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Study on Groundwater In and Around Bellandur Industrial Area June 2022

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ABSTRACT:
Groundwater is an important naturalresource and shouldbe protected from the pollution. Bangalore is one of the fastgrowing cities in the countryand it is generating several tonnes of solid waste everyday.Due to human and industrial activities the ground water is contaminated. This is the serious problem now a day.Thus the analysis of the water quality is very important to preserve and prefect the natural eco system.Water quality refers to the chemical, physical and biological characteristics of water. It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose. It is most frequently used by reference to a set of standards against which compliance can be assessed. The most common standards used to assess water quality relate to health of ecosystems, safety of human contact and drinking water. Different properties were analysed & compared during the course of the project.
The assessment of the ground water quality was carried out in Bellandur lake and different bore wells around that particular region. The present work is aimed at assessing the water quality index (WQI) for the ground water of Bellandur industrial area The ground water samples of all the selected bore wells were collected for a physiochemical analysis. For calculating present water quality status by statistical evaluation and water quality index, following 23 parameters have been considered Viz. pH, colour, total dissolved solids. electrical conductivity, total alkalinity, total hardness, calcium, chromium, zinc, manganese, nickel and others.
The obtained results are compared with Indian Standard Drinking Water specification IS: 9001-2008. The study of physio-chemical and biological characteristics of this ground water sample suggests that the evaluation of water quality parameters as well as water quality management practices should be carried out periodically to protect the water resources.
In present work attempt has been made to study the quality ofbellandurlakewater by analysing various water quality parameters and monitoring the lake water quality.
The study indicated that the Bellandur lake of Bangalore city needs continuous monitoring for the restoration of their water quality and aesthetic appearance.

Keywords: Ground water, water quality standards, physio-chemical, Water Quality Index, Bellandur lake.

I. INTRODUCTION

Ground water is the principle source of drinkingwater to large percentage of population living inrural areas. No proper estimate is presentlyavailable of the extent to which this resource isutilized for domestic and industrial purposes.Water is an essential natural resource for sustaining the life and environment. In the last few decades, there has been tremendous increase in utilization of ground water for drinking, irrigation, industry and much commercial purpose. Ground

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water is an invisible and endangered open or common access resource(Anitha Pius et al.2011). Presently over 94% of drinking water is met by ground water. Use of groundwater has gradually increased due to the increase of freshwater demand and the exhaust of surface water(Sivakumar et al.2014).It is believed that bore well water (groundwater) is much purer than surface water and less susceptible to contamination but due to highly intervention of anthropocentric activities (agricultural explanation, deforestation, urbanization, industrialization, over utilization of agrochemicals etc) ground water quality highly varied with heavy metal contamination. The influence of solid waste dumping site, aquifer material mineralogy together with semiarid climate, other anthropogenic activities and increased human interventions have adversely affected the groundwater quality(Sarala et al.2012). Water is a precious commodity but in the last few decades there has been tremendous increase in the demand for freshwater due to rapid growth of population and the accelerated place of industrialization(Abhilash et al.2017). Presence of heavy metals in grains, vegetables, fruits and milk has shown that nothing has remained pure in this universe and this level of water pollution have reached to the alarming stage(Anil Dwivedi.2017). The purpose of the study is to ascertain the quality of groundwater collected from different sources and in different seasons (pre and post monsoon seasons) during 2014 and 2015.

The chemistry of ground water in a catchment ecosystem of one or more river basins depends on a number of factors including the nature of recharge, hydrologic gradient, residence time of ground water in the aquifer, pollution by anthropogenic activities and rock-water interactions.

About 45% of the country's irrigation needs is fulfilled by ground water. Creating access to ground water for irrigation isimportant for agrarian economics. Groundwater is generally considered to be purer than surface water. Factors like discharges ofindustries, agriculture and domestic activity, land use practices, geological formations, are reported to affect the quality of ground water

II. STUDY AREA AND GEOGRAPHY

Lakes are vital parts of freshwater ecosystems of any country. A freshwater lake when maintained free from pollution can offer many beneficial uses in an urban area. Lakes give very beautiful landscape view to the city. Lakes encircled with trees and parks perhaps could be the only place where the urban population can find a place close to nature and provide aesthetic enjoyment and recreational potential.

