Soil Resources Potentialities of Some Areas Adjacent to Bani Mazar-El-Boiety Road, West of El-Minia, Egypt

Taher, M. H. Yossif
Pedology Dept., Water Resources and Desert Soils Division, Desert Research Center, Cairo, Egypt.

ABSTRACT: The present study is concerned with assessment of land potentiality of an area locating at Bani Mazar's Western Desert fringe, that is bounded by longitudes 30° 09` and 30° 30` E and latitudes 28°30` and 28° 35` N, covering an area of approximately 82883 acres. The area could be distinguished, on basis of remote sensing as well as GIS facilities, into eleven (11) landforms; i.e. three different tablelands (TL), in terms of topography (almost flat TL, gently undulating TL, undulating TL); depression; plateau foot slope; major and minor escarpments; hills; hill foot slope; denuded hills and sand dunes. Twenty two (22) soil profiles, representing the tableland, depression, and plateau foot slope were morphologically described, their physical and chemical properties were determined; and their diagnostic characteristics were assessed. Data indicated that soils generally belong to the order *Entisols* and could be place, at sub-group level, to *Typic Torriorthents* and *Typic Torripsamments.* In addition, there is a relatively limited area belonging to *Lithic Torrorthents*. Based on CERVATANA model, around 61.9 % of the area is moderately capable for agricultural production (S3), whereas 13.93 % is non-productive and the rest of the area (24 %) is associated with sand dunes, hills and escarpment landform units. At subclass level, there are S3r, referring to moderate capability with slight constraint severity and S3lr specifying those affected by severe soil constraints and erosion risk. In terms of ALMAGARA model, related to the suitability of soil for crop cultivation, tested crop could be arranged as olive > sugar beet > alfalfa > peach > citrus > wheat > maize > melon > potato > sunflower. It is also indicated that about 2.75 % of the acreage area are suitable for peach, citrus and olive, whereas 25.23 % is moderately suitable, 14.36 % is marginally suitable and 33.36 % is not suitable for the selected crops.

Keywords: El-Minia Governorate, Soil characteristics, Micro LEIS, Land capability, Land Suitability, Remote Sensing, and GIS.

INTRODUCTION

Egypt has experienced a rise and the prevalence of combined food insecurity and income poverty to 17.2% (an estimated 13.7 million people) in 2011, up from 14% of the population in 2009. The increasing population and limited cultivated land, combined with land degradation and desertification pose significant challenges for production. Between 2010 and 2011the total cultivated area in Egypt decreased by about 1 percent, associated with encroachment of aeolion sand on agricultural land (World Food Program, 2013), which necessitates the need for exploring the desert land around the old cultivated area in Egypt to find out the suitable soils for agriculture and reasonable sustainable way. Agricultural expansion, on scientific basis, is considered the mainstay of Egypt's national economy to take up and cope with the current economic chalenges.

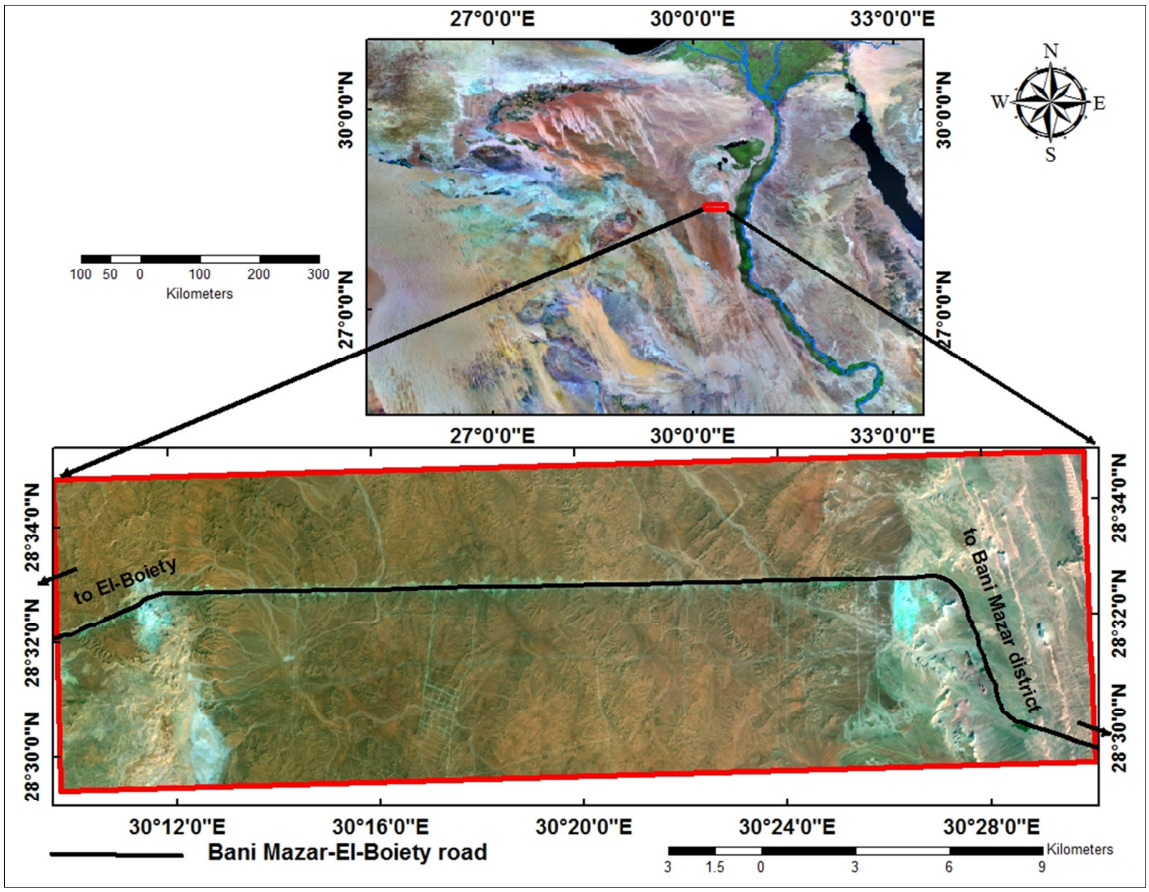
The full understanding of the geological, geomorphological and pedological, as well as chemical and physical properties of soils is considered as the fundamental base for a successful reclamation plan in Egypt. Land evaluation is the process of estimating the potentials of land for alternative kind of use.

According to Dent and Young (1981), it includes productive uses, such as arable farming, livestock production and forestry, together with the uses that provide services or other benefits, such as water catchment's area, recreation, and tourism and wildlife conservation.

Remote sensing techniques have been utilized in soil science for many years as a tool for soil surveyors, reducing the time and expense for sampling (Palacios-Orueta and Ustin, 1998). Geographic information system plays a major role in spatial decision-making. The collected information for the suitability analysis for crop production should present both opportunities and constraints for the decision maker (Ghafari *et al*., 2000). The ultimate aim of GIS is to provide support for spatial decision making process (Foote and Lynch, 1996). Spatial analysis can be defined as the analytical technique associated with the study of geographic phenomena locations together with their spatial dimensions and their associated attributes (ESRI, 2010).

The present investigation deals mainly with the geomorphologic setting, soil condition and its classification in order to evaluate the potentialities of some soil resources adjacent to Bani Mazar-El-Boiety Road, West of El-Minia in terms of land capability and land suitability for the horizontal agricultural expansion and their optimum agricultural use based on remote sensing data, GIS facilities, selected soil-sites characteristics and physical and chemical characteristics of the different soil units.

