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Assessment of the Water Quality of Industrial Area of Bhilwara using Water Quality Index

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Abstract: Groundwater is an essential source of drinking water supply near industrial areas, particularly in District Bhilwara. Groundwater quality deteriorates in the nearby industrial area and dissolves in direct discharge effluent in groundwater. In this work, an effort has been made to comprehend whether groundwater is suitable for human consumption. To determine the quality of the groundwater, physicochemical characteristics such as pH, EC, TDS, alkalinity, and total hardness of bicarbonate, sulfate, chloride, fluoride, and nitrate were examined. The Water Quality Index (WQI) is a tool used to classify water quality. quality to be exceptional, good, poor, etc., is a very helpful tool for informing residents and policymakers about the condition of the water. The study area's total WQI shows that the groundwater is unsuitable for the industries that are close by. According to the current study, the groundwater in the industrial districts nearby that have degraded water quality needs to be cured before consumption and shielded from[1].

Water quality is still a serious issue globally due to human activity (especially when it comes to freshwater and human consumption). To assess the total water quality status of aquifer and surface water, the critical water quality index (WQI) technique has been employed. The WQI approach, Alternatively, is a drawn-out procedure used for water quality metrics, such as water consumption (area and time), among other things. As a result, this review explains the WQI method for Evaluating Water Quality in straightforward steps.[2].

Keywords: WQI, Groundwater, Contamination, Anthropogenic, Physico-chemical Parameters.

I. INTRODUCTION

The ecology depends heavily on water. The groundwater quality is declining due to both natural and man-made activity. An arid area is the Bhilwara District in northern IndiaIn this study, five water samples were collected for analysis collected from five distinct places were investigated for physicochemical properties. To compare the drinking and domestic uses of sample collecting tube wells, hand pumps, dug wells, and open source to WHO worldwide standards (WQI), the Water Quality Index was used. [3]. Examples of natural features that impact water quality include hydrological, atmospheric, climatic, topographical, and lithological components. For example, human activity damages the quality of the water near industrial areas. The qualities include turbidity, temperature, color, odor, conductivity, salinity, suspended solids, pH of TDS, DO, nitrates, fluoride, sulfate, chemical oxygen demand, turbidity, turbidity, and different heavy metals. The WQI, which can show the overall state of "water quality" in a single grade, is based on several parameters, including the production and disposal of waste (industrial, municipal, and agricultural), increased sediment run-off or soil erosion due to changes in land use, and heavy metal pollution. [4].

A. Study Area

The industrial districts of Hamirgarh and Mandal in Bhilwara were selected for the study. The location is on Ricco Industrial Road, 15 km north and 20 km east of National Highway 79. Eight water quality metrics are essential indicators for assessing the overall condition of the water in ten groundwater wells spread around the area.

We have selected the following textile industrial areas for our investigation:
1: Site I. 25º13'58.15" N 74º37'19.59" E
2: Site II. 25º20'54.74" N 74º37'20.00" E
3: Site III. 25º19'6.10" N 74º35'52.96" E
4: Site IV. 25º19'35.86" N 74º36'49.17" E
5: Site V. 25º19'35.86" N 74º36'49.17" E

