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ORIGINAL ARTICLE **OPEN ACCESS**

Role of Remote Sensing And Geographic Information System In Land Use Land Cover Interpretation: A Case Study Of Eastern Sohag, Egypt

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ABSTRACT

Nowadays, there is an increasing need for accurate soil spatial data to be easily shared and used between the soil science communities. This study aimed to present the role of remote sensing and geographic information system as effective tools for land use land cover interpretation. The investigated area was a part of Eastern Sohag, Egypt with an area of 204km^2. Landsat7 ETM$^+$ multispectral satellite image and Google earth image were used for visual interpreting of the land use land cover (LULC) of the study area. Digital elevation model was extracted from the image and generated in a map using ArcGIS-10.1 software. The area was classified depending on its elevation in six mapping units viz, Wad floor (61.82km^2), Low elevated sand sheet (30.07km^2), High elevated sand sheet (31.05km^2), Bajada (27.47km^2), Piedmont (27.45km^2) and Table land (26.54km^2). Supervised classification was done for the area of study using ENVI-5.0 software. Land used land cover interpretation was done which soil, vegetation, water bodies and built-up areas were identified easily. These results can be used as a guide for decision makers and stake holders for better planning and agricultural land management. Remote sensing (RS) and geographic information system (GIS) as promising techniques should be strongly recommended for different fields of soil studies.

Keywords: remote sensing, geographic information system, Arc-GIS, ENVI, Sohag.

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INTRODUCTION

For more than 50 years, remote sensing (RS) and geographic information system (GIS) became as effective tools for soil studies. They play an important role in land use land cover interpretation purposes. Nowadays, the integration of RS, GIS and global positioning system (GPS) is a vital tool for obtaining an accurate soil spatial data. Furthermore, there is an increasing demand for such detailed spatial information for precision agriculture studies. For that, RS was found to be fast and saving time, has several solutions for agricultural problems, accurate and can visualize any spatial data to be used with the tools of GIS to develop maps [1].Landsat multispectral imagery provides an ability toacquire such amounts of spatial information. Landsat scenes can be studied using standard photo-interpretation techniques in a systematic analysis of the visible pattern elements, which include topographic forms, drainage patterns, landform boundaries, color or image tone, land use and vegetation characteristics. The same combination of pattern elements generally indicates similar landforms and soils [2].Alrababah and Alhamad [3] stated that, the supervised and unsupervised classification schemes were used with and without spatial enhancement techniques and their results indicated that Landsat ETM$^+$ images are effective in classifying heterogeneous landscapes with accuracy of up to 83%. Arafat, *et al.* [4] applied remote sensing data using EgyptSat-1 and could be used them for predicting the crop productivity to serve the soil and water management. The first investigation in Eastern Sohag using GIS tools was carried out by Lenny *et al*. [5] to assess the status of new reclaimed lands.Mandal and Ghosh [6]mentioned that, the use of GIS in agriculture has increased because of misuse of resources like land and water. Denton et al. [7]pointed out that, the use of GIS to produce the thematic maps of soil properties is necessary in the implementation of effective management strategies for sustainable agricultural production.

The main target of this study was to apply RS and GIS as effective tools for LULC interpretation of a part of Eastern Sohag, Egypt.

MATERIAL AND METHODS

Site description

The investigated area is a part of Eastern Sohag, Egypt. It is located between the 26°.653 - 26°.754 latitudes (N) and 32°.717- 32°.911 longitudes (E), and it covers about 204 km^2. The location map of the studied area is shown in figure (1). The Eastern Sohag area is a new land which covered with Quaternary deposits which is consisting of gravels, sands and cemented by fine clay materials [8]. The catchment is a typical arid basin, which is characterized with extremely arid climate. The annual rainfall ranges between 2.75 and 50 mm, while heavy showers are recorded occasionally during winter causing flash floods. The minimum temperature is ranging between 5ºC and 14ºC and the maximum is ranging between 28ºC and 42ºC. The relative humidity (RH) ranges between 30% and 56%. The maximum monthly evapotranspiration is 23.5 mm during June, while the minimum value is 3.1 mm during December [9]. Prevailing winds are dominantly from the northwest to the southeast with an average maximum speed of 10 knots/h. The natural vegetation is sparse and distributed randomly over the area. *Moringa, Wild Caper* and*Salvadoroprisca* are the common natural vegetation in the area. Furthermore, agricultural activities are very limited in the area [10].

