

Industrial activities and rapid urbanization has resulted in the discharge of enormous pollutants surrounding the aquatic ecosystems of Chennai. Heavy metals are one of the major groups of toxic environmental contaminants due to their toxicity, persistence and bioaccumulative properties (Pekey 2006; Nouri *et al.*, 2006). Heavy metals are an important category of pollutants and impose major detrimental effects on human and environmental health (Ogundiran & Afolabi 2008). Heavy metals are considered to be potential pollutants in aquatic ecosystems because of their adsorption in bottom sediments even at low concentrations, environmental persistence, their toxicity at low concentration and their ability to get incorporated into food chain and concentrate in aquatic organisms (Negilski 1976).

Understanding the distribution of toxic metals between the sediment and water resources is of

great importance. The present investigation is taken up to assess the heavy metal pollution status in the sediments of Ennore, Pulicat and Muttukadu estuaries around Chennai, which receives industrial and urban wastes.

MATERIALS AND METHODS

Study Area:

The study area covers three major estuaries - Pulicat, located 60 km North of Chennai, Ennore estuary and Muttukadu located in the southern part. The sediments were collected from the points of sources of contamination where it receives discharges from domestic and industrial effluents.

Sediment Collection:

Sediment samples were collected from the three estuaries during the premonsoon season in the months of June and July 2014. The soil sediments were collected from sites close to the

industrial areas which receive continuous effluents and untreated sewage.

Sample digestion and instrumentation:

The samples were immediately transported to the laboratory. Sediment samples were dried at 105 °C for physical and chemical analysis. The analysis of trace metals was carried out using a standard method (Alam *et al.*, 2002). The dried samples were filtered through a Millipore filter and about 1 g of the sample was subjected to acid digestion in a microwave oven using 7.5 ml of nitric acid. Determination of all the metals in the samples was carried out by ICP – MS (Shimadzu). All the reagents were analytical grade of high purity. The results of the heavy metal concentrations were determined on a dry weight basis $\mu\text{g g}^{-1}$,

RESULTS AND DISCUSSION

The accumulation of heavy metals As, Cd, Pd and Cr in Ennore, Pulicat and Muttukadu Estuaries are presented in Figure 1 and Table 1. The metal concentration in the Ennore Estuary is as follows Cr $80.6 \mu\text{g g}^{-1}$, Pb $30.5 \mu\text{g g}^{-1}$, As $16.3 \mu\text{g g}^{-1}$ and Cd $8 \mu\text{g g}^{-1}$. There was a high concentration of Cr $81.3 \mu\text{g g}^{-1}$ in Pulicat as compared to Ennore. The concentration of other metals are Pb $23.7 \mu\text{g g}^{-1}$, As $12 \mu\text{g g}^{-1}$, and Cd $5 \mu\text{g g}^{-1}$. When compared to Ennore and Pulicat estuaries Muttukadu Estuary located in the South of Chennai exhibited comparatively less amount of heavy metals. There was an elevated concentration of Pb $25 \mu\text{g g}^{-1}$, when compared to other metals which exhibited the following concentrations: Cr $23.5 \mu\text{g g}^{-1}$, As $5.6 \mu\text{g g}^{-1}$, Cd $3 \mu\text{g g}^{-1}$.

Earlier studies by Rajkumar *et al.*, 2008 had revealed the concentrations of Cd, Cu, Zn and Pb above the permissible limits in the Ennore estuary. Ramanibai *et al.*, 2012 has also recorded a higher concentration of Pb, Cd, Zn, Ni, Co and Cu in Ennore. In accordance to the above reviews the present study also demonstrates a high level of metal contamination in the Ennore estuary.

Figure-1. Concentration of Cr, Pb, As and Cd in three estuaries

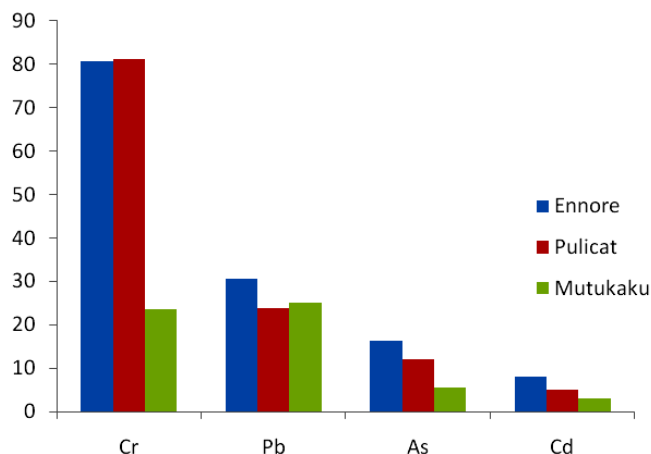


Table 1: Concentration of heavy metals in the Near Shore sites of three Estuaries during the pre-monsoon season 2014.

Sites	Cr	Pb	As	Cd
Ennore	80.6	30.5	16.3	8
Pulicat	81.3	23.7	12	5
Muttukadu	23.5	25	5.6	3

The higher concentration of Cr recorded at the Ennore and Pulicat estuaries are mainly due to the industrial effluents, domestic waste, iron and steel industries which contains large amount of organic particles. Cr is added for anti-corrosive purpose in refinery and fertilizer industries. The elevated concentration of Pb is directly related to the excessive discharge of industrial effluents from the industrial regions in the north of Chennai which are dominated by petrochemical, painting, thermal plant and other chemical industries (Jayaprakash *et al.*, 2005, Selvaraj *et al.*, 2003). The discharge of pollutants containing these heavy metals into the estuary is responsible for the pollution and deterioration of water quality in the Ennore estuary (Joseph *et al.*, 1993).

Pulicat Lake located 40km from the north of Chennai receives improperly treated industrial effluents from the Ennore creek and Buckingham Canal.

Earlier studies in Pulikat lake has recorded an elevated levels of heavy metal concentrations especially Cd, Hg and As (Padma and Periakali 1998). Studies in Pulicat lake recorded an elevated level of heavy metal concentrations, especially iron, cadmium and mercury (Kannan and Krishnamoorthy 2006). The present study on the soil sediments of Pulicat lake revealed and elevated level of Cr, Pb, As and Cd.

Unlike Ennore and Pulicat, the Muttukadu estuary which is located in the south of Chennai shows comparatively less concentration of heavy metals. This site is free of polluting industries, but receives a considerable amount of effluents from the domestic and industrial sewage. Among the metals analyzed Pb was found to be higher in this site.

These coastal regions are rich source of biodiversity and are cherished with ecological richness. Various studies have reported the deposition of these toxic heavy metals in the tissues of various aquatic species (Chitrrarasu *et al.*, 2013, Arokia Vasanthi *et al.*, 2013, Siji Thomas *et al.*, 2014) . The present study reports an elevated level of Cr, Pb, As and Cd in Ennore and Pulicat, when compared to Muttukadu which is free from much of the industrial pollutants. Hence there is an immediate necessity to minimize the levels of heavy metals in the three study areas to conserve these aquatic ecosystems.

CONCLUSION

In the present study, the concentration of Cr, Pb, As and Cd was found to be higher in the Ennore and Pulicat Estuaries when compared to the Muttukadu Estuary. Hence a continuous monitoring is recommended in these fragile ecosystems to prevent the levels of toxic contaminants.

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