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The effect of climate on the physical properties of the soil of the shoulders of the Al-Razzaza lake

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ABSTRACT

The soil in the study area differs in its physical and chemical properties depending on the variation of its general characteristics and affecting its composition, and since there are five main factors that affect the formation of soil: climate, parent material, time, living organisms and topography, so the climate factor is one of the important factors in the variation and formation of soil properties as a result of the prevalence of dry climate , as it is located within its rainy composition (96) mm, and the vegetation cover decreased and the activity of various desert erosion factors was a consequence of the climatic conditions and the accompanying high temperatures and intense evaporation, in addition to the hydrology of the study area, which is represented in the high groundwater and the decrease in water discharge, which had a significant impact on the spread of The salinity of the soil, the soil became loose, as the soil textures of the shoulders of the Razaza Lake depression ranged during the summer season between silt sandy texture in sample (1), where the percentage of sand particles reached (89%), clay (4%) and silt (7%), while it was Soil texture during the summer, and there was a slight change in the percentage of soil particles in sample (12), which was about 19.2% sand, 58.8% clay, and 22% green. As for the real density of the soil in the study area, it ranged between (2.61) g/cm3 in sample (1) as a minimum during the winter season, and up to (2.678) g/cm3 as a maximum in sample (12) during the summer, and the porosity of the soil of the shoulders of the Razaza Lake ranged between its lowest during the summer season. In winter, its values reached (39.464%) as a minimum in sample (1), while during the summer the porosity values increase to reach (50.299%) as a maximum (12), while the results of measuring the temperature of the shoulders of the soil of the lowlands of Al-Razzaza Lake at a depth of (30) showed) cm The seasonal rates for it ranged between (11.1) m̊ as a minimum during the winter season in sample (1) and up to (32.07) m̊ as a maximum in a sample (12) during the summer, as these values increase in the northern and northwestern parts West and southwest in Lake Razzaza.

1. Introduction :

The importance of climatic factors on the soil

Climate change is a global phenomenon that has occurred continuously since the inception of the Earth. Climate change has become a major scientific and political issue during the past decade. There are noticeable cold and hot cycles in the history of the Earth's climate, and the climate has an obvious effect on soil.

The importance of climatic factors on the soil

Soil formation is controlled by many factors including climatic factors such as:

temperature.

Rainfall.

This climatic information affects soil formation directly by providing biomass and weathering conditions. The main climate information that directly affects soil formation is the sum of active temperatures and the ratio of precipitation to evaporation. It determines the values of energy consumption for soil formation, soil water balance, and the mechanism of Organic and mineral interactions, conversion of organic matter and minerals, and flow of soil solutions.

The importance of climatic factors on what is under the soil
_ Gradual stable climate warming leads to irreversible changes in the mineral matrix of the soil (soil minerals), that is, what is under the soil. Changes in the external factors of soil formation (temperature and precipitation) lead to the transformation of internal factors (energy, hydrological, biological).
Climate change increases the destructive energy of soil minerals leading to simplification of the mineral matrix due to the accumulation of weathering minerals, will lead to loss of the soil function to maintain fertility and increase dependence on mineral fertilizers.
Soil development is broadly controlled by three major factors, namely climate, indigenous material and type of vegetation.
The effects of climate change on soil development are projected mainly through a change in soil moisture conditions and an increase in soil temperature and carbon dioxide levels.
Climate affects soil moisture levels through direct climate influences (precipitation, temperature effects on evapotranspiration), climate-induced changes in vegetation cover, plant growth rates, rates of soil water extraction by plants and the effect of enhanced carbon dioxide levels on plant transpiration. Changes in soil water fluxes may also drive climate itself and may contribute to drought conditions by reducing available moisture, altering circulation patterns, and increasing air temperatures, among the various factors that control the soil development process.
Climate factors such as humidity, temperature, and carbon dioxide have variable effects on soil processes and their various properties related to soil fertility and productivity. These effects of climate change factors cannot be viewed separately, because one factor affects the other and the resulting effect is complex.

2. Literature Review :

1- A study (Ali Hussein Al-Bayati, Hussein Zaidan Ali, Ali Muhammad Raji) on the effect of soil erosion on the natural vegetation cover in the eastern Razzaza region, where the study concluded that the results of erosion are the results of predicting erosion at 89.5, 92.9, and 100.0 Meg. ha 1. year -1 at site 1, 2 and 3 respectively, indicating the presence of severe erosion in the area with an average of 94.1 Mb. Hectare 1. The first year, because the higher proportion of fine sand and silt is also poor soil structure, in addition to the prevailing dry climate with fast winds and poor vegetation cover, all these factors have a clear effect in increasing the amount of erosion in the studied sites. At site 1 perennial species reached 70% compared to annual species 30%, the highest percentage in perennial species was 21.7% for Haloxybn salicornicum Boiss but for annual species 9.9% was recorded for Diplotax harra Boiss, second site 2 both species Perennial and annual species showed a similar percentage of 50%, the highest percentage of perennial species recorded for Atriplex halimus L. and Haloxybn salicornicum Boiss 12.9%, however, the annual species Neotorularia torulesa Hedge showed the highest percentage of 6.45%, while in 3 locations perennial species accounted for 40% compared to species The annual which accounted for 60% Haloxybn salicornicum Boiss had the highest incidence of 7.5% but the annual species showed Neotorularia torulesa dominant hedge of 7.5%.
2- A study (Thaer Mudhar Fahmy, Hala Muhammad Abd al-Rahman, Zainab Damad Hassan) using the digital classification to follow up the change of the detection of Al-Razzazah Sabkha for the period (1976-2013), where the study found The use satellite image (Raw Data), Landsat 30M Mss for the year 1976 Landsat 7 ETM, and the Landsat 8 for year 2013 (LDCM) for the summer Landsat Data Continuity Mission and perform geometric correction, enhancements, and subset image And a visual analysis Space visuals based on the analysis of spectral fingerprints earth's This study has shown that the best in the discrimination of Sebkha Remote sensing techniques and Geographic information system (GIS) proved the efficiency in determining the spatial distribution of the crust of salt sebkha and arable soil moisture content by different visual interpretation and advanced digital classification (statistical), Then the expense of space, time and conduct analysis and matching process conducted between the years of study in geographic information systems program after the application of water guide NDWI using a statistical formula To isolate the Pixels to extract water only own, to determine the change in the water area during the period of study to demonstrate the impact on the spread of salt in Sebkha besides the salinity and poor amount of water surface and slow flow, climatic conditions suitable for the occurrence of the area under investigation, within the dry and semi-dry climate, which is characterized by high temperatures and lack of precipitation that cause increased evaporation from water bodies and in low land areas, in addition to the role of human factors of agricultural, industrial and urban activities. And analysis of the positive and negative of basic elements and heavy elements of surface and ground water was performed, besides the soil with regard.
3- A study (Mortada Jalil Ibrahim, Muhammad Muslim Awaid) of some of the physical and chemical properties of the soil affecting the failure of the gapyun lining and its performance level, as the study concluded that physical and chemical properties have significant effect on the failure of Gapyun. The result of mechanical analysis significant effect at 0.01 level for two percent Silt and Clay Composed with sand percentage, when we analyzed that data by Randomized Complete Block Design (RCBD) as well as Duncans test. Either chemical properties which clacked for determinations meq / 100 gram soil, meq / L and the later as percentage, indicate that Gapyun failure was affected by Cation exchange Capacity CEC, Electric Conductivity EC, exchangeable sodium ion, available sodium ion and exchangeable potassium ion for tow level 0.01, 0.05, which are compared

with HCO3 and Soil - PH that haven't any significant effect. These results were reached by the same analysis (CRBD) and Duncans test.

3. Methodology First: The problem of the study: -

The research problem can be formulated as follows ((Does climate have an effect on the physical properties of the soil of the shoulders of the Al-Razzaza Lake Depression?))

Second: The hypothesis of the study: -

Since the main study problem was ((the effect of climate on the physical properties of the soil of the shoulders of the lake of Razzaza depression)), a main hypothesis was developed in contrast to the main problem represented by ((the effect of climate on the physical properties of the soil of the shoulders of the depression of Lake Razzaza)), especially during the winter and summer seasons .

Third: The boundaries of the study area: -

Al-Razzaza Lake is located astronomically between latitudes (32.30°- -33.10°) minutes north and longitude (20, 43° - -50, 43°) minutes east. Map (1) where it is located in the northwestern part of Karbala Governorate, and is bordered to the north by Lake Habbaniyah, while Anbar Governorate is bounded from the west, east and south by the lands of the city of Karbala and Al-Hussainiya, and the Northern Badia plateau is bounded by it from the west.

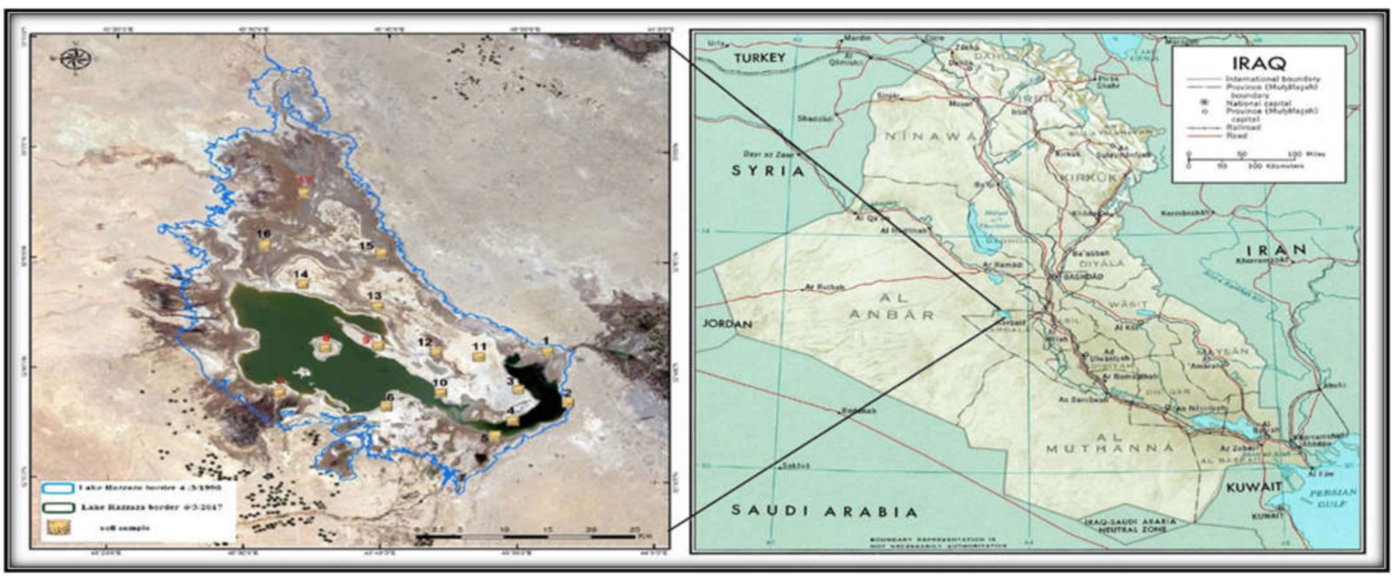
The total area of the Al-Razzaza Lake depression is estimated at 1584.34 km2, while the area of the shoulders soil surrounding the waters of the Al-Razzaza Lake, which appeared after the lake's water receded, is estimated at 1,315,515 km2, which is the subject of the researcher's study.

The study is determined chronologically by examining the impact of climate on changing the physical properties of the soil of the shoulders of the Razzaza Lake depression for the year 2019, while the climatic data were for a major climatic cycle from the year (1990 - 2019), that is, for a period of 30 years.

Objectively, it is represented in the study of climatic characteristics and their impact on changing the physical properties of the soil of the shoulders of the Al-Razzaza Lake depression.

map (1)

The astronomical and geographical location of the boundaries of the study area



Source / researcher's work based on satellite imagery (1990 and 2017) captured by Landsat 8.7 and software outputs (Arc GIs 10.3).

