



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

# IJIRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**

# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 2, February 2021

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

**Impact Factor: 7.512**

9940 572 462

6381 907 438

[ijirset@gmail.com](mailto:ijirset@gmail.com)

[www.ijirset.com](http://www.ijirset.com)



# Ground Water (Well Water) Quality Studies with Special Reference to Physico-Chemical Characteristics of Water-Pimpalner Region, Tahasil- Sakri, Dist- Dhule (M.S.)

W. B. Shirsath

Associate Professor, Department of Chemistry, Karm. A. M. Patil Arts, Commerce & Kai. Annasaheb N. K. Patil Science Sr. College, Pimpalner, Tal-Sakri, Dist-Dhule (M.S.) India

**ABSTRACT:** The increased human activity changes the land occupancy and land use, intolerable burden on the natural resources leading to the ground water system. Therefore keeping in mind these problems associated with rural area due to human activities and their effects the present investigation were undertaken on the well water quality in a region of Pimpalner.

The drinking water quality was investigated in rural area to ensure the safe drinking water for the public health protection. In this regard, a detailed physical and chemical analysis of drinking water samples was carried out in different residential village areas nearest to Pimpalner. The drinking water samples were taken from the ground water (well water) sources where maximum peoples were using them for drinking purpose. The Physico-chemical parameters considered for drinking water like pH, turbidity, electrical conductivity, total dissolved solids, total hardness, chlorides etc. were analyzed for-monsoon and post-monsoon well water samples collected from different areas and obtained values of each parameter were compared with the standard values set by the World Health Organization (WHO) and local standards such as National Drinking Water Quality Standard (NDWQS). The values of each parameter were found to be within the safe limits set by the WHO. Overall, the water from all the locations was found to be safe as drinking water.

**KEYWORDS:** Drinking well water, water quality standard, Physico-chemical Parameter, monsoon Post monsoon.

## I. INTRODUCTION

Water is one of the most important of all natural resources for all kinds of life on this planet. The main source of water on earth is rainfall. Portions which penetrate into the earth are called the ground water and that can be collected by digging well. It is essential and important to all living organisms, most ecological systems, food production and economic development and plays a significant role in maintaining the human health and welfare. [1][However it adversely affected both qualitatively and quantitatively by all kinds of human activities on land, in air or in water.

Contaminants in the water can affect the water quality and consequently the human health. The potential sources of water contamination are geological conditions, industrial and agricultural activities, and water treatment plants. These contaminants are further categorized as microorganisms, inorganic, organics, radionuclides, and disinfectants [2]. The safety of drinking water is affected by various contaminants which included chemical and microbiological. Such contaminants in the water can affect the water quality and consequently the human health problems. Due to these contaminants quality of the drinking water becomes poor. Sometimes such poor quality water causes many diseases in the humans so that quality of the water must be tested for both the chemical as well as for the microbial contaminants. During the study it was found that maximum number of physical and chemical parameter were within the desirable limit, as suggested by [3].



Natural Water contains suspended impurities including microorganisms and dissolved impurities. Other pollutants can also be added to water through human activities [4]. Ground water is not pure because it usually contains some amount of dissolved minerals ion. The inorganic chemicals hold a greater portion as contaminants in drinking water in comparison to organic chemicals The type and concentration of these dissolved minerals can affect the usefulness for groundwater for various purposes. [5]. Water acts as a vehicle or medium for the transfer of these organisms to humans. So it has been proved that water quality and human health have been strongly related to each other. Water borne and related diseases have been the major cause of human morbidity and mortality [6].

In many residential areas those were purified and treated water is not available, ground water is the main source of potable water for people. In case of contamination of ground water born diseases is likely to be happening. Agricultural pesticides and lack of proper drainage increase the danger of water borne diseases. Hard and soft property of ground water is good in quality but requires some treatment to remove dissolved impurities and improve its chemical characteristics [7] and its impact on human health. Water temperature plays an important factor which influences the chemical, bio-chemical characteristics of water body. Water quality and suitability for consumption and use are determined by its taste, odor, colour and concentration of organic and inorganic matters [8].

