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Building Digital Hydrological Models for the Habbaniyah Lake Reservoir to Calculate Area Variable

Aws Talak Mashaan Satam, Zuhair Jaber Mushref Nahar, Ameer Muhammed Khalaf

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Abstract

Water storage in lakes or reservoirs is accompanied by changes in the shape of the reservoir. These changes are caused by the occurrence of natural phenomena that are necessary as a result of changing the hydrological and morphological properties in the lake or reservoir area, as well as human interventions in these areas in one way or another which have an impact on the water of the lakes. In addition to that Habbaniyah Lake is considered one of the important lakes in the country, therefore it was necessary to study it continuously for the purpose of knowing the changes taking place and the extent of their impact on the shape of the reservoir using modern methods such as remote sensing and geographic information systems in the process of evaluating and following up the shape of the reservoir where the remote sensing technique is distinguished, which depends on Extraction of information through satellite images with several factors, including speed, comprehensiveness, repeatability, and accuracy, in addition to its low cost compared to traditional methods in such , during our study of the reservoir.

1. Introduction

Natural factors control surface, climate, and geological formation. And soil in the establishment and success of any water tank, in addition to determining its location, directions, sizes and extent of need, and surface factors lead to the determination of the storage places that are built on river courses.

The study of the spatial and formal characteristics of Lake Habbaniyah and the changes that occurred in it during a specific time period since the beginning of the new millennium and until the year 2019 and identifying the reasons for these changes helps to determine the most important treatments for these changes to raise the efficiency of this reservoir and achieve economic feasibility from its establishment, especially that Iraq is witnessing an unprecedented water crisis After Iraq was classified as a water-rich country compared to countries in the region.

This research aims to study the surveyed and formal characteristics of Lake Habbaniya and its changes based on the analysis of images and space visuals and the use of modern technologies, and this study is one of the rare studies in this field where the study was characterized by accuracy in obtaining information and data for the subject of the study through the use of (Arc Map 10.5) To extract the surface area of the lake from the satellite visualizations obtained from the satellite (Land Sat 2, 5, 7) for specific years and for two seasons per year, then knowing the amount of retraction of the lake's water area and explaining the reasons for that retreat.

The problem: The research problem represents the first step of the scientific research steps, through which facts can be found and validated to develop solutions to that problem that can be asked with the following question:

Is the shape of the lake constantly changing, and what is the role of water drainage in controlling the surveying characteristics of the reservoir?

Geographical and astronomical location: Lake Habbaniyah is located along the Euphrates River and on the right side of its bank to the southeast in the city of Ramadi, located between latitudes 33˚10'-33˚48 'north and longitudes 43˚15'-43˚45' east, and that The importance of the lake lies in controlling the flood waters of the Euphrates, in addition to agricultural and tourist purposes. Surface water enters the lake through the Al-Warar canal from the Euphrates River by discharging the project's basic design of 2800 m3 / s. Water comes out of the lake from the Daban Canal with a discharge of basic design of 285 m 3 / sec. The lake's storage capacity is about 3.34 km3 in case the lake level reaches a height 51.2 m above sea level.

Importance: The lake was created as a result of the construction of the Ramadi Dam, which is a huge project in Anbar Governorate on the banks of the Euphrates River, to generate hydroelectric power and reduce the strength of floods at the course of the river. The importance of the lake stems from the presence of a group of different types of fish, which encouraged the fishing process in the region, in addition to the presence of many tourist places, including: the tourist city.

First: Spatial characteristics and their changes of Lake Habbaniyah:

