

## An Environmental Study on the Impact of Surface Water Salinity on Agricultural Activity in Thi-Qar Governorate"

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### ABSTRACT

This study aims to assess the impact of salinity, sodium Hazard and some physical and chemical properties of irrigation water on agricultural activity in three selected main sites in the Thi Qar governorate in southern Iraq, the Euphrates River, the jabayish marshes, and the Gharraf River. Water samples were collected during the summer seasons of 2025, and the study included determining water quality indicators, including electrical conductivity (EC), total dissolved salts (TDS), (pH), chloride ions ( $\text{Cl}^-$ ), sulfate ( $\text{SO}_4^{2-}$ ), sodium ( $\text{Na}^+$ ), potassium ( $\text{K}^+$ ), bicarbonate ( $\text{HCO}_3^-$ ), magnesium ( $\text{Mg}^{+2}$ ), calcium ( $\text{Ca}^{+2}$ ), in addition to the sodium absorption ratio (SAR).

The results of the study showed a clear spatial and temporal contrast between the three sites. The values of electrical conductivity, total dissolved salts, chloride, sulfate, sodium, potassium, magnesium and calcium ions often exceeded the permissible limits for irrigation water, indicating high salinity and potential risks to agricultural use. While the values of both the pH and (SAR) were within acceptable levels, reflecting the reduced severity of alkalinity and the danger of sodium.

The water of the Euphrates River recorded greater increases in salinity and concentration of dissolved elements, while the waters of the AL-Gharraf River and the jabayish marshes showed moderate fluctuations reflecting the impact of seasonal changes, surface runoff caused by agricultural activity and local environmental pressures. These results confirm the vulnerability of surface water resources in the study area to Salinization and chemical pollution, and the negative effects on soil fertility and crop productivity. Accordingly, the study recommends the need for continuous monitoring of water quality and the application of integrated management programs to reduce the risk of salt pollution, and encourage the cultivation of plants that are not sensitive to high salt concentrations. The study also provides comprehensive data supporting sustainable agricultural planning and Water Resources Management in southern Iraq.

**Keywords:** *Jabayish marshes, Environmental stress, Salinization, SAR*



## INTRODUCTION

Salinity has become a major environmental barrier to agricultural productivity, particularly across arid and semi-arid landscapes. In southern Iraq, particularly within the Thi Qar governorate, surface waters including rivers, canals, and marshes show steadily increasing salt concentrations. This trend reflects both natural processes and human activity, such as reduced river drainage, the construction of dams upstream, shifts in climate patterns, and inefficient irrigation methods [1].

Agricultural production in Thi Qar relies heavily on surface water for irrigation, so even modest shifts in water quality particularly increases in salinity have immediate consequences for soil condition, crop choices, and overall yields. Farmers across the governorate report declining harvests, progressive soil degradation, and mounting limitations on the cultivation of salt-sensitive crops. These pressures endanger not only regional food security but also the socio-economic stability of rural communities whose livelihoods remain closely tied to farming [1][2].

Salinity becomes a problem when soluble salts accumulate in the root zone of the plant, which leads to a decrease in crop productivity. This accumulation may result from a rise in the saline groundwater table or from salts introduced through irrigation water. With high salt levels, plants have difficulty absorbing water, which leads to stress symptoms such as wilting and dark bluish-green leaf color. The intensity of these effects depends on the stage of plant growth and is usually greater during early development. Since the salts responsible for salinity are water-soluble and easily transportable, they can often be filtered out of the soil through deliberate irrigation, a key practice for managing and mitigating salinity. The rate of salt removal by washing should be equal to or exceed the rate of their accumulation from irrigation water to avoid harmful levels. The concentration of salts in the root zone changes depending on the depth, with surface layers having closer salt concentrations and deeper layers having higher concentrations. [2] [3].

