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Water quality analysis of ground water from locations in North Bangalore

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Abstract

Water quality can be defined as the chemical, physical and biological characteristics of water, usually in respect to its suitability for a designated use. Water has many uses, such as for recreation, drinking, fisheries, agriculture and industry and the quality of the water for each of the above-mentioned uses have different defined chemical, physical and biological standards necessary to support that use. We expect higher standards for water we drink and swim in comparison to that used in agriculture and industry. Water quality standards are put in place to ensure that the water is safe to use and also supports efficient utilisation of water for that specific purpose. Water quality analysis is to measure the required parameters of water, following standard methods, to check whether they are in accordance with the standard and provides us an opportunity to monitor the water quality on a regular basis. Groundwater is generally an excellent source of water for drinking, cleaning, bathing, irrigation and industrial purposes. The quality of water invariably is contaminated in many ways by natural, agricultural and anthropogenic activities with the release large number of pollutants into the water bodies. The objective of this study is to perform qualitative analysis of some physicochemical parameters of groundwater in study area. This may be considered as reference for the society to get cautious about the impending deterioration of their environment and health.

Keywords Water, Quality, Physiochemical

Introduction

Water quality can be defined as the chemical, physical and biological characteristics of water, usually in respect to its suitability for a designated use. As we all know, water has many uses, such as for recreation, drinking, fisheries, agriculture and industry. Each of these designated uses has different defined chemical, physical and biological standards necessary to support that use. We expect higher standards for water we drink and swim in comparison to that used in agriculture and industry. Water quality standards are put in place to ensure the efficient use of water for a designated purpose. Water quality analysis is to measure the required parameters of water, following standard methods, to check whether they are in accordance with the standard. Water quality analysis is required mainly for monitoring purpose. Some importance of such assessment includes to check whether the water quality is in compliance with the standards, and hence, suitable or not for the designated use.

Rapid increase in population along with enhancing trend in industrialization and urbanization has contributed towards rising demand for groundwater in many areas. Groundwater is used for domestic, agriculture and industrial purpose in most parts of the world. In India ponds, rivers and ground water are used for the domestic and agricultural purposes. The quality of water invariably is contaminated in many ways by natural, agricultural and anthropogenic activities with the release large number of pollutants into the water bodies. Groundwater is generally an excellent source of water for drinking, cleaning, bathing, irrigation and industrial purposes. Groundwater quality depends on the quality of recharged water, atmospheric precipitation, in- land surface water, and subsurface geochemical processes (1, 2). Temporal changes in the origin and constitution of the recharged water, hydrologic and human factors, may cause periodic changes in groundwater quality. According to WHO, about 80% of all the diseases in human beings are caused due to contaminated water. Groundwater contamination leads to major disturbance in the quality of water and it cannot be restored just by stopping the pollutants from their sources (3, 4). Groundwater chemistry has been utilized as a tool to outlook water quality for various purposes. The polluted ground water leads to various health problems (5). The objective of this study is to perform qualitative analysis of some physicochemical parameters of groundwater in study area (6). This may be considered as reference for the society to get cautious about the impending deterioration of their environment and health.

The water quality analysis is performed using the techniques Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS) and Most Probable Number (MPN) (7). The Biochemical Oxygen Demand (BOD) is one of the most widely used criteria for water quality assessment. It provides information about the readily biodegradable fraction of the organic load in water. However, this analytical method is time-consuming (generally 5-7 days, this parameter is defined as the amount of oxygen, divided by the volume of the system, taken up through the respiratory activity of microorganisms growing on the organic compounds present in the sample (e.g. water or sludge) when incubated at a specified temperature (usually 20˚C) for a fixed period (usually 5-7 days, BOD) (8). It is a measure of that organic pollution of water which can be degraded biologically. In practice, it is usually expressed in milligrams per litre (mg/l).

