iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** II **Month of publication:** February

DOI: http://doi.org/10.22214/ijraset.2019.2090

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue II, Feb 2019- Available at www.ijraset.com

Assessment of Water Quality Index of Groundwater of Panchkula & Derabassi Region

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Abstract: Water quality of groundwater is getting deteriorated due to the percolation of polluted water in to the soils from the wastewater drains, polluted rivers and ponds making it unsuitable for drinking and other purposes. Evaluation of the groundwater quality is gaining attention now days. In the present study, groundwater quality of the Derabassi and Panchkula region along Ghaggar is being studied. Water quality index was calculated for the sample and it was observed that out of the twenty samples collected, three samples collected adjacent to the river have poor water quality and as the distance increase between the river and sampling sites the quality of water improves. Around six of the samples sites water qualities were on the verge of poor quality of WQI.
Keywords: Water quality Index, water quality, groundwater, drinking water

I. INTRODUCTION

Water is the most important natural resource of any country. Water plays a vital role in the living organism and is essential for survival of all the living organisms. In India, maximum population depends on groundwater for drinking purpose. Groundwater term is for the subsurface water beneath water table in soils and geologic formation that are fully saturated.. Ground water plays a vital role in the development of arid and semi-arid zones. It is believed to be comparatively much clean and free from pollution than surface water.

The average level of groundwater development in India is 32%, although some states have exploited their resources to a much greater extent (94% in Punjab, 84% in Haryana, 60% in Tamil Nadu, 64% in Lakshadweep, 51% in Rajasthan). 85% of ground water extracted is used for irrigation purposes and 15% for Industrial and domestic purposes. Reciprocally, as much as 70 to 80% of India's agricultural output may be groundwater dependent The groundwater quality depends on large number of things like recharge water composition, water and soil interaction, and residence time and reactions that occur within the aquifer (Freeze and Cherry, 1979; Appelo and Postma, 2005). It is estimated that 80% of domestic needs in rural areas and 50% in urban areas is met by groundwater. Quality of groundwater is affected by various natural and anthropogenic activities. Undesirable groundwater quality restrains the in living conditions of rural people.

Therefore, it has become essential for organized assessment and monitoring of groundwater quality to examine its appropriateness for drinking and to adopt suitable measures for protection. Water quality index (WQI) plays one of the most useful approaches to correspond quality of any water.

The WQI is a mathematical equation used to transform large numbers of water quality data into a single number (Stambuk, 1999). It helps in understanding of water quality issues by integrating complex data and generating a score that better describes water quality status to policy makers (Reza and Singh, 2010).

WQI is a dimensionless number that combines multiple water-quality factors into a single number by normalizing values to subjective rating curves The area under investigation is a rural where residents depend on groundwater for drinking and domestic purposes. The objective of this paper is to consider the suitability of groundwater for human consumption based on compliance of physicochemical data with reference to drinking water standards and computed WQI values. (Miller *et al*., 1986)

A. *Study Area*

The present study had been conducted on groundwater of area along the river Ghaggar. River originates in the outer Himalayas & flows through state of Haryana, Punjab and Rajasthan. Its water is used for multiple purposes.

During its course of flow it receives discharge from various cities and runoff from agricultural lands. In the study water samples were collected from groundwater along the river from Derabassi, Punjab and Panchkula Haryana for studying the physicochemical parameters.

The discharge in the river varies i.e. quite low during the dry weather and very high during the rainy seasons. The dry period discharge is contributed by waste drains discharging into the river.

Thus, polluting water of the river and renders it unsuitable for it various uses. Groundwater along the River gets recharged by the rainfall or by seepage from the river. In the study, total twenty sampling points were isolated, out of which twelve were from Derabassi region and six from the Panchkula region.

The groundwater samples were taken and their physic-chemical parameter analysis was done. All the samples were analyzed as per the specification given in Standard Methods for the Examination of Water and Wastewater (18th edition). Some of the physico-chemical parameters were analyzed at the site like pH and temperature, colour. The samplings were done in both pre monsoon & post monsoon season and compared with the ISO 10500-2012 (Standard for Drinking Water in India).

II. METHODOLOGY & CALCULATION

To get the complete depiction of the groundwater quality overall, WQI was being used. WQI is defined as a rating reflecting the composite influence of different water quality parameters on the overall quality of water. The Indian standard specified for drinking water (ISO 10500-2012) was used for the calculation of WQI. The WQI was computed through following steps. First of all, parameters to be studied were identified and were assigned weight (w_i) according to its relative importance in the overall quality of water for drinking purposes. The weights were assigned from the range of 1 to 5. The maximum weight 5 was assigned to a parameter because of its major importance in water quality assessment; minimum weight 1 was assigned to another parameter because of its insignificant role. Similarly other parameters were assigned weights between 1 and 5 based on their relative significance in the water quality evaluation.

