



Basic Parameters Of Ground Water Of Sanganer Area Of Jaipur City, Rajasthan

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Abstract

The current study was conducted to assess the quality of groundwater of Sanganer Tehsil of Jaipur City (Rajasthan), India. For the study, samples from 30 villages/area were collected from publically used hand pumps and bore wells. Correlations between physicochemical parameters were also investigated. The samples underwent bacteriological examination as well as physicochemical analysis of parameters which included Chlorides, Fluorides, Nitrates and Totally Dissolved Solids. When compared to the permissible limit of Bureau of Indian Standard (BIS) norms for potable water, the results showed that the water of many villages was not potable. The water quality of many villages failed the guidelines for bacteriological quality and required treatment to be used as drinking water.

Keywords: Correlation study; Bacteriological examination; Groundwater quality; physicochemical analysis; Sanganer Tehsil.

1. Introduction

Water is the most abundant compound on the surface of Earth, and it is also the most abundant compound in the human body. Water is essential for human beings to survive. Major sources of water are surface water and groundwater. Ground water is a significant natural source of water that is used all over the world, and it may have been the most widely used. Irrigation, industry, and domestic purposes all use groundwater. The consistency of discharged water, the atmosphere, surface water, and subsurface geochemical processes all influence ground water quality. Rajasthan is known to be a dry and semi-arid area. Due to the insufficiency of surface water, the majority of the population in the state has to rely on groundwater sources. In a lot of areas, groundwater is the sole source of water which is to be used for drinking. Jaipur is the capital & largest city of Rajasthan in northern India. It is the tenth most populous district of India & spreads over an area of 11,152 km². It has 13 sub-divisions and among those, Sanganer (Longitude: 75° 46' E Latitude: 26° 49' N; is a big sub-division of Jaipur.

Sanganer is a town/tehsil (an administrative division) situated in Jaipur district, Rajasthan, 16 km south of state capital Jaipur. Jaipur has been divided in 13 Sub divisions and Sanganer is one of these 13 Sub divisions. It is famous for textile printing, handmade paper industry, and for Jain temples. Sanganer prints are one of its own kinds, for the reason that the patterns in bright colours are always printed on white backgrounds. Sanganeri Hand block printing received the geographical indication (GI) tag in 2010.

