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Research Article

Heavy Metals Toxicity

A Study On the Assessment of Heavy Metals in Gogi Lake, Yadgir District, Karnataka, India

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Abstract: The lakes are the source of people's livelihood for surrounding communities, due to urbanization, and industrialization, these lakes are threatened with emerging environmental pollution as well as heavy metal pollution is a thoughtful major problem for lakes and wetlands. Heavy metal containment was toxic to human health, and the natural environment. Our study , aims to find out the concentration of heavy metals in the aquatic ecosystem. The study was conducted in a one-year period of three seasonal variations of ten different sites during the period of June 2020 to May-2021 of Gogi Lake. The analysis of the concentration of heavy metals is Zn, Cu, Mn, Cr, Fe, Mg, Cd, and Pb. The collection of samples, sampling preparation, pre-treatment processing, and analysis by using the instrument atomic absorption spectrophotometer (AAS) was done and data was subject to descriptive statistics to arrive at meaningful conclusions. During the study period, Zn concentration was found 0.01564 mg/L to 2.05866 mg/L, The Cu concentration ranged from 0.06794 mg/L to 0.01243 mg/L. Fe was found at 0.285 mg/L to 0.0256 mg/L, Mn concentration between 0.03272 mg/L to 0.00626 mg/L, The Cr was found at high concentration in monsoon season 0.0174 mg/L at site 2 and low concentration was found in post-monsoon 0.0015 mg/L at site 1., the study revealed. Heavy metals have been shown within the permissible limits, except Pb, as per recommendations of WHO and BIS 10500 2012 standard of water criteria. The objective of the present research was to assess the concentration of heavy metals to understand aquatic environment problems. and the study recommended that continuous monitoring and assessment investigation will be beneficial for the management and protection of this Lake.

Keywords: Gogi Lake, Heavy metals, Seasonal variation, Water quality, Instrumental analysis.

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1. INTRODUCTION

Heavy metals are among one of the pollutants of freshwater[1], and there are several sources of heavy metals some originate from anthropogenic activities like agriculture activities, draining of sewerage, dumping of hospital wastes, vehicular, household, agricultural, industrial waste mining and recreational activities[2]. Equally, metals also occur in minor amounts naturally and may enter the aquatic system through the leaching of rocks, airborne dust, forest fires and vegetation[3, 4]. As heavy metals cannot be degraded, they are continuously being deposited and incorporated into the aquatic system causing serious environmental complications[5]. These heavy metals have a habit of bioaccumulation in the food chain that gradually affects aquatic and public health[6]. The solubility of the metal forms is extremely impelling the absorption segment, in either oral or pulmonary routes. Non-solvable forms have commonly a very limited absorption (below 1%) range of values for numerous heavy metals absorbed via both ways [7]. Excessive accumulation of these heavy metals in human bodies produces problems similar to cardiovascular, kidney, nervous, and bone diseases. Everyday Consumption estimation of Pb, Cu, Cd and Zn: There are many methods for approximating the consumer-based health risk assessment and the Provisional tolerable Daily Intake (PTDI) is also one of the methods. Heavy metals in soils decrease the yield of vegetables because of distressing the metabolic processes of plants. soil, irrigation water, and roughly vegetables from peri-urban locations are significantly contaminated by heavy metals i.e. Cu, Cd, Pb and Zn, and heavy metals, not simply disturb the healthy value of vegetables but also affect the health of human beings consequently, the harmless perimeters of these heavy metals are lowered frequently in these vegetables. This instruction is the accountability of National and International regulatory authorities[8]. Therefore, a present water pollution assessment and monitoring are crucial because of their direct effects on aquatic life and human health. Mercury (Hg) and lead (Pb) are poisonous even at low concentrations, and are non-degradable elements, permitting their accumulation through the food chain. On the other hand, iron (Fe), copper (Cu), and zinc (Zn) are important micronutrients, but they also showing harmful things on the physiology of the living creatures at high concentrations [9]. In India, the role of agriculture plays an important contribution to the development of the Indian economy [10]. The factor endowments play a significant role in the specialization of the division of labor, especially in the regions which are resources are abundant in this present situation resource which including both stock and flow resources are very important in the process of production of any agricultural commodities, especially in dryland area when lack to water is a major problem and even it leads to the low productivity of crops, especially in low rainfall area of dryland. As numerous studies have described, the main potential contamination sources of heavy metals in agricultural regions are resultant of anthropogenic sources like irrigation using sewage, fertilization, industrial wastes, and etc[11]. Spreading and accumulation of heavy metals in agricultural soils, with increasing industrialization and agriculture accumulating the occurrence of heavy metals in our environment, their presence in food crops and most edibles, there is an increasing need to study heavy metals [12]. On the other hand, we treat land as a god gift by nature; similarly, we treat water as well, looking to the scarcity of water, it is very essential to analyze the presence of portability tests for drinking water, agricultural and allied uses general [13]. This study is to understand the awareness of the prospective impacts of contaminants and provide a crucial to effective management of surface water quality in mining areas. Therefore, the objective study focuses on identifying the presence of heavy metals in lake water bodies of Gogi Lake, which helps to make an awareness process for deciding the kind of water suitability for specific use either for human consumption, agricultural and domestic use.

