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"Chemical Analysis of Water Quality in Raipur Village in Mandawar Tehsil"

Nikita Sharma[1], **Dr Jasvinder Kaur**[2]*

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Abstract: This study is aimed at assessing the water quality of borewells in Raipur, Mandawar tehsil, Rajasthan for domestic as well as irrigation purposes. So, giving the importance of borewells in rural areas as a source of water, the quality of borewells need to be tested thoroughly [1]. The chemical analysis that was conducted included the values [2,3] of pH, total hardness, total suspended solid, total dissolved solids, biochemical oxygen demand, chemical oxygen demand, dissolved oxygen and fluoride [4,5]. Some of the values exceeded the permissible limits, especially during winter [6]. Potentiometric, filtration, gravimetric, colorimetric, and titrimetric methods were used in the measurement of water scaling/ corrosiveness potential, analysing for pH, TH, TDS, TSS, BOD, COD, DO and fluoride. It is recommended that they remain under continuous monitoring, though they are generally acceptable [7]. There is very little fluctuation and, in some cases, samples are not even apt for use in irrigation.

Keywords: *Borewell Water, Raipur, Mandawar, Chemical Properties, Drinking Water Quality, Water Contamination, Health Risk Assessment*

1. INTRODUCTION:

Despite its importance as a substrate for life and supporting all biological processes, water also has other attributes that give it a more intrinsic value. So, the quality of India's democracy remains an ongoing topic of debate and discussion amongst scholars and the general public [8]. The hydrosphere, which includes all the water on, above and below the surface of the Earth, points to water's centrality to life on the planet and importance for ecological equilibrium [1]. Clean and safe water is directly relevant to human life, agricultural output and the general development of society as a whole. The situation becomes increasingly alarming with growing populations and increasing industrialization, and the strains put on water resources result in concerns over both the quantity and the quality of water [9,10].

The water scarcity and water quality problems have been a rising concern in the country, and in the arid/semi-arid north-western state of Rajasthan in India [10]. Also, this region is very critical due to a noxious mix of its geology, its climate and the increasing social pressure that human activity is exerting. It is mostly consumed for drinking purposes as well as for irrigation amongst many communities in Rajasthan [9]. But it is at risk due to over-extraction, industrial effluents, agricultural runoff [11] and domestic waste [12,13]. All these variables have multiple interactions, highlighting the need of an understanding of hydro-chemical behaviour in controlling groundwater quality.

Factors such as industrial effluent, over-exploitation of resources, human intervention, urbanization, population increase, wastewater, sewage [11,12] and excess of pesticides and chemical fertilizers all have an impact on water quality [13]. Industrial development, associated with rapid urbanization and/or in the absence of effluent treatment, discharges untreated or partially treated effluents into water bodies containing a mix of contaminants, such as "chemical agents such as chlorine, sulphur dioxide, hydrogen sulphide ketones, phenols amines etc" [1]. Use of chemical fertilizers and pesticides is responsible for this type of pollution, as agriculture is a main non-point source that contaminates water bodies with both surface and subterranean sources. Household waste produced by domestic sewage and household chemicals are another contributor to the problem, especially where there is a lack of proper sanitation infrastructure. In Jaipur, urbanization, agriculture, and domestic waste are leading to groundwater quality reduction [9]. The latter is a pollution hazard to human beings [4].

On top of that, assessment of water quality generally focuses on the testing of a series of chemical parameters, biological markers, and new or emerging contaminants. PH, Total Hardness, Total Suspended Solid, Total Dissolved Solid, BOD, COD, DO, Fluoride are the chemical parameter for the water

[1]*Research Scholar, Chemistry Department, Apex University, Jaipur, Rajasthan, India*
[2]*Associate Professor, Chemistry Department, Apex University, Jaipur, Rajasthan, India*
**Author for Correspondence*

which gives the indication about the quality of the water sample. These are controlled by natural processes like weathering of rocks and soil, but also from human activities. These indicators are common coliform bacteria and other microorganisms to evaluate pathogens and waterborne diseases risk. Thus, pharmaceuticals, personal care products, endocrine disrupting chemicals and other chemical substances, are being detected more frequently in the natural aquatic environment, and there are growing concerns over the possible long-term consequences of this exposure to human health and the aquatic environment.

1.1. STUDY AREA:

Raipur village in Mandawar tehsil, adjoining Pakhar, also experiences hot and dry weather with the temperature fluctuating from a minimum of 9°C in January to a maximum of 43°C in May [9]. The weather in the region is very hot in summers up to 46 °C with mild winters at a temperature of about 10-15 °C in December [14]. Rainfall is also varied; higher rainfall is received in east Rajasthan as well as some rainfall in comparison to west region [14]. Rajasthan in particular greatly depends on groundwater for drinking [10].

