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PRODUCING A GEOGRAPHICAL INFORMATION SYSTEM (GIS) MODEL FOR THE PRELIMINARY LOCATION OF GROUNDWATER WELLS FOR THE REGIONS OF AL NAJAF GOVERNMENT

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Abstract

Groundwater is the type of water, which present beneath the surface of the earth in the fractures of rock formations and in soil pore spaces. A unit of an unconsolidated deposit or rock is called an aquifer when it can yield a usable quantity of the water. The depth at which fractures or soil pore spaces and voids in the rock become completely saturated with water is called the table of water. When the groundwater is recharged from, and eventually flows to the surface which naturally discharge often occurs at seeps and springs which can form oases or wetlands. Groundwater is also often withdrawn for municipal, agriculture, and industrial use by operating and constructing extraction wells.

Statistical Package for the Social Sciences (SPSS) is a software package used in statistical analysis for the data used in this study to show the correlations between Easting, Northing, Elevation, and Depth.

In this study, Assessment of Underground Water using Contour lines, digital elevation model high-resolution (1m) with a different interval for choosing regions of Al Najaf Government was obtained. The Triangulated Irregular Network (TIN) ranging is between (26–30) m and knowledge of the direction of water flow wells by Arcgis10.3.

Key word: SRTM (Shuttle Radar Topography Mission), GIS, TIN (Triangulated Irregular Network), DEM (Digital Elevation Model).

Introduction

Groundwater returns to the ground surface through springs and seepage into streams where it is particularly scattered from the earliest starting point or unfurled by vegetation (Pyne and David, 1995). Water well is a whole, shaft, or evacuation used to extricate groundwater from the subsurface. Water may stream to the surface, typically in the wake of uncovering of the pole. Such a well is known as a gushing artesian well. Simply more typically, water must be drawn out of the well (Thomas, 2003). On the yearly ordinary, Al-Najaf domain gets just around 100 millimeter of precipitation. On the eastern side of this domain and near to the Euphrates River, there is Al-Kufa City, which spoke to the second capital populated region in this district. Water customers around there are dependent generally of the water running in the groundwater sums and Euphrates River, which are pumped from the well field to encourage their livelihoods. A bit of these advancements has enormous measures of water, especially those aquifers arranged on the Western Sahara and some have obliged water sum (Hayder, 2018).

The greater part of the aquifer in Al-Najaf region is made out of dolomite, limestone, coarse, dolomitic limestone, sand, fine stones, claystone, sandstone, gypcrete, pasty limestone with marl beds, and others (Jassim and Goff, 2006).

The area of a well is primarily dictated by the well's motivation, and to decide if the coveted measure of groundwater is accessible at a specific area and whether

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it is of fitting quality, drillers and groundwater advisors depend on their earlier learning of the neighborhood groundwater framework, involvement in comparable regions, and an assorted cluster of data, for example, arrive surface geography, nearby vegetation, shake breaking (where appropriate), neighbourhood topography, groundwater science, data on thickness, profundity, and penetrability of nearby aquifers from existing wells, groundwater levels, satellite or elevated photos, and geophysical estimations (Benni, 2009).

The development of methods for filtering and interpolation of digital elevation model data continues to be a central area of digital terrain analysis, but the methods now applied to wider types of data sources. These include traditional data sources such as points, profiles, streamlines, contours, and break-lines, for which specific interpolation techniques have been developed, and remotely-sensed elevation data, for which different filtering procedures are required. Included in the task of DEM generation is a variety of associated DEM manipulation tasks such as DEM resampling, DEM editing, and data structure conversion between regular grids and TINs; the two dominant forms of terrain representation (Jordan, 2007).

Several techniques can be found in a preliminary location of groundwater wells such as the digital elevation model (DEM) and triangulated irregular networks (TIN).

