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ARTICLE

# Study of some physical and chemical characteristics of the Al-Daghara and Al-Shamiyah Rivers

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## ABSTRACT

This study was conducted to evaluate some physical and chemical characteristics of water in Al-Daghara and Al-Shamiyah Rivers during the period 2025–2026. Several parameters were measured to assess water quality, including temperature, pH, electrical conductivity (EC), total dissolved solids (TDS), and turbidity, total hardness (TH), calcium (Ca), magnesium (Mg), dissolved oxygen (DO), biochemical oxygen demand ($BOD_5$), nitrite ($NO_2$), nitrate ($NO_3$), and phosphate ($PO_4$). The results showed considerable spatial and seasonal variations among the study sites. The highest water temperature recorded was 25°C, while the lowest was 11°C. pH values ranged from 7.4 to 8.6, indicating neutral to slightly alkaline water. Electrical conductivity varied between 1036 and 2480 µS/cm, whereas TDS ranged from 600 to 1438 mg/L. Turbidity values ranged from 0.56 to 52.52 NTU. Total hardness recorded values between 320 and 732 mg/L. Calcium concentrations ranged from 320 to 732 mg/L, while magnesium concentrations ranged from 81.3 to 160 mg/L. Dissolved oxygen varied between 7.56 and 12.91 mg/L, whereas $BOD_5$ ranged from near zero to 4.52 mg/L. Nitrite concentrations ranged from 0.003 to 0.729 mg/L, nitrate from 1.268 to 14.391 mg/L, and phosphate from 0.002 to 0.171 mg/L. The study concluded that water quality in both rivers is influenced by seasonal changes, agricultural activities, and runoff, resulting in noticeable fluctuations in physicochemical parameters.

**Keywords:** *Water Quality; Physical Parameters; Chemical Parameters; Al-Shamyia River; Al-Daghara River, Iraq.*

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## INTRODUCTION

All living things are inherently dependent on water for survival. It covers about 97% of the Earth's surface, with freshwater accounting for only 3% (Mishra and Dubey, 2015). Aquatic life is threatened by industrial growth, which has a detrimental effect on organism survival. Severe water shortages have decreased biodiversity in aquatic environments (Kılıç, 2020). The evaluation of water quality is becoming a delicate matter, particularly because freshwater will eventually become a limited resource (Halder and Islam, 2015). There are two ways that water contamination can happen. The first is from specific pollution sources that can be directly identified, like pipes connected to manufacturing, oil leaks from the Solid and liquid waste from the industry, as well as non-point sources of pollution, whether industrial or municipal, and rainwater drainage, which mostly impacts the surrounding gareawhe, reads the none. The term "neighborhood sources" refers to pollutants that enter groundwater or surface water from various sources and enter the environment from unidentified sources (Amin *et al.*, 2024). Since water pollution has become a worldwide issue, legislation about water resources must be continuously reviewed in order to address this issue and prevent deaths. Since water is the primary component of life on Earth, illness should be of the water's quality to avoid harming living things (Jadhav *et al.*, 2013). Water pollution happens when materials are dumped into bodies of water, making the water unfit for human consumption. Consumption and disrupting marine environments, Lakes, rivers, and streams are essential for supporting a variety of activities (Igwe *et al*., 2021). For example, some human activities and industry-related greenhouse gas emissions significantly contribute to global warming, an increase in the planet's temperature, and a decrease in atmospheric air quality (Bhadarka *et al*., 2025). The study are measuring some of the physical and chemical characteristics of the Al-Daghara and Al-Shamiyah rivers and their impact on water quality, and comparing the results of both stations.

## MATERIAL AND METHODS

### Study area

The Al-Shamiyah River is located south of Diwaniyah Governorate and The AL-Daghara River is located in the Diwaniyah Governorate from the northwest (Shaawiat, 2010).

**S1**: It is located between latitude to the east (44º, 57735) and longitude north (31º, 97859) as start Al-Shamiyah which belongs to the Diwaniyah Governorate.

**S2:** It is located between latitude to the east (44º, 59300) and longitude (31º, 96575). It branches off from the Al-Hindiya canal south of Al-Kifl.

**S3:** It is located between latitude (44º, 59282) and longitude (31º, 92063), and it is one of the areas around AL-Daghara district.

**S4:** It is located between latitude to the east (44º, 84010) and longitude (32º, 20776) and is located at AL-Daghara District in AL-Diwaniyah Governorate.

### Water Samples

Al-Shamiyah River and AL- Daghara River samples have been obtained from (25 cm) deep during the summer and winter seasons for October 2025- March 2026.

### Physical and Chemical Parameters

#### *Temperature*

A mercury thermometer was used to measure the water sample's temperature in the field (Baird *et al*., 2017).

