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The Challenges Facing Agriculture and the Production of Agricultural Crops and Ways to Develop them in the Al-Haydariyah District

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KEYWORDS

Agriculture,
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Salinity,
Water Scarcity,
Arid Climate

ABSTRACT:

Natural factors play a significant role in the emergence of many problems that hinder agricultural production and development in the study area. Foremost among these is the issue of climate extremism, including temperature fluctuations beyond the permissible range for crop needs, increased wind speed, and dust storms, all of which have a negative impact on agricultural crops. Additionally, there is the problem of salinity, particularly in the river basins and the western plateau of the study area, due to a combination of natural and human factors. Furthermore, the issue of water scarcity and water shortages has led to a reduction in the cultivated area due to the policies pursued by upstream countries. The arid climate, characterized by minimal rainfall, which cannot be relied upon for agricultural activities in the study area, further compounds the issue. The scarcity of rainfall also limits the number of crops that can be cultivated in the study area.

Introduction

In order to better utilize and protect the available resources and promote continuous food security and agricultural product supply to meet the increasing needs of the population in the long term, agriculture plays a vital role in the development process, particularly in developing countries. Agricultural production makes a significant contribution to the national income, making its development and improvement crucial. This research aims to review the problems hindering agricultural production and their substantial impact on the decline of agricultural productivity, particularly focusing on the plant-based agricultural activity in the Al-Haydariyah area, one of the sub-districts of Al-Najaf Governorate. This region is characterized by agricultural potential that qualifies it for agricultural expansion in the production of grain crops.Firstly, the research problem includes:

What are the natural problems affecting plant-based agricultural production in the Al-Haydariyah area?

What are the suitable solutions and remedies to mitigate the impact of natural problems on agricultural production?

Secondly, the research hypothesis:

The study area is confronted with several natural factors that hinder the expansion of cultivated land and increased production in the study area.

Several recommendations and proposals have been formulated in the study area based on scientific principles.

Thirdly, the research objective:

The research aims to identify the most significant natural problems that affect the study area, leading to negative impacts on agricultural production. It seeks to understand these problems and their causes for the purpose of proposing appropriate solutions and recommendations.

Fourthly, the study boundaries:

The study is limited to the Al-Haydariyah sub-district, which falls under Al-Najaf Al-Ashraf Governorate in Iraq. It is located to the west of central Iraq, and it is bordered by Karbala Governorate to the north, Babil Governorate to the east, Al-Najaf Al-Ashraf Governorate and Al-Kufa Al-Muqaddasah district to the south, and Al-Anbar Governorate to the west.

The geographic coordinates of Al-Haydariyah sub-district are approximately between 32° - 33°55' North

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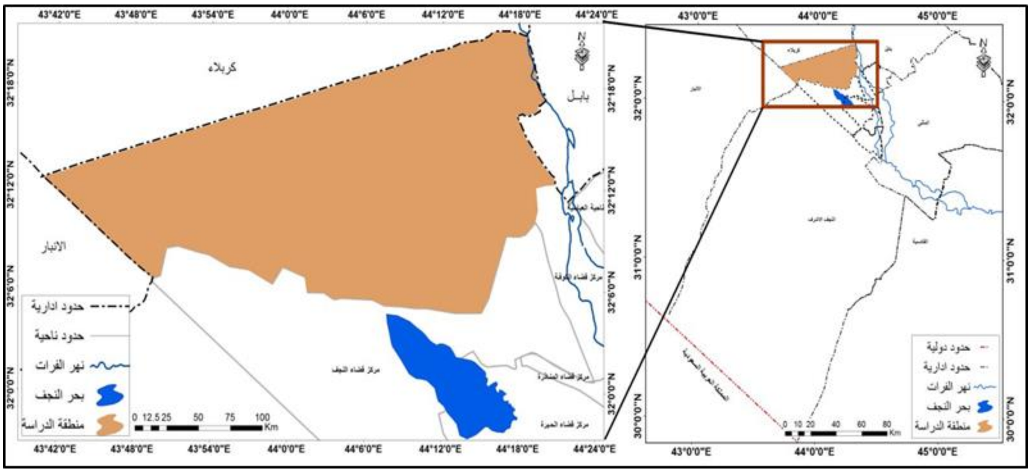
latitude and 38°43' - 44°22' East longitude. Its area is approximately 1260.1 square kilometers, which accounts for about 4.2% of the total area of Al-Najaf Governorate (28,824 square kilometers). The sub-district comprises 25 districts with varying areas (Map (1)).



Map (1) Boundaries of Al-Haydariyah Sub-District in Al-Najaf Al-Ashraf Governorate [1].

Table (1): Districts of Al-Haydariyah Sub-District.

Sequence	District Number	District Name	Area (km²)	Area (Donum)
1	4	Northeastern Najaf Island	793.2	317,280.3
2	5	Northwestern Najaf Island	415.3	166,138.1
3	6	Northern Khan Al-Hamad and Al-Ajdaa	8.5	3,412.9
4	7	Qasbah and Orchards of Khan Al-Hamad	0.64	256.7
5	10	Southern Khan Al-Hamad	1.03	415.02
6	65	Southern Al-Wasmiah	1.3	556.4
7	66	Northern Al-Wasmiah	5	1,979.8
8	67	Al-Kreia	1.7	715.7
9	68	Northern Al-Mazrookah	2.6	1,037.9
10	69	Eastern Al-Mazrookah	1.4	573.3
11	70	Southern Al-Mazrookah	2	814.4
12	71	Western Al-Mazrookah	1.8	753.4
13	72	Southern Al-Majr	2.2	910.4
14	73	Central Al-Majr	1.8	748.8
15	74	Northern Al-Majr	0.8	328.3
16	75	Southern Um Al-Raji	1.5	605.8
17	76	Northern Um Al-Raji	2	790.2
18	77	Ash-Shayta	0.9	362.8
19	78	Um Nagheifah	1.5	466.8
20	79	Um Nagheifah and Al-Jadeedah	0.8	352.3

