



Physico-Chemical Analysis of Groundwater of Shekhawati Vicinity of Rajasthan (Pre-Monsoon)

Hari Ram ^{a*}, N. P. Lamba ^a and Praveen Kumar ^a

^a *Department of Chemistry, Amity University Rajasthan, Jaipur (Raj), India.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2022/v12i1030889

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/87918>

Original Research Article

Received 03 April 2022

Accepted 06 June 2022

Published 15 June 2022

ABSTRACT

The Shekhawati regions constitute of Sikar, Neemkathana and Khandela areas of Rajasthan where actually exist various types of groundwater problems. Due to this reason, there are various diseases found in these regions such as Fluorosis, methaemoglobinaemia etc. For this purpose, samples from the Shekhawati region in Rajasthan were first collected and subsequently various parameters such as pH, EC, TDS, Total Hardness, Total Alkalinity, Calcium Hardness, Magnesium Hardness, Chloride content, NO₃⁻ content, F⁻ content were determined. The study showed that many of the all given parameters were either lower or higher than the ideal limits prescribed by WHO and ISI and are causing health problems to the people living in the region.

Keywords: Groundwater; physico-chemical parameters; Shekhawati region.

1. INTRODUCTION

Water is the precious natural resources, and is used for drinking, irrigation, washing, bathing and without it, we cannot think of life on earth [1]. 97 % of the earth's water supply is in the oceans. Only 3% of fresh water is available in which one third is inaccessible as it is being locked up in the

mountains, glaciers and difficult terrains. Only 1% is available in the form of fresh water [2]. Groundwater is easily available to us for drinking, agricultural, industrial and domestic purposes and hence is useful to animals and humans [3]. The only resource of water is fresh water. Surface water is water present in rivers or lakes and in wetland which is naturally replenishment

*Corresponding author: E-mail: hrkurichemistry@gmail.com;

by precipitation or naturally lost through discharge to the oceans, evaporation and ground seepage. Surface water is having combination of O₂, inorganic nutrients etc and it is the sunlight which supports different life forms in the water, including algae, bacteria, fungi, small insects and fish [4].

Rajasthan state is having a climate of prominently low rain-fall, intense summers with very high temperatures, high day to day variation of temperatures and low dimness and high evaporation. Rajasthan states is one Indian state with complex agro-climatic zones and is in urgent need of enlarge groundwater resources [5]. Moreover, increase in population and urbanization leads to groundwater depletion. Thus, groundwater study plays an important role in estimation, observation, planning, development and combined Water Resources Management in Rajasthan state because the Rajasthan State of 33 districts have been affected area by fluorosis [6]. The Blocks of Sikar district, (Sikar, Neemkathana and Khandela) are the main hotspots for drinking water and also the quick increment in the human population, the study on drinking water management is not sufficient. A qualitative study of drinking water is needed to be done [7].

The man objective of this study is to find out the groundwater quality in the critical zones of Rajasthan. Since there are no Surface water Sources in the Sikar District, the only Source of drinking water is underground water. The underground water table varies from 50 meter to 250 meter. Due to scanty rainfall, the recharging of groundwater is much less [8]. The available groundwater quality in some Blocks (Sikar, Neemkathana and Khandela) of the district is very poor.

1.1 Area of Study

Study area Shekhawati region (27,527 km²) includes the districts of Sikar, Jhunjhunu and Churu in Rajasthan state of India. Shekhawati division of Rajasthan is administered by 13 blocks and 13 Tehsils. The geographical and historical area is of 11,151 sq. km that constitutes the north eastern part of Rajasthan state which covers approximately 3.3% of the State [9].

2. REVIEW OF LITERATURE

1. R. Shyam and G.S. Kalwania [10] studied Ground water samples, collected from Sikar

District and studied different water quality parameters, such like pH, Electrical Conductivity, TDS, TH, DO, calcium, magnesium, sodium, potassium, carbonate, bicarbonate, chloride, sulfate, nitrate and fluoride content. Electrical Conductivity, TDS, nitrate, chloride and fluoride content in some samples are found to be more than desired range in sikar district.