#### *PH*

A PH meter type (Lovibond pH 200) was used to assess the water's pH after it had been calibrated using a standard controlled solution buffer (4, 7, 9) (Khudhair *et al*., 2020).

#### *Electrical Conductivity and Total Dissolved Metal*

Electrical conductivity and total dissolved metal were measured using a conductivity meter model Hanna H19032, expressing the results of electrical conductivity in (µS/cm) or (ms/cm), and total dissolved metals in mg/L or (g/l) units (Baird *et al*., 2017).

#### *Turbidity*

The Turbidity meter model (Lamotte 2020) was used to measure the turbidity, and the results were expressed in NTU units after calibration with a standard (0, 10, 100), controlled solution (Baird *et al*., 2017).

***Total Hardnenss***

It was measured by titration with EDTA2Na and Erichromic black T as an indicator (Baird *et al*., 2017). Total Hardness (mg/l) = (sample A×1000)/V; Where: A=EDTA solution

***Calcium and Magnesium ions***

Calcium ion was evaluated by titration sample with EDTA 2Na solution after adding 2 ml of (NaOH 1N and Murexide) as an index and expressing it in an mg/l unit. While the magnesium ion was calculated mathematically based on the total hardness and hardness of calcium (APHA, 2003). Ca (mg/l) =A * B * 400.8/ volume of sample Ca hardness (mg/l) =A*B*1000// volume of sample

Mg (mg / l) = Total Hardness (mg/l) – Hardness of Calcium (mg/l) * 0.224.

***Nitrite (NO2)***

Since the sharpness of the purple hue created is proportional to the quantity of nitrate, 50 milliliters of filtered water were obtained, and 1 milliliter of sulphanilamide solution was added while continuously stirring. Next, 1 milliliter of N-(1-naphthyl) ethylenediamine dihydrochloride solution was added. The data were then expressed in mg/l using an optical absorption (spectrophotometer) wavelength of 543 nanometers.

***Nitrate (NO3)***

The cadmium Reduction column method was used according to the method, where nitrite is reduced into nitrate. Then it was measured in the same steps as in the paragraph above.

***Phosphate***

The mixed solution method was adopted according to (APHA, 2003), using a spectrophotometer with a wavelength of 885nm and results were expressed in mg/l unit.

***Dissolved Oxygen***

The dissolved oxygen concentration is measured directly in the sample using an oxygen meter (DO meter). Measure two unit's mg/l or ppm.

***Biological Oxygen Demand***

The BOD5 was estimated using the dissolved oxygen measurement method after placing the unfixed and opaque bottles in the incubator at a temperature of 20°C for five days. Then the dissolved oxygen (DO5) was determined and expressed in mg/L. The BOD5 was then calculated from the following equation (APHA, 2003). BOD5 mg/l = DO mg/l - DO5 mg/l.

## RESULTS AND DISCUSSION

**Physical and Chemical Parameters**

***Temperature***

Figure 1 shows the air temperature values and water temperature. It was noted during the study period that the highest value recorded for air temperature was in October month 2025 in site one the value 30Cº The lowest value was found on the site 4 Where it was valued 11Cº in January month 2025, As for the water temperature, it was clearly affected by the water temperature, The highest water temperature value 25Cº in the site 1 was in October 2025 and The lowest value of water temperature in the site4 reached 11Cº in January in 2026, The reason for the variation in temperature in the current study is due to what characterizes the climate The region is also affected by the continental climate that characterizes Iraq (Toama and Abed, 2023).

