The Statistical Assessment of Nitrate Contamination Status of Ground Water in Balotra block of District Barmer, Rajasthan, India

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ABSTRACT:
Ground water is the major source of drinking water and over 94% of the drinking water demand is met by groundwater. Water quality monitoring shows that nitrate is present in ground water throughout country at relatively low concentrations, but in areas of intense farming the nitrate-nitrogen concentration may approach or exceed the WHO and IS 10500 ground water permissible limit of 100 mg/L. There are isolated cases where the concentration of Nitrate -nitrogen is very high. This is attributed to disposal of high nitrogen containing waste on land.

This study focuses on the actual status of nitrate contamination in various regions of Balotra block of Barmer District, Rajasthan, India. The maximum limit of nitrate is found to be 286mg/l, 285mg/l and 152mg/l in Buriwara, Bhimarlai Station and Jagsa region of Balotra respectively which is higher than desirable and maximum permissible limit for nitrate in drinking water by IS10500 and WHO Standards. On basis of our results we found that most of the groundwater sources are unfit for drinking purposes.

Key words: Ground water, Nitrate, Barmer district, Water quality, WHO

INTRODUCTION:

Water is the most common liquid and the most essential element to life on earth. Water covers 71% of the Earth's surface. On Earth, 96.5% of the planet's crust water is found in seas and oceans, 1.7% in groundwater, 1.7% in glaciers and the ice caps of Antarctica and Greenland, a small fraction in other large water bodies, and 0.001% in the air as vapor, clouds and precipitation. Only 2.5% of this water is freshwater, and 98.8% of that water is in ice and groundwater. Ground water is a significant water resource in India for domestic, irrigation and industrial needs. More than 85% of rural and 50% of urban area domestic water requirements are being met from ground water resources, while irrigation accounts for around 92% of ground water extraction [1, 3].

Pollution of the ground water due to gelogenic and anthropogenic factors often render the ground water un-potable as consumption of such water can lead to various health related complications. 54% of India faces high to extremely high water stress because of degraded quality of water, mainly caused by human activities. Excessive application of fertilizers as well as organic wastes and sewage has been implicated in the nitrogen pollution of groundwater. 70 to 80% of water pollution by volume is from sewage [4-5].

Excessive use of nitrogenous fertilizer in agricultural farms as well as organic waste and sewage (landfills), has been implicated in the nitrate pollution of groundwater. Nitrate pollution has become one of the key environmental issues because of its impact on human and animal health. With the increasing use of nitrogenous fertilizers and huge amount of organic wastes generated by massive population, nitrate contamination in many regions of our country has assumed alarming proportions and may become serious problem in the forthcoming years. Urbanization has introduced number of dilemmas including overexploitation as well as deterioration of quality of groundwater resources. The origin of high nitrate contents in groundwater resources involves various activities taking place in surroundings include leakage from old sewage systems and soak pits, lack of solid waste disposal system, seepage from unlined drains (carrying effluents and sewerages). In soil, fertilizers used in agricultural land are containing inorganic nitrogen and wastes containing organic nitrogen are first decomposed to give ammonia, which is then oxidized to nitrite and nitrate. The required amount of nitrate is taken up by plants during their growth and used in the synthesis of organic nitrogenous compounds. In natural water, nitrate (NO_3^-) is usually <5mg/l additional amount of excess nitrate in groundwater arise due to the biological oxidation of organic nitrogenous substances of sewage, industrial and agricultural origin. Nitrate concentration in drinking water beyond WHO and IS 10500standards may have carcinogenic effects. Nitrate levels excess of 100mg/l can lead to Blue Baby syndrome and hamper oxygen transportation in blood. 300mg/l or more concentration of nitrate in water can cause gastric cancer and have adverse effect on cardiovascular system. Contaminated water can cause nausea, fever, vomiting, gastroenteritis and intestinal inflammation [7-8].

MATERIALS AND METHODS:

Study Area - Barmer district in Rajasthan, India, is situated between 240 40' 00" & 260 32' 00" North altitudes and 700 05' 00" & 720 52' 00" East longitudes covering geographical area of 28,387 sq. km. Balotra, the region which is chosen for this study, is a block in Barmer. This arid region was chosen to conduct this study because this area receives very scanty rainfall throughout year and the major water resource is groundwater.

