Available online at **www.joac.info**

ISSN: 2278-1862

Journal of Applicable Chemistry

2022, 11 (5): 849-857

(International Peer Reviewed Journal)

The Study of Ground water Quality in Dungarpur, with Special Reference to Pollution

Roshan Kumar Mehta* and Jayana Upadhyay

Department of Botany, Govind Guru Tribal University, Banswara, Rajasthan-327001, **INDIA**

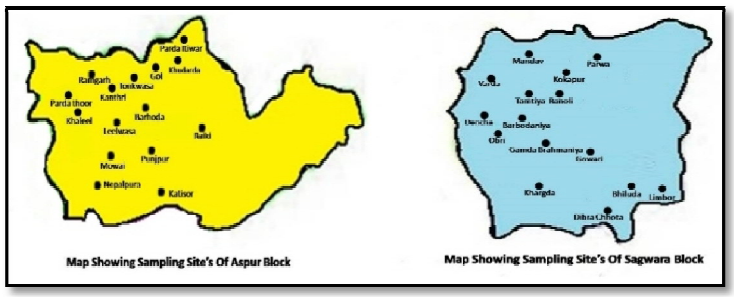
Email: roshan224225@gmail.com

Accepted on 4th August, 2022

ABSTRACT

The objective of the present investigation is to assess the quality of groundwater in Aspur and Sagwara blocks of Dungarpur district, Rajasthan, where groundwater is the primary source of drinking water and other uses for the people in the study area. Physico-chemical analysis of groundwater was conducted in the selected blocks of Dungarpur district. As per the purpose of the investigation, various Physico-chemical parameters were selected such as pH, electro conductivity, total dissolved solids, total alkalinity, total hardness, chloride, and nitrate. Therefore, 30 samples (15 from each block) were collected from different villages of Aspur and Sagwara blocks during the pre-monsoon, monsoon and post-monsoon seasons of 2020–2021 and all samples were analyzed using standard methods of APHA. To determine the quality of groundwater, the results were compared with the drinking water standards prescribed by BIS and WHO for each parameter. The results showed that the pH value was alkaline in nature of both the blocks, while the values of electro conductivity, total hardness, total dissolved solid, total alkalinity, chloride, and nitrate were found to be higher in the Aspur block as compared to the Sagwara block. A one-way ANOVA test was also conducted to estimate the highly significant or non-significant value of selected Physico-chemical parameters of both the blocks. The results showed a highly significant difference ($p<0.01$) in the values of electrical conductivity, total dissolved solids, chloride and nitrate, while no significant difference ($p > 0.05$) was found in the values of pH, total hardness, and total alkalinity in both the blocks of Dungarpur district.

Graphical Abstract:



Sampling Locations of Aspur and Sagwara blocks

Keywords: Physico-chemical parameters, Groundwater, ANOVA test, Water quality.

INTRODUCTION

Water is an inorganic, transparent, colourless, tasteless, and odourless chemical substance that is the main constituent of the earth, and it is a vital substance for all living beings on earth. In nature, it occurs in oceans, rivers, ponds, ice, and glaciers as surface water, and it is also found as groundwater [**1**] .Water that is found beneath the surface of the earth in rocks and soil pores is called groundwater. Rainwater percolates in soil pore spaces, deposits at saturated zones, and forms water tables, recharging groundwater through the hydrological cycle. The depth at which soil pore spaces, or fractures and voids in rock, become completely saturated with water is called the "water table." This groundwater can be accessed through hand pumps, tube wells, and open wells for different purposes like drinking, agriculture, and industrial use [**2**]. Ground water is the ultimate source of fresh water and it is safe for all organisms on earth. It contains balanced concentrations of different minerals for human consumption. Groundwater is the primary source of drinking water in urban as well as rural areas of India, and over 94% of the drinking water demand is met by groundwater [**3, 4**] But due to many anthropogenic activities like unplanned urbanization, unrestricted exploration policies, and dumping of polluted water at inappropriate places, the infiltration of hazardous compounds into the groundwater has increased [**5-8**]. Although, when compared with surface water, groundwater is less prone to contamination and pollution **[9, 10**]. Generally, groundwater quality is determined by a variety of chemical components and their quantities, which are mostly obtained from the geological data of the specific place [**11, 12**]. Due to the consumption of contaminated water, many health related problems and consequences have been observed in people. Therefore, the assessment of groundwater quality and the impact of polluted groundwater on the environment and human health has drawn the attention of the researchers.