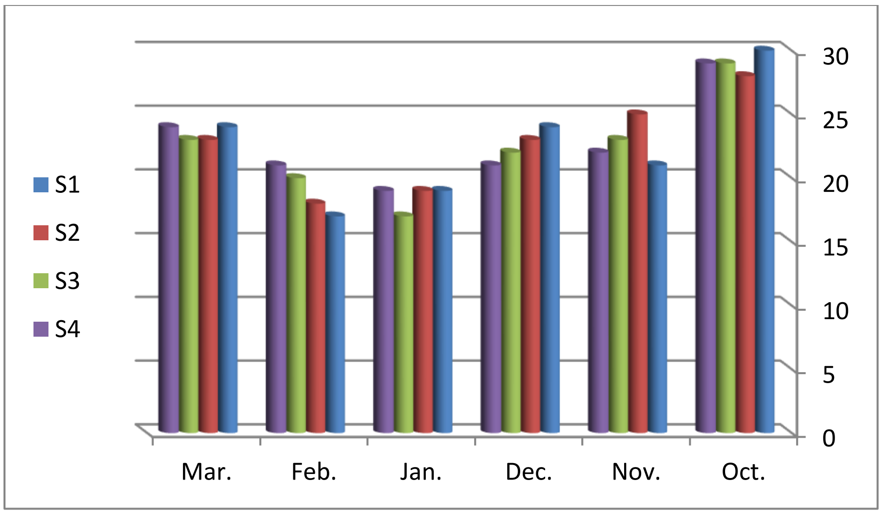


**Figure (1)** Seasonal and localized temperature (C°) variations of wells in the study area

***PH:***

Figure (2) shows value of PH Where it reached the highest value of pH 8.6 in January 2026 in site 3 and record the lowest of pH value 7.4 in October 2025 in site 1 The results of the current study recorded that the high pH values during the winter were due to increased concentrations of carbonates and bicarbonates, as rainwater increased the dissolving of carbon dioxide, which converted dissolved calcium carbonate to insoluble. Also, observed that all the water samples are neutral to slightly basic because most of the Iraqi water is basic and the soil is rich in calcium carbonate, in addition to the high Buffer Capacity for hard water that resists pH change (Kraikriangsri *et al.*, 2022). The results don’t agree with the study of (Toama and Abed, 2023).

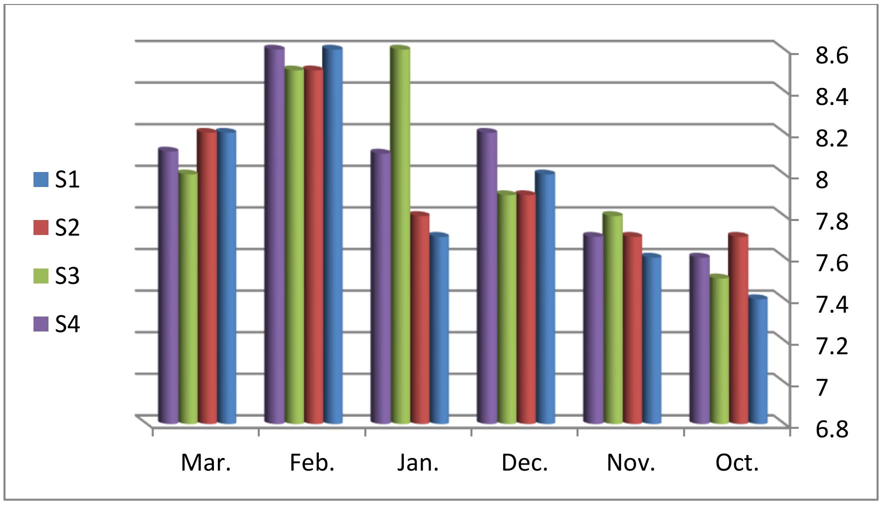


**Figure (2)** Seasonal and localized pH variations of wells in the study area

***Electrical conductivity and Total dissolved solids***

Figure (3) Show the highest value of Electrical conductivity 2480 µs/cm in November 2026 Site3, and record lowest value of the Electrical conductivity 1036 µs/cm in March 2026 Site 4, Where the highest value of Total dissolved solids 1438 mg/l was recorded in November 2026 in site 3. The lowest value was recorded for TDS 600 mg/l in March 2026 in site 4, and was highest value site 1 record 1336 mg/l in November 2025 and value lowest site 1 record 655 mg/l in October 2025. The highest value of the site2 in November 1394 mg/l 2025 and was lowest of the site 2 was 876 mg/L in January 2026 (Figure 4). The results show a difference in the values of electrical conductivity during the summer and winter seasons in the Al-Daghara and Al-Shamiyah rivers (Kraikriangsri *et al*., 2022).

