Evaluation of Ground Water Quality in Arsikere Taluk

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Abstract:
Groundwater is an essential and vital component of our life support system. The ground water resources are being utilized for drinking, irrigation and industrial purpose. There is growing concern on deterioration of groundwater quality due to geogenic and anthropogenic activities. Groundwater, being a fragile must be carefully managed to maintain its purity within standard limits. So, quality assessment and management are to be carried out hand –in-hand to have a pollution free environment and for a sustainable use. In order to assess the quality for consumption by human beings and for use in agriculture, the groundwater from the shallow aquifers and deep aquifers, spatial distribution of Total Dissolved Solids (TDS), Fluoride, Total iron, Chloride (CL), Nitrate (NO_3), Hardness, Alkalinity and Acidity content of groundwater samples collected from the shallow and deep aquifers of ARSIKERE Taluk, HASSAN District, Karnataka state, India. In Arsikere Taluk, the shallow aquifers that supply water to dug wells of the catchment area under study have poor water quality than those of the bore wells from the deep aquifers. Result shows that groundwater of both aquifers is found to be alkaline and acidic in nature. The total fluoride content is found to be more than 1.0mg/l in certain areas of the region. For the shallow aquifers the observed maximum total dissolved solids (TDS) was 536.0mg/l.

Keywords: Ground water, coliform, nitrate, fluorides, TS

I. INTRODUCTION

Ground water is the water found below the surface of the land. Such water exists in pores between sedimentary particles and in the fissures of more solid rocks. It maintains a fairly even temperature very close to the mean annual temperature of the area. Verydeep lying groundwater can remain undisturbed for thousands or millions of years. Most groundwater lies at shallower depths. As depth increases, high pressure squeezes the pores shut. As a result almost all groundwater is found in the top 8km (5mi) of the earth's crust. It is important to realize that groundwater is not resource that could be utilized unmindfully simply because it is available in abundant quantities. Water use has to be integrated effectively with water regeneration, as was done in many traditional technologies. Although groundwater is less contaminated than surface waters. Pollution of this major water supply has become an increasing concern in industrialized nations. Analytical techniques have been refined so that early warning can be given and plans can be implemented to mitigate or prevent water quality hazards. Ranjanaagarwall et al., has studied the physic-chemical parameters of ground water quality of DUDU town in Rajasthan, have been taken up to evaluate its suitability for domestic purpose. 21 ground water samples were collected from different places of DUDU town Jaipur District. The quality analysis has been made through the PH, EC,T DC, DO,BOD,COD, Total hardness, Sodium, Potassium, Calcium, Magnesium, Chloride, Sulphate, Nitrate, Fluoride and Alkalinity. Comparative Studies of samples in different seasons were conducted and it was found that electrical conductivity and total dissolved solids were decreased; Alkalinity and Total hardness were increased after the rainfall. Navaneethkumar et al., conducted the studies on various parameters of ground water of DhampurTehsil area, Bijnor district Uttar Pradesh, India in general is found to be alkaline in nature with an the average EC value of less than 300μS/cm.The total Iron content is found to be more than 0.5mg/l in certain areas of the region. For the shallow aquifers the observed maximum TDS was 827.34mg/L and 562.14 mg/L for the deep aquifers. In general, the concentration of EC and TDS in the ground water of the shallow and deep aquifers reveals the shorter groundwater rock contact time. The chloride content is observed in both the aquifers invariably. The fluoride contents in both aquifers were found to be within the permissible limits. Based on these observations the groundwater quality in shallow aquifers in the catchments area of study is found to be severely polluted and moderately polluted in deep aquifers. Malick et al. (1998) have reported drinking water quality in the city of Karachi. During the study, forty samples were taken from supply lines of different locations of the city originating with waters from the Indus River and Hub sources. These samples were analysed for physico— chemical parameters such as pH, turbidity, EC, TDS, and residual chlorine. Results showed that the treated water from the treatment plants meets WHO guidelines. However, the samples taken from Kemari and Maripur area showed significant TDS increase from the original values of treated water, perhaps due to seepage of brackish water or saline water intrusion People depended on the polluted water are prone to health hazards and water quality management is needed. The present study is urgently required to draw the attention towards this region for taking necessary steps to minimize the adverse impacts likely to occur because of polluted water. Main objectives of present study is

- To study whether the quality of water at the consumer end is well within the standards.
- To study the adverse effects of human activities! Industries and hilly areas on the quality of water.

