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IMPACT OF AGRICULTURAL PRACTICES ON GROUND WATER QUALITY OF FEW VILLAGES OF LADPURA TEHSIL IN KOTA DISTRICT, RAJASTHAN

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ABSTRACT

To find out impact of agricultural practices on ground water quality, ground water samples were collected from five villages around Ladpura tehsil, situated in Kota district and analyzed during year 2008 to 2010. Some important physicochemical parameters like pH, total dissolved solids, alkalinity, total hardness, sulphate, chloride, nitrate, phosphate were analyzed and results were compared with water quality standards prescribed by WHO and BIS 10500. Data reveals that all the water samples showed not too much higher values which indicates that water is not polluted. The correlation coefficients were calculated. The significance of result is further discussed.

Key words: Ground water, Correlation analysis, Agricultural practices.

INTRODUCTION

The present studies have been initiated to find out impact of agricultural practices on ground water quality of Ladpura tehsil of Kota district area. The main source of income or occupation of most of the people in this area is agriculture/farming. Animal manures are commonly used as fertilizer in agricultural practices; as a result concentration of nitrogen may increase in ground water of the area selected. Our environment consists of various types of substances but water is the fabulous substance on earth. Clean, fresh water is essential for nearly every human endeavor. Perhaps more than any other environmental factor, the availability of water determines the location and activities of human on earth. About 97.2% of water on earth is salty and only 2.8% is present as fresh water from which about 20% constitutes groundwater[1]. Groundwater serves as a major source for drinking, irrigation and industrial use. Water is the most abundant chemical component within the biosphere. Water

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is the basic medium of metabolic functioning. The removal and dilution of most natural and manmade wastes are also accomplished almost entirely by water. Being an important component of ecosystem, any impurities added to water can create imbalance resulting harm to whole ecosystem. When water contains enough impurities to make it unfit for an intended purpose like as drinking, domestic, agricultural, fishing and industrial, then it is called as polluted. High quality of ground water is essential for the health and welfare of the human beings. The continuous addition of toxic materials on the land and water bodies reaches to ground water through seepage and contaminates the ground water[2]. Once ground water is contaminated, its purification hopelessly difficult.

EXPERIMENTAL

Materials and methods

Study area

Kota city is centrally located in Hadoti Region. The district Kota lies between 24°25' and 25°51' North latitudes and 75°31' and 77°26' East longitudes with total area of 5217 sq Kms. "Kota City" is located at extreme South of it at 25°11' North latitude and 75°51' East longitude occupying total area of 238.59 sq Kms with average height of 253.30 meters from mean sea level. The only perennial river "Chambal" originating from the hills of Western Madhya Pradesh passes through the district. According to 2011 census, total population of district is 10,01,365. Total male population of Kota district is 5,29,768 and female population is 4,71,570. Total land area of Ladpura tehsil is 153824 hector in which agricultural land is 40880, 40788, 40579 hectare and nonagricultural land is 101758, 101803, 101927 hector in year 2008, 2009 and 2010 respectively. In year 2008, 2009 and 2010 the irrigated agricultural land area was 33564, 33202 and 32380 hectare respectively. In agricultural practices, various types of agrochemicals are used by farmers. In Ladpura tehsil, agrochemicals which were used during 2008-2010 are; sulphur, urea, D.A.P., potash (as fertilizer) and endosulphan (as pesticides). In the study area main source of irrigation is open well/tube well. In selected location the total number of open well was 226, 234 and 240 in year 2008, 2009 and 2010, respectively and 39 tube wells were used in irrigation during these years (Source-Milan Khasara, Land Record Office, Tehsil Ladpura Kota (Rajasthan) V.S. 2064).

Sampling locations and techniques

To find out ground water quality status in Ladpura tehsil, water samples were collected from twenty different selected sites in winter, spring, per-monsoon and post monsoon, period of years 2008, 2009 and 2010. Five villages Godlyahedi, Rajpura, Morpa,

Dhara and Kaithodi were selected for study. The open wells/tube wells located in residential, commercial and agricultural area were selected for sampling. The samples were collected as composite samples; at every site, samples were collected from four different points and then mixed together i.e. from five villages locations, samples were collected from twenty different sites. Sample were collected in pre-cleaned good quality narrow mouth screw-capped polypropylene bottles of two-liter capacity and rinsed thrice with the water to be collected and then filled completely to avoid encroachment of any air bubble. Sample bottles were then screw-caped tightly and brought to the laboratory. The samples were procured with traditional methods and preserved in a refrigerator at 4^{o}C. Samples were protected from any outside contamination. The coding of sampling locations are given in Table 1.

