LINEAMENT EXTRACTION FOR ASSESSMENT OF GROUNDWATER POTENTIAL / WEST OF IRAQ

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ABSTRACT:

. The lineaments can have significant impact on the hydrogeology since they reflect evidence of zones of permeability and porosity. Additionally, it has been found that wells yields are significantly enhanced in carbonate rocks settings where wells are sited on fracture traces or fracture trace intersections. The study area lies west of Iraq with coordinates: (39° 53' E, 33° 18' N), (41° 5'E, 32° 47' N). And with approximate area 6479 Km^2. Dem images with 90 m resolution were used in the research to create four shade relief maps with (0, 45, 90, and 135) azimuth angle. In addition data from nine wells represents the groundwater in study area were used. There was 1000 lineaments extract in the study area; classification was made of lineaments depending on length (small 976, medium 19, and large 5). We conclude that availability of groundwater in the study area occurs in locations that contain small number of lineaments, and that large number of lineaments gives a clue of deep groundwater because lineaments are a passages that groundwater seeps through it.

استخلاص الخطيات لتقييم أحتمالية المياه الجوفية/غرب العراق

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الخلاصة :

للخطيات تاثير واضح على المياه الجوفية نظرا لأنها تعكس عادة دليلا على المناطق الخاضعة للنفاذية والمسامية . بالإضافة إلى ذلك، فقد وجد أن انتاجية الابار عادة ما تكون إلى حد كبير في محيط الصخور الكاربونية حيث يتم اختيار مواقع الآبار على آثار الكسور(الخطيات) أو تقاطعات اثار الكسور. تقع منطقة الدراسة الى الغرب من العراق بالإحداثيات :

(39° 53' E, 33° 18' N), (41° 5'E, 32° 47' N). وبمساحة تقدر 6479 كم^2. أستخدمت بيانات الارتفاعات الرقمية DEM بدقة وضوح 90 م في البحث لإنشاء أربع خرائط ظلال المرتفعات (صفر، 45، 90، و 135) من زاوية السمت، وكذلك بيانات من تسعة آبار تمثل المياه الجوفية في منطقة الدراسة. تم استخلاص 1000 من الخطيات في المنطقة ، كما تم عمل تصنيف للخطيات اعتمادا على اطوالها فكانت (976 قصير، 19متوسط ، 5كبير). استنتجنا من الدراسة إلى أن تواجد المياه الجوفية يكون في المواقع التي تحتوي على عدد قليل من الخطيات،

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وأن عدد الخطيات الكبيرة تعطينا فكرة واضحة عن ألاعماق البعيدة للمياه الجوفية بسبب ان الخطيات هي ممرات تتسرب من خلالها المياه الجوفية.

1. Introduction:

The term "lineament" is one of the most commonly used terms in geology. A lineament is any extensive linear surface on a planet, as a fault line or fracture line. Lineaments can be defined as linear topographical or tonal features on the terrain representing zones of structural weakness. We summarized the definition of lineament in different geological features, such as (1) shear zones/faults; (2) rift valleys; (3) truncation of outcrops; (4) fold axial traces; (5) joint and fracture traces; (6) topographic, vegetation, soil tonal changes alignment etc. Lineaments are natural crustal structures that may represent a zone of structural weakness. Positive straight lineaments, interpreted as linear ridges, scarps, ridges, troughs and crater (light toned lineaments). Negative straight lineaments, represents joints, faults, and shear zones(dark toned lineaments),(Abdullah,et al.2010).

2. Methodology

2.1. Location of study area:

The study area is located west of Iraq between 32° 47' and 33° 18' N latitude, and between 39° 53' and 41° 5' E longitudes. The total area is approximately 6479 Km^2. (Fig 1).

