IJARSE, Vol. No.4, Issue No.01, January 2015 ISSN-2319-8354(E)

ASSESSMENT OF WATER QUALITY INDEX OF GROUND WATER OF OSIAN TEHSIL, JODHPUR (RAJ.) INDIA

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ABSTRACT

Water quality index is a single number by which the overall quality of water can be expressed. The water quality is classified as excellent, good, poor, very poor and unsuitable for drinking. In this work, an attempt has been made to develop the water quality index (WQI) for the ground water of Osian tehsil of Jodhpur district (Raj.), to assess the suitability of water for drinking purposes.

For this, Twenty water samples were collected from the different areas of Osian tehsil in the month of November 2013 to February 2014. The samples were analyzed for the physico-chemical parameters like pH, Conductivity, total dissolved salts (TDS), total alkalinity (TA), total hardness (TH), Calcium, Magnesium, Nitrate, Chloride, Sulphate, fluoride, sodium etc. The obtained WQI ranges between 60.66 and 331.85. The obtained values were compared with drinking water quality standards prescribed by ICMR & ISI standards to rank as suitability.

Key Words: Ground Water, Osian Tehsil, Physico-Chemical Analysis, Water Quality, Water Quality Index.

I INTRODUCTION

Water is a precious compound available on earth. It is essential for the survival of all living organisms. Without water life is not possible. Ground water is a good source of fresh water available on the earth. It is the important renewable resource having several inherent advantages over surface water (1). It is necessary to analyze the quality of water not only for present but also for future consumption (2). Water should be clean, odorless, colorless and free from disease producing bacteria. Though three-fourth part of earth is being surrounded by water, a little portion of it can be used for drinking purpose. In India there are enormous number of natural and manmade water bodies which can be used for various purposes, like drinking and agriculture etc. However, in recent years due to rapid urbanization, industrialization and modern agricultural activities, the quality of water bodies deteriorated causing environmental hazards [3]. Environmental pollution has become a severe problem now days. Most of this concern is focused on quality of water because it plays an important role in maintaining the health of man kind and ecosystem. Water quality is used for describing the condition of the water, including its chemical, physical and biological characteristics, with respect to its suitability for various purpose (i.e., drinking, agriculture, swimming or fishing), [8,9, and 10]. Water quality index (WQI) is a metric to describe the quality of water as a number. In this work, WQI is calculated for Osian Region of Jodhpur district.

Jodhpur district forms part of Great Thar Desert of Rajasthan. In this arid region, there are sand dunes, alluvial areas dotted with few hillocks and hill chains scattered in the 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).

Fig: 1

II METHODS AND MATERIALS

To evaluate the water quality index, 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-1and the map of region is indicated by fig 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 dissolved solids (TDS), total alkalinity (TA), total hardness (TH), calcium (Ca^{+2}), magnesium (Mg^{+2}), sodium (Na^{+}), chloride (Cl^{-}), nitrate (NO_3^{-}),fluoride and sulpahte etc. were determined in the laboratory as per standard procedure[5,6.] The parameters estimated and the methods used are given in Table 2.The results are recorded in Table-3. For the calculations of Water Quality Indices the

standards prescribed by WHO were used. WQI of 20 different samples of Osian region was calculated by the method proposed by "Horton"

TABLE- 1: Description of Sources of Water Sample

S. No.	Source	Type	S. No.	Source	Type
1.	Ujaliya	Ow	11	Simardha baba ki samadhi,forest dept,Osian	Tw
2.	Oochiyara panchatat samiti,Osian	Ow	12	Ashok kumar mali ,Geeta dham road, Tiwari	Ow
3.	Ghatinav,Osian	Tw	13	agdish mali ,Geeta dham road Tiwari	Ow
4.	Devka bera,Osian	Ow	14	Sohan sankhla Tiwari	Ow
5.	Sirmandi (Birjaram singada),Osian	Tw	15	Sanwar ram ji mali Tiwari	Ow
6.	Simardha baba ki samadhi,Osian	Tw	16	Pepa ram ji mali,geeta dham road Tiwari	Ow
7.	Vidhyalaya,Osian	Ow	17	Pukhraj cOwdhry Tiwari	Ow
8.	Pashu mela maidan,Osian	Tw	18	Sunil kumar siyol, Geeta dham road Tiwari	Ow
9.	Shri sachiyaya mat athiti grah,Osian	Tw	19	Phed ,Bijariya bawari road Tiwari	Ow
10.	Mataji mandir road ,Osian	Hp	20	Handpump Tiwari	Hp