Picture i Bellandur Lake

https://www.google.com/imgres?imgurl=https%3A%2F%2Fstatic.toiimg.com%2Fthumb%2F65298904.cms%3Fresizemode%3D4%26width%3D400&imgrefurl=https%3A%2F%2Fbangaloremirror.indiatimes.com%2Fbangalore%2Fcover-story%2Fsomebodys-watching-over-bellandur-lake%2Farticleshow%2F65298734.cms&tbnid=Vp-5QaS_p5_t_M&vet=12ahUKEwjGu571huD7AhWqi9gFHQyVCYsQMygKegUIARD5AQ..i&docid=8RWiRSpf1kuuRM&w=400&h=177&q=bellandur%20lake&ved=2ahUKEwjGu571huD7AhWqi9gFHQyVCYsQMygKegUIARD5AQ

Bellandur Lake is a lake in the suburb of Bellandur in the southeast of the city of Bangalore and is the largest lake in the city. It is a part of Bellandur drainage system that drains the southern and the southeastern parts of the city. The lake is a receptor from three chains of lakes upstream, and has a catchment area of about 148 square kms(37.000 acres). Water from this lake flows further cast to the Varthur Lake, from where it flows down the plateau and eventually into the Pinakini river basin It is currently highly polluted with sewage, and in May 2015 the foam covering the water surface caught fire and burned for hours.

Picture iiBellandur lake top view

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Coordinates:12°56'3""N77°39′46″E Catchment area: 148 km²
Max. Length: 3.6 km
Max. Width: 1.4 km
Surface area: 3.61 km²
Average depth: 9.21 m (30.2 ft)

Bellandur Lake is a major water body which is located in one of the three main valleys of Bangalore. It forms a part of Ponnaiyar River catchment, and water from Bellandur flows toVarthur Lake, ultimately joining the Pennar River, Currently, most of Bengaluru's treated and untreated sewage is let into this lake, severely polluting it, resulting in a depletion of wildlife in and around the lake. Impact of Urbanization with ongoing to fulfill the requirements and greed of Humans has cost the lake to lose its glory, forcing the fauna which was previously dwelling to change habitats. Residential and Commercial activities in and around the region has resulted in increasing the silt deposition in and the Surrounding location of lake has been major cause for loss of under-ground water recharge.

The lake was a prominent catchment area with a good green cover and was a watering hole for the region's numerous, indigenous wildlife. But 30 years of unplanned urbanization have taken a toll on the lake, now several species are gone from the area, including kingfishers, parrots, parakeets, wood pigeons, kites, king cobras, rat snakes, monitor lizards. As more and more large apartment complexes come up on the lake's shores, more such species will disappear.

III. MATERIALS AND METHODS

The study provides a detailed description of the chemical criteria of groundwater. Six representative samples were collected during midmonsoon, June 2022 and analysed for calcium, magnesium,sodium, potassium, iron, zinc, manganese, chloride, carbonate, bicarbonate, fluoride, sulphate, nitrate, total hardness (TH), total alkalinity (TA), total dissolved solids (TDS), pH, electrical conductance (EC), turbidity and coliform bacteria.

Sampling locations along the Bellandur lake were identified to serve as nodal points. As many as three nodal points, spaced at a distance of about one to one and half kms between them, were chosen around the lake. Further, at each nodal point two sample stations were identified, around the lake. On each side the stations were so picked that one was near the lake and the other was away. Thus a total of 6 samples stations were identified from which water samples were collected. It would be significant to note here that the choice of nodal points as well as sample stations has been arrived at to facilitate representative, equidistant sampling and not for the sake of convenience.

The list of sampling stations has been provided in Table 1. In the present study, 3 bore well water samples and 3 Lake water samples along the Bellandur lake Bangalore,India, were collected in June 2022, for the analysis of physicochemical and bacteriological parameters.

Sample	Name of sample station	Depth of Borewell/Lake (Ft)	Distance from Lake (mtrs)
A	Hawks Sports Road	910	50
B	Rangan ata temple	1020	770
C	Mint plaza	810	490
D	At lake's corner	-	-
E	At ¼th Distanc e from lake	-	-
F	At other end	-	-

A qualitative and quantitative analysis of water is a report reflecting the kind and amount of impurities contained in water. The form of statement will depend on the point of view from which the water is being treated, whether it is being examined for its suitability for consumption, irrigation and industrial process.

