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STUDY IN SURFACE AND HYDROLOGICAL ANALYSIS FOR THERTHAR LAKE AND SURROUNDING AREAS BY GEOGRAPHIC INFORMATION SYSTEM (GIS)

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ABSTRACT
This study aims to surface and hydrological analysis to the Therthar Lake and the surrounding areas by using digital elevation model (DEM) for the region and the product of radar data, which is one of the most important sources digital used in geographic information systems (GIS). In this research was to use digital elevation model as data entry to GIS programs through integrate it with each other and extract surface and hydrological analysis of Therthar Lake and its surrounding areas.

KEYWORDS: Therthar Lake, hydrological analysis, digital elevation model.

INTRODUCTION

Geographic Information System (GIS) refers to a system used for storing, manipulating, and retrieving spatially referenced data. This definition also includes systems designed to capture spatial information and to process it. Data in a GIS are its database, usually composed of data planes derived from different data sources. The combination of data sets allows data interpretation. A data plane is composed of one data type, for example, digitized elevation data. Digital data may either be in form of written text, Maps tables or photographs[1]. Digital elevation models (DEMs) provide one of the most useful digital data sets for a wide range of users. The need for global coverage with a medium scale DEM (1-3 arc second or 30-100 m post spacing) led to the Shuttle Radar Topography Mission[2]. Digital Elevation Models (DEM) also called digital terrain models provide a 3D representation of the real-world topography. DEM creation requires data collection and processing procedures. Data collection step depends on the areal extent and importance of the study. They can be constructed by ordinary ground survey when the area is small or when the objective is of relatively minor importance. On the other hand if the area is large satellites can be used to map the ground. These maps then have to be processed by remote sensing imagery to give topographic elevation information. This is how the DEMs covering the entire world, for example, those from Consortium for Spatial Information (CGIAR-CSI) are formed. DEMs play vital role in hydrological analysis especially in delineating watersheds, obtaining stream network, and related analysis. The accuracy of the stream network obtained from DEMs is highly dependent on the resolution of the DEM[3].The digital elevation model of one of the basic components of GIS and the base upon which to infer properties relating to Topography valleys and extrapolation of information about the surface topography and properties of hydrological flow of waterways using a variety of analytical methods applied to the digital elevation models to calculate the altitude values and tendencies of the ground surface and monuments as a border docks water and water drainage network.

METHODOLOGY

The databases which included several layers after the introduction of the necessary data for the composition of each layer as in the figure (3) where this data was treated using a geographic information system software used in this research.

The study area

Therthar Lake is located in the west of Iraq, between the provinces of Anbar and Salahddin between longitudes (43˚-44˚) and latitude (33˚-35˚) Figure (2) and (3).

Surface Analysis

Elevation

The advantage of a digital elevation model (DEM) it can take by model analysis and classification work to the DEM for the values of elevation in the study area. The searcher classifies DEM to five levels for easy identification of rises in the study area[4]. As shown in figure (4).

Figure (4) of the areas color dark green areas represent at least rise in the study area (15 m - 83 m), where it appears the Therthar Lake area of the southern and eastern regions of the study area (the end of the sedimentary region). While areas represent a pale green and yellow flat areas of high (83 m -204 m) it is located north-west of the study area. While areas in brown and red represents the most up areas in the study area (277 m -518 m)

Contour line

It is an imaginary line connecting the set of points that have the same level rise as in figure (5).