The area under investigation is located in the west of El-Minia Governorate, adjacent to Bani Mazar-El-Boiety Road with about 33.5 km in length. It is bounded by longitudes 30^{o} 09` and $30^{o}$ 30` E and latitudes $28^{o}30$` and $28^{o}$ 35` N, covering an area of approximately 82,883 acres, (Map 1). Said (1993) mentioned that in the western side of the Nile valley, the middle Eocene formations are covered by Oligocene gravel and cobbles. The Eocene limestone may crop to the surface locally. The main geological deposits in the study area are Nile deposits, sand dunes, aeolian deposits, gravel and basalt, (EGPC - Conco Coral Staff, (1987). According to Abu El-Izz (2000) the investigated area is built of recent alluvium sediments belong to Pleistocene, and Pliocene periods. The area is characterized by arid climate as the total rainfall is 7.8 mm/year. The dryness is prevailing most of the year and the wet periods are comparatively short. Based on the Egyptian Meteorological Authority data (2009) and Soil Taxonomy System (USDA Soil Survey Staff, 2014a), the soil temperature regime of the studied area is defined as Thermic, and the soil moisture regime as Torric. Ground water is considered the main source of irrigation water in the study area.



Map (1). Location of the investigated area at the west of El-Minia.

MATERIALS AND METHODS

A Landsat-8 Operational Land Imager (OLI) data covering the investigated area acquired in 2016 (path 177 / row 40) was employed in this study. It was merged and processed with Digital Elevation Model (DEM), (Fig. 1), which has been generated from the vector contour lines, and prepared in ERDAS Imagine 9.3 software (2010) to identify the different landforms of the study area. The OLI data were classified using the ISO-DATA classification technique (Map. 2) to produce unsupervised soil map for the resultant landforms (Lillesand and Kiefer, 2000).

A rapid reconnaissance survey was made throughout the investigated area in order to identify and verify landforms and to gain an appreciation of the broad soil patterns and landscape characteristics of the investigated area. The primary mapping units were verified based on the field interpretation and the information gained during the field work. Twenty two soil profiles were dug (note: soil profiles No. 1 & 16 not represented on the soil profile location map) to represent

unsupervised soil mapping unit within the resultant landforms and to fulfill the requirements of the digital soil maps, in addition to some testing auger observations for the purpose of recognizing the boundaries among the different mapping units. A detailed morphological description of soil profiles was recorded on the basis of guidelines for soil description, FAO (2006).

The collected soil samples from genetic horizons/layers of the profile pits were subjected to some physical and chemical analyses using soil survey laboratory methods manual, USDA Soil Survey Staff (2014). Soil characteristics values were recalculated over a certain depth, some of them by using weighting factors for the different profile sections, Sys *et al*. (1991a). Soil classification was carried out according to the USDA Soil Taxonomy, USDA Soil Survey Staff (2014).

A land capability and suitability evaluation were applied using CERVATANA and ALMAGRA models constituent of MicroLEIS DSS respectively. These two models were designed by De la Rosa *et al.* (1992) and modified for computing purpose by De la Rosa *et al.* (2004). Following the generally accepted norms of land evaluation (Klingebiel and Montgmery, 1961; FAO, 1976; Dent and Young, 1981; ONERN, 1982; Verheye, 1986), the CERVATANA model forecasts the general land use capability or suitability for a broad series of possible agricultural uses. That model works interactively, comparing the values of the characteristics of the land-unit to be evaluated with the generalization levels established for each Use Capability Class. The prediction of general land use capability is the result of a qualitative evaluation process or overall interpretation of the following biophysical factors: relief, soil, climate, and current use or vegetation. Following the procedure of maximum limitation method, four capability classes are determined: Class S1-Excellent, Class S2-Good, Class S3-Moderate, and Class N-Marginal and Nule. Four subclasses are also defined according to the most limiting land qualifies.

While the second Model, ALMAGRA model, fits the types of biophysical evaluation that use as diagnostic criteria those soil characteristics or conditions favorable for crop development in function of productivity. The soil characteristics considered in this model are: limit of useful depth, useful depth, stoniness, texture, drainage, carbonates content, salinity, sodium saturation, and degree of development of the profile. For each soil characteristic, it was established a gradation matrix which relates the soil characteristic value with the corresponding soil crop requirements. Following the procedure of maximum limitation, five relative suitability classes are determined: Class S1-Highly suitable, Class S2- Suitable, Class S3-Moderately suitable, Class S4-Marginally suitable, and Class S5- Not suitable. The subclasses are indicated by the letters corresponding to the main limiting soil diagnostic criteria. Ten land uses were tested for their suitability in the investigated area, namely: traditionally crops wheat (T), maize (M), melon (Me), potato (P), sunflower (G) and sugar beet (R) as annuals; alfalfa (Af) as semiannual; and peach (Me), citrus fruits (C) and olive (O) as perennials. The requirements of each kind of land use are obtained according to Sys *et al.,* (1993).

The tested crops were chosen on basis that several problems are facing the decision makers which are: low quality soil resources, shortage of available irrigation water and low quality of the available water.

Geomorphologic, soil, land capability and land suitability maps were spatially generated by using Arc GIS software, ESRI (2010).

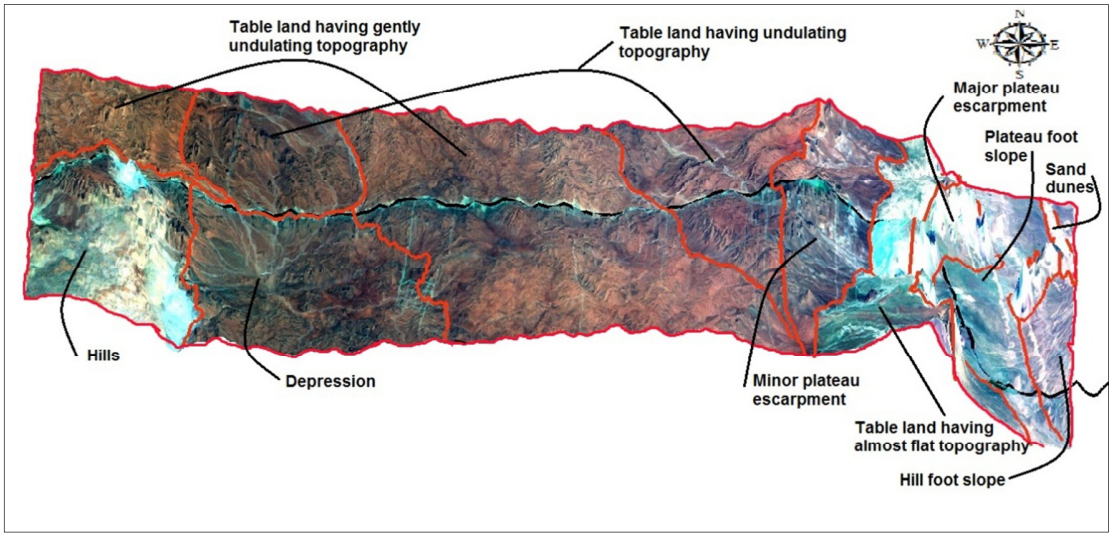
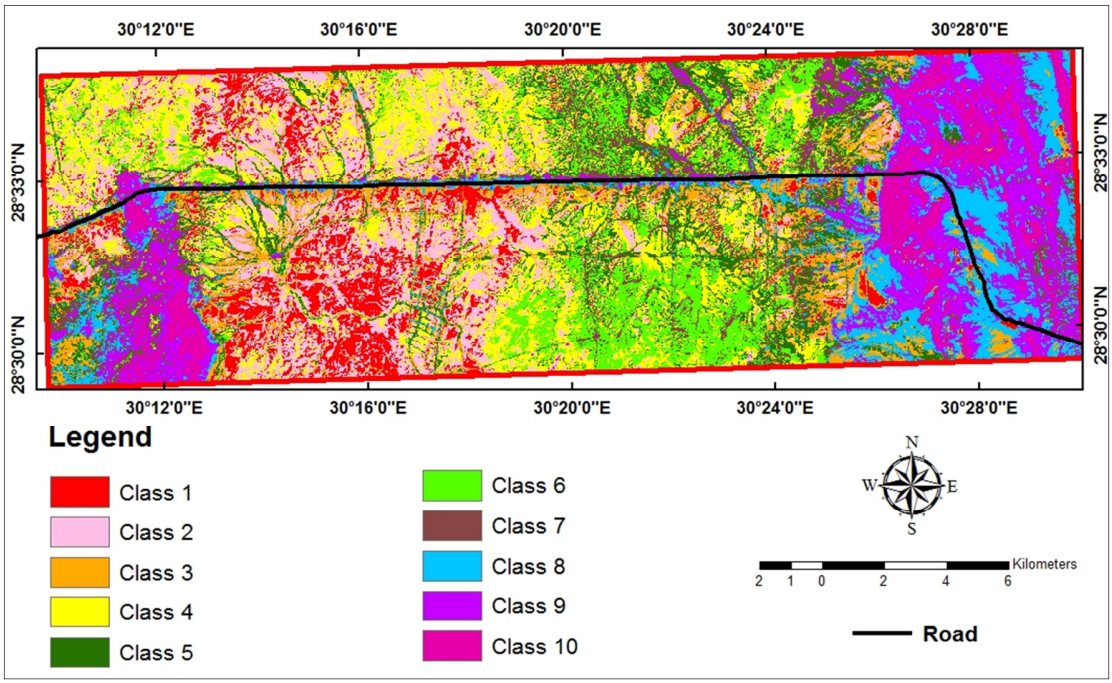