II. WATER TABLE AND WATER CYCLE

2.1 WATER TABLE:

Water Table is the underground border between the grounds in which all spaces are filled with water and the ground above in which the spaces contain some air. The level of the Water table tends to follow the shape of the overlying ground surface, rising under hills and dipping in valleys, but with a gentler slope than the ground. It also varies with the climate, rising during rainy periods and falling during dry spells. Wells dug down below the water table will be filled with water. The water table marks the top of the region underground that is saturated with water. While most precipitation evaporates back to the atmosphere or flows directly into streams. The rest percolates down through the ground to the water table. In the ground above the water table, a region called the aeration zone, pore spaces are filled with a mixture of air and water [3]
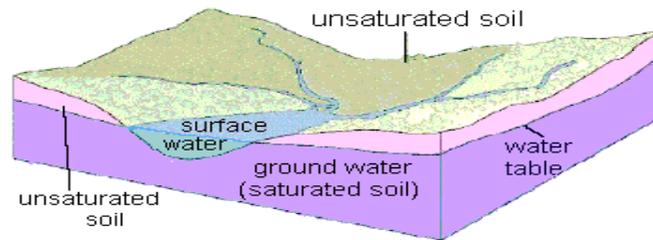
Figure.1. Water table

2.2 WATER CYCLE:

Water cycle or Hydrologic Cycle is a series of movements of water above, on and below the surface of the earth. The water cycle consists of four distinct stages[1]: storage, evaporation, precipitation, and runoff .Water may be stored temporarily in the ground; in oceans, lakes, and rivers; and in ice caps and glaciers. It evaporates from the earth's surface, condenses in clouds, falls back to the earth as precipitation (rain or snow), and eventually either runs into the seas or re-evaporates into the atmosphere.

2.2.1 STORAGE:

Enormous volumes of water are involved in the water cycle. Slightly more than 97 percent of this amount is ocean water and is therefore salty[2]. However, because the water that evaporates from the ocean is almost free of salt, the rain and snow that fall on the earth are relatively fresh. Fresh water is stored in glaciers, lakes, and rivers. It is also stored as groundwater in the soil and rocks.
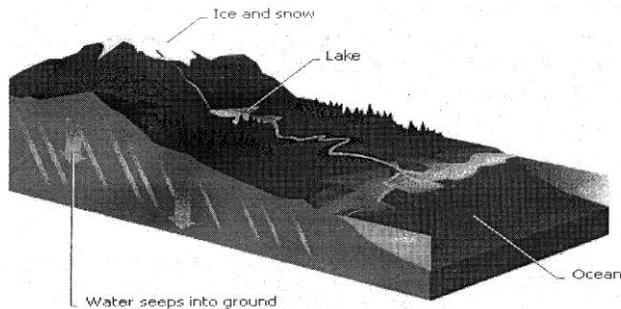
Figure. 2. Water Storage

2.2.2 EVAPORATION:

Evaporation is the process by which liquid water changes to water vapor and enters the atmosphere as a gas. Evaporation of

ice is called sublimation. Evaporation from the leaf pores, or stomata, of plants is called transpiration. The evaporation rate increases with temperature, sunlight intensity, wind speed, plant cover, and ground moisture, and it decreases as the humidity of the air increases [1]
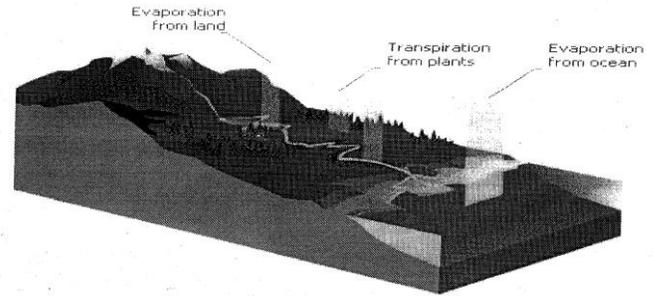
Figure. 3. Water Evaporation

2.2.3 PRECIPITATION:

Precipitation occurs when water vapor in the atmosphere condenses into clouds and falls to the earth. Precipitation can take a variety of forms, including rain, snow, ice pellets, and hail. About 300 cu km (about 70 cu mi) of precipitation falls on the land each day [3].
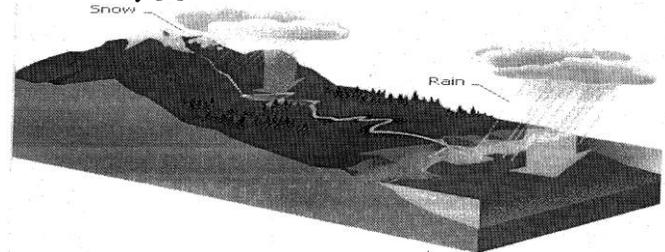
Figure.4. ater Precipitation

2.2.4 RUNOFF:

Water that flows down streams and rivers is called surface runoff. Water reaches rivers in the form of either overland flow or groundwater flow and then flows downstream. Overland flow occurs during and shortly after intense rainstorms or periods of rapid melting of snow and ice [2]. Groundwater flow runs through rocks and soil. Precipitation and Melt water percolate into the ground and reach a level, known as the water table[3]. At which all of the spaces in the rocks are filled with water. Groundwater flows from areas where the water table is higher to areas where it is lower.
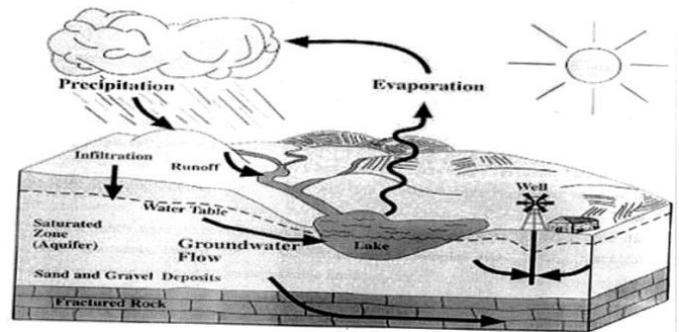
Figure.5.Sources of Ground water