## II. AIMS AND OBJECTIVES

For this present piece of work, the area which I have selected Pimpalner region Tal. Sakri, Dist. Dhule, Maharashtra. This is basin of Sahyadri ranges and very close to Dang forest of Gujrath. This area characterized by good rainfall, surrounded by three dams and highly irrigated. Farmers are involved commonly applied in advance agricultural practice constantly using chemical fertilizers and pesticides to overcome nutrient deficiency in permanent agricultural lands. During a rainfall season the fertilizers used in the agricultural field leaches in to the ground and mixes with the water.

Since groundwater is the major source for agriculture in this area. The nature of soil and rock in an area has an impact on its groundwater quality. Similarly in these villages most of the farmers they uses well water for drinking. Therefore aim of my study is to find out the ground water quality contamination with reference to well water only and the best way is to raise public awareness of hygiene measures and to avoid excess application of fertilizers in agriculture. This paper compares the quality of ground water monsoon and post monsoon in such villages. This study attempted to assess the seasonal variation of physico-chemical properties of ground water (well water.)

## III. MATERIAL AND METHOD

The physical and chemical characteristics of water determine its usefulness for drinking purpose. In order to get an idea about ground(Well) water quality the methodology used for obtaining reliable and useful data includes selection of sampling sites, collection of water samples and analytical method.

**Selection of sampling sites and Collection of samples** - Seven different sites and locations in region of Pimpalner Tal. Sakri, Dist. Dhule (M.S.) was selected based on designed criteria. All of the drinking water samples were taken from the well water. The samples were numbered from 1 to 7 against their locations and sources (Table -1). The samples were collected in 1-liter polyethylene bottles, which were washed with distilled water before use. A representative water sampling was carried out from each location during the monsoon and post monsoon period. During the period, the temperature at the time of sampling was noted /recorded. During the monsoon the temperature at the time of sampling was 29-30°C, while it was 23- 24°C during the water sampling in winter. The collected samples were brought to the Shejmi laboratory Tahasil Satana (Nashik) for analysis. The analysis was carried out by adopting suitable analytical or instrumental method [9].The data is tabulated and statistically analyzed.

Table-1: Location of well water samples

Sample No.	Source	Location /Place	Sample No.	Source	Location /Place
A	Well water	Pan Kheda	E	Well water	Balhane
B	Well water	Jebhapur	F	Well water	Deshshirwade
C	Well water	Manav Kendra	G	Well water	Dighave
D	Well water	Samode	--	--	--

#### IV. RESULT AND DISCUSSION

A detailed physical and chemical analysis was carried out by taking water samples from different residential areas of the region. The parameters Physical parameters (colour, Turbidity Taste and Odour.) Chemical parameters such as pH, Electrical Conductivity (E.C), Total Dissolved Solids (TDS), Total Hardness, calcium, magnesium, iron, Potassium, Sodium. Carbonates Nitrates, Sulphates, Chlorides, organic carbon and Biological parameters were also analyzed in each water sample. The results of each parameter were compared to the guidelines and standards set by the WHO and local standards such as NDWQS [9][10]

The analytical data on physicochemical properties of all the drinking water samples at studied source location for Pimpalner region is reproduced in Table 2 and 3

Table-2: physicochemical parameters of well water in Monsoon period (July-2020)

Sr. No.	Characteristic s properties of Water sample	Sample- A	Sample -B	Sample -C	Sample D	Sample E	Sample F	Sample G	Drinkin g water Desirabl e
1	Color (Hazen unit)	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear
2	Taste and Odour	Unobjec- tionable	Unobje- c- tionabl e	Unobjec- tionable	Unobje- c- tionable	Unobjec- tionable	Unobjec- tionable	Unobjec- tionable	Unobjec- tionable
3	Turbidity (NTU)	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear
4	TDS	562	473	732	865	895	547	754	500
5	pH	7.32	7.40	7.19	7.20	7.22	7.61	7.10	6.5 to 8.5
6	EC ( $\mu$ mhos/cm)	0.94	0.59	1.01	1.29	1.38	0.73	0.92	--
7	Total Hardness	278	174	298	381	408	216	273	200/300
8	Ca ( % )	62.5	30	50	75	70	45.0	57.5	75
9	Mg ( % )	6.8	4.0	7.0	9.0	10	5.3	6.8	30
10	Fe (%)	ND	ND	ND	ND	ND	ND	ND	0.1
11	Na (PPM)	150	50	120	160	164	120	152	< 50
12	K( Potassium)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	-
13	Carbonate	Nil	Nil	Nil	Nil	Nil	Nil	Nil	--
14	Bicarbonate	366	231	396	488	549	305	414	
15	Chloride	142	84	177	241	298	142	191	200
16	Sulphate	95	45	110	116	120	105	104	200
17	Nitrate (NO <sub>2</sub> )	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Nil