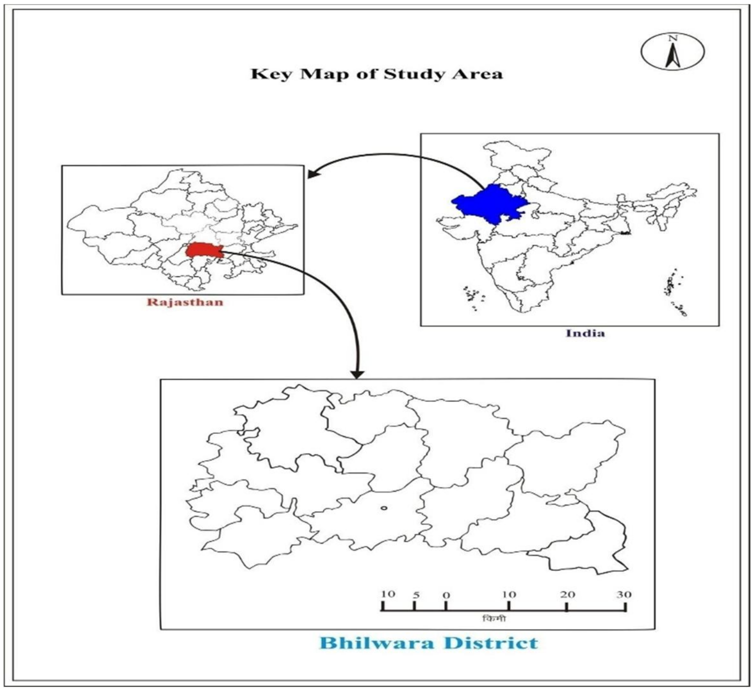

Figure 1: Key Map of Study Area

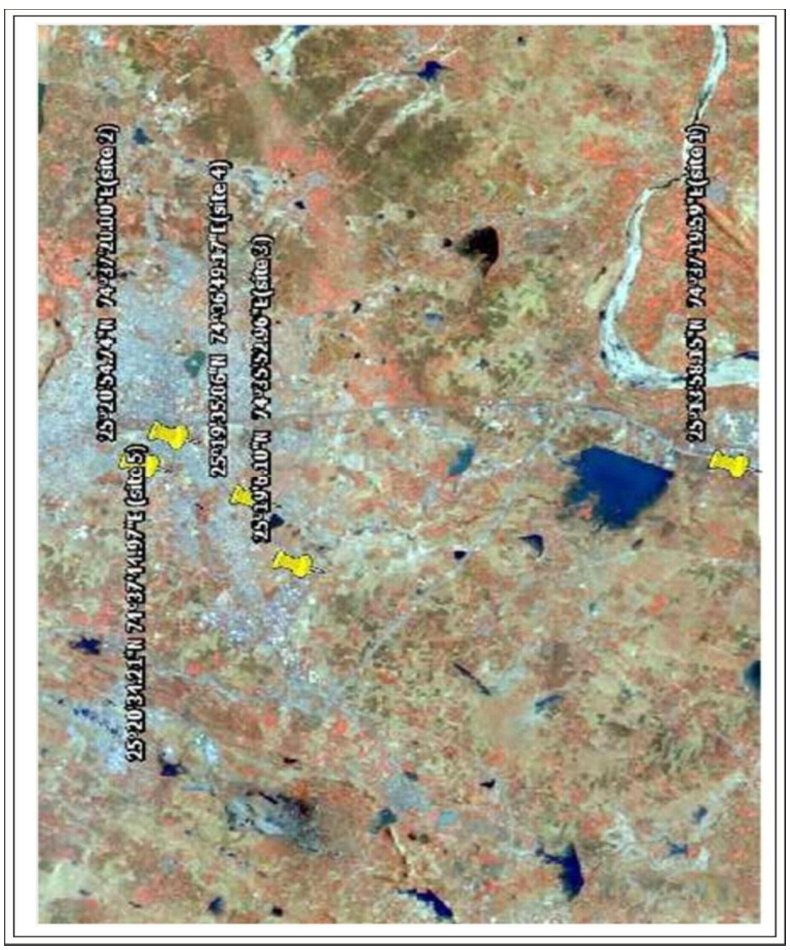

Figure 2: GPS Image of 5 Sites

II. MATERIAL AND METHODS

Five locations provided groundwater samples for physicochemical analysis during the summer, season. To obtain fresh groundwater samples, the tube wells were flushed, and samples were then collected in sterile plastic containers. To identify environmental implications, the study is designed to examine the physicochemical characteristics of water (adjoining textile effluent) from dye houses, agricultural areas, and irrigation water. This sample was taken from the Bhilwara district, which is 15 km from the north-central region of Rajasthan and 15 km from the east-central region. Five industries in the Bhilwara (Raj) area were surveyed and samples were gathered in May and June of 2023–24. Numerous physicochemical characteristics were examined in the collected samples: EC, TDS, and pH The measurements were taken using the indicated technique with digital conductivity meters. Using EDTA, the overall hardness of Ca, and Mg was also ascertained. Potassium oxalate was used as an indicator in both volumetric and silver nitrate titrimetric methods to assess total alkalinity. The argentometric method was employed to determine the chloride content, while the spectrophotometric method was utilized The water samples were collected from various industrial sites to measure the levels of nitrate and fluoride during the summer., i.e. In the villages of Mandal and Swarupganj, which are close to an industrial area where the effluent drains into a pond and soaks into shallow aquifers A groundwater sample was collected using a... specific method tube wells, and hand pump.[5-6].

A. WQI Calculation

$$qn = \frac{Vn - Vi}{Sn - Vi} \times 100$$

Weightage Factor: (W)

$$Wn \propto \frac{1}{Sn}$$

$$Wn = \frac{K}{Sn}$$

