

## Comparative study on physico-chemical and Heavy metal profile of Purle and Kunchenahalli Tanks of Shivamogga District, Karnataka

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### Abstract

The present investigation is aimed to know the concentration of physico-chemical and trace metals (Iron, Zinc, Copper, Nickel, Chromium, Lead and Cadmium) in the sediment and water samples of Purle tank and Kunchenahalli tank of Shivamogga district, Karnataka during the year 2017-18. The study revealed that the Purle tank is contaminated by few trace metals. The order of sequence of the levels of trace metals in the tank water for 5 sites was  $Pb > Zn > Cu > Cr > Cd > Fe$ , for sediment samples was  $Fe > Pb > Cr > Zn > Cd > Cu$ . The geoaccumulation index for trace metals show that the Purle tank is extremely polluted. Kunchenahalli tank is contaminated with high concentration of Iron and zinc, threatening to use for the domestic and irrigation purposes and also for survival of aquatic organisms. The present analysis reveals that sediment and water of the lentic water bodies needs some degree of treatment in order to protect them from future contamination.

**T**anks are the dynamic lentic aquatic system that supports a unique biological integrity. Tanks are degrading due to anthropogenic activities. Biodiversity of tanks are threatened due to over utilization of resources and undesirable activities. It is noted that species rich water bodies are capable of self maintaining<sup>1</sup>. Several limnologists have studied the limno-biotic factors of certain tanks and rivers showed that physical, chemical and

biological components act simultaneously to influence the biotic fluctuations<sup>1,4,8</sup>. Human activities drastically altered the biogeochemical cycles of some heavy metals. These metals entering the food chain of the ecosystem may causes to bioaccumulation and biomagnification in the living organisms<sup>2,10</sup>. The pollutants are get deposited on the soil when the soil gets accumulated by the toxic metals, elements and other organic substances from

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domestic wastes and industrial effluents<sup>2,11</sup>.

The impact of expanded silt stacks on aquatic environments can be calamitous. Silt can cover the bringing spawning beds of fish, by occupying in the space between rock on the stream bed<sup>18</sup>. Sediment contamination is an inescapable natural issue that undermines aquatic biological systems around the world. Once discharged into surface waters, numerous poisonous and persistent contaminants become adsorbed to residue and can get fused into aquatic food networks. As such, polluted silt can have harmful and bio aggregate impacts on aquatic life contaminants in biological systems.

Trace metals are extremely unsafe poisons because of their bioaccumulation and harmfulness Which legitimately impacts the biological procedures. The issue of overpowering metal toxicity may remain as a legacy of mass mechanical development for certain ages and is most likely going to rise further in future. In such way, the accumulation of past and the present files of generous metal fixation is an activity of phenomenal criticalness. Overpowering metal sullyng is a quickly creating issue for our surface water resources. As of now it may not be the best sullyng issue, yet basically keeping things under control for it to leave or to light up itself won't help. We should think about the issues follow metals make, so we in general, in our own one of a kind little ways, can add to the arrangements. Clean water is our movement into an ideal future. We need to exhort people about how follow metal contamination gets into our condition so they can be progressively aware of the risks of these poisons<sup>15</sup>.

Due to these reasons the present study was aimed to carried out the physico-chemical and trace metal levels in the sediment and water of the Purle tank and Kunchenahalli tank of Shivamogga, Karnataka.

#### *Study area :*

Purle tank (Figure 2) of Shivamogga is the main sources of water supply to agricultural/farming areas receiving domestic waste water throughout the year and exhibit abundance of living biota. Purle tank is a perennial water body as it receives the water from Tunga canal and waste water from Shivamogga town. The total area of the tank is 55 hectares and the water spreads area is about 43 hectares with an mean depth of 6 feet. This tank water is used for domestic purposes and fisheries<sup>14</sup>. Tank is surrounded by thick human population. Kunchenahalli tank is located in 14.06°N latitude and 75.55°E longitude. This lake is covered in 48N/12 Toposheet of Survey of India. This Lake is having an area of 4 square kilometers and serving 5000 residents with 1300 household in Kunchenahalli village. Kunchenahalli tank water is used for agriculture and for domestic activities by the human beings.