Fig. (1). 3D view of the investigated area showing the main landforms.

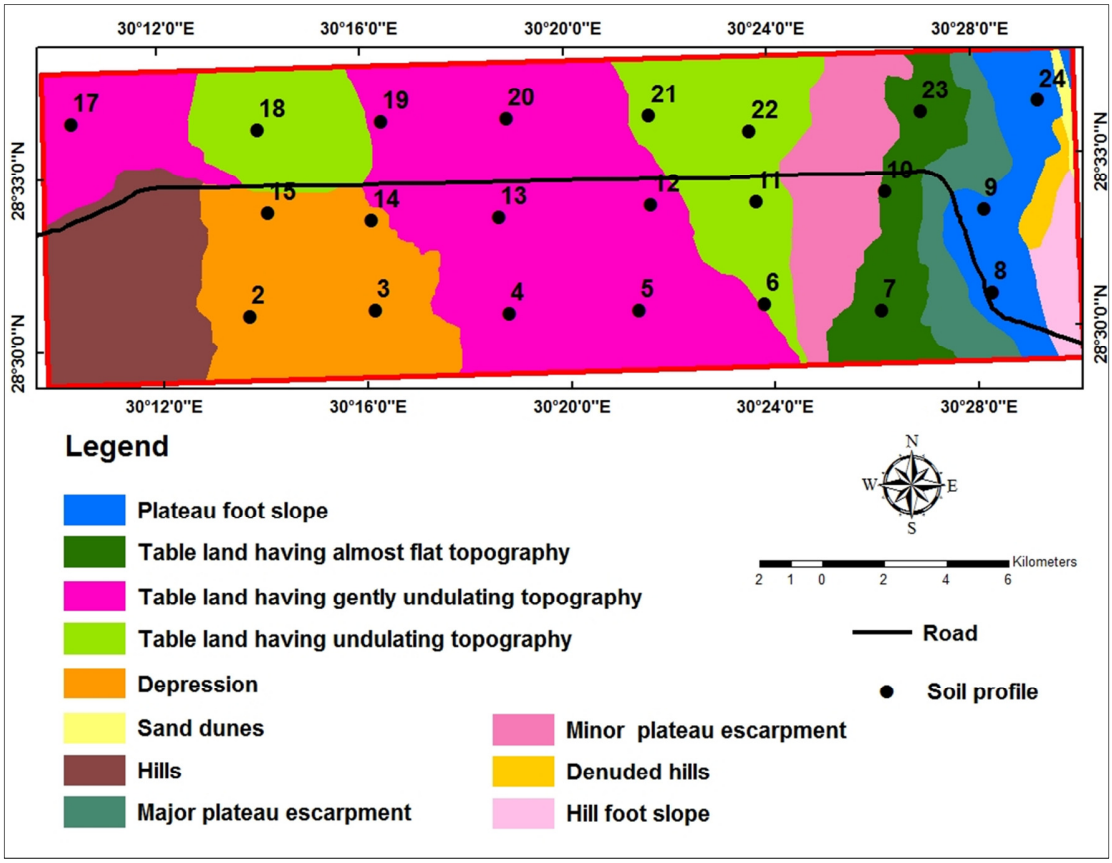


Map (2). Unsupervised classification of the investigated area.

RESULTS AND DISCUSSION

A- Geomorphology of the investigated area

The results showed that viewing a remotely sensed image merged with Digital Elevation Module (DEM) can often lead to get the better understanding of the patterns in the image and how they relate to the shape of the earth's surface. And based on the visual and digital interpretation of merged Digital Elevation Module (DEM) with Landsat-8 OLI image together with knowledge drawn from the geological map (Egyptian General Petroleum Corporation Conco Coral Staff, 1987), topography map, ground truth data and soil survey of the study area, the geopedological approach (Zinck, 1989) is adopted to produce the physiographic map, (Map 3). The combination among landscape, lithology, morphology of the terrain surface, and the photo mapping units are shown in Table (1). Landforms map was considered a Geo- database map over which the representative soil profiles were spatially distributed.



Map (3). Main landforms of the investigated area represented by soil profiles.

Table (1). Physiographic legend, proportions of each landform and associated soil profiles of the study area.

Landscape	Relief [1]	Lithology/Origin [2]	Landform	Mapping unit symbol	Representative Soil profiles	Elev. (m)	Area (Acre)	Area (%)
Plateau Pu	Almost flat 0.5 - 2% Pu 2	Wadi Rayan formation Pu 23	Plateau foot slope	Pu 231	8, 9 and 24	90 – 120	5011	6.04
			Table land having almost flat topo	Pu 232	7,10 and 23	120 - 130	5304	6.4
	Almost flat 0.5 - 2% Pu 2	Oligocene to Pleistocene Pu 24	Depression	Pu 241	2, 3,14 and15	140 - 160	10871	13.11
	Gently undulating 2-5% Pu 3	Oligocene to Pleistocene Pu 34	Table land having gently undulating topo.	Pu 341	4,5,12,13,17,19 and 20	150 - 170	28103	33.9
	Undulating 5-10% Pu 4	Oligocene to Pleistocene Pu 44	Table land having undulating topo.	Pu 441	6,11,18,21 and 22	145 - 175	13476	16.25
	Rolling 10 – 15% Pu 5	Quaternary Pu 55	Sand dunes	Pu 551		90 - 100	335	0.4
	Hilly 15-30% Pu 6	Minia formation Pu 61	Hills	Pu 611		160 - 230	8041	9.7
	Steeply dissected 30 - 60% Pu 7	Wadi Rayan formation Pu73	Major plateau escarpment	Pu 731		120 - 150	3438	4.14
			Minor plateau escarpment	Pu 732		140 - 170	5921	7.15
Hilland Hi	Hilly 15-30% Hi 6	Samalut formation Hi 62	Denuded hills	Hi 621		110 - 140	699	1
			Hill foot slope	Hi 622		100 - 130	1588	1.91
Total							82883	100

1- The relief indicated by an Arabic number in sequence of decreasing slope gradient as follows:
1 Flat, 2 Almost flat, 3 Gently undulating, 4 Undulating, 5 Rolling, 6 Hilly, 7 Steeply dissected, and 8 Mountainous.
2- The lithology/ origin indicated by an Arabic number in sequence of old age to recent age.

