The Effect Of Climate On The Variation Of The Area Of Water And Vegetation Cover In The Sea Of Najaf

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Abstract

The results of the study showed that there is an effect of climatic elements on the study area, as this affected the ecosystem through the variation in the area of water cover, vegetation and land, and through the use of the water cover index (NDWI) and based on the satellite visualization (Landsat8) that the area of water cover reached its maximum area During the study period in the year 2022, it was recorded as a maximum of (158.41) square kilometers, with a percentage of (92.93%) during the spring semester on 04/22/2022, while its lowest area was recorded in the summer on 7/11/2022, as it decreased by about (125.85) km 2 at a rate of (73.83%), while the maximum area in which there is no water cover was about (44.61) km 2 at a rate of (26.17 %) during the summer season on 11/7/2022, while the lowest area was recorded at (12.05) km 2 at a rate of (7.07%) during the spring season on 22/04/2022, while it is clear through the use of the vegetation cover index (NDVI) that the vegetation cover area during the year 2022 recorded a maximum area of about (44.3) km 2 at a rate of (25.99%) during the summer On 7/11/2022, while the area decreased to its lowest value during the spring season on 04/22/2022, when it reached (12.8) km 2 with a rate of (7.51%). An area in the spring on 04/22/2022, when it reached (157.66) km2, with a rate of (92.49%), while it decreased to its lowest area during the summer on 7/11/2022, reaching (126.16) km2, with a rate of (74.01%).).

The reason for this discrepancy is due to the influence of the climatic elements of the study area on the water surface of the Sea of Najaf, as with the decrease in the angle of incidence of solar radiation and the decrease in the number of hours of theoretical and actual solar brightness, the decrease in the amount of solar radiation, the decrease in wind speed, the increase in relative humidity, the increase in the amount of precipitation, and the decrease in evaporation / transpiration increases. The area of the water body to submerge the surrounding coastal lands in the Najaf Sea, as well as some island areas located within the Najaf Sea depression, which leads to a decrease in the area of lands with dense vegetation, especially during the month of March, while the area of vegetation increases with the receding of water from these lands, especially during The month of June is due to the increase in the angle of incidence of solar radiation, the number of hours of actual and theoretical solar brightness, the increase in wind speed, the decrease in relative humidity, the increase in the amount of evaporation / transpiration, and the absence of rain.

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Chapter one
Introduction and theoretical framework

Introduction:
The climatic conditions affect the variation of the water and land area of the Najaf Sea, in terms of the development of the features of the earth's surface, and the characteristics of the animal and plant cover. Geographical and astronomical, as well as what you get from the sun's rays, and as it is known, the amount of sunlight that reaches the earth's surface decreases in the direction from the equator to the poles, north and south, and also varies according to the distribution of the terrain along the meridians, and the sun's rays affect and differences in Temperatures depend on the temperature of the world's seas, the movement of winds, and the levels of atmospheric pressure, which are reflected in one way or another on weather and climatic conditions.
Climate change is also one of the most serious threats to natural ecosystems anywhere, whether they are aquatic ecosystems or terrestrial ecosystems, as the nature of the climatic characteristics of the study area affects many natural changes that occur within the general framework of environmental systems and biological systems that It includes plant and animal life, which leads to the interaction of climate elements that reflect on the local environment, such as the relationship between solar radiation, temperature, wind, atmospheric pressure, relative humidity, rain and evaporation, which leads to the creation of important environmental effects as in the dry and semi-arid environmental characteristics in a region study depending on the nature of their interrelationship.
Because it is a closed lake that has no other outlet for the water entering it, it is exposed to the effects of climate, especially in the summer, as high temperatures and increased evaporation increase the amount of dissolved salts, electrical conductivity, and concentrations of heavy elements in its natural structure. Previously, the flood waters flowed from the Euphrates River and the dry valleys that flowed with the waters of the desert plateau, which helps to mitigate the effects of climate change by refilling the water inside it and reducing the concentration of salt and elements, while the decrease in the water level in it and the exposure of the region to the influence of climatic conditions led to a change In the chemical, physical and biological characteristics of the aquatic environment of the Sea of Najaf, this contributed a great role. In the destruction of the living environment of the Najaf Sea as a result of the impact of the climatic conditions that the study area is exposed to, the increase in the concentration of salts and heavy elements, which caused a change in the chemical, physical and biological characteristics of the water, which led to the death of many organisms that were not suitable for these rapid environmental and climatic conditions, especially during The summer season due to high temperatures, low humidity and high evaporation rates, as living species suffered as a result of climatic conditions and their environmental repercussions, various environmental problems that were addressed in the study.

First: the problem of the study: -
The problem of the study can be formulated as follows ((What is the role of climate in affecting the variation of water and land area in Sea al-Najaf?))

Second: The hypothesis of the study: -
Since the main problem of the study was ((What is the role of climate in affecting the variation of the water and land area in the Sea of Najaf?)), a main hypothesis was set against the main problem represented by ((The climate has an effect on the variation of the water and land area in the Sea of Najaf))

Third: The aim of the study:
1- The study aims to identify the climatic characteristics in the study area and their relationship to the variation of water and land area in the Sea of Najaf, which affects the ecosystem in the Sea of Najaf.

Fourth: 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 climate data for climate elements and analyzing satellite visuals for selected years to know the size of changes in

its area in the past and compare it to current changes and link that to climatic characteristics.

Fifth: The boundaries of the study area:

1- Geographical location:

It is located geographically in the Najaf Governorate, in central Iraq, and extends longitudinally from the north of the city of Najaf to the southwest of the city of Al-Hirah, one of the districts of Najaf, and within the transitional region between the ancient, stable western Arkian plateau, and the newly established sedimentary plain, which was formed from the deposits of the Tigris and Euphrates rivers, which is located at a close distance from it It is bordered on the west by the Western desert known as the Northern Badia (Najaf Desert) and on the east by the city of Najaf, Al-Hirah and Al-Mishkhab.) km 2, which is equivalent to (1800) miles, a length of (60) miles, a width of (30) miles, and a depth of (10) meters above sea level.

2- Astronomical location:

Astronomically, the Najaf Sea lies between latitudes (31.30-32.10) north, and longitudes (43.30-44.30) east, as shown in map (1)

