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EVALUATION OF NAGAVARA LAKE WATER QUALITY

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ABSTRACT

Ever increasing population, urbanization and modernization are posing problems of sewage disposal andcontamination of surface waters like lakes. Natural water gets contaminated due to weathering of rocks, leaching of soils and mining processing, etc. Various types of problemsin lake which cause nutrient enrichment in lake have been reviewed. Land use change and longer growing seasons could increase the use of fertilizers with subsequent leaching to watercourses, rivers and lakes, increasing the risk of eutrophication and loss of biodiversity. Water quality can be assessed by various parameters such as BOD, Electrical Conductivity, Nitrate, Phosphate, Potassium, Dissolved Oxygen, etc. Heavy metals such as Nickel, Lead, Chromium are of special concern because they produce water or chronic poisoning in aquatic animals. Harmful algal blooms are becoming increasingly common in freshwater ecosystems globally. Pollution by plastic debris is an increasing environmental concern in water bodies, where it affects open-water and benthic environments. Surface water densities of plastics are as high as those reported for areas of litter accumulated. It is recommended that pollution prevention and water re-use should be adopted in combination with the recycling of nutrients in controlled urban agriculture.

KEYWORDS: ***Contaminated, eutrophication, debris.***

INTRODUCTION

Lakes are inland bodies of water that lack any direct exchange with an ocean. Lake ecosystems are made up of physical, chemical and biological properties contained within these water bodies. Lakes may contain fresh or salt water (in arid regions). They may be shallow or deep, permanent or temporary. Lakes of all types share many ecological and biogeochemical processes and their study falls within the discipline of 'limnology'. Lakes are superb habitats for the study of ecosystem dynamics: interactions among biological, chemical and physical processes are frequently either quantitatively or qualitatively distinct from those on land or in air. Because the boundaries between water and land and water and air are distinct, there is tight coupling among many ecosystem components. The isolated lakes are saline due to evaporation or groundwater inputs. Depending on its origin, a lake may occur anywhere within a river basin. A headwater lake has no single river input but is maintained by inflow from many small tributary streams, by direct surface rainfall and by groundwater inflow. Such lakes almost invariably have a single river output. Further downstream in river basins, lakes have a major input and one major output, with the water balance from input to output varying as a function of additional sources of water. Many organisms depend on freshwater for survival and humans frequently depend on lakes for a great many 'goods and services' such as drinking water, waste removal, fisheries, agricultural irrigation, industrial activity and recreation. For these reasons lakes are important ecosystems.

OBJECTIVES

1. To determine the various water quality parameters of Nagavara Lake.

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METHODOLOGY

The sample from the lake was collected on 22 February 2021 from three different regions of the lake. The physiochemical analysis includes data of 22 parameters which was collected in three different plastic water bottles, each of 2000 ml. The bottles were closed immediately after taking it out of the water to avoid any exposure to air. The sample were taken to the laboratory within an hour with necessary precautions.

Study Area

Nagavara Lake is one of the popular attractions of Bangalore. The lake is situated in the Outer Ring Road of Bangalore. Adding to the natural beauty of the lake is the recently developed Lumbini Gardens that stands on the banks of the water body. The lake is spread across an area of 43.86 hectares.

Fig 1: NagavaravLake

Area	43.86 ha
Coordinates	13.0449° N, 77.6085°
Location	Karnataka
City	Bangalore

Collection and Analysis of Water Sample

The sample was collected from different locations around the lake which is marked in the map below indicated by R1, R2 and R3 with the latitudes and longitudes.

