

Evaluation of Groundwater Quality for Drinking and Agricultural Purpose

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Abstract: This study examines a variety of chosen groundwater samples from Mohanur, which has issues with its quality for drinking and agricultural use. Reading the study's findings will give you crucial information status of the ground water in Mohanur and can assist in locating the domestic and industrial sources of contamination. This is very helpful in guiding future research to pinpoint and reduce the issue of ground water pollution and helps to take action to address the problem. When a body of water is harmed by anthropogenic toxins, it is often considered to as polluted when it either cannot be used for human purposes, such as drinking water, or when its ability to support its biotic populations significantly changes. Despite their interdependence, surface water and groundwater have frequently been researched and managed as separate resources. In this study, 14 significant parameters were picked to calculate the water quality index. The World Health Organization (WHO) and Indian Council for Medical Research's criteria (ICMR) for the quality of drinking water were used to create the Water Quality Index (WQI). In this study, the weighted arithmetic index approach was employed to calculate WQI.

Key words: Water treatment, Agriculture, Water Parameter, Ground Water Quality.

1 Introduction

Groundwater is an integral part of the water cycle. Once groundwater is polluted, preventing pollutants from entering the water source will not restore its quality. With dwindling freshwater resources, India is facing a severe shortage of safe drinking water. The lack of access to safe drinking water severely limits local socio-economic growth [1,2]. In this context, the Indian government established the Water Technology Mission for Drinking Water in 1987. Using the scientific method, resources can be performed very effectively in all infrastructure, intra- and inter-state, and basin-by-basin structures of international flows.

1.1 Importance of the study

For many rural and small communities, groundwater is the primary source of drinking and irrigation water. Much attention has been paid in recent years at the global level to the chemical composition of groundwater in rural areas because it revealed the possibility of a causal link between the geochemical environment and groundwater quality [11]. Irrigation and subsurface geological formations in rural areas may also cause significant groundwater contamination. The three main reasons for studying the distribution of geochemical constituents in the study area's groundwater are as follows: Because rock geochemistry data are more widely available and reliable, lithology can become a source of chemical constituents to the groundwater column, allowing rock geochemistry data to be used to uncover the pollution history of an aquatic system [3,5]. To save people from water-borne diseases, the fraction of chemical constituents accumulated in drinking water should be identified, and irrigation water should be analyzed to improve agriculture.

2 Objectives

- To characterize the physio-chemical parameter of groundwater of the study area.
- To evaluate the suitability of groundwater for domestic by Water Quality index (WQI) and Irrigation indices for agriculture purpose.
- To predict the WQI value for the Study area using Mathematical methods.

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3 Methodology

Step 1: Identification of risk zone due to groundwater pollution in Mohanur Taluk.

Step 2: Water sampling.

Step 3: Physio-chemical parameters analysis (pH, EC, TDS, Total alkalinity, Total hardness, Calcium, Magnesium, Chloride, Sulphate, K, Ca).

4 Methods

4.1 pH

pH is a measure of hydrogen ion activity that is used to express the intensity of a solution's acidic or alkaline condition. It is also an important factor in water analysis because it is used to calculate acidity, alkalinity, and other processes such as coagulation, disinfection, and corrosion control. The pH of a solution can be measured electrometrically or calorimetrically.

4.2 Electrical conductivity

Electrical conductivity is a measurement of the capacity of water to carry electric current. It is measured in Micromhos/cm³ or Microseisms/cm³. Water conductivity varies with temperature and is proportional to its dissolved mineral matter content [4]. Because electrical conductivity determination is quick, the number of dissolved salts in a water sample can be determined quickly.

4.3 Total Dissolved Solids

Shaking thoroughly mixed the sample for total dissolved solids (TDS) measurement before filtering through standard glass fibre filters. A clean porcelain dish was dried for one hour at 180 - 200 C, cooled in a desiccator, and weighed. In the dish, a sample of the required volume (250 ml) was carefully evaporated to 38 dryness. The dish was dried for one hour at 180 - 200 C before being cooled in a desiccator and weighed [6]. The weights of the empty dish and the dish containing the TDS were only recorded after the constant weights were obtained by repeatedly drying desiccating for cooling and weighing. TDS was calculated using the following formula:

Total Dissolved Solids,

$$\text{mg/L} = (A-B) \times 10^6 \text{ V} \quad (1)$$

Where,

A = Weight of dried residue + dish, g

B = Weight of the dish, g

V = Sample volume, ml.

