Case Study: Ground Water Quality Assessment in Jaipur Region

[1]Saurabh Singh, [2]Payal Kumari, [3]Peeyush Gupta and [4]Kishore Kumar

[1]Assistant Professor, Department of Civil Engineering, PIET, Jaipur
[2,3]B.Tech Student, Department of Civil Engineering, PIET, Jaipur
E-mail: [1]saurabh.singh@poornima.org

Abstract—*Ground water directly affects the agriculture sector, and indirectly affects the industries, domestic life and even economy of the country. A parameters present in ground water not only varies spatially and temporally but also with the depth. Parameters present in the water affects the surroundings and have deep impact on human activities. Due to increase in urbanization and industrialization ground water sources are degrading day by day. Essential parameters are converted into pollutants. These parameters varies from place to place and it also depends upon the depth of aquifers as well as nature of waste deposits over the soil. Present study adopts a methodology to identify the variation of groundwater parameters around the straight path of 14 km in Jaipur region starting from JalMahal to Sanganer. Various tests are conducted for pH, temperature, TDS, nitrate, fluoride and turbidity. The result declares that the quality of ground water sample is not in permissible limit which is very bad and need purification before use...*

Index Terms*: Aquifer, nitrates, pollutants, Turbidity.*

1. INTRODUCTION

Rainfall is the main source of ground water recharge. Due to less rainfall and increased ground water withdrawals, the groundwater levels are declining [1]. Irrigation in the Jaipur area is mainly done by ground water i.e. dug wells and tube wells [4]. At present there are 120471 dug wells / dug cum bore wells/ tube wells for irrigation and 27378 hand-pumps/ dug cum bore wells/ tube wells for domestic and industrial use [2].

Various chemicals like fluoride, chlorides, nitrates, magnesium, etc. are present in the ground water causes water pollution. Jaipur ranked second in fluoride concentration among all the districts of Rajasthan [3]. The permissible limits of fluoride in water are 1.5mg/lt. if fluoride is more than 2 mg/lt causes dental fluorosis in human skeleton. Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air. The measurement of turbidity is a key test of water quality. The World Health Organization (WHO) establishes that the turbidity of drinking water should not be more than 5 NTU, and should ideally be below 1 NTU. pH is the potential of the hydrogen. Some gases like carbon dioxide, hydrogen sulphide and ammonia also affect pH value of water.

The quality of drinking water of Jaipur region is poor. So the water purification is essential for drinking and cooking purpose. It is essential to know the concentration of pollutants present in ground water to perform purification operation. In this study variation of water quality is identified by performing various test on water samples collected from the eight station along the straight line of 14 km .These result are helpful in understanding the water quality of Jaipur city.

2. STUDY AREA

Study area (SA) is consisting of Jaipur region. Annual rainfall of Jaipur is 526.52 mm and situated at the elevation of 431m from the mean sea level. In the current study, the SA consisting of a straight line of 14 km starting from Jalmahal to Sanganer in the Jaipur region of Rajasthan. Water table for the given distance varies from 340m to 420 m from the mean sea level. The stations selected in the stretch from Jalmahal to Sanganer are shown in Table 1 and Fig. 1.

Table 1: Stations of Study Area

S. No.	Place	Distance (km)	Latitude	Longitude
1	Jalmahal	0	26.96	75.85
2	Chaura Rasta	2	26.92	75.82
3	Albert Hall	3.78	26.91	75.81
4	SMS Hospital	4.08	26.9	75.81
5	Birla Mandir	5.36	26.87	75.81
6	Smriti Van	7.76	26.88	75.81
7	Jawahar Circle	11.44	26.84	75.8
8	Sanganer	14	26.8	75.76

Fig. 1: Stations of Study Area

3. DATA COLLECTION

The data sample is collected from the hand pumps and boring machines from various stations making a straight path. The sample is collected in the clean plastic polythene polymer bags and tested in the laboratory to analysis the purity of water.

4. METHODOLOGY

Methodology for the current study starts with the site selection and ends with the analysis of results.

Site selection — data collection → testing → analysis ►

5. SITE SELECTION

According to the population and surroundings eight stations were chosen for water collection. These stations were selected in such a way that they could cover the major area and create a straight path.

6. DATA COLLECTION

The ground water samples were collected from various stations from hand pumps or dug wells.

7. TEST AND RESULT:

The various tests (pH, fluoride, nitrate, turbidity, temperature, and TDS) to check the quality of water are performed in laboratory.

8. ANALYSIS

Obtained results were analyzed to check the variation of ground water properties along the straight line.