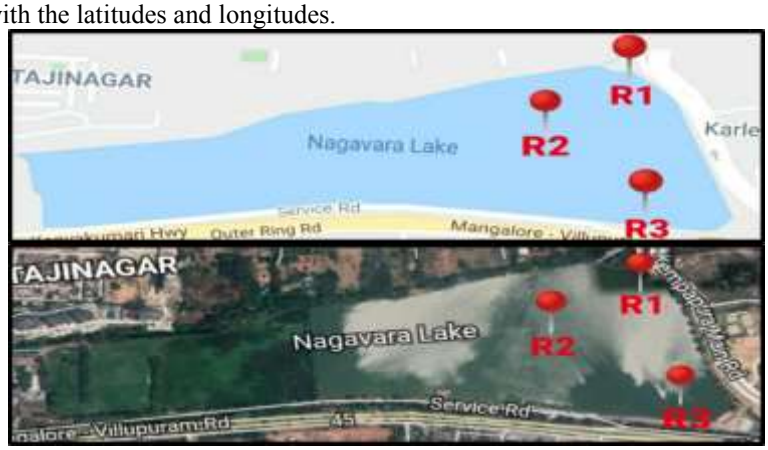

Fig 2: Location of Samples collected

R1 : Lattitude – 13.04641°N
Longitude – 77.61123°E
R2 : Lattitude – 13.04538°N
Longitude – 77.60982°E
R3 : Lattitude – 13.0433°N
Longitude – 77.61134°E

RESULT AND DISCUSSION

Accurate and timely information on the quality of water is necessary to implement the water quality improvement programs efficiently. The result obtained from analysis of water samples of Nagavara Lake are shown in below table. The result shows that the quality of water does not vary considerably from location to location.

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Table 1: Sample 1

SN.	Test	Result	Desired Limit	Permissible Limit	UOM	Protocol
1	pH value	6.85	6.5-8.5	No relaxation		IS 3025/Part-11
2	Colour	3	5	15	Hazen	IS 3025/Part-11
3	Electrical Conductivity	520	-	200	mhos/cm	IS 3025/Part-11
4	Total Hardness	173.1	200	600	mg/l	IS 3025/Part-11
5	Total Dissolved Solids	416	500	2000	mg/l	IS 3025/Part-11
6	Total Alkalinity	193.9	200	600	mg/l	IS 3025/Part-11
7	Magnesium	13	30	100	mg/l	IS 3025/Part-11
8	Chloride	64.5	250	1000	mg/l	IS 3025/Part-11
9	Nitrate	1.23	45	No relaxation	mg/l	IS 3025/Part-11
10	Phosphate	3.1	-	-	mg/l	IS 3025/Part-11
11	Sodium	25	-	-	mg/l	IS 3025/Part-11
12	Potassium	1.2	-	-	mg/l	IS 3025/Part-11
13	Turbidity	25.4	1	5	NTU	IS 3025/Part-11
14	Biological Oxygen Demand (BOD)	7	0	0	mg/l	IS 3025/Part-11
15	Chemical Oxygen Demand (COD)	48.7	0	No relaxation	mg/l	IS 3025/Part-11
16	Dissolved Oxygen (DO)	3.5	-	-	mg/l	IS 3025/Part-11
17	Nickel	0.01	0.02	No relaxation	mg/l	IS 3025/Part-11
18	Lead	0.01	0.01	No relaxation	mg/l	IS 3025/Part-11
19	Chromium	0.01	0.05	No relaxation	mg/l	IS 3025/Part-11

Table 2: Sample 2

SN.	Test	Result	Desired Limit	Permissible Limit	UOM	Protocol
1	pH value	6.98	6.5-8.5	No relaxation		IS 3025/Part-11
2	Colour	3	5	15	Hazen	IS 3025/Part-11
3	Electrical Conductivity	520	-	200	mhos/cm	IS 3025/Part-11
4	Total Hardness	193.8	200	600	mg/l	IS 3025/Part-11
5	Total Dissolved Solids	425	500	2000	mg/l	IS 3025/Part-11
6	Total Alkalinity	181.8	200	600	mg/l	IS 3025/Part-11
7	Magnesium	17	30	100	mg/l	IS 3025/Part-11
8	Chloride	68.4	250	1000	mg/l	IS 3025/Part-11
9	Nitrate	1.18	45	No relaxation	mg/l	IS 3025/Part-11
10	Phosphate	2.9	-	-	mg/l	IS 3025/Part-11
11	Sodium	25.7	-	-	mg/l	IS 3025/Part-11
12	Potassium	1.25	-	-	mg/l	IS 3025/Part-11
13	Turbidity	34	1	5	NTU	IS 3025/Part-11
14	Biological Oxygen Demand (BOD)	5.5	0	0	mg/l	IS 3025/Part-11
15	Chemical Oxygen Demand (COD)	38.9	0	No relaxation	mg/l	IS 3025/Part-11
16	Dissolved Oxygen (DO)	3.9	-	-	mg/l	IS 3025/Part-11