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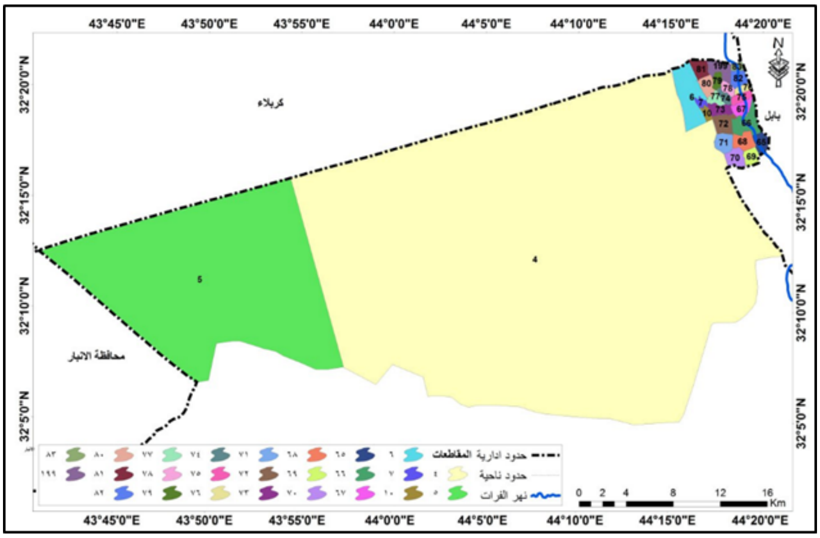
Sequence	District Number	District Name	Area (km²)	Area (Donum)
21	80	Northern Al-Ajdaa	2.5	905.4
22	81	Southern Al-Ajdaa	2.3	934.4
23	82	Southern Al-Munaythir	3.5	1,271.02
24	83	Northern Al-Munaythir	3.1	1,212.9
25	199	Ash-Shamatooniyah	3	1,224.8
Total		Total Area of Al-Haydariyah Sub-District	1,260.1	504,047.9

Source: Ministry of Agriculture, Agriculture Directorate in Al-Najaf Al-Ashraf Governorate, Agricultural Atlas Project, 2011, page 105.



Map (2): Districts of Al-Haydariyah Sub-District [2].

First Section: Natural Challenges Affecting Agricultural Production in Al-Haydariyah Sub-District

The study area is afflicted by a set of natural problems, including climate extremism, salinity, and water scarcity. Therefore, these will be studied in more detail.

Issue of Climate Extremism

One of the global problems that the Earth is currently facing due to global warming and its resulting climate changes is the occurrence of extreme weather conditions. These include heatwaves, cold spells, and extreme temperatures, along with high-speed winds and dust storms. The increase and decrease in temperatures beyond the permissible range and the rise in wind speed and dust storms have a negative impact on plants. Scientifically, each agricultural crop has a minimum and maximum temperature threshold, and when these thresholds are exceeded, whether in the form of lower or higher temperatures, it puts the crops at risk, potentially leading to their demise [17][18].

The study area, like other parts of Iraq, experiences fluctuations in temperature and wind speed throughout the year, which have negative consequences on agricultural activity in the study area [19][20].

Extreme High Temperatures:

High temperatures have a significant impact on the growth of agricultural crops, affecting their physiological processes. The effect of high temperatures varies depending on the duration of exposure and the growth stages of plants, starting from seed germination to the impact on vegetative and fruiting growth, which can lead to a reduction in yield. Most agricultural crops have a temperature threshold beyond which their growth is

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severely affected. The lethal temperature for most plant cells is scientifically estimated to be between 60-50 degrees Celsius.

The extreme high temperatures during the summer months (June, July, August) reached 49-50-49 degrees Celsius, respectively. However, these temperatures have been observed to exceed the mentioned values in recent years. These temperatures represent shaded conditions, while the cultivated crops are exposed to direct solar radiation. When compared with the upper temperature limits harmful to agricultural crops, these extreme high temperatures have surpassed the maximum thermal limits for crops. High temperatures cause significant damage to crops due to heat stress, disrupting the balance between transpiration and water absorption. This imbalance leads to a higher rate of transpiration than water absorption, causing the death of protoplasts when temperatures exceed the upper growth limits of plants, leading to plant stasis, leaf yellowing, leaf senescence, and eventually death. This results in damaged pollen grains, the formation of empty grains as seen in rice, weakened pollen grains with abnormal development, depletion of stored carbohydrates, and slow growth of summer crop leaves. It can also lead to flower drop and non-fruit setting, as in eggplants, and the death of pollen grains, leading to the occurrence of the "blossom-end rot" disease, as seen in tomato crops. Fruit trees are also affected by extreme high temperatures, although different types show varying degrees of tolerance to extreme heat [21][22].

Table (2): Extreme High Temperatures in Al-Najaf Al-Ashraf Governorate for the Period (2018-2022) [3]

Months	January	February	March	April	May	June	July	August	September	October	November	Decembe r
Extreme Temperatures	15	22	32	36	45	49	50	49	44	40	29	21

Table (3): Upper and Lower Temperature Limits Harmful to Agricultural Crops [4, 5]

Crop	Minimum Damaging Temperature (°C)	Maximum Damaging Temperature (°C)
Fig	-12	43.3
Winter Vegetables	6-15	>30
Summer Vegetables	10-7	40
Rice	10	43
Pomegranate	-17	43.3
Grapes	-12	40
Wheat	4-	38
Date Palms	-12	50

Severe damages are inflicted by extreme temperatures on vegetative and fruit growth, leading to flower drop, reduced production, and exposing fruits and leaves to the ailment of scorching. Moreover, the rapid ripening of fruits before their due date results in a change in the nature of vegetative growth and chemical composition, rendering them unappetizing with a brown color and an undesirable taste. Date palms are affected by excessive high temperatures, causing a condition locally known as 'June drop,' which leads to fruit wrinkling and the dropping of flowers and fruits. This results in significant damage to the quantity and quality of production, affecting around 41% of farmers in the study area [23][24].