Following parameters like pH, turbidity, TDS, temperature, fluoride and nitrate are determined to check the quality of ground water.

A. Temperature
Measurement of the temperature of water at a particular depth with the thermometer directly immersed in water body and after a certain time when it removed out it gives exact temperature of water and gives the correct reading.

B. pH
The pH value may be determined electrometrically. The electrometric method is more accurate but requires special apparatus (pH Meter).

C. Turbidity
The turbidity is based on comparison of the intensity of light scattered by the sample under defined condition with the intensity of light scattered by a standard reference suspension under the same conditions. It is determined by the help of turbid meter. If the measurement comes under the standard level of the range and instrument is already calibrated in standard units, then only accuracy has been checked. And if the unit is less than 40 then shake the sample to disperse the solids and wait for disappearance of air bubbles. Then pour the sample into turbid meter tube and take the reading directly from the measurement scale.

D. Total Dissolve Solid (TDS):

In a laboratory setting, the total dissolved solids are determined by filtering a measured volume of sample through a standard glass fiber filter. The filtrate (i.e., filtered liquid) is then added to a pre weighed ceramic dish that is placed in a drying oven at a temperature of 103 C. After the sample dries, the temperature is increased to 180 C to remove occluded water, i.e., water molecules trapped in mineral matrix. TDS means the total dissolved (filterable) solids as determined by use of the method specified in Title 40 of the Code of Federal Regulations (40 CFR) Part 136.

E. Fluoride:

Fluoride testing is carried out to investigate fluoride levels in water. Fluoride is a naturally occurring ionic compound (or salt) that is found in low levels in most bodies of water. The concentration of fluoride in water is affected by: climate, geology, contact with fluoride minerals and groundwater chemical composition. Fluoride is dissolved into water from the surrounding soils and rocks. Some research has shown that water temperature and hardness appears to influence the toxicity of fluoride, but more needs to be done to strengthen this relationship. Occurrence of high fluoride in ground water in the district is a great concern.

9. RESULTS AND DISCUSSION:

After performing various test on ground water samples. Following results were identified:

A. Temperature

With the help of thermometer temperature of the water sample is, ensures as shown in fig. 2.
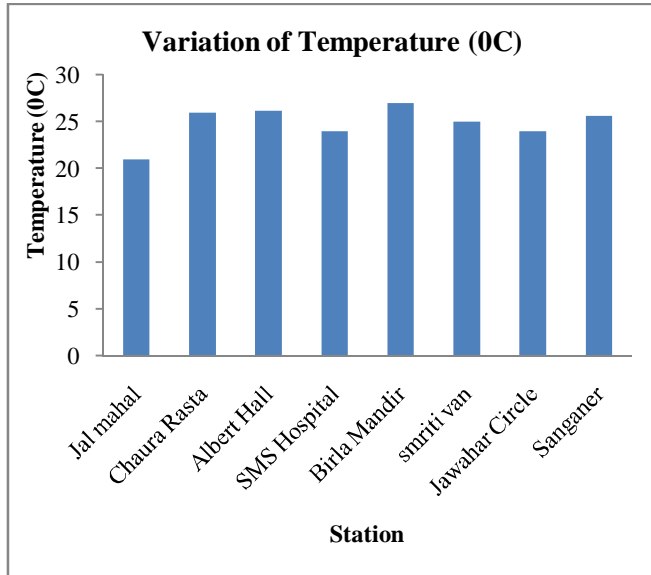
Fig. 2: Variation of Temperature

