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Evaluation of TDS, PH and Electrical Conductivity in well-Water's of Nandgaon, Maharashtra and Its Significance

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Abstract

Groundwater is one of the most vital natural resources for drinking, domestic, agricultural, and industrial applications, especially in rural and semi-urban regions where surface water availability is limited. The quality of groundwater is influenced by natural geological processes as well as anthropogenic activities such as agriculture, urbanization, and industrial discharge. Among the various physicochemical parameters used to evaluate groundwater quality, electrical conductivity (EC), pH, and total dissolved solids (TDS) are considered fundamental indicators of water suitability for human consumption and other applications.

The present study investigates the physicochemical characteristics of well water collected from 28 different locations, with special emphasis on EC, pH, and TDS. Standard analytical methods were employed to determine these parameters, and the results were compared with World Health Organization (WHO) and Bureau of Indian Standards (BIS) guidelines. The electrical conductivity values ranged from 0.513 to 1.447 mS/cm, pH values varied between 6.32 and 7.68, and TDS values ranged from 232 to 518 mg/L. The results indicate that most water samples fall within permissible limits, though some locations exhibited relatively higher mineral content, suggesting possible geological influence and agricultural runoff.

Overall, the study reveals that the majority of well water samples are suitable for potable and domestic use, while certain locations require regular monitoring to prevent future deterioration of groundwater quality. The findings emphasize the importance of periodic assessment and sustainable groundwater management to ensure safe water availability for present and future generations.

Keywords: Groundwater quality, Well water, Electrical conductivity, pH, Total dissolved solids, Physicochemical analysis.

1. Introduction

Water is an indispensable resource for the survival of all living organisms and plays a critical role in economic development and environmental sustainability. Groundwater constitutes a major portion of the world's freshwater resources and serves as a primary source of drinking water in many developing countries, including India. Due to its widespread availability and relatively lower susceptibility to microbial contamination compared to surface water, groundwater is often preferred for domestic and potable purposes. However, groundwater quality is not immune to contamination and deterioration.

The quality of groundwater depends on several factors such as geological formations, soil characteristics, rainfall patterns, recharge processes, and human activities. In rural and agricultural regions, excessive use of fertilizers, pesticides, and improper waste disposal significantly affects groundwater chemistry. Moreover, urban expansion and industrial development have further increased pressure on groundwater resources, leading to changes in its physicochemical composition.

Among the various parameters used for groundwater quality assessment, electrical conductivity (EC), pH, and total dissolved solids (TDS) are considered basic yet crucial indicators. Electrical conductivity measures the ability of water to conduct electric current, which depends on the concentration of dissolved ions such as calcium, magnesium, sodium, chloride, and sulfate. Higher EC values indicate higher salinity and mineral content, which may affect the suitability of water for drinking and industrial use.

The pH of water indicates its acidic or alkaline nature and plays a significant role in determining water quality. Water with extremely low or high pH values may cause corrosion of pipes, affect taste, and have adverse health effects. Total dissolved solids represent the combined content of all inorganic and organic substances dissolved in water. Elevated TDS levels may impart unpleasant taste, reduce water usability, and cause scaling in industrial equipment.

Several researchers have emphasized the importance of monitoring EC, pH, and TDS for groundwater quality evaluation (Sylus & Ramesh, 2015; WHO, 2017). Continuous assessment of these parameters helps in identifying pollution sources, understanding hydrogeochemical processes, and ensuring safe drinking water supply.

In this context, the present study aims to assess the physicochemical quality of well water from selected locations by analyzing EC, pH, and TDS values. The study also compares the observed values with national and international drinking water standards to evaluate the suitability of groundwater for domestic and industrial applications.

2. Materials and Methods

2.1 Study Area

The study was conducted in selected rural and semi-urban locations where groundwater from open wells is the primary source of water for drinking, household activities, irrigation, and small-scale industries. The region is characterized by agricultural activities, moderate rainfall, and basaltic geological formations, which significantly influence groundwater composition.

2.2 Sample Collection

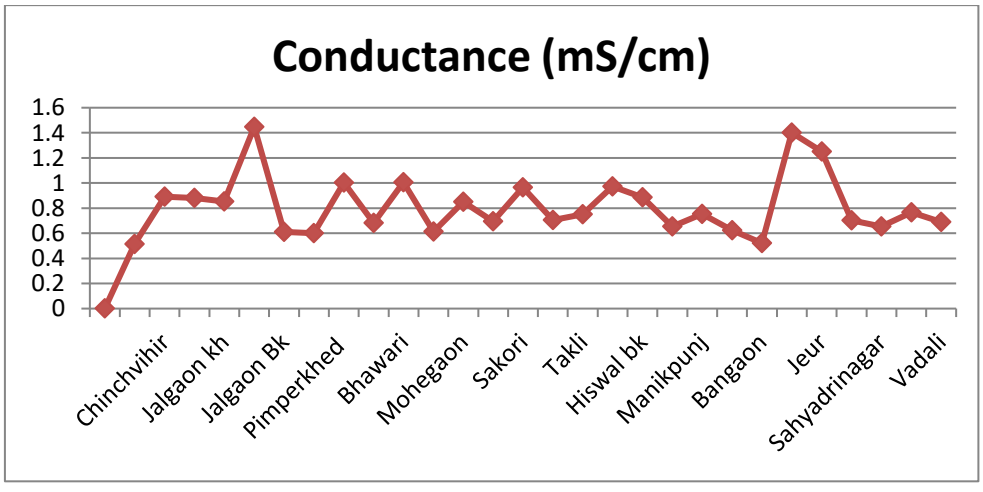
A total of 28 well water samples were collected from different locations during the study period. Clean, high-density polyethylene bottles were used for sample collection. Prior to sampling, the bottles were washed with detergent, rinsed with distilled water, and finally rinsed with the sample water to avoid contamination.