4.4 Total hardness

Distilled water was used to dilute a known volume (20.0 ml) of standard calcium solution to 50 ml. 1 - 2 drops Eriochrome Black-T indicator solution and 1.0 - 2.0 ml ammonium chloride-ammonium hydroxide buffer solution (pH 10) was added.

It was titrated with EDTA solution, which was slowly standardized with continuous stirring until the colour changed from Wine red to blue- The same procedure was followed for the reagent blank. The EDTA concentration was calculated using the following formula:

$$\text{Concentration of EDTA, moles/ L} = \text{V xM (A - B)} \quad (2)$$

Where,

A = Volume of EDTA solution consumed for calcium solution, ml.

B = Volume of EDTA solution consumed for reagent blank, ml

V = Volume of calcium solution, ml

M = Concentration of calcium solution, moles.

4.5 Calcium estimation

A known volume (20.0 ml)[7,8] of sample was diluted to 50 ml with distilled water before being mixed with 2.0 ml Sodium hydroxide buffer solution and 0.2 to 0.4 g murexide indicator. It was titrated with standardized EDTA solution while stirring continuously until the colour changed from red to blue violet.

4.6 Estimation of magnesium

Magnesium was calculated as Mg mg/l by using the formula:

Amount of Magnesium,

$$\text{Mg} = \frac{[(A-B) - (C-D)] \times M \times V}{24000} \quad (3)$$

mg/L

Where,

A = Volume of EDTA consumed for the sample with EBT indicator, ml,

B = Volume of EDTA consumed for the blank with EBT indicator, ml

C = Volume of EDTA consumed for the sample with murex indicator, ml

D = Volume of EDTA consumed for the blank with murex indicator, ml

M = Concentration of EDTA, moles/l

V = Volume of the sample.

4.7 Determination of Chloride

A given volume of the sample (20.0 ml) was taken and pH of the sample was acclimated in between 7.0 to 10.0 with nitric acid of sodium hydroxide. To this potassium chromate index result was added and adulterated to 100 ml with distilled water. It was titrated against formalized tableware nitrate result with nonstop shifting till the conformation of red tableware chromate precipitate was just observed.

4.8 Sulphate (Gravimetric system) Determination of sulphate

A given volume (250 ml) of filtered sample was taken, acidified with hydrochloric acid to a pH between 4.5 to 7.0 using methyl red index and 2.0 ml hydrochloric acid was added in excess. The sample was also concentrated to an optimum position by boiling, while the result was in hot condition, 10 barium chloride result was added drop wise with gentle shifting until the rush was completed.

4.9 Nitrate

Glass hair draw was fitted into the bottom of a reduction column. The column was also filled with distilled water. Sufficient bobby - cadmium grains were placed to produce 18.5 cm long column. Proper care was taken to avoid the rise of air while filling- up the column with grains. The column was washed with 200 ml dilute ammonium chloride-EDTA result and actuated by passing a admixture of 75 ml dilute ammonium chloride- EDTA result and 25 ml, 1 mg NO₃⁻/ L standard nitrate solution, at a rate of 7 to 10 ml/ min, through the column[9,10]. A series of standard nitrite results were prepared in the required range (0.04 to mg NO₂⁻/ L) by lacing working nitrite result to 25.0 ml. A series of standard nitrate⁴³ results were prepared in the required range (0.2 to 2.0 mg NO₃⁻/ L) by lacing working nitrate result to 100 ml. The pH of a given volume of the sample (20.0 ml) was acclimated between 7 and 9 with dilute hydrochloric acid or dilutes sodium hydroxidesolution. 75.0 ml adulterated ammonium chloride- EDTA result was added to the sample and made up to 100 ml. It was passed through the column at the rate of 7 to 10 ml/ min. A given volume of eluent (20.0 ml) was collected after discarding the first 35 ml of the eluent. Whenever necessary, the sample was first duly adulterated before it was passed through the reduction column. The reduction of nitrate norms and blank was carried out exactly as described in the sample. Within 15 twinkles after the collection of eluent of the sample and the norms, ml sulphanilamide result and 1.0 ml N-(1-naphthyl) ethylene di amine di hydrochloride result was added and adulterated to 25 ml. A sanguine grandiloquent color was redounded. The same procedure was espoused for reagent blank. The absorbance of the color developed for the sample and reduced nitrate norms were measured at 543 nm against reagent blank. A standard wind was prepared by conniving absorbance of norms against their corresponding attention. The attention of nitrate in the sample was determined directly from the standard wind. The effectiveness of the reduction column was checked for confidence as follows. Standard results of nitrite were prepared with the same attention as that of nitrate norms used. The reagents were added to the nitrite norms as explained over and the color was developed. The absorbance of the results was measured and compared with that of nitrate standard results. The nitrate and nitrite norms of same attention redounded in nearly same absorbance. Whenever there was a distinction the reduction column was prepared lately.