2- Extreme Low Temperatures

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Each crop has its own lower temperature thresholds that vary with different crops, determining the timing of planting and the onset of crop growth. When these temperature thresholds are exceeded, it negatively affects agricultural crops. The sensitivity to low temperatures varies according to the growth stages of the plants. Seedlings, roots, and leaves are more sensitive to low temperatures than older plants. A temperature of 6°C is considered the zero-growth point, according to researchers. Any drop in temperature below this limit is referred to as 'harmful low temperatures.' At this temperature, plant processes cease, and tissues and cells freeze due to water expansion during freezing, resulting in cell and tissue damage.

"Table 4 reveals that the average minimum temperatures in the study area decrease during the months of December, January, and February, reaching (-0.2, -0.3, 0.3)°C. Looking at Table 3, we observe that agricultural crops vary in their tolerance to extreme low temperatures. When comparing the rates of temperature drop with the harmful minimum temperature thresholds for crop growth, we notice that the temperature rates fell below the harmful minimum temperature thresholds for agricultural crops. In reality, temperatures drop even further than what's shown in Table 4, especially during the cold nights of the winter months.

This extreme cold leads to tissue freezing in some wheat varieties, weakened apex growth, reduced the number of grains, and pollen death. It also results in slow growth of fruit trees, fruit damage, and leaf tearing. The crop germination process becomes slow, causing significant damage to vegetative and fruit growth. Severe damage is inflicted on winter green crops when this situation occurs suddenly and within a short period. This is due to a change in the protein composition inside plant cells, leading to the cessation of physiological processes due to increased viscosity caused by water loss from inside the cells due to water freezing between cells. The lower temperatures also reduce the activity of plant roots in absorbing moisture from the soil, making the plant unable to compensate for the lost water due to evaporation. Approximately 30% of farmers in the study area suffer from this issue.

Table 4: Extreme Minimum Temperatures in Al-Najaf Governorate for the Period (2018-2022) [3].

Month	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
Temperatures	-0.3	0.3	5	8	15.7	23	25	24.7	21.0	11.7	5.7	-0.2

This table provides extreme temperature values (in °C) for each month of the year in the given location.

3- Extremes in Wind Speed and Dust Storms

Extreme wind speeds have a significant impact on agricultural crops in the study area. They can cause the breaking of grain crop stalks, leading to lodging (the bending or collapsing of crop plants), which damages the grains and makes the harvesting process challenging, especially when using machinery. Additionally, wind can hinder the process of pollination.

Table (5) illustrates that the study area has experienced several occurrences of high wind speeds. These occurrences peaked during the rice crop's maturity in the months of October and November (19 occurrences), while during wheat crop maturity in June, there were 98 occurrences. This leads to crop damage and makes the harvesting process more difficult, affecting both the quality and quantity of the harvest.

Extreme wind speeds directly impact fruit trees. Whenever wind speeds exceed 14-17 meters per second, they cause mechanical damage to both deciduous and evergreen trees. These winds can break tender branches, cause flower and fruit drop, and create wounds on the tree branches and fruits. Newly formed flowers and fruits are particularly susceptible. During the spring season when flowers bloom, the study area is exposed to winds with speeds of 14-17 meters per second, which occurred 45 times.

The effects of extreme winds on both summer and winter vegetable crops include stalk bending, leaf loss, and tearing. These effects result in a reduction in leaf area and have a negative impact on food production and, consequently, crop growth and yield.

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The dry northwesterly (Shamal) winds have an impact on summer agricultural crops, as they lead to increased evaporation and reduced relative humidity in the air surrounding the plants. This, in turn, results in a higher rate of evaporation that exceeds the crops' ability to absorb water, causing them to lose a significant amount of energy at the expense of other functions. Consequently, the growth of crops is reduced, leading to wilting, yellowing, and sometimes death of the crops. Additionally, there is an increased evaporation from the soil's surface, leading to moisture loss, which harms the plants. In many areas, including the study region, there is a lack of surface water due to the general decline in water resources and the scarcity of surface water in recent years.

Winds with speeds exceeding 7 meters per second lead to dust storms, especially during the hot, dry summer season and due to the aridity of the soil, particularly in the western part of the study region.

Table (5): Extreme Wind Speeds (m/s) in Al-Najaf Governorate (2018-2022)

Extreme Wind Speed (m/s)	**11-13**	**14-17**	**18-20**	**21-24**	**25-28**	**29-33**	**Total**
Months	Occurrences	Occurrences	Occurrences	Occurrences	Occurrences	Occurrences	
January	0	0	0	0	0	0	0
February	8	3	0	0	0	0	11
March	20	12	17	0	0	1	49
April	21	17	0	0	0	0	38
May	40	28	8	0	0	0	68
June	56	30	12	0	0	0	98
July	31	24	0	0	0	0	55
August	42	18	0	0	0	0	60
September	15	9	0	0	0	0	24
October	7	0	0	0	0	0	7
November	9	3	0	0	0	0	12
December	0	0	0	0	0	0	0

Dust storms are among the climatic phenomena experienced by the study area, especially in recent years. They have both direct and indirect impacts on agricultural processes and agricultural production. These impacts can be summarized as follows:

Materials deposited by dust storms (sand, dust, fine particles) bury seedlings, especially in the initial stages of germination.

The deposited materials on plants reduce the amount of solar radiation reaching the plants even after the dust storm ends, affecting agricultural production in the study area.

As plants respire, the presence of deposited materials from dust storms on various parts of the plant hinders this process, resulting in a disruption of the photosynthesis process, which is responsible for creating plant food.

Over time, the materials deposited on agricultural lands alter the soil properties for the worse. This transformation leads fertile lands to become sandy and unsuitable for agriculture.

