

# Assessment of the water environment of the Euphrates river in the district of Fallujah

Cite as: AIP Conference Proceedings 2400, 040005 (2022); <https://doi.org/10.1063/5.0112622>  
Published Online: 31 October 2022

Aws Talak Mashaan Satam, Ameer Mohammed Khalaf Aldulaimi and Zuhair Jaber Mushref



View Online



Export Citation

1.8 GHz

8.5 GHz

**Trailblazers.** New

Meet the Lock-in Amplifiers that measure microwaves.

Zurich Instruments [Find out more](#)

# Assessment of the Water Environment of the Euphrates River in the District of Fallujah

Aws Talak Mashaan Satam <sup>a)</sup>, Ameer Mohammed Khalaf Aldulaimi <sup>b)</sup>,  
Zuhair Jaber Mushref <sup>c)</sup>

*Department of Geography, Education for Humanities, University of Anbar,  
Anbar, Ramadi 31001, Iraq*

<sup>a)</sup> Corresponding author: ed.aos.mishan@uoanbar.edu.iq

<sup>b)</sup> ed.amir.mohammad@uoanbar.edu.iq

<sup>c)</sup> ed.zuhair.jaber@uoanbar.edu.iq

**Abstract.** By determining the land cover, the degree of its sensitivity to riverine water environments and human activities can be detected in order to identify patterns of land uses, make the required measurements on it, assess its locations, and pay attention to the environmental factors affecting the water quality, especially the salinity of the soil, mineral rock elements dissolved in the water, and the chemical fertilizers used. In fertilization by farmers, as well as temperature, and accordingly the study came to show the most important qualitative characteristics of river water and its suitability for various human uses. Through research, it was found that the river's water did not go beyond the permissible range in most areas of the study.

## INTRODUCTION

The interest in determining the suitability of water for irrigation began since man resorted to the use of new sources for irrigation (ground water and wastewater) as well as the diversity in water delivery methods. The study of the quality and validity of water for irrigation is one of the main topics that should be taken care of when expanding the irrigation of lands through Irrigation systems or when reclaiming or improving the characteristics of the land to increase its productive capacity, and it has been proved that it is very necessary to obtain information on the type of salts present in the water, due to the chemical reactions that may occur when they are added to the soil, in addition to their effect on the natural properties of the land and on plant growth [1-3]. The geographic interest lies in the land and its resources, especially the water ones, in order to be able to achieve a distinct goal, which is the link between the water environment and the reflection of its effects on human activity. This is by emphasizing the applied aspects to derive scientific facts, especially when studying the lands that are under the influence or control of river activity. Which is known as the river environment, in which man activates through the formation and modification of the current local environment, depending on the change of the environment of the land cover.

## Research Problem

Does the high and low rates of water discharge of the Euphrates have an effect on the hydrological system and on changing the physical and chemical properties of the river's water.

## **Research Hypothesis**

The situation of the environment and natural resources in the region, in light of the negative repercussions caused by humans, has become the first danger in it, which Mayler described in his writing (The Environmental Crisis) as suffering from an environmental disease imposed by technology.

## **Research Importance**

The importance of the research comes from the fact that the Euphrates River is the main and only source of water resources for the district and extends throughout the city. The residents of the district, the largest in Iraq, depend on the river for all their human activities.

## **Aim of Study**

The research aims to assess the water environment of the Euphrates River in the district of Fallujah and to detect the main pollutants of the water environment within the research area and the most important environmental factors affecting the qualitative characteristics of the water of the Euphrates within the district of Fallujah and to reach the most important solutions and treatments required to avoid the problem of pollution.

## **RESEARCH METHODOLOGY**

The research relied on the quantitative, qualitative and inductive analytical approach, which aims the quantitative analysis approach to apply statistical and mathematical methods, in measuring pollution degrees, as well as analyzing models for selected samples and detecting high rates of polluting elements of water, and correct reading of the qualitative characteristics of the water of the Euphrates River within the district of Fallujah.

## **The Geographical Location of The Study Area**

From the Fig 1, the city of Fallujah is located between the latitudes 33.12 and 2-4. 33N and longitudes 3-9. 43 and 56. 43 East in the eastern part of Al-Anbar governorate, it is bordered to the east by the governorate of Baghdad, to the west by the district of Ramadi, to the north by the province of Salah al-Din, to the south by the province of Karbala, and to the southeast by the governorate of Babel. The Fig 1 was based on the map of the Republic of Iraq, Ministry of Water Resources, Public Survey Directorate, Anbar Topographic Map, 2018, scale (100000: 1).