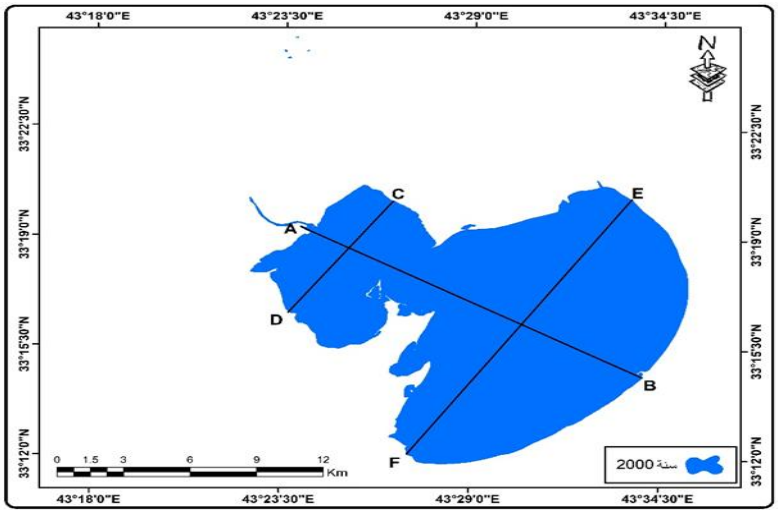
The study of the spatial characteristics and its changes for any water reservoir as well as identifying the most important causes of change, if any, are very important in hydrological studies, especially for countries that suffer from a decrease and retreat in the quantities of their fresh water, and for this it is necessary to study the change in the area of lakes and fresh water tanks and determine the reasons for that change in order to put The best possible treatments to stop or minimize the decline in the area of water, so Habbaniyah Lake was studied in four different periods (2000, 2006, 2012, 2018) for the same period, to show the area changes both by progress and retreat of the lake, which can happen, so it was adopted in the study to know the changes in the area The waters of Habbaniyah Lake through satellite visualizations. Three sectors of the lake's body were approved, one of which is a longitudinal section and two cross section to know the amount of retreat and progress for each side of the lake and to determine the most regressing and changing sides.

1- - Spatial change of Lake Habbaniyah in 2000:

By analyzing the satellite image of Lake Habbaniyah for the year (2000) during the spring semester it became clear that the area of the lake's water reached (193) km2, and it is thus considered the smallest surface area of the lake during the study years, so it was adopted as a base year that is based on its area measuring the area of the change in water The lake for the rest of the study years, therefore, the rate of progress and decline in the water area for this study will be clear through the three sections that have been identified on the lake and consistently for all years to know the size of the retreat for each side of the lake according to the points of the sections and considering the area of the sections for this chapter is the fixed base area which On its light, the retreat amount will be measured for each sector for the remainder of the years to consider the area of the lake's water base, as the length of the longitudinal section (AB) reached (18) km, while the cross section (CD) reached the length of (8) km, and the length of the cross section (EF) (18) km, as shown in Map (1) and Table (1).

Map (1)

The Three Sections and the Amount of Change of Water Area of Habbaniyah Lake for Spring Semester (2000)



Source: Using satellite land satellite imagery (Land Sat 2) in the spring of 2000, using Arc Map 10.5 software.

Table (1)

The lengths of the longitudinal and transverse sections of Lake Habbaniyah and the area of the lake

	The area is 2 km	) E-F(	) C-D(	) A-B(	season
%19	193	18	8	18	2000
%30	296	19	10	23	2005
% 30	294	18	10	21	2013
%21	204	18	8	17	2018
	978				

Source: Based on the analysis of space visuals of Lake Habbaniyah, drawing of syllables on them and measuring them using (Arc Map 10.5)

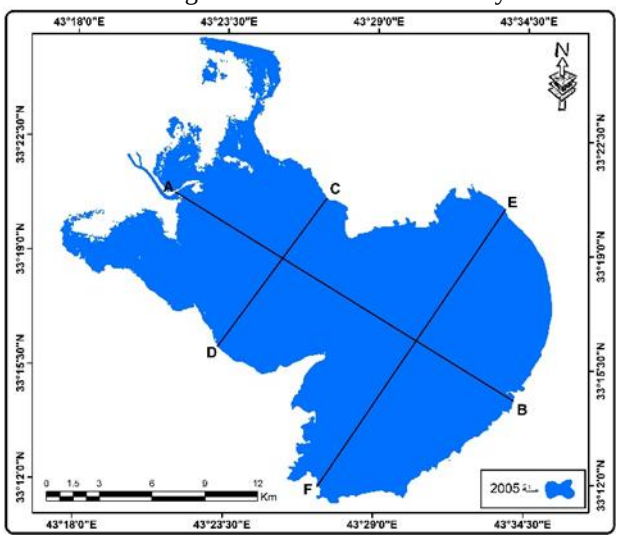
2- Spatial change of Lake Habbaniyah in the year (2005):

Through an analysis of the satellite visibility for this year and for the spring, it is clear that the area of the Habbaniyah Lake (296 km2) as shown in Table (1). It is also noticed by studying the three specific sections on

the lake that the longitudinal section (AB) has reached 23 km in length and an area It is the largest in the study period for the point (AB), and 10 km for the point (CD), while the cross section (EF) has reached a length of (19) km, and it is clear here that the expansion of the lake is mostly with the extension of (AB) especially if we know that this year It is the largest stretch of the lake.

