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Environmental Factors Affecting Surface Water in Al-Mishkhab District

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Abstract

This study focuses on investigating the natural and human factors that contribute to the deterioration of surface water in the Al-Mishkhab district. The research reveals that natural factors such as climate, soil, and natural vegetation have a significant impact on the qualitative characteristics of water, leading to pollution. Climate elements, particularly temperature and evaporation, were found to play a role in changing and deteriorating water quality. The characteristics of the soil in the study area were also identified as contributing to the alteration of water quality. Additionally, natural vegetation, including riverbank plants and aquatic and semi-aquatic plants, were found to affect the qualitative characteristics of water, especially during the summer season. Human-related factors were identified as another significant influence on water quality. The study highlights the high population density in certain areas along watercourses, particularly in urban residential areas, which leads to the discharge of sewage water and solid household waste. Agricultural activities were also identified as a major factor, with the use of fertilizers and pesticides contributing to the degradation of surface water. The study area is characterized by extensive cultivation along the river and watercourses, further exacerbating the alteration of water quality.

Keywords: *Surface water, Natural factors Water, quality, Human factors, Pollution.*

Introduction

Water is an essential resource for humans, used in various administrative, industrial, and civil fields. God Almighty has made this blessing the foundation of life for living organisms, as He mentioned in His noble book, "And We made from water every living thing." Water is also mentioned in several verses of the Quran, such as "And We send down from the sky rain charged with blessing, and We produce therewith gardens and grain for harvest [1-2]".

Water stands out among other natural resources due to its finite quantity on Earth and the significant need for its conservation. In recent times, there has been a significant deterioration in the natural environment, particularly in the aquatic environment. It can be said that every individual directly or indirectly contributes to the deterioration of the qualitative characteristics of surface water in some way, due to incorrect practices and

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behaviors. Water has become in a deplorable state, especially rivers, in our present time. It is known that water covers more than three-quarters of the Earth, yet the portion suitable for use remains limited due to the agricultural, industrial, and civic waste disposed into it. The continuous pollution of water can lead to its deterioration if left untreated and poorly managed. This poses a threat to humans and other living organisms.

Through the research on the natural and human factors that contribute to the deterioration of water, our study focuses on analyzing the chemical and physical characteristics of water and comparing them with international and local standards for most human uses (such as drinking, agriculture, industry, and livestock livelihood).

1-Problem of the Study

1. What are the natural factors that affect the qualitative characteristics of surface water in Al-Mishkhab district?

2. Do human factors influence the qualitative characteristics of surface water in Al-Mishkhab district?

3. What is the geographic extent of surface water in Al-Mishkhab district?

2-Study Hypothesis

1. The natural factors, including surface characteristics, climate, soil, and natural vegetation, have an impact on the qualitative characteristics of surface water in Al-Mishkhab district.

2. Human factors, such as population, residential units, and cultivated areas, significantly affect the qualitative characteristics of surface water in Al-Mishkhab district.

3-Study Objectives

The objectives of the study are to identify the natural and human factors that affect the qualitative characteristics of surface water in Al-Mishkhab district. Additionally, it aims to understand the geographic extent of surface water in order to determine its specific physical, chemical, and biological properties. The study seeks to identify the problems faced by surface water in Al-Mishkhab district and propose solutions for their mitigation.

4- Study Area Boundaries

The spatial boundaries of the study area are defined by the administrative borders of Al-Mishkhab district in Al-Najaf Al-Ashraf Governorate, located in the southeastern part of the governorate, as shown in Map (1). It is strategically located between longitude lines (44.00 E - 41.20 E) and latitude lines () east and (32.00 - 31.48) north. The geographical location of the study area is bordered to the north, northeast, northwest, west, and southwest by the center of Al-Najaf Al-Ashraf district. It is bordered to the northeast by the center of Al-Munathirah district, and to the south and southeast by Al-Qadisiyah subdistrict, as shown in Map (1).

As for the temporal boundaries, the study relied on data from 1986 to 2016, including climatic, hydrological, demographic, agricultural, topographic, and cartographic data. The study period itself began in 2018 and continued until 2019.

Regarding the objective boundaries, they were defined through a spatial analysis of the qualitative characteristics in the study area. This involved studying and analyzing the characteristics of natural and human factors that affect water degradation, as well as examining the qualitative properties (physical and chemical) and evaluating the suitability for various uses based on international and local standards. Additionally, samples of surface water were analyzed to determine their qualitative properties and the extent of their impact on surface water pollution.