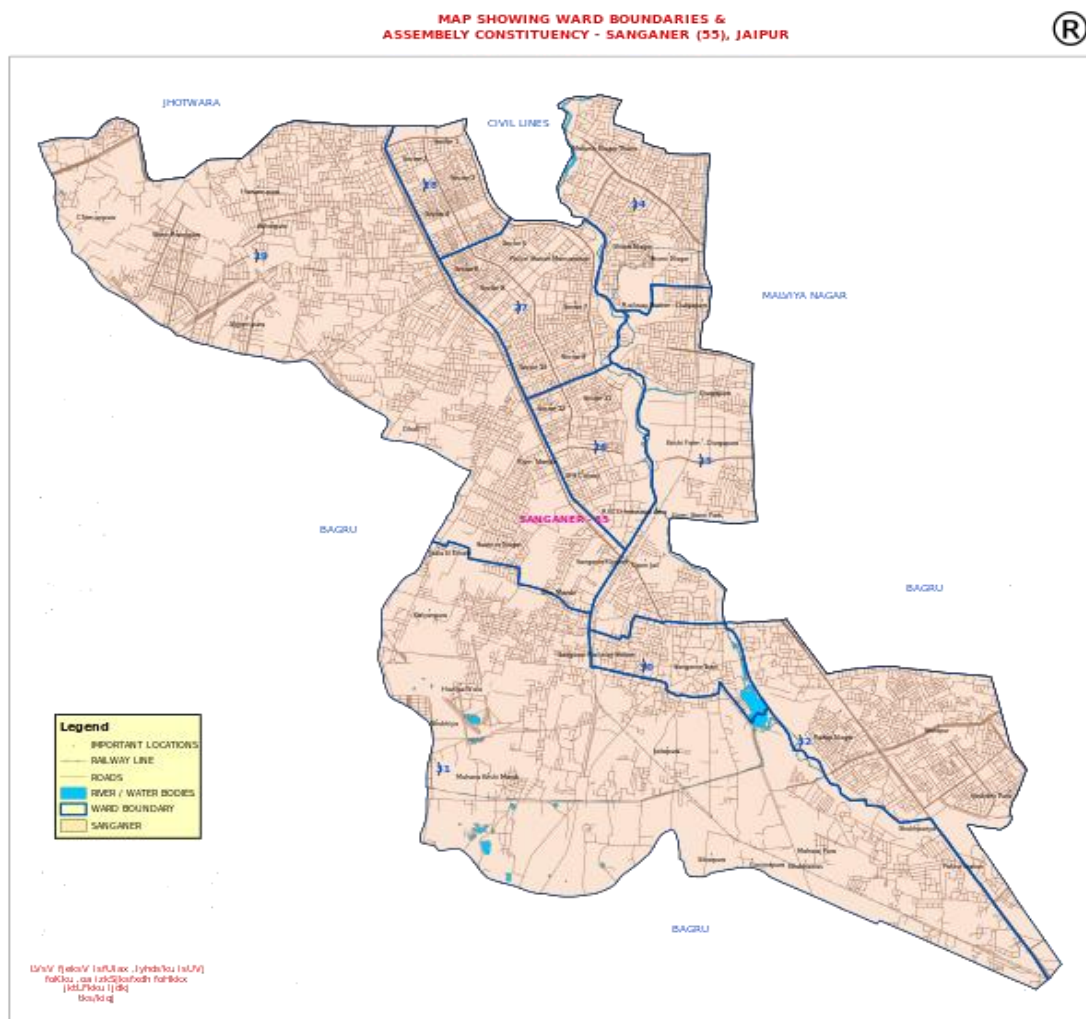


Fig.1 Area of sanganer, jaipur

It is spread over an area of 710 km² which includes 495.54 km² rural area and 214.67 km² urban area. Jaipur is highly dependent on groundwater for daily water supply. But due to urbanization, agricultural & domestic waste, the groundwater quality has deteriorated immensely, which has led to the spread of many fatal diseases. Hence, this study is designed to assess the quality of groundwater of Sanganer, Tehsil and to make people aware of the kind of water they are using. And find a correlation between physicochemical parameters.

Review of literature:

Several workers in our country have conducted extensive studies on water quality. (Abbasi et al) and (Jagdap Jyashri et al.) investigated the water quality of various rivers. (Shriniwas et al. and Jha et al) investigated water quality in Hyderabad and Bihar, respectively. (Patnaik et al) reported water pollution in an industrial area. Fluoride levels in drinking water from various sources in and around Jaipur, as well as in many villages, and trace metals have previously been tested in our laboratory. Recent studies of industrial wastewater and ground water, as well as the pollution problem in ground water, have been conducted in our laboratory.

Groundwater quality parameter measurements have always been critical, especially at regular intervals. (Rathore et al. 2005) conducted prominent studies on groundwater exploration and augmentation efforts in Rajasthan. Hydro-chemical investigations and correlation-analysis of Jaipur city's ground water quality have also been carried out, which essentially characterises the status of groundwater quality in a simple and comparable manner (Tatawat and Chandel, et al. 2007).

Many authors have also emphasised the importance of hydrochemistry knowledge in assessing ground water quality for various beneficial uses (Latha 2012; Singh and Singh 2002; Srinivas et al. 2013). (Tietenberg 1984) proposed that sustainability be addressed by ensuring that future generations are at least as well off as current generations.

However, there is no measuring gauge or standard against which sustainability is measured, and policies are developed accordingly (Hinterberger et al., 1997; Phillis and Andriantiatsaholiniaina, 2001).

The significance and importance of groundwater have been widely recognised by all nations dealing with water-related issues. In India, where the economy is developing, the best development, effective use, and viable administration of their water assets ought to be the primary strategy for monetary development; however, in recent years, unscientific administration and utilization of these assets for various reasons has frequently resulted in undesirable issues, for

example, water logging and saltiness in the case of agribusiness use, and environmental contamination of various bristles. In India, the majority of the population relies on groundwater as their primary source of drinking water. Groundwater is generally thought to be cleaner and less contaminated than surface water.

According to Zafar, the pH value of water appears to be dependent on the relative amounts of calcium, carbonates, and bicarbonates. When water contains carbonates, it becomes more alkaline. The absence of carbonate alkalinity indicates that the total alkalinity recorded was due solely to bicarbonate accumulation. Fluoride in tap water causes a mild form of dental fluorosis. According to (Sarala kumari D. et al.), drinking water contains a significant amount of fluoride that enters the human body. Those named (Gopal et al.) have studied that fluoride samples which exceeded the acceptable limit are not recommended for consumption without treatment. Fluoride is considered as an essential element though health problems may arise from either deficiency or excess amount.