Chemical Oxygen Demand (COD) is the second method of estimating how much oxygen would be depleted from a body of receiving water because of bacterial action (8). While the BOD test is performed by using a population of bacteria and other microorganisms to attempt to duplicate what would happen in a natural stream over a period of five days, the COD test uses a strong chemical oxidizing agent (potassium dichromate or potassium permanganate) to chemically oxidize the organic material in the sample of wastewater under conditions of heat and strong acid (10). The COD test has the advantage of not being subject to interference from toxic materials, as well as requiring only two or three hours for test completion, as opposed to five days for the BOD test (11). It has the disadvantage of being completely artificial but is nevertheless considered to yield a result that may be used as the basis upon which to calculate a reasonably accurate and reproducible estimate of the oxygen-demanding properties of a wastewater. The COD test is often used in conjunction with the BOD test to estimate the amount of non-biodegradable organic material in a waste water.

In the case of biodegradable organics, the COD is normally in the range of 1.3 to 1.5 times the BOD. When the result of a COD test is more than twice that of the BOD test, there is good reason to suspect that a significant portion of the organic material in the sample is not biodegradable by ordinary microorganisms. It is important to be aware that the sample may contain leachable mercury above regulatory limit in such case, the sample must be managed as a toxic hazardous waste (12).

Total dissolved solids (TDS) comprise inorganic salts (calcium, magnesium, potassium, sodium, bicarbonates, chlorides, and sulphates) and some small amounts of organic matter that are dissolved in water. The total dissolved solids concentration is the sum of the cations (positively charged) and anions (negatively charged) ions in the water. Therefore, the total dissolved solids test provides a qualitative measure on the number of dissolved ions but does not explain the nature or ion relationships. Therefore, the total dissolved solids test is used as an indicator test to determine the general quality of the water (13). The sources of total dissolved solids can include all the dissolved cations and anions. An elevated total dissolved solids (TDS) concentration is not a health hazard (14). The TDS concentration is a secondary drinking water standard and, therefore, is regulated because it is more of an aesthetic rather than a health hazard. An elevated TDS indicates that the concentration of the dissolved ions may cause the water to be corrosive, salty or brackish taste, result in scale formation, and interfere and decrease efficiency of hot water heaters. Many contain elevated levels of ions that are above the Primary or Secondary Drinking Water Standards, such as an elevated level of nitrate, arsenic, aluminium, copper, lead, etc.

Natural water (rivers, lakes etc.) contains microorganisms but groundwater has fewer microorganisms than surface water because of its long travel time in the subsurface environment. Ground water in general is fresh and clean. Coliform bacteria are the most commonly associated with water quality. Coliforms are defined as facultative anaerobic, gram-negative, non-sporing, rod-shaped bacteria that ferment lactose with gas formation within 48 hours at 35˚C. Coliforms, including Escherichia coli, are members of the family Enterobacteriaceae, which also includes Enterobacter aerogenes and Klebsiella pneumoniae (15). If such bacteria are not detectable in water in 100ml, the water can be claimed to be potable. These bacteria makeup approximately 10% of the intestinal microorganisms of humans and other animals were found widespread used as indicator organism and regarded as the faecal type of Coliform.

More than five million people die from water related diseases every year and about 50% population of the developing countries are exposed to polluted water resources. Bacterial population is often considered as an important indicator of pollution. The total number of Coliform bacteria indicates the degree of pollution. In India, 80% of the infectious diseases are water-borne such as typhoid, cholera, dysentery and infectious hepatitis, which are due to the contaminated water. Therefore, the present study was aimed to analyse the quality and properties of groundwater in the selected locations, the consumption of contaminated groundwater may lead to many health hazards.

Materials and Method

Study Area

The study area comprises of locations in North Bangalore which lies between 12° 58' to 12.90', north latitudes and 77° 34' to 77.58' east longitudes. It is located at an altitude of 914 meters above means sea level. The samples were collected from the regions of Kothanur, Ulsoor, Babusapalya, R.T. Nagar, and Lingarajapuram (16).

