



Groundwater Quality Assessment of Al-Qayrawan District, Northwest of Nineveh Governorate

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ABSTRACT

The study examined groundwater samples from wells distributed in the Al-Qayrawan district, located to the west of Nineveh Governorate, northern Iraq. Water samples were collected over a five-month period, from April to August 2025, for laboratory testing, a study of their characteristics, and the determination of their potential for use for drinking and various civil uses. The study of groundwater samples indicated variations in pH average values ranging between (7.41-7.68), EC average values ranged between (1690-1910) $\mu\text{S}/\text{cm}$, and total hardness average values ranged between (870-1120) mg/L . As for positive ions, their values ranged between (244-352) mg/L and (56-119) mg/L to calcium and magnesium ions, respectively. Negative ion values ranged between (227-310) mg/L , (7-11) mg/L , (17-34) mg/L and (75-140) mg/L for bicarbonate, nitrates, chlorides, and Sulfates respectively, most of values are higher than acceptable limits for water use according to international standards.

Regarding the application of the water quality Index for drinking, applied using the weighted arithmetic, the results showed that the values for the groundwater studied in the Al-Qayrawan ranged between (52-60), indicating water is poor for drinking.

Keywords: Groundwater, Well Water, Water Quality Model, Al-Qayrawan.

INTRODUCTION

Many countries around the world depend on groundwater as their primary source of drinking water and agricultural irrigation, especially in countries without rivers or any surface water, the percentage of reliance on groundwater may surround 90% of water needs (Dalas *et al.*, 2022).

Groundwater is a potential source of water, especially when surface water is unavailable in some climate regions that are subject to significant surface water deficits worldwide (Allafta and Patra, 2020). Consequently, approximately 33% of the world's population consumes groundwater (Ifediegwu, 2022). Despite the fact that groundwater is clear and free of sediments and organic materials, it is affected by the climate and vegetation, human activities, and the mineral nature of the Water-retaining rocks and through which it passes. Thus, groundwater contains dissolved mineral materials and compounds from these rocks (Ram *et al.*, 2021). It may contain some pollutants, such as toxic metals, plant fertilizers, nitrates, pesticides, which pose a threat to human health and economy (Li *et al.*, 2021). Groundwater can also be affected by irrigation water because of its mixing with fertilizers, agricultural and animal waste, and various human activities (Adimalla and Qian, 2021).

Continuous groundwater withdrawal increases with increasing in population, agricultural, and industrial density, which puts pressure on this natural resource and increases the need to monitor it and determine its suitability for various uses (Ali and Sabri, 2023).

Evaluating water build on comparing physical and chemical properties with standard specifications for each variable individually is a simple insufficient method for assessing water quality. Therefore, a water quality Index is used to provide a single, summarized result about the quality of the water under study and to determine the extent to which it can be used in all fields (Shihab and Kannah, 2021). We have many types of (WQI) that can we depend upon. The study (Oseke *et al.*, 2021) relied on the sub-index of (WQI), while the study (Shaaban and Stevens, 2025) depend on the weighted arithmetic (WQI) In addition to many other studies that relied on multiple models.

The current study aims to assess the quality of groundwater in the Qayrawan district and determine its potential use for drinking and irrigation.

MATERIALS AND METHODS

Study region

Al-Qayrawan District, located to west of Nineveh Governorate in northern Iraq (36.156268, 42.036298), is an agricultural area that relies primarily on groundwater for drinking, various civil uses, and irrigation of crops.

The study was undertaken by collecting samples from five locations in the district, as shown in (Table 1) and Satellite Fig. (1).

