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WATER QUALITY ASSESSMENT OF BORE WELL WATER FOR DRINKING PURPOSE IN AND AROUND MRIT AND PALAHALLI, MANDYA

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Abstract: This study focuses on assessing the quality of bore well water in and around MRIT and Palahalli, Mandya, to evaluate its suitability for drinking purposes. Groundwater samples were collected from 29 bore wells and analysed for physical-chemical parameters such as pH, turbidity, total dissolved solids (TDS), total hardness, calcium hardness, alkalinity, chlorides, sulphates, nitrates, fluorides, and iron. Standard methods of water testing were applied and results were compared with ISI and WHO standards for drinking water. The findings reveal that while some parameters such as pH, fluorides, nitrates, and sulphates mostly fall within permissible limits, others including turbidity, alkalinity, calcium hardness, TDS, and chlorides often exceeded safe limits. This indicates that the groundwater in several locations is not fit for direct consumption without treatment. The study highlights the urgent need for water treatment and sustainable management practices to ensure safe drinking water in the region.

***IndexTerms* –pH, Turbidity,TDS, Total hardness.**

I. INTRODUCTION

1.1 General

Having safe drinking water and basic sanitation is a human need and right for every man, woman and child. People need clean water and sanitation to maintain their health and dignity. Having better water and sanitation is essential in breaking the cycle of poverty since it improve people's health and strength to work. Groundwater quality plays an important role in quality conservation. Hence, it is very important to assess groundwater quality not only for its present use but also from the viewpoint of a potential source of water for future consumption. It is well known that occurrence of groundwater in which it occurs as well as geological structure, geomorphology and hydrological setting and hydrometer logical condition.

The effect of acid rain on the groundwater depends on the ability of soils to neutralize the acid. Limestone and other rocks and soil containing calcium carbonate are most effective Water quality analysis is one of the most important aspects groundwater studies. Purandara et al., (2014) explain the modern agricultural practices give rise to large quantities of water soluble contaminants which in turn are applied frequently to the soil surface for irrigation.

The chemical composition of ground water is controlled by many factors that include the composition of precipitation, mineralogy of the watershed and aquifers, climate and topography.

These factors can combine to create diverse water types that change in composition spatially and temporally. Generally, the approach is to divide the samples into hydro-chemical faces that is groups of samples with similar chemical characteristics that can then be correlated with location. Paul et al., (2013) provide a simple and concise method for expressing the water quality for different usage in the project. Akshay Kotan et al., (2018) explains the physico-chemical parameters of the all well water samples, analysed for all the parameters, Most of the samples in this location are found acidic in nature and Water Quality Index acts as a decision support system to take up preventive and mitigation measures in the areas of poor quality.

The hydro-chemical study reveals quality of water that is suitable for drinking, agricultural and industrial purpose. Groundwater often consists of seven major chemical elements-Ca^{2+}, Mg^{2+} Cl, K^{+} and SO_4^{-2}. The chemical parameters of groundwater play a significant role in classifying and assessing water quality.

1.2 Drinking water quality

BIS has set specifications in it IS-10500 standards for drinking water. The revised edition of IS 10500: 2012 standard shall be followed in Uniform Drinking Water Quality Monitoring protocol. Some parameters apart from those mentioned in IS 10500: 2012 may also be measured if the States deem it necessary. This standard has two limits i.e. desirable limits and maximum permissible or cause for rejection limits. If any parameter exceeds the cause for rejection limit, that water is considered unfit for human consumption.

Three sources that are used to collect drinking water are:

1 Ground water -Water that fills the spaces between rocks and soil making an aquifer. Ground water depth and quality varies from place to place. About half of the world's drinking water comes from the ground.

2 Surface water-Water that is taken directly from a stream, river, lake, pond, spring or similar source. Surface water quality is generally unsafe to drink without treatment.

3 Rainwater-Water that is collected and stored using a roof top, ground surface or rock. The quality of rain water collected from a roof surface is usually better than a ground surface.

