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المجلة العراقية لبحوث السوق
وحماية المستهلك

WATER QUALITY OF TIGRIS RIVER IN JADRIYAH DISTRAC OF IRAQ

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Abstract

The Tigris River, which is the second-longest river in Western Asia, passes through densely inhabited areas, particularly in Baghdad, which is inhabited by nearly 8 million people. The Tigris flow has declined significantly over the past few decades, and this, together with rising wastewater volumes and wastewater treatment. Three sites were chosen, in this paper water quality evaluation is carried out in the Jadriyah area of Iraq and analyzed for various physicochemical parameters. These sites were close to many residential and commercial buildings and the presence of electrical power generation stations. These samples were analyzed laboratory and field using internationally approved methods. This study was designed to determine the amount of pollution in this area according to the standards of the WHO and the Iraqi Ministry of Environment. The results indicated that the third site in the study had the highest percentage of ions. The sodium level in this site reached about 130 mg/l and 128 mg/l in January. Likewise, for the phosphate compound, the highest value recorded in the third site was 0.187 mg/l. The presence of these ions in abundance in this site, in addition to phosphate compounds, which are considered one of the most important plant nutrients, helps the growth of plants such as algae, and this leads to an increase in oxygen consumption at the site and reduces water quality. The results of this study are worrying, but they also contribute to a better understanding of the factors the water quality and can help authorities and stakeholders with sustainable development.

Keywords: Water Quality, Water Health Organization (WHO), Major Ions, Tigris River.

جوده مياه نهر دجله في منطقه الجادرية في العراق

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الخلاصة

نهر دجله الذي يعتبر ثاني اطول نهر في غرب اسيا حيث انه يمر بمناطق مكتظه سكانيا مثل مدينة بغداد التي تحتوي على حوالي 8 مليون نسمه نهر دجله الذي بدء بالانخفاض مجراه على مر العقود مع زياده كميه مخلفات المياه ومخلفات معالجه المياه من قبل محطات المعالجه. ثلاث مواقع تم اختيارها 1في هذه البحث تم تقييم جوده مياه نهر دجله في منطقه الجادريه في العراق وتحليل مقايسس فيزيائيه وكيميائيه مختلفه وهذه المناطق قريبه من العديد من محطات توليد الطاقه الكهربائيه والبيوت السكنيه والمباني الترفيهيه تم تحليل هذه العينات مختبريا وحقليا بالاعتماد على معايير دوليه عالميه تم تحديد كميه الملوثات ومقارنتها مع نتائج وزاره البيئه العراقيه ونظمه الصحه العالمية حيث اظهر الموقع الثالث تزايد في كميه الاملاح والمغذيات مثل الصوديوم بلغت نسبته حوالي 130 ملغم/ لتر وبلغت نسبه الفوسفات 0.187 ملغم/ لتر تواجد هذه المغذيات في الموقع يساعد في ازدياد نسبه الطحالب مما يزيد من استهلاك الاوكسجين في الموقع ويقلل جوده المياه للموقع بالرغم من القلق المتزايد من هذه النسب الا ان هذه ادى الى زياده فهم العوامل المؤثره على جوده المياه ومساعدة السلطات وأصحاب المصلحة في التنمية المستدامة.

الكلمات المفتاحية: جودة المياه، منظمة الصحة العالمية، الايونات الرئيسية، نهر دجلة.