5-The structure of the study is divided into six axes

1. Natural factors influencing the qualitative characteristics of surface water in Al-Mishkhab district.

2. Human factors influencing the qualitative characteristics of surface water in Al-Mishkhab district.

3. The natural extent of surface water.

4. The methodology used in the study.

5. The results obtained from the study.

6. The recommendations derived from the study.

Firstly, the natural factors influencing the qualitative characteristics of surface water in Al-Mishkhab district are as follows:

1. Climate:

Climate is one of the important factors that directly and indirectly affect the interpretation of spatial phenomena. In the view of geographers, climate is one of the most significant elements that shape the natural characteristics of any region. Therefore, the influential characteristics of climate can be presented as follows: [further details can be provided based on the available information.]

A-Temperature:

Temperature is a natural outcome of the mutual relationship between solar radiation and the Earth on one hand, and the physical characteristics on the other hand. Temperature plays a crucial role in determining the climatic characteristics of the study area. The study area represents the region of the alluvial plain, which is an essential factor governing the thermal conditions. It determines the angles of solar radiation incidence, thus affecting the qualitative characteristics of surface water in Al-Mishkhab district.

From Table 1, it can be observed that the annual average temperature is 24.9°C. This average varies on a monthly basis, reaching its highest point in July (38.2°C) and decreasing to its lowest point in January (10.8°C). This temperature variation between summer and winter seasons has an impact on the available water resources in Al-Mishkhab district.

The high temperatures during the summer season lead to increased evaporation rates from water bodies in the study area and plant transpiration, affecting the quantity and characteristics of water resources. This, in turn, affects the qualitative characteristics of surface water, particularly in terms of salinity concentrations in the study area.

Table 1: Average temperature, wind speed, rainfall, relative humidity, and evaporation rates in Al-Najaf Governorate for the period 1986-2016 [3-4].

Dust Storms	Relative Humidity	Evaporation	Rainfall (mm)	Average Wind Speed (m/s)	Average Temperature (°C)	Month
0,3	67	58,2	15,6	1,2	10,8	Jan.
0,4	58	120,8	13,3	1,7	13,7	Feb.
1,0	49	202,8	12,1	2,1	8,2	Mar.
1,2	42	280,8	13,6	2,1	24,8	Apr.
0,8	32	401,1	3,1	2,2	31	May
0,8	25	502,4	0	2,8	35,2	Jun.

0,1	23	534,5	0	2,7	38,2	Jul.
0,0	24	514	0	2,1	37,7	Aug.
0,1	29	347,7	0	1,7	32,4	Sep.
0,2	40	262,6	5,2	1,4	28	Oct.
0,1	57	135,5	10,3	1,2	17,7	Nov.
0,1	65	90,2	14,3	1,1	12,6	Des.
5,1	51,1	3513,2	94,5	1,9	24,9	annual rate

B - Winds

Winds operate as mechanical energy by transferring heat energy and water vapor, resulting in changes in atmospheric phenomena that impact water resources through variations in water loss via evaporation from surface streams. This affects the qualitative characteristics in the study area. If the winds are strong, they enhance the evaporation process from riverbeds. However, they also remove the remaining water layer through water vapor to allow contact with the water surface, which is covered by drier upper air layers compared to the lower ones. This contributes to an increase in evaporated water, thereby affecting the characteristics of the surface waters in the Al-Mashkhab district [6].

It is evident from Table (1) that the annual average wind speed is 109 m/s, with monthly variations reaching their maximum (-8, -2, 2, 7) during June and July, respectively. The wind speed gradually decreases with maximum values of (8, 2, 7, 2) during June and July, respectively, and further decreases to minimum values of (1.4, 1.2, 1.1) m/s during October and December, respectively. These variations in wind speed contribute to changes in its characteristics, as well as increased erosion processes on the shores through wave action, leading to increased turbidity of the water and deterioration of the qualitative characteristics of surface waters in the Al-Mashkhab district.

C-Rainful

The rainfall in the study area follows the rainfall pattern of the Mediterranean Sea, occurring only during the cold season of the year. Its onset is typically in summer, and most of the rainfall is associated with the passage of mid-latitude cyclones that originate in the Atlantic Ocean and pass through the Mediterranean Sea, moving eastward. This increases the water content in the study area and deteriorates the qualitative characteristics of surface water in the study area.

In Table (1), the annual total rainfall amount in Al-Najaf station is 94.5 mm, with variations from month to month. It is noteworthy that the rainfall amounts are concentrated during approximately eight months of the year. Therefore, they cannot be relied upon as a consistent economic resource due to their fluctuation and instability in the region. The highest amounts were recorded in January, with an average of 15.6 mm, while rainfall amounts during October were minimal (5 mm). Rainfall is completely absent during the months of June, July, August, and September, which contributes to the deterioration of the qualitative characteristics of the water in Al-Mashkhab district [7].