Various researchers have conducted extensive studies in the related field. (Karunakaran K. et al.) have made statistical study on physicochemical characteristics of groundwater in and around Namakkal, Tamilnadu, India and suggested the necessity to purify the available water resource prior to utilization. (Patil V. T. and Patil P.R. et al.) conducted Physicochemical Analysis of selected groundwater samples from Amalner Town in Jalgaon District, Maharashtra, India and reported that some treatment was required to minimise the various parameters. (Das G. et al.) assessed the drinking water quality of the Brahmani River. (Raja R. E. et al.) evaluated the physicochemical parameters of groundwater samples from Kotputli Town in Jaipur, Rajasthan.

Research and Methodology:

For the study, groundwater samples from hand pumps and tube wells of 46 villages in the North-Western part of Sanganer were collected in the winter period from December 20, 2020 to February 20, 2021. The samples were collected in sterile plastic bottles and examined for bacterial presence as well as chemical parameters like fluoride, nitrates, chlorides, and total dissolved solids (TDS) using standard methods which are listed below in Table.1.

Table1. Prescribed standard for potable water

Parameters	methods
Fluoride	IS 3025 (Part 60)
Nitrates	IS 3025 (Part 34)
Chlorides	IS 3025 (Part 32)
Total dissolved solids (TDS)	IS 3025 (Part 16)
Bacterial Presence	IS 1622 (1981)

Result and Discussion :

All achieved results are compared with that of standard permissible limits recommended by the Bureau of Indian Standard (B.I.S), the Indian Council of Medical Research (I.C.M.R) and the World Health Organization (W.H.O.) as shown in Table-2. Table-3 shows the results of the tests for water quality parameters in the groundwater samples obtained from Sanganer.

Table 2. Prescribed standard for potable water.

S. No	Parameters	BIS (2012)	ICMR (1975)	WHO (2003)
1	Fluoride (mg/l)	1.5	1.5	1.5
2	Nitrate (mg/l)	45	50	50
3	Chloride (mg/l)	1000	200	250
4	TDS (mg/l)	2000	500	-
5	Bacteriological Presence	Nil	-	Nil

Table 3. Analysis of ground water sample collected from various places in the Sanganer tehsil of Jaipur city.

Sample. No	Village name	Fluoride (mg/l)	Nitrate (mg/l)	Chloride (mg/l)	TDS (mg/l)	Bacteriological (P/A)
1	Dehmi Kalan	0.56	56.93	144.79	1267.66	A
2	Begas	1.18	52.75	99.85	340.99	A
3	Dehmi khurd	0.69	27.29	314.98	364	P
4	RIICO ind. area	1.07	18.534	339.84	1820	A
5	Sanjhariya	0.37	16.792	351	580	P
6	Thikariya	0.68	58.986	376.25	580.447	P
7	Awaniya	0.25	50.898	316.55	384.65	A
8	Achanchukya	0.56	57.144	335.52	391.025	A
9	Harchandpura @ deoliya	1.01	27.696	318.55	395.512	A
10	Chorasya ki dhani	0.81	19.236	405.355	1858.974	A
11	Sitapura bas	0.45	17.734	156.7	288.46	P

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	sanjhariya					
12	Sarangpura	0.24	58.516	343.51	576.99	P
13	Kodar	0.71	57.162	339.521	423.076	A
14	Garedo ki dhani	0.2	56.896	329.535	391.025	A
15	Hardhyanpura	0.45	26.126	355	378.205	A
16	Dhami	0.95	18.234	294.58	1903.842	A
17	Balmukundpura @ nada	1.0	18.048	157.77	310.256	P
18	Nangal bargoojran	0.25	58.07	324.5	606.41	A
19	Kumawat ki dhani	0.39	56.968	333.52	392.564	A
20	Barh awaniya	0.68	50.876	333.52	416.36	A
21	Rampurawas deoliya	0.78	26.67	355.535	391.025	P
22	Hasampura	0.97	19.76	479.89	195.128	A
23	Prithvisinghpura @ naiwala	0.5	16.806	145.79	294.87	P
24	Ramchandpura	0.31	59.516	436.39	634.615	P
25	Chimanpura	0.81	25.86	192	372	A
26	Ghegha	0.21	32.59	148	524	P
27	Bhaosinghpura	0.15	28.132	178	537	A
28	Mansinghpura	0.38	24.5	390	585.5	A
29	Ramsinghpura	0.16	31.94	552	825	A
30	Chak begas	0.59	29.85	226	530.5	A