Fig. 1: Map of Balotra (Courtesy: Google Maps)

Water Sampling - A total of 35 samples of groundwater used for drinking purpose were collected from different sources during September 2016 like deep wells, shallow wells, hand pumps, open wells, canals or tanks at different spots spread over the Balotra region. These spots were specifically identified on basis of frequent use. The water samples were collected in pre-cleaned, sterilized polyethylene bottles of 1 L capacity. All water samples were analyzed within 12 to 24 hours after collection.

Methodology:

Nitrate ($NO3^-$) mg/lit -Spectrometric method

UV SPECTROPHOTOMETRIC PROCEDURE -Measurement of the UV absorption at 220nm enables rapid determination of nitrate. The nitrate calibration curves follow Beer's law up to 11mg/l NO_3^--N. Because dissolved organic matter may also get absorbed at 220nm and NO_3^- doesn't get absorbed at 275nm, a second measurement can be made at 275nm to correct the NO_3^- value. The extent of empirical corrections is related to the nature and concentration of the organic matter and may vary from one water sample to another. Filtration of the sample is intended to remove possible interference from suspended particles. Readings of the absorbance or transmittance are taken against redistilled water set at zero absorbance or 100% transmittance. At 220nm, the NO_3^- readings are taken and at wavelength of 275nm readings are also observed due to dissolved organic matter. To obtain the absorbance due to NO_3^-, the reading at 275nm was subtracted from the reading at 220nm. From the graph of standard values and absorbance data, equivalent values of NO_3^- were obtained.

RESULTS AND DISCUSSION:

Nitrate contamination also leads to eutrophication of water bodies keeping in mind the various health hazards, it becomes necessary to determine the Nitrate content in these ground waters going to be used for drinking purpose in the study area. Analytical data as given in Table indicates that out of 35 samples of groundwater tested; 31 samples are under permissible concentration of Nitrate as mentioned by W.H.O. 2006; and IS 10500, remaining 4 samples of groundwater showed high concentration of nitrate. The maximum limit of Nitrate in study area was found to be 286.0 mg/l while to that of minimum it was found to be 4.0 mg/l indicating a huge variation in nitrate concentration.

Table: Nitrate concentration in ground water samples collected from different regions of Balotra block.

S. No.	Sampling Site	Sample No.	Location	Type of Source	Nitrate (mg/l)
1.	Asada	S1	CWR Asada	Deep Tubewell	57.00
2.	Asotra	S2	PSP (HED WAR.)	Deep Tube well	25.00
3.	Asotra	S3	T/W raw water Asotra	Deep Tube well	25.00
4.	Asotra	S4	GLR Asotra	Deep Tubewell	25.00
5.	Kheteswar Braham DhamTirth	S5	GLR Asotra Braham Dham	Deep Tubewell	25.00

6.	Bithuja	S6	T/W (raw) 2 near H .W Bithuja	Deep Tubewell	44.00
7.	Jasol	S7	CWR new Jasol	Deep Tubewell	23.00
8.	Mananawas	S8	GLR Mananawas	Deep Tube well	28.00
9.	Meghwalalo Ki Dhani	S9	H/P Meghwalo Ki Dhani	Shallow Tube well	46.00
10.	AkarliBakshiram	S10	GLR AkarliBakshiram	Deep Tube well	42.00
11.	Bagundi	S11	T/W raw water Bagundi	Deep Tubewell	59.00
12.	Bithuja	S12	T/W (raw) 2 near H .W Bithuja	Deep Tubewell	47.00
13.	Jasol	S13	Raw water Jasol	Deep Tubewell	29.00
14.	Bithuja	S14	T/W-1 Bithuja	Deep Tubewell	32.00
15.	Gopari	S15	Tanka AganvadiGopari	Khadins/ Nadis/ Tankas/ Ponds/ Wells/ Ooranis	6.00
16.	Mandapura	S16	Tap Aganvadi School Parisar Shiv Colony	Canal	4.00
17.	Pachpadra	S17	Tap AganvadiHarejanBasti	Canal	5.00
18.	Parloo	S18	CWR- near AganvadiCenterMeghwaloKa Bas	Deep Tubewell	6.00
19.	Bagundi	S19	CWR Bagundi	Deep Tubewell	47.00
20.	Gugari	S20	GLR Gugari	Deep Tubewell	47.00
21.	Mahadev Nagar	S21	GLR Mahadev Nagar	Deep Tubewell	47.00
22.	Dudhwa	S22	CWR Dudawa	Deep Tubewell	47.00
23.	Sodho Ki Dhani	S23	GLR Sodho Ki Dhani	Deep Tubewell	47.00
24.	Gopari	S24	GLR Gopadi	Deep Tubewell	47.00
25.	Newai	S25	CWR Newai	Deep Tubewell	47.00
26.	Pachpadra	S26	CWR-1 Pachpadara	Deep Tubewell	47.00
27.	Bhilon Ki Dhani	S27	Tanka Bhilo Ki Dhani	Khadins/ Nadis/ Tankas/ Ponds/ Wells/ Ooranis	59.00
28.	Mungra	S28	GLR Mungra	Deep Tubewell	67.00
29.	Asada	S29	CWR Asada	Deep Tubewell	43.00
30.	Buriwara	S30	T/W Buriwara	Deep Tubewell	286.00
31.	Jagsa	S31	T/W Jagasa	Deep Tubewell	151.00
32.	Bhimarlai Station	S32	O/W Bhimarali Station	Openwell	285.00
33.	Kitnod	S33	T/W-1 Kitnod	Deep Tubewell	19.00
34.	SinliChousera	S34	H/P SinliChousera	Shallow Tubewell	114.00
35.	Kanana	S35	T/W near main bus stand	Deep Tubewell	48.00