-Evaporation

It is evident from Table (1) that the annual total evaporation amount in Al-Najaf province is high, reaching 3513.2 mm. The evaporation rates vary monthly, with the highest recorded in July at 534.5 mm. This is attributed to the high temperatures and low cloud cover, resulting in lower relative humidity levels. On the other hand, the highest evaporation rates occur in January, averaging 85.2 mm, due to lower temperatures, increased cloud cover, and higher relative humidity levels in the atmosphere.

The results indicate an increase in the evaporation rate in the study area, especially during the summer season, due to the aforementioned factors. This leads to an increase in water

losses. In the winter season, there is a decrease in evaporation rates and an increase in relative humidity levels, which affect the characteristics of water in Al-Mashkhab district.

-relattirehumidity

Humidity is influenced by several factors, including temperature, wind speed and direction, amount of rainfall, evaporation rates, and more. As a result of these factors, it is evident that the relative humidity percentage increases during the winter months and decreases during the summer season [8].

From Table (1), it can be observed that the annual average relative humidity in the study area is 51.1%. The relative humidity reaches its lowest levels during the summer season, which can be attributed to high temperatures, lack of rainfall, and the prevalence of north and northwest winds that are characterized by dryness and high temperatures. The lowest levels of relative humidity

during the summer months of August, July, and June are recorded as 24%, 23%, and 25%, respectively.

-Dusty shorts

Conversely, the highest relative humidity rates are recorded during the winter season in the months of December, January, and February, reaching 65%, 67%, and 58% respectively. This is due to the lower temperatures during this season. The importance of humidity is evident through its impact on groundwater levels, higher temperatures, the prevalence of dry winds, and increased evaporation rates. These factors contribute to increased water losses, which affect the analysis of water characteristics in the study area.

Dusty storms are a climatic phenomenon that occurs in both dry and non-dry regions. The study area is part of the sedimentary plain and is influenced by this phenomenon within a desert region. It is a result of the general wind circulation, limited and intermittent rainfall, and the distribution center of atmospheric pressure and temperature. These factors lead to the occurrence of atmospheric instability and the passage of air depressions caused by cold fronts, resulting in the effects of dust. This, in turn, affects the pollution of water quality characteristics in the Al-Mashkhab district.

Table (1) shows the annual total of dusty storms as 5.1. The highest rate of dusty storms was recorded in the month of April with a rate of 1.2, while the lowest rates were recorded in the months of July, September, November, and December with a rate of 5.1 [9].

2-Soil

The importance of studying soil in qualitative research is highlighted because different soil types and their properties are factors that determine their permeability, affecting their qualitative characteristics and drainage rates. The physical and chemical properties of soil vary consistently from one area to another. Soil is not of a single type and exhibits variability even within the same region. This variation is influenced by several factors, including soil fertility and complex composition, which are shaped by parent rocks, climate, and vegetation cover. The main types of soil are classified as follows [10-11]:

A-river levee soil

This type of soil is found along the banks of rivers, specifically on the side of the main channel of the Al-Mashkhab River and its branching tributaries from the Euphrates River in the study area. Map (1) shows that the main reason for the formation of this soil is the sediment deposits carried by the river, mainly resulting from the floods of the Euphrates River. These deposits occupy extensive areas along the banks of Al-Mashkhab, leading to reduced salinity levels. This type of soil is considered one of the finest soil types due to its high organic matter content and reduced evaporation rates. Consequently, it is

expected to retain a moderate level of moisture, reducing its susceptibility to drought and minimizing its potential for wind erosion [12-13].

B- River soir busins

This type of soil is relatively distant from the river channels. It consists of fine sediment deposits that floodwaters cannot carry far from the river channels, resulting in a soft saturation. The surface level of the area carrying this soil is lower than the floodplain soil by approximately (3.2) meters, which raises the level of the groundwater located at a depth ranging between (1.5-2.5) meters. This leads to an increase in salinity levels. Therefore, such soil is expected to encounter problems of waterlogging and salinization, which further increase the concentration of saline chemical elements. Consequently, it becomes unsuitable for agricultural activities. Due to the slight decrease in the surface level of this soil, the rise in the saline groundwater exacerbates land degradation, allowing the percolation of saline water into the aquifers and contributing to their pollution [14-15].

