International Journal of Research in Engineering, Science and Management
Volume-1, Issue-9, September-2018
www.ijresm.com | ISSN (Online): 2581-5782

Water Quality Analysis of Byramangala Lake and its Surrounding Ground Water Quality

Ankesh S. B[1], Rakesh Gulaki[2], Kushal R[3], Sudeep K. V[4], Shreenatha K[5]
[1]*Assistant Professor, Dept. of Civil Engineering, Dr.Ambedkar Institute of Technology, Bengaluru, India*
[2,3,4,5]*B.E. Student, Dept. of Civil Engineering, Dr.Ambedkar Institute of Technology, Bengaluru, India*

***Abstract*—Bangalore is a metropolitan and capital city of the state of Karnataka in India it is considered to be the fastest growing information technology and bio technology hub of the world. In contrest with the same the city is subjected to continuous development through anthropogenic activities where in it has lost most of its wet lands like lakes and the existing water bodies are exploited to the highest order resultant of which is seen through the spread of disesase and loss of existing natural aquatic bodies and loss of eco system .A study was carried out to find out the water quality of Byramangala lake of Ramanagara district. The water quality of Byramangala lake water and ground water from bore wells situated in the area within 600 meters surrounding the lake was analyzed. The quality analysis of various parameters such as PH value, BODs, COD, DO, E-Coli, and pH, Total Dissolved Solids, Total Suspended Solids and Total Hardness were tested. In addition, the presence of metals such as Cadmium (Cd), Chromium (Cr), Lead (Pb), and Iron (Fe) in the lake water and ground water samples were tested. Results for the various tests conducted showed similar trends for both lake water and ground water. It was observed that certain parameters such as BOD5, and COD were beyond permissible limits as per the BIS standards for drinking water. A few remedial measures have been proposed that may help in mitigating the pollution in the selected project area Byramangala Lake.**

***Index Terms*—water quality analysis**

I. Introduction

One of the major crises faced in the recent times is the strain on the potable water resources. Bangalore city originally met its water demand from the lakes and tanks which were constructed across the city in the 16th century. The lakes that were once a source of water for irrigation, drinking, fishing etc are now used as dumping sites for industrial effluents, domestic sewage, domestic solid waste etc.

In this research Byramangala Lake of Ramanagara District has been chosen as study area. The lake joins river Arkavathi downstream, which ultimately joins the river Cauvery. The pollution of the lake began in the 1960's. The main sources of pollution are the industrial effluents, the municipal effluents and the untreated sewage discharge from the Bangalore urban area, which eventually enters the Vrishabhavathi reservoir. The right bank of the lake houses a large industrial zone known as the Bidadi Industrial Area. Most of these industries discharge their effluents into the Byramangala Lake without subjecting the effluents to secondary or advanced treatment.

Industrial effluents were collected from three different stations during the year 2011 and 2012 for three different seasons and analyzed. COD concentration recorded was comparatively high during pre-monsoon season due to high temperatures and low dilution. The alkalinity of water was much higher than the Indian standard.

Conceptual Design of a wastewater treatment plant for the Derabassi industrial estate, Punjab (2013) shows that overall goal of the project was to prevent the contamination of the aquifer.

Studies on heavy metal contamination in Vrishabhavathi river water and groundwater of the surrounding river (2013) aims to assess the physicochemical parameter, extent of heavy metal content in Vrishabhavathi River and its surrounding ground water Toxic heavy metal analysis was done using atomic absorption spectrophotometer. Heavy metals Pb, Cr, Ni, Mn and Fe concentrations were found to be above permissible limit.

Evaluation of water quality in and around Byramangala Reservoir (2015) of three villages was taken into consideration Byramangala, Bannigere and MG doddi. The samples were collected thrice in the months of February, April and June and in all. Twenty five samples were tested for sixteen chemical parameters. Heavy metals like Nickel, copper and chromium were found to be at higher rate during the rainy days indicating the dangerous effect of leaching. Other parameters such as pH, Calcium hardness, Chlorides, Nitrate, Sodium and Potassium were oscillating around permissible limits. Fluoride concentration was found to be high and around 2.3 mg/l. Water quality index values were 16%-28%, poor with respect to drinking water quality.

II. Literature Review

S. Chandra, A. Singh, et,al., (2013). all Analysis of Water from Various Sources and Their Comparative Studies" Have described, lake water is a source of drinking and domestic use water for rural and urban population of India. The main goal of the present study was to assess drinking water quality of various lakes i.e. Porur lake Chennai, Hussain Sager HydrabadVihar lake Mumbai in India. For this, lakes water samples were collected from six different sites and composite sample prepared were analyzed for pH, turbidity, electrical conductivity, total dissolved solids, total alkalinity, total hardness and calcium hardness, chemical oxygen demand (COD), biochemical oxygen demand (BOD), dissolved oxygen, sulphate, nitrate and chloride levels .Some heavy metals like Iron, Zinc, Cadmium, Mercury, Nickel and Chromium were also analyzed in these samples. There were variations for EC (141-1041 "#$%&), turbidity (2-9 NTU), TDS (107.1–935.8 mg/L), SO42- (4–8 mg/L), TA (42–410 mg/L), TH (41-280 mg/L), Ca–H (14-10 mg/L), BOD (5-9mg/L), COD (4–32 mg/L) NO3(1.1-3.6 mg/L) and Cl- (49-167 mg/L) levels at different sites. Water pollution indicates that these parameters were manifold higher than the prescribed limit by the WHO & BIS standard have studied, in present investigation an attempt was made for assessment of Seasonal Variation in Physico-chemical Characteristics and Quality of Pravara River Water for Irrigation during year 2008. The study reveals that most of the physicochemical parameters of river water at five selected sites show moderate variation in their concentration for all seasons. However site 3 and 4 stands evidence of discharge of waste water from the city in the river. This intern indicated the quality of water for irrigation in the study area. The Sodium absorption ratio and Residual sodium carbonate values show good water quality for irrigation. However at site 3 and 4 the values of Kelly's index and Soluble Sodium Percentage exceed their standards in monsoon season indicating doubtful quality of water for irrigation.