Saline irrigation or groundwater in agriculture can harm plants with poor salt tolerance. Environmental water resources contain diverse chemical compounds and salt ions. Salinity is measured using the sum of dissolved solids (TDS) and electrical conductivity (EC). These are two separate parameters: TDS is a gravity analysis of the total mass weight of solids dissolved in water, while EC measures all charges in the solution capable of conducting electricity. TDS and EC can also be used to measure impurities in domestic and industrial water supplies. [2]

The TDS of Euphrates water has increased between 1980 and 2009, causing severe water stress in Iraq [3]. Some regions rely on untreated groundwater for agricultural and social purposes, leading to waterborne diseases [4]. Iraq suffers from extreme water stress, with saline hazard affecting 74% of irrigated areas. Saline water has been used for irrigation since 1977, and salinity has been documented in Indian River citrus since 1900. The osmotic pressure from soluble salt ions decreases available water at the plant root zone, making trees unable to absorb or transport enough water under stress. [1] [5]

Salinity affects plant growth in sandy soil, but soil solution salinity at the root zone directly impacts plant growth, as it is assumed to be triple irrigation water salinity. The critical level of salinity that affects plants depends on soil properties, buffering capacity, and climate. High leaf Na and Cl can disrupt nutrient balance, with citrus leaves potentially accumulating Cl or Na from aqueous drops directly contacting them. Lower leaves contain Cl and Na at concentrations four times higher than those at the plant top, similar to grapefruits and Valencia. [6]

The salinity of lower layers in a plant depends on the amount of washing that occurred. After irrigation, the most available water is in the upper layers with low salinity, which decreases as the plant consumes water. The timing of irrigation is crucial for maintaining soil water availability and reducing the need to draw water from the saltiest areas. To achieve good productivity, two basic factors must be considered:



maintaining soil water abundance and ensuring the washing out of accumulated salts before their concentrations exceed plant tolerance limits. In conventional surface irrigation systems, the yield is often related to the average salinity of the root zone, but in drip irrigation systems, the yield is more influenced by the average salinity of the area from which the plant absorbs water. Controlling the groundwater table is essential for managing salinity and achieving sustainability in irrigated agriculture. Salinity management becomes rational management to ensure adequate irrigation water and appropriate amounts of water for washing, while maintaining acceptable salt concentrations for crop tolerance. [7], [8].

Several studies have been conducted to assess water quality in Iraq in general and in Thi Qar governorate in particular, where some studies focused on the waters of the AL-Gharraf River [9],[10], while others dealt with the waters of the Tigris and Euphrates rivers [11],[12], in addition to individual studies [13] and [14].

These studies used a variety of methods, including various statistical models or comparison with standard water parameters, and their results resulted in a significant increase in the concentration of certain pollutants in the studied rivers. In general, water quality assessments have shown that its condition ranges from very poor to poor and unfit for multiple uses .

This study aims to assess the spatial and temporal variation of surface water salinity across selected agricultural areas within Thi Qar governorate. By studying the relationship between salinity levels and key agricultural performance indicators, this study aims to clarify the scope and severity of the problem. Furthermore, it investigates potential adaptation strategies and mitigation measures that can help maintain agricultural productivity under conditions of high salinity pressure.

## MATERIAL AND METHOD

### Description of the study area

The study focuses on several major water bodies in Thi Qar governorate, southern Iraq, which are the main sources of water and have a direct impact on local agricultural practices. The first location is the Euphrates River in Fadliya District (30°57'50.0"N, 46°21'35.5"E), one of the most important rivers in Iraq, providing water for irrigation, supporting fisheries, and supporting agricultural activities around Nasiriyah. The second site is the Jabayish marshes (30°58'09.8" N, 47°02'17.5" E), part of the Southern Marsh network. These wetlands form a humid and biologically diverse environment that supports traditional agriculture and fishing, provides water for local use, and is highly sensitive to changes in water quality. The third location is the Al-Gharraf River (31°20'20.3"N, 46°12'38.5"E), one of the main tributaries of the Euphrates, which provides additional surface water for irrigation and agriculture. The Al Gharraf region benefits from relatively fertile soils but faces increasing challenges from water pollution and increased salinity. In general, all study sites are located in areas with intensive agricultural activity and a strong dependence on surface water, highlighting the importance of water quality assessment to understand the effects of salinity and pollutants on local agricultural productivity.