INTRODUCTION

The ecosystem cannot exist without water, yet the quality of both surface and groundwater has long been declining because of both natural and human-caused activities Hydrological, atmospheric, climatic, topographical, and lithological elements all naturally affect water quality **(Magesh *et al.*, 2013)**. Examples of anthropogenic activities that adversely affect water quality are mining, livestock farming, production and disposal of waste (industrial, municipal, and agricultural), increased sediment run-off, or soil erosion due to land-use change **(Lobato *et al*., 2015)**. Developing countries have recently faced significant issues in conserving water quality as they try to enhance water supply and sanitation **(Carvalho *et al*., 2011)**. According to the (WHO), about 80% of all diseases in human beings are water-borne **(WHO, 2017)**. Water quality is of particular importance both for people and for their environments. Even industrialized countries have struggled to preserve or enhance the quality of their water in the face of issues like the eutrophication of water resources (as well as the supply of water and wastewater services to expanding populations) **(Abbasi & Abbasi, 2012)**. Specific contamination when the source of water contamination is recognized or contaminants entering water come from recognizable sources like a ditch or pipe. Point source pollution referred to as pollution from industry, storm drains, sewage treatment plants, etc... is distinguishable from other causes of contamination **(Hogan, 2010)**.

Non-point source pollution is defined as pollution that cannot be attributed to a single discrete source or whose source is unknown **(Moss, 2008)**. It can arise from a variety of sources, including pesticides, fertilizers, industrial wastes, etc., and is exceedingly difficult to manage **(Moss, 2008)**. The Tigris River ecosystem for plants and other living things is threatened by contamination of the water caused by the transmission of toxic pollutants from anthropogenic activities like domestic wastewater, hospitals, and industrial factories that discharge their wastewater directly into the river without any real treatments (**Al-Ansari *et al*, 2019)**. Fecal bacteria, including pathogens, are commonly found in rivers because of untreated wastewater discharges, sewage effluent from household waste, trash placed there, and washing and/or effluent from human/animal instruments **(Labbate *et al*., 2016)**.

The aim of designing this study is to Evaluate pollution in Jadiriyah and then compare the water quality of different points along the course of the Tigris River passing through the Jadriyah area, with the data of the Iraqi Ministry of Environment for the same location and year. In addition, the study can help both the government and the local people had better understand the impact of increased pollution of the Tigris River and its consequences on both people and wildlife in the Jadiriyah area.

MATERIALS AND METHODS

Study area:

The study was conducted in the Al-Jadriyah area, which is crossed by the Tigris River. Samples were collected along the letter-shaped U cross-section that runs through this area, which is divided into two sections by the river: to the east is the University of Baghdad campus, and to the west is the tourist island of Umm Al-Khanazeer **(Fig. 1)** and **Table 1.**

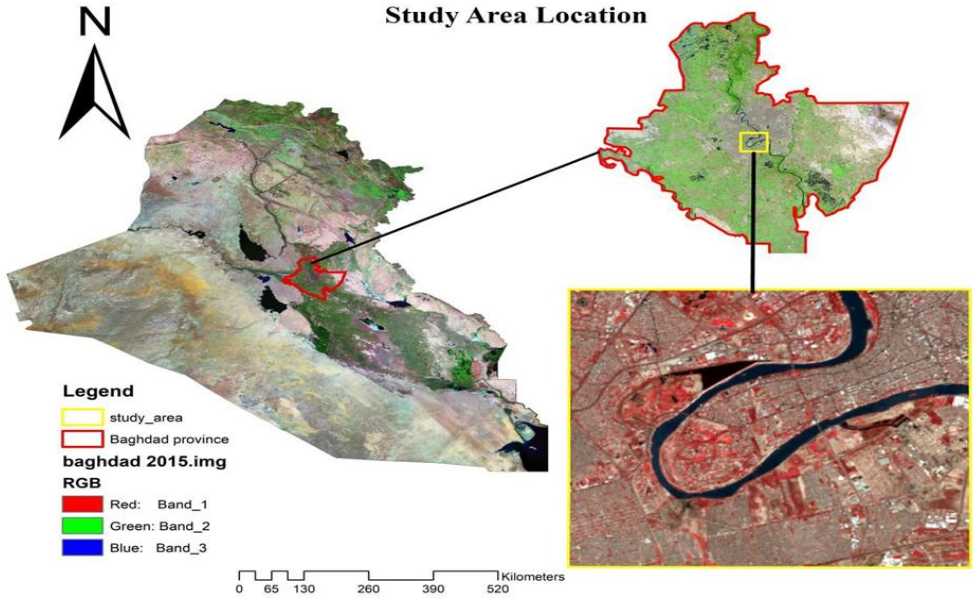


Figure (1): The map of the study area represents the administrative map of the Republic of Iraq red boundary represents Baghdad province yellow boundary represents the Jadriyah area and the Umm Al-Khanazeer Island.