This study is limited to the groundwater quality of the borewell in Raipur village, Mandawar tehsil, Dausa district, Rajasthan and is situated in close proximity to Pakhar Chouraki village [15,16]. It is 80.0 kms away from Dausa district, 1.5 kms from Mandawar, 17.0 kms from village Mahwa and also 1 km from village Pakhar Chouraki. The pH, TH, TDS, TSS, BOD, COD, DO and fluoride show the suitability of water for irrigation and observed that, even within the permissible limits, the water may not be suitable for irrigation because of least fluctuation. The findings and conclusions of the research are drawn from the data gathered in this study.

2. MATERIALS & METHODS

2.1 MATERIALS:

In 2024, a chemical study was conducted in Raipur to assess drinking water quality, focusing on groundwater sources. Samples were collected throughout the year from a borewell in the Raipur area, Mandawar Tehsil, a primary source of groundwater [17]. Recognizing the importance of accessible and safe drinking water, sampling locations were strategically chosen to represent key water sources within the Raipur village, Mandawar tehsil. Pre-cleaned plastic bottles were used to collect 5-liter samples, a volume deemed appropriate for comprehensive water property analysis and ease of handling.

Fig. 2.1 Raipur Brewell Water Collection

The water samples were kept away from the light in the plastic bottles during transportation to avoid irradiation-induced reactions, and were stored in cleaned plastic bottles with an air-tight cap to avoid any possibility of reactions with the bottle and kept in dark conditions to preserve the stability of the samples which may lead to reliability of the results [18]. The temperature was recorded, and the samples were maintained at 4°C until analysis, according to APHA [19]. The chemical analysis of the drinking water was conducted keeping in view the APHA standards and the results were cross verified with the B.I.S codes for safe and potable water quality. This amount of rigor must be in place if we are attempting to analyse

the water for its potability or "health suitableness", claiming it is a responsibility to ensure public health by regular monitoring of groundwater quality [20,21].

Table 2.1. Primary Water Sources of the Targeted Villages

Sr. No.	Village	Source Mode Use
1	Raipur, Mandawar	Category 1

2.2 METHODOLOGY:

Various chemical parameters were analyses on the collected water samples. Following standard protocols to ensure accuracy and reliability.

- **pH:** PH was determined through standard potentiometrically measurement, which consists in the use of an electrode that measures the electrical potential difference of the sample [22] and such potential is, directly, a measure of the activity of the hydrogen ion in the sample, hence of the water's acidity or basicity.
    - **pH:** It is a quantify of hydrogen ion concentration. pH is determined as in the following equation [23]: **pH = -log10 [H+]**
- **Total Dissolved Solids:** Total Dissolved Solids were determined by gravimetric method [18]. A weighed quantity of water was evaporated and the residue weighed. The residue is dried and weighed and will provide the TDS concentration of the sample.
- **Total Hardness:** The total hardness, mainly due to calcium and magnesium ions, was analysed through EDTA titration [18]. These ions react with EDTA (ethylenediaminetetraacetic acid) forming a complex, measure of EDTA needed for the reaction is a measure of the concentration of total hardness.
    - **Total Hardness:** To get the total hardness use the same formula I gave above but remember all ionic concentrations must be in mg/l: **Hardness (mg/l as CaCO3) = ([Ca2+] x 2.497 + ([Mg2+] x 4.118)**
- **Fluoride:** Fluoride was analysed by colorimetry [19]. The procedure consists in the use of a reagent which under a specific condition reacts with fluoride ions to give a coloured solution whose intensity is directly proportional to the fluoride concentrations and measure with a spectrophotometer.
- **Biochemical Oxygen Demand:** BOD, a measure of organic pollution, was measured using the titrimetric method [18]. The water sample is incubated to a certain length of time, and then the oxygen uptake used by the microorganisms in degrading the organic material is calculated through a titration and expressed as BOD.
- **Chemical Oxygen Demand:** The chemical oxygen demand (COD) test, which is an index of the amount of oxygen needed to oxidize all the organic substances in the sample, was performed through reflux digestion. The method consists in digestion of sample with a high oxidizing value agent at boiling temperature, while the consumed volume of this agent is used to calculate the oxidability value.
- **Dissolved Oxygen:** DO is important for aquatic life and was estimated using the Winkler's method [18]. This consists of a set of laboratory reactions, where the dissolved oxygen is absorbed and subsequently measured by titration in order to determine the amount of oxygen in the water sample.
    - **Biochemical Oxygen Demand: BOD5 = DO Initial – DO Final**
- **Total Suspended Solids:** TSS, the concentration of particulate material in the water, was measured by filtration. A volume of known water was filtered through a pre-weighed piece of filter paper, and the material caught on the filter was then dried and weighed. The weight difference is equivalent to the concentration of TSS [18].