M. S. Islam, B. S. Ismail,et,al., (2014) "Assessment of Physico-chemical and Microbiological parameters of Lakes" have studied; the purpose of this study was to assess the hydrological properties and water quality characteristics of Chini Lake in Pahang, Malaysia. A total of seven sampling stations were established at the main Feeder Rivers of Chini Lake for measurement of stream flow. A total of 10 monitoring stations covering the study area were selected for water sampling. Fourteen water quality parameters were analyzed based on in-situ and ex-situ analysis for two seasons and laboratory analyses were carried out according to the HACH and APHA methods. Stream flow from the seven Feeder Rivers into the Chini Lake was relatively slow, ranging from 0.001 to 1.31 m/s 3 or an average of 0.21 m /s. According to the INWQS (Interim National Water Quality Standards, Malaysia) 3 classification, the temperature was within the normal ranges; conductivity, total suspended solids , nitrate, sulphate and total dissolved solids were categorized under class I, while turbidity, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), ammoniacal nitrogen and phosphate came under class II and pH under class III. Furthermore water quality in Chini Lake varied temporally and spatially and the most affected parameters were pH, turbidity, DO, ammoniacal nitrogen, phosphate and conductivity. Based on the Malaysian Water Quality Index (WQI), the water in the Chini Lake was classified under class II, meaning it is suitable for recreational activities and safe for body contact.

M.S. Nagaraja Gupta and, C.Sadashivaiah, et,al.,(2014) "Assessment of water quality in peenya industrial area Bangalore" .The rapidity of industrialization that has recently become the need of the hour, for a developing country like India has turned into a major source of groundwater contamination. Huge inputs of pollutants from the industries have been taking the pollutant levels beyond the prescribed tolerable limits. The industries that induce the pollutants into the surface and groundwater sources from their activities do not strictly regulate their pollutant to safe limits. Many industries discharge their effluents without any proper treatment into nearby open pits or pass them through unlined channels, which move towards the low lying depressions on land, resulting in the contamination of groundwater and surface water sources. The industrial effluents, if not treated to remove or bring pollutant concentration level below standards specified, can pollute and cause serious damage to the surface and groundwater resources. The present study aims at evaluating the chemical characterization of Surface and Ground-water present in Peenya industrial area, Bangalore city in India. Surface and Groundwater samples from 40 distinct locations in the industrial area were collected. Analytical procedures as described in the Standard methods for the examination of water and wastewater were implemented for chemical analysis of these samples and the results were compared with the Bureau of Indian Standards (IS 10500) guideline values for potable water, in order to evaluate the possibility of health hazards in the study area. The results reveal that most of the study area is highly polluted, because of the excessive concentration of one or more water quality parameters such as pH, Total Hardness, Total Dissolved Solids, Dissolved Oxygen, Salinity, Alkalinity, Acidity and Electrical Conductivity. It is evident that more than 50 percent of water samples are non-potable as per Bureau of Indian standards (IS 10500).

Dr. GeethaViswanathan, Dr. Boppaiah, et,al.,(2010) "Water quality study of Hoskerehalli Lake of Bangalore" .The amount of atmospheric oxygen dissolved in the water is termed as dissolved oxygen and Salinity isthe dissolved salt content of water body. It is a general term used to describe the levels of different saltssuch as sodium chloride, magnesium and calcium sulfates, and bicarbonates etc. Optimum levels of DO and Salinity are required for the survival of all the aquatic living organisms. Rapid increase in thepopulation, drastic growth of industries, which are the resultants of Urbanization have introduced enormous amount of pollutants like NO_2, CO_2, SO_2 gases into the air, which when dissolves in the water bodies, making the water acidic. This depletes the amount of Dissolved Oxygen and Salinity, which are essential for the aquatic life. Dissolved oxygen, Salinity, organic matter, hydrological patterns, geological position, paleoclimatic events, human interactions and biological interactions, determine the biological communities and ecological status of an inland lake. Muddy bottom also controls the distribution of dissolved substances in the natural lake. Life in aquatic ecosystem depends on dissolved oxygen in the water bodies. Oxygen concentration is higher in the air about 21% than that of oxygen concentration in water bodies. Oxygen concentration differs in epilemnion and hypolemnion of the lakes. Dissolved oxygen may change with depth. Dissolved oxygen % determines the type of organisms in a lake. Temperature increase also lowers the oxygen; microbes also play a role in altering the oxygen concentrations in the water bodies. The aim of our experiment was to find out the DO and salinity of the four lakes in our city at different ecological location s of the lakes, like the boating area sewage entering area, undisturbed area etc. and collect the water samples to check the algal biodiversity in these lakes, because algal bloom in the water bodies can be a bio indicator of that ecosystem. Our result shows that Sankey tank and lalbagh lake show similarities and Hebbal Lake and Ulsoor Lake show lot of variation.