Table 1: Sampling Locations

Sampling Locations		Source
Godlyahedi	(L_1)	Open well/ Tube well
Rajpura	(L_2)	Open well/ Tube well
Morpa	(L_3)	Open well/ Tube well
Dhara	(L_4)	Open well /Tube well
Kaithodi	(L_5)	Open well /Tube well

The physicochemical parameters like pH, total dissolved solids (TDS), alkalinity, total hardness (TH), chloride (Cl^-), nitrate (NO_3^-), phosphate, sodium, potassium, calcium and magnesium were analyzed using standard methods[3-6]. The methods used for estimation of various physicochemical parameters are tabulated in Table 2.

Table 2: Methods used for estimation of physicochemical parameters

Parameters	Methods
pH	pH metry
Conductivity	Laboratory method
Total dissolved solids	Calculation method
Total alkalinity	Titration method
Total Hardness, calcium and magnesium	EDTA titration
Sodium and Potassium	Flame photometric method

Cont…

Parameters	Methods
Chloride	Silver nitrate method
Nitrate	Ion-selective electrode method
Phosphate	Spectrophotometric method

There are some methods adopted for computation of some important indices, the formulas of the calculated indices are as follows -

Aggressive index (AI)

$$AI = pH + \log (TA.\ TH)$$

where

pH = Measured water PH

TA = total alkalinity in mg/L

TH = total hardness in mg/L

Langlier saturation index (LSI)

$$LSI = pH - pHs$$

$$pHs = (9.3+A+B) - (C+D)$$

where

$A = (\log_{10}(TDS)-1)/10$

$B = -13.72*\log_{10}(^{o}C + 273) + 34.55$

$C = \log_{10}(TH \text{ as } CaCO_3) - 0.4$

$D = \log_{10}(A \text{ as } CaCO_3))$

Ryzner index (RI)

$$RI = 2pHs - pH$$

Percentage sodium (% NA)

$$\% Na = \frac{Na^{+}}{(Ca^{+2} + Mg^{+2} + K^{+}Na^{+})} \times 100$$

Sodium adsorption ratio (SAR)

$$SAR = \frac{Na^{+}}{\sqrt{(Ca^{+2} + Mg^{+2})/2}}$$

Exchangeable sodium percentage (ESP)

$$ESP = \frac{100\,(-0.0126 + 0.01475\,SAR)}{1 + (-0.0126 + 0.01475\,SAR)}$$

Residual sodium carbonate (RSC)

$$RSC = (CO_3^{2-} + HCO_3^{-}) - (Ca^{+2} + Mg^{+2})$$

RESULTS AND DISCUSSION

The average results of the sampling locations (L_1, L_2, L_3, L_4, L_5) of physicochemical parameters for water samples are presented in Table 3.

Table 3: Average results of the sampling locations (L_1, L_2, L_3, L_4, L_5) of physico-chemical parameters

Year	2008				2009				2010			
Parameters	Season				Season				Season			
	Pre-monsoon	Post-monsoon	Winter	Spring	Pre-monsoon	Post-monsoon	Winter	Spring	Pre-monsoon	Post-monsoon	Winter	Spring
pH	8.10	7.70	7.80	8.00	8.20	7.70	7.90	8.00	8.20	7.60	7.90	8.00
Conductivity	625	416	491	542	657	448	514	581	688	451	542	610
TDS	400	266	314	347	420	287	329	372	440	289	347	390
Total alkalinity	217	151	172	190	193	140	162	176	209	147	171	185
Carbonate alkalinity	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Bicarbonate alkalinity	217	151	172	190	193	140	162	176	209	147	171	185