Table (1): Sample collection locations on Map

Well Number	Location on Map (Latitude and Longitude)
Wl.No.1	36.167946, 42.029003
Wl.No.2	36.161594, 42.027163
Wl.No.3	36.154250, 42.025326
Wl.No.4	36.151365, 42.039019
Wl.No.5	36.154092, 42.054651

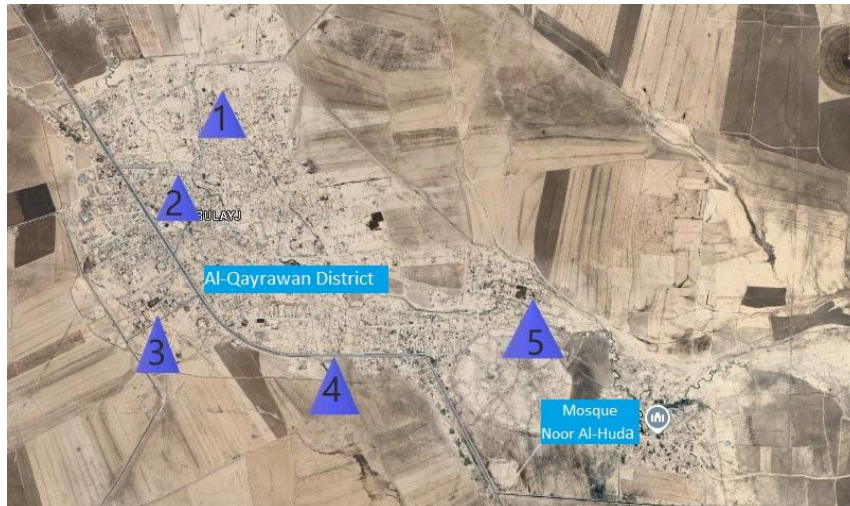


Fig. 1: Satellite image of Al-Qayrawan District showing location studied groundwater samples

Sample collection

Sample collection continued for five months, starting from April to August 2025, following the data collection methods approved by (APHA, 2017). Samples were stored in glass bottles after being thoroughly cleaned and rinsed with water from the studied well water, then filled and transported to the laboratory for testing.

Irrigation indices

A set of irrigation indices were calculated (Sodium Adsorption Ratio (SAR), Sodium percentage (% Na), potential salinity (P.S), Kelly Index (KI), Permeability Index (PI) and Magnesium Adsorption Ratio (MAR)) according to the methods adopted elsewhere (Ajayi *et al.*, 2022; Anyango *et al.*, 2024), as shown in (Table 2).

Table (2): Irrigation indices (Ajayi *et al.*, 2022; Anyango *et al.*, 2024)

Irrigation indices	Mathematical Equation
SAR *	$SAR = \frac{Na}{\sqrt{\frac{Ca+Mg}{2}}}$
%Na	$\%Na = \frac{Na}{Na + K + Mg + Ca} \times 100$
P. S *	$P. S = Cl + \frac{1}{2} SO_4$
KI *	$KI = \frac{Na}{Ca+Mg}$
Pi	$Pi = Na + \left[\left(\frac{\sqrt{HCO_3}}{Na + Mg + Ca} \right) \times 100 \right]$
MA Ratio	$MAR = \frac{Mg \times 100}{Ca + Mg}$

* unit meq/L

Water quality index application

(WQI) was applied using the weighted arithmetic (WQI), as reported by (Diwyanjalee and Premaratne, 2024; Kumar and Saxena, 2024), which it calculated according to the following equation:

$$wqi = \sum_{i=1}^n WiQi / \sum_{i=1}^n Wi \dots\dots\dots (1)$$

n = number of variables, Wi = weighted value the parameter studied, Qi = quality index

The weighted value of the parameter studied for drink water quality parameters is inversely proportional to the standard specifications recommended by (WHO, 2017) (Table 3) and for irrigation according to (Rehman *et al.*, 2024) as shown in (Table 4).

