JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

STUDY AND ANALYSIS OF CHIKKABANAVARA LAKE, BANGALORE URBAN DISTRICT, KARNTAKA, INDIA

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Abstract: Chikkabanavara lake is a naturally formed lake which is located at a distance of 1.5 km north of Chikkabanavara Railway Station along Bangalore – Tumkur railway line, situated between Chikkabanavara and Kereguddadahalli village, It lies between Lat. 13^0 08'N and longitude of 77^0 50'E. The lake is accessible by Hesaraghatta Road from 8th mile (T. Dasarahalli) junction on the Bangalore -Tumkur highway (NH4). The total extent of the lake is 105 acres and 15 guntas (according to Bangalore Development Authority (BDA) records. This lake is situated outside BBMP area coming under the custody of BDA North Division. The Chikkabanavara lake gets water from rain fall having catchment in nearby chimney hills due to the topography of land the natural in flow runoff water reaches the lake from all the sides of lake. In the present study water chemistry of the lake water and encroachment of lake has been discussed.

IndexTerms - Water quality, Urbanization, Water pollution, Chikkabanavara lake

I. INTRODUCTION

Chikkabanavara lake is a naturally formed sub watershed which was having an area of 170 acres of watershed (which is now reduced to 105 acres and 15 guntas), Several city folks who had their farms in Chikkabanavara village therefore still remember that this lake used to be just around 700 metres from the railway line. The encroachment over the lake can be gauged from the fact that it has been pushed almost1.5km away from the railway line. In past years the lake water was used for irrigation, agricultural, fishing purposes by the surrounding villages. The lake water was even used drinking and cooking by people nearby in the past decades. The water was used to washing clothes by the Dobhi (dry cleaners) from surrounding locality in western part of lake nearby waste weir nearly 10 years before. Few decades ago, the road which was connecting the Chikkabanavara village and Abbigere village via Dasappanapalya village is now completely submerged by lake and became un existed for nearly two decades from now. It is learnt that the reasons for the un-existence of road is mainly because of the increase in the volume of water in lake, encroachment of the lake, and lack of planning for up-gradation of bunds and waste weir of the lake. In 2013, the huge number aquatic life (fishes) was killed due the increase in the pollution of water, which was also reported in the Paravani, The Hindu, Deccan Herald newspapers. Influent on the eastern part of the lake started producing lather/foam due the entry of the sewage. The aerial view and encroachments in the study area is shown in the Figures 1,2 and 3.

II OBJECTIVES OF THE STUDY

The main objective of the present study is to evaluate the water quality parameters of Chikkabanavara lake and to find the extent of encroachment of lake has happened due urbanization. This lake is one of the main lakes constructed by the founder of Bangalore. Since the Bangalore city is far from perennial rivers of the State, several lakes have been constructed to meet the demand of water for domestic usage and irrigation. The water samples from the lake have been collected from different locations of the lake for chemical analysis. The chemical analysis data has been presented here. The main reason for different chemical anomalies is due the entry of municipal waste water and improper disposal of solid waste especially during the festival times.

III METHODOLOGY

Field study has been carried to check present condition of the lake. During the filed study it is observed that lot of encroachment has occurred and lake bed area has been damaged due to urbanization. It is also noticed that demolished waste of the buildings has also been dumped at some places in the lake bed area.