A DEM is a propelled depiction of land topography addressing ascends on the world's surface. A DEM can be addressed by one of three data structures (1) gridded models, where stature is surveyed for each point on a standard cross area; (2) *Triangular irregular networks* (TIN), where the domain rise is addressed by an arrangement of no covering unusual triangles; and (3) frame-based frameworks, where the scene is segregated into close to nothing, sporadically formed polygons in light of trademark shape lines and they're symmetrical. The square-lattice (gridded) demonstrate is the most surely understood sort of DEM by virtue of its straightforwardness and effortlessness of PC utilization (Kumler, 1994). The shapes address centers having ascended to stature/status with respect to a particular datum, for instance, Mean Sea Level (MSL). On the frame-based structure, the shape lines are taken after from the topographic maps and are secured with their region (x, y) and rise information (Nelson *et al.*, 1999).

Materials and methods

Study Region

Al-Najaf area nourishes for the most part of the water surface provided by the Euphrates stream, which passes through its eastern side. Four regions south of Al-Najaf are sustaining for the most part on the waters of the surface which given by the Euphrates River, where tremendous zones of arable land are left without being shown because of the dry season, which additionally exacerbated its decay level, prompting serious water deficiencies in this area. The low water level in the Euphrates River (Fig. 2) constrained ranchers to develop a fourth of the land which typically develops beforehand. Moreover, the diminution in the level of the Euphrates River's brought about a lack of these waters amounts required to address the issues of the populace for water system and drinking (Al-Ansari, 2013).

The district is called (Al Najaf Government), The aggregate territory of Al-Najaf is around 28824×106 m^2.

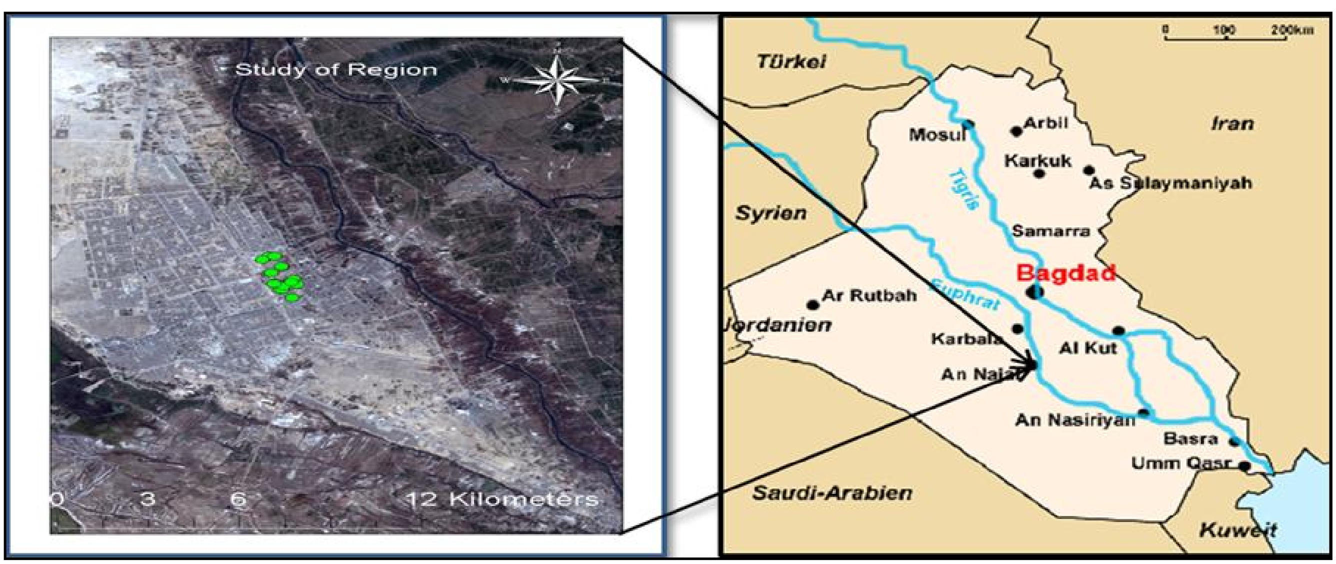

Fig. 2. Location of the study area

The organized arrangement of this informational index is characterized by utilizing the accompanying qualities which have the accompanying projection information (Varoujan *et al.,* 2015).

