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Seasonal Variation in Water Quality Index of Ground Water of Osian Region, Jodhpur India

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Abstract

The present study is carried out to assess the water quality index (WQI) for the ground water of Osian Region of Jodhpur district to examine the suitability of water for drinking and irrigation purposes. For this, ten water samples were collected during pre-monsoon and post-monsoon seasons in the month of June and November 2013 respectively. The samples were analyzed for the physico chemical parameters like pH, Conductivity, total dissolved salts (TDS), total hardness (TH), calcium, magnesium, nitrate, chloride, sulphate, etc. Water quality index provides a single number to express the overall quality of water at a certain location and time based on several water quality parameters. WQI help us to convert the complex water quality data in to simple information which can be understandable and useable by the public. The value of water quality index obtained in present study ranges from 68.9 to 146.3 in pre monsoon and 64.8 and 143.5 in post monsoon seasons respectively.

Keywords: *Water quality, water quality index, Osian region, physico-chemical analysis.*

1. Introduction

Water, a precious or priceless gift provided by nature to human being, is going to be polluted day-by-day. Although three-fourth part of earth is being surrounded by water, but a little portion of it can be used for drinking purpose. Global environmental pollution has become a severe problem now days. Most of this concern is focused on to increasing population, urbanization, rapid industrial development and excessive use of fertilizers and pesticides the quality of water is dwindling day by day. Therefore the purification and supply of fresh and safe water has become a great challenge. Therefore it is necessary to obtain precise and appropriate information to observe the quality of any water resources and the development of some useful tools to keep watch on the quality of such priceless water resources to retain their excellence for various uses .Water quality plays an important role in maintaining the health of mankind and ecosystem. The quality of ground water can be assessed by different physico-chemical parameters. There may be a change in the quantity of parameters due to different types of pollution, seasonal variation, etc. thus a regular monitoring of water is required to minimize the pollution and have control on the pollution-caused agents
WQI indicates is a single number like a grade. it can be used to express the overall quality of water at a certain area and time. It is based on several water quality parameters. WQI reflects a composite influence of contributing factors on the quality of water. Water quality index is one of the most effective tools to monitor the surface as well as ground water pollution and can be used efficiently in the implementation of water quality upgrading programmes. The objective of an index is to transform a large water quality data into single number which represents overall quality of water. Water quality index was first formulated by Horton (1965) and later on used by several workers for the quality assessment of different water.
Water quality index was calculated by taking important physico chemical parameters using ICMR and ISI standards. Following formula is used-

$$WQI = \sum_{i=1}^{n} q_i w_i \; / \; \sum_{i=1}^{n} w_i$$

q_i = Quality rating n^{th} parameter

Where w_i = unit weight factor given by formula

$$w_i = K / S_i$$

S_i = Standard value of i^{th} parameter

K = Proportionality constant

w_i = unit weight assigned for all the chosen parameters is given in table -5

Quality rating q_i is determined by following formula (For pH and DO ONLY)

$$Q_{pH\ or\ DO} = \frac{(V_I - V_{10})}{(S_i - V_{10})} \times 100$$

Where as for other parameters it is :-

$$Q_i = \frac{V_I}{S_i} \times 100$$

q_i = Quality rating for Standard value of n^{th} Water quality parameter

V_i = Estimated value for n^{th} parameter at the given station

S_i = Standard permissible value for n^{th} parameter

V_{10} = Ideal value for n^{th} parameter in pure water

All the Ideal values V_{10} are taken as zero for drinking water except pH= 7.0 and DO= 14.6 mg/L.

For computing the WQI, the S_i is first determined for each chemical parameter, which is then used to determine the WQI as per the following equation

$$S_i = W_i \times q_i$$
$$WQI = \sum_n S_i$$

Fig-1 Map of Osian

2. Study Area

The Osian tehsil of Jodhpur district is situated at a distance of about 58 kms to the north-west of Jodhpur city. It stretches between 26°25' and 27°05' north latitude and 72°30' and 73°20' east longitude. It has geographical area of about 4280.40 Sq.km The place is famous for its sixteen brahmnical and Jain temples, most of which are in ruins,

It is famous for 'Sachiyay Mata' temple.The depth of ground water in the area ranges form 10.87 m (Gangani) to 102.10m (Palli). Osian has 134 inhabited villages having a total population of about 0.5 lac. In this tehsil no urban sector exists. The economy of the area is basically agro-based. The area is having sandy soil. Extreme temperatures characterize the climate of the area and dryness. The temperature varies from 28° to 50°C in summer and 1°-15°C in winter. In summer strong winds blow with dust and sand.

