PalArch's Journal of Archaeology of Egypt / Egyptology

A STUDY AND MONITORING THE HYDROLOGICAL INDICATORS OF THE SEASONAL LAKE OF SHARI IN THE IRAQI SALAH AL-DIN PROVINCE AND THE POSSIBILITY OF USING THEM TO HARVEST WATER USING THE TECHNOLOGIES OF GIS AND RS

[1]Dr. Aws Talak Mashaan, [2]Dr. Zuhair Nawraz Yaseen
[1]University of Anbar College of Education for Humanities. ed.aos.mishan@uoanbar.edu.iq
[2]General Directorate of Education in Anbar Governorate. awsanas699@gmail.com

Dr. Aws Talak Mashaan, Dr. Zuhair Nawraz Yaseen: A Study and Monitoring the Hydrological Indicators of the Seasonal Lake of Shari in the Iraqi Salah al-Din Province and the Possibility of Using them to Harvest Water Using the Technologies of GIS and RS-- Palarch's Journal Of Archaeology Of Egypt/Egyptology 17(6). ISSN 1567-214x

ABSTRACT

The aim of the study is to find out the storage volume and the surface area of the reservoir as well as the perimeter and the area for each contour line, by analyzing the spatial variables of geomorphological phenomena at elected levels of the reservoir, and that the working method is imposed by the process of selecting the optimum level, which is the method that leads to the goal, by identifying seven different levels. It is the maximum lake height, as the study data was derived using the Digital Height Model (DEM), which is a digital file that shows the heights of the lands on a regular basis horizontally in the form of a set of points in the region, what is determined by their flat positions (Y. X) and their height (Z), origin It was conducted by the American NASA Research and Space Sciences agency on the SRTM radar satellite with a discriminatory accuracy of (12.5 × 12.5) m for the year (2011) which is high accuracy and appropriate for this study and its treatment using the (Arc GIS 10.4) program by adopting a separator Contour (1) meter.

The optimum level ،Seasonal lake ،Keywords: Samarra

Problem Statement: Is it possible to determine the optimum storage level in Lake Shari? In addition to the damage resulting from salinization and future engineering problems, will filling it cause harm to the residents of nearby areas, whether damage resulting from the flooding of areas, displacement or changing the use of the land?

Research Objectives:

1- To create a database of possible prospects while selecting the optimum reservoir level in order to take reasonable decisions.

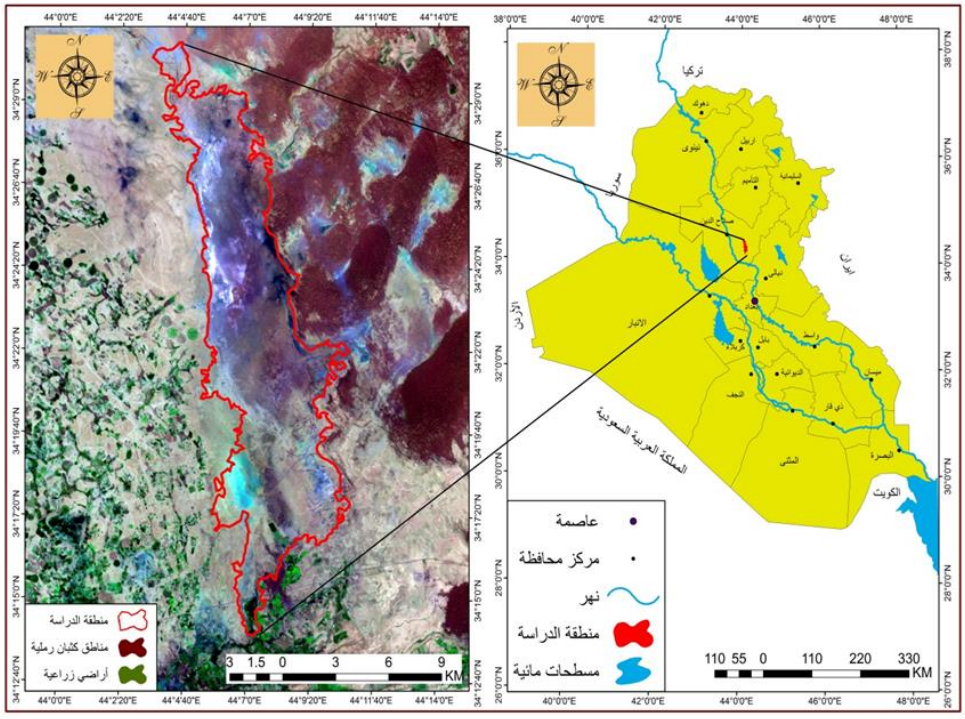
2- To decide the amount of changes in the shape of the storage basin and the effect of level change, as the reservoir can flood land areas and turn a variety of forms and examine geomorphological phenomena at levels chosen for the reservoir spatial variables.
3- The storage expansion is accompanied by an increase in the surface area of the water, which increases the amount of evaporation that instigates the salinization of water, and the seepage that contributes to an increase in groundwater recharge. The reservoir must therefore be scientifically maintained in order to allow it to benefit maximally.