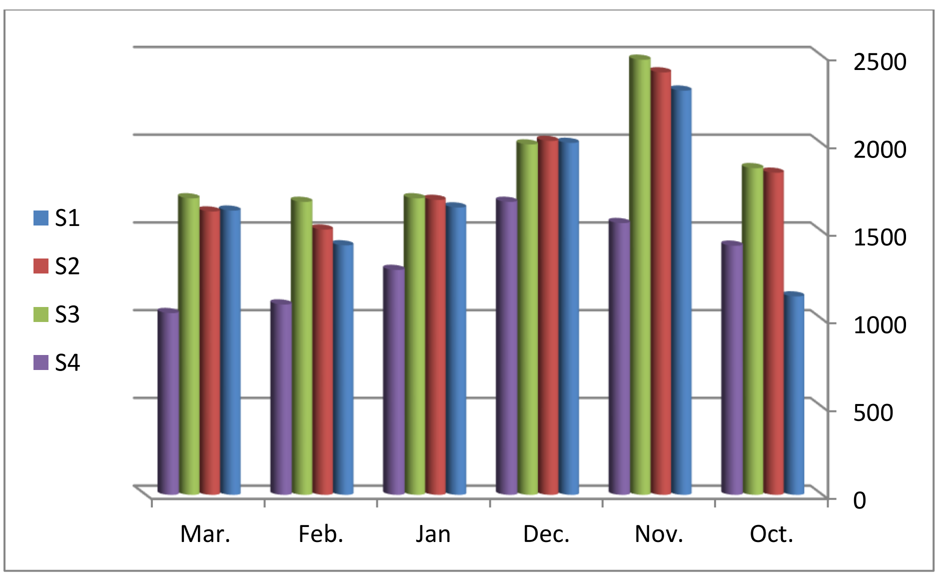


**Figure (3)** Seasonal and localized EC (µs/cm) variations of wells in the study area

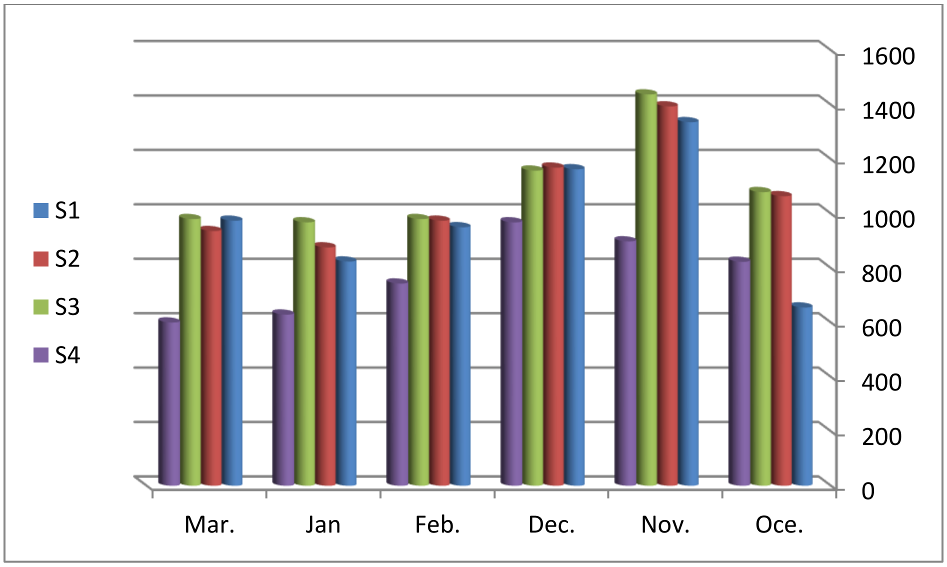


**Figure (4)** Seasonal and localized TDS (mg/l) variations of wells in the study area

***Turbidity***

Figure 5 shows the highest value of turbidity, 52.52 NUT, recorded at site 1 during February 2026. The lowest value, 0.56 NUT recorded at site 4 during December 2025. The highest value, 11.42 NUT recorded at site 3, and the lowest value, 1.19 NUT recorded at site1 in January 2026. Turbidity is affected by a range of hydrological, physical, and biological factors that change significantly over the seasons. Effect of wind and waves in winter: High wind speeds create waves that increase shear stress at the bottom of shallow water bodies (Shaawiat *et al*., 2024).

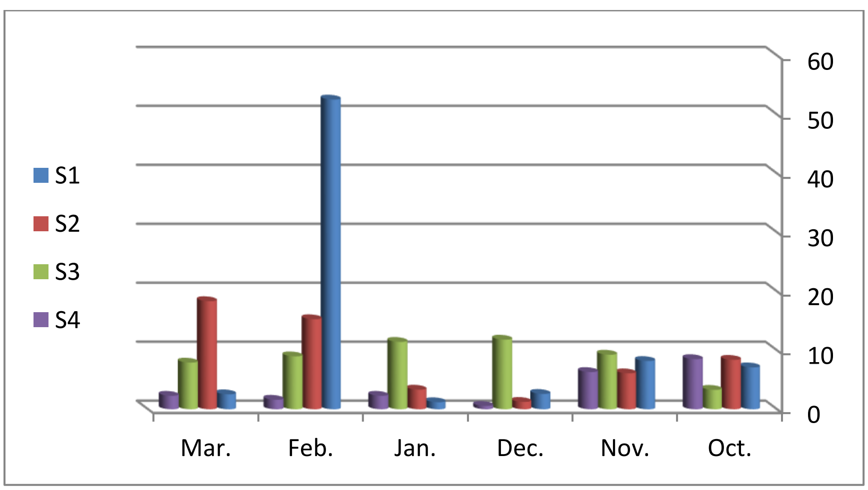


**Figure (5)** Seasonal and localized Turbidity (NTU) variations of wells in the study area.

***Total hardness***

Figure 6 shows the highest value recorded were 732mg/l at station during February 2026. The lowest value recorded was 340mg/l at site 3 during February. The highest value recorded was 730 mg/l at site 3. The lowest value recorded was 320mg/l at site 1 in January 2026. The rise in some stations is due to runoff and rainwater washing away the surrounding agricultural soil. Due to the nature of the lands in these areas, which are rich in limestone and gypsum deposits, runoff water washes large quantities of calcium and magnesium salts into the river. Hardness increases as a result of significant increases in temperature and high evaporation rates, which lead to lower water levels and the condensation (concentration) of salts and ions that cause hardness in the remaining water (Hammadi *et al*., 2024).

