Studying and Assessment of Water Quality of Euphrates River in Iraq

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Abstract

One of Iraq's primary water sources, the Euphrates River, was the subject of this water quality assessment. This study set out to evaluate the quality of the water flowing down the Euphrates River in Iraq. Water samples were collected seasonally at seven stations: S1 (Al-Ramadi), S2 (Al-Hilla), S3 (Karbala), S4 (Al-Najaf), S5 (Al-Diwaniya), S6 (Al-Samawa), and S7 (Al-Nasiriyah) from January 2023 to December 2023. Five parameters were analyzed, Hydrogen Ions (pH), and total dissolved solid (TDS). Dissolved oxygen (DO), Nitrate (NO3), and Phosphate (PO4). In the research region of the Euphrates River, seasonal fluctuations in the tested parameters of water varied from one season to the next. The values of these parameters are high in all stations in Summer, and they decrease in Spring. The parameters (pH, DO, NO3, and PO4) in all stations were within the allowable limit of water quality according to the (Iraqi Standards of River Water), while in station (5), the value of TDS exceeded the allowable value in Summer (2750) and Autumn (2600), in stations (6) the values of TDS were exceed the allowable value in all Seasons which reach (2291ppm, 2750 ppm, 1870 ppm, 3120 ppm and 2990 ppm). In stations (7), TDS exceeded the allowable value in all Seasons which reach (2709 ppm, 2305 ppm, 3900 ppm, and 3670 ppm).

Keywords- Euphrates River, Part per million, Polluted water, Standard allowable values, Water quality.

I. INTRODUCTION

One of the most important sources of naturally occurring fresh surface fluids, river water, is used for a variety of human needs, including irrigation, drinking, and industrial production. The importance of surface water quality (WQ) monitoring and management in ensuring the sustainable use of these water resources and protecting the environment cannot be overstated [1]. A lot of work has been done to try to improve WQ management and sustainability in the last several decades by accurately simulating the biological, chemical, and physical processes of different pollutants [1],[2].
One of the two primary components of the Tigris-Euphrates River system, the 1,740 mile (2,800 km) long Euphrates River, is the longest river in southwest Asia. The river begins its journey in Turkey and continues southeast, passing through Syria and Iraq. [3]. Numerous ancient cities, the foundations of which may still be seen today, sprung up along its banks as a result of the extensive irrigation that occurred there. It forms the historical boundary of what was formerly called Mesopotamia with the Tigris [4].
April through May saw the highest levels of runoff into the Euphrates since that's when the river gets the majority of its water from precipitation and melting snow [5]

The pH of surface water is a common field measurement quantitative measure of the acidity or basicity of aqueous or other liquid solutions [6].
When evaluating the quality of a water supply, total dissolved solids (TDS) are a useful indication of the water quality. The components of total dissolved solids (TDS) include organic compounds and inorganic salts [7],[8].
Commonly used methods for quantifying the quantity of dissolved substances in water include total dissolved solids (TDS) measurements [9].
The concentration of oxygen in water that is not bound to any compounds is called its dissolved oxygen level. This metric is crucial for evaluating water quality since it affects the aquatic creatures. Water quality and the safety of aquatic life are both impacted by the dissolved oxygen level [10],[11].
Surface water is heavily contaminated by nitrate. Nitrate concentrations over the permissible limit are not safe for usage in the home. Nitrate alone is usually not dangerous to humans, but it can be transformed into nitrite and nitrosamines through metabolic processes. Animal welfare is so impacted as well [12].

Chemical compounds that contain the phosphate ion (PO_4^{-3}) are utilized extensively in agricultural fertilizers to boost plant development and are essential to several biological processes [9]. However, One major environmental problem is the phosphate load that enters aquatic ecosystems from sewage discharge, industrial effluents, and agricultural runoff [13].

One of the primary impacts of elevated phosphate levels is eutrophication, a process that leads to excessive growth of algae and aquatic plants [14].