Table (3): Weights of the studied variables and the standard value of drinking water use for each variable according to (WHO, 2017)

Parameter	Unit	WHO 2017	Weighted value
pH	---	7.0- 8.5	0.688073394
EC	μS/cm	1000	0.005848624
T. Hardness	mg /L	200	0.029243119
Alkalinity	mg /L	150	0.038990826
Ca ⁺⁺	mg /L	200	0.029243119
Mg ⁺⁺	mg /L	150	0.038990826
NO ₃	mg /L	50	0.116972477
Cl ⁻	mg /L	200	0.029243119
SO ₄	mg /L	250	0.023394495
			$\sum_{i=1}^n Wi = 1$

Table (4): Weights of the studied variables and the standard value for irrigation water use for each variable according to (Rehman *et al.* 2024)

Parameter	Unit	Standard Value	Weighted value
pH	---	7.5	0.080631022
EC	μS/cm	2000	0.000302366
Cl ⁻	meq/L	10	0.060473267
HCO ₃	meq/L	8.5	0.07114502
SAR	meq/L	10	0.060473267
% Na	---	40	0.015118317
PS	meq/L	7	0.086390381
KI	meq/L	1	0.604732668
PI	---	70	0.008639038
MA Ratio	---	50	0.012094653
			$\sum_{i=1}^n Wi = 1$

$$Wi = K/S_n \dots\dots\dots (2)$$

Where:

S_n : The standard parameter, K: The proportionality constant, calculated as follows:

$$K = 1/\Sigma(\frac{1}{S_n}) \dots\dots\dots (3)$$

(Qi) calculated from the following equation:

$$Qi = 100 [(V_0 - V_i)/(S_n - V_i)] \dots\dots\dots (4)$$

Where:

V_0 : Value of the standard under study, V_i : Ideal value in pure water

The ideal value of the studied parameter must be equal to zero in pure water, except if the studied characteristic is the hydrogen ions (pH), in which case the ideal value is considered to be (7.0), and the maximum permissible limit is (8.5), and it is calculated using the equation for hydrogen ions only:

$$Qi = 100 [(V_{pH} - 7.0)/(8.5 - 7.0)] \dots\dots\dots (5)$$

After calculating the (WQI) model value, the values were projected on (Table 5) to exactly determine quality of the water to be studied.

Table (5): Water quality classification according to the weighted arithmetic water quality index (WQI) as mentioned in (Diwyanjalee and Premarathne, 2024) and (Kumar and Saxena, 2024)

WQI	Water type
0-25	Excellent
26-50	Good
51-75	Poor
76-100	Very Poor
> 100	Unsuitable

RESULTS AND DISCUSSION

Groundwater pH values it affected by the presence and type of salts, high water hardness, and calcium and magnesium ions (Podgorski and Berg, 2022). The results of the study shown in (Table 6) indicated that the highest pH values reached approximately (7.86) at well No. (2), while the lowest values reached (6.85) at well (4), at rates ranging between (7.41-7.68) While the results of the study shown in (Table 6) indicated that the rates of Electrical Conductivity (EC) rates ranged (1690-1910) $\mu\text{S}/\text{cm}$, while the highest values reached the limits of (2015) $\mu\text{S}/\text{cm}$ at well No. (5), high values are due to the dissolution of the salts that make up the reservoir rocks through which the groundwater passes, As well as sewage leakage from homes and agricultural activities (Ram *et al.*, 2021).

Total hardness (TH) results for the studied water samples, as shown in (Table 6), indicated that (TH) values reached (1370) mg /L in the water of Well (5), while the average values ranged between (1120-870) mg /L. The (TH) is due to the presence of calcium and magnesium ions dissolved in the water, as well as carbonic acid (H_2CO_3), which it formed by dissolved carbon dioxide gas in the water.

This acid, in turn, reacts with the calcium and magnesium ions to form calcium and magnesium bicarbonates $\text{Ca}(\text{HCO}_3)_2$ and $\text{Mg}(\text{HCO}_3)_2$, which increases the hardness of the water (Valiollahi and Yazdani, 2025).