The groundwater of Aspur and Sagwara blocks also contains a high level of contamination which has a serious and adverse impact on the health of the living beings of the study area. Every year, a large number of people are affected due to polluted water-borne diseases. Our primary and foremost objective nowadays is to save water and its purity.

MATERIALS AND METHODS

Dungarpur is a small district in Rajasthan, which is a tribal rural area, located in the southern part of Rajasthan and the western part of India. It is situated between the latitudes of 23.20° and 24.01° N and the longitudes of 73.22° and 74.23° E. Its northern and eastern borders are bounded by Udaipur district and Banswara district. In its south and west, it has a common border with Gujarat state. The district has an area of 3,770 km^2 and had a population of 1,388,906 as per the census 2011. The district is roughly triangular in shape. It has a dry climate with a hot summer season. There are five blocks in the district: Aspur, Bichiwara, Dungarpur, Sagwara, and Simalwara. Out of these two blocks, Aspur and Sagwara, of Dungarpur district, were selected for the present investigation, which lies in the eastern part of the district. The selected two blocks for the present study are shown in the map of Dungarpur district.

The quality of groundwater in the Aspur and Sagwara blocks has deteriorated. To determine the groundwater quality of these two blocks, 30 samples (15 samples from each block) of groundwater were randomly collected from different villages of both blocks in pre monsoon, monsoon, and post monsoon seasons from hand pumps and tube wells, and they were analyzed using Physico-chemical parameters like pH, electrical conductivity (EC), total dissolved solid (TDS), total hardness (TH), total alkalinity (TA), chloride (Cl^-), and nitrate (NO_3^-) and all parameters were analyzed according to the standard methods of APHA (2017) [**13**].

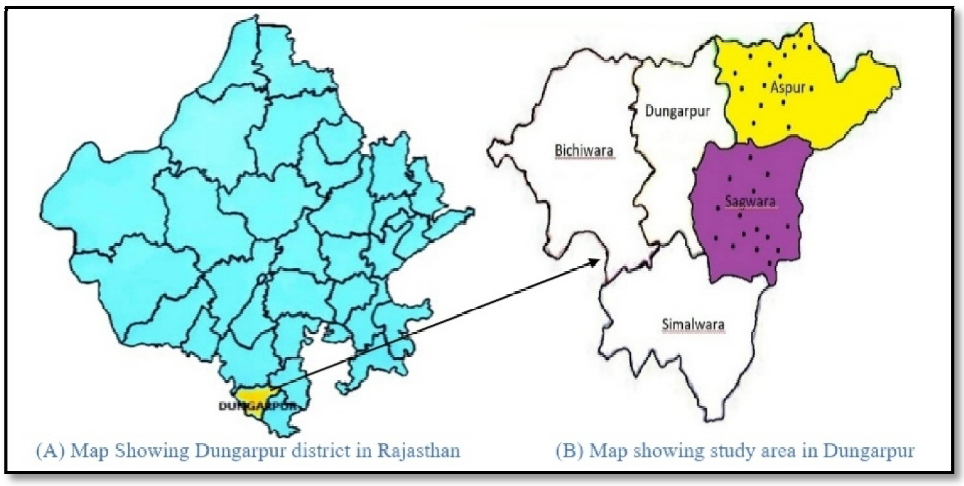


Figure 1. Showing maps of sampling sites in study area of Dungarpur district in Rajasthan

The results of the analysis were compared with the standard values of drinking water parameters prescribed by BIS [**14**] and WHO [**15**]. A one-way ANOVA test was also conducted to estimate the highly significant or non-significant value of selected Physico-chemical parameters of both the blocks.

RESULTS AND DISCUSSION

pH: pH is an important parameter for groundwater to determine the acidity and alkalinity of groundwater. As per the results of analysis shows all most samples were found alkaline except samples of Nepalpura (6.87) of Aspur block in post monsoon and Barbodaniya (6.84) of Sagwara block in Monsoon season. Hence, groundwater of both blocks was safe for drinking purposes because drinking water should be alkaline (> 7) according to WHO and BIS.