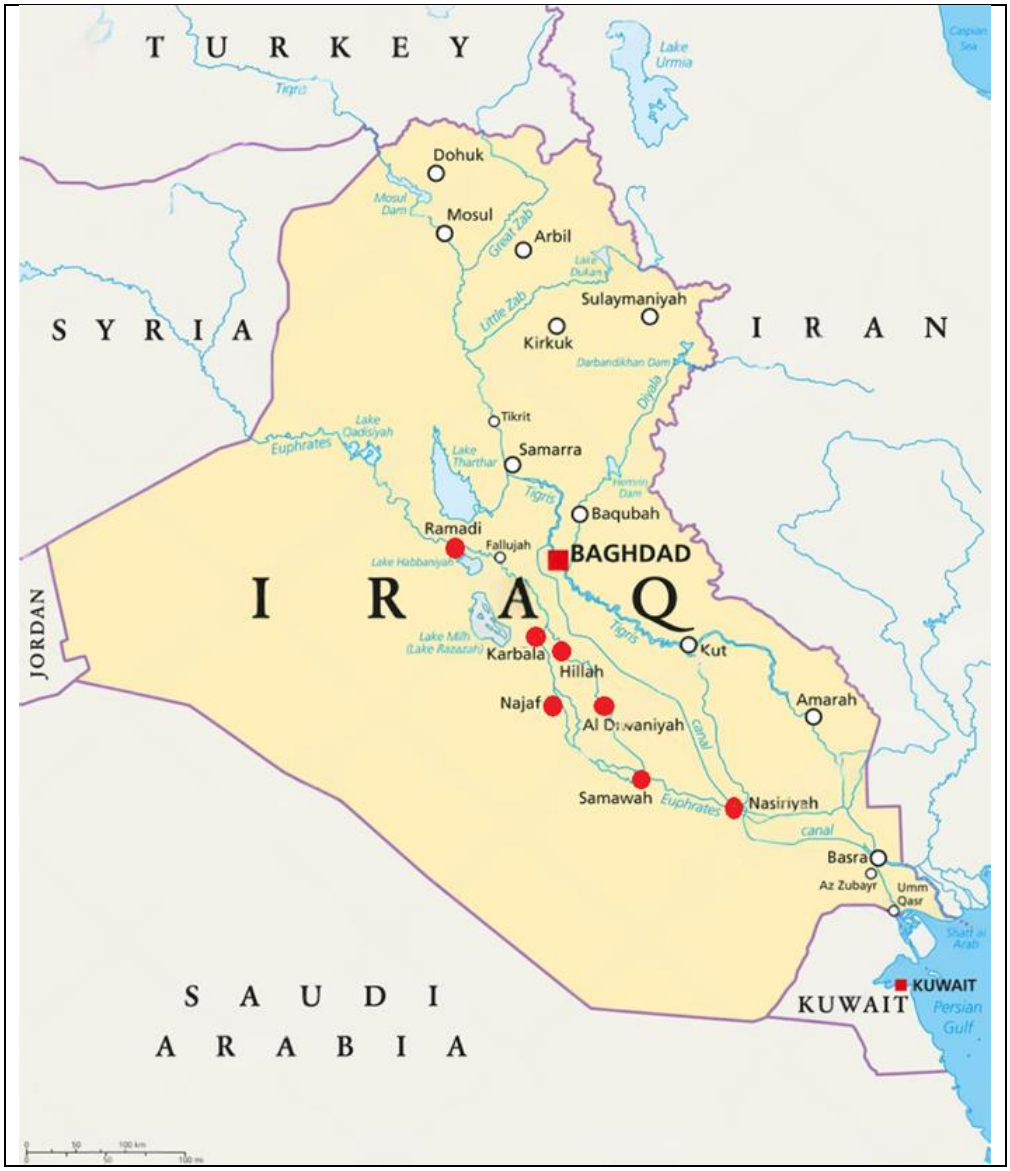
II. STUDY REGION

The study region covers seven governorates located along the Euphrates River (Al-Ramadi, Al-Hilla, Karbala, Al-Najaf, Al-Diwaniya, Al-Samawa, and Al-Nasiriyah).

The quality of Euphrates River water was tested seasonally (Winter, Spring, Summer, and Autumn) as shown in "Figure 1".

Water tests include finding the values of (pH, DO, TDS, NO3, and PO4) parameters at these seven stations.

"Table 1" represents the stations and GIS along the study region.