2. MATERIALS AND METHODS

2.1 STUDY SITE

The systematic study was carried out for Gogi Lake (Table. 1 & Fig. 1), a freshwater body situated in Shahapur taluk, Yadgir district, Karnataka. The average coordinates of the study area are 16° 72'58"N Latitude and 76° 74'19" E Longitude with an elevation of 1609 ft. above sea level [14]. The present research study area is the uranium mining area. In the study area, many people undergo health hazards including skin diseases, joint pain, infertility, and kidney damage. Children are born with ill health for the reason that their mothers consumed contaminated water during their perinatal period. Now the government has closed mining activities.

Table1. Showing the location of the sampling sites of the Gogi Lake

Sl.No	Sampling Stations	Site Locations		Elevation in meter
		Longitude	Latitude	
1	S1	E 76°43'53.6"	N 16° 43'05.9"	444
2	S2	E 76°43'44.2"	N 16° 43'03.6"	450
3	S3	E 76°43'45.5"	N 16° 43'19.6"	471
4	S4	E 76°43'16.4"	N 16° 43'19.6"	471
5	S5	E 76°43'52.3"	N 16° 43'16.9"	453
6	S6	E 76°44'43.1"	N 16° 43'39.2"	448
7	S7	E 76°44'37.8"	N 16° 43'37.8"	444
8	S8	E 76°44'33.6"	N 16° 43'45.8"	449
9	S9	E 76°44'31.7"	N 16° 43'37.8"	444
10	S10	E 76°44'26.0"	N 16° 43'32.2"	445

Table 1 illustrates that the study was conducted in a semi-arid area of Karnataka, the Gogi Lake is a natural water body located in Shahapur taluk, Yadgir district, Karnataka. The standard methodology was followed in conducting a comprehensive study and carried out on the concentration of heavy metals in surface water at ten different sampling

points from the lake ecosystem. The samples were collected during three Seasons: Monsoon season (July -2020), post-monsoon season (Nov -2020) Pre-monsoon Season (March – 2021) also locations were recorded (Latitudinal and Longitudinal position) using a hand-held Global Positioning System (GPS), and also elevation was recorded in meters.

