GSC Advanced Research and Reviews
eISSN: 2582-4597 CODEN (USA): GARRC2
Cross Ref DOI: 10.30574/gscarr
Journal homepage: https://gsconlinepress.com/journals/gscarr/

(RESEARCH ARTICLE)

Check for updates

Evaluation of the Tigris River's Water Quality in the Wasit Governorate, Iraq

Shayma Abdulwahab Luibi *

Third Rusafa Education, Ministry of Education, Baghdad, Iraq.

GSC Advanced Research and Reviews, 2025, 25(02), 025-032

Publication history: Received on 26 September 2025; revised on 02 November 2025; accepted on 04 November 2025

Article DOI: https://doi.org/10.30574/gscarr.2025.25.2.0333

Abstract

The objective of this study is to evaluate the water quality of the Tigris River physicochemical and biological properties throughout dry and wet seasons in the governorate at Wasit, Iraq. Five points were selected over the course of the governorate's river path, and samples of water were measured in both the dry season in September 2023 as well as the wet season in February 2024. The key points that were measured included the pH, EC, TDS, Turbidity, DO, BOD5, and concentrations of heavy metals and major ions, (Fe, Pb, Cd) and (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Cl^{-}, and SO_4^{2-}), respectively. The results were compared with the drinking and aquatic life standards of the World Health Organization, as well as Iraq. To provide an overview of the general state of the water, the WQI of the water was calculated. The results show significant seasonal variation, as well as an overall degradation of the water quality during the dry season. With reduced river flow and higher levels of the untreated home and industrial waste discharge, as well as the runoff from the agricultural areas, most of the parameters, especially TDS, BOD5 and the heavy metals have crossed the permissible limits at many locations. The WQI of the river water lies between "Very Poor" to "Unsuitable" drinking for the humans. This study underlines the immediate necessity of efficient pollution abatement and watershed management strategies in the area.

Keywords: Tigris River; Wasit; Heavy Metals; Physicochemical Parameters; Pollution; Water Quality Index (Wqi)

1 Introduction

Tigris River in Iraq is an essential freshwater resource that supports industrial activity, agriculture, and millions of people's access to drinking water. There are several reasons why the river has become increasingly environmentally stressed in the recent past: diminished water flow due to upstream dams in Iran and Turkey and more extended droughts due to climate change, as well as severe pollution from industrial, agricultural, and urban sources. [1-3].

One of the most significant sources of drinking and municipal water supply in the Wasit Governorate, southeast Iraq, is the Tigris River. For this reason, the quality of water in this part of the river matter not only to the health and well-being of the residents of the chosen region but also to the long-term existence of the agricultural sector. The outcomes of the study at hand are particularly useful for determining the status of the specified river concerning the season in question, as well as the locations analyzed. The wide range of water quality measures was analyzed, revealing a concerning picture. The Impact of Employee Diversity Network and Opportunities for a Multicultural Environment [4-6].

Aims

The aims of paper are

- Identify the seasonal and regional fluctuations in the Tigris River's biological and physicochemical characteristics in Wasit.

* Corresponding author: Shayma Abdulwahab Luibi

- Evaluate the parameters and compare them to international and national water quality requirements.
- Calculate the Water Quality Index (WQI) to get a comprehensive evaluation of the potability of the water.
- Identifies possible sources of pollution and suggests ways to mitigate them.

2 Materials and Procedures

2.1 Study Region and Sites for Sampling

In the Wasit Governorate, five sample locations were chosen along the Tigris River:

- S1: Upstream (close to Al-Aziziyah): Indicates the quality of the entering water.
- S2: Evaluates the urban effect within Al-Kut City (upstream of the city center).
- S3: Impacts of Urban Wastewater Discharge Reflected in Al-Kut City (below the city center).
- S4: Agriculturally Used Region (south of Al-Kut).
- S5: Near Maysan Governorate borderline.

2.2 Collection and Analysis of Samples

The samples of water were collected in September 2023 in the dry season and in February 2024 in the wet one. In ice freezers, the prepared polyethylene bottles previously cleaned were used to transport the samples to the laboratory. All analyses were conducted according to the generally accepted methodologies.