Figure, 1 Map of the Republic of Iraq showing the seven study stations on the Euphrates River

TABLE 1 Stations and GIS along the study region

Stations	Latitude	Longitude
S1 (Al-Ramadi)	33°89′75.1″ N	37°01′45.8″ E
S2 (Al-Hilla)	41°92′99.9″ N	36°56′54.3″ E
S3 (Karbala)	43°14′24.7″ N	36°21′48.3″ E
S4 (Al-Najaf)	43°99′23.6″ N	35°66′07.8″ E
S5 (Al-Diwaniya)	46°63′70.2″ N	34°93′99.8″ E
S6 (Al-Samawa)	52°68′25.8″ N	34°65′06.7″ E
S7 (Al-Nasiriyah)	61°92′89.1″ N	34°34′93.4″ E

III. MATERIALS AND METHOD

Seven sampling sites' water samples were chosen to be analyzed for pH, DO, TDS, NO_3, and PO_4.
The samples were collected in sterile vials using the standard approach outlined by the American Public Health Association (1995). Hydrogen ions (pH), total dissolved solids (TDS), and three other parameters were examined. The experiment involved the use of dissolved oxygen (DO), nitrate (NO_3), and phosphate (PO_4).

IV. Water Quality Standard

The percentages stated in "Table 2 are permissible value in rivers water. If they are exceeded, they are considered harmful in the implementation of the provisions of the River and Water Maintenance System from Pollution in Iraq [15].

TABLE 2 The allowable limit according to the Iraqi standards [15]

Parameters	Allowable Limit
pH	6.5 - 8.5
TDS	< 1000 mg/L
DO	> 5 mg/L
NO3	< 15 mg/L
PO4	< 0.4 mg/L

V. Water Quality Parameters Tests

A. pH value
The sample is measured in the field, so no preparation or preservation is required. The samples were collected and measured without delay.
By comparing the values from a reference electrode and a sample electrode, a pH meter may determine the acidity of the water [16].
In order to test pH, the pH electrode meter was used after the instrument had been calibrated. Then, 250 ml of the sample was added to the electrode (Fisher, pH meter, Hydrous®400).

B. TDS value
What remains in a sample container after evaporation and oven drying at a certain temperature is called the mass of anhydrous residue, and it is called TDS [17].
To separate the suspended solid, 200 ml (V) of the sample was filtered using filter paper. The beaker was filled with the filtered sample and weighted (A). After 5 hours of drying in the oven at 105 ^{o}C, the beaker containing the dissolved solid were weighted again (B) [18]
Then, TDS was calculated by:

$$TDS(ppm) = \frac{B - A}{V}$$

C. DO value
The dissolved oxygen levels were measured using a (DYS-1 Portable Handheld Dissolved Oxygen Meter), which necessitates both calibration and swirling the sample water while taking the readings [14].

D. NO_3 value
The concentration of nitrate anions may be found by employing the UV-visible spectrophotometric technique, also known as spectrophotometry [19].

The method is done by measuring the intensity of light that passes through a water sample with respect to the intensity of light through a reference sample or blank [9].

E. PO_4 value

The phosphorus concentration in the water was found using the Spectrophotometry technique, which measures the absorption and transmission of light by chemical compounds [20]. By comparing the solution's light absorbance profile to that of a known sample, we determined the presence and concentration of individual chemicals. [21]

VI. RESULTS AND DISCUSSION

Variations in seasonal levels of parameter values (pH, TDS, DO, NO3, and PO4) along the study region of Euphrates River for the seven selected stations (S1, S2, S3, S4, S6, and S7) are shown in Table 3.