17	Nickel	0.01	0.02	No relaxation	mg/l	IS 3025/Part-11
18	Lead	0.01	0.01	No relaxation	mg/l	IS 3025/Part-11
19	Chromium	0.02	0.05	No relaxation	mg/l	IS 3025/Part-11

Table 3: Sample 3

SN.	Test	Result	Desired Limit	Permissible Limit	UOM	Protocol
1	pH value	6.84	6.5-8.5	No relaxation		IS 3025/Part-11
2	Colour	4	5	15	Hazen	IS 3025/Part-11
3	Electrical Conductivity	510	-	200	mhos/cm	IS 3025/Part-11
4	Total Hardness	164.9	200	600	mg/l	IS 3025/Part-11
5	Total Dissolved Solids	425	500	2000	mg/l	IS 3025/Part-11
6	Total Alkalinity	181.8	200	600	mg/l	IS 3025/Part-11
7	Magnesium	14	30	100	mg/l	IS 3025/Part-11
8	Chloride	66.5	250	1000	mg/l	IS 3025/Part-11
9	Nitrate	1.2	45	No relaxation	mg/l	IS 3025/Part-11
10	Phosphate	23.4	-	-	mg/l	IS 3025/Part-11
11	Sodium	24	-	-	mg/l	IS 3025/Part-11
12	Potassium	1.1	-	-	mg/l	IS 3025/Part-11
13	Turbidity	33.9	1	5	NTU	IS 3025/Part-11
14	Biological Oxygen Demand (BOD)	7.5	0	0	mg/l	IS 3025/Part-11
15	Chemical Oxygen Demand (COD)	47	0	No relaxation	mg/l	IS 3025/Part-11
16	Dissolved Oxygen (DO)	3.3	-	-	mg/l	IS 3025/Part-11
17	Nickel	0.02	0.02	No relaxation	mg/l	IS 3025/Part-11
18	Lead	0.01	0.01	No relaxation	mg/l	IS 3025/Part-11
19	Chromium	0.03	0.05	No relaxation	mg/l	IS 3025/Part-11

Table 4: Averge of Samples

SN.	Test	Result	Desired Limit	Permissible Limit	UOM	Protocol
1	pH value	6.89	6.5-8.5	No relaxation		IS 3025/Part-11
2	Colour	3.33	5	15	Hazen	IS 3025/Part-11
3	Electrical Conductivity	516.66	-	200	mhos/cm	IS 3025/Part-11
4	Total Hardness	177.26	200	600	mg/l	IS 3025/Part-11
5	Total Dissolved Solids	422	500	2000	mg/l	IS 3025/Part-11
6	Total Alkalinity	185.83	200	600	mg/l	IS 3025/Part-11
7	Magnesium	14.66	30	100	mg/l	IS 3025/Part-11
8	Chloride	66.46	250	1000	mg/l	IS 3025/Part-11

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9	Nitrate	1.2	45	No relaxation	mg/l	IS 3025/Part-11
10	Phosphate	9.8	-	-	mg/l	IS 3025/Part-11
11	Sodium	24.9	-	-	mg/l	IS 3025/Part-11
12	Potassium	1.18	-	-	mg/l	IS 3025/Part-11
13	Turbidity	31.1	1	5	NTU	IS 3025/Part-11
14	Biological Oxygen Demand (BOD)	6.66	0	0	mg/l	IS 3025/Part-11
15	Chemical Oxygen Demand (COD)	44.86	0	No relaxation	mg/l	IS 3025/Part-11
16	Dissolved Oxygen (DO)	3.56	-	-	mg/l	IS 3025/Part-11
17	Nickel	0.01	0.02	No relaxation	mg/l	IS 3025/Part-11
18	Lead	0.01	0.01	No relaxation	mg/l	IS 3025/Part-11
19	Chromium	0.02	0.05	No relaxation	mg/l	IS 3025/Part-11