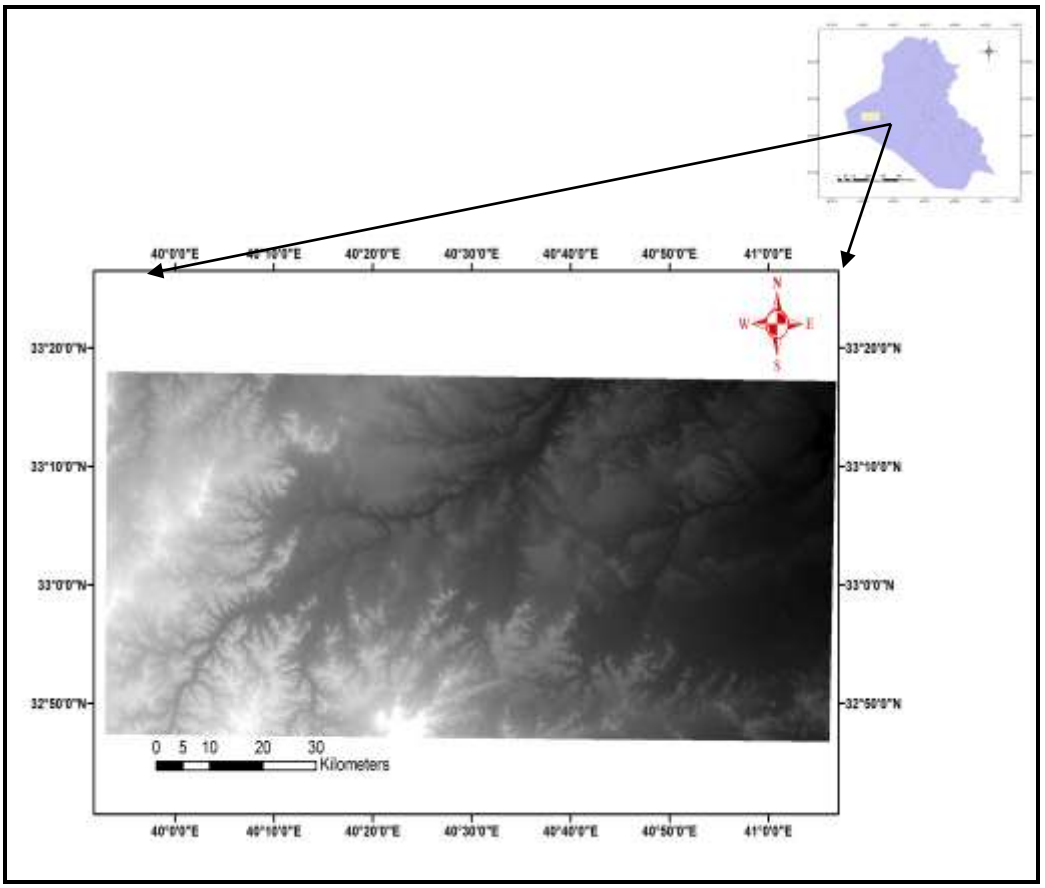

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Figure (1): location of study area

2.2. Software:

ERDAS Imagine 9.2 was used to subset and edge enhancements while all the layout process was made by using Arc GIS 9.3 software.

2.3. Auxiliary Data:

Dem images with 90 m resolution were used in the research, as well as the data of wells (names, location, and depth) obtained from the general commission of groundwater.

3. Lineaments Delineation and Extractions

The "lineament" or " Fracture trace" is a commonly used term in geological remote sensing. Nevertheless, it is still misleading, since similar features on satellite image or aerial photos exist, which can create confusion between geologic and nongeologic features. The lineament mapping is aided by the existence of the geomorphological features such as aligned ridges and valleys, displacement of ridge lines, scarp faces and river passages, straight drainage channel segments, pronounced breaks in crystalline rock masses, and aligned surface depressions. Geological lineaments for example paths, roads, power cables and field boundaries (Mogaji, et al.2011).

3.1. Shaded relief:

Shaded relief images derived from a digital elevation model (DEM) with a resolution of 90 meters were used for lineaments extractions.

In order to identify lineaments topographic features from the DEM, four shaded relief images were generated. The first step is the production of four separate shaded relief images with light sources coming from four different directions. The first shaded relief image created had a solar azimuth (sun angle) of 0°, 45°, 90°, and135 ° (Fig 2).

