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Evaluation Of Water Quality Index In The Vicinity Of Rampur Dump Yard.

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Abstract:*Unscientific dumping of solid waste is a threat to the surrounding environment which causes pollution by contamination soil, water and groundwater resources. The present study has been carried out to assess water quality index and the impact of solid waste dump yard at Rampur village, Warangal urban district, Telanagna, India. Twenty sampling sites were selected around the dumpyard in 1km radius and analysed ground water for physico-chemical parameters, like pH, pH, all other studied parameters like EC, TDS,TA, TH,* Na^+, Ca^{2+}, Mg^{2+}, Cl^-, SO_4^-, NO_3^-*,and* K^+*, accordingly water quality index has been calculated based on the pre and post monsoon seasonal data following standard method. Most of the parameters of the sample sites exceeded the BIS standard limits for drinking water. The water quality index of the sampling sites were found excellent category, except four samples were good category in all the seasons. Therefore, to protect the environment, it is very important to adopt proper scientific method to assess the index for water quality management.*
Keywords: *Physico-chemical parameters, Water quality index, Municipal solid waste, Pollution, Environment*

INTRODUCTION

Municipal Dump site is causing major damage and polluting the surface and ground water resources. Indiscriminate dumping of wastes in the open area is causing infiltration in rainy season (Mausam Kumar Paul and Mithra Dey 2011). Unscientific dumping of solid waste leads to groundwater pollution, air pollution. The present study focuses study of groundwater quality is the main source of drinking for nearby village drinking water and also source for other living beings. The groundwater quality problem has become a problem now a day (Nitin Kamboj and Mohrana Choudhary 2013). In urban areas uncontrolled growth of population has left and several cities inadequate in solid waste management. The most common problem to human health from these solid waste dump yards is from the use of ground water that has been contaminated by leachates (Rajkumar Nagarajan et al., 2012). The leachate water percolates through the dumpyard, contaminants are leached from the solid waste dump. When the moisture enters leachate is produced in solid dump. Once Leachate is generated in a dumpyard as a consequence of the contact of water resources with this solid waste (Nitin Kamboj and Mohrana Choudhary, 2013). Most of the india major cities have dump yards in the outskirts where municipal solid waste is dumped in an unscientific manner (Navarro Ferronato and Vincenzo Torretta., 2019). The solid waste dumpyard of Rampur site also dumping in unscientic manner. Hence the study area was selected to study and assess the quality of ground water and water quality index.

MATERIAL AND METHODS

The present study encompasses the critical issues involved in our day to day life. The main objective was to evaluate the impact of dump yard waste on the quality of groundwater. The waste generated in the Warangal city is collected by the Greater Warangal Municipal Corporation (GWMC) and carried towards the disposal site located in the Rampur. Warangal urban district is the second-largest city in Telangana state after the capital city of Hyderabad. It has been dumping its solid waste in over 35 acres of land for many years.

Ground water sampling:

To study the impact of the Rampur municipal solid waste dump yard on ground water quality, the groundwater samples were collected in twenty sampling sites. Each sample was randomly selected and representative samples were collected once a month for over three years (2018-2020). Groundwater samples were collected randomly around dump yard locations of 1km radius and samples were analyzed for various Physico-chemical parameters to check the quality of ground water.

Water Quality Index (WQI):

Water quality index (WQI) is a scientific method of rating the water quality in a single expression and it provides a complete picture of the water quality with a single volume. The water quality index uses different water quality data (18 physicochemical parameters data) and derives a single volume which will be useful for policymaking. This is initially developed by Horton R.K in the year 1965 and further it was modified by many other scientists.

A general approach for the determination of WQI includes parameter selection based on their impact on water quality (surface and groundwater). Once the parameters were fixed, sub-index indix of these parameters are qualified, which were finally aggregated using an aggregate indexing method using different mathematical expressions. The weighted arithmetic water quality index method classified the water quality based on the degree of purity by using the commonly measured variables of water quality. The method has been widely used by various scientists (Chowdhury, R.M *et al.*, 2012; Rao C.S *et al.*, 2010; Balan I.N *et al*, 2012) and the calculation of WQI was made by (Brown R.M *et al.*, 1972) using the following equation:

$$WQI = {\sum Q_i W_i}/{\sum W_i}$$

The quality rating scale (Qi) for each parameter is calculated by using this expression (Shweta Tyagi*et al.*, 2013):