P-present, A- absent

Fluoride

Fluoride concentration in all samples is within the permissible limit of BIS, ICMR, and WHO. Fluoride levels were found to be below the acceptable limit (1 mg/l) in 30 samples, causing a number of health issues like enamel fluorosis, bone weaknesses, etc. Fluoride is an important life element for the health of humans and crucial for normal mineralization of bones and for the formation of dental enamel with the presence of lesser quantity. However, higher concentrations, such as more than 1.18 mg/l, can have negative health consequences. Fluorosis is a disease caused by high fluoride levels in the water. Fluoride existence in groundwater can be attributed to geological reasons. Fluoride is present innately in water resources. Generally, the majority of groundwater sources have excessive fluoride concentrations when compared to surface water sources. Weathering of rocks, precipitation, and untreated water, mostly from the fertilizer industry, all contribute to fluoride in the soil. Drinking water is a sizeable source of the daily fluoride intake. The enamel fluorosis is spotting of enamel that is forever present once a child's teeth are created. It is explained as a harmful effect caused by interference of fluoride with ameloblasts in the developing tooth, emerging in a disturbance of the process of formation of enamel, making it ever more porous. Fluoride weakens bones and increases the risk of fractures. People exposed to around 4 mg/l of fluoride through drinking water over their lifespan are likely to have an increase in bone fractures over those subjected to 1 mg/l. There are multiple endocrine effects of fluoride exposure, which include earlier sexual maturity, reduced thyroid function and Type 2 diabetes. Fig. 2 shows the concentration of fluoride in different samples as per sample numbers in Table-3. The fluoride concentration of the area studied varies from 0.15 mg/l to 1.18 mg/l. The highest fluoride concentration was recorded at Begas (Sample 2, Fig.2) and the lowest was at Bhaosinghpura (Sample 27, Fig.3)