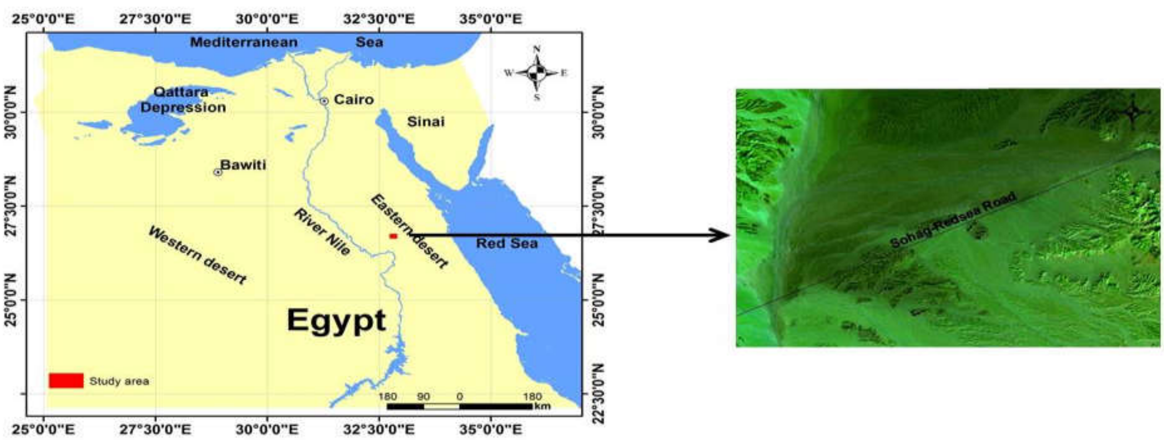

Fig. 1 : Location map of the study area.

Materials

Data

Remotely sensed data: Multispectral landsat ETM+ image dated (7/2005) path/row-172/42 (Figure. 2) was downloaded from USGS data base. The spectral characteristics of the Landsat 7 image was shown in table (1).

Fig. 2 :Full scene landsat7 ETM+ satellite image

Table 1 : Spectral characteristics of Landsat image

Satellite	Bands	Wavelength (μm)	Band Centre	Resolution (m)
Landsat7	Band1-Coastal	0.35-0.43	0.433	30
	Band2-Blue	0.45-0.51	0.482	30
	Band3-Green	0.53-0.59	0.562	30
	Band4-Red	0.64-0.67	0.655	30
	Band5-NIR	0.85-0.88	0.865	30
	Band6-SWIR1	1.57-1.65	1.610	30
	Band7-SWIR2	2.11-2.29	2.200	30

Software

ENVI-5.0 [11] was used for image processing (layer-stacking, DEM extraction and density slicing of DEM). Arc-GIS-10.1 [12]was used for presenting vector and raster data and also for mapping purposes. Google earth Pro.was used for area identification and visual interpretation of the LULC of the studied area.

Methods

Remote sensing tools

Landsat7 ETM+ full scene/Extent satellite image which covers the study area was resized and geometrically corrected/rectified using ENVI 5.0 software to mask and extract the exact area. False Colour Composite (FCC) image was used for Land use-Land Cover (LULC) interpretation, and data visualization. Digital Elevation Model (DEM) extracted then used in density slicing of the image. Density slicing visually enhances elevation differences based on image brightness. Density slice was done to cluster the Digital Elevation Model (DEM) into some ranges expressing the elevation values that range from 185 to 447 meters above Sea level (m.a.s.l). Supervised classification technique used to generate the physiographic map of the study area using the DEM. The area under investigation is represented by six landforms/mapping units i.e., Wadi-Floor (WF), Low-elevated Sand Sheet (LSS), High-elevated Sand Sheet (HSS), Bajada (B), Piedmont (P) and Table Land (TL).