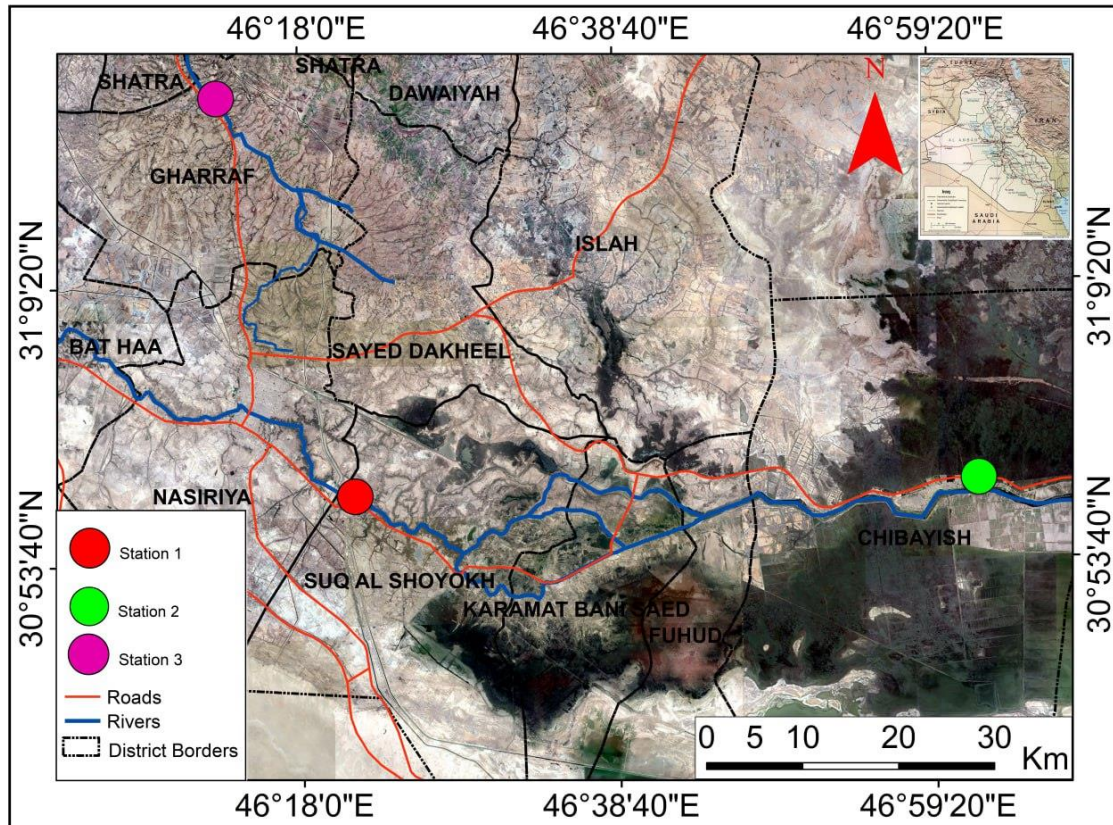


Fig. 1. Shows the three study stations, Station 1 on the Euphrates River, Al-Fadliya district, Red Circle: Station 2; jabayish marshes, Green Circle: Station 3; Purple circle of the Gharraf River .

### Collection of sample

Water samples were collected from three stations: Using clean 5-liter polyethylene bottles, with three repeaters per station, and at a depth of about 20 cm below the water surface.

Water samples were transported directly from the study stations to the laboratory to measure the electrical conductivity (EC), total dissolved salts (TDS), and (pH) using a Hanna-type device. The value of electrical conductivity was expressed in  $\mu\text{S}/\text{cm}$ , while the values of dissolved salts were expressed in  $\text{mg}/\text{L}$ . As for the concentration of chloride (Cl) in water samples, it was estimated in the  $\text{mg}/\text{L}$  unit according to the method mentioned in [15], while sulfate ( $\text{SO}_4$ ) in the  $\text{mg}/\text{L}$  unit was measured using a spectrophotometer at a wavelength of 420 nm, according to the same method [15]. The total hardness and the values of magnesium (Mg) and calcium (Ca) were also estimated according to the calculation method described in [16], with the results expressed in the unit  $\text{mg}/\text{L}$ . As for sodium (Na), it was measured in  $\text{mg}/\text{L}$  according to the standard method mentioned in [15]. The bicarbonate concentration ( $\text{HCO}_3$ ) was estimated according to [17], with the results expressed in  $\text{mg}/\text{L}$  unit. As for potassium ( $\text{K}^+$ ), it was measured using a flame Photometer, at a wavelength of 766.5 nm and with a unit  $\text{mg}/\text{L}$  according to [15]. The sodium absorption ratio (SAR) was calculated using the Na, Ca, and Mg concentrations according to the equation given in [18],[8].