Shivamogga (Figure 1) lies in the latitude 13°27'-14°39' N and between the longitudes 74°38' and 76°04' E at a mean height of 640 meters above sea level<sup>9</sup>. The pinnacle Kodachadri slope at a height of 1343 meters above sea level is the most elevated point in this region. Streams Kali, Gangavati, Sharavati and Tadadi start in this region. The two significant waterways that course through this area are Tunga and Bhadra which meet at Kudli close Shimoga city to pick up the name of Tungabhadra, which later joins stream Krishna.

In this study water and sediment samples were collected during the year 2017-18 and analysed as per standard methods prescribed by APHA<sup>3</sup> and Trivedy and Goel<sup>17</sup>. For trace metal analysis the samples were collected in good quality polypropylene bottles, each with 2 liter capacity, properly labelled and estimated for trace metals by Atomic Absorption Spectrophotometer (AAS).

One-way ANOVA with post-hoc Tukey HSD test with Scheffe, Bonferroni and Holm multiple comparisons are calculated by using astatsa.com software (Table 1-5).

#### *Water quality :*

##### *Purle tank :*

The pH level varied from 6.8 (S<sub>1</sub>) to 7.5 (S<sub>5</sub>). The electrical conductivity fluctuated from a minimum of 255 µmhos/cm to a maximum of 480 µmhos/cm at site S<sub>4</sub>. Nitrate content ranged from 10 mg/l (S<sub>1</sub>) to 44 mg/l (S<sub>3</sub>). While, phosphorus level fluctuated from 45 mg/l at Site S<sub>1</sub> to 460 mg/l at S<sub>3</sub>. Potassium content deviated from 980 mg/l (S<sub>3</sub>) to 2600 mg/l (S<sub>5</sub>) respectively. Sulphate level varied from 3260 mg/l (S<sub>5</sub>) to 9800 mg/l (S<sub>1</sub>). With respect to the trace metals the iron content fluctuated from 0.20 mg/l (S<sub>2</sub>) to 2.80 mg/l (S<sub>4</sub>). Lead level varied from 2.7 mg/l (S<sub>1</sub>) to 37.6 mg/l (S<sub>3</sub>). However, Cadmium content of water deviated from 0.32 mg/l (S<sub>1</sub>) to 1.92 mg/l (S<sub>2</sub>). While the levels of Zinc, Copper and Chromium fluctuated from 1.8 - 24.5 mg/l, 1.6-22.9 mg/l and 1.2 - 19.5 mg/l respectively (Figure 3).

##### *Kunchenahalli tank :*

The pH level ranging from 8.4 (S<sub>5</sub>) to 8.9 (S<sub>2</sub>). The electrical conductivity fluctuated from a minimum of 240 µmhos/cm to a maximum of 500 µmhos/cm at site S<sub>3</sub>. Nitrate content ranged from 6 mg/l (S<sub>1</sub>) to 30 mg/l (S<sub>2</sub>). While, phosphorus level fluctuated from 24 mg/l at Site S<sub>1</sub> to 230 mg/l at S<sub>3</sub>. Potassium content deviated from 450 mg/l (S<sub>3</sub>) to 1200 mg/l (S<sub>5</sub>) respectively. Sulphate level varied from 1600 mg/l (S<sub>5</sub>) to 3500 mg/l (S<sub>3</sub>). With respect to the trace metals the iron content fluctuated from 2.1 mg/l (S<sub>5</sub>) to 2.6 mg/l (S<sub>1</sub>). Lead level varied from 1.0 mg/l (S<sub>1</sub>) to 17.0 mg/l (S<sub>3</sub>). However, Cadmium content of water deviated from 0.2 mg/l (S<sub>1</sub>) to 1.1 mg/l (S<sub>2</sub>). While the levels of Zinc, Copper and Chromium fluctuated from 0.004 – 0.008 mg/l, 0.002 – 0.04 mg/l and 0.6 – 9.2 mg/l respectively (Figure 4).