Dust storms prevent the pollination of various crops, including fruit trees like apricots and peaches, and hinder pollination in several vegetable crops.

Crops are at risk of infestation by various pests, including dust mites that affect palm trees.

The field study revealed that 29% of farmers in the study area suffer from this problem among a sample of the study area's agricultural population.

Secondly, Soil Salinity:

One of the major problems facing agricultural activity in the study area is its impact on agricultural production,

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soil properties, and water. Increased salt concentrations in the soil have significant detrimental effects on agricultural crops. These salts accumulate around the root zone, forming a barrier to the absorption of water and essential nutrients for crop growth, such as nitrogen and potassium, leading to competition for nutrients. This effect is evident through stunted plant growth and leaf edge burn.
The issue of salinity appears more prominently in the eastern part of the study area, within the alluvial plain regions along the rivers and is more widespread in the northernwestern sections moving towards the southwestern parts of the study area. Two types of saline soils are observed in the study area:
Low saline soils (0-4 decisiemens/cm): These soils affect the production of some crops by less than 40%.
Moderate saline soils (4-8 decisiemens/cm): These soils impact the agricultural production of certain crops by up to 70%.
High saline soils (8-15 decisiemens/cm): These soils are present in eleven provinces, and the average salt concentration is 10.4 decisiemens/cm. They affect crop production by 40-70% (Table 6).

Table (6): Electrical Conductivity Values in the Soils of Al-Haidariya District for the Year 2022 [6]

Province Number	Province Name	Electrical Conductivity (EC) in decisiemens/cm
65	Southern Al-Wasmiah	3.9
66	Northern Al-Wasmiah	3.7
75	Southern Um Al-Raji	3.5
76	Northern Um Al-Raji	3.8
Average		3.7
67	Al-Kari'ah	4.3
82	Southern Al-Muneethir	4.8
83	Northern Al-Muneethir	5.2
68	Northern Al-Mazukah	7.2
79	Um Nghayfah and Al-Jadeedah	7.9
Average		5.9
69	Eastern Al-Mazukah	8.3
70	Southern Al-Mazukah	8.2
71	Western Al-Mazukah	9.9
72	Southern Al-Mujir	9.1
73	Central Al-Mujir	10.1
74	Northern Al-Mujir	10.7
77	Al-Shaytah	10.5
78	Um Nghayfah	9.8
80	Northern Al-Ajda'	14.2
81	Southern Al-Ajda'	13.4
199	Al-Shamatooniyah	9.7
Average		10.4
4	Northeastern Najaf Island	15.2
5	Northwestern Najaf Island	15.8

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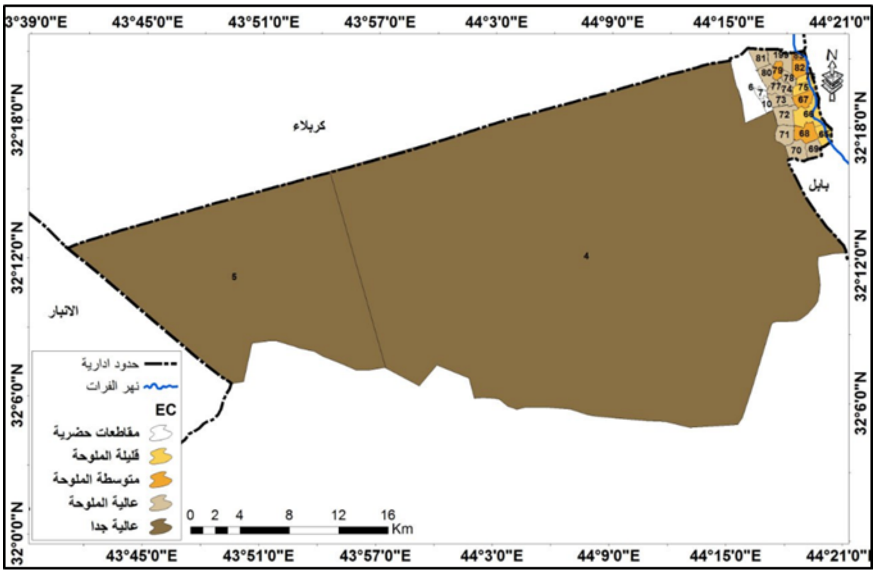
Province Number	Province Name	Electrical Conductivity (EC) in decisiemens/cm
Average		15.5

As for highly saline soils (EC greater than 15 decisiemens/cm), two provinces are affected, namely Province 4 (Northeastern Najaf Island) and Province 5 (Northwestern Najaf Island), with a salt concentration level of 15.5 decisiemens/cm. These soils have a significant adverse impact on agricultural production, causing a reduction of up to 70-80%.

The high salinity in these soils is due to the intense evaporation in this region and the use of groundwater. However, the success of agriculture in such soil is attributed to its coarse sandy texture, which is highly permeable, preventing salt accumulation and the formation of salt layers around plant roots. Instead, these soils remain moist, benefiting plant growth, and allow excess salts to leach downward, potentially reaching the groundwater.

In the study region, approximately 68% of farmers face issues related to soil salinity.



Map (3): Soil Salinity in Al-Haidariya District for the Year (2022) [7]

There are several factors that have contributed to the appearance and exacerbation of the salinity problem, including:

A. Surface Nature:

The study area is part of the alluvial plain and the western plateau, with a general slope from the southwest to the northeast. This gradual slope makes it difficult to dispose of excess irrigation water, in addition to the inefficiency of the existing drainage system due to sediment buildup and poor maintenance, as well as the dense growth of natural plants inside and around it, especially the reed plant, which extends along the drainage channels. All of these factors have contributed to water accumulation on the soil surface.

B. High Evaporation Rates:

High temperatures, intense solar radiation, and the prevalence of northwesterly winds, especially during the summer, lead to increased evaporation rates, which can reach up to 50% of the irrigation water in some areas. This increased evaporation contributes to the accumulation of salts in the soil, as water evaporates, leaving the salts behind. This effect is exacerbated in low-lying areas where groundwater is relatively shallow and has a high salt content.