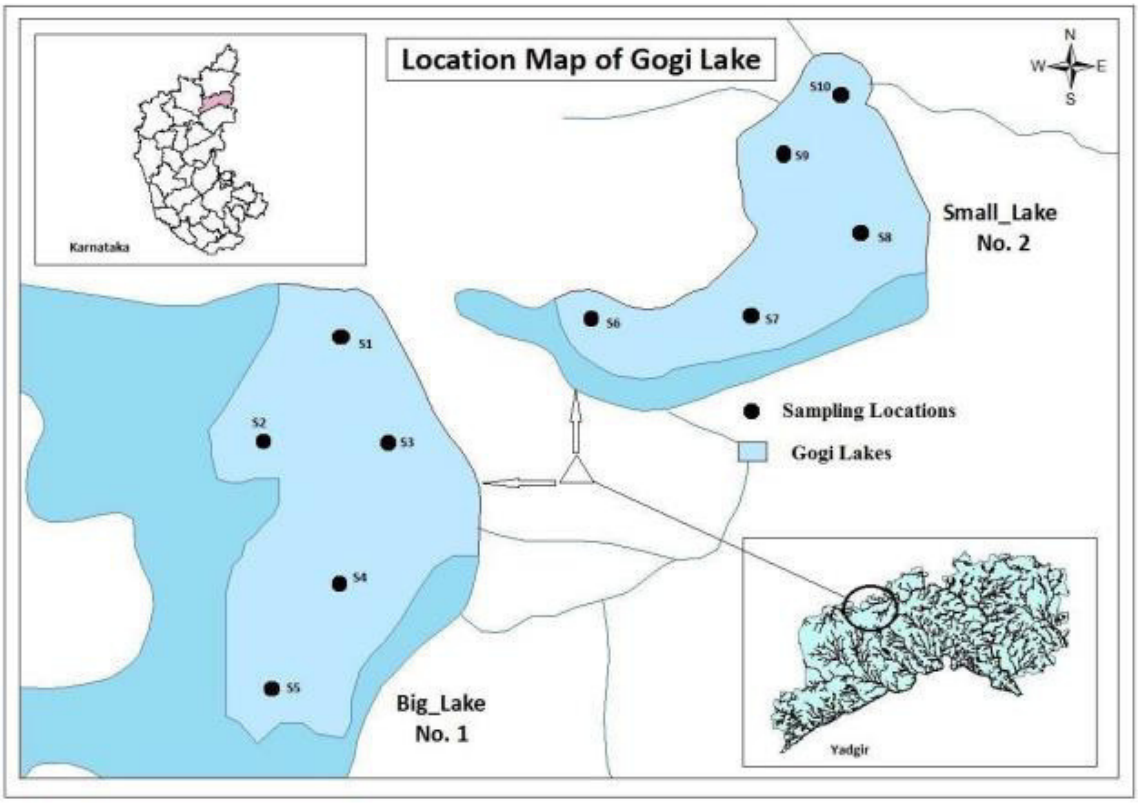

Fig No 1. Location of the study area and the different numbers showing water sampling sites

Source: https://zoom.earth/#view=16.722645,76.734199,15z

Fig No 2. Satellite view of the study area

2.2 SAMPLING AND ANALYSIS

The water sample has collected a total of 10 Surface water samples collected during three Seasons: Monsoon season (July -2020), post-monsoon season (Nov -2020) Pre-monsoon Season (March – 2021). The sampling site's locations were recorded (Latitudinal and Longitudinal position) using a hand-held Global Positioning System (GPS), the collected one-liter water samples were labeled and then transferred to the laboratory, and the water samples were filtered into the 100 ml volumetric flask using Whatman No. 42 filter paper and preserved by adding 5 ml conc. HNO_3 to each sample by which pH was lowered to 1-2. Preserved samples were then refrigerated at 4°C until analysis, and were processed for determination of heavy metals by AAS (Thermo Scientific). The procedures followed to analyze the heavy metal concentration were taken from Standard Methods for the Examination of Water and Wastewater[15-17].

3. STATISTICAL ANALYSIS

The data pertaining to 10 sites in the Yadgir district was subjected to statistical analysis using the Statistical Package for Social Sciences (SPSS) V22.0 statistical software was used for data analysis. The results were expressed in terms of statistical inferences such as mean, standard deviation and Standard error, apart from these; descriptive statistics were used to arrive at a meaningful interpretation.

