Evaluation of Heavy Metal content in the Sediments of Valliyar River along Kadiyapattanam Estuary, Tamil Nadu, South West Coast of India

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ABSTRACT

Main objective of the study is to evaluate the heavy metal content in the river bed and estuarine sediment in Kadiyapattanam Estuary, which is located in the Kanyakumari district of Tamil Nadu, south west coast of India. For this study, five various sampling stations were selected along Valliyar River leading to Kadiyapattanam Estuary. Sediment samples from river bed and estuary were collected throughout the year continuously from June 2015 to May 2016 covering the monsoon (June-September), post-monsoon (October-January), and pre-monsoon (February-May) seasons. In the present study heavy metal such as zinc, copper, iron, manganese, lead, cadmium, and Mercury were estimated using standard procedures. The results obtained show that the order of heavy metal content of sediment in the study area was Fe > Mn > Zn> Cu > Pb> Cd>Hg. Mercury was found absent in the samples in the study area throughout the year. Concentration of Iron was found higher compared to other metals. The results of the study shows sediment of Kadiyapattanam estuary was contaminated with toxic heavy metals, land runoff from agricultural field and anthropogenic activities.

KEY WORDS: Heavy metals, Pollutant, Estuary, Sediment, Anthropogenic

INTRODUCTION

Soil is an important resource which serves as many vital functions particularly in food production. Sediments are loosely held soil particles containing sand slit clay and other particles, which deposited under water. Sediments are considered as the sink of all the pollutants that present in the aquatic ecosystem [1, 2, 3,]. The contribution of sediment particles are from erosion of bed rocks or soil, floods, agricultural runoff, organic matter and the decomposition of plants and animals. Health and survival of aquatic organisms largely depend on sediment characteristics, type and intensity of agricultural land. During flood, agricultural drainage water carrying pesticides, insecticides, fertilizers industrial and sewage effluents contains huge amount of heavy metals which contaminate aquatic system [4] as well as the sediments. According to hydrological cycle, less than 0.1% of metals are dissolved in water and remaining is stored in the sediment and soil [5]. Determination and specification of heavy metal is an important environmental problem. Therefore heavy metal analysis in sediments enables the detection of water quality and provides information about critical sites of water system [6]. Kadiyapattanam is one of the minor estuaries in Kanyakumari District. Valliyar is the one of the main river systems in the district. It originates from Velimalai Hills in Western Ghats and conflicts with Arabian Sea through Kadiyapattanam

estuary. Kadiyapattanam estuary situated about 32 kilometers northwest of Cape Comorin falling within the latitude $8^{o}12^{1}$n and longitude $77^{o}29^{1}$e and $77^{o}31^{1}$e. The main objective of this study is to assess the heavy metal content of river and estuarine sediments

MATERIALS AND METHODS

The present investigation of heavy metal content of sediment in and around Kadiyapattanam estuary was analysed over a period of twelve months starting from June 2015 to May 2016, covering the monsoon (June-September), post-monsoon (October-January) and pre- monsoon (February-May), seasons. Station 1 Kadiyapattanam Estuary is the bar mouth of the river Valliyar. Station II Manavalakurichi Bridge is situated approximately 2kms from estuary station. Station III Thiruninarkurichi is a very beautiful place situated 3kms away from station II. The surrounding area of this location is mainly agriculture field. Station IV Keezhekalkurichi is situated approximately 4.5kms away from station III. In this station where it's tributary Thoovalar joins with Valliyar. Station V Puliyoorkurichi is situated approximately 3kms away from station IV.

The sediment samples were collected in pre cleaned polythene bags, air dried for 1-2 weeks, then finely grounded using pistil and mortar and sieved through a 2mm sieve. The sieved sediment samples were used for further analysis. Analysis was done using standard methods and procedures (APHA) [7]. Extraction of metals from sediment was done using mixed acid digestion method. Total concentration of heavy metal zinc, copper, lead, cadmium, iron, manganese, and Mercury were estimated using Perkin Elmer A Analyst 200 Atomic absorption spectroscopy.

