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An Investigative Study on Heavy Metal Content in Sediment of Bellandur Lake, Bengaluru

Anoop Toolahalli[1], Dr. K. M. Sham Sundar[2]

[1]MTech student, Department of Civil Engineering, U B D T College of Engineering, Davanagere, Karnataka, India
[2]Professor, Department of Civil Engineering, U B D T College of Engineering, Davanagere, Karnataka, India

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Abstract - *Wetlands also referred as lakes and water bodies are one of the linkages that is necessary for sustainable ecology. They provide linkage between land and water resources. Quality of the lakes and wetlands depends directly on integrity of the watershed. Rapid urbanization and anthropogenic activities in recent two decades have altered the integrity of Lake Ecosystem all over the world. Bellandur Lake is one of the largest lakes in Bengaluru city stretching out from 12°49'5"N to 13°08'32"N and 77°27'29"E to 77°47'2"E and covering 366.89 hectares of land. The present study concentrates on determination of chemical characteristic and concentrations of heavy metals present in sediments samples collected at Bellandur lake bottom at different locations and also chemical characteristics. The samples were analyzed for pH, EC, Organic Carbon, Total Nitrogen, Phosphorous, Potassium, and Heavy metals viz. Cu, Ni, Zn and Pb. From study it was found that pH of lake is basic, electric conductivity is within limits for healthy growth of plants, Phosphorous values for sediment are higher than standards and values for soil are within limits given by Soil manual of Department of Agriculture, whereas Potassium value for both sediment and soil are within limits. Copper values in sediment are above limits prescribed by WHO and CPCB, but within NOAA freshwater sediment guidelines limits. Zinc values at some sediments points are above limits of WHO. Nickel values are above CPCB and WHO limits and Lead values for sediment are within limits of WHO but above CPCB limits.*

Key Words: Sediment, Bellandur Lake, ASS, Heavy Metals, Chemical Characteristics, Bengaluru City.

1. INTRODUCTION

Wetlands also referred as lakes and water bodies are one of the linkages that is necessary for sustainable ecology. They provide linkage between land and water resources. Quality of the lakes and wetlands depends directly on integrity of the watershed. Rapid urbanization and anthropogenic activities in recent two decades have altered the integrity of Lake Ecosystem all over the world. Historically the lakes were constructed for purpose of conserving hydrogeological regime in water flow for flood checks, recharging and maintenance of Ground water table. They also served the purpose of sediment traps, major role in preventing clogging of natural valleys and reduce runoff. Lakes and tanks have a substantial biological and ecological role to play, natural filters to strain out pollutants and maintain the delicate balance between biota and aquatic environment.

Sediments are naturally occurring material in aquatic ecosystem. Sediments are innate and indivisible part of aquatic ecosystem. They play a key role in physicochemical and ecological dynamics in aquatic ecosystem. Sediments origin leads back to breaking down of parent rocks, but in case of sediments; broken down rock are transported by natural agents like wind, water and ice.

Soil erosion particularly from agricultural field runoff is leading global cause of water pollution due to sediment load carried by runoff. Sediment itself acts as pollutant and carries other pollutant loads particularly heavy metals. Urbanization at rapid rate and Industrialization with inadequate and inefficient environment plan also often end up discharging their effluents into lake systems.

Majority of sediments in water bodies like ocean, lake and rivers are being contaminated by pollutants or have been already contaminated by intentional or non-intentional discharge from industrial outflow and raw sewage runoff. Other source of sediment contamination are from polluted runoff from urban and agricultural lands and at some rare conditions also due to historic contamination.

Contaminated lake sediments threaten organisms in the lake ecosystem. Some pollutants in sediments that are fatal to certain organisms in Lake Environment kill those organisms resulting in reduction of food to higher tropic level organisms such as fishes. Certain contaminants in sediments which are stable and persistent that cannot be biologically degraded tend to accumulate by entering into food chain through lower level tropic organisms in process known as bioaccumulation. When higher level organisms feed on contaminated lower level organisms, pollutants make their way up in food chain by entering into higher level organisms' body, this continues further up in food chain causing bio magnification.

Heavy metals are one of the most significant form of pollution in the aquatic environment as they are prime pollutant that are toxic at higher concentration and gets accumulated in organisms of lake leads to imbalance in aquatic ecosystem. A significant small amount of certain heavy metals are important for life. Also they are crucial as they cannot be synthesized by living matter. Sediment contamination due to heavy metal is one of the burning issue in term of growing environmental concern, such contaminants are usually caused by anthropogenic activities.

