TECHNIUM

Technium Vol. 21, pp.73-82 (2024)
ISSN: 2668-778X
www.techniumscience.com

Application of Water Quality Index in Assessing water Quality: A Case Study of the Shatt Al Arab River.

Zuhal Abdul Hadi Hamza
Department of Civil Engineering, College of Engineering/ University of Basrah, Iraq.
Email: Zuhal.hamza@uobasrah.edu.iq

Abstract

This investigation pertains to the evaluation of water quality in the Shatt Al-Arab River, located in the Basrah province of southern Iraq, from 2017 to 2022. Its quality should be assessed regularly, and the condition of water resources should be maintained accordingly. The most common analytical method for describing and assessing general water quality is the Water Quality Index (WQI). Various physicochemical parameters like pH, total dissolved solids, total hardness, calcium, magnesium, chloride, and total alkalinity are considered for the present study. The Weighted Arithmetic Water Quality Index Technique is used to evaluate these data. For checking the portability of the parameters within the acceptable limit, WHO is adopted. According to the study mentioned above, the quality has been found to be very low compared to the WQI value. It is also observed that the water was found unsuitable for drinking purposes, and it is considered harmful to human health; therefore, it requires some kind of processing before use. This study will be beneficial to policymakers for identifying and providing details about water quality in the form of a specific value.

Keywords: Shatt Al-Arab River; physicochemical parameters; standard values; water quality index.

1. Introduction

Water is a crucial natural resource with social and economic significance for humans. Without water, the survival of humans would be in jeopardy. Groundwater and surface water are the world's most significant drinking supplies [1, 2]. An alteration in the quality of the water source could arise from the accumulation of pollutants in surface water caused by human factors, climate change, and hydrology, due to widespread social and economic growth. In the field of managing water resources, maintaining a suitable level of water quality is a challenge [3, 4]. Water bodies' physical, chemical, and biological characteristics can be examined for changes associated with either natural or man-made phenomena [5]. As a result, by gathering samples and gathering data at particular locations, the physical, chemical, and biological parameters—also known as variables—can be used to test the water quality of any given body of water [6]. One tool for assessing water quality is the Water Quality Index (WQI), which is also one of the best ways to summarize the quality of the water since it condenses a lot of information into a single number, making it easier to understand and present the facts in an understandable way [7]. To better understand water quality, several researchers have conducted a variety of studies [8, 9].

The Water Quality Index (WQI) is a useful tool for evaluating or categorizing the quality of different types of water. It can be used to identify physical and regional variations in surface water conditions as well as to educate policymakers and concerned citizens about water quality [10, 11]. There is currently increased interest in artificial intelligence and its possible applications for controlling and monitoring water quality [12]. It is crucial to process, assess, and determine the water resource's quality. Measurements of T C°, electrical conductivity (EC), organic materials, metals, and all other parameters are commonly used to compute WQI [13]. because it can ascertain the ultimate water quality condition without the need to interpret individual evaluation methods [14].Then, instead of using temporary weights, these rates are converted. The final weight of each variable is then obtained by dividing each temporary weight by the total of all the temporary weights [15, 16]. An artificial neural network approach has recently been used to estimate water quality, saving time and effort [17]. WQI has an advantage over other evaluation techniques since it can ascertain the ultimate state of the water quality without having to interpret each variable [18].

The primary goal of the current study is to use WQI to determine whether the quality of Shatt Al-Arab water is suitable for drinking.

2. Materials and Methods

Study Area and Data Collection

The Shatt Al-Arab River is located in the south of Iraq. The Shatt Al-Arab River is roughly 192 kilometers long. It empties into the Arabian Gulf after flowing southeast through Basrah City. The width of the Shatt Al-Arab River varies over its course, reaching 2000 meters at the estuary, 600 meters close to Basrah City Center, and 250–300 meters near the Euphrates–Tigris confluence. It is situated between latitudes (30) and (59) in the north and (47) and (26) in the east. The data period is from January 2022 until August 2022. Statistical analyses on the data that had been collected. The sites where the stations are represented as Al-Qurna, Karmat Ali, Al-Ashar, and Sehan. Figure 1 shows the study area map of the Shatt Al Arab River.