RESULTS AND DISCUSSION

The concentration of heavy metal .zinc, copper, lead, cadmium, iron, manganese, and Mercury were estimated from the collected samples and the result obtained are shown in the following figures. The main source of these heavy metals in the sediments are through weathering of mineral rocks, chemical fertilizers, pesticides, industrial waste water and human activities. Sediment adsorbs metals from overlying water system. When these heavy metals enter into the food chain leads to bio-accumulation. Their toxic nature causes severe damage to aquatic organisms.

Zinc

Trace amount of zinc is useful for living organism. Monthly variation of zinc in the study area is shown in figure I. Maximum value (8.016ppm) of zinc was measured at station V in the month of April during pre-monsoon season and minimum zinc value (0.21ppm) was recorded at station I in the month of January during post monsoon season. This may be due to evaporation and stagnant status of water, anthropogenic activities. Weathering of rocks and sewage disposal also increase the concentration of Zn. Zinc is harmful to living organism and higher amount may accumulate in body of fish and enter into other organisms through food chain. Excesses intake of zinc cause vomiting, liver failure, Kidney failure and anemia in human [8]

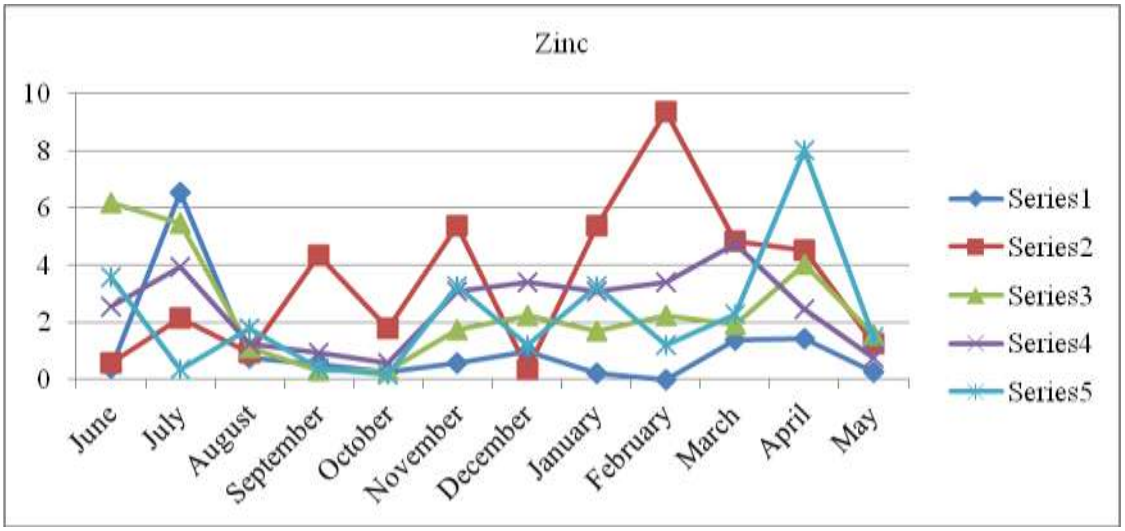

Fig.1: Concentration of Zinc (ppm)

Copper

The monthly variation of copper in sediment samples during the study period was shown in figure2. Highest amount of copper (5.17 ppm) was recorded at station II in the month of December during post monsoon season and lowest value was recorded (0.292 ppm) at station I in the month of July during monsoon season. Irrespective of seasons, some of the stations recorded values below detectable level. Copper is an essential micronutrient for human but higher concentration will lead to health problems like gastrointestinal, anemia and kidney damage. The most toxic form of copper is the high content of cupric ion I aquatic system [9].