Graphical Representations

The Graphs given below which indicated, signify and give a comparative idea of the result of the parameters from different locations of the lake.

pH Value

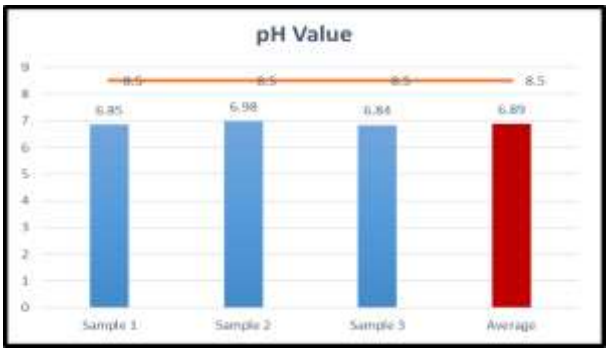

Fig. 1: Variation of pH

The pH indicates the acidity or alkalinity of water. pH is an important parameter because it controls the state of various concentration of Hydrogen. The permissible limit for both drinking water and irrigation is 6.5 to 8.5. In Nagavara Lake, the value of the pH was within the range.

Electrical Conductivity

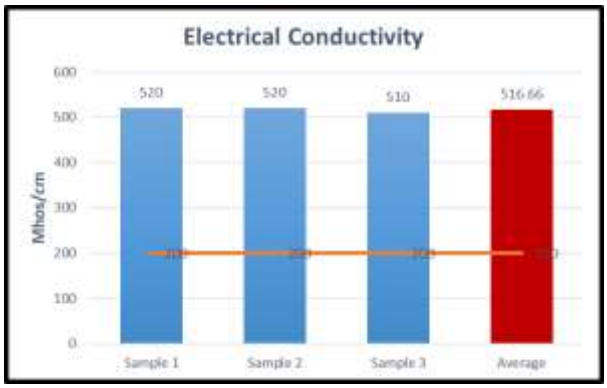

Fig. 2: Variation of Electrical Conductivity

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Conductivity shows significant correlation with parameters such as pH value, alkalinity, total hardness, total solids, total dissolved solids and chemical oxygen demand, chloride concentration of water. Lakes that run through areas with clay soils tend to have higher conductivity because of the presence of materials that ionize when washed into the water. The permissible limit is 200. In Nagavara Lake, the value of the EC is greater than the limit.

Total Hardness

Fig. 3: Variation of Total Hardness

The total hardness is a measure of the capacity of water to the concentration of calcium and magnesium in water. As per Indian standard 200 mg/l is the desired limit and 600mg/l is the permissible limit. In our study the total hardness of the water sample range between 160 mg/l to 195 mg/l.

Total Dissolved Solids

Fig. 4: Variation of Total Dissolved Solids

Total dissolved solids (TDS) is a measure of the dissolved combined content of all inorganic and organic substances present in a liquid in molecular, ionized, or micro-granular suspended form. As per Indian Standard 500 mg/l is the desired limit and 2000 mg/l is the permissible limit. In our study, Total Dissolved Solids vary from 415 mg/l to 425 mg/l.