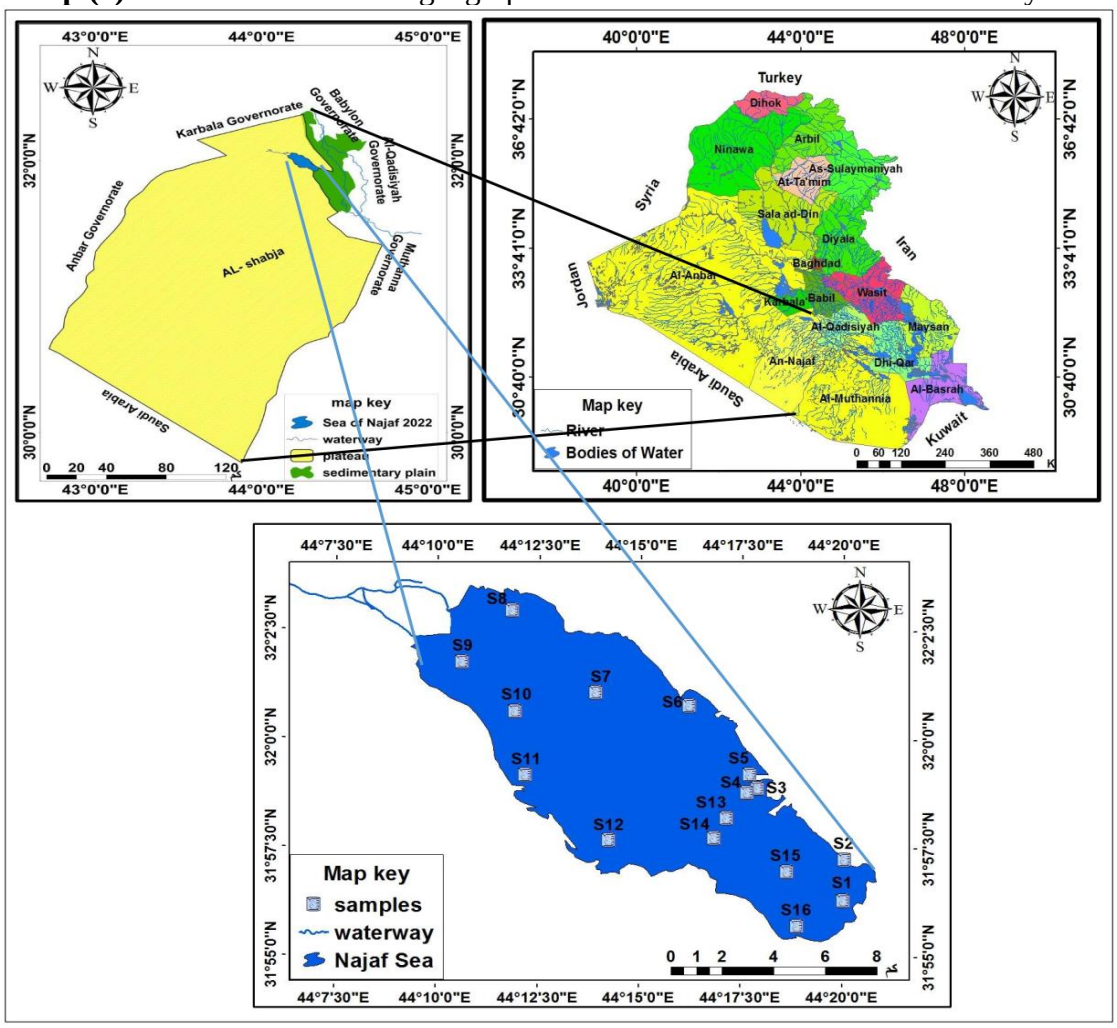
3- Temporal limits:

The study determines temporally by examining the effect of climate on the variation in the area of water and vegetation cover in the Najaf Sea for the year 2022, while the climatic data were from the year (1990-2022), i.e. for a period of 32 years.

4- Objective Boundaries:

Objectively, it is the study of the effect of climate on the variation of the area of water and vegetation cover in the Sea of Najaf.

Map (1) The astronomical and geographical location of the borders of the study area



Source / The researcher worked by relying on the satellite video captured from the Landsat 8 satellite on 2/17 2022 and software outputs (Arc GIs 10.8).

Sixth: the importance of the study:
Environmental studies are an essential part of physical geography, and the result is a new branch of geography called biogeography, which analyzes the geographical distribution of plant and animal life on the planet's surface and the causes that contribute to the diverse spatial patterns.
Despite the importance of this branch of geography as a natural branch of geography, it has interaction effects with other natural disciplines such as climate, soil, terrain and water. Interest in life geography is one of the current studies in the world in general and in Iraq in particular. Protecting living ecosystems on land and water, as well as increasing attention to the components of the vital atmosphere, as many living ecosystems on land and water, as well as the living species they contain, have decreased in number and spread.

Seventh: How it works:
In order to know the effect of climate on the variation of water and land area in Sea al-Najaf, the climatic data represented in the following climatic elements (the amount of solar radiation, temperature, atmospheric pressure, wind, relative humidity, evaporation and rain) from the year (1990-2022) were analyzed by extracting the monthly averages, in addition to To use the vegetation cover index (NDVI) and water cover (NDWI) based on the satellite visualization (Landsat8) during the month of January on January 8/1/2022 and March on 3/13/2022 and June on 5/8/2022 based on the equations next , And to find the statistical relationship between the climate and the variation of the area of water and vegetation cover in the Sea of Najaf through statistical analysis based on the Pearson correlation coefficient, the regression coefficient and the interpretation coefficient.

Water bodies index:

$$NDWI = \frac{Green - \boldsymbol{NIR}}{Green - NIR}$$

since:
NDWI = Bodies of Water Index
Green = green wavelength
NIR = wavelength of infrared radiation

Vegetation Cover Index [(1)]:
NDVI = (**NIR** - **R**)/(**NIR** + **R**)
Since:
NDVI = vegetation index
NIR = Infrared Band (BAND4)
R = the infrared band
This is what concerns the visuals (Landsat 5 TM). As for the visuals (Landsat 8 OLI), it is Extracting the vegetation cover index from (BAND 4) and (BAND5).
Eighth: Research Structure:
The study included three sections, as the first topic represented the introduction and the theoretical framework of the research, which included the main research problem and its hypothesis, the research objective, the research methodology, the limits of the research, the importance of the study, the justification for the research, the method of work, the research structure and the list of terms, as the second topic dealt with the climatic characteristics of the study area, which included the analysis of climatic characteristics Affecting the study area (the amount of solar radiation, average temperature, maximum and minimum, atmospheric pressure, wind, relative humidity, precipitation and evaporation.

The second topic
The climatic characteristics of the Najaf Sea
To find out the effect of the current climate on the ecosystem in the Sea of Najaf, the climatic elements will be dealt with (solar radiation, temperature, wind, atmospheric pressure, relative humidity, precipitation and evaporation). Table (1) The location of the study area station in relation to longitude and latitude, and its height above sea level.

)[1](Salim Yawz Jamal, Using Remote Sensing and Geographic Information Systems to Classify Agricultural Land Uses and Land Cover in Al-Sad Al-Azim District - Iraq, Alustath Journal for Human and Social Science, Issue 225 - Volume Two for the year 2018 AD, p. 260.

Table (1) The location of the selected station according to the nuclear number, longitude and latitude, and the station's height above sea level

station	infective number	Coordinate location		Height above sea level/m
		Latitude/north/degree	Longitude/ east /degrees	
Najaf	670	31 57	44 19	53

Source // The researcher worked on the basis of the Ministry of Transport and Communications, the General Authority for Meteorology and Seismic Monitoring, Climate Department, unpublished data, 2022.

The following are the climatic elements chosen for the study area:

First: the amount of solar radiation: -

The study area receives large quantities of solar radiation in the summer compared to the winter season due to the large angle of incidence of solar radiation and the clearness of the sky, and thus the high rates of temperatures. plant to complete its life cycle[(2)].

