European Scholar Journal (ESJ)
Available Online at: https://www.scholarzest.com
Vol. 4 No.07, July 2023
ISSN: 2660-5562

WATER QUALITY ASSESSMENT BY USING GEOGRAPHIC INFORMATION SYSTEM (GIS) OF AI-MSHARRAH RIVER IN MISAN GOVERNORATE

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Article history:

Received: 26th May 2023
Accepted: 26th June 2023
Published: 28th July 2023

Abstract:

The aim of the study to the assessment of water quality by WQI model, Overall Index of Pollution (OIP-WQI) through field survey and visual interpretation of satellite images in Al-Musharrah River. Samples were collected from three sites in al AI-Msharrah River during 2022-2023 the water quality of the AI-Msharrah River was classified as slightly polluted, as it ranged (3.08) in the first site, and in the second and third sites, the values ranged (4.5-4.51) during the summer, and the river water was classified as polluted and unfit for human uses, while in the autumn and winter, the river water was classified as slightly polluted in the three sites, as the values in the three sites ranged between (3.6-3.72). GIS maps were created based on OIP-WQI for the AI-Msharrah River for the summer, and the first site was classified in yellow as slightly polluted, its value ranged between (3.08-3.56), and at a distance from the first site, the color represented the green color with values ranging from (3.57-4.03) and classified as polluted. The rest of the sites in red ranged in value (4.04-4.51) where water quality was classified according to the OIP-WQI General Pollution Guide as also polluted. In the fall, the results recorded values ranging from (3.4-3.24) for the first site and the sites near it, which were yellow and the value of (3.41-3.56) sites in green, while the sites in red, including the second and third sites of the current study, ranged values between (3.72-3.57) and on the basis of these values water was classified during the autumn as slightly polluted. In winter, the results recorded values ranging from (3.46-3.54) for the sites in yellow and values ranging from (3.55-3.63) represented in green and (3.64-3.71) for the sites in red. These results obtained using GIS are similar to the measured OIP-WQI index values.

Keywords: AI-Msharrah River, Water Quality Index ,Remote Sensing Techniques,

INTRODUCTION

Euphrates and Tigris Rivers and their tributaries are the main and essential sources of fresh surface water in addition to the lakes, and just a little of water resources (14%) originates from groundwater [1].

AI-Msharrah River is one of the short rivers in Iraq that branches off from the northwestern side of the Tigris River in the city of misan . AI-Msharrah River provides the residential, agricultural and industrial areas that lie on its banks with water [2]. Water is a very essential and precious natural resource for sustaining life on this planet. Owing to the increase in population and indiscriminate utilization, this vital resource is now under tremendous pressure. A complete understanding of water quality issues, it is important to translate it to a language understandable to policy makers [3]. The purpose of the overall index of pollution (OIP) is to integrate complex data and generate a score that defines water quality status and assesses water quality trends [4],[5]. This study concentrates on determination and assessment of water quality of AI-Msharrah River using OIP index and finally depicting it using geographical information system (GIS). The index method was firstly proposed by Horton [6]. Numerous water quality indices have been expressed all over the world like national sanitation foundation- WQI [7], Oregon WQI [8], British Columbia WQI [9], Canadian Council of Minister of the Environment -WQI [10] to assess the water quality. OIP-WQI is a promising tool and efficient to study the effect of water quality changes along a the river. It is also a very useful tool for communicating the information on overall quality of water to the concerned citizens and policy makers. This could help to evaluate and solve local and regional surface water quality related problems [11], [12]. AI-Msharrah River is of fundamental importance for domestic, agricultural and industrial uses and its importance Water bodies are essential to meet the requirements of misan Governorate.

The study aimed to use nine environmental criteria in assessing the quality of the AI-Msharrah River General use during the three seasons.

MATERIAL AND METHODS

Study Area

This study included taking three sites along the AI-Msharrah River, Figure (1). The first site was located at the beginning of the river's fork, and the second in the middle of the river. The last site was in the center of AI-Msharrah district. These sites were determined by the Global Positioning System (GPS).