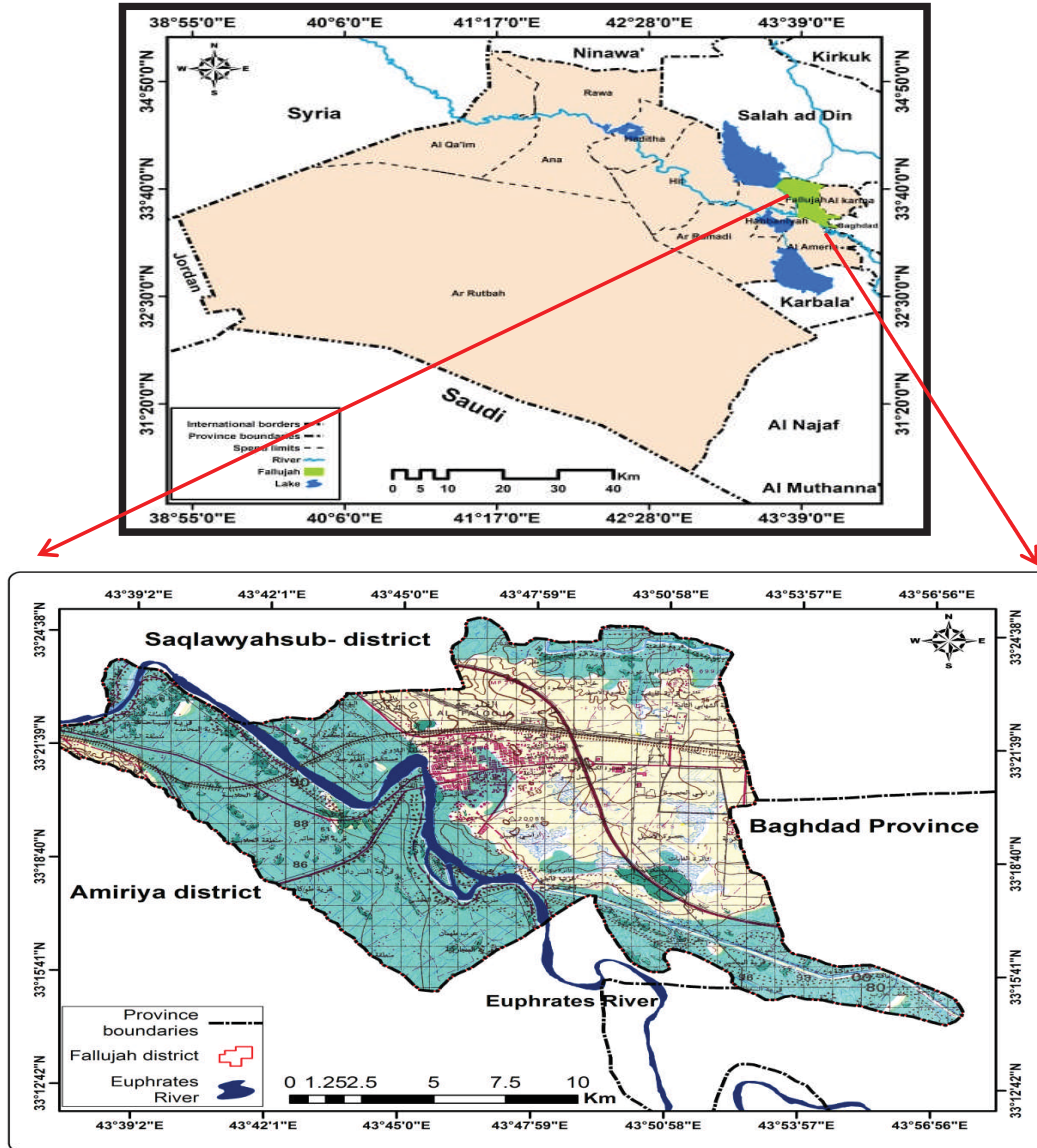


Figure 1. The location of the search area for Anbar Governorate

## IRRIGATION WATER

Irrigation water contains different quantities of dissolved salts and sometimes toxic components, and the use of this water for irrigation of crops depends on the types and quantities of salts in them, where the quality of the water to be used for irrigation must be taken into account and to ensure the proportion of its contents from the following materials [4-5]

1. The salt content of the soil.
2. The sodium content of the soil.
3. The rate of water infiltration in the soil.
4. The presence of toxic elements in irrigation water that may poison the irrigated plants.
5. The effect of irrigation water on the production of irrigated crops.