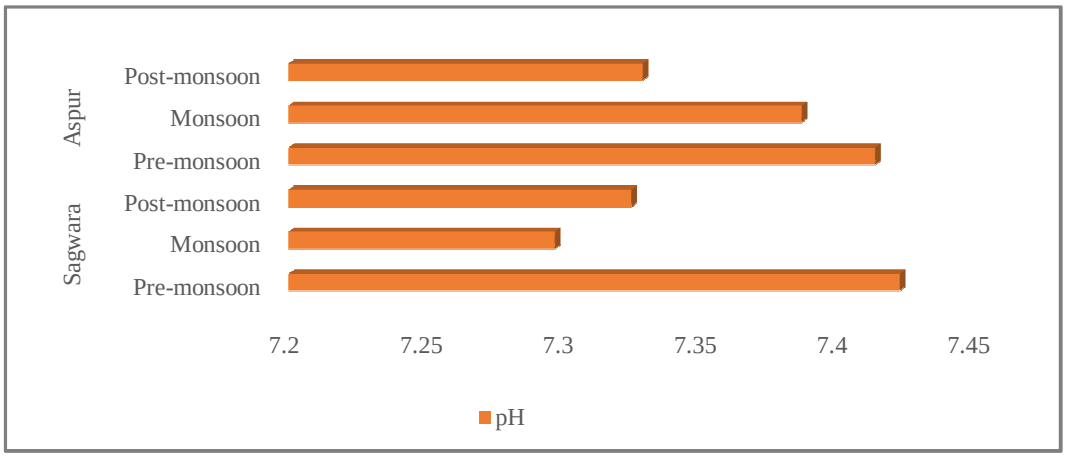


Figure 2. Showing the mean value of pH in both Aspur and Sagwara blocks in different season.

The graphical representation of the statistical analysis shows the mean value of pH in the pre-monsoon, monsoon, and post-monsoon seasons. The bars of the graph clearly depict that the values of pH are higher in the Aspur block than in the Sagwara block during all three seasons of the year 2021. The graph also showed that the pH values were higher in the pre monsoon season than in the monsoon and post monsoon seasons in both the blocks. The result of a one-way ANOVA test for pH is shown in table 1.

Table 1. Showing ANOVA test applied for pH parameter of Aspur and Sagwara blocks of Dungarpur district

Block	N	Minimum	Maximum	Mean	Standard Deviation	't' value	P-Value
Sagwara block	45	6.84	7.69	7.348	0.195	0.824	0.412
Aspur block	45	6.87	7.58	7.377	0.128		

The results of the ANOVA test show that there is a non-significant difference in the pH value of both the blocks (t = 0.824, p value = 0.412 > 0.05). The reasons for the non-significant pH value result could be mining, distribution of mineral-bearing rocks, and domestic waste dumping.

Electrical conductivity: EC is a useful tool to examine the quality of groundwater [**16**]. EC values for all the analyzed samples from both the blocks were found to be higher than the desirable limit prescribed by BIS and WHO (750 us cm^{-1}). High EC values show that the groundwater contains a high concentration of dissolved inorganic substances in ionised form. [**17**] The results show that the mean value of electrical conductivity in Aspur block (1765.333 us cm^{-1}) is higher than in Sagwara block (1303.333 us cm^{-1}).

The graph drawn to compare the mean values of electrical conductivity of Aspur and Sagwara blocks in different seasons clearly shows that the mean value of electrical conductivity is comparatively high in Aspur block than in Sagwara block and also shows that the values of conductivity were comparatively high in pre monsoon The result of one why ANOVA test for EC is shown in table 2.

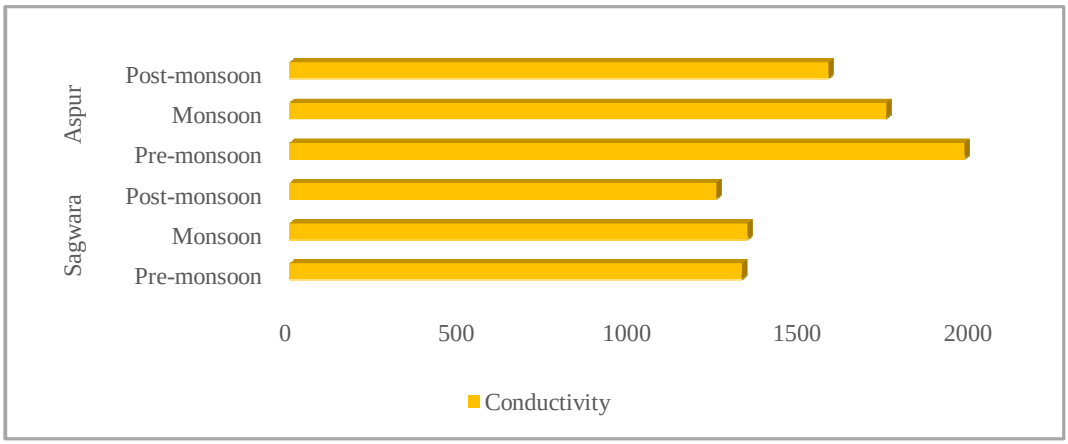


Figure 3. Showing the mean value of Electrical conductivity in both Aspur and Sagwara blocks.