Field Survey: sampling protocol

Eight times for field collections of water samples were taken from the Tigris River located in the Jadriyah area once a month from December 2022 to July 2023. Water samples were taken randomly for three locations on the Tigris River passing through the Jadriyah area, close to the University of Baghdad and Umm Al-Khanazir Island. The collection process lasted each time from 8 a.m. to 11 a.m. by using a boat at a depth of about 50 cm. The first location was near Central Bank, the second location to the hotel Heart of the World, and the third location was behind the Al-Dora refinery Water sampling sites are shown in **(Fig. 1)**. where 24 samples were collected for eight months using a Polyethylene bottle of 2 liters. The parameters were measured laboratory and filed as shown in **Table 2.**

Table (1): Global Position System (GPS) of the study sites.

Site	Longitude (eastwards)	Latitude (northwards)
S1	44º 13’59.2 E	33º 61’25.17 N
S2	77’43.2 Eº44	21’47.15 Nº33
S3	01’05.2 Eº44	30’36.16 Nº33

Statistical analyses:

The Statistical Analysis System- SAS (2018) program was used to detect the effect of different factors on study parameters. The least significant difference –the LSD test (Analysis of Variation-ANOVA) was used to significantly compare between means in this study **(SAS, 2018).**

Table (2): Physicochemical parameters in the current study **(APHA, 2017)**

Parameters	Methods	Device name	Manufacturer and Origin
pH	Method 4500 H "pH Value"	Combined meter PH /EC / TDS / Temperature	Romania
Electrical Conductivity (EC)(µS/cm)	Method 2510 B, "Electrical Conductivity"	Digital Portable Mustimeter	Hach HQ40d - (Germany)
Total dissolved solids (TDS)(mg/L)	Method 4500 H "pH Value"	Combined meter PH /EC / TDS / Temperature	Romania
Salinity %	Calculation Method (Parsons *et al.*, 2010)		
Total Phosphorus (mg/L)	4500-P E. Ascorbic Acid		
Total Nitrogen (mg/L)	Sulphanilamide (Mackereth *et al.*1978)		
Sodium (Na) (mg/L)	Ft01035	Atomic Absorption Spectrometer	Perken Elemer (USA)
Chloride (Cl)(mg/L)	4500-Cl-B. Argentometric Method		
Potassium (K) (mg/L)	Ft01035	Atomic Absorption Spectrometer	Perken Elemer (USA)
Calcium (Ca)(mg /L)	3500-Ca B, EDTA Titrimetric Method		
Magnesium (Mg)(mg/L)	3500-Mg B, Calculation Method		

Laboratory analysis:

The analysis of water samples was carried out in the water quality laboratory in the College of Science, University of Baghdad, using the standard methods recommended by (WHO, 2022). Parameters were analyzed in the lab to measure concentrations of water salinity, nutrients, and anions in samples from the Tigris River.

