Estimation of Water Quality Index (WQI) and Its precision on Groundwater in parts of Faridkot district, Punjab, India

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ABSTRACT–*The continuous assessment groundwater quality has a substantial influence on human beings and agriculture, thus overlays mode to provide baseline information in solving the problems caused by lower water quality. Therefore, the quality of groundwater for drinking purposes has been assessed for different areas of district Faridkot. 40 groundwater samples have been collected from different locations of the district Faridkot for both pre monsoon and post monsoon seasons to evaluate the Groundwater Quality index in 2016. Water Quality Index (WQI) for drinking water in District Faridkot during Pre monsoon, 29.08 % samples stipulate "good water", 67.88 % samples exhibit "poor water", and 3.04% designate "very poor water". During Post monsoon, 24.73% samples indicate "good water", and remaining 71% of samples appear with "poor water" and 4.27% samples illustrate "very poor water". The greater percentage of post monsoon samples reveal poor quality as compared to pre monsoon, might be due to effectual leaching of ions and unwavering release of effluents, over exploitation of groundwater and agricultural consequences. Henceforth, need instant and effective management strategies for better living conditions of the people.*

Keywords: Groundwater quality, Agriculture, Management, WQI

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ISSN (ONLINE) 2583-2506
http://publications.rayatbahrauniversity.edu.in
RBIJMR-Rayat Bahra International Journal of Multidisciplinary Research, Vol. 01, Issue 01, December 2021

INTRODUCTION

The over-exploitation of groundwater, has adversely affected its quantity and quality also. The chemical quality of groundwater is effected by natural activities like: the chemical composition of soils and rocks through which the water flows, mineral dissolution, mineral solubility, ion exchange, oxidation, reduction, as well as anthropogenic activities (population explosion, poor sanitary conditions, application of fertilizers and pesticides for higher crop yields, without understanding the chemical characteristics of soils, industrial development and without following any appropriate remedial measures [1] and [2]. Established on several water quality parameters, water quality index generate a precise measure that point out overall water quality at a distinct location and time. The purpose of water quality index is to turn complex water quality knowledge into information that is understandable and functional by the society.

The Water quality index is not a complex visionary model for technological and scientific application but a valuable means for interrelating water quality information to the vast public and to policy makers [3].

The WQI has the capability to reduce the most of the information into a single value to accurate the data in a simplified and logical

Form and illustrate annual cycles, spatial and temporal.

variation and trends in water quality at low concentrations. Water quality index lessen the dissimilar parameters into a single number, thereby making it well-situated to examine on the comprehensive quality of the water sample from its pollution point source [4]. Water quality index is intended to ascertain the condition of water for different purposes like drinking, agricultural uses [5].The importance of the WQI is given by the distinction as an effective tool to the authorities' for devising management plans to improve water quality in the area, as well as the citizens' support concerning the water resources importance in their living area [6].

Punjab, the most cultivated state in India and also with the highest consumption of fertilizers and Faridkot is one of the agricultural dominated districts in Punjab. Therefore, it is important to study the Water Quality Index (WQI) of groundwater and its suitability for drinking purposes which ultimately effects upon the health of the public.

ISSN (ONLINE) 2583-2506
http://publications.rayatbahrauniversity.edu.in
RBIJMR-Rayat Bahra International Journal of Multidisciplinary Research, Vol. 01, Issue 01, December 2021

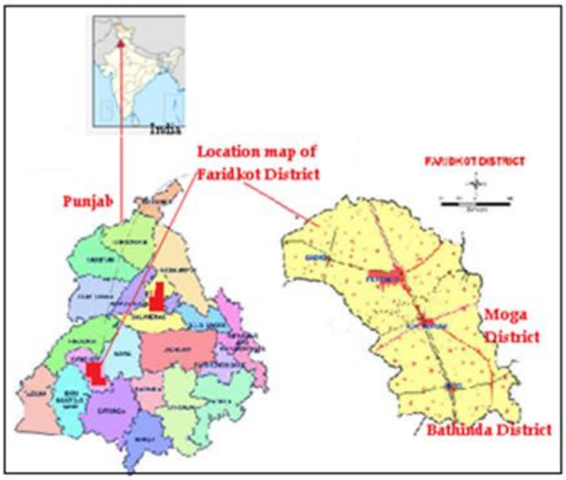


Figure 1: Location map of the study area

LOCATION

Faridkot is one of the latest in the series of districts created by Punjab Government by re-adjoining Moga (East), Muktsar, and Bhatinda (South) districts as shown in Figure 1. Faridkot is one of the smallest districts in the state having an area 1468.75 sq.kms. The Faridkot district is limited within northern latitudes of 29^{0}54'to 34^{0}54'and the eastern longitudes of 74^{0}15'to 75^{0}25' located in the southwestern parts of Punjab state. The population density is 456 persons per sq.kms. Topograhically, the study area has no river and is enclosed expansively by the canal network of Sirhind feeder canal.