$$Q_i = 100[({V_i - V_o}/{S_i - V_o})]$$

Where, Vi is the estimated concentration of i_{th} parameter in the analysed water sample (ShwetaTyagi *et al.*, 2013)
Vo is the ideal value of this parameter in pure water
Vo = 0 (except pH =7.0 and DO = 14.6 mg/l)
Si is recommended standard value of i_{th} parameter
The unit weight (Wi) for each water quality parameter is calculated by using the following formula (ShwetaTyagi*et al.*, 2013):

$$W_i = {Ki}/{S_i}$$

Where, K = proportionality constant and can also be calculated by using the following equation (Sanman P. Kulkarni and S. S. Jain, 2014):

$$K = \frac{1}{\sum\left(\frac{1}{Si}\right)}$$

This water quality index was determined based on BIS 10500 standards by assessing weights (wi) according to the relative importance of each parameter for drinking purposes and summarized.
Parameters like Cl^-, NO^{3-}, TS, NH^{4+}, SO_4^{2-} and F^- has been given maximum weightage that is 5 because of their significance in maintaining water quality, other parameters like Ca^{2+}, mg^{2+}, TH and TA were assigned weights between 1-5 depending on their importance in their water quality assessments. Water quality rating was given (table 1.1) as per BIS 10500.

Table 1.1: Water quality index rating

WQI Values	Water Quality Status	Water Quality Rating	Usage
0–25	Excellent	A	Drinking, irrigation and industrial
26–50	Good	B	Drinking, irrigation and industrial
51–75	Poor	C	Irrigation and Industrial
76–100	Very poor	D	Irrigation
> 100	Unsuitable	E	Proper treatment is required for any kind of usage

(Chatterjee C and Raziuddin M, 2002)

Analysis of Water Quality Index (WQI):

When physicochemical parameters were studied, abtained ground water data were interpreted using a statistical tool weighted arithmetic method (WQI). Status of WQI represented in 1.2 table, found that majority of the samples (among the studied 20 samples) were falling under "excellent" quality in pre-monsoon but S1, S3, S6 and S11 were reported as good quality (as per 2019 data). Whereas the range of the studies in "pre monsoon" and "post-monsoon" of 2018, 2019 and 2020 were falling in excellent quality. The WQI is a valuable tool for calculating ground water quality for a different purpose. WQI for various sampling sites throughout different seasons (pre and post-monsoon) in three years was studied in this study.

Table 1.2: Water quality index of 2018, 2019 and 2020 years

Sample site	WQI pre-2018	WQI post-2018	WQI pre-2019	WQI post-2019	WQI pre-2020	WQI post-2020
S1	24.3625	15.3769	26.4088	19.0275	21.2729	20.1021
S2	20.114	19.6053	20.6724	19.4142	19.8191	19.0059
S3	16.9789	17.4289	27.3871	16.5916	16.6978	16.1906

S4	19.5047	19.1367	18.2954	18.186	16.9936	16.6094
S5	18.3884	14.8644	20.3502	16.4833	17.5001	18.0751
S6	17.552	13.7684	26.2549	14.5264	17.688	17.9042
S7	20.4555	12.8806	16.8133	14.5622	18.6845	15.2652
S8	18.5523	16.6935	23.2768	19.6583	19.8345	16.9123
S9	14.9968	18.5184	17.906	19.593	18.0767	17.6917
S10	15.4298	16.4067	17.7568	16.4864	17.0801	19.3168
S11	17.8924	17.0598	29.8849	15.8345	16.9477	17.8647
S12	18.5716	14.8016	17.6141	16.1917	19.588	16.5038
S13	19.4136	15.6914	23.2605	16.1829	15.7126	20.2625
S14	16.5769	14.8214	22.5728	17.0976	16.3464	18.4
S15	15.5584	16.5105	19.4647	17.2089	16.3652	15.5976
S16	16.5906	17.6862	19.6889	19.0199	20.0521	18.0747
S17	18.9711	16.9964	19.2741	17.9051	22.4591	19.9542
S18	20.8934	18.3894	24.2805	19.3228	17.5559	18.2693
S19	22.1116	19.9511	21.9007	20.4712	19.6868	17.6877
S20	17.7454	18.8011	19.6342	18.9808	18.7582	20.1182

Table 1.2 shows all of the WQI values during the last three years. According to the WQI index assessment, all samples from the 2018 pre-monsoon period had WQI values ranging from 14.9968 to 24.3625, and all samples had WQI values in the "Excellent" category

In 2018 post-monsoon period readings, WQI values were 12.8806 and 19.1367. which were falling in excellent quality. In 2019 pre-monsoon season readings WQI values were 16.8133 and 29.8849. Among the 20 samples, 16 sample readings indicated excellent water quality as per WQI index rating, whereas the remaining 4 sample sites indicated good quality.