Cont…

Year	2008				2009				2010			
Parameters	Season				Season				Season			
	Pre-monsoon	Post-monsoon	Winter	Spring	Pre-monsoon	Post-monsoon	Winter	Spring	Pre-monsoon	Post-monsoon	Winter	Spring
Total hardness	211	133	153	177	202	138	162	179	208	130	155	183
Calcium hardness	97.0	60.0	71.0	82.0	94.0	66.0	76.0	84.0	95.0	63.0	74.0	85.0
Magnesium hardness	114	73.0	82.0	95.0	108	72.0	86.0	95.0	113	67.0	81.0	98.0
Sodium	47.0	34.0	39.0	42.0	46.0	30.0	34.0	40.0	49.0	36.0	41.0	43.0
Potassium	7.00	4.00	5.00	5.00	6.00	3.00	3.00	4.00	5.00	4.00	5.00	4.00
Chloride	32.0	21.0	23.0	26.0	36.0	19.0	22.0	32.0	37.0	23.0	28.0	31.0
Sulphate	36.0	20.0	24.0	27.0	35.0	24.0	26.0	30.0	29.0	18.0	23.0	27.0
Nitrate	31.0	17.0	22.0	27.0	34.0	16.0	23.0	21.0	33.0	21.0	24.0	32.0
Phosphate	0.15	0.08	0.12	0.13	0.14	0.08	0.12	0.12	0.16	0.1	0.12	0.14

Table 4: Correlation analysis between various physicochemical parameters

	pH	Alkalinity	TDS	Hardness	Calcium	Magnesium
pH	1	0.9027	0.9643	0.9694	0.9655	0.9661
Alkalinity		1	0.8954	0.9508	0.9350	0.9570
TDS			1	0.9597	0.9687	0.9463
Hardness				1	0.9953	0.9971
Calcium					1	0.9851
Magnesium						1

pH

The lower values of pH may cause corrosion in containers and pipeline, while the higher values may produce sediment, deposit and difficulties in chlorination for disinfection of water[7]. In the present studies the pH values in all ground water samples varied from 7.6 to 8.2 which are within the maximum limit. As the pH ranges within limits, so it cannot produce any harmful effect.

Table 5: Average result of calculated indices of sampling locations (L_1, L_2, L_3, L_4 and L_5)

Cation-anion	-0.0410	-0.0573	-0.0550	-0.0314	0.0497	0.0540	0.0276	0.0430	0.0639	-0.0314	-0.0607	-0.0156
% Na	31.7164	34.8579	34.7195	33.2361	32.2901	31.4963	30.8280	32.0772	33.1914	36.6752	35.5752	33.1946
SAR	1.4068	1.2818	1.3709	1.3726	1.4072	1.1103	1.1614	1.2999	1.4772	1.3728	1.4318	1.3820
ESP	3.2274	3.0544	3.1777	3.1801	3.2279	2.8161	2.8873	3.0795	3.3245	3.1804	3.2620	3.1932
RSC	0.1200	0.3600	0.3800	0.2600	-0.1800	0.0400	0.0000	-0.0600	0.0200	0.3400	0.3200	0.0400
AI	12.7887	11.8700	12.1662	12.4972	12.8807	11.9407	12.3875	12.6991	13.0489	11.7202	12.2732	12.7668
LSI	0.8123	0.0721	0.2822	0.5844	0.8403	0.0519	0.3790	0.5530	0.8856	-0.0531	0.3810	0.5822
RI	6.4755	7.5559	7.2355	6.8312	6.5194	7.5961	7.1419	6.8939	6.4288	7.7062	7.1380	6.8355

Conductivity

Conductance is not too harmful but water with higher conductance is not suitable for drinking, irrigational and other purposes. The values of conductivity varied between 415 to 690 μS, which is also within the limit.

Total dissolved solids (TDS)

Higher concentration of TDS causes gastrointestinal irritation. TDS is an important parameter for drinking water and water to be used for other purposes. The values of TDS varied between 265 to 440 mg/L, which is also within the limit.

Alkalinity

The presence of carbonates, bicarbonates and hydroxides are the main source of alkalinity in natural waters[8]. In large quantities, alkalinity imparts a bitter taste of water. The value of alkalinity for water samples varied from 145 to 220 mg/L, which were all within limit.

Hardness

Higher values of hardness are responsible for incrustation and scaling in pipe lines. Hardness of water mainly depends upon the amount of calcium and magnesium salt or both[9]. Hardness was found in the range of 130 to 211 mg/L, which were all in the limit.

Calcium and magnesium (Ca^{+2}, Mg^{2+}): Water with high calcium content is undesirable for household uses such as washing, bathing and laundering because of consumption of more soap and other cleaning agents. In the present investigation, calcium concentration ranged from 60 mg/L to 100 mg/L and at high concentration, magnesium salts have a laxative effect particularly when present as magnesium sulphate. Magnesium content in the investigated water samples was varied from 67 mg/L to 115 mg/L and found above prescribed limit.