The Tube well (Bore well) water samples were collected in pre cleaned plastic water bottles of five liter capacity with all necessary precautions. Water samples from identified bore wells (hand pump and motor pump) were collected after running them for sufficient time (15-20 minutes for hand pumps and 8-10 minutes for motor pumps) to ensure that fresh water from the water table was obtained. Then, the container is rinsed in the

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sample water at least 2 to 3 times. Then the sample was collected and the temperature was measured immediately using a thermometer. Then the water samples were carried to the laboratory for the analysis of various physicochemical parameters. All the samples were analyzed as per the prescribed standard methods of IS-3025 and APHA (1998).

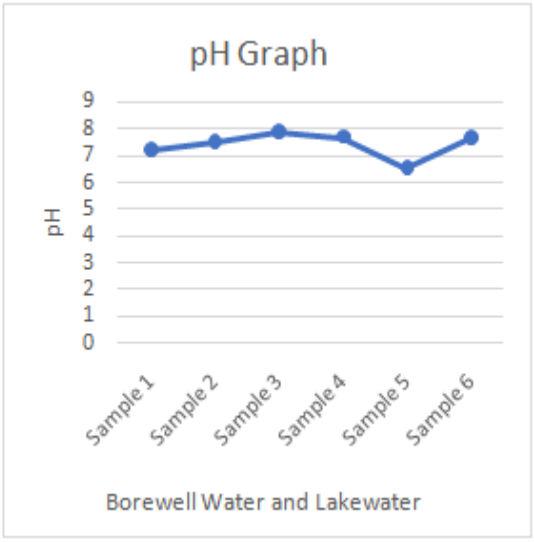
The chemical analysis data for various ionic constituents of the groundwater and Lake Water samples have been tested and verified. The values obtained for each parameter are expressed in mg/L except for pH values, electrical conductivity, turbidity and E.Coli.

Once heavy metals or trace metals, which are non-biodegradable, get into the soil or water they reside for long durations, even for several years. Also the trace elements such as iron, zinc, copper, cadmium, lead, chromium, nickel were analysed and tabulated. The results of Physicochemical, biological parameters and trace metal concentration of groundwater and lake water samples from all the 6 samples stations have been collected on 19-06-2022.

IV. RESULTS AND DISCUSSIONS

pH

It is used as a means to express the acidic or alkaline intensity of a solution. pH is a measure of hydrogen ion concentration in solution. It is an important parameter of water to living systems because even the small variation in the pH can largely affect the cell structure and its normal metabolism. The desirable pH range for necessary for drinking water is from 6.5 to 8.5. The pH value of most groundwater is controlled by the amount of dissolved carbon dioxide gas and the dissolved carbonates and the bicarbonates in mineral salts. pH value is also affected by the presence of naturally present humid (which are the major organic constituents of s) substances which may get discharged into a body of water throughthe wastes. The knowledge of pH plays a vital role in the choice of coagulants for water purification. The acidity (low pH) may not affect the health directly, but as this water corrodes the water pipes and dissolves most of the metals in it, contaminated water enters the biological system and causes health hazards. Copper especially dissolves in water from the pipes and pumps. The decrease in permicidal potential of chlorine and scale formation in water heaters is observed when the pH values are higher.



Total Hardness (TH)

The total hardness of water Is due to dissolved bicarbonates of Ca and Mg in water (Temporary hardness) and due to the dissolved sulphates and chlorides of Ca and Mg in water (Permanent hardness). Natural hardness of water depends upon the geological nature of the drainage base. Hardness of water prevents the lather formation with soap due to the formation of precipitates as depicted in the reaction. Hard water is not appreciable for domestic use. Due to the presence of calcium and magnesium salts the boiling point of the water elevates which is not advisable for cooking purposes.

Hardness in natural water comes mainly from the leaching of igneous rock and carbonate rocks (dolomite, calcite and limestone). Generally hard water originates in the areas where thick topsoil and limestone formations are present. Soft water originates in the areas where the topsoil is thin and limestone formats are absent. The hardness in water is derived largely from contact with the soil and rock formation. In general, ground water will always have high hardness when compared to surface water.