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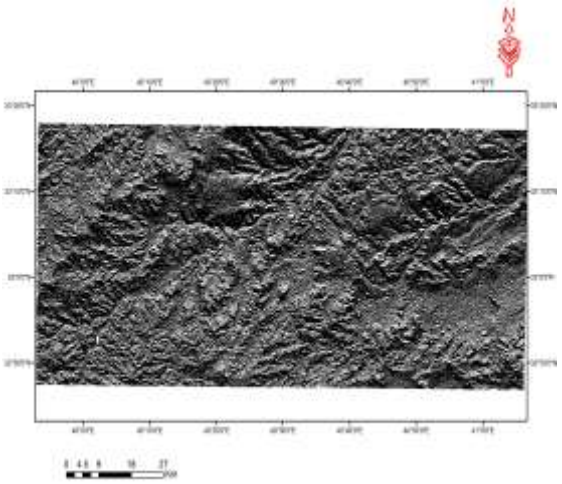
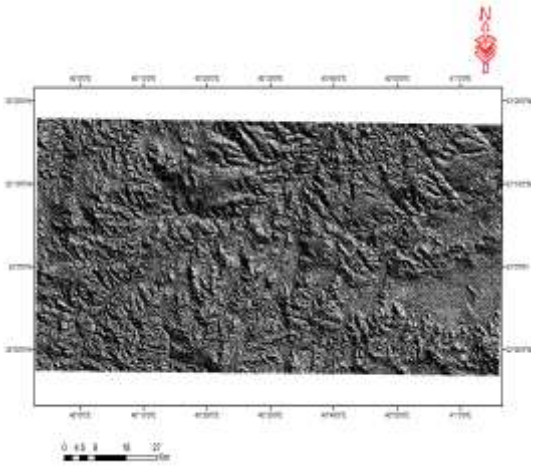
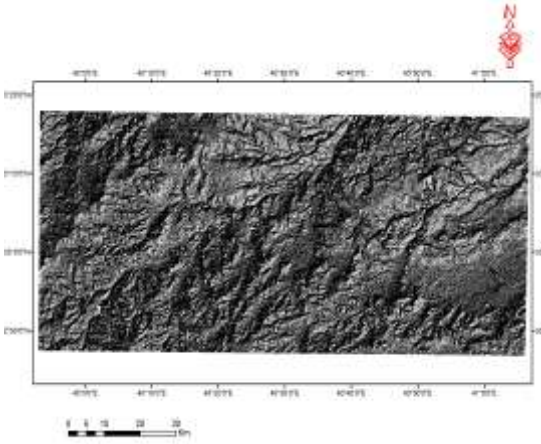


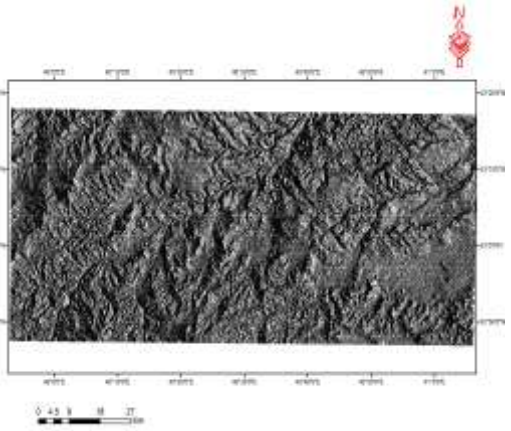
Shaded relief 0



Shaded relief 45



Shaded relief 90



Shaded relief 135

Figure (2): Four shaded relief images derived from DEM

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The second step is to combine four shaded relief image to produce one shaded relief image. For this purpose, the combinations of the four shaded relief maps are computed by using GIS overlay technique as in (Fig 3).