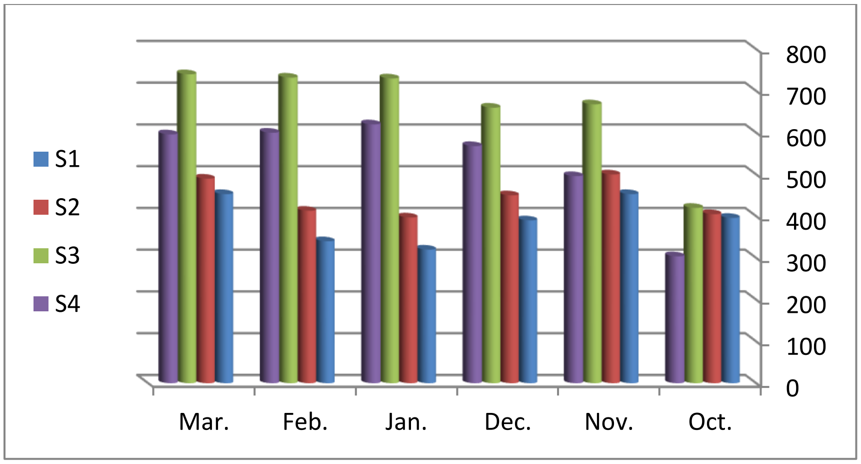


**Figure (6)** Seasonal and localized TH (mg/l) variations of wells in the study area

***Calcium (Ca+) and Magnesium (Mg+) ions***

Figure 7 shows the highest value recorded for calcium was 732 mg/l at site 3 during February 2026. The lowest value was recorded as 320mg/l at site S1 during January 2026, and the highest value for the Mg in site 2 was recorded as 160 (Figure 8). The lowest value for site4 was recorded at 81.3 in February. In winter, the Ca, it is usual for element concentrations to decrease due to water from rain and increased water releases, as we see in the S1 value falling to 490 in February. However, remaining very high values at other stations such as S3 may be due to surface runoff; Rainwater washes adjacent salty farmland and washes precipitated calcium ions downstream, causing localized spikes in concentration. The Mg Globally and locally, concentrations of dissolved ions (including magnesium) rise in rivers during the summer in arid and semi-arid regions such as Iraq (Shaawiat, 2010).