Table 2. Showing ANOVA test applied for Electrical conductivity parameter of Aspur and Sagwara blocks of Dungarpur district

Block	N	Minimum	Maximum	Mean	Standard Deviation	't' value	P-Value
Sagwara block	45	880	1920	1303.333	226.505	4.913	0.000
Aspur block	45	860	3170	1765.333	588.730		

The above results of the ANOVA test show a highly significant difference in the conductivity of Aspur and Sagwara blocks (t = 4.913, p<0.01). The results also show high salinity, which is due to an imbalance in the ratio of precipitation and evaporation a pattern in the area, the geological composition of rocks and the discharge of domestic waste [**17**].

TDS: Total dissolved solids means the total concentration of dissolved inorganic and organic substances in water. The results of the analysis show that the mean value of TDS was higher in both

the blocks than the permissible limit of BIS and WHO (500 mg L^{-1}), and that the mean value of TDS is very high in Aspur block (1022.489 mg L^{-1}) as compared to Sagwara block (743.578 mg L^{-1}).

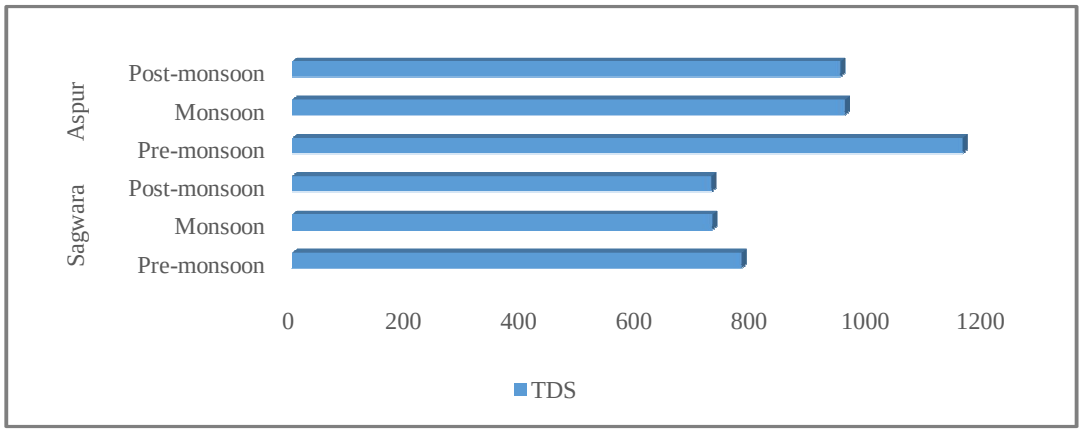


Figure 4. showing the mean value of Total dissolved solids in Aspur and Sagwara blocks in different seasons.

The graphical representation of total dissolved solids in the Aspur and Sagwara blocks during the pre-monsoon, monsoon, and post-monsoon seasons of 2021. The graph clearly shows that the mean value of total dissolved solids is higher in Aspur block than in Sagwara block and TDS values are comparatively high during the pre-monsoon season in both the blocks.

Table 3. Showing ANOVA test applied for Total dissolved solid parameter of Aspur and Sagwara blocks of Dungarpur district

Block	N	Minimum	Maximum	Mean	Standard Deviation	't' value	P-Value
Sagwara block	45	490	1090	743.578	120.193	5.198	0.000
Aspur block	45	587	1810	1022.489	339.275		

Results of the ANOVA test conducted for TDS showed a highly significant difference in both the blocks ($t = 5.198, p < 0.01$). The significant difference in the mean value of TDS may be due to the weathering of rocks near the source of groundwater, the disposal of waste water without treatment by industries, and domestic waste water in water bodies.

