



PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER OF SAMBHAR LAKE CITY AND ITS ADJOINING AREA, JAIPUR DISTRICT, RAJASTHAN, (INDIA)

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ABSTRACT

Groundwater samples were collected from different locations of Sambhar lake city and its adjoining area for their physico-chemical studies. Laboratory tests were performed for analysis of samples for total dissolved solids, EC and major ions e.g., Ca^{+2} , Mg^{2+} , NO_3^- , F^- , Na^+ and K^+ . In this analysis, results for main ions contributing towards TDS and NO_3^- are being reported. On comparing the results against drinking water quality standards laid by Indian Council of Medical Research (I.C.M.R.), it is found that most of the water samples are non-potable for human beings due to high concentration of one parameter or the other. Most of the samples have total dissolved solids values much higher than maximum permissible levels by I.C.M.R., which is 1500 ppm. The high value of these parameters may have health implications and therefore, needs attention.

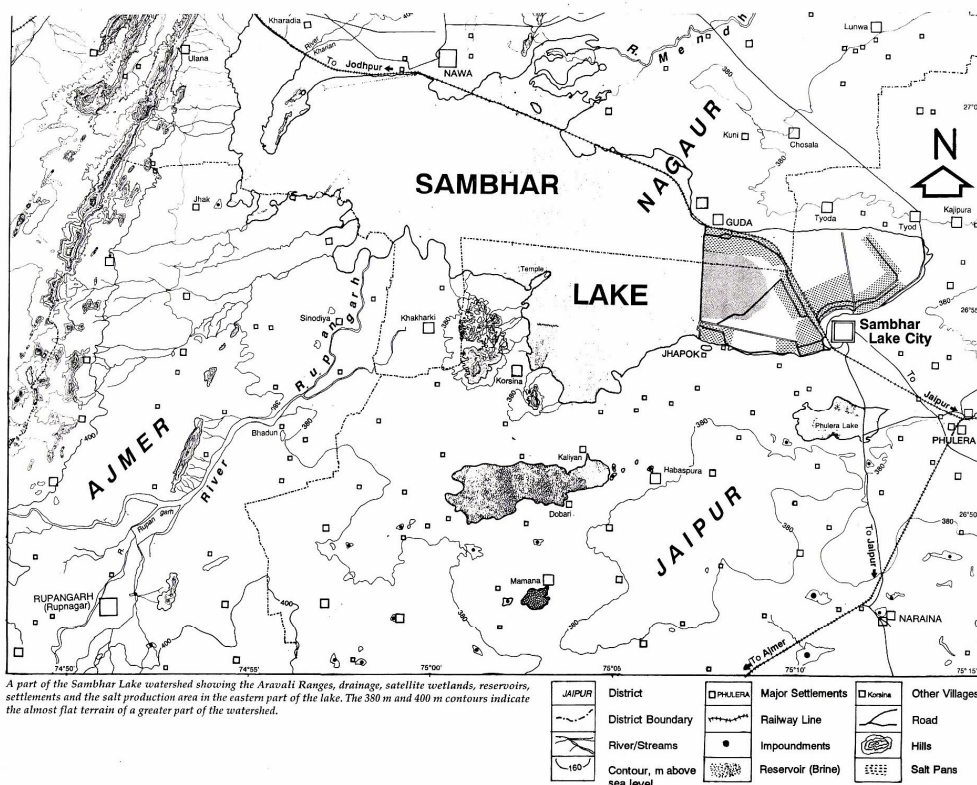
Key words : Groundwater quality, Total dissolved solids, Nitrate, Fluoride, Sambhar lake city.

INTRODUCTION

With rapid growing population and improved living standards, the pressure on water resources is increasing day-by-day¹. To meet the rising demands, it is imperative to recognize the fresh water resources and also to find out remedial methods for improvement of water quality. Water is a universal solvent² and it dissolves the minerals from the rock in which, it is stored and thus, chemical and physical parameters of a particular area will be changed. The quality of groundwater may also vary with depth of water table. Seasonal changes are governed by the extent and composition of the dissolved salts depending upon source of the salt and sub surface environment. The quality of ground water is the resultant of all the process and reaction that act on the water from the moment, it condenses in the atmosphere to the time, it is discharged by a well³.

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The socioeconomic growth of a region is severely constrained by non-availability of safe drinking water⁴. Groundwater meet domestic needs of more than 80% rural and 50% urban population besides irrigation. Around two fifth of India's agriculture output is contributed from areas irrigated by ground water. Contribution form groundwater of India's Gross domestic product has been estimated to be 9% as reported⁵.



A part of the Sambhar Lake watershed showing the Aravalli Ranges, drainage, satellite wetlands, reservoirs, settlements and the salt production area in the eastern part of the lake. The 300 m and 400 m contours indicate the almost flat terrain of a greater part of the watershed.