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Total Alkalinity

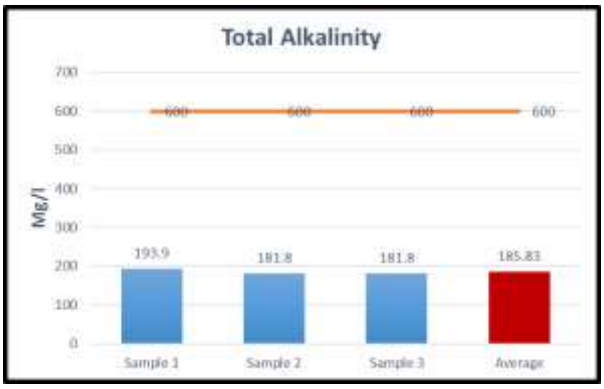

Fig. 5: Variation of Total Alkalinity

The most prevalent mineral compound causing alkalinity is calcium carbonate. The Indian standard for alkalinity as desired limit is 200 mg/l and permissible limit is 600 mg/l. The value obtained in our study is varies from 180 mg/l to 195 mg/l. In our study alkalinity is approximate to the desirable limits. If it exceeds than the permissible limit, it imparts a bitter taste to water.

Magnesium

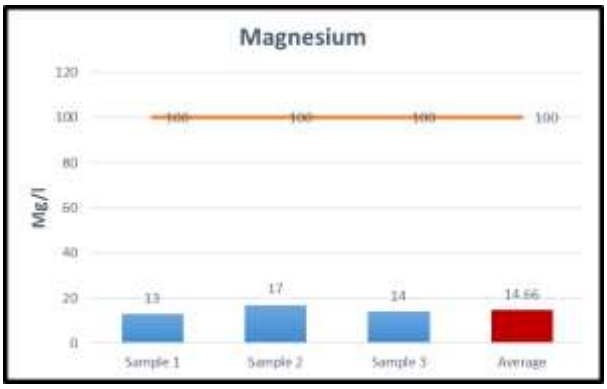

Fig. 6: Variation of Magnesium

The carbonate equilibrium reactions for magnesium are more complicated than for calcium and conditions for direct precipitation of dolomite in natural waters are not common. Magnesium is an essential element in chlorophyll and in red blood cells. Some salts of magnesium are toxic by ingestion or inhalation. Concentrations greater than 125 mg/L also can have a cathartic and diuretic effect. According to Indian Standards the desired limit is 30 mg/l and permissible limit is 100 mg/l. The Magnesium content in our samples is very less varying from 13 mg/l to 17 mg/l.

Chloride

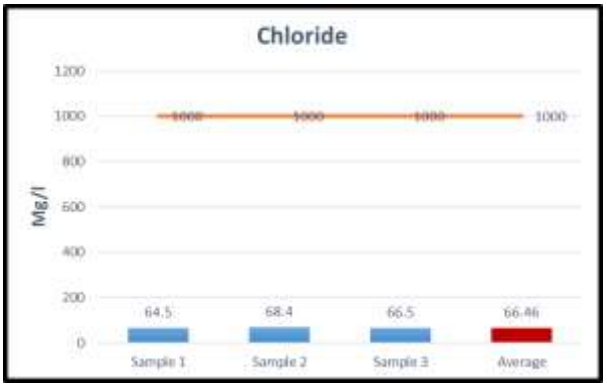

Fig. 7: Variation of Chloride

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Chloride is the indicator of contamination with animal and human waste. The chlorides value as per Indian standard the desired limit is 250 mg/l and permissible limit is 1000 mg/l. The value obtained in our study is varies from 64 mg/l to 69 mg/l.

Nitrate

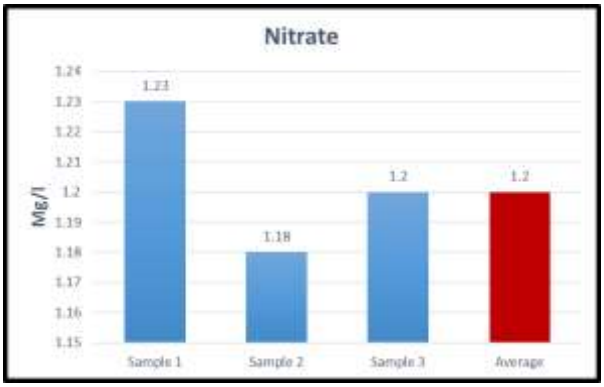

Fig. 8:Variation of Nitrate

Nitrate concentrations are highly variable during lake seasonal cycles. For deep stratified lakes, nitrate is higher during mixing events and usually decreases in late summer and fall. The value obtained in our study for nitrates vary from 1.1 mg/l to 1.3 mg/l which is very and almost negligible to the desired limit.