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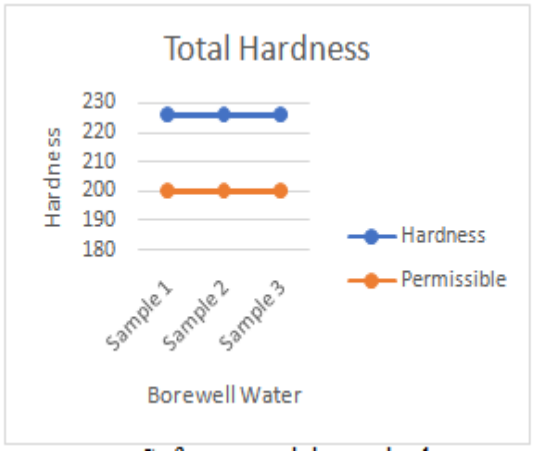


In the present study the total hardness exceeded the range of **226mg/L.**

The IS 10500:2012 acceptable level for total hardness is **200mg/L**.

The degree of hardness has been classified in terms of equivalents of calcium carbonate concentration (APHA, 1998)

The results obtained in the present investigation indicates that 100% of groundwater samples belongs to the very hard category and the hardness of groundwater samples are more when compared with lake water quality.

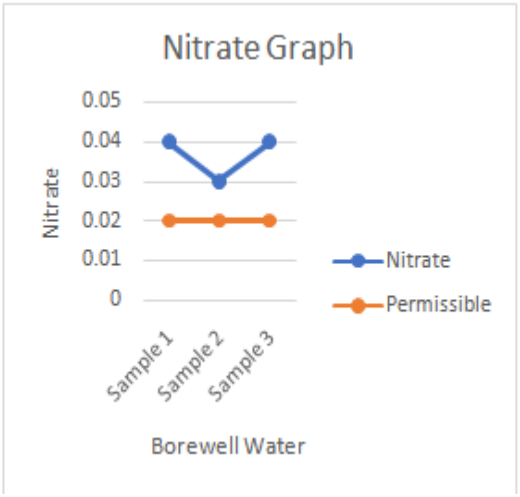
Nitrate (NO^{-3})

Nitrate is found naturally in air and soil and is a crucial nutrient for plant and animal growth. Nitrate is a usual constituent of tube well water. Nitrogen is a chief component of the earth's atmosphere and occurs in several different gaseous forms such as elemental nitrogen, nitrate and ammonia.

Natural reactions of the different forms of the atmospheric nitrogen with rain water result in the development of nitrate and ammonium ions.

The intake of nitrate in small quantities is harmless. Nitrate can cause health problems especially in babies of six months of age or less. Nitrate interferes with their blood's ability to transport oxygen thereby affecting the haemoglobin. This causes an oxygen deficiency, which results in a dangerous condition called "blue baby syndrome". In adults, the most common symptom of nitrate poisoning is bluish skin colouring, especially around the eyes and mouth

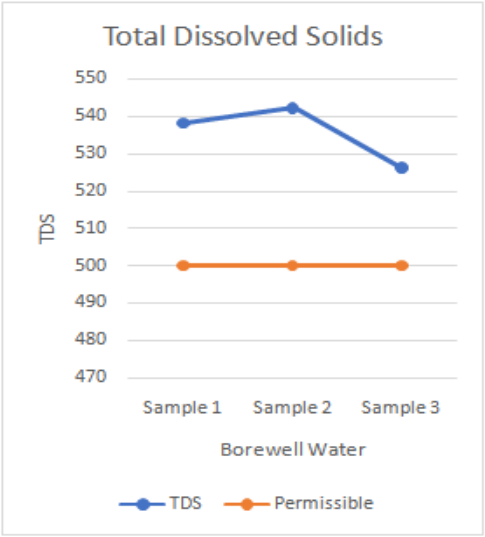
In the present study, the nitrate was detected in the bore well water samples of about **0.04 mg/L**. The IS 10500:2012 acceptable value for nitrate is **0.02 mg/L** for drinking water standards. The study reveals that the water samples taken for nitrate analysis are within the permissible limit.



Total Dissolved Solids (TDS)

The substances dissolved in the water were estimated. Dissolved minerals, gases and organic constituents my produce aesthetically colour, displeasing taste and odour. Several processes may cause an increase in the dissolved content of ground water. They include movement of water through rocks containing soluble mineral matter, concentration by evaporation and contamination due to influx of sea water and industrial and municipal wastewater disposal. Dissolved materials result from the solvent action of water on solids, liquids and gases.

The dissolved substances may be organic or inorganic in nature. The term solid refers to matter either filterable or non- filterable that remains as a residuesin water. The dissolved solids concentration is proportional to the depth to which water has travelled and the time taken for the travel in the ground.