#### *Sediment Quality :*

##### *Purle tank :*

In the sediment the pH fluctuated between 6.9 (S<sub>2</sub>) and 8.2 (S<sub>3</sub>). The electrical conductivity varied from 240 µmhos/cm (S<sub>5</sub>) to 1680 µmhos/cm (S<sub>2</sub>). Nitrate content deviated 10.4 mg/g (S<sub>5</sub>) and 13.5 mg/g (S<sub>3</sub>). Phosphorus level fluctuated from 1.9 mg/g (S<sub>4</sub>) to 14.1 mg/g at S<sub>2</sub>. While, Potassium content varied from 13.7 mg/g (S<sub>5</sub>) to 121 mg/g (S<sub>1</sub>). Sulphur level deviated from 210 mg/g (S<sub>1</sub>) to 910 mg/g (S<sub>3</sub>). Iron content in the sediment ranged between 0.2 mg/g (S<sub>1</sub>) and 5.8 mg/g (S<sub>4</sub>). Lead level ranged from a minimum of 0.18 mg/g (S<sub>5</sub>) to a maximum of 0.65 mg/g at S<sub>3</sub>. Cadmium and Copper metals deviated from below detectable level (BDL) to 0.02 mg/g (S<sub>2</sub>). Nevertheless, the zinc content ranged from 0.02 mg/g (S<sub>4</sub>) to 0.09 mg/g (S<sub>3</sub>).

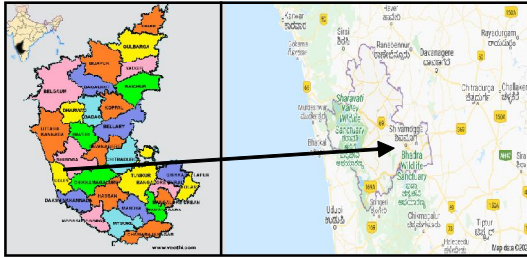


Figure 1: Study area map  
(Source: [www.veethi.com](http://www.veethi.com); in printerest.com)



Figure 2: Views of Purle tank and Kunchenahalli tank during summer

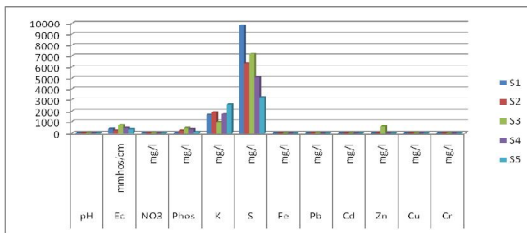


Figure 3: Physico-chemical and trace metal levels in the water of Purle tank, Shivamogga during 2017-18.

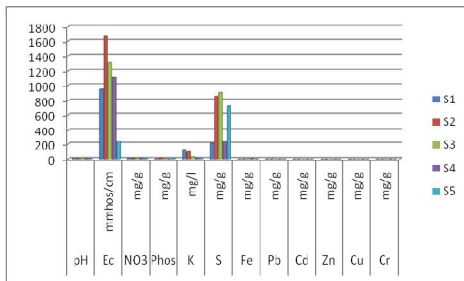


Figure 4 : Physico-chemical & trace metal concentration in the sediment samples of Purle tank, Shivamogga

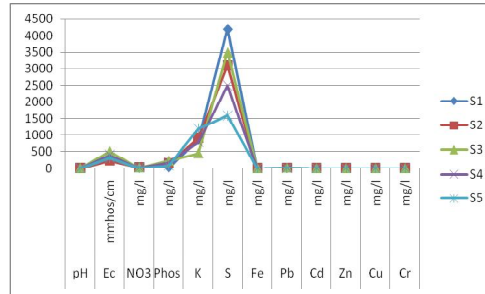


Figure 5: Physico-chemical and trace metal levels in the water of Kunchenahalli tank, Shivamogga during 2017-18.