Table (6): Values of variables for the studied water

Parameter		WL.No.1	WL.No.2	WL.No.3	WL.No.4	WL.No.5
pH	Max	7.75	7.86	7.66	7.85	7.65
	Min	6.95	7.16	7.20	6.85	7.35
	Mean	7.46	7.41	7.58	7.68	7.45
EC μS/cm	Max	1790	1890	1990	1970	2015
	Min	1610	1550	1670	1660	1890
	Mean	1690	1760	1790	1780	1910
T. Hardness mg /L	Max	1270	1310	1160	1235	1370
	Min	980	870	780	815	910
	Mean	1120	980	910	870	1090

The results shown in (Table 7) indicated that the values of positive ions reached (392) mg /L for calcium ions at well (2) and (125) mg /L for magnesium ions in the studied samples of well water (1). The presence of positive ions in groundwater is due to several factors, including the nature of the rocks the groundwater passes from it and the excessive extraction of groundwater (Qian *et al.*, 2024).

Table (7): Positive and negative ions of the studied water

Parameter		WL.No.1	WL.No.2	WL.No.3	WL.No.4	WL.No.5
Ca ⁺⁺	Max	304	392	300	348	366
	Min	180	260	196	236	268
	Mean	294	272	244	254	352
Mg ⁺⁺	Max	125	83	89	83	109
	Min	83	67	54	49	50
	Mean	119	76	63	65	56
Na ⁺	Max	34	46	53	61	54
	Min	21	16	21	34	22
	Mean	28	30	36	42	37
K ⁺	Max	1.34	1.21	1.38	1.46	1.24
	Min	1.09	1.10	1.13	1.17	1.07
	Mean	1.17	1.16	1.24	1.27	1.14
HCO ₃	Max	245	325	255	270	285
	Min	220	290	230	240	270
	Mean	227	310	235	255	275
NO ₃	Max	20	16	18	11	8
	Min	7	7	6	4	5
	Mean	9	10	11	7	8
Cl ⁻	Max	50	38	18	36	46
	Min	22	19	15	21	30
	Mean	27	31	17	28	34
SO ₄	Max	120	210	220	175	245
	Min	70	90	150	140	130
	Mean	90	112	75	110	140

* unit mg /L

The results shown in (Table 7) indicate that the bicarbonate values in the studied water samples reached (325) mg /L in Well (2), while the average values ranged between (220-290) mg /L. The alkalinity of the water attributed to the presence of carbonates and bicarbonates in the geological layers, such as dolomite and calcite minerals (Benyoussef *et al.*, 2024).

Source of nitrates in groundwater attributed to the use of nitrogen-containing fertilizers, such as urea, which are soluble in irrigation water and can leach into the groundwater (Craswell, 2021; Abascal *et al.*, 2022). Nitrate levels ranged between (7 - 11) mg /L. as shown in (Table 7)

Chloride is an inorganic negatively charged ion that enters water from various sources. These sources include natural processes, such as the interaction between water and soil, activities human, wastewater discharge, agricultural runoff, and fertilizer use. (Benyoussef *et al.*, 2024) As shown in (Table 7), the results indicated that the chloride concentrations in the studied water samples ranged between (30-50) mg /L.

Sulfates are considered, non-toxic compounds in water when present at low concentrations, but higher concentrations can lead to increased water hardness, altered taste, and diarrhea, as well as damage to pipes and water tanks (Jakóbczyk-Karpierz and Ślósarczyk, 2022).

Results in (Table 7) indicate that the sulfate concentration levels ranged between 75 and 120 mg /L.

Irrigation indicators

(SAR) determines quality of water irrigation a high value indicates poor water quality which is considered one of the most dangerous indicators of salinity that relied upon to determine the percentage of sodium absorption in water, which determines the relative activity of sodium ions that interact with the soil (Anyango *et al.*, 2024). High levels of sodium compared to calcium concentrations reduce water flow into the soil and create poorly aerated soil (Imneisi, 2022).