2. S. Gupta and P. Kumar [11] studied water quality of 136 villages during the period January 2009 to January 2012 in Jhunjhunu district, Rajasthan. It was found that 152 patients were suffering from Blue baby syndrome (methaemoglobinemia).
3. M. S kurdi [12] Physico-chemical and fitful variations under anthropogenic activities, in two consecutive years were studied. The bacteriological analysis included total viable counts (TVC), total coli forms (TC), fecal coli forms (FC) and fecal streptococci (FS). The physicochemical factors included pH, temperature, conductivity, TDS, dissolved oxygen (DO), (BOD) and (COD). The pure bacterial isolates belonged to the families *obacteriaceae*, *micrococcaceae*, *pseudomonadaceae* and *bacillaceae*.
4. U. Barwar [13] studied groundwater from the Fatehpur area (district Sikar) and the samples were collected from the different locations and analyzed for their physico-chemical parameters such as Temperature, pH, EC, TDS, Total hardness, dissolved oxygen, Calcium hardness, Magnesium hardness, Bicarbonate, Carbonate, Na⁺, K⁺, Cl⁻, SO₄²⁻, NO₃⁻ and F⁻. The study was carried out to demonstrate the advantage of multi- component data analyses.
5. H. Kanwar et al. [14] studied variation in the physico-chemical parameters in groundwater quality of Amer tehsil, Jaipur in Pre- and Post-monsoon phase of the year 2017. Groundwater quality of parameters such as pH, electrical conductivity, Hardness, Alkalinity, Phosphate, Cl⁻, SO₄²⁻, NO₃⁻ and F⁻ were study to analyze the drinkable groundwater quality of the area.
6. S. K. Verma et al. [15] studied the Quality Index of Drinking Water in Ganeshwar and Chala Villages of Neemkathana Block, Sikar District. It was not of a good quality for drinking purposes. The drinking water quality TDS level of Ganeshwar and Chala villages found higher than the sufficient

limit of 500 mg/L. This study gave a direction for researchers in this area and facilitates the reason to analyze the sickness in the area due to these abnormal Physico-chemical parameters.

3. MATERIALS AND METHODS

3.1 Sample Collection and Physiochemical Investigations

In present investigation 24 ground water samples were collected in Blocks (Khandela, Neemkathana and Sikar) from the tube wells and bore wells. Polythene bottles of 2.5 L capacity were thoroughly cleaned with hydrochloric acid, washed with tap water until rendered free of acid and then with distilled water twice and finally rinsed with the water sample to be collected in the session (July 2019 to January 2019) Pre and post Monsoon.

In present investigation complete chemical analysis [16] including determination of various parameters like, pH, EC, TDS are calculated and Total Alkalinity, Total Hardness, Calcium + Magnesium Hardness and Chloride were studied by Titrimetric Method whereas NO_3^- and F^- content were determined by Spectrophotometric method and Ion Selective method.

4. RESULTS AND DISCUSSIONS

The analysis of physico-chemical parameter reported in Tables 1-3.

1. **pH:-** pH regulates biological functions and can inhibit some biological processes. The pH range of 6.5-8.5 is considered normal and in the Shekhawati region of Rajasthan state consisting of Sikar, Neemkathana and khandela the pH ranged from 7.1 to 8.2 which is considered as normal.
2. **Electrical Conductivity:-** The permissible limit of EC is 2100ms/cm and in the Shekhawati region consisting of Sikar and Neemkathana normal range is 1595-2050 ms/cm and in khandela, it was in high range of 2140-2280 ms/cm in Rajasthan state. The specific conductivity is responsible for heart stroke and disturbing osmotic pressure of body regions.
3. **TDS:-** The desirable concentration of TDS is less than 500 ppm and maximum allowable limit is 1500 ppm and in Shekhawati region consisting of Sikar, Neemkathana and Khandela of Rajasthan state it varies from

1280-1750 ppm which is slightly lower and higher than the allowable limit. The high TDS indicated that drinking water is highly mineralized. If human body is allowed to take water with large TDS content, it will be expose body to various chemical, toxic and may cause chronic health problems in liver, kidney and even can cause cancer.