WQI values varied 0 to 25 in 2019 "post-monsoon" season, with lowest and highest values of 14.5264 and 19.6583 from 20 sampling sites, respectively, with "Excellent" quality.

All of the sample sites WQI values in 2020 "pre-monsoon" period varied from 0 - 25, with lowest and maximum values of 15.7126 and 22.4591, respectively, falling into the excellent quality category.

The lowest and maximum readings for 2020 in the post-monsoon season were 15.2652 and 20.2625, respectively, indicating an excellent category according to WQI classification. During the study period, the majority of the samples fell into the "excellent" category. For three years, the area's average WQI was 18.48679.

Groundwater WQI value ranges were depicted in table 1.2 as "pre-monsoon" and "post-monsoon" seasons for three years from the study area with 20 different groundwater sample sites (S1 to S20).

The study aim is to assess the water quality at all of the sample sites. Sample site S1 showed readings varied from 15.3769 to 26.4088 in all three successive study periods, this highest value was found in (pre-monsoon 2019) as per water quality index status it was found as good water quality. The second sample site S2 showed values from 19.0059 to 206724 in the study period and all the samples were falling in excellent water quality. In sample sites, S3 readings varied from 16.1906 to 27.3871 and the highest value was found in pre-monsoon (S3-27.3871). Sample site S4 values were varied from 16.6094 to 19.5047 in all the study period from this sample site values were found to have excellent water quality. From the sample site S5, all the readings found excellent water quality with readings from 14.8644 to 20.3502.

In sample site S6 recorded values varied from 13.7684 to 26.2549, the highest value from pre-monsoon 2019 S6 value (26.2549) was found as good water quality and remaining all the water samples were excellent water quality. Sample site S7 all the readings were found as excellent water quality and the values varied from 12.8806 to 20.4555. In sample sites S8, S9 and S10 readings were varied (16.6935 to 23.2768), (14.9968 to 19.593) and (15.4298 to 19.3168) respectively. In sample site S11 readings varied from 15.8345 to 29.8849, the highest value was found in the pre-monsoon 2019 it was found as good water quality remaining all the readings were falling in excellent water quality.

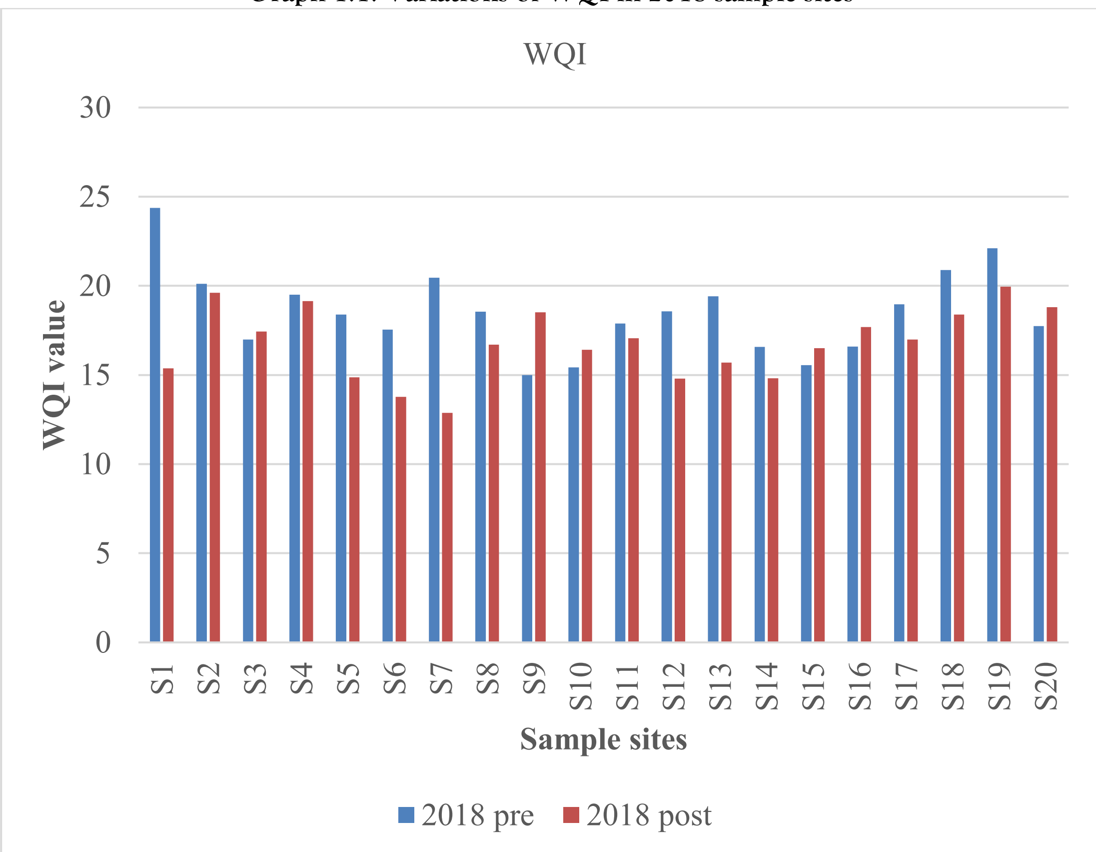
Sample sites S12, S13, S14, S15, S16, S17 and S18 the water samples from these sites recorded values varied lowest to highest as (14.8016 to 19.588), (15.6914 to 23.2605), (14.8214 to 22.5728), (15.5584 to 19.4647), (16.5906 to 20.0521), (16.9964 to 22.4591) and (17.5559 to 24.2805) respectively and these all the sample sites were found as excellent water quality. The remaining sample sites S19 and S20 values varied from (17.6877 to 22.1116) and (17.7454 to 20.1182) which were falling in excellent water quality.

