

Assessment of Ground Water Quality of Jaipur Rajasthan India Using WQI (Water Quality Index)

Ankita Mathur¹ and Umesh Gupta²

JK Lakshmi Pat University, Lalya Ka Vaas, Jaipur, India

Email: ¹ ankita25jaipur@gmail.com, ² umeshindian@yahoo.com

Abstract

The present study is related to the assessment of water quality parameters of Jaipur, Rajasthan and to calculate water quality index. This has been determined by collecting ground water samples to a comprehensive physico chemical analysis. In the present study seventy water samples are taken from different areas of Jaipur and 9 water quality parameters are have been considered: pH, Total hardness, Chloride, Fluoride and Total dissolved solids, Calcium, Magnesium, Nitrate and alkalinity. The WQI for these samples ranges from 10.30216- 4001.991. The analysis reveals that the ground water of the Jaipur needs some treatment before consumption and it is also needs to be protected from contamination.

1 INTRODUCTION

Water is indispensable and one of the precious natural resource of our planet. Ground water is an important natural source of water which is used all over the world. Ground Water is usable in the fields like irrigation, industries and domestic purpose ^[1]. Ground water quality depends on the quality of discharged water, atmosphere, surface water, and on geochemical processes held on sub-surface.

There is increasing awareness that the water will be one of the most critical natural resources in future. Water paucity is increasing worldwide and stress on the existing water resources is increasing due to rising demand of different sectors such as household, cultivation and trade, hydropower etc. Therefore evaluation of water quality is important research topic in the recent years

It is therefore necessary that the quality of drinking water should be checked at regular time interval because due to use of contaminated drinking water, human inhabitants undergo from a variety of water borne virus [1]. In last few decades, there has been a tremendous increase in the demand for the fresh water due to rapid growth of population and their accelerated pace of industrialization.

According to WHO, about 80% of all the diseases in human beings are caused by water? As the groundwater is infected, its value cannot be restored by stopping the pollutants from their sources. It therefore becomes crucial to regulate oversee the quality of groundwater and to device ways and means to protected. Water quality index is the one of the most effectual tools. ^[2-5] WQI is defined as a rating reflecting the compound influence of dissimilar water quality parameters. WQI is intended from the viewpoint of suitability of ground water for individual consumption. ^[6] WQI is an arithmetic tools used to alter large water quality data into a single cumulatively derived figure. It represents a certain rank of water quality while eliminating the subjective assessment of such quality [7-9] to summarized the huge amount of analytical data regarding water quality into useful, easy to comprehend and convenient management tools for the consideration of water quality, the idea of WQI was developed and proposed first by Horton [10]. It is a single number like a position that express the overall water quality at a certain region and time based on several water quality parameters. When their specific classification and boundaries are considered [11-13]. In present paper we evaluate the WQI of Jaipur.

The following steps are mainly linked with the development of any WQI:

- Parameter selection

- Conversion of the parameters of different units to a common extent
- Weightage assignment to each parameters
- Calculation of sub-indices to produce a final index

2 STUDY AREA

Location:	26.92°N 75.82°E
Altitude:	431 m (1417 ft.) Above Sea Level
Area:	11,117.8 km ² (4,292.6 sq. mi.)

Jaipur, the capital city of the Indian state of Rajasthan is located in the eastern boundary of Thar Desert, a semi-arid territory. This state is one of the largest of the nation which shares the global boundary with Pakistan on the western side. Jaipur is usually known as the pink city and is one of the well-designed cities in India, in fact, also the first. It is located at an elevation of 1417 feet above the sea level. On three sides, the city is enclosed by the Aravali hills and this is why, it is shielded from the jagged desert. In the north, it is delimited by Sikar and Mahendragarh area; in the south by Tonk; in the east by Alwar, Dausa and Sawai Madhopur; and in the west by Nagaur and Ajmer district [14].

The total length of Jaipur extending from east to west is about 180 km whereas the width from north to south is about 110 km. The main rivers passing through the Jaipur are Banganga and Sabi. About 28.65 million cubic meter ground water resources are available in Jaipur. To supply the drinking water to the old city, there is Ramgarh dam on the River Ban Ganga. The main minerals of the city are copper, iron, dolomite, white marble, glass and silicon. Sambhar Lake, which is the only natural lake with salty water is also the foremost source of good quality of salt in the state as well as country, is very close to Jaipur [14].