1.3 Importance of the study

Urban and Rural development has taken insufficient account of local hydrological and hydro- geological condition. Research in precipitation chemistry has intensified in recent years because of increased awareness of the actual and positional ecological and economic problems caused by acid rain. Recently, acid rain problems have also extended to Asia, because of significant increase in atmospheric emission resulting from industries and automobiles. Therefore, it is important that acid rain monitoring be conducted in urban and rural areas. The chemical composition of groundwater was the combined result of the composition of rain water that enters the groundwater reservoir with minerals present in the soil that may modify the water composition. Apart from the natural processes as controlling factors on the groundwater quality, lately the effect of pollution due to acid rain and nitrites from fertilizes also influences the groundwater chemistry. Water samples were collected from selected from selected Bore wells, Mini well for water quality analysis. The analysis result indicates that in general the quantity of ground water is potable for drinking purpose.

1.4 Need of drinking water quality testing

The following are common reasons to do water quality testing at the household level: Ensure safe drinking water.

1. Identify problems.
2. Adopt precautionary measures.
3. Raise awareness.
4. Select an appropriate water source.

Household water treatment and safe storage is becoming a popular option for obtain safe water. Different processes and technologies such as the bio sand filter, ceramic filter, solar disinfection (SODIS) and chlorination are being introduced from different governmental and non-governmental organizations (NGOs). Water quality tests are very useful in understanding the difference between source water, treated water and stored water quality.

1.5 Water Quality Index

The water quality index reduces technical water quality information to a simple description of the state of water quality. The ranks water quality into one of five categories: excellent, good, fair, borderline, and poor, each category describes the state of water quality compared to objectives that usually represent the natural state. The Index thus indicates the degree to which the natural water quality is affected by human activity. The results of water quality objectives attainment are used as the basis for the water quality index.

1.6 Ground water pollution

Groundwater is precious and the most widely distributed resources of the earth, if gets it's annual replenishment from the meteoric precipitation. The ground water is the largest source of fresh water on the planet excluding the polar ice caps and glaciers. The amount of groundwater within the 800m from the ground surface is over 30 times the amount in all freshwater lakes and reservoirs, and about 300 times the in stream channel.

The rainfall that percolates below the ground surface passes through the voids of the soil as well as rock and joints and reaches the water table, These voids are generally interconnected, permitting the movement of the groundwater, But in some rock they may be isolated and thus, preventing the movement of the water between interstices, Evidently the mode of occurrence of groundwater depends upon the type of formation and hence, upon the geology of the area.

Ground water is a national asset available in a finite quantity one cannot afford to forget that if one cannot afford to polluted air which is available in unlimited quantities, much less can afford to the liberties with the use if the limited asset if the water. Sources of contamination can be divided basically into two groups natural and cultural (these caused by man). The sources can be further classified as either as either point or diffused (nonpoint) source of pollution, point sources enter the pollution transport routes as discrete, identifiable locations and can be measured directly or otherwise quantified and there impacts can be evaluated directly. Major point sources include effluent from buildings or solid waste disposal sites.

There are many sources that contribute contaminants to the ground water zone. The major sources which contribute to pollution problem are.

- Land disposal of solid wastes
- Sewage disposal on land
- Agricultural activities
- Deep-well disposal of a liquid wastes
- Petroleum leakage and spills
- Urban runoff and polluted surface water
- Mining activity
- Radiological sources.

1.7 Objectives

- To collect field Data at the selected sampling points and analyze the sample, required for Water quality assessment.
- To determine the groundwater quality and it's suitability for the domestic use at kothathi hobli.
- To propose different treatability and discharge options to maintain targeted water quality criteria in the ground water stretches

II. STUDY AREA

2.1 Details of Study Area

The main objective of project work is to compare the ground water quality in and around MRIT and palahalli, Mandya with drinking water standards for the study purpose. In and around Palahalli borewells selected as the study area. This was chosen, because in palahalli more use of Borewell water for drinking and domestic purpose. There are 29 Borewells.