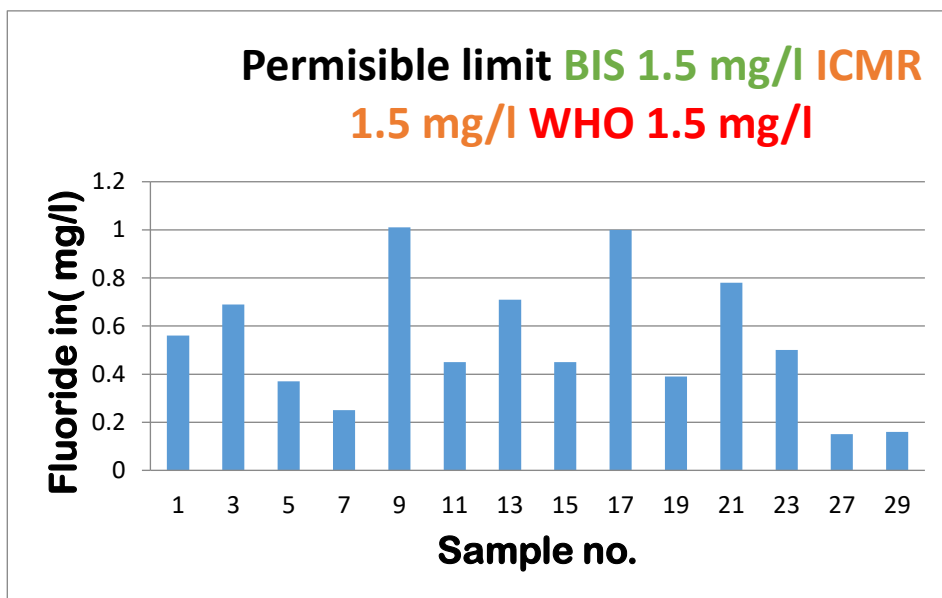


Fig.2. Fluoride concentration in various samples

Nitrate

In 30 samples, we found higher nitrate levels than the BIS permissible limit and 18 samples have crossed the permissible limit of all three (BIS, WHO, and ICMR). Nitrate exposure has toxic biological effects. Hence, it is considered to be a contaminant in the drinking water which is mostly sourced from the ground. High concentrations of nitrate can cause methemoglobinemia. It is a blood disease which causes blue-baby syndrome (infant cyanosis). Methemoglobin presumably forms in the intestinal tract of infants when nitrite ion is formed from nitrate ion by bacteria. Methemoglobin is formed when one nitrite molecule interacts with two molecules of hemoglobin. This reaction occurs rapidly in acidic environments. The altered type of blood protein prevents blood cells from taking in oxygen, resulting in the infant's prolonged suffocation, which may be fatal. Also, diseases such as Alzheimer's disease, vascular dementia, multiple sclerosis can happen in human beings due to excess of nitrate consumption. Nitrate contamination also promotes eutrophication of water bodies. Mostly, man-made sources cause the concentration of nitrate to increase towards a hazardous level. Human and animal sewage disposal sites; waste from industries related to processing of food, munitions are a few sources of potential nitrate contamination of groundwater. Recently, it has come to attention that vacant manure storage facilities can be more dangerous to groundwater than completely full ones. The concentration of nitrate in groundwater is also related to rainfall. Where there is low rainfall, the concentration happens to be greater because the dilution effect decreases. Fig.4 shows the concentration of nitrate in different samples as per sample numbers in Table 3. In the area studied, the nitrate concentration varies from 16.796 mg/l in Sanjhariya Sample 5 , Fig.3) to 59.516 mg/l in Ramchandpura (Sample 24, Fig.3)

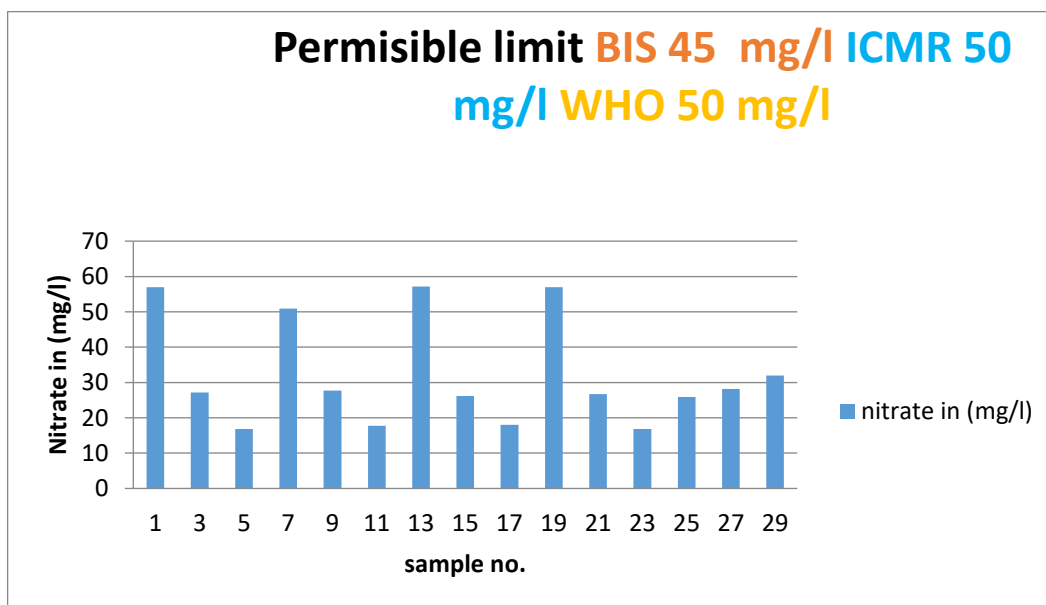


Fig.3 Nitrate Concentration in Various Samples

Chloride

Chlorides of calcium (CaCl₂), potassium (KCl), and sodium (NaCl) are widely found in nature and some chlorides are present in industrial effluent. MgCl is widely used in ice and snow control. KCl finds its use in the production of fertilizers. The process of weathering makes chlorides leach from multiple rocks into water and soil. The chloride ion is very mobile and is transported to oceans or closed basins. Chloride reaches groundwater and surface water from both natural and anthropogenic sources, including industrial effluents, landfill leachates, deicing salt run-off, use of chemical fertilizer, septic tanks and animal feeds. Irrigation drainage, and seawater intrusion in coastal places. About 88% of chloride presence in humans is extra-cellular and it promotes the osmotic activity of bodily fluids. A normal adult human contains almost 81.7 grams of chloride. Due to the amount of obligatory loss of about 530 mg/day chloride, an intake for adults of about 9 mg of chloride per kilogram of body weight is suggested. As far as children up to 18 years of age are concerned, a daily intake of 45 milligrams of chloride is deemed to be enough. An intake of 1 gram of NaCl per kg of body weight was reported to have fatal consequences in a 9-week old child. Chloride noxiousness hasn't been seen in human beings except in the special case of damaged NaCl metabolism, for e.g., in congestive heart failure.