Map (2)

The Three Sections and the Amount of Change of Water Area of Habbaniyah Lake for Spring Semester (2000)



Source: Based on the analysis of space visuals of Lake Habbaniyah, drawing of syllables on them and measuring them using (Arc Map 10.5)

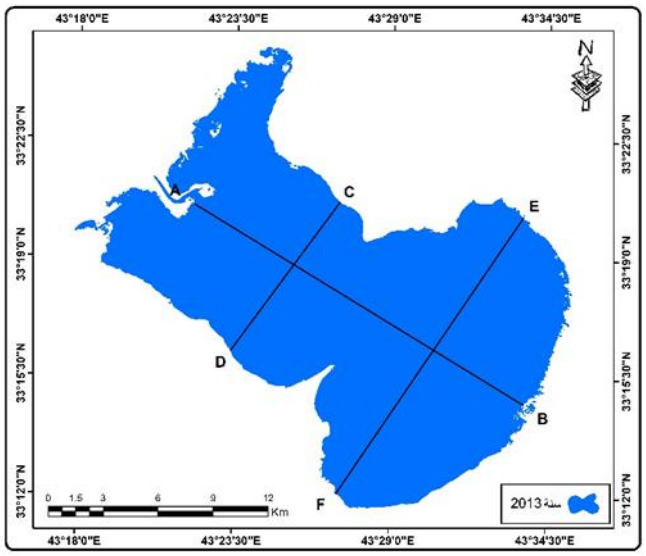
The reason for the increase in the area of the lake water on the one hand and its progress on the other hand is due to the accumulation of sediments in some sides of the lake, especially the northeastern and southwestern parts, as well as due to the slope factor of the surface of the land and the rise from the sea level to the northern side of the lake. Slope, height, and exposure to sediments represented by the southeast and southwestern sides of the lake. The reasons for the increase in the area of lake water in general for this year from 2000 were due to the increase in incoming expenses to the lake from the Euphrates River.

3- Spatial change of Lake Habbaniyah in (2018):

It is clear from the analysis of the satellite video of Lake Habbaniyah for this year during the spring season that the lake water area reached (294) km2, therefore the amount of retreat to the water area (2) km2 and a small percentage, as shown in Table (1), and by studying the three sections of the lake it became clear that the sector The linear (AB) length reached (21) km and the retraction area reached (2) km, while the cross section (CD) has reached (10) km with an area that remains relatively fixed, while the length of the cross section (EF) (18) km And with a surveyed area of (1) km, Table (1) and Map (3).

Map (3)

The Three Sections and the Amount of Change of Water Area of Habbaniyah Lake for Spring Semester Year (2013)



Source: Based on the analysis of space visuals of Lake Habbaniyah, drawing of syllables on them and measuring them using (Arc Map 10.5)

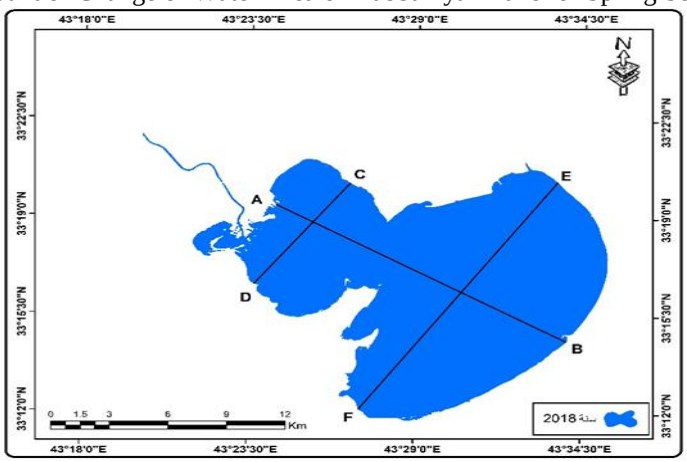
It turns out that the area of retreat of the lake water is very close to the area of retreat for the spring semester during the year (2005) and this is a simple retreat, but in fact it is the beginning of a large and dangerous area retreat of the Habbaniyah lake water, and that the decrease in the retention of the water area was due to the large water supply of the lake from the Euphrates River For the school year.