GIS tools

The Arc-GIS software was used for calculating areas of the mapping units. It was also used for documentation and annotation of the generated maps of DEM (density sliced), physiographic map and supervised classification map of the studied area.

RESULTS AND DISCUSSION

Remote sensing products

The full-scene multispectral lands at ETM+ image was resized and subsetted to extract the exact area of the study. The Geometrically corrected false color composite (FCC) images were shown in Figure (3). Google earth satellite image was also used for the interpretation of the study area. From the visual interpretation of LULC in the study area was shown in figure (4). It was obvious that, the major area was fallow as new reclaimed area. The very limited vegetation activities were carried out in the area. The Sohag-Safaga road could be also identified. Two plateaus in the east and west sides of the road could be distinguished from the image. The digital elevation model (DEM) was extracted as shown in figure (5). Densityslice tool was applied to color the DEM map (Figure .6). Supervised classification of the digital elevation model was applied to classify the area to different colored mapping units or landforms depending on its variability in the elevation. This developed map was considered as a physiographic map of the studied area.

GIS products

Arc-GIS software was used for calculating areas of the mapping units as shown in table (2). The documentation and annotation work also done by the mentioned software for mapping purposes. The generated physiographic map was shown in Figure (7).

Fig. 3 :The FCC subsetted landsat satellite image of the study area.

Fig. 4 :The visual interpretation of the study area using Google earth image.

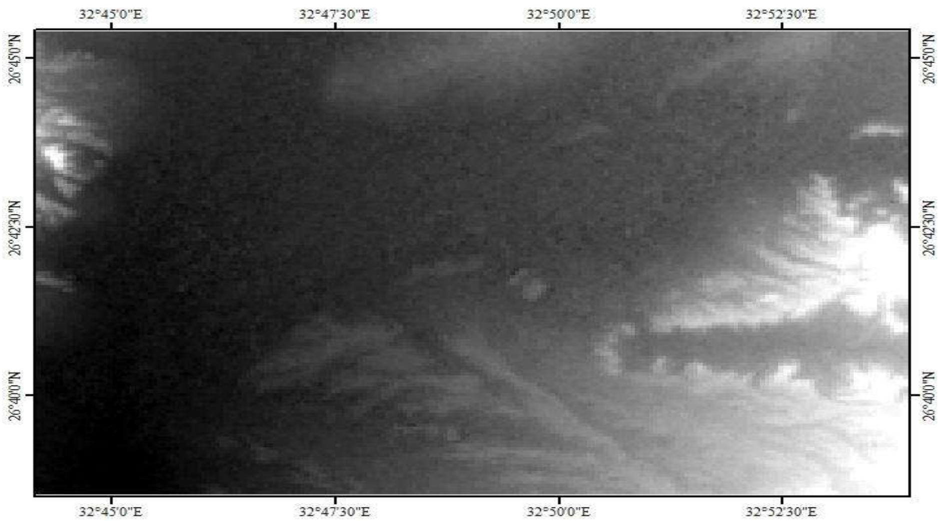

Fig. 5 :The DEM of the study area extracted from satellite image.