The average annual rainfall in the area is about 32 cm. The forestry reserves in the area are very poor due to scanty rainfall and scarcity of groundwater reserves. The main hydrogeological formation of the block is Bilara lime stone (Marwar Super Group)..Map of Osian is shown in Fig-1

3. Methods and Materials

Twenty water samples were collected in clean and sterilized plastic bottles form the different areas of Osian region their locality are given in the Table- 1.

The samples were collected within the distance of 5-6 km. in the Osian region. The reagents used for the analysis were AR grade and double distilled water was used for preparation of solutions. Physicochemical parameters pH, electrical conductivity (EC), total solids (TS), total dissolved solids (TDS), dissolved oxygen (DO), total alkalinity (TA), total hardness (TH), calcium (Ca^{+2}), magnesium (Mg^{+2}), sodium (Na^{+}), chloride (Cl^{-}), nitrate (NO_3^{-}), etc. were determined in the laboratory as per standard procedure[2,4.]

The parameters estimated and the methods used are given in Table 2.The results are recorded in Table -3 and Table - 4 for pre and post monsoon seasons respectively.

Table 1: Sample detail

S. No.	*Source*	*Type*	*S. No.*	*Source*	*Type*
1	Ujaliya,	Ow	6	Simardha baba ki samadhi,Osian	Tw
2	Oochiyara panchatat samiti,Osian	Ow	7	Vidhyalaya,Osian	Ow
3	Ghatinav,Osian	Tw	8	Pashu mela maidan,Osian	Tw
4	Devka bera,Osian	Ow	9	Shri sachiyaya mat athiti grah,Osian	Tw
5	Sirmandi (Birjaram singada),Osian	Tw	10	Mataji mandir road ,Osian	Hp

Tw – Tube well , Ow- Open well

Table 2: Methods used for estimation of physico-chemical parameters

S.No.	*Parameters*	*Method*
1.	pH	pH Metry
2.	Total dissolved solids	Filtration method
3.	Dissolved oxygen	Iodometric method
4.	Total hardness	EDTA method
5.	Calcium	EDTA method
6.	Magnesium	EDTA method
7.	Sulphate	Turbidimetric Method
8.	Chloride	Silver nitrate method
9.	Nitrate	Spectrophotometric method

Table 3: Physico - chemical characterization of some water samples of Osian (pre - monsoon)

S. No.	*Sample No.*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1.	pH	8.2	8.1	8.1	7.5	8.0	7.3	7.8	7.8	7.4	8.0
2.	TH	490	970.0	160	460	240	270	330	220	190	1080.0
3.	TDS	3000	4290.0	950	1716	1300	1063	1386	1130	1148	4150.0
4.	Ca	84	108.0	44	96	44	68	76	36	28	116.0
5.	DO	6	5.6	5	6	6	4.9	6.2	6.5	6.1	5.9
6.	Mg	67	168.0	12	53	31	24	33.6	31.2	28.8	189.6
7.	Cl	1030	1460.0	200	580	480	260	360	260	270	1230.0
8.	NO_3	100	60.0	25	45	25	60	137.5	25	40	20.0
9.	SO_4	314	384.6	259	102	173	47.1	39.25	54.95	54.95	282.6

Table 4: Physico - chemical characterization of some water samples of Osian (post - monsoon)											
S. No.	***Sample No.***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***
1.	pH	8.1	8.0	7.9	7.3	7.9	7.1	7.6	7.4	7.2	7.8
2.	TH	410	890.0	130	400	200	230	290	190	160	890.0
3.	TDS	2620	4125.0	607	1597	1210	990	1353	977	1069	4000.0
4.	Ca	80	80.0	36	80	36	52	68	32	20	104.0
5.	DO	5.9	5.3	5.1	5.7	5.6	4.7	6.0	6.3	5.9	5.8
6.	Mg	50	165.6	10	48	26	24	28.8	26.4	26.4	151.2
7.	Cl	990	1400.0	170	500	410	210	320	230	230	1120.0
8.	NO3	1	0.8	1	1	1	0.6	0.6	0.9	1	1.3
9.	SO4	275	368.9	235	86	157	39.25	23.55	39.25	47.1	266.9

Table 5:: Drinking water standards recommending agencies and unit weights				
S. No.	***Parameter***	***Standards (S_i)***	***Recommending Aagencies***	***Unit Weight (W_i)***
1.	pH	6.5-8.5	ICMR and ISI	0.2190
2.	TDS	500	ICMR and ISI	0.003708
3.	Dissolved Oxygen	0.5	ICMR	0.370
4.	Total Hardness	500	ICMR and ISI	0.00618
5.	Calcium	75	ICMR and ISI	0.024720
6.	Magnesium	30	ICMR and ISI	0.0618
7.	Chloride	250	ICMR and ISI	0.007416
8.	Nitrate	45	ICMR and ISI	0.0412
9.	Sulphate	150	ICMR and ISI	0.012360
			$\sum W_i =$	0.746384