6. The quality of the irrigation water to be used.

Therefore, the physical and chemical properties of the water of the Euphrates River were studied through samples that were selected from three selected sites within the research area, the first in the north of Fallujah, the second sample near the old iron bridge, while the third sample was selected from the south of Fallujah. The Fig 2 was based on the map of the Republic of Iraq, Ministry of Water Resources, Directorate of Public Survey, Anbar Topographic Map, 2018, scale (100000: 1), based on the digital elevation model (DEM) with distinct accuracy (30 × 30) m, and the outputs of Arc Map 10.4.1.

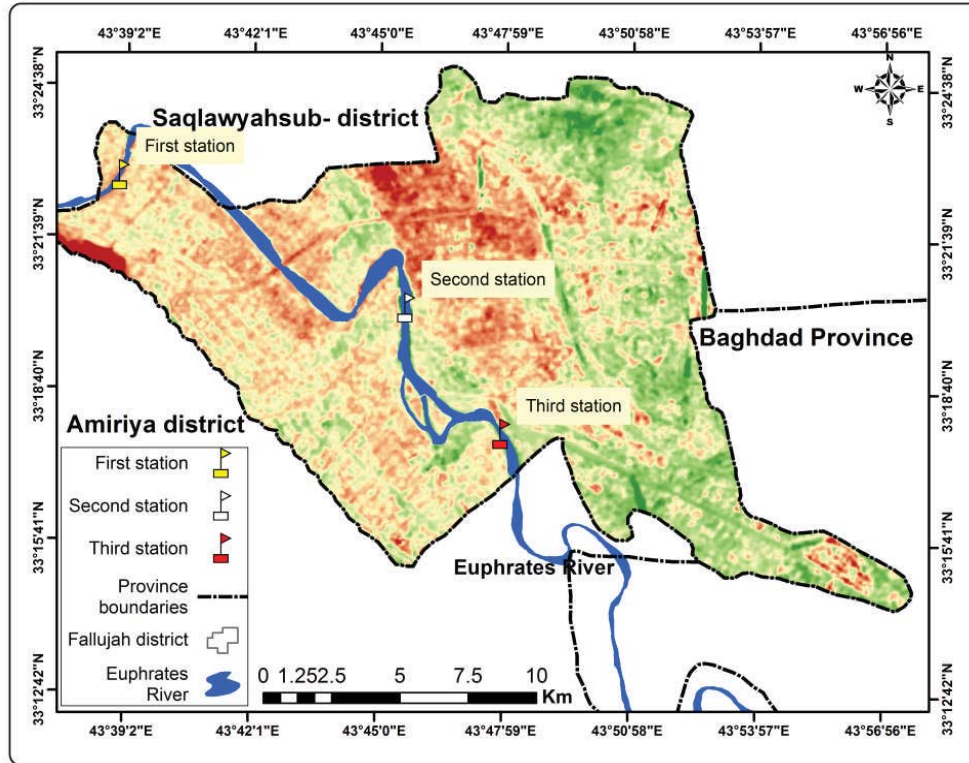


Figure 2. The locations of samples from the search area

## CHARACTERISTIC THAT DETERMINES – QUALITY WATER

Water resources are one of the most important pillars of the national wealth of any country and have a fundamental role in the growth and prosperity of civil life by exploiting them in agriculture, industry and generating electric power. In using and distributing them in an optimal and efficient manner, water resources, with their characteristics and the nature of their exploitation, are issues that have received increasing attention since ancient times. That civilization continues with it side by side in the march of its development and progress. The river can be seen from the Fig 3. Where the Fig 3 was based on the map of the Republic of Iraq, Ministry of Water Resources, Directorate of Public Survey, Anbar Topographic Map, 2018, scale (100000: 1), based on the visualization of Land Sat8 in 2019, and Arc Map 10.4.1 program outputs.