III. SOURCES AND IMPACTS

3.1 TOTAL SOLIDS OR TOTAL RESIDUE:

Total Solids refers to matters suspended or dissolved in water or waste water, and is related to both specific conductance and

turbidity. The Total Solids includes both Total Suspended Solids (The portion of total solids retained by a filter paper) and Total Dissolved Solids (The portion that passes through a filter paper).

3.1.1 SOURCE:
Total Dissolved Solids (TDS) comes from organic sources such as decay products of vegetation, plankton, organic chemicals, and inorganic materials such as rocks and air that may contain calcium bicarbonate, nitrogen, iron, sulphur etc.

3.1.2 IMPACT:
- Excessive TDS causes aesthetically displeasing color, taste and odor to the potable water.
- It causes stomach upset, fever and imparts salty taste to the water.
- High levels of TDS can adversely affect industrial applications requiring the use of water such as cooling tower operations, food and beverage industries and electronics manufacturers.

3.2 HARDNESS:
Hardness of water is defined as the concentration of multivalent metallic cat ions (ions which bear positive electron charges) in solution. It is classified as carbonate or non- carbonate, depending upon the anion (ion which bears negative electron charge) with which it associates. The standard domestic measurement for hardness is parts per million (ppm) or milligrams per liter (mg/L) as calcium carbonate ($CaCO_3$)

3.2.1 SOURCE
The hardness of a water supply generally depends on the soil or rocks from which the water is derived. High hardness waters are derived from chalk and limestone; low hardness (soft) waters from moorland. Deeper aquifers are more likely to contain higher concentration of minerals in solution because the water has more time (perhaps millions of years) to dissolve the mineral rocks.

Table.1. Classification of Water Hardness

Description	Hardness in mg/L as calcium	Hardness in mg/L as calcium carbonate
Soft	0-20	0-50
Moderately soft	20-40	50-100
Slightly hard	40-60	100-150
Moderately hard	60-80	150-200
Hard	80-120	200-300
Very hard	Above 120	Above 300

3.2.2 IMPACT:
- Boiling changes the bicarbonates into insoluble carbonates and is seen as scales in kettles, pipes, boilers, and tanks or a slight film on hot drinks.
- It also makes the production of lather difficult.
- Extremely soft water is likely to corrode metals, although it is preferred for laundering, dish washing, and bathing.
- Yellowing of fabrics

3.3 ACIDITY:
Acidity of water is its quantitative capacity to neutralize a strong base to a designated p^H Acidity is a measure of a gross property of water and can be interpreted in terms of specific substances only when the chemical composition of the sample is known. A test of the acidity of water is p^H, which is a measure of the hydrogen-ion concentration. Acid substances turn blue litmus paper red.

3.3.1 SOURCE:
Acidic waters usually attain their acidity from the seepage of acid mine waters, mineral acids ($p^H< 4.5$) of wastewater, free carbon dioxide, sulphates of iron and aluminum, etc.

3.3.2 IMPACT:
- Acidic water causes corrosion of water pipes, releasing metals into the drinking water

3.4. ALKALINITY
Alkalinity of water is its quantitative capacity to neutralize a strong acid to a designated p^H Alkalinity is a measure of a gross property of water and can be interpreted in terms of specific substances only when the chemical composition of the sample is known. It indicates the presence of alkaline (acid neutralizing) minerals in water. Alkali turns red litmus paper blue.

3.4.1. SOURCE
Alkalinity of natural waters is due to the presence of compounds like CO_3^{2-}, HCO_3^-, OH^-, $HSiO_3^-$, $H_2BO_3^-$, HPO_4^{2-}, $H_2PO_4^-$, HS^-, and NH_3. These compounds result from the dissolution of mineral substances in the soil and atmosphere. Phosphates may also originate from detergents from wastewater discharges and from fertilizers and insecticides from agricultural land. Hydrogen sulfide and ammonia may be the products of microbial decomposition of organic material.

a) All the compounds that cause alkalinity do not cause hardness.
b) At times highly alkaline water may have low H or vice versa.

3.4.2. IMPACT
a) Highly alkaline water (above 500 mg/L) is usually associated with high p^H values, hardness and high dissolved solids and hence causes hard scales on hot water systems (water heaters, boilers, heat exchangers) leading to the wastage of fuel.
b) Excessive alkalinity may interfere with coagulation.
Bitter taste in strongly alkaline water ($p^H> 8.5$, i.e. hard water).
c) Excessive drying of skin due to removal of normal skin oils.