4. RESULTS AND DISCUSSIONS

4.1. In the present investigation, eight heavy metals were analyzed for one year and depicted in Table 2. the measured concentration of heavy metals levels showed the considerable different seasons of Gogi Lake. Zinc is a micronutrient found throughout our body, immune system, metabolism function and growth and development, however, drinking water containing high levels of zinc can lead to stomach pains, sickness and vomiting. In the current study, Zn concentration was found to be high in pre-monsoon season at site 2, 2.05866 mg/L and the lowest Zinc Concentration was found in monsoon season at site no 2, 0.01564 mg/L, however, the concentration of Zn is within the permissible limits. The high concentration of zinc in pre-monsoon may be due to the discharge of a large quantity of sewage and agricultural runoff from the surroundings into the lake [18,19]. The Cu concentration ranged between 0.06794 mg/L to 0.01243 mg/L. A high concentration of Cu was found in the monsoon at site no1. and the lowest Cu concentration found in pre-monsoon at site 2. Cu is commonly found in aquatic systems as a result of both natural and anthropogenic sources, Copper is an essential nutrient at low concentrations, but is toxic to aquatic organisms at higher concentrations. In addition to acute effects such as mortality, chronic exposure to copper can lead to adverse effects on survival, growth, and reproduction as well as alterations in brain function, enzyme activity, blood chemistry, and metabolism [20-22]. Manganese(Mn) is a mineral, that is found naturally in the environment and is one of the most abundant metals on the earth's surface in water and soil. The Mn concentration at the sampling site was ranged from 0.0327 mg/L to 0.0045 mg/L. The high value is found in pre-monsoon at site 1 and the low value was post-monsoon at site 1. It can be the result of human activity such as mining, industrial discharges and leaching from landfills [23]. Chromium does not occur freely in nature. The main chromium mineral is chromite. As was mentioned earlier, chromium compounds can be found in waters only in trace amounts. The Cr was found to have high concentration in monsoon season 0.0174 mg/L at site 2 and a low concentration was found in post-monsoon 0.0015mg/L at site 1. Monsoon may cause the discharge of the element and its compounds can be discharged on to the surface water, through various human activities [24]. In the aquatic environment, iron is one of the biochemically active transition metals. The high concentration of Fe was found in the pre-monsoon 0.285 mg/L at site 2. The low concentration of Fe was found in monsoon season0.0256 mg/L. however, according to WHO, Fe is the permissible limit of 0.3 mg/L. Iron in water may be present in varying quantities depending upon the geology of the area and other chemical components of the waterways. Ferrous and ferric ions are the primary forms of concern in the aquatic environment [25]. Magnesium was found to be highest in seasons ranging from 2.6394 mg/L to 6.4706 mg/L, the maximum found in post-monsoon at site 1, and the minimum found in pre-monsoon at site 2. Magnesium is washed from rocks and subsequently ends up in the water. The presence of magnesium helps plants to produce chlorophyll, which is very vital for photosynthesis. It is found in the center of the porphyrin ring in chlorophyll functions like iron. However, in many studies absence of magnesium creates its deficiency and many plants showed yellowing in between leaf veins especially during the delayed season, exclusively in older leaves, and this can be overcome by applying Epsom salts or crushed limestone in the combination of dolomitic nature to the soil [26]. The higher concentration of cadmium is extremely toxic to the fish population [19]. Its effects on growth rate have been observed even for concentrations between 0.0034mg/L to 0.0382 mg/L, the high concentration was found in pre-monsoons at site 2 and a low concentration of Cd was found post-monsoon at site 2. The higher levels of cadmium obtained in water samples of Gogi Lake might be due to contribution from agricultural runoff, indiscriminate use of pesticides, chemicals, fertilizers, insecticides, and other non-point sources [27,28]. Similarly in the case of lead (Pb), during monsoon, there was a high concentration of 0.0682 mg/L in site 1 and during the pre-monsoon season, Pb was found at a low concentration of 0.0083 mg/L at site 2. However, the concentration of Pb was found to be beyond the permissible limit according to WHO 0.05 mg/L. The high concentration of Pb in water can be attributed to industrial, agricultural discharge and human activities [29].