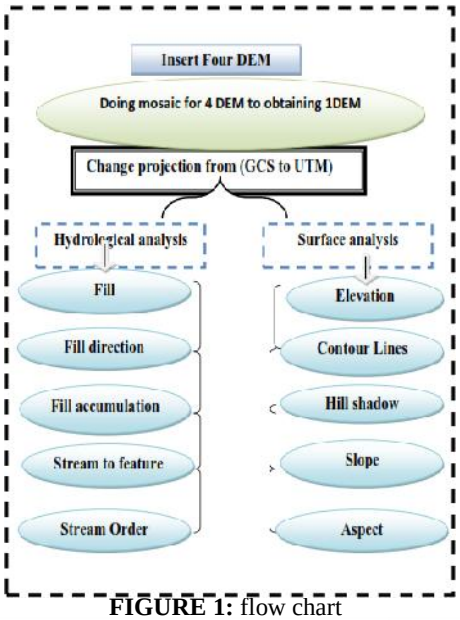

FIGURE 1: flow chart

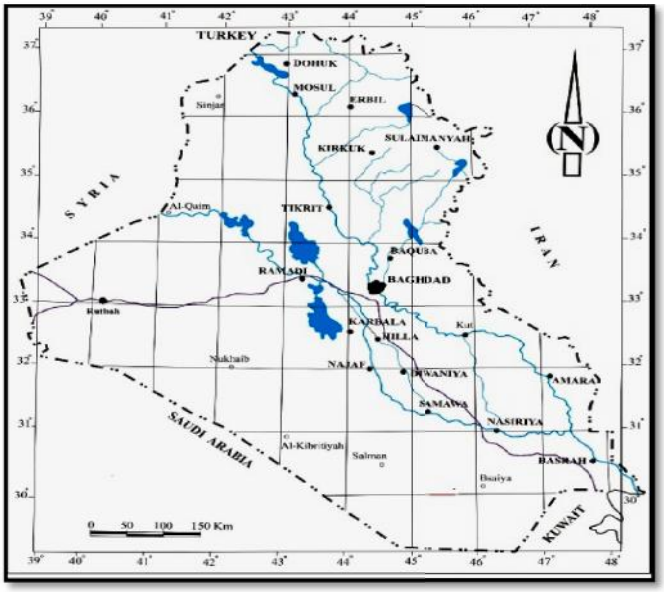

FIGURE 2 Iraq map

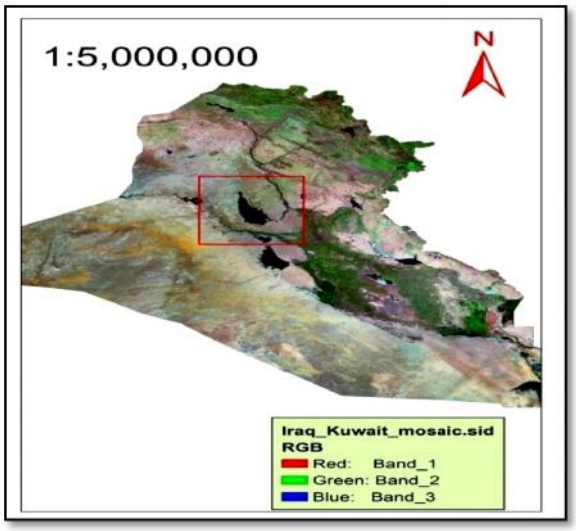

FIGURE 3: Iraq satellite image

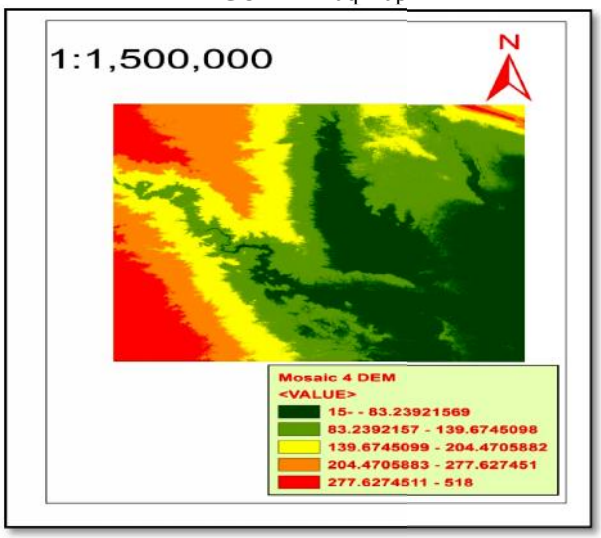

FIGURE 4: map of elevation for study area

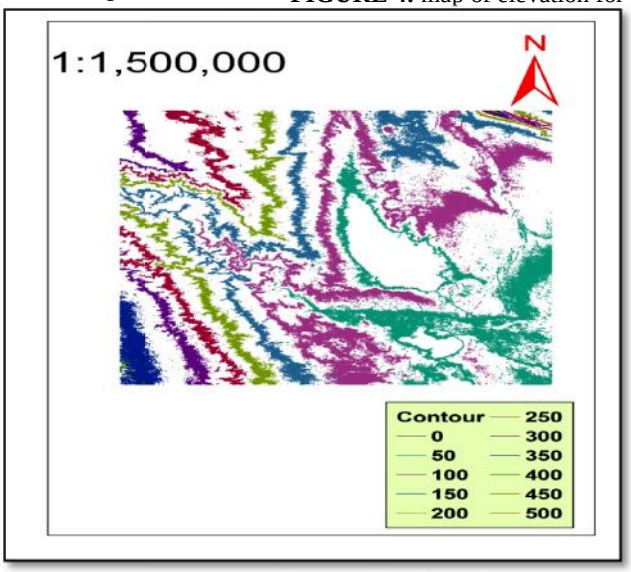

FIGURE 5: map of contour line for study area

Slope

The slope is generated from a topographic ratio, which represents the ratio of the elevation difference between two points divided by the horizontal straight distance between the two points. The slope is derived from the Digital Elevation Model (DEM), and classified into 5 slope percentage classes according to the FAO slope classification Table (1). Show the classification of slope in five zones[4] the result map as shown in figure (6).

TABLE 1: Slope classification

No	Slope class	Slope %
1	Flat	< 2
2	Undulating	2 – 8
3	Rolling	8 -15
4	Hilly	15 – 30