Fourth: Objective of the study:

The study aimed to identify the climatic characteristics in the study area and its relationship to the challenging variations that occur in changing the physical properties of the soil of the shoulders of the Al-Razzaza Lake depression.

Fifth: Study Methodology:

In order to achieve the objectives of the study, the researcher followed the descriptive approach and the analytical approach that was used in analyzing the climatic data of the elements of the climate, analyzing the physical and properties of the soil and explaining its causes, and linking all this to the climatic characteristics and their impact on changing the physical characteristics of the shoulders of the Razzaza Lake depression.

Sixth: The structure of the study:

The study included three sections, as the first topic dealt with the theoretical framework, as it included the problem of the study, its hypothesis, the boundaries of the region, the study's objective, methodology and structure of the study, while the second topic came to show the climatic characteristics of the study area. and a list of sources. :

This section should contain detailed information about the procedures and steps followed. It can be divided into subsections if several methods are described.

5. Conclusion :

1- It was shown through the results of measuring the temperature of the soil of the shoulders of the Al-Razzaza lake at a depth of (30) cm that its seasonal rates ranged between (111,1) m̊ as a minimum during the winter season in sample (1) and up to (12,83) m̊ A maximum in a sample (12) during the summer.

2- The soil textures of the shoulders of the Al-Razzaza Lake depression ranged during the summer season between sandy alluvium in sample (1), where the percentage of sand particles reached (89%), clay (4%) and silt (7%), while the soil texture in the sample was (12) It has a clay texture, where soil particles formed % sand, 58% clay, and 22% green. During the summer, there was a slight change in the percentage of soil particles, as it was sandy alluvial texture, and the percentage of soil particles reached 88.1% sand and 4, 7% clay and 7.2% green in sample (1), while in sample (12) the soil texture was also clay, and the proportion of soil particles was 19.2% sand, 58.8% clay and 22% green.

3- Bulk density in soil samples of the shoulders of the lowlands of Al-Razzaza Lake ranged from its lowest value to (1.36) g/cm3 in sample (12) and to (1.58) g/cm3 as maximum in sample (1), respectively during Winter season, while during summer it ranged (1,331) g/cm3 in sample (1) as a minimum, while it reached about (1,547) g/cm3 (12) as a maximum.

4- It showed through the analysis of the real density of the soil of the shoulders of the depression of Lake Al-Razzaza that its values ranged between (2.61) g/cm3 in sample (1) as a maximum and (2,659) g/cm3 in sample (12) as a maximum on respectively during the winter season, while their values ranged during the summer between (2,628) g/cm3 as a minimum in sample (1) and (2,678) g/cm3 as a maximum in sample (12).

5- The porosity of the soil of the shoulders of the Al-Razzaza Lake depression ranged between its lowest during the winter season, as its values reached (39.464%) as a minimum and (47.853%) as a maximum, respectively, in sample (1) and (12), but during the season In summer, the porosity values increase to reach (41,134%) as a minimum and (50.299%) as a maximum, respectively, in sample (1) and (12).

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10 researcher's work based on satellite imagery (1990 and 2017) captured by Landsat 8.7 and software outputs (Arc GIs 10.3).

11- Ministry of Transport and Communications, General Authority for Meteorology and Seismic Monitoring, Climate Section, unpublished data.

12- field study on 30/1/2017 and 20/8/2019.

13- The results of laboratory analyzes of samples of low shoulder soil and sediment from the bottom of Al-Razzaza Lake in the laboratories of the Ministry of Science and Technology.

The second topic

Climatic characteristics of the study area

Climate is one of the main phenomena of natural ecosystems, whether aquatic or terrestrial ecosystems of any region. And wind, atmospheric pressure, relative humidity, rain and evaporation, which reflect important environmental implications and in the creation of dry and semi-arid environmental features in the study area. In order to complete this, a major climatic cycle was chosen from 1990 to 2019 and the Karbala Climate Station was selected as shown in Table (1) the location of the study area station for longitude and circles. Width and altitude above sea level.

Table (1)

The location of Karbala station according to the antenna number, longitude, latitude and altitude

T	Station	Antenna number	Coordinate location		Altitude above sea level / m
			Latitude / north / degree	Longitude / East / Degree	
1	Karbala	656	32,34°	44,03°	25

First: Solar Radiation

A- Theoretical sunshine hours:

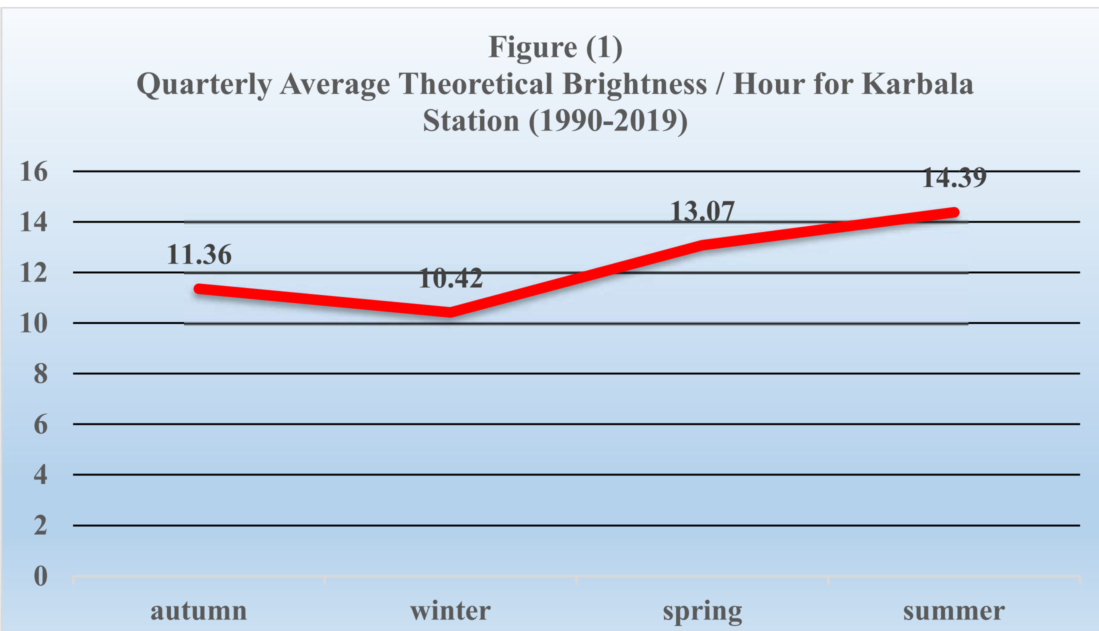
It is shown in Table (2) and Figure (1) that the theoretical average brightness of Karbala station varied temporarily in the study station, where the average rate during the autumn was about (11.36) hours and then the rates start to decrease gradually in the beginning of winter. The lowest seasonal mean number of hours of theoretical solar brightness was recorded during the period (1990-2019) as shown in Table (2). The average quarterly rate dropped to (10.42) hours, then these rates start to increase gradually during the spring to about (13.07) hours. During the summer, the station of the study area records the highest quarterly rates of brightness hours as shown in Figure (1). It reached about (14.39) hours.

Table (2)

Quarterly Brightness Ratio / Hour for Karbala Station (1990-2019)

autumn	winter	spring	summer	annual rate
11.36	10.42	13.07	14.39	12.31

Source: Ministry of Transport and Communications, General Authority for Meteorology and Seismic Monitoring, Climate Section, unpublished data.



Source // Based on Table (2).

B - Hours of actual sun brightness: -

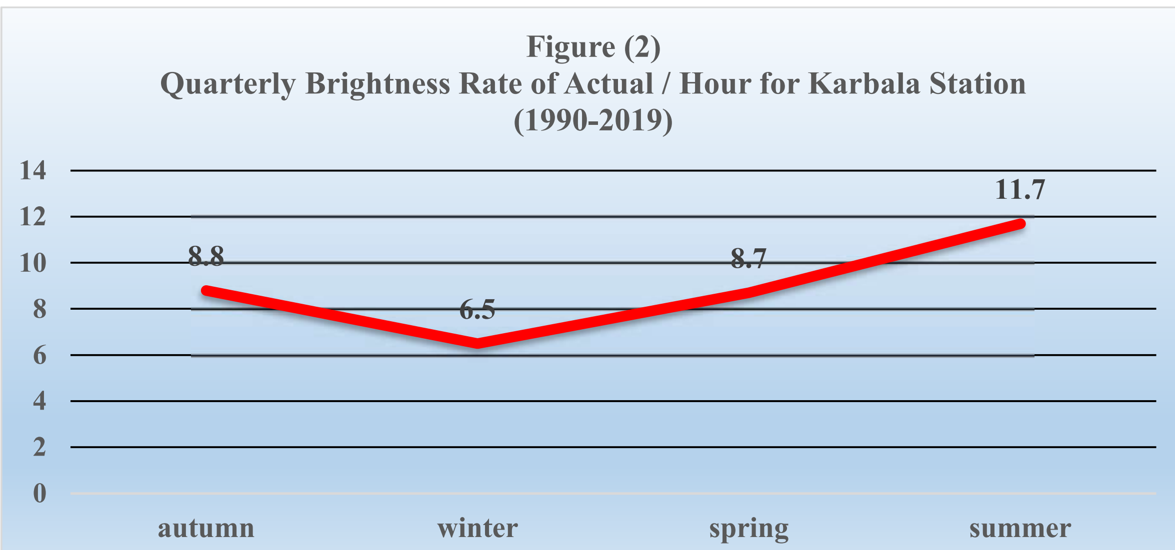
It is clear from Table (3) that the average and quarterly rates of actual solar brightness varies in the station area throughout the seasons. During the winter months as these rates reach the lowest quarterly average number of hours of actual solar brightness, where it decreased by (6.5) hours.

Table (3)

Annual and annual average brightness / hour of Karbala station for the period (1990-2019)

autumn	winter	spring	summer	annual rate
8.8	6.5	8.7	11.7	8.9

Source: Ministry of Transport and Communications, General Authority for Meteorology and Seismic Monitoring, Climate Section, unpublished data.



Source // Based on Table (3).

Then, the actual number of hours starts to rise towards the spring season, where the average quarterly rate during this season was around (8.7) hours. The actual hours of solar brightness continue to increase during the summer to reach a peak of about (11.7) hours. The study reached (8.9) hours.

C - the amount of solar radiation: -

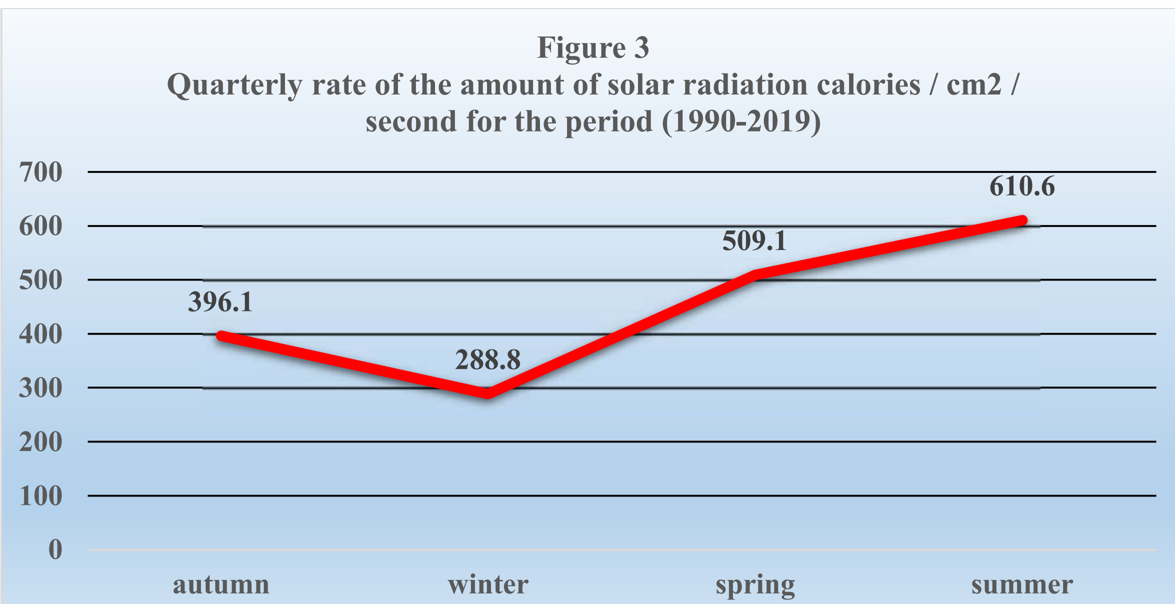
As shown in Table (4) and Figure (3) that the quarterly rates of the amount of solar radiation vary during the seasons of the study, with a quarterly rate of the amount of solar radiation during the fall of about (396.1) calories / cm 2 / second, and continue to gradually decrease the amount of solar radiation To reach the lowest amount during the winter, as the quarterly average reached (288.8) calories / cm 2 / second, which is the lowest quarterly rate of the amount of solar radiation during the seasons of the study period, and then start the quarterly rates gradually rising during the spring as it reached 509.1) calories / cm2 / s, and it is shown in Figure (3) that the quarterly rates reach a peak during Summer, as the quarterly average has reached the limits of (610.6) kcal / cm 2 / s, the highest quarterly rate for the amount of solar radiation during the duration of the study classes, while the annual rate was up to (451.2) kcal / cm 2 / sec.