4.10 Determination of Fluoride

A series of norms (0.5, 1.0, 2.5, 5.0 mg F⁻/ L) were prepared from the working fluoride result in 100 ml volumetric steins. A given volume of the sample (50.0 ml) was taken in a 100 ml volumetric beaker and equal volume of TISAB buffer was added. An analogous system was espoused for the norms and the reagent blank. The fluoride picky electrode and the reference electrode (single junction electrode) were completely washed with distilled water. Reference electrode was filled with the single junction electrode stuffing result. Both the reference and fluoride sensitive electrodes were immersed in the reagent blank. After attaining stable reading, the cadence was set for zero attention.

Also, the reagent blank was replaced by fluoride standard. The instrument was set for the attention of that standard. Again, the electrodes were placed in the alternate standard. The attention of the alternate standard was achieved by conforming the pitch.

Result

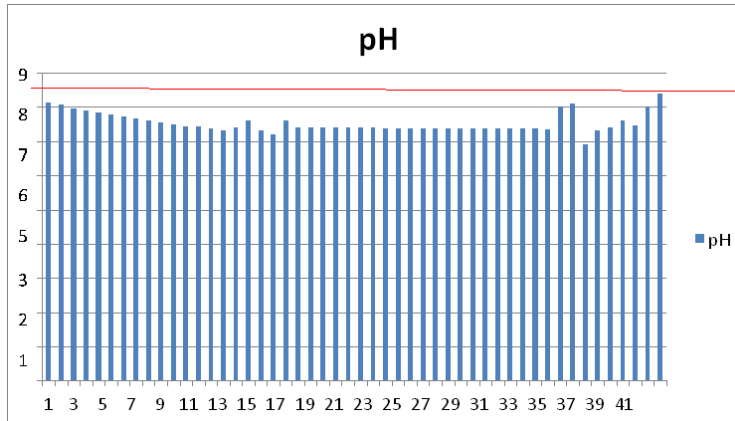


Fig. 1. pH value of 50 samples

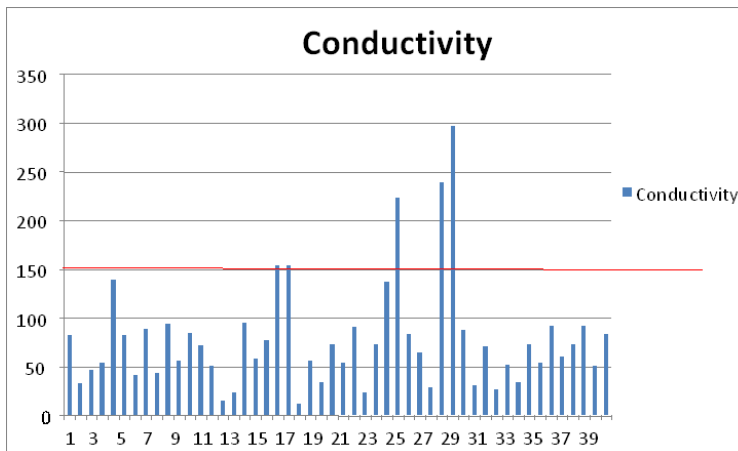


Fig. 2. EC value of 50 samples

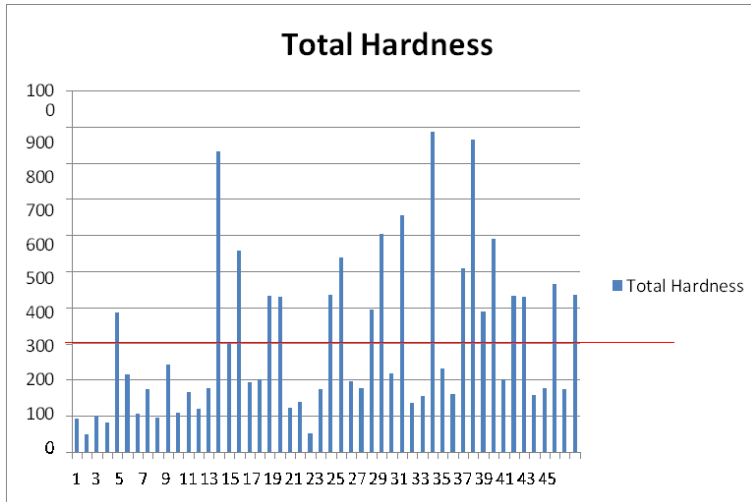


Fig. 3. TH value of 50 samples

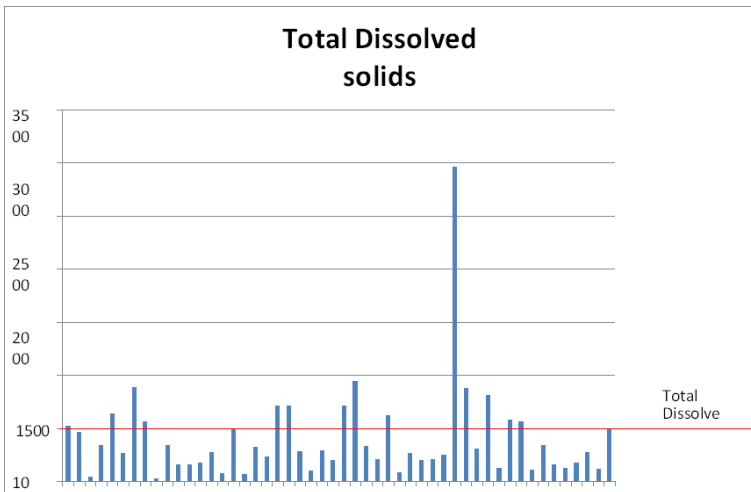


Fig. 4. TDS value of 50 samples

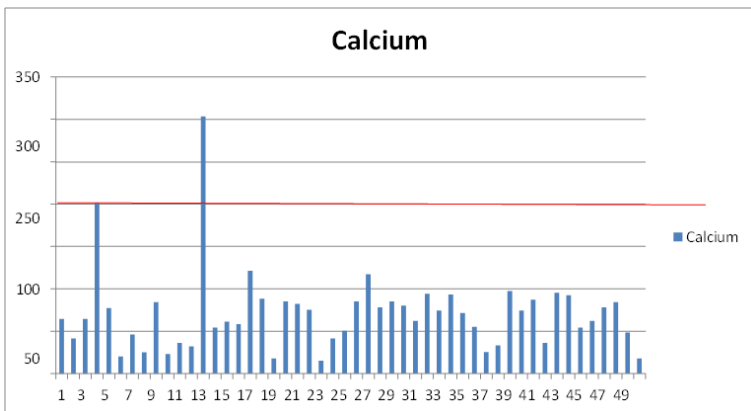


Fig. 5. Calcium value of 50 samples

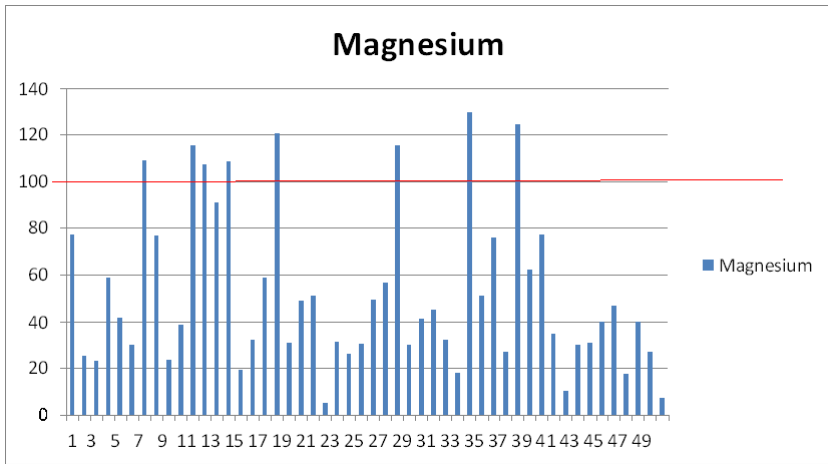


Fig. 6. Magnesium value of 50 samples

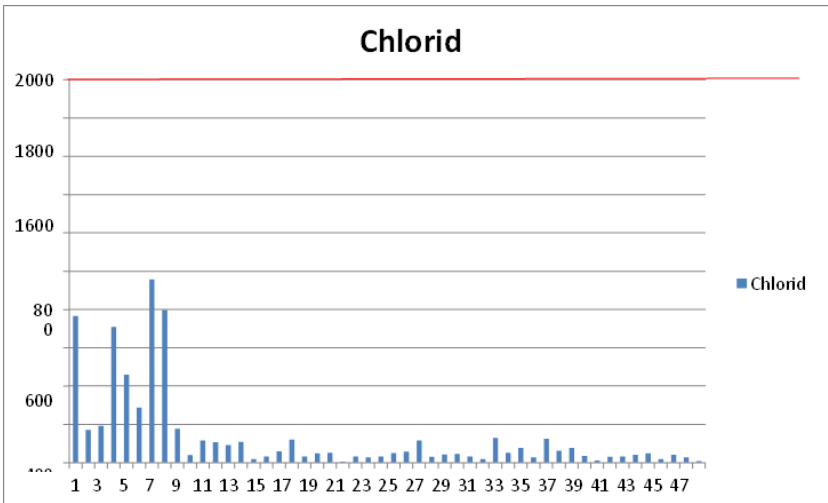


Fig. 7. Chloride value of 50 samples

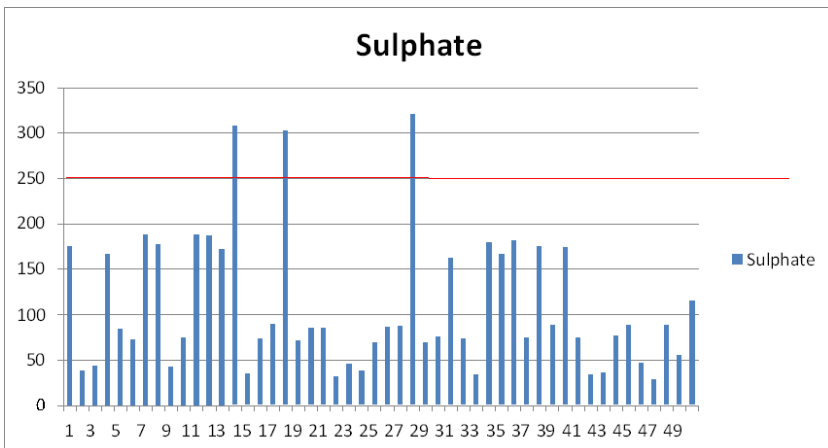


Fig. 8. Sulphate value of 50 samples

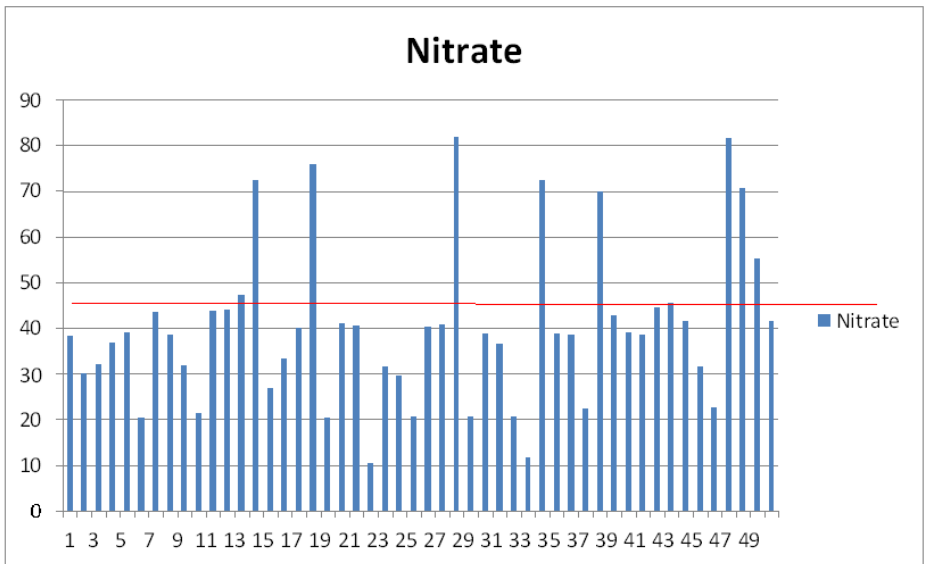