B- Soils of the investigated area

The results showed that the area under investigation has different morphological, physical and chemical characteristics according to the studied soil profiles representing the different unsupervised soil mapping units of the resultant landforms. Tables (2 and 3) show values of soil attributes of some potential landform units which could be discussed and classified according to Soil Taxonomy (Map 4), (USDA Soil Survey Staff, 2014) as the following:

1- Soils of plateau foot slope (Pu 231)

Soils of this unit were formed at the down of a major rock escarpment of the limestone plateau landscape in the eastern part of the study area, formed from Wadi Rayan formation dated back to middle Eocene age. They occupy an area of about 5,011 acre covering 6.04 % of the total area and represented by soil profiles No. 8, 9 and 24. The surface is almost flat, sloping towards the east, and covered with many fine gravel. Surface runoff and associated hazard of water erosion are slight due to dominant very gentle slope. The data show that, because of the erosional and depositional process, soil profiles are either moderate (< 100 cm) or deep (> 100 cm) and lack any evidence of development. Characteristics of soils formed on it are mainly related to the local lithology.

Soil texture is sand throughout the different layers of representative soil profiles. Calcium carbonate content ranges between 10.7 and 29.92% with a general trend to increase in the profile bottoms reflecting the calcareous parent materials nature in the representative profile. Gypsum content is recorded among the studied soil samples and ranges from 1.76 to 4.01%. Secondary formations of carbonates and gypsum in detectable amount were identified throughout the layers without any diagnostic horizons. Soil-pH is slightly alkaline (pH 7.4-7.7), ESP values indicate low sodium hazard (ESP 4.74-9.88%), and soil salinity varies from moderately to extremely saline (EC 9.03-50.2 dSm^{-1}). The vertical distribution of salts shows gradual homogenity with depth. The soils of this unit are classified as *Typic Torripsamments.*

2- Soils of tableland having almost flat topography (Pu 232)

This unit is a part of the plateau landscape located between the major escarpment in the east and the minor escarpment in the west at the eastern part of the study area; formed from Wadi Rayan formation dated back to middle Eocene age. They occupy an area of about 5304 acre covering around 6.4 % of the total area and represented by profiles No. 7, 10, and 23. The surface is almost flat and covered with much fine gravel. The hazardous effect of water erosion is slight as surface runoff is very slow due to slight slope class. Because of the erosional and depositional process or due to limitation by a lithic contact, soil profiles are either shallow depth (< 50 cm) or moderately deep (50 - 100 cm) and lack any evidence of development. Characteristics of soils formed on it are mainly related to the local lithology.

Data in Table (3) show that soils have coarse texture and are generally strongly to extremely calcareous ($CaCO_3$ % 18.93 – 66.34 %), moderate in gypsum content (1.71 – 4.5), and considerably varied salinity level are obtained (EC 3.88 – 29.17 dS/m). In representative profile No. 10, the salinity increases with depth reflecting the Eocene marine nature in the profile bottoms (Wadi Rayan formation). Values of pH (7.8 – 8.1) and ESP (16 -21%) show that the soils are saline-alkaline except soil profile-10 which has pH and ESP ranging from 7.4 – 7.9 and 8.5 – 10.5 %, respectively is saline. The soils of this unit are classified as *Typic Torripsamments* (profile-10) and *Lithic Torriorthents* (profiles-7 and 23).

3- Soils of depression (Pu 241)

Soils of this unit cover an area of about 10,871 acre, representing 13.11 % of the total area and are represented by soil profiles No. 2, 3, 14, and 15. They are formed in the low-lying lands existing in the Oligocene to Pleistocene plateau surface which is located at south west of the study area. The surface is almost flat, very gently sloped towards the center of this unit, and is covered with many varysized gravel. The hazardous effect of water erosion is slight as surface runoff is very slow due to slight slope class. Data in tables (2 and 3) show that soils represented by profiles 2, 3 and 14 are moderately deep while profile 15 is deep and all are characterized by sandy to gravelly sand texture, moderately well to excessively drainage and devoid of any sign of horizon development. Total carbonates are moderate ($CaCO_3$ % 4.49-10.51%), gypsum content is present as traces, soil-pH is slightly too moderately alkaline (pH 7.6-8.1), ESP values indicate low sodium hazard (ESP 5.11-13%), and soil salinity varies widely from very slightly to moderatley saline (EC 2.2-14.5 dSm^{-1}). Based on analytical data and field studied soils of depression are classified as *Typic Torripsamments* (profiles-3, 14, and 15) and *Typic Torriorthents* (profile- 2).

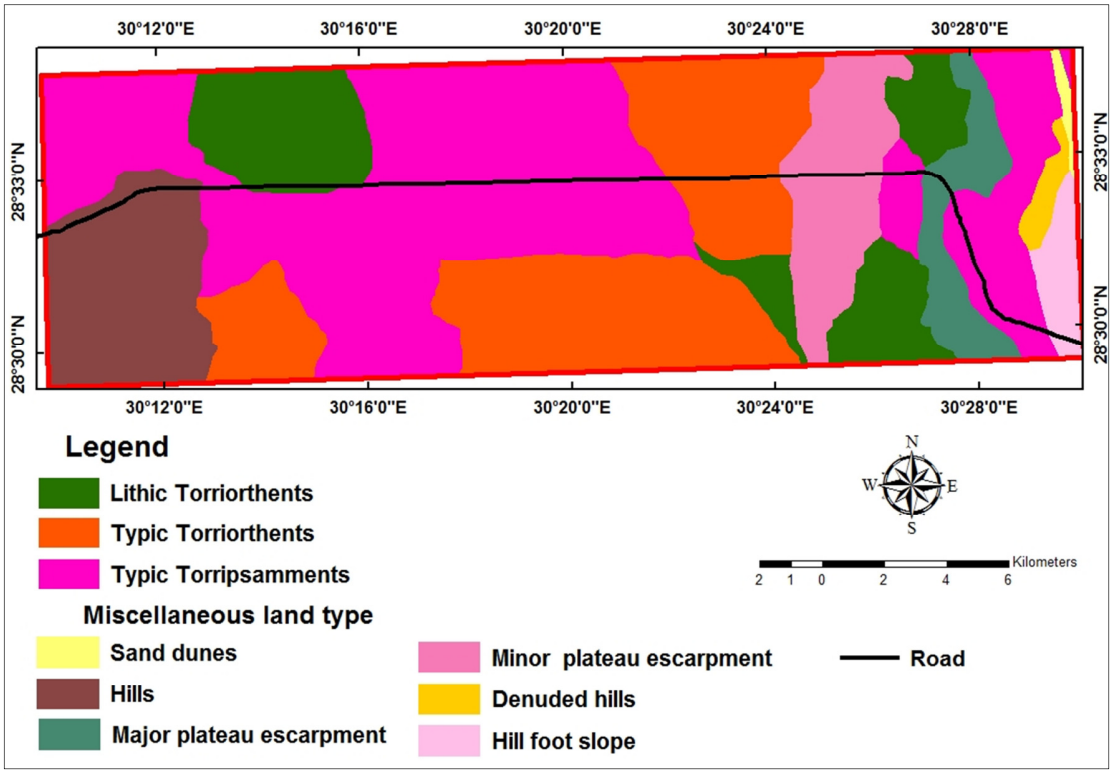
4- Soils of tableland having gently undulating topography (Pu 341)

These soils dominate the plateau surface of the study area occupying an area of about 28,103 acre representing 33.9% of the total area. They are developed from the formations dated back to Oligocene to Pleistocene ages. They are formed from sandy to gravelly sand soils. Surface is gently undulating and covered with gravel associated with desert varnish which minimizes surface runoff with slight hazard of water erosion. Soils of this landform were examined through profiles 4, 5, 12, 13, 17, 19, and 20. They are excessively and/or moderately well drained and characterized by deep to moderately deep profile. Very wide variation in total carbonate content are recorded among the representative soil profiles and ranging between 3.29 and 35.56 % due to the nature of parent material which consists essentially of sandy and gravelly sediments, while gypsum content is present as trace. Secondary formations of carbonates and gypsum in detectable amount were identified throughout the layers without any characteristics of diagnostic horizons. Soil reaction is slight tending to moderately alkaline range where pH values fluctuate between 7.4 and 8.4. Soils have wide range of salinity with EC values ranging between 4.07 and 27.25 dSm^{-1}. Values of ESP (from 6.5 to 14.5 %) indicate with values of EC and pH that those soils are saline. Hence, soils are

classified as *Typic Torriorthents* (Profiles-4 and 5) and *Typic Torripsamments* (profiles-12, 13, 17, 19 and 20).