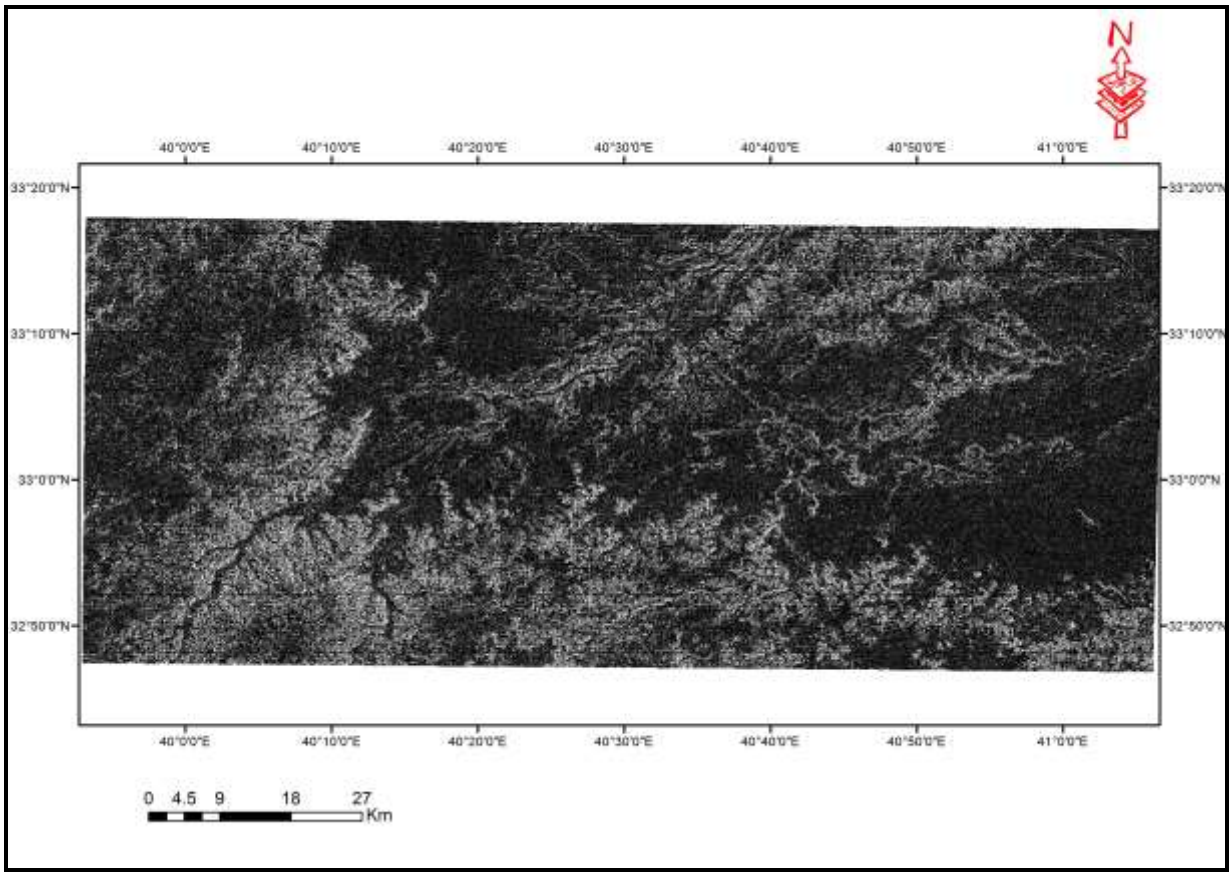

Figure (3): Shaded relief image created by combining different shaded relief images

The four shaded relief images were overlaid to produce one image with multi – illumination directions (0°, 45°, 90°, and and135 °). Finally, this image has been used for automatic lineaments extraction over the study area.

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3.2. Lineaments Extraction and Classification

There are two common methods for the extraction of lineaments from satellite images: 1. Visual extraction in which the user starts by some image processing techniques such as edge enhancements, using the directional and non directional filters such as the Laplacian, and Sobel, then the lineaments are digitized manually by the user according to length. (Edet et al. 1998). 2. Automatic (or digital) extraction where various computer-aided methods for lineament extraction are used (Abdullah, et al.2010).

In this research, there were 1000 lineaments extracted using arc GIS program (Fig 4).