Total hardness: Total hardness is the total concentration of calcium and magnesium ions in water. Hardness prevents the lather formation of soap in water and increases the boiling points of water [**18**]. The results revealed that the mean value of total hardness in both the blocks was higher than the permissible limit prescribed by BIS and WHO (300 mg L^{-1}). It is also observed that total hardness is higher in the Aspur block (514.422 mg L^{-1}) than in the Sagwara block (499.356 mg L^{-1}). The below graph shows the mean value of total hardness in Aspur and Sagwara blocks during pre-monsoon, monsoon, and post-monsoon seasons. The bars in the graph depict comparatively higher total hardness in Aspur block than in Sagwara block in all seasons. The graph also indicates comparatively higher total hardness in the pre-monsoon season than in the monsoon and post-monsoon seasons.

The high value of total hardness may be due to the presence of high calcium and magnesium in mineral bearing rocks which seep out into groundwater.

Table 4. Showing ANOVA test applied for Total hardness parameter of Aspur and Sagwara.blocks of Dungarpur district

Block	N	Minimum	Maximum	Mean	Standard Deviation	't' value	P-Value
Sagwara block	45	300	780	492.689	98.128	1.029	0.306
Aspur block	45	320	740	514.422	102.123		

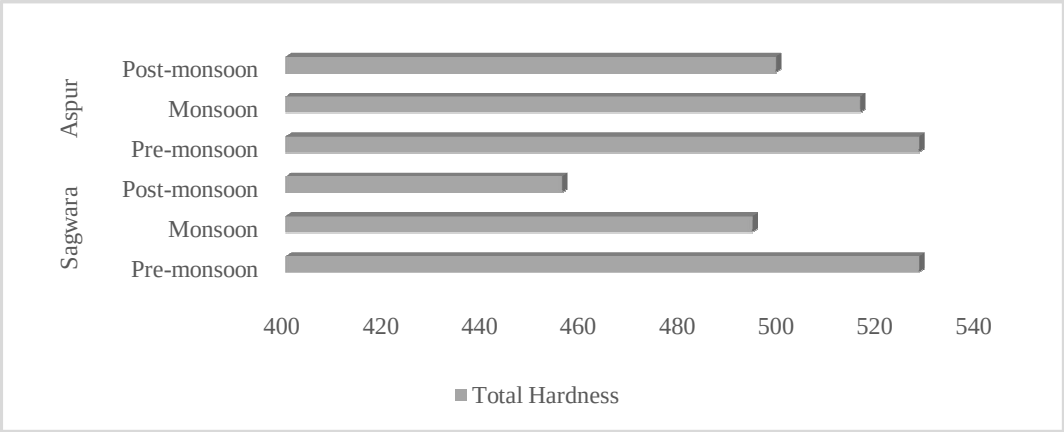


Figure 5. Showing the mean value of total hardness in both Aspur and Sagwara blocks.

The above test results show a non-significant difference in the total hardness value of both Aspur and Sagwara blocks ($t = 1.029$, $p > 0.05$).

Total alkalinity: The alkalinity shows the presence of natural salts in the water. The main cause of alkalinity in water is the minerals which dissolve in water from the soil. The presence of various ions like bicarbonate, hydroxide, phosphate, borate, and organic acids determines the alkalinity of water. These ions are characteristics of the source of water and natural processes taking place at a particular time [**19**]. The high alkalinity is not harmful to living beings, but it gives a bitter taste to water, which is unpalatable in taste. The results show that the alkalinity of all assessed samples fell within limits compared to the permissible limit of drinking water prescribed by BIS and WHO (200 mg L^{-1}). The mean value of total alkalinity is comparatively higher in the Aspur block (85.444 mg L^{-1}) than in the Sagwara block (82.711 mg L^{-1}).