Phosphate

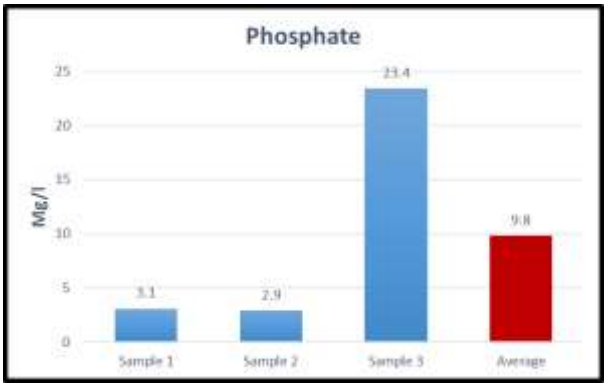

Fig. 9: Variation of Phosphate

Phosphorus is an essential nutrient for the plants and animals that make up the aquatic food web. The value obtained in our study for phosphate vary from 2.9 mg/l to 24 mg/l.

Sodium

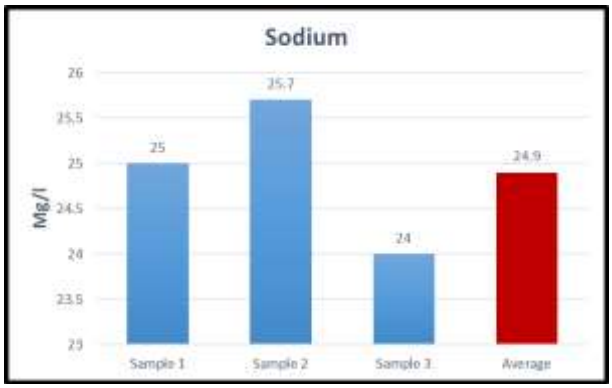

Fig. 10: Variation of Sodium

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It is measured with the help of flame photometer. The instrument is standardized with the known concentration of sodium ion (1 to 100 mg/l). Soil permeability can be harmed by a high sodium ratio. Persons afflicted with certain diseases require water with low sodium concentration. Sodium can be removed by the hydrogen-exchange process or by distillation. The value obtained in our study for Sodium is around 25 mg/l.

Potassium

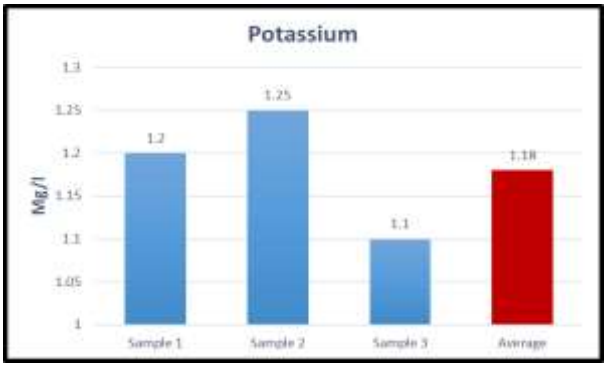

Fig. 11: Variation of Potassium

It is measured with the help of flame photometer. The instrument is standardized with the known concentration of potassium ion (1 to 5 mg/l). Potassium is an essential element in both plant and human nutrition and occurs in groundwater as a result of mineral dissolution. The value obtained in our study for Potassium is around 1 mg/l.