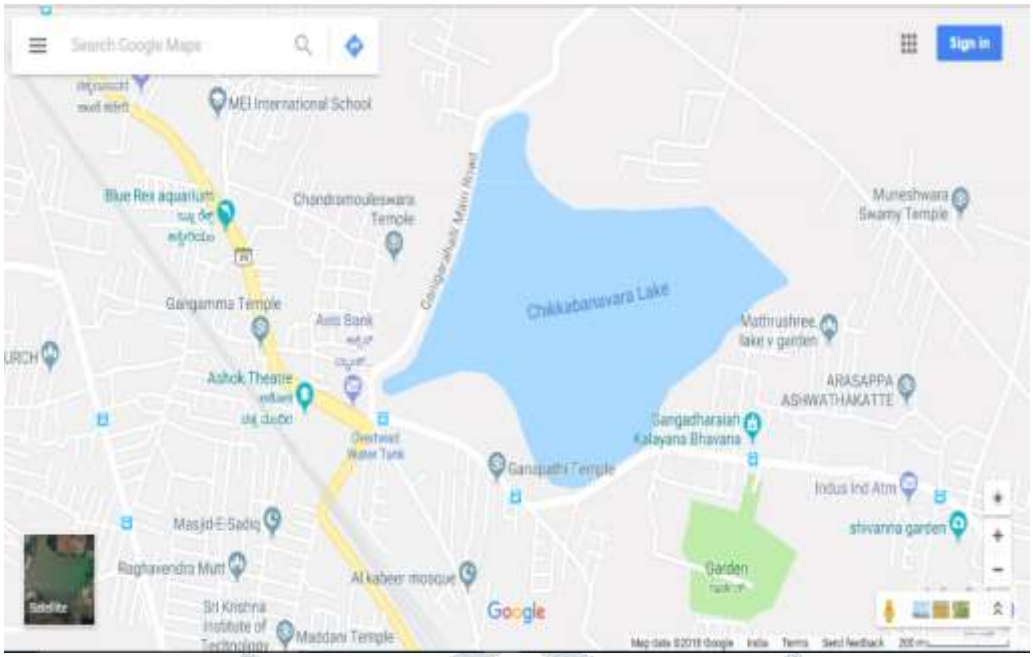

Fig.1: Showing Google Satellite View of Chikkabanavara lake.

Fig. 2: Google View of Chikkabanavara lake

IV WATER CHEMISTRY

In recent years water is becoming scarce resource and has led to recognize that the quality of water is an important as quantity. It is well established that the chemical characteristics of the groundwater determine its usefulness for Agricultural, Industrial and domestic consumption. Waters with high amount of different unwanted elements may prove fatal to the living beings. Water chemistry plays an important role in the groundwater quality which was poorly understood so far. It is believed that the natural variations in water chemistry are a random phenomenon. Though it is true, that in detail, the chemistry of groundwater is exceedingly complex, much information can be gathered and various factors that affect the groundwater quality of a particular place (Aswathanarayana U. 2003, Sabhajyothi Das. 2011)