The results showed that SAR values ranged between (0.348-0.608) meq/L with rates reaching (0.477) meq/L as shown in (Table 8).

Table (8): Irrigation indicators of studied samples

Parameter	Wl.No.1	Wl.No.2	Wl.No.3	Wl.No.4	Wl.No.5	Mean	Max	Min
SAR *	0.348	0.414	0.531	0.608	0.483	0.477	0.608	0.348
Na%	4.733	6.161	8.253	9.18	6.752	7.016	9.18	4.733
ps *	1.699	2.041	1.261	1.936	2.417	1.871	2.417	1.261
Ki *	0.05	0.066	0.09	0.101	0.073	0.076	0.101	0.05
Pi	8.727	11.968	11.932	12.122	10.531	11.056	12.122	8.727
MAR	39.99	31.508	29.829	29.643	20.756	30.345	39.99	20.756

* unit meq/L

(%Na) concerned with evaluating expected effects of using water irrigation on the soil composition and its degree of permeability, if the sodium concentration increases, it leads to a deterioration in the soil composition and structure, the degree of water permeability, and soil aeration. (Hakami *et al.* 2024) results showed %Na values ranged (4.733-9.18) with rates reaching (7.016) as shown in (Table 8).

(P.S) is responsible for determining any increase in chloride or sulfate ions amounts in water, the higher the values, the lower the suitability water for irrigation (Rehman *et al.*, 2024). results showed that (P.S) values ranged between (1.261-2.417) meq/L with rates reaching (1.871) meq/L as shown in (Table 8).

(KI) is an essential indicator to determine the suitability of water for irrigation purposes. Whenever the value does not exceed one, the water is considered suitable for irrigation (Nadjai *et al.*, 2024). Results showed that KI values ranged between (0.05-0.101) meq/L with rates reaching (0.076) meq/L as shown in (Table 8).

(PI) primarily affects crop production and water distribution over long periods, as it is affected by increased concentrations of dissolved minerals, especially sodium, magnesium, and bicarbonates

(Dimple *et al.*, 2022). Results showed that (PI) values ranged between (8.727-12.122) as shown in (Table 8).

(MAR) depends on calculating the percentage of magnesium compared to the percentage of calcium in irrigation water. If the concentrations of magnesium are higher than the concentrations of calcium, this leads to an imbalance in the rate of soil water absorption (Gaagai *et al.*, 2023). The results showed that the MAR values ranged within the limits (30.345) as shown in (Table 8).

Water quality index

Water quality index is a method that reflects the combined effects of various parameters and variables on overall quality. It is essential for providing a comprehensive picture of the current water quality status (Ahsan *et al.*, 2023). Using (WQI), was can classify water as poor, good, or excellent.

(WQI) for drinking water used to calculate for the studied groundwater samples based on nine parameters (Table 3), results shown in (Table 9) indicate that (WQI) values ranged from (52.02) for samples from well no.2 to (60.06) for samples from well no.4. Moreover, when these values compared to (Table 5), it was found that studied samples fall into the "poor" category according to (WQI), which it attributed to most of the studied parameters exceeded the standard values set by the (WHO, 2017).

Table (9): Average values of (WQI) for drinking water use for the studied water samples

Well number	Wl.No.1	Wl.No.2	Wl.No.3	Wl.No.4	Wl.No.5
(WQI)	55.10	52.02	55.80	60.06	55.13

(IWQI) used ten parameters and results are shown in (Table 10). The values ranged from 12.66 to 17.74, when these values compared to (Table 5), it found that all of the samples studied are of excellent quality to irrigation.