3.5. CHLORIDE
Chloride is the most important and widely distributed member of the halogen group to be found in nature. Some common chlorides include sodium chloride (NaCl), potassium chloride (KCl), calcium chloride ($CaCl_2$) and magnesium chloride ($MgCl_2$). Chlorine alone as Cl_2 is highly toxic and it is often used as a disinfectant. In combination with a metal such as sodium it becomes essential for life. Small amounts of chlorides are required for normal cell functions in plant and animal life. They maintain proper osmotic pressure, water balance and acid-base balance.

3.5.1. SOURCE
Chlorides may get into surface water from several sources like effluent wastewater from wastewater treatment plants, leaching of marine sedimentary rock deposits containing chlorides, oil well wastes, organic pollution, road salting (using NaCl & $CaCl_2$

for snow and ice removal), wastewater from industries and saltwater intrusion, human excreta; for example, contain about 6 g of chlorides per person per day.

3.5.2. IMPACT
a) Chlorides are not usually harmful to people; however, the sodium part of table salt (NaCl) has been linked to heart and kidney diseases.
b) Sodium chloride may impart a salty taste at 250 mg/L; however, calcium or magnesium chlorides are not usually detected by taste until levels of 1000 mg/L are reached.
c) Chlorides can corrode metals and affect the taste of food products.
d) Chlorides can also contaminate fresh water streams and lakes. Fish and aquatic communities cannot survive in high levels of chlorides.

3.6. IRON
Iron makes up at least 5% of earth's crust. Iron and manganese salts are generally found dissolved together in well water or anaerobic reservoir water. It is essential for good health as it helps transport oxygen in the blood. It is also a key element in enzymes responsible for nitrogen fixation and denitrification.

3.6.1. SOURCE
Iron is generally derived from minerals contained within the underlying bedrock. Limestone, shale, and coal that often contain iron-rich mineral pyrite are large contributors of iron. Iron occurs naturally in ground waters in three forms — Ferrous iron (clear water iron or ferrous bicarbonate), Ferric Iron (red water iron), and Herne Iron (organic iron). Each can exist alone or in combination with the others. Iron exists in natural groundwater in soluble (ferrous) state but when exposed to oxygen, is converted into insoluble (ferric) state.

3.6.2. IMPACT
a) Iron is not considered hazardous to health and is therefore considered a secondary or aesthetic contaminant. When the concentration of iron and manganese exceeds 0.3 and 0.05 mg/L respectively, the following problems occur:
b) Discoloration of clothes washed in such water due to the deposition of red/brown colored oxides of iron/manganese.
c) Incrustation of the water mains due to the deposition of ferric hydroxide and manganese oxide.
d) The water becomes unpleasant to taste (metallic taste).
Iron bacteria cause increased chances of sulfur bacterial infection and also form bacterial slimes in the pipelines.
e) Eggs spoil faster when washed in water containing iron in excess of 10 mg/L.

3.7. FLUORIDE
Fluoride (F) is a common constituent of many minerals. Optimum concentrations from 0.7 to 1.2 mg/L are recommended depending upon the mean air temperature for the prevention of dental caries; high air temperature corresponds to the use of low fluoride. Concentrations above 5 mg/L are detrimental to tooth structure and bones.

3.7.1. SOURCE
Fluoride is naturally present in water in some areas. High concentrations are contained in wastewater from the manufacture of glass and steel, as well as from foundry operations Organic fluorine is present in vegetables, fruits, and nuts. Inorganic fluorine, under the name of sodium fluoride, is a waste product of aluminum and is used in some rat poisons.

3.7.2. IMPACT
The various problems caused by excessive presence of fluorine in water are as listed below:
a) If it exceeds 2 mg/l mottling (fluorosis) of teeth will occur
b) If it exceeds 5 mg/l it results in bone fluorosis and skeletal abnormalities like osteoarthritis.
c) Causes birth defects and perinatal deaths.
d) Causes bone cancer (Dept. of Health. New Jersey).
e) Causes large numbers of acute poisonings.
f) Changes bone structure and strength.
g) Contributes to the development of Repetitive Stress Injury (A clinical study in New Zealand).
h) Impairs immune system.
i) Inhibits key enzymes of the body.
j) Neurotoxin and lowers IQ.

3.8. NITRATE
Nitrate is a colorless, odorless and tasteless compound and is a common inorganic form of nitrogen. It easily dissolves in water (anionic property) but extremely hard to remove. It is expressed as NO_3 (Nitrate) or NO_3-N (i.e. Nitrate-Nitrogen). The partly oxidized organic matter present in water in the form of nitrites (NO_2) is highly dangerous and therefore, its permissible limit in potable water is nil (IS: 10500 - 1991) or 1 mg/L Nitrite as N (U.S. EPA). However, nitrates (NO_3) are fully oxidized organic matter and their optimum presence in water may not be harmful.

3.8.1. SOURCE
Nitrate (NO3) comes into water supplies through the nitrogen cycle rather than via dissolved minerals. It is one of the major ions in natural waters. Most nitrates that occur in drinking water are the result of contamination of groundwater supplies by septic systems, feed lots, and agricultural fertilizers.