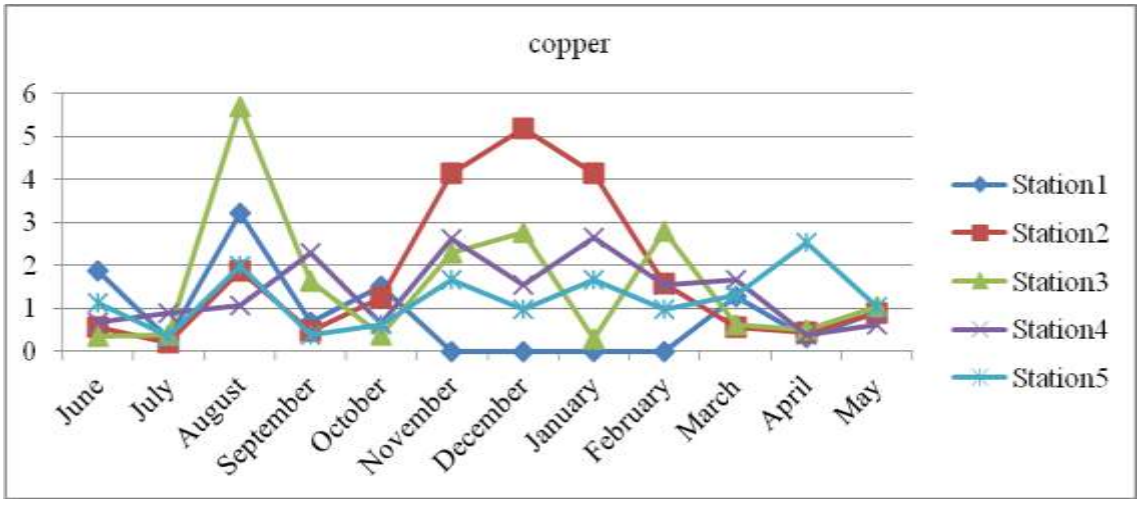

Fig. 2: Concentration of Copper (ppm)

Iron

Monthly variation of iron in the study area is shown in the fig 3. Maximum value (305.12 ppm) of iron was measured at station II in the month of April during pre-monsoon season and minimum iron value (112.58ppm) was recorded at station I in the month of December during post monsoon season. Values

observed are greater than guideline values. Iron is the abounded element and it enters in to the water bodies through weathering of rocks and corrosion of iron pipes. It an important plant nutrient and also take part in various biological activities.

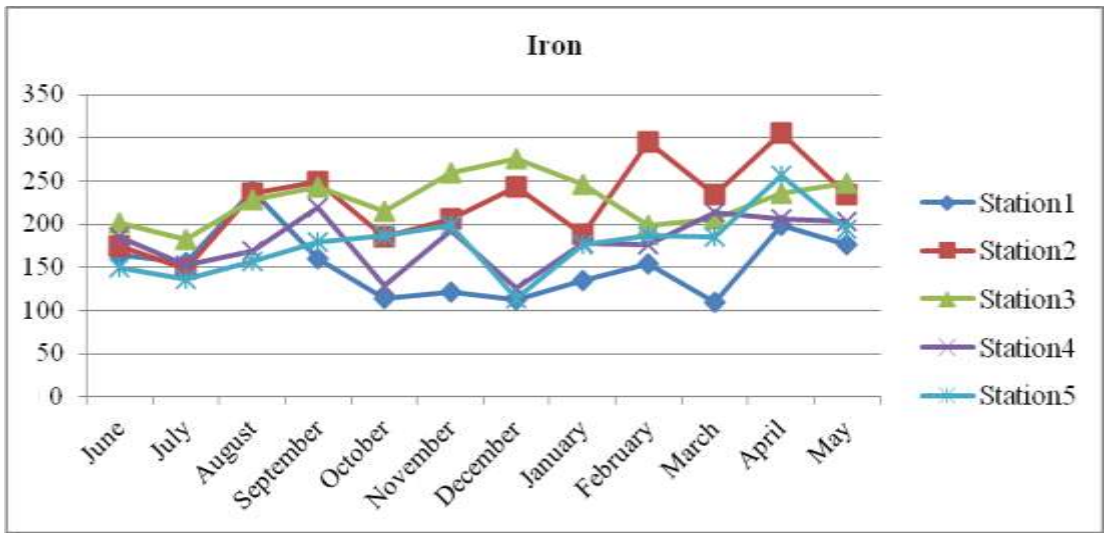

Fig. 3: Concentration of Iron (ppm)