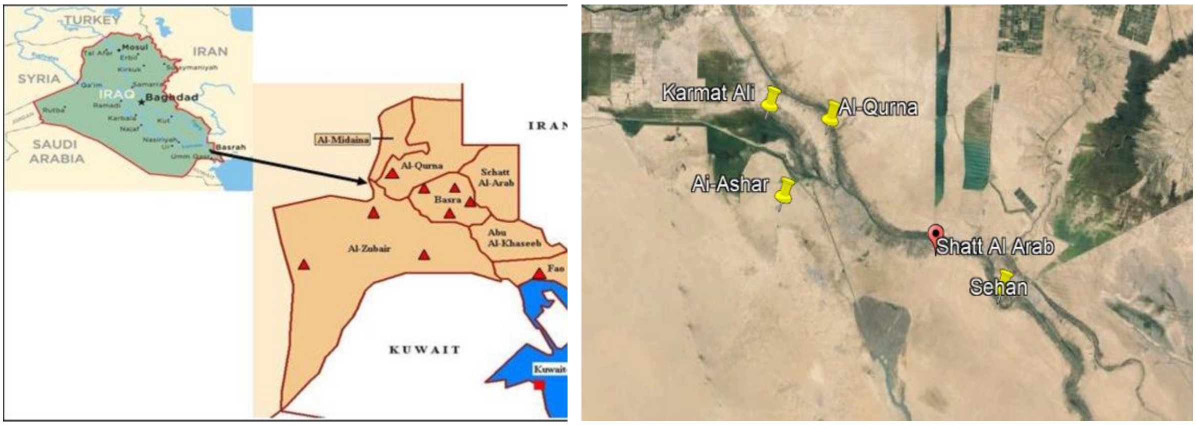

Figure 1. study area map.

2-2 Methods

The test procedure is based on the method described by the American Public Health Association (APHA) in 2012 for the collection and testing of water quality parameters for the assessment of water quality [19]. The specified physical and chemical parameters were assessed in accordance with the recommendation provided by the Iraqi Standard Water specification code, and WHO [20]. An analytical method known as the Water Quality Index (WQI) was used to measure a number of additional water quality factors and determine their impact on the overall quality of the water. In the following studies, the WQI was evaluated using the Weight Arithmetic Water Quality Index (WAWQI) method [11, 12]. Ten characteristics of the water quality—pH, turbidity, and total dissolved solids—were analyzed. Complete alkalinity, sulfate, nitrate, calcium, magnesium, chloride, and total hardness.

This study employed the WAWQI method, which consists of the following four steps [21]:

1- Choosing parameters to measure the quality of water [16].
2- Every parameter has a scaled quality rating.
3- The weight of the unit (Wi) is determined and is inversely related to the standard value (Si) of the suggested parameters [22].
4- The final WQI is obtained by aggregating the sub-index values.

The WQI was computed using the following formulas. Equation (1) was used to calculate the unit weight (Wi) for each water quality parameter as follows [13, 14].

$$W_i = \frac{K}{S_i} \quad (1)$$

where Wi represents the ith parameters' unit weight.

K is denoted a proportionality constant. Si is the standard value of each parameters .

$$K = \frac{1}{\sum \frac{1}{S_i}} \quad (2)$$

Equation (3) was used to determine the quality rating scale (Qi) for each parameter [23]:

$$Q_i = \left(\frac{V_i - V_o}{S_i - V_o}\right) \quad (3)$$

Equation (4) determined the quality rating scale for pH,

$$Q_i = \left(\frac{V_i - 7}{S_i - 7}\right) \quad (4)$$

where Vo is the parameter's ideal value and Vi is the concentration value for the ith analyzed parameter. While the ideal value of every other parameter is zero, with the exception of pH, which has an ideal value of 7. The final equation can be presented in Equation (5).

$$SI_i = \frac{\sum W_i Q_i}{\sum W_i}$$

$$WQI = \sum SI_i \quad (5)$$

SI_i is the sub index of the I th parameter and I represents the number of the parameter taken into consideration. In Table 1, The ideal values and unit weights for the water quality variables and their standard values are shown [17].