Udayashankara T.H, Anita K.G, et,al.,(2013) "Study of water quality analysis of freshwater lakes of mysore".Lakes in urban regions are ecological security zones and true indicators of sustainable urban development. They provide opportunities for recreation, study of local aquatic life and ornamental purposes. As a result of increasing land use conflicts and effluent disposal, water bodies and their catchments in the urban regions have been the real casualties. The lakes considered have their specific importance. Lingambudhi Lake was one of the major lakes in Mysore a few decades ago. However, because of development of housing colonies and overgrazing, this lake has lost its quality. Hinkal Lake has been a sewage disposal site for the surrounding Hinkal area. Due to lack of natural water, the Government has decided to convert it into commercial areas. Mandakalli Lake provides water for irrigation to the surrounding agricultural areas and is used for fishing purposes. But due to agricultural runoff and sewage inputs, this lake has undergone degradation over the years. Kukkarahalli Lake is a major lake and is used for ornamental and recreational purposes. However, the disposal of treated domestic wastewater has caused severe pollution in the lake. In order for the policy makers and general public to understand the extent of pollution in these lakes, water quality indices have been formulated. In this study, water quality indices which have been used are Canadian Council of Ministers of Environment (CCME) and National Sanitation Foundation (NSF). CCME provides information on quality for all designated purposes of a lake, while NSF provides the quality level, if the lake is being used, or is to be used for drinking purposes. One of the remarkable aspects of the lake environment is the large number of phytoplankton species that are present at any given time. Phytoplankton diversity in four lakes of Mysore has been discussed. Nine diversity indices have been derived using the PASTA software program. An attempt has been made to correlate the presence and interactions of phytoplanktons and the variation of water quality parameters in the considered lakes.

Panduranga Murthy, G, Puttaramaiah,G, et,al.,(2014) "The Innovative Water Quality Index (Iwqi) for Lakes of Mysore" Anew 'Innovative water quality Index' (IWQI) was applied to 4 lakes of Mysore City, India. Unlike many other indexes, this index requires the analysis of only 5 water chemistry parameters. Dissolved oxygen, Total phosphorous, Turbidity, Specific conductance and fecal coli forms were analyzed. The involvement of only a few parameters has the advantage of using the data in calculating the Total Maximum Daily Load (TMDL) of the undesired variables. Lingambudhi Lake had an index value between 1.9 and 2.2 and is rated between marginal and acceptable. Dalvoi Lake had values less than 2 and is raied as marginal, values in Kukkarahalli lake range between 1.7 and 2.3 which is also rated between marginal and acceptable. Yennehole Lake has values of 2.4 and can be rated as acceptable quality. Poor water quality in lakes imparts the lives of many species including fish and plants. This is often due to the nutrient loads from agricultural fertilizer run off, chemical pollutants, faces and urine of fish and animals. These excess nutrients over power the natural bacterial population that normally would keep the aquatic environment in balance. Due to such processes sludge develops and become overabundant. Oxygen saturation reduces and fish mortality rates increases. Permanent blooms of cyanobacteria were recorded in Kukkarahalli Lake (Microcystis aeruginosa) and Yennehole Lake (Spirulinaplatensis and Raphidiopsismedetereana). These two lakes have experienced massive fish kill during the past years. The IWQI involves only 5 parameters, is simple and can be applied to lake ecosystems also. Smaller number of parameters is advantageous in lake restoration activities.

R. W. Gaikwad, V. V. Sasane, et,al.,(2012) "Physico-chemical analysis of Lonar Lake Water". has explained, the present work is aimed at assessing the water quality of the groundwater in and around Lonar Lake. Water quality has been determined by collecting groundwater samples and subjecting the samples to a comprehensive physiochemical analysis. For assessing water quality, pH, total hardness, calcium, magnesium, bicarbonate, chloride, nitrate, sulphate, total dissolved solids, iron, manganese and fluorides have been considered. The higher values has been found to be mainly for Iron, Total hardness, chloride, fluoride, calcium and magnesium, many literature shown that groundwater quality in Lonar Taluka has been badly affected by nitrate contamination. The analysis reveals that the groundwater of the area needs some degree of treatment before consumption, and it also needs to be protected from the perils of contamination. Many different options are now in progress for treatment of water locally.Various community based programs have been tried in the past, but only few of these purely community run plants are successful. The future lies in providing safe drinking water in rural areas with a mixture of these options so that the objectives of providing safe water at low cost for sustaining over a long time and reaching to maximum number of people is achieved.

R. M. Khan, M. J. Jadhav, et,al.,(2007) "Qualitative and quantitative analysis of drinking water of TriveniLake".have explained, in order to understand the water quality of Triveni Lake, Physico-chemical parameters were studied and analyzed for the period of one year i.e. December 2010 to November 2011. Various physicochemical parameters, such as water temperature, air temperature, pH, humidity, conductivity, free Co_2, total solid, dissolved oxygen, Total alkalinity,Total hardness, $caco_3$, ca++, mg++ were studied. The results revealed that there was significant seasonal variation in some physicochemical parameters and most of the parameters were in normal range and indicated better quality of lake water. It has been found that the water is best for drinking purpose in winter and summer seasons.

Sulochna et. al., (1998) analyzed samples from bore well of Remote village near Tirunelveli in TamilNadu. The result revealed that declining of groundwater level increases the concentration of inorganic ions due to the predominate influence of sub soil rocks. Suk and Lee, (1999) studied the characterization of a groundwater hydrochemical system through multivariate analysis using clustering of groundwater zones in Incheon, Korea. According the study, the site was governed by two distinct hydrochemical regimes. Somashkar et. al (2000) analyzed ten different locations in Channapatna taluk Bangalore, Karnataka with the parameters pH, total alkalinity, total hardness, chloride, fluoride, total dissolved solids, calcium magnesium, nitrates and conductivity. They observed low fluoride content in this area.

Sohani et. al., (2001) collected 16 ground water samples from the Bore Wells of different colonies of Nandurbar Town (Maharashtra) and analyzed for 15 parameters related to water quality and found that some Physico-chemical parameters within the permissible limit and some are beyond the permissible limit of drinking water standards. High iron content (0.0 to 5.80 mg/L) has been detected. Ramanathan, (2002) carried out study of Systematic sampling of groundwater in different season's from1997 to 1999 in the entire Periyar district of Tamilnadu. Groundwater was colorless, odorless and is alkaline in nature. The water chemistry showed distinct variation in space and time and the influence of the anthropogenic sources. SAR, RSC, Na%, CR, TH etc shows that the water is generally good for domestic, agricultural purpose and is not good for long distance transport. Here the Fluoride concentration is generally lower than prescribed limit except few areas where the concentration exceeds 1.5ppm.