2.2 Location of Study Area

The total geographical area of village is 604.04 hectares. Palahalli has a total population of 6,000 people. There are about 1200 houses in palahalli village. As per 2019 status, palahalli villages comes under Srirangapatna assembly & Mandya parliamentary constituency. Srirangapatna is nearest town to palahalli which is approximately 5km away.

Palahalli is a village panchayat located in the Mandya district of Karnataka state, India. The latitude 12.4179655 and longitude 76.6946782 are the geocoordinate of the palahalli village.

Area Sq.kms: 55.83 Sq.kms

Population: 6000 people

Number of Borewells: 29

III. METHADOLOGY

The detail methodology of the project is as shown in the flow chart.

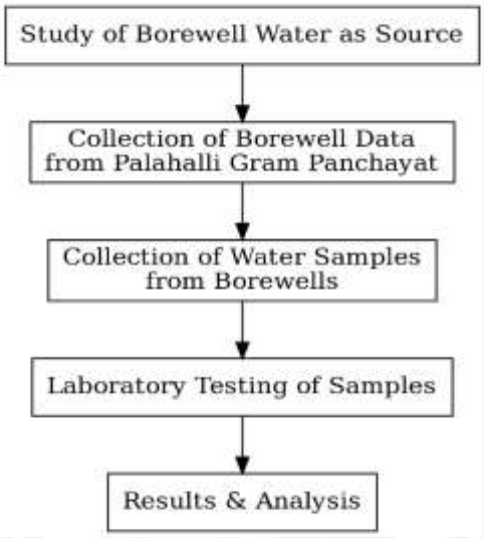

Table 3.1: Methodology used for assessment of borewell water

3.1 COLLECTION OF SAMPLES

3.1.1Collection of Samples and Storage

It is important to collect water samples under normal, everyday conditions, in order to gain a representative sample. Proper procedures for collecting samples must also be observed. Samples should be collected in a plastic container with a screw cap that will mistake or if multiple tests are required.

The basic procedure for collecting a drinking water sample is as follows:

- Use sample containers only for water samples and never for the storage of chemicals or other liquids
- Use sample containers for microbiological testing only for that purpose
- Use sterile sample containers for microbiological testing. Sample containers for chemical and physical testing need to be clean, but not sterile.
- Label the container before sampling
- Wash or disinfect your hands before opening the sample container or wear disposable gloves if available
- Do not touch the inside of the sample container or cap with your fingers or any other object
- Do not rinse the sample container since it is sterile
- Keep the sample container cap in a clean place (not on the ground) to prevent contamination at any time that the sample container is open

3.1.2 Sampling of Ground water

Remove any attachments (e.g., nozzles, pipes, screens) from the pump outlet. These attachments are a frequent source of contamination. Pump the water for four to five minutes (it depends on depth of the well, it may take up to 10 minutes) to remove standing water from the plumbing system or rising main of the pump. You can usually tell the standing water is removed when colder water comes through the pump. Take the water sample as soon as possible after pumping.

Carefully remove the cap from the container and put it facing up in a clean place or ask somebody to hold it. Take care to prevent dust from entering the container or anything else that may contaminate the sample. Hold the sample container under the water flow to fill it. Leave an air space in the container. This allows space for mixing the water sample before analysis. Put the cap back on the container.

Groundwater samples were collected in polythene containers of two litre capacity. These containers were carefully cleaned using Hydrochloric acid and thoroughly rinsed in tap water and distilled water before collecting the samples. Prior to the collection of sample, the bore well water was discharged for 5 minutes and the containers were rinsed two to three times in the sample water to be collected in order to achieve true representative of the existing condition and securely scaled. Sampling of water was done as per standard methods.