5- Soils of tableland having undulating topography (Pu 441)

Soils of table land having undulating topography cover an area of 1,3476 acre representing 16.25 % of the total area. The surface is undulating and covered with many varysized gravels. They are represented by soil profiles No. 6, 11, 18, 21 and 22. These soils are characterized by shallow or deep gravelly sand profile with excessively drained (profiles-11, 21 and 22) and poorly drained (profiles-6 and 18) status. Secondary formations of carbonates and gypsum in detectable amount were identified throughout the layers with no any characteristics of diagnostic horizons. The electrical conductivity values revealed that soil salinity varies widely from very slightly saline (EC ≈ 3.16 dS/m) to extremely saline (EC ≈ 20.6 dS/m). The higher figures of salinity are mostly concentrated in the middle layers of profiles- 11, 21, and 22 as its EC values vary from moderately (EC ≈ 12.3 dS/m) to extremely saline (EC ≈ 20.6 dS/m). The soil-pH values vary from slightly (pH ≈ 7.6) to moderately alkaline (pH ≈ 8.3). ESP values (from 2.5 to 16.24 %) indicating with the other parameters (pH and EC) that these soils are mostly slightly saline – slightly alkaline. Hence, they are classified as *Typic Torriorthents* (Profile-11, 21and 22) and *Lithic Torriorthents* (profiles-6 and 18).



Map (4). Soil classification of the investigated area.

Table (2). The main morphological features of representative soil profiles in the investigated area.

Profile No.	Lat. N Log. E	Topography, Slope, Surfac cover	Erosion	Drainage	Depth (cm)	Soil colour		Consistency*
						Dry	Moist	
Plateau foot slope (Pu 231)								
8	28°30'36.21" 30°28'18.87"	Almost flat, Nearly level, Many fine gravel	Slight	Excessive	0-30	10 YR 6/6	10YR 5/8	LO
					30-90	10 YR 6/6	10YR 5/8	HA
					90-105	10 YR 6/8	10YR 5/8	HA
					105-120	10 YR 6/8	10YR 5/8	EHA
9	28°32'3.73" 30°28'11.52"		Slight	Moderately well	0-30	10 YR 8/2	10YR 7/2	SO
					30-60	10 YR 8/3	10YR 7/4	HA
					60-90	10YR 8/3	10YR 7/4	HA
24	28°33'54.78" 30°29'18.07"		Slight	Excessive	0-30	10 YR 6/6	10YR 5/8	LO
					30-90	10 YR 6/6	10YR 5/8	HA
					90-105	10 YR 6/8	10YR 5/8	HA
					105-120	10 YR 6/8	10YR 5/8	EHA
Tableland having almost flat topography (Pu 232)								
7	28°30'21.14" 30°26'7.60"	Almost flat, Nearly level, Many fine gravel	Slight	Poor	0-30	7.5YR 8/4	7.5YR 7/4	SHA
10	28°32'24.69" 30°26'15.32"		Slight	Moderately well	0-35	10YR 7/4	10 YR 6/6	LO
					35-55	10YR 7/4	10 YR 6/6	SO
					55-90	10YR 7/4	10 YR 6/6	HA
23	28°33'40.43" 30°26'16.42"		Slight	Poor	0-30	10YR 8/3	10YR 7/6	SHA

* Consistency: LO - Loose, SO - Soft, SHA - Slightly Hard, HA - Hard

Table (2). Cont.

Profile No.	Lat. N Log. E	Topography, Slope, Surfac cover	Erosion	Drainage	Depth (cm)	Soil colour Dry	Soil colour Moist	Consistency*
Depression (Pu 241)								
2	28°30'32.53" 30°13'42.99"	Almost flat, Very gently sloping, Many varysized gravel	Slight	Moderately well	0-25	10YR 7/6	10 YR 6/6	LO
					25-65	10 YR 6/6	10YR 5/8	SHA
					65-90	7.5YR 6/6	7.5 5/8	HA
3	28°30'35.11" 30°16'10.81"		Slight	Moderately well	0-30	10YR 7/4	10YR 5/8	HA
					30-60	7.5YR 7/6	7.5 5/8	HA
14	28°32'9.61" 30°16'8.60"		Slight	Moderately well	0-30	10 YR 6/6	10YR 5/8	SO
					30-50	10YR 7/6	10 YR 6/6	SHA
					50-80	7.5YR 6/8	7.5 5/8	HA
15	28°32'19.91" 30°14'6.15"		Slight	Excessive	0-40	10YR 7/4	10 YR 6/6	LO
					40-80	10YR 7/6	10 YR 6/6	SO
					80-120	7.5YR 6/8	7.5 YR 5/8	SHA
					120-150	7.5YR 6/8	7.5 YR 5/8	HA
Tableland having gently undulating topography (Pu 341)								
4	28°30'27.75" 30°18'48.55"	Gently undulating, Gently sloping, Many varysized gravel	Slight	Excessive	0-30	10YR 7/6	10YR 6/6	LO
					30-80	10YR 7/6	10YR 6/6	SHA
					80-120	7.5YR 7/4	7.5YR 5/8	HA
5	28°30'27.39" 30°21'21.52"		Slight	Excessive	0-40	10YR 7/4	10 YR 6/6	SO
					40-80	7.5YR 6/6	7.5YR 5/8	SHA
					80-120	7.5YR 6/6	7.5YR 5/8	HA
12	28°32'17.33" 30°21'38.80"		Slight	Moderately well	0-15	10YR 7/4	10 YR 6/6	SO
					15-60	7.5YR 7/6	7.5 YR 6/6	SHA
					60-85	7.5YR 8/4	7.5 YR 7/6	HA
13	28°32'8.87" 30°18'38.63"		Slight	Moderately well	0-30	10YR 7/6	10 YR 5/8	SO
					30-60	7.5YR 6/6	7.5 YR 5/6	SHA
					60-80	7.5YR 6/6	7.5 YR 5/6	HA

Table (2). Cont.