3. RESULTS & DISCUSSIONS:

3.1 RESULT:

Exposure The section is the description of Raipur village's water quality in Mandawar tehsil is described in terms of the chemical characteristics of

the water and the subsequent testing. It details the health impacts, treatments methods required and whether or not it is safe for human consumption and uses. This underscores the need for better measures to sustain water quality, so that people can have space to use water, and thus be safer [1].

Table 3.1: Chemical parameters result of Raipur Village, Madawar

Parameter	Units	Results	Requirement as per IS: 10500: 2012	
Physical & Chemical Parameters			Standard Value	Maximum Value
pH Range	-	8.39	6.5 to 8.5	Not relaxed
TDS	ppm	904	500 Max	2000 Max
TSS	ppm	3.0	-	-
TH	ppm	416.37	200 Max	600 Max
Fluoride	ppm	0.03	1.0 Max	1.5 Max
Dissolved Oxygen	ppm	6.2	-	-
BOD 27°C @ 3 Days	ppm	LOWER LOQ (less than 2.0)	-	-
COD	ppm	57.60	-	-

- **pH:** Thus, the obtained pH value of 8.39 is within the allowable range of 6.5-8.5 as per IS, codes. This means the water is slightly alkaline. The hydrolysis of dissolved gases or salts is also frequently responsible for pH changes in water solutions [24].
- **Total Dissolved Solids:** TDS can be read up to 904 ppm, higher than the desired limit of 500 ppm but lower than the acceptable limit of 2000 ppm. Although within the realm of the acceptable this value is at its upper level.
- **Total Suspended Solids:** The TSS is 3.0 ppm. There are no specified requirements for TSS.
- **Total Hardness:** TH is 416.37 ppm; this value is over the desired limit of 200 ppm but below the maximum allowed limit of 600 ppm.
- **Fluoride:** It also has such a low Fluoride level, being 0,03 ppm, when the admissible one is 1.0 ppm and the highest acceptable is 1.5 ppm.
- **Dissolved Oxygen:** The Dissolved Oxygen is 6.2 ppm. There are no specified requirements for DO.
- **Biochemical Oxygen Demand:** The BOD is less than 2.0 ppm (lower limit of quantification) confirms that there is not a high concentration of biodegradable organic matter in the water meaning that the sample is not very contaminated with organics.
- **Chemical Oxygen Demand:** The COD is 57.60 ppm. There are no specified requirements for COD.

3.2 DISCUSSION:

In general, the water quality analysis of Raipur Village has some of the parameters within the prescribed limit of IS. But the TDS and Total Hardness do appear to be at or near their maximum allowable limit and are “good” [25] and “acceptable” [26].

Here are some points to consider:

- **TDS:** High levels of TDS can give an unpleasant taste and can be also associated with unacceptable salts or minerals excess [2,5].
- **Total Hardness:** High hardness can cause scaling in pipes and reduce the effectiveness of soaps and detergents [26].
- **BOD & COD:** On top of that, the low BOD value indicates that there is not much of biodegradable organic pollutants [27]. This indicates that although the COD total value is high, the tannery effluent contains non-biodegradable organic compounds [28,5].

It should be underline that in the case of TDS and hardness, exceeding such levels does not mean that the water is necessarily unsafe, but it might affect aesthetic and utility values. The values of these parameters should be regularly monitored as an indication of the water quality in the long run [29,21].

4. CONCLUSIONS:

Summary of Water Quality over chemical parameters and compliance:

- **pH:** The slightly alkaline water, as reflected by a pH of 8.39, is well within the IS standard and therefore not alarming [18].
- **TDS:** The TDS content of 904 ppm is more than acceptable limit, but is not beyond limits. This means it is potable but might not be suitable for direct consumption for taste and might reflect presence of undesirable minerals [2,5].
- **TSS:** The low TSS at 3.0 ppm shows that the water is not turbid and does not have much suspended solids [24].
- **TH:** Total Hardness of 416.37 ppm is higher than desirable limit but within maximum permissible limit. Hardness at this level may also form scale, and will impair soap efficiency, but will not hurt us in any way [26].
- **Fluoride:** Spotty presents a fluoride content of only 0.03 ppm, that is very low, is under normal conditions and clearly does not represent any danger to develop any health problem due to fluoride [29].
- **Dissolved Oxygen:** A DO level of 6.2 ppm is adequate for supporting aquatic life.
- **BOD:** Presence of BOD below detectable levels is also an indication of low level of biodegradable organic pollution in the water [5].
- **COD:** The COD of 57.60 ppm shows that there are some organic compounds, but without a standard under IS to compare it to, it is difficult to draw any concern [30]. The above compounds may be potential candidates for such inquiries [16].