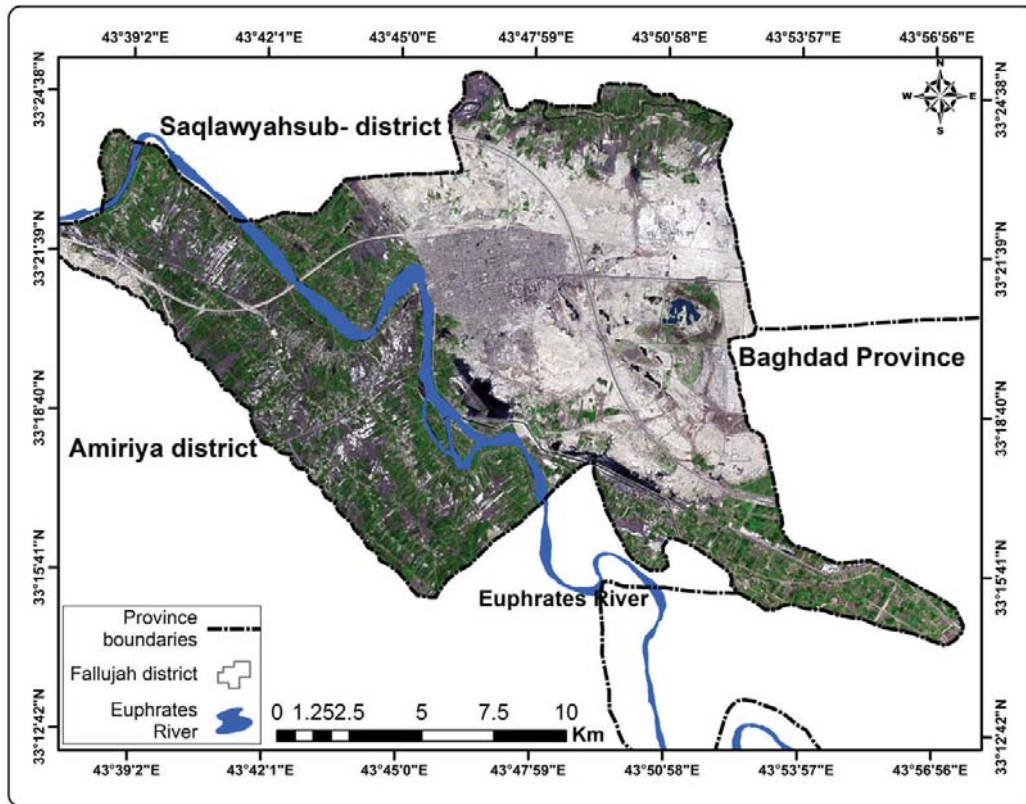


Figure 3. The location of the river in relation to the district of Fallujah (Ministry of Water Resources, 2018)

### RIVER WATER QUALITATIVE ANALYSIS

The temperature, suspended matter of an organic and mineral source and the ability to conduct electrical conductivity are important physical properties, as the optimum temperature of water for most plants is 25 °C, and it can be used if its temperature is between 15 - 35 °C, but it has a clear effect on limiting plant growth [6-8]. Because temperature is one of the important characteristics that affect to some extent the quality of irrigation water, because of its effect on the vital processes that accompany the changes in the water as a result of its containment of organic or mineral substances, and this is what makes its study important in any hydrological study as it affects the degree of Concentration of substances in the water, such as carbonate [8-12] As for the chemical properties, the most important elements of the basic components are the positive ions calcium, magnesium, sodium, potassium, as well as the negative ions carbonate, bicarbonate and chloride, and the importance of studying them is to avoid increasing soil salinization, given the variation in water drainage in rivers and the concomitant wide variation in the amount of salts transported with River water The constant examination should not be neglected [9-13]. To find out scientifically the most important qualitative characteristics of water, the research dealt with the study of the qualitative characteristics of the river in different regions and for all seasons of the year, and from Table 1 which samples were taken in the winter season as in Fig 4 and Fig 5. The data of Table (1,2,3,4) was based on the Results of laboratory analysis of the Euphrates River, Directorate of Environment in Anbar Governorate, unpublished data, 2020, as in Fig 6 and Fig 7.