Fig. 9. Nitrate value of 50 samples

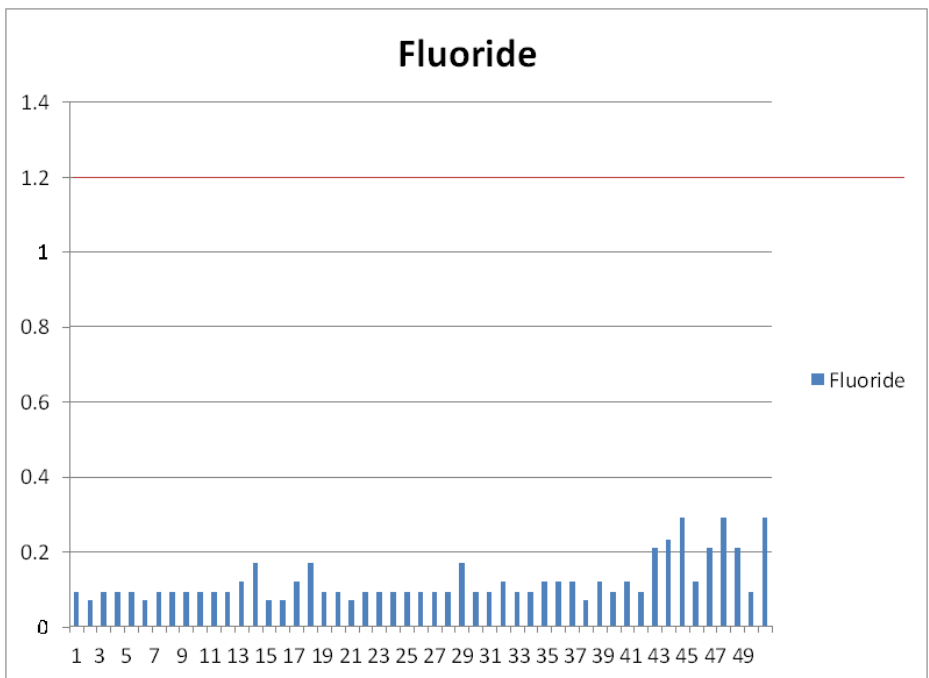


Fig. 10. Fluoride value of 50 samples

Table 1. Comparison of Result with Standard Value as per IS3025

S.NO	PARAMETERS	UNITS	TEST METHOD	MAXIMUM VALUE	MINIMUM VALUE	STANDARD VALUE
1	pH	Na	IS 3025:PART11	8.4	6.9	6.5-8.5
2	ELECTRICAL CONDUCTIVITY		IS 3025:PART 14	2962.81	124.72	–
3	TOTAL DISSOLVED SOLIDS	mg/L	IS 3025:PART 16	2962.81	464.58	500
4	TOTAL HARDNESS	mg/L	IS 3025:PART 21	884.8	48.8	300
5	CALCIUM	mg/L	IS 3025:PART 40	303.4	15.4	75
6	MAGNESIUM	mg/L	IS 3025:PART 46	129.6	5.3	30
7	CHLORIDE	mg/L	IS 3025:PART 32	957.5	5.3	250
8	SULPHATE	mg/L	IS 3025:PART 24	308.2	28.2	200
9	NITRATE	mg/L	IS 3025:PART 34	81.8	10.6	45
10	FLUORIDE	mg/L	IS 3025:PART 60	0.29	0.07	1.5

6 Conclusion

Groundwater defiled due to natural or anthropogenic sources has rounded in attention that exceed non-supervisory norms for drinking water. This thesis describes the physio - chemical parameters (pH, electrical conductivity, turbidity, total dissolved solids, total suspended solids, total hardness, calcium hardness, magnesium hardness, total alkalinity, chloride, fluoride, sulphate, nitrate, dissolved oxygen, and natural oxygen demand). The study of a Mohanur Taluk to more understand the status impurity using water quality indicator of groundwater and can have on a community and implicit remedial strategies. Accurate information on the quality of water is ineluctable to form a public policy and to apply the water quality enhancement programmes. Water quality indicator (WQI) provides information about water quality in a single value.

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