3.8.2. IMPACT
Nitrate poisoning cause's methemoglobin in the blood causing Methemoglobinemia (Infant Cyanosis or Blue Baby Disease). The methemoglobin combines with hemoglobin and hence does not carry oxygen to body cells in infants. Prolonged intakes of high levels of nitrate are linked to gastric problem due to formation of nitrosamines, although healthy adults can absorb nitrate and excrete in the urine.

3.9. SULPHATE
Sulphates (SO_4) are mineral salts containing sulfur. Sulphate is one of the major dissolved constituents in rain. Sulphate is reduced biologically under anaerobic conditions to sulphide, which in turn can combine with hydrogen to form hydrogen sulphide (H_2S).

3.9.1. SOURCE
Sulphates occur in almost all natural waters through the natural deposits of magnesium sulphate (Epsom salt), calcium sulphate (gypsum) or sodium sulphate (Glauber's salt). Most sulphate compounds originate from the oxidation of sulphite ores, the presence of shale, and the existence of industrial wastes.

3.9.2. IMPACT
The following are the effects caused by the presence of sulphates in water:
- Diarrhea and intestinal pain (esp. in babies).
- Breathing sulphur causes lung irritation.
- Magnesium sulphate and sodium sulphate (above 500 mg/i) cause laxative effect on person unaccustomed to the sulphate rich water.
- Accumulated H_2S can be oxidized biologically to sulphuric acid (H_2SO_4), which is corrosive to sewer pipes.

3.10. WATER BACTERIA
Bacteria are one-celled organisms visible only through a microscope. Their size varies from 1 to 4 microns. They do not have chlorophyll to help them manufacture their own food. They reproduce by binary fission and can be of various shapes like spherical (in single, pairs, chains or irregular), straight rod-like, spiral and curved shapes.

3.10.1. SOURCE
Microorganisms are usually absent in groundwater because of the filtering action of the aquifer. A group of bacteria, the crenothrix are found in groundwater and may be troublesome. One type grows in iron-bearing waters and precipitates iron oxide or rust. There are also other two species, one precipitates manganese as a dark-brown deposit and the other aluminum as a yellowish-white deposit. They are prevented by iron and manganese removal. Untreated surface waters may contain many bacteria. Aerobacter aero genes is found in the soil, on plants and grains and sometimes in the feces of man and animals, Aerobacter cloacae is found in the feces of man and animals, and also in the soils. Escherichia coli (E.coli) normally inhabit the intestinal tract of man and animals and is excreted with the feces. It is considered non-pathogenic but may cause infections of genito-urinary tract. Each person discharges from 100 to 400 billion coli form organisms (rod shaped bacteria) per day, in addition to other kinds of bacteria.

3.10.2. IMPACT
Although some bacteria do cause disease, many kinds of bacteria live on or in the human body and prevent disease. Bacteria associated with the human body outnumber body cells by ten to one. Wells rich in nitrate (>10 mg/L) and sulphate levels should be bacteriologic ally tested. Bacteria can convert nitrate in water to the more dangerous nitrite. Water rich in sulphur could contain bacteria that may convert sulphate ions to potentially toxic sulphide ions. Bacillus anthraces causes anthrax; E.coil causes diarrhea; Mycobacterium tuberculosis causes tuberculosis; Mycoplasma pneumonia causes pneumonia; Neisseria meningitides causes meningitis; Salmonella typhi causes typhoid fever; Salmonella typhimurium causes salmonella gastroenteritis; Shigella dysenteriae causes bacillary dysentery; Spirillum minor causes rat-bite fever and Vibrio cholerae causes endemic cholera.

IV. METHODOLOGY
The analyses of water samples were done as per the procedures given in Methods of Sampling and Test (Physical and Chemical) for Water Used in Industry (IS: 3025-1964) and Standard Methods for the Examination of Water and Wastewater (APHA, Inc.).

4.1. TOTAL SOLIDS OR TOTAL RESIDUE
4.1.1. TOTAL SOLIDS
- A 100 ml (V) of water sample is transferred to a clean evaporating dish after knowing its initial weight (W_1).
- It is then kept in an oven for 24 h at 105°C and cooled down to room temperature in adesiccators.
- The final weight after full drying is then determined (W_2).

$$\text{Total Residue (g/ml)} = \frac{\text{Final weight (W2)} - \text{Initial Weight (W1)}}{\text{Volume of water sample used (i.e.V)}}$$

$$\text{Total Residue (mg/l)} = \frac{\text{Final weight (W2)} - \text{Initial Weight (W1)}}{\text{Volume of water sample used (i.e.V) x (1/106)}}$$

4.2. HARDNESS (EBTA TITRIMETRIC METHOD)
4.2.1. TOTAL HARDNESS
A 100 ml (V) of water sample is transferred to a clean conical flask through a pipette. Now 1 ml of freshly prepared ammonia buffer solution (basic) is added to it. This is done because EBT indicator will not give response if the water sample is too acidic. Some 2-3 drops of Eriochrome Black T (EBT) indicator are then added and mixed. Titration is then done against a standard EDTA (i.e. ethylene diamine tetra acetate) titrant till the color changes from wine red to blue. On getting this end point, the volume of EDTA used is noted and further calculations done.