Projection	Units	Zone
UTM	Meter	38

The study region located in the South of Iraqi country, Latitude (32°2' 37.39") N, Longitude (44°19'56.74") E.

Data Collection

To find the elevations of the ground surface of the region of interest (ROI), the Shuttle Radar Topography Mission model (SRTMn) (30m) was downloaded from https://earthexplorer.usgs.gov/. The information are processed using a GIS program to extract the ground surface elevations as in the table 1.

The wells data were obtained from the water resources in Najaf Government and the depth of the wells was 20 meters approximately, as well as the location of the wells as in the table 1.

Statistical studies

SPSS software used in statistical analysis of data in this study to show the correlations between Easting, Northing, Elevation, and Depth as in table 2 and fig. 3.

Table 1: Shown the location of wells in the Region of Interest (ROI).

No.	E	N	Z	Elevation of the water table
1	440309	3545105.7	27	7
2	441034.98	3543654.28	27	7
3	440665.07	3543194.55	31	11
4	441082.29	3542761.05	29	9
5	441033.91	3543469.53	30	10
6	440751.45	3544518.08	26	6
7	440518.81	3545104.48	26	6
8	440098.1	3544922.19	28	8
9	440408.51	3544181.37	30	10
10	440510.01	3543595.74	29	9
11	440770.17	3543224.73	31	11
12	440810.66	3543421.56	29	9
13	441127.82	3543832.33	28	8
14	441251.79	3543495.99	27	7
15	441061.1	3543635.65	27	7
16	440725.41	3544549.03	27	7
17	440483.6	3543565.1	29	9

Table (2): (a) Pearson correlation Sig. (2-tailed) between these affected parameters

Correlations						
		E	Depth	N	Z	Elevation
E	Pearson Correlation	1	.[a]	-.622**	-.067-	-.067-
	Sig. (2-tailed)		.	.008	.798	.798
	N	17	17	17	17	17
Depth	Pearson Correlation	.[a]	.[a]	.[a]	.[a]	.[a]
	Sig. (2-tailed)	.		.	.	.
	N	17	17	17	17	17
N	Pearson Correlation	-.622**	.[a]	1	-.618**	-.618**
	Sig. (2-tailed)	.008	.		.008	.008
	N	17	17	17	17	17
Z	Pearson Correlation	-.067-	.[a]	-.618**	1	1.000**
	Sig. (2-tailed)	.798	.	.008		.000
	N	17	17	17	17	17
Elevation	Pearson Correlation	-.067-	.[a]	-.618**	1.000**	1
	Sig. (2-tailed)	.798	.	.008	.000	
	N	17	17	17	17	17

a. means cannot be computed because at least one of the variables is constant.

**. Means the correlation is significant at the 0.01 level (2-tailed).

GIS processes

The importance of this study is to develop a methodology for producing a GIS model for the preliminary location of the groundwater wells using ArcGIS. The approach adopted in this study has the following steps:

1. Insert satellite images of Landsat 8 for the study of regional, and insert points (E, N) only as shown in Fig. 4.
2. Download the digital elevation model (SRTM) (30m) from https://earthexplorer.usgs.gov/, as shown in Fig. 5.
3. Fills sinks in the raster surface to remove the small imperfections in the data, as shown in Fig. 6.
4. Cut the study region from the Raster and insert the wells Spatial Interpolation Results, as shown in Fig. 7.
5. The ArcGIS Spatial Analyst spatial interpolation tools that were tested to determine which would be best suited for this application were: TIN was created in ArcMap, as shown in Fig. 8.
6. Generating a digital elevation model for the study region accurately (1m), as shown in Fig. 9.
7. Production of the contour lines for the ROI of the DEM with interval of 0.5 m, as shown in Fig. 10.
8. Show the direction of water flow wells for the ROI, as shown in Fig. 11.