Location: Lake Shari is located on the eastern side of Samarra, Salah al-Din Governorate, between the Tigris River and the Azim River.

As for its southern tip, it is relatively low and ends in a natural valley called Wadi As-Sadah, to meet this valley with the Tigris River, and this lake also derives its water from the surplus water of the Azim River, and the water stored in the Shari Lake was used to raise the proportion of Nahrawan River water in Summer season , In which the waters of the Tigris River are reduced, where the lake water moves through the dam valley, which is called Wadi Al-Rajaa', and it was called Al-Rajaa' (the returner) because it was returning the water of the lake to Nahrawan river.

Astronomically, it is located between latitude (30-13- ´34 °) and (31- ´34 °) north and between longitude arcs (3 - 43 °) and (10 - 43 °) to the east.

The Geographical Map of Shari Lake



Source: Republic of Iraq, General Survey Authority, map of Lake Shari, scale 1: 50,000 for the year 2018.

Geological and structural description of the Lake Shari area: The location consists of new or old river sediments, as well as air sediments

represented by (Sand Dunes). Water sediments and gravel conglomerate are either represented with simple surfaces in the western part and contain ripples under the sediments of river gravel deposits and sediments. It goes back to the former Al-Bakhtiari Formation of Al-Muqdadiya, (Upper Miocen), which is mainly composed of sandy and alluvial rocks with the presence of clay rocks and a proportion of secondary gypsum in parts of them and settles beneath it (Upper Miocen), as for the Middle Miocene formations, which are exposed below those sediments and consist of limestone, mudstone, and clay layers of stone, in addition to the hydrate and rock salt deposits.

The structural condition of the Shari region is that it is situated inside the Unstable Shelf in the northern part of the Mesopotamian Zone. It also suggests, specifically in the northern part of the Tigris range chain, that this part of the range was strongly affected by the alpine movement as well as by the presence of a transverse general direction fault (WSW-ENE) stretching for hundreds of kilometers and entering the border with Iran., and it is It is the result of a vertical displacement with the presence of structures with convex layers beneath the surface extending in the same direction, where they are determined depending on the results of geophysical measurements, and that the distinctive composition in the region is the presence of a concave fold. The layers are slightly towards the northeast (NE), while the northern wing of the fold appears at the Hamrin Mountains, and the tilt of the layers in them is towards the southwest direction (SW). Therefore, the study area is located in a synthetic valley.

Climatic characteristics: Before starting any hydrological study, it is necessary to study the states of the different climatic elements, because the climatic elements have a major role affecting all elements of the hydrological cycle. For this reason, the climate of the study area is hot, dry in summer and cold and rainy in winter, with two moderate seasons. Below is a detailed study of the study area, because the study area has a meteorological station available, so meteorological information for the Samarra station was obtained and its elements studied to show its role in the seasonal Lake Shari Basin area.

Rainfall: The rain fall is one of the most important climatic elements that affect the hydrological cycle, and despite the lack of rain and its fluctuation, its sudden fall in the form of rapid showers that leaves torrential rains, which plays a key role in feeding the water basins, and from the analysis of Table (4) show clear that the rains vary In their monthly averages, the months (May, June, July, August, and September) are characterized by dryness. As for the months (January, February, March, April, October, and December) they are rainy months despite their variation. The second is the highest, as it reached 29.2 mm, while the annual total in the study period was 171.5 mm / year.