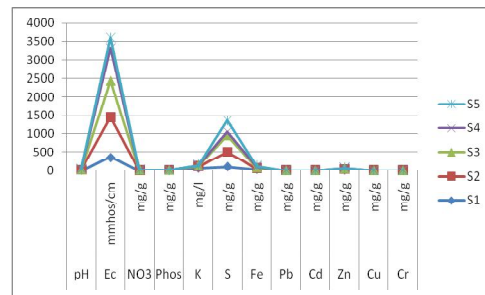


Figure 6: Physico-chemical and trace metal levels in the sediment of Kunchenahalli tank, Shivamogga during 2017-18.

Chromium content fluctuated from 0.15 mg/g (S<sub>1</sub>) to 0.40 mg/g (S<sub>3</sub>) (Figure 6).

*Kunchenahalli tank :*

The pH fluctuated between 7.0 (S<sub>2</sub>) and 8.1 (S<sub>3</sub>). While, the electrical conductivity varied from 350 µmhos/cm (S<sub>1</sub>) to 1100 µmhos/cm (S<sub>2</sub>). Nitrate content deviated 2.8 mg/g (S<sub>5</sub>) and 4.6 mg/g (S<sub>4</sub>). Phosphorus level fluctuated from 0.8 mg/g (S<sub>4</sub>) to 7.2 mg/g at S<sub>2</sub>. Whereas, Potassium content varied from 7.0 mg/g (S<sub>5</sub>) to 60 mg/g (S<sub>1</sub>). Sulphur level deviated from 100 mg/g (S<sub>1</sub>) to 450 mg/g (S<sub>3</sub>). Iron content in the sediment ranged between

18.2 mg/g (S3) and 31.0 mg/g (S1). Lead level ranged from a minimum of 0.10 mg/g (S5) to a maximum of 0.40 mg/g at S2. Cadmium and zinc metals deviated from 0.01-0.03 and 12.8-18.5 mg/g respectively. Nevertheless, the copper content ranged from 0.2 mg/g (S1) to 1.0 mg/g (S4). Chromium content fluctuated from 0.1 mg/g (S1,S5) to 0.30 mg/g (S3,S4) (Figure 6).

Table-1. One-way ANOVA with post-hoc Tukey HSD Test with Scheffe, Bonferroni and Holm multiple comparison

Treatment	A	B	C	D	Pooled Total
N	60	60	60	60	240
sum	45,19 8.0100	8,665. 7750	21,799. 0620	5,384. 5300	81,047. 3770
mean	753.3 002	144.4 296	363.3 177	89.74 22	337.69 74
sum of squares	244,6 92,14 2.6053	8,960, 193.0 575	52,944, 794. 6365	3,649, 578.0 041	310,24 6,708.3 034
sample variance	3,570, 245.3 244	130,6 54.21 67	763,1 32.36 56	53,66 7.0952	1,183,5 86.692 4
sample std. dev.	1,889. 5093	361.4 612	873.5 745	231.6 616	1,087.9 277
std. dev. of mean	243.9 346	46.66 44	112.7 780	29.90 74	70.225 4

A= water quality & trace metals in Purle tank; B=Sediment quality & trace metals in Purle tank; C= Water quality & trace metals in Kunchenahalli tank; D= Sediment quality & trace metals in Kunchenahalli tank

Table-2. One-way ANOVA of independent treatments

Source	Sum of squares	Degrees of freedom	Mean square
Treatment	16,332,978.3678	3	5,444,326.1226
Error	266,544,241.1082	236	1,129,424.7505
Total	282,877,219.4760	239	
F statistic-4.8204			
0.0028			

The p-value corresponding to the F-statistic of one-way ANOVA is lower than 0.05.