18	Nitrate (NO <sub>3</sub> )	2.0	0.5	0.5	2.5	1.2	1.0	2.0	45
19	Organic carbon	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Nil
20	Sodium shoshan (S.A.R)	5.5	5.0	5.6	6.0	6.5	5.5	5.2	< 10
Microbiological Analysis									
21	Nonchlorinated	> 1800	700	Nil	> 1800	> 1800	> 1800	200	Nil
22	Chlorinated	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

Table-3: Physicochemical parameters of well water in winter period- Jan-2021

Sr. No.	Characteristics properties of Water sample	Sample-A	Sample-B	Sample-C	Sample-D	Sample-E	Sample-F	Sample-G	Drinking water Desirable
1	Color (Hazen unit)	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear
2	Taste and Odour	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
3	Turbidity(NTU)	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear
4	TDS	562	473	732	865	895	547	754	500
5	pH	7.2	7.29	7.4	7.32	7.18	7.45	7.86	6.5 to 8.5
6	EC	0.76	0.64	0.99	1.17	1.21	0.74	1.01	--
7	Total Hardness	224	189	293	346	358	219	301	200/300
8	Ca ( % )	55	37.5	55	75	62.5	47.5	70	75
9	Mg ( % )	5.6	4.8	7.3	8.6	8.5	5.4	7.5	30
10	Fe ( % )	ND	ND	ND	ND	ND	ND	ND	0.1
11	Na (PPM)	142	60	124	160	160	130	140	< 50
12	K Potassium	Nil	Nil	Nil	Nil	Nil	Nil	Nil	-
13	Carbonate	Traces	Traces	Traces	Traces	Traces	Traces	Traces	--
14	Bicarbonate	224	274	427	500	488	305	457	--
15	Chloride	142	120	184	248	177	149	213	200/250
16	Sulphate	71	61	95	130	90	70	105	200
17	Nitrate (NO <sub>2</sub> )	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Nil
18	Nitrate (NO <sub>3</sub> )	2.0	0.5	0.5	2.5	1.2	1.0	2.0	45
19	Organic carbon	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Nil
20	Sodium shoshan (S.A.R)	6.9	3.7	2.96	6.6	4.6	4.0	6.0	< 10
Microbiological Analysis									
21	Nonchlorinated	> 1800	700	Nil	> 1800	> 1800	> 1800	200	Nil
22	Chlorinated	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

(Note: all parameters are in mg/l except pH, EC in  $\mu$  mhos/cm and Turb in NTU)

In the studied area, water used for drinking purposes should be colourless, odourless and free from slight turbidity and excess salts. The temperature of the water is in the range 29-31°C, in monsoon and in post monsoon and 23-24 °C Water sample temperature plays an important factor which influences the chemical, bio-chemical characteristics of water body. pH values for all the sampling points before and after monsoon are shown in Table-2 and 3. Most of the water samples are slightly alkaline due to presences of carbonates and bicarbonates. The pH values of all the drinking water samples are found to be in the range between 7.10 to 7.86 for the same water sample of G, there was no significant change in the pH value during the observation period; these values within the limit prescribed by WHO and NDWQS guidelines is

between 6.5 and 8.5 (Table 2). The normal drinking water has the lowest and highest values are from samples -E and G respectively (Table-2 and 3). All water samples are within the desirable and suitable range.

**TDS** is important parameter in drinking water quality standard. It develops particular taste to the water and at higher concentration reduces its portability water with more than 500 mg/L usually has a disagreeably strong taste. High TDS levels generally indicate hard water. TDS are the inorganic matters and small amounts of organic matter, which are present as solution in water. Table - shows TDS values for all seven drinking water samples. Desirable limit for TDS is 500 mg/l and maximum limit is 1000 mg/l which prescribed for drinking purpose .The concentration of TDS in present study was observed in the range of 473 mg/L and 895 mg/L The highest TDS values of 895 mg/L and the lowest TDS values of 473 mg/L correspond to samples from E and B, respectively (Table-2 and 3)

One of the important things is that the acceptable TDS level in the water listed in Table-4.