Zhang and Cheng, (2002) studied groundwater in GTA, Canada with special emphasis on the GIS spatial statistical analysis of. According to this study, the identification of binary evidential features to predicting the potential distributions of confined aquifers. These binary patterns correlated to the locations of flowing wells were integrated using multivariate logistic regression model and a predictive map was created to illustrate the potential distributions to confined aquifers in the OMR area. Mishra and Sahoo, (2003) studied the ground water quality in and around Deogarh and found that, the physico-chemical parameters like pH, EC, TDS, TH, Na+ , K+ , Mg2+, Ca2+, Cl, SO4 2- and HCO3 - indicate that, the ground waters are suitable both for domestic and irrigation purpose.

Ramachandramoorty et. al., (2004) analyzed the fluoride ion concentration in the groundwater of Tiruchirapalli, Tamilnadu, India. They reported that low calcium content and high alkalinity increased the fluoride level in water; lower the total hardness higher was the fluoride ion concentration; and that groundwater was contaminated by the industrial activity and application of large amount of fertilizer around the area.

Ackah et. al., (2011) assessed the groundwater quality for drinking and irrigation of Teiman-Oyarifa community, Ga East municipality, Ghana. According the study theionic dominance for the major cations and the anions respectively were in these order; Na+ >K+ >Mg2+.>Ca2+ and Cl>HCO3 - >SO4 2->NO3 - and most of the samples fell in the US salinity laboratory classification of C2-S1. Arya et. al., (2011) assessed undergroundwater quality of Jhansi city, U.P., India. According the study, it was observed that parameters alkalinity, pH, DO,hydrogencarbonates were negatively correlated and EC, TDS, TA, TH, CO3 2-, Cl were show a positive correlation with temperature. Balakrishnan et. al., (2011) studied the groundwater quality mapping using geographic information system (GIS) of Gulbarga city, Karnataka, India. According the mapping was coded for potable zones, in the absence of better alternate source and non-potable zones in the study area, in terms of water quality. Gopalkrishna, (2011) assessed the physico-chemical status of groundwater samples in Akot city during post monsoon period. The parameters namely F and PO4 2- were found as zero for all sites. Liu and Xu, (2011) studied the water quality using hydrochemical and statistical analysis. According the study, the Q-mode hierarchical cluster analysis was applied to the standard z-scores of the data and 4 spatial groundwater types distinguished. The result revealed that the most predominant water type in cluster 1 and 3 was the Ca_2+-HCO_3 - water type and cluster 2 indicated the marlstone and sulphate strata were the predominant factors influencing the water quality. Mande et. al., (2011) studied the evolution processes of groundwater quality in an urban area of Beijing. This study revealed that nitrate concentration was high in groundwater samples. According to them the distribution of soluble ions in the groundwater was stratified in the research area because of clay layers. The clay layers were found to control the concentration of cations and silica, as well as that of chloride ions in the groundwater. Meena et. al., (2011) studied fluoride

Mouna et. al., (2011) studied the use of geographical information system and water quality index to assess groundwater quality in EI Khairat deep aquifer, Enfidha, Tunisian Sahel. According the study, the spatial distribution map of TH shows that a majority of the groundwater samples falls in the very hard category and from the water quality index

(WQI) assessment,water samples fall within the poor and very poor categories, suggesting that groundwater is unsuitable for drinking purposes. Obiefuna and Sheriff, (2011) assessed the groundwater quality of Pindiga Gombe area, Yola area, NE, Nigeria for irrigation and domestic purposes. They found that groundwater neither cause salinity hazard nor have an adverse effect on the soil properties of the study area. Patil et. al., (2011) monitored physico-chemical quality of fifteen water samples from different stations of Amalner town in Jalgaon district, Maharashtra, India. The chemical analysis of water sample showed considerable variations and samples compared with W.H.O. standards for the parameter measured and identified that the data of instrumental analysis indicated that very few situations nearby to sewage pond showed above the permissible limit. Samples showed increase in trend with respect to higher year. Pavendan et. al., (2011) assessed the physico-chemical and microbial parameters of drinking water from different water sources of Tiruchirappalli district, South India.

A. Objectives

- The objective of the study is to be analyses the water quality of Byramangala lake & nearby sub surface water sample.
- Specific objective is to compare the lake water quality & nearby sub surface water quality
- To study effects caused due to water.
- To suggest measures to be taken to prevent the pollution

III. Materials and Methodologies

A. General

Several laboratory tests are conducted on water (raw as well as treated) to determine its characteristics and to determine the degree of treatment required to make it potable, as stated in the report.

Usually at under graduate level, the following tests will be required to be performed in water testing laboratory.