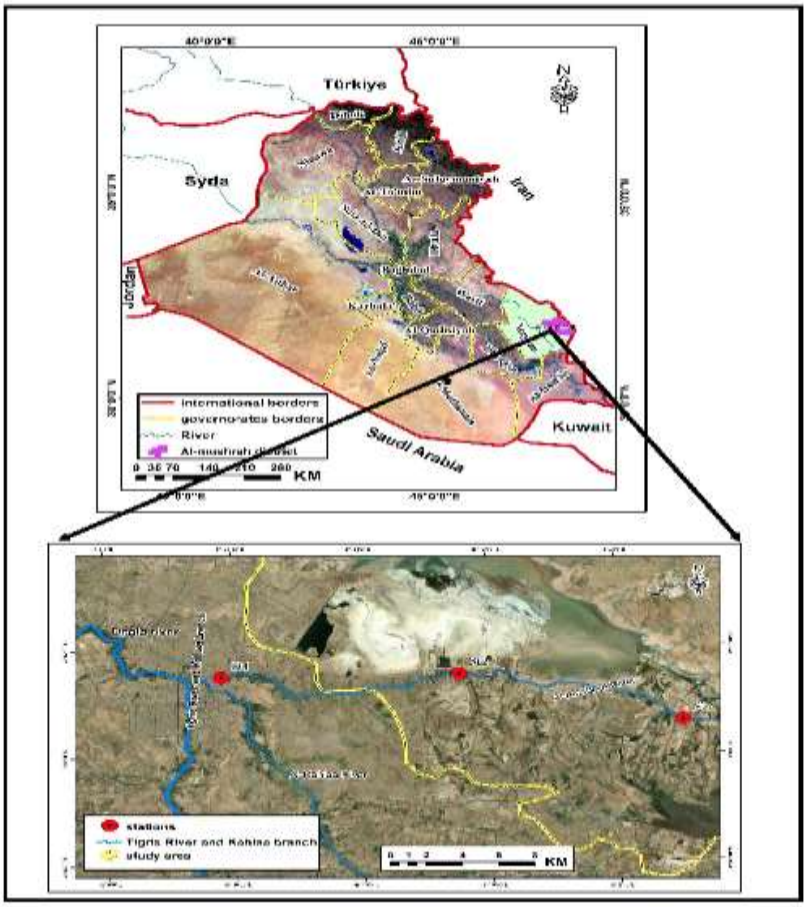

Figure (1) A map showing the study sites in the AI-Msharrah River using GIS by Department of Water Resources, 2023

Field sampling and analytical procedures

Water samples were collected monthly for the period from July 2022 to January 2023 and expressed during the summer season (July, August), autumn (October, November) and winter (December, January) from three different stations of AI-Msharrah River in misan Governorate for the purpose of conducting physical examinations. Samples were preserved and analyzed according to [10]. Physical and chemical parameters including water turbidity (NTU), Total dissolved solid (TDS), Chloride (CL), Dissolved oxygen (DO), and pH were measured in situ using a WTW multi-meter model Multi 340i. Biological oxygen demand (BOD_5) measured by winkler method. Total hardness (TH) was measured by Na2EDTA complex metric titration. Sulfate (SO4) and nitrate (NO3) concentration was determined spectrophotometric-ally method.

Estimating the OIP-WQIs

The OIP-WQI was developed to use as a tool for simplifying and describe the water quality data [14]. OIP creates a score to evaluate the surface water quality of Indian rivers founded on measurements and classification of pH, BOD5, dissolved oxygen, turbidity, total hardness, total dissolved solids, sulfate, nitrate and Chloride. The model classified the river water to five categories as Slightly Polluted (requires filtration and disinfection) and Polluted (requires special treatment and disinfection) according to Indian standards or WHO standard as presented in Table (1).

The mathematical expression of this OIP method is given by [14]:

$$OIP = \sum_{i=1}^{n} \frac{Pi}{n} \qquad \text{Eq.(2.19)}$$

Where:

Pi = pollution index for ith parameter can be obtained from mathematical expressions for each of the parameter concentration levels Table (1).
n = number of parameters.