It is clear from Table (2) that the highest average amount of solar radiation during the months of the study period was about (26.82) cal/cm2/sec during the month of June, while the lowest amount reached about (10.36) cal/cm2/sec during december,

Table (2) Monthly averages of the amount of solar radiation cal/cm2/sec for Najaf station for the period (1990-2022)

Month	Monthly rate	Month	Monthly rate
December	10.36	June	26.54
January	11.25	July	26.82
February	14.49	August	25.04
March	18.01	September	21.58
April	20.01	October	16.48
May	23.46	November	12.61

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

It also appears from Table (2) that the amount of solar radiation is during the winter months, which records the lowest monthly averages of the amount of solar radiation, as it reached its highest amount by (14.49) cal/cm2/sec during February, while the lowest Its quantity reached about (10.36) cal/cm2/sec during the month of January , As for the spring months, the monthly averages gradually rise to reach (23.46) calories/cm2/sec as a maximum during the month of May, while it decreases to its lowest level during the month of March to reach (18.01) calories/cm2/sec, then it starts to rise to the highest. Its quantity during the summer months to reach (26.82) calories/cm2/sec as a maximum during the month of July and up to (25.04) calories/cm2/sec as a minimum during the month of August , As for the autumn months, it is clear from Table (2 that the monthly averages gradually decrease, reaching its highest amount, which reached about (21.58) cal/cm2/sec during September, while its lowest amount reached about (12.61) cal/second. cm2/sec during the month of November.

Second: Temperature:

A- Average temperature:

It appears from Table (3) that the monthly neutrophils average temperature recorded its lowest levels during the winter months, as it reached a maximum of (14.02) °C during

)[2](Rafah Muhani Muhammad, The Effect of Climate Water Balance on Determining Water Needs for Samples of Some Agricultural Crops in Al-Muthanna Governorate, Alustath Journal for Human and Social Science, Volume (61), Issue (1) for the year 2022 AD, p. 198.

February, while it decreased to its lowest level during the months of the study period. In January, it reaches (11.2) C°, then the monthly rates begin to gradually increase, as it reaches a maximum mean temperature of (31.32) C° during May and a minimum of (18.79) C° during March.

Table (3) Monthly averages of average temperature, maximum temperature and minimum temperature (°C) for Najaf station For the period (1990-2022)

Month	temperature rate	Maximum temperature rate	minimum temperature rate
December	12.86	18.79	7.92
January	11.2	17.06	6.26
February	14.02	20.05	8.3
March	18.79	25.48	12.56
April	24.81	31.48	18.17
May	31.32	38.42	23.83
June	35.84	43.25	27.77
July	38.16	45.38	29.94
August	37.55	45.06	29.36
September	33.23	41.46	25.91
October	28.43	34.87	34.87
November	18.13	24.75	24.75

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

As for the summer months, which recorded the highest monthly averages of the temperature, as it reached (38.16) °C as a maximum during the month of July and around (35.84) °C as a minimum during the month of June, then the monthly rates of temperature begin to gradually decrease during the months of the autumn season and coincide This is with the decrease in the amount of solar radiation, to range between (33.23) C° as a maximum during the month of September and up to (18.13) C° as a minimum during the month of November.

b- Average maximum temperature:

Table (3) show that the monthly averages of the maximum temperature decrease during the months of the winter season, as it reached a maximum rate of (20.05) °C during February, while the lowest temperature during this season was recorded in January It decreased to (17.06) °C, which is the lowest temperature recorded during the months of the study period. , As for during the months of the spring season, the maximum temperature rises gradually from March to May, reaching a maximum of (38.42) °C during the month of May, to decrease to its lowest level during the months of the spring season in the month of March, when it reached (25.48) °C. As for the summer months, the monthly averages of the maximum temperature reach their peak, especially during the month of July, which recorded the highest degree during the months of the study period, as it reached about (45.38) °C, while the lowest temperature during this season was recorded in June. As it reached about (43.25) °C, then the monthly averages of the maximum temperature begin to gradually decrease during the autumn months, reaching a maximum of (41.46) °C as a maximum during September, while it decreases to its lowest during the autumn months during October. the second to reach (24.75) ° C.

C - average minimum temperature:

It is clear from Table that the monthly averages of temperature drop to their lowest during the winter months, reaching a maximum average of (8.3) °C, while the lowest average reached around (6.26) °C during a month. January, which is the lowest rate during the months of the study period.

As for during the months of the spring season, it is noted from Table (3) that the monthly averages of the minimum temperature begin to gradually rise during the months of the spring

season, as it reached its highest rate during the month of May at (23.83) °C, while the lowest monthly average reached it , Up to (12.56) °C during the month of March, as shown in Table (3) , that the monthly averages reach their maximum during the summer months, which records the highest monthly averages of the minimum temperature during the months of the study period, as it reached (29.94). C° during the month of July, which is considered the maximum monthly average of the minimum temperature during the months of the study period, while the lowest average during this semester reached about (27.77) C° during the month of June, and the monthly averages of the minimum temperature begin to gradually decrease during the months of the season Autumn and this coincides with the decrease in the amount of solar radiation and the number of hours of actual and theoretical sunshine, so that the monthly average ranges between (25.91) C° as a maximum during the month of September and around (12.74) C° as a minimum during the month of November.

Third: atmospheric pressure:

It is clear from Table (4) that the monthly averages of atmospheric pressure values reach their maximum during the winter months at the Najaf station during December, as they amounted to (1020.9) millibars, and gradually decrease during the winter months to reach (1018.5) millibars. As a minimum during the month of February, but during the months of the spring season.

Table (3) Monthly averages of atmospheric pressure values (in millibars) for the Najaf station for the period (1990-2022)

Month	Monthly rate	Month	Monthly rate
December	1020.9	June	1003.5
January	1020.3	July	1000
February	1018.5	August	1001.9
March	1015.1	September	1007.2
April	1012	October	1013.7
May	1008.4	November	1018.4

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

as it is clear from that the monthly averages gradually decrease from March to May, as the values ranged between (1015.1) millibars as a maximum during the month of March and up to (1008.4)) millibars as a minimum during the month of May, and the monthly averages decrease to their lowest during the summer months during the study period, as they ranged between (1003.5) millibars as a maximum during the month of June and up to (1000) millibars as a minimum during the month of July, which is considered the lowest monthly rate during the months The duration of the study, and the monthly averages of the atmospheric pressure values gradually decrease during the months of the autumn season, to range between (1018.4) millibars as a maximum during the month of November and up to (1007.2) millibars as a minimum during the month of September.

Fourth: wind:

It is clear from Table (5) that the monthly mean wind speeds reach their lowest speed during the winter, as they ranged between (1.52) m/s as a maximum during February and about (0.97) m/s as a minimum during the month of February. December, while during the months of the spring season, the monthly averages ranged between (1.89) m/s as a maximum during the months of April and May, and up to (1.86) m/s as a minimum during the month of March , While it appears through that the monthly averages reach the maximum wind speed during the summer months, as it reached about (2.38) m / s as a maximum during the month of July, while it reaches its lowest speed

during this season in the month of August to reach It is about (1.86) m/s in, then the monthly and seasonal averages of wind speed begin to gradually decrease during the months of the autumn season, where the monthly mean of the wind speed reached about (1.4) m/s as a maximum during the month of September, while the lowest monthly average is during the season Autumn was recorded at (0.98) m/s during November.

Table (5) Monthly average wind speed (m/s) for Al-Najaf Station for the period (1990-2022)

Month	Monthly rate	Month	Monthly rate
December	0.97	June	2.37
January	1.08	July	2.38
February	1.52	August	1.86
March	1.86	September	1.4
April	1.86	October	1.16
May	1.89	November	0.98

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

Fifth: relative humidity:

Moisture in the air comes from the evaporation of water from water bodies and soil and transpiration from plants. Evaporation and transpiration affect the water balance of a plant because they occur more often in dry air and less frequently when moisture saturation is reached. Relative humidity is one of the most important aspects of climate because it causes most of the Condensation processes, including rain, showers, drizzle and other phenomena that have an impact on plant life. With the rise in relative humidity in the atmosphere, this affects how tissues balance their water content[(3)].