3.1.3 Test Procedure

The water sample were analyzed for pH, TDS, total hardness, calcium, chloride, iron, sulphate, fluoride, calcium, magnesium, Nitrate were analyzed.

Before starting water quality analysis, each sample container was brought to room temperature in the laboratory. Then required amount of water was taken for the analysis depending on the type of parameter. Similarly quality parameters of the bore wells samples were determined as per standard methods. The soil samples were analyzed for pH, sieve analysis, density, moisture content, permeability, specific gravity. Also heavy metals like copper, cadmium, manganese.

Fig 3.1: Conducting pH in lab

Calibrate the pH meter by using Buffer solution. Press Cal button and put pH7 buffer solution and immerse the electrode for 1 or 2 min. after pH 7 wash the electrode with distilled water and wipe with tissue paper. Put pH 4 or pH 9.2 buffer solution and press enter button. (A buffer solution is a solution offering resistance to change in pH and whose pH value is known. The reading is taken after the indicated value remains constant for about a minute.

Fig 3.2: Spectrophotometer

Select Nitrate by using up and down arrow key or Press 265 button and Enter button. Take 10 ml of distilled water in a cuvette and keep it in a sample chamber and press Zero button and calculate nitrates as N in mg/l.

Select Iron by using up and down arrow key or Press 222 button and Enter button. Take 10 ml of distilled water in a cuvette and keep it in a sample chamber and press ZERO button. After zero setting take 10 ml of water or wastewater sample in another cuvette. Weight for 3 min. and note down the Iron concentration in mg/L using spectrophotometer.

IV. STANDARDS FOR DRINKING WATER

Parameter	Indian Standards (IS 10500-1983)		ICMR		WHO	
	Permissible limit	Excessive limit	Permissible limit	Excessive limit	Permissible limit	Excessive limit
Physical:						
Colour (units)	10	50	5	25	5	50
Turbidity(NTU)	10	25	5	25	5	25
Chemical:						
pH	6.5- 8.5	6.5 - 9.2	7.0 - 8.5	6.5 - 9.2	7.0 - 8.5	6.5 - 9.2
Total solids	--	--	--	--	500	1500
Total hardness	300	600	300	600	--	--
Calcium	75	200	75	200	75	200
Magnesium	30	100	50	150	50	150
Iron	0.3	1.0	0.3	1.0	0.3	1.0
Chlorides	250	1000	250	1000	200	600
Sulphates	150	400	200	400	200	400
Nitrate	45	--	20	50	--	50-100
Fluoride	0.5-1.2	--	1.0	2.0	0.5	1.0-1.5
Alkalinity	200	600	--	--	200	600

Table 4.1: Standards for Drinking Water

V. RESULTS AND DISCUSSION

The study was conducted in and around Kothathi hobli , Bore well water samples were collected and analyzed in laboratory according to the method depicted in standard methods.Water quality parameters were analyzed for following parameters – pH, TDS, Total Hardness, Calcium Hardness, Chlorides, Iron, Sulphates, Nitrates, Fluorides, Alkalinity, Turbidity.