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References:

[1] Singh, S. K. (2020). Water Quality Assessment for Drinking and Irrigation Purpose of Rewa Block, District-Rewa, Madhya Pradesh, India. International Journal of Current Microbiology and Applied Sciences, 9(4), 2576. https://doi.org/10.20546/ijcmas.2020.904.309

[2] Acharya, G. D., Hathi, M. V., Patel, A. D., & Parmar, K. C. (2008). Chemical Properties of Groundwater in Bhiloda Taluka Region, North Gujarat, India. Journal of Chemistry, 5(4), 792. https://doi.org/10.1155/2008/592827

[3] Peddiwar, S. T., Ingole, D. K., & Nimbarte, G. R. (2022). Groundwater quality assessment and its insinuations in some parts of Aheri taluka dist. - Gadchiroli, Maharashtra. IOP Conference Series Earth and Environmental Science, 1032(1), 12021. https://doi.org/10.1088/1755-1315/1032/1/012021

[4] Rani, A. K. L., & Arun, A. U. (2019). The physico-chemical analysis of five major areas drinking water quality in Moradabad district. International Journal of Chemical Studies, 7(5), 302. https://doi.org/10.22271/chemi.2019.v7.i5f.12124

[5] Shah, M., Shilpkar, P., & Acharya, P. B. (2007). Ground Water Quality of Gandhinagar Taluka, Gujarat, India. Journal of Chemistry, 5(3), 435. https://doi.org/10.1155/2008/481694

[6] Budhlani, G. N., Musaddiq, M., Khan, J., & Zubair, N. (2011). Seasonal Variation in Physicochemical Characteristics of Bor and Vidarbha (Idarba) Rivers of Amravati (M.S.), India. https://www.worldwidejournals.com/indian-journal-of-applied-research-(IJAR)//file.php?val=January_2014_1388585947_2f2d0_155.pdf

[7] Kumar, R., Kumari, R., Prasad, C., Deep, A., Singh, N., Namtak, S., Tiwari, V., Merugu, R., Mohapatra, S., & Singh, R. (2021). Influence of

water quality on the diversity of macroinvertebrates in the Mandakini River in India. Water Science & Technology Water Supply, 21(4), 1843. https://doi.org/10.2166/ws.2021.020

[8] Soni, S., & Singh, R. K. (2018). Study of ground water quality in tap and hand pump water of Tonk city, Rajasthan, India. International Journal of Scientific Research and Management (IJSRM), 6(2). https://doi.org/10.18535/ijsrm/v6i2.fe01

[9] Singh, S. P., Singhvi, S., Gupta, R., Gaur, R. C., & Sharma, M. K. (2021). Correlation Study for the Assessment of Groundwater Quality of Sanganer Tehsil, Jaipur City, Rajasthan. IOP Conference Series Earth and Environmental Science, 796(1), 12048. https://doi.org/10.1088/1755-1315/796/1/012048

[10] Tiwari, K. K., Krishan, G., Bhagwat, A., Prasad, G., Mondal, N. C., & Bhardwaj, V. (2020). Evaluation of fluoride contamination in groundwater in a semi-arid region, Dausa District, Rajasthan, India. Groundwater for Sustainable Development, 11, 100465. https://doi.org/10.1016/j.gsd.2020.100465

[11] Itha, K., Polisgowdar, B. S., & Tarranum, R. (2020). Characterization of Surface Water and Ground Water Reservoirs. International Journal of Current Microbiology and Applied Sciences, 9(6), 4070. https://doi.org/10.20546/ijcmas.2020.906.476

[12] Kalal, V., Giri, M. N., Baskar, S., & Kuba, R. (2021). DETECTION OF POLLUTANTS PRESENT IN THE SURFACE WATER OF AYAD RIVER, UDAIPUR, RAJASTHAN. International Journal of Biological Innovations, 3(1), 2122. https://doi.org/10.46505/ijbi.2021.3123

[13] Thakur, R. (2020). 8-1-438.1. https://www.chemijournal.com/archives/2020/vol8issue1/PartAR/8-1-438-373.pdf

[14] Shahnawaz, H., Kriplani, C., & Iqbal, M. A. (2019). Investigations on Quality of Ground Water Seasonal Variations in Sanganer Tehsil, Jaipur (Rajasthan). SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3362175