$$\text{Total Hardness of water asCaCO3 (mg/L)} = \frac{\text{Volume of EDTA used x 1000}}{\text{Volume of water sample used (i.e.V)}}$$

4.2.2. PERMANENT HARDNESS
The water sample is boiled for about 5 minutes and allowed to cool completely. Repetition of the above steps from 1 to 5 is done.

$$\text{Permanent Hardness of water as CaCO3 (mg/L)} = \frac{\text{Volume of EDTA used x 1000}}{\text{Volume of water sample used (i.e.V)}}$$

Temporary Hardness of water as CaCO3 (mg/L) = Total Hardness — Permanent Hardness

Carbonate Hardness is also called Temporary Hardness and Non-Carbonate as Permanent Hardness. Carbonate Hardness is equal to the Total Hardness or Total Alkalinity, whichever is lesser and the excess amount is the Non-Carbonate Hardness. If Total Hardness < Total Alkalinity, then there is no Non-Carbonate Hardness.

4.3. ACIDITY
A 100 ml (V) of water sample is transferred to a clean conical flask through a pipette. Now 3-4 drops of phenolphthalein indicator are added and mixed. Titration is done against a O.02N NaOH (i.e. sodium hydroxide) titrant till the colorless solution changes to pink. On getting this end point, the volume of NaOH used is noted and further calculations done.

$$\text{Acidity of water (mg/L)} = \frac{\text{Volume of NaOH used x 1000}}{\text{Volume of water sample used (i.e.V)}}$$

4.4. ALKALINITY

A l00mI (V) of water sample is pipette into a conical flask. Some 3-4 drops of phenolphthalein indicator is added and mixed. If pink color develops, it indicates the presence of Hydroxide Alkalinity. In this case, it is titrated against 0.02N H_2SO_4 (i.e. sulfuric acid) till we get the colorless end point from this pink color. If no pink color development in step 3, then there is no Hydroxide Alkalinity. The volume of H_2SO_4 (i.e. P ml) used is noted and further calculations done. For the latter case, 1 -2 drops of methyl orange indicator are added furthermore. Now this mixture it is titrated against 0.02N H2S04 till the color changes from yellow to orange end point.

The volume of H2SO4 (i.e. T ml) used is noted and further calculations done. Alkalinity of water (mg/L)

$$= \frac{\text{Volume of H2S04 used x 1000}}{\text{Volume of water sample used (i.e.V)}}$$

4.5. CHLORIDE (Mohr Method/Argentometric Method)

A l00mi (V) of water sample is pipette into a conical flask. Add to it 5-6 drops of K2CrO4 (i.e. potassium chromate) indicator. Titrate it against N/35.5 AgNO3 (i.e. silver nitrate) titrant till the color changes from yellow to brick red end point. Further calculations are done after noting the volume of titrant used up.

Chloride concentration in water sample (mg/L) =

$$\frac{\text{Volume of AgNO 3 used x 1000}}{\text{Volume of water sample used (i.e.V)}}$$

4.6. IRON, FLUORIDE, NITRATE AND SULPHATE

The parameters iron, fluoride, nitrate and sulphate were determined by using Data Logging Spectrophotometer. The procedure of operation can be known from the manual. The reagents used were prepared in laboratory itself.

4.6.1 IRON

The wavelength is 460 nm. For 15 ml of each sample, 3ml of 4N HCl, 2.5ml of Potassium Theocyanite are used.

4.6.2 FLUORIDE

The wavelength is 570 nm. The reagent used is SPADNS Reagent for Fluoride. The SPANDS reagent is prepared by dissolving 958mg spands, 133mg $ZnCl_28H_2O$ (Zirconyl Chloride Octahydrate) in 350ml of HCl and dilute to 500ml.For 10 ml of each sample, 5 ml of reagent and 1 ml of Sodium Arsenate is used.

4.6.3 NITRATE

Pipette out exactly 25ml of sample solution to the beaker and keep it in a hot plate till the residue left in the beaker. Add 0.5ml of PDA (Posphoryl Disulphonic Acid) to each beaker, then add 10ml of Ammonium Hydrochloride and shake well. Take the absorbance in each sample solution at 150nm.

4.6.4 SULPHATE

The wavelength is 420 nm. The reagent used is conditioning reagent. The reagent was prepared by 25ml Glycerol, 25ml Con. HCl, 150ml H_2O, 50ml ethanol and 37.5g NaCl. For 25 ml of each sample, 5ml of conditioning reagent, 0.1g of $BaCl_2$ crystal is used

4.7. BACTERIOLOGICAL TEST (PRESUMPTIVE)

In our experimentation, we have done only the Presumptive Test using Multiple-Tube Fermentation Method to check the presence of bacteria, if any, and hence only this test Procedure is discussed here.

The presence of coli form in water and wastewater are determined by the following three tests:
- Presumptive Test
- Confirmed Test
- Completed Test

The indicator organism for Drinking Water is Total Coliform, whereas for freshwater Recreation we consider fecal coliform, E.coli and Enterococci.