2.3 Analysis of Parameters

The anthropogenic and natural marine pollution elements can be classified into physical, chemicals, and ions. Some of the physical ions include turbidity and total dissolved solids TDS, electrical conductivity EC, pH, and temperature. Chemicals are the BOD 5, DO, and phosphates PO_4^{-3} and nitrates NO^{-3}, Primary ions include the sodium Na +, potassium K +, calcium Ca^{+2} magnesium Mg^{+2}, chloride Cl^{-}, sulfate SO_4^{-2}, Finally, heavy metals include cadmium Cd, lead Pb, and iron, Fe.

2.4 Water Quality Index (WQI) Calculation

A weighted arithmetic index approach was used to construct the WQI, taking into account important factors (pH, TDS, DO, BOD5, NO_3^{-}, and Cl^{-}).

3 Results and Discussion

3.1 Parameters of Physicochemistry

3.1.1 pH

Showed a modest rise downstream, most likely as a result of algae photosynthetic activity, but remained within acceptable bounds at all sites as shown in Table 1 and Figure 1 [7,8].

3.1.2 EC and TDS

An increasing trend from S1 to S5 during the dry season. The value was above 1000 mg/L for drinking water. The causes were due to evaporation, lesser dilutions, and the intrusion of saline agricultural drainage water into the river. However, due to dilution from rainfall, the wet season had the least concentrations as shown in Table 1 and Figure 2,3 [9, 10].

3.1.3 Turbidity

For both seasons, turbidity was high 1. The causes were different due to the above conditions. During the rainy season, it was due to the surface runoff of transport of suspended particles. However, during the dry season, it implies the proliferation of algae and possibly the discharge of untreated wastewater as shown in Table 1 and Figure 4 [11, 12].

3.1.4 DO and BOD5

The significant decrease of DO concentrations at the sites S3, S4 and S5, below the 5 mg/L, required for supporting of aquatic life, is an important result. An associated sharp increase in BOD5, an important indicator of organic pollution of

sewage and agriculture sources, is the direct cause of it; it is of extremely serious concern for the ecological health of the river during a dry season as shown in Table 1 and Figure 5,6 [13,14].

Table 1 Seasonal Differences in Physicochemical Characteristics at Various Locations

Parameter	Standard (WHO/Iraqi)	Season	S1	S2	S3	S4	S5
pH	6.5 - 8.5	Dry	7.8	7.9	8.1	8.2	8.3
		Wet	7.5	7.6	7.7	7.8	7.8
EC (µS/cm)	1500	Dry	1850	2100	2350	2800	2950
		Wet	1200	1350	1550	1850	2000
TDS (mg/L)	1000	Dry	1180	1340	1500	1790	1880
		Wet	768	864	992	1184	1280
Turbidity (NTU)	5	Dry	8.5	12.1	18.5	22.4	20.1
		Wet	25.4	34.2	45.8	55.1	48.3
DO (mg/L)	> 5	Dry	6.8	5.9	4.2	3.8	4.1
		Wet	7.5	6.8	5.9	5.2	5.5
BOD_5 (mg/L)	< 4	Dry	3.5	4.8	7.2	8.5	7.8
		Wet	2.1	3.2	4.5	5.9	5.1