Sample Collection and analysis

Water samples from these selected locations were collected from tube well and open well source. The sample collection was carried out in a good quality polyethylene bottle of one-litre capacity. Samples were analysed in the laboratory for different physiochemical parameters. The sample was analysed for the following parameters total dissolved solids (TDS), Dissolved oxygen (DO), Biochemical oxygen demand (BOD) and Chemical oxygen demand (COD) in addition to pH, Ca, Mg, HCO_3, Cl^-, $SO_4^{2-}$and Total Hardness. The results were compared with WHO standard values (17, 18). The samples collected for analysis were from five areas in North Bangalore and drawn from three different points of water collection in that area.

The collected sample was analysed to check the quality of the water which was collected from the various locations.

Biological Oxygen Demand

The water sample was collected from underground source. It was carefully filled in respective BOD bottles without allowing air bubbles. Following which 2ml of manganese sulphate was added to the BOD bottle carefully by inserting the pipette just below the surface of water. This will avoid the formation of air bubbles. About 2 ml of alkaline Potassium Iodide reagent was added in the same manner. The bottle was closed and the contents were mixed by inverting many times. A brownish cloud would appear in the solution as an indicator of the presence of Oxygen. The brown precipitate was allowed to settle to the bottom of the bottle. About 2ml of conc.H_2SO_4 was carefully added without forming air bubbles. The bottle was closed and the contents were mixed well to dissolve the precipitate. The bottle was incubated in BOD incubator for 7 days of incubation.

After incubation, 50 ml of sample water was titrated with 0.025N sodium thiosulphate to a pale-yellow colour, followed by 2ml of starch solution. So, the sample turns blue in colour.

The titration was continued till the sample becomes colourless; the concordant values were recorded. The concentration of dissolved oxygen in the sample is equivalent to the number of millilitres of titrant used.

Chemical Oxygen Demand

Water sample collected is used for the analysis, 10ml of sample was taken in three 100 ml conical flask labelled as Test1, Test2, and Test3. Simultaneously the distilled water was taken in three 100ml conical flask labelled as Blank1, Blank2 and Blank3. To this 5ml of potassium dichromate solution was added in each of the six conical flasks. The flasks were incubated in water bath at 100°C (boiling temperature) for 1 hour. The samples were allowed to cool for 10 minutes, followed by addition of 5ml potassium iodide and 10ml of sulphuric acid in each flask. The contents of each flask are titrated with 0.1N Sodium thiosulphate until the blue colour disappear completely.

Total Dissolved Solids

The sample evaporating dish is cleaned such that it does not contain any residue from a previous use. An acid rinse of the inside surface of the evaporating dish can be done with approximately 3-5 ml of concentrated hydrochloric acid.

The clean evaporating dish is dried in a convention oven at a temperature of 180 ± 2°C for no less than 60 minutes. It is cooled to room temperature after which it is weighed to record the weight - this is the tarred weight of the dish. 50 ml of the sample is added to the evaporating dish and allowed to evaporate completely.

The weight of the dish with the salts is recorded.

The total solids are calculated using the formula,

Total Solids, as mg TS/L [(A-D) × 1,000]/ S

where A = final 180°C weight of the dried residue + the tarred dish, mg, D = tarred dish weight, mg, and S = ml of sample volume.

Physicochemical analysis

Analysis was carried out for various water quality parameters such as pH, Ca, Mg, HCO_3, Cl, SO_4^{2-} and Total Hardness. The pH, temperature and conductivity were determined immediately after sampling and the sample was stored at a temperature below 4°C, this is to prevent the growth of microorganisms (19).

Total Hardness

Hardness of all the water samples was tested by using EDTA-tritrimetric method by taking 50ml of water sample into a conical flask along with 10ml of ammonia buffer solution and 100-200-mg of Erichrome black- T indicator followed by tiatration with EDTA solution present in a burette. End point is noted down by changing of the water solution colour from wine red to blue and expressed as CaCO3 equivalent in mg/l. Amount of Hardness in water is calculated by using the formula (20).

Hardness as mg/l CaCO3= ml of EDTA solution used x 1000/ Volume of water samples

Most Probable Number

Preparation of the Medium

Prepare medium (either Mac Conkey broth or Lactose broth) in single and double strength concentration.

For untreated or polluted water

Dispense the double strength medium in 10 tubes (10ml in each tube) and single strength medium in 5 tubes (10 ml in each tube) and a Durham's tube is added in inverted position.