Table 1. Standard limits for parameters

Parameters	Acceptable limit	Ideal values Vo
pH	6.5-8.5	7
Turbidity	1	0
TDS	500	0
Calcium	75	0
Magnesium	30	0
Chloride	250	0
sulphate	200	0
Nitrate	45	0
Total Alkalinity	200	0
Total Hardness	200	0

3. Results and Discussion

Table 2. Shows the WAWQI water quality range.

WQI	Water Types (Class)
0-25	Excellent Water
26-50	Good Water
51-75	Poor Water
76-100	Very Poor Water
Above 100	Unsuitable water

It was noted that the concentration of various parameters in Table 3 was high and had surpassed the acceptable limit for the area under consideration. In the majority of the cases, the TDS, TH, Ca, Mg, Cl, and total alkalinity concentrations were higher than the allowable limit for the specific year. It has been noted that the TH, TDS, Mg, and total alkalinity influence the water quality and contribute to the WQI with other parameters. Total hardness and TDS, on the other hand, were much higher than the values for TH and TDS given in the acceptable value (WHO) guidelines. The pH values lie within the allowable limits. With rising values for these parameters, the WQI score increases. WQI, which is often used for the recognition and analysis of quality and the state of pollution, can be considered a representation of the combined impact of various water quality variables on the overall water quality. The ecological status of water may be assessed using the WQI value produced using the WAWQI method procedure. The WQI for all samples taken was calculated according to the procedure explained in materials methods, as shown in Tables (4,5, 6, and 7). WQI indicates the quality of water in terms of an index number, which represents the overall quality of water for any intended use. On the basis of the WQI, the water quality index obtained for water samples in different sites in August 2017 and August 2018 (for years in 2018, 2020, 2021, and 2022) is shown in Table 8.

Table 3. Physicochemical parameters analyzed and comparison with Acceptable values.

Iraqi acceptable Values for irrigation		2500	300	147	6.5-85	250	200	450
Acceptable value (WHO)		500	200	30	6.5-8.5	250	200	75
Site	Year	TDS	TH	Mg	pH	Cl	Alkalinity	Ca
Al-Qurna	2017	1270	510	56	8.3	360	203	109
Karmat Ali	2017	2652	784	103	8.1	960	208	140
Al-Ashar	2017	2886	804	108	8	1045	203	140
Sehan	2017	6952	1352	193	7.5	3200	203	218
Al-Qurna	2018	1326	564	62	8.5	352	286	126
Karmat Ali	2018	1291	546	66	8.5	333	186	111
Al-Ashar	2018	15670	4004	660	8.3	7078	250	518
Sehan	2018	41938	8000	1488	8.4	21850	269	720
Al-Qurna	2020	951	533	69	7.32	261	211	97
Karmat Ali	2020	2272	821	80	8.5	689	189	194
Al-Ashar	2020	1680	688	74	8.3	466	102	150
Sehan	2020	2640	777	58	8.37	855	168	211
Al-Qurna	2021	1080	614	60	8.4	265	123	146
Karmat Ali	2021	4300	1267	179	8.2	1715	167	208
Al-Ashar	2021	3440	979	124	8.2	1225	147	185
Sehan	2021	11334	1920	313	8.1	5978	181	246
Al-Qurna	2022	1160	499	46	8.4	400	140	118
Karmat Ali	2022	10156	3456	598	7.8	4258	188	370
Al-Ashar	2022	12342	3840	644	7.8	5849	188	444
Sehan	2022	37035	8640	1656	7.86	20425	184	666