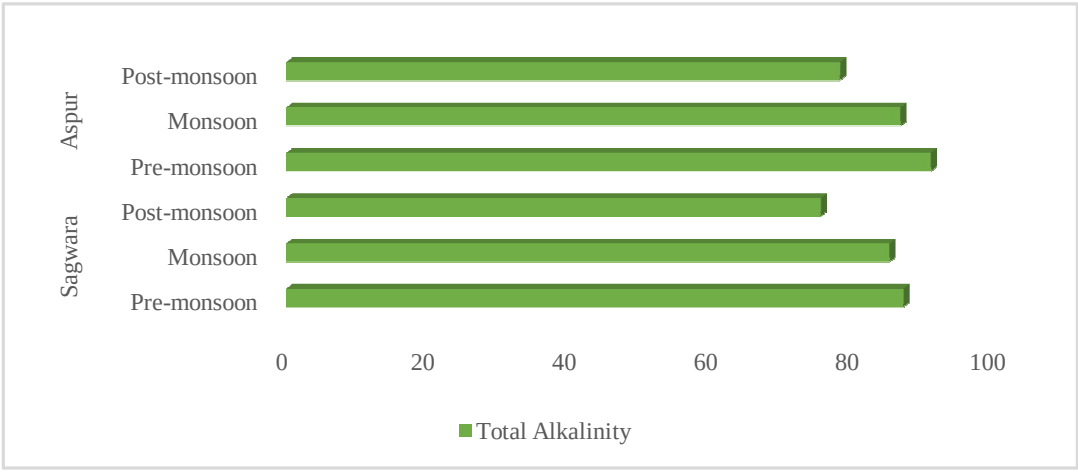


Figure 6. Showing the mean value of total alkalinity in both the blocks.

The graphical representation of the statistical analysis of the mean values of total alkalinity in groundwater samples of both the blocks during pre-monsoon, monsoon, and post monsoon seasons. The bars of the graph depict high alkalinity in the Aspur block as compared to the Sagwara block in all three seasons. The graph also shows higher total alkalinity in the pre-monsoon season than in the monsoon and post-monsoon seasons.

Table 5. Showing ANOVA test applied for Total alkalinity parameter of Aspur and Sagwara blocks of Dungarpur district

Block	N	Minimum	Maximum	Mean	Standard Deviation	't' value	P-Value
Sagwara block	45	60	115	82.711	13.520	0.867	0.388
Aspur block	45	52	122	85.444	16.261		

The results of the ANOVA test conducted for total alkalinity show a non-significant difference in the value of total alkalinity in both the blocks ($t = 0.867$, $p > 0.05$). The high value of total alkalinity in groundwater may be due to alkaline pH, mining and discharge of industrial waste water.

Chloride: In natural waters, chloride ions usually occur in the form of salts like NaCl, $CaCl_2$, and MgCl in different concentrations. These salts are dissolved in groundwater through the solvent action of water from sewage and trade wastes [**15**]. The result shows that the mean value of chloride in Aspur block (265.711), which is higher than the standard permissible limit of chloride for drinking water (200 mg L^{-1}) according to BIS and WHO, while in Sagwara block (191.778), which is within the permissible limit.

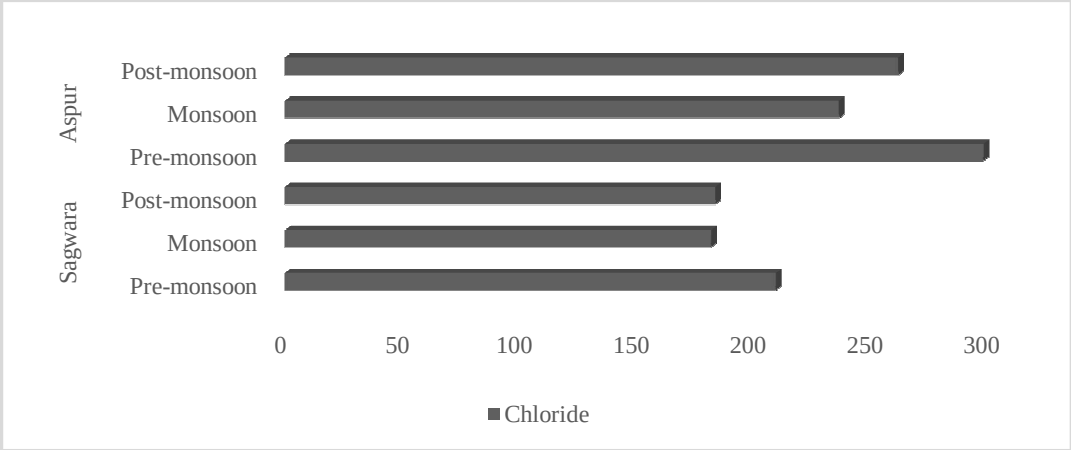


Figure 7. Showing the mean value of chloride in both the blocks.

The graphical representation shows the statistical analysis of the chloride in ground water of both the blocks of the Dungarpur district during pre-monsoon, monsoon, and post-monsoon seasons. The graph clearly demonstrates the high chloride value in the Aspur block as compared to the Sagwara block in all three seasons. The graph also shows comparatively high chloride values in pre monsoon. The high level of chloride in Aspur block may be due to chloride bearing rocks, discharge of industrial effluent, domestic waste, and animal-derived organic waste.