Spatial change of Lake Habbaniyah in (2018):

Through an analysis of the satellite video of Lake Habbaniyah for this year and for the spring semester it is clear that the area of the lake's water has reached (204) km2, and thus the water retraction area is (90) km2 as shown in Table (1), and by studying the three sections of the lake it is clear that the longitudinal section (AB It has reached (17) km, i.e. with a retracting area of (4) km, as well as the length of the cross section (CD) (8) km and with a retracting area of (2) km, while the cross section (EF) has reached (18) km Maintaining this along the same line without change, and can be seen through Table (1) and Map (4).

Map (4)

Three Sections and Amount of Change of Water Area of Habbaniyah Lake for Spring Semester Year (2018)



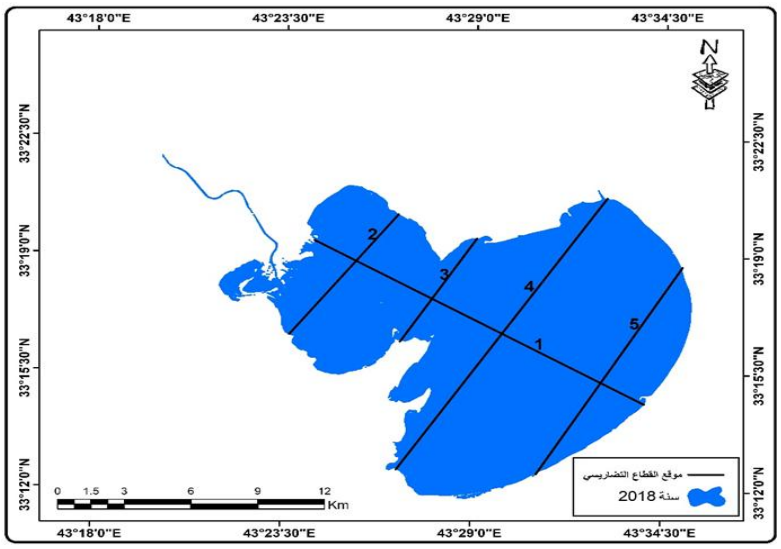
Source: Based on the analysis of space visuals of Lake Habbaniyah, drawing of syllables on them and measuring them using (Arc Map 10.5)

Second: The formal characteristics of Lake Habbaniyah and its changes:

The study of the morphological characteristics of the lake is of great importance to know the degrees of slope and elevation of each side of the lake, as well as showing the deep, medium and shallow areas of the lake, knowing the reason for the accumulation of deposits in one side without the other, and noting the formal changes in the body of the lake during the study period and the reasons for those changes, the lake has been studied in the form of Sectors to know the nature of the surface of the earth and the places of rise and fall within the region through which the sector passes, where the line rises in the areas where sedimentation increases and decreases in other regions, so six sectors were studied, one of which is longitudinal and the rest are cross-sections in order to study most of the lake area, and these sectors were studied through Satellite visual study of the Land Sat 7 satellite (DEM) for the year 2015 and its treatment using the Arc Map 10.5 program, as shown in the map (5).

Map (5)

Sites of the five sectors of Habbaniyah Lake



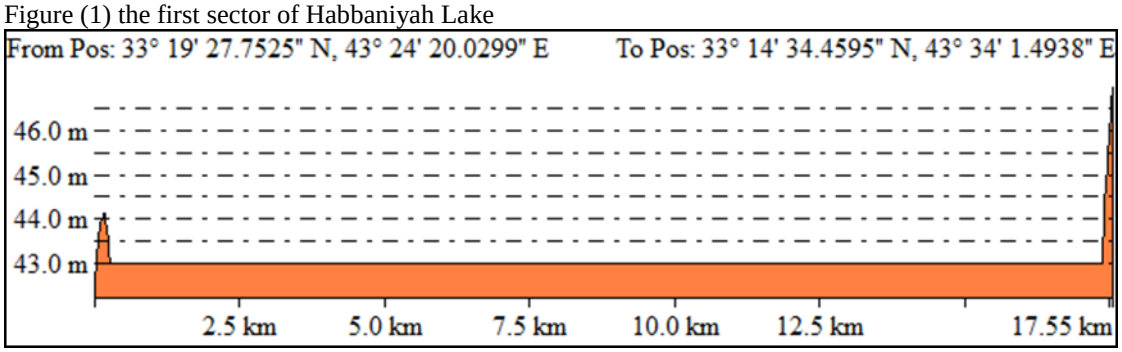
Source: Land Sat 7 Satellite Type (DEM) for 2018 and processed with (Arc Map 10.5).