5	Mountainous	>30

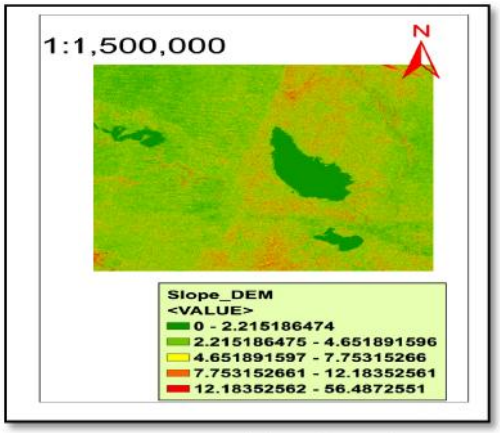

FIGURE 6: map of slope for study area

Through Figure (6) Note that the region is color dark green represents less valuable slope (0°-2.2°) and found to be in the Therthar Lake area and Lake Habbaniyah and part of the Euphrates River in the area between the (Ana and Hdetha) The reason why it is known that the water level has slope. While areas that appear in red biggest owns a slope around Therthar Lake region.

Aspect

When the earth is flat sloping they face in terms of geographical entities (north, northeast, ... *etc*.), a box that stores the values of the picture elements which represents the corner facing this element in the ability of digital elevation model on the scale is the sixtieth square guidance in this box elements of digital values ranging between 0-360 to indicate the direction in which faces the ground[5] the result map as shown in figure (7).