Table (4)

Quarterly and annual rate of the amount of solar radiation calories / cm 2 / second for the period (1990-2019)

autumn	winter	spring	summer	annual rate
396.1	288.8	509.1	610.6	451.2

. Source: Ministry of Transport and Communications, General Authority for Meteorology and Seismic Monitoring, Climate Section, unpublished data.



Source // Based on Table (4).

Second: Temperature:

A- Temperature Range:

It is shown in Table (5) that the seasonal rates of temperature start to decrease gradually during the fall season, where the average temperature reached about 25.37 ° C, then these rates drop to the lowest during the winter, where the lowest quarterly rate was about (11.96) ° C. The rates continued to rise gradually during the spring season reaching about (16.16) ° C, and the rates continue to increase until it reaches its peak, reaching (36.09) ° C as shown in Figure (4), as for the annual average temperature in and as shown in the table. 15) It reached the limits of (24.4) ° C.

B- Maximum average temperature:

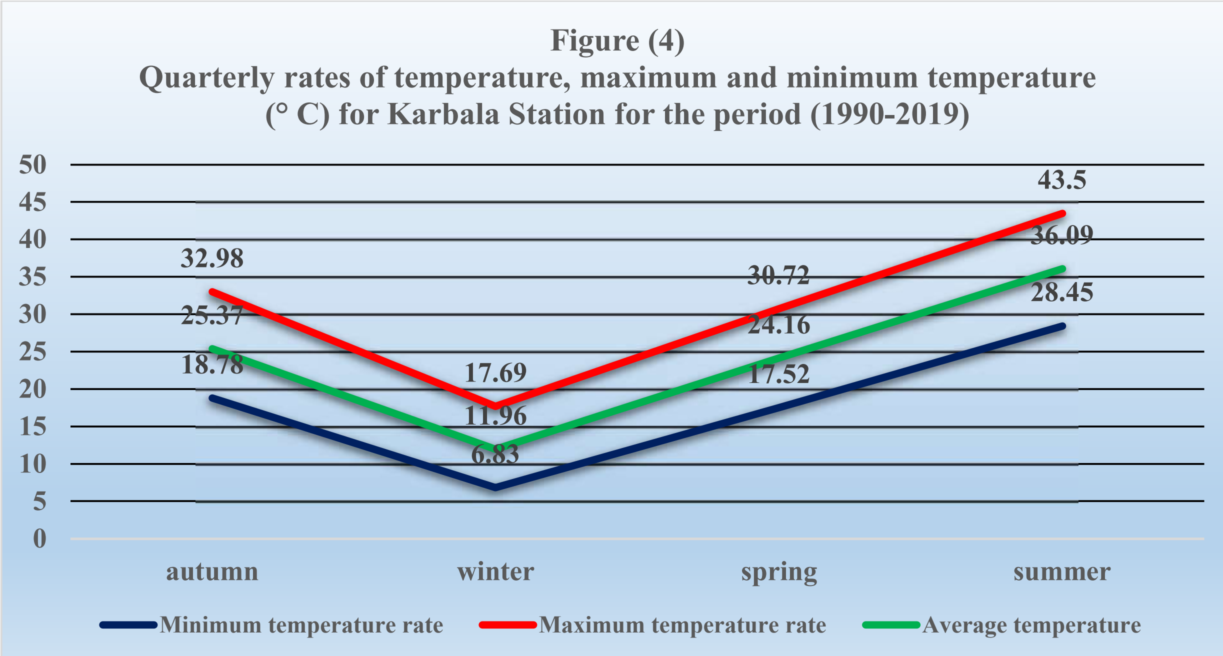
Table (5) shows the variation of the maximum average temperature in the study station, where the rates start to decrease gradually during the fall season in Karbala Station as shown in Figure (4). The gradual rates of progress during the winter are reduced to (17.69) ° C and the rates gradually increase with the progress during the spring and as shown in Figure (4) as it reaches about (30.72° C and reach the peak during the summer as (43.5) ° C, As for the annual average maximum temperature in the study area plant as shown in Table (5) The annual rate is (31.22) ° C.

Table (5)

Quarterly rates and annual average temperature, maximum and minimum temperature (° C) for Karbala Station for the period (1990-2019)

season	Average temperature	Maximum temperature rate	Minimum temperature rate
autumn	25.37	32.98	18.78
winter	11.96	17.69	6.83
spring	24.16	30.72	17.52
summer	36.09	43.5	28.45
annual rate	24.4	31.22	17.9

Source: Ministry of Transport and Communications, General Authority for Meteorology and Seismic Monitoring, Climate Section, unpublished data.



Source // Based on Table (5)

C- Minimum Temperature:

It is shown in Table (5) that the seasonal rates of the minimum temperature in the station of the study area are temporarily varied, and that the rates drop to the minimum temperature during the fall and fall to (18.78)̊ . It is shown in Figure (4) that the low rates continue until they reach the lowest during the season. Winter, which decreases to about (6.83) ° C, which is the lowest quarterly rate during the seasons of the study period, then these rates gradually increase with progress during the spring, rising to about (17.52) m, while it is shown in Figure (4) that the rates peak in progress during The summer season, where the quarterly average reached (28.45) ° C, the annual rate as shown in Table (5) It reached about (17.9) ° C.

Third: Atmospheric pressure: -

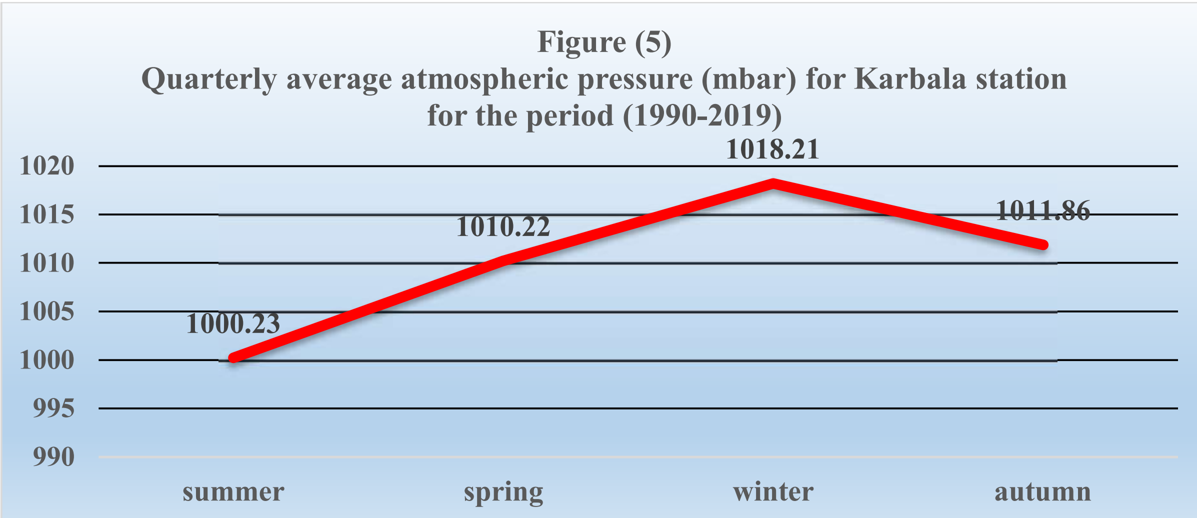
It can be seen from Table (6) that the average atmospheric pressure varies temporarily in the station area, where the rates increase gradually during the fall season as shown in Figure (5) to about (1011.86) mbar and these rates continue to rise gradually during the winter. As shown in Table (6), it rises to reach (1018.21) mbar, then the rates begin to gradually decrease during the spring to about (1010.22) mbar and continue to decline rates of atmospheric pressure until it reaches the lowest during the summer, where it reaches about (1000.23) mbar, As for the annual rate of atmospheric pressure in the study area and station As shown in Table (6), the annual rate is about (1010.13) mbar.

Table (6)

Quarterly and annual average atmospheric pressure (mbar) for Karbala station for the period (1990-2019)

autumn	winter	spring	summer	annual rate
1011.86	1018.21	1010.22	1000.23	1010.13

Source: Ministry of Transport and Communications, General Authority for Meteorology and Seismic Monitoring, Climate Section, unpublished data.



Source // Based on Table (6).

Fourth: Wind: -

To determine the impact of wind on the study area we will focus on wind speed and direction.

1. Wind speed:

As shown in Table (7), the average wind speed varies temporarily in the station area, where the rates gradually decrease during the fall season, as shown in Figure (6) to about (2) m / s and continue to decrease these rates during the winter. The minimum wind speed is about 2.2 m / s. Figure (6) shows that the rates start to rise gradually during the spring to reach (3.1) m / s and the rates of wind speed peak during the summer reached about (3.7) m / s which represents the maximum wind speed during the study period. The annual rate of wind speed reached about (2.7) m / s.

Table (7)

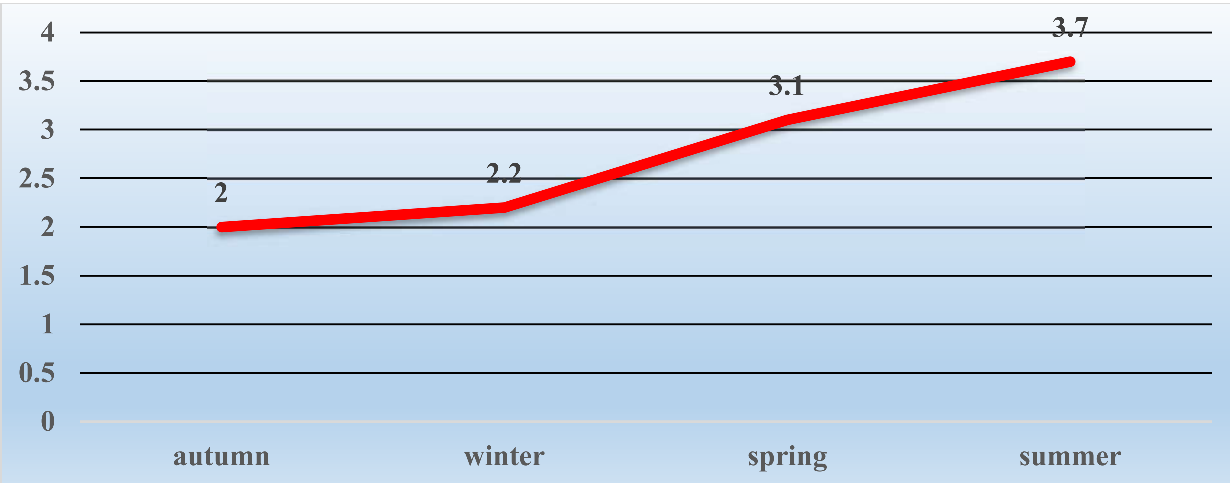
Quarterly and annual rate of wind speed (m / s) for Karbala station for the period (1990-2019)

autumn	winter	spring	summer	annual rate
2	2.2	3.1	3.7	2.7

Source: Ministry of Transport and Communications, General Authority for Meteorology and Seismic Monitoring, Climate Section, unpublished data.