B. List of Physical and Chemical Tests Conducted in the Laboratory

1) Ph
2) Color
3) Odor
4) Turbidity
5) Total dissolved solids
6) Total hardness
7) Chlorides
8) Total alkalinit
9) Sulphates
10) COD
11) BOD
12) Oil and grease
13) phosphates
14) Temperature
15) Phenolic compound
16) Iron
17) Hexavalent Chromium

C. Results

TABLE I
TESTS FOR LAKE WATER SAMPLE-1

S. No.	Tests for lake water Sample-1	Results	Maximum Acceptable Limits(Mg/l)	Maximum Permissible Limits(Mg/l)	Protocol IS-3025
1	pH Value	7.41	6.5-8.5	No Relaxation	IS 3025 (Part 11)
2	Color , Hazen Unit	10	5	25	IS 3025(Part 5)
3	Odor	Agreeable	Agreeable	-	IS 3025 (Part 05)
4	Turbidity , NTU	19.5	1	5	IS 3025 (Part 10)
5	Total Dissolved Solids , mg/L	1010.0	500	2000	IS: 3025(Part 16)
6	Total Hardness as $CaCO_3$,mg/L	390.0	200	600	1S 3025 (Part 21)
7	Chloride as Cl , mg/L	120.0	250	1000	1S: 3025 (Part32)
8	Total Alkalinity as $CaCO_3$, mg/L	520.0	200	600	IS 3025 (Part 23)
9	Sulphates as SO_4, mg/L	58.0	200	400	IS: 3025 (Part 24)
10	COD , mg/L	320	250	-	IS 3025 (Part 58)
11	BOD (3days @ 27 ^{0}C) , mg/L	32.9	10	-	IS 3025(Part 64)
12	Oil & Greases , mg/L	<1.0	-	10	IS 3025(Part 39)
13	Phosphate as PO_4, mg/L	0.1			IS 3025(Part 31)
14	Temperature, ^{O}C	26	-	-	IS 3025(Part 9)
15	Phenolic Compound as C_6H_5OH, mg/L	<0.01		0.002	IS 3025(Part-43)
16	Iron as Fe , mg/L	0.2	0.3	1	IS 3025(Part-53)
17	Hexavalent Chromium as Cr^{6+}, mg/L	<0.01	0.05	No Relaxation	IS 3025(Part-52)

TABLE II
TESTS FOR LAKE WATER SAMPLE-2

S. No.	Tests for lake water Sample-2	Results	Maximum Acceptable Limits(Mg/)	Maximum Permissible Limits(Mg/l)	Protocol IS-3025
1	pH Value	7	6.5-8.5	No Relaxation	IS 3025 (Part 11)
2	Color , Hazen Unit	8	5	25	IS 3025(Part 5)
3	Odor	Agreeable	Agreeable	-	IS 3025 (Part 05)
4	Turbidity , NTU	13	1	5	IS 3025 (Part 10)
5	Total Dissolved Solids , mg/L	900	500	2000	IS: 3025(Part 16)
6	Total Hardness as $CaCO_3$,mg/L	350.0	200	600	1S 3025 (Part 21)
7	Chloride as Cl , mg/L	110.0	250	1000	1S: 3025 (Part 32)
8	Total Alkalinity as $CaCO_3$,mg/L	450.0	200	600	IS 3025 (Part 23)
9	Sulphates as SO_4, mg/L	70.0	200	400	IS: 3025 (Part 24)
10	COD , mg/L	300	250	-	IS 3025 (Part 58)
11	BOD (3days @ 27^0C) , mg/L	25.8	10	-	IS 3025(Part 64)
12	Oil & Greases , mg/L	<1.0	-	10	IS 3025(Part 39)
13	Phosphate as PO_4, mg/L	0.1			IS 3025(Part 31)
14	Temperature, ^{O}C	26	-	-	IS 3025(Part 9)
15	Phenolic Compound as C_6H_5OH, mg/L	<0.01		0.002	IS 3025(Part-43)
16	Iron as Fe , mg/L	0.125	0.3	1	IS 3025(Part-53)
17	Hexavalent Chromium as Cr^{6+} , mg/L	<0.01	0.05	No Relaxation	IS 3025(Part-52)

TABLE III
TESTS FOR LAKE WATER SAMPLE-3

S. No.	Tests for lake water Sample-3	Results	Maximum Acceptable Limits(Mg/)	Maximum Permissible Limits(Mg/l)	Protocol IS-3025
1	pH Value	6.8	6.5-8.5	No Relaxation	IS 3025 (Part 11)
2	Color , Hazen Unit	12	5	25	IS 3025(Part 5)
3	Odor	Agreeable	Agreeable	-	IS 3025 (Part 05)
4	Turbidity , NTU	16.3	1	5	IS 3025 (Part 10)
5	Total Dissolved Solids , mg/L	1300	500	2000	IS: 3025(Part 16)
6	Total Hardness as $CaCO_3$,mg/L	450.0	200	600	1S 3025 (Part 21)
7	Chloride as Cl , mg/L	180.0	250	1000	1S: 3025 (Part 32)
8	Total Alkalinity as $CaCO_3$,mg/L	570.5	200	600	IS 3025 (Part 23)
9	Sulphates as SO_4, mg/L	120.0	200	400	IS: 3025 (Part 24)
10	COD , mg/L	350	250	-	IS 3025 (Part 58)
11	BOD (3days @ 27^0C) , mg/L	38.3	10	-	IS 3025(Part 64)
12	Oil & Greases , mg/L	<1.0	-	10	IS 3025(Part 39)
13	Phosphate as PO_4, mg/L	0.1			IS 3025(Part 31)
14	Temperature, ^{O}C	26	-	-	IS 3025(Part 9)
15	Phenolic Compound as C_6H_5OH, mg/L	<0.01		0.002	IS 3025(Part-43)
16	Iron as Fe , mg/L	0.2	0.3	1	IS 3025(Part-53)
17	Hexavalent Chromium as Cr^{6+} , mg/L	<0.01	0.05	No Relaxation	IS 3025(Part-52)