Tw – Tube well , Ow- Open well , Hp= Hand pump

Table 2: Methods Used for Estimation of Physico-Chemical Parameters

S. No.	Parameters	Method
1.	pH	pH Metry
2.	Electrical conductivity	Conductometry
3.	Total dissolved solids	Filtration method
4.	Total alkalinity	Titration method
5.	Total hardness	EDTA method
6.	Calcium	EDTA method
7.	Magnesium	EDTA method
8.	*Sodium*	Flame photometric method
9.	Chloride	Silver nitrate method

10.	**Nitrate**	**UV-Vis Spectrophotometry method**
11.	**Fluoride**	**Ion Selective electrode method**
12.	**Sulphate**	**UV Spectrophotometry method**

TABLE 3: PHYSICO-CHEMICAL PARAMETERS

Sample No.	*pH*	*EC*	*TDS*	*TA*	*TH*	Ca^{2+}	Mg^{2+}	*Na*	Cl^{-}	NO_3^{-}	*F*	SO_4^{2-}
1	**8.2**	**5000**	**3000**	**540**	**490**	**84**	**67.2**	**350**	**1030**	**100**	**1.0**	**313.97**
2	**8.1**	**6500**	**4290**	**570**	**970**	**108**	**168**	**250**	**1460**	**60**	**0.9**	**384.62**
3	**8.1**	**1050**	**950**	**430**	**160**	**44**	**12**	**300**	**200**	**25**	**1.1**	**259.03**
4	**7.5**	**2600**	**1716**	**360**	**460**	**96**	**52.8**	**600**	**580**	**45**	**1.0**	**102.04**
5	**8.0**	**2300**	**1300**	**380**	**240**	**44**	**31.2**	**320**	**480**	**25**	**1.6**	**172.68**
6	**7.3**	**1610**	**1063**	**360**	**270**	**68**	**24**	**300**	**260**	**60**	**0.9**	**47.1**
7	**7.7**	**2100**	**1386**	**390**	**330**	**76**	**33.6**	**250**	**360**	**137.5**	**0.7**	**39.25**
8	**7.7**	**1620**	**1130**	**380**	**220**	**36**	**31.2**	**210**	**260**	**25**	**1.1**	**54.95**
9	**7.3**	**1740**	**1148**	**450**	**190**	**28**	**28.8**	**300**	**270**	**40**	**1.2**	**54.95**
10	**7.9**	**7600**	**4150**	**530**	**1080**	**116**	**189.6**	**990**	**1230**	**20**	**1.7**	**282.57**
11	**7.8**	**1685**	**1070**	**390**	**150**	**24**	**21.6**	**210**	**230**	**75**	**0.8**	**117.74**
12	**8.18**	**820**	**490**	**190**	**210**	**44**	**24**	**240**	**180**	**50**	**1.5**	**80**
13	**7.28**	**860**	**568**	**210**	**200**	**44**	**21.6**	**210**	**170**	**60**	**0.7**	**15.7**
14	**7.26**	**790**	**470**	**230**	**180**	**36**	**21.6**	**130**	**160**	**50**	**0.5**	**20**

15	**7.43**	**950**	**600**	**200**	**190**	**44**	**19.2**	**140**	**170**	**30**	**0.4**	**60**
16	**7.32**	**880**	**581**	**180**	**250**	**32**	**40.8**	**120**	**170**	**60**	**0.4**	**80**
17	**7.54**	**900**	**594**	**180**	**210**	**24**	**36**	**130**	**190**	**45**	**0.6**	**100**
18	**7.2**	**950**	**627**	**210**	**230**	**32**	**36**	**140**	**190**	**50**	**0.4**	**78**
19	**7.41**	**680**	**449**	**170**	**240**	**80**	**9.6**	**200**	**150**	**12.5**	**0.4**	**23.55**
20	**7.54**	**690**	**455**	**180**	**430**	**132**	**24**	**260**	**180**	**15**	**0.4**	**120**

III EXPERIMENTAL SETUP

Water quality index is a metric to define quality of water through a single number. It can be defined as a rating or grade which is used to reflect the composite influence of different water quality parameters in overall 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 program.