Fig.4 shows the concentration of chloride in different samples as per sample numbers in Table 3. In the study area, the range of chlorides was from 99.85 mg/l which was found in Begas (Sample 2, Fig.4) to 552 mg/l found in Ramsinghpura (Sample 29, Fig.4). No sample concentrations were found to exceed the permissible limit of BIS. Twenty one sample concentrations were found to exceed the permissible limit of WHO and Twenty two sample concentrations were found to exceed the permissible limit of ICMR.

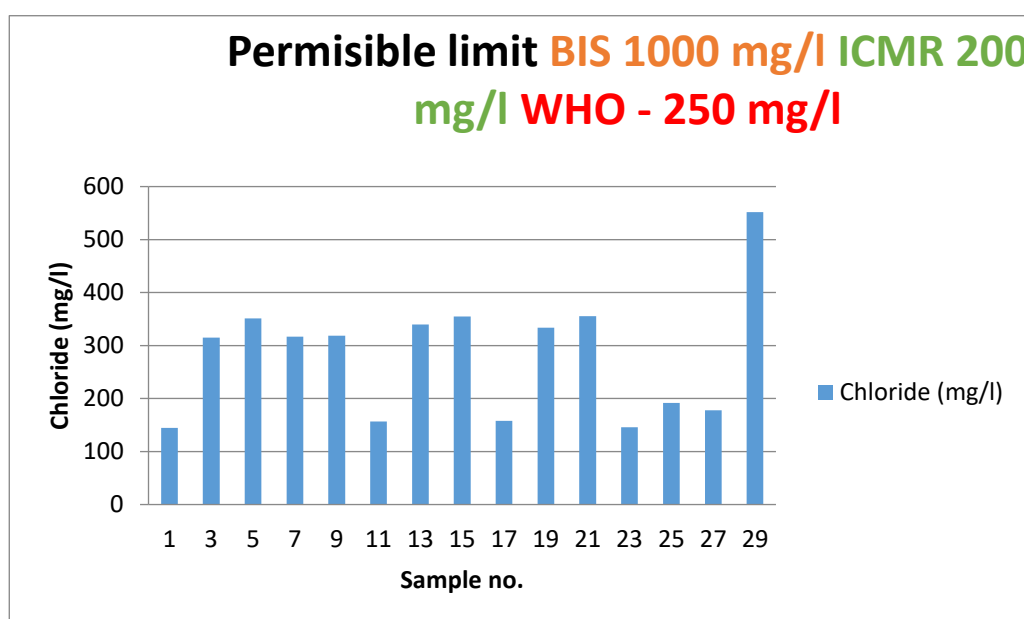


Fig.4 Chloride Concentration in Various Samples

Total Dissolved Solids

Total Dissolved Solids (TDS) are the total amount of active charged ions dissolved in water, including minerals, salts, and metals. TDS is directly related to the consistency and purity of water, as well as water purification systems, and influences everything that consumes it. Any salts, metals, minerals, anions, or cations that may dissolve in water are referred to as dissolved solids. This includes anything present in water other than suspended solids and pure water molecules. The number of the anions and cations in the water is the TDS concentration. Leaves, plankton, silt, sewage, and industrial waste are some of the organic sources of dissolved solids and other sources include urban runoff, fertilizers and pesticides used on lawns and fields, and road salts used on city streets during the winter. A source for dissolved solids may be inorganic materials such as rocks and air that has sulfur, calcium bicarbonate, nitrogen, phosphorous, iron, and other minerals. The majority of the materials mentioned above combine to form salts, which are compounds that contain both a non-metal and a metal. Salts usually dissolve in water forming ions. Ions are charged particles that are either negative or positive.

In the study area, the highest TDS of 1903.842 mg/l was found in Dahami (Sample 16 , Fig.5) and the lowest TDS of 195.128 mg/l was found in sample no.22 . Only two sample concentrations were found to exceed the permissible limit of BIS and twenty-nine samples have exceeded the permissible limit ICMR standard. The presence of high dissolved solids causes an unpleasant taste that can be metallic, salty, or bitter. It may also be a sign of the existence of toxic minerals, which cause scaling in the sanitary system and reduces performance. Fig.5 shows the concentration graph of TDS in different samples as per sample numbers in Table 3.