Table 4. Calculation of water Quality index in Al-Qurna

Year	Parameters	Observed Values (vi)	Unit weight Wi	Quality Rating Qi=vi/si	QiWi
2017	TDS	1270	0.006536785	127	0.830172
	TH	510	0.01307357	102	1.333504
	Mg	56	0.06536785	56	3.6606
	pH	8.3	0.769033529	86.66666667	66.64957
	Cl	360	0.02614714	144	3.765188
	Alk	203	0.032683925	101.5	3.317418
	Ca	109	0.087157133	145.3333333	12.66684
	QWI= 92.22329				
2018	TDS	1326	0.006536785	132.6	0.866778

	TH	564	0.01307357	112.8	1.474699
	Mg	62	0.06536785	62	4.052807
	pH	8.5	0.769033529	100	76.90335
	Cl	352	0.02614714	140.8	3.681517
	Alk	286	0.032683925	143	4.673801
	Ca	126	0.087157133	168	14.6424
	QWI=40.38196				
2020	TDS	951	0.006536785	95.1	0.621648
	TH	533	0.01307357	106.6	1.393643
	Mg	69	0.06536785	69	4.510382
	pH	7.32	0.769033529	21.33333333	16.40605
	Cl	261	0.02614714	104.4	2.729761
	Alk	211	0.032683925	105.5	3.448154
	Ca	97	0.087157133	129.3333333	11.27232
	QWI=99.75819				
2021	TDS	1080	0.006536785	108	0.705973
	TH	614	0.01307357	122.8	1.605434
	Mg	60	0.06536785	60	3.922071
	pH	8.4	0.769033529	93.33333333	71.77646
	Cl	265	0.02614714	106	2.771597
	Alk	123	0.032683925	61.5	2.010061
	Ca	146	0.087157133	194.6666667	16.96659
	QWI= 99.75819				
2022	TDS	1680	0.006536785	116	0.758267
	TH	688	0.01307357	99.8	1.304742
	Mg	74	0.06536785	46	3.006921
	pH	8.3	0.769033529	93.33333333	71.77646
	Cl	466	0.02614714	160	4.183542
	Alk	102	0.032683925	70	2.287875
	Ca	150	0.087157133	157.3333333	13.71272
	QWI= 97.03053				

Table 5. Calculation of water Quality index in Karmat Ali

Year	Parameters	Observed Values (vi)	Unit weight Wi	Quality Rating Qi=vi/si	QiWi
2017	TDS	2652	0.006536785	265.2	1.733555
	TH	784	0.01307357	156.8	2.049936
	Mg	103	0.06536785	103	6.732889
	pH	8.1	0.769033529	73.33333333	56.39579
	Cl	960	0.02614714	384	10.0405
	Alk	208	0.032683925	104	3.399128
	Ca	140	0.087157133	186.6666667	16.26933
	WQI=96.62113				
2018	TDS	1291	0.006536785	129.1	0.843899

	TH	546	0.01307357	109.2	1.427634
	Mg	66	0.06536785	66	4.314278
	pH	8.5	0.769033529	100	76.90335
	Cl	333	0.02614714	133.2	3.482799
	Alk	186	0.032683925	93	3.039605
	Ca	111	0.087157133	148	12.89926
	QWI=102.9108				
2020	TDS	2272	0.006536785	227.2	1.485158
	TH	821	0.01307357	164.2	2.14668
	Mg	80	0.06536785	80	5.229428
	pH	8.5	0.769033529	100	76.90335
	Cl	689	0.02614714	275.6	7.206152
	Alk	189	0.032683925	94.5	3.088631
	Ca	194	0.087157133	258.6666667	22.54465
	QWI=118.604				
2021	TDS	4300	0.006536785	430	2.810818
	TH	1267	0.01307357	253.4	3.312843
	Mg	179	0.06536785	179	11.70085
	pH	8.2	0.769033529	80	61.52268
	Cl	1715	0.02614714	686	17.93694
	Alk	167	0.032683925	83.5	2.729108
	Ca	209	0.087157133	277.3333333	24.17158
	QWI=124.1848				
2022	TDS	10156	0.006536785	1015.6	6.638759
	TH	921	0.01307357	691.2	9.036452
	Mg	598	0.06536785	598	39.08997
	pH	7.8	0.769033529	53.33333333	41.01512
	Cl	4258	0.02614714	1703.2	44.53381
	Alk	188	0.032683925	94	3.072289
	Ca	370	0.087157133	493.3333333	42.99752
	QWI=186.3839				