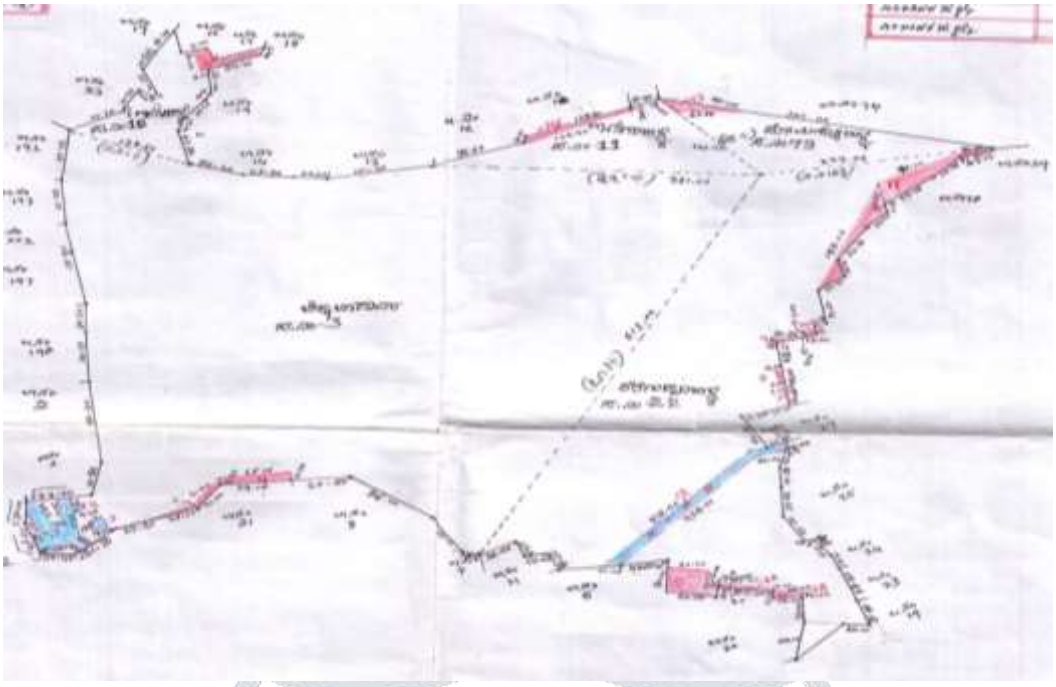

Fig. 3: Map showing the Encroachment of lake due urbanization.

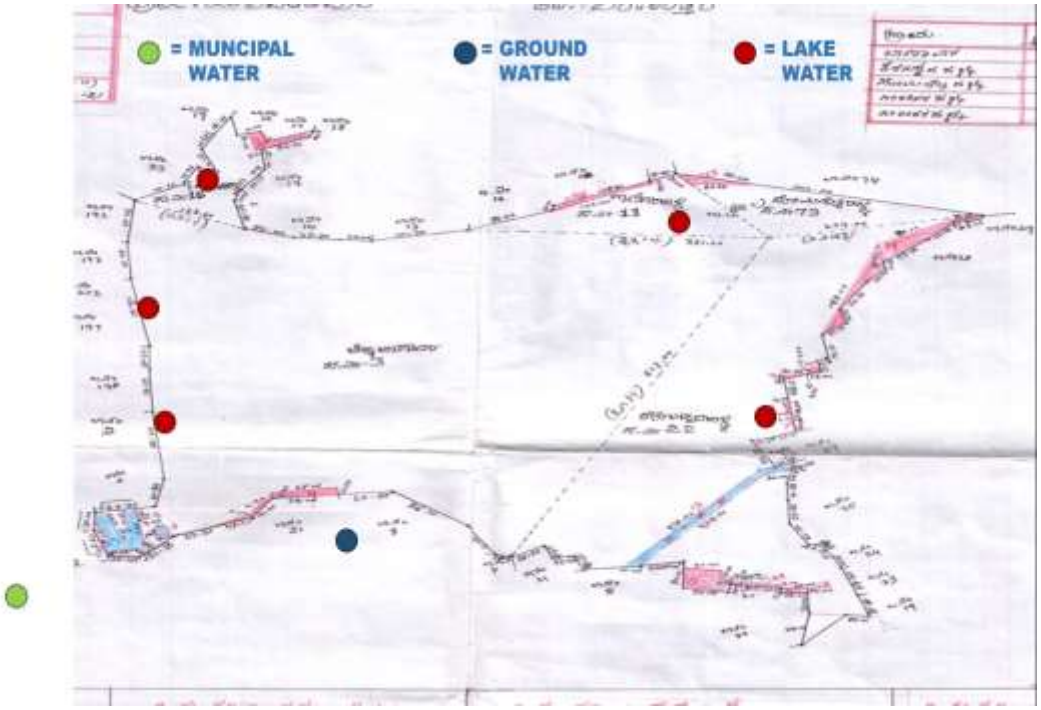

Fig.4: Showing the Sample locations. Red dots indicate samples from the lake. Blue dot indicates the sample from the bore well near the lake. Green dot indicates Water supplied by BWSSB.

Quality criteria for agricultural practices are based on the tolerance by the vegetation properties of soil and climate. But the main factor that controls the quality of water is the associated rock type and soil. In the present context the quality is emphasized basically for agricultural and domestic usage.

pH

Excessively high and low pH can be detrimental for the use of water. High pH causes a bitter taste, water pipes and water-using appliances become encrusted with deposits, and it depresses the effectiveness of the disinfection of chlorine, thereby causing the need for additional chlorine when pH is high. Low-pH water will corrodeor dissolve metals and other substances**.** In all the five samples of the lake water the pH is in the permissible limit only.

Table 1: Showing the Chemical parameters of the water in Chikkabanavara lake.