Table 1: Weights assigned to physic-chemical parameters

Parameters	pH	TDS	Alkalinity	Chloride	Sulphates	Nitrate	F	Na^+	Ca^{+2}	Mg^{+2}	Hardness	Iron	Zinc
Weight (w_i)	4	4	2	3	4	5	4	2	2	2	3	4	1

Second, the relative weight (Wi) of the chemical parameter was computed using the following equation

$$W_i = \frac{w_i}{\sum_{i=1}^{n} w_i}$$

where W_i is the relative weight, w_i is the weight of each parameter and n is the number of parameters.

Next, a quality rating scale (q_i) for each parameter is calculated by dividing measured concentration of each water sample with parameter standard and is multiplied by 100.

$$q_i = \frac{C_i}{S_i} \times 100$$

Where C_i is the concentration of chemical parameter in each water sample in mg/L and S_i is the Indian drinking water standard for each chemical parameter in mg/L.

Table 2: Calculated a quality rating scale (q_i) for each parameter of sampling points

	quality rating (qi)												
Parameters/sampling Points	pH	TDS	Alkalinity	Chloride	Sulphates	Nitrate	F	Na^+	Ca^{+2}	Mg^{+2}	Hardness	Iron	Zinc
G1	116.9231	105.2	96	30	13.96	2.711111111	35	80	28	86.66667	175.5	300	2
G2	118.4615	102	102	32	5.935	2.4	53	98.35	38.66667	120.3333	204.5	366.6667	2
G3	112.3077	115	38.2	32.84	13.155	3.822222222	41	90	41.46667	88.66667	153	33.33333	0
G4	93.84615	146	99	55.6	31.55	12.66666667	46	142.5	33.6	123	179.9	200	10
G5	98.46154	121.6	107.5	53.68	24.55	10.88888889	37	177	37.33333	122	175.3	100	6
G6	112.3077	103.6	100.5	46.4	20.95	4.666666667	38	145.5	34.93333	77.33333	133.2	70	4
G7	115.3846	98.2	100	56.8	25.75	4	19	78.5	29.33333	90.66667	80.3	66.66667	3.6
G8	116.9231	102.4	98	51.6	18.155	2.822222222	22	89.5	28.8	90.33333	60.35	66.66667	0
G9	89.23077	151.8	73	70.8	37.25	4.422222222	34	177	149.6	409.6667	162.4	333.3333	22
G10	95.38462	144.4	58	60.8	34.05	4	32	168	136.1333	369.6667	187.1	266.6667	34
G11	106.1538	82.4	96	58.56	20.25	3.777777778	88	126	93.33333	124	84.8	100	0
G12	107.6923	100.8	74.6	62.8	22.9	4.4	36	117	86.66667	131.3333	62.2	66.66667	0
G13	115.3846	104	32.1	26.56	11.045	17.53333333	41	95	46.66667	113.6667	142.5	33.33333	8
G14	107.6923	99	52.6	25.16	8.8	6.644444444	35	91.05	97.33333	79.66667	131	366.6667	4.8
G15	83.07692	111.2	49	46.48	29.5	7.088888889	46	135	192.2667	132	149	123.3333	2.4
G16	104.6154	85	66.2	37.76	17.9	2.8	53	86	169.4667	173.3333	137	333.3333	4
G17	107.6923	49	62	29.6	10.25	2.955555556	32	75	105.3333	220	105.5	400	0
G18	110.7692	64	68.2	32.8	14.8	0.333333333	25	85	85.33333	163.3333	137.5	96.66667	4
G19	116.9231	82.4	51.2	18.56	13.5	1.488888889	34	60	78.66667	190	132.5	400	0
G20	120	84	52.2	24.96	14.65	1.733333333	52	95	61.33333	176.6667	137	366.6667	0

Finally aggregation function is applied in order to compile the sub-indices into a single index called as water quality index as per the equation below:

$$SI_i = W_i \times q_i$$

where, SI_i is the sub index of i^{th} parameter

$$WQI = \sum_{i=0}^{n} SI_i$$

Table3: Calculated WQI at sampling points

Sampling Point	$WQI = \sum_{i=0}^{n} SI_i$
G1	87.44303
G2	100.6613
G3	58.81205
G4	91.14045
G5	79.03743
G6	66.55244
G7	58.29763
G8	56.69517
G9	123.6175
G10	113.7826
G11	72.87127
G12	63.8109
G13	59.91913
G14	90.41095
G15	80.33147
G16	97.69187
G17	93.51284
G18	64.13109
G19	95.19125
G20	95.35533

