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# Assessment of Heavy Metals Pollution on Different Seasons in Manjakkudi and Pakkam Lakes

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## ABSTRACT

*Water pollution by heavy metals has been exaggerated in recent years as a result of various industrial activities. The present study aimed at assessing the concentrations of heavy metals, Copper, Iron, Manganese and Zinc (Cu,Fe, Mn and Zn) in Manjakkudi and Pakkam lakes during different seasons of the year 2013-2015.The results emphasized that, Fe accounted to be maximum pollutant in both the lakes during all the seasons analysed. All the heavy metals were found to be in fractional amount in both the lakes. The studies also showed that the heavy metal concentrations were high in both the lakes during the months of April and June of each year. The heavy metal pollution brings risk to the water ecological system and more attention should be paid for their effective removal.*

***Key words:*** *Heavy metals, Water pollution, Iron, Seasonal variation*

## INTRODUCTION

Water pollution by various organic and inorganic chemicals possesses serious threat to the survival. Usually, heavy metals are naturally present in aquatic environments at very low concentrations. The anthropogenic sources have raised their concentrations which imposes several environmental problems[1]. Heavy metal contamination in the lake sediments is the indication of anthropogenic influences. The heavy metals will be concentrated on the aquatic life forms when consumed and subsequently enters the food chain which affects their survival. Few of the metals in trace amounts are considered as essential for the growth of living organisms including copper, iron and zinc. These metals are non-degradable and causing damage to the nervous system and internal organs beyond the permissible limits[2].

In India, the main source of these metal pollution are industrial wastes as well as pesticides and chemical fertilizers used in crop farms[3]. The quality of the lake sediment is the best indicator of pollution, where the concentration of heavy metals and other pollutants is higher. Since, the heavy metal contamination is found to be influenced by industrial activities, the comparison among heavy metal concentration in the sediments from the lakes during different seasons is of great significance in learning about their toxic effects on aquatic organisms.

The present research study aimed to assess the pollutant levels, including the accumulation of some heavy metals Copper, Iron, Manganese and Zinc (Cu, Fe, Mn and Zn) in Manjakkudi and Pakkam lakes during the years 2013-2015.

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The lakes present in Manjakkudi and Pakkam, Pudukkottai, TN, India were selected for the present study to assess the heavy metal pollution. These lakes were situated very near and hence possess similar weather conditions. The lakes are considered as an important natural resource for agricultural purposes and frequently get contaminated by anthropogenic sources.

## MATERIALS AND METHODS

### Sampling sites

In the present investigation, the sampling sites were located in the district of Pudukkottai, in the state of Tamil Nadu, India. Respectively, in every month for two years (2013-2015),we used the self-sampling methods to collect surface and bottom water samples in these two lakes.

### Sample collection and processing

Water samples were withdrawn from the surface and bottom of lakes and stored in separate sterile containers. In the field itself, few 151 physico-chemical variables were analyzed such as, dissolved oxygen (DO), hydrogen-ion-concentration (pH), free-carbon-di-oxide (free-$CO_2$), Phenolphthalein alkalinity (PPA) and Methyl Orange Alkalinity (MOA). After field inspection, the samples were brought to the laboratory for further analysis.

### Analytical methods

The atmospheric temperatures of the surface and bottom water were measured using a centigrade mercury thermometer. The water levels of both the lakes were measured using a graduated nylon rope and the measurement was done on every sampling day at the particular spot in both the lakes. The Dissolved Oxygen (DO) was estimated using Winkler's method[4], while free carbon dioxide (Free $CO_2$), total dissolved solids (TDS) and phenolphthalein alkalinity (PPA) and methyl orange alkalinity (MOA) were determined according to Saxena[5]. Electrical conductivity was measured using water analysis kit (Elico). Further, The analysis of heavy metals like copper, iron, manganese and zinc in the water samples was also estimated every month for two years using an atomic absorption spectrophotometer (GBC model 902) at Bharat Heavy Electricals Ltd., Tiruchirappalli. The samples for heavy metals were prepared according to Maina *et al.*[6] and APHA[7].

### Statistical analysis

All the sample analysis studies were carried out in triplicated and the results expressed were the mean of the three values.

## RESULTS AND DISCUSSION

The results revealed that in both the sampling sites, water was slightly alkaline. The range of pH was alkaline in the winter, whereas slightly acidic in summer. In case of Total dissolved solids (TDS), there was a significant difference in the dissolved ion concentrations in summer and winter seasons in both the sampling sites. Higher concentration of TDS was observed duringthe summer. Various are concentrated. The discharging of effluents from industries increases the TDS concentration in the lakes[8].