Table 6. Calculation of water Quality index in AL-Ashar

Year	Parameters	Observed Values (vi)	Unit weight Wi	Quality Rating Qi=vi/si	QiWi
2017	TDS	2886	0.006536785	288.6	1.886516
	TH	804	0.01307357	160.8	2.10223
	Mg	108	0.06536785	108	7.059728
	pH	8	0.769033529	93.33333333	71.77646
	Cl	1045	0.02614714	418	10.9295
	Alk	203	0.032683925	101.5	3.317418
	Ca	140	0.087157133	186.6666667	16.26933
	WQI=113.3412				
2018	TDS	15670	0.006536785	1567	10.24314

Technium Vol. 21, pp.73-82 (2024)
ISSN: 2668-778X
www.techniumscience.com

	TH	4004	0.01307357	800.8	10.46931
	Mg	660	0.06536785	660	43.14278
	pH	8.3	0.769033529	86.66666667	66.64957
	Cl	7078	0.02614714	2831.2	74.02778
	Alk	250	0.032683925	125	4.085491
	Ca	518	0.087157133	690.6666667	60.19653
	QWI=268.8146				
2020	TDS	1680	0.006536785	168	1.09818
	TH	688	0.01307357	137.6	1.798923
	Mg	74	0.06536785	74	4.837221
	pH	8.3	0.769033529	86.66666667	66.64957
	Cl	466	0.02614714	186.4	4.873827
	Alk	102	0.032683925	51	1.66688
	Ca	150	0.087157133	200	17.43143
	QWI=98.35603				
2021	TDS	3440	0.006536785	344	2.248654
	TH	979	0.01307357	195.8	2.559805
	Mg	124	0.06536785	124	8.105613
	pH	8.2	0.769033529	93.33333333	71.77646
	Cl	1225	0.02614714	490	12.8121
	Alk	147	0.032683925	73.5	2.402268
	Ca	185	0.087157133	246.6666667	21.49876
	QWI=121.4037				
2022	TDS	12342	0.006536785	1234.2	8.067701
	TH	3840	0.01307357	768	10.0405
	Mg	644	0.06536785	644	42.0969
	pH	7.8	0.769033529	93.33333333	71.77646
	Cl	5849	0.02614714	2339.6	61.17385
	Alk	188	0.032683925	94	3.072289
	Ca	444	0.087157133	592	51.59702
	QWI=246.8247				

Table 7. Calculation of water Quality index in Sehan

Year	Parameters	Observed Values (vi)	Unit weight Wi	Quality Rating Qi=vi/si	QiWi
2017	TDS	6952	0.006536785	695.2	4.544373
	TH	1352	0.01307357	270.4	3.535093
	Mg	193	0.06536785	193	12.616
	pH	7.5	0.769033529	93.33333333	71.77646
	Cl	3200	0.02614714	1280	33.46834
	Alk	203	0.032683925	101.5	3.317418
	Ca	218	0.087157133	290.6666667	25.33367
	WQI=154.5914				
2018	TDS	41938	0.006536785	4193.8	27.41397

	TH	8000	0.01307357	1600	20.91771
	Mg	1488	0.06536785	1488	97.26736
	pH	8.4	0.769033529	93.33333333	71.77646
	Cl	21850	0.02614714	8740	228.526
	Alk	269	0.032683925	134.5	4.395988
	Ca	720	0.087157133	960	83.67085
	QWI=533.9683				
2020	TDS	2640	0.006536785	264	1.725711
	TH	777	0.01307357	155.4	2.031633
	Mg	58	0.06536785	58	3.791335
	pH	8.37	0.769033529	93.33333333	71.77646
	Cl	855	0.02614714	342	8.942322
	Alk	168	0.032683925	84	2.74545
	Ca	211	0.087157133	200	17.43143
	QWI=115.5331				
2021	TDS	11334	0.006536785	1133.4	7.408793
	TH	1920	0.01307357	384	5.020251
	Mg	313	0.06536785	313	20.46014
	pH	8.1	0.769033529	93.33333333	71.77646
	Cl	5978	0.02614714	2391.2	62.52304
	Alk	181	0.032683925	90.5	2.957895
	Ca	246	0.087157133	328	28.58754
	QWI= 198.7341				
2022	TDS	37035	0.006536785	3703.5	24.20898
	TH	8640	0.01307357	1728	22.59113
	Mg	1656	0.06536785	1656	108.2492
	pH	7.5	0.769033529	93.33333333	71.77646
	Cl	20425	0.02614714	8170	213.6221
	Alk	184	0.032683925	92	3.006921
	Ca	666	0.087157133	888	77.39553
	QWI=520.8503				