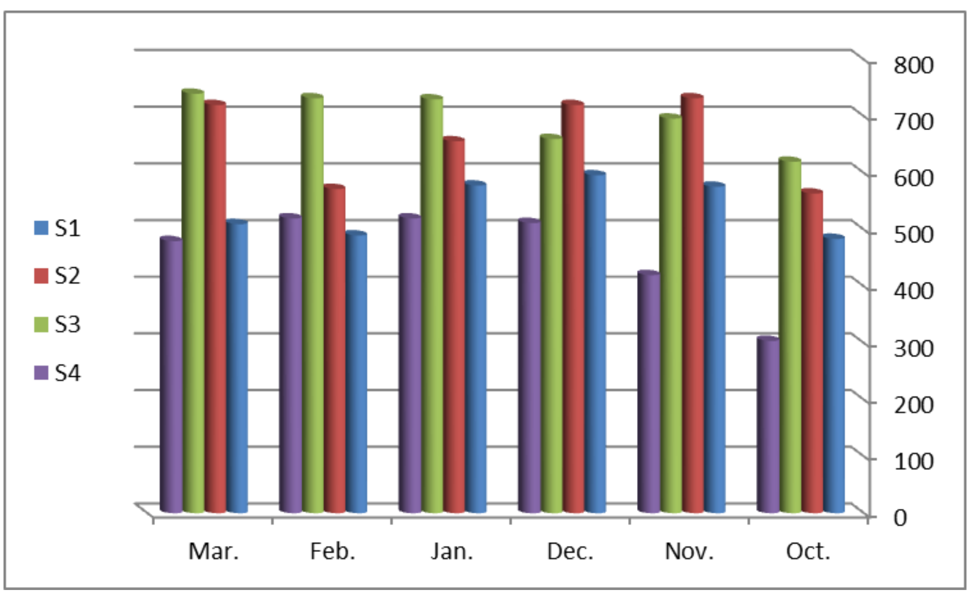


**Figure (7)** Seasonal and localized Ca+ (mg/l) variations of wells in the study area

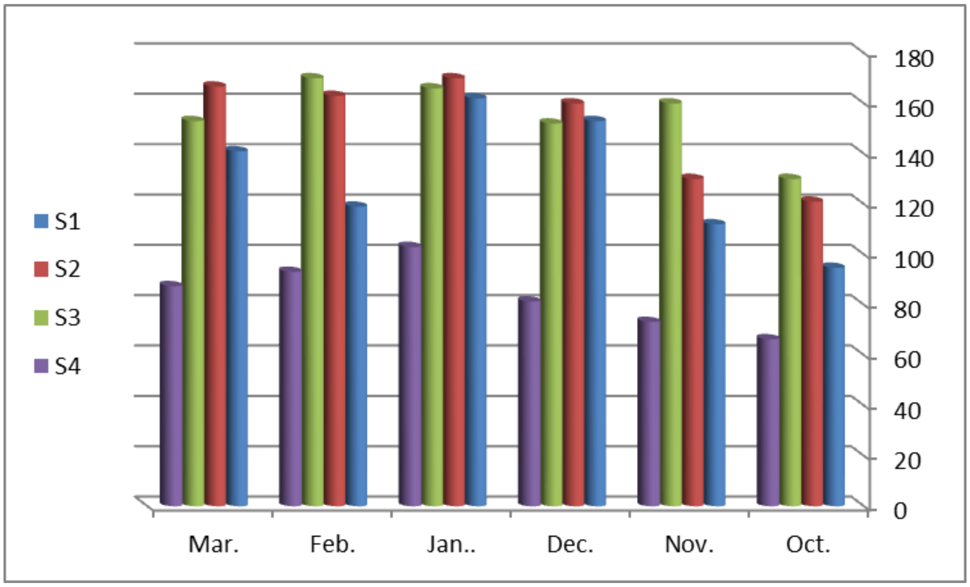


**Figure (8)** Seasonal and localized Mg+ (mg/l) variations of wells in the study area

***Dissolved Oxygen (DO)***

Figure 9 Show The highest value Site4 recorded the highest value for dissolved oxygen, reaching 12.91 mg/L in March 2026, and the lowest value of dissolved oxygen was recorded at 7.56 mg/L in October 2025. This height may indicate a higher slope in the riverbed, which increases the speed of flow and atmospheric mixing, or the presence of a high intensity of photosynthesis by phytoplankton and attached algae that release oxygen during the day. Dissolved oxygen values in Al-Shamiyah are considered within acceptable environmental limits, but they witness clear seasonal and spatial fluctuations (Hammadi *et al*., 2024).

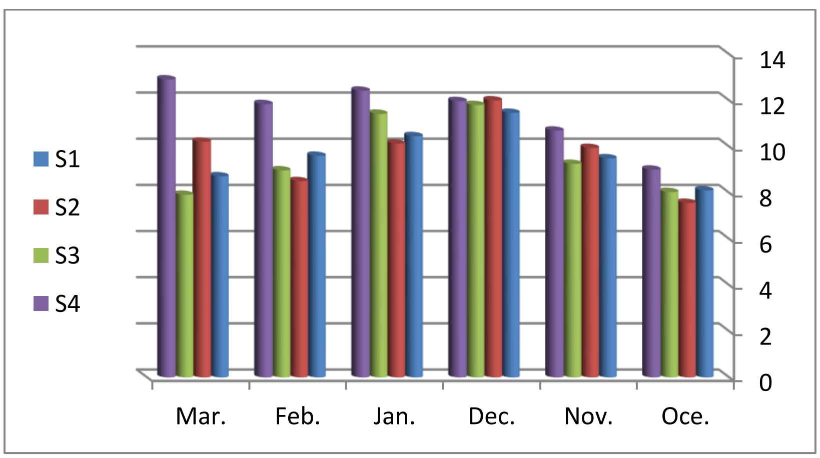


**Figure (9)** Seasonal and localized DO (mg/l) variations of wells in the study area

***Biochemical Oxygen Demand (BOD5)***

Figure 10 shows that the highest value was recorded at site 1 during October 2025, reaching 4.52 mg/L. The lowest value was recorded at site 3 during March 2026. Recording the highest BOD values in both rivers during October is not a coincidence. In this period, water levels are often low after summer, and organic materials (such as plant residues and agricultural runoff) accumulate. This rise in organic matter activates aerobic bacteria to decompose it, increasing oxygen consumption. The rapid deterioration of BOD values to near-zero numbers in February and March is due to increased water flows (dilution process), in addition to lower water temperatures, which slow down microbial activity and organic decomposition processes (Hassan *et al*., 2018).