The concentrations of metal ions in the water collected from Manjakkudi and Pakkam lakes are illustrated in Tables 1and 2 respectively. The difference among the metal distribution in Manjakkudi and Pakkam Lakes is significant (Figs. 1 and 2). The metal ion concentrations in water were found in the following hierarchy: Fe > Zn >Mn> Cu in Manjakkudi lake, whereas they follow the order of Fe >Mn> Cu > Zn in Pakkam lake. Nevertheless, both the systems appeared to show the minimal levels in the rainy season (October-December) while the maximum loads were noticed in summer (April-June). Hameed[9] had proved that the clay sediments possess higher concentrations of trace metals when compared to the sandy sediments based on the study he conducted in Nile sediments.

A perusal of the heavy metal content in the waters of both the systems reveals that the Fe content ranged from 2.28 to 2.90 mg/l in Manjakkudi lake, it was found to vary from 1.84 to 2.66 mg/l in Pakkam lake. Iron attained their maximum values at both the lakes with little difference in its concentrations. Manjakkudi lake ranked first in accumulation of iron, while Pakkam Lake was slightly less polluted one. The concentration of heavy metal in the water may be attributed by the presence of aquatic and higher plants which absorb the metals.Iron is an essential component of clay minerals, which will be the major component of lake sediments[10].

Next to iron, zinc was found to be the second mostly polluted metal in the Pakkam lake, whereas, the Manjakkudi lake was found to possess zinc at trace amounts. However, zinc was found to oscillate between 0.33 and 0.46 mg/l in Manjakkudi lake and from 0.058 to 1.1 mg/l in Pakkam lake. On the other hand Mangnese ranged from 0.22 to 0.49 mg/l in Manjakkudi lake and from 0.076 to 0.119 mg/l in Pakkam lake. The copper content was found to vary from 0.08 to 1.150 mg/l in Manjakkudi lake and from 0.06 to 0.089 mg/l in Pakkam lake. Among the four heavy metals screened, the concentration of Fe and Zn showed significant variation with respect to seasonal change, whereas in case of Cu and Mn, exhibits no significant variation on seasonal change.

Thus, it appears that Manjakkudi lake recorded higher heavy metal load for all the metals analysed. The maximum mean values of the other measured were recorded at Manjakkudi lake when compared to Pakkam lake. The differences in the accumulation of heavy metals in the lakes might be attributed by the discharge of huge amounts of raw sewage and industrial wastewater[11].

In this study, the months of April to June showed higher values of heavy metals than the other months of the year. This variation in the environment temperature was reflected in the metals distribution. The increase in heavy metal concentration in the summer may be attributed to the high evaporation rate of surface water due to the elevated temperature. Abdel-Satar[12] also agreed with this,who analysed the heavy metal concentration in running water sediments. Phiri et al. [13] had proved that the seasonal variation also influences the heavy metal concentration in water bodies. His findings are evidenced by other researchers, including Wu *et al.*[14] and Pandey *et al.*[15]. Phiri *et al.* [13] also found that, Ni concentration in the lakes was highest during winter due to the effect of rain. By comparing the accumulation of heavy metals in water and sediments, it can be concluded that the heavy metals highly accumulate in sediments than water.

**Table 1: Seasonal Variations of Heavy Metals in Manjakkudi Lake**

| Months | Copper (Cu) (mg/l) | | Iron (Fe) (mg/l) | | Manganese (Mn) (mg/l) | | Zinc (Zn) (mg/l) | |
|---|---|---|---|---|---|---|---|---|
| | 2013-14 | 2014-15 | 2013-14 | 2014-15 | 2013-14 | 2014-15 | 2013-14 | 2014-15 |
| **March** | 0.092 | 0.074 | 2.520 | 2.560 | 0.280 | 0.250 | 0.400 | 0.390 |
| **April** | 0.126 | 0.098 | 2.900 | 2.700 | 0.290 | 0.350 | 0.404 | 0.410 |
| **May** | 0.134 | 0.110 | 2.900 | 2.720 | 0.490 | 0.470 | 0.406 | 0.410 |
| **June** | 0.158 | 0.150 | 2.400 | 2.500 | 0.292 | 0.270 | 0.460 | 0.450 |
| **July** | 0.172 | 0.150 | 2.400 | 2.400 | 0.302 | 0.300 | 0.330 | 0.340 |
| **August** | 0.098 | 0.112 | 2.300 | 2.300 | 0.320 | 0.305 | 0.430 | 0.410 |
| **September** | 0.084 | 0.119 | 2.320 | 2.300 | 0.330 | 0.320 | 0.440 | 0.420 |
| **October** | 0.076 | 0.086 | 2.380 | 2.280 | 0.220 | 0.230 | 0.340 | 0.430 |
| **November** | 0.078 | 0.086 | 2.300 | 2.280 | 0.220 | 0.230 | 0.330 | 0.340 |
| **December** | 0.068 | 0.080 | 2.440 | 2.420 | 0.310 | 0.290 | 0.410 | 0.390 |
| **January** | 0.073 | 0.082 | 2.500 | 2.530 | 0.270 | 0.270 | 0.400 | 0.370 |
| **February** | 0.085 | 0.090 | 2.500 | 2.540 | 0.280 | 0.260 | 0.390 | 0.380 |