Table 6. Showing ANOVA test applied for Chloride parameter of Aspur and Sagwara blocks of Dungarpur district

Block	N	Minimum	Maximum	Mean	Standard Deviation	't' value	P-Value
Sagwara block	45	108	260	191.778	37.816	5.441	0.000
Aspur block	45	79	550	265.711	82.938		

The results of the above table show a highly significant difference in the value of Chloride in Aspur and Sagwara blocks ($t = 5.441$ and $p<0.01$).

Nitrate: Nitrate is a common contaminant found in groundwater; naturally, it is found at very low levels (<10 mg L^{-1}), but human activities such as agriculture, domestic effluents, industry, and emissions from combustion engines raise its level. As per the result, the mean value of nitrate is very

high in both the blocks as compared to the standard permissible limit of nitrate (45 mg L^{-1}) for drinking water according to BIS and WHO. It is also observed that the mean value of nitrate in the Aspur block (70.600 mg L^{-1}) is higher than that in the Sagwara block (56.467 mg L^{-1}).

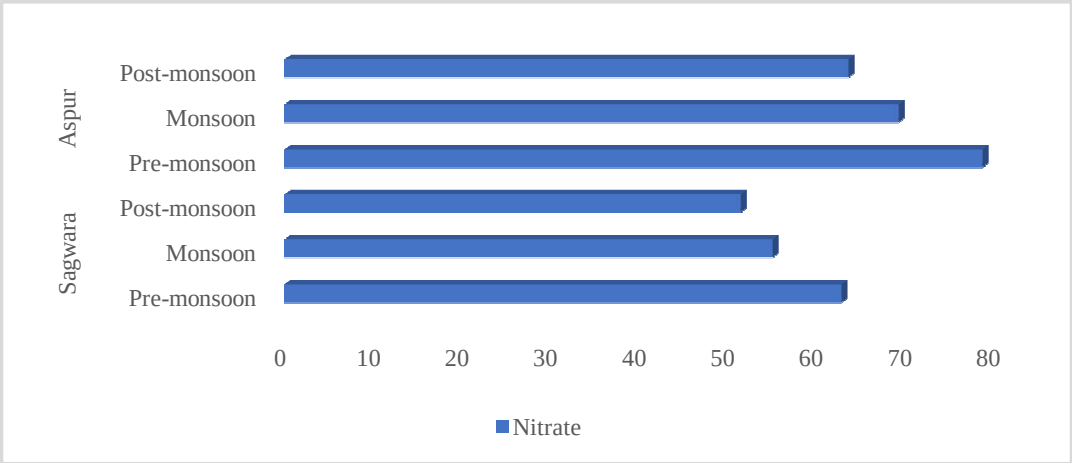


Figure 8. Showing the mean value of nitrate in Aspur and Sagwara blocks.

The graphical representation shows the statistical analysis of nitrate in groundwater in both the blocks of Dungarpur district in pre monsoon, monsoon, and post-monsoon seasons. The bars of the graph show the high nitrate value in the Aspur block as compared to the Sagwara block in all three seasons. The graph also shows higher nitrate values in the pre-monsoon season in both the blocks.

Table 7. Showing ANOVA test applied for Nitrate parameter of Aspur and Sagwara blocks of Dungarpur district

Block	N	Minimum	Maximum	Mean	Standard Deviation	't' value	P-Value
Sagwara block	45	40	72	56.467	8.151	4.490	0.000
Aspur block	45	45	131	70.600	19.478		

The above results show a highly significant difference in nitrate value in both Aspur and Sagwara blocks (t = 4.40 and p 0.01). The high nitrate value may be due to the presence of nitrate-bearing rocks, inorganic fertilizer, mining, seepage of sewerage and septic systems near sampling sites.

APPLICATION

The inhabitants of the study region currently rely on groundwater as their primary source of water. Nowadays, groundwater contamination has become a serious problem. The protection of groundwater quality benefits from parameter estimation. All sources of groundwater are covered by this study. To serve society and ensure sustainable development, it is crucial to protect and restore water bodies. The current study aids locals and government officials in analysing the quality of groundwater and taking the required steps to raise it.