Sl No.	Chemical Parameters	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
1	pH	7.72	8.00	8.16	8.07	8.07
2	Sulphur	75.35	51.04	53.47	94.78	70.48
3	Carbonates	26.88	13.44	47.04	47.04	26.88
4	Bicarbonates	778.84	833.5	1489.37	696.86	327.94
5	Chloride	574	504	560	728	568
6	Copper	0.21	0.21	0.21	0.63	0.21
7	Iron	1.05	0.84	1.05	1.68	2.94
8	Manganese	0.84	2.31	2.94	3.78	1.89
9	Zinc	0.84	0.21	0.21	0.42	0.21
10	Sodium	298.39	312.69	288.94	471.53	257.54
11	Potassium	29.11	28.83	28.62	31.48	23.90
13	Calcium	112.56	120.33	117.60	125.76	120.75
14	Magnesium	50.19	49.98	42.63	52.92	52.50
15	Boron	11.76	10.5	10.92	12.60	7.56

Table 2: Showing the Chemical parameters of the Borewell water and Municipal water supplied in the study area.

Sl No.	Chemical Parameters	Borewell water	Municipal Water
1	pH	7.41	7.01
2	Sulphur	12.15	9.722
3	Carbonates	13.44	0
4	Bicarbonates	573.88	560.224
5	Chloride	383.40	392
6	Copper	0.21	0.21
7	Iron	4.83	1.05
8	Manganese	3.54	0.84
9	Zinc	0	0.84
10	Sodium	121.95	88.032
11	Potassium	7.224	6.174
13	Calcium	128.73	151.41
14	Magnesium	60.06	55.65
15	Boron	1.26	1.68

CALCIUM

It is an abundant constituent in water. Ca and Mg constitute to the hardness of water. Calcium is abundantly available in rocks and soil and it is the main constituent of calcareous rocks. It is readily available in water. The solubility increases with temperature. Maximum concentration Calcium in the water samples of lake of the present study is 125.76 ppm and minimum of117.60 ppm (WHO 1983).

MAGNESIUM

Magnesium is abundant in dolomites, limestones, magnesites and ferro-magnesian and ultrabasic rocks. Magnesium carbonates and double carbonates are made available from these rocks for solution. Magnesium salts are so soluble that they continue in the solution till the end. Maximum concentration Magnesium in the water samples of lake is 52.92 ppm and minimum of 42.63 ppm.

SODIUM

Sodium and potassium are alkali metals. These are abundant in igneous rocks and are leached from their rocks. Sodium salts are readily soluble in water, and so mainly remains in solution. Essentially, all water contains sodium, water from pure limestone and gypsum beds contain low sodium (1-10 ppm) other water generally contains about 50 ppm for 1000 TDS. In stagnant and water contaminated by sea water sodium concentrations are very high. Maximum concentration Sodium in the water samples of lake is 471.53 ppm and minimum of 257.54 ppm.

POTASSIUM

Potassium minerals are not only abundant in igneous rocks but also in sedimentary rocks. But they are more resistant and besides, recombine with other products when available in solution. So, potassium occurs in lesser quantities in groundwater. In water with low concentration of chemical constituents K and Na ratio is 1:1. When sodium concentration is over 5ppm, the amount of K becomes smaller. Generally, K ranges in water between 10 to 15ppm (Hem 1967). In the present study maximum concentration Sodium in the water samples of lake is 31.98 ppm and minimum of 23.90 ppm.

IRON

The iron released from the chemical disintegration of iron rich minerals like magnetite, hematite, pyroxenes and amphiboles and also soils. Iron is present in less than 0.5 ppm is slightly alkaline water. In the ferric it is present even in lesser (0.1 ppm) concentration. On the other hand, in acid water with pH <3.0 ferric iron may be present in amounts exceeding 100 ppm. Ferrous iron concentrations range between 10 and 50 ppm. The maximum percentage of iron in the lake water is 2. 94 ppm and minimum of 0.84 ppm.