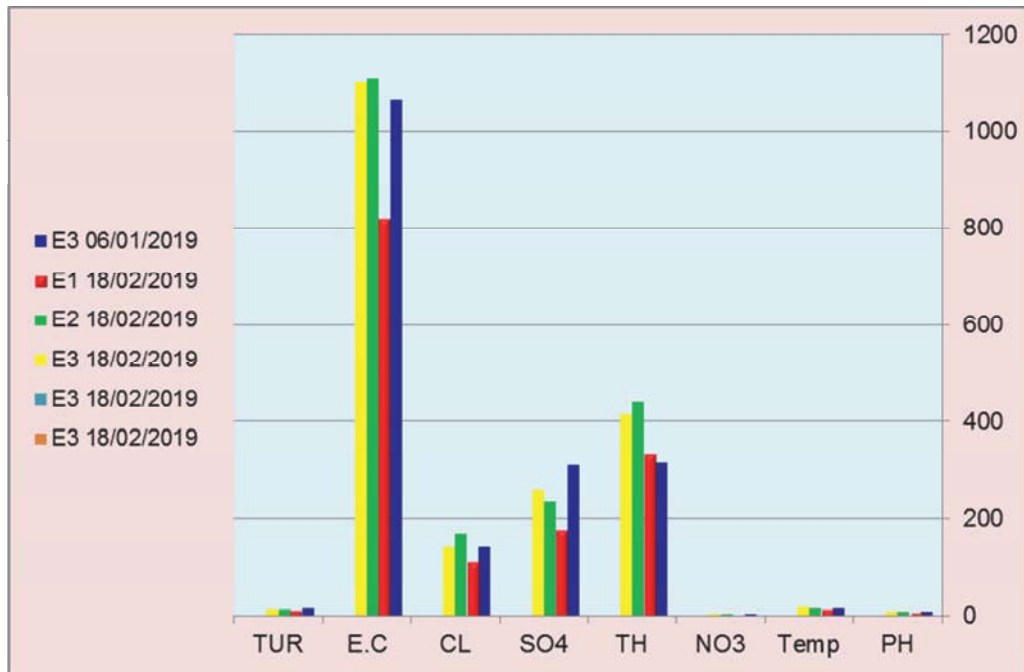
1. **Alkalinity and acidity (PH):** it refers to the pH and it is defined as a measure of the capacity of the water on the equation of the standard acid, and its values range between (0-14) where the values of acidity and basicity are equivalent, which are considered the fresher water, and their properties do not change at the value of (7) if I said about this value, it tends to be acidic, although it increased to be basic, and from the observation of Table 1 for samples taken in the winter season, it appears that their values increased in all sampling areas, noting that the (PH) values increase with lower temperatures and decrease inversely. It is clear from Table 2

of the spring season that the values of basicity and acidity remained within the limits, but it showed that the water quality tends to be basic in most of the sampling sites. The summer season did not differ much from spring in terms of the tendency of river water to pH higher than average 7 Table 3. It turns out that the samples taken from the river at the front of Fallujah recorded a ratio of 6.6, meaning that the water was tending to acidic, only to return to a remarkable rise in the pH and return its quality to alkalinity.

2. **Temperature (TEMP):** Temperature has an important and influential role in the quality of water and its physical and chemical properties, as it affects the activity and effectiveness of aquatic organisms, and determines the temperature of the water in all the sites from which the samples were taken by the temperature of the air. The air temperature increased, the water temperature increased (10). Table 1 of the samples taken in the winter season shows that the water temperature ranged between (15-17) degrees Celsius, and here the role of weather becomes clear in the decrease in the water temperature. However, the temperatures began to register a noticeable rise in the spring season (20-24.6), Table 2, to record in the summer the highest degrees affected by the climatic condition of Iraq, as it recorded (29-31) degrees Celsius Table 3, to return and decrease in the season Autumn with a drop in temperatures (22-24.6) Table 4
3. **Nitrates (NO<sub>3</sub>):** Fertilizers are one of the most important sources of nitrate concentration in the water, in addition to the industrial activities that throw their water into the Euphrates River, and the percentage of what is allowed is (50 / mg / liter) and it is clear from Table 1 that its percentage is low. Where the winter samples recorded (2.5 - 3.9), while the rate of NO<sub>3</sub> was (1.6 - 4.2) in the spring. From the observation of Table 3, the percentage of nitrates remained within the limited proportions recorded (2.1 - 2.9) and the percentages did not differ in the autumn season, but rather decreased. Significant levels of nitrates.
4. **Total hardness TH:** It is a numeric expression for what the water contains in terms of calcium and magnesium ionic concentrations as well as other alkaline salts. It is one of the most important causes of hardness and one of its natural sources is limestone that dissolves in water during contact with it and thus its concentrations depend on the geological formations that the river passes through. From Table (1,2,3,4), their percentages are high, but they remain within the permissible limits.
5. **Sulfate SO<sub>4</sub>:** Sulfate concentrations were recorded in the study areas from which the samples were taken, in addition to the times of their taking a noticeable increase in their proportions and the variation in their distribution. Sulfates and bicarbonate.
6. **Chloride (CL):** It is known that chlorine is used to sterilize water, so its value has increased in populated areas due to the waters returning to the river, causing an increase in the concentration of ion inside the river, but it is noticeable that its value remained within the permissible limits in all sampling areas. As well as the seasons in which those samples were taken.
7. **Electrical conduction EC:** The unit of measurement of electrical conductivity values is measured in (micro-Siemens / cm). Their values increase in water the more salts present in the river, and we have previously touched upon the fact that the percentage of salts rises in the river in all its provinces, and this is due to the reason for the high rates of conduction. The electrophoresis indicates the concentration of salts as a result of the effect of the Tharthar channel that flows into the Euphrates River, as Lake Habbaniyah is characterized by a high salinity rate of 7634.7 micro Siemens / cm It has the effect of taps that flow into the river at its sides.
8. **Turbidity: TUR** It is clear from the analysis of Tables (1,2,3,4) of samples taken in all seasons of the year that turbidity values increased in most sites, and this is due to the slow flow of the river due to the presence of the Fallujah dam, which contributed to reducing the velocity. Water and the slope of the surface in that area has a great impact on reducing the speed as well, and the range permitted by the World Health Organization and the Iraqi standard specifications ranges between (5-25) International Turbidity Units (NTU), as their rates remained within the permissible and did not exceed it anywhere.