**Table-4**

TDS Level in parts per million(ppm)	Palatability Quotient
Between 50-150	Excellent for drinking
150-250	Good
250-300	Fair
300-500	Poor
Above 1200	Unacceptable

**Turbidity** is the cloudiness of water caused by a variety of particles and is another key parameter in drinking water analysis. It is also related to the content of diseases causing organisms in water, which may come from soil runoff. The turbidity results for all seven drinking water samples studied are shown in table. The standard recommended maximum turbidity limit, set by WHO and NDWQS, for drinking water is 5 (five) nephelometric turbidity units (NTU) [6]. The results indicate that the turbidity of all the samples studied was not seen.

**Electrical conductivity:** The conductivity of well water is shown in Tables 2 and 3. The results reveal that obtained value was not accordance with standard value of drinking water. Conductivity shows significant correlation with parameters such as temperature, pH value, alkalinity, total hardness, calcium, total dissolved solids, chlorides and iron concentration of water. Gupta N. and et.al [11] suggested that the underground drinking water quality of study area can be checked effectively by controlling conductivity of water and this may also be applied to water quality management of other study areas. The results (Table 2 and -3 ) reflect that the mean conductivity of drinking water samples of the well water is found to be in the range between 0.59 to 1.38  $\mu\text{s}/\text{cm}$ . The maximum value of the conductivity of well water is 1.38  $\mu\text{s}/\text{cm}$ . The minimum conductivity value is 0.59  $\mu\text{m}/\text{s}$ . The obtained value after analysis when compared with the standard value is 200  $\mu\text{w}/\text{s}$  of conductivity.

There are no wide differences among the values of the electrical conductivity of different water samples are not yet known. Scatena [12] explained the differences based on various factors such as agricultural and industrial activities and land use, which affect the mineral contents and thus the electric conductivity of the water. Conductivity does not have direct impact on human health. It is determined for several purposes such as determination of mineralization rate (existence of minerals such as potassium, calcium, and sodium) and estimating the amount of chemical reagents used to treat this water. High conductivity may lead to lowering the aesthetic value of the water by giving mineral taste to the water.

**Chlorides:** In the study area the chlorides values range from 84 mg/l to 298 mg/l. The maximum value of chloride and minimum value of chloride (298 mg/l) and (84 mg/l) correspond to samples B and E respectively. High chloride values in water cause problems in after sewerage. Excess amount also changes the taste of drinking water and make it saline. All the samples not more cross the barrier of WHO, so the water of may be considered to be suitable for domestics uses. But some Sampling sites (sample D and E) showed the somewhat higher chloride concentration than the prescribed by



WHO. This is mainly because of chloride salts which may be from soils in monsoon period So it can conclude that water is hard at these sampling sites, which necessitates the softening of water prior to its use.

**Nitrates:** The WHO allows maximum permissible limit of nitrate 5 mg/l in drinking water The values of nitrate ranges from 0.5 mg/l to 2.5 mg/l. the maximum value (2.5mg/l) was observed in sample D and minimum (0.5 mg/l) in sample Band E These results indicate that the quantity of nitrate in the study site is acceptable.

According to WHO standards, its permissible range in drinking water is 75 mg/l. In the study areas, results show that the concentration of calcium ranges from 30 to 75 % mg/l If calcium is present beyond the maximum limit causes the incrustation of pipes and deterioration of clothes.

**Magnesium value** in the studied area varied between the 4.0 to 10 % sampling sites showed suitable value within the prescribed limit by WHO. The results exhibit that concentration of magnesium in study area was lower than the standard limit of WHO. The iron values in the studied area were not observed. If the value of iron is higher in water prevents the self purification of water and thereby produces adverse effect for aquatic lives.