Table (1). OIP ranks water quality in 5 categories.

OIP values	Water quality
0-1	Excellent
1-2	Acceptable
2-4	Slightly polluted
4-8	Polluted
8-16	Heavily polluted

RESULTS AND DISCUSSION

The results of the study showed during the three seasons in the first, second and third sites that they are low in pollution, which ranged from 3.6 to 3.72. Except for the second and third sites in the summer, the values of the variables ranged From (4.1-4.1) and classified as polluted according to the measurements of the OIP-WQI water quality index, Figure (2). This difference in the degree of pollution was due to the high values of variables during this period in the second and third sites, such as a pH of 8.8, total suspended solids 1415 mg / L, total hardness higher than 500 mg / L, and the biological requirement for oxygen higher than 6.8 mg / L, which exceeded the standards of the World Health Organization for drinking water. Chlorine was higher in the second and third sites in the summer compared to the rest of the results in the seasons and sites. These results showed that the river water is unsuitable for human use without prior treatment, as it was classified as slightly polluted to polluted due to various natural reasons and human activities such as the increase of untreated domestic sewage and runoff water from agricultural lands on both banks of the river. In the fall and winter seasons, the results of the study indicated that there was little pollution in the water quality in the three locations. The values of the general index for pollution ranged between (3.24 -3.72), and it was classified according to the OIP-WQI scale as slightly polluted (2-4).

It is possible to estimate pollution values by entering colors or contour lines, through which we can benefit from them in the future. This method has become a predictive tool in our study. The current study used the inverse distance measurement method Inverse Distance Weighted) IDW) for spatial interpolation [15]. GIS maps were created based on OIP-WQI for the Musharah River for three seasons (summer, autumn, and winter). In the summer season, the first yellow site was classified as slightly polluted, with a value ranging between(3.08-3.56)At a distance from the first location, the color represents green with ranged values(3.57-4.03)It is classified as contaminated. The rest of the sites in red ranged in value (4.04-4.51) The water quality therein was classified according to the Overall Index of Pollution (OIP-WQI) as polluted as well, Table (2) Figure (3). In the autumn, the results recorded values ranging (3.4-3.24) for the first site and the sites close to it, which were represented in yellow, and a value of (3.41-3.56) for the sites in green. As for the sites in red, including the second and third sites of the current study, their values ranged between (3.72-3.57). On the basis of these values, the water of Al-Musharah River was classified during the autumn season as slightly polluted according to the classification and the results obtained based on the OIP-WQI guide and as shown on the GIS Figure (4).

In the winter, the results recorded values that ranged from (3.46-3.54) for sites in yellow, and values ranged (3.55-3.63) in green and (3.64-3.71) for sites in red, Figure (5). These results obtained using GIS are close to the measured OIP-WQI index values.

This result agreed with Al-Mayah [17] in his study of twenty-one sites along the Al-Gharraf River when using the general index of pollution, as he found a discrepancy in the percentage of pollution in the sites located at the end of the Al-Gharraf River. And another study of the Hawizeh marsh AL-Nakeeb [16]. And international studies in which the General Index of Pollution was used to assess water quality, such as Dras Fulazzaky [13] on the Citarum River in Malaysia.

Table (2) the values of the (OIP-WQI) for the study sites during the summer.

ID	Individual parameter indices									OIP-WQI valu	OIP - WQI scale	Wate Quality Rating
	Turb. NTU	TH mg/l	pH	TDS mg/l	DO %	BOD_5 mg/l	SO_4 mg/l	Cl mg/l	NO_3 mg/l			
S1	2.18551	2.38	2.40609	2.63847	3.653099	4.13	7.3793	1.99	1	3.08	2-4	Slightly polluted
S2	2.48986	5.6	5.2782	2.8633	4.036825	4.5333	8.5893	2.56	1	4.1	4-8	polluted
S3	2.64928	8.4	1.09683	3.55442	5.039303	7.3333	7.9693	3.63	1	4.51	4-8	polluted

Table (3) the values of the (OIP-WQI) for the study sites during the Autumen.