The computed WQI values are classified into five types, “excellent water” to “Water, unsuitable for drinking

Table 6: Water quality based on WQI value	
WQI	***Water Quality***
< 50	Excellent
50-100	Good water
100-200	Poor water
200-300	Very poor water
> 300	Water unsuitable for drinking

4. Result and Discussion

The computed water quality index alues are give in table 7 and 8 for pre and post monsoon season respectively.

Table 7: Water quality index and water quality in Osian region (Pre –monsoon) $W_i q_i$

S. No.	*Parameter*	*Sample No.*									
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1.	pH	17.520	16.060	16.644	7.300	14.600	4.380	10.950	11.096	5.256	13.870
2.	TH	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.	TDS	1.009	1.998	0.330	0.948	0.494	0.556	0.680	0.453	0.391	2.225
4.	Ca	2.225	3.181	0.705	1.273	0.964	0.788	1.028	0.838	0.851	3.078
5.	DO	2.769	3.560	1.450	3.164	1.450	2.241	2.505	1.187	0.923	3.823
6.	Mg	40.083	34.688	36.229	33.531	33.917	37.385	32.375	31.219	32.760	33.531
7.	Cl	13.843	34.608	2.472	10.877	6.427	4.944	6.922	6.427	5.933	39.058
8.	NITRATE	5.092	7.218	0.989	2.868	2.373	1.285	1.780	1.285	1.335	6.081
9.	SULPHATE	9.156	5.493	2.289	4.120	2.289	5.493	12.589	2.289	3.662	1.831
	$W_i q_i$	93.64	109.18	62.71	64.71	63.58	57.37	69.07	55.13	51.45	105.24
	WQI =	125.5	146.3	84.0	86.7	85.2	76.9	92.5	73.9	68.9	141.0
		Poor	Poor	Good	Good	Good	Good	Good	Good	Good	Poor

Table 8: Water quality index and water quality in Osian region (Post monsoon) $W_i q_i$

S. No.	*Parameter*	*Sample No.*									
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1.	pH	16.060	14.600	13.140	4.380	13.140	1.460	8.760	5.840	2.920	11.680
2.	TH	0.845	1.833	0.268	0.824	0.412	0.474	0.597	0.391	0.330	1.833
3.	TDS	1.943	3.059	0.450	1.184	0.897	0.734	1.003	0.725	0.793	2.966
4.	Ca	2.637	2.637	1.187	2.637	1.187	1.714	2.241	1.055	0.659	3.428
5.	DO	33.531	35.844	36.615	34.302	34.688	38.156	33.146	31.990	33.531	33.917
6.	Mg	10.382	34.114	1.978	9.888	5.438	4.944	5.933	5.438	5.438	31.147
7.	Cl	4.895	6.922	0.840	2.472	2.027	1.038	1.582	1.137	1.137	5.537
8.	NITRATE	6.867	5.036	1.831	3.662	1.831	5.036	11.444	1.831	3.204	1.602
9.	SULPHATE	2.264	3.040	1.940	0.711	1.294	0.323	0.194	0.323	0.388	2.199
	Wi qi=	79.42	107.08	58.25	60.06	60.91	53.88	64.90	48.73	48.40	94.31
	WQI =	106.4	143.5	78.0	80.5	81.6	72.2	87.0	65.3	64.8	126.4
		Poor	Poor	Good	Good	Good	Good	Good	Good	Good	Poor

5. Conclusion

The value of water quality index obtained in the study are of Osian region ranges from 68.9 to 146.3 in pre monsoon and 64.8 and 143.5 in post monsoon seasons respectively. The water quality of regions Ujaliya, Oochiyara panchatat samiti,Osian and Mataji mandir road ,Osian was found poor and in the areas Ghatinav, Devka bera, Sirmandi (Birjaram singada), Simardha baba ki samadhi, Vidhyalaya, Pashu mela maidan, Shri sachiyaya mat athiti grah, the water quality was found good. The

water from these sites is suitable for drinking purpose and human consumption. Water quality ranges from WQI values greater than 100 shows poor water quality. The high values of WQI have been found mainly due to higher values of TDS, TH, Cl^- and SO_4^{2-} in ground water. The ground water from these sampling points needs some degree of treatment before consumption. It also requires some precautionary steps to protect these sites from possible contamination. The water from these sites is unfit for drinking purpose.

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