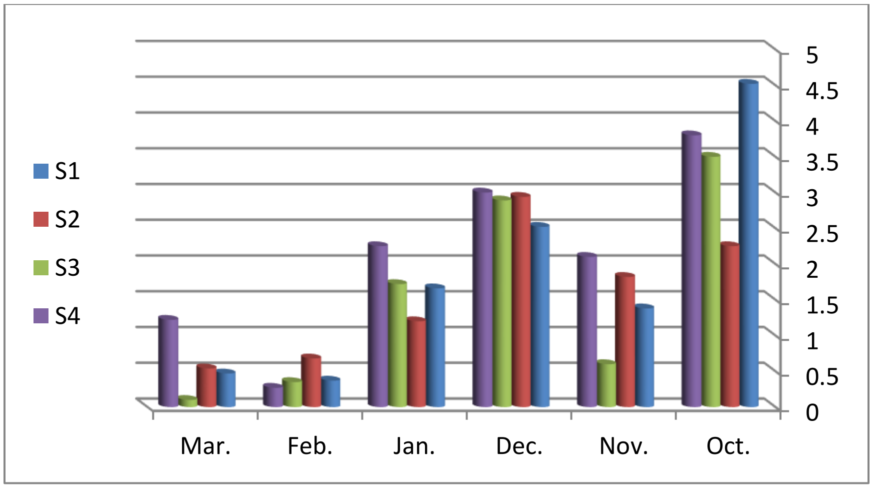


**Figure (10)** Seasonal and localized BOD5 (mg/l) variations of wells in the study area

***Nitrite (NO2) and Nitrate (NO3)***

Figure 11 shows that the highest value was recorded at site (S2) during January, 0.729 mg/L, followed by a value of 0.479 in S1 in the same month. The lowest value was recorded at site (S1) during December and decreased to 0.003 mg/L. The highest value was recorded for NO3 at site1 during the month of December 2025, reaching 14.391 mg/L, while the lowest value was recorded at site4 during the month of February 2026, at 1.268 mg/L (Figure 12). The sudden and simultaneous rise in nitrite values at all four sites during January represents a classic hydrological situation. Nitrite is an unstable transition state in the nitrogen cycle (between ammonia and nitrate). This rise is almost certainly attributable to surface runoff resulting from winter rains, which washes nitrogen fertilizers (such as urea) and animal waste from agricultural lands adjacent to the two rivers into the waterway. In the cold months, the activity of Nitrobacter bacteria, which is responsible for oxidizing nitrite (NO2) to nitrate (NO3), decreases, which leads to the temporary accumulation of nitrite in the water and its appearance in these high concentrations (Hassan *et al*., 2018).

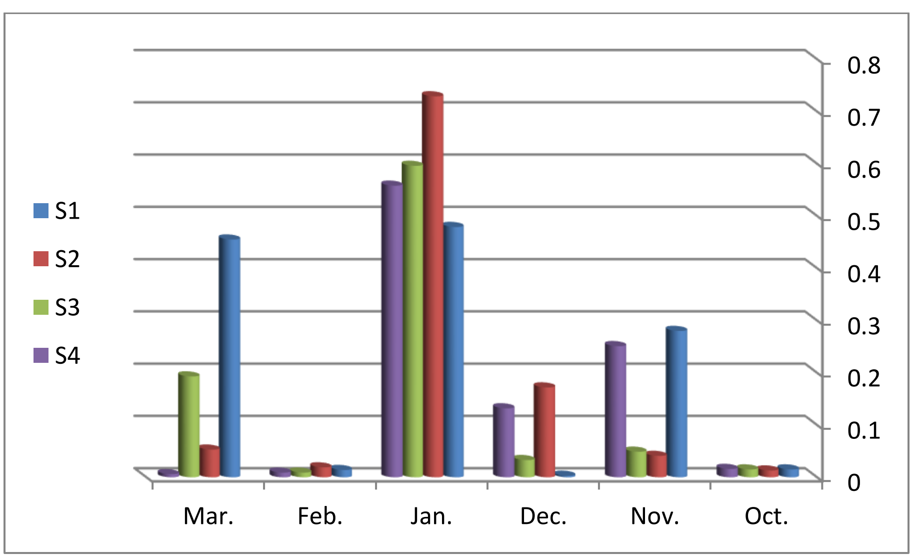

Figure (11) Seasonal and localized NO2 (mg/l) variations of wells in the study area