For treated water

Dispense the double strength medium in 5 tubes (10ml in each tube) and 50 ml single strength medium in 1 bottle and add a Durham's tube in inverted position. Examine the tubes to make sure that the inner vial is full of liquid with no air bubbles. Sterilize by autoclaving at 15lbs pressure (121°C) for 15 minutes.

Procedure for untreated water

Take 5 tubes of double strength and 10 tubes of single strength for each water sample to be tested. Using a sterile pipette add 10 ml of water to 5 tubes containing 10 ml double strength medium. Similarly add 1 ml of water to 5 tubes containing 10 ml double strength medium and 0.1 ml water to remaining 5 tubes containing 10 ml double strength medium. Incubate all the tubes at 37°C for 24 hrs. If no tubes appear positive re-incubate up to 48 hrs. Compare the number of tubes giving positive reaction to a standard chart and record the number of bacteria present in it.

Results and Discussion

Sample Sites

The sample locations and sources used for water quality analysis was depicted in Table 1. Three samples were collected from each location from open as well as tube wells.

Table 1: Groundwater sample location

S.No.	Sampling Location	Sample No	Source	
			Tube well	Open well
1.	Kothanur	3	2	1
2.	Babusapalya	3	1	2
3.	Ulsoor	3	1	2
4.	R.T. Nagar	3	2	1
5.	Lingarajapuram	3	3	-

Table 2: BOD Analysis of ground water sample

S.No.	Samples	Day 1	Day 7	Oxygen Demand
1.	Control	0	0	0
2.	Kothanur Sample 1	0.5	0.1	0.0008
3.	Kothanur Sample 2	0.6	0.1	0.001
4.	Kothanur Sample 3	0.7	0.2	0.001
5.	Babusapalya Sample 1	0.5	0.1	0.0008
6.	Babusapalya Sample 2	0.4	0.2	0.0004
7.	Babusapalya Sample 3	0.6	0.2	0.0004
8.	Ulsoor Sample 1	0.3	0	0.0006
9.	Ulsoor Sample 2	0.2	0	0.0004
10.	Ulsoor Sample 3	0.2	0	0.0004
11.	R T Nagar Sample 1	0.3	0.1	0.0004
12.	R T Nagar Sample 2	0.3	0.1	0.0004
13.	R T Nagar Sample 3	0.2	0	0.0004
14.	Lingarajpuram Sample1	0.4	0.1	0.0006
15.	Lingarajpuram Sample 2	0.2	0.1	0.0002
16.	Lingarajpuram Sample 3	0.1	0	0.0002

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Biological Oxygen Demand

The BOD values ranged from 0.0002 to 0.001 ppm. The BOD values for all water samples were found below the prescribed limit WHO (10ppm) Table 2. This indicates that the water is of good quality and is portable. BOD is done to determine the pollution strength of domestic and industrial wastewaters in terms of the oxygen that they will require if discharged into natural watercourses in which aerobic conditions exist (Figure 1). The samples were extracted from the regions of Kothanur, Ulsoor, Babusapalya, R.T. Nagar, and Lingarajapuram, Bangalore, among which, it is noticed that Kothanur has the highest range of Oxygen Demand (Figure 2), indicating presence of putrescible organic matter in water (data represents mean value±S.D, * p value between 0.05 and 0.01, significant at 5% ANOVA).