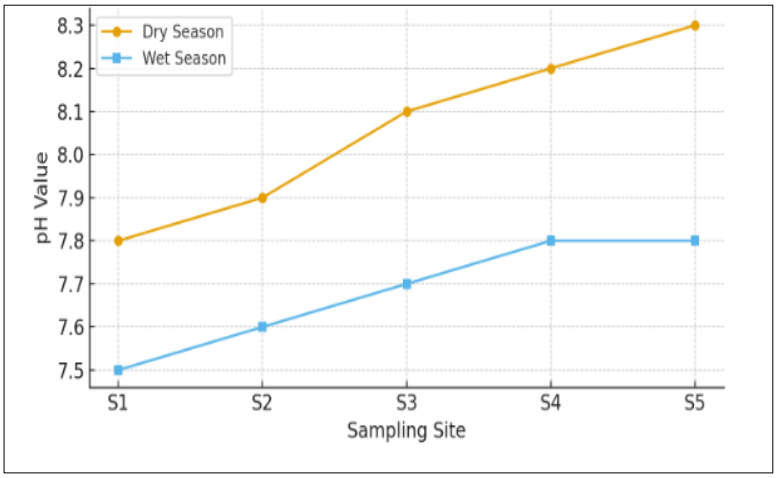

Figure 1 PH variation across sites

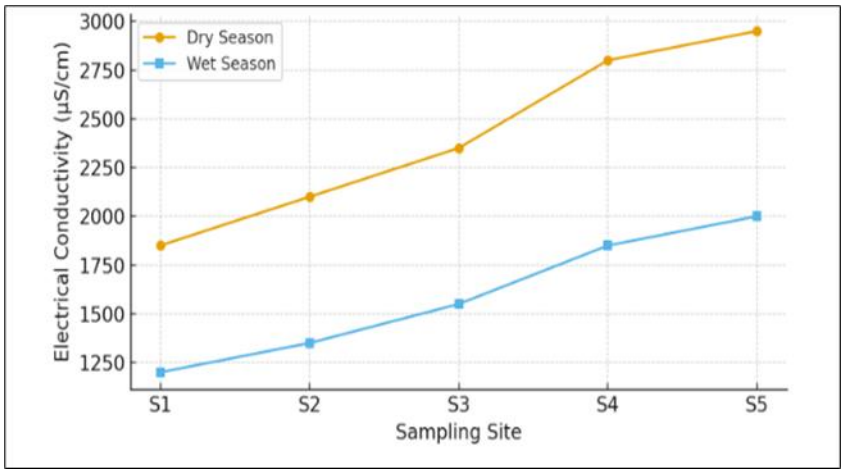

Figure 2 EC variation across sites

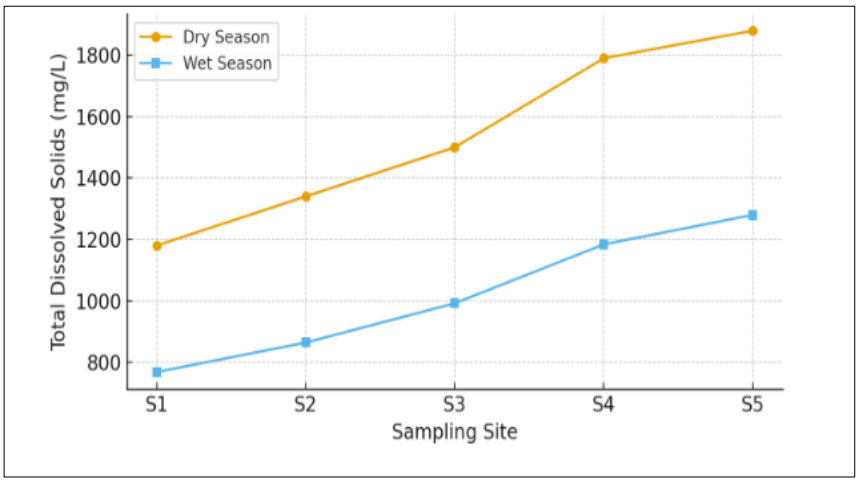

Figure 3 TDS variation across sites

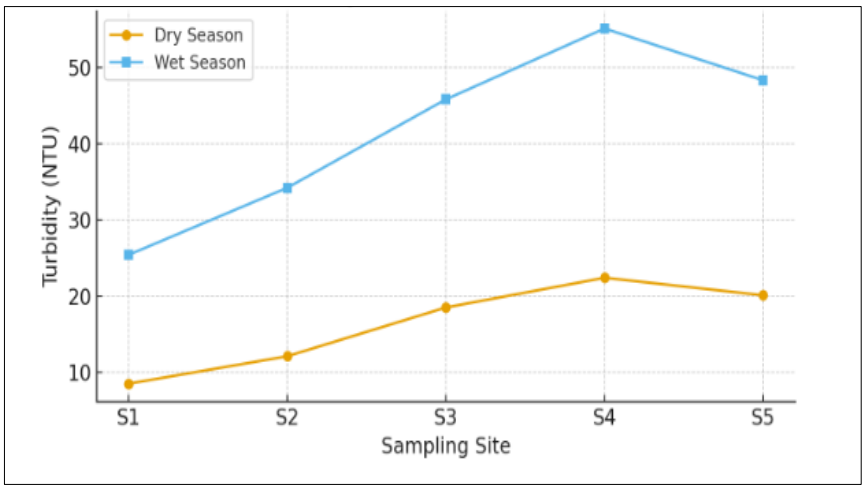

Figure 4 Turbidity variation across sites

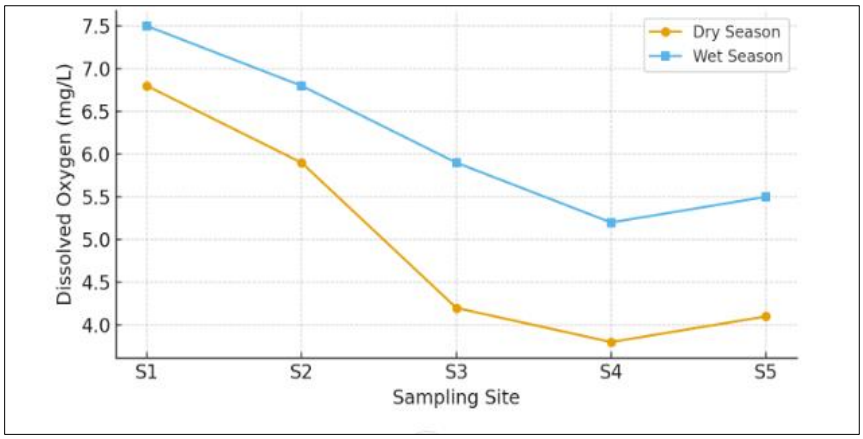

Figure 5 DO variation across sites

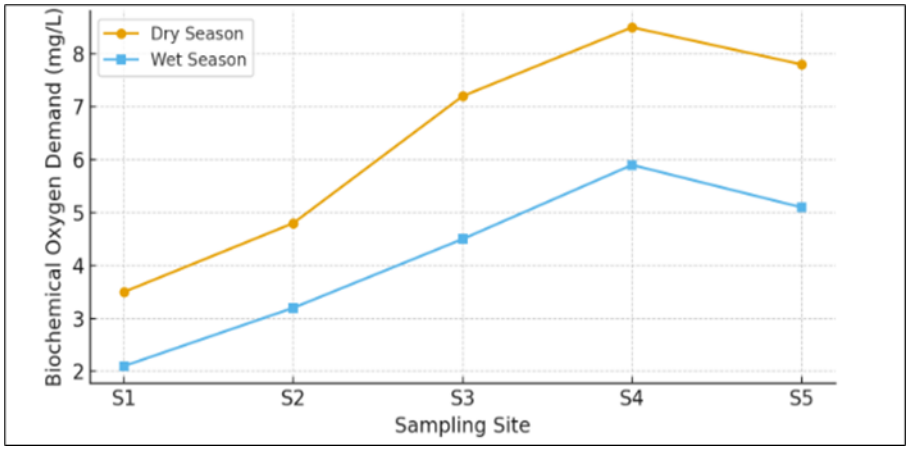

Figure 6 BOD variation across sites

3.2 Concentration of Heavy Metals

Table 2 displays the concentrations of a few chosen heavy metals.

Table 2 Concentration of Heavy Metals (mg/L)

Heavy Metal	Standard (WHO)	Season	S1	S2	S3	S4	S5
Iron (Fe)	0.3	Dry	0.25	0.31	0.45	0.52	0.48
		Wet	0.18	0.22	0.28	0.35	0.32
Lead (Pb)	0.01	Dry	0.005	0.008	0.015	0.018	0.017
		Wet	0.003	0.005	0.009	0.012	0.011
Cadmium (Cd)	0.003	Dry	0.001	0.002	0.004	0.005	0.005
		Wet	< 0.001	0.001	0.002	0.003	0.003

Fe, Pb, and Cd levels at the agricultural and urban sites increase significantly S3-S5. The levels of Pb and Cd at S3, S4, and S5 above WHO limits during the dry season but Fe slightly exceeds the limit. The sources of these metals include use of phosphate fertilizers and pesticides in agriculture, urban runoff, and industrial discharges. Both cadmium and lead are toxic elements and have the capability to bio accumulate in the food chain posing a severe risk to human health as shown in below Figures 7, 8 and 9 [10-14].