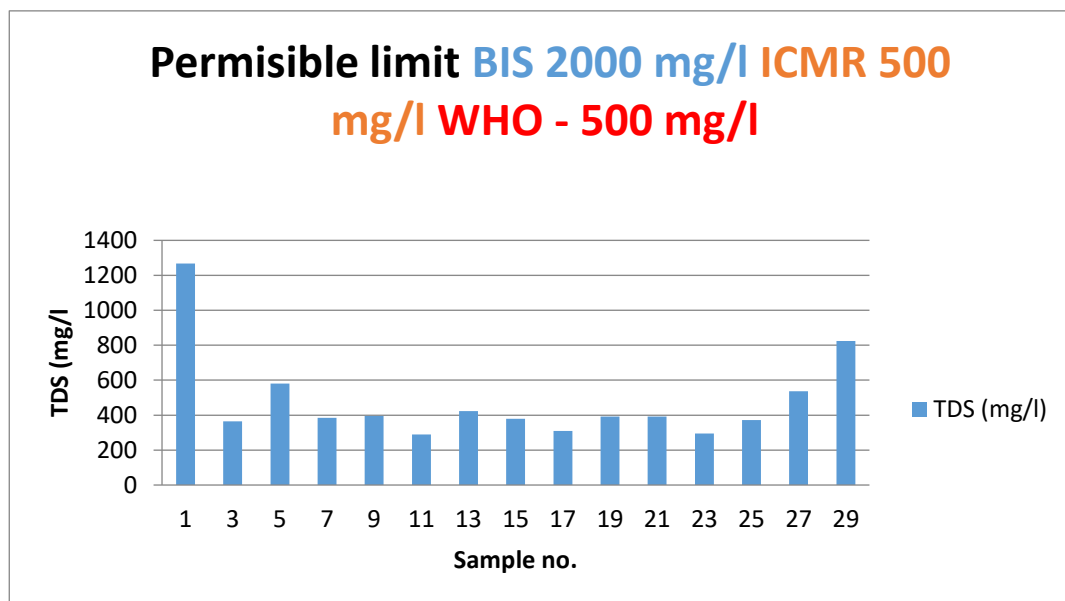


Fig.5 TDS Concentration in Various Sample

Bacteriological Presence

Total coliforms (TC) are a group of bacteria that can be found in the environment, such as in plants, water bodies, or soil, as well as in the intestines of mammals, including humans. While TC bacteria are unlikely to cause disease, their presence indicates that the water supply may be vulnerable to pollution by even more toxic microbes. *Escherichia coli*, which is also called *E.coli*, is one part of the TC bacteria group bacteria that is discovered only in the intestines of mammals, including human beings. *E. coli* when found in water shows recent faecal pollution and may show the likely existence of illness-generating microbes, like bacteria, viruses, as well as parasites. Some strains of *E.coli* such as *E.coli* 0157: H7, may induce diseases, but not all *E.coli* bacteria are hazardous. Drinking water which contains coliform bacteria ups the possibility of catching a water-borne disease. A confirmed result of faecal coliform or *E. coli* presence in samples is a severe breach of standards for potable water. Faecal coliform bacteria live chiefly in the guts and faeces of warm-blooded animals. Faecal coliforms are thought of as a better signal of animal waste or human waste pollution than total coliforms. *E. coli* is a kind of faecal coliform. Its presence is known to be the foremost indication of faecal contamination and that more microbes may be available. Insufficient attention to the treatment of supplied water, the manure of animals, and septic tanks are great originators of coliforms in groundwater and drinking water. The existence of microbes in groundwater deeply relies upon properties of soil.