ID	Individual parameter indices									OIP-WQI value	OIP - WQI scale	Wate Quality Rating
	Turb. NTU	TH mg/l	pH	TDS mg/l	DO %	BOD_5 mg/l	SO_4 mg/l	Cl mg/l	NO_3 mg/l			
S1	2.44638	3.77	1.51573	2.79662	3.584919	4.26667	6.8693	3.00	1	3.24	2-4	Slightly polluted
S2	2.77971	8.31	1.25993	2.50311	3.721279	4.22	6.9993	1.63	1	3.6	2-4	Slightly polluted
S3	3.06957	5.98	1.0473	2.95195	4.036825	5.40667	8.2293	1.80	1	3.72	2-4	Slightly polluted

Table (4) the values of the (OIP-WQI) for the study sites during the winter.

ID	Individual parameter indices									OIP-WQI value	OIP - WQI scale	Wate Quality Rating
	Turb. NTU	TH mg/l	pH	TDS mg/l	DO %	BOD_5 mg/l	SO_4 mg/l	Cl mg/l	NO_3 mg/l			
S1	1.93913	3.26	1.82347	2.32583	3.380378	4	6.7893	8.96	1	3.71	2-4	Slightly polluted
S2	2.14203	4.03	1.44728	2.3226	3.85764	4.33333	7.2993	4.72	1	3.46	2-4	Slightly polluted
S3	2.28696	8.08	1.20303	2.53453	3.92582	5.2	7.4693	1.15	1	3.64	2-4	Slightly polluted

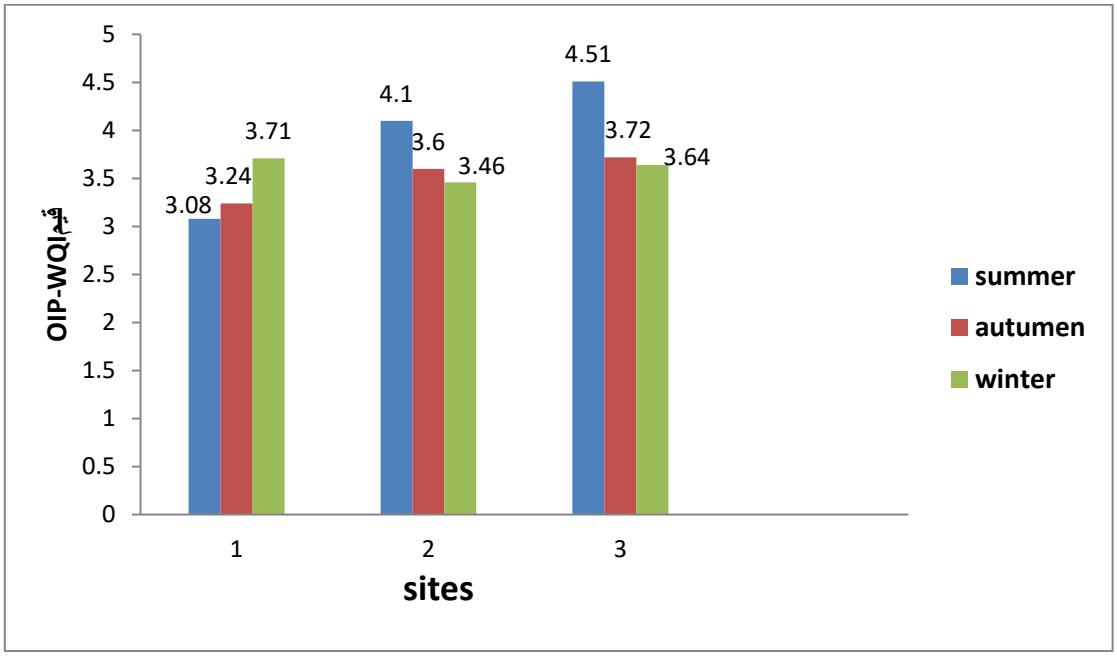

Figure (2) sites and Seasonal (OIP-WQI) values for Al-Musharah River.