**Table 2: Seasonal Variations of Heavy Metals in Pakkam Lake**

| Months | Copper (Cu) (mg/l) | | Iron (Fe) (mg/l) | | Manganese (Mn) (mg/l) | | Zinc (Zn) (mg/l) | |
|---|---|---|---|---|---|---|---|---|
| | 2013-14 | 2014-15 | 2013-14 | 2014-15 | 2013-14 | 2014-15 | 2013-14 | 2014-15 |
| **March** | 0.069 | 0.070 | 2.10 | 2.20 | 0.089 | 0.092 | 0.91 | 0.94 |
| **April** | 0.052 | 0.059 | 1.44 | 1.50 | 0.090 | 0.094 | 0.92 | 0.82 |
| **May** | 0.068 | 0.069 | 2.62 | 2.66 | 0.116 | 0.119 | 1.04 | 1.10 |
| **June** | 0.080 | 0.089 | 1.94 | 1.98 | 0.110 | 0.112 | 1.00 | 1.00 |
| **July** | 0.074 | 0.078 | 2.00 | 2.04 | 0.086 | 0.088 | 0.90 | 0.92 |
| **August** | 0.072 | 0.074 | 2.12 | 2.14 | 0.096 | 0.100 | 0.80 | 0.84 |
| **September** | 0.076 | 0.082 | 2.22 | 2.20 | 0.107 | 0.100 | 0.80 | 0.84 |
| **October** | 0.080 | 0.084 | 1.32 | 1.44 | 0.116 | 0.102 | 0.68 | 0.68 |
| **November** | 0.082 | 0.088 | 1.84 | 1.84 | 0.076 | 0.086 | 0.60 | 0.62 |
| **December** | 0.060 | 0.066 | 1.42 | 1.58 | 0.090 | 0.087 | 0.58 | 0.60 |
| **January** | 0.064 | 0.078 | 2.22 | 2.28 | 0.086 | 0.088 | 0.80 | 0.82 |
| **February** | 0.066 | 0.068 | 2.12 | 2.18 | 0.088 | 0.092 | 0.90 | 0.92 |