Manganese

Manganese is an essential micro nutrient for plant growth, but high level of manganese in soil can cause toxicity. Monthly variation of manganese in sediment samples collected from selected locations during the study period was shown in fig 4. Highest concentration of manganese was found in station III (99.9 ppm) in the month of February in pre-monsoon season and lowest value (3.174 ppm) was found at station V in the month of July during monsoon season. Most of the values observed exceed the limits of USEPA guidelines and the study area is polluted.

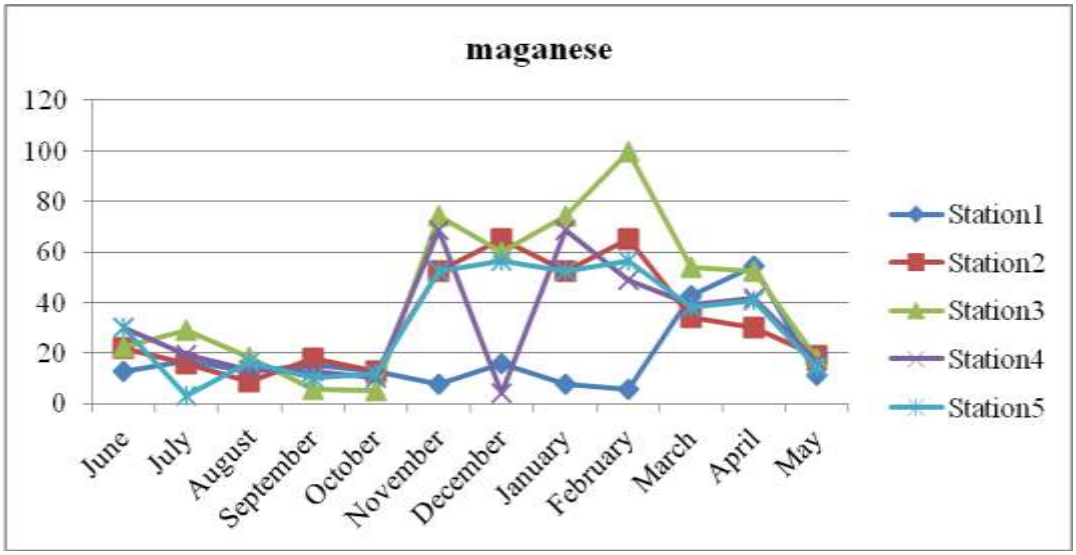

Fig. 4: Concentration of Manganese (ppm)

Lead

Monthly variation of lead for collected sediment samples during the study period were shown in fig 5. Highest amount of lead (4.26 ppm) was recorded at station III in the month of March during pre monsoon season and lowest value was recorded (0.13 ppm) at station IV in the month of January during post-monsoon season. Concentration of lead is below the USEPA values and sediment samples were not contaminated by lead. Some station recorded values at below detected levels. Lead is a hazardous material and the main sources are sewage, lead batteries, degradation of matter oil spillage and automotive exhaust. The sediment adsorbed the lead from the water and retained in the surface layer.