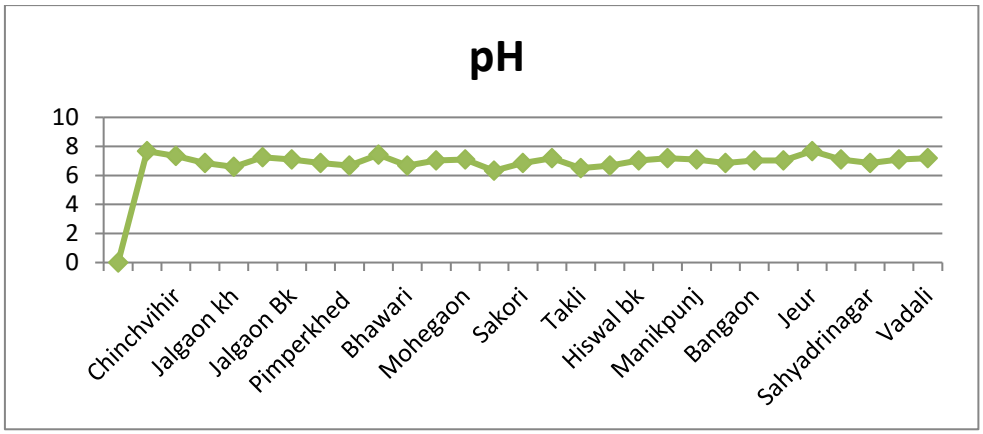
Samples were collected directly from wells after allowing the water to flow for a few minutes to remove stagnant water. The collected samples were properly labeled with location name and sample number and transported to the laboratory for analysis.

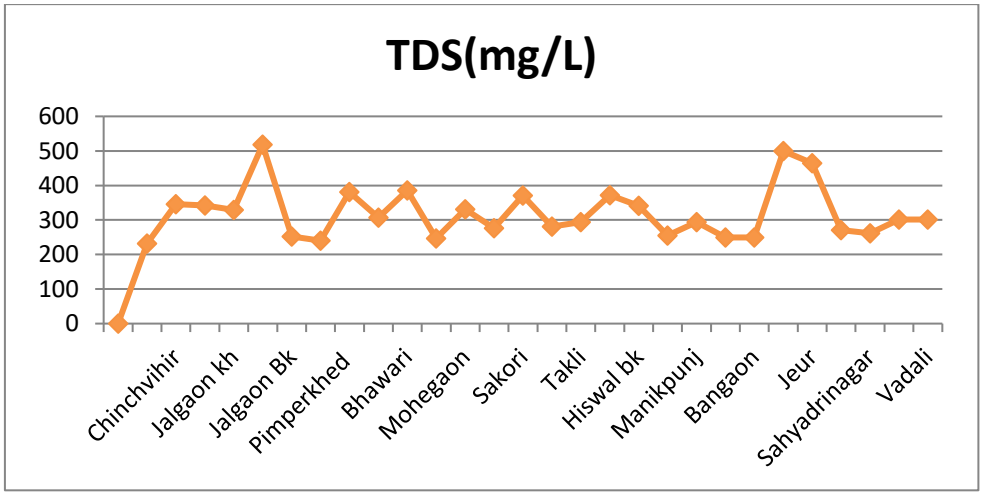
Conductance, pH and TDS of Well water

Sr. No	Location	Conductance (mS/cm)	pH	TDS(mg/L)
1	Gangadhari	0.513	7.66	232
2	Chinchvihir	0.890	7.34	346