When analyzing the first longitudinal sector, its length becomes clear (17.55) km. Also, the southern part of the lake at this sector has a maximum height of (49) m above sea level, and then begins gradient down until it reaches the bottom level and a height of (43) m, and this side It is one of the most declining points for the accumulation of sediments dumped by the valleys, including the Tharthar Valley, as the regression and elevation factor assisted in the area. As for the southern side of the lake at this sector, the maximum height of its edge reaches (44) m and the presence of a simple gradient gradient that starts and then ends to the bottom level Consequently, this indicates the inability of the lake to expand on this side due to the height of its southern edge with the possibility of minor changes by spatial retraction due to the presence of a slight gradient in its edge, as shown in Figure (1).

As for the analysis of the second cross-section, which has a length of (8.45) km, it turns out that the ends of the lake have a high height and reached on the eastern side to more than (49) m above sea level and then gradually take down to the bottom and in an irregular and variable way, and here it becomes clear The lake cannot be expanded at this point, and the western side at this sector has the highest elevation of the edge of the lake (46) meters, as well as a variable gradient down to the bottom but more simple from the eastern side, as shown in Figure (2).

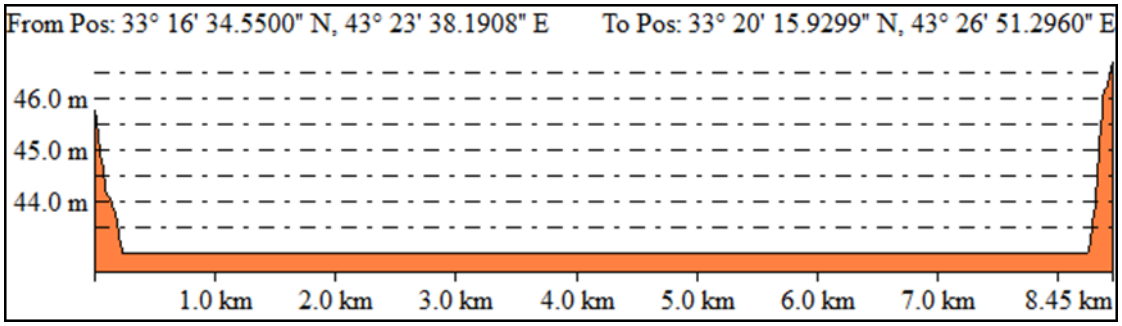
By analyzing the third cross section, which is 6.5 km in length, it turns out that the eastern side of the lake at this sector has reached a height of its edge (44.5 m) with a large slope towards the bottom with some gradients, and this is evidence of the lack of sediments in this side compared to the second sector, either. The western side of the lake is at this sector, the height of its edge has reached (45) meters and a relatively simple slope towards the bottom, and this indicates the possibility of the lake expanding in that direction if it is full, as well as indicating the presence of deposits that have worked to make the graduation towards the bottom, as shown in Figure (3).