Profile No.	Lat. N Log. E	Topography, Slope, Surfac cover	Erosion	Drainage	Depth (cm)	Soil colour		Consistency*
Tableland having gently undulating topography (Pu 341)								
17	28°33'56.61" 30°10'17.07"	Gently undulating, Gently sloping, Many varysized gravel	Slight	Moderately well	0-40	10YR 7/6	10 YR 6/6	SO
					40-80	7.5YR 6/8	7.5 YR 5/8	HA
19	28°33'51.83" 30°16'22.94"		Slight	Excessive	0-20	10YR 7/4	10YR 5/8	SO
					20-60	7.5YR 6/8	7.5 YR 5/8	SHA
					60-90	7.5YR 6/8	7.5 YR 5/8	SHA
					90-120	7.5YR 6/8	7.5YR 5/8	HA
20	28°33'51.47" 30°18'51.13"		Slight	Excessive	0-30	10YR 7/6	10YR 5/8	SO
					30-50	7.5YR 6/8	7.5 YR 5/8	SHA
					50-90	7.5YR 6/8	7.5 TR 5/8	HA
					90-120	7.5YR 5/8	7.5 YR 4/6	SHA
Tableland having undulating topography (Pu 441)								
6	28°30'30.70" 30°23'50.08"	Undulating, Sloping, Many varysized gravel	Moderate	Poor	0-20	7.5YR 7/6	7.5YR 6/6	HA
					20- 35	7.5YR 7/6	7.5YR 6/6	HA
11	28°32'17.33" 30°23'43.46"		Moderate	Excessive	0-40	10YR 7/4	10YR 5/8	SO
					40-80	10 YR 6/6	10YR 5/8	SHA
					80-150	5YR 6/6	5YR 5/6	HA
18	28°33'45.95" 30°13'56.96"		Moderate	Poor	0-25	10YR 7/4	10YR 5/8	SHA
					25-45	7.5YR 7/6	7.5YR 6/6	HA
21	28°33'50.36" 30°21'39.54"		Moderate	Excessive	0-30	10YR 7/4	10YR 5/8	SHA
					30-65	7.5YR 6/8	7.5 YR 5/8	HA
					65-110	7.5YR 6/8	7.5 YR 5/8	HA
22	28°33'31.24" 30°23'37.21"		Moderate	Excessive	0-30	10YR 7/4	10 YR 5/8	SHA
					30-80	7.5YR 7/6	7.5 YR 6/6	HA
					80-120	7.5YR 7/6	7.5 YR 6/6	HA

Table (3). Physical, and chemical soil properties in the investigated area.

10.5	Depth (cm)	Gravel (%) > 2 mm	Texture class	pH	EC dSm^{-1} in soil paste extract	$CaCO_3$ %	Gypsum %	ESP %
Plateau foot slope (Pu 231)								
8	0-30	16.67	S	7.72	13.40	18.77	1.76	4.74
	30-90	6.15	S	7.6	24.20	29.30	2.28	8.33
	90-105	9.52	S	7.51	29.50	27.16	2.77	9.23
	105-120	3.81	S	7.44	50.20	29.92	4.68	9.61
9	0-30	0.00	S	7.65	9.03	10.70	2.22	8.68
	30-60	25.00	GrS	7.37	25.02	23.87	4.01	9.88
	60-90	24.32	GrS	7.5	29.50	27.98	3.94	9.60
24	0-30	16.67	S	7.72	13.40	18.77	1.76	4.74
	30-90	6.15	S	7.6	24.20	29.30	2.28	8.33
	90-105	9.52	S	7.51	29.50	27.16	2.77	9.23
	105-120	3.81	S	7.44	50.20	28.50	4.68	9.61
Tableland having almost flat topography (Pu 232)								
7	0-30	12.50	LS	7.79	22.50	65.68	3.55	16.00
10	0-35	4.55	S	7.86	3.88	18.93	1.71	8.50
	35-55	15.38	LS	7.4	8.20	32.10	2.14	9.00
	55-90	26.67	GrS	7.75	29.17	40.99	4.50	10.50
23	0-30	7.14	S	8.1	20.45	66.34	3.07	21.00

*Texture: S - Sand, LS - loamy sand, GrS - Gravelly sand, VGrS - Very gravelly sand, VGrLS - Very gravelly loamy sand

Table (3). Cont.

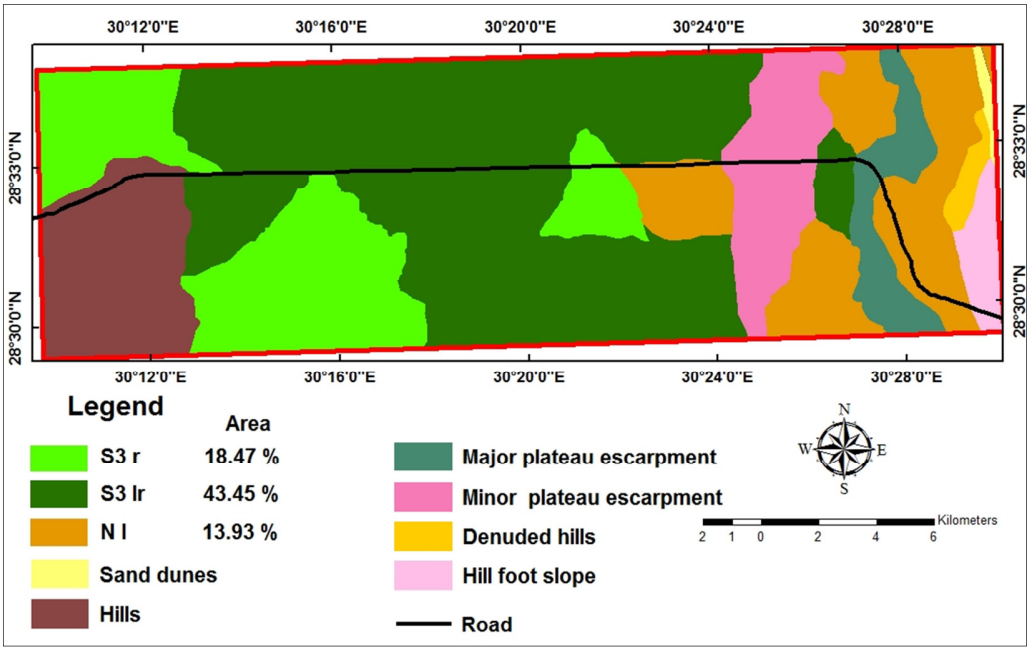
Profile No.	Depth (cm)	Gravel (%) > 2 mm	Texture class	pH	EC dSm-1 in soil paste extract	CaCO3 %	Gypsum %	ESP %
Depression (Pu 241)								
2	0-25	4.17	S	7.98	2.18	10.51	0.03	9.04
	25-65	58.75	VGrS	8.06	14.50	8.07	1.99	6.54
	65-90	63.45	VGrS	7.75	13.20	10.35	0.81	5.51
3	0-30	6.67	S	7.95	3.13	4.49	0.25	7.64
	30-60	30.00	GrLS	7.79	6.00	5.76	2.02	5.11
14	0-30	8.33	S	8.1	3.95	9.17	1.68	7.91
	30-50	6.86	LS	7.92	9.20	8.48	1.20	7.70
	50-80	10.43	LS	7.73	13.35	9.01	1.20	6.46
15	0-40	3.85	S	8.02	3.38	9.22	1.68	10.10
	40-80	26.92	GrS	7.94	6.77	6.58	0.67	13.00
	80-120	27.27	GrS	7.67	6.91	9.05	0.25	8.83
	120-150	18.06	GrS	7.6	9.50	10.04	0.30	5.96
Tableland having gently undulating topography (Pu 341)								
4	0-30	4.55	S	7.82	4.64	11.85	1.38	9.05
	30-80	66.67	VGrLS	7.91	4.60	18.11	1.98	8.38
	80-120	56.50	VGrLS	7.93	4.85	30.78	1.66	10.21
5	0-40	25.00	GrS	8.4	4.26	13.99	1.52	9.83
	40-80	50.50	GrS	7.87	10.82	13.33	2.08	14.50
	80-120	57.81	GrS	7.67	8.85	19.09	1.98	13.11
12	0-15	16.67	S	7.76	4.20	13.99	1.16	9.67
	15-60	14.00	LS	8.42	10.16	3.29	2.00	14.50
	60-85	34.00	GrLS	8.34	10.55	3.62	2.43	14.50

Table (3). Cont.