Jaipur has a semiarid climate under the Köppen climate classification, receiving over 650 millimeters (26 in) of rainfall annually but most rains occur in the monsoon months between June and September. Temperatures remain relatively high throughout the year, with the summer months of April to early July having average daily temperatures of around 30 °C (86 °F). During the monsoon there are frequent, heavy rains and thunderstorms, but flooding is not common. The winter months of November to February are mild and pleasant, with average temperatures ranging from 15–18 °C (59–64 °F) and with little or no humidity though occasional cold waves lead to temperatures near freezing [14].

3 METHODOLOGY

Ground water samples were collected for chemical investigation from diverse geographical horizons. The techniques and methods for compilation and analysis of water samples followed in this study were those after Rain Water [6,7] and main chemical constituents were determined by following standard method^[8]. The analytical accuracy for measurements of cations and anions is within the predetermined limit of + or –5%. The chemical data is subjected to multivariate analysis [9-12] and the results are tabulated. The present work attempts to determine water quality index to evaluate the appropriateness of groundwater for different purposes [13].

The methodology for the evaluation of the WQI is adopted from the paper *Water Quality Index and Regression Models for Predicting Water Quality and Water Quality Parameters for Tumkur Amanikere Lake Watershed, Tumkur , Karnataka , India* by Rajendra D. S. Prasad , C. Sadashivaiah and G. Ranganna.

For calculating WQI, 3 steps are followed:

In the first step each parameter is assigned a weight (w_i) according to its relative importance in the overall quality of water for drinking purposes as shown in Table I. The maximum weight of 5 has been assigned to the parameter nitrate due to its importance in water quality assessment.

In the second steps, the relative weight (W_i) is computed from the following equation

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

where W_i is the relative weight, w_i is the weight of each parameter and n is the number of parameters. Relative weights are presented in Table II.

Table I

Chemical Parameter	Indian Standard (Upper Limit)	Weight [w(i)]
Ph	8.5	4
TDS	2000	4
Alk.	600	4
TH	600	2
F	1.5	4
CaH	200	2
MgH	100	2
Cl	1000	3
NO ₃	100	5
		$\sum w = 30$

Table II

Chemical Parameter	Indian Standard (Upper Limit)	Weight [w(i)]	Relative Weight [W(i)]
Ph	8.5	4	0.133333333
TDS	2000	4	0.133333333
Alk.	600	4	0.133333333
TH	600	2	0.066666667
F	1.5	4	0.133333333
CaH	200	2	0.066666667
MgH	100	2	0.066666667
Cl	1000	3	0.1
NO ₃	100	5	0.166666667
		$\sum w = 30$	

In the third step, a quality scale (q_i) for each parameter is assigned by dividing its concentration in each water sample by its respective standard limit value according to the guidelines of BIS (Bureau of Indian Standards) and the result is multiplied by 100. The equation for q_i is:

$$q_i = (C_i/S_i) \times 100,$$

where q_i is the quality rating, C_i is the concentration of each parameter in each water sample in mg/l and S_i is the Indian standard limit for each parameter in mg/l according to BIS 10500:1991 (reaffirmed in September 2003).

For computing the WQI, the Sub-Index (SI) is first determined for each chemical parameter, which is then used to determine the WQI as per the following equations:

$$SI_i = W_i q_i$$

$$WQI = S.SI_i$$

SI_i is the sub index of i th parameter, q_i is the quality rating. The computed WQI values are presented in Table III.

Table III

Chemical Parameter	Indian Standard (Upper Limit)	Weight [w(i)]	Relative Weight [W(i)]	[q(i)]	SI	WQI
Ph	8.5	4	0.133333333	87.2719457	11.63626	98.90821
TDS	2000	4	0.133333333	51.17841987	6.823789	13647.58
Alk.	600	4	0.133333333	50.02489316	6.669986	4001.991
TH	600	2	0.066666667	40.98055556	2.732037	1639.222
F	1.5	4	0.133333333	51.01581197	6.802108	10.20316
CaH	200	2	0.066666667	53.71973684	3.581316	716.2632
MgH	100	2	0.066666667	138.925641	9.261709	926.1709
Cl	1000	3	0.1	12.66512821	1.266513	1266.513
NO ₃	100	5	0.166666667	68.61275641	11.43546	1143.546
		$\sum w = 30$				

The computed WQI values are classified into five types, “excellent” to “unsuitable for drinking”. The computed WQI values ranges from 10.20316 to 4001.991. Table IV shows the percentage of water samples that falls under different quality.