Figure (6)

Quarterly Average Wind Speed (m / s) of Karbala Station for the Period (1990-2019)



Source // Based on Table (7).

2. Wind direction:

Table (8) and Figure (7) show that the percentages of the frequency of the prevailing wind direction prevail over the study area, as it shows that the wind is not characterized by its stability, but shows that the study area is exposed to multiple types of winds as the percentage of the direction of the south winds about (3.12%). The percentage of the frequency of the direction of the south-east winds was about (4.83%). These winds are considered to be warm. They blow from the hot and dry desert areas and cause the temperature to rise during the study area. (2.65%) while the The direction of the north-east winds was 2.88%. The western wind direction was the lowest in the study area. It decreased to about 12.37%. These winds blew from the subtropical high to the semi-polar low and descend from the strange plateau towards the study area. While the proportion of the direction of the south-west winds to about (2.08%) and the ratio of the direction of the north winds to about (14.92%), which is considered as the highest percentage of the frequency of prevailing winds and the north-west winds by about (18.62%), while the general rate of sleep rate was about (38.53%).

Table (8)

Percentage of prevailing wind direction repetition rate for Karbala station for the period (1990-2019)

Stillness	North West	West	Southwest	South	Southeast	east	Northeast	North
38.53	18.62	12.37	2.08	3.12	4.83	2.65	2.88	14.92

Source // Ministry of Transport, General Authority for Meteorology and Seismic Monitoring, Climate Section, unpublished data.

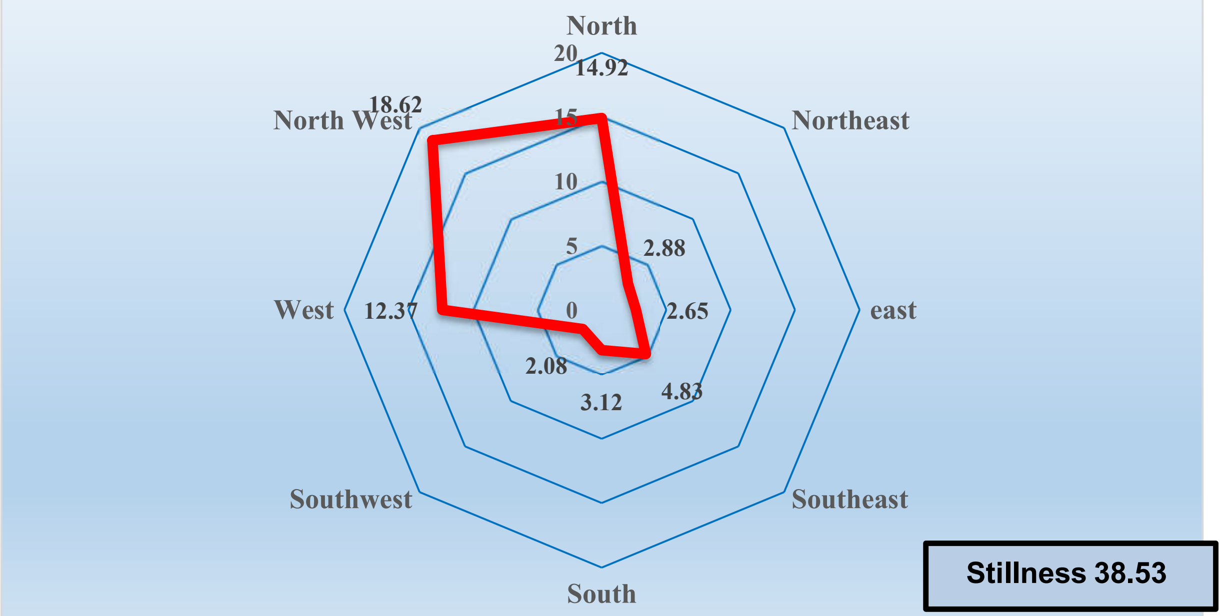


Figure 7
Percentages of prevailing wind direction and stillness in Karbala station for the period (1990-2019)

Source // Based on Table (8).

Fifth: Relative Humidity: -

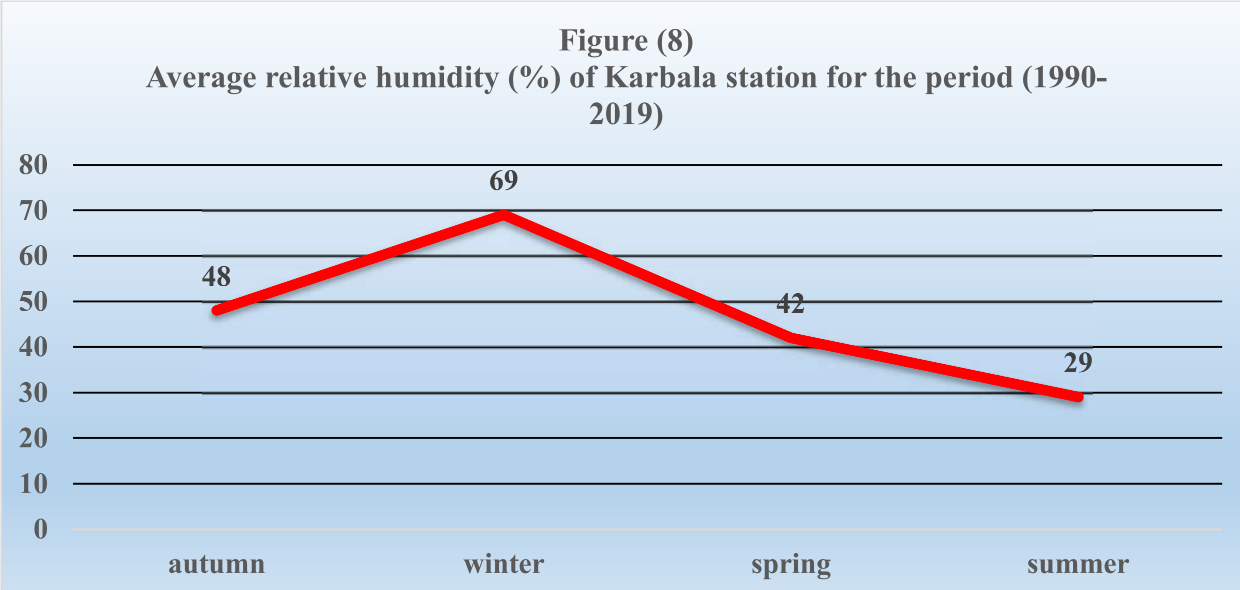
Table (9) shows that the average relative humidity rates vary temporarily in the study area station. These rates increase gradually during the fall to reach (48%) and it is shown in Figure (8) that the seasonal rates peak during the winter in the study area station. It increases to about (69%) and then the relative humidity gradually decreases with the progress during the spring season as it reaches (42), and the rates of relative humidity during the summer are below as it decreases to about (29), while the annual rate is about (47) %).

Table (9)

Average annual and relative humidity (%) of Karbala station for the period (1990-2019)

autumn	winter	spring	summer	annual rate
48	69	42	29	47

Source: Ministry of Transport and Communications, General Authority for Meteorology and Seismic Monitoring, Department of Water Meaning, unpublished data.



Source // Based on Table (9).

Sixth: Rain: -

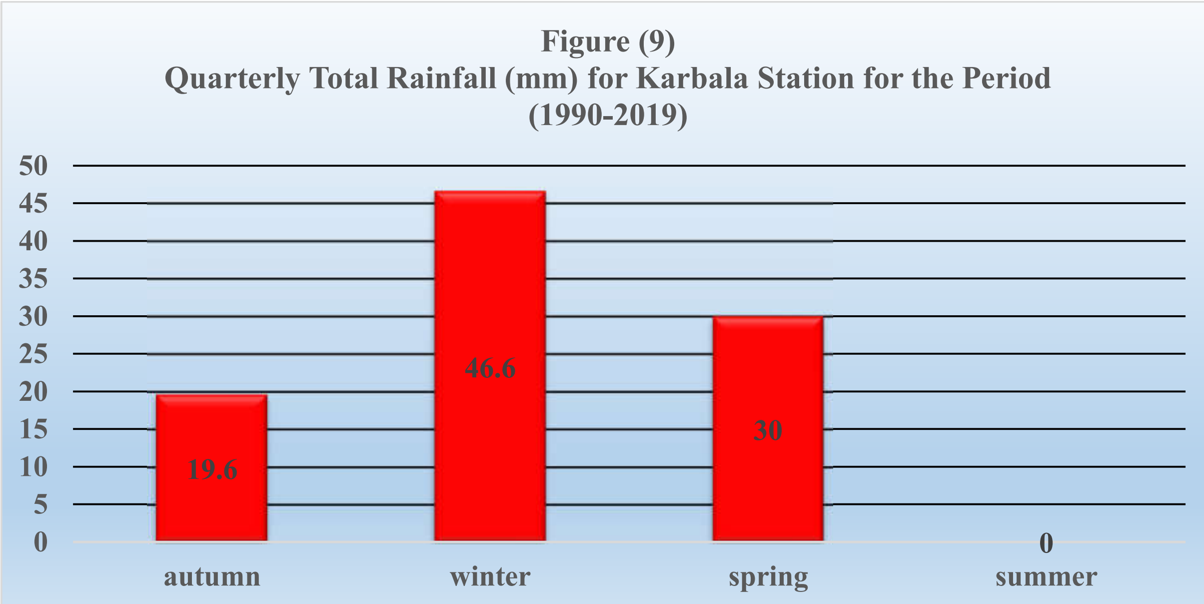
Table (10) shows that the average total amount of rainfall (mm) quarterly varies during the seasons of the study period as the total total amount of rainfall (mm) in Karbala station is about (96) mm, and the totals gradually increase progress during the fall to about (19.6) mm, and continue to rise the totals of rainfall in the station study area during the winter, where it is noted from Figure (20) that the highest quarterly total rainfall recorded by the station study area in the winter as it rises to about (46.6) mm, either during the spring Start down to about (30) mm during this chapter and can be seen from Table (10) and Figure (9) that the quarterly total of Rainfall falls during the summer.

Table (10)

Quarterly and Annual Total Rainfall (mm) for Karbala Station for the Period (1990-2019)

autumn	winter	spring	summer	annual rate
19.6	46.6	30	0	96

Source // Ministry of Transport and Communications, General Authority for Meteorology and Seismic Monitoring, Department of Water Implications, unpublished data.



Source // Based on Table (10).