C-soil marshes and swamps

This type of soil covers small areas within the Mishkhab district. It is characterized as clayey or clayey loam soil. Agricultural investments have led to the emergence of this soil formation, which is one of the newest soil types in the study area. It prevails in elevated lands within the northern and northeastern parts of the region. Due to its heavy natural texture and low elevation, it is poorly drained soil with a high groundwater level, reaching approximately (1) meter below the natural ground surface and sometimes even reaching the surface. It is expected to have a high water table, which exposes it to the deterioration of surface water hydrological characteristics in the study area. This type of soil predominates in the low-lying areas within the northern and northwestern parts of the river basin area in the study region. Its impact on surface water deterioration is characterized by low salinity, but this ratio fluctuates during the summer season due to high temperatures and intense evaporation. It is considered one of the finest soil types for cultivating rice crops. However, this soil leads to the deterioration of its own specific characteristics in surface water within the study area [16-18].

3-natural vegetation

The natural vegetation in any area is a product of environmental conditions and soil, but the climate is considered the primary determinant for natural vegetation. Additionally, the type and density of vegetation along the river course have a significant impact on the process of flow and the study of temperature and evaporation rates. The presence of natural vegetation along the river helps reduce the process of soil erosion and sedimentation. Therefore, its density varies from one area to another within the basin. The vegetation cover also reduces the intensity of evaporation in the soil. In general, the study area is home to various types of diverse natural plants, with their density increasing closer to the Mishkhab river course, irrigation channels, and drainage outlets, while decreasing as one moves towards the depositional plain. It is worth noting that the study area exhibits high diversity in natural plant species [19-20].

A-Auuatic plahts

These plants grow within the watercourse of the Mishkhab river, and among the types of aquatic plants found in the study area are reeds, cattails, bulrush, and Persian bulrush (Image 5). These plants also grow in wetland areas and marshes within the study area. Another aquatic plant is the water hyacinth, which grows in the river channels as a result of the deterioration of the hydrological characteristics of surface water in the study area compared to the main course of the Mishkhab river and Pond 2. It is observed that the number of aquatic plants varies between the months of January and July due to differences in climatic factors, such as solar radiation and temperature. The density of aquatic plants increases in July due to higher temperatures and longer duration of solar

radiation, while it decreases in January due to lower temperatures and shorter duration of solar radiation. This variation has an impact on the qualitative characteristics of surface water in the study area. Reed and cattail are native aquatic plants that are widespread and dense in rivers, ponds, irrigation networks, and drainage systems in the Mishkhab area. On the other hand, the water lettuce (Shalant) is a fully adapted aquatic plant (Image 6) that is densely distributed in the water network of the study area. Crocodile weed and water lily are also invasive plants that grow extensively in the study area. It is evident during this study that these plants have a significant impact on the deterioration of the qualitative characteristics of surface water in the study area [21-22].

Table Number (2): Aquatic Plant Species in Shatt al-Mishab and Their Populations per 4 km2.

density	**Its population in the month of Jul.**	**Its population in the month of Feb.**	**Scientific name of the plant**	**Common Arabic name**
dense	1200	900	Phragmaits australis	reeds
dense	850	750	Typhaomingenis	papyrus
moderate	600	250	Sypris litoralis	The Golan Heights
moderate	120	150	Potumogeton pectingtu	Pondweed
moderate	150	110	Lemanl	غدس الماء
dense	900	700	Around donax	Giant Reed
				Nile Lily

B- plants riverbunks

These plants are concentrated along the banks of rivers and their density increases near the outlets of rivers and ponds. The interlacing of roots of these plants provides resistance against river erosion, especially in the meander regions. The height of these plants ranges from 15 to 180 cm. Table (3) demonstrates the plant counts, which vary between the months of January and July. They increase in July and decrease in January. They grow in the form of shrubs and grasses, including reeds, willows, palms, calotropis, and sidr.

Table (3) shows the variation in plant counts between the months of January and July.

density	**Its population in the month of Jul.**	**Its population in the month of Feb.**	**Scientific name of the plant**	**Common Arabic name**
dense	2500	1150	Tamarixsp	The West
dense	1500	1500	Salix fragilis	Willow
dense	2500	3500	Phenix daetylifera	Palm tree
dense	500	750	Encalg ptug bicolor	Calotropis
moderate	300	700	Ziziy phing chruti	Ziziphus
moderate	200	800	Mursa- parudisiaco	Mulberry
moderate	70	80	Myrtus com unis	juniper
Few	30	70	Myturastram	Date palm

Secondly, the human factors influencing the quality characteristics of surface water in the study area:

Human factors interact with natural factors to influence water characteristics, but human activities and behavior can have a greater impact than natural characteristics. They are the most important determining factors and have a direct and effective impact on changing water quality, both negatively and positively. With the increase in population and the diversity of human activities, the pressure on available resources has increased, leading to their depletion and deterioration. These factors can be divided into:

1- agricultural activity

and can be summarized as follows:

A-Agricultural areas and crop types

The use of water in agriculture is considered one of the most important consumer uses of water resources in the study area. Most of the agricultural lands in the study area are distributed on both sides of the Al-Mashkhab River and its branching channels in order to obtain the necessary water quantities for agricultural purposes. This requires the consumption of large amounts of water, leading to the deterioration of the quality characteristics of surface water. Consequently, this results in the alteration of the river water properties [23].

