

Seasonal Variations of Physico-Chemical Characteristics in Open-Well Water Quality in Bakani Tehsil of Jhalawar District, Rajasthan, India

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Abstract

Seasonal variation of physico-chemical parameters of open-well water in Bakani tehsil of Jhalawar district, Rajasthan were determined. The hydrochemical investigation revealed that the seasonal effect does change the concentration of various ions present in the open-well water. Water samples were analyzed for physico-chemical parameters including pH, Turbidity, EC, TDS, Total Hardness, Na^+ , K^+ , Cl^- , F^- , NO_3^- and SO_4^{2-} . The data showed variation of the investigated parameters in samples as follows: pH, 6.92 to 9.33; Turbidity, 0.5 to 13.1 NTU; EC, 1000 to 6200 μscm^{-1} ; TDS, 340 to 1850 mg/l; Total Hardness, 88.2 to 745.4 mg/l; Na^+ , 11.4 to 54.8 mg/l; K^+ , 10.5 to 70.8 mg/l; Cl^- , 24.4 to 656.8 mg/l; F^- , 0.12 to 1.65 mg/l; NO_3^- , 19.3 to 91.5 mg/l; SO_4^{2-} , 8.5 to 64.5 mg/l. The concentrations of most of the investigated parameters in the water sample were exceeded the permissible limit of WHO (1971).

Key words: Seasonal Variation, Physico-Chemical Parameters, Hydrochemical investigation, Open-well Water.

Introduction

Water, an essential requirement for all forms of life, needs protection from pollution which otherwise pose a threat to human life. Environmental conditions such as salinity, oxygen, temperature and nutrients influence the composition, distribution and growth of its biota¹.

Groundwater occurs as a part of the hydrological transformations of permeable structured zones of the rocks, gravel and sand. Groundwater can be obtained from aquifers and hypopheric zones. Fractured crystalline bedrocks are excellent sources of potable water in many parts of the world².

Ground water is the most important

source of the domestic, industrial and agricultural water supply in the world. The preference for groundwater to surface water must be due to the purification of the latter prior to distribution³.

Ground water quality includes the physical, chemical and biological characteristics of groundwater and depends on natural processes as well as anthropogenic activities. Human activities can alter the natural composition of ground water through the disposal or dissemination of chemical and microbial matter at ground surface and into soil or through the injection of waste directly into the groundwater. During the last few years, it has been observed that ground water gets drastically polluted because of the increase in human activities. Thus, groundwater pollution is defined as an undesirable change in groundwater quality resulting from human activities⁴.

Hence, a continuous monitoring on ground water becomes mandatory in order to minimize the groundwater pollution and have control on the pollution causing agents. Continuous monitoring on groundwater may become easier with the development of rapid water quality measurement technique without making much compromise on the accuracy of measurement⁵.

The major aim of the study was to report on the assessment of the physico-chemical parameters of the water sample in three different seasons (pre-monsoon, monsoon, and post-monsoon) from open wells of Bakani tehsil.

Material and Methods

Study area: Jhalawar district is located

in the south-east of Rajasthan, between the longitudes of 75°27' 35" to 76°56' 48" East and latitudes of 23°45' 20" to 24°52' 17" North, adjoining the neighbouring state of Madhya Pradesh. Bakani is located at 24.28°N 76.23°E. It has an average elevation of 354 meters (1161) feet. Bakani is 42 km away from its district headquarters, Jhalawar. Where groundwater is mainly found in layers of basalt, sandstone and shale, intercalated with sandstone.

Methodology: Water samples were collected from the Open-well of 42 gram panchayats of Jhalrapatan tehsil in 2011. Samples were collected in clean polythene bottles pre-washed with dilute hydrochloric acid and rinsed three to four times with the water samples before the samples were stored at a temperature below 4° C prior to analysis in the laboratory. The physico-chemical parameters such as pH, TDS, EC, Cl⁻, NO₃⁻, SO₄²⁻ and F⁻ were determined by using standard methods⁶. Sodium and potassium were determined by Flame Photometric methods. Trace metals were determined by Atomic Absorption Spectrophotometer (Shimadzu-6300). Specific reagents were used for the analysis and double distilled water was used for preparation of solutions.