Seventh: Evaporation:

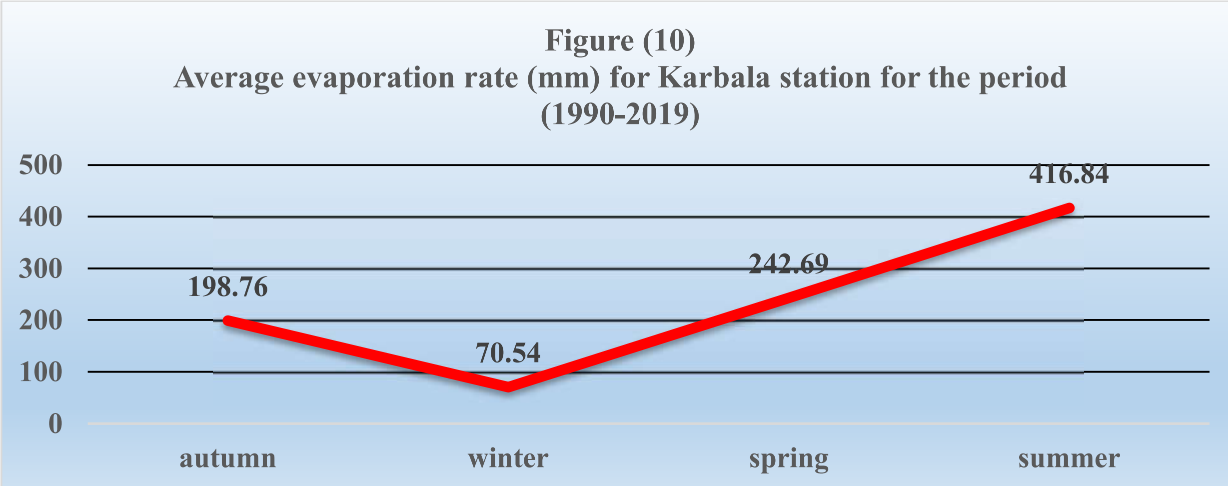
From Table (11), it is found that the seasonal evaporation rates vary temporarily in the station of the study area. The rates fall in the fall season as shown in Table (11) to (198.76) mm. Winter reached to the lowest during the period (1990-2019) as it reached the limit (70.54) mm, and then the rates start during the spring gradually rise compared to the winter to reach about (242.69) mm and shows from table (11) that the rates reach the peak during the season Summer in the study station station, as shown in Figure (10) as it rises to about (416.84) mm, as for the annual rate of evaporation in the station Of the study it emerges from the table (11) Faisal annual rate of evaporation in Karbala station to about (232.21) mm.

Table (11)

Quarterly rates and annual evaporation rate (mm) for Karbala plant for the period (1990-2019)

autumn	winter	spring	summer	annual rate
198.76	70.54	242.69	416.84	232.21

Source: Ministry of Transport and Communications, General Authority for Meteorology and Seismic Monitoring, Department of Water Meaning, unpublished data.



Source // Based on Table (11).

Some of the most important phenomena that affect the study area and that affect the ecosystem are:

1- Dust phenomena

These phenomena are attributes associated with the climate of arid and semi-arid regions, which are related to the moisture characteristics of the study area. Temperature, which affects the wind speed and instability, as well as increased daylight hours and increased heating capacity, which leads to severe currents causing these phenomena () These dust phenomena that are exposed to the study area can be classified into three categories Depending on the wind speed and the concentration of dust minutes and their source.

A- Dust storms:

Table (12) and Figure (11) show that the rates fall during the fall season, which is the lowest quarterly rate in the autumn, reaching about (0.42) days and rates gradually increase with progress during the winter months to reach (0.4) days and through the figure (11) It turns out that the average peak is in the spring to reach (1.86) days, and then the rates start to decline gradually during the summer as it reaches about (0.85) days, while the annual rate of dust storms from table (12) shows that the annual rate It reached about (0.88) days of dust storm.

Table 12

Annual and Annual Average of Dust Storms (Day) for Karbala Station (1990-2019)

autumn	winter	spring	summer	annual rate
0.42	0.4	1.86	0.85	0.88

Source: Ministry of Transport and Communications, General Authority for Meteorology and Seismic Monitoring, Climate Section, unpublished data.

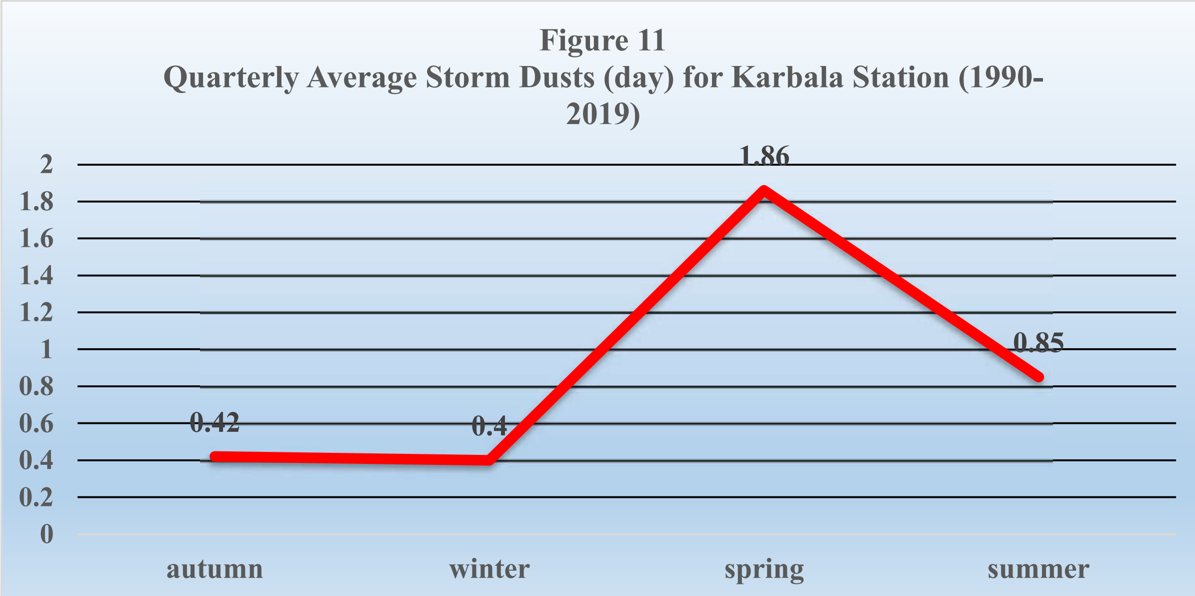


Figure 11
Quarterly Average Storm Dusts (day) for Karbala Station (1990-2019)

Source // Based on Table (11).

B- Suspended dust: -

The study area is exposed to the phenomenon of dust suspended due to the dryness of the region and the lack of rainfall and lack of vegetation and the abundance of sources of the formation of this type of dust from the surrounding areas such as Tharthar area, which lies north of Lake Razza The study would be susceptible to this type of lingering dust.

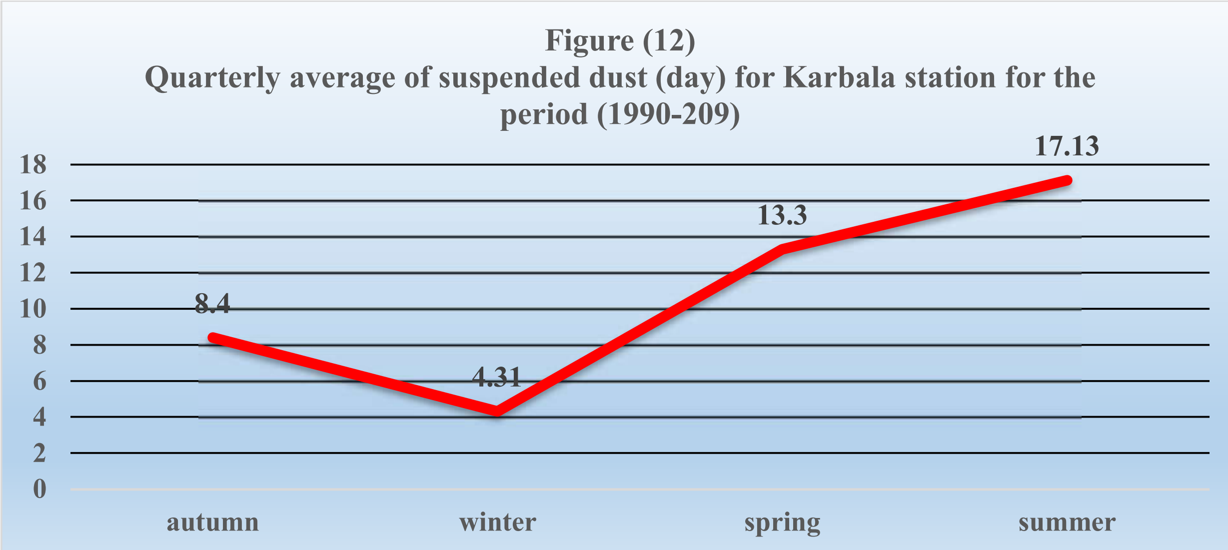
From the table (13) it is found that the seasonal rates of suspended dust rise in the

Table (13)

Quarterly and annual rate of suspended dust (day) for Karbala station for the period (1990-2019)

autumn	winter	spring	summer	annual rate
8.4	4.31	13.3	17.13	10.87

Source: Ministry of Transport, General Authority for Meteorology and Seismic Monitoring, Climate Section, unpublished data.



Source // Based on Table (13).

beginning of autumn, reaching about (8.4) days, and reach the lowest rates during the winter and as shown in Figure (12) as it is noted that these rates reach about (4.31) days The rates during the spring season gradually rise to about (13.3) days, and the peak rates of progress during the summer to reach (17.13) days, while it is shown in table (13) that the annual rate of suspended dust amounted to (10.87) days.

C- Dust mounting: -

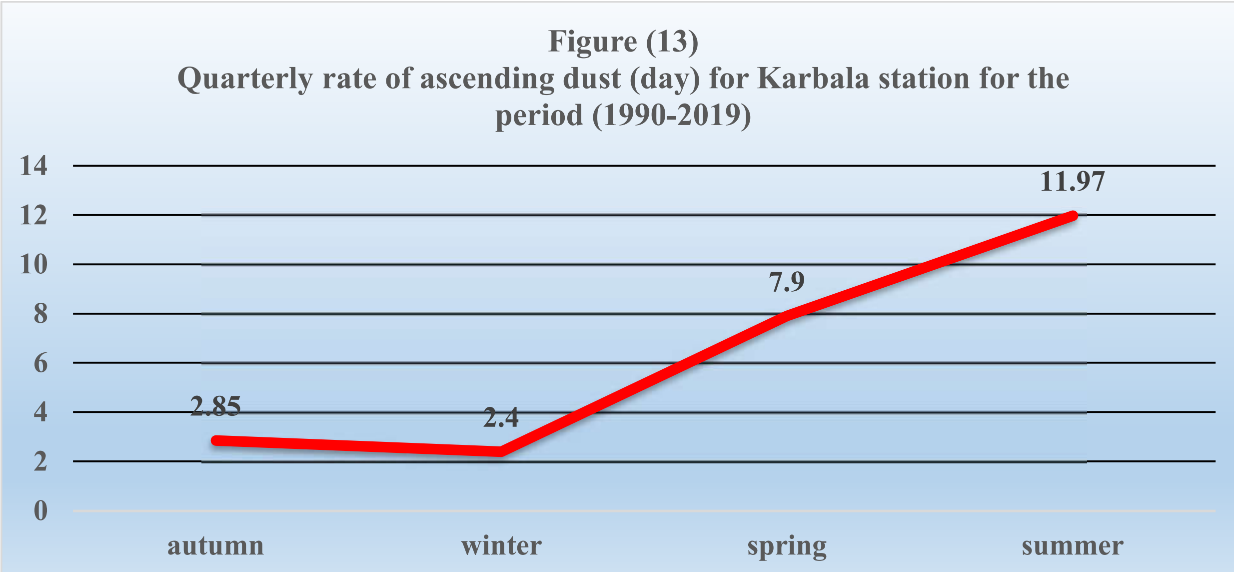
Table (14) shows that the seasonal rates of dust days vary in time in the study station. Figure (13) shows the gradual decrease in rates during the fall to about (2.93) days, and the rates fall in the winter to the lowest as shown in Figure (13) as it decreases to about (2.4) days, and the rates start to rise gradually during the spring to reach (7.9) days, and it is shown by Figure (13) that the quarterly rates reach their peak during the summer seasonal average of (11.97) days And from table (14) shows that the annual rate of days of dust rising in the station study area, amounted to (6.28) days.