The main objectives of the hydrochemical study is to know the distribution of solutes in ground water, and the suitability of the groundwater for domestic and agriculture purpose. Rajasthan state is characterized by high evaporation, extreme variations in the temperature low and erratic rainfall. Average rainfall in Jaipur district is 350.5 mm and therefore, it is categorized as arid zone⁶. Due to shortage of water in these arid and semi arid areas, it is imperative to know the quality of ground water as the surface water sources are meager. Bacterial contamination and total dissolved solids are two main criteria for judging the quality of water for drinking purpose. Since ground water mainly contains no suspended particles and practically no bacteria, the suitability of ground water for domestic

use has been based on chemical composition of dissolved solids. The I.C.M.R. (1975) has recommended highest desirable level of 500 mg/lit and maximum permissible limit of 1500 mg/lit. for total dissolved solids⁷, which are in good agreement with the WHO international standards. In continuation of the work earlier done, related to ground water analysis in parts of Rajasthan state^{3,4,8,11}, the results of groundwater analysis in Sambhar lake city and its adjoining area, Jaipur district, Rajasthan are presented here.

EXPERIMENTAL

Materials and method

Samples were collected in polythene bottles from the various wells covering the study area. Utmost care was taken during sampling to avoid any kind of contamination. Temperature and pH were measured at the time of sampling itself. Physical attributes like TDS and EC were evaluated by microprocessor. The conductivity values were corrected for 25°C. Major ions like Ca^{2+} , Mg^{2+} , HCO_3^- and Cl^- were analysed using standard titrimetric methods. Sulphate ion estimation was done spectrophotometrically. Na^+ and K^+ analysis were done by Systronics flame photometers.

RESULTS AND DISCUSSION

The results of the analysis are reported in Table 1. The lower values of pH may cause tuberculation and corrosion while the higher values may produce incrustation, sediment, deposit and difficulties in chlorination for disinfections of water⁹. In the present studies the pH values in all the samples range from 7.10-9.00, which are all within the limit. Saline nature of the water manifests itself in high electrical conductivity (EC) values of the samples which range from 440 $\mu\text{S}/\text{cm}$, the lowest at Lunwa to as high as 11500 $\mu\text{S}/\text{cm}$, at Phulera. EC is strongly dependent on temperature and therefore, EC of water samples measured at various temperatures have to be corrected for 25°C.

Alkalinity in the ground water of the region caused by bicarbonate as carbonates values in all the samples ranges from 8.5 mg/lit. to 7.5 mg/lit.

Chloride concentrations in most of the samples were higher than highest desirable level i.e. 200 mg/lit., by ICMR; yet these values are well below the maximum permissible limits i.e. 5000 mg/lit. High chloride ion concentration indicate organic pollution.

Table 1. Physico-chemical analysis of groundwater at Sambhar lake city and its adjoining areas

S. No.	pH	EC ($\mu\text{S}/\text{cm}$)	Cl ⁻	CO ₃ ²⁻	HCO ₃ ⁻	TDS	Ca ²⁺	Mg ²⁺	SO ₄ ²⁻	Na ⁺	K ⁺	NO ₃ ⁻	
1	Sambhar lake-I	7.80	2880	720	300	1440	3200	430	370	240	176	115	404
2	Sambhar lake-II	8.00	1640	410	350	920	2000	290	250	132	150	110	138
3	Sambhar lake-III	8.20	5680	1420	370	2640	4800	850	710	172	178	120	450
4	Sambhar lake-IV	7.80	4240	1060	200	2020	3600	370	560	540	160	117	404
5	Sambhar lake-V	8.10	5600	1400	150	2700	3900	800	700	150	177	120	425
6	Sambhar lake-VI	8.00	1800	450	250	800	2500	250	240	135	110	100	135
7	Sambhar lake-VII	8.20	6000	1500	100	2900	2500	860	730	100	179	122	440
8	Sambhar lake-VIII	7.90	5800	1450	NT	2800	2800	850	750	250	178	120	500
9	Sambhar lake-IX	8.21	3600	900	200	1700	4500	800	790	450	175	115	400
10	Sambhar lake-X	7.90	8100	2347	170	190	NT	NT	NT	NT	NT	NT	648
11	Sambhar lake-XI	8.00	4600	1050	270	293	2825	72	142	110	120	NT	691
12	Phulera-I	7.80	11500	3106	150	200	4900	70	150	120	100	NT	17
13	Phulera-II	8.50	1720	227	24	439	994	30	53	90	100	80	36
14	Phulera-III	8.00	560	140	200	450	1440	50	30	100	110	90	28
15	Phulera-IV	8.20	600	150	NT	400	1400	120	140	260	105	97	90
16	Lunwa-I	9.00	1890	319	96	281	1000	18	21	80	85	60	1
17	Lunwa-II	8.50	440	35	12	185	233	32	21	80	88	65	10
18	Lunwa-III	7.05	2200	7084	NT	200	NT	NT	NT	NT	NT	NT	6
19	Kajipura	7.10	5870	161	200	525	500	92	168	100	105	98	85
20	Chocla	7.05	8400	2127	150	250	NT	NT	NT	NT	NT	NT	1102
21	Devwani	7.10	10900	3765	250	300	NT	NT	NT	NT	100	NT	6
22	Irolav-I	7.90	820	180	170	500	2000	50	50	140	98	88	138
23	Irolav-II	8.20	960	190	190	450	2500	70	110	140	110	69	145
24	Irolav-III	8.00	990	200	200	305	2300	100	140	170	163	70	170
25	Irolav-IV	7.10	1260	220	170	305	730	32	21	36	NT	83	49
	Max. value	8.50	11500	3765	370	2900	4900	860	790	540	179	120	1102
	Min. value	7.05	440	35	12	185	233	18	21	36	85	65	1