Table 2. Shows the average values of concentration of the heavy metals in different seasons of Gogi Lake

	Zn mg/L	Cu mg/L	Mn mg/L	Cr mg/L	Fe mg/L	Mg mg/L	Cd mg/L	Pb mg/L
Monsoon season	0.0252	0.03804	0.0068	0.01432	0.0256	3.3717	0.00814	0.0682
	0.01564	0.0268	0.0062	0.01742	0.0325	3.3271	0.01976	0.0321
Post Monsoon season	0.435	0.06794	0.0045	0.0015	0.124	6.4706	0.0234	0.012
	0.525	0.02918	0.0232	0.0121	0.214	6.3757	0.0184	0.021
Pre Monsoon season	1.15676	0.01992	0.0327	0.01214	0.1336	2.6481	0.0034	0.0268
	2.05866	0.01243	0.0244	0.01656	0.285	2.6394	0.0382	0.0083
Min	0.01564	0.01243	0.0045	0.0015	0.0256	2.6394	0.0034	0.0083
Max	2.05866	0.06794	0.0327	0.01742	0.285	6.4706	0.0382	0.0682
Mean	0.70271	0.032385	0.0163	0.01234	0.13578333	4.13876666	0.01855	0.0280667
SD ±	0.741	0.007	0.012	0.006	0.098	2.280	0.012	0.009
SE ±	0.320	0.021	0.004	0.002	0.041	0.739	0.004	0.008
WHO*	5	1	0.04	0.1	0.1	NA	0.005	0.05
USEPA*	5	1.3	0.05	NA	NA	NA	0.005	0.05
ISI*	5	0.05	NA	0.05	0.3	NA	0.01	0.1
CPCB*	15	2	2	0.05	1	NA	2	0.1
ICMR*	0.1	1.5	NA	0.1	1	NA	0.01	0.05
BSI 10500 2012*	5	0.05	0.1	0.05	0.3	30	0.03	0.01

Water quality standards, permissible limits. SD - Standard Deviation. SE - Standard Error, NA – Not Available.

Table2 illustrates the seasonal variation of heavy metal concentration at two sites of ten sampling points of Gogi Lake. The results expressed average data of ten sampling points. The Zn concentration was found 0.01564 mg/L to 2.05866 mg/L, The Cu concentration ranged from 0.06794 mg/L to 0.01243 mg/L. Fe was found at 0.285 mg/L to 0.0256 mg/L, Mn concentration between 0.03272 mg/L to 0.00626 mg/L, The Cr was found at high concentration in monsoon season 0.0174 mg/L at site 2 and low concentration was found in post-monsoon 0.0015 mg/L at site 1., The present data were compared to different Water quality standards with references of permissible limits of standard and calculated mean, Standard Derivation, and Standard Error respectively

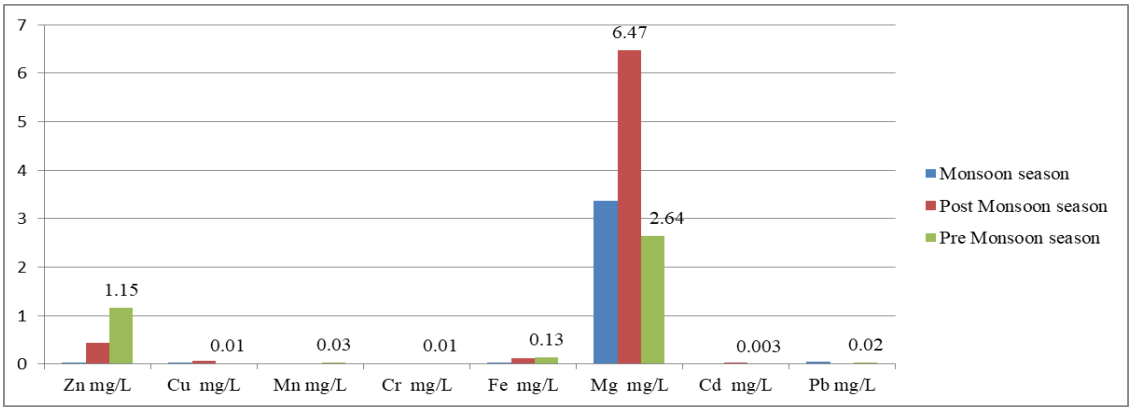

Fig No 3. Showing site 1 seasonally variation of heavy metals of Gogi Lake.