K= Proportionality Constant

$$K = \frac{1}{\Sigma(\frac{1}{Sn})}$$

$$K = \frac{1}{\frac{1}{8.5} + \frac{1}{1} + \frac{1}{500} + \frac{1}{600} + \frac{1}{600} + \frac{1}{200} + \frac{1}{4.5} + \frac{1}{2.0}}$$

$$K = \frac{1}{1.2002023922}$$

$$K = 0.8331928069$$

Table 1: water quality index grading value-

WQI	Rating of Quantity	Grading Power
0-25	Excellent	A
26-50	Good	B
51-75	Poor/ Bad	C
76-100	Very Poor/Very Bad	D
100-above	Unfit for Drinking	E

Table 2: Observation table for siteI

SITE	I						
Parameters	Sn	Vn	Qn	W=K/Sn	W×Q	WQI	Grading
pH	8.5	7.3	20	0.11764	20×0.11764	162.37	E
E.C.	1	2.1	210	0.607	210×0.607		
T.D.S. (mg/L)	500	1220	244	0.0012	244×0.0012		
T.A. (mg/L)	600	440	73.33	0.0011666	73.33×0.0011666		
T.H. (mg/L)	600	460	230	0.0011666	76.66×0.0011666		
Nitrate (mg/L)	45	50.12	115.82	0.01348	115.82×0.01348		
Sulphate(mg/L)	200	15.60	7.8	0.0030	7.8×0.0030		
Fluoride(mg/L)	2.0	2.01	100.5	0.3035	100.5×0.3035		

Table 3: Observation Table for Site II

SITE	II						
Parameters	Sn	Vn	Qn	W=K/Sn	W×Q	WQI	Grading
pH	8.5	7.5	33.33	0.0714	33.33×0.0714	122.43	E
E.C.	1	1.8	180	0.607	180 ×0.607		
T.D.S. (mg/L)	500	2620	524	0.0012	524×0.0012		
T.A. (mg/L)	600	230	115	0.0011666	115×0.0011666		
T.H. (mg/L)	600	1100	183.33	0.0011666	550×0.0011666		
Nitrate (mg/L)	45	138.0	306.66	0.01348	306.66×0.01348		
Sulphate(mg/L)	200	13.60	6.8	0.0030	6.8×0.0030		
Fluoride(mg/L)	2.0	0.345	17.25	0.3035	17.25×0.3035		

Table 4: Observation Table for Site III-

SITE	III						
Parameters	Sn	Vn	Qn	W=K/Sn	W×Q	WQI	Grading
pH	8.5	7.4	26.66	0.0714	26.66×0.0714	143.07	E
E.C.	1	2.2	200	0.607	200 ×0.607		
T.D.S. (mg/L)	500	1100	220	0.0012	220×0.0012		
T.A. (mg/L)	600	410	205	0.0011666	205×0.0011666		
T.H. (mg/L)	600	610	101.66	0.0011666	305×0.0011666		
Nitrate (mg/L)	45	22.44	49.86	0.01348	49.86×0.01348		
Sulphate(mg/L)	200	22.77	11.385	0.0030	11.385×0.0030		
Fluoride(mg/L)	2.0	1.20	60	0.3035	60×0.3035		