Figure 1. BOD sample bottles

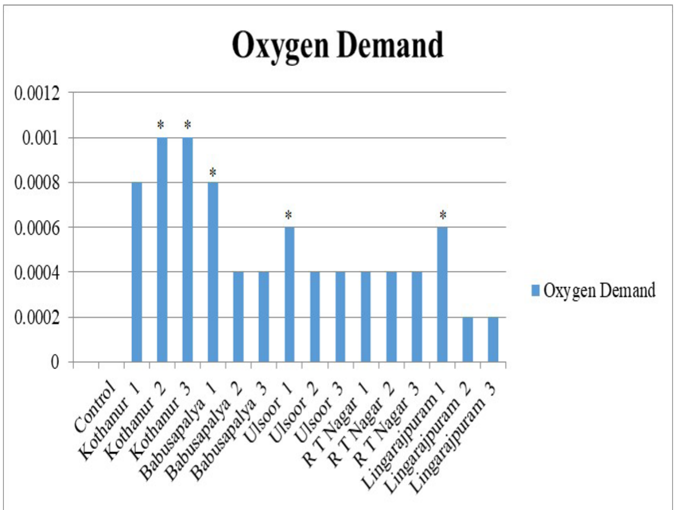

Figure 2. Graphical representation of BOD of ground water sample

Chemical Oxygen Demand

Chemical Oxygen Demand is often used in conjunction with the BOD test to estimate the amount of non-biodegradable organic material in a wastewater. In the present study the COD values are ranged from 4.5 to 7.5 ppm and below the permissible limit set by WHO (10ppm). COD is used to determine the quantity of pollution in water after wastewater treatment. The higher value of chemical oxygen demand indicates the higher organic pollution in the water sample (Figure 3). Only chemically digest able matter can be determined by the COD test. The samples were collected from the regions of Lingarajapuram, Ulsoor, Babusapalya, R.T. Nagar, and Kothanur, Bangalore. Among which, it was noticed that Babusapalya has the highest demand which means there is a greater amount of oxidizable organic material in the sample compared to the other samples, which will reduce dissolved oxygen (DO) levels Table 3 and Figure 4 (data represents mean value±S.D, * p value between 0.05 and 0.01, significant at 5% ANOVA).

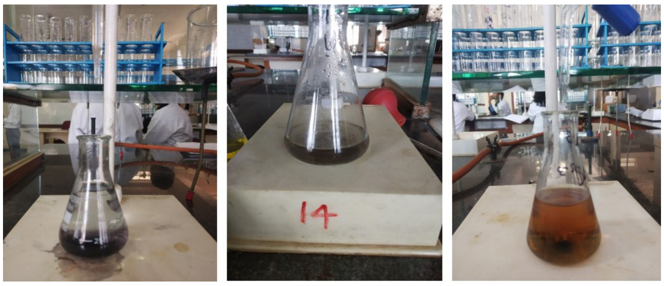

Figure 3. COD Analysis of ground water sample

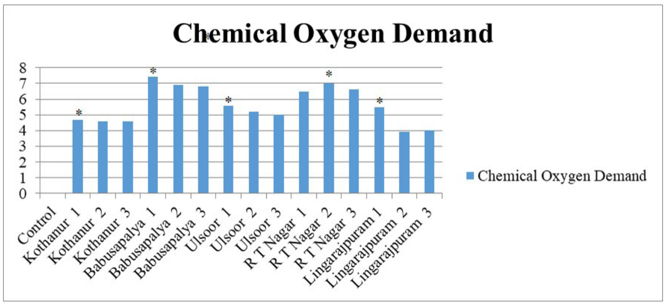

Figure 4. Graphical representation of COD of ground water sample

Table 3. COD Analysis of ground water sample

S. No.	Samples	Titre I (ml)	Titre II (ml)	Titre III (ml)	Concordant value (ml)
1.	Control	0	0	0	0
2.	Kothanur Sample 1	4.7	4.7	5	4.7
3.	Kothanur Sample 2	4.8	4.6	4.6	4.6
4.	Kothanur Sample 3	4.5	4.6	4.6	4.6
5.	Babusapalya Sample 1	7.4	7.4	7.4	7.4
6.	Babusapalya Sample 2	6.9	6.9	6.6	6.9
7.	Babusapalya Sample 3	7	6.8	6.8	6.8
8.	Ulsoor Sample 1	5.6	5.6	5.6	5.6
9.	Ulsoor Sample 2	5.2	5.2	5.3	5.2
10.	Ulsoor Sample 3	5	4.8	5	5.0
11.	R T Nagar Sample 1	6.5	6.5	6.5	6.5
12.	R T Nagar Sample 2	6.9	7	7	7.0
13.	R T Nagar Sample 3	6.6	6.6	6.7	6.6
14.	Lingarajpuram Sample1	5	5.5	5.5	5.5
15.	Lingarajpuram Sample 2	3.5	3.9	3.9	3.9
16.	Lingarajpuram Sample 3	4	4	4	4