Figure (1) the first sector of Habbaniyah Lake



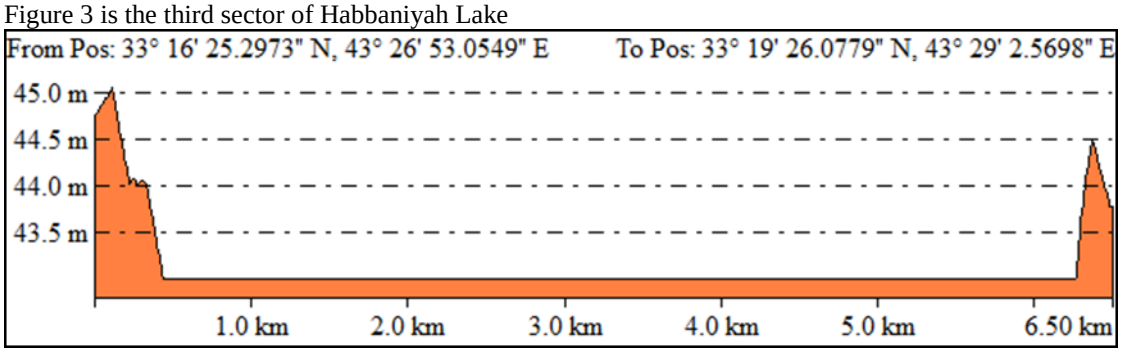
Source: Based on Map (5) and using (Arc Map 10.5).

Figure (2), the second sector of Lake Habbaniyah



Source: Based on Map (5) and using (Arc Map 10.5).

Figure 3 is the third sector of Habbaniyah Lake

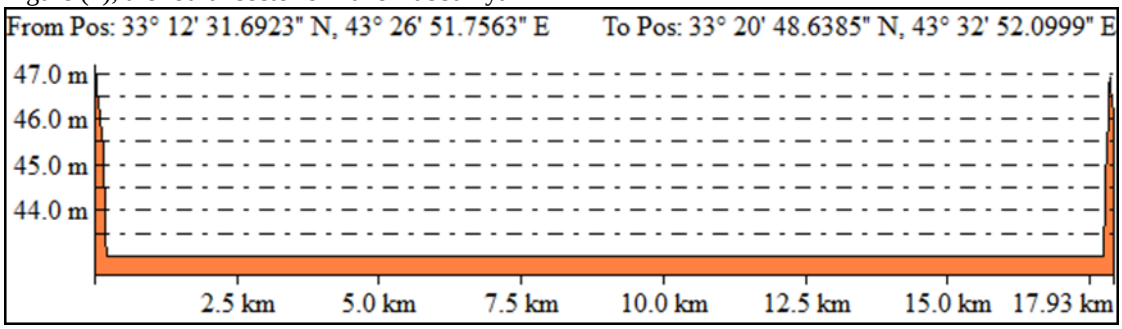


Source: Based on Map (5) and using (Arc Map 10.5).

As for the analysis of the fourth sector, which represents approximately the center of the lake with a length of (17.93) km, it is clear that the eastern side of the lake at this sector has a height of its edge in excess of (47) m, then a semi-steep slope begins, indicating a slight sedimentation at this side as well as survey changes By progressing and regressing within the area of that gradient according to the amount of lake water, as for the western side of it at this sector, the height of its edge reaches (47) m. It descends towards the bottom significantly, and this indicates a lack of precipitation as well as a few changes that occur at that part, as shown in Figure (4).).

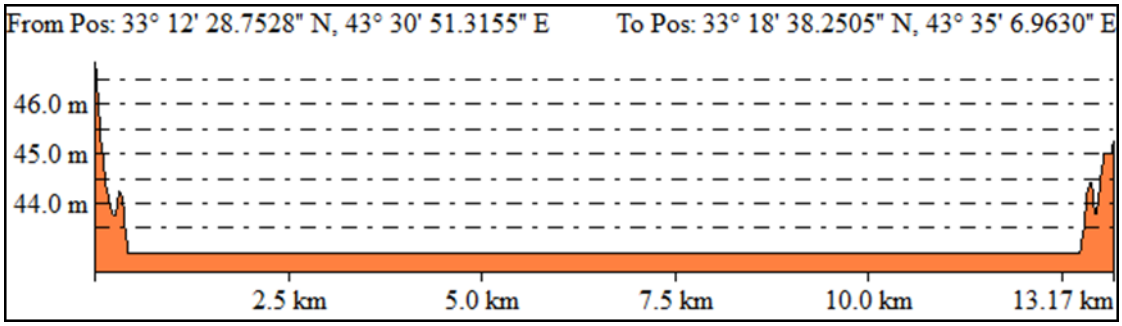
As for the analysis of the fifth sector, whose length is (13.17) km, it is clear that the height of the ridge to the eastern side at this sector reaches more than (45) m. Then it descends downward towards the bottom and gradually for these gradients. This indicates the lack of deposits and also the spatial changes according to the change in the amount of water, which It will be by retreating only to the large height of the ridge and thus the inability to expand the lake at that side. As for the western side, the height of its edge is more than (46) m and a relatively simple gradient towards the bottom and this indicates the presence of sedimentation and the possibility of progress in the event of a full lake as well as the possibility of changes , As shown in Figure (5).