Table (6) Monthly averages of relative humidity (%) for Najaf station for the period (1990-2022)

Month	Monthly rate	Month	Monthly rate
December	65	June	24
January	67	July	23
February	58	August	24
March	47	September	29
April	41	October	40
May	31	November	56

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

and is evident in Table (6) that the monthly rates of relative humidity reach their peak during the months of the winter season, as the highest monthly average was recorded about (67%) during the month of January - which is the highest monthly average during the study period, while the lowest monthly average was recorded during The winter season reached about (58%) during the month of February, while during the months of the spring season, it appears through that the monthly averages gradually decrease during this season, as the highest monthly average of relative humidity reached about (47%) during the month of March, while Its lowest rate reached (31%) during the month of May , It also appears through that the monthly rates of relative humidity reach their lowest during the summer months, as it reached its highest rate at (24%) during the months of June and August, while the rates decrease during the month of July to reach (23%), which is considered The lowest monthly rate during the months of the study period , As shown in Table (6), the monthly rates of relative humidity gradually decrease during the months of the autumn season, reaching its maximum monthly rate of about (56%) during the month of November, while the lowest monthly rate during this season was recorded at about (29). %) during the month of September.

Sixth: Rain:

)[3](Salman Hadi flowers, wind speed and its effect on the variation of seasonal evaporation values at stations: (Sulaymaniyah - Khanaqin - Baghdad - Basra) by adopting the Penman equation, Alustath Journal for Human and Social Science, Issue 24, Volume 1, 2015 AD, p. 399.

Rain is a source for the natural environment industry with its complex content, and it is a source of nourishment for the underground aquifers of great value and importance in arid and semi-arid environments, and the study area is part of it and shows its general system [(4)],This is illustrated by Table (7) that the monthly totals of the amount of precipitation falling at the stations are shown during the months and seasons of the study period. The maximum amount of rain reached about (19.87) mm during the month of November, while the lowest amount reached it during the month of September at about (0) mm , It is noted from that the monthly totals of rain reach their peak during the winter months, as they reached a maximum of (16.25) mm during January, while they decreased to their lowest during February, reaching about (11.29) mm , As for the months of the spring season, where the maximum total amount of rain reached about (14.92) mm during the month of April and about (3.2) mm as a minimum during the month of May. It is also noted in Table (7) that the monthly totals did not record any amount of rainfall during the summer months.

Table (7) Monthly total rainfall for Najaf for the period (1990-2022)

Month	Monthly rate	Month	Monthly rate
September	0	March	12.43
October	0	April	16.25
November	0	May	11.29
December	0	June	9.15
January	6.37	July	14.92
February	19.87	August	3.2

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

Seventh: Evaporation:

It is clear from Table (8) that the monthly rates of evaporation decrease to their lowest value during the winter months, as the highest monthly rate reached (68.37) mm as a maximum during February, while the lowest rate reached (40.94) mm. During the month of December, which is the lowest monthly average during the months of the study period. As for the months of the spring season, it is clear from that the monthly rates of evaporation gradually rise during this season, to reach a maximum during the month of May, around (254.68) mm. As for the lowest monthly average, it was recorded during March, to reach (122.24) mm.

Table (8) Monthly and annual rates of evaporation (mm) for the Najaf station for the period (1990-2022)

Month	Monthly rate	Month	Monthly rate
December	40.94	June	318.38
January	68.07	July	341.21
February	68.37	August	301.7
March	122.44	September	235.13
April	159.62	October	140.29
May	254.68	November	73.16

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

As for the summer months, it is shown in that the monthly averages reach their peak during this season, especially during the month of July, as they reached (341.21) mm as a maximum, which is considered the maximum monthly average during the months of the study period, while the lowest monthly average is It reached about (301.7) mm during the month of August, and the monthly averages began to gradually decrease during the months of the autumn season, reaching a maximum monthly average of about (235.13) mm during the month of September, while it decreased to

)[4](Nazeer Sabar Hamad Al-Muhammadi, The Impact of Climatic Characteristics on the Cultivation of Vegetable Crops (An Applied Study on the Rural District of Al-Ramadi District / Al-Anbar Governorate, Alustath Journal for Human and Social Science, Issue 217 - Volume One for the year 2016 AD, p. 201.

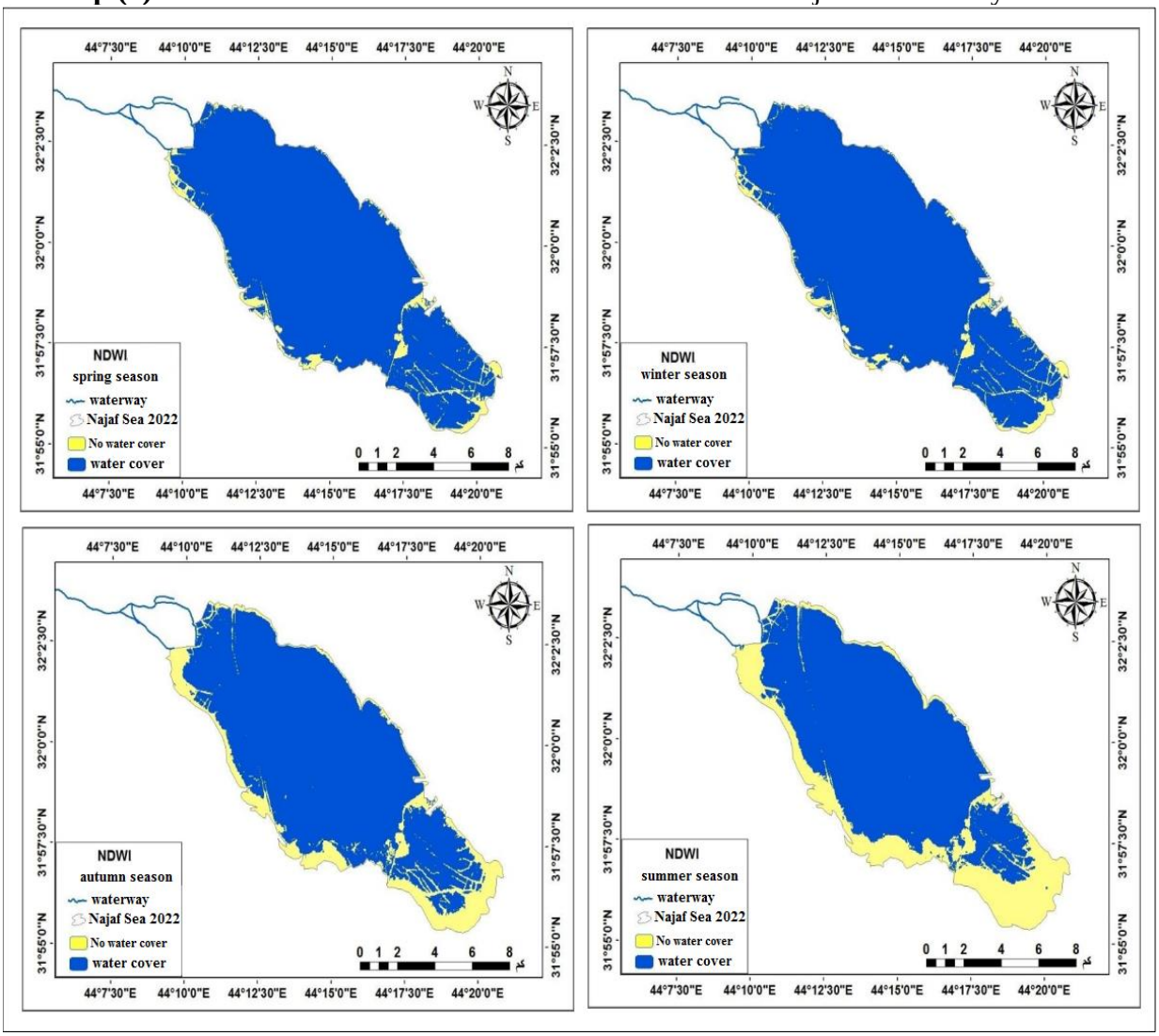
its lowest at the end of this season, especially during the month of November, when it reached (73.16) mm.