METHODOLOGY TO CALCULATE WATER

WATER QUALITY RANGE AND CATEGORY

QUALITY INDEX

The Water Quality Index (WQI) brings a wide-ranging image of the quality of groundwater for largely domestic uses. WQI is defined as a ranking which consider the multiple influence of different water quality parameters [7]. There are three steps to calculate the WQI of a water sample. The first step consists of allotting of weight (w_i) to each of the chemical parameters on the basis of their apparent effects on primary health as shown in Table 1. The highest weight of five was allotted to parameters, which have the main effects on the quality of water because of their importance in the water quality assessment as shown in Table 1.

Second step involved calculating the relative weight (Wi) of each parameter by using the formula

$$Wi = wi/\sum_{i=0}^{n} wi$$

Whereas, $Wi$is the relative weight

$wi$is the weight of each parameter

nis the number of parameters. Calculation of relative weight (Wi) values of each parameter is given in Table1.

Table 1: Relative Weights of Chemical Parameter

Chemical Parameters	BIS Standards 2012	Weight wi	Relative weight $Wi = \frac{wi}{\sum wi}$
Total	500	5	0.156
Chloride	250	5	0.156
Sulphate	200	4	0.125
Phosphate	-	1	0.031
Nitrate	45	4	0.125
Fluoride	1	5	0.156
Calcium	75	3	0.093
Magnesium	30	3	0.093
pH	6.5-8.5	2	0.062
		$\sum wi = 32$	$\sum Wi = 0.997$

In the third step, a quality rating scale (q_i) for each parameter is assigned by dividing its concentration in each water sample by its respective standard according to the guidelines laid down in the BIS 10500 (2012) and the result is multiplied by 100:

$qi = (Ci/Si) \times 100$where$qi$is the quality rating,

Ci is the concentration of each chemical parameter in each water sample in milligrams per litre

Si is the Indian drinking water standard for each chemical parameter in milligrams per litre according to the guidelines of the BIS [8].

Range	Categories
<50	Excellent water
50<100	Good water
100-200	Poor water
200-300	Very Poor water
>300	Water unsuitable for

TABLE-2: WATER QUALITY RANGE AND CATEGORY

For computing the WQI , the SI is first determined for each chemical parameter, which is thenused to determine the WQI as per the following equation:

$$SIi = Wixqi$$

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

Where,

$SIi$is the sub-index of ith parameter

$qi$is the rating based on concentration of ith parameter

$n$is the number of parameters

Water quality types, were determined on the basis of WQI (Table 2). The WQI range and type of water can be classified as below:

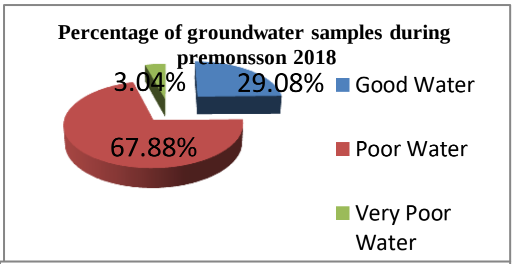
ISSN (ONLINE) 2583-2506
http://publications.rayatbahrauniversity.edu.in
RBIJMR-Rayat Bahra International Journal of Multidisciplinary Research, Vol. 01, Issue 01, December 2021

RESULTS AND DISCUSSION

Calculation of WQI for individual samples is represented in Table 3 and Figure 2 for district Faridkot.

Table 3: Calculation of WQI for 40 Water Samples during premonsson and post monsoon (2016), District Faridkot

Category	No. of samples during pre monsoo	% of samples during pre monsoo	No. of samples during post monsoo	% of samples during pre monsoo
Good	11.6 32	29.08	9.892	24.73
Poor Water	27.152	67.88	28.4	71
Very Poor	1.216	3.04	1.708	4.27



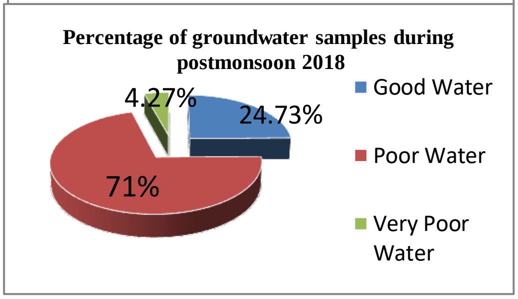


Figure 2& 3: Pie chart showing % of groundwater quality during the both premonsoon and postmonsoon (2016) of the study area

CONCLUSION

Water Quality Index (WQI) for drinking water in District Faridkot during Pre monsoon, 29.08 % samples stipulate "good water", 67.88 % samples exhibit "poor water", and 3.04% designate "very poor water". During Post monsoon, 24.73% samples indicate "good water", and remaining 71% of samples appear with "poor water" and 4.27% samples illustrate "very poor water".The greater percentage of post monsoon samples reveal poor quality as compared to pre monsoon might be due to effectual leaching of ions, unwavering release of effluents, over exploitation of groundwater and agricultural consequences.

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