Table (10): Average values of the (IWQI) water use for the studied water samples

Well number	Wl.No.1	Wl.No.2	Wl.No.3	Wl.No.4	Wl.No.5
WQI	12.66	14.92	15.16	17.74	15.38

CONCLUSIONS

The current study showed high concentrations of electrical conductivity values which attributed to high values are due to the dissolution of the salts that make up the reservoir rocks through which the groundwater passes, as well as sewage leakage from homes and agricultural activities 32 Application of (WQI) to the groundwater samples studied indicated that water quality was poor for both drinking and various other municipal uses, as most of the parameters tested exceeded the international standards used in the study, which it attributed to most of the studied parameters exceeded the standard values set by the according international standards when applied (IWQI) to the analyzed samples, indicated that water was of excellent quality for irrigation.

REFERENCES

- Abascal, E.; Gómez-Coma, L.; Ortiz, I.; Ortiz, A. (2022). Global diagnosis of nitrate pollution in groundwater and review of removal technologies. *J. Sci. Total Envir.*, **810**, 152233. doi.org/10.1016/j.scitotenv.2021.152233
- Adimalla, N.; Qian, H. (2021). Groundwater chemistry, distribution and potential health risk appraisal of nitrate enriched groundwater: a case study from the semi-urban region of South India. *J. Ecotox. Environm. Safety*, **207**, 111277. doi.org/10.1016/j.ecoenv.2020.111277

- Ahsan, A.; Ahmed, T.; Uddin, M. A.; Al-Sulttani, A. O.; Shafiquzzaman, M.; Islam, M. R.; Masria, A. (2023). Evaluation of water quality index (WQI) in and around Dhaka city using groundwater quality parameters. *J. Water*, **15**(14), 2666. doi:10.3390/w15142666
- Ajayi, O. O.; Bagula, A. B.; Maluleke, H. C.; Gaffoor, Z.; Jovanovic, N.; Pietersen, K. C. (2022). Waternet: A network for monitoring and assessing water quality for drinking and irrigation purposes. *J.IEEEAccess*, **10**,48318-48337. doi.org/10.1109/ACCESS.2022.3172274
- Ali, S. F.; Sabri, N. G. (2023). Assessment of Groundwater Quality for Different uses at the Kharab Bazar Village in Al-Baaj District of Nineveh Governorate. *Raf. J. sci.*, **32**(3 A). doi.10.33899/rjs.2023.180287
- Allafta, H.; Opp, C.; Patra, S. (2020). Identification of groundwater potential zones using remote sensing and GIS techniques: a case study of the Shatt Al-Arab Basin. *J. Remote Sensing*, **13**(1), 112. doi.org/10.3390/rs13010112
- Anyango, G. W.; Bhowmick, G. D.; Bhattacharya, N. S. (2024). A critical review of irrigation water quality index and water quality management practices in micro-irrigation for efficient policy making. *J. Desalin. Water Treatm.*, **318**, 100304. doi.org/10.1016/j.dwt.2024.100304
- APHA, AWWA and WCPE (2017). "Stand Method for Examination of water and wastewater American public Health Association, 23rd ed., Washington DC, USA.
- Benyoussef, S.; Arabi, M.; El Yousfi, Y.; Makkaoui, M.; Gueddari, H.; El Ouarghi, H.; Boughrous, A. A. (2024). Assessment of groundwater quality using hydrochemical process, GIS and multivariate statistical analysis at central Rif, North Morocco. *Environmental Earth Sciences*, **83**(17), 515. doi.org/10.1007/s12665-024-11798-6
- Craswell, E. (2021). Fertilizers and nitrate pollution of surface and ground water: an increasingly pervasive global problem. *J. SN. Applied sci.*, **3**(4), 518. doi.org/10.1007/s42452-021-04521-8
- Dalas, M. S.; Farhan, M. G.; Altae, M. (2022). Evaluation of physical and chemical properties of water from some wells in Balad district within Salah al-Din governorate. *Tik. J. Pure Sci.*, **27**(4), 23-30. doi.org/10.25130/tjps.v27i4.29
- Dimple, D.; Rajput, J.; Al-Ansari, N.; Elbeltagi, A. (2022). Predicting Irrigation Water Quality Indices Based on Data-Driven Algorithms: Case Study in Semiarid Environment. *J. Chemistry*, **2022**(1), 4488446. doi.org/10.1155/2022/4488446
- Diwyanjalee, G. R.; Premarathne, W. A. P. J. (2024). Impact of rainfall on the water quality of a tropical river: Based on the Nilwala River in the southern province of Sri Lanka between March and October 2019. *J. Water Prac. Tech.*, **19**(6), 2352-2363. doi.org/10.2166/wpt.2024.119
- Gaagai, A.; Aouissi, H. A.; Bencedira, S.; Hinge, G.; Athamena, A.; Heddam, S.; Ibrahim, H. (2023). Application of water quality indices, machine learning approaches, and GIS to identify groundwater quality for irrigation purposes: A case study of Sahara Aquifer, Doucen Plain, Algeria. *J. Water*, **15**(2), 289. doi.org/10.3390/w15020289
- Hakami, R. A.; Naser, R. S.; El-Bakkali, M.; Othman, M. D. M.; Yahya, M. S.; Raweh, S.; Belghyti, D. (2024). Groundwater quality deterioration evaluation for irrigation using several indices and geographic information systems: A case study. *J. Des. Water Tre.*, **320**, 100645. doi.org/10.1016/j.dwt.2024.100645
- Ifediegwu, S. I. (2022). Assessment of groundwater potential zones using GIS and AHP techniques: a case study of the Lafia district, Nasarawa State, Nigeria. *J. App. Water Sci.*, **12**(1), 10. doi.org/10.1007/s13201-021-01556-5
- Imneisi, I. B. (2022). Estimation of the Sodium Adsorption Ratio (SAR) and SAR-Adjusted Ratio of groundwater in Siret Najem of Kuwayfiah-North Libya. *Scientific J. Uni. Ben.*, **35**(2). doi.org/10.37376/sjuob.v35i2.3801
- Jakóbczyk-Karpierz, S.; Ślósarczyk, K. (2022). Isotopic signature of anthropogenic sources of groundwater contamination with sulfate and its application to groundwater in a heavily