RESULTS AND DISCUSSION

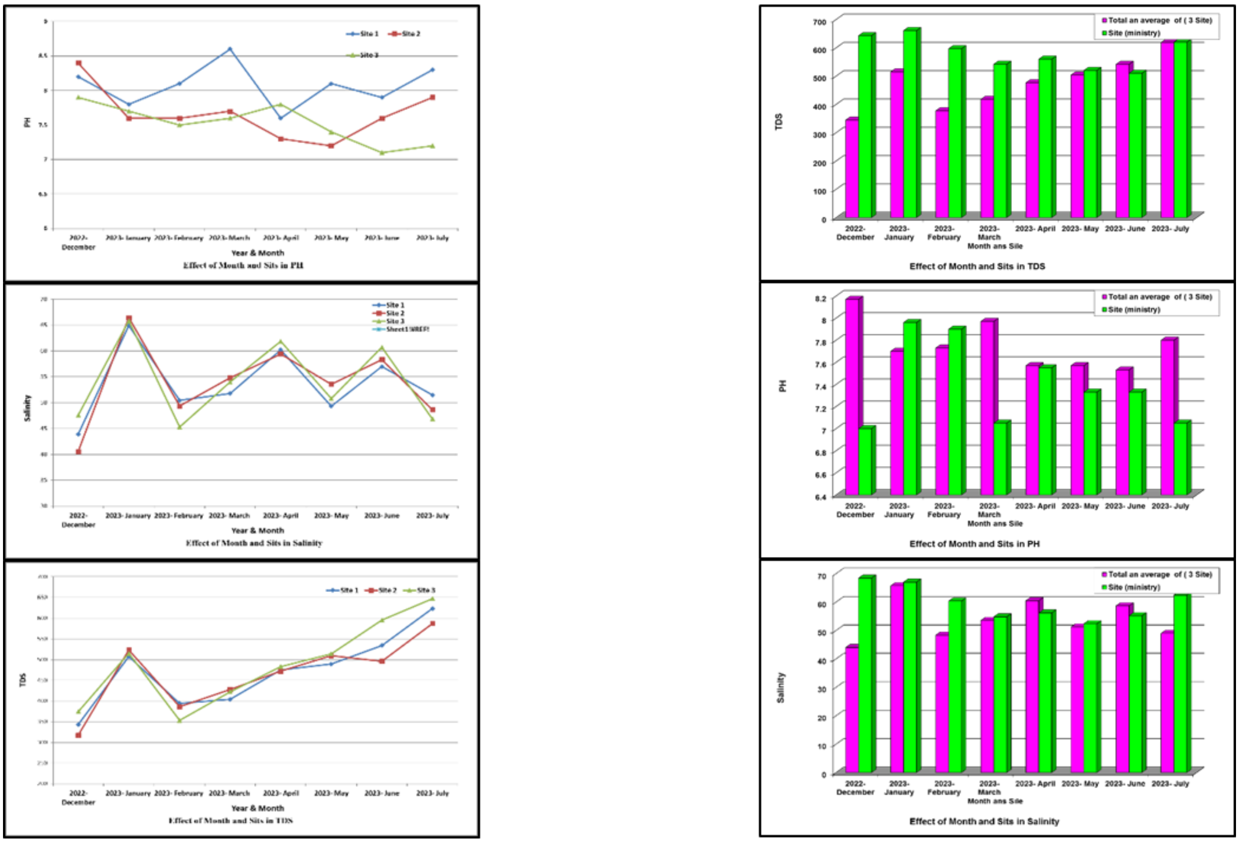
Results of the laboratory analysis for 11 parameters (pH, Salinity, TDS, NO_2, NO_3, PO_4, Na, K, Ca, Mg, Cl,) indicated variation between river zone (site1,2and3) measurement with the data of the Iraqi Ministry of Environment. The result has been separated into three groups. These parameters included a variety of physical and chemical water quality indicators **(Nadheer *et al.*, 2021).**

Group 1 (pH, Salinity, and TDS) to evaluate and give an overall assessment of the Tiger River and the data of the Iraqi Ministry of Environment. Group 2 (NO_2, NO_3, and PO_4) to evaluate Nutrients in the river and the data of the Iraqi Ministry of Environment.

Group 3 (Na, Cl, Mg, Ca, and K) to evaluate major ions. The comparison was in two parts, the first part is a comparison between the three sites (1,2 and 3) The second part of the comparison was between the average of the three sites with the site of the Ministry, which was in the Jadiriyah area, and then comparing this data with the standard data of the World Health Organization of water quality (**WHO, 2022).**

Group 1: PH, Salinity, and TDS.