(b): Descriptive statistics (Range, Minimum, Maximum, Mean, and Std. Deviation mean for (E, and Depth) calculated for the whole sample for each of N = 17

Descriptive Statistics						
	N	Range	Minimum	Maximum	Mean	Std. Deviation
E	17	1.153690E3	4.400981E5	4.412518E5	4.40743687E5	3.252759733E2
Depth	17	0	20	20	20.00	.000
Valid N (listwise)	17					

(c): Descriptive statistics (Mean, Std. Error of Mean, and Std. Deviation for (E, N, Z, Depth and Elevation) calculated for the whole sample N = 17

Statistics						
		E	**N**	**Z**	**Depth**	**Elevation**
N	Valid	17	17	17	17	17
	Missing	0	0	0	0	0
Mean		4.40743687E5	3.54389596E6	28.29	20.00	8.29
Std. Error of Mean		7.889101149E1	1.714918543E2	.391	.000	.391
Std. Deviation		3.252759733E2	7.070790292E2	1.611	.000	1.611

9. The inclusion of the contour lines of the ROI of the satellite image, as shown in Fig. 12.

Results and Discussion

The statistical studies show that and according to the magnitude of the (2-tailed) are less than 0.05, this means the correlation between the parameters were selected in this study is significant.

In this study DEM was created for Al- Najaf using contours. An integrated approach of remote sensing techniques was used for identification of groundwater prospective zones using