C. Irrigation Water Quality:

The quality of irrigation water is one of the main factors contributing to salinity problems. The irrigation water contains salts, which are added to the soil when the water evaporates. Additionally, some of this water infiltrates into the soil, carrying salts with it and contributing to

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increased soil salinity. In the study area, surface water from the Euphrates River, Bani Hassan Reservoir, and its associated distributary channels are predominantly used for irrigation. Groundwater from wells is also used for irrigation in the western plateau. The quality of irrigation water varies, and according to the American Salinity Laboratory's classification (1954), it can be categorized as moderately saline for the Euphrates River and Bani Hassan Reservoir water. In contrast, groundwater used for irrigation is highly saline.

Table (7) Classification of Water According to Salinity Levels Based on the U.S. Department of Agriculture (U.S.D.A) Salinity Standard (1954) [8]

Water Salinity Class	Salinity (dS/m)
Low Salinity	Less than 0.250
Moderate Salinity	0.750-0.250
Medium Salinity	2.250-0.750
High Salinity	4-2.250
Very High Salinity	6-4
Excessive High Salinity	More than 6

Table (8) Electrical Conductivity Values for the Euphrates River and Bani Hassan Reservoir in Al-Haidariyah District [6].

Element	Symbol	Measurement Unit	Area	Start (July)	Middle (July)	End (July)	Average (July)
Electric Conductivity	EC	Deci Siemens per cm	Euphrates River	1.18	1.05	1.23	1.07
			Bani Hassan	1.03	1.32	1.05	1.73

Table (9) Electrical Conductivity Values for Well Water in Al-Haydariyah District.

The Element	Symbol	Unit of Measurement	W1	W2	W3	W4	W5	W6
Electrical Conductivity	EC	Deci Siemens/meter	8.3	9.1	8.6	8.1	16	8.7

Th - The rising groundwater level in the alluvial plain area of the study region:

One of the sources contributing to soil salinity, especially during the summer, is the high temperatures, increased evaporation, lack of precipitation, and low relative humidity. This causes the groundwater to rise through capillary action to the soil surface, especially in areas with inadequate natural or efficient drainage networks. As the groundwater level rises and evaporation rates increase, soil salinity accelerates. The salinity of the water in this area can reach up to 16 Deci siemens/m.

H - Excessive irrigation water waste:

Wasteful use of irrigation water and increased water losses due to non-compliance with water regulations for crops lead to the leaching and percolation of some of this water to deeper layers. This results in a significant loss of water through evaporation, leaving salts on the soil surface, especially in areas with poor natural and industrial drainage. Additionally, selecting the wrong time for irrigating crops, such as midday when the sun's rays are nearly vertical, can lead to water evaporation and leave salts on the soil surface. The rising groundwater levels due to water percolation further complicate the situation, turning the soil into a sponge that draws water to the root zone. This process hinders root water uptake due to increased osmotic pressure, especially in arid and semi-arid regions and areas with poor natural and industrial drainage, as well as unlined irrigation channels.

K - Inefficient and insufficient drainage systems:

Drainage systems are responsible for discharging excess water, particularly water laden with salts, from flat lands in the alluvial plain area. The study area struggles with the inefficiency or absence of drainage systems, the presence of bushes and human waste, as well as a lack of maintenance. This situation prevents water from draining properly and results in its evaporation, which is one of the significant causes of salinity issues in irrigated lands.

D - Agricultural practices:

Farmers in the study area follow the practice of alternate wetting and drying. About 84% of the sampled farmers in the study area adopt this method. This practice involves alternating between cropping the soil in one season and leaving it uncultivated in another season. Following this method leads to rising groundwater levels due to percolation and deep leaching caused by gravitational force. Traditional irrigation methods are also prevalent in the alluvial plain area, such as furrow and basin irrigation, which results in significant water losses through evaporation.

Third - Water Deficiency:

Water is the essential element of life; there is no life without it. It is the main element in agricultural development. Iraq today faces water deficiency problems in dry and semi-arid regions. Drought is considered one of the most severe modern-day challenges and has significantly affected the performance of the agricultural sector. According to United Nations statistics, Iraq has lost 90% of its most fertile lands. The Ministry of Agriculture has stated that 90% of agricultural lands, especially in central and southern Iraq, are threatened by drought. The Minister of Water Resources has also stated that the water reserves will not last until the end of the year, and summer farming is a gamble. Approximately 86% of farmers in the study region are facing this issue.

Several factors have contributed to exacerbating this problem:

Climate change, characterized by decreased rainfall in recent years, rising temperatures, increased evaporation, low humidity, and strong winds, especially during the summer. These conditions lead to increased water losses, with an estimated evaporation rate of 2795.8 mm in the study area.

The water policies of neighboring countries, as the sources of the Tigris and Euphrates Rivers lie outside Iraq's territorial boundaries. This has led to these waters being managed by the upstream and riparian countries, posing a threat to water security. Turkey has constructed dams and reservoirs on the sources of the Euphrates River, with the GAP (Southeastern Anatolia Project) being the most significant project. It relies on Euphrates River water by 80% and includes 22 water storage dams and 19 hydroelectric power stations. In 2022, the inflow to the Euphrates River was only 7 billion cubic meters, leading to a reduction in water allocations for agricultural lands and a decrease in cultivated areas. In 2022, the rice cultivation area was only half of what was planned in the agricultural plan for that year.

Increased water losses through irrigation, particularly in non-lined irrigation networks, with water loss percentages ranging from 30% to 40%. Additionally, water-loving plants growing along riverbanks and ponds consume large quantities of water. There is also an increase in riverine drainage and inadequate purification, as well as increased water losses from agricultural fields due to traditional irrigation practices and non-compliance with water regulations for crops, resulting in the waste of 50% of the water.