Profile No.	Depth (cm)	Gravel (%) > 2 mm	Texture class	pH	EC dSm^{-1} in soil paste extract	$CaCO_3$ %	Gypsum %	ESP %
Tableland having gently undulating topography (Pu 341)								
13	0-30	9.57	S	8.02	5.95	9.88	1.98	12.00
	30-60	13.83	S	7.74	22.50	9.38	2.59	13.00
	60-80	35.00	GrS	7.63	22.03	11.52	2.62	14.50
17	0-40	9.09	S	8.22	4.07	10.37	1.78	12.82
	40-80	9.52	LS	8.01	17.26	10.37	2.18	9.72
19	0-20	14.29	LS	7.82	4.56	11.85	1.12	12.00
	20-60	12.00	LS	7.86	6.51	22.39	1.98	13.60
	60-90	14.78	S	7.68	8.30	27.49	1.78	13.75
	90-120	3.70	S	7.8	10.46	35.56	1.98	6.50
20	0-30	11.76	LS	7.88	4.20	12.51	1.64	14.50
	30-50	4.17	LS	7.75	4.10	12.18	2.20	14.50
	50-90	4.35	S	7.46	27.25	12.51	4.16	14.50
	90-120	3.45	S	7.6	19.25	11.03	2.57	14.20
Tableland having undulating topography (Pu 441)								
6	0-20	51.85	VGrS	7.86	4.45	3.46	1.71	2.90
	20- 35	37.00	GrLS	8	13.75	7.01	2.30	2.50
11	0-40	51.28	VGrS	7.64	16.10	42.80	1.72	4.20
	40-80	79.23	VGrLS	7.54	20.60	12.35	3.37	12.50
	80-150	26.32	GrS	8.09	8.50	15.80	1.06	14.60
18	0-25	40.17	VGrS	7.93	4.16	12.35	1.55	14.90
	25-45	36.67	GrLS	8.14	14.25	7.24	2.57	2.60
21	0-30	13.89	LS	8.31	4.97	16.79	0.04	14.50
	30-65	70.32	VGrLS	7.4	16.50	29.63	1.58	16.24
	65-110	65.16	VGrLS	7.55	13.30	34.57	1.58	16.10
22	0-30	19.35	GrS	8.02	3.16	9.22	1.60	8.50
	30-80	62.67	VGrLS	8.22	12.30	13.50	2.22	13.80
	80-120	53.33	VGrS	7.92	7.86	15.64	1.98	11.20

C- Land capability of the investigated area

Results of the agricultural land capability evaluation generated by CERVATANA model constituent of MicroLEIS DSS are presented in Table (4) and Map (5). They include land capability classes and associated limitations of the studied soils representing different landforms. Two land capability classes were recognized, "Moderate Capability, S3" and "Non-Productive, N". Lands of moderate capability have two subclasses abbreviated as "S3 r" referring to soils with slight constraint severity, and "S3 lr" including soils affected by severe soil constraints and erosion risk. S3 r subclass includes soils of most of the depression unit and partially the tableland having gently undulating topography, which has slight limitation regarding erosion factor. Meanwhile, S3 lr subclass has considerable limitations linked to topographic (slope), edaphic (shallow profile, poor drainage, and/or high gravel content), or climatic factors. It includes partially soils of the table-land having almost flat topography and depression units, whereas it includes most of the table-land having gently undulating or tableland having undulating topography. These substantially reduce the range of possible crops and the productive capability. Management techniques are more difficult to apply due to higher costs. Intensive practices are necessary - and sometimes special conservation practices to maintain a continued productivity. Non-productive land (N l) includes soils of plateau foot slope, most of the tableland having almost flat topography and partially of the tableland having undulating topography. They do not provide the ecological conditions necessary for agricultural crops, therefore they are recommended for pasture or forestry land utilization types. They may need very different management and conservation practices to overcome its topographic (slope), edaphic (high salinity and gravels), or climatic deficiencies.



Map (5). Land capability grades of the investigated area.

Table (4). Main land characteristics of representative soil profiles of the investigated area and its capability classes.

Profile No.	Slope*	Depth (cm)	Texture	Gravel (%) > 2 mm	Drainage	EC dS/m	Soil erosion	vegetation	Erosivity	Water dificency	Frost	Capability** class and limitation	Area (acre)
Plateau foot slope (Pu 231)													
8	NL	120	S	10.7	Excessive	20.60	Slight	Nil	Slight	Moderate	Slight	Nl	1033
9	NL	90	S	11.5	Moderatly well	17.00	Slight	Nil	Slight	Moderate	Slight	Nl	1634
24	NL	120	S	9.4	Excessive	19.00	Slight	Nil	Slight	Moderate	Slight	Nl	2343
Tableland having almost flat topography (Pu 232)													
7	NL	30	S	12.5	Poor	22.50	Slight	Nil	Slight	Moderate	Slight	Nl	2584
10	NL	90	S	10.6	Moderatly well	9.20	Slight	Nil	Slight	Moderate	Slight	S3lr	1033
23	NL	30	S	7.14	Poor	20.45	Slight	Nil	Slight	Moderate	Slight	Nl	1688
Depression (Pu 241)													
2	VGS	90	S	33.4	Moderatly well	8.50	Slight	Nil	Slight	Moderate	Slight	S3r	2703
3	VGS	60	S	14	Moderatly well	4.00	Slight	Nil	Slight	Moderate	Slight	S3r	3890
14	VGS	80	S	7.8	Moderatly well	6.70	Slight	Nil	Slight	Moderate	Slight	S3r	1993
15	VGS	150	S	14.6	Excessive	4.70	Slight	Nil	Slight	Moderate	Slight	S3lr	2286
Tableland having gently undulating topography (Pu 341)													
4	GS	120	S	38.5	Excessive	4.60	Slight	Nil	Slight	Moderate	Slight	S3lr	3679
5	GS	120	S	37	Excessive	6.40	Slight	Nil	Slight	Moderate	Slight	S3lr	5654
12	GS	85	S	13.3	Moderatly well	7.20	Slight	Nil	Slight	Moderate	Slight	S3r	1984
13	GS	80	S	9.8	Moderatly well	10.50	Slight	Nil	Slight	Moderate	Slight	S3lr	3291

Table (4). Cont.

Profile No.	Slope*	Depth (cm)	Texture	Gravel (%) > 2 mm	Drainage	EC dS/m	Soil erosion	vegetation	Erosivity	Water dificency	Frost	Capability* class and limitation	Area (acre)
17	GS	80	S	9	Moderatly well	6.20	Slight	Nil	Slight	Moderate	Slight	S3r	4736
19	GS	120	S	12.7	Excessive	6.60	Slight	Nil	Slight	Moderate	Slight	S3lr	2265
20	GS	120	S	6.9	Excessive	11.00	Slight	Nil	Slight	Moderate	Slight	S3lr	6494
Tableland having undulating topography (Pu 441)													
6	S	35	S	46	Very poor	7.5	Moderate	Nil	Slight	Moderate	Slight	S3lr	1024
11	S	150	S	51	Excessive	19.9	Moderate	Nil	Slight	Moderate	Slight	Nl	2169
18	S	45	S	14.6	Poor	7.4	Moderate	Nil	Slight	Moderate	Slight	S3lr	5071
21	S	110	S	45.3	Excessive	10	Moderate	Nil	Slight	Moderate	Slight	S3lr	2522
22	S	120	S	42.7	Excessive	7.6	Moderate	Nil	Slight	Moderate	Slight	S3lr	2691

*Slope: NL-Nearly level, GS- Gently sloping, S- Sloping

**Capability classes: (S3r) Moderate capability soils with slight constraint severity due to erosion risk

– (S3lr) Moderate capability soils with sever soil constraints and erosion risk.