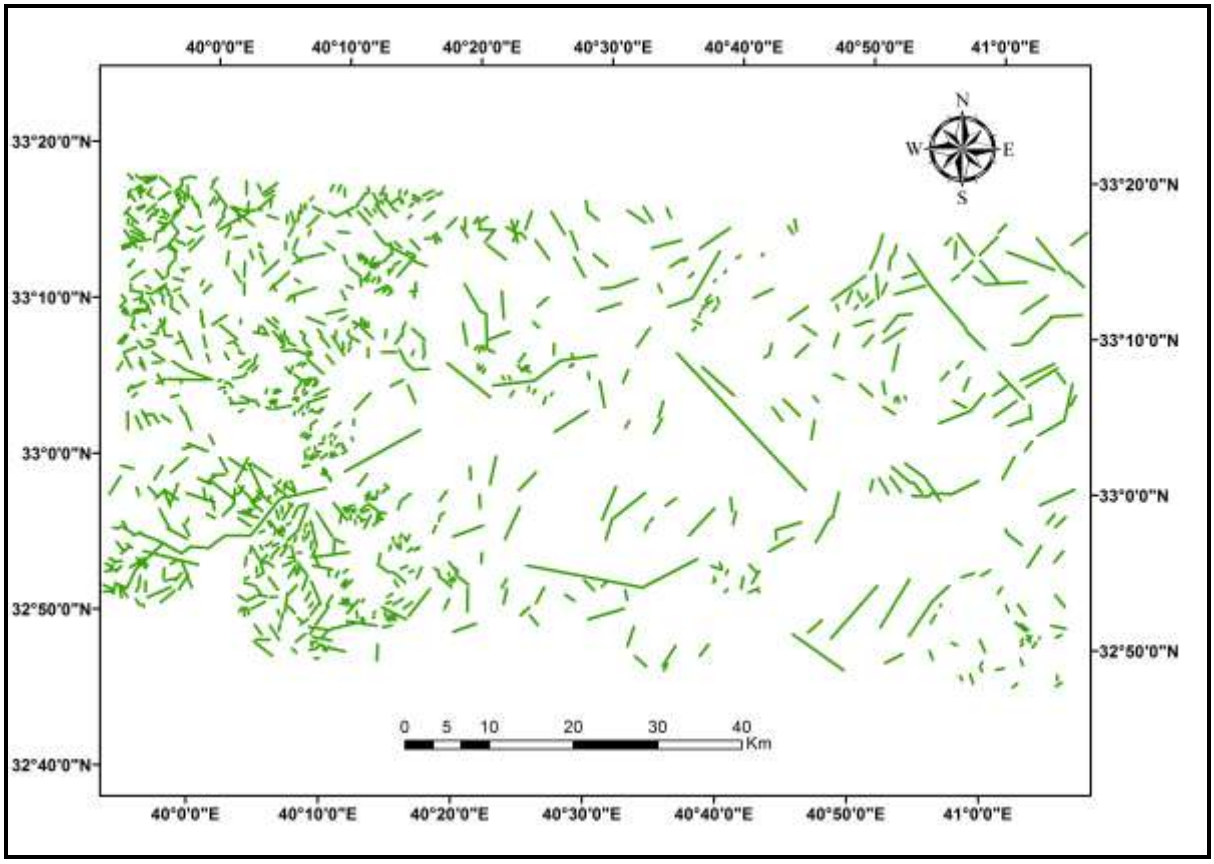

Figure (4) Lineaments in the study area

Of these lineaments, there were 967 was considered small (length less than 2 Km). (Figure 5).

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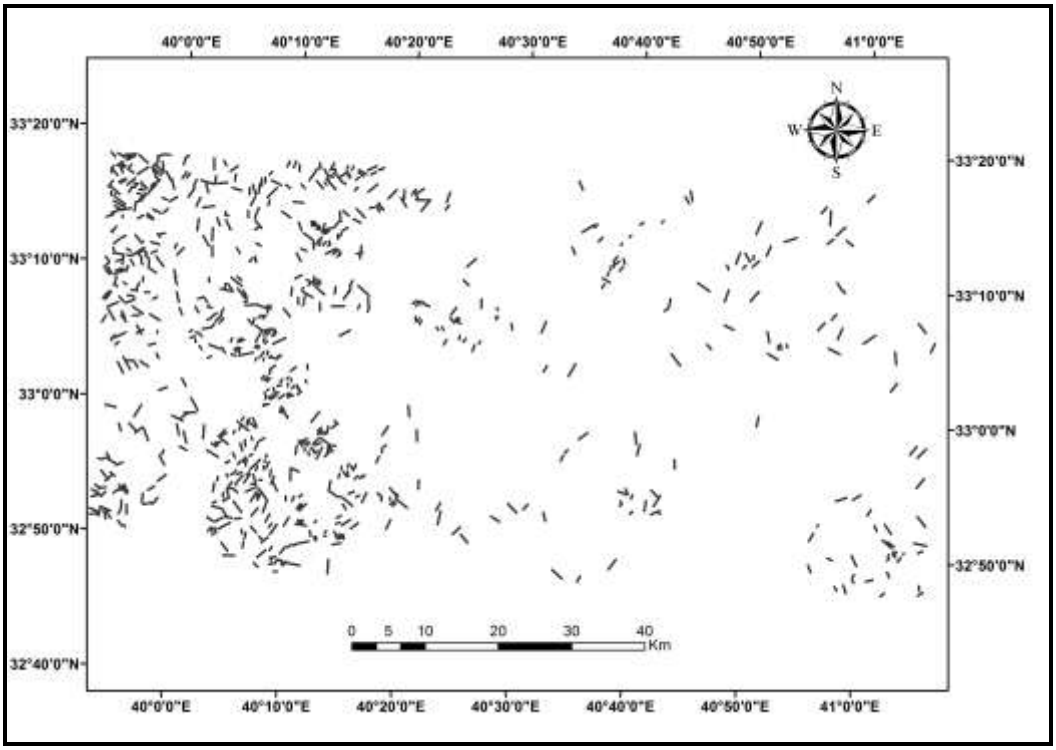