[15] Barwar, U., Gudesaria, D. D., & Mathur, R. P. (2018). Research Journal of Science and Technology. https://rjstonline.com/HTMLPaper.aspx?Journal=Research%20Journal%20of%20Science%20and%20Technology;PID=2018-10-1-8

[16] Kapoor, C. S. (2017). Comparative Assessment of Physicochemical Parameters of Udaipur City, (Raj.) India. International Journal of Environmental Sciences & Natural Resources, 1(2). https://doi.org/10.19080/ijesnr.2015.01.555560

[17] Emenike, P. C., Tenebe, I. T., Ogarekpe, N., Omole, D. O., & Nnaji, C. C. (2019). Probabilistic risk assessment and spatial distribution of potentially toxic elements in groundwater sources in Southwestern Nigeria. Scientific Reports, 9(1). https://doi.org/10.1038/s41598-019-52325-z

[18] Upadhyay, M., & Jindal, M. K. (2020). ANALYTICAL ESTIMATION OF WATER QUALITY INDEX IN INDUSTRIAL ESTATE BHILAI, CHHATTISGARH AND CORRELATION BETWEEN VARIOUS WATER QUALITY PARAMETERS. RASAYAN Journal of Chemistry, 13(3), 1777. https://doi.org/10.31788/rjc.2020.1335853

[19] Khan, R., & Saxena, A. (2022). Potentially toxic elements (PTEs) in Gomti-Ganga Alluvial Plain, associated human health risks assessment and potential remediation using novel-nanomaterials. Environmental Monitoring and Assessment, 195(1). https://doi.org/10.1007/s10661-022-10562-2

[20] Siročić, A. P., Ojdanić, K., Dogančić, D., & Plantak, L. (2023). Water Quality for Human Consumption from the Public Water Supply System. 21. https://doi.org/10.3390/ecws-7-14230

[21] Pushpalatha, N., Sreeja, V., Karthik, R., & Saravanan, G. (2022). Total Dissolved Solids and Their Removal Techniques. International Journal of Environmental Sustainability and Protection, 2(2), 13. https://doi.org/10.35745/ijesp2022v02.02.0002

[22] Soceanu, A., Dobrinaș, S., Dumitrescu, C.-I., Manea, N., Sîrbu, A., Popescu, V., & Vizitiu, G. I. (2021). Physico-Chemical Parameters and Health Risk Analysis of Groundwater Quality. Applied Sciences, 11(11), 4775. https://doi.org/10.3390/app11114775

[23] Moula, M. T., Nath, R. K., Chowdhury, M. M. I., & Siddique, Md. A. B. (2020). An Overview of River Side Pollutants and their Effects on Physico-Chemical Changes in Water Quality of River Halda, Bangladesh. Asian Journal of

Chemistry, 32(4), 827. https://doi.org/10.14233/ajchem.2020.22347
[24] Galit. (2004). chemical_analysis_of_water. https://auroville.info/ACUR/documents/laboratory/chemical_analysis_of_water.pdf
[25] Khanna, S. (2013). Document2. https://connectjournals.com/file_html_pdf/163570 3H_171-174.pdf
[26] M, Q. U. (2015). Studies on the Physico-Chemical Parameters and Correlation Coefficient of Sarkhej Roza Lake, District Ahmedabad, Gujarat, India. Journal of Environmental & Analytical Toxicology, 5(4). https://doi.org/10.4172/2161-0525.1000284
[27] Khanal, L. N., Adhikari, N. P., Paudel, G., & Adhikari, S. (2021). Physicochemical assessment of leachate from Pokhara landfill site and its impact on the quality of Seti River water, Nepal. Archives of Agriculture and Environmental Science, 6(2), 194. https://doi.org/10.26832/24566632.2021.060201
1
[28] Rao, D. N., Rao, T. B., & Machiraju, P. V. S. (2021). Chemical and Pathogen Impacts on Human Health near Aquaculture Areas in West Godavari District of Andhra Pradesh, India. Nature Environment and Pollution Technology, 20(3). https://doi.org/10.46488/nept.2021.v20i03.040
[29] Sankpal, S. J. (2019). Drinking Water Analysis of Pokhale Village and Engineering Solutions for its Upgradation. International Journal of Engineering Research And, 12. https://doi.org/10.17577/ijertv8is120261
[30] Swarnakar, A. K., & Choubey, S. (2016). Testing and Analysis of Pond Water in Raipur City, Chhattisgarh, India. International Journal of Science and Research (IJSR), 5(4), 1962. https://doi.org/10.21275/v5i4.nov162709