CONCLUSION

On the basis of the above results of statistical data analysis of physico-chemical parameters in groundwater samples of Aspur and Sagwara blocks, it is concluded that the groundwater quality of these two blocks is highly deteriorated, and it is not fit for drinking purposes. Contaminated groundwater has adversely affected the people of the study area. They are facing many health problems due to the consumption of contaminated groundwater. Therefore, it is suggested to the state government and local bodies of the study area to adopt water filtration techniques like activated

carbon, reverse osmosis, ion exchange, distillation, etc. in the affected area to make ground water potable.

REFERENCES

[1]. B. L. Chavan, N. S. Zambare, Physicochemical Analysis of Groundwater Samples in Solapur City, Maharashtra, India, *International Journal of Research in Civil Engineering, Architecture and Design*, **2014**, 2(3), 7-12.

[2]. S. P. Mishra, S. N. Pandey, Essential Environmental Studies, *Ane Books Pvt.Ltd*, New Delhi, 82, **2008**.

[3]. R. P. Kumar, B. Vijayalakshmi, Assessment of fluoride concentration in ground water in Madurai district, Tamilnadu, India, *Research Journal of Pharmacy and Technology*, **2017**, 10 (1), 309-310.

[4]. U. Saxena, S. Saxena, Correlation study on physico-chemical parameters and quality assessment of ground water of Bassi tehsil of district Jaipur, Rajasthan. *Journal of Environment, Science and Technology*, **2015**, 1(1), 78-91.

[5]. J. Upadhyay, N. Rai, Ground water quality in Dungarpur district, Rajasthan, India. *J. Environ. and Ecoplan*, **2011**, 18 (1), 45–54.

[6]. D. Sharma, A. Physico-Chemical analysis and management of ground water bodies from 20 locations of Jodhpur district, *J. Applicable Chemistry*, **2014**, 3(2), 764-768.

[7]. L. Salimi, A. Hajiali, Determination of poly aromatic hydrocarbons (PAHs) amounts in anzali Lagoon (Iran) and assessment of their origin, *J. Applicable Chemistry*, **2017**, 6(3), 363-373.

[8]. P. D. Sreedevi, S. Ahmed, Assessment of fluoride concentration in groundwater of semi-arid region, India, *J. Applicable Chemistry*, **2013**, 2(3),526-531.

[9]. G. E. Oteze, Potability of groundwater from the Rima Group aquifers in the Sokoto Basin, *J. Min. Geol.*, **1991**, 27(1), 17-24.

[10]. M. Jalali, Major ion chemistry of groundwater in the Bahar area, Hamadan, western Iran, *Environ. Geol.*, **2005**, 47, 763-772.

[11]. A. Bukhzam, A. Elgornazi, N. Alshelmani and N. Bader, Study of Some Physical and Chemical Characteristic Properties of Ground Water in Sug al Juma'a area in Tripoli, Libya. *J. Applicable Chemistry*, **2021**, 10(1), 42-48.

[12]. I. P. Tripathi, Arvind Prasad Dwivedi and M. Suresh Kumar, Assessment of Ground Water Quality in Umaria District, Vindhya Pradesh, India, *J. Applicable Chemistry*, **2014**, 3(2), 798-811.

[13]. APHA, AWWA, WEF, Standard Methods for Examination of Water and Wastewater (23rd edition). American Public Health Association Washington D. C., **2017**.

[14]. BIS Indian Standard Specification for drinking water. B.S.10500. Bureau of Indian Standards, New Delhi, **2012**.

[15]. WHO Guidelines for drinking-water quality: recommendations, vol. 1. World Health Organization, Geneva, **2004**.

[16]. G. D. Acharya, M. V. Hathi, A .D. Patel, K. C. Parmar, Chemical properties of groundwater in Bhiloda Taluka Region, North Gujarat, India, *E-Journal of Chemistry*, **2008**, 5(4), 792-796.

[17]. K. K. Yadav, N. Gupta, V. Kumar, S. Arya, D. Singh, Physico-chemical analysis of selected ground water samples of Agra city, India. *Recent Research in Science and Technology*, **2013**, 4 (11), 51-54.

[18]. V.T. Patil, and R.R. Patil, Physicochemical analysis of selected groundwater samples of Amalner Town in Jalgaon District, Maharashtra, India, *E-Journal of Chemistry*, **2010**, 7(1), 111-116.

[19]. M. R. Sharma, Assessment of groundwater quality of Hamirpu area in Himanchalpradesh. *Journal Pollution Research*, **2004**, 23(1), 131-134.