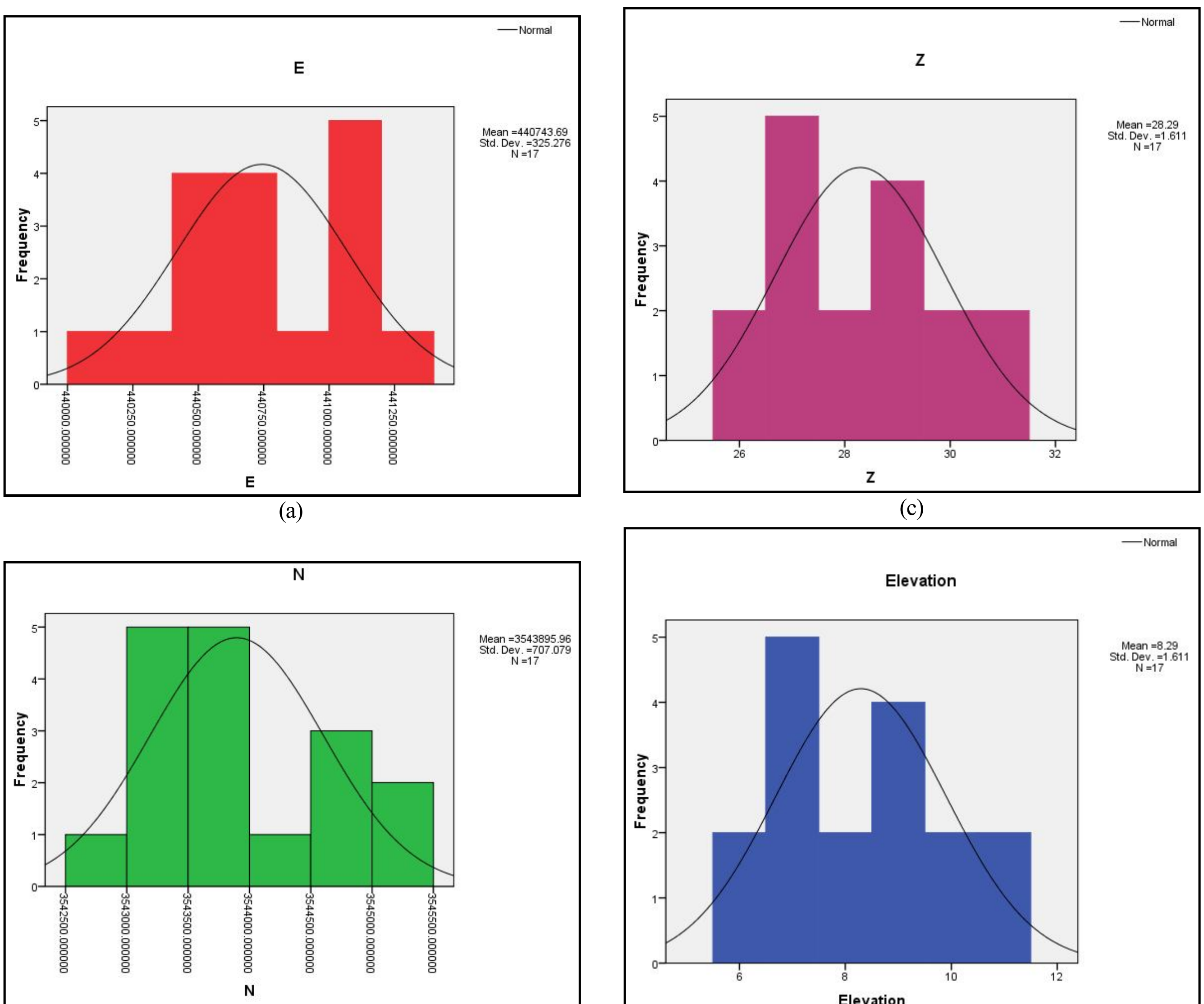

Fig. 3. (a), (b), (c), and (d): this figure shows the frequencies, Mean, Std. Dev. for E. N., Z., and elevation respectively.

Fig. 4. Satellite images of Landsat 8 for the ROI.

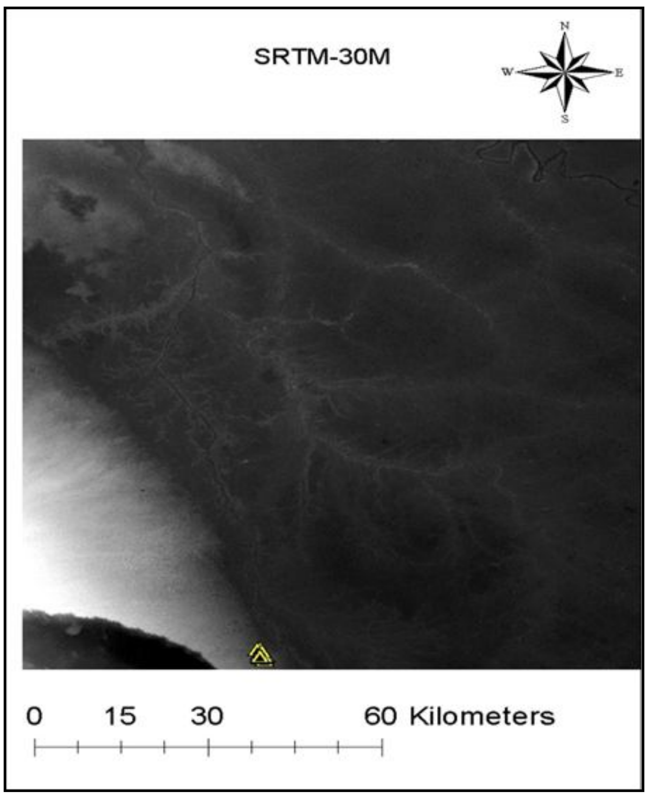

Fig. 5. SRTM (30m) for the ROI.