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 researchers for evaluation or expression of the quality of water. For the determination of WQI three steps were carried out. For computing WQI, physico chemical parameters like pH, electrical conductivity, total dissolved solids, dissolved oxygen, total alkalinity, total hardness, calcium, magnesium, sodium, chloride, fluoride, nitrate and sulphate were selected

Step 1: First of all, each parameter has been assigned a weight (wi) according to it's relative importance in overall quality of water for drinking purpose. These weights range from 1 to 5 depending on the collective expert opinions taken from different previous studies. Maximum weight 5 is assigned to the parameter nitrate because of its mojor importance in water quality assessment. Minimum weight 1 is assigned to Magnesium because it is not harmful. The weights for the remaining parameters have been assigned according to their relative importance in the drinking water.

Step 2. In the Second step relative weight was calculated

$$RW = \frac{AW_i}{\sum_{i=1}^{n} AWi}$$

Where

RW= Relative weight

AW= Assigned weight of each parameter

n = the number of parameters.

The calculated relative weight (*RW*) values of each parameter are given in table -3

Step 3 : In the **third step**, Quality rating q_i is determined by using following formula (For pH and DO only)

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

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

Finally for computing the WQI, the value of sub indices (SI_i) is first determined for each chemical parameter, which is then used to determine the WQI as per the following equation

$$SI_i = RW \times q_i$$

$$WQI = \sum_{i=1}^{n} SI_i$$

The computed WQI values are classified into five types, "excellent water" to "Water, unsuitable for drinking". are given in Table 4.

TABLE 4: RELATIVE WEIGHT OF PHYSICO-CHEMICAL PARAMETERS

S. No.	Parameter	WEIGHT W_I	RELATVE WEIGHT	IS 10500-91	IDEAL VALUE
1	pH	4	0.1026	8.5	7.0
2	EC	4	0.1026	1400	0
4	TDS	4	0.1026	500	0
6	TA	2	0.0513	200	0
7	TH	2	0.0513	300	0
8	Ca^{2+}	2	0.0513	75	0
9	Mg^{2+}	1	0.0256	30	0
10	Na^{+}	2	0.1026	200	0

11	Cl^-	**3**	**0.0769**	**250**	**0**
12	NO_3^-	**5**	**0.1282**	**45**	**0**
13	F^-	**4**	**0.1026**	**1.5**	**0**
14	SO_4^{2-}	**4**	**0.1026**	**150**	**0**
		$\sum W_i = 39$	$\sum W_i = 1.000$		

TABLE 5: 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**

IV RESULT AND DISCUSSION

pH- The pH value of natural water changes due to biological activity and industrial contamination. The pH values of present investigation were found in the range 8.7- 9.9. Which is comparatively higher than WHO standard (7.0-8.5).

EC-The electrical conductivity for all the sample studies in all the areas has been ranging from 4.98-55.68 µS/cm.

TDS- The TDS values of research area was found ranging from 9.2 – 88 mg/L .

Nitrate – water containing more than 45 mg/l has been reported to cause methemoglobemia in infants. The high level of these ions may be attributed to the discharge of wastewater from domestic activities and hazardous waste of Industries. Nitrate values are within the WHO limits ranging from 3.6-39 mg/L.

Sulphate – According to WHO the desirable value of sulphate is 200 mg/L. Sulphate ions do not affect the taste of water, if present in low concentrations. The sulphate ion concentration in the present study is varied 1.07- 26.0 mg/L.

Fluoride – The concentration of fluoride ion present in water is higher and low, then various problems are arises in human, animal and plants and also it a source of water pollution.

The concentration of fluoride in the present study varied 2.7- 12 mg/L which is beyond the permissible limit of WHO standard.