Table (14)

Quarterly and annual rate of ascending dust (day) for Karbala station for the period (1990-2019)

autumn	winter	spring	summer	annual rate
2.85	2.4	7.9	11.97	6.28

Source: Ministry of Transport and Communications, General Authority for Meteorology and Seismic Monitoring, Climate Section, unpublished data.



Source // Based on Table (14).

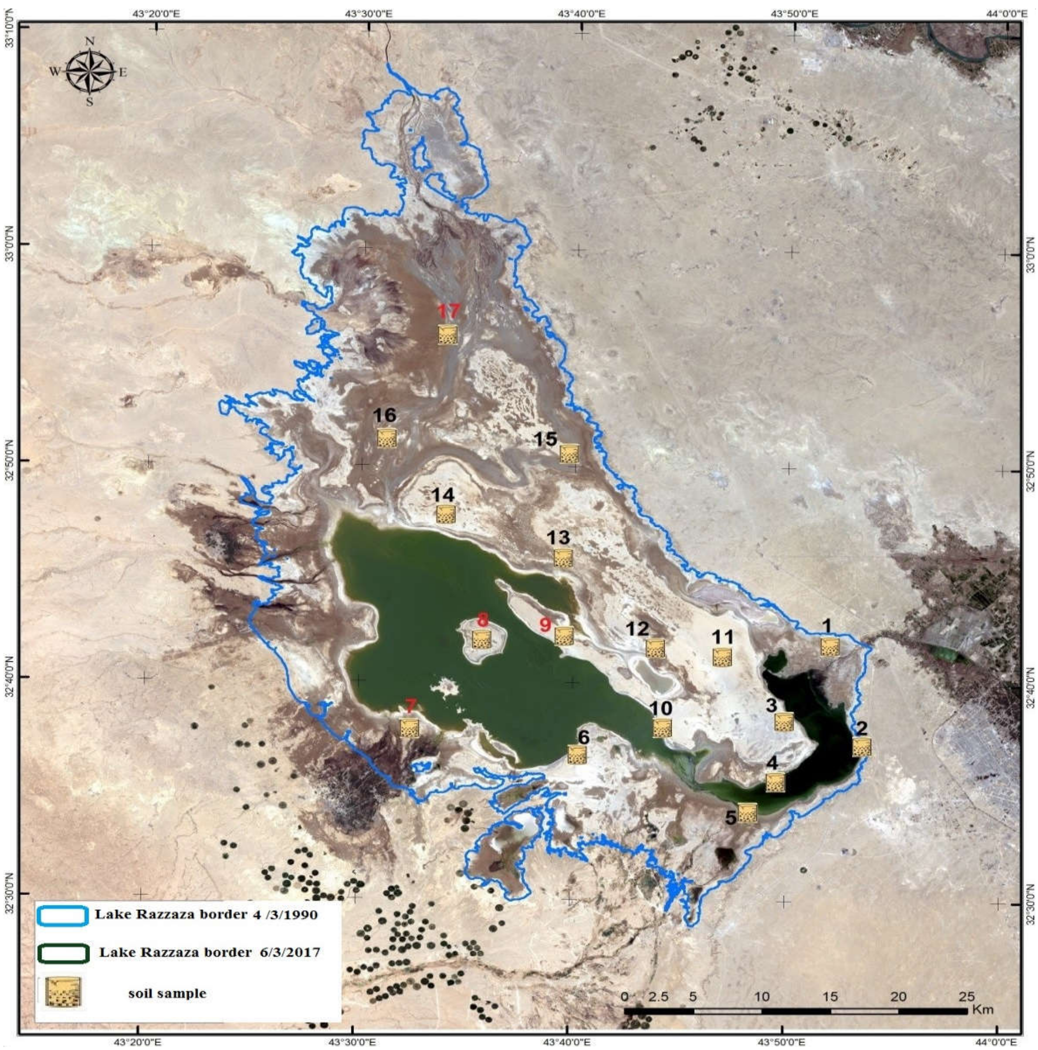
The third topic

Spatial and seasonal variation of the physical properties of the shoulders soil of Al-Razzaza Lake

This topic deals with the most important physical properties of the soil of the shoulders of the lake of Razzaza depression, whose characteristics were reached through the soil samples obtained from the sites shown in map (2), which shows the geographical distribution of the sites of soil samples of the shoulders of the depression of Lake Razzaza, which were taken at a depth of 30 .

Map (2)

Soil samples of the shoulders of Al-Razzaza Lake



Source / researcher's work based on satellite imagery (1990 and 2017) captured by Landsat 8.7 and software outputs (Arc GIs 10.3).

The following are the most important physical characteristics of the soil of the shoulders of the Al-Razzaza lake depression during the winter and summer seasons:

1- Soil temperature:

It is shown in Table (15) and Figure (14) that the temperature of the soil of the shoulders of the Razaza Lake depression ranged during the winter between (11.1) °C as a minimum in sample (1) and up to (12,83) °C as a maximum. Sample (12) during the month of January, but during the summer, it is clear from Table (15) and Figure (14) that the lowest temperature of soil samples reached (27.75) ° C in sample (1), while the highest A temperature of about (32,07) °C in a sample (12) in a row during the month of August.

Table (15)

Soil temperature (°C) for low-shoulder samples Lake Razzaza during the winter and summer seasons (2019)

Sample / Season	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
winter season	11.1	11.3	11.35	11.47	11.45	11.5	12	11.53	11.8	11.54	12.33	12.83	12.4	11.87	11.9	11.66	11.63
summer season	27.75	28.25	28.37	28.67	28.63	28.75	30	28.82	29.5	28.85	30.82	32.07	31	29.68	29.75	29.15	29.08

Source // field study on 30/1/2017 and 20/8/2019.

The reason for the decrease in the soil temperature in sample (1) compared to the soil temperature in sample (12) is due to the nature of the soil, because of the nature of the physical properties of the soil in sample (1), which is represented in the nature of its alluvial sandy texture, low moisture level and light color, which results in low conductivity Thermal ([1])The soil in (12) has a clay texture, which has high porosity and low permeability, which works to retain moisture. Therefore, its heat capacity increases by increasing its moisture compared to dry soil, and the presence of organic materials in it and its dark color, which leads to an increase in its absorption of solar radiation and a decrease in the amount of reflected rays by about 15 -20% While sandy soils, due to their physical properties, absorb the amount of solar radiation, so their reflectivity rises from 40-45 ([2])And because of the decrease in the amount of solar radiation during the winter season, which leads to a decrease in the air temperature, this caused a decrease in the temperature of the soil in sample (1) due to its inability to retain heat compared to sample (12).

2- Soil texture:-

It is shown in Table (16) and Figure (15) that the soil texture of the shoulders of the Al-Razzaza Lake depression ranged between that of alluvial sand in sample (1) during the winter season, as it constituted the proportion of sand particles (89%), clay (4%) and silt (7%).) and clay tissue in sample (12) in which the proportions of soil particles were (20% sand, 58% clay and 22% green,

During the summer, there was no great variation in soil texture from the winter season because its properties do not change much during one year, but rather require a longer period of time during which to be exposed to geological factors such as the occurrence of twists or fractures that change the composition of the soil or expose it to geomorphological processes represented in In (weathering, erosion and sedimentation) by water, wind or snow, as these factors have a weak effect in the study area represented in the shoulders of Al-Razzaza Lake, due to the small amount of rain that falls on the study area, which leads to a small change in its texture as well as the decrease and flatness of the study area Which reduces the processes of wind on erosion, transport and sedimentation, and thus the occurrence of slight changes in its texture. This can be seen from Table (16), as its textures ranged during the summer between alluvial sandy texture in sample (1) and soil particles formed (88.1% sand, 4.7% clay and 7.2% green) and clay textures in sample (12) The percentage of soil particles reached 19.2% of sand, 58.8% of clay, and 22% of green.

table (16)

The percentage of tissue% of the soil of the shoulders of Al-Razzaza Lake during the winter and summer seasons (2019)

T	sample number	Seasonal changes of winter in the shoulder soil samples of Al-Razzaza Lake				Seasonal changes of summer in the shoulder soil samples of Al-Razzaza Lake			
		sand %	Clay %	Green %	soil texture	sand %	Clay %	Green %	soil texture
1	1	89	4	7	sandy alluvial	88.1	4.7	7.2	sandy alluvial
2	2	54	16	30	sandy alluvial	53.4	16.5	30.1	sandy alluvial
3	3	54	18	28	sandy alluvial	53.2	18.6	28.2	sandy alluvial
4	4	28	20	52	Gregorian Celtic	27	21	52	Gregorian Celtic
5	5	30	17	53	Gregorian Celtic	29.1	17.7	53.2	Gregorian Celtic
6	6	40	21	39	placer	39.3	21.4	39.3	placer
7	7	32	24	44	placer	31.2	24.4	44.4	placer
8	8	40	30	30	alluvial clay	39.3	30.5	30.2	alluvial clay
9	9	28	24	48	alluvial clay	27.4	24.4	48.2	alluvial clay
10	10	31	33	36	alluvial clay	30.7	33.3	36	alluvial clay
11	11	26	51	23	clay	25.3	51.7	23	clay
12	12	20	58	22	clay	19.2	58.8	22	clay
13	13	34	35	31	alluvial clay	33.3	35.7	31	alluvial clay
14	14	36	24	40	placer	35.5	24.4	40.1	placer
15	15	34	34	32	alluvial clay	33.5	34.5	32	alluvial clay
16	16	30	32	38	alluvial clay	29.3	32.7	38	alluvial clay
17	17	22	32	46	alluvial clay	21.8	32.2	46	alluvial clay

Source // The results of laboratory analyzes of samples of low shoulder soil and sediment from the bottom of Al-Razzaza Lake in the laboratories of the Ministry of Science and Technology.

The reasons for these changes are due to rainfall during the winter season, which dissolves soil components such as clay and silt, thus removing them through rain erosion, while its effect on coarse soil components such as sand is little, which leads to a high percentage of sand and a decrease in the percentage of clay in sample (1) during winter season.

While the reason for the high percentage of clay in sample (1) and (12) during the summer is due to the high percentage of sand in addition to the increase in the amount of solar radiation, the angle of incidence of solar rays and the length of the day, which leads to a rise in the air temperature, which causes the dismantling of the soil and since the soil Rumaila has less moisture content than clay soil because of its increased permeability and lack of water retention, which leads to its disintegration, as there is an inverse relationship between the content of soft-textured soil (mud and silt) and its susceptibility to erosion due to its retention of moisture. On the contrary, sandy soils([3]).It is related to a direct relationship between the amount of sand it contains and its susceptibility to erosion, which leads to a decrease in its resistance to wind erosion due to its lack of cohesion and high permeability, which leads to a decrease in humidity([4])Table (17) shows the relationship between soil texture and wind speed m/s required for the movement of its grains.

table (17)

The relationship between soil texture and wind speed m/s required for the movement of its grains

T	Soil weaving	Wind speed m / s needed for its movement
1	Sandy	4-3
2	Light clay	5
3	Heavy clay	7-5,5

Source / Kazem Shinta Saad, Geography of Soil, first edition, Dar methodology for publication and distribution, Amman, 2017, p. 287.

Refer to Table (7) where it is noted that the wind speed during the summer ranges between (3.7 m / s), so its impact on sandy soils faster than alluvial clay soils in addition to the occurrence of dust storms and the content of dust particles suspended and rising which works Not to decrease the slurry in the sample (1) and (12) during the summer.

3. The bulk density of the soil

It is clear from Table (18) and Figure (16) that the bulk density of the soil of the low shoulders of LakeRazzazaranged during the winter between the lowest value of about **(**1.36) mcg / m 3 in a sample (12) and the limit of (1.58) mica In summer, it decreased to (1,331) mcg / m3 in sample (1) as a minimum and with a limit of (1,547) mcg / m3 (12) maximum.