Result and Discussion

In this study analysis of water quality in different seasons was carried out to determine the seasonal variation of physical and chemical characteristics of water. The results were listed in table 1 and fig. 1.

In the study area, pH value ranged from 6.92 to 9.21 with an average value of 7.75 during pre-monsoon, 6.99 to 9.28 with an

Table 1. Physico-chemical analysis of open well water in different seasons

Parameters		Pre-monsoon			Monsoon			Post-monsoon		
		Min.	Max.	Average	Min.	Max.	Average	Min.	Max.	Average
PH		6.92	9.21	7.75	6.99	9.28	7.76	6.99	9.33	7.79
Turbidity	NTU	0.6	12.8	5.3	0.7	13.1	6.1	0.5	12.3	5.4
EC	$\mu\text{S cm}^{-1}$	1100	6200	2645.8	1300	5800	2667.3	1300	5900	2712.6
TDS	mg/l	340	1850	806.1	390	1700	837.1	390	1780	853.8
TH	mg/l	88.2	740.2	326.2	100.3	745.4	331.6	95.9	735.9	334.7
Na ⁺	mg/l	12.3	45.3	28.5	11.4	46.9	27.6	13.9	54.8	35.7
K ⁺	mg/l	18.4	62.8	32.8	10.5	65.8	30.8	17.6	70.8	41.9
Cl ⁻	mg/l	24.4	656.8	165.8	35.6	650.3	169.4	36.9	610.8	167.5
F ⁻	mg/l	0.12	1.65	0.69	0.22	1.59	0.77	0.15	1.59	0.76
NO ₃ ⁻	mg/l	19.3	91.5	50.9	27.7	87.3	53.4	22.4	89.3	49.5
SO ₄ ⁻²	mg/l	8.5	64.5	32.7	9.5	59.8	36.5	10.3	58.7	36.7

average value of 7.76 during monsoon and 6.99 to 9.33 with an average value of 7.79 during post-monsoon period and most of the wells showed pH in the alkaline range during the study period. Electrical conductivity is the capacity of a solution to conduct the electric current, in this study the electrical conductivity reported to be in the range of 1100-6200 μscm^{-1} in pre-monsoon, 1300-5800 μscm^{-1} in monsoon and 1300-5900 μscm^{-1} in post-monsoon. Turbidity is a measure of murkiness of water. Turbidity is the condition which results due to the suspension of solid particles in water⁷. In the present study it ranged between 0.6 – 12.8 NTU, 0.7 – 13.1 NTU and 0.5 – 12.3 NTU in pre-monsoon, monsoon and post-monsoon respectively. As per the TDS classification⁸, most the open-well water samples collected

during pre-monsoon, monsoon and post-monsoon periods belong to brackish type (TDS > 1,000 mg/l). TDS of open-well water varied between 340– 1850 mg/l, 390 – 1700 mg/l and 390 – 1780 mg/l during pre-monsoon, monsoon and post-monsoon respectively. Total hardness of open-well water varied between 88.2 – 740.2 mg/l, 100.3 – 745.4 mg/l and 95.9 – 735.9 mg/l as CaCO₃ during pre-monsoon, monsoon, and post-monsoon respectively. Classification of open well water based on total hardness shows that a majority of open well water samples fall in the hard water category.

During pre-monsoon, the concentration of cations Na⁺, K⁺ ions ranged from 12.3 to 45.3; 18.4 to 62.8 mg/l with a mean of 28.5 and 32.8 mg/l respectively.