From Table (4), it can be observed that the total agricultural area for rice cultivation reached approximately 34,600 dunums. The total river water requirements for this crop amounted to about 932.17 million cubic meters per dunum, while the total water consumption for this crop was 910.8 million cubic meters per dunum. Consequently, the total water deficit for this crop was 682.91 million cubic meters per dunum.

As for wheat cultivation, the total agricultural area for this crop was 37,148 dunums, and the theoretical water requirements for this crop amounted to 87.89 million cubic meters per dunum. The actual water consumption reached 95.081 million cubic meters per dunum. Therefore, the total water losses for this crop were 7.191 million cubic meters per dunum.

The number of farmers in the agricultural areas is approximately 2,620 dunums, while the area of orchards is 2,602 dunums. The number of palm trees is 34,668, and the number of grapevines is 327, with 687 fig trees.

(Note: The translation provided for the numerical values is based on the assumption that the numbers are written in Arabic numerals and not spelled out in words. If the numbers are spelled out, please provide the numerical values for accurate translation [24].

As mentioned earlier, agricultural activity consumes a significant amount of water from the Shatt Al-Mishkhab, in addition to the increasing volume of water losses due to farmers not following the specific water regulations for each crop. This leads to the depletion of water resources on one hand and changes in water quality characteristics on the other hand. Consequently, it results in soil contamination through the accumulation of salts, especially after being exposed to intense evaporation. This, in turn, leads to the destruction of water properties in the study area.

Table Number (4): Financial Losses Used in the Study Area (2021-2022)

Actual consumption m/year	**Water losses m/year**	**Total theoretical water requirement m/year**	**Donum (Unit of Area Measurement)**	**Crop**
915,08	682,91	232,17	23,600	Rice
95,081	7,191	28,89	27,148	Wheat
-	-	-	36,2	Orchards
1,010,61	690,101	320,06	3,673,7	The total

B- fertitier

Fertilizers are defined as those substances added to agricultural soil with the aim of increasing the available nutrients and compensating for any deficiencies in the soil, in order to enhance the productivity per unit area. They can be organic or chemical fertilizers, consisting of one or more elements. Due to the large agricultural area for wheat and rice crops in the Mashkhab district, the study area aims to extensively use fertilizers of various types (urea, DAP, superphosphate). Table (5) shows the quantities of fertilizers used for the wheat crop during the agricultural season (2021-2022), which vary spatially for all agricultural areas and depend on the type of fertilizer. These quantities were distributed in the study area, where the quantity of urea fertilizer used was 65 kg per dunum, DAP fertilizer was 45 kg per dunum, and superphosphate fertilizer was 55 kg per dunum. As for the rice crop, the quantities of fertilizers used during the agricultural season (2021-2022) were distributed according to the cultivated areas in the administrative units of the study area. The quantity of urea fertilizer was approximately 80 kg per dunum, and DAP fertilizer was 55 kg per dunum. It is worth mentioning that the superphosphate fertilizer is prepared by the Mashkhab Agricultural Department. It should be noted that the residues of these fertilizers reach the water of Shatt Al-Mashkhab through the leaching process of these lands, leading to changes in the water's quality characteristics [25].

Table (2): Quantity of Fertilizers Used in Agricultural Operations in the Study Area

Total quantity of fertilizers used: tons/year	**Quantity of Fertilizers Used {kg/dunum}**			**Crop area: dunums**	**Crop**
	Superphosphate	**DAP**	**Urea**		
34,4	55	45	65	37,148	Rice
40,6	-	55	80	34,600	Wheat
75	-	-	-	71,748	The total

C- insecticides

Pesticides are defined by the Food and Agriculture Organization (FAO) as substances used to prevent or control pests, or materials added to crops to prevent damage. The United States Environmental Protection Agency (EPA) defines pesticides as a diverse group of chemicals developed to prevent or suppress a range of pests. In the study area, farmers contribute to the deterioration of the surface water quality indirectly through excessive and improper use of chemical pesticides. This is due to their lack of awareness, resulting in the transfer of these pesticides to water sources through excessive irrigation water, winds, or runoff. Different types of liquid or solid pesticides are used, and toxic substances known locally as "Zahra" are used in fishing. These pesticides are highly toxic and can cause direct pollution and the death of aquatic organisms.