The following points are to be noted:

a) The water samples are to be tested within 24 hr of their collection without any external contamination

b) All the equipments that are to be used for experiment (pipettes, test tubes, druham tubes, etc.) are sterilized for 24 hr in an autoclave.

4.7.1. MATERIALS

3Durham tubes of Double Strength Lactose Broth (DSLB) for 10ml water samples, 6 Durham tubes of Single Strength Lactose Broth (SSLB) for 1 ml and 0.1 ml water samples,10 ml pipette-1 no,1 ml pipette- 1no.

4.7.2. PROCEDURE

Set up three DSLB and six SSLB and label each tube according to the amount of water sample that is to be dispensed to it: 10 ml, 1.0 ml and 0.1 ml respectively. Mix the bottle of water to be tested by shaking 25 times. With a 10 ml pipette, transfer 10 ml of water to each of the DSLB tubes. With a 1 ml pipette, transfer 1 ml of water to each of the middle set of tubes and 0.1 ml to each of the last three SSLB tubes. Incubate the tubes at 35°C for 24 hours. Examine the tubes and record the number of tubes in each set that have 10% gas or more. Determine the Most Probable Number (MPN) by referring to the MPN Determination Table. For example, if out of 5 tests on 10 ml samples, 2 are positive; and all the 5 tests on 1 ml samples are negative; and 1 test in 0.1 ml samples is positives, the combination of positive tests will be 2-0-1. For this combination in MNP Determination Table, the MPN/100 ml is read to be 7 with number of coli forms to be 1 (lower limit) and 17 (upper limit) with 95% confidence limit.

V.   RESULTS AND DISCUSSIONS

Figure.6. Arsikere Rural

2.1 OVERVIEW:

The place under study was Arsikere town of Hassan district, Karnataka state. It is a residential area with some industrial setup. The area does not have underground drainage system. The experimentation was carried on various water samples for determination of inorganic nonmetallic constituents (fluoride, nitrate, sulphate, acidity, alkalinity and chloride), Metals (iron and hardness) and physical examination for residue/solids content. In addition, Presumptive test for coli form was also done and their presence was not found in all the water samples.

2.2 NATURE OF WATER SAMPLES:

The water samples were obtained from two different sources namely Bore wells (BW) under Gram Panchayat jurisdiction and private bore wells (PW) from selected locations. Twenty BW and twenty PW samples were used for observations. PW samples were selected from locations covering the entire sector whereas the BW samples were mainly from the selected areas of Arsikere and surrounding villages. All the samples were tested within 24 hours of collection for precise results.

VI. RESULTS AND CONCLUSION

Table.2. Non-metallic constituents

Sample no	Acidity (mg/L)	Fluoride (mg/L)	Nitrate (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Alkalinity (mg/L)
1	26.5	1.73	12.9	92.0	224.5	474.0
2	31.0	062	11.80	71.0	189.0	432.0
3	19.5	2.05	12.20	10.0	28.0	126.0
4	35.5	1.05	8.10	36.0	91.0	312.0
5	19.0	1.81	16.9	20.0	50.0	178.0
6	27.5	2.74	18.9	43.0	176.0	353.0
7	34.5	1.26	11.4	83.0	193.0	417.0
8	46.0	2.86	10.6	54.0	158.0	294.0
9	42.5	2.53	10.9	90.0	201.0	410.0
10	15.0	1.57	3.7	31.0	82.0	165.0
11	48.0	3.42	5.80	84.0	84.0	493.0
12	24.5	3.21	16.10	41.0	73.0	312.0
13	36.0	2.29	12.0	33.0	276.0	329.0
14	64.5	3.16	5.60	90.0	11.0	542.0
15	31.5	1.31	6.3	58.0	44.0	328.0
16	29.5	1.47	10.4	40.0	116.0	300.0
17	42.0	0.80	10.0	63.0	56.0	378.0
18	18.0	0.70	6.3	28.0	32.0	290.0
19	15.5	0.90	5.1	13.0	66.0	189.0
20	29.0	0.70	3.8	21.0	197.0	213.0

Table .3. Metallic Constituents

Sample no	Iron (mg/L)	Total Hardness(mg/L)
1	0.09	163
2	1.38	405
3	0.1	300
4	0.19	210
5	0.10	150
6	0.26	180
7	0.51	210
8	0.11	165
9	0.12	210
10	0.16	270
11	0.20	165
12	0.21	180
13	0.56	165
14	0.18	150
15	0.30	420
16	0.24	390
17	0.10	750
18	1.32	240
19	0.30	450
20	1.04	375