(All values are in mg/lit. except pH and EC)

NT = Not tested

Sodium is also very high ranging from 50 mg/lit. i.e. from 1400 mg/lit, Phulera. to 1100 mg/lit., Lunwa. Total dissolved solid varies from 233 mg/lit. to 4900 mg/lit.. Hardness is an important factor for domestic as well as industrial purpose. I.C.M.R. set highest desirable level for total dissolved solid as 300 mg/lit..

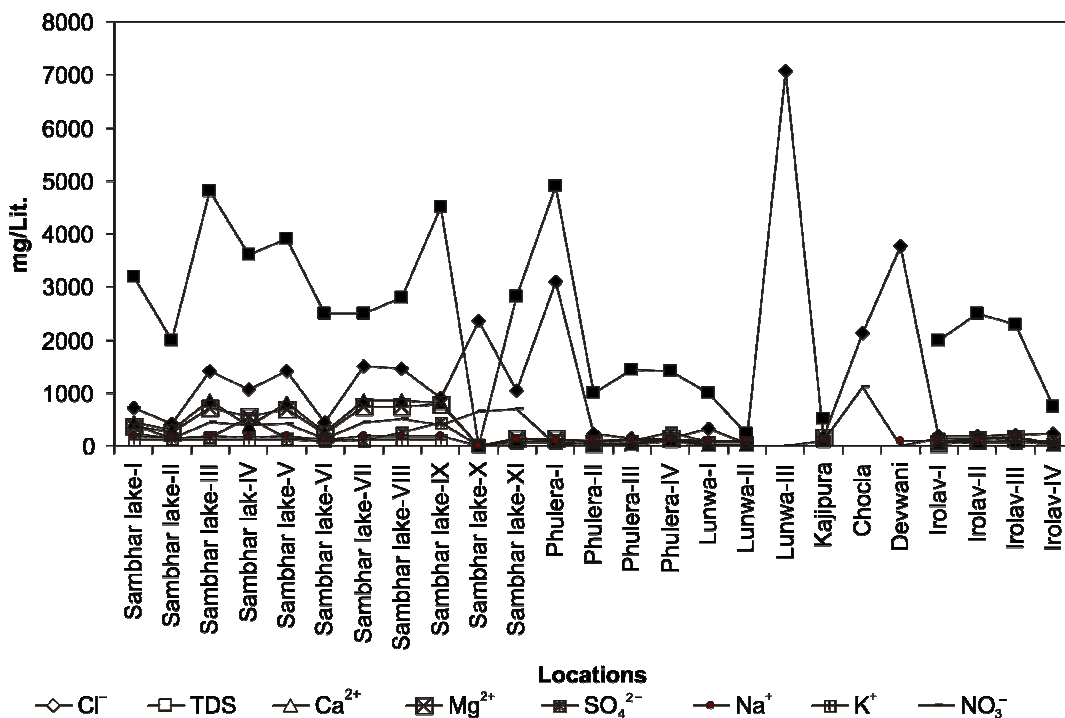


Fig. 1 : Comparative graphical representation of analytical results of ground water at Sambhar lake city and its adjoining areas

Magnesium is a beneficial metal but it is toxic at higher concentrations. Magnesium hardness associated with sulphate ion has laxative effect on persons not accustomed to it. Calcium is also essential for healthy growth of bones and plays an important role in biological systems. Most of the samples have high magnesium values, while calcium ion in most of the samples is below highest desirable levels (75 mg/lit.). Magnesium ion ranges from 30 mg/lit. to 790 mg/lit.. (Highest desirable level of magnesium by I.C.M.R. is 100 mg/lit., and for sulphate, it is less than 200 mg/lit.).

Sulphate in most of the samples was found to be lower than highest desirable level i.e. 200 mg/lit.. It can be concluded from the results that the groundwater in Sambhar lake

city and its adjoining areas possess higher values of total dissolved solids, chloride ion concentration, sodium ion concentration etc. Though none of these factors pose any serious health hazards, yet these degrade quality of groundwater and therefore, required to be treated.

The work is in progress to relate these parameters to environmental factors as well as geomorphology of the area.^{3,11}

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