Table 5: Observation Table for Site IV-

SITE	IV						
Parameters	Sn	Vn	Qn	W=K/Sn	W×Q	WQI	Grading
pH	8.5	7.2	13.33	0.0714	13.33×0.0714	163.95	E
E.C.	1	2.4	240	0.607	240 ×0.607		
T.D.S. (mg/L)	500	1880	376	0.0012	376×0.0012		
T.A. (mg/L)	600	220	36.66	0.0011666	110×0.0011666		
T.H. (mg/L)	600	640	106.66	0.0011666	320×0.0011666		
Nitrate (mg/L)	45	32.66	72.57	0.01348	72.57×0.01348		
Sulphate(mg/L)	200	44.90	22.45	0.0030	22.45×0.0030		
Fluoride(mg/L)	2.0	1.01	50.5	0.3035	50.5×0.3035		

Table 6: Observation Table for Site V-

SITE	V						
Parameters	Sn	Vn	Qn	W=K/Sn	W×Q	WQI	Grading
Ph	8.5	7.1	6.666	0.0714	6.666×0.0714	134.49	E
E.C.	1	1.8	180	0.607	180 ×0.607		
T.D.S. (mg/L)	500	1120	224	0.0012	224×0.0012		
T.A. (mg/L)	600	330	55	0.0011666	165×0.0011666		
T.H. (mg/L)	600	360	60	0.0011666	60×0.0011666		
Nitrate (mg/L)	45	30.10	84.66	0.01348	84.66×0.01348		
Sulphate(mg/L)	200	10.12	5.06	0.0030	5.06×0.0030		
Fluoride(mg/L)	2.0	0.8	40	0.3035	40×0.3035		

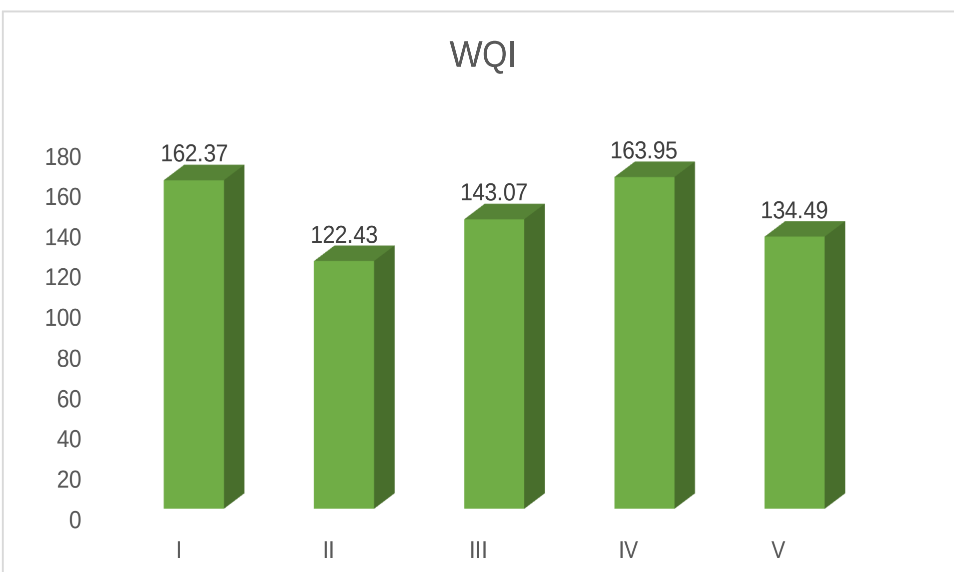

Figure 3: WQI of all V Sites

III. RESULT AND DISCUSSION

An investigation of the chemical and physical characteristics of tube wells, hand pumps, and dug wells yields important information about Bhilwara City's water quality. The parameters that are causing the water quality to decline are identified in this study [7]. For every sampling site in Bhilwara City, the average values of the measured physicochemical parameters were compared with the World Health Organization's guidelines.Table 1-5; Fig.3).