TABLE IV
TESTS FOR LAKE WATER SAMPLE-4

S. No.	Tests for lake water Sample-4	Results	Maximum Acceptable Limits(Mg/)	Maximum Permissible Limits(Mg/l)	Protocol IS-3025
1	pH Value	7.2	6.5-8.5	No Relaxation	IS 3025 (Part 11)
2	Color , Hazen Unit	14	5	25	IS 3025(Part 5)
3	Odor	disagreeable	Agreeable	-	IS 3025 (Part 05)
4	Turbidity , NTU	11.33	1	5	IS 3025 (Part 10)
5	Total Dissolved Solids , mg/L	1280.0	500	2000	IS: 3025(Part 16)
6	Total Hardness as $CaCO_3$,mg/L	420.0	200	600	1S 3025 (Part 21)
7	Chloride as Cl , mg/L	135.0	250	1000	1S: 3025 (Part 32)
8	Total Alkalinity as $CaCO_3$,mg/L	545.0	200	600	IS 3025 (Part 23)
9	Sulphates as SO_4 , mg/L	58.0	200	400	IS: 3025 (Part 24)
10	COD , mg/L	380	250	-	IS 3025 (Part 58)
11	BOD (3days @ 27^0C) , mg/L	32.9	10	-	IS 3025(Part 64)
12	Oil & Greases , mg/L	<1.0	-	10	IS 3025(Part 39)
13	Phosphate as PO_4 , mg/L	0.1			IS 3025(Part 31)
14	Temperature, ^{O}C	26	-	-	IS 3025(Part 9)
15	Phenolic Compound as C_6H_5OH,mg/L	<0.01		0.002	IS 3025(Part-43)
16	Iron as Fe , mg/L	0.2	0.3	1	IS 3025(Part-53)
17	Hexavalent Chromium as Cr^{6+} , mg/L	<0.01	0.05	No Relaxation	IS 3025(Part-52)

TABLE V
TESTS FOR LAKE WATER SAMPLE-5

S. No.	Tests for lake water Sample-5	Results	Maximum Acceptable Limits(Mg/)	Maximum Permissible Limits(Mg/l)	Protocol IS-3025
1	pH Value	6.83	6.5-8.5	No Relaxation	IS 3025 (Part 11)
2	Color , Hazen Unit	17	5	25	IS 3025(Part 5)
3	Odor	disagreeable	Agreeable	-	IS 3025 (Part 05)
4	Turbidity , NTU	13.66	1	5	IS 3025 (Part 10)
5	Total Dissolved Solids , mg/L	1360.0	500	2000	IS: 3025(Part 16)
6	Total Hardness as $CaCO_3$,mg/L	425.0	200	600	1S 3025 (Part 21)
7	Chloride as Cl , mg/L	185.0	250	1000	1S: 3025 (Part 32)
8	Total Alkalinity as $CaCO_3$,mg/L	568.0	200	600	IS 3025 (Part 23)
9	Sulphates as SO_4 , mg/L	64.0	200	400	IS: 3025 (Part 24)
10	COD , mg/L	355	250	-	IS 3025 (Part 58)
11	BOD (3days @ 27^0C) , mg/L	41.4	10	-	IS 3025(Part 64)
12	Oil & Greases , mg/L	<1.0	-	10	IS 3025(Part 39)
13	Phosphate as PO_4 , mg/L	0.1			IS 3025(Part 31)
14	Temperature, ^{O}C	26	-	-	IS 3025(Part 9)
15	Phenolic Compound as C_6H_5OH, mg/L	<0.01		0.002	IS 3025(Part-43)
16	Iron as Fe , mg/L	0.18	0.3	1	IS 3025(Part-53)
17	Hexavalent Chromium as Cr^{6+} , mg/L	<0.01	0.05	No Relaxation	IS 3025(Part-52)

TABLE VI
TESTS FOR LAKE WATER SAMPLE-6

S. No.	Tests for lake water Sample-6	Results	Maximum Acceptable Limits(Mg/)	Maximum Permissible Limits(Mg/l)	Protocol IS-3025
1	pH Value	6.86	6.5-8.5	No Relaxation	IS 3025 (Part 11)
2	Color , Hazen Unit	5	5	25	IS 3025(Part 5)
3	Odor	Agreeable	Agreeable	-	IS 3025 (Part 05)
4	Turbidity , NTU	9.6	1	5	IS 3025 (Part 10)
5	Total Dissolved Solids , mg/L	960.0	500	2000	IS: 3025(Part 16)
6	Total Hardness as $CaCO_3$,mg/L	420.0	200	600	1S 3025 (Part 21)
7	Chloride as Cl , mg/L	100.0	250	1000	1S: 3025 (Part 32)
8	Total Alkalinity as $CaCO_3$,mg/L	490.0	200	600	IS 3025 (Part 23)
9	Sulphates as SO_4 , mg/L	52.3	200	400	IS: 3025 (Part 24)
10	COD , mg/L	8.0	250	-	IS 3025 (Part 58)
11	BOD (3days @ 27^0C) , mg/L	<1.0	10	-	IS 3025(Part 64)
12	Oil & Greases , mg/L	<1.0	-	10	IS 3025(Part 39)
13	Phosphate as PO_4 , mg/L	<0.1			IS 3025(Part 31)
14	Temperature, ^{O}C	25.4	-	-	IS 3025(Part 9)
15	Phenolic Compound as C_6H_5OH, mg/L	<0.01		0.002	IS 3025(Part-43)
16	Iron as Fe , mg/L	0.1	0.3	1	IS 3025(Part-53)
17	Hexavalent Chromium as Cr^{6+} , mg/L	<0.01	0.05	No Relaxation	IS 3025(Part-52)