The pesticides used in the study area vary in their types, including lethal, harmful, and harmless pesticides. The quantities of pesticide use also vary from one season to another and from one area to another, depending on the crop areas. In the agricultural and winter season of the 2021-2022 period, approximately 29 kg of GoldenX pesticide was used per 150 dunums to combat weed growth. Additionally, approximately 50 kg of SpotLine pesticide was used for an area of 150 dunums to control palm tree pests, while 80 grams of Shlentz pesticide was used for an area of 50 dunums to combat the same pests. Moreover, 125 mm of Palas pesticide was used for an area of 180 dunums to control weed growth in wheat crops. For rice crops, approximately 1 liter of Nosy pesticide was used for an area of 7,800 dunums, and 75 liters of Flak pesticide was used for an area of 7,000 dunums to control weed growth. Lastly, 450 liters of Ranbo pesticide were used for an area of 18 dunums to combat weed growth in rice crops [26-28].

Table (6) Types of Chemical Pesticides Used (in kg - liters) in the Study Area within the Mashkhab District for the Agricultural Season (2021-2022)

The area for pesticide control in dunams	**The quantity of pesticides in (kg) - (L)**	**The name of the pest being controlled**	**The pesticide used**	**No.**
150	ل39[L]	To control wheat weeds	)Coldenex(	1
150	50[kg]	To control the red palm weevil that affects palm trees	)Spotlight(	2
50	180	80[kg]	To control weeds in wheat fields	3
180	125[kg]	To control wheat weeds	Bayleton	4
7800	125[L]	To control rice weeds	Nominee	5
7000	75[L]	To control rice weeds	Flak	6
1800	450[L]	To control rice weeds	Ranbo	7

D-Irriyation

It is known as the process of supplying water to the soil through various methods to provide an appropriate moisture level for plant growth and production. The amount of water needed to cover a specific crop throughout its life cycle is referred to as the irrigation water requirement, which depends on the type of plants and various environmental factors. Our study focuses on irrigation methods in the study area [29-30].

lrrination metnids

There are several different factors that govern and contribute to the selection of the appropriate irrigation method, including the slope of the land, soil type, quantity and quality of irrigation water, climatic conditions, crop type, and economic cost. It depends on the elevation of agricultural land relative to the level of water in the river network branching from both sides of Shatt Al-Mishkhab. Some important methods include:

1-Flood irrigation method

Due to the gradual slope of agricultural lands from the beginning of the river channels to the end of the agricultural lands, with an increase in the water levels of the main rivers, the flood irrigation method is commonly used. This method requires farmers to divert water from the channels to the agricultural fields. The advantages of this irrigation method include increasing agricultural land area and continuously flushing the soil to remove excess salts. This, in turn, leads to increased agricultural production. In Table (7), the irrigated areas using this method in the Mashkhab district reach 3,635 dunums, accounting for 20% of the total agricultural area in the study area.

2- Irrigation style pro

This refers to the method of delivering water to agricultural lands through sprinklers using pumps. This method is concentrated in areas adjacent to rivers, characterized by higher agricultural land elevation compared to their water sources. It is not possible to control water distribution equally through this method. One of the advantages of this method is reducing water losses, as well as the ability of pumps to control the flow and speed of water to agricultural lands. However, it has some drawbacks, such as increased irrigation costs and farmers' lack of knowledge about water regulations for each crop, resulting in deviations from the specified quantities and hence changes in their qualitative characteristics [31].

Table (7), the irrigated areas using this method in the Mashkhab district reach 33,414 dunums, accounting for 80% of the total agricultural area in the study area.

The total agricultural land area is measured in dunams.	**The percentage of agricultural land in the study area is .%**	**Pumping (kg/acre)**	**Percentage of areas in the study area(%)**	**Surface Irrigation - Dunam (unit of area)**	**Administrative Unit**
38,140	80	33,414	20	3635	Al-Mashkhab district

C- drainage

The drainage water from the agricultural lands is considered one of the sources that affect the characteristics of Al-Mashkhab beach. This water is characterized by high concentrations of self-salts, ranging from 6000 to 30000 milligrams per liter. Additionally, the drainage water contains a high percentage of pesticides and fertilizers used for agricultural pest control and soil quality improvement. These substances are classified as hazardous agricultural materials. Therefore, the drainage network categorizes the type of residence in the study area as follows [32]:

main drans

The main drainage channels in the study area receive the drainage water from the agricultural lands through the sub-drainage channels. These channels are used to drain the irrigation water from a portion of the agricultural area. The total number of main drainage channels in the study area is six, which are as follows:

1-Al-Jamaali Drainage Channel:

is one of the main drainage channels located in the northern and northwestern parts of the study area. It receives water from both the main and sub-drainage channels and is named after the shape it takes from the northwestern directions. This drainage channel has a length of approximately 6 km and a discharge rate of 6 m/s. Its drainage is then directed towards the Al-Jadwal (Table) 8.