(Figure 5): Small lineaments in the study area

19 were considered medium (length between 5-10 km) (Fig 6).

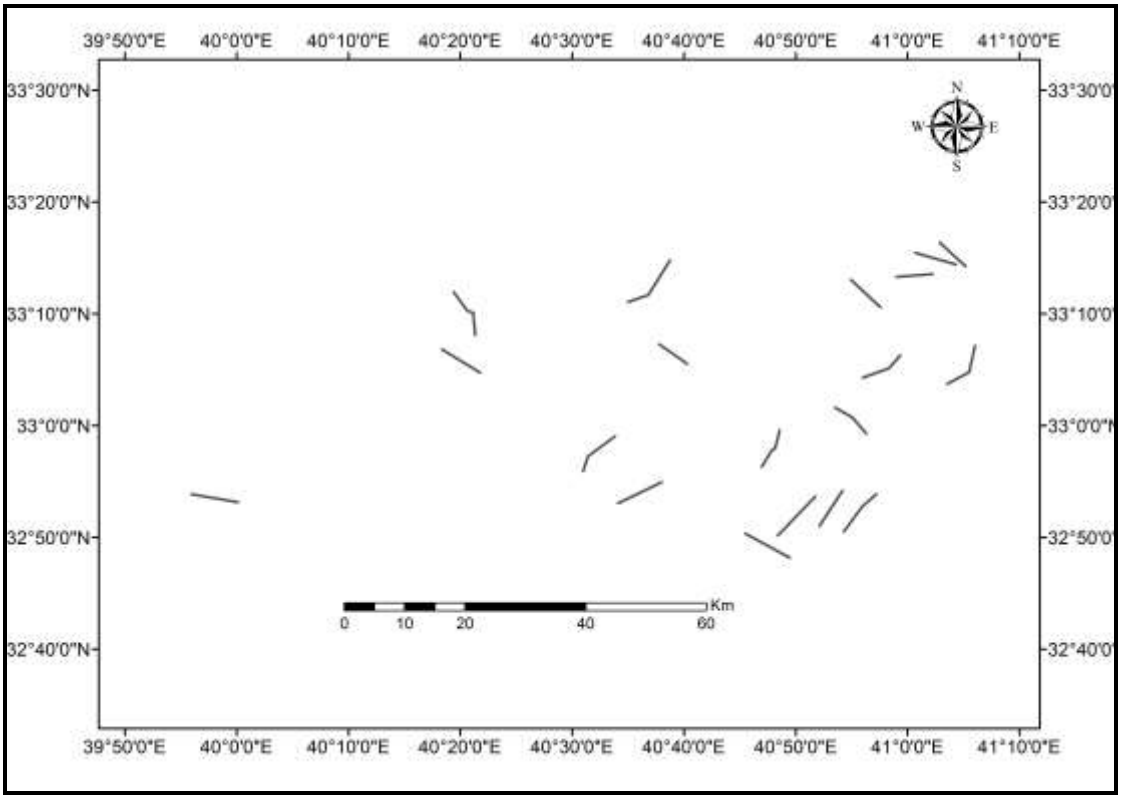

Figure (6): Medium lineaments in the study area

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And 5 was considered large (length greater than 10 km) (Fig 7).