3	Mandwad	0.880	6.86	342
4	Jalgaon kh	0.854	6.59	329
5	Nagapur	1.447	7.26	518
6	Jalgaon Bk	0.611	7.10	252
7	Vadalkar wada	0.601	6.86	240
8	Pimperkhed	1.003	6.68	381
9	Malharwadi	0.683	7.42	307
10	Bhawari	1.005	6.68	386
11	Jatpura	0.614	7.02	247
12	Mohegaon	0.850	7.10	331
13	Khirdi	0.696	6.32	276
14	Sakori	0.966	6.86	371
15	Sakora	0.704	7.18	281
16	Takli	0.752	6.50	294
17	Hiswal bk	0.972	6.68	372
18	Hiswal bk	0.886	7.02	341
19	Jalgaon kh	0.654	7.18	255
20	Manikpunj	0.753	7.10	294
21	Chandora	0.623	6.86	249
22	Bangaon	0.521	7.02	249
23	Vakhari	1.400	7.02	500
24	Jeur	1.250	7.68	464
25	Nayadongri	0.703	7.10	271
26	Sahyadrinagar	0.653	6.86	261
27	Takali	0.767	7.10	301
28	Vadali	0.689	7.18	301







2.3 Analytical Methods

The physicochemical parameters were analyzed using standard procedures as recommended by APHA (2017).

pH Measurement:

The pH of water samples was measured using a calibrated digital pH meter. Calibration was carried out using standard buffer solutions of pH 4.0, 7.0, and 9.2.

3. Electrical Conductivity (EC):

Electrical conductivity was measured using a digital conductivity meter and expressed in millisiemens per centimeter (mS/cm). The instrument was calibrated using standard potassium chloride solution.

Total Dissolved Solids (TDS):

TDS values were determined using a digital TDS meter and expressed in milligrams per liter (mg/L). TDS values were also correlated with EC measurements.

All measurements were carried out at room temperature. The obtained values were compared with WHO (2017) and BIS (2012) drinking water standards.

3. Results and Discussion

The results of physicochemical analysis of well water samples from selected locations are presented and discussed below.

3.1 pH of Well Water

The pH values of the analyzed well water samples ranged from 6.32 to 7.68, indicating slightly acidic to slightly alkaline nature. The majority of samples showed pH values between 6.8 and 7.4, which is considered ideal for drinking water.

According to WHO and BIS guidelines, the acceptable pH range for drinking water is 6.5–8.5. In the present study, all samples fall within this permissible range, except one sample showing marginally acidic nature. Slight acidity may be attributed to carbon dioxide dissolution, organic matter decomposition, or soil mineral interactions.

The observed pH values suggest that the groundwater is chemically stable and does not pose significant risk related to acidity or alkalinity. Neutral pH also favors better taste and reduces corrosion in water distribution systems.

3.2 Electrical Conductivity

Electrical conductivity values ranged from 0.513 to 1.447 mS/cm, indicating variation in ionic concentration among different locations. Lower EC values were observed in areas with less anthropogenic influence, while higher values were recorded in locations with intensive agricultural activities.

Higher EC values indicate the presence of higher concentrations of dissolved ions such as chlorides, sulfates, nitrates, calcium, and magnesium. The elevated EC observed in some locations may be attributed to rock–water interaction, fertilizer leaching, and evaporation effects.

Although there is no strict drinking water limit for EC, values above 1.5 mS/cm generally indicate higher salinity. In the present study, EC values remained within moderate range, suggesting acceptable water quality.

3.3 Total Dissolved Solids (TDS)

TDS values of the well water samples varied from 232 to 518 mg/L. Based on TDS classification:

<300 mg/L: Excellent quality

300–600 mg/L: Good quality

Most samples fall under good quality water, while a few samples with TDS below 300 mg/L can be categorized as excellent.

According to WHO guidelines, TDS values up to 500 mg/L are desirable for drinking purposes. Samples showing TDS values slightly above 500 mg/L may affect taste but are not considered hazardous to health.

Higher TDS values observed in certain locations may be due to dissolution of minerals from aquifer materials, agricultural runoff, and prolonged water–rock interaction.

3.4 Relationship between EC and TDS

A strong positive correlation was observed between electrical conductivity and total dissolved solids, confirming that EC is a reliable indicator of dissolved ionic content in groundwater. Locations with higher EC values consistently showed higher TDS levels, supporting findings reported by earlier researchers (Sylus & Ramesh, 2015).

3.5 Suitability of Well Water

Based on the observed physicochemical parameters and comparison with drinking water standards, the majority of well water samples are suitable for drinking, domestic, and limited industrial use. However, locations exhibiting higher EC and TDS values require regular monitoring and proper groundwater management practices

4. Conclusion

The present study provides a comprehensive assessment of electrical conductivity, pH, and total dissolved solids of well water from selected locations. The results indicate that groundwater quality is largely influenced by natural geological formations and agricultural activities. The pH values of all samples were within permissible limits, suggesting chemical stability of groundwater.

Electrical conductivity and TDS values indicate moderate mineralization, with most samples falling under acceptable drinking water standards. A few locations showed relatively higher ionic concentration, emphasizing the need for continuous monitoring.

Overall, the study concludes that the well water in the study area is generally suitable for potable and domestic use, though precautionary measures and periodic quality assessment are essential to prevent future contamination. Sustainable groundwater management, controlled use of fertilizers, and public awareness are recommended to maintain groundwater quality.

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