**Fig. 1: Seasonal Variations of Heavy Metals in Manjakkudi Lake**

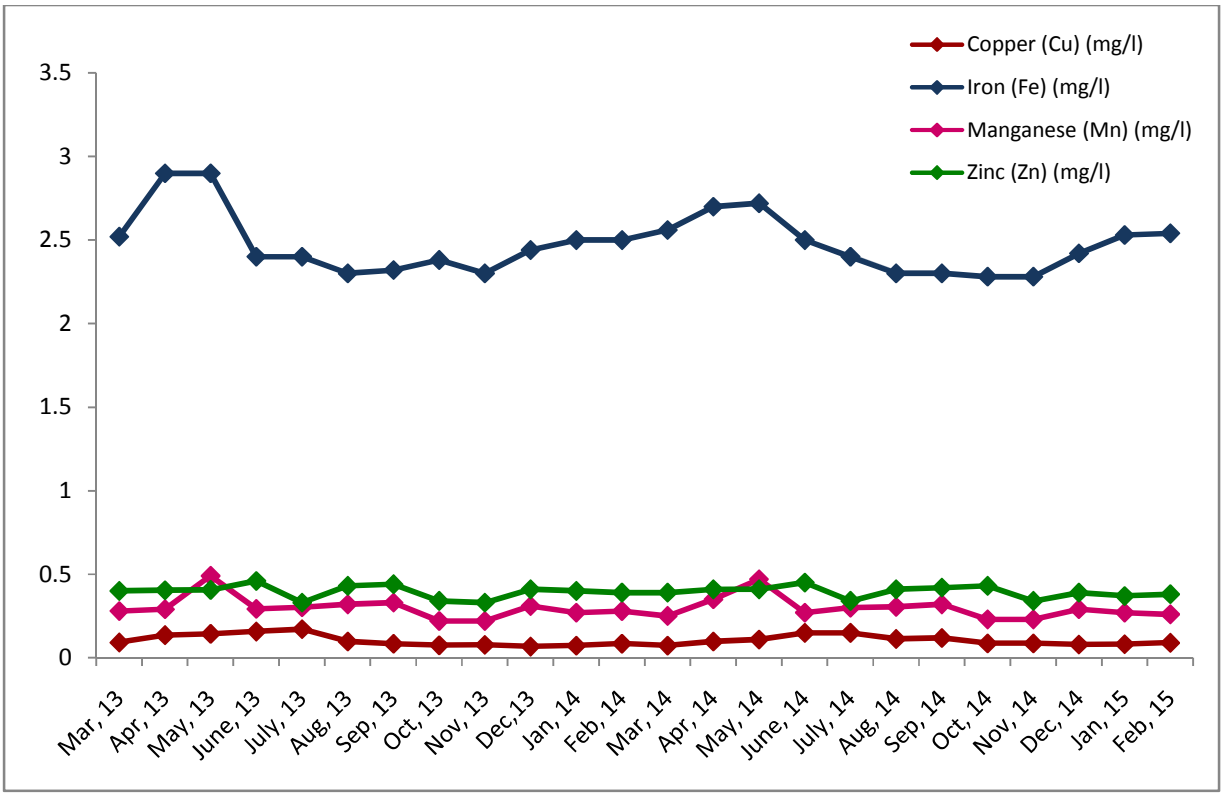
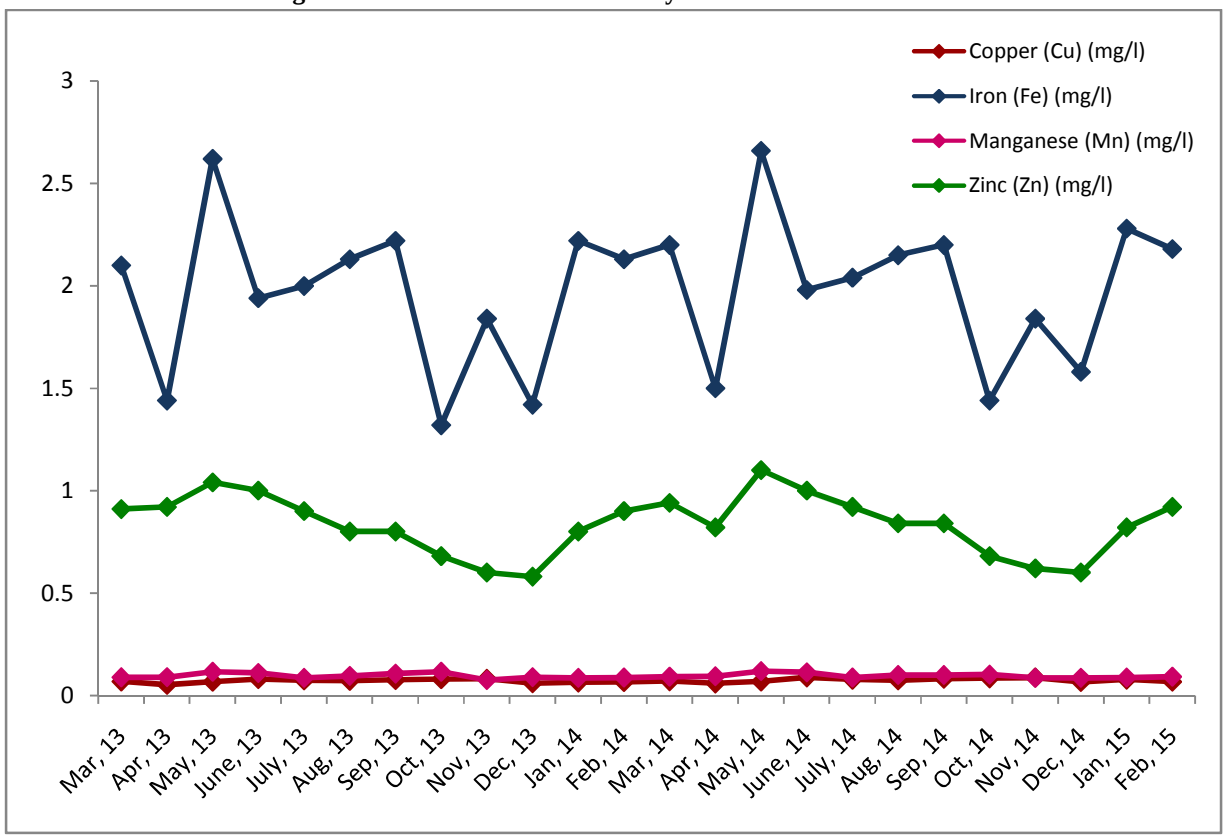


**Fig. 2: Seasonal Variations of Heavy Metals in Pakkam Lake**




## CONCLUSION

The present study revealed that the water samples collected from Manjakkudi and Pakkam lakes were found to be polluted with higher concentration of iron and traces of other heavy metals such as copper, zinc and manganese were found. The month wise heavy metal contamination profile showed that the heavy metal concentration was tending to be high during summer season when compared to winter season. The trend in seasonal variation is attributed by the associated industries nearby and the environmental factors associated with the respective seasons.Hence, adequate measures are necessary for the removal the heavy metals from the industrial wastewater and contaminated sitesfor preventing further deterioration of the water quality.

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