TABLE VII
TESTS FOR LAKE WATER SAMPLE-7

S. No.	Tests for lake water Sample-7	Results	Maximum Acceptable Limits(Mg/)	Maximum Permissible Limits(Mg/l)	Protocol IS-3025
1	pH Value	6.72	6.5-8.5	No Relaxation	IS 3025 (Part 11)
2	Color , Hazen Unit	5	5	25	IS 3025(Part 5)
3	Odor	Agreeable	Agreeable	-	IS 3025 (Part 05)
4	Turbidity , NTU	9	1	5	IS 3025 (Part 10)
5	Total Dissolved Solids , mg/L	860.0	500	2000	IS: 3025(Part 16)
6	Total Hardness as $CaCO_3$,mg/L	430.0	200	600	1S 3025 (Part 21)
7	Chloride as Cl , mg/L	120.0	250	1000	1S: 3025 (Part 32)
8	Total Alkalinity as $CaCO_3$,mg/L	440.0	200	600	IS 3025 (Part 23)
9	Sulphates as SO_4 , mg/L	51.2	200	400	IS: 3025 (Part 24)
10	COD , mg/L	8.0	250	-	IS 3025 (Part 58)
11	BOD (3days @ 27^0C) , mg/L	<1.0	10	-	IS 3025(Part 64)
12	Oil & Greases , mg/L	<1.0	-	10	IS 3025(Part 39)
13	Phosphate as PO_4 , mg/L	<0.1			IS 3025(Part 31)
14	Temperature, ^{O}C	25.4	-	-	IS 3025(Part 9)
15	Phenolic Compound as C_6H_5OH, mg/L	<0.01		0.002	IS 3025(Part-43)
16	Iron as Fe , mg/L	0.2	0.3	1	IS 3025(Part-53)
17	Hexavalent Chromium as Cr^{6+} , mg/L	<0.01	0.05	No Relaxation	IS 3025(Part-52)

TABLE VIII
TESTS FOR LAKE WATER SAMPLE-8

S. No.	Tests for lake water Sample-8	Results	Maximum Acceptable Limits(Mg/)	Maximum Permissible Limits(Mg/l)	Protocol IS-3025
1	pH Value	7.10	6.5-8.5	No Relaxation	IS 3025 (Part 11)
2	Color , Hazen Unit	3	5	25	IS 3025(Part 5)
3	Odor	Agreeable	Agreeable	-	IS 3025 (Part 05)
4	Turbidity , NTU	7.2	1	5	IS 3025 (Part 10)
5	Total Dissolved Solids , mg/L	820.0	500	2000	IS: 3025(Part 16)
6	Total Hardness as $CaCO_3$,mg/L	410.0	200	600	1S 3025 (Part 21)
7	Chloride as Cl , mg/L	140.5	250	1000	1S: 3025 (Part 32)
8	Total Alkalinity as $CaCO_3$,mg/L	460.3	200	600	IS 3025 (Part 23)
9	Sulphates as SO_4 , mg/L	45.6	200	400	IS: 3025 (Part 24)
10	COD , mg/L	5.0	250	-	IS 3025 (Part 58)
11	BOD (3days @ 27^0C) , mg/L	<1.0	10	-	IS 3025(Part 64)
12	Oil & Greases , mg/L	<1.0	-	10	IS 3025(Part 39)
13	Phosphate as PO_4 , mg/L	<0.1			IS 3025(Part 31)
14	Temperature, ^{O}C	25.4	-	-	IS 3025(Part 9)
15	Phenolic Compound as C_6H_5OH, mg/L	<0.01		0.002	IS 3025(Part-43)
16	Iron as Fe , mg/L	0.18	0.3	1	IS 3025(Part-53)
17	Hexavalent Chromium as Cr^{6+} , mg/L	<0.01	0.05	No Relaxation	IS 3025(Part-52)

TABLE IX
TESTS FOR LAKE WATER SAMPLE-9

S. No.	Tests for lake water Sample-9	Results	Maximum Acceptable Limits(Mg/)	Maximum Permissible Limits(Mg/l)	Protocol IS-3025
1	pH Value	7.18	6.5-8.5	No Relaxation	IS 3025 (Part 11)
2	Color , Hazen Unit	<5	5	25	IS 3025(Part 5)
3	Odor	Agreeable	Agreeable	-	IS 3025 (Part 05)
4	Turbidity , NTU	1.9	1	5	IS 3025 (Part 10)
5	Total Dissolved Solids , mg/L	1190.0	500	2000	IS: 3025(Part 16)
6	Total Hardness as $CaCO_3$,mg/L	440.0	200	600	1S 3025 (Part 21)
7	Chloride as Cl , mg/L	220.0	250	1000	1S: 3025 (Part 32)
8	Total Alkalinity as $CaCO_3$,mg/L	380.0	200	600	IS 3025 (Part 23)
9	Sulphates as SO_4 , mg/L	51.1	200	400	IS: 3025 (Part 24)
10	COD , mg/L	10.0	250	-	IS 3025 (Part 58)
11	BOD (3days @ 27^0C) , mg/L	<1.0	10	-	IS 3025(Part 64)
12	Oil & Greases , mg/L	<1.0	-	10	IS 3025(Part 39)
13	Phosphate as PO_4 , mg/L	<0.1			IS 3025(Part 31)
14	Temperature, ^{O}C	25.8	-	-	IS 3025(Part 9)
15	Phenolic Compound as C_6H_5OH, mg/L	<0.01		0.002	IS 3025(Part-43)
16	Iron as Fe , mg/L	0.14	0.3	1	IS 3025(Part-53)
17	Hexavalent Chromium as Cr^{6+} , mg/L	<0.05	0.05	No Relaxation	IS 3025(Part-52)