4. **Total Alkalinity:-** According WHO and ISI standards for drinking water, the desirable limit of alkalinity is 200-600 mg/L and in Shekhawati region consisting of Sikar, Neemkathana and Khandela of Rajasthan, it varies from 390-910 ppm which is considered as high range. The high alkalinity in water can make people to suffer from nausea and vomiting disease.
5. **Total Hardness:-** Hardness is one the important properties of drinking water. According to WHO and ICMR Permissible limit of total Hardness of drinking water is 500 mg/l [17]. Total hardness in Shekhawati region consisting of Sikar, Seemkathana and Khandela of Rajasthan state varies from 185-410 ppm which is quite higher than the ideal limit. Hard water is harmful to the health of humans as it contains soap level released from houses, laundries and textile plants. It also has effect on human body particularly muscle cramps & blood pressure.
6. **Calcium hardness:-** Calcium is essential element of drinking water and has important role in bone building. According to WHO and ISI standards for drinking water, the desirable limit of calcium is 75 mg/L and in Shekhawati region consisting of Sikar, Neemkathana and Khandela of Rajasthan, calcium concentration is found from 80-200 ppm which is a bit higher than ideal range. Large calcium content in drinking water may negatively influence the human health as it causes irritation and abnormalities in skin, eyes and in mucous membrane.
7. **Magnesium hardness:-** As the maximum relaxable limit of magnesium is 100 ppm and in Shekhawati region consisting of Sikar, Neemkathana and Khandela of Rajasthan, it varies from 190-290 ppm which is slightly above than the normal limit. After Calcium, it is the most commonly found cation in oceans. Human body contains about 25 g of magnesium, of which 60% is present in the bones and 40% is present in muscles and other tissues [18]. The large oral doses of

magnesium may cause vomiting and diarrhoea.

8. **Chloride (Cl⁻):**- Chloride is one of the major inorganic anions in drinking water. The highest desirable limit of chloride in drinking water is 250-1000 ppm and in Shekhawati region consisting of Sikar, Neemkathana and Khandela of Rajasthan state, it varies from 290-511 ppm which is considered as desirable limit.
9. **Nitrites (NO₃⁻):**- According to ISI and WHO, the permissible limit of nitrate in drinking water is 45 mg/L. The NO₃⁻ then combines with the hemoglobin of blood to form methemoglobinemia, which interferes with the O₂ carrying capacity of the blood. The disease produced is called methaemoglobinaemia (Blue Baby Syndrome). Symptoms include shortness of breath and blue coloration of skin. The ideal range is of 5-10 ppm and in shekhawati region consisting of Sikar,

Neemkathana and Khandela of Rajasthan; it varies from 22-97 mg/L depicting the high nitrite concentration present. It was found that it effected 204 patients in this area.

10. **Fluoride (F⁻):**- According to ISI and WHO, the permissible limit of fluoride content in drinking water is 1.0 - 1.5mg/L. High concentration of fluoride, cause fluorosis which affects the teeth and bones. Chronic high-level of fluoride can lead to skeletal fluorosis which include stiffness and pain in the joints [11]. Fluoride above 4ppm is considered as hazardous. In Shekhawati region consisting of Sikar, Neemkathana and Khandela of Rajasthan, it varies from 1.6-3.8 mg/L. The present research study revealed that fluoride concentration was found more than 1.5 ppm in different water samples. From the total, 1139 patients were affected by the fluorosis (Dental Skeletal and leg fluorosis).

Table 1. Physicochemical parameters of groundwater of Shekhawati region, Sikar

S. No.	Sample	pH	EC	TDS	Alk.	T.H	Ca-H	Mg-H	NO ₃ ⁻	Cl ⁻	F ⁻
1	W1	7.2	1820	1410	420	310	120	190	40	310	2.2
2	W2	7.2	1810	1415	440	320	110	210	52	290	2.2
3	W3	7.6	2050	1750	530	410	165	245	35	290	2.5
4	W4	7.4	1960	1680	510	390	175	215	30	420	2.4
5	W5	7.5	1960	1680	550	370	145	225	45	380	2.4
6	W6	7.6	1970	1700	470	410	200	210	22	350	2.2
7	W7	8.0	1990	1750	680	320	100	220	49	340	3.8
8	W8	8.1	1980	1750	650	320	120	200	78	360	2.7

Table 2. Physicochemical parameters of groundwater of Shekhawati region, Khandela