**Table 1.** The extent and rate of the physical and chemical properties of the water of the Euphrates River in the winter season

Monitoring station icon	E1	E2	E3	E1	E2	E3
Withdrawal date	06/01/2019	06/01/2019	06/01/2019	18/02/2019	18/02/2019	18/02/2019
PH	7.4	8.3	7.5	7.9	7.3	7.1
Temp	15.1	15.4	15.1	16	16	17
NO3	3.7	3.8	3.9	2.5	2.5	3.7
TH	341	332	314	334.5	441	414
SO4	285	290	310	180	235	260
CL	169.2	145.7	141	112.8	169.2	142
E.C	1055	1008	1064	820	1108	1100
TUR	15.1	14.1	15.1	12	12.5	13

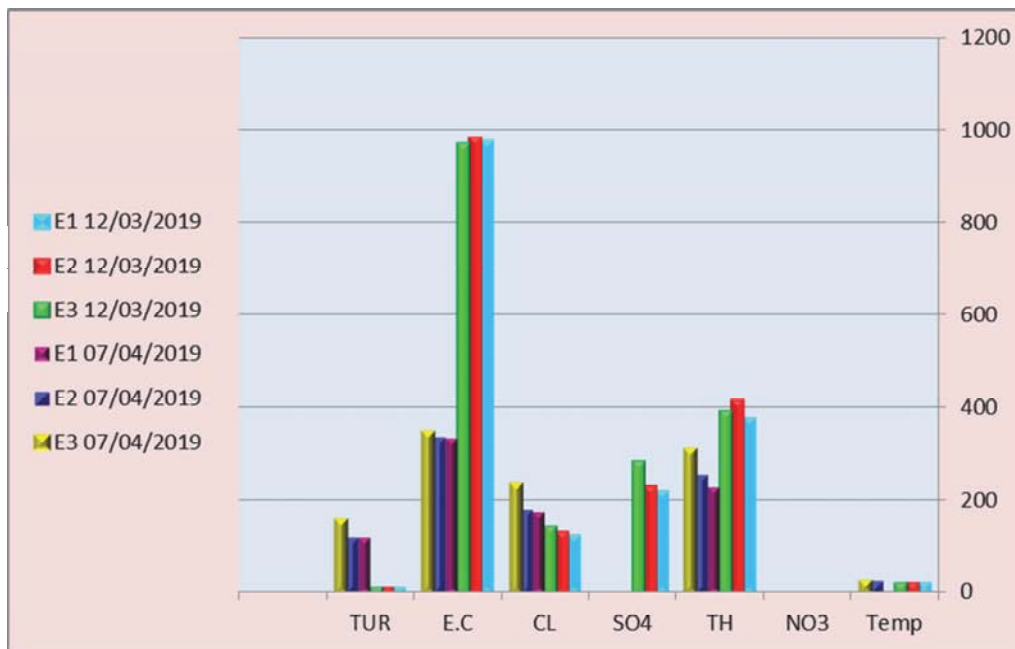


**Figure 4.** the extent and rate of the physical and chemical properties of the water of the Euphrates River in the winter season



**Table 2.** The extent and rate of the physical and chemical properties of the water of the Euphrates River in the spring.