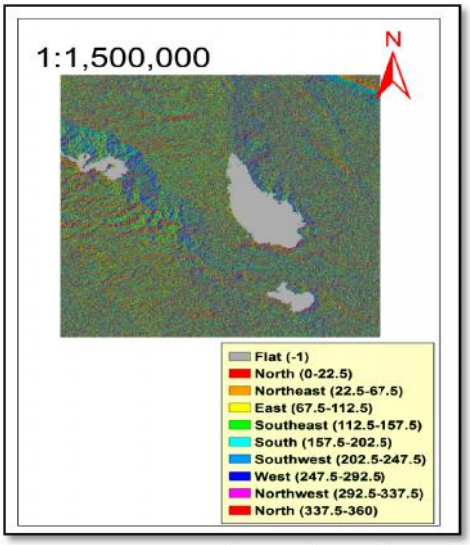

FIGURE 7: map of aspect for study area

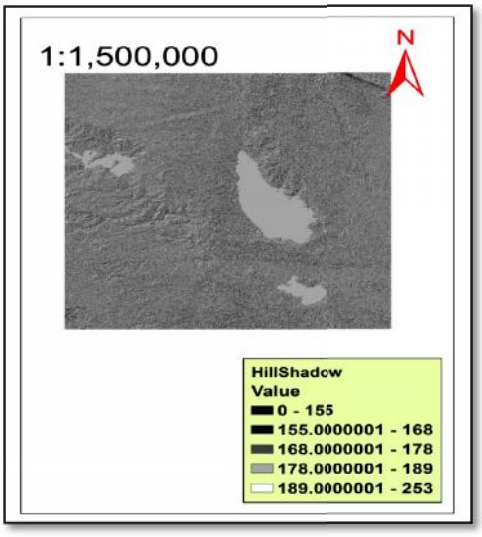

FIGURE 8: map of hill shadow for study area

Through Figure (7) Note that the region is color gray represents less valuable aspect (flat (-1) and found to be in the Therthar Lake area and Lake Habbaniyah and part of the Euphrates River in the area between the (Ana and

Hadetha) The reason why it is known that the water level has slope.

Hill shadow

The shadow of the earth represents default lighting the Earth's surface as a result of the existence of the sun at an altitude of (45˚) and (315˚) azimuths and range of value (0-255) to zero is not facing the sunlight while facing (255) sunlight directly. The shadow of the Earth gives data three-dimensional appearance [5]. The result map as shown in figure (8)

Hydrological Analysis

Hydrological analysis of the most important analyzes that can be used in digital elevation models are considered. Which specializes in water depth, trends and communicated with each other, who suggest that modeling in a Geographical Information System (GIS) with embedded hydrological tools is useful? Such hydrological tools rely on a surface model, a gridded DEM, whose quality determines the quality of the analysis. Since movement of water is primarily driven by gravity, the lowest pass in the DEM indicates the flow path[6].

To extract the flow accumulation and drainage pattern the following steps were carried out:

Fill Sinks

It is important that eventually sinks or pits are removed from the DEM to avoid discontinuities in the flow network. The sinks could be caused by errors in the sampling points, during the generation of the DEM (false sinks), or it could be naturally sinks in the terrain (true sinks). In relatively steep terrain greater sinks than one meter could be assumed as false. Sinks in the DEMs used in this article have been removed by the sink filling method, which is the most common method for this purpose. This method aim that the height level in the sinks gradually is raised until the level of the lowest out flow is reached, see Figure (9) [7].

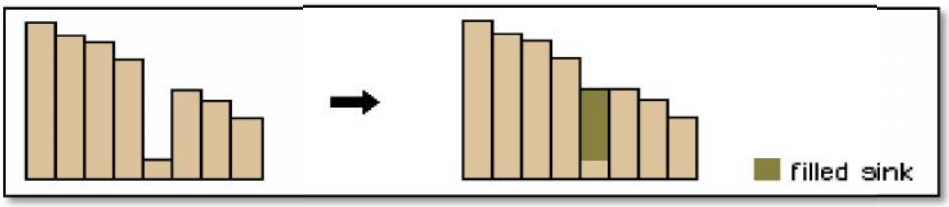

FIGURE 9: the filling method [8]

The result map after use fill method as shown in figure (10).

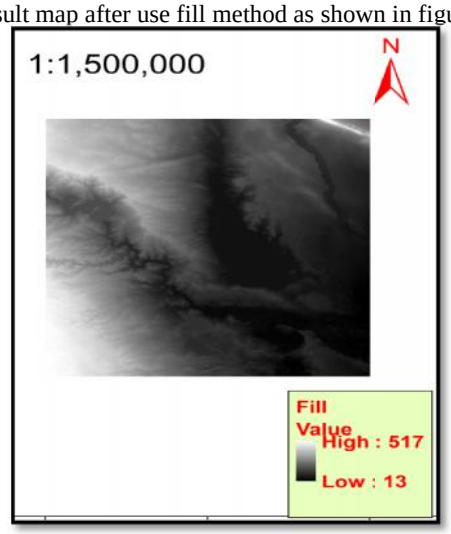

FIGURE 10: shows a digital elevation model after using fill method

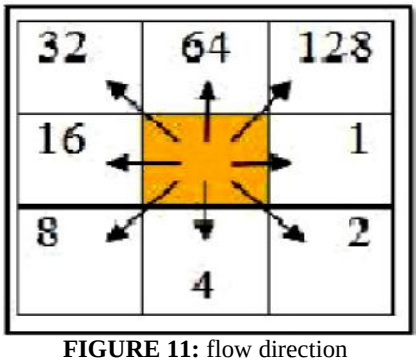

FIGURE 11: flow direction

Flow direction

This function computes the flow direction for a given grid. The values in the cells of the flow direction grid indicate the direction of the steepest descent from that cell. This function computes the flow accumulation grid that contains the accumulated number of cells upstream of a cell, for each cell in the input grid[8].