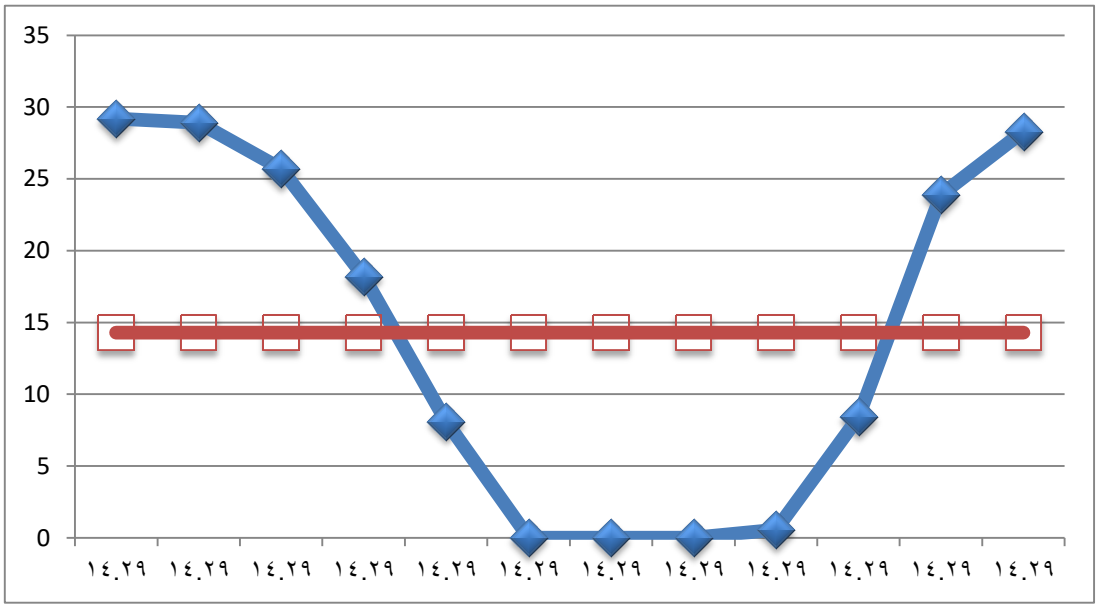
Table (4) The amount of rainfall (mm) in Samarra Station for the period (1983-2018).

Months	Jan	Feb	Mar	April	May	June	July	August	Sep	Oct	Nov	Des	l
Rainfall	29.2	28.9	18.2	25.7	8.1	**0**	**0**	**0**	0.57	8.4	23.9	28.3	171.5

Source: Ministry of Transport and Communications, General Authority for Meteorology and Seismic Monitoring, Climate Division, (unpublished data)

From Figure (2), the great variation in the rate of rainfall becomes clear, especially if we know that there are three months characterized by complete drought, which are the months (June, July, August).

Figure (2) Average precipitation (mm) for the period (1983-2018).



Source: based on Table (4).

Temperatures: Table (5) shows the increase in the average maximum temperatures in the months of July and August, as the average temperature reached (44 and 43.8) C, respectively, while the lowest temperatures reached (the minimum temperatures) in the months (January, February, and December First) (4.9, 6.5, 6.5) m 0, and it is evident that the thermal range varies greatly between the maximum and minimum temperatures, as it was recorded (July, August) (16.1, 16.3) m 0 and this range is large and its effect on evaporation from water bodies is evident. The annual recorded is 23.3 m, which is very high and affecting the surface of Lake Shari.

Table (5) Monthly and annual averages of the maximum and minimum temperature (C0) at t he station in Samarra for the periods in question (1983-2018)

Months	Jan	Feb	Mar	April	May	June	July	August	Sep	Oct	Nov	Des	I
High	14.8	17.4	22.9	29.5	32.8	40.3	44	43.8	39.7	32.7	23.6	16.7	**30.1**
Low	4.9	6.5	10.3	15.8	21	24.7	27.9	27.5	23.9	18.6	11	6.5	**16.5**
Average	9.85	11.95	16.6	22.6	26.6	32.5	35.9	35.6	31.8	25.6	17.3	11.6	**23.3**

Range	9.9	10.9	12.6	13.2	11.8	15.6	16.1	16.3	15.8	14.1	12.6	10.2	**13.6**

Source: Ministry of Transport and Communications, General Meteorological and Seismic Mo nitoring Authority, Division of Climate (unpublished data).