**Sulfate concentration** in natural water ranges from a few to a several 100 mg/liter, but no major negative impact of sulfate on human health is reported. The WHO has established 250 mg/l as the highest desirable limit of sulfate in drinking water. In study area, concentration of sulfate varied between the 45-130 mg/L

The summation of calcium hardness and magnesium hardness is regarded as the total hardness of water. In the present investigation, it has been observed that calcium concentration is in between 30 to 75 % and magnesium hardness 4.0 to 10 %. Sodium values in the studied area between 50-164 mg/L. The higher the concentration of sodium can be related to cardiovascular diseases and in woman toxemia associated with pregnancy. Sampling sites showed higher concentration of sodium than the prescribed by WHO According to WHO standards the permissible limit of potassium is 12 mg/l. Results show that the concentration of potassium in study areas did not found in all water samples.

**Total hardness:** In the present investigation, maximum and minimum total hardness for well water was 408 mg/l and 174 mg/l. The total hardness of sample D and E was high in comparison with other samples in both seasons which is less than the WHO guidelines value i.e., 500 mg/L as CaCO<sub>3</sub>. Therefore all sources were satisfactory.

The slight increase in hardness for some sources was observed during monsoon than winter. These increases in values may be due to the addition of calcium and magnesium salts. The TDS also contributed by the type of soil through which the water leaches in to the ground during rainfalls. The amount of fertilizers applied in the agricultural field could also contribute to the total dissolved solids. The results obtained after analysis when compared with the standard values of hardness are found to be less than the permissible limits set by WHO excluding Sample D and E which are not suitable for drinking in terms of total hardness.

Presence of carbonates depends upon pH values. All water samples having pH values less than eight carbonates is indicated in trace form in winter period but not in monsoon period Below pH 8.0 the carbonates are converted into the equivalent amount of bicarbonates. Bicarbonates values in the studied area between 224-549 mg/L. The maximum value of bicarbonate 549 mg/L and minimum value of (224mg/l) correspond to samples E (monsoon period) and A (Post monsoon period) respectively.

In this study, the sample C were found to be more free from various micro gram positive bacterial activities Sample B (700 MPN) and F (200 MPN) and remaining samples have more value greater than 1800 .Excessive amount of physical, chemical and biological parameters accumulated in drinking water sources, leads to affect human health. As discussed in the result, all study area of drinking water well samples is under limit of WHO guideline standards. Therefore, the present study was found the drinking water safe and no residence health impacts.

To the best of our knowledge there no more work on well water in this region, although more research and process of optimization is still needed, this study is a step towards success.

**Table-5: Water quality parameters and drinking water standards**

Sr. No.	Parameter	Permissible	Excessive
01	Temperature	--	--
02	Color	2.5	10 Hazen unit
03	Odour	Acceptable	Acceptable
04	Electrical conductivity	-	-
05	pH	7.0 - 8.5	6.5 – 9.5
06	Total solid	500	1500
07	Total Hardness as CaCO <sub>3</sub>	200	600
08	Bi carbonate	--	--
09	Carbonate	--	--
10	Chloride	200	1000
11	Magnesium	30	150
12	Iron as Fe	0.1	0.1
13	Nitrite	Nil	Traces
14	Nitrate	45	45
15	Potassium	--	--
16	Sodium	less than 50	50
17	Sulphate	200	400
18	Calcium	75	200
19	Organic carbon	Nil	Traces
20	Sodium shoshan (S.A.R)	less than 10	less than 10
21	Microbiological analysis		
Most probable number			
22	Nonchlorinated	Nil	less than 10
23	Chlorinated	--	less than 2

**Table-6: Different analytical water quality parameters with their analytical technique**

Studied Parameter	Technique/ Method used	Studied Parameter	Technique / Method used
Temperature	Thermometer	Magnesium	A.A Spectrophotometer
Color	Visual / color kit	Nitrate	UV Visible Spectrophotometer
Odour	Physiological sense	Nitrite	UV Visible Spectrophotometer
Electrical conductivity	Conductivity meter	Potassium	Flame Photometer
pH	pH meter	Sodium	Flame Photometer
Total Hardness	Complexometric titration	Sulphate	Nephelometer / Turbidimeter
Bi carbonate	Titration	Calcium	Flame Photometer
Carbonate	Titration	Organic carbon	Titration
Chloride	Argentometric titration		

## V. CONCLUSION

1) It is evident that all the values of sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), chloride (Cl), SO<sub>4</sub>, and NO<sub>3</sub> fall under the permissible limit and there were no toxicity problem.