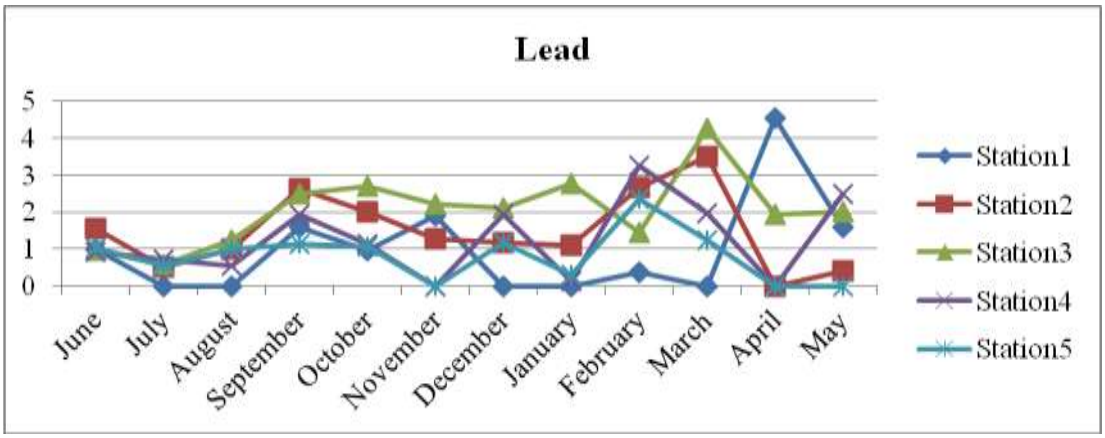

Fig. 5: Concentration of Lead (ppm)

Cadmium

Cadmium is highly toxic and carcinogenic to human and also damage liver and kidney. Monthly variation of Cadmium in the study area is shown in the fig.6. Maximum value (0.15ppm) of Cadmium was measured at station III in the month of April during pre monsoon season and most of seasons showed below detectable levels of cadmium. In the present study the result shows highest concentration was recorded in pre monsoon season was due to slow flow of water and various anthropogenic sources. Major source of cadmium are the extensive use of inorganic fertilizers [10, 11], Ni-Cd batteries and various man made activities

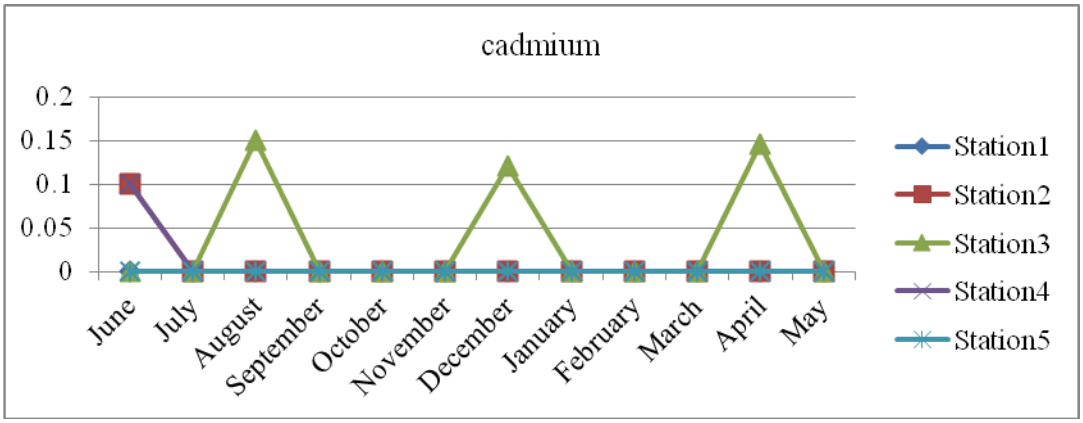

Fig. 6: Concentration of Cadmium (ppm)

CONCLUSION

In Present study heavy metal content of sediment collected from Valliyar along Kadiyapattanam estuary were analysed throughout the year and the results obtained shows that the sediment samples were polluted. Metal concentration in the sediment was higher in pre monsoon season. The results obtained show that the order of heavy metal content of sediment in the study area was Fe > Mn > Zn> Cu > Pb> Cd>Hg. Mercury was found absent in the samples in the study area throughout the year. Concentration of Iron was found higher compared to other metals. Heavy metal contamination in sediments is of great importance because higher concentration causes serious damage to aquatic system. Maximum metal contamination was observed in area surrounded by agricultural field. The main source of sediment contaminations are sewage disposal, drainage of agrochemical waste during monsoonal flood, and various anthropogenic activities. It is necessary to take proper steps to protect the estuary and nearby areas from pollution. It is important to take necessary steps to conduct an awareness campaign among the people to highlight the ecological importance of the estuaries and the impact of pollution.

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