Figure (4), the fourth sector of Lake Habbaniyah



Source: Based on Map (5) and using (Arc Map 10.5).

Figure (5) the fifth sector of Lake Habbaniyah

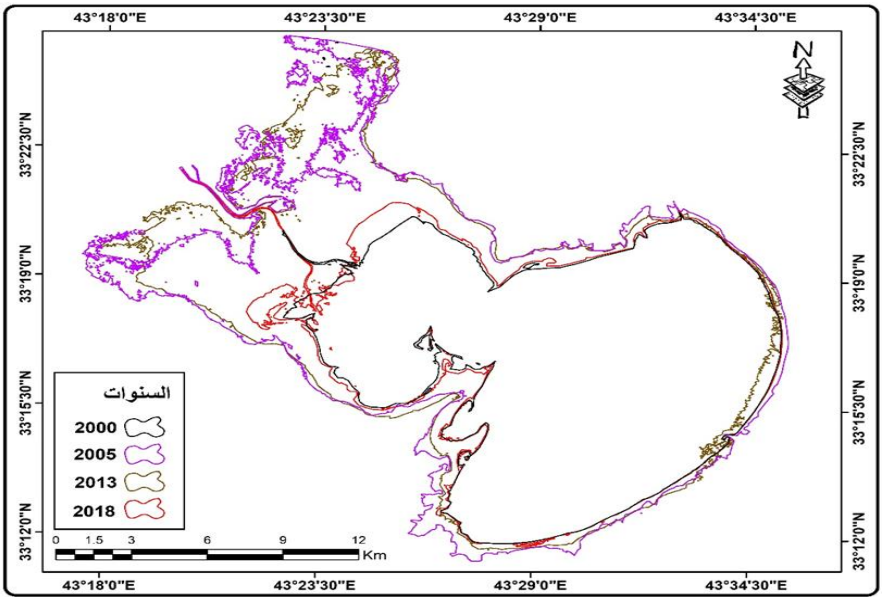


Source: Based on Map (5) and using (Arc Map 10.5).

After studying the five sections of the lake and knowing the slope and its direction and the elevation above the sea level for all sides of the lake and the reason for concentrations of deposits in one side and not others, as well as the reason for the survey progress in some areas of the lake, therefore the cause of the area and formal change of the lake can be explained annually, where surveying changes of the lake were studied for years of study Previously, it affects the shape of the lake, which witnessed a continuous change during the study years in terms of surveying progress on the one hand and regression on the other hand, and this can be seen more clearly in Map (6), where it shows the amount of area and formal change of the lake and the large and continuous contraction of it and dangerously and with results Negative in many ways.

Map (6)

The formal changes of Lake Habbaniyah during the school years



Source: Based on Table (25) and using (Arc Map 10.5)

Conclusions

1. By studying the area of the lake, the study showed a great variation in terms of area according to the water return of the reservoir in those years.

2 The year 2005 recorded the largest reservoir space during the study period with an area of 296 km2 while the year 2000 was the smallest with an area of 193 km2.

3.After studying the five sections of the lake, knowing the slope, its direction, and the elevation above sea level for all sides, it became clear why the sediments were concentrated on one side and not others.

Recommendations

1-The study recommends the necessity of continuous watering of the tank in order to increase the carrying capacity of the tank and also contribute to the disposal of deposits.

2- The necessity of rationalizing water, in a way that ensures maximum benefit from this important resource.

3- Carrying out studies that show the importance of water reservoirs and not limiting their importance in protecting against floods, but rather exceeding them to ensure a secondary water source in times of drought.

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Author Information

Dr. Aws Talak Mashaan Satam
University of Anbar – College of Education for Humanities

Dr. Ameer Muhammed Khalaf
University of Anbar – College of Education for Humanities

Dr. Zuhair Jaber Mushref Nahar
University of Anbar – College of Education for Humanities