TABLE 3 Water quality in seven stations at Euphrates River in the study region

Parameters	S1	S2	S3	S4	S5	S6	S7
pH							
Win.	8.0	7.4	6.7	7.6	8.2	7.7	7.5
Spr.	7.7	7.5	7.1	7.8	8.1	7.5	7.3
Sum.	7.2	7.1	6.9	7.3	7.7	7.1	7.1
Aut.	7.4	7.3	7.1	7.6	7.8	7.5	7.2
TDS (ppm)							
Win.	623	848	869	971	1033	2291	2709
Spr.	580	720	773	840	910	1870	2305
Sum.	900	988	1000	1080	2750	3120	3900
Aut.	810	885	975	994	2600	2990	3670
DO (ppm)							
Win.	8.3	8.6	11.1	7.2	10.2	9.4	8.1
Spr.	9.1	8.8	11.7	8.1	10.9	9.9	8.7
Sum.	7.8	7.1	9.9	7.3	9.7	8.6	7.6
Aut.	8.1	7.9	10.2	7.9	10.2	9.1	7.9
NO_3 (ppm)							
Win.	4.7	4.5	3.3	6.5	6.0	5.3	2.2
Spr.	3.2	2.9	3.0	5.1	4.8	3.8	1.9
Sum.	5.2	5.9	4.3	6.9	6.7	6.0	3.1
Aut.	5.0	5.2	3.7	6.4	6.1	5.7	2.6
PO_4 (ppm)							
Win.	0.02	0.21	0.01	0.08	0.01	0.23	0.02
Spr.	0.01	0.19	0.01	0.02	0.01	0.17	0.01
Sum.	0.10	0.30	0.02	0.11	0.06	0.30	0.02
Aut.	0.08	0.27	0.01	0.10	0.03	0.26	0.02

The results were compared with the allowable limits according to the Iraqi standard were represented in the following figures:

The graph in “Figure 2” shows the change in pH in the study region, which ranges from 6.7 to 8.2; compared with the allowable limits, the values of pH in all stations were between 6.7 to 8.2, so these values are accepted according to the Iraqi standards which are between 6.5 to 8.5.

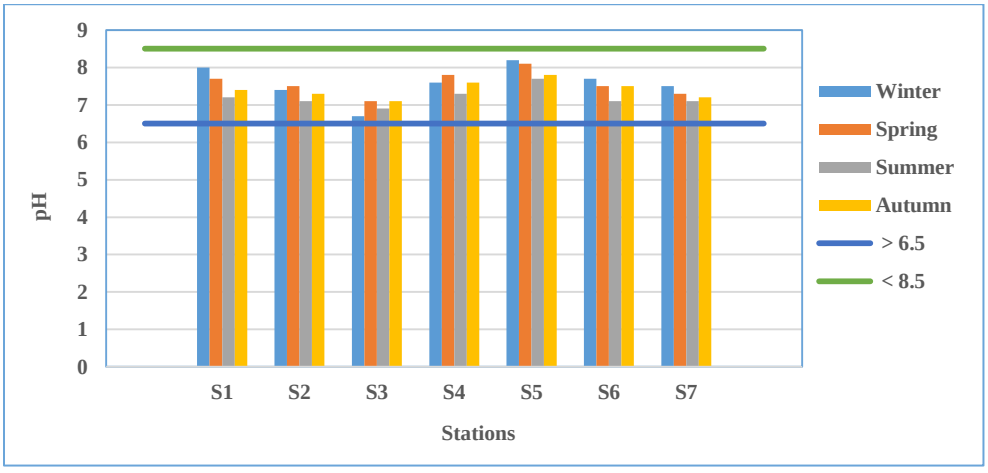


Figure 2 pH values in the study region

The graph in “Figure 3” shows the change in TDS in the study region of from accepted in S1, S2, S3, S4 to unacceptable levels in S5, S6 and S7 according to the Iraqi standards (should be less than 1000 ppm). This is mainly due to the rise in the level of total dissolved solids to high levels (where they reach high concentrations especially in summer (2750 mg/liter in S5 (Al-Diwaniya), 3120 mg/liter in S6 (Al-Samawa) and 3900 mg/liter in S7 (Al-Nasiriyah)), that is due to the nature of the geological formations and the high levels of pollution and discharges into the river, which determine the nature of water uses and their impact on human health and biological systems.