A lack of awareness among citizens about the importance of conserving and efficiently using water for agricultural, industrial, and domestic purposes.

Overstepping water allocations and installing unauthorized pumps with high horsepower that draw large quantities of water. This has caused problems and conflicts among farmers, compounded by the lack of oversight by relevant authorities. There are also thousands of unauthorized fish ponds that are fed by surface water.

To illustrate the water deficiency experienced in the study area, it was necessary to rely on what is known as the climate water balance, which represents the relationship between effective rainfall and evaporation.

Analyzing the data in Table (10), it is evident that all months of the year recorded monthly and quarterly water deficiencies, indicating a negative climate water balance. The total evaporation/transpiration for the period from 1992 to 2022 was 2495.5 mm, while the total rainfall was 88.8 mm. This results in a water deficiency of -2423.2 mm. The water deficiency varies among the months, with January and February having the lowest water

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deficiency, at 57.9 and -37.7 mm, respectively. The reason for this is the lower temperatures, rainfall, higher relative humidity, and lower evaporation rates during these months. Conversely, the highest water deficiencies were recorded in June, July, August, and September, reaching -305.7, -352.9, -372.9, and -352.3 mm, respectively. The higher temperatures, lack of rainfall, low relative humidity, and increased evaporation rates during these months contribute to the higher water deficiencies in the study area.

Table (10) Climate Water Balance in Najaf Governorate for the Period (2022-1992) [9-10]

Month	Evaporation/Transpiration (mm)	Rainfall Average (mm)	Actual Rainfall Value (mm)	Climate Water Balance (mm)
January	57.4	14.9	19.6	-37.7
February	66.9	11.1	9.0	-57.9
March	131.1	8.5	3.8	-127.3
April	185.7	13.0	7.1	-178.7
May	275.1	3.1	0.3	-274.8
June	352.3	0.0	0.0	-352.3
July	372.9	0.0	0.0	-372.9
August	352.9	0.0	0.0	-352.9
September	305.7	0.0	0.0	-305.7
October	209.9	6.3	1.4	-208.5
November	113.0	19.0	18.8	-94.2
December	72.4	12.9	12.1	-60.2
Total	2495.5	88.8	72.2	-2423.2

ETO=p/3 $c^{1.31}$
Whereas:
ETO = Potential Evaporation/Transpiration (mm).
P = The percentage of monthly sunshine hours relative to the annual sunshine hours.
C = Average temperature (°C).
Refer to Basim Mohammed Wahid Al-Jubouri, "The Impact of Climate on Estimating the Water Requirements of Wheat and Barley Crops in Najaf Governorate," Master's Thesis, College of Arts, University of Kufa, 2021, p. 94.

The Effective Rainfall Factor was calculated using Lang's method based on the following equation:
F = N/T
Where:
F = Rainfall factor.
T = Monthly average temperature (°C).
N = Monthly rainfall average (mm).

The climatic water balance was determined using the following equation:
p - pe = ±
Where:
p = Precipitation (mm).
pe = Potential Evaporation/Transpiration (mm).
The plus sign (+) indicates a water surplus, while the minus sign (-) indicates a water deficit.
Second Section: Proposed Solutions to Address Issues Related to Natural Factors
Mitigating the Impact of Climate Extremes
It's impossible to overcome or control climate changes when extreme temperature and wind variations occur, but their effects can be mitigated through several methods, including:
a. Using crop residues to cover the soil surface, which helps prevent soil surface temperature from rising and reduces the intensity of solar radiation. Examples of suitable crops for coverage include clover, barley, and oats grown outside the regular planting season.

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b. Timely irrigation, where during heatwaves, crops are irrigated in the early morning or evening, and during periods of low temperatures, irrigation takes place at noon.
c. Eliminating harmful weeds and shrubs from agricultural fields since most weeds are better equipped to withstand heat stress than cultivated plants, which can lead to competition for resources like water and nutrients. It is essential to minimize the presence of these weeds to allow the crops to survive.
d. Genetic improvement through breeding heat-resistant crop varieties, especially wheat.
e. Providing heating and cooling systems within plastic and glass greenhouses, ensuring they are maintained and ready for use at any time to combat heatwaves and cold spells in the study area.
f. To mitigate the effects of frost on crops that occur during some cold winter nights, the use of the smoking method, by burning wood, can help. The heat generated by the burning process mixes with the ambient air temperature, reducing the decrease in temperature.
g. Compelling farmers to plant windbreak trees facing the northwest in the study area, which serves as a local climate ameliorator. These trees help lower daytime temperatures in the summer and increase nighttime temperatures in the winter.