The third topic

Statistical analysis between the climate elements and the variation in the area of Najaf Sea

As a result of the influence of climatic elements on the study area, it affected the ecosystem through the variation in the area of water, vegetation and land cover, as shown in Table (9) and Map (2) and through the use of the Water Cover Index (NDWI) and based on the satellite view (Landsat8) The water cover area reached its maximum area during the study period in the year 2022 by about (158.41) square kilometers as a maximum, with a percentage of (92.93%) during the spring season on 04/22/2022, while its lowest area was recorded in the summer season on 11/ 7/2022, as it decreased by about (125.85) km2, or by (73.83%), while it is clear from table (9) and map (2) that the maximum area in which there is no water cover reached about (44.61) km2, or by (26.17%) during The summer season was dated 7/11/2022, while the lowest area was recorded at (12.05) km 2, at a rate of (7.07%), during the spring season, on 04/22/2022.

Map (2) Seasonal variation in the area of water cover in the Najaf Sea for the year 2022



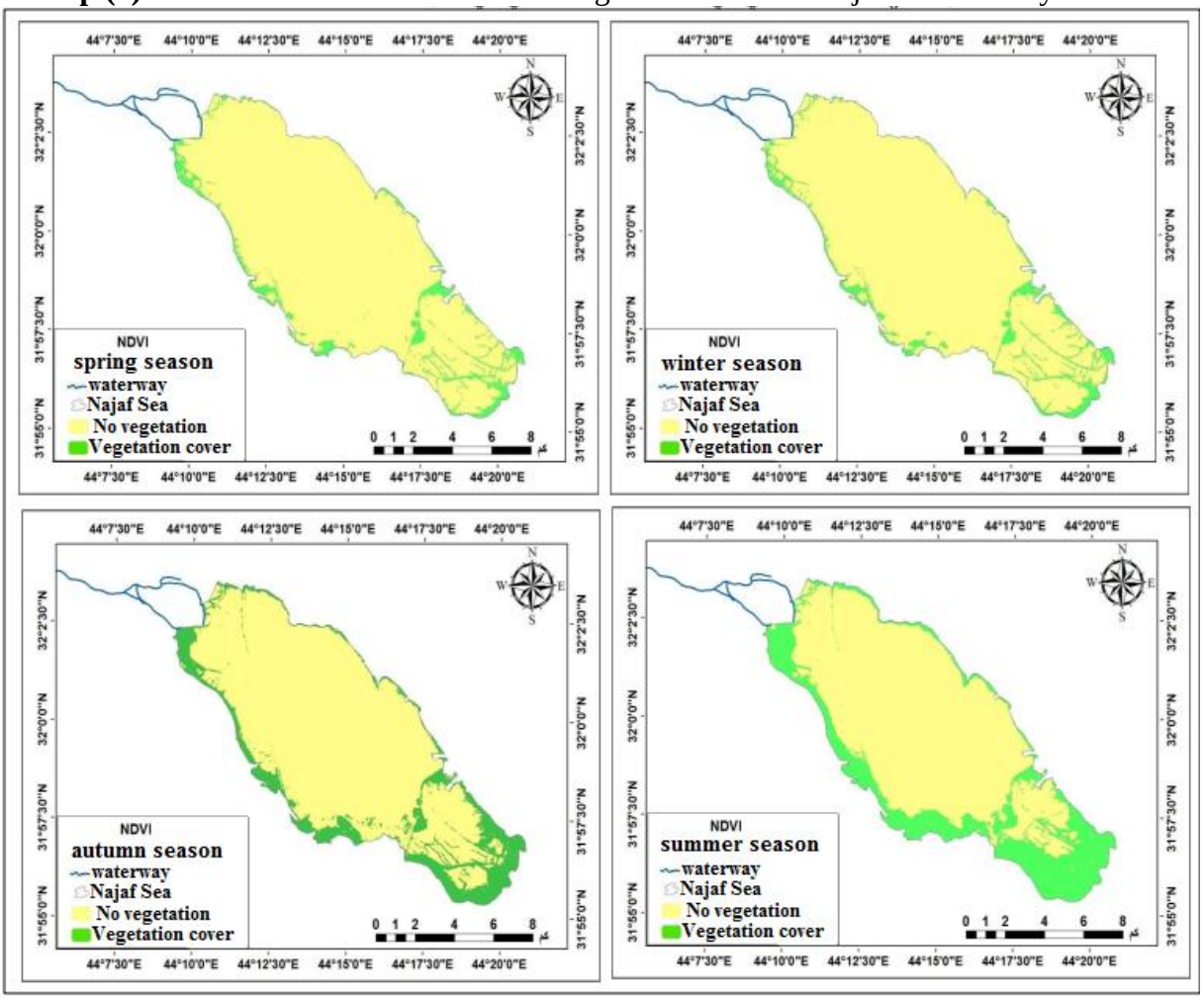
The source / the researcher worked by relying on the satellite visual captured from the satellite (8 Landsat) on (01/08/2022, 04/22/2022, 07/11/2022 and 10/15/2022) and the outputs of the Arc gis 10.8 program.

Table (9) Seasonal variation in the area and percentage of vegetation cover index of the Najaf Sea for the year (2022)

the chapter / pointer	Area (km2)				Percentage (%)			
	autumn	summer	spring	winter	autumn	summer	spring	winter
area of water cover	158.22	158.41	125.85	141.38	92.82	92.93	73.83	82.94
The area where there is no water cover	12.24	12.05	44.61	29.08	7.18	7.07	26.17	17.06
vegetation area	13.4	12.8	44.3	29.11	7.86	7.51	25.99	17.08
The area where there is no vegetation cover	157.06	157.66	126.16	141.34	92.14	92.49	74.01	82.92

Source / researcher work based on map (2).

Map (3) Seasonal variation in the area of vegetation cover in Najaf Sea for the year 2022



The source / the researcher worked by relying on the satellite visual captured from the satellite (8 Landsat) on (01/08/2022, 04/22/2022, 07/11/2022 and 10/15/2022) and the outputs of the Arc GIs 10.8 program.