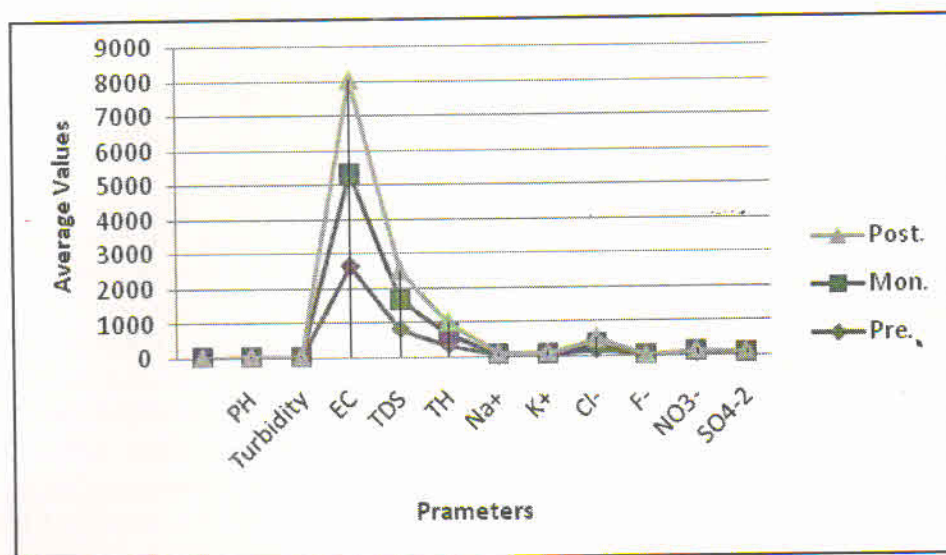


Fig 1. Seasonal Variation of Physico-chemical Characters of Open Well Water in Bakani Tehsil

During monsoon the concentration of cations Na^+ , K^+ range from 11.4 to 46.9; 10.5 to 65.8 mg/l with a mean of 27.6 and 30.8 mg/l respectively. But post-monsoon the concentration of cations Na^+ , K^+ ions ranged from 13.9 to 54.8; 17.6 to 7.8 mg/l with a mean of 35.7 and 41.9 mg/l respectively. The seasons effect does change the concentration of various ions similarly in the case of anions during pre-monsoon, Cl^- , F^- , NO_3^- , SO_4^{2-} ranged from 24.4 to 656.8; 0.12 to 1.65; 19.3 to 91.5; 8.5 to 64.5 mg/l with a mean of 165.85, 0.69, 50.91 and 32.78 mg/l respectively. During monsoon Cl^- , F^- , NO_3^- , SO_4^{2-} ranged from 35.6 to 650.3; 0.22 to 1.59; 27.7 to 87.3; 9.5 to 59.8 mg/l with a mean of 169.41, 0.77, 53.40 and 36.52 mg/l respectively. During post-monsoon Cl^- , F^- , NO_3^- , SO_4^{2-} ranged from 36.9 to 610.8; 0.15 to 1.59; 22.4 to 89.3; 10.3 to 58.7 mg/l with a mean of 167.58, 0.76, 49.57 and 36.75 mg/l

respectively.

Most of the open-well water samples showed higher concentration of Chloride and Nitrate ions. Chloride usually occurs as NaCl , CaCl_2 and MgCl_2 in widely varying concentration, in all natural waters. They enter water by solvent action of water on salts present in the soil, from polluting material like sewage and trade wastes⁹. Nitrate may result due to livestock facilities, agro chemicals and sewage disposal¹⁰. Increasing presence of nitrate in water is a big threat to the public health. The nitrate rich water is not fit for drinking¹¹. Excess of nitrate in drinking water may become the cause of methemoglobinemia (blue baby syndrome)¹². Some of water samples showed higher concentration of Fluoride ions. Its concentrations is dependent on solubility of fluoride containing rocks. Intake of excess fluoride

causes skeletal and dental fluorosis. The non skeletal fluorosis due to continuous intake of fluoride containing water, air and agricultural produce¹³.

Conclusion

Physico-chemical characteristics of selected priority parameters in open-well water during pre-monsoon, monsoon and post-monsoon has been determined in this study. Deleterious levels of almost all the physico-chemical parameters were observed, which stands as a potential health hazards to the inhabitants of the area, that uses these water resources directly for domestic purpose without treatment. The overall observation of the data indicated a fast deterioration of water quality in the available water resources, the pollution source being nonpoint sources. It is therefore needful that urgent steps be taken to ensure effective water resources management.

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