If assume the existence of our water in the cell layer of the value of this cell is calculated according to the direction in which this water will overwhelmingly. The water Ascends vertically to the top (64) to take the

Cell value, if moved to the right, take cell value (1)

There are eight feasible flow directions determined by unique numbers; East = 1; Southeast = 2; South = 4; Southwest = 8; West = 16; Northwest = 32; North =64; Northeast = 128" [9].

The result map after use flow direction method as shown in figure (12)

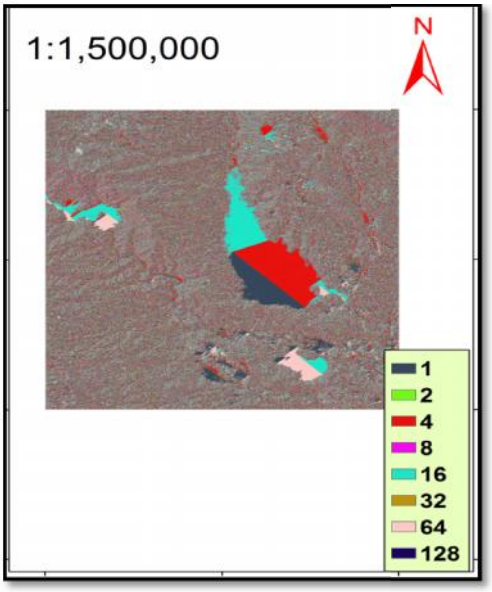

FIGURE 12: shows a digital elevation model after using flow direction method

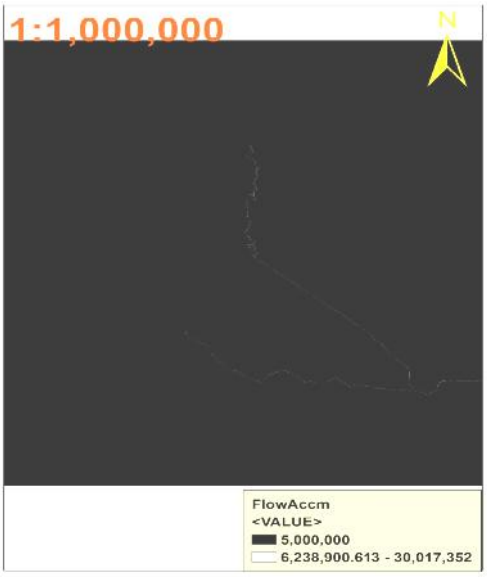

FIGURE 13: shows a digital elevation model after using flow accumulation

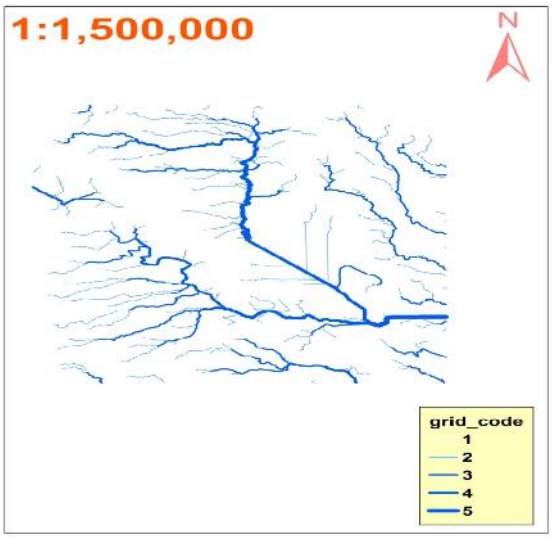

FIGURE 14: the water way in study area

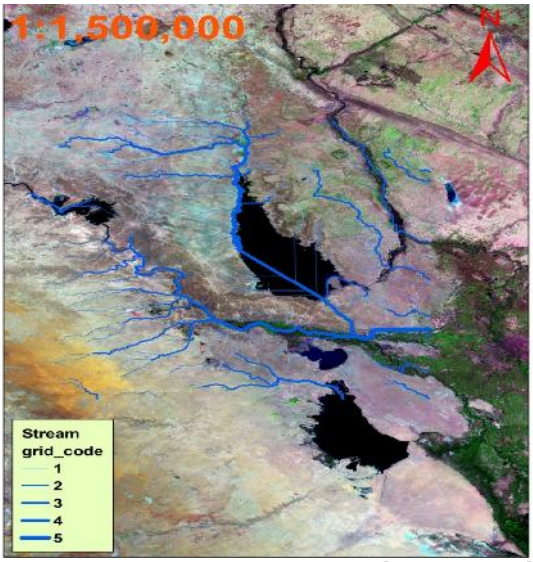

FIGURE 15: projection water way in study area on satellite image for study area

Figure (12) that the water direction of Therthar Lake consists of three trends, namely) ,

1- South of the south-eastern part of the lake
2- East in the northern part of the lake
3- East in the south-eastern part of the lake

Flow Accumulation

As mentioned, the main motivation for addressing the flow routing problem is its role in the computation of flow accumulation. Flow accumulation quantifies how much water flows through each cell of a terrain if poured uniformly onto it (and assuming the terrain surface is impervious). To compute the flow accumulation we assume that each cell initially has one unit of flow (water) and that the flow of a cell (initial as well as incoming) is distributed to the neighbors using the flow directions (assuming no infiltration and no evaporation)[7]. The result map after use flow accumulation method as shown in figure (13)

Stream Order

A layer of classification lines Entry into water by grade, where class

1 lines entry into water secondary and flowing lines in entry into water

Level 2. This is called Category (stehler).

According to the stehler which states that the primary rivers has the first rank and the second rank consists of two branches gathered from the first grade and made up the third rank of the two branches gathered from the second grade and so on in the rest of the ranks .the main river take the highest-ranking value and can receipt of all least ranks directly. Since the GIS data Qaeda organized in tables indexed and classified with respect to the ranks and