Table (8) Drainage Network in the Study Area: Lengths, Discharge Rates, and Type of Drainage Channel.

Type of Canal	Irrigation Method	Discharge (m^3/s)	Length (km)	Canal Name	**No.**
Principal	Siyah	6	6	Al-Jamali Canal	1
Principal	Siyah	3	6	Am Hareejah Canal	2
Principal	Siyah	2,5	9	Al-Fatlah Canal	3
	Siyah	5	7	Sayewd Noor Canal	4
Secondary	Siyah	5	13	Abu Khashina Canal	5
Principal	Siyah	10	8	The Nakara Canal	6
	Siyah	31,5	49	The total	

2-Am Hareejah Canal

This canal is considered one of the important canals in the Mshakhab area. It receives the drainage water from the agricultural lands and flows into Shatt al-Mshakhab. This canal

contributes to the moisture of its characteristics. It is located in the western part of the Mshakhab district and has a length of approximately 6 km. Its discharge is 3 cubic meters per second, as indicated in Table 8.

3- Al-Fatlah Canal

This canal is located in the southern and southwestern direction. It drains the saline lands, and this canal contains high levels of salts and chemical fertilizers. It is called by this name because it passes through the Al-Fatlah tribal area. It is situated on the right side and has a length of approximately 9 km. Its discharge is 2.5 cubic meters per second, as mentioned in Table 8.

4- Sayewd Noor Canal

This canal is located in the southern direction. This canal is considered harmful because it returns water to the shore of Al-Mashkhab, altering its characteristics. It is situated on the right side and has a length of 7 km. Its discharge is 5 cubic meters per second, as mentioned in Table 8.

5- Abu Khashina Canal

This canal is located in the northeastern direction and is considered one of the main canals in the Mashkhab area. It has a length of 13 km and a discharge of 5 cubic meters per second. This canal is situated on the left side, and its information is included in Table 8.

6- The Nakara Canal

This canal is considered one of the main canals and connects several secondary canals. It is located in the southeastern direction of Mashkhab and has a length of approximately 8 km. Its discharge is 10 cubic meters per second, as indicated in Table 5. Its length, discharge, and other details are included in Table 8.

Through the study, it is observed that the irrigation network in the study area is limited to a partially integrated system of secondary canals. The total length of these canals is approximately 49 km, consisting of 6 secondary canals. The total discharge of these canals is 31.5 cubic meters per second, as shown in Table 14.

It is evident that the existing canal network is insufficient to cover the agricultural area in the study area. Consequently, the quality characteristics of surface water in the study area have deteriorated. As a result, most farmers discharge the excess irrigation water towards surface water bodies, exacerbating the existing issues due to the characteristics of the irrigation water.

The process of irrigation becomes the major source of agricultural activities that deteriorate the quality characteristics of surface water in the study area. It transports agricultural soil, salts, residues of fertilizers, and pesticides from the area, carried by soil particles with excessive irrigation water beyond the plant's needs.

(2) civicactivity

A-The evolution of popnbation pumbets

The water demand of the population increases proportionally with the per capita annual water allocation. It is related to the volume of domestic use, agricultural investments, and industrial activities. Therefore, water abundance is determined and assessed annually. There are factors that influence the process of renewal and utilization. The population density affects the daily per capita water allocation. In Iraq, the per capita consumption is estimated at around 280 liters per day for urban residents and 40 liters per day for rural residents. The urban consumption is lower than that in rural areas.

As urbanization rates are high, the water demand increases with population growth. From Table 9, it is evident that the urban population reaches 24,943 individuals, accounting for

49.5% of the total population in the study area. On the other hand, the rural population is 28,021 individuals, representing 55.4% of the total population in the area. The population has increased by a certain number during the period 2010-2017 [33].

The population growth in the study area has resulted in the deterioration of the qualitative characteristics of surface water, mainly due to the low environmental services, particularly sanitation services. Additionally, the lack of environmental awareness among the population in preserving the water network exacerbates the situation as population numbers increase. This is accompanied by an increase in the quantity of solid and liquid waste (sewage).

Moreover, the population increase has led to the construction of a number of residential, service, and industrial units, which have had a negative impact on water degradation.

Table (9): Population Estimation in the Study Area for the Year 2022 According to the Environment

rural				urban			
Percentage(%)	Total	Females	Males	Percentage(%)	Total	Females	Males
55.4	28021	14000	14021	45.6	24943	12523	12420
52964							Total

The number of geographic housing units in the study area reached 2,544, of which 2,282 units were occupied by residents and 262 units were unoccupied. As for rural housing units, there were 2,480 units, with 2,204 units occupied by residents and 276 units unoccupied. The overall total of housing units in the study area amounted to 5,024 units, with 4,486 units being inhabited and 538 units uninhabited. This is illustrated in Table (10).