## RESULTS AND DISCUSSION

Physical and chemical measurements of the selected stations showed a clear disparity between the study sites during different research seasons. It was noted that most of the factors exceeded the permissible limits according to the classification standards of irrigation water, while both the pH and SAR remained within the acceptable range.

The results of the analysis reveal that the Euphrates shows a relatively high salinity, with a measured value of 2.55 g/L and an electrical conductivity of 3.3 dS/m, which places it in the category of medium to high salinity according to [7]. This classification suggests that constant watering with such water can lead to the accumulation of salt in the root zone of the plant. To alleviate the potential stress on crops caused by salinity, preventive measures such as increasing leaching irrigation and adjusting irrigation schedules are recommended (Table 1).

Also showed the waters of the jabayish marshes and the AL-Gharraf River lower salinity levels, ranging from 1.72 to 2.05 g/L and 1.32 to 3.3 dS /m, classifying them as low to medium salinity waters. This makes it generally suitable for growing most crops. However, periodic monitoring is recommended to track the accumulation of salt, especially when using such water continuously or under high temperature conditions, which can increase salt concentrations through evaporation. Regular assessments will help ensure that the salinity levels remain within acceptable ranges for agricultural sustainability. Additionally, implementing effective irrigation practices can further mitigate the risk of salt buildup in the soil. Based on the irrigation water classification presented in [7] , The Euphrates River is categorized as “medium- to high-salinity water,” whereas the Jabayish Marshes and Al-Gharraf River fall into the “low to medium salinity water” category. This distinction highlights the need for appropriate water management practices. For instance, when using Euphrates water, additional leaching irrigation may be required, and irrigation schedules should be adjusted according to the salinity tolerance of crops. Implementing these measures is essential to maintain stable and sustainable agricultural productivity [19][20].

The contribution of ions in the EC is challenging to determine due to differences in ionic charge, size, weight, mobility, and interaction with other moieties. Solutions with equal EC differ in TDS due to molecular weight differences [21]. Ion types in water resources are influenced by neighboring environments and septic tank leakage [22].

Table 1: Comparison of the study results with the irrigation water classification according to [7].

Salinity (g/L)	TDS (mg/L)	EC (dS/m)	pH	Temperature (°C)	Stations
2.55	2550	3.30	7.8	34.5	Euphrates River
1.72	1720	1.32	7.5	33.5	Al-jabayish marshes
2.05	2050	1.80	7.6	32.5	Gharraf River
-	0 -2000	0 - 3	6.0 -8.5	-	Range in irrigation water

The results of the analysis of water ions and SAR indicated that the waters of the Euphrates River contain the highest concentrations of the main ions, including  $\text{SO}_4^{2-}$  (455 mg/L),  $\text{Cl}^-$  (610 mg/L), and  $\text{Na}^+$  (460 mg/L), as well as a relatively high SAR (7.9), which classifies them into the category of medium- to high-salinity and medium- to high-SAR waters. In turn, the Jabayish marshes recorded the lowest values for ions and SAR ( $\text{SO}_4^{2-}$  = 325 mg/l,  $\text{Cl}^-$  = 410 mg/L,  $\text{Na}^+$  = 560 mg/l, SAR = 6), which



makes them waters of medium salinity and medium SAR, while the waters of the Gharraf River are in the medium to high range of ions and SAR ( $SO_4^{2-} = 385$  mg/l,  $Cl^- = 510$  mg/L,  $Na^+ = 710$  mg/l, SAR = 6.6). Compared with the results of general salinity and electrical conductivity, it shows that all plants exceed the recommended standard range for conventional irrigation water, reflecting the need for careful management of irrigation water and periodic washing of the soil to reduce the accumulation of salts and prevent negative impact on crop growth. It is advisable to use the waters of the Euphrates River with caution, increasing the washing water and applying frequent irrigation schedules, and choosing salt-tolerant and sodium-tolerant crops. As for the waters of the Jabayish marshes and the Gharraf River, they are more suitable for most crops, with the need for periodic monitoring of the accumulation of salts, especially in periods of high temperatures that lead to an increase in the concentration of salts through evaporation. In general, the results demonstrate the importance of adopting an integrative approach to water and salinity management, combining salinity control, SAR, and ionic components with the implementation of regular washing strategies to ensure the sustainability of agricultural productivity and reduce the risks related to salt stress on crops and soil structure[7],[8],[20]. Table 2.