While it is clear from Table (9) and Map (3) and using the Vegetation Cover Index (NDVI) that the vegetation cover area during the year 2022 recorded a maximum area of (44.3) km2, with a rate of (25.99%) during the summer on 11/7/2022, while The area decreases to its lowest value during the spring season on 04/22/2022, when it reached (12.8) km2, or (7.51%). As for the area in which there is no vegetation, it is clear from Table (9) and Map

(3), as it was recorded The maximum area in the spring was on 04/22/2022, when it reached (157.66) km 2, or (92.49%), while it decreased to its lowest area during the summer on 7/11/2022, when it reached (126.16) km 2, or (74.01%). %).

The reason for this discrepancy is due to the influence of the climatic elements of the study area on the water surface of the Sea of Najaf, as with the decrease in the angle of incidence of solar radiation and the decrease in the number of hours of theoretical and actual solar brightness, the decrease in the amount of solar radiation, the decrease in wind speed, the increase in relative humidity, the increase in the amount of precipitation, and the decrease in evaporation / transpiration increases. The area of the water body to submerge the surrounding coastal lands in the Najaf Sea, as well as some island areas located within the Najaf Sea depression, which leads to a decrease in the area of lands with dense vegetation, especially during the month of March, while the area of vegetation increases with the receding of water from these lands, especially during The month of June is due to the increase in the angle of incidence of solar radiation, the number of hours of actual and theoretical solar brightness, the increase in wind speed, the decrease in relative humidity, the increase in the amount of evaporation / transpiration, and the absence of rain.

Statistical relationships between climatic elements and the water and vegetation index

To show the variation in the water and land area of the Najaf Sea, it was necessary to clarify this discrepancy using statistical methods to find out its amount, as well as to clarify which climatic elements have the most influence, as some elements affect directly and others affect indirectly, and statistical methods show the direction of the influence of the climate element Some of them have a positive effect, that is, they have a direct relationship that works to enhance the variation in the area of water, vegetation, and land, while others have a negative effect, and here their relationship is inverse, that is, they work to reduce the area of water, vegetation, and land in the study area.

In order to find the statistical relationships between the climatic elements, water area, inhabited land, low-density vegetation cover, and dense vegetation cover in the Sea of Najaf, each of the Pearson correlation coefficients was used to extract the strength of the correlation, and then the interpretation or determination coefficient (R2) was used to interpret the influence of the dependent element on the dependent element. As well as the use of the regression coefficient, the monthly averages of the average solar radiation, the rate of temperature, relative humidity, precipitation and evaporation, shown in Table (10), were used for the months of 1/8/2022, 04/2022, 07/11/2022 and 10/15/2022 Which corresponds to the date of capturing the used satellite visuals and linking them with the water area, the inhabited land, the sparsely dense vegetation cover and the dense vegetation cover in the sea of Najaf.

Table (10) Monthly data for climatic elements at Najaf station for the period (1990-2022)

the month	The average total solar radiation is milliwatts/cm2/day	Normal temperature range (c)	Relative Humidity (%)	Rainfall (mm(	Evaporation rate (mm(
December	263.79	12.5	65	20.81	68.07
April	499.07	24.6	44	16.92	159.62
July	630.17	39.5	25	0	341.21
October	389.08	28.6	41	9.26	140.29

Source / Ministry of Transport and Communications, General Authority of Meteorology and Seismic Monitoring, Department of Climate and Water Significance, unpublished data, 2022.

The reason why the researcher chose the satellite visuals during these months is because

they represent the middle of each season of the year, so the results drawn from the relationship between them and the climatic **elements will be more realistic, and in the following the researcher builds the statistical relationships:**

1- The statistical relationship between the monthly rates of total solar radiation (mW/cm2/day) and the water and vegetation cover index in Najaf Sea:

It is noted from Table (11) that there is an average inverse correlation with statistical significance under a significant level (0.05) and a degree of freedom (95%), as the value of the correlation between the monthly mean of total solar radiation and the indicator of the area of water cover is an area in which there is no vegetation, reaching by (-0.69) and (-0.68), respectively, and this indicates that any increase in the amount of solar radiation will be accompanied by a decrease in the water cover area and the area in which there is no vegetation cover.

Table (11) The statistical relationship between the monthly rates of total solar radiation (mW/cm2/day)
And the water and vegetation cover index in the Najaf Sea for the year 2022

the test / pointer	correlation coefficient	T calculated	Tabular T	regression coefficient	Interpretation coefficient
area of water cover	-0.69	3.582	2.353	-0.07	0.47
The area where there is no water cover	0.69	5.771		0.07	0.47
vegetation area	0.68	5.747		0.07	0.47
An area without vegetation	-0.68	3.598		-0.07	0.47

Source // The researcher's work based on Tables (9) and (10).

While an average direct correlation coefficient was recorded between the monthly average of the total solar radiation and the area in which there is no water cover and the area of vegetation cover, as it reached the limits of (0.69) and (0.68), respectively, and this indicates that any increase in the amount of solar radiation will be accompanied by an increase The area in which there is no water cover and the area of vegetation cover. As for the value of the calculated T test, it is noted that it was higher than the tabular T value, and this indicates the existence of a significant correlation, while the regression coefficient shows that the rate of change in the area of water cover and the area without There is vegetation in it as a result of the change in the monthly rate of solar radiation, as whenever the monthly average of solar radiation increases by 1 milli watt/cm2/day, the area of water cover and the area in which there is no vegetation decrease by (-0.07) km2 for each, and this indicates the existence of a relationship There is an inverse relationship between the monthly average of solar radiation and the area of water cover and the area in which there is no vegetation cover, while the regression coefficient shows that the rate of change in the area in which there is no water cover and the area of vegetation cover is a result of the change in the monthly average of solar radiation as the greater the monthly average of solar radiation by 1 milli watt/cm2/day, the area that does not have water cover and the area of vegetation cover increases by (0.07) km2, and this indicates that there is a positive relationship between the monthly rate of solar radiation and the area where there is no water cover and the area of vegetation cover.

As for the coefficient of interpretation, the amount of change caused by the monthly rate of solar radiation in the water cover area reached (47%), meaning that the amount of the other change (53%) is caused by other factors in the area change, and so on for the area in which there is no water cover and the area of the cover. The vegetation and the area in which there is no vegetation cover, this explains that the monthly rate of solar radiation affects the water and vegetation cover index and is associated with it with direct and inverse

correlations, and this proves the validity of the researcher's hypothesis that the solar radiation has an effect on the area of water and vegetation cover in the Sea of Najaf.

2- The statistical relationship between the monthly averages of the normal temperature (°C) and the water and vegetation cover index in Najaf Sea:

It is noted from Table (12) that there is a strong inverse correlation with statistical significance under a significant level (0.05) and a degree of freedom (95%). by (-0.89) for each of them, and this indicates that any increase in temperature will be accompanied by a decrease in the water cover area and the area in which there is no vegetation cover.