B. TDS:

The concentration of TDS at JalMahal is 10 ppm then suddenly increase in the amount of TDS in city are covering the area of Chaurarasta, Albert Hall and SMS hospital increase up to 1200 ppm . Then decreases linearly to the Sanganer region. Fig. 3.shows the variation of TDS along the straight path of 14 km from Jalmahal to Sanganer region. As per Indian Standards (IS) the permissible upper limit of TDS in water for drinking purpose is 500ppm and the lower limit is starting from 30ppm. But maximum limit is 1200 ppm is observed by testing of water samples. So the concentration of TDS is very high as compare to the permissible limits in main city. High concentration of TDS may affect the aesthetic quality of the water, interfere with washing clothes and corroding plumbing fixtures. For aesthetic reasons, a limit of 500 mg/l (milligrams per liter) has been established as part of the Secondary Drinking Water Standards.
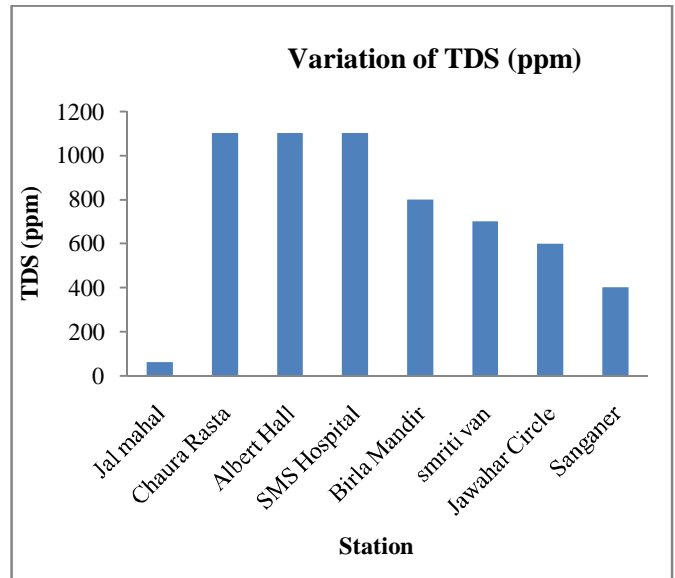
Fig. 3: Variation of TDS (ppm)

C. pH:

The pH value for the given stretch of 14 km varies from 7.9 to 8.5. It means that water is alkaline in nature. SMS Hospital is having highest pH value that is 8.5 in given study area. Variation of pH is not specific in the given stretch of 14 km in fig. 4.
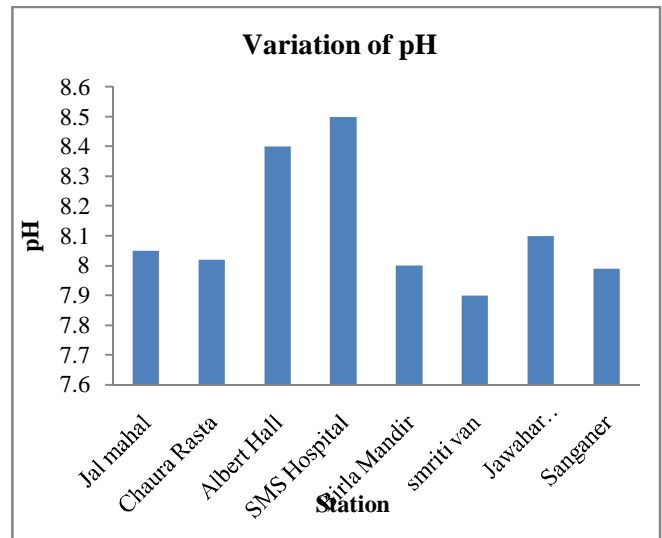
Fig. 4: Variation of pH

D. Turbidity

The turbidity of study area varies from 4.5 NTU to 14.26 NTU. As per IS the permissible limit of turbidity is 5 NTU, and should ideally be below 1NTU. But we get the limit of 14NTU.The maximum turbidity is at Albert hall and minimum at Smiritan Van area. The fig. 5 shows the variation of turbidity from Jalmahal to Sanganer region.
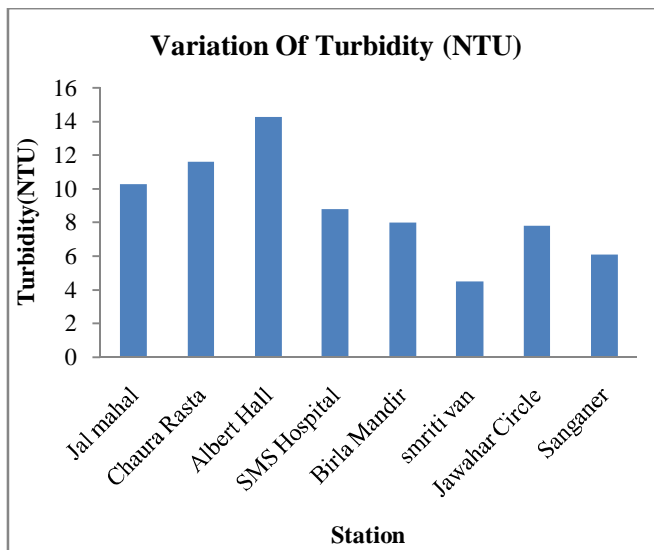

Fig. 5: Variation of turbidity (NTU)