Table 8. The values of WQI for different sites in Shatt Al-Arab River

Year	Al-Qurna	Karmat Ali	Al-Ashar	Sehan
2017	92.22329	96.6211335	113.3412	154.5914
2018	106.2954	102.910824	268.8146	533.9683
2020	40.38196	118.604047	98.35603	115.5331
2021	99.75819	124.184812	121.4037	198.7341
2022	97.03053	186.383924	257.8247	520.8503

According to the range of the WQI, a low number denotes the best water quality, while a higher number denotes the worst quality. Table 8 shows the calculated WQI values for the study area. The WQI for all sites was greater than 100, which indicates an unsuitable quality of water.

4. Conclusions

The WQI approach used in the current study to analyze sites' water quality was helpful. According to the WQI value, the majority of the sites had very bad water quality. Most of the locations under study had unsuitable water, only in the Al-Qurna site in 2020 had good water. The results found the total hardness and TDS levels were observed to be at or above the permitted limit for the period taken into consideration and for all sites. This indicates one reason for the WQI value to be impacted by the water. The advantage of the WAWQI approach is that it combines data from numerous water quality parameters into a mathematical equation that depicts the water's ecological state. Additionally, it shows the significance that each parameter has in the evaluation and control of the quality of water and can be used to define whether a source of water in the Shatt Al-Arab River is fit for human use. After a discussion and analysis of the results that have been obtained through existing sites on the river, the following are concluded: The need for construction of wastewater treatment plants connecting the residential area to prevent discharge to the water streams.

5. Declarations

Author Contributions

The author has read and agreed to the published version of the manuscript.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

Funding

The author received no financial support for the research, authorship, and/or publication of this article.

Conflict of Interest

The author declare no conflict of interest.

6. References

[1] Kumar P (2018) Simulation of Gomti River (Lucknow City, India) future water quality under different mitigation strategies. Heliyon 4:e01074. https://doi.org/10.1016/j.heliyon.2018.e01074.
[2] Zhang L (2017) Different methods for the evaluation of surface water quality: the case of the Liao River, Liaoning Province, China. Int Rev Spat Plan Sustain Dev 5:4–18. https://doi.org/10.14246/irspsd.5.4_4.
[3] Zhao, E., Kuo, Y.-M., and Chen, N., Assessment of water quality under various environmental features using a site-specific weighting water quality index. Science of The Total Environment, 2021. **783**: p. 146868.https://doi.org/10.1016/j.scitotenv.2021.146868.
[4] Uddin, M. G., Nash, S., and Olbert, A. I., A review of water quality index models and their use for assessing surface water quality. Ecological Indicators, 2021. **122**: p. 107218.https://doi.org/10.1016/j.ecolind.2020.107218.