S. No.	Name	pH	EC	TDS	Alk.	T.H	Ca-H	Mg-H	NO ₃ ⁻	Cl ⁻	F ⁻
1	W1	7.9	2210	1490	910	240	110	130	46	410	2.1
2	W2	7.3	2190	1450	750	205	95	110	72	410	1.9
3	W3	7.8	2240	1770	610	210	105	105	62	511	2.2
4	W4	7.7	2230	1890	615	215	110	105	66	390	3.6
5	W5	8.1	2140	1410	710	235	115	120	48	510	2.6
6	W6	8.2	2205	1800	650	240	115	125	43	420	1.9
7	W7	8.0	2180	1590	570	225	110	115	69	460	2.5
8	W8	7.9	2280	1420	580	185	90	195	52	390	2.7

Table 3. Physicochemical parameters of groundwater of Shekhawati region, Neemkathana

S. No.	Name	pH	EC	TDS	Alk.	T.H	Ca-H	Mg-H	NO ₃ ⁻	Cl ⁻	F ⁻
1	W1	7.4	1810	1350	410	310	90	220	97	350	2.9
2	W2	7.9	1790	1310	450	330	80	250	49	320	2.8
3	W3	7.1	1750	1460	390	300	90	210	22	415	2.3
4	W4	7.8	1800	1470	440	380	120	260	44	340	2.1
5	W5	7.7	1680	1370	580	300	110	190	56	360	1.6
6	W6	7.9	1670	1510	510	370	120	250	66	410	3.7
7	W7	7.4	1715	1290	380	370	80	290	32	380	2.6
8	W8	7.5	1595	1280	390	360	80	280	43	390	2.7