2. MATERIALS AND METHODOLOGY

Bellandur Lake is one of the lakes that come under K C valley watershed, it is located at 12°56'47.04"N to 12°55'39.72"N and 77°38'31.2"E to 77°40'50.52"E is largest lake in Bengaluru city which is spread across six villages. Grab samples of surface sediment was collected from the top 10 cm of lake bottom The samples were then transferred to pre-labeled polythene bags. Samples were ground to fine in pestle and mortar only after air drying of samples at room temperature. Further ground samples were sieved through 2mm mesh and stored in containers awaiting digestion and further for analysis. Sampling was carried out for period of from December 2017 till April 2018 for a period of 5 months.

Details of sampling locations for sediment sampling for 6 locations in Bellandur Lake are given below, locations are designated numerically with Latitude and Longitude details tabulated for sampling points, sampling locations are selected by considering major inlets and outlets on perimeter of lake along the bank. Descriptions starting from

- Sediment sampling point 1 which is towards southern part of lake in Ibbalur village
- Sediment sampling point 2 towards Bellandur village.
- Sediment sampling point 3 is located at outlet of lake were the lake water overflows feeds to Vartur Lake.
- Sediment sampling point 4 is located near Yamalur outlet.
- Sediment sampling point 5 is located towards Kempapura inlet region.
- Sediment sampling point 6 is located at major lake inlet for lake.

Table -1: Details of Sampling Locations

Sl No.	Sampling Point Designation	Latitude	Longitude
1	Sediment 1	12°55'43.13"N	77°39'49.59"E
2	Sediment 2	12°55'51.76"N	77°40'15.06"E
3	Sediment 3	12°55'53.19"N	77°40'36.84"E
4	Sediment 4	12°56'23.47"N	77°40'41.73"E
5	Sediment 5	12°56'26.97"N	77°40'34.51"E
6	Sediment 6	12°55'48.32"N	77°39'31.97"E

Fig -1: Sampling Locations

Table -2: Methods for Chemical Characteristic Analysis of Sediment

Sl No.	Parameter	Method
1	pH	Electrometric
2	Electric Conductivity	Electrometric
3	Organic Carbon	Titration Method
4	Total Nitrogen	Titration Method
5	Phosphorous	U V Spectrophotometry
6	Potassium	Flame Photometry

2.1 Digestion for Heavy Metals

This study used Aqua Regia method of decomposition sediments. Weighed prepared samples either of soil or sediments are taken, 0.5 to 1 gm taken in 100 mL flask. 15 mL of HCl and 5 mL of HNO_3 at ratio of 3:1are added to flask and mixture is kept for heating till vapors cease to evolve. Then the mixture is cooled further it is made up to 100 mL, then solution is filter through Whatman filter paper to obtain supernatant for analysis. Calibration of AAS is done using standard solution of each metals. Cu, Ni, Zn and Pb were analyzed in sediment.