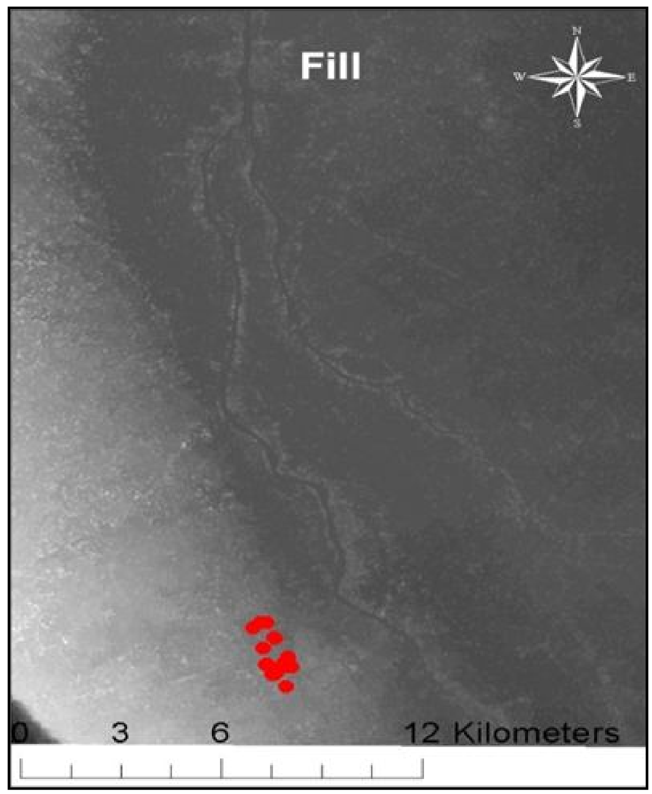

Fig. 6. Fill for the ROI.

DEM.

DEM and TIN models were created from GIS layers like contour lines. This result is a grid data of which their controls of them quality are the quality of the original data and grid size assigned to the interpolation techniques. To achieve the best result, integrated data should be employed for interpretation. DEM and TIN can also be used for watershed prioritization, development and management at an acceptable level, particularly when some other data are not available.

Conclusion

1. The Creation of the high-resolution digital elevation model (1m) was done using the TIN method. From the obtained results, the highest elevation is 30 m and

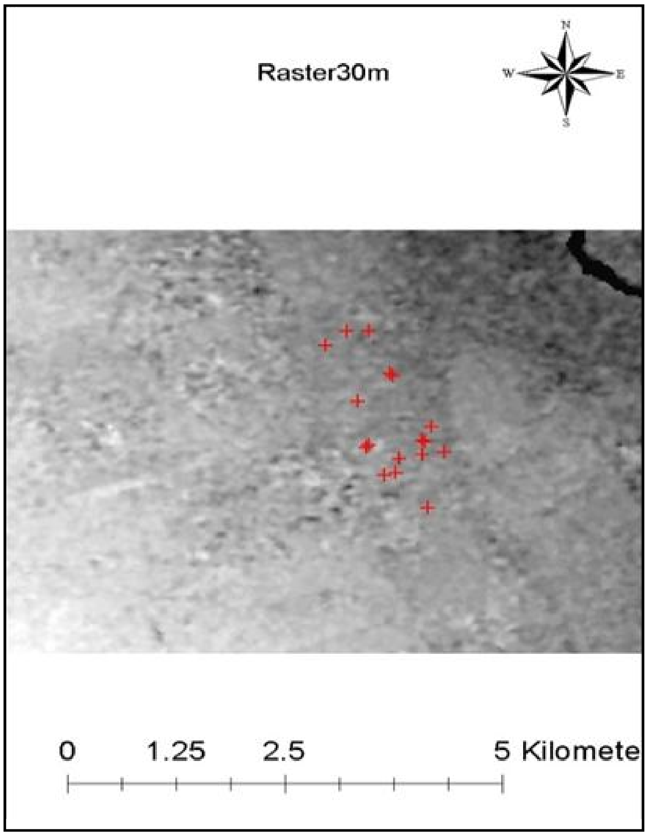

Fig. 7. Raster (30m) for the ROI.