The results indicate that there are no significant differences in pH between the sites, where there is a slight gradient between the sites, despite the fact that the month of December recorded the highest pH value (8.7) among the months. The lowest percentage was in the month of May (7.5) among the three locations **(Fig. 2A).** The data showed between the averages of the three sites with the Ministry's site **(Fig. 2B),** as there were no significant differences between the two sites where the water moderately tended to alkaline and these results are within the standard limits of the World Health Organization data **(Abbot *et al*., 2022).** As for salinity, the results showed that there were no significant differences between the three sites, the percentage ranged from (44.02 to 65.7). **(Fig. 2A).** As for the comparison between the averages of the three sites with the Ministry site, a difference appeared, as the average of the three sites had a higher salinity value than the Ministry site. Values range between (52.35 to 68.41) **(Fig. 2B).** The water of the Tigris is considered slightly brackish within the limits implemented by the World Health Organization **(Abbot *et al*., 2022)**. The total dissolved solids showed significant changes among the three sites, where the second site recorded the highest percentage among the sites, (344-541) highest value in June. **(Fig. 2A).** In addition, we found differences between the average of the three sites with the Ministry's site, (510-661), as well as the months. The month of January recorded the highest value for total dissolved solids **(Fig. 2B).** As the percentage of total dissolved solids is around 600 mg/liter, it is considered good drinking water within the limits implemented by the World Health Organization **(Abbot *et al*., 2022).**