3 RESULTS AND DISCUSSIONS

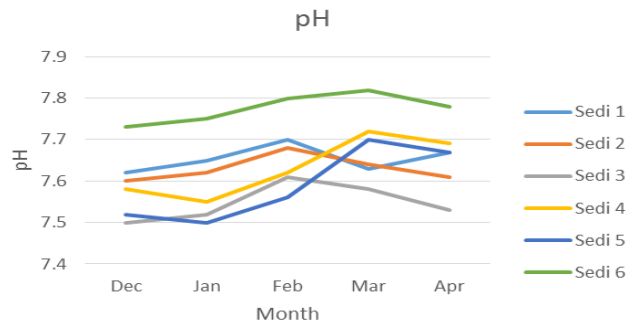

Chart -4: pH Values of Sediment

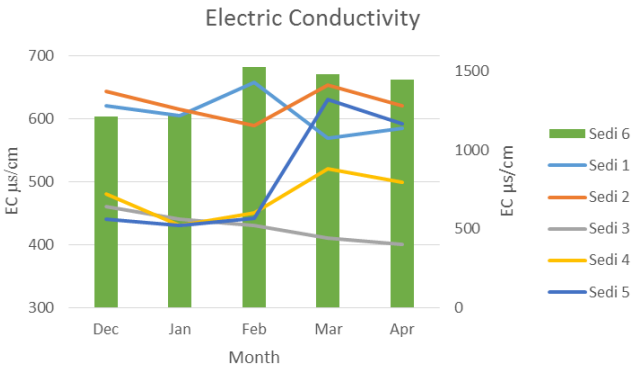

Chart -5: Electric Conductivity of Sediment

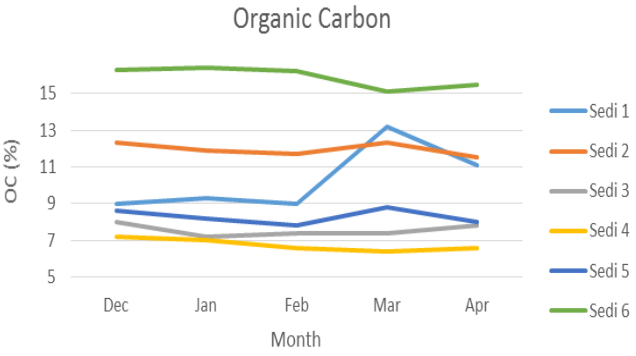

Chart -6: Total Organic Carbon of Sediment

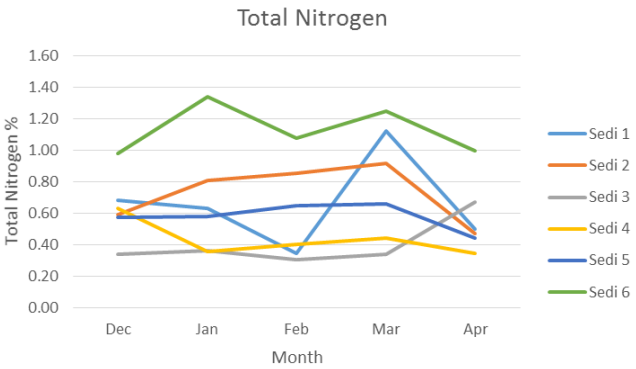

Chart -7: Total Nitrogen Values of Sediment

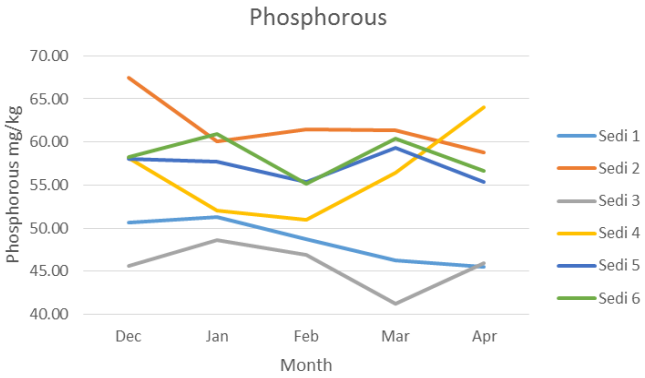

Chart -8: Phosphorous Values of Sediment

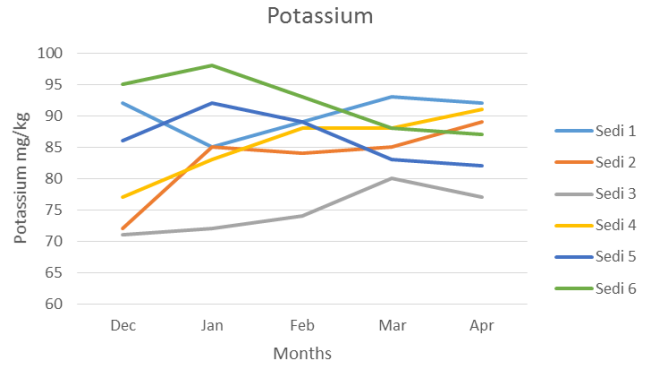

Chart -9: Potassium Values of Sediment

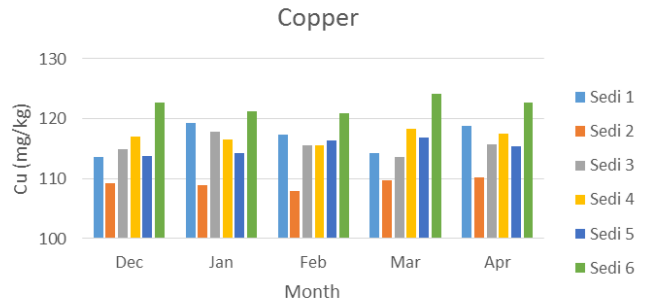

Chart -10: Copper Values of Sediment

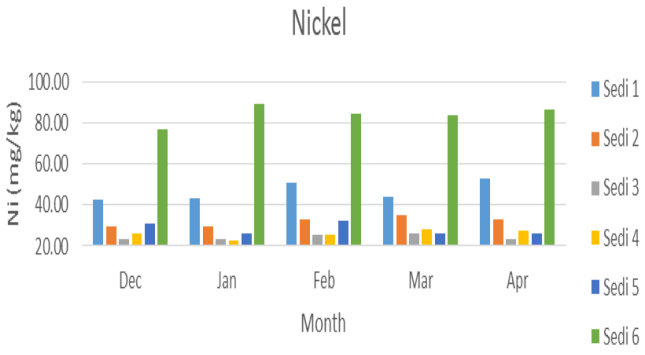

Chart -11: Nickel Values of Sediment

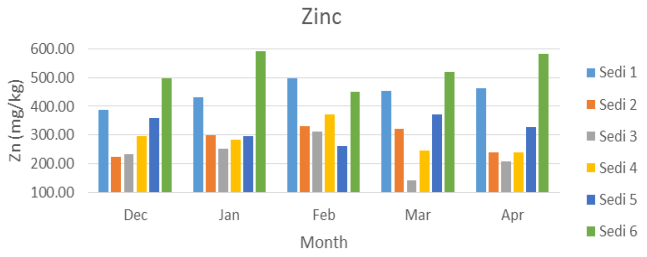

Chart -12: Zinc Values of Sediment

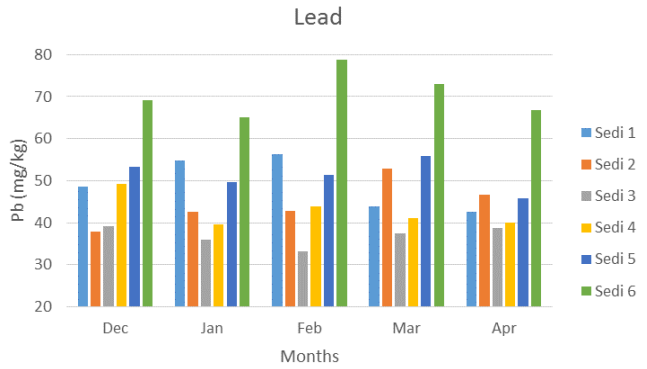

Chart -13: Lead Values of Sediment

The pH of sediment samples varies from 7.5 to 7.82 which shows that sediment in lake is alkaline in nature in and in extension the lake also, but values are nearest to optimum range of 5.5 to 8. Electric Conductivity of sediment reveal that values varying from 400 – 1528 µs/cm, which is the measure of ability of solution to conduct electricity. The variation in monthly and spatial values are because of hotter temperature during the study period and spatial variations may be due to dilution of raw sewage further into the lake. The organic carbon values of sediment varied from 6.39% - 16.48%. As the samples were collected on the periphery there was higher concentration, which may reduce considerably when sampling taken at inner portion of lake. The total nitrogen values of sediments varied from 0.31% - 1.34%. Phosphorous values of sediment varied from 45.67 – 67.44 mg/kg. Values are higher than the standards provided by Soil manual. Potassium values in sediment varies from 71 – 98 mg/kg, values are within standards from Soil manual.