Evaporation: Evaporation is one of the climatic components that has a major role to play in determining the quantity of flowing water and in determining the water balance of water supplies and in determining the actual rainfall value. This factor is influenced by other climate factors.

Table (6) shows the amount of evaporation (mm) in Samarra station for the period (1983-2018)

Months	Jan	Feb	Mar	April	May	June	July	August	Sep	Oct	Nov	Des
Evaporation	70.7	96.9	155.4	231.8	341.1	426.5	486.2	464.2	337.8	256.7	140.3	256.7

Source: Ministry of Transport and Communications, General Authority for Meteorology and Seismic Monitoring, Climate Division, (unpublished data)

Based on the analysis of Table (6), it was found that the highest evaporation rate in the months (July, August) was observed, corresponding to the highest recorded months of the year and that evaporation is directly influenced by the increase in temperatures.

Hydrological analysis: This analysis shows the different reflections between the level and its relationship with the storage volume on one side and the surface area on the other side, as well as the relationship between the reservoir perimeter and the shape coefficient and the submerged areas, as well as the determination of the maximum level height within the lake in order not to interfere with the limits of the lake In order to ensure that the boundaries of various human activities do not clash, whether they are residential, agricultural, leisure or other diverse activities, the preparation of a database enables design professionals to refer to support their decisions in a manner that does not conflict with storage.

Since the hydrological study forms the basis for the management and growth of water supplies and their protection, which is the result of an increase in population and, thus, an increase in demand and a continuous pressure on new water sources, which calls for the development of research and analysis methods for water problems and knowledge of their characteristics and for the development of research and analysis methods for water problems. Also, To maintain this resource's permanence in order to grow the agricultural sector.

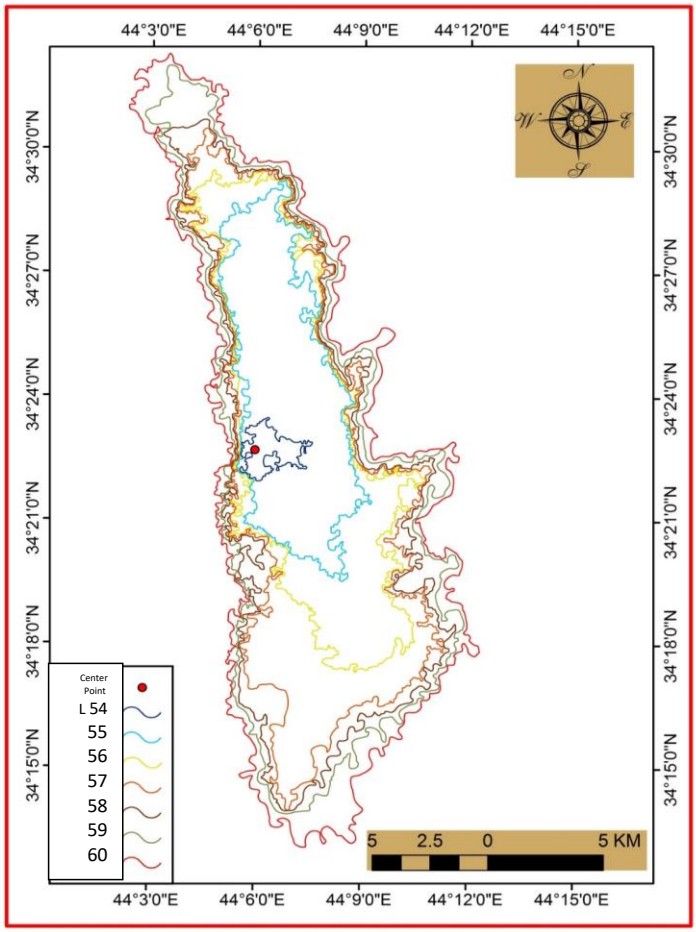
It was necessary to find alternatives that would conserve the water resources available, and also to find alternatives that would achieve the economic viability of projects that rely on water resources, which are the most critical vital sector for achieving economic growth. The research therefore aims to exploit Shari Lake as a water resource, particularly if we know that the

province of Salah al-Din owns agricultural land, some of which need water for scientific and practical use .