1) pH: The Hamirgarh Ricco industrial area's water is alkaline, with a pH range of 7.1 to 7.5. The deposition of an acid-forming chemical and a nutrient sink is the cause to a low pH, which is indicative of an acidity nature and is crucial for phytosanitary practices. Because of its carbonate chemistry, the high organic content will typically cause the pH to drop. The study's pH results indicate that the readings fall within the WHO's recommended range.
2) Electrical Conductivity (EC): The ability of any material or solution to carry electrical current through water is measured by this. The amount of dissolved material in a water sample directly correlates with the EC. For drinking purposes, an EC of 0–1 µS/cm is ideal. The electrical conductivity in this investigation ranges from 1.8 to 2.4 µS/cm. Because these locations are close to intensive urbanization, high EC at some points indicates that sewage is mixed with groundwater.[8-9].
3) Total Dissolved Solid (TDS): The quantity of residue that remains after a water sample has dried up by evaporation. Bicarbonate, Ca, Mg, Na, K, carbonate, chloride, and sulfate are among its constituents. The research area's TDS levels range from 1100 to 2620 mg/l. TDS levels from natural sources, sewage, and urban and agricultural runoff are high in industrial areas.
4) Total Alkalinity (TA): It is a measurement of the amount of hydroxide, bicarbonate, and carbonate ions in water. This makes the water taste bad. The alkalinity in the studied area varies from 220 to 410 mg/l.
5) Total Hardness (TH): It shows the amount of dissolved calcium and magnesium in the water. Water dissolves naturally occurring minerals as it moves through rock and soil and carries them into groundwater because it is a great solvent for calcium and magnesium. In this study, the hardness range is 230–640 mg/l. The high amounts of TH in groundwater can cause kidney stones and heart disease in humans.
6) Nitrate (NO^-_3)-: Nitrate is a naturally occurring ion that plays an essential role in the nitrogen cycle. Nitrate ions in groundwater, however, Unwanted outcomes occur because they lead to methemoglobinemia. Its elevated concentration poses health risks. Its content in the studied region varies between 30.10 and 138.0 mg/l.[10-11].
7) Sulfate (SO_2^-): Rocks that contain gypsum, iron sulfide, and other sulfur-bearing substances dissolve and leach it. It falls within the range of 10.12 to 44.90 mg/l in the current investigation.
8) Fluoride (F−): Groundwater is the source of geogenic fluoride. It is the lightest halogen and one of the most reactive elements. A range of fluoride-bearing minerals releases fluoride into the groundwater as a result of the groundwater's interaction with the host rock groundwater. The range of 0.8 to 2.01 mg/l is found in the study region, which includes granite, granitic gneiss, etc. [12–13].

IV. CONCLUSION

The Riico industrial area's groundwater is contaminated and unsafe for human consumption, according to the WQI investigation. According to the analysis, pH is the best chemical factor that significantly affects the Water Quality Index since it has the lowest observed variance, the highest mean correlation, and the least estimated variance from sampling. Water is essential to our survival as well as the survival of other species and the ecosystem. For all living beings, it is crucial. The main source of water for several applications, such as inland transportation, industrial operations, and agricultural use, is tube wells that are sunk in the river[14]. However, contaminated water is extremely harmful to both people and animals. Drinking water that has been tainted might have negative health effects. Water contamination is an international issue. Educating ourselves on how to avoid water pollution is the best way to preserve water supplies. Before wastewater enters rivers, it is recommended that appropriate waste disposal techniques be applied. Pollution should be reduced by organizing a variety of educational and awareness-raising activities, such as seminars and workshops. The aquatic environment should be improved by conducting additional studies on different water treatment technologies. These systems, like those in other industrialized countries, should be built and utilized. Every website is unsafe to use. [15]