TABLE 6: EVALUATION OF PHYSICO-CHEMICAL PARAMETERS FOR SAMPLE

S.No.	pH	EC	TDS	TA	TH	Ca^{2+}	Mg^{2+}	Na	Cl	NO_3^-	F^-	SO_4^{2-}	WQI
1	9.89	36.63	61.54	13.85	8.38	5.74	5.74	17.95	31.69	28.49	6.84	21.47	248.21
2	9.77	47.62	88.00	14.62	16.58	7.38	14.36	12.82	44.92	17.09	6.15	26.30	305.62
3	9.82	7.69	19.49	11.03	2.74	3.01	1.03	15.38	6.15	7.12	7.52	17.71	108.69
4	9.05	19.05	35.20	9.23	7.86	6.56	4.51	30.77	17.85	12.82	6.84	6.98	166.72
5	9.65	16.85	26.67	9.74	4.10	3.01	2.67	16.41	14.77	7.12	10.94	11.81	133.74
6	8.81	11.79	21.81	9.23	4.62	4.65	2.05	15.38	8.00	17.09	6.15	3.22	112.81
7	9.35	15.38	28.43	10.00	5.64	5.20	2.87	12.82	11.08	39.17	4.79	2.68	147.42
8	9.36	11.87	23.18	9.74	3.76	2.46	2.67	10.77	8.00	7.12	7.52	3.76	100.21
9	8.88	12.75	23.55	11.54	3.25	1.91	2.46	15.38	8.31	11.40	8.21	3.76	111.39
10	9.59	55.68	85.13	13.59	18.46	7.93	16.21	50.77	37.85	5.70	11.62	19.32	331.85
11	9.41	12.34	21.95	10.00	2.56	1.64	1.85	10.77	7.08	21.37	5.47	8.05	112.49
12	9.87	6.01	10.05	4.87	3.59	3.01	2.05	12.31	5.54	14.25	10.26	5.47	87.27
13	8.78	6.30	11.65	5.38	3.42	3.01	1.85	10.77	5.23	17.09	4.79	1.07	79.35
14	8.76	5.79	9.64	5.90	3.08	2.46	1.85	6.67	4.92	14.25	3.42	1.37	68.09
15	8.97	6.96	12.31	5.13	3.25	3.01	1.64	7.18	5.23	8.55	2.74	4.10	69.05
16	8.83	6.45	11.92	4.62	4.27	2.19	3.49	6.15	5.23	17.09	2.74	5.47	78.45
17	9.10	6.59	12.18	4.62	3.59	1.64	3.08	6.67	5.85	12.82	4.10	6.84	77.07
18	8.69	6.96	12.86	5.38	3.93	2.19	3.08	7.18	5.85	14.25	2.74	5.33	78.43
19	8.94	4.98	9.21	4.36	4.10	5.47	0.82	10.26	4.62	3.56	2.74	1.61	60.66
20	9.10	5.05	9.33	4.62	7.35	9.03	2.05	13.33	5.54	4.27	2.74	8.21	80.61

V CONCLUSION

On the basis of the above discussion, it may be concluded that, The water quality index of sample 12, 13,14,15,16,17,18,19,20 was found "good". The poor WQI values were found for sample no. 3,4,5,6,7,8,9,11. The water quality index of sample no. 1 was found very poor and sample no. 2 and 10 are not suitable for drinking. So highest priority should be given to water quality monitoring and there indigenous technologies

should be adopted to make water fit for domestic and drinking purpose after treatment.

REFERENCES

[1] Sinha, S. K., 1945. Potability of some rural pond water at Muzaffarpur, Bihar. A note of water quality index. J.Pollution Research. 14(1): 135-140.

[2] Kotadiya, N. G., Acharya, C.A., Radadia, B. B.,and Solanki,H.A., 2013. Determination of Water Quality Index and Suitability of a Rural Freshwater Body in Ghuma Village, District hmedabad, Gujarat. Life Sciences Leaflets 2:68-75.

[3] Bhadja, P., and Vaghela, A., 2013. Status of River water quality of Saurashtra, Gujarat, India.International Journal of Advanced Biological Research. 3(2): 276-280.

[4] Horten RK (1965). An Index number for rating water quality. J. Water Poll. Cont. Fed. 37(3): 300-306.

[5] APHA, Standard Methods for the Examination of Water and Waste Water, American Public Health Association, Washington, DC, 17th Ed. (1989).

[6] N. Manivaskam, Physicochemical Examination of Water Sewage and Industrial Effluent. Pragati Prakashan Meerut, 5th Ed. (2005).

[7] C. R. Ramakrishnaiah, C. Sadashivaiah and G. Ranganna, E. J. Chem., 6(2), 523-530 (2009). Diersing N. 2009. Water Quality: Frequently Asked Questions. Florida Keys