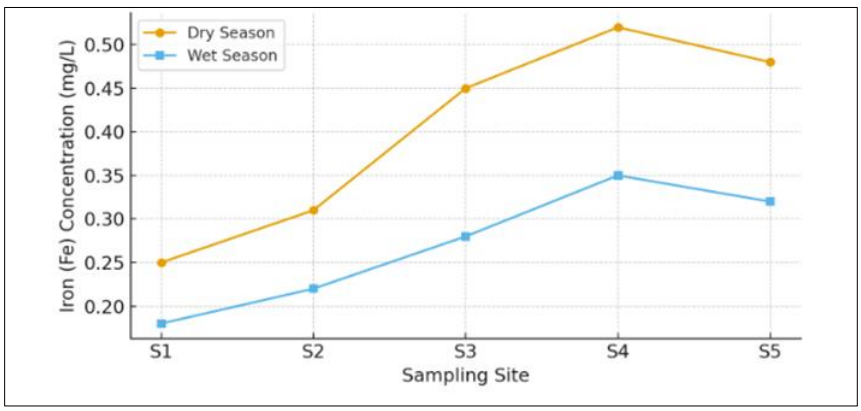

Figure 7 Fe Concentration variation across sites

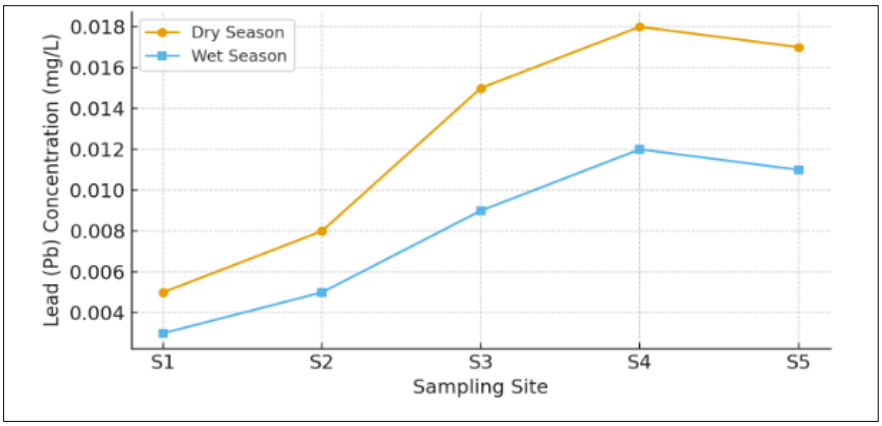

Figure 8 Pb Concentration variation across sites

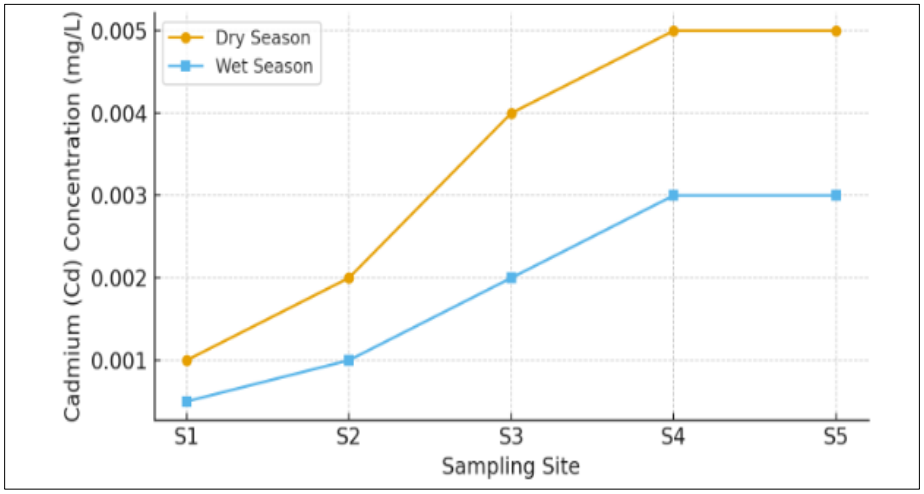

Figure 9 Cd Concentration variation across sites

3.3 Water Quality Index (WQI)

Table 3 provides a summary of the determined WQI values for the dry season.