Total Dissolved Solids

Total dissolved solids indicate the salinity behaviour of water. Water containing more than 500 ppm of TDS is not considered desirable for drinking water supplies. TDS values varied from 182 to 590 ppm. In the present investigation TDS values are showed higher than the prescribed limit given by WHO. The TDS concentration was found to be above the permissible limit may be due to the leaching of various pollutants into the ground water which can decrease the portability and may cause gastrointestinal irritation in human and may also have laxative effect (21). High level of TDS may aesthetically be unsatisfactory for bathing and washing. The accumulation of organic and inorganic solids also contributes to high total dissolved solids (Figure 5). The samples were extracted from the regions of Lingarajapuram, Ulsoor, Babusapalya, R.T. Nagar, and Kothanur, Bangalore. Among which, it is noticed that Babusapalya had the highest level of dissolved solids and Ulsoor has the lowest number of dissolved solids Table 4 and Figure 6 (data represents mean value±S.D, * p value between 0.05 and 0.01, significant at 5% ANOVA).

Figure 5. TDS of ground water sample Physicochemical analysis

Table 4. TDS of ground water sample

S. No.	Samples	Result in grams	Dissolved salts in ppm
1.	Kothanur Sample 1	0.41 g	410
2.	Kothanur Sample 2	0.45 g	450
3.	Kothanur Sample 3	0.49 g	490
4.	Babusapalya Sample 1	0.54 g	540
5.	Babusapalya Sample 2	0.59 g	590
6.	Babusapalya Sample 3	0.51 g	510
7.	Ulsoor Sample 1	0.18 g	180
8.	Ulsoor Sample 2	0.33 g	330
9.	Ulsoor Sample 3	0.26 g	260
10.	RT Nagar Sample 1	0.34 g	340
11.	RT Nagar Sample 2	0.28 g	280
12.	RT Nagar Sample 3	0.22 g	220
13.	Lingarajpuram Sample 1	0.20 g	200
14.	Lingarajpuram Sample 2	0.32 g	320
15.	Lingarajpuram Sample 3	0.29 g	290

The pH range of water sample varied from 6.73-8.3 possess wide concentration of various physicochemical parameters. The range of calcium concentration in the groundwater is dependent on solubility of CaCO3, sulphates and very rarely chlorides. The solubility of CaCO3 depends upon the partial pressure of CO2 in the atmosphere, calcium ranges from 10.2 mg/L to 290.9 mg/L. The Mg ion was determined between 8.1 mg/L and 410.7 mg/L. Total hardness of water is a measure of dissolved Ca and Mg in water expressed as CaCO3, in present study we found that bicarbonates range from 149 mg/L to 767 mg/L and chloride is higher during summer (2422 mg/L) due to leaching of upper layer of soil in dry climates, higher SO42- is noted with concentration of (2301 mg/L). Water is considered as "hard" when the measured hardness exceeds 120 mg/L (22). The ground water quality has been evaluated for the concentrations of various chemical compounds and further categorised as suitable and unsuitable for drinking purpose (Table 5).