Treating Soil Salinity

a. Maintaining, improving, and enhancing the drainage efficiency of furrows, along with constructing new furrows. Furrows help in draining excess water, lowering the groundwater level, reducing soil salinity, and creating a comprehensive drainage system starting from field furrows to sub-furrows, secondary furrows, and primary furrows.
b. Soil washing by leaching salts with water and then directing the salt-laden water to furrows or distant lands. Soil washing is carried out using several methods:
Continuous washing: Used in soils with good permeability and high groundwater, and when there is low salinity. It involves continuously submerging the soil, maintaining a constant water column height above the soil surface until soil salinity is reduced to the desired level, taking care to have a well-established drainage system. The washing process is best done in winter to minimize water evaporation.
Intermittent washing: Applied to soils with low permeability, high groundwater level, and moderate salinity. The process involves adding water in quantities sufficient to dissolve salts soluble in the soil and then allowing for rest periods. After these resting periods, water is added in subsequent time intervals, separated by rest intervals. The salt leached during the first phase is removed by draining it out with the irrigation water.
Sprinkler washing: This modern method is used for washing saline soils with low to moderate salinity.
Proposing the use of the sprinkler washing method in the study area, particularly in areas where salts accumulate in the surface layer, especially in riverbeds, due to the unavailability of water to implement the previous washing methods.
Using chemical fertilizers and pesticides wisely, as excessive use can introduce salts into the soil.
Avoiding wasteful irrigation and adhering to water management regulations for agricultural crops.
Avoiding land reclamation because it can increase soil salinity due to water level rise through capillary action.
Reducing water evaporation by leaving plant residues on the soil surface. This method is important for increasing soil organic matter content. It's also helpful to cultivate low-evapotranspiration crops like wheat and plant dense trees that reduce the evaporative demand.
Employing biological methods by cultivating salt-tolerant crops and developing plants through genetic engineering to create salt-tolerant strains.
Utilizing the winter leaching method to allow rainwater the opportunity to wash the soil and remove excess salts.
Using chemical amendments like diluted sulfuric acid, gypsum, and a mixture of gypsum with phosphorus to reduce soil salinity.
Limiting the use of drainage water or avoiding it in the irrigation process.
Expanding the use of organic fertilizers and reducing the use of chemical fertilizers.
Following crop rotation is crucial for managing salinity. Crop rotations are tailored to soil salt levels, crop tolerance, and local climate conditions.
To enhance soil quality and productivity, follow the agricultural cycle by planting specific crops in a defined area of the field during a specific timeframe. Each crop rotation cycle requires a different duration for cultivating crops, and it's essential to consider factors such as climate, soil, water, and high-quality seed compatibility with the field's conditions.

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Table (11): Crops Cultivated in the Triennial Crop Rotation in the Study Area [11]

Crop Section	Season	1st Year	2nd Year	3rd Year
First Section	Winter	Wheat	Yellow Corn	Barley
	Summer	Cotton	Flax	White Corn
Second Section	Winter	Barley	Cotton	Flax
	Summer	Wheat	Yellow Corn	Barley
Third Section	Winter	Flax	White Corn	Wheat
	Summer	Barley	Cotton	Wheat

Table (12): Crops Cultivated in the Hexennial Crop Rotation in the Study Area [11]

Crop Section	Season	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year
First Section	Winter	Barley	Cotton	Barley	Cotton	Barley	Cotton
	Summer	Sorghum	Sorghum	Sorghum	Sorghum	Sorghum	Sorghum
Second Section	Winter	Sorghum	Sorghum	Sorghum	Sorghum	Sorghum	Sorghum
	Summer	Barley	Cotton	Barley	Cotton	Barley	Cotton

3- Approaches to Managing Water Resources or Addressing Water Shortages

A. Using Magnetized Water Technology: A new scientific approach that can transform deserts into green areas. This technology has been utilized in various arid regions in the UAE, Saudi Arabia, Egypt, and elsewhere. It involves passing water through a magnetized metal tube, and the device's effectiveness extends for more than ten years. Through this technology, there is an intense concentration of the magnetic field as water passes through the metal tube's wall. This powerful field alters the physical and chemical properties of water, affecting hydrogen bonds between water molecules. This results in increased salt mobility and the breaking of these bonds, making water more capable of dissolving salts. This process helps in soil washing and aids plants in absorbing water and minerals more easily from high-salinity soil [12-14]. Consequently, using magnetically treated water helps increase agricultural production in terms of quantity and quality, enhances plants' disease resistance, and reduces the use of chemical fertilizers. This technology allows the use of brackish well water for agriculture and cultivation of new lands. It changes the physical and chemical properties of natural water, increasing its dissolving capacity for soil salts, improving irrigation water efficiency [15, 16]. Plants can absorb nutrients and fertilizers more effectively, increase seed germination rates, and through this technology, new areas can be developed and irrigated. This is one of the goals of agricultural development, especially in the western part of the study area within the Western Plateau region, which is a promising area for expanding agricultural production in the district and governorate.

B. Utilizing Water Harvesting Technology: Water harvesting techniques are one of the proposed solutions to mitigate and alleviate water scarcity in arid and semi-arid regions. These techniques involve collecting rainwater during its falling seasons and storing it for later use in agriculture, drinking, and domestic purposes. The wadis in the study area are utilized for water harvesting.

C. Developing and Exploiting Unconventional Water Sources, whether by treating wastewater or treated industrial water.

D. Enhancing the Efficiency of Irrigation Water Use through more precise scheduling of irrigation to align with the water needs of plants. Using computer systems connected to irrigation networks enables farmers to determine when and how to irrigate their crops with great precision throughout the growing season.

E. Reaching Agreements with Bordering Countries to secure Iraq's share of water resources.

F. Compelling the Ministry of Water Resources to Prepare a Plan for Distributing Water Revenues

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according to population density and agricultural activity for each province.

G. River Rehabilitation, by increasing financial expenditures for the Ministry of Water Resources, lining main and subsidiary rivers, channels, and the channels branching from them to reduce water loss.

H. Preserving Groundwater, taking urgent measures to protect groundwater resources and make optimal use of them, employing various recharge methods. It is essential to evaluate groundwater continuously using dedicated monitoring networks for water level and quality, and develop them to achieve optimal resource management objectives. This includes encouraging collaboration and sharing experiences among countries in studying and assessing the feasibility and impact of recharging groundwater with partially treated wastewater.

I. Establishing a Monitoring System for Groundwater Levels and Quality to take appropriate measures that ensure water resource sustainability.

J. Determining Crop Types and Areas for Irrigation Based on the Daily Withdrawal Rate from Wells, without compromising the food security principle.

Results

The study area suffers from several natural problems, including climatic extremes due to both high and low temperatures beyond the allowable limits for crop growth. Furthermore, the area is subject to strong winds and dust storms that cause significant damage to cultivated crops.

The study area faces salinity issues, especially in river basins and the western plateau areas, due to various natural and human factors contributing to this problem.

The use of traditional methods in irrigation without following specific water regulations for each crop, along with the elevated salinity of irrigation water, has exacerbated the salinity issue.