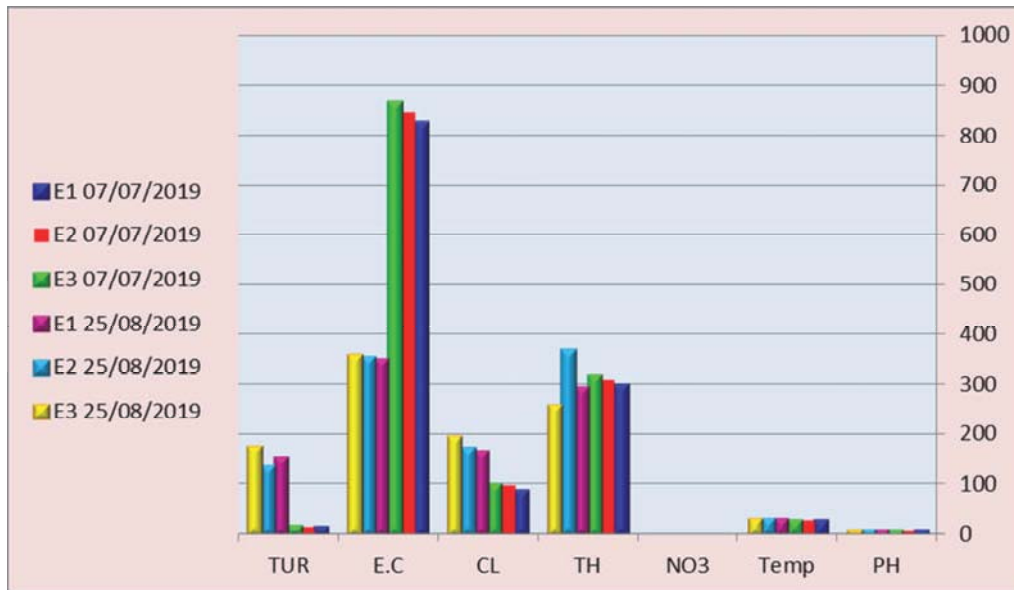
Monitoring station icon	E1	E2	E3	E1	E2	E3
Withdrawal date	12/03/2019	12/03/2019	12/03/2019	07/04/2019	07/04/2019	07/04/2019
PH	7.6	7.8	7.2	7.8	7.9	7.5
Temp	20	20	21	24	24.6	24.4
NO3	3.2	3.7	4.2	1.6	1.8	2.1
TH	379.1	415.8	393.6	228.1	253.9	309.1
SO4	220	230	285			
CL	125.4	131.4	144.6	175	180	235
E.C	978	985	971	333	336	347
TUR	9.5	10	10.6	119.5	120.2	159.1



**Figure 5.** the extent and rate of physical and chemical properties of the water of the Euphrates River in the spring season.

**Table 3.** The extent and rate of the physical and chemical properties of the water of the Euphrates River in the summer

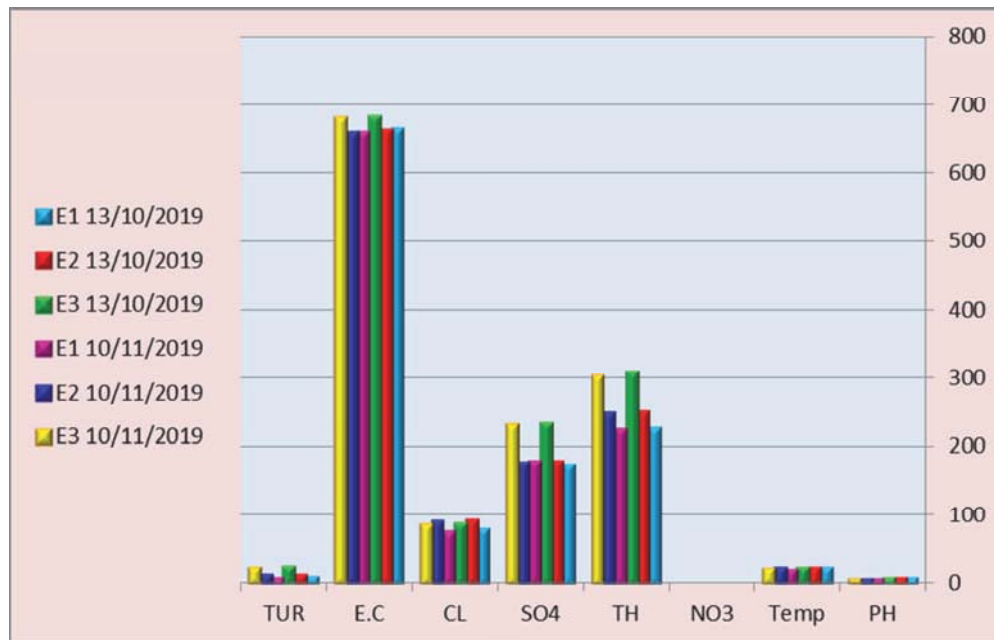
Monitoring station icon	E1	E2	E3	E1	E2	E3
Withdrawal date	07/07/2019	07/07/2019	07/07/2019	25/08/2019	25/08/2019	25/08/2019
PH	7.5	7.4	7.3	7.8	7.7	7.6
Temp	29	29	29	30	31	31
NO3	2.1	2.9	2.4	2.1	2.6	2.4
TH	301.2	310.4	320.5	294.4	368	257.6
SO4	90.1	98.3	101.3	168	175	195
CL	826	845	866	350	354	360
E.C	14	15.3	17.4	155	135.8	175.4
TUR	7.5	7.4	7.3	7.8	7.7	7.6