Table (10): Occupied and Unoccupied Housing Units in the Study Area by Environment (2018)

Rural housing units			Urban housing units		
Total	Unoccupied	Occupied	Total	Unoccupied	Occupied
2480	276	2204	2544	262	288.2
5024					Total

B- Sewage waste (effluent)

Sewage waste is considered an environmental pollutant and can alter the characteristics of the environment. Therefore, unless it is treated and disposed of in a safe and proper manner without causing harm to the environment, it can have negative impacts. The average amount of fecal matter discharged per person is about 90 grams per day, and the average amount of liquid waste is about 120 grams per day. When applied to the population of the area, the total amount of fecal matter and liquid waste generated by the population in 2013 reaches approximately 12,068 tons per day [34-36].

Household waste is divided into two categories:

1-Solid household waste

It consists of household waste, which includes kitchen waste, food residues, plastics, wood, diapers, metal scraps, glass, construction waste, household furniture, poultry waste, and other solid household waste. These wastes are often disposed of in waterways, sewer systems, landfills, or burned, all of which lead to the deterioration of water quality and environmental pollution.

2-household liquid waste

It consists of sewage waste generated from water used in homes, including kitchen, bathroom, and toilet wastewater, as well as other household activities. This sewage waste is composed of both organic and inorganic waste, along with pollutants present in the water used. The purpose of treating this wastewater is to make it safe for reuse or disposal.

C- Rainwater drainage networks

The rainwater drainage system in the study area is carried out through several networks, some of which are located in the Mashkhabs district and others in the Qadisiyah sub-district. The total length of the networks located in the Mashkhabs district is 20,000 meters, of which approximately 1,244 meters have been implemented, accounting for 4% of the total length. The rainwater flowing through these networks contains residues of fats, oils, as well as soil and street waste, which increases the risk of these components and alters their hydrological characteristics in the Mashkhabs estuary [37-43].

Results

Firstly, the study clarified that natural factors have a clear impact on the deterioration of surface water in the Mashkhab district, and the qualitative characteristics include climate, soil, water resources, and natural vegetation, as follows:

1. The study revealed that climate elements, especially temperature and evaporation, are natural factors that play a role in changing and deteriorating the qualitative characteristics of water and causing pollution.

2. The characteristics of the soil in the study area were found to have an impact on changing the qualitative characteristics of surface water and causing pollution.

3. Natural vegetation, particularly riverbank plants and aquatic and semi-aquatic plants, have an effect on changing the qualitative characteristics of water and causing pollution, especially in summer, especially plants such as Nile flower, Shamblan, water hyacinth, reeds, and cattails.

Secondly, the study indicated that human-related factors play a significant and evident role in changing the qualitative characteristics of water in the study area, as follows:

1. The study revealed that the study area is characterized by high population density in certain locations along watercourses, especially in urban residential areas. This means that the outputs of these human communities include sewage water and solid household waste.

2. The study found that the area has an agricultural nature compared to other human activities. It was also found that all lands are cultivated, and fertilizers and pesticides are widely used in both seasons. Most agricultural lands are located alongside the river and watercourses, which contribute to the deterioration and alteration of the qualitative characteristics of surface water due to the use of fertilizers and pesticides.

Conclusions

1. Natural factors such as climate, soil, water resources, and natural vegetation have a significant impact on the deterioration of surface water quality in the Mashkhab district. Temperature and evaporation affect the qualitative characteristics of water, while soil composition contributes to pollution. Riverbank plants and aquatic vegetation also play a role in changing water quality, particularly during summer months.

2. Human-related factors are major contributors to the changing qualitative characteristics of water in the study area. The high population density in certain locations results in increased sewage water and solid household waste production, which can contaminate surface water sources. Agricultural activities, prevalent in the area, involve the use of fertilizers and pesticides that can contribute to water pollution. Additionally, the proximity of agricultural lands to watercourses exacerbates the impact.

To address the degradation of surface water quality in the Mashkhab district, it is crucial to focus on both natural and human-related factors. Implementing measures to manage pollution from climate-related factors, such as temperature and evaporation, can help mitigate their impact on water quality. Soil conservation practices and proper wastewater treatment facilities are necessary to prevent contamination from human activities. Promoting sustainable agricultural practices and regulating the use of fertilizers and pesticides can also contribute to improving surface water quality.

Overall, a comprehensive approach that addresses both natural and human-related factors is required to protect and restore the qualitative characteristics of surface water in the Mashkhab district.

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