While a strong direct correlation coefficient was recorded between the monthly average of the normal temperature and the area in which there is no water cover and the area of vegetation cover, as it reached the limits of (0.89) for each of them, and this indicates that any increase in temperature will be accompanied by an increase in the area in which there is no water cover. Water cover and the area of vegetation cover. As for the value of the calculated T test, it is noted that it was higher than the value of the tabular T, and this indicates the existence of a significant correlation, while the regression coefficient shows that the rate of change in the area of water cover and the area in which there is no vegetation cover is a result of For the change in the monthly average temperature, as whenever the monthly average temperature increases by one degree Celsius, the area of water cover and the area in which there is no vegetation decrease by (-1.25) km2 and (-1.19) km2 for each, and this indicates an inverse relationship between The monthly average of temperature, the area of water cover and the area in which there is no vegetation cover, while the regression coefficient shows that the rate of change in the area in which there is no water cover and the area of vegetation cover is a result of the change in the monthly rate of temperature, as the higher the monthly rate of temperature by one degree Celsius One, the area in which there is no water cover and the area of vegetation increase by (1.25) km 2 and (1.19) km 2 respectively, and this indicates a direct relationship between the monthly mean temperature and the area in which there is no water cover and the area of vegetation cover.

Table (12) The statistical relationship between the monthly averages of the normal temperature (°C) and the water and vegetation cover index in Najaf Sea for the year 2022

the test / pointer	correlation coefficient	T calculated	Tabular T	regression coefficient	Interpretation coefficient
area of water cover	-0.89	-9.19	2.353	-1.25	0.80
The area where there is no water cover	0.89	0.48		1.25	0.80
vegetation area	0.89	0.39		1.19	0.79
An area without vegetation	-0.89	-9.39		-1.19	0.79

Source // The researcher's work based on Tables (9) and (10).

As for the coefficient of interpretation, the amount of change caused by the monthly average temperature in the water cover area reached (80%), meaning that the amount of the other change (20%) is caused by other factors in the area change, and so on for the area in which there is no water cover and the cover area The vegetation and the area in which there is no vegetation cover, where the percentage of change reached about (80%), (79%) and (79%), respectively. The researcher hypothesis proves that the temperature has an effect on the water and vegetation cover of the Najaf Sea.

3- The statistical relationship between the monthly averages of relative humidity (%) and the water and vegetation cover index in Najaf Sea:

It is noted from Table (13) that there is a strong direct correlation with statistical significance under a significant level (0.05) and a degree of

freedom (95%). (0.85) and (0.84) respectively for each of them, and this indicates that any increase in relative humidity will be accompanied by an increase in the water cover area and the area in which there is no vegetation cover, while a strong inverse correlation coefficient without statistical significance was recorded between the monthly average For the relative humidity and the area in which there is no water cover and the area of vegetation cover, it reached the limits of (-0.85) and (-0.84) respectively, and this indicates that any increase in the relative humidity will be a decrease in the area in which there is no water cover and the area of vegetation cover. As for the value of the calculated T test, it is noted that it was higher than the tabular T value for each of the area of water cover and the area in which there is no vegetation cover, and this indicates the presence of a significant correlation, while the area of vegetation cover and the area in which there is no water cover were insignificant. morale.

Table (13) The statistical relationship between the monthly average relative humidity (%) and the water and vegetation cover index in Najaf Sea for the year 2022

the test / pointer	correlation coefficient	T calculated	Tabular T	regression coefficient	Interpretation coefficient
area of water cover	0.85	-23.105	2.353	0.81	0.72
The area where there is no water cover	-0.85	1.25		-0.81	0.72
vegetation area	-0.84	1.25		-0.77	0.71
An area without vegetation	0.84	-22.856		0.77	0.71

Source // The researcher's work based on Tables (9) and (10).

While the regression coefficient shows that the rate of change in the area of water cover and the area in which there is no vegetation cover is a result of the change in the monthly rate of relative humidity, as whenever the monthly rate of relative humidity increases by 1%, the area of water cover and the area in which there is no vegetation cover increases by (0.81).) km 2 and (0.77) km 2 respectively, and this indicates that there is a positive relationship between the monthly average relative humidity and the area of water cover and the area in which there is no vegetation cover, while the regression coefficient shows that the rate of change in the area in which there is no water cover and the area of cover The vegetation as a result of the change in the monthly average relative humidity, as whenever the monthly average relative humidity increased by 1%, the area without water cover and the vegetation cover area decreased by (-0.81) km2 and (-0.77) km2, respectively, and this indicates the presence of An inverse relationship between the monthly mean relative humidity, the area without water cover, and the area of vegetation.

As for the coefficient of interpretation, the amount of change caused by the monthly average relative humidity in the water cover area reached (72%), meaning that the amount of the other change (28%) is caused by other factors in the area change, and so on for the area in which there is no water cover and the cover area The vegetation and the area in which there is no vegetation cover, where the percentage of change reached (72%), (71%) and (71%), respectively. The researcher's hypothesis proves that the relative humidity has an effect on the water and vegetation cover of the Najaf Sea.

4- The statistical relationship between the monthly total rainfall (mm) and the water and vegetation cover index in the Najaf Sea:

It is noted from Table (14) that there is a very strong direct correlation with statistical significance under a significant level (0.05) and a degree of freedom (95%). (0.98) for each, and this indicates that any increase in the amount of rain will be accompanied by an increase in the area of water cover and the area in which there is no vegetation cover, while a strong inverse correlation coefficient was

recorded without statistical significance between the monthly total rainfall and the area in which there is no vegetation. Water cover and the area of vegetation cover, where it reached the limits of (-0.98) for each of them, and this indicates that any increase in the amount of rain will be with a decrease in the area in which there is no water cover and the area of vegetation cover. As for the calculated value of the T test, it is noted that it was higher than the value of T The tabular data for each of the water cover area and the area in which there is no vegetation cover, and this indicates the existence of a significant correlation relationship, while the vegetation cover area and the area in which there is no water cover was insignificant, while the regression coefficient shows that the rate of change in the area The water cover and the area in which there is no vegetation cover as a result of the change in the monthly total rainfall, as whenever the monthly total rainfall increases by 1 mm, the area of water cover and the area in which there is no vegetation cover increases by (1.67) km 2 and (1.60) km 2 respectively, and this indicates The existence of a direct relationship between the monthly total rainfall and the area of water cover and the area in which there is no vegetation cover, while the regression coefficient shows that the rate of change in the area in which there is no water cover and the area of vegetation cover is a result of the change in the monthly total of rain, as the more the monthly total rain increases by 1 mm , , The area in which there is no water cover and the area of vegetation decrease by (-1.67) km 2 and (-1.60) km 2 respectively, and this indicates an inverse relationship between the monthly total rainfall and the area in which there is no water cover and the area of vegetation cover .

Table (14) The statistical relationship between the monthly total rainfall (mm) and the water and vegetation cover index in Najaf Sea for the year 2022

the test / pointer	correlation coefficient	T calculated	Tabular T	regression coefficient	Interpretation coefficient
area of water cover	0.98	-39.651	2.353	1.67	0.97
The area where there is no water cover	-0.98	-1.032		-1.67	0.97
vegetation area	-0.98	-1.094		-1.6	0.96
An area without vegetation	0.98	-43.131		1.60	0.96

Source // The researcher's work based on Tables (9) and (10).

As for the coefficient of interpretation, the amount of change caused by the monthly total rainfall in the water cover area reached (97%), meaning that the amount of other change (3%) is caused by other factors in the area change, and so on for the area in which there is no water cover and the area of vegetation cover And the area in which there is no vegetation cover, where the percentage of change reached (97%), (96%), and (96%), respectively. The researcher hypothesis that rain has an effect on the water and vegetation cover of the Najaf Sea.