the number of sewage and length in each rank it easy to query the number and length of each rank in the process [10]. The result map after use stream order method as shown in figure (14).

CONCLUSION

Results of the hydrological analysis steps of the study area
From fill sink tool we got a DEM of study area without any sinks and pits and make the flow network continuities
From flow direction tool we got that the water direction of Therthar Lake consists of three trends, namely

- South of the south-eastern part of the lake
- East in the northern part of the lake
- East in the south-eastern part of the lake

From flow accumulation we got the watercourse of the study area
From stream order we got waterways classified in Therthar Lake and extracted from the DEM to five degrees it can be called from the narrowest course to the wider course, including water source, water table, watercourse, Small River, river.
Finally projection water way of Therthar Lake on satellite image for study area.
From elevation tool we got many areas have different elevations where the areas color dark green areas represent at least rise in the study area (15 m - 83m), where it appears the Therthar Lake area of the southern and eastern regions of the study area (the end of the sedimentary region). While areas represent a pale green and yellow flat areas of high (83 m -204 m) it is located north-west of the study area. While areas in brown and red represents the most up areas in the study area (277 m -518 m).
From contour line tool we got the contour lines of study area and each line has elevation. Where the contour lines of study area have elevations from (0-500 m).
From slope tool we got the degree of slope of study area. Where the region is color dark green represents less valuable slope (0°-2.2°) and found to be in the Therthar Lake area and Lake Habbaniyah and part of the Euphrates River in the area between the (Ana and Hdetha) The reason why it is known that the water level has slope. While areas that appear in red biggest owns a slope around Therthar Lake region.
From aspect tool we got the face slope of study area. Where the region is color gray represents less valuable aspect (flat (-1) and found to be in the Therthar Lake area and Lake Habbaniyah and part of the Euphrates River in the area between the (Ana and Hadetha)The reason why it is known that the water level has slope.
From Hill shadow tool we got the strength of hill shadow of study area. Where the dark black region has hill shadow equal (0-155) and note that Therthar lake has hill shadow equal (178-189).

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