Turbidity

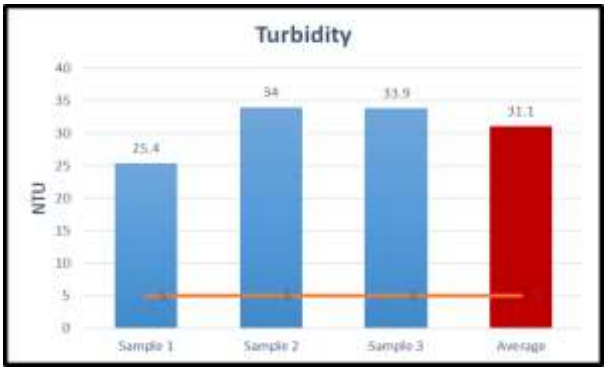

Fig. 12: Variation of Turbidity

Turbidity is a measure of resistance of water to the passage of light through it. The more total suspended solids in the water, the murkier it seems and the higher the turbidity. Turbidity is considered as a good measure of the quality of water. The turbidity standard as per BIS is 5 NTU.

Biological Oxygen Demand

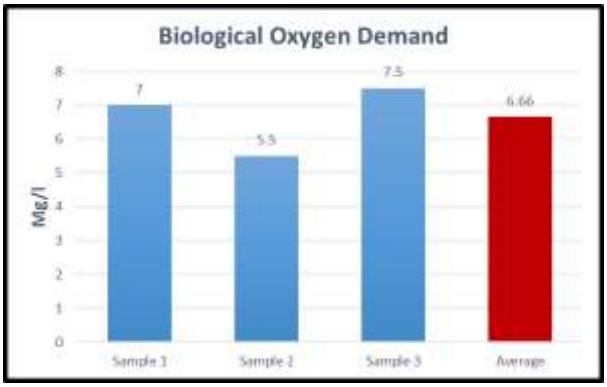

Fig. 13: Variation of BOD

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BOD is a measure of the dissolved oxygen consumed by microorganisms during the oxidation of reduced substances in waters and wastes. The greater the BOD, the more rapidly oxygen is depleted in the stream. This means less oxygen is available to higher forms of aquatic life. The consequences of high BOD are the same as those for low dissolved oxygen aquatic organisms which become stressed, suffocate and die. The values acquired from the samples vary from 5 mg/l to 8 mg/l.

Chemical Oxygen Demand

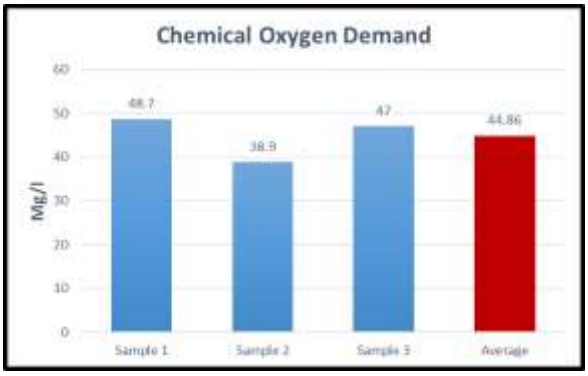

Fig. 14: Variation of COD

The chemical oxygen demand (COD) is a measure of water and wastewater quality. The COD test is often used to monitor water treatment plant efficiency. This test is based on the fact that a strong oxidizing agent, under acidic conditions, can fully oxidize almost any organic compound to carbon dioxide. The values acquired from the samples vary from 38 mg/l to 49 mg/l.

Dissolved Oxygen

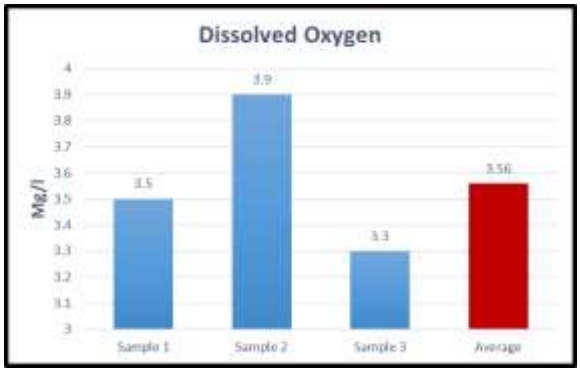

Fig. 15: Variation of DO

The dissolved oxygen has a great importance in an aquatic eco-system. It is considered as the pollution indicator parameter. It reflects the biological activity taking place in a water body and also determines the biological changes, which is due to aerobic and anaerobic organisms. The value obtained in our study is around 3.5 mg/l.