All the water quality index values from 20 different sites (S1 to S20) were represented in graphs 1.1 to 1.3. In Graph 1.1 pre-monsoon, 2018 sample site S1 was found the least value (15.5584) and the highest value was found in S1 (24.3625). In post-monsoon 2018 samples least value was 12.8806 in the S7 sample site and 19.9511 was found in the S19 sample site

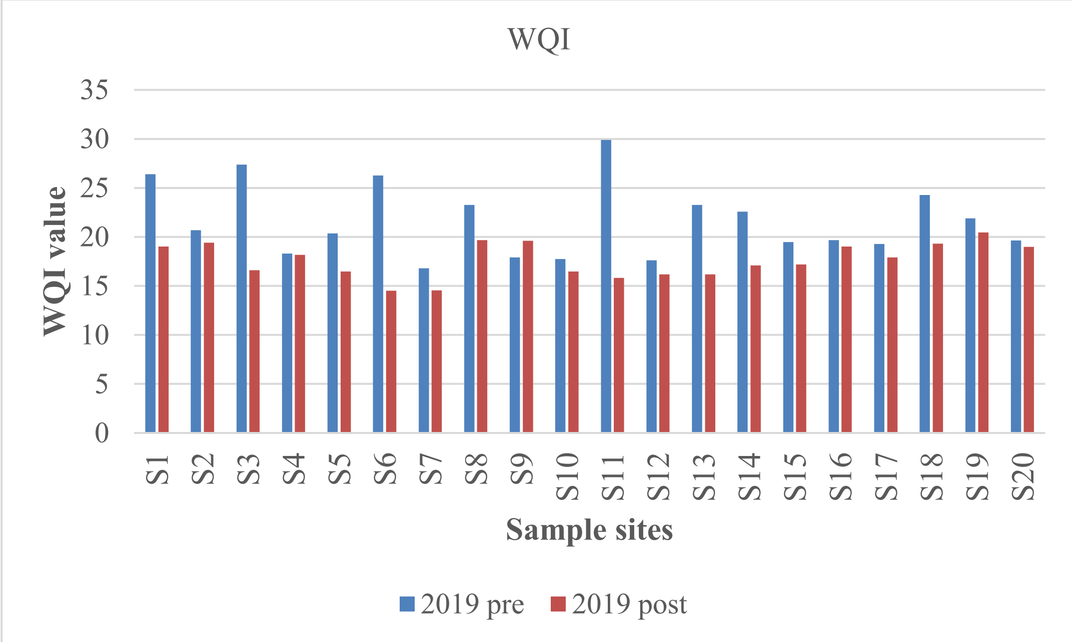
From the represented Graph 1.2 it was observed that the high "WQI" value (29.8849) was found in the S11 sample site and the least value (16.8133). "Post-monsoon 2019 " highest WQI value, (20.4712) in the S19 sample site and the least value (14.5264) in the S6 sample site is represented in Graph 1.2.