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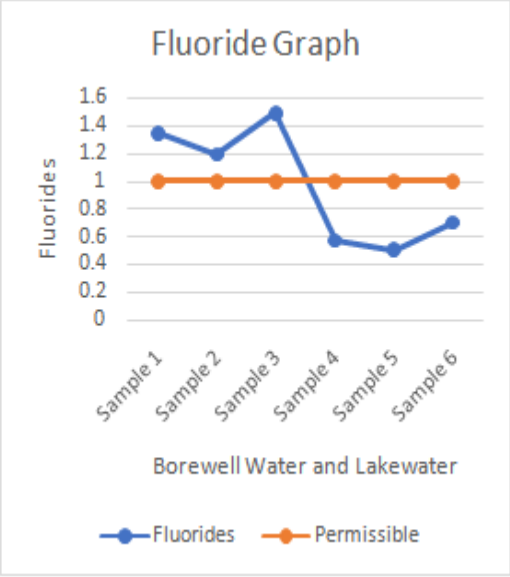
The values of TDS varied from a minimum of **500.0 and 550.0 mg/L.** The TDS values above the **500 mg/L** causes **gastrointestinal** irritation. In the present study, 50% of total water samples crossed the permissible limits of IS 10500:2012 for drinking water standards. The permissible limits of **IS 10500:2012** for drinking water standards is **500 mg/L.**

Fluoride (F)

Generally fluoride occurs in the combined form due to its high reactivity. It is the thirteenth most abundant element in the earth's crust. It is widely dispersed in nature and is a common constituent of most of the soils, rocks, plants and animals. It accounts for 0.38 g/kg of the earth's crust and exists in the form of fluorides in a number of minerals, of which fluorspar, cryolite and fluorapatite are the most common. Fluorspar is the most important fluoride containing mineral which has a variety of tints (blue, yellow and green).

The excess of fluoride levels in water causes mottling of teeth, skeletal fluorosis, bending of vertebral column, deformation of knee joints and other bone disorders of the body and even causes paralysis.



High level fluoride also affects economically important plants and animals and in humans may result in low motility of spermatozoa, which in turn may cause low rate of fertility leading to decreased birth rates. High concentrations of fluorides have been reported in India in the states of Tamil Nadu, Andhra Pradesh, Kerala, Karnataka, Gujarat, Rajasthan, Punjab and Bihar.

In present study, the fluoride concentration varied from **0.20 mg/L** in lake water and **1.5 mg/L** in ground water. All the borewell watersamples were having fluoride content more than the permissible limits and Lakewater samples less than limits of IS 10500:2012 for drinking water standards. As per IS 10500:2012 the permissible limit for drinking water is **1.0mg/L**. Fluoride content in groundwater is less when compared it with lake water quality.

Fluoride concentration below and above the permissible limits has an implication related to health. If fluoride is totally absent in water supplies, it is known to cause dental caries. Long term consumption of water containing **1.0 mg/L** may lead to dental fluorosis (mottling of teeth). Skeletal fluorosis has been observed in persons consuming water containing fluoride between **3.0 mg/L** and **6.0 mg/L**. Water containing fluoride in excess of **10.0 mg/L**, if consumed over long period, results in crippling skeletal fluorosis. Therefore, fluorosis has been considered as one of the incurable diseases. Hence, prevention is the only remedy for the disease.

Faecal Coliform (MPN)

Coliform bacteria are a collection of relatively harmless microorganisms that live in large numbers in the intestines of humans and warm- and cold-blooded animals. They aid in the digestion of food. A specific subgroup of this collection is the faecal coliform bacteria, the most common member being Escherichia coli. These organisms may be separated from the total coliform group by their ability to grow at elevated temperatures and are associated only with the faecal material of warm-blooded animals.

The faecal coliform group includes all of the rod-shaped bacteria that are non-spore forming, Gram-Negative, lactose-fermenting in 24 hours at 44.5 °C, and which can grow with or without oxygen.

The presence of faecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the faecal material of humans or other animals. At the time this occurred, the source water may have been contaminated by pathogens or disease-producing bacteria or viruses which can also exist in faecal material.

In the present study it revealed the presence of total coliform in bore well water samples.