Table 2: Comparison of the study results with the irrigation water classification according to [7].

SO <sub>4</sub> (mg/L)	Cl (mg/L)	HCO <sub>3</sub> (mg/L)	K (mg/L)	Mg (mg/L)	Ca (mg/L)	Na (mg/L)	SAR	Stations
455	610	245	36	82	122	460	7.9	Euphrates River
325	410	185	31	62	102	560	6	Al-jabayish marshes
385	510	205	33	72	112	710	6.6	Gharraf River
0 -20	0 -30	0 – 10	0 - 20	0 - 5	0 - 20	0 - 40	0 -15	Range in irrigation water

Table 3: Comparison of measured electrical conductivity (EC,  $\mu$ S/cm) with irrigation water classification according to [23]

Salinity Hazard	Electrical conductivity EC. $\mu$ s /cm	Present study	Stations
None (Excellent)	$\leq 750$		
Some (Good)	760 - 1500	1320	Al-jabayish marshes
Moderate (Acceptable)	1510 - 3000	1800	Al- Gharraf River
Severe (Unacceptable)	$\geq 3000$	3300	Euphrates River

The results of the stations of this study showed the analysis of general salinity (EC and TDS) as shown in Table 4 (A, B, C) that the waters of the Euphrates River have the highest salinity levels compared to other stations, followed by the waters of the Gharraf River, while the water of Al-jabayish marshes were the least saline. This gradation suggests that the waters of the Euphrates River may cause salt stress for plants if watering and periodic washing of the soil are not carefully managed, while the water of Al-jabayish marshes are more suitable for most crops, with the need to monitor the accumulation of salts with constant use. [8],[20],[23].



Table 4: Shows a comparison between the measured (EC) values and (TDS) with the irrigation water classification based on the standards of the American Salinity Laboratory [24] for study stations.

**A: Euphrates River**

Salinity Hazard	EC. $\mu\text{s/cm}$	EC. $\mu\text{s/cm}$ In this study	TDS mg/L	TDS mg/L in Present study
Low salinity	0 -250		0 -160	
Medium salinity	250 -750		160 - 480	
Very salty	750 - 2250		480 - 1440	
Very severe salty	2250 - 5000	3300	1440 - 3200	2550

**B: Al-jabayish Marshes**

Salinity Hazard	EC. $\mu\text{s/cm}$	EC. $\mu\text{s/cm}$ In this study	TDS mg/L	TDS mg/L in Present study
Low salinity	0 -250		0 -160	
Medium salinity	250 -750		160 - 480	
Very salty	750 - 2250	1320	480 - 1440	
Very severe salty	2250 - 5000		1440 - 3200	2050

**C: Al- Gharraf River**

Salinity Hazard	EC. $\mu\text{s/cm}$	EC. $\mu\text{s/cm}$ In this study	TDS mg/L	TDS mg/L in Present study
Low salinity	0 -250		0 -160	
Medium salinity	250 -750		160 - 480	
Very salty	750 - 2250	1800	480 - 1440	
Very severe salty	2250 - 5000		1440 - 3200	1720

The combination of electrical conductivity (EC) and sodium absorption coefficient (SAR) is a vital indicator for assessing the quality of irrigation water and its impact on plants and soil Table 5. The results indicate a clear discrepancy between the three stations, reflecting the difference in water characteristics and potential environmental hazards: the Euphrates River recorded the highest EC levels (3300  $\mu\text{S/cm}$ ) with an average SAR (7.9), which means that high-salinity water poses a hydro-saline stress on plants, as the ability of roots to absorb water decreases[8], while moderate SAR indicates a moderate risk of soil structure degradation. From an environmental point of view, the constant use of this water without management leads to the accumulation of salts and sodium in the soil [25], which may reduce water permeability and increase the risk of long-term Salinization, affect soil fertility, and limit the sustainability of agricultural production. The results of the study agreed with [20].