- urbanized and industrialized area (Upper Silesia, Poland). *J. Hydro.*, **612**, 128255. doi.org/10.1016/j.jhydrol.2022.128255
- Kumar, R.; Rajput, J.; Saxena, A. K. (2024). Assessment of Water Quality of Tighra Reservoir Using Weighted Arithmetic Water Quality Index (WA-WQI). *Int. J. Innov. Sci. Res. Techno. (IJISRT)*, **9**, 1086-1092. doi.org/10.38124/ijisrt/IJISRT24MAY1308
- Li, P.; Karunanidhi, D.; Subramani, T.; Srinivasamoorthy, K. (2021). Sources and consequences of groundwater contamination. *J. Archives of environmental contamination and toxicology*, **80**, 1-10. doi.org/10.1007/s00244-020-00805-z
- Nadjai, S.; Bouderbala, A.; Khammar, H.; Nabed, A. N.; Benaabidate, L. (2024). Assessment of groundwater suitability for drinking and irrigation purposes in the middle Cheliff Aquifer, Algeria. *J. Des. Water Treat.*, **319**, 100528. doi.org/10.1016/j.dwt.2024.100528
- Oseke, F. I.; Anornu, G. K.; Adjei, K. A.; Edivie, M. O. (2021). Assessment of water quality using GIS techniques and water quality index in reservoirs affected by water diversion. *J. Water-Ene. Nex.*, **4**, 25-34. doi.org/10.1016/j.wen.2020.12.002
- Podgorski, J.; Berg, M. (2022). Global analysis and prediction of fluoride in groundwater. *J. Nat. Com.*, **13**(1), 4232. doi.org/10.25678/0006GQ
- Qian, Y.; Zhen, S.; Yue, C.; Cui, X. (2024). Distribution and Origins of Hardness in Shallow and Deep Groundwaters of the Hebei Plain, China. *J. Water*, **16**(2), 310. doi.org/10.3390/w16020310
- Ram, A.; Tiwari, S. K.; Pandey, H. K.; Chaurasia, A. K.; Singh, S.; Singh, Y. V. (2021). Groundwater quality assessment using water quality index (WQI) under GIS framework. *J. App. Water Sci.*, **11**, 1-20. doi.org/10.1007/s13201-021-01376-7
- Rehman, N.; Ali, W.; Muhammad, S.; Tepe, Y. (2024). Evaluation of drinking and irrigation water quality, and potential risks indices in the Dera Ismail Khan district, Pakistan. *Kuwait J. Sci.*, **51**(1), 100150. doi.org/10.1016/j.kjs.2023.11.001
- Shaaban, N. A.; Stevens, D. K. (2025). Transforming Complex Water Quality Monitoring Data into Water Quality Indices. *J. Water Res. Man.*, 1-17. doi.org/10.1007/s11269-025-04135-4
- Shihab, H. F.; Kannah, A. (2021). Assessment of the Water Qualitative Characteristics of the Tigris River Passing Through the City of Mosul and Calculating the Water Quality Index Coefficient. *Raf. J. sci.*, **30**(3), 27-37. doi.org/10.33899/rjs.2021.168912
- Valiollahi, J.; Yazdani, M. (2025). Evaluating groundwater quality by examining electrical conductivity, total dissolved solids, total hardness, and turbidity using geographic information systems (GIS®): a case study of selected wells in the Taleghan region, Iran. *J. App. Water Sci.*, **15**(3), 1-11. doi.org/10.1007/s13201-025-02395-4
- WHO. (2017). Guidelines for drinking water quality - 4th ed. World Health Organization, Geneva 541.
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تقييم جودة المياه الجوفية في قضاء القيروان، شمال غرب محافظة نينوى