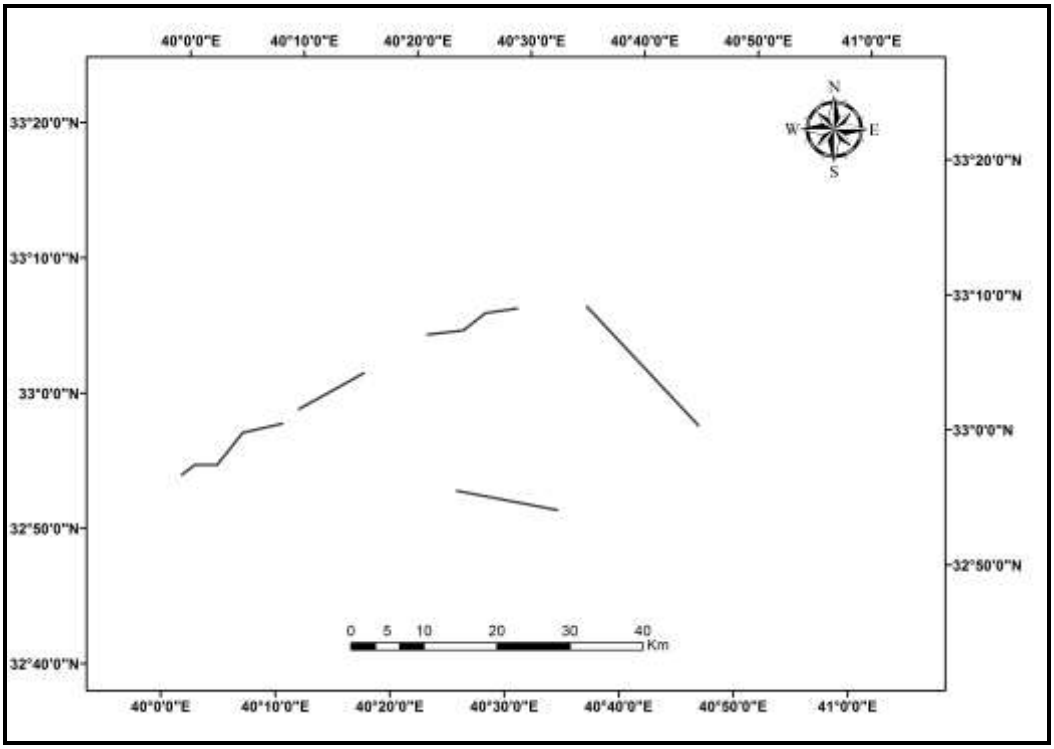

Figure (7): Large lineaments in the study area

4. Groundwater potential

Groundwater is a form of water occupying all the voids within a geological stratum. Water bearing formation of the earth's crust acts as conduits for transmission and as reservoirs for storing water. The occurrence of groundwater in a geological formation and the scope for its exploitation primarily depend on the formation porosity. In the presence of interconnected fractures, cracks, joints, crushed zones (such as faults zones or shear zones) or solution cavities, rainwater can easily percolate through them and contribute to groundwater. The conventional methods used to prepare groundwater potential zones are mainly based on ground surveys. With the advent of remote sensing and geographic information system (GIS) technologies, the mapping of groundwater potential zones within each geological unit has become an easy procedure. The groundwater conditions vary significantly depending upon the slope, depth of weathering, presence of fractures, surface water bodies, canals, etc. These factors can be interpreted or analyzed in GIS using remote sensing data, (Hung, et al.2005).

4.1. Groundwater data

Mapping of groundwater resources have been increasingly implemented in recent years because of increased demand for water. The data most commonly available for

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groundwater study are geological, geomorphological and hydrological information. In this study we attempted to identify groundwater potential zones using remote sensing and geographic information system techniques. (Gauapuram. et al.2008). The groundwater data are represented in the study area by wells. Nine wells were found in the area as in Table 1, (Data Bank of Ministry of Water resources, 2010).

Table 1: Information of wells in the study area

Series	Well name	Longitude	Latitude	Depth (m)	Yield (L/S)
1	AMIJ 2	33.0167	40.8333	200	4.5
2	THERTH AKE3A	33.0833	40.8	250	4
3	NATHRA VILLAGE	33.165694	40.313417	154	1
4	RUTBA FORST/1	33.04225	40.322528	185	6
5	AHMAD FOAZ VILLAGE	33.049	40.385306	198	5
6	RUTBA STUDY	33.032083	40.475972	360	3
7	THABAA PROJECT	33.032167	40.523722	210	7
8	RUTBA MASAD	32.904111	40.233194	370	3
9	ALBU-HERF	33.031611	40.548861	198	6

4.2. The lineament as indicators of groundwater exploration

The distribution of wells in the study area is shown in (Fig 8).