The river's waters fall into the EC and SAR medium-to-high categories, reflecting the exposure of crops to moderate salt stress and a moderate to high risk of sodium on the soil structure. Ecologically, if periodic washing of the soil and regulation of irrigation schedules are not carried out, the accumulation of sodium can lead to deterioration of the soil structure, its increased salinity and a decrease in crop productivity in the medium and long term [8],[26]. The Jabayish marshes showed the lowest EC and SAR levels among the three stations, indicating brackish water and a low to moderate risk of sodium. Such water is less of a threat to soil and vegetation, but it requires periodic monitoring of salt accumulation, especially in dry seasons or high temperatures, as long-term use can gradually increase the salt concentration. Through the above, the analysis shows that the relationship between EC and SAR represents two interrelated factors for assessing the environmental risks of irrigation water.



High electrical conductivity increases the salt stress of plants[25] , while high SAR exposes the soil structure to potential degradation, which reduces water permeability and affects the ability of the soil to support plant growth in the long term. Thus, irrigation water management should be customized for each plant[20].

Table 5: Compares (EC  $\mu\text{s/cm}$ ) values and sodium adsorption ratio with irrigation water classification according to [24]. for study stations.

Classification of water (Sodium Hazard)	Electrical Conductivity (EC. $\mu\text{s/cm}$ )				Present study Euphrates River
	100 - 250	250 - 750	750 - 2250	> 2250	
	Sodium Adsorption Ratio SAR				
Low	0 - 10	0 - 8	0 - 6	0 - 4	
Moderate	10 - 18	8 - 15	6 - 12	4 - 9	7.9
Severe	18 - 26	15 - 22	12 - 18	9 - 14	
Very severe	> 26	> 22	> 18	> 14	

Classification of water (Sodium Hazard)	Electrical Conductivity (EC. $\mu\text{s/cm}$ )				Present study Al-jabayish marshes
	100 - 250	250 - 750	750 - 2250	> 2250	
	Sodium Adsorption Ratio SAR				
Low	0 - 10	0 - 8	0 - 6	0 - 4	
Moderate	10 - 18	8 - 15	6 - 12	4 - 9	6
Severe	18 - 26	15 - 22	12 - 18	9 - 14	
Very severe	> 26	> 22	> 18	> 14	

Classification of water (Sodium Hazard)	Electrical Conductivity (EC. $\mu\text{s/cm}$ )				Present study Al- Gharraf River
	100 - 250	250 - 750	750 - 2250	> 2250	
	Sodium Adsorption Ratio SAR				
Low	0 - 10	0 - 8	0 - 6	0 - 4	
Moderate	10 - 18	8 - 15	6 - 12	4 - 9	6.6
Severe	18 - 26	15 - 22	12 - 18	9 - 14	
Very severe	> 26	> 22	> 18	> 14	

The danger of sodium is one of the most prominent factors affecting positive ions because of its direct role in changing the physical structure of the soil and its hydrological properties[8]. When the sodium adsorption rate (SAR) is high, the soil microelements are dispersed like clay, which leads to the formation of a cohesive surface crust when drying, which in turn reduces water permeability, hinders soil aeration, and limits the ability of roots and seeds to penetrate the surface. These effects are even more pronounced when there are high levels of electrical conductivity (EC), since the relationship between SAR and PEC together determines how dangerous irrigation water is for soil and plants. To evaluate this effect, the study employed the classification system proposed in [24], which categorizes irrigation water into four main classes based on the sodium absorption ratio (SAR). The thresholds for each class are adjusted according to the measured electrical conductivity (EC) values [7]. This



approach allows researchers to assess the suitability of irrigation water for agricultural use more accurately. By understanding the relationship between SAR and EC, farmers can make informed decisions to optimize crop yields while minimizing potential soil and water degradation.