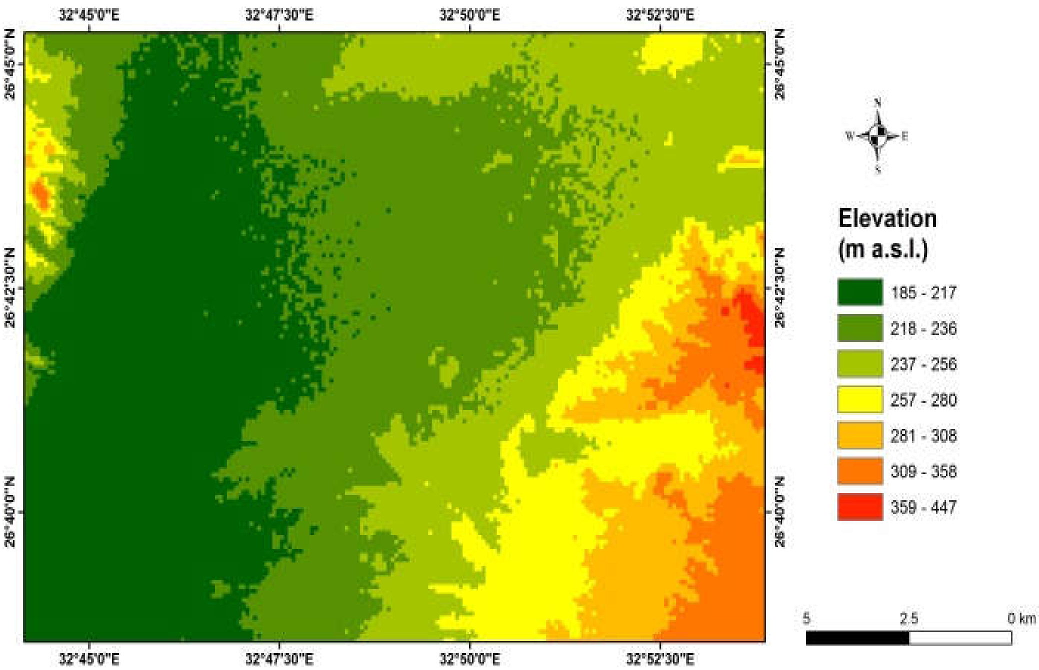

Fig. 6 :The Density slice colored map of the DEM.

Table 2 : Mapping units of the study area

Mapping units and Symbols		Area (km²)	Area (%)
1	Wadi-Floor (WF)	61. 82	30. 24
2	Low-elevated Sand Sheet (LSS)	30. 07	14. 71
3	High-elevated Sand Sheet (HSS)	31. 05	15. 19
4	Bajada (B)	27. 47	13. 44
5	Piedmont (P)	27. 45	13. 43
6	Table Land (TL)	26. 54	12. 98
Total		204. 39	100.00

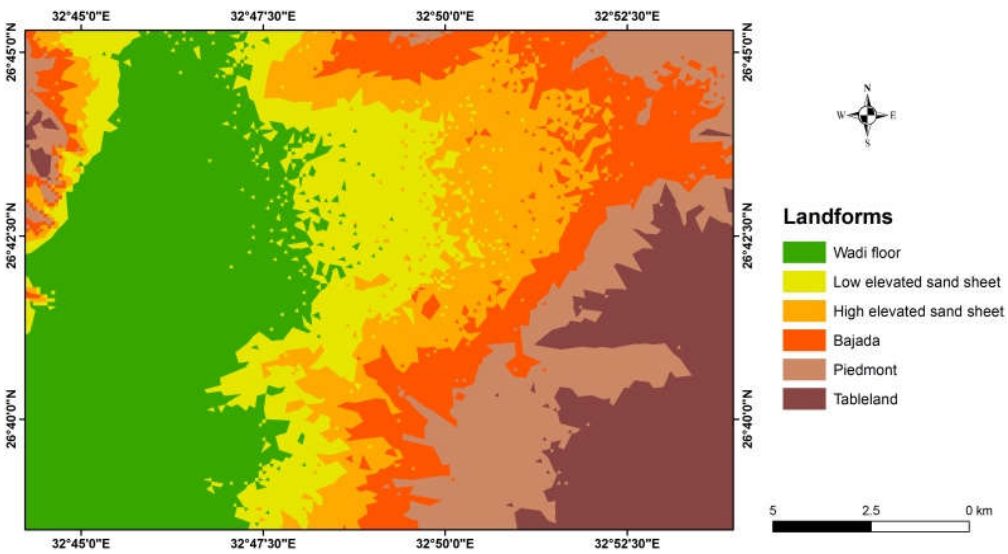

Fig. 8 :The physiographic map of the study area

CONCLUSION

Remote sensing and GIS tools were utilized for LULC interpretation of Eastern Sohag area. Landsat multispectral satellite image was successfully used for identifying different mapping units and landforms in the investigated area. The DEM density sliced map can be used in the agricultural activities as a source of the variability in elevation. The developed images and GIS products are considered as guide for decision makers and stake holders. They can be utilized for better planning and agricultural land management. It could be concluded that RS and GIS should strongly recommended for soil studies. Further studies using RS and GIS tools should be carried out for such new reclaimed areas to assess the change detection of the agricultural activities progress.

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