TABLE X
TESTS FOR LAKE WATER SAMPLE-10

S. No.	Tests for lake water Sample-10	Results	Maximum Acceptable Limits(Mg/)	Maximum Permissible Limits(Mg/l)	Protocol IS-3025
1	pH Value	7.5	6.5-8.5	No Relaxation	IS 3025 (Part 11)
2	Color , Hazen Unit	<5	5	25	IS 3025(Part 5)
3	Odor	Agreeable	Agreeable	-	IS 3025 (Part 05)
4	Turbidity , NTU	1.3	1	5	IS 3025 (Part 10)
5	Total Dissolved Solids , mg/L	1050.0	500	2000	IS: 3025(Part 16)
6	Total Hardness as $CaCO_3$,mg/L	410.0	200	600	1S 3025 (Part 21)
7	Chloride as Cl , mg/L	200.0	250	1000	1S: 3025 (Part 32)
8	Total Alkalinity as $CaCO_3$,mg/L	355.0	200	600	IS 3025 (Part 23)
9	Sulphates as SO_4 , mg/L	48.1	200	400	IS: 3025 (Part 24)
10	COD , mg/L	9.0	250	-	IS 3025 (Part 58)
11	BOD (3days @ 27^0C) , mg/L	<1.0	10	-	IS 3025(Part 64)
12	Oil & Greases , mg/L	<1.0	-	10	IS 3025(Part 39)
13	Phosphate as PO_4 , mg/L	<0.1			IS 3025(Part 31)
14	Temperature, ^{O}C	25.8	-	-	IS 3025(Part 9)
15	Phenolic Compound as C_6H_5OH, mg/L	<0.01		0.002	IS 3025(Part-43)
16	Iron as Fe , mg/L	0.16	0.3	1	IS 3025(Part-53)
17	Hexavalent Chromium as Cr^{6+} , mg/L	<0.05	0.05	No Relaxation	IS 3025(Part-52)

IV. CONCLUSION

pH: It is –ve logarithm to base 10 of hydrogen ion concentration. For pure water pH is 7.If this value will increases their reduction in the hydrogen ions concentration. As per our study pH value of all the samples such as lake water, bore well water, well water lies between 6.5-8.5 (Max. acceptable limits).

Turbidity: It is caused due to the wide variety of suspended matters which ranges in size from colloidal to coarse dispersion. Turbidity for drinking water must be less than 1 NTU but as per results all collected water samples crosses their limit.

Total Dissolved Solids: Higher concentration may make appearance of water dull and water may give salty taste and unpleasant odor. Water with lower TDS may corrosive and leak toxic metal such as copper lead etc. According to our studies all the sources of samples crosses the maximum acceptable limits (500mg/l).

Total Hardness: It is the property of water which prevents the lathering of soap. It is caused due to carbonates, sulphates of calcium and magnesium ion. If hardness is greater than 200 it is hard water. As per our tests results total hardness of all the samples is more than the acceptable limits. Hence some softening methods are required.

Chlorides: The presence of chloride is due to the presence of saline water and sewage water. Excess of chloride is dangerous and unfit for use. Chloride content of all the samples is lies within the acceptable limits (250mg/l).Hence safe.

Total Alkalinity: Alkalinity of water is its capacity to neutralize an acid. The presence of carbonates, bicarbonates and hydroxides decreases H+ ions and increases pH value of water. Results shows all the samples crosses their acceptable limits.

Sulphate: The concentration of sulphate in water less than 200mg/l is an indicate that water is fresh and unpolluted. As per results of samples sulphate content shows less than acceptable limits. Hence safe.

COD: It is the important water quality parameter. Higher COD level mean a greater amount of oxidizable organic materials in the sample which will reduce DO level, reduced DO lead anaerobic condition which is deleterious higher aquatic life. Test results shows COD in lake water is more whereas bore well water and well water is less than the acceptable limits. Hence Lake water is not safe.

BOD: Bio chemical oxygen demand is the amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic materials given water sample at certain temperature over a specified time period. Lower the BOD indicates the water is of good quality and higher the BOD indicates water is polluted. As per our studies BOD in lake water is more whereas bore well water and well water is less than the acceptable limits. Hence Lake water is not safe.

Temperature: Temperature is one of the physical parameter. Temperature above 26°C is undesirable and above 35°C is not potable. As per our test results temperature of all the samples is ≤ 26°C. Hence ok.

Iron: If these are present less than 0.3ppm, it is not objectionable, but if it exceeds 0.3ppm the water is not suitable for domestic usage. As per test results none of the sample shows more than 0.3ppm. Hence safe.

REFERENCES

[1] Madhukar R and Srikantaswamy S (2013). Impact of industrial effluents on water quality of Vrishabhavathi river and Byramangala Lake in Bidadi area. International journal of Geology, Earth and Environment Sciences. 3(2)p.p132-141.

[2] Jayadev and E.T Puttiah (2013). Studies on heavy metal contamination in Vrishabhavathi river water and ground water of the surrounding. International journal of scientific and engineering research 4.

[3] Jan, Nasrut, Nandini, N., Jumbe, about S. and S. Anupama B. (2008). Impact of municipal and industrial pollution on Byramangala Lake, Bangalore Rural district, India. The 12th World Lake Conference, 1717-1728.

[4] Farid Ansari and Yashwant K. Pandey (2013). Conceptual design of Waste water treatment plant for the Dera Bassi Industrial Estate, Punjab (India). 13(4). [5] L Uday Simha and Mahesh Babu (2015). Evaluation of water quality in and around Byramangala reservoir. List B scientific journals 8(2) p.p 215-221.
[5] IS 3025 code book
[6] R. M. Khan, M. J. Jadhav,"Qualitative and quantitative analysis of drinking water of TriveniLake"July(2007)
[7] S. Chandra, A. Singh and P. K"Physicochemicalet.all Analysis of Water from Various Sources and Their Comparative Studies"(Jul. - Aug. 2013)
[8] M.S. Nagaraja Gupta and, C.Sadashivaiah, "Assessment of water quality in peenya industrial area Bangalore" may 2014
[9] R. W. Gaikwad, V. V. Sasane"Physico-chemical analysis of Lonar Lake Water"2012has
[10] Sulochna et. al., (1998) analyzed samples from bore well of Remote village near Tirunelveli in TamilNadu.
[11] Sohani et. al., (2001) collected 16 ground water samples from the Bore Wells of different colonies of Nandurbar Town (Maharashtra)