5- The statistical relationship between the monthly rates of evaporation (mm) and the water and vegetation cover index in Najaf Sea: It is noted from Table (15) that there is a strong inverse correlation with statistical significance under a significant level (0.05) and a degree of freedom (95%). (-0.86) for each, and this indicates that any increase in the amount of evaporation will be accompanied by a decrease in the area of water cover and the area in which there is no vegetation cover, while a strong direct correlation coefficient was recorded between the monthly rate of evaporation and the area in which there is no water cover and the area of cover vegetation, where it reached the limits of (0.86) for each of them, and this indicates that any increase in the amount of evaporation will be accompanied by an increase in the area in which there is no water cover and the area of vegetation cover, and the value of the calculated T test is noted that it was higher than the value of the tabular T, and this indicates There is a significant correlation,

while the regression coefficient shows that the rate of change in the area of water cover and the area in which there is no vegetation cover as a result of the change in the monthly rate of evaporation, since whenever the monthly rate of evaporation increases by 1 mm, the area of water cover and the area in which there is no vegetation decrease. Vegetation cover by (-0.12) km 2 and (-0.11) km 2 for each of them, and this indicates an inverse relationship between the monthly rate of evaporation and the area of water cover and the area in which there is no vegetation cover, while the regression coefficient shows that the rate of change in the area without There is water cover and the area of vegetation cover as a result of the change in the monthly rate of evaporation, as whenever the monthly rate of evaporation increases by 1 mm, the area in which there is no water cover and the area of vegetation cover increases by (0.12) km2 and (0.11) km2, respectively, and this indicates There is a direct relationship between the monthly rate of evaporation and the area in which there is no water cover and the area of vegetation.

Table (15) The statistical relationship between the monthly rates of evaporation (mm) and the water and vegetation cover index in Najaf Sea for the year 2022

the test / pointer	correlation coefficient	T calculated	Tabular T	regression coefficient	Interpretation coefficient
area of water cover	-0.86	0.483	2.353	-0.12	0.74
The area where there is no water cover	0.86	2.966		0.12	0.74
vegetation area	0.86	2.944		0.11	0.74
An area without vegetation	-0.86	0.491		-0.11	0.74

Source // The researcher's work based on Tables (9) and (10).

As for the coefficient of interpretation, the amount of change caused by the monthly rate of evaporation in the water cover area reached (74%), meaning that the amount of other change (26%) is caused by other factors in the area change, and so on for the area in which there is no water cover and the area of vegetation cover And the area in which there is no vegetation cover, this explains that the monthly rate of evaporation affects the water and vegetation cover index and is associated with it with direct and inverse correlations, and this proves the validity of the researcher's hypothesis that evaporation has an effect on the area of water and vegetation cover in the Sea of Najaf.

Conclusions:

1- The results of using the water cover index (NDWI) and based on the satellite visualization (Landsat8) showed that the water cover area reached its maximum area during the study period in the year 2022 by about (158.41) square kilometers as a maximum, with a percentage of (92.93%) during the spring season. On 22/04/2022, while its lowest area was recorded in the summer on 11/7/2022, as it decreased by about (125.85) km2, by (73.83%), while the maximum area in which there is no water cover was about (44.61) km 2 at a rate of (26.17%) during the summer season on 11/7/2022, while the lowest area was recorded at (12.05) km 2 at a rate of (7.07%) during the spring season on 22/04/2022.

2- Through the use of the vegetation cover index (NDVI), it is clear that the vegetation cover area during the year 2022 recorded a maximum area of about (44.3) square kilometers, with a rate of (25.99%) during the summer on 11/7/2022, while the area decreases to its lowest value during The spring season on 04/22/2022, when it reached (12.8) km2, at a rate of (7.51%). As for the area in which there is no vegetation cover, it turns out that it recorded the maximum area in the spring season on 04/22/2022, when it reached (157.66).) km 2 at a rate of (92.49%), while it decreased to its lowest area during the summer on 11/7/2022, reaching about (126.16) km 2 at a rate of (74.01%).

3- The results of Pearson's statistical analysis showed between the independent factors (the

daily rate of solar radiation (watts / m2), the normal, maximum and minimum temperature, wind speed, relative humidity, amount of rain, and amount of evaporation) and the dependent variable (area of water, populated land, low-density vegetation cover, and dense vegetation cover). the next :-

A - The presence of a statistically significant inverse direct correlation, as the value of the correlation between the monthly average of total solar radiation and the water cover area index was an area in which there is no vegetation, reaching (-0.69) and (-0.68) respectively, while the record Average direct correlation coefficient between the monthly average of the total solar radiation and the area in which there is no water cover and the area of vegetation cover, as it reached the limits of (0.69) and (0.68), respectively.

B - The presence of a strong inverse correlation with statistical significance, as the value of the correlation between the monthly average of the normal temperature and the indicator of the water cover area was an area in which there is no vegetation cover, as it reached (-0.89) for each of them.

C - The existence of a strong direct correlation with statistical significance, as the value of the correlation between the monthly average relative humidity and the indicator of the water cover area was an area in which there is no vegetation cover, as it reached (0.85) and (0.84) respectively for each of them, while the coefficient was recorded A strong inverse correlation without statistical significance between the monthly average relative humidity and the area in which there is no water cover and the area of vegetation cover, as it reached the limits of (-0.85) and (-0.84), respectively.

D - It is noted that there is a very strong direct correlation with statistical significance, as the value of the correlation between the monthly total rainfall and the indicator of the water cover area is an area in which there is no vegetation cover, as it reached (0.98) for each of them, while a strong inverse correlation coefficient was recorded without Statistically significant between the monthly total rainfall, the area in which there is no water cover, and the area of vegetation cover, as it reached the limits of (-0.98) for each of them.

C - The presence of a strong inverse correlation with statistical significance, as the value of the correlation between the monthly rate of evaporation and the indicator of the water cover area was an area in which there is no vegetation cover, as it reached (-0.86) for each of them, while a strong direct correlation coefficient was recorded between the monthly average For evaporation, the area in which there is no water cover, and the area of vegetation cover, it reached the limits of (0.86) for each of them.

Recommendations:

1- The necessity of preserving the water harvest through the construction of dams to store water during the winter season in the western, southwestern and southeastern sides, as they contain many seasonal valleys that receive large amounts of rain during the winter season, and these dams are opened during the summer season to feed the Najaf Sea It compensates for the shortage of water as a result of its vulnerability to climatic elements, especially high temperature, low relative humidity, lack of precipitation, and increased evaporation.

2- Taking care of the biological diversity in the waters of the Najaf Sea, which contains many fish, birds, snails and crustaceans, and preventing the drainage of sewage into it because it destroys the ecosystem, especially since the low water level during the summer will increase the concentration of dissolved ions and heavy elements in the water, which constitutes Danger to aquatic life.

3- Eliminate the manifestations of desertification in the Najaf Sea region through planting green belts, which have an effect on preserving the water area in the Najaf Sea by reducing temperatures and the amount of evaporation and increasing the relative humidity.

4- The use of remote sensing in surveying and monitoring of land resources in general, and the land cover in particular, for the features it provides to meet the needs of plans and development programs for data and information, and to benefit from the data provided by geographic information systems in its various forms after building the system, to facilitate data circulation, updating, processing

and analysis. and drawing scenarios and strategies.

5- Carrying out future studies of the study area to detect variation in the land cover, observing changes, addressing problems, proposing solutions, as well as following up on plans, programs, and recommendations.

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