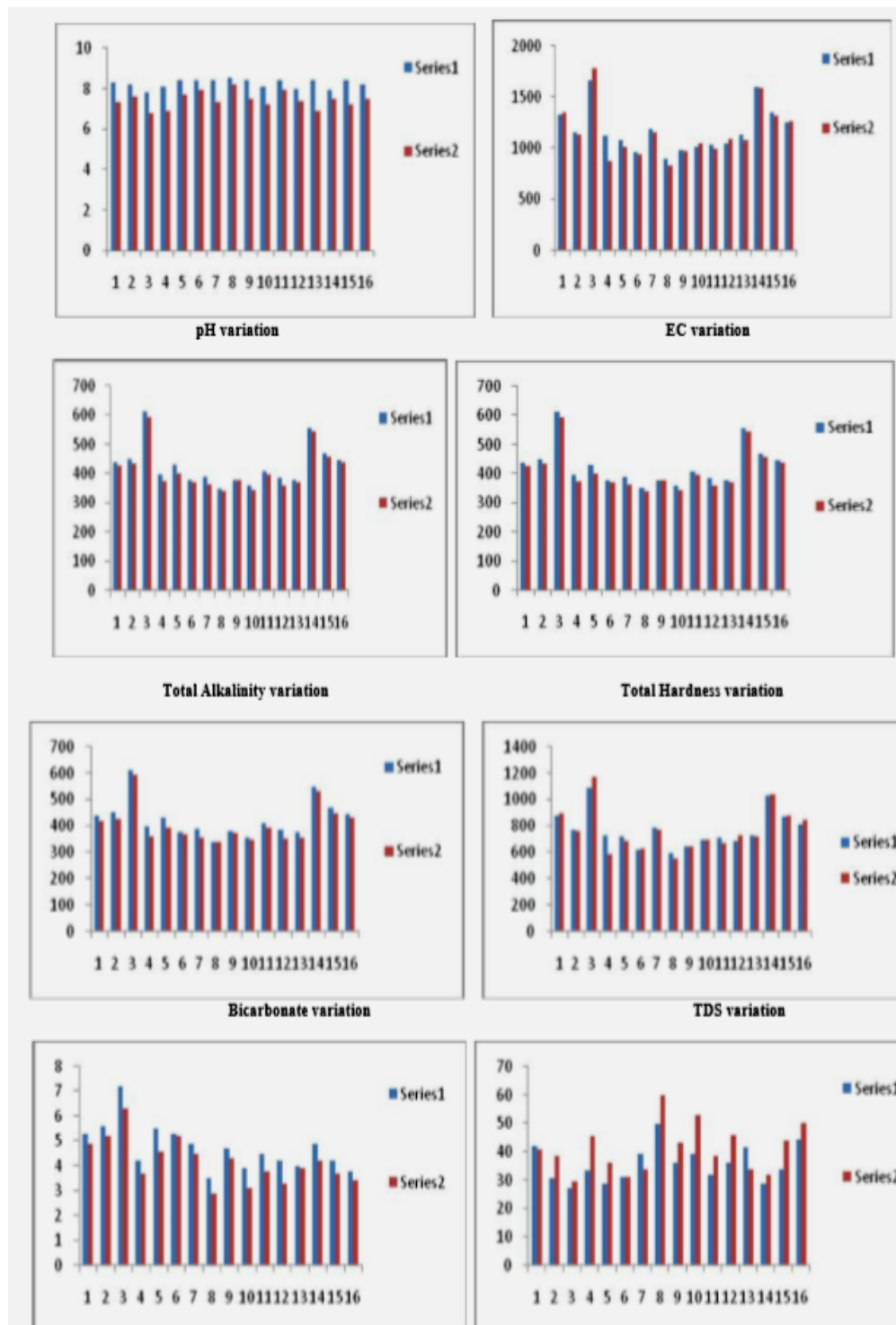


Fig. 1. Graphical representations of different physico-chemical parameters

5. CONCLUSION

In this study, various physico-chemical parameters were studied and analyzed. It was found that in Sikar region, pH, EC, Cl^- , and F^- are lying in normal range whereas Mg-H, Ca-H, TDS, TH,

NO_3^- and alkalinity were higher than the desirable limits. Whereas in the Khandela region pH, TDS, Cl^- and F^- are lying in normal range and Mg-H, Ca-H, NO_3^- , alkalinity, EC and T.H are higher than the desirable limit and at last in Neemkathana region pH, EC, TDS, Cl^- and F^- are

lying in normal range whereas Mg-H, Ca-H, NO₃⁻, alkalinity and T.H are higher than desirable limit which is ultimately causing various diseases and health problems among the people.

ACKNOWLEDGEMENT

Authors thank the Department of Chemistry for the research support and for the successful completion of work.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Asadullah, Kherun. Journal of Science, Technology and Development. 2013;32:28-33.
2. De AK. Environmental Chemistry, 6th Edition, New Age International, New Delhi. 2006;28-33.
3. Pandey V, et al. Basic Environmental Engineering, Book. NeelkanthPublishers Mangal Marg, BapuNahgar, Jaipur Edi. 2008;19-27.
4. Himmat Kanwaret.al.International Journal of Environment, Science and Technology. 2021;7:1-10.
5. Shilpimitra S Kumar. International Journal of chemistry Sci. 2013;11(1):186-196.
6. Sunder el at. International Research Journal biological science. 2015;5(4):2278-3202.
7. Bhalla LR, Bhalla K. Contemporary Rajasthan. Kuldeep Publication India. 2013;43-47.
8. Choubisa SL. International Journal Environmental Study. 2007;64(2):151-159.
9. Yadav AK, Sharma SK. Engineering Journal of Chemistry. 2010;41-46.
10. Shyam R, Kalwania GS. International Journal of Applied Engineering Research. 2011;2(2):367-378.
11. Gupta S, Kumar P. International Journal of chemistry Sci. 2013;11(1):269-270.
12. Kurdi MS, et al. International Journal of Anesthesia. 2016;60.
13. Barwar U, et al. Research Journalof science and Technology. 2018;10:109-118.
14. Kanwar H, et al. International Journal of Environment, Science and Technology. 2021;7:1-10.
15. Verma SK, et al. Journal of Applicable Chemistry. 2022;11(1):28-39.
16. Shanker G, et al. India current world Environment. 2017;12(3):630-634.
17. Agarwal S, Chanda AK. Environmental Chemical and Medical science. Edition. 2018;253-257.
18. Barwar U, et al. Research J. Science and Tech. 2018;10(01):382-387.

© 2022 Ram and Lamba; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:
<https://www.sdiarticle5.com/review-history/87918>