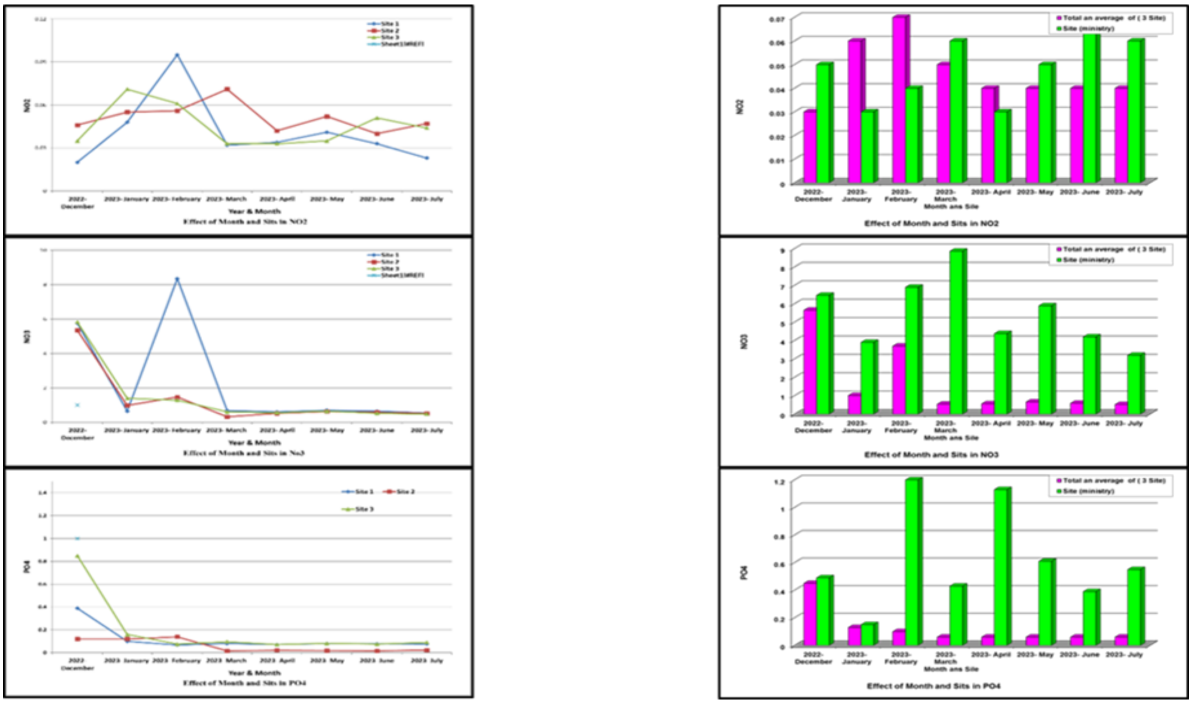


(A) **(B)**

Figure (2): Field measurements of Mean ± SE of PH, Salinity values in %, TDS values in mg/L, OF Tigers River in Jadiriyah from months December 2022 To July 2023 N = 24 samples Across entire field seasons**.**

Group 2: NO_2, NO_3 and PO_4

NO_2 values show a significant difference in the first and third sites. On the other hand, there were no significant differences in the second site. The months did not show any differences **(Fig. 3A).** In relation to the average of the three sites with the Ministry's site, significant differences were shown in close proportions in the two sites and no differences appeared between the months **(Fig. 3B).** In addition, the results are within the permissible limits of the World Health Organization, not to cross a rate of more than 3 mg/liter, which is considered safe, water **(Abbot *et al*., 2022).** The results of NO_3 showed slight significant differences between the three sites and no differences appeared between the months except for the month of February when a significant difference was shown **(Fig.3A)**. The average of the three sites with the Ministry's sites illustrated significant differences between them and also no significant difference between months **(Fig. 3B).** The result of PO_4 indicated that there were significant differences between the three sites with simple gradations, but in terms of months, significant differences appeared only in March and December **(Fig. 3A).** There were significant differences between the averages of the three sites with the Ministry's sites, where the Ministry's sites recorded the highest value of the phosphate compound, significant differences appeared between the months, and the months of April and February recorded the highest value **(Fig. 3B).**



(A) (B)