The sort, size, and activity of the microbes' group are also essential components that dictate terms of transport of microbes. The diagnosis of coliform bacteria could be a sign of the existence of a life form that may cause illnesses, including toxic strains of coliforms, parasites such as *Cryptosporidium* or *Giardia*, and bacteria which are non-coliform. These beings can cause diseases from intestinal infections, dysentery, and gastroenteritis to hepatitis, typhoid fever, cholera, and many other diseases. Intestinal infections and dysentery are generally considered small health issues in otherwise healthy adults. However, such problems may be deadly to infants, the old and to those who are already sick. Bacterial presence was found in 9 out of 30 samples, which indicates a very dangerous situation. Bacterial presence can cause waterborne diseases. The indications of water-borne diseases are fever, abdominal cramps, nausea, vomiting, headaches, fatigue, maybe jaundice, and diarrhoea. These symptoms might lead to severe malnutrition, dehydration, kidney failure, and, in some cases, death. When found in drinking water, the existence of coliform generally indicates insufficient water treatment, complications or unknown oozing within the system of water distribution, and/or pollution due to seepage from septic tank seepage and livestock affairs. Almost 39% of the sampling sites' groundwater was contaminated by coliforms as revealed by the study.

Correlation Matrix

Correlation studies were performed on the tested physicochemical parameters (fluoride, nitrate, chloride, and TDS) using a correlation matrix. The correlation matrix is a table showing the correlation coefficient (r) between different sets of variables (parameters). Correlation is a statistical term. The word "correlation" refers to the degree to which two variables shift in accordance with one another. When two variables move in the same direction, they are said to be positively correlated. shows the correlation matrix with correlation spectrum and interpreted with data of correlation coefficient. After interpretation, we decide the correlation strength between two physicochemical parameters.

During this study, we found both positive and negative value of the correlation coefficient in this matrix. The correlation coefficient value between nitrate and fluoride, chloride and fluoride, TDS and fluoride are -0.290, -0.234 and -0.130 respectively that show a weak and negative correlation. The correlation coefficient value between chloride and

nitrate is +0.201 that show a weak and positive correlation. The correlation coefficient value between TDS and nitrate is +0.044 respectively. That show no correlation. The correlation coefficient value between TDS and chloride is +0.739 respectively. That shows a positive and strong correlation.

Conclusion

After study of analytical data of groundwater of Sanganer Tehsil, Jaipur, Rajasthan for the chemical parameters such Fluoride, Chloride, Nitrate and TDS and also Bacteriological Examination, it is noted that fluoride concentrations are all under the permissible range of 1.5 mg/l as per BIS and WHO. Nitrate concentrations of almost 50% of the villages exceed the permissible amount. The excess of nitrogen-full fertilizers in the soil in truth kills biota that helps to supply the soil with nitrogen, which can be used by the plants. By using less quantity of fertilizers, these crops could still be as highly yielding as the crops grown under highly fertilized soils, because of much healthier and suitable surroundings for the micro-organisms. If farmers use a huge amount of fertilizer at the start, then they are forced to use increased amounts each following year. Utilizing moderate to low amounts at the beginning gives the farmer a chance to avoid being caught up in this cycle. In addition, several of the mitigation methods listed above can be used to help reduce nitrate leaching from the soil into groundwater. Slurry storage and concrete lagoon pits will significantly reduce nitrate levels. Turf grass managers and farmers can help to control nitrate leaching into groundwater by avoiding over-irrigation of a field.

When it comes to nitrate levels in groundwater, the foremost advice to avert risk of health is to get wells checked frequently and reduce the use of fertilizers on fields. As per BIS, chloride concentration is under the permissible limit for all villages, and only 5% of villages exceed the permissible limits and 5% of villages exceed the permissible limits of TDS. Chloride presence higher than about 250 mg/l may cause water to attain a taste, but the threshold is up to the associated cations. However, consumers can be used to concentrations in excess of 250 mg/liter. There is no health based standard concentration value for chloride in drinking water. To reduce TDS, RO (reverse osmosis) and other technologies are being used.

Reverse Osmosis is the most in-depth technique of large-scale water purification available. Distillation is another method available for water purification. Water vapour is produced by boiling the water. The water vapour condenses back into liquid form after rising to a cooled surface where it is collected. As the dissolved solids do not generally vaporize, they stay in the boiling solution.

The bacterial presence was found in 39% of the villages, indicates poor quality of ground water and it causes waterborne diseases, like fever, stomach cramps, vomiting, headaches, fatigue, jaundice, and diarrhea. Methods to remove bacteria from water can be disinfection and/or filtration. Even though only filtration can not be sufficient to fully oust bacteria, it does increase the output of disinfection by removing sediments that may contain bacteria. Methods of disinfection include iodization, chlorination, ozonation, ultraviolet light and methods such as steam sterilization or boiling, which are physical methods.

In the correlation study, only a strong positive correlation was identified between Chloride and TDS. Correlation between other parameters were negative and weak or positive and weak or un-correlation.

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