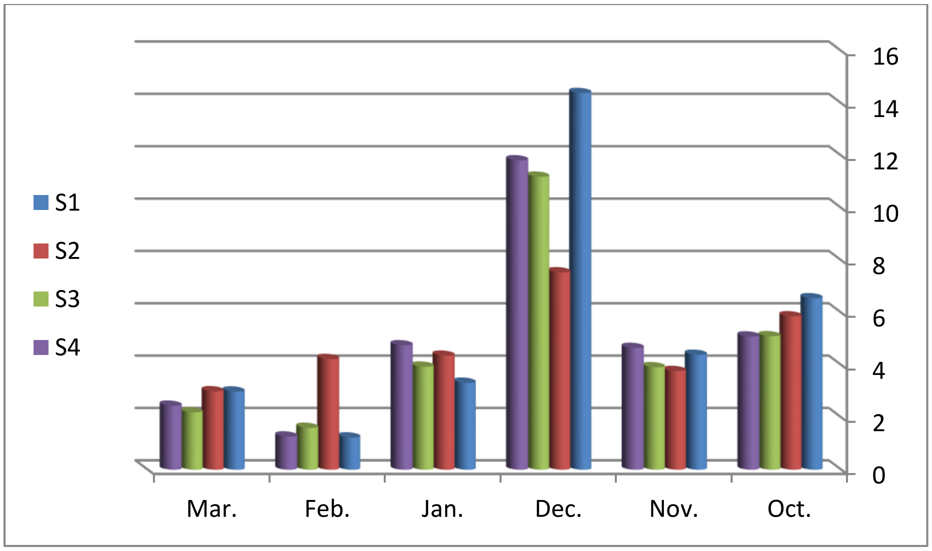


**Figure (12)** Seasonal and localizedNO3 (mg/l) variations of wells in the study area

### *Phosphate (PO4)*

Figure 13 shows that the highest value was recorded in December, at 0.171 mg/L in 2025. The lowest value was recorded in sites S3 and S4, 0.002 mg/L during the month of March 2026. The noticeable increase in phosphate concentrations (especially the value of 0.171 in the Daghara River and 0.157 in Al-Shamyia) is due to the rainy season. Rainwater washes away the chemical phosphate fertilizers used extensively in the agricultural lands surrounding the two river basins. The sharp decrease (reaching 0.002 mg/L in the Daghara River in March) is mainly due to the bloom of phytoplankton and algae with the onset of warmth and rising water temperatures (Bhadarka *et al*., 2025).

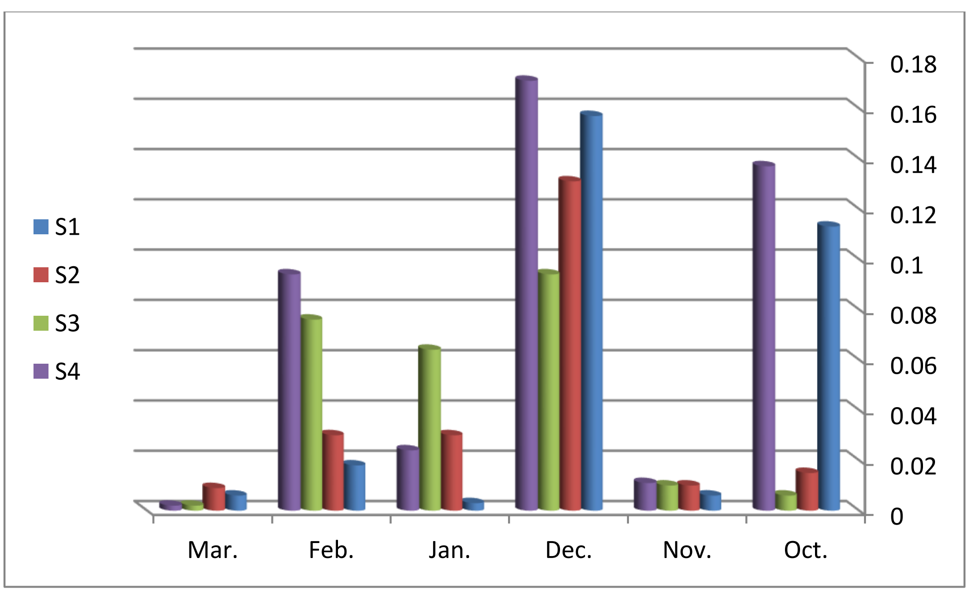


**Figure (13)** Seasonal and localized PO4- (mg/l) variations of wells in the study area

## CONCLUSIONS

Agricultural & Human Pollution: The Rivers experience mild to moderate organic pollution and high turbidity driven by agricultural fertilizers and residential waste. High Salinity & Hardness: Geological formations and evaporation processes have resulted in water that is saline and classified as "very hard." Resilient Ecosystem: Despite these stressors, Dissolved Oxygen (DO) levels remain excellent, ensuring a healthy environment for fish and aquatic life.

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**Conflict of interest:** The authors declare that they have no relevant financial or non-financial interests to disclose.

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