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Nickel

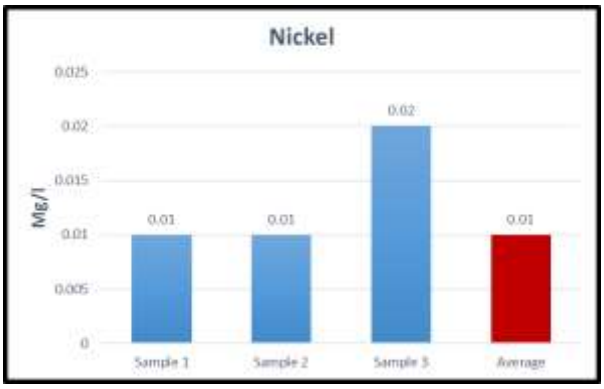

Fig. 16: Variation of Nickel

Nickel is necessary in many organism's diets but can become carcinogenic and toxic in high doses. Inhalation of nickel is the greatest risk of developing health problems, as it becomes highly carcinogenic. EPA recommends that drinking water levels for nickel should not be more than 0.1 mg/l. The value obtained in our study is around 0.001.

Lead

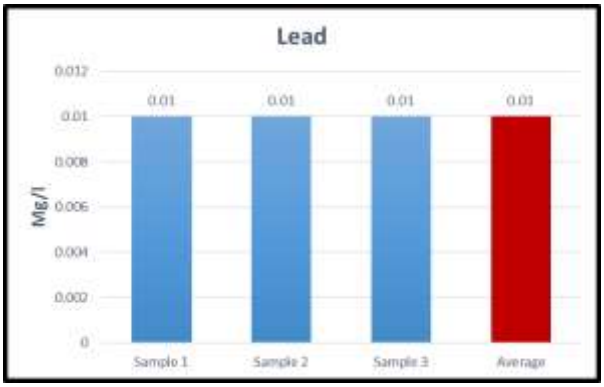

Fig. 17: Variation of Lead

Lead can enter drinking water when plumbing materials that contain lead corrode, especially where the water has high acidity or low mineral content that corrodes pipes and fixtures. Despite the BIS Drinking Water Specifications (IS-10500 1991) prescribing lead content in water not to exceed 50 parts per billion, in India it shockingly ranges from 50 to 400 parts per billion. In our study the Lead content is under the limit i.e, 10 ppb or 0.01 mg/l.

Chromium

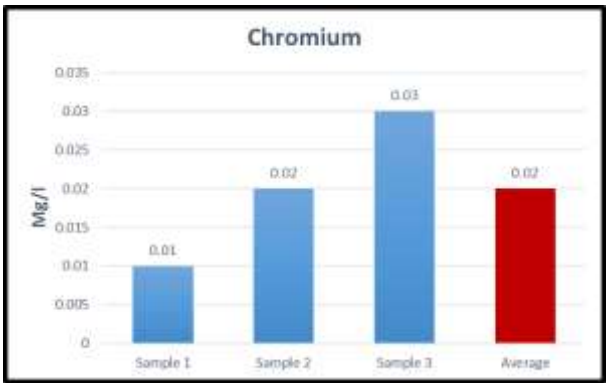

Fig. 18: Variation of Chromium

EPA has a drinking water standard of 0.1 milligrams per liter (mg/l) or 100 parts per billion (ppb) for total chromium. The value in our study are around 0.02 mg/l.

CONCLUSION

The Nagavara lake water is not suitable for drinking purpose. The average of the parameters like Electrical Conductivity, Turbidity, COD and BOD are exceeding the limits. The water shows the presence of solids and microorganisms, the lake water require treatment before use for drinking and is unfit.

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