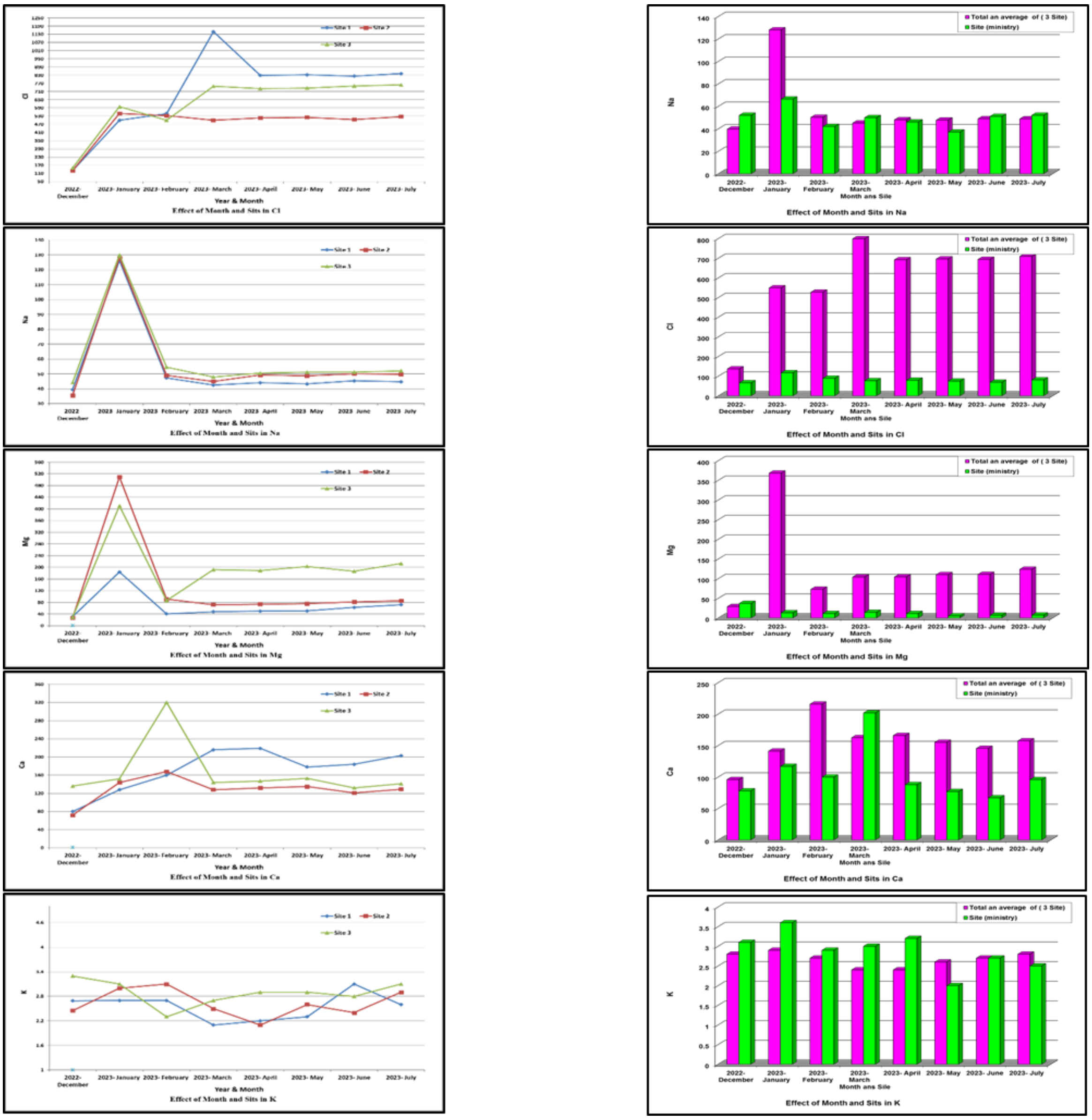
Figure (3): Field measurements of Mean ± SE of NO_2 values in ppm, NO_3 values in ppm, and PO_4 values in ppm OF Tigers River in Jadiriyah from months December 2022 To July 2023 N = 24 samples Across entire field seasons.

Group 3: Na, Cl, Mg, Ca and K

The results of Na analysis showed that there were significant differences between the three sites, and the third site had the highest value, while no significant differences appeared between the months **(Fig. 4A).** While the Ministry's sites have apparent moral value compared to the average of the three sites. Instead of there being no significant differences between the months, the month of January recorded a clear moral value **(Fig. 4B).**

Chloride ion was measured because it accompanies sodium as salt in the water, and the results showed that there were highly significant differences between the three locations, and the third location recorded the highest value **(Fig. 4A).** As well as the presence of significant differences between the months, while March recorded the highest value between the two comparisons. The average of the three sites recorded the highest value of chloride ions compared with the Ministry **(Fig. 4B).** The results that have been reached agree with data from the Ministry site for sodium and chloride within the standard limit allowed by the World Health Organization while chloride does not excess 250 mg / L and does not cross over 200 mg/L for sodium **(Abbot et al., 2022).** Mg and Ca data showed that there were significant differences between the three sites and the months. The second site recorded the highest value, while July recorded the highest value for magnesium **(Fig. 4A).**

The average of the three sites recorded the highest value for magnesium compared to the Ministry's site, and the month of January showed the highest value between the two sites **(Fig. 4B).** Ca bonded with magnesium as calcium salts so it measured, the third site recorded the highest value among sites, and February recorded the highest value for calcium between the three sites **(Fig. 4A).** The Ministry's site recorded a lower value than the average of the three sites of calcium, and the month of February was the highest value **(Fig. 4B).** The measurements indicated that there were significant differences between the three locations of K, with slight gradations between the locations, and the month of December recorded the highest value **(Fig. 4A).** As well as the presence of significant differences between the Ministry sites and the average of the three sites. The Ministry sites had the highest value, and the month of April recorded the highest value as well **(Fig. 4B).**



(A) (B)

Figure (4): Field measurements of Mean ± SE of Na in mg/L, Cl in mg/L, Mg in mg/L, Ca in mg/L, and K in mg/L OF Tigers River in Jadiriyah from months December 2022 To July 2023 N = 24 samples Across entire field seasons.