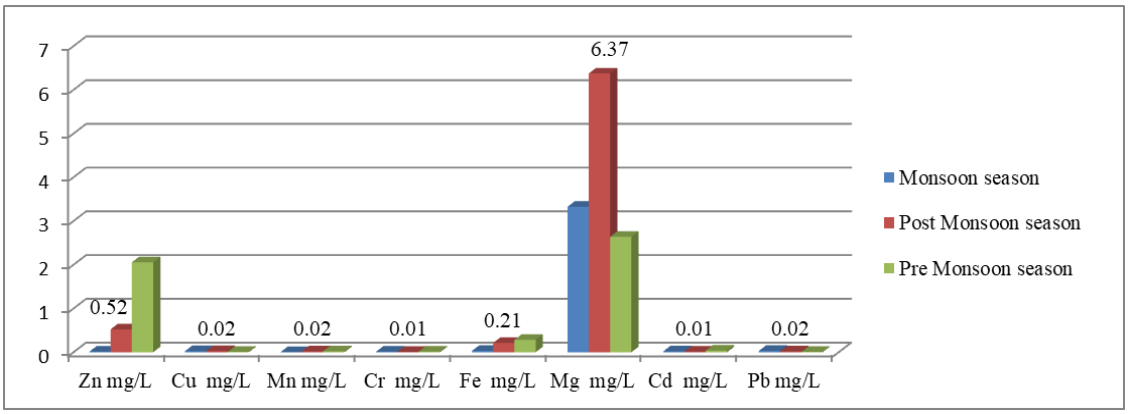

Fig No 4. Showing site 2 seasonally variation of Heavy metals of Gogi Lake.

The present investigation demonstrates that the lake is slightly polluted with various heavy metals in the study area Cu, Mn, Cr, Fe, Mg, and Cd, however, Pb was found within permissible limits except for Pb, during the study period Pb concentration ranging from lowest concentration is 0.00836 mg/L and the highest concentration is 0.0682 mg/L, Pb is present in maximum in monsoon at site 1 and in the pre-monsoon season at site 2 is beyond the permissible limits prescribed by (WHO) (BIS 10500 2012). This indicates metal contamination and the water quality of aquatic water bodies. Public responsiveness regarding the lake should be refreshed to receive its life. Data attained in the present research can be used as a standard and reference point when evaluating further anthropogenic modification in this lake.

5. CONCLUSION

In conclusion, regularly maintained water quality, therefore, is necessary to assess the heavy metal content in water, hence, helpful measures can be implemented to accept the aquatic water from heavy metal contamination from domestic, and agricultural activities and sewage discharge. Regularly monitoring, and evaluating pollutants assessment in the lake is very important and recommended. and there is a need of the hour to create awareness to the public regarding this problem and needs to be addressed at the earliest. Some of the novel approaches which are environmental friends should be adopted that can be followed to combat the contamination problem.

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Om Prakash Jadhav and Sudindra conceived the practical work at University Science Instrumentation Centre, Gulbarga University, Kalaburagi. Dr. K. VijayKumar conceived the help of writing the manuscript. The authors discussed the methodology and result.

7. AUTHORS CONTRIBUTION STATEMENT

I am greatly thankful to our guide Dr. K. Vijaykumar. Professor of Zoology, Gulbarga, University, Kalaburagi., has led us to the efficacious completion of this work with constant insistence on perfection and a depth scientific approach.

8. CONFLICT OF INTEREST

Conflict of interest declared non.

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