Tukey HSD data :

The p-value corresponding to the F-statistic of one-way ANOVA is lower than 0.01 which strongly suggests that one or more pairs of treatments are significantly different.

Table-3. Tukey HSD values

Treatment pair	Tukey HSDq statistic	Tukey HSD p-value	Tukey HSD inference
A vs B	4.4378	0.0102813	* p<0.05
A vs C	2.8424	0.1872128	insignificant
A vs D	4.8364	0.0040895	** p<0.01
B vs C	1.5954	0.6526510	insignificant
B vs D	0.3986	0.8999947	insignificant
C vs D	1.9940	0.4944808	insignificant

Table-4. Scheffe multiple comparison

Treatments pair	Scheffe T-statistic	Scheffe p-value	Scheffe inference
A vs B	3.1380	0.0216130	* p<0.05
A vs C	2.0099	0.2599542	insignificant
A vs D	3.4199	0.0095739	** p<0.01
B vs C	1.1281	0.7358134	insignificant
B vs D	0.2819	0.9941683	insignificant
C vs D	1.4100	0.5757619	insignificant

The obtained data of water and sediment samples gives clear evidence about trace elements is source of lithology/ soil/anthropogenic or by any other nature. Most of the trace elements are also used to estimate the level of pollution in a region<sup>5,7,13,16</sup>. The study area is dominated by human activities. The generated wastes are sometimes disposed

Table-5. Bonferroni and Holm results: all pairs simultaneously compared

Treatment pairs	Bonferroni and Holm T-statistic	Bonferroni p-value	Bonferroni inference	Holm p-value	Holm inference
A vs B	3.1380	0.0115044	* p<0.05	0.0095870	** p<0.01
A vs C	2.0099	0.2734725	insignificant	0.1823150	insignificant
A vs D	3.4199	0.0044282	** p<0.01	0.0044282	** p<0.01
B vs C	1.1281	1.5624962	insignificant	0.5208321	insignificant
B vs D	0.2819	4.6698291	insignificant	0.7783049	insignificant
C vs D	1.4100	0.9591941	insignificant	0.4795971	insignificant

in nearby place by surface run off. The fluctuated water and sediment concentration in a samples is clearly indicates its part of anthropogenic and industrial activity in a surrounding area, due to this activity wastes were leached from soil or carried through water leads to contamination of tank sediment. Ravi Kumar *et al.*,<sup>12</sup> investigation was aimed to know the concentration of physico-chemical and trace metals in the sediment and water samples of Purle tank, Karnataka. Their study revealed that the Purle tank was contaminated by few trace metals. The geoaccumulation index for trace metals show that the Purle tank is extremely polluted.

Ganesh Prasanna and Hiremath<sup>6</sup> made an attempt to assess the physico-Chemical parameters and trace metals in the water and sediment samples of Kunchenahalli lake in Shivamogga District, Karnataka. Their results indicated that the lake was contaminated with high concentrations of Iron and Manganese, threatening for the survival of aquatic organisms.

*Scope for further study :*

The elements like Mercury, Arsenic and pesticides can also be studied for future work. Bacterial count and Coliform to be carried out with regular intervals along with trace elements. Long term analysis of the sites with toxic metals contamination is recommended so that possible reason can be ascertained.

Regular monitoring of the water bodies are required for the proper management and development of the tanks. From the above findings it can be concluded that quality of tank water in the study is contaminated from domestic sewage and industrial effluents. The overall quality of water of the Purle tank is not suitable for human consumption. Safe and proper disposal of domestic sewage, solid waste and factory effluents are not practiced. The sediment analysis showed the heavy metal pollution in the Kunchenahalli tank is owing to threaten for the use of water for the domestic point of view. This study revealed that there is degree of pollution in the studied water

bodies and hence, preventive measures are required to avoid further deterioration of the water quality and make use of the water bodies for community usage.

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