Copper concentration varies from 107.98 - 124.24 mg/kg, Sediment values are well beyond background levels and WHO limits, and within CPCB limits. Zinc concentration varies from 143.5 - 592.11 mg/kg, Sediment values are slightly above critical soil concentrations and WHO limits, but far beyond and greater than the background values of sediments. Nickel concentrations varies from 22.76 -88.92 mg/kg. Sediment values were within critical soil concentration, and values are greater than CPCB and WHO limits. Lead concentration varies from 33.24 - 78.79 mg/kg. Sediments are greater than the background soil concentrations, within WHO limits and slightly greater than CPCB.

3. CONCLUSIONS

A distinct variations in the parameters was observed during the study in terms of spatial as well as in temporal. Sediments of the lake when analyzed showed that it undergoes variations due to changes in inflow into lake, also variations may occur as due to seasonal variation of the location. It was evident by study that lake is greatly polluted when various chemical parameters and heavy metals was analyzed namely pH, Electric conductivity, Organic carbon, Total Nitrogen, Phosphorus, Potassium, Zinc, Nickel, Copper, Lead. The main problem is with the entry of untreated raw sewage from Bengaluru city into the lake with effluents of several listed industries. All heavy metals are well over the critical limits and unpolluted concentration. The lake has reached the peak of contamination with severe algal blooms and pollutant resistant dense macrophyte beds throughout study period with limited light penetration into lake, state of lake is extremely eutrophicated.

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