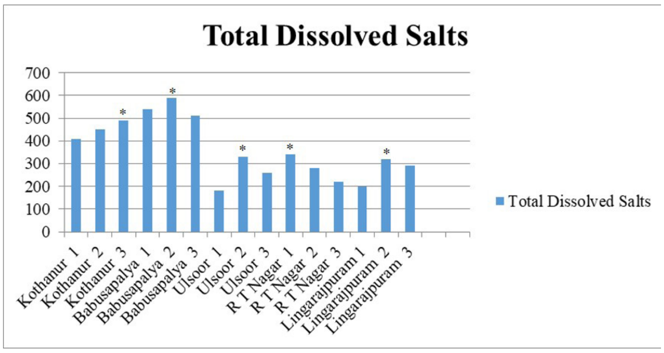

Figure 6. Graphical representation of TDS of ground water sample

Table 5: Physicochemical parameters of the ground water samples

Sample Locations	pH	Ca2+ mg/ L	Mg2+ mg/ L	HCO3 mg/ L	Cl- mg/ L	SO_4^{2-} mg/ L	Total Hardness Mg/ L	Suitability for drinking
Kothanur Sample 1	7.60	12.0	31.8	389	90	182	163	Suitable
Kothanur Sample 2	8.02	30.1	20.6	341	71	152	162	Suitable
Kothanur Sample 3	8.3	32.1	21.7	222	122	151	175	Suitable
Babusapalya Sample 1	7.42	20.0	30.2	246	212	256	176	Suitable
Babusapalya Sample 2	6.73	118.2	410.7	563	2329	2301	2028	Unsuitable
Babusapalya Sample 3	7.12	264.5	287.6	304	1825	723	1886	Unsuitable
Ulsoor Sample 1	7.14	172.3	136.6	354	915	952	1201	Unsuitable
Ulsoor Sample 2	7.43	24.0	51.3	234	173	301	265	Suitable
Ulsoor Sample 3	7.35	60.1	48.3	149	296	364	345	Suitable
RT Nagar Sample 1	7.04	290.9	241.1	466	2241	952	1736	Unsuitable
RT Nagar Sample 2	7.56	18.0	29.1	334	102	150	164	Suitable
RT Nagar Sample 3	8.28	262.5	269.2	511	2422	840	1671	Unsuitable
Lingarajpuram Sample 1	7.32	10.2	8.1	621	71	126	50	Suitable
Lingarajpuram Sample 2	8.17	12.0	12.1	767	142	176	70	Suitable
Lingarajpuram Sample 3	7.3	36.1	16.2	405	175	218	150	Suitable

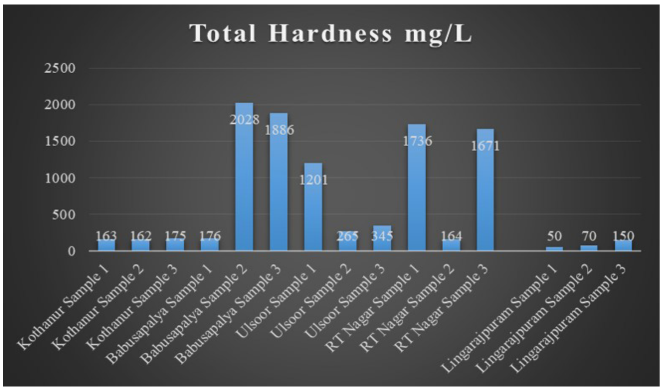

Figure 7. Graphical representation of total hardness of ground water samples mg/L

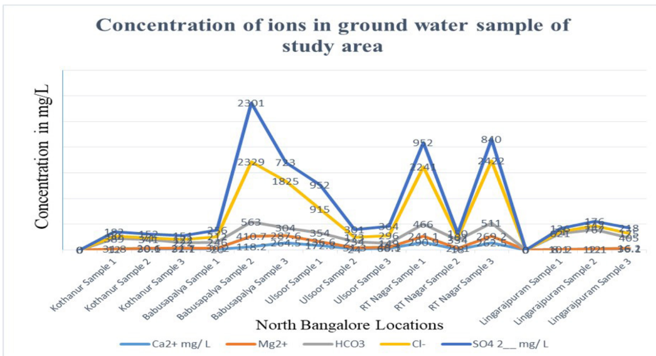

Figure 8. Graphical representation of ion concentration in ground water samples

The formation of 10% gas or more in the Durham's tube within 24 to 48 hours, together with turbidity in the growth medium and the colour change in the medium constitutes of positive presumptive test for coliform bacteria which infers possible contamination of water samples with faecal matter. No growth or formation of gas in the tube was observed which results in absence of coliforms Table 6, Figure 9 (data represents mean value±S.D, * p value between 0.05 and 0.01, significant at 5% ANOVA).