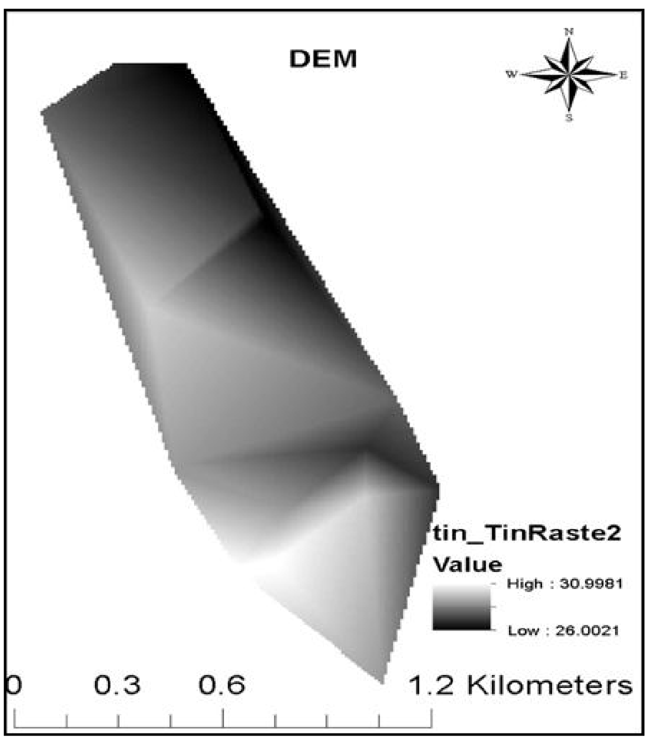

Fig. 9. DEM for the ROI.

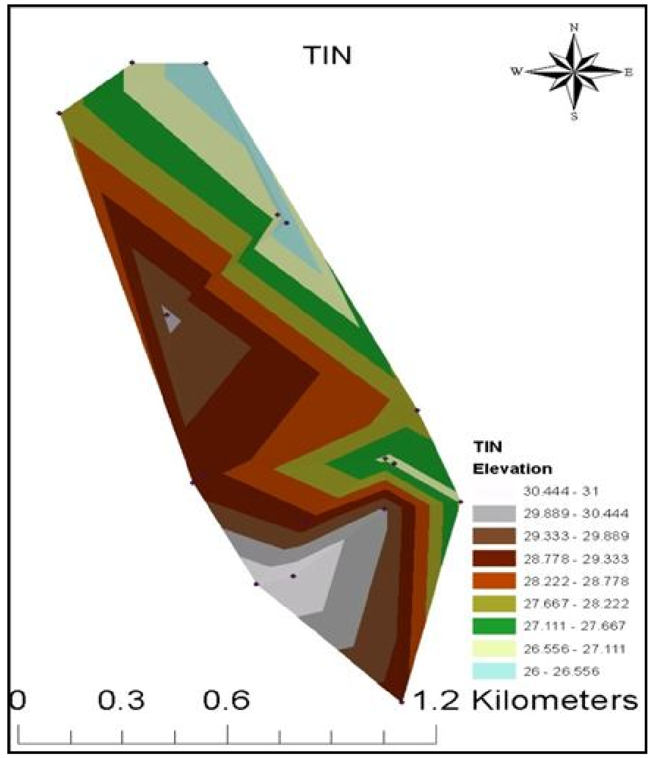

Fig. 8. TIN for the ROI.