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REFERENCES

[1] Magesh NS, Krishnakumar S, Chandrasekar N, Soundranayagam JP (2013) Groundwater quality assessment using WQI and GIS techniques, Dindigul district, Tamil Nadu, India. Arab J Geosci 6:4179–4189

[2] Mehmet ATK, Huseyin S (2014) Parameters selection for water quality index in the assessment of the environmental impacts of land-based trout farms. Ecol Indic 36:672–681

[3] Jha, D.K., Devi, M.P., Vidyalakshmi, R., Brindha, B., Vinithkumar, N.V., Kirubagaran, R., 2015. Water quality assessment using water quality index and geographical information system methods in the coastal waters of Andaman Sea, India. Mar. Pollut. Bull. 100, 555–561. https://doi.org/10.1016/j.marpolbul.2015.08.032.

[4] Kosha AS, Geeta SJ (2015) Evaluation of water quality index for River Sabarmati, Gujarat, India. Appl Water Sci. doi:10.1007/ s13201-015-0318-7

[5] Mohamed I, Othman F, Ibrahim A I N, Alaa-Eldin M E, and Yunus R M 2015 Assessment of water quality parameters using multivariate analysis for Klang River basin Malaysia

[6] Mostafa MG, Uddin SMH, Haque ABMH (2017) Assessment of hydrogeochemistry and groundwater quality of Rajshahi City in Bangladesh. Appl Water Sci. 7:4663–4671

[7] Chaurasia AK, Pandey HK, Tiwari SK, Prakash R, Pandey P, Ram A (2018) Groundwater quality assessment using water quality index (WQI) in parts of Varanasi district, Uttar Pradesh, India. J Geol Soc India 92:76–81

[8] Iticescu C, Georgescu L P, Murariu G, Topa C, Timofti M, Pintilie V, and Arseni M 2019 Lower Danube water quality quantified through WQI and multivariate analysis Water 11(6) 1305

[9] Bui D T, Khosravi K, Tiefenbacher J, Nguyen H and Kazakis N 2020 Improving prediction of water quality indices using novel hybrid machine-learning algorithms. Science of the Total Environment 721(March) 137612 https://doi.org/10.1016/j.scitotenv.2020.137612

[10] Xu T, Coco G, and Neal, M 2020 A predictive model of recreational water quality based on adaptive synthetic sampling algorithms and machine learning Water Research 177 115788. https://doi.org/10.1016/j.watres.2020.115788

[11] Sharafati A, Asadollah S B H S, and Hosseinzadeh M 2020 The potential of new ensemble machine learning models for effluent quality parameters prediction and related uncertainty Process Safety and Environmental Protection 140 68–78

[12] Rezaie-Balf M, Attar N F, Mohammadzadeh A, Murti M A, Ahmed A N, Fai C M, Nabipour N, Alaghmand S, and El-Shafie A 2020 Physicochemical parameters data assimilation for efficient improvement of water quality index prediction: Comparative assessment of a noise suppression hybridization approach Journal of Cleaner Production 271 122576

[13] Bawoke GT, Anteneh ZL (2020) Spatial assessment and appraisal of groundwater suitability for drinking consumption in Andasa watershed using water quality index (WQI) and GIS techniques: Blue Nile Basin. Northwestern Ethiopia Cogent Eng 7(1):1748950

[14] Panneerselvam, B., Karuppannan, S., & Muniraj, K. (2020b). Evaluation of drinking and irrigation suitability of groundwater with special emphasizing the health risk posed by nitrate contamination using nitrate pollution index (NPI) and human health risk assessment (HHRA). Human and Ecological Risk Assessment: An Int J, pp 1–25.

[15] Leong W C, Bahadori A, Zhang J and Ahmad Z 2021 Prediction of water quality index (WQI) using support vector machine (SVM) and least square-support vector machine (LS-SVM) International Journal of River Basin Management 19(2) 149–56

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