Table 3 Classification (Dry Season) and Water Quality Index (WQI)

Sampling Site	WQI Value	Status
S1: Upstream	68.2	Medium
S2: Urban (Upstream)	78.5	Poor
S3: Urban (Downstream)	115.3	Unsuitable
S4: Agricultural	134.7	Unsuitable
S5: Downstream	126.9	Unsuitable

3.4 Classification by WQI

The WQI provides a complete, clear assessment about the drinkability. The upstream site has a water quality of "Medium", while the downstream sites have an "Unsuitable" water quality. This spatial degradation clearly identifies the agricultural zones and the parts in Al-Kut city as major hotspots in pollution. The higher level of TDS, BOD5, and nitrates are the main cause of the high WQI.

4 Conclusion

This study unequivocally shows that the Wasit Governorate's Tigris River water quality is severely stressed. The primary findings are

- Spatial Degradation: As the river flows through Al-Kut city and agricultural regions, the quality of the water drastically declines.
- Seasonal Variation: Because there are less flow and concentration of contaminants during the dry season, the water quality is lower.
- Major Issues: The main issues include heavy metal contamination (Pb, Cd), salinity (high TDS), and high organic pollution (low DO, high BOD5).
- Overall Status: The river water is rated as "Poor" to "Unsuitable" for drinking by the WQI, particularly in locations downstream.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict-of-interest to be disclosed.

References

[1] World Health Organization (WHO). (2017). Guidelines for Drinking-water Quality (4th ed.).

[2] Al-Ansari, N. (2013). Management of Water Resources in Iraq: Perspectives and Prognoses. Engineering, 5(6), 667-684.

[3] Iraqi Ministry of Health. (2009). “Iraqi Standards for Drinking Water”.

[4] Al-Hamdani, M. A., and Al-Mussawi, W. H. (2022). Assessment of Heavy Metal Pollution in the Tigris River within Baghdad City, Iraq. IOP Conference Series: Earth and Environmental Science, 1120(1), 012045.

[5] Ali, S. S., Al-Ansari, N., and Knutsson, S. (2021). The Future of Water Resources in Iraq: A Prospective Study. Journal of Water Resource and Protection, 13(12), 919-940.

[6] Hama Aziz, K. H., and Karim, H. H. (2020). Heavy Metal Pollution in the Sediments of the Tigris River: A Review. Journal of Environmental Protection, 11(04), 250-263.

[7] APHA (2017). Standard Methods for the Examination of Water and Wastewater (23rd ed.). American Public Health Association, American Water Works Association, Water Environment Federation. Washington, DC.

[8] Ismael, A. H., Al-Sulaiman, M. A., and Al-Mahmood, H. K. (2023). Evaluation of Water Quality Index for Drinking Purpose and Health Risk Assessment of Heavy Metals in Diyala River, Iraq. Environmental Monitoring and Assessment, 195(1), 215.

[9] Khalaf, R. M., and Hassan, W. H. (2023). Impact of Climate Change and Anthropogenic Activities on the Water Quality of the Tigris River, Southern Iraq. Water, Air, and Soil Pollution, 234(4), 245.

[10] Mahdi, K., Al-Murani, M., and Al-Saadi, S. (2022). Spatial and Temporal Variation of Physicochemical Parameters and Water Quality Index in the Euphrates River, Iraq. Polish Journal of Environmental Studies, 31(3), 2801-2813.

[11] Mohammad, A. H., and Al-Obaidi, A. S. (2021). Impact of Agricultural Drainage on the Water Quality of the Tigris River in Maysan Governorate, Iraq. Egyptian Journal of Aquatic Research, 47(4), 389-395.

[12] Nadhim, A. A., and Al-Ansari, N. (2020). Application of Water Quality Index for Assessment of Tigris River Water Quality in Baghdad. Journal of Civil Engineering and Architecture, 14, 355-362.

[13] UNESCO. (2021). Water Quality and Pollution in a Changing World: The Case of the Tigris-Euphrates Basin. United Nations Educational, Scientific and Cultural Organization.

[14] World Bank. (2023). Iraq: Priorities for Water Resources Management and Sector Reform. World Bank Group.