Table IV

WQI value	Water Quality	Number of Samples	%
< 50	Excellent	1	11.11
50-100	Good	1	11.11
100-200	Poor	0	0
200-300	Very Poor	0	0
>300	Unsuitable for Drinking	7	77.77

4 CONCLUSION

Water quality index (WQI) is the most efficient technique to communicate water quality. Water quality index (WQI) <50 means absolute absence of pollutants. When $50 < \text{WQI} < 100$, indicates the water is under consideration and fit for human use and $100 < \text{WQI} < 200$ reflects that water is of poor quality and should not be used for drinking purpose. $\text{WQI} > 300$ reflects that it is totally unsuitable for human, wild animals and cattle's. (Bahera *et al.*, 2004).

In the present study it was found that in 7 samples water is totally unsuitable to use whereas in 1 sample water is found excellent and good. There is no such sample where water is poor in quality.

REFERENCES

- [1] P.M. Makode, Physico- chemical parameters of Charghad dam district Amravati, Maharashtra, *IJSID*, 2(1), 164-169, 2012.
- [2] P.C. Mishra and R.K. Patel, *Indian J Environ Ecoplan.*, 5(2) 293-298, 2001.
- [3] S. Naik and K.M. Purohit, *Indian J Enviorn Ecoplan.*, 5(2) 397-402, 2001.
- [4] D.F. Singh, *Proc Acad Enviorn Biol.*, 1(1), 61-66, 1992.
- [5] T.N. Tiwari and M.A. Mishra, *Indian J Enviorn Proc.*, 5, 275- 279, 1985.
- [6] C.R. Ramakrishanaiah, C. Sadashivaiah and G. Ranganna, Assessment of water quality index for the ground water in Tumkur Taluk, Karnataka state, India, 6(2), 523-530, 2009.
- [7] N. Giljanovic, *Water Research*, 33(16) 3423-3440, 1999.
- [8] N. Giljanovic, *Water Environment Research*, 75(5), 388-405, 2003.
- [9] W.W. Miller, H.M. Joung, C.N. Mahannah, J.R. Garrett, *Journal of Environmental Quality*, 15, 265-272, 1986.
- [10] R.K. Horton, *Journal of Water Pollution Control Federation*, 37(3), 300-306, 1965.
- [11] W.R. Ott, *Environmental Indices: Theory and Practice*, Ann Arbor Science Publishers Inc., Michigan, USA.1978.
- [12] D. Hollock, *A Water Quality Index for the ecology stream monitoring program*, Environmental Assessment Program, Olympia, 2002.
- [13] S.F. Pesce, D.A. Wunderlin, *Water Research*, 34(11) 2915-2926, 2000.
- [14] <http://www.jaipur.org.uk/location.html>

Authors Profile



Ankita Mathur is currently pursuing research under the guidance of Dr. Umesh Gupta from JK LakshmiPat University. So far, she has completed B.Sc., M.Sc., B.Ed., ‘A’ Level in Computer course.



Dr Umesh Gupta, the Associate Professor of Institute of Engineering and Technology (IET) at JK LakshmiPat University has 13 years of teaching, research, and administrative experience. He did his PhD from University of Rajasthan. Currently he is supervising his PhD candidates working in the area of Optimization Techniques.. He is the life member of various national and international academic bodies, like, Indian Science Congress, Indian Mathematical Society, Operational Research Society of India, and Rajasthan Academy of Physical Sciences. He is an elected senior member of IACSIT, Singapore. Besides teaching and research, he is also the Coordinator of Practice School at JKLU in addition to various other administrative responsibilities. He is an active core committee member of Entrepreneurship Cell (E-Cell) established at the University.