**Figure 6.** the extent and rate of the physical and chemical properties of the Euphrates water in the summer

**Table 4.** The extent and rate of the physical and chemical properties of the Euphrates water in the summer

Monitoring station icon	E1	E2	E3	E1	E2	E3
Withdrawal date	13/10/2019	13/10/2019	13/10/2019	10/11/2019	10/11/2019	10/11/2019
PH	7.8	7.9	7.5	6.6	7.4	7.1
Temp	24	24.6	24.4	21	23.3	22.3
NO3	1.6	1.8	2.1	1.3	1.4	1.8
TH	228.1	253.9	309.1	226.2	251.5	304.2
SO4	175	180	235	180	178	232
CL	80.8	94	89.4	77.6	92	87.3
E.C	666	664	684	661	662	682
TUR	10.5	14	25	8.5	13	23



**Figure 7.** The extent and rate of the physical and chemical properties of the Euphrates water in the summer

## CONCLUSIONS

1. The basic and acidic ratio (PH) of samples taken in the winter season showed that their values increased in all sampling areas, and they increase with lower temperatures and decrease inversely.

2. The samples taken in all seasons of the year revealed that turbidity values increased in most of the sites, and this is due to the slow flow of the river due to the presence of the Fallujah dam, which contributed to reducing the water velocity

### **RECOMMENDATIONS**

1. The necessity of using and applying the quantitative, qualitative and inductive analytical approach, statistical and mathematical methods, in measuring the degrees of water pollution.
2. The necessity of draining the river periodically and also reducing untreated wastewater disposal operations.
3. Establishing an advanced laboratory for biological and chemical analyzes
4. Carrying out awareness campaigns for farmers to introduce the dangers of some types of agricultural fertilizers

### **REFERENCES**

1. K. I. A. A., Water Relations and Irrigation Systems, publisher, Ma'arif facility, Alexandria, 1998, p. 149.
2. A. Jamal, Applied Geography, Methods of Application and Its Achievements, Modern Art Press, Cairo, 1971, p. 139.
3. A. A. E. Salah, Geography Supporting Planning, The English Company for Printing and Publishing, Alexandria, 1971, p. 18.
4. I. Hassan and others, Remote Sensing and Global Environmental Changes, Sensing Journal, General Remote Sensing Authority, Issue 12, 2000, p.10.
5. A. M. Adnan and A. A. Imad, Irrigation and Drainage, Dar al-Kutub Press, Damascus, 2010, p. 29.
6. S. Ahmed, Irrigation and Civilization in the Mesopotamian Valley, previous source, p. 168.
7. I. K. Laith, Irrigation and Punishment, Directorate of Dar Al Kutub and Printing Press, University of Mosul, 1988, p. 54
8. M. A. Al-Nahhas and A. A. Imad, Irrigation and Drainage, Dar al-Kutub Press, Damascus, 2010. pp. 31-32.
9. S. M. Wahran, Determination of Chemical and Biological Pollutants in the Euphrates River, Habbaniyah and Tharthar Lakes, Master Thesis (unpublished), Anbar University, 2008, p. 81.
10. S. M. Wahran, p. 62.11.
11. M. T. Aws, The Hydrology of the Fallujah Dam and its Environmental Effects, Master Thesis (unpublished), Anbar University, 2011, p.74.
12. A. T. M. Satam , Z. J. M. Nahar and A. M. Khalaf. (2020). Building Digital Hydrological Models for the Habbaniyah Lake Reservoir to Calculate Area Variable. Multicultural Education, 6(4).
13. Z. Jaber, A. Talak, A. M. K. A. Aldulaimi, and S. Othman. (2020). Geomatics Techniques Of Assessing The Land Cover Of Sehailiya Valley's Basin In Iraq. Multicultural Education, 6(3).