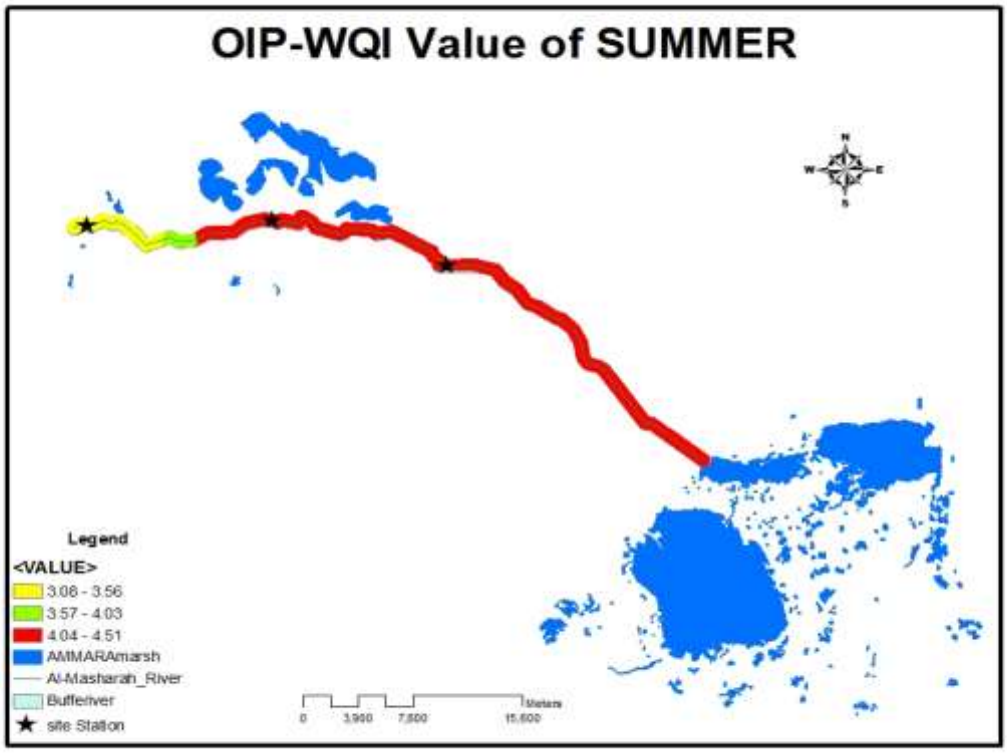

Figure (3) Summer values map (OIP-WQI).