2) Water samples showed no extreme variations in the concentrations of cations and anions. Parameters like Hardness, TDS and Nonchlorinated of samples were reported with higher values than the permissible level, but this value does not have any impact for the water to use for drinking purpose. According to this report, the well water is suitable for drinking purposes and agricultural utilization generally it is not harmful to human beings.

3) The Physico-Chemical parameter were studied and analyzed in two season (Monsoon and post monsoon ) i.e. in July-2020 and Jan-2021. Various physico-chemical parameters such as water temperature, water colour, Turbidity, free ammonia, Total dissolved solid, pH, Dissolved oxygen, Free CO<sub>2</sub>, Total hardness, total alkalinity, chlorides, , Nitrates, Phosphates, Sulphates were studied. The results revealed that there were significant seasonal variation in some physicochemical parameters and was moderately polluted in some sites. Characteristic behavior of the well water samples in two seasons and different sampling stations. The result of the study shows that as the season changes there is fluctuation in the physico-chemical characters of the water, this will be due to flow flushing of river water nearest to some villages (sites) in monsoon period.

4) The physicochemical of chemical characteristics of water samples in the study area suggested that there was no harmful chemical contamination. The sample C were found to be more free from various micro gram positive bacterial activities. Sample B (700 MPN) and F (200 MPN) and remaining samples have more value greater than 1800.

5) The quality of water sample was acceptable from majority of Physico-chemical parameter but as per bacteriological parameter for some sites water need to be treated before using it drinking purpose.

It was recommended that proper water treatment especially effective chlorination with residual chlorine be rendered at all sources in order to achieve safe water quality up to the consumer's end.

After observing all results it was concluded that quality of well water under study area is nearly fit for drinking purpose, agricultural utilization, and generally it is not harmful to human beings.

It is evident that all the values of sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), chloride (Cl), SO<sub>4</sub>, and NO<sub>3</sub> fall under the permissible limit and there were no toxicity problem. Water samples showed no extreme variations in the concentrations of cations and anions. The study revealed that some well water sampling sites (B,C,G) were not contained various micro gram positive bacterial activities except some water sampling sites.

## VI. ACKNOWLEDGEMENT

Authors are heartily thankful to all the Hon. Members of the management committee, Pimpalner education society Pimpalner and to the Principal Dr. S.T. Sonawane of the College for giving necessary facilities. My sincere thank also to Arunkumar B. Sawant, Ex. Professor in Chemistry, M.S.G. College, Malegaon Camp (Nashik), and Department of Zoology of my College for giving valuable guidance. I express whole hearted thank to my friend Associate Prof. K. D. Kadam for encouragement, support.

## REFERENCES

1. World Health organization, International standards for drinking water (third edition Geneva 1972)
2. L. M. L. Nollet, Handbook of Water Analysis, Marcel Dekker, New York, NY, USA, 2000.
3. WHO (1971) and BIS (1991).
4. J. De Zuane, Handbook of Drinking Water Quality, John Wiley & Sons, 1997.
5. World Health Organization (WHO), Guidelines for Drinking-Water Quality, WHO Press, Geneva, Switzerland, 4th edition, 2011.
6. World Health Organization (WHO), Guidelines for Drinking-Water Quality, WHO Press, Geneva, Switzerland, 4th edition, 2011



7. G.S Birdle. and J.S. Birdle (1997) Water supply and sanitary Engineering ,5<sup>th</sup> Ed Dhanpathrai and Sons
8. G. E. Dissmeyer, Drinking water from Forests and Grasslands, South Research Station, USDA Forest Service, Asheville, NC, USA, 2000.
9. Standard APHA Methods for the examination of Water, 22<sup>ND</sup> Edition, (2012)
10. Beuro of Indian Standards for Drinking water 2012 (BIS2012), (2012)
11. Gupta N. and et.al., Physico-Chemical Analysis of Drinking Water Quality from 32 locations in Delhi, *Journal of Indian Water Works Association*, (2010)
12. F.N. Scatena “Drinking water quality,” in drinking water from forest and grass lands: A synthesis of scientific literature, Department of agriculture southern research station Asheville, NC, USA, 2000.



**INNO SPACE**  
SJIF Scientific Journal Impact Factor

**Impact Factor:  
7.512**

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  [ijirset@gmail.com](mailto:ijirset@gmail.com)



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details