From Graph 1.3, it was represented as S17 sample site in pre-monsoon 2020 as highest WQI value (22.4591) and least value 15.7126 were represented in S13 sample site. In the post-monsoon 2020 sample site, S20 represented the highest WQI value (20.1182) and the least value was 15.2652 in post-monsoon 2020.

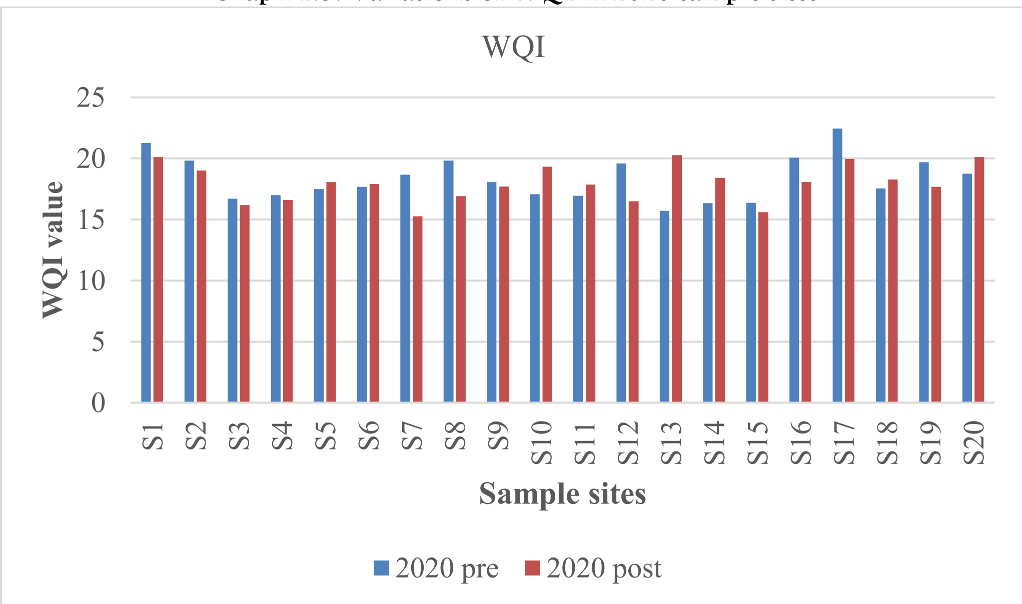
Graph 1.1: Variations of WQI in 2018 sample sites



Graph 1.2: Variations of WQI in 2019 sample sites



Graph 1.3: Variations of WQI in 2020 sample sites



Anju Anil Kumar *et al.* (2015) completed a study on the effect of MSW on groundwater quality and revealed that the WQI of the samples were 64.9 and 58.7 in pre-monsoon and post-monsoon, respectively, indicating that the water quality was good. However, in "pre-monsoon" and "post-monsoon" seasons, groundwater samples near the dumping site found to be as high as 101.9 and 97.6, respectively, landing the groundwater in the poor water category according to the water quality classification.In the surroundings of the municipal solid waste dump yard, Olayiwola Oni and Olubunmi Fasakin (2016) conducted a study on surface and groundwater. The computed WQI levels for stream and groundwater sites were GW1, GW2, SW1 and SW2, respectively, indicating the water samples were of very poor quality during the study period. Contamination around the dumpsite was studied (Justus Reymond D 2016) and it was found that 34.37 % of samples were poor quality, 37.5% very poor in quality samples, 12.5% of the samples were good quality and 6.25 % samples were found of excellent quality. Only 9.37 % of samples were unfit for drinking. An arithmetic weighing method was used to calculate the percentage of distinct water quality based on WQI. The WQI values varied from 16 to 89, allowing four different types of water quality to be detected (Excellent to very poor).Budhlani G. N, (2015) conducted a study and determined the water quality index of Holy Wardha river water (Kaundyanapur) from Amravati District, Maharashtra, India. The WQI was evaluated for the reservoir water system in different seasons in the study period. Calculated WQI ranges were 259.30, 103.66 and 117.06 respectively which indicate the very poor quality of samples based on the