Sodium (Na^{+}): Excessive amount of sodium in drinking water is harmful to person suffering from cardiac, renal and circulatory diseases. Sodium concentration in the present analysis was found from 30 mg/L to 47 mg/L and was within the prescribed limit.

Potassium (K^{+}): Potassium is an essential nutrition element but in excessive amounts, it act as cathartic. Potassium content in the water samples varied from 2 mg/L to 7 mg/L.

Chloride (Cl^{-}): Chloride in drinking water is relatively harmless; however, high chloride contents in water bodies are harmful for metallic pipes and agricultural crops. Chloride

contents in fresh water are generally influenced by evaporation and precipitation[10]. Chloride contents varied from 20 to 37 mg/L in all the samples, which were all within the limit.

Sulphate (SO_4^{2-}): Sulfates can be more troublesome than chloride because they generally occur in greater concentrations. Higher value of sulphate may cause intestinal disorder. Sulphate values ranged in ground water samples from 18 to 36 mg/L, which were all within the limit.

Nitrate (NO_3^-): Nitrate (NO_3^-) is the highest oxidized from nitrogen. Nitrate in water supply in concentration over 100 mg/L causes methamoglobinemia or blue baby disease, particularly in infants up to 6 month of age. Nitrate Forms nitrosamine in stomach which causes gastric cancer. The nitrate concentration in the samples varied from 16 to 34 mg/L, which were all within the limit.

Phosphate (PO_4^{3-}): Occurrence of phosphate in groundwater is due to domestic sewage, detergents, agricultural effluents with fertilizers and industrial waste water. The phosphate concentration in ground water samples varied from 0.08 to 0.15 mg/L which all were within the limit.

Seasonal trends

Usual seasonal trends in values of different parameters i.e. dilution effect from pre monsoon to post-monsoon period and conducting effect from post-monsoon to winter, spring are observed within study period.

Correlation analysis

Correlation is a mutual relationship between two variables. Direct correlation exists when increase or decrease in the value of one parameter is associated with a corresponding increase or decrease in the value of other parameter[11]. The average result of correlation analysis of sampling locations (L_1, L_2, L_3, L_4, L_5) between various physicochemical parameters are tabulated in Table 4.

Calculated indices

In the study Millie equivalents (Cation-Anion), Percentage Sodium (%Na), Sodium Adsorption Ratio (SAR), Exchangeable Sodium Percentage (ESP), Residual Sodium Carbonate (RSC), Aggressive Index (AI), Langlier Saturation Index (LSI), Ryzner Index (RI) were calculated. The values indicated that there is no specific impact of agricultural practices on ground water quality of study area during study period. The average result of calculated indices of sampling locations (L_1, L_2, L_3, L_4, and L_5) tabulated in Table 5.

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REFERENCES

1. A. Jameel and J. Sirajudeen, Environ. Monit. Assess., **123**, 299 (2006).
2. B. C. Chakraborty, Bacteriological Quality of Water in some District of Assam. Indian J. Environ. Prot., **19(8)**, 587-589 (1991).
3. American Public Health Association (APHA): Standard Methods for the Examination of Water and Wastewater, 17th Edition, Washington, DC. (1989).
4. BIS: 10500, Specification for Drinking Water, Indian Standards Institution (Bureau of Indian Standards), New Delhi (1991).
5. O. Jayalakshmi Devi and S. L. Belagali, Nature, Environment and Pollution Technol., **5(4)**, 553 (2006).
6. D. Garg, R. Kaur, D. Chand, S. Mehla and R. Singh, Rasayan J. Chem., **1(4)**, 743 (2008).
7. B. Guru Prasad, Evaluation of Water Quality in Tadepalli Mandal of Guntur Distt., A.P., Nature Environ. and Pollution Tech., **2(3)**, 273-276 (2003).
8. C. K. Jain et al., Ground Water Quality in Malaprabha Sub-Basin, Karnataka, Indian J. Environ. Prot., **23(3)**, 321-329 (2003).
9. B. Shrinivas Rao and P. Venkateswarlu, Indian J. Environ. Prot., **20(3)**, 161 (2000).
10. N. Kumarswamy, Poll. Res., **10**, 13 (1991).
11. K. Karunakaran, P. Thamilarasu and R. Sharmila, E-J. Chem., **19(5)**, 3449 (2009).

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