Water shortages result from the decrease in water revenue due to the policies practiced by neighboring countries in Iraq, as well as the primitive methods used in the irrigation process. Consequently, the study area has registered a water deficit throughout all seasons, as indicated by the climate water balance.

Recommendations

Avoid fertilization during heatwaves, as fertilization can raise soil temperatures when there is limited irrigation water, leading to damage to crop tissues that respond rapidly to nutrient influx.

Cover the soil with a layer of straw, hay, and leaves to reduce the impact of high temperatures on crops and roots.

Plant evergreen trees individually or as windbreaks to reduce wind speed's effects on cultivated crops and the moisture vapor they release through transpiration, leading to a reduction in heat extremes.

Use the sprinkler wash method in the study area, as salts tend to accumulate in the surface layer, especially in the riverbed areas, in the absence of continuous and intermittent wash water availability.

Remove all encroachments on water allocations, whether for domestic, industrial, or agricultural purposes, especially unauthorized fish farming ponds.

Expand the use of modern irrigation techniques and government support in providing sprinkler and drip irrigation devices at reasonable, subsidized prices, and reduce or eliminate interest rates on the prices of these devices.

References

1. General Authority for Survey, Administrative Map of Iraq, Visual Satellite Imagery from the LandSat 8 satellite for the year 2019, and outputs of ArcMap 10.8 program.
2. Agriculture Directorate of Al-Najaf Al-Ashraf, Map of Al-Haydariyah Sub-District, and outputs of ArcMap 10.8 program.
3. Ministry of Transportation, General Authority for Meteorology and Seismology in Iraq, Climate Department, Unpublished Data, 2022.
4. Salam Hatif Ahmad Al-Jubouri, Fundamentals of Agricultural Climatology, Dar Al-Raya for Publishing and Distribution, Amman, 1st edition, 2014, p. 45.
5. Ali Hussein Khlef Al-Hasnawi, Climatic Characteristics and Their Effects on Agricultural Crops in Al-Kufa Sub-District, Master's Thesis, College of Arts, University of Kufa, 2020, p. 136.
6. Soil and Water Analysis Laboratories, Faculty of Agriculture, University of Kufa, dated January 19, 2023 - July 24, 2022.
7. Data from Table (6) and Ark Map 10.8 software.
8. U.S Salinity Laboratory staff, Diagnosis and Improvement of Saline and Alkali Soil U.S.D.A,

Journal of Chemical Health Risks

www.jchr.org

JCHR (2023) 13(3), 1012-1026 | ISSN:2251-6727

Agricultural Hand Book, No 60, Washington, Government Printing Office, 1969, P.71.

9. Ali Abdul Zahra Kazim Al-Waeli, Fundamentals of Applied Climatology, Dar Al-Raya for Publishing and Distribution, Oman, 1st ed., 2015, p. 241.
10. Basim Mohammed Wahid Al-Jubouri, "The Impact of Climate on Estimating the Water Requirements of Wheat and Barley Crops in Najaf Governorate," Master's Thesis, College of Arts, University of Kufa, 2021, p. 94.
11. Omid Nouri Mohammad Amin, Principles of Field Crops, University of Basra Press, Basra, 1988, p. 352.
12. Almudhafar, S.M. Spatial Variation of Biological Contamination of Soil from Najaf City. Indian Journal of Environmental Protection this link is disabled, 2020, 40(2), pp. 192–196.
13. Almudhafar, S.M., Alattabi, I.A. Effect of environmental factors on drainage water network in Najaf governorate, Iraq. Indian Journal of Environmental Protection this link is disabled, 2019, 39(11), pp. 1050–1056.
14. Almudhafar, S.M. Environmental assessment of shut alkufa in Iraq. Plant Archives, 2018a, 18(2), pp. 1545–1551.
15. Almudhafar, S.M., Abboud, H.A. Spatial variation of surface water contamination by heavy elements in Alhira relative to tourism. African Journal of Hospitality, Tourism and Leisure, 2018b, 7(4).
16. KR Kadhim, S Almudhafar, BA Almayahi, 2023. An environmental assessment of the non-living natural resources and the available capabilities and their investment in Al-Najaf Governorate, HIV Nursing 23 (3), 265–273.
17. IA Alattabi, SM Almudhafar, BA Almayahi (2023). Natural constituents of the elements affecting soil pollution and health effects and changing their properties by wastewater in Najaf district center, Solid State Technology 63 (6), 5438-5452.
18. Mall, Pawan Kumar, et al. "Rank Based Two Stage Semi-Supervised Deep Learning Model for X-Ray Images Classification: AN APPROACH TOWARD TAGGING UNLABELED MEDICAL DATASET." Journal of Scientific & Industrial Research (JSIR) 82.08 (2023): 818-830.
19. Narayan, Vipul, et al. "A Comprehensive Review of Various Approach for Medical Image Segmentation and Disease Prediction.
20. Mall, Pawan Kumar, et al. "A comprehensive review of deep neural networks for medical image processing: Recent developments and future opportunities." Healthcare Analytics (2023): 100216.
21. Narayan, Vipul, et al. "Severity of Lumpy Disease detection based on Deep Learning Technique." 2023 International Conference on Disruptive Technologies (ICDT). IEEE, 2023.
22. Saxena, Aditya, et al. "Comparative Analysis Of AI Regression And Classification Models For Predicting House Damages İn Nepal: Proposed Architectures And Techniques." Journal of Pharmaceutical Negative Results (2022): 6203-6215.
23. Kumar, Vaibhav, et al. "A Machine Learning Approach For Predicting Onset And Progression"“Towards Early Detection Of Chronic Diseases “." Journal of Pharmaceutical Negative Results (2022): 6195-6202.
24. Chaturvedi, Pooja, A. K. Daniel, and Vipul Narayan. "A Novel Heuristic for Maximizing Lifetime of Target Coverage in Wireless Sensor Networks." Advanced Wireless Communication and Sensor Networks. Chapman and Hall/CRC 227-242.