Turbidity

Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to

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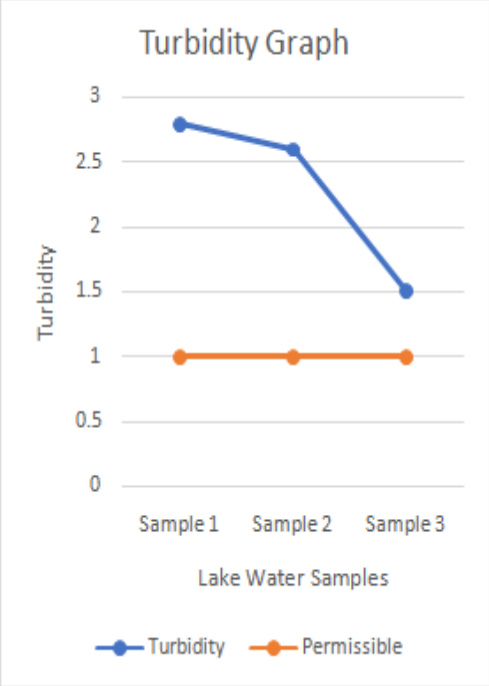
the naked eye, similar to smoke in air. The measurement of turbidity is a key test of water quality.

Fluids can contain suspended solid matter consisting of particles of many different sizes. While some suspended material will be large enough and heavy enough to settle rapidly to the bottom of the container if a liquid sample is left to stand (the settable solids), very small particles will settle only very slowly or not at all if the sample is regularly agitated or the particles are colloidal. These small solid particles cause the liquid to appear turbid.

Turbidity (or haze) is also applied to transparent solids such as glass or plastic. In plastic production, haze is defined as the percentage of light that is deflected more than 2.5° from the incoming light direction.



Governments have set standards on the allowable turbidity in drinking water. In the United States, public water systems that use conventional or direct filtration methods must **not** have a turbidity higher than **1.0 NTU** at the plant outlet and all samples for turbidity must be less than or equal to 0.3 NTU for at least 95 percent of the samples in any month. Systems that use filtration other than the conventional or direct filtration must follow state limits, which must include turbidity at no time exceeding 5 NTU. Many drinking water utilities strive to achieve levels as low as 0.1 NTU

The values of Turbidity varied from a minimum of **0 to 2.8NTU.** As per IS 10500:2012 the permissible limit for drinking water is **1NTU.** All the Lake water samples were having more Turbiditymore than the permissible limits.

V. CONCLUSION

Freshwater for animal and human consumption is a delicate resource. The major sources of fresh water such as surface water and underground water is getting polluted due to ever growing population, release of untreated domestic, industrial wastes and the use of chemical fertilizers and pesticides for agriculture crops. The deviation of fresh water supply for domestic, agriculture and Industrial needs stretches the hydrological system to its limit.

The current examination is undertaken in order to appraise and to supervise the character variations in groundwater caused by natural and anthropogenic activities in the observation area. The study involved a multidisciplinary approach involving Physical, Chemical, trace metals and bacteriological (E.Coli).

The ground water around the Bellandur lake was examined. Six nodal points were selected to collect samples. The data generated during the study of physicochemical parameters of ground water samples are compared with Bellandur lake water quality and the observations are summarized below:

- Temperature of groundwater in study area varies between 22-23°C and it is normal.
- Among the physicochemical parameters studied, the mean values of pH reflected the groundwater and lake water are alkaline.
- The taste of the bore well water is not acceptable.
- The values of TDS of the bore well water is not acceptable.

Total Hardness of groundwater are more than that of surface water of lake water is not good for industrial purposes as it is hard.

- Total Alkalinity is more in groundwater samples than that of surface water of lake and is within the limits.
- Total Coliform is detected in Bore well water samples.
- Calcium content in groundwater is more than that of surface water of lake.
- Heavy metals such as Iron, Chromium, Copper, Cadmium, Nickel, Zine, Lead and Arsenic are not detected in the groundwater samples and as well as in surface water of lake.
- Though E.coli is present in lake water. It is not detected in groundwater

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VI. RECOMMENDATION

- A proper management of disposal of solid wastes, Industrial effluent, domes waste on land fill activities by concerned authorities must be made for avoiding the groundwater pollution.
- An artificial recharge of ground water may be adopted to reduce higher chemical parameters wherever it is necessary.
- People should be educated and awareness is to be created regarding the ill borne diseases through mass media programmes.
- Proper treatment of industrial effluent MUST BE MADE COMPULSORY before it is disposed into the lake. Concerned authorities must ensure that no effluent is d proper treatment and neutralisation.
- The concerned authorities should take care the sewage water should not percolate to pollutethe borewell water.
- Proper treatment of water is required before using the borewell water for drinking purpose.

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