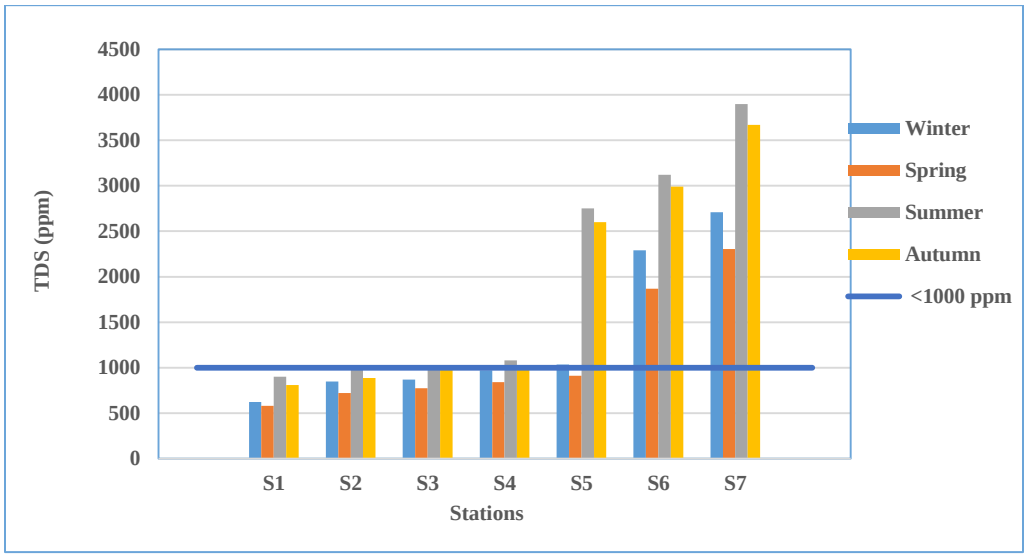


Figure 3 TDS values in the study region

The graph in “Figure 4” shows the change in DOT in the study region, which ranges from 7.2 to 10.9, compared with the allowable limits (should be greater than 5 ppm).

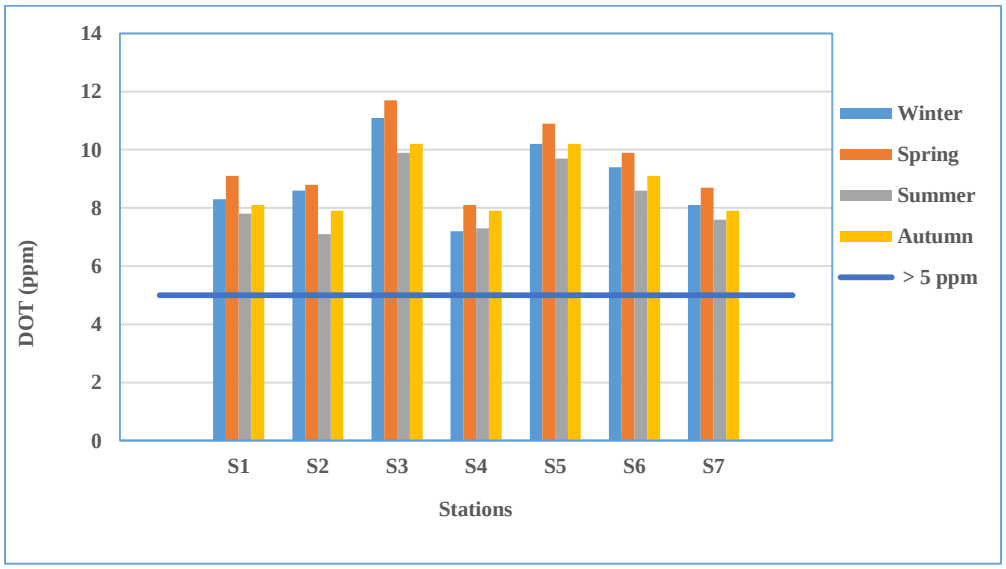


Figure 4 DOT values in the study region

The graph in "Figure 5" shows the change in NO_3 in the study region, which ranges from 1.9 to 6.9, compared with the allowable limits (should be less than 15 ppm).