Table 6. MPN Analysis of ground water sample

Broth solution used (ml)			10ml		5ml							MPN Index per 100ml
Concentration of Broth			2X		1X							
	Samples used (ml)		10ml		1ml				0.1ml			
S no	Samples											
1.	Kothanur Sample 1	No. of bubbles	1	1	1	0	0	1	0	0	0	11
2.	Kothanur Sample 2	No. of bubbles	1	1	0	1	0	1	0	0	0	9
3.	Kothanur Sample 3	No. of bubbles	1	1	1	0	0	0	0	0	0	8
4.	Babusapalya Sample 1	No. of bubbles	0	1	1	1	0	0	0	0	1	9
5.	Babusapalya Sample 2	No. of bubbles	1	1	1	0	0	1	0	0	0	11
6.	Babusapalya Sample 3	No. of bubbles	1	1	1	0	0	1	0	0	0	11
7.	Ulsoor Sample 1	No. of bubbles	1	1	1	0	1	1	0	0	1	17
8.	Ulsoor Sample 2	No. of bubbles	1	1	1	0	1	1	0	0	0	14
9.	Ulsoor Sample 3	No. of bubbles	1	1	1	1	0	0	0	1	0	14
10.	RT Nagar Sample 1	No. of bubbles	1	0	0	0	0	0	0	0	0	2
11.	RT Nagar Sample 2	No. of bubbles	0	1	0	0	0	0	0	1	0	4
12.	RT Nagar Sample 3	No. of bubbles	0	1	0	0	1	0	0	0	0	4
13.	Lingarajpuram Sample 1	No. of bubbles	1	1	1	1	0	1	0	0	1	17
14	Lingarajpuram Sample 2	No. of bubbles	1	1	1	1	0	0	0	0	1	14
15.	Lingarajpuram Sample 3	No. of bubbles	1	1	1	0	1	1	0	0	0	14

If coliform bacteria are present in your drinking water, your risk of contracting a water-borne illness is increased. Although total coliforms can come from sources other than faecal matter, a positive total coliform sample should be considered an indication of pollution in your well. The samples were extracted from the regions of Lingarajapuram, Ulsoor, Babusapalya, R.T. Nagar, and Kothanur, Bangalore. Among which most of the tubes from each sample has been found to be positive for the presumptive test for coliform bacteria, it is completely unfit for consumption and can be used for other domestic purposes.

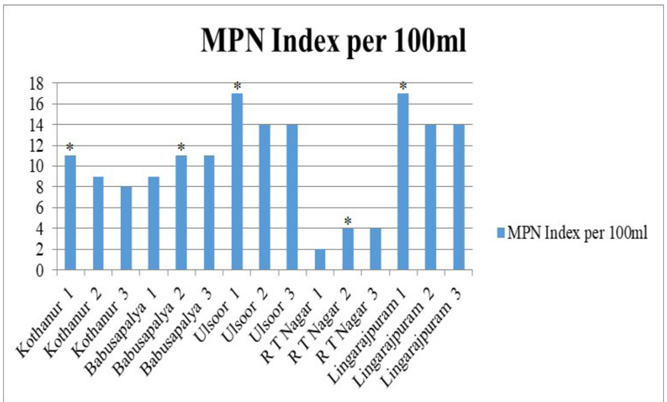

Figure 9. Graphical representation of MPN Analysis of ground water sample

Conclusion

The ground water samples were collected from five different locations in North Bangalore. The samples were subjected to physicochemical analysis where the results showed that most of the parameters like TDS, BOD, COD and MPN are well below the permissible limit prescribed by WHO. Further the ground water quality has been evaluated for the allowed concentrations of various chemical compounds and further categorised as suitable and unsuitable for drinking purpose. It is advisable that the ground water sample which falls under the suitable category must be boiled or purified before using for drinking purposes, while they can be used for other domestic purposes as well.

These experiments were done to provide people awareness on the water quality of ground water in their area. Also, to give an insight on importance of sanitation and economical water treatment methods like filtration and boiling which would prove beneficial for improving the quality of water being used and to avoid waterborne disease. The remedial measure must be taken to safeguard and conserve the precious water resources from pollution for future generation.

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