On the calculation of the WQI, water quality is classified into five categories as shown in the table:

Table 4: Range of water quality index (WQI) as specified for drinking purpose

WQI	**Water quality**
< 50	Excellent
50-100	Good
100-200	Poor
200-300	Very poor
>300	Unsuitable

(Ramakrishnaiah *et al.*2009)

III. CONCLUSION

By using the weighted arithmetic index method, "3" water samples fell in the category of "poor water quality" and only "17" samples fell into the category of "good water quality". This comes out that only 10% of water samples falling into the category of "poor" drinking water. The water quality index (weighted index method) of around six points out of seventeen is very close to the margin of poor water quality.

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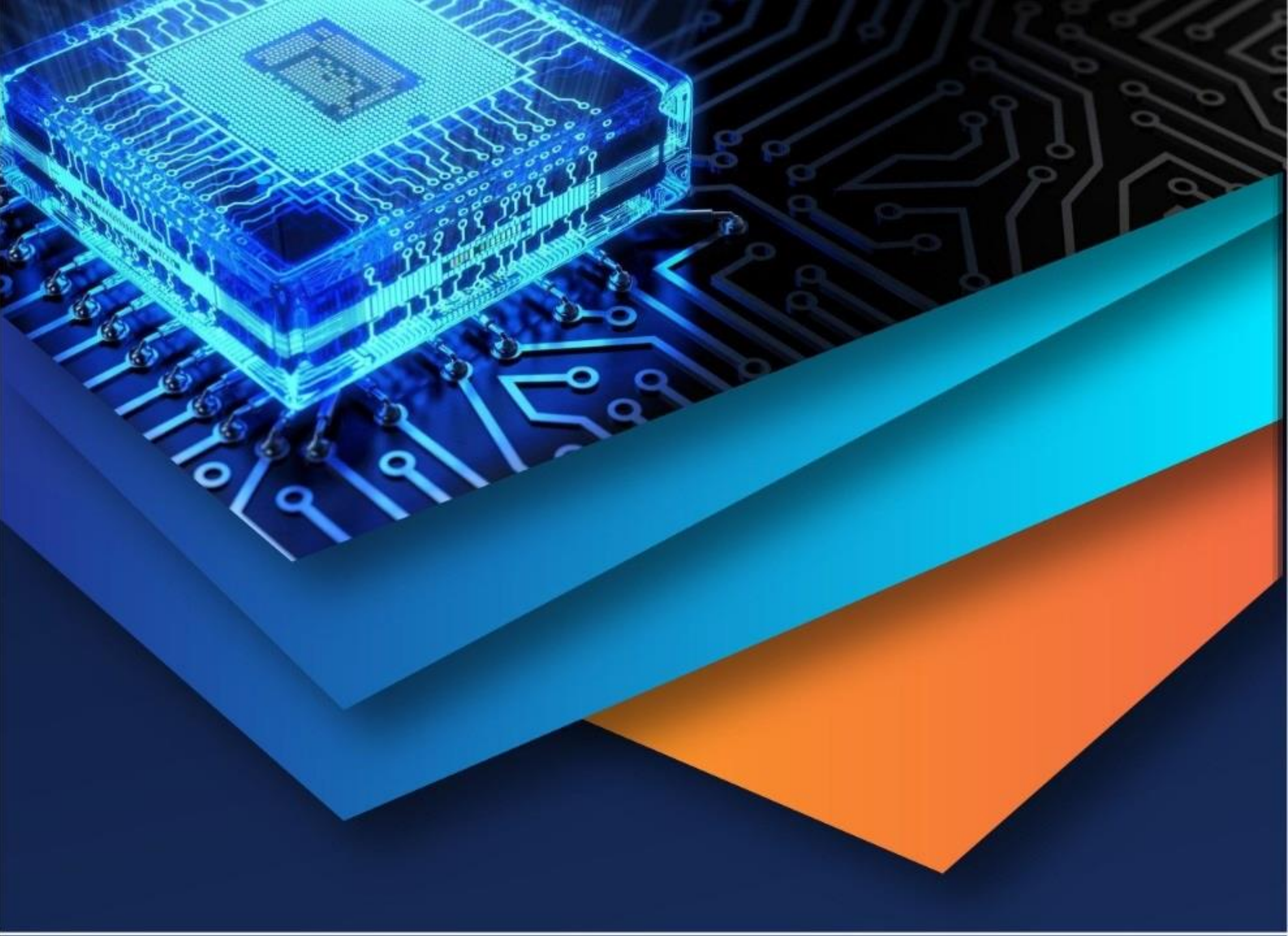

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