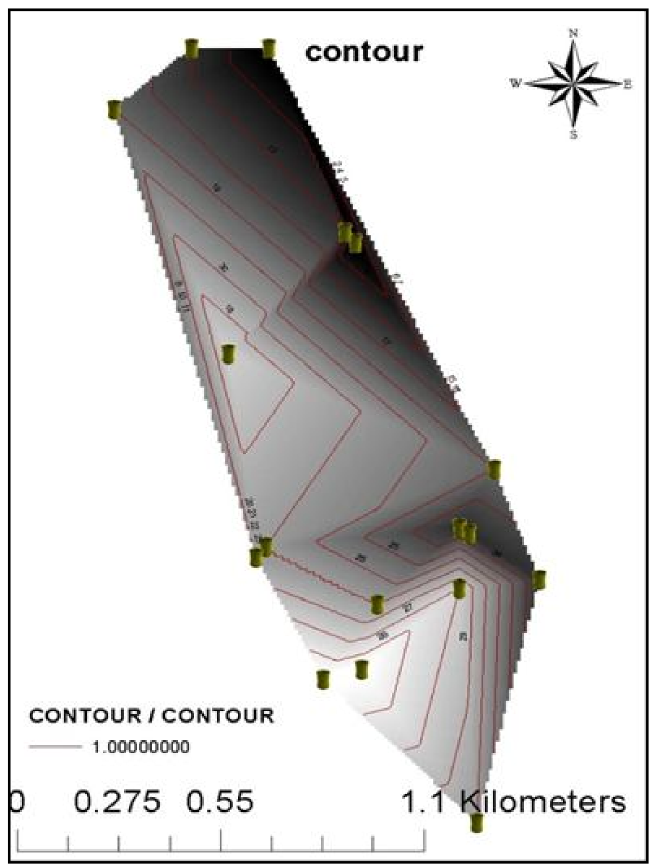

Fig. 10. The contour lines for the ROI.

the lowest elevation is 26 m for AL-Najaf region.

2. One key concept for using topographic maps to understand watersheds is that contour lines represent a change in surface elevation. Thus, the direction of

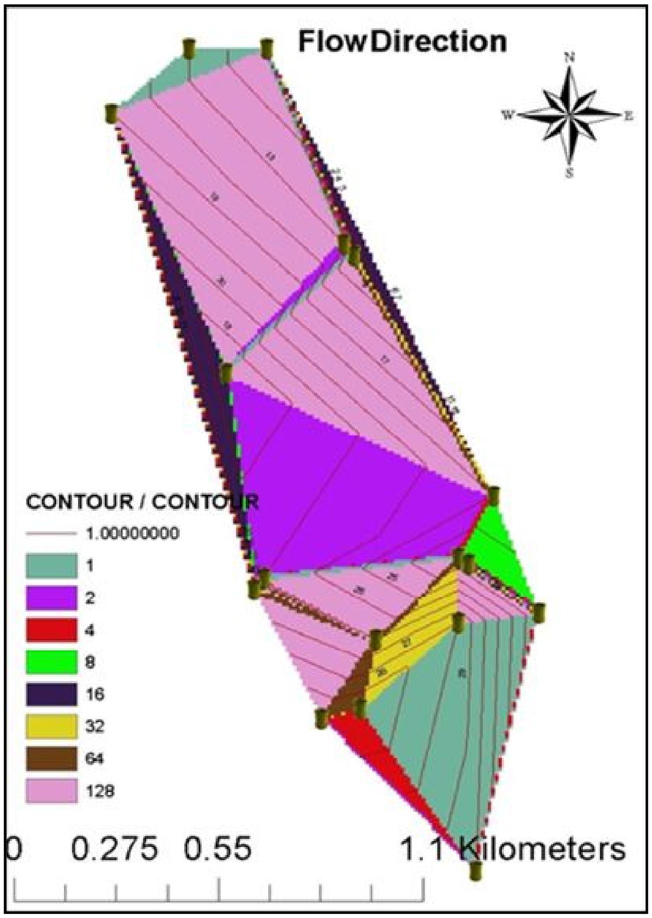

Fig. 11. The flow direction for the ROI.

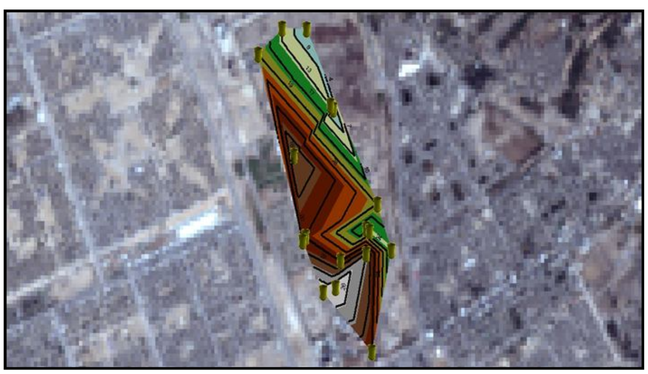

Fig. 12. The application of the contour lines to the satellite image for the ROI.

water flow wells is perpendicular to contour lines.

Conclude that topography significantly influences the distribution of groundwater recharge and discharge areas. By using DEM and TIN in GIS-program, the distribution of groundwater recharge and discharge areas in the landscape can be predicted.

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