The high porosity of soil in sample (1) and (12) during the summer is due to the nature of the soil texture and its percentage of sand, mud and silt particles, so the porosity of coarse sandy soil as shown in Table (16) is larger than soft soil containing Organic materials such as clay and alluvial soils have a large surface area, but their porosity is low and vice versa for clay and alluvial soils. Therefore, due to the high sand content in a sample (1) during winter, the bulk density of the soil increases when its density decreases slightly in the same sample during summer A little bit of sand While the increase in bulk density of the sample (12) during the winter is due to the low clay ratio slightly, while the reason for the low bulk density of the same sample during the summer is due to the increase of the proportion of slurry slightly.

Table (18)

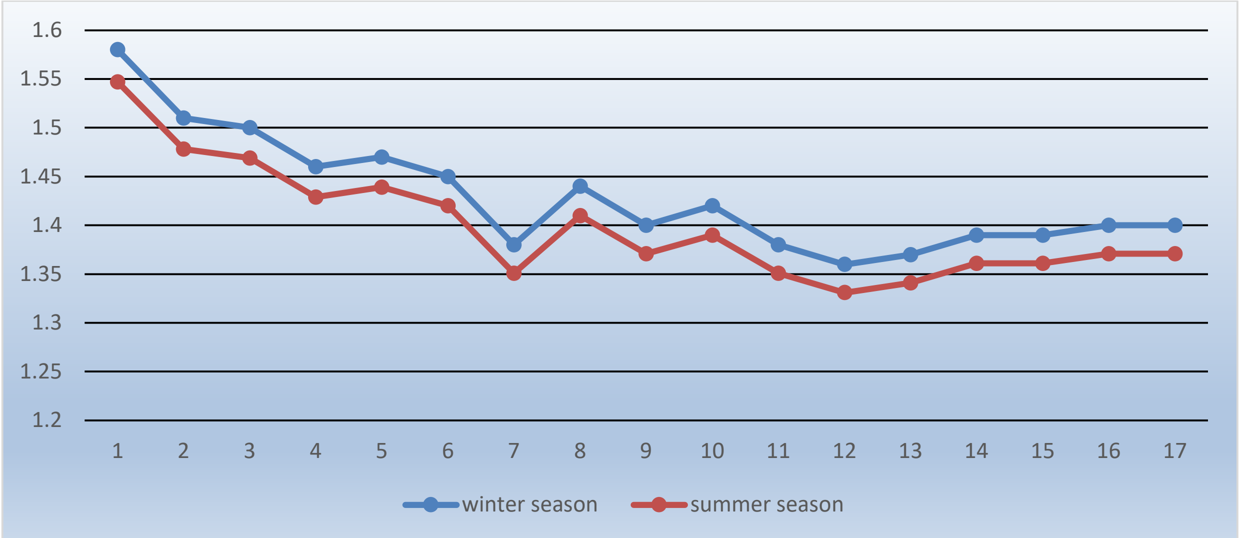
Bulk density values of mica g / m3 for soil samples of the low shoulders of Razaza Lake during the winter and summer seasons of 2019

Sample / Season	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
winter season	1.58	1.51	1.5	1.46	1.47	1.45	1.38	1.44	1.4	1.42	1.38	1.36	1.37	1.39	1.39	1.4	1.4
summer season	1.547	1.478	1.469	1.429	1.439	1.42	1.351	1.41	1.371	1.39	1.351	1.331	1.341	1.361	1.361	1.371	1.371

Source // Results of laboratory analyzes of low-soil soil samples of Razzaza Lake in Ministry of Science and Technology laboratories.

Figure (16)

Bulk density values of mica g / m3 for soil samples of low shoulders of Razaza Lake during the winter and summer seasons of 2019



4. Real density:

Table (19) and Figure (17) show that the actual density of soil shoulders of LakeRazzazaranged during the winter between (2,61) mcg / m 3 in a sample (1) and a maximum of (2,659) mcg / m3 in a sample During summer, the actual density values of the soil shoulders ranged between (2,628) mcg / m3 as a minimum in a sample (1) and a maximum of (2,678) mcg / m3 in a sample (12).

The reason for the low density of the soil shoulders of LakeRazzazain winter and its increase in summer in sample (1) and (12) is due to the change in the mineral composition of the soil, the high sand content and the low mud ratio in the sample (1) and (12) respectively during the season. Winter and low sand content and high clay content in sample (1) and (12), respectively during the summer, resulting in an increase in the concentration of minerals in clay soils during the summer and since the sandy soil is less retention of heavy metals of high quality weight such as Alkolin and dolomite and calcareous And increase in clay soils, resulting in increased density Virtual during the summer as the increase in the soil content of organic matter during the winter, especially in the surface layers works on low real density of minutes of organic matter, leading to a decline in real density Mqarndta lower layers in the soil (5) During the summer, due to high temperatures, part of these organic materials begin to decompose and the other part of the surface layers is removed by wind erosion, resulting in an increase in the soil mineral content, increasing its true density, and since most natural soils range between 2 and 2. (57-2.67) mcg / m3 and sometimes up to 2 mcg / m3(6) Therefore, the soil of the low shoulders of LakeRazzazawas within the natural limits according to its true density.

Table (19)

Real density values of mica g / m3 for low soil shoulders samples of Razaza Lake during the winter and summer seasons of 2019

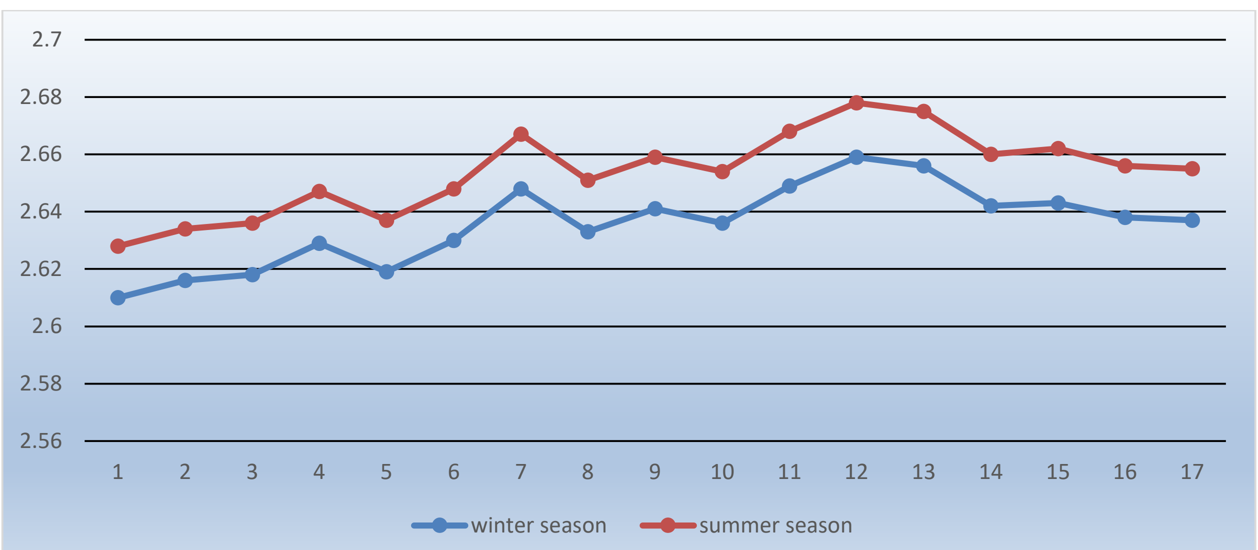
(5)Abdullah Naji Al-Ani, Principles of Soil Science, First Edition, College of Agriculture, Baghdad University, 1980, p. 73.
(6)Mr. Abdel Fattah El-Qasabi, Soil Mechanics, Scientific Books House for Publishing and Distribution, Cairo, Egypt, 2010, p. 40.

Sample / Season	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
winter season	2.61	2.616	2.618	2.629	2.619	2.63	2.648	2.633	2.641	2.636	2.649	2.659	2.656	2.642	2.643	2.638	2.637
summer season	2.628	2.634	2.636	2.647	2.637	2.648	2.667	2.651	2.659	2.654	2.668	2.678	2.675	2.66	2.662	2.656	2.655

Source // Results of laboratory analyzes of low-soil soil samples of Razzaza Lake in Ministry of Science and Technology laboratories.

Figure (17)

Real density values of mica g / m3 for low soil shoulders samples of Razaza Lake during the winter and summer seasons of 2019



5- Porosity: -

As shown in Table (20) and Figure (18), the porosity values of the soil of the low shoulders of LakeRazzazaranged between (39,464%) and a maximum of (48,853%), respectively in a sample (1) and (12) during the winter, During the summer, their pores ranged between (41,134%) as a minimum and the limits (50,299%) respectively in a sample (1) and (12).

Table (20)

Percentage of porosity% of low-shouldered soil samples of Lake Razzaza during the winter and summer seasons of (2019)

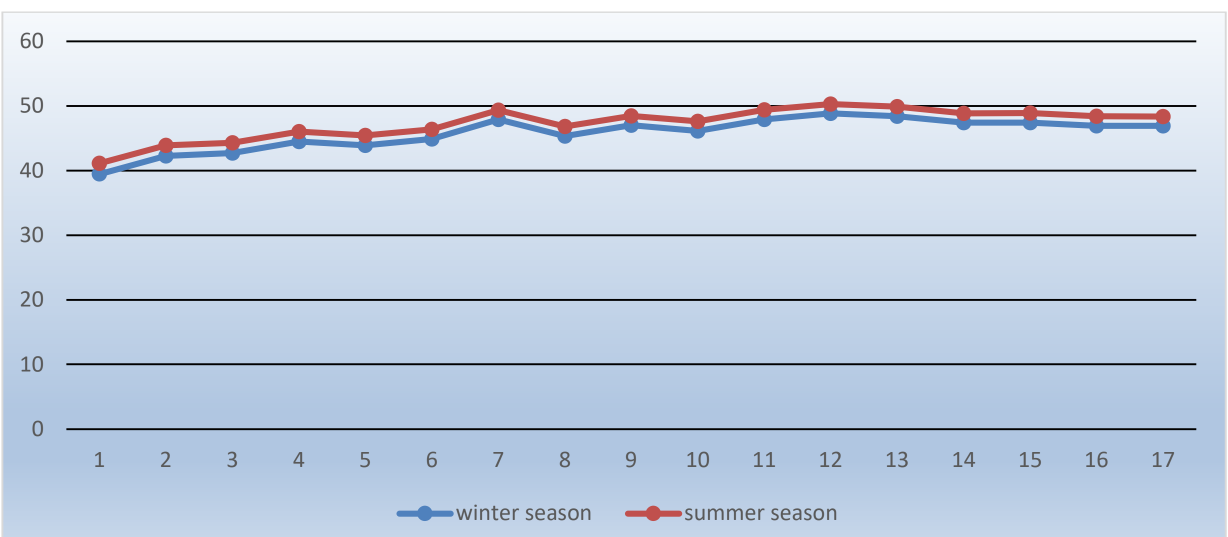
Sample / Season	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
winter season	39.464	42.278	42.704	44.466	43.872	44.867	47.885	45.31	46.99	46.131	47.905	48.853	48.419	47.388	47.408	46.929	46.909
summer season	41.134	43.888	44.272	46.014	45.43	46.375	49.344	46.813	48.439	47.626	49.363	50.299	49.869	48.835	48.873	48.381	48.362

Source // Results of laboratory analyzes of low-soil soil samples ofRazzazaLake in Ministry of Science and Technology laboratories.

The reason for the low soil porosity of the soil samples of low shoulders of LakeRazzazain sample (1) and (12) during the winter and high during the summer because of the nature of soil tissue and the content of soil content, which fills the distance between the parts of the soil, and because of a relationship Between the apparent density of the soil and its true density Since the bulk density of sandy soil is high during the winter and low during the summer in a sample (1) and be reversed the real density, which leads to reduced porosity in the winter because of the increase in the proportion of sand in the soil where the sand works because of large The size of its minutes compared to a These particles have a larger area, which reduces their porosity.