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الملخص

تناولت الدراسة عينات مياه جوفية من آبار موزعة في قضاء القيروان، غرب محافظة نينوى، شمال العراق. جُمعت عينات المياه على مدى خمسة أشهر، من نيسان/أبريل إلى آب/أغسطس 2025، لإجراء الفحوصات المختبرية عليها، ودراسة خصائصها، وتحديد مدى وملاءمتها للشرب والاستخدامات المدنية المختلفة.

أظهرت دراسة عينات المياه الجوفية تفاوتاً في قيم الرقم الهيدروجيني (pH) بين (7.41-7.68) وتراوح متوسط قيم الموصلية الكهربائية (EC) بين (1690-1910) مايكروسيمنز/سم، وتراوحت معدلات العسرة الكلية بين (870-1120) ملغم/لتر. أما بالنسبة للأيونات الموجبة، فقد تراوحت قيمها بين (244-352) ملغم/لتر و(56-119) ملغم/لتر لأيونات الكالسيوم والمغنيسيوم على التوالي. وتراوحت قيم الأيونات السالبة بين (227-310) ملغم/لتر و(7-11) ملغم/لتر، و(17-34) ملغم/لتر و(75-140) ملغم/لتر للبيكربونات والنترات والكلوريدات والكبريتات على التوالي. ومعظم هذه القيم أعلى من الحدود المقبولة لاستخدام المياه وفقاً للمعايير الدولية.

وفيما يتعلق بتطبيق مؤشر جودة المياه للشرب المطبق باستعمال دليل الحساب الموزون، أظهرت النتائج أن قيم المياه الجوفية المدروسة في منطقة القيروان تراوحت بين (52-60)، مما يدل على أن المياه ذات جودة رديئة للشرب والاستخدامات المدنية المختلفة.

الكلمات الدالة: المياه الجوفية، مياه الآبار، مؤشر جودة المياه للشرب، القيروان