5.1 Results of various borewell water samples

SAMPLE NO	pH	Turbidity NTU	Alkalinity (Mg/l)	Total hardness (Mg/l)	Calcium hardness (Mg/l)	Chlorides (Mg/l)	Total Dissolved Solids (Mg/l)	Nitrates (Mg/l)	Remarks
1	6.61	6.7	484	392	292	438	840	12	Not safe for drinking
2	6.53	8.2	432	332	324	115.7	342	19	Not safe for drinking
3	6.59	4.6	328	756	620	171.9	1210	28	Not safe for drinking
4	7.08	5.5	368	288	236	148.9	236	14	Not safe for drinking
5	6.63	3.2	216	428	152	167.5	492	16	Safe for drinking
6	6.93	4.9	384	276	172	159.57	566	21	Not safe for drinking
7	6.51	2.4	356	248	180	141.7	406	18	Not safe for drinking
8	6.73	1.8	208	412	160	214	420	23	safe for drinking
9	6.86	3.3	416	652	180	194.6	857	15	Not safe for drinking
10	6.82	7.8	544	916	132	415.02	286	26	Not safe for drinking
11	6.96	6.1	396	286	280	79.92	332	17	Not safe for drinking
12	6.94	1.7	568	480	260	206.5	292	31	Not safe for drinking
13	6.94	2.4	420	300	120	186.5	816	22	Not safe for drinking
14	6.53	5.3	488	704	608	70	986	14	Not safe for drinking
15	6.55	1.8	536	500	304	246.2	1030	18	Not safe for drinking
16	6.5	5.9	492	616	352	146.94	717	11	Not safe for drinking
17	6.98	7.1	532	720	512	325.6	292	22	Not safe for drinking
18	6.75	4.3	380	400	188	223.82	353	17	Not safe for drinking
19	6.88	9.1	344	432	224	327.6	313	17	Not safe for drinking
20	6.85	3.5	168	520	440	99.2	772	11	Not safe for drinking
21	6.66	6.7	488	868	432	148.93	986	13	Not safe for drinking
22	6.97	0.4	500	552	372	188.6	803	21	Not safe for drinking
23	6.81	2.1	348	328	208	31.77	296	9	Not safe for drinking
24	6.88	3.3	424	496	256	119.14	799	15	Not safe for drinking

25	6.57	4.7	388	536	492	119.14	705	21	Not safe for drinking
26	6.75	6.2	356	500	456	135.03	730	12	Not safe for drinking
27	6.85	1.1	292	256	236	35.7	278	6	Not safe for drinking
28	6.93	2.5	432	480	400	156.07	788	14	Not safe for drinking
29	6.87	0.8	288	268	156	73.9	269	9	Not safe for drinking

Table 5.1: Results of various borewell water sample

VI. CONCLUSION

1. pH values of samples are within the permissible limit between 6.5-8.5.
2. Turbidity values are around the 5 NTU, All samples are within the permissible limit except sample no 1, 2, 4, 14, 17, 19, 21 are exceed the permissible limit. Low turbidity values indicates the clear water and high Turbidity values shows some diseases like Nausea, Cramps and Headaches. Alkalinity, sample no 5 and 20 are within the permissible value and remaining all of samples are beyond the permissible limit, which increases pH levels in water. It harmful to aquatic animals and it doesn't pose serious health risks in humans.
3. Total hardness values between range of 300-600Mg/l , Samples no 3, 9, 14, 16, 17, 21, 31 values exceed the permissible limit and remaining all samples are within the permissible limit.
4. Calcium hardness values between range of 75-200Mg/l , Sample no 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 18, 32, 33 values within the permissible limit and remaining sample values are beyond the permissible limit.
5. Chlorides values around the 250 Mg/l, all samples are within the permissible limit except sample no 18, 19 are exceed the permissible limit. High levels of chlorides can corrode and weaken metallic piping, fixtures, damage household appliances, boilers and give a 'salty' taste to the drinking water.
6. Total dissolved solids values around 500Mg/l , Here we are getting samples values are within permissible limits except sample no 3, 6, 7, 8, 9, 13, 14, 15, 16,20, 22, 24, 25, 26, 31, 32, 33, 34, 38 values exceed the permissible limit. High levels of TDS means it is unfit for consumption and it causes several diseases like Nausea, Lung irritation, Rashes, Vomiting, Dizziness.
7. Fluorides values within the 0.5-1.2Mg/l, So all the sample values within the range of permissible limit.
8. Sulphates values within 150Mg/l , So all the sample values within the range of permissible limit except sample no 1 are beyond the permissible limit
9. Nitrates values within 45Mg/l, So all the sample values within the range of permissible limit
10. Iron values within the 0.3-1Mg/l , So all the sample values within the range of permissible limit, But in the sample no 27 and sample no 30 iron content are absent.

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