Due to the importance of water resources at the present time, which coincides with the shortage of water resources and the influence of upstream countries over Iraq's imports of water, it has become important to find alternatives for efficient water usage. Despite the fact that the Tigris River nearly bisects the 350-km long Salah al-Din Governorate from north to south. This does not deter the search for new sources of water, such as the 100 km long Azim River, and the widespread groundwater dividing its exploitation into two parts, artesian wells and surface wells, and the existence of the Samarra Dam and Tharthar Valley played a role in the expansion of agricultural land. From here came the idea. Research into the exploitation of Lake Al-Shari through the construction of a lake dam and the use of its seasonal waters to increase the area of agricultural land.

Procedures: Based on the digital elevation model (DEM), the research aims to construct a derived table of Shari lake depths with different measurements to calculate the amount of water at each level, which is a digital file that regularly displays the heights of the land horizontally in the form of a group of points in the region that determine their level positions (X Y) and their height (Z). The US Agency for Research and Space Sciences (NASA) prepared this model by means of an SRTM radar satellite with a differential resolution of (12.5 x 12.5) m for the year(2011), which is a high resolution appropriate for this analysis and its therapy using the software (Arc MAP10.4.1) by adopting a contour interval(1) meter. Seven levels of the map (2) were determined consecutively and were of different areas, where the study area occupied an area of 149.63 km2, the area of the first level was 5.19 km2 and that was at contour line 54 above sea level with a line length of 20.13 km, where the amount of water at this level was 5190 million m3 It is the smallest level in terms of area and water volume, and it is the first line around the center point. Table (2), while the net area of the second level was 61.72 km2 at the contour line (55 above sea level, with the circumference of its line length of 73.52 km) and the quantity of water estimated at about 61,720 million / m3, and at this level the largest possible amount of water storage in the study area is determined. It is ranked second on Contour Line 56 above sea level in terms of the amount of water storage, as its capacity to consume 36,450 million / m3 of water covers an area of 36.45 km2 and its perimeter line is 117.86 km long.

Map (2) elevation lines of Lake Shari



Source: From researcher's previous work focused on a digital elevation model (DEM) with differential precision (12.5 x 12.5 m) and processed using software (Arc GIS 10.4.1).

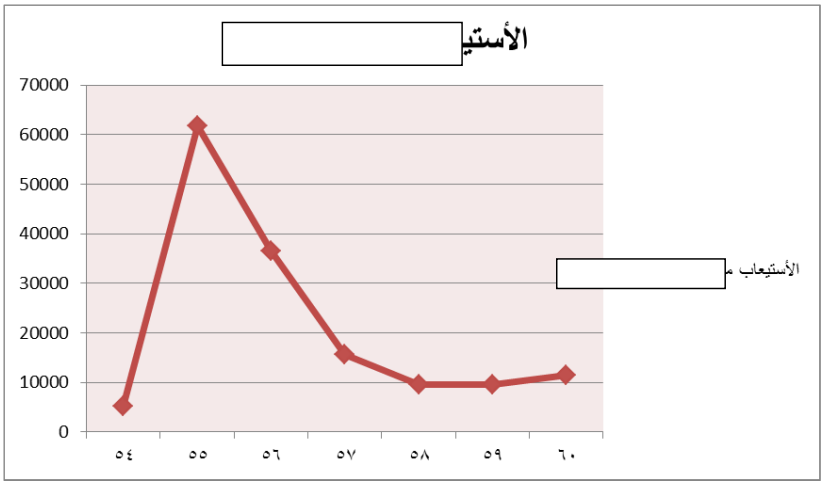
Table (2) shows areas and quantities of water distributed according to contour lines.