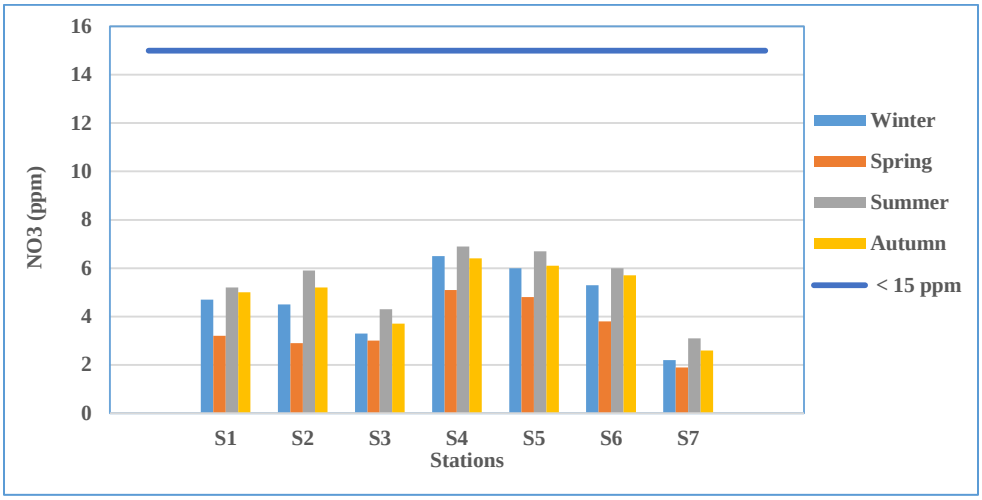


Figure 5 NO_3 values in the study region

The graph in "Figure 6" shows the change in PO_4 in the study region, which ranges from 0.01 to 0.3, compared with the allowable limits (should be less than 0.4 ppm).

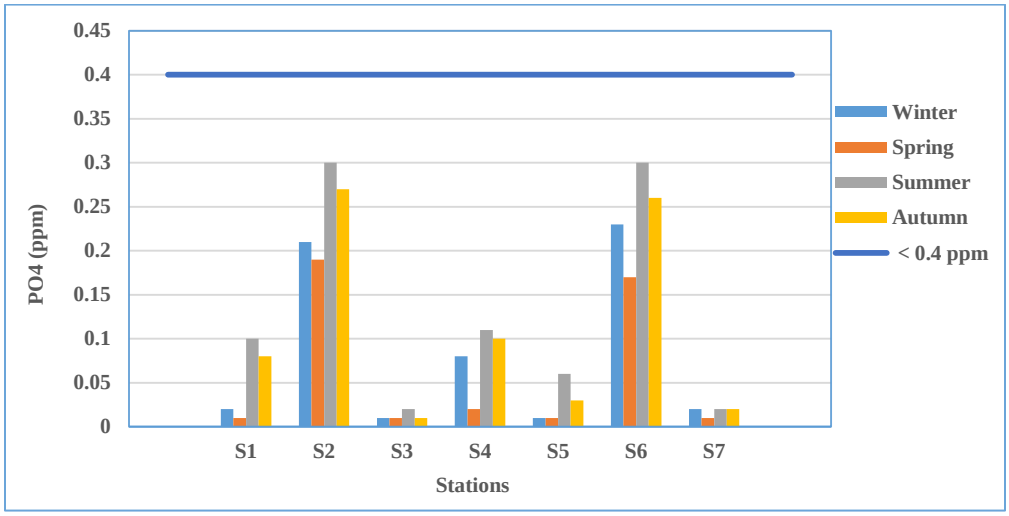


Figure 6 PO_4 values in the study region

As shown in the figures above, the concentrations of the parameters were changed according to the location and season. The concentrations increase in summer due to the lack of river water, while they decrease in spring due to the abundance of water resulting from rain and the increase in the river's water level.

According to the location, the concentrations of these parameters increase as the riverbed moves towards the south, which explains the higher concentrations in stations (S5, S6, and S7) compared with those in stations (S1, S2, S3, and S4).

The concentrations are also affected by the disposal of water produced from industrial and agricultural activities. To maintain the safety of the river's water, it's necessity to monitor and treat the dumping water from industrial and agricultural activities before discharging to the river.

VII. CONCLUSION

When the Euphrates River flows lower through the study zone, the river's water quality decreases.

According to the findings of the pH, DO, NO_3, and PO_4 tests, the water quality of the Euphrates Water Rivers was found to be satisfactory. However, the TDS values in S1, S2, and S3 were found to be outside of the permitted range. Effluents from various sources, including urban runoff, industrial effluents, home effluents, and irrigation water drainage, all contribute to the rise in total dissolved solids (TDS).

It is important to keep an eye on nearby industries, farms, and sewage systems to make sure they aren't dumping dirty water into the river, which would raise its salinity.

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