Figure 18

Percentage of porosity% of low-shouldered soil samples of Lake Razzaza during the winter and summer seasons of 2019



The harder the soil particles are, the less porosity and vice versa. Soil with soft tissue, such as clay and silty soils, decreases the porosity values in the sample (12) during winter with clay texture due to its raining. The increase of sand content in the soil, it is noted that during the summer increase the proportion of area in the sample (12) because of the low proportion of sand slightly during the removal by the winds remain muddy soil, which is coherent and the object of the study area of the occurrence of dust storms and the transfer of minutes of soft soil The porosity of the topsoil ranges between (35% - 50%), while the porosity of soft soil (mud and silt) ranges between (40-60%). (7) Thus, the soil of the shoulders and the content of the soil quality of tissue (sand, clay, silty and Celtic) within the natural limits of the soil.

6- Electrical connection EC.

Table (21) and Figure (19) show that the electrical conductivity values of the low shoulders soil ofRazzazaLake during the winter ranged from (5,25) decimens / m in a minimum sample (1) and up to (57,838) decimens / m In the sample (12) during the summer, the value was between (7,878) decimens / m minimum and the maximum (69,406) decimens / m maximum respectively in sample (1) and (12).

Table (21)

Electrical conductivity values of Decimens / m for low soil shoulders samples of Razaza Lake during the winter and summer seasons of 2019

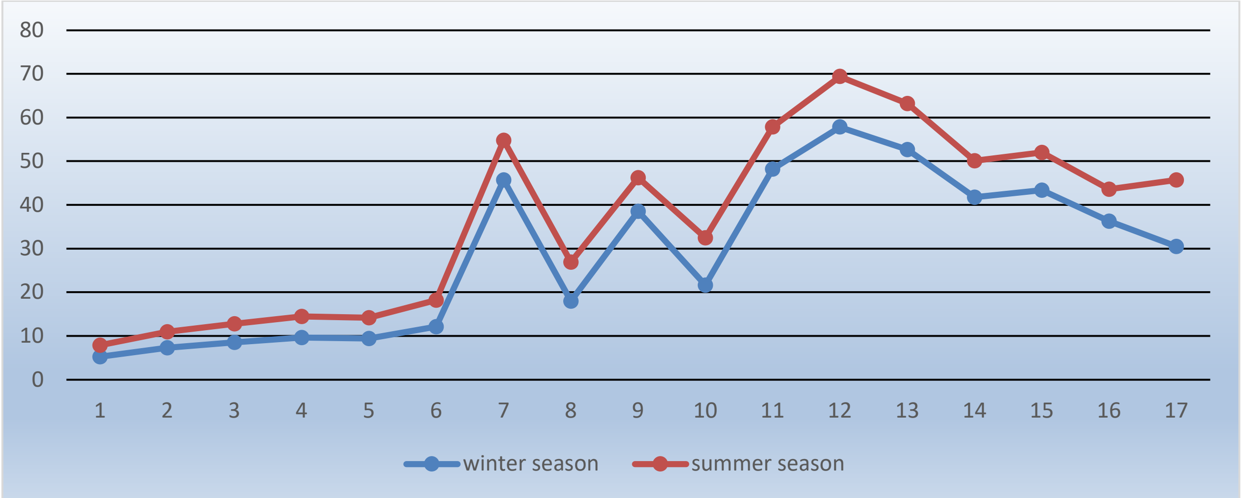
Sample / Season	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
winter season	5.25	7.311	8.498	9.643	9.428	12.113	45.675	17.948	38.54	21.637	48.213	57.838	52.663	41.773	43.356	36.304	30.482
summer season	7.878	10.969	12.75	14.467	14.147	18.171	54.809	26.926	46.249	32.458	57.858	69.406	63.197	50.129	52.028	43.563	45.727

Source // Results of laboratory analyzes of low-soil soil samples of Razzaza Lake in Ministry of Science and Technology laboratories.

Figure (19)

Electrical conductivity values of Decimens / m for low soil shoulders samples of Razaza Lake during the winter and summer seasons of 2019

(7) M.R.Carter and E.G.Gegorich, Soil Sampling and Methods of Analysis, Second Edition, Canadian Society of Soil Science, CRC Press, Taylor and Francis Group, LLC, U.S, 2007, P.751.



The reason for the low electrical conductivity values during the two seasons in sample (1) and high in sample (12) is due to the physical characteristics of the soil and the impact of climate, during the winter due to the decrease in the amount of solar radiation and the angle of the fall of solar radiation and short day length and low temperature and high humidity ratio and low amount of evaporation And rainfall, which reduces the value of the dissolved salts in the soil and because of the different physical characteristics between the soil of the shoulders in the sample (1) and (2) previously, which reduces the amount of dissolved salts in the sample (1) compared to the sample (12) and this works on Low electrical conductivity values For the winter, either during the summer and because of the increase in the amount of solar radiation and the angle of the fall of solar radiation and the length of day in the study area, which increases the temperature of the air and the length of day in the study area, which works to increase the temperature of the atmosphere and decrease relative humidity and increase the amount of evaporation and dryness of the study area Due to the lack of rainfall, this is reflected on the soil of the shoulders of LakeRazzazaand because of the physical properties of the soil in the sample (1) and (2) mentioned above, which reduces the soil temperature and reduced the amount of evaporation in the sample (1) compared to the sample (2) which leads Reducing the amount of salts rising through th Asih capillary them to the soil surface because of the low water and thermal ext soil as a result of low porosity and high permeability on the work of the low values of the electrical wiring in the sample (1) Mqarndta sample (2) during the summer.

Table

Classification of Awareness of Soil Shoulders ofRazzazaLake by Electrical Connection

Sample number	Soil quality during winter	Soil quality during the summer
1	Slightly salty	Slightly salty
2	Slightly salty	Moderate salinity
3-5	Moderate salinity	Moderate salinity
6	Moderate salinity	Very salty
7-17	Very salty	Very salty

Table (22) Classification of Saline Soil Quality by Electrical Connection

T	Electrical connection Decimens / m	Soil quality
1	Less than 4	Not salty
2	4 - 8	Slightly salty
3	8 - 15	Moderate salinity
4	More than 15	Very salty

Source: Based on:

M. Akram Kahlown and et al, Fordwah Eastern Sadiqia (South) Irrigation and Drainage Project, Waterlogging, Salinity and Crop Yield Relationships, by MREP and IIMI, Mona Reclamation Experimental Project, WAPDA and International Irrigation Management Institute, Pakistan, 1998, P 78 .

7- Cation exchange capacity: - (ECE)

It is clear from Table (23) and Figure (20) that the cation exchange capacity of the soil of the shoulders decreases during the winter and increases during the winter, which ranged during the winter between (8.5) centimol / kg in a sample (1) minimum and a minimum) 14.6 centimeters / kg in a sample of (12) max. During the summer, the minimum was (10.2) centimeters / kg in a sample (1), while the highest limit was (17.52) centimeters. / Kg in a sample (12).

The reason for the decrease in cation exchange capacity in sample (1) compared to sample (2) is due to the characteristics of the soil mentioned above, while the percentage of decrease in cation exchange capacity in winter and high in summer in sample (1) and (2) due to the low quantity Solar radiation and the angle of the fall of solar radiation and short day length and low soil temperature and high relative humidity and low amount of evaporation and rainfall during the winter, which works to decrease the soil temperature and decrease the amount of dissolved salts, since the cation exchange capacity depends on dissolved salts and the positive ions contained Katie NAT) and negative ions (ion) by replacing the last ion and cations another is done in clay soils charged electric or organic colloids (8) As in the sample (12) and due to the high concentration of ions and cations and high electrical conductivity values and decrease in soil with coarse tissue as in the soil of the sample (1) because of the reduction of ions and cations and low electrical conductivity in them, which reduces the values of exchange capacity Cationism during the winter, while cation exchange capacity increases during the summer due to the increase of concentration of ions and cations in the soil due to high amount of solar radiation and low humidity ratio and high amount of evaporation and non-rainfall, which leads to high soil temperature Low moisture and increase the amount of evaporation, which increases the ions and cations in the soil because of its high capillary property, which leads to an increase in the cation exchange capacity during the summer, but the sample (1) remains because of its physical characteristics in terms of tissue with a cation exchange capacity less than a sample (12) .

Table (23)

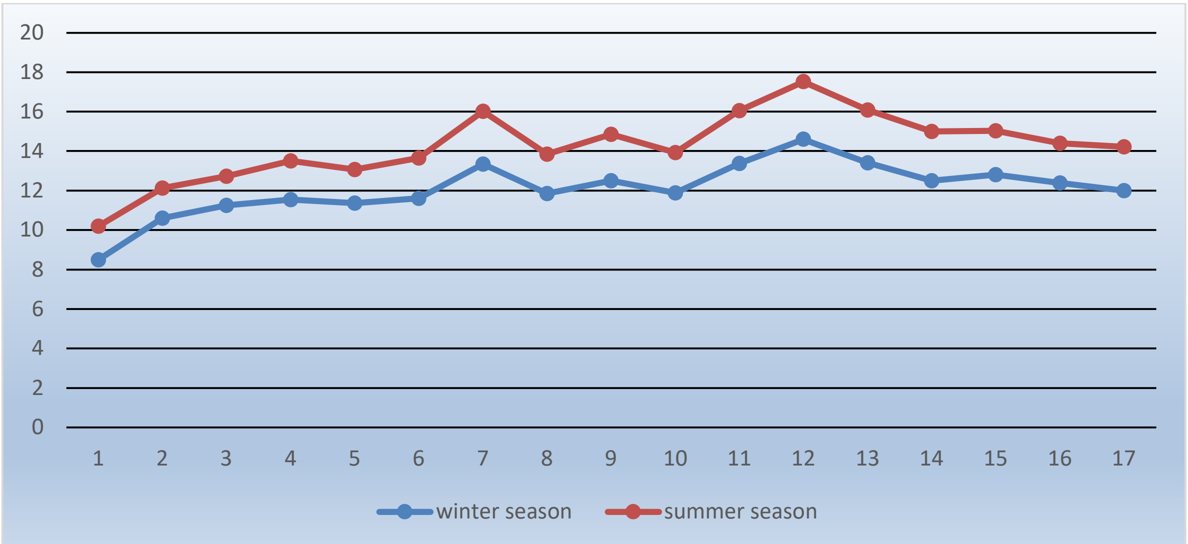
Cationic Capacitance (CCM) / kg values for low-shouldered soil samples of Razaza Lake during the winter and summer seasons of 2019

Sample / Season	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
winter season	8.5	10.6	11.25	11.54	11.37	11.6	13.35	11.85	12.5	11.88	13.38	14.6	13.4	12.5	12.81	12.38	12
summer season	10.2	12.12	12.72	13.5	13.07	13.644	16.02	13.848	14.856	13.92	16.056	17.52	16.08	15	15.03	14.4	14.22

Source // Results of laboratory analyzes of low-soil soil samples of Razzaza Lake in Ministry of Science and Technology laboratories.

Figure (20)

Cationic Capacitance (CCM) / kg values for low-shouldered soil samples of Razaza Lake during the winter and summer seasons of 2019



The quality of low-shouldered soils in LakeRazzazacan be classified according to its cation exchange capacity based on Table (24) where samples (1,2,3,4,5,6,8,9,10,14,15,16,17) High salinity during winter while samples (7,11,12,13) are high salinity during winter and very high during summer.

Table (24)

Classification of saline soil cation exchange capacity of ions (saturated soil paste extract)

T	Cation exchange capacity Centimol / kg	Soil quality
1	Less than 2	Not salty
2	2 - 4	Low salinity
3	4 - 8	Moderate salinity
4	8 - 16	High salinity
5	More than 16	Very attic

Source: Based on:

Shabbir A. SHahid and Mahmoud A.Abdelfattah and Faisal K. Taha, Developments in Soil Salinity Assessment and Reclamation, Innovative Thinking and Use of Margina Soil and Water Resources in Irrigated Agriculture, Springer science and Business Media, Dordrecht, 2013, P89.

(8)Kazim Shinta Saad, previous source, p. 16.