Water intake volume (million m3)	Net area (km2)	Line length (km)	Height (meters)	line
5190	5.19	20.13	54	**1**
61720	61.72	73.52	55	**2**
36450	36.45	117.86	56	**3**
15730	15.73	129.33	57	**4**
9510	9.51	141.98	58	**5**
9650	9.65	168.57	59	**6**
11380	11.38	191.11	60	**7**
149630	**149.63**	**842.51**	**7**	**T**

Source: Arc Map 10.4.1 output.

While the area of 15.73 km2 occupied the fourth level, represented by line 57 above sea level, with a circumference of 129.33 km of long line, this level was able to store 15730 million / m3 of water. Line 58 above sea level would then have recorded an area of 9.51 km2 and a length of 141.98 km2. The capacity of line 59 was 9510 million / km3, and the capacity of line 59 did not differ significantly from that of the previous line in terms of its ability to absorb water, since the capacity of that line was estimated at 9650 million / m3 and its perimeter was 168.57 km long. Km2, while its perimeter line is 191.11 km long and can accommodate 11380 million / m3 of water, and it was collected to estimate the maximum possible amount of water in the reservoir to reach 149.630 million / m3 after studying each line and calculating its water absorption capacity. (see figure 1)

Figure 1: Water capacity million / m3 for each contour line.



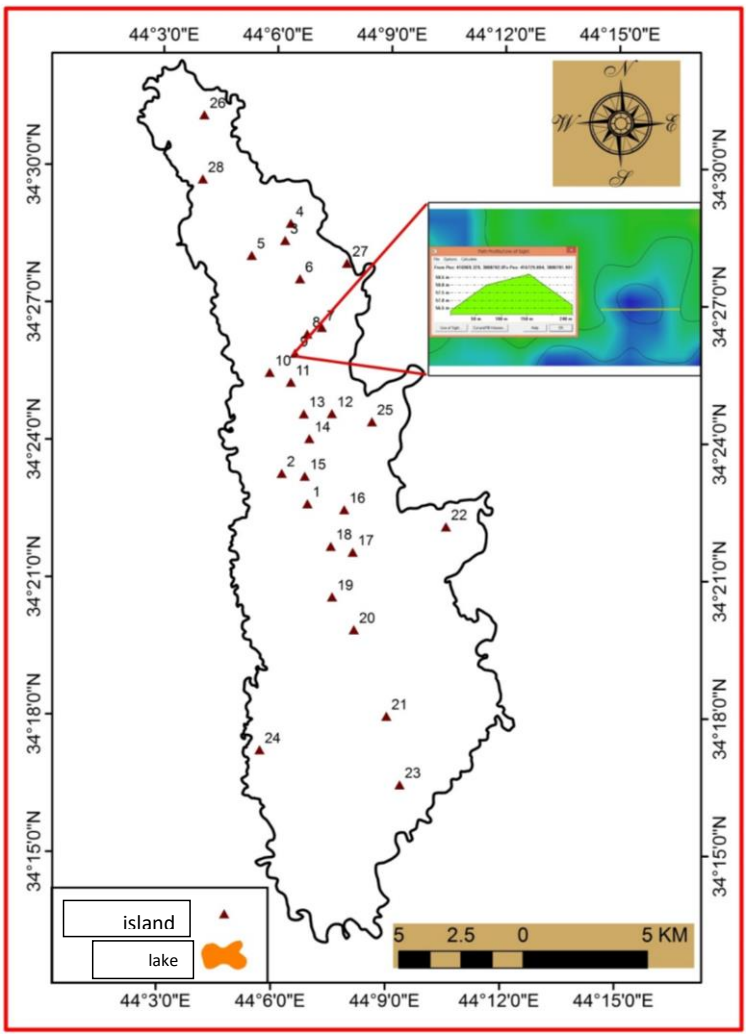
Source: researcher's previous work based on Table 2

The dimensions of the reservoir: In hydrological studies, the study and analysis of the shape of water reservoirs is very important as it clarifies the relationship between the reservoir body and its capacity, which makes it easier to measure and estimate the shape factor, which is the basis for the reservoir's significant spatial characteristics, and remote sensing techniques have been adopted to estimate the surface.