Table.4. Physical Examination

Sample no	Total Solids (mg/L)	Color	Odor	Taste	Bacteria (Coli form)
1	629	Clear		Agreeable	Nil
2	1214	Clear		Agreeable	Nil
3	1414	Clear		Agreeable	Nil
4	640	Clear		Agreeable	Nil
5	569	Clear		Agreeable	Present
6	662	Clear		Agreeable	Present
7	1901	Clear		Agreeable	Present
8	1796	Clear		Agreeable	Present
9	730	Clear		Agreeable	Present
10	805	Clear		Agreeable	Present
11	515	Clear	Unobjectionable	Agreeable	Present
12	723	Clear		Agreeable	Present
13	1521	Clear		Agreeable	Present
14	517	Clear		Agreeable	Present
15	1404	Clear		Agreeable	Present
16	1913	Clear		Agreeable	Present
17	1020	Clear		Agreeable	Nil
18	1291	Clear		Agreeable	Nil
19	1632	Clear		Agreeable	Present
20	1350	Clear		Agreeable	Nil

VI. CONCLUSIONS

The tests on the groundwater samples were carried out as perthe specification of the Methods of Sampling and test (Physical and Chemical) for Water Used in Industry (IS: 3025 - 1964) and Standard Methods for the Examination of Water and Waste water (APHA, Inc.) and all the parameters were checked using Indian Standard Drinking Water Specifications (IS: 10500 - 1991).The tests made were for iron, fluoride, nitrate, sulphate (using spectrophotometer), hardness. Acidity, alkalinity, chloride (using Titrimetric Method).There is no danger of nitrate poisoning in any of the samples as all the samples tested were below the desirable limit, i.e. , 45 mg/L. There will be problem of fluorosis as the fluoride concentrations in some of the samples were found above the desirable limit, 1 mg/L. Since all the samples were found to have fluoride above the desirable limit defluoridation is recommended for samples. Encrustation in the pipes could occur for those hard water samples tested above the desirable limit, 300 mg/L. Some of the remedial exercises are also given as below:

- Iron can be removed by aerating the water, use of softeners and oxidizing agents like chlorine followed by mechanical filtration.
- Boiling and use of lime for removing temporary hardness and lime-soda process, zeolite process and demineralization for removing permanent hardness can reduce hardness of water. We also use softeners and reverse osmosis.
- Total dissolved solids (TDS) can be removed by deionization, reverse osmosis and electro dialysis.
- Fluoride can be removed by some defluoridation techniques.

VII. REFERENCES

[1]. Corbitt, Robert A, "Standard Handbook of Environmental Engineering", McGraw.- Hill, New York, 1990, Pg. 5.10 — 5.18

[2]. Anurag Tewari , Ashutosh Dubey and Aviral Trivedi, A study on physico-chemical characteristics of ground water quality, Journal of Chemical and Pharmaceutical Research J. Chem. Pharm. Res., 2010, 2(2): 510-518.

[3]. Gopal Krishan, Surjeet Singh, Kumar CP, Garg PK, Suman Gurjar, Ghosh NC and Anju Chaudhary, Assessment of Groundwater Quality for Drinking Purpose by Using Water Quality Index (WQI) in Muzaffarnagar and Shamli Districts, Uttar Pradesh, India Rec date: Jan 21, 2016; Acc date: Feb 11, 2016; Pub date: Feb 20, 2016

[4]. Sultan Singh, Prem Singh, Rajesh Kumar, Sunita Saharan , Groundwater Quality Analysis of Safidon and Julana Blocks of District Jind, Haryana, India, Journal of Water Resource and Protection, 2012, 4, 39-47.

[5].Gouri.J.Pilla and ChithiraVenu, ASSESSMENTOFWATER QUALITY AND ITS SUITABILITY FOR PORTABLE WATER SUPPLY SYSTEM, International Journal of Scientific & Engineering Research, Volume 7, Issue 4,April-2016.

[6]. R. W. Gaikwad, V. V. Sasane - "Assessment of ground water quality in and around Lonar lake and possible water treatment", International Journal of Environmental Sciences, Volume 3, No 4, 2013.

[7]. BIS, (1994),"Indian Standards Specifications for Drinking Water", Bureau of Indian Standards, IS:10500 -1994).

[8]. Goel P.K.,(2000), " Water Pollution-causes, effects and control", New Delhi, New Age Int. (P) Ltd. [3] Pandey Sandeep K. and Tiwari S.,(2009), "Physico-chemical analysis of groundwater of selected area of Ghazipur city-A case study, Nature and Science, 7(1).
[9]. Sharma, V.V.J., (1982) "Ground Water Resources of Northern Eastern Ghats" Proceedings of the Seminar on Resources Development and Environment in the Eastern Ghats, Visakhapatnam, pp.69-75.

[10]. Subba Rao, N., Krishna Rao., G., (1991) "Intensity of Pollution of Groundwater in Visakhapatnam Area, A.P., India, Journal of Geological Society India., Vol. 36., pp. 670-673.

[11]. Todd D.K., (2001), "Groundwater Hydrology". John Wiley and Sons Publication, Canada, 280–281p.

[12]. WHO. (1996), "Guidelines for drinking-water quality, health criteria and other supporting information", V.2, 2nd edn, World Health Organisation, Geneva, 940-949 pp

[13]. Linsley, Ray K. & Joseph B. Franzini, "Water- Resources Engineering", McGraw- Hill, Singapore, 1979, Pg. 76-82.