[5] Mukate S, Wagh V, Panaskar D, Jacobs JA, Sawant A (2019) Development of new integrated water quality index (IWQI) model to evaluate the drinking suitability of water. Ecol Indic 101:348–354. https://doi.org/10.1016/j.ecolind.2019.01.034.
[6] Britto FB, do Vasco AN, Aguiar Netto ADO, Garcia CAB, Moraes GFO, Silva MGD (2018) Surface water quality assessment of the main tributaries in the lower São Francisco River, Sergipe. RBRH 23:6–23. https://doi.org/10.1590/2318-0331.231820170061.
[7] Nayak, J.G.; Patil, L.G.; Palki, V.K. Artificial neural network based water quality index(WQI) for rover Godavari (India). Mater. Today Proc. 2021, 81,212-220.
[8] Hamlat A, Guidoum A, Koulala I (2017) Status and trends of water quality in the Tafna catchment: a comparative study using water quality indices. J Water Reuse Desal 7:228–245. https://doi.org/10.2166/wrd.2016.155.
[9] Kachroud, M.: Trolard, F.: Kefi, M.; Jebari, S.; Bourrie, G. Water Quality Indices: Challenges and Application Limits in the Literature. Water 2019, 11, 361.
[10] Yan, T.; Shen, S.L.; Zhon, A. Indices and models of surface water quality assessment: Review and perspectives. Environ. Pollut. 2022, 308, 119611.

[11] Patki, V. K.; Jahagirdar, S.; Patil, Y. M.; Karale, R.; Nadagoud, A. Prediction of water quality in municipal distribution system. Mater. Today Proc. 2022.
[12] Islam, M.S.; Azadi, M.A.; Nasiuddin, M; Islam, M. S. Water quality index of Halda River, Southeastern Bangladesh. Am. J. Environ. Eng. 2020, 10, 59-68.
[13] Abulhaija, M.M.; Mohammad, A.H. Assessing Water Quality of Kufranja Dam (Jordan) for Drinking and Irrigation: Application of the Water Quality Index. J. Ecol. Eng. 2021, 22, 159-175.
[14] Tokatli, C. Application of water quality ondex for drinking purposes in dam lakes: A case study of thrace region. Sigma J. Eng, Nat. Sci. 2020, 38, 393-402.

[15] Kachroud M, Trolard F, Kefi M, Jebari S, Bourrié G (2019a) Water quality indices: challenges and application limits in the literature. Water 11:361. https://doi.org/10.3390/w11020361.

[16] Shah KA, Joshi GS (2017) Evaluation of water quality index for River Sabarmati, Gujarat. India Appl Water Sci 7:1349–1358. https://doi.org/10.1007/s13201-015-0318-7.
[17] Zolghadr, M.; Zomorodian, S. M. A.; Fathi, A.; Tripathi, R.P.; Jafari, N.; Mehta, D.; Sihag, P.; Azamathulla, H. M. Experimental Study on the Optimum Installation Depth and Dimensions of Roughening Elements on Abutment as Scour Counter measure. Fluids 2023, 8, 175.
[18] Mehta, D. J.; Yadav, S. Meteorological drough analysis in Pali District of Rajasthan State using standard precptation index. Int. J. Hydrol. Sci Technol. 2023, 15, 1-10.
[19] Federation, W. E. and Association, A., Standard methods for the examination of water and wastewater. American Public Health Association (APHA): Washington, DC, USA, 2012. **22.**
[20] WHO Guidelines for Drinking- Water Quality. Third Edition Volume 1. Recommendation World Health Organisation. Geneva. (2004).
[21] Paun I, Cruceru L, Chiriac FL, Niculescu M, Vasile GG, Marin NM (2016) Water quality indices—methods for evaluating the quality of drinking water. In: Proceedings of the 19th INCD ECOIND International Symposium—SIMI 2016, "The Environment and the Industry", Bucharest, Romania, 13–14 October 2016: 395–402. https://doi.org/10.21698/simi.2016.0055.
[22] Tripathi M, Singal SK (2019) Allocation of weights using factor analysis for development of a novel water quality index. Ecotox Environ Safe 183:109510. https://doi.org/10.1016/j.ecoenv.2019.109510.
[23] Jena V, Dixit S, Gupta S (2013) Assessment of water quality index of industrial area surface water samples. Int J Chemtech Res 5:278–283.
[24] Yogendra K, Puttaiah ET (2008) Determination of water quality index and suitability of an urban waterbody in Shimoga Town, Karnataka. Proceedings of Taal 2007: The 12th world lake conference 342: 346.