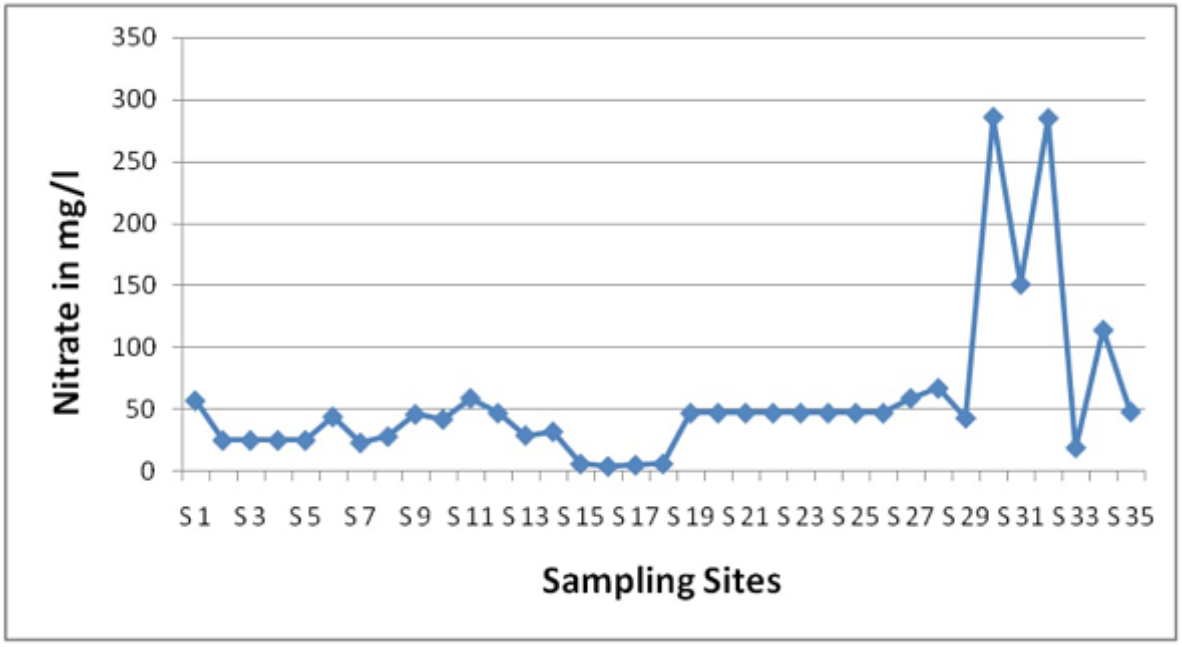

Fig: 2 Variation in Nitrate (mg/L) with sampling sites of Balotra block.

CONCLUSION:

The quality of water is of vital concern for mankind, since it is directly linked with human welfare it is now recognized that the quality of water available in study area is as important as the quantity. Ground water quality data gives important clues to the geologic history of rocks and indication of ground recharge movement and storage. In our study it has been observed that the concentration of nitrate in drinking water is not uniform in different locations of Balotra block, District Barmer, Rajasthan. It has been also observed that few samples of the study area have higher nitrate concentration. This indicates that the groundwater is polluted, and it should be treated to get rid of excess nitrate before using it as drinking water.

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