The geomorphological forms covering the lake basin are various and take the form of different hills in terms of distribution and height, map (3), when the levels rise to cover the lower parts of them it takes another form defined by river islands, and the areas of these islands vary inversely with the height of the level as the areas of these islands decrease with the height of the water table (3 The relationship between location, volume and water level is the basis of the hydrological analysis, as the future reservoir operational strategy is designed to determine the usage of the land at each level after the storage phase and to determine the optimum level after the storage process to ensure the safe operation of the reservoir. The analysis aims to examine the spatial

variables of the hills at different levels within the lake, on the basis of which the reservoir surface area is measured, as well as the water depth and the shape factor. At each hypothetical reservoir stage, the changes that occur are also studied.

Map (3) Distribution of hills within Lake Shari



Source: Based on the digital elevation model (DEM) with distinct accuracy (30 x 30) meters and the outputs of Arc Map 10.4.1.

Table (3) The areas of hills that form islands with each level.

Contour line	Height / M	Island area (m^2) in height 57	Island area (m^2) in height 56	Island area (m^2) in height 55	Island area (m^2) in height 54	S
54	**1**	**-**	**-**	**-**	**129.97**	**1**
54	**1**	**-**	**-**	**-**	**71.30**	**2**
54	**1**	**-**	**-**	**-**	**125.20**	**3**

54	1	-	-	-	138.79	4
55	2	-	-	4.46	18.12	5
55	2	-	-	27.56	27.89	6
54	1	-	-	-	14.88	7
54	1	-	-	-	83.77	8
54	1	-	-	-	19.65	9
55	2	-	-	5.36	9.20	10
54	1	-	-	-	16.74	11
54	1	-	-	-	33.75	12
54	1	-	-	-	13.83	13
54	1	-	-	-	20.74	14
55	2	-	-	13.49	16.32	15
54	1	-	-	-	23.20	16
54	1	-	-	-	30	17
54	1	-	-	-	10.19	18
54	1	-	-	-	95.87	19
54	1	-	-	-	24.83	20
55	2	-	-	12.26	29.14	21
56	3	-	8.28	10.47	19.43	22
54	1	-	-	-	21.6	23
54	1	-	-	-	13.47	24
56	3	-	6	9.57	21.90	25
55	2	-	-	6.39	10.11	26
57	4	2.83	5.17	22.35	26.19	27
54	1	-	-	-	10.98	28

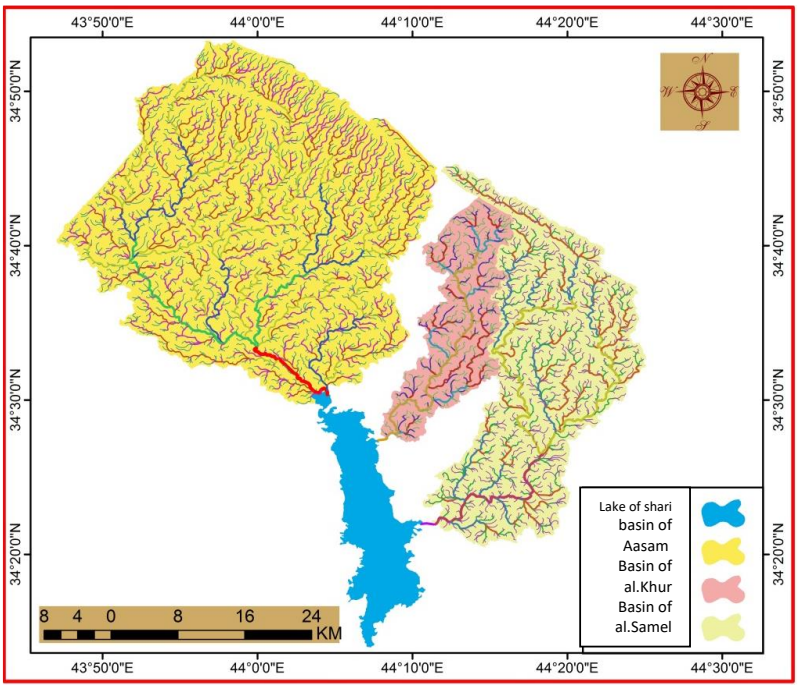
Source: From the researcher's work using the map (3).