E. Flouride

According to WHO 1984 and Indian standards drinking water specification 1991 the maximum permissible limit of fluoride in drinking water is 1.5 ppm and highest desirable limit is 1.0 ppm. Fluoride concentration above 1.5ppm in drinking water cause dental fluorosis and much more diseases. For the study area fluoride concentration varies from 0.5 - 0.2 is shown in fig. 6. So observed results are with in permissible limits. So it can be suggested that there is no need for fluoride purification.
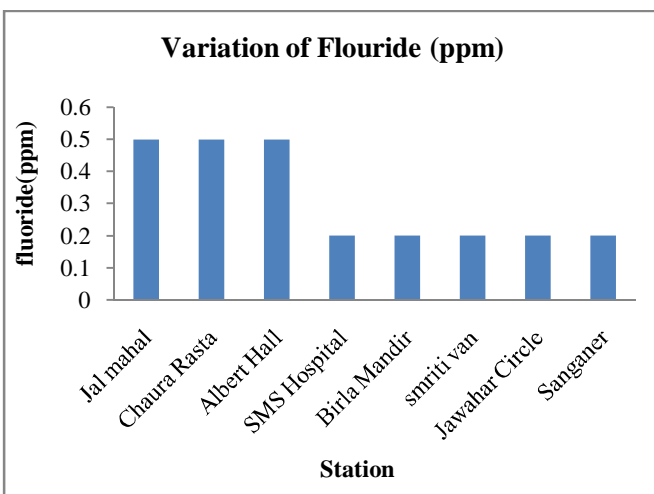

Fig. 6: Variation of fluoride (ppm)

F. Nitrate

The permissible limit of nitrate is 10ppm as per the brucine method used for the testing of water. But we analysis that variation of limit is 60-600ppm shown in fig.7. So it is considered that the nitrate present in that region very high and it is not drinkable without purification. So the nitrate test is most necessary for making the water is utility purpose.
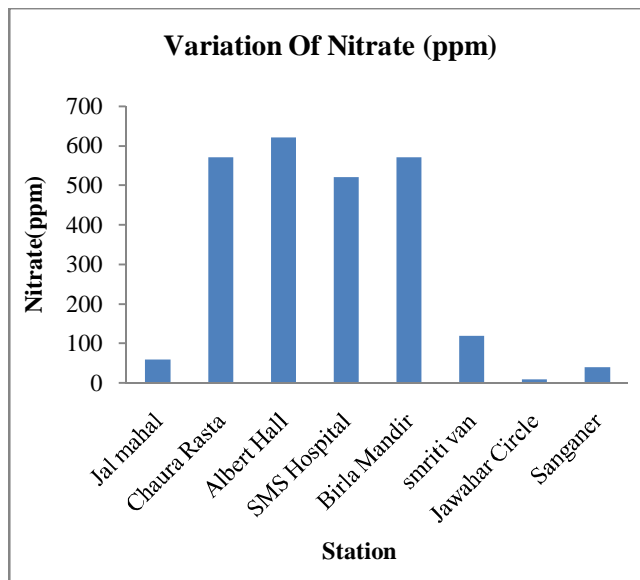

Fig. 7: Variation of Nitrate (ppm)

10. CONCLUSION

Various tests were conducted on ground water sample taken from the various stations along the straight line of 14 km. Various parameters like pH, fluoride, nitrate, TDS, temperature, turbidity are identified and analyzed.

The permissible limit of TDS is 500ppm but test conclude that the limit is varies and maximum limit is 1200ppm so the quality of water is not good for drinking purpose. So for TDS impurities purification of water is required. we perform pH test and determine that values is in between 7.9-8.5 and according to desirable and permissible limit it varies from 6.2-8.5 so water is good as per pH level so we use that water according to pH level. Then we determine the value of water by turbidity test whose permissible limit is 5NTU but by the test it varies from 4.5- 14.26NTU so it is out of permissible limit. Due to high turbidity in water the water is very bad of the where it is high from the standard limit and it is necessary to purify the water to make it usable. After that we perform fluoride test in which we conclude that the limit of water is below permissible limit, the permissible limit of water is 1.5ppm and we get the variation of 0.2-0.5ppm so it is good and the water of Jaipur in that region is best for drinking use as per fluoride test. At last but not the least we perform nitrate test in which we get too much impurity of water because

permissible limit of nitrate is 10ppm but we the variation from 60-600ppm so the quality of water is very bad and it needs to much attention for making the quality of water good. So overall it conclude that the water of that regions of Jaipur is varies according to test for some tests it is good and for some it is out of the purification level it needs too much time and attention .

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