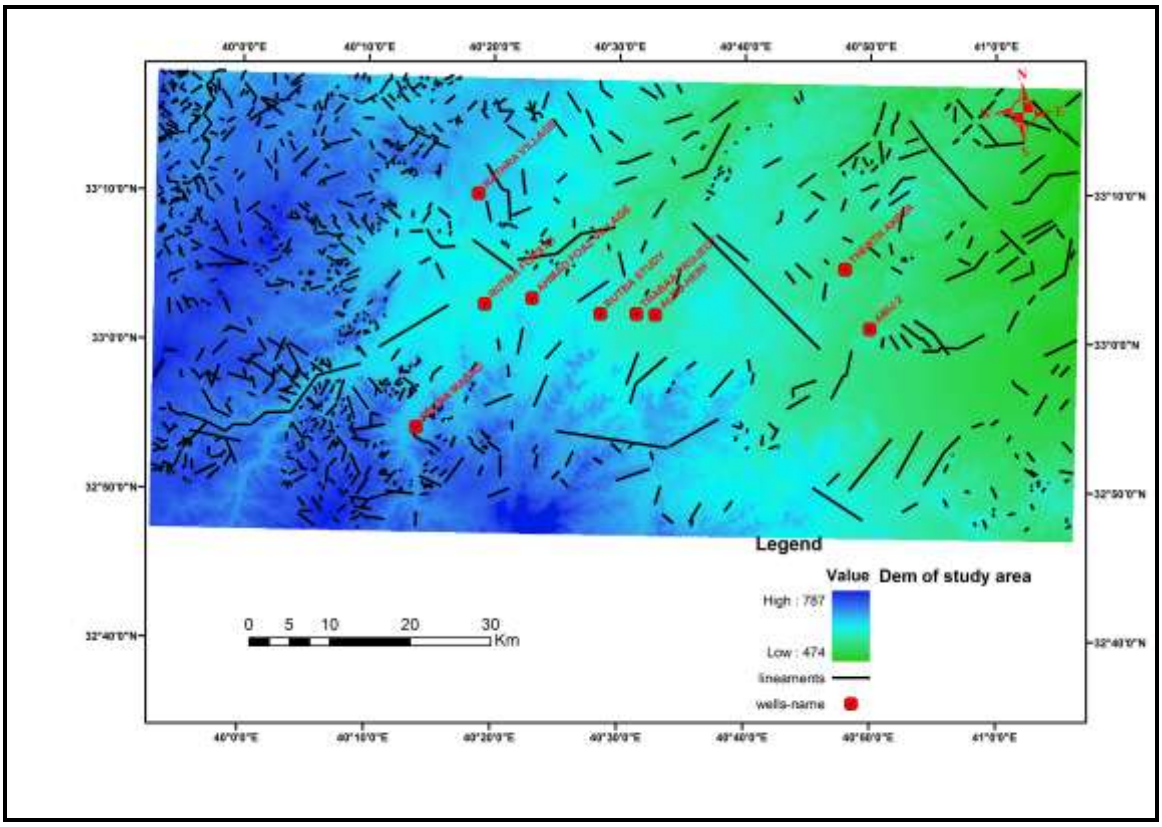

Figure (8): The distribution of wells in the study area

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From figure (8) we conclude that availability of groundwater in the study area occurs in location that contains few lineaments. When the lineaments density is high in n-w and s-w of the study area we expect poor groundwater availability.

5. Conclusion

From the obtained research, several conclusions can be made:

A- The development of remotely sensed data introduced valuable supplementary information on terrain and groundwater characteristics. The lineaments feature, the subject of this study, is one principal aspect of this information.

B- Using the approaches of shaded relief is one of the efficient tools to identify the lineaments.

C- The availability of groundwater in the study area occurs in locations with few lineaments.

D- Depending on lithology and types of aquifers, large lineament gives a clue about the deep groundwater because the lineaments are passages through which groundwater seeps in.

6. References

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