The results of the study agreed with the results of another study on the presence of statistically significant differences when comparing the values of the studied variables with the Iraqi standard as well as the World Health Organization (WHO) and the following variables (K, TDS, pH, Cl, Mg, NO_3, Na) **(Alobaydi& Almahdawi, 2016).** Between 1970 and 2008, the salinity of the Tigris and Euphrates rivers in Mesopotamia increased significantly as a result of a sharp decline in the volume of water delivered into each river**. (Al Maarofi, 2015).** Two factors influence salinity in general. The amount of water that feeds the water surface is the first, and it reaches its peak in April to June as well as in September to November. Evaporation is the second cause, and it gets worse because of climate change **(Al-Ansari, 2013).** The results indicated that salinity in the average of the three sites was higher than that of the Ministry's site; in addition, December recorded a high value in salinity due to rainfall and surface runoff from the neighboring lands to the river. The increased salinity is attributed to evaporation, pollution, dam building upstream of the rivers, and an increase in agricultural activity **(Pearce, 2013) (Figs. 2A, B).**

Additional proof of changes in salinity concentration due to the changing concentration of major ions. Previous studies **(Al-Saad *et al.*, 2010) indicated** that the chloride ion appears in large and simple quantities, especially in the summer, compared to the magnesium and calcium ions. Moreover, the sodium ion is treated as chloride because it is associated with it as a salt compound. The levels of ions in the three sites were higher than the site of the ministry due to the three sites being close to the electric power production station of Jadiriyah and the presence of the Dora petrochemical refinery and sewage water in the Jadiriyah region which flows directly into the Tigris River. The ministry's site for collecting samples was far from the three points near the Qadisiyah area **(Fig. 4A, B).** Globally, Eutrophication seen as a serious issue affecting the aquatic ecosystem. Global freshwater and marine environments must have less nutrient input. Harmful algal blooms (HABs) are among the well-researched adverse biological reactions to increasing fertilizer discharge into coastal and marine waterways (Glibert & Burford, 2017). Recent scientific literature has shed light on this, emphasizing that in order to prevent coastal eutrophication, both nitrogen and phosphorus must be reduced. Agriculture and surface runoff, in addition to the presence of populated areas, are among the most important causes of the increase in nutrients. Although these factors exist, the study indicated that there were no significant differences between the three sites, and there are no significant differences between the average of the sites and the site of the ministry. This is because the study three site has running water, not stagnant water, which contributes in a large proportion, to a reduction in the proportions of nutrients **(Fig. 3A, B).** Further investigation is needed in order to provide strong evidence for the effect of nutrients on salinity in the river**.** High salt levels could have an effect on residents and wildlife. The experiment has demonstrated the adverse effects of this management approach on major ions and water salinity, and it may have a domino effect that leads to other issues in the future. The results showed that the raw water tends to be slightly alkaline, and this may be due to the presence of carbonates and bicarbonates in it **(Zinah *et al.*, 2018).** More evidence is needed to prove the large interactions that nutrients and ions play in the water and the effect of increasing them.

Taking into account the imposition of the government on factories, refineries, stations, and farms to limit the pollutants that they release into river water and to impose laws and penalties with implementation for these crimes that lead to risks to aquatic life and their negative impact on wildlife should have to protect and improve water resources.

CONCLUSION

The study concluded that there are significant differences between the three sites, as the third site, which was close to the Dora refinery, is the saltiest due to the large presence of major ions due to the presence of refinery sewage in this area. When comparing the average of the three points with the site of the Ministry, the average points were also higher in terms of salinity, but no results exceeded the limits of WHO standards.

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