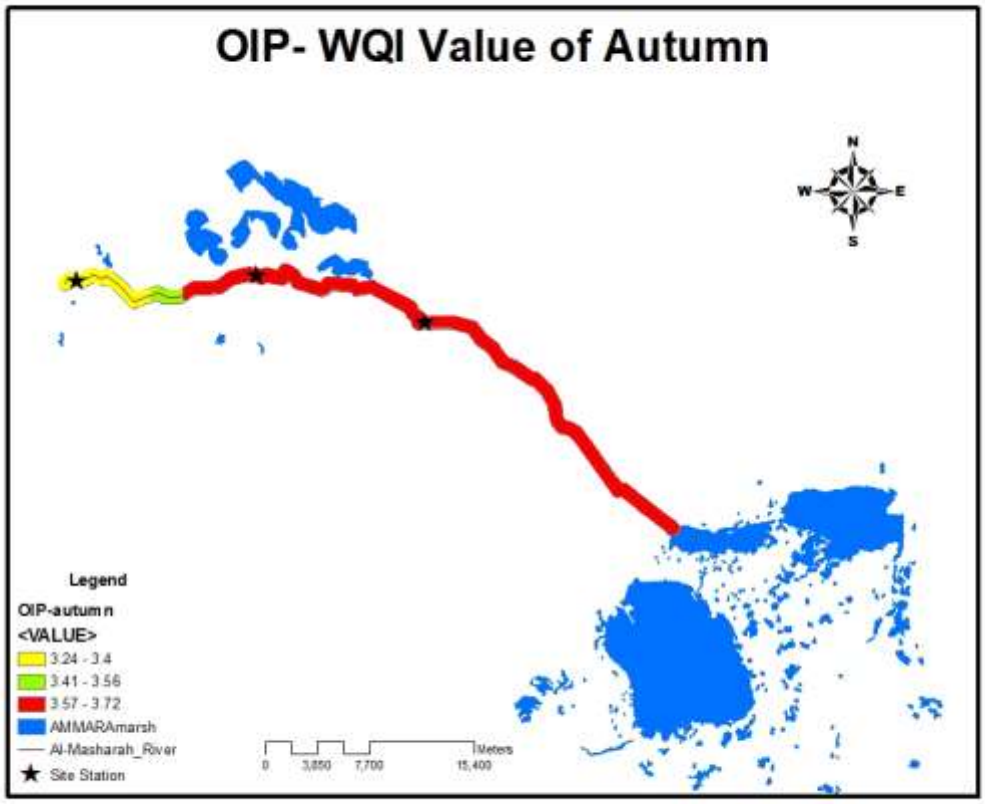

Figure (4) Autumn values map (OIP-WQI).

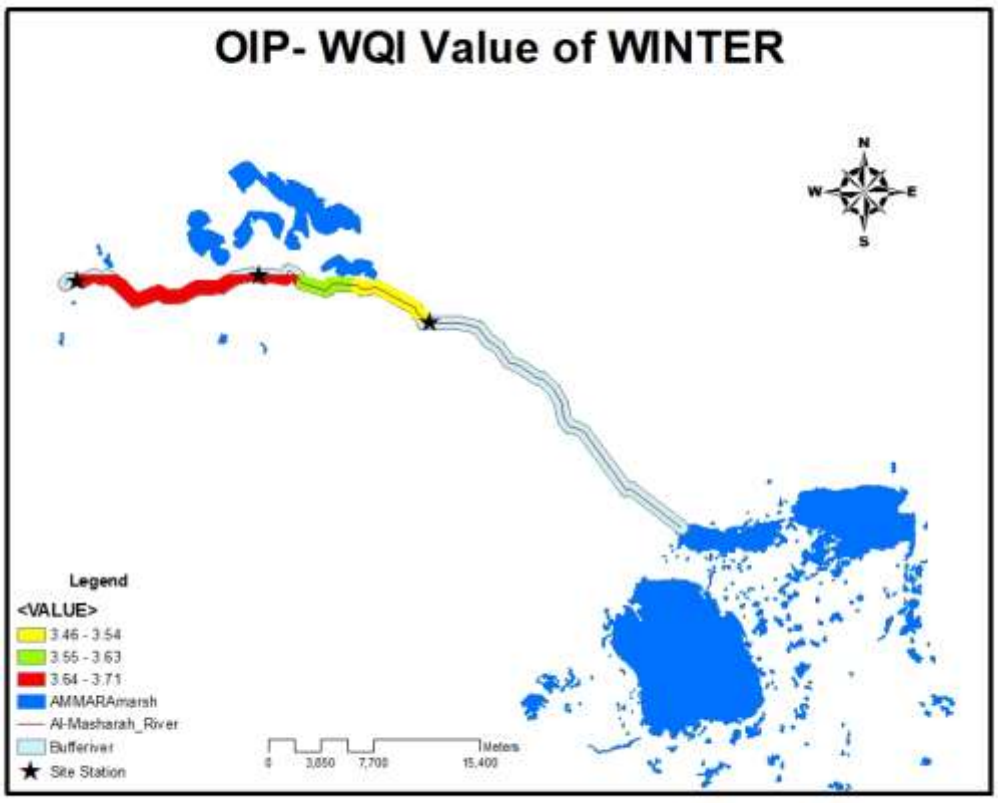

Figure (5) Winter values map (OIP-WQI).

CONCLUSION

The results of the study revealed that the waters of the Mashrah River can be used for the public Consumption after detailed treatment. On the other hand, the lack of water in the river and The discharge of sewage and runoff from agriculture has negatively affected the water quality. The study showed that the OIP application is a useful tool in assessing the public river quality. Therefore, assessing water quality with the OIP tool can help local assessment and solve it and regional water quality problems along the river.

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