WQI index.The Water Quality Index for Bhalswa Lake water was established from the assessment of water quality for different seasons (Deepika and Singh S.K, 2015). The WQI calculated with using various physicochemical parameters. "Pre-monsoon", "monsoon", and "post-monsoon" water quality index were reported to be 120.45, 113.65, and 119.267, respectively. The WQI of Bhalswa Lake was high, representing poor water quality.Mohamad Roslam M.K *et al.,* (2007) researched open landfill areas by using a water quality index and results showed that the WQI value was 26.27 which indicates good water quality.Kosha, A. Shah and Geeta S. Joshi, (2017) conducted a study and evaluated the WQI for River Sabarmati, Gujarat. From the study, it was found that the WQI of the sample site was (S1) sample value (42.71 to 56.43). Whereas (S2) sample value (80.75 to 86.34) and the (S3) sample value (85.67 to 95.08). The results indicated the quality status as S1 "poor water quality" and S2 "very poor quality".Shubhrasekhar Chakraborty and Naresh Kumar R, (2016) conducted a study on groundwater quality at a municipal solid waste landfill site. The annual average WQI value for groundwater was 121 with the normal WQI and 157 with the modified WQI. During the winter, monsoon, and summer, the seasonal variation values indicated as standard WQI was 101, 106, and 133, respectively. With the altered WQI during the monsoon season, a WQI value of 181 was obtained, representing poor water quality.Ragab ElSayed Rabey (2018) used a water quality index to assess groundwater quality. Only 20% of the groundwater sampling sites were found to have excellent water and were safe for drinking, according to WQI calculations. More than 45% of the groundwater was good water for drinking, while 33% sampling sites were "poor" to "very poor quality". 9 sample sites groundwater was unsuitable for drinking.Palwasha Akram *et al.,* (2020) researched the water quality index by assessing in nine major cities of groundwater samples. According to WQI calculation results presented, the groundwater of Jamshoro, Sanghar and Hyderabad cities fall in excellent water quality. Karachi, Mirpurkhas and Naushehro Feroz cities were found to have "good water quality".The groundwater quality was assessed by the water quality index of the samples (Rabia Shabbir and Sheikh Saeed Ahmad, 2015). Values varied from 21 to 201. From the study 23% of the samples fell in the excellent water quality category, 27% of groundwater samples fell in good water quality, 45% of samples showed "poor water quality" and 1% of samples indicated "very poor water quality". Groundwater samples at wastewater discharge points were largely poor, while the rest of the groundwater samples ranged from excellent to good water quality, with excellent quality reported in fewer points.Sravan Kumar Chilukuri *et al.*, (2019) used the Weighted Arithmetic Method to assess groundwater quality around the dumpsite. During the study period, 7 samples of groundwater were analysed and a WQI was calculated. 'WQI' of the groundwater samples were S1 (34.7), S2 (42.8), S3 (54.2), S4 (26.8), S5 (54.8), S6 (34.7) and S7 (72.4) respectively. From the obtained water quality index values four samples (S1, S2, S4 and S6) were falling in good quality and three samples (S3, S5 and S7) were falling in poor water quality.Arif Ahamad *et al.,* (2018) assessed groundwater quality in parts of Varanasi city and calculated WQI values to understand the quality of groundwater. WQI ranges were found in the region from 16.09 to 53.03. A total of 93 % of the 15 samples analysed fell into the excellent water category, with the remaining samples falling into the good water quality category.

CONCLUSION:

The present study employed a statistical approach to compute the Water Quality Index (WQI), helped in integrated assessment of groundwater quality in the study area. A range of various physicochemical parameters including EC, TDS,TA, TH, Na^+, Ca^{2+}, Mg^{2+}, Cl^-, SO_4^-, NO_3^-,and K^+, and other key indicators were analyzed to evaluate the overall suitability of groundwater for drinking purposes. The WQI results revealed that the majority of water samples fall under the category of "Excellent quality," while only four samples were classified as "Good quality." The few deviations from excellent quality may be due to localized sources of contamination, such as agricultural runoff, leaching from domestic waste, or naturally occurring geogenic influences.

Overall, continued monitoring and periodic assessment using WQI and statistical tools are recommended to ensure the long-term sustainability of groundwater resources. These results may serve as a baseline for policymakers, environmental planners, and local authorities to implement effective water resource management strategies and mitigate any emerging threats to groundwater quality.

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