Number of layers	Length km	Area km^2	Valley name
7	42.82	1018.69	Aasam

6	41.10	470.35	**samel**
5	30.87	180.91	**alkhr**
		1669.95	**I**

The area of Lake Shari Basin is 1669.95 km2 divided into three wadis, and Wadi Al-Asam is the largest, with an area of 1018.69 km2 and consists of seven river levels, while Wadi Al-Samal comes second in terms of area 470.35 km2 and Wadi Al-Kharr is the smallest with an area of 180.91 km2 and can be through the analysis of Table (4) And Map (4) Map (4) The Water Basin of the Shari Lake Valleys **Table (4) The water basin of Lake Shari**

The area of Lake Shari Basin is 1669.95 km2 divided into three wadis, and Wadi Al-Asam is the largest, with an area of 1018.69 km2 and consists of seven river levels, while Wadi Al-Samal comes second in terms of area 470.35 km2 and Wadi Al-Kharr is the smallest with an area of 180.91 km2 and can be through the analysis of Table (4) And Map (4) Map (4) The Water Basin of the Shari Lake Valleys.



Source: Arc Map4.1 program output based on the Ministry of Irrigation, General Commission for Survey, topographic map, scale 1/25000.

This means that the basins of the study area vary in their water yield according to the variation of their areas in the event that other factors affecting the amount of runoff remain constant. Knowing the hydrology of the study area has great importance as it is the most important natural resource on which the economic well-being of any country depends.

It is also clear from the map that there is no valley on the western side of the lake, as there are secondary wadis all heading to the Tigris River, which indicates that the western side is relatively high compared to the rest of the regions.

Conclusions:

1- The area of the reservoir is large and can be adopted as a source of water in Iraq, as the area of the reservoir reached (149.63 km2), while the areas of the valley basins that form the lake basin varied greatly.

2- The Lake Shari Basin consists of three valleys, and Wadi al-Asam is the largest of these valleys, with an area of 1018.69 km2, while Wadi al-Samal comes second with an area of 470.35 km2, and the smallest of these valleys is 180.91 km2.

3- The total annual rainfall in the study area is 171.5 mm, and it is characterized by not being distributed throughout the days of the year. Rather, it falls mostly suddenly, which increases the flow factor and thus can be used.

4- The lake bed is characterized by the abundance of hills in it, as it reached 28 mounds, most of them with a slight height.

Recommendations:

1- The study recommends first the adoption of strategic plans in the exploitation of water by establishing a group of dams in valleys and depressions and adopting them as sources of fresh water.

2- Working on expanding the reservoir and increasing its capacity to absorb large quantities of water, especially if we know that Lake Shari alone has more than 28 hills, most of which do not exceed a few meters.

3- Since Lake Shari is a seasonal lake, it is possible to establish tourist complexes in those areas that would provide job opportunities.

References:

(Bashir Yusef Francis. Encyclopedia of Cities and Sites in Iraq - Part One (pdf) E-Kutub Ltd., page 125.

Bolton,C.M.G., Geological report on the saline deposits of shari lake, Near Sammara. *REPOH*, 1956, VII(36), sitc investigations Co. Ltd.

Buday, T. (1980). The Regional Geology of Iraq: stratigraphy and pale geography, Dar Al- Kutib Pub. House Univ of Mosul, 445p..

Buday, T. (1987). The Regional Geology of Iraq Vz. Tectonic and structure. , 445p..

Buday, T. (1987). The Regional Geology of Iraq Vz. Tectonic and structure.

Araim, H.I.; Iaboutka, M. and Ghazoul, S. (1976). Report on Hydrogeological in Shari lake- Sammara, state organization for minerals Baghdad.

Abdulaziz Muhammad Al-Bassam, *The Importance of Hydrological and Hydrogeological Information, in Assessing the Water Situation*, King Saud University, 2005, p. 53.

Directorate of Water Resources in Salah al-Din Governorate, unpublished data, 2018.

Muhammad Sabry Mahsoub, *Geomorphology of Earth Forms*, Cairo University, Arab Thought House for Printing and Publishing, 2001, p.205