## CONCLUSIONS

The results of this study highlight that high salinity levels and sodium absorption rates (SAR) pose significant challenges to the sustainability of Agriculture in Thi Qar governorate. Addressing these issues requires the implementation of integrated management strategies. One of the main recommendations is to improve the quality of irrigation water, either by mixing high-salinity sources with low-salinity water when available or by treating the water with agricultural gypsum to reduce sodium concentrations. It is also advisable to strengthen irrigation systems, including the adoption of more efficient techniques such as drip irrigation or intermittent flooding, which help to reduce the accumulation of salt on the soil surface. Strengthening agricultural drainage networks is necessary to facilitate the removal of dissolved salts from the root zone.

Soil improvement through the addition of organic matter and gypsum is a crucial step to restore permeability and natural aeration. In parallel, agricultural practices should favor the cultivation of salt-tolerant crops, while implementing well-planned crop rotations to alleviate salt stress in the long term. Regular monitoring and monitoring of electrical conductivity and search and rescue levels in both irrigation water and soil is recommended, along with the development of salinity maps to support informed agricultural planning. Where possible, soil filtration should be carried out during the cold seasons using appropriate water to further reduce the risk of salinity.

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"دراسة بيئية حول تأثير ملوحة المياه السطحية على النشاط الزراعي في محافظة ذي قار

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الخلاصة

تهدف هذه الدراسة إلى تقييم أثر الملوحة وخطر الصوديوم ، بالإضافة إلى بعض الخصائص الفيزيائية والكيميائية لمياه الري ، على النشاط الزراعي في ثلاثة مواقع رئيسة بمحافظة ذي قار جنوب العراق ، وهي : نهر الفرات، أحوار الجبايش، ونهر الغراف. اذ جُمعت عينات المياه خلال صيف عام 2025، وتم تحليلها لتحديد مؤشرات جودة المياه بما في ذلك التوصيلية الكهربائية (EC)، مجموع الأملاح الذائبة (TDS)، درجة الحموضة (pH)، أيونات الكلوريد (Cl<sup>-</sup>)، الكبريتات (SO<sub>4</sub><sup>-2</sup>)، الصوديوم (Na<sup>+</sup>)، البوتاسيوم (K<sup>+</sup>)، البيكربونات (HCO<sub>3</sub><sup>-</sup>)، المغنيسيوم (Mg<sup>+2</sup>)، الكالسيوم (Ca<sup>+2</sup>)، بالإضافة إلى نسبة امتصاص الصوديوم (SAR). أظهرت النتائج وجود تباينات واضحة على المستويين المكاني والزمني بين المواقع الثلاثة. فقد تجاوزت قيم التوصيلية الكهربائية، مجموع الأملاح الذائبة، أيونات الكلوريد، الكبريتات، الصوديوم، البوتاسيوم، المغنيسيوم، والكالسيوم في كثير من الحالات الحدود المسموح بها لمياه الري، مما يعكس ارتفاع مستويات الملوحة ووجود مخاطر محتملة على الاستخدام الزراعي . في المقابل ، بقيت قيم pH و SAR ضمن المستويات المقبولة ، مما يشير إلى أن شدة القلوية وخطر الصوديوم كانت محدودة نسبيًا. كما سجلت مياه نهر الفرات ارتفاعات



أكبر في الملوحة وتركيز العناصر الذائبة، بينما أظهرت مياه نهر الغراف وأهوار الجبايش تقلبات متوسطة ، وهو ما يعكس تأثير التغيرات الموسمية والجريان السطحي الناتج عن الأنشطة الزراعية والضغط البيئية المحلية . تؤكد هذه النتائج هشاشة الموارد المائية السطحية في منطقة الدراسة تجاه ظاهرتي التملح والتلوث الكيميائي، وما لذلك من تأثير سلبي على خصوبة التربة وإنتاجية المحاصيل .

وبناءً على ذلك، توصي الدراسة بضرورة المراقبة المستمرة لجودة المياه وتطبيق برامج إدارة متكاملة للحد من مخاطر الملوحة، مع تشجيع زراعة المحاصيل المقاومة للملوحة العالية. كما توفر الدراسة بيانات شاملة تدعم التخطيط الزراعي المستدام وإدارة الموارد المائية في جنوب العراق، بما يساهم في الحفاظ على استقرار الإنتاج الزراعي وتعزيز الأمن الغذائي المحلي.