SULPHATES

Sulphur occurs in water as sulphate and sulphides. Sulphates of evaporates and those produced from the weathering of sulphides are the source of soluble sulphates in groundwater. But in the present study the reason for concentration of sulphur may due to the industrial waste water directly disposed to the lake. The maximum concentration of sulphur in the water samples collected from the lake is 94.78 ppm and minimum of 51.04 ppm.

CHLORIDES

Chloride (Cl) is highly soluble anion found in high concentrations in groundwater. The presence of chloride in drinking water is harmless but in excess may affect the taste. The rocks types and minerals due contribute chloride to groundwater but on an average of 6-10 mg/litre (White et al. 1963). The permissible limit of chloride concentrations is 250 ppm/litre. In the present study all the sample are shown beyond the permissible limit. The maximum concentration in the water samples of the lake analysed is 728 ppm and minimum of 504 ppm (ISO 2012).

BORON

Waterborne boron may be adsorbed by soils and sediments. Adsorption–desorption reactions are expected to be the only significant mechanism influencing the fate of boron in water. The extent of boron adsorption depends on the pH of the water and the concentration of boron in solution. The greatest adsorption is generally observed at pH 7.5– 9.0. In the present study the maximum concentration observed is 12.60 ppm and minimum is 7.56 ppm.

MANGANESE

Manganese occurs naturally in many surface and groundwater sources (from the dissolution of manganese oxides, carbonates and silicates in soil and rock. Anthropogenic sources (from industrial discharges, mining activities and landfill leaching) can also be a source of manganese contamination in water. According to Indian Standards for Drinking water (IS 10500:2012) manganese concentration in drinking water is 0.1 ppm (acceptable limit) and 0.3 ppm as permissible limit. In the present study the maximum concentration observed is 3.78ppm and minimum is 0.84 ppm. It shows that the high concentration of manganese in the lake water is due to anthropogenic activities viz improper disposal of municipal waste in to the lake water.

Zinc and Copper in the water samples analyzed are in the permissible limits. The maximum concentration of zinc in the water samples analyzed is 0.84ppm and minimum is 0.21ppm. The copper maximum concentration is 0.63 ppm and minimum is 0.21ppm.

V RESULTS AND DISCUSSION

Water quality data of the present study indicate that most of the chemical parameters are above the permissible limits. Calcium, magnesium, sodium, carbonates and bicarbonates are not having any impact when they present more than the permissible limits. But Zinc, manganese, iron and boron in the present study are beyond the permissible limits (Table 1). This may be due to urbanization and disposal of municipal and industrial waste water directly to the lake. Drinking of this highly polluted water may also have great impact on the birds and aquatic species in the lake. The concentration of manganese is very high in the bore well water analyzed in the present study (Table 2). pH has not much changed though lot of variation has been noticed of other chemical parameters of the lake water.

VI CONCLUSION

The values of various water quality parameters analysed in the study area are shown in Table 1 and 2. The study shows that the Chikkabanavara lake water is so much deteriorated due to the improper disposal of municipal and industrial waste water. In addition to this lake bed encroachment (buffer zone) was also happened due to urbanization. During the field survey we have observed that the lake water was exhibiting a bad smell. Several industries and residential apartments have been set up in and around the Chikkabanavara lake and they have disposed various types waste material into the lake water, The waste water released from the industries and residential apartments is the major cause for the pollution of water in the lake. Though it has been reported in the Newspapers (Prajavai, Deccan Herald and Hindu), the concerned authorities have still not taken any appropriate action to prevent the lake from the pollution. To save this lake it is necessary to educate the people in the surrounding area about the impact pollution on health and environment and methods to restore the lake. There is a need for critical assessment of Chikkabanavara lake water for other toxic metals like cadmium, chromium, mercury and nickel and their impact on the aquatic life.

ACKNOWLEDGEMENT

The authors are thankful to Prof. H P Mahendra Babu, Head of the Department of Civil Engineering, Sir M. Visvesvaraya Institute of Technology, International Airport Road, Bangalore for extending the necessary facilities to carry out this research activity. The authors also like to Anjan Gowda, Sheshan and Harish Babu, Final Year Civil Engineering students of Sir MVIT for their help during field work and sample collection.

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