– (Nl) Non productive soils with sever topographic (slope), edaphic (high salinity and gravel)

D- Land suitability of the investigated area

The physical and chemical soil properties (soil suitability criteria) were further evaluated to define land suitability for ten land uses types which are; wheat, maize, melon, potatoes, sunflower, sugar beet, alfalfa, peach, citrus, and olive. For each land utilization type, matching soil characteristics with the crop requirements were performed to recognize the current suitability, and limiting factors. The land suitability evaluation results are shown in Tables (5 and 6) and Maps (6, 7, 8, and 9) for the selected land uses. The results showed that the soils under consideration were placed in classes S2, S3, S4, and S5 as follows;

1- Suitable soils (S2)

Limited area is evaluated as suitable for some of the tested crops, namely; peach, citrus and olive (about 2,286 acre for each). This area is generally deep, sandy with almost flat topography. They are represented by profile 15. Agriculture limitations are mostly ascribed to the presence of slight salinity, and excessive drainage. Economically, under low input level, these soils will be highly suitable for these crops.

2- Moderately suitable soils (S3)

Wide areas are evaluated as moderately suitable for the tested crops as follow; 1- Sugar beet and alfalfa (26,549 acre for each), 2- Wheat, maize, watermelon, potato and sunflower (22,225 acre for each), 3- Olive (19,192 acre) and 4- Peach and citrus (12,884 acre for each).

These areas are represented by profiles 3, 10, 12, 13, 14, 15, 17, 18, and 19. Agriculture limitations for the tested crops generally include coarse texture and severe salinity in addition to excessive drainage in profiles 18, and moderately effective depth for fruit trees in profile 3. From economical point of view, these soils under moderate to high input level will be better to be utilized for the tested crops.

3- Marginal suitable soils (S4)

The marginally suitable area for the tested crops ranges from 4,324 – 22,320 acre. They are represented by profiles 2, 4, 5, 7, 8, 9, 10, 12, 13 18, 20, 21, 22, 23, and 24. The main limitations of land are severe salinity, moderate to severe soil texture, poor drainage, effective depth, and gravel content.

4- Not suitable soils (S5)

Most of the soils in the studied area are considered not suitable for the tested crops. These soils have severe problems due to the high salinity and alkalinity, severe soil texture, high gravel content, shallow rooting zone, and poor drainage.

Table (5). Main landform and representative soil profiles and its suitability classes* for the selected land use types in the investigated area.

Profile No.	Land use										Area (acre)
	Wheat	Maize	Melon	Potato	Sunflower	beet	Alfalfa	Peach	Citrus	Olive	
Plateau foot slope (Pu 231)											
8	S5s**	S5s	S5s	S5s	S5s	S4s	S4s	S5s	S5s	S5s	1033
9	S5s	S5s	S5s	S5s	S5s	S4s	S4s	S5s	S5s	S5s	1634
24	S5s	S5s	S5s	S5s	S5s	S4s	S4s	S5s	S5s	S5s	2343
Tableland having almost flat topography (Pu 232)											
7	S5s	S5s	S5s	S5s	S5s	S4ps	S4ps	S5ps	S5ps	S5ps	2584
10	S4s	S4s	S4s	S4s	S4s	S3ts	S3ts	S5s	S5s	S3s	1033
23	S5s	S5sa	S5s	S5s	S5s	S4psa	S4psa	S5ps	S5ps	S5ps	1688
Depression (Pu 241)											
2	S5t	S5t	S5t	S5t	S5t	S5t	S5t	S4ts	S4ts	S4t	2703
3	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S3p	S3p	S3p	3890
14	S3t	S3t	S3ts	S3t	S3t	S3t	S3t	S3s	S3s	S3s	1993
15	S3t	S3ta	S3t	S3t	S3t	S3t	S3t	S2tds	S2tds	S2tdc	2286
Tableland having gently undulating topography (Pu 341)											
4	S5t	S5t	S5t	S5t	S5t	S5t	S5t	S4t	S4t	S4t	3679
5	S5t	S5t	S5t	S5t	S5t	S5t	S5t	S4t	S4t	S4t	5654
12	S3ts	S3tsa	S3ts	S3ts	S3ts	S3t	S3ts	S4s	S4s	S3s	1984
13	S4s	S4s	S4s	S4s	S4s	S3ts	S3ts	S5s	S5s	S3s	3291
17	S3t	S3ta	S3ts	S3t	S3t	S3t	S3t	S3s	S3s	S3s	4736
19	S3t	S3ta	S3ts	S3t	S3t	S3t	S3t	S3s	S3s	S3s	2265
20	S5s	S5s	S5s	S5s	S5s	S4s	S4s	S5s	S5s	S5s	6494

Table (5). Cont.

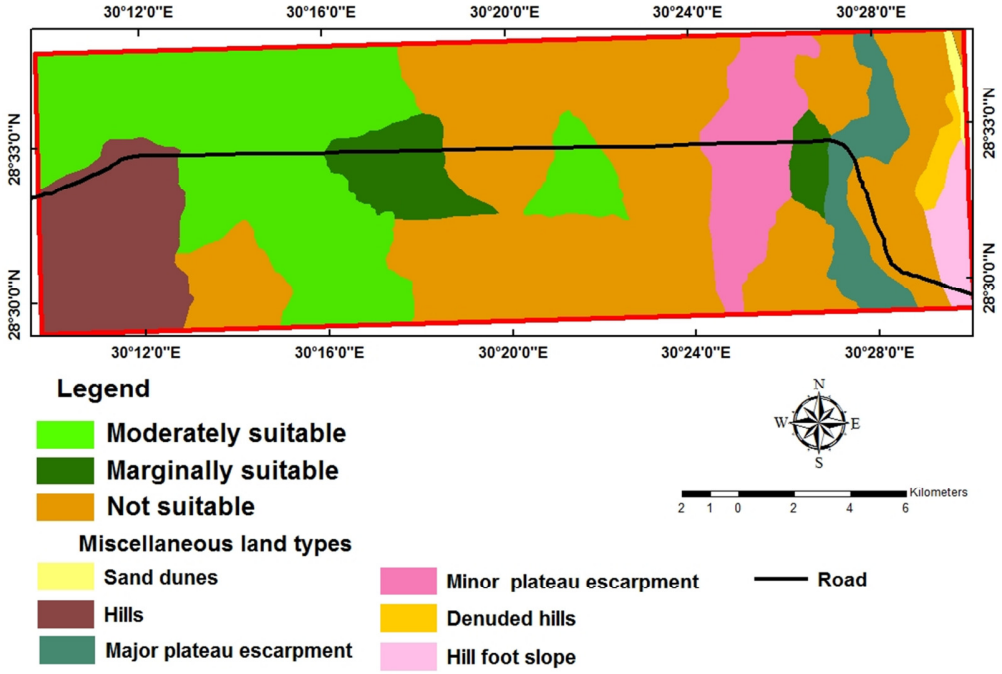
10.	Land use										Area (acre)
	Wheat	Maize	Melon	Potato	Sunflower	beet	Alfalfa	Peach	Citrus	Olive	
Tableland having undulating topography (Pu 441)											
6	S5t	S5t	S5t	S5t	S5t	S5t	S5t	S5p	S5p	S5p	1024
11	S5ts	S5ts	S5ts	S5ts	S5ts	S5t	S5t	S5s	S5s	S5s	2169
18	S3tds	S3tsa	S3pts	S3ts	S3pts	S3ptd	S3ptd	S4pds	S4pds	S4pd	5071
21	S5t	S5t	S5t	S5t	S5t	S5t	S5t	S5s	S5s	S4t	2522
22	S5t	S5t	S5t	S5t	S5t	S5t	S5t	S4ts	S4ts	S4t	2691

* Suitability classes: (S1) highly suitable soils – (S2) suitable soils – (S3) moderately suitable soils - (S4) marginally suitable soils – (S5) not suitable soils
** Soil limitations: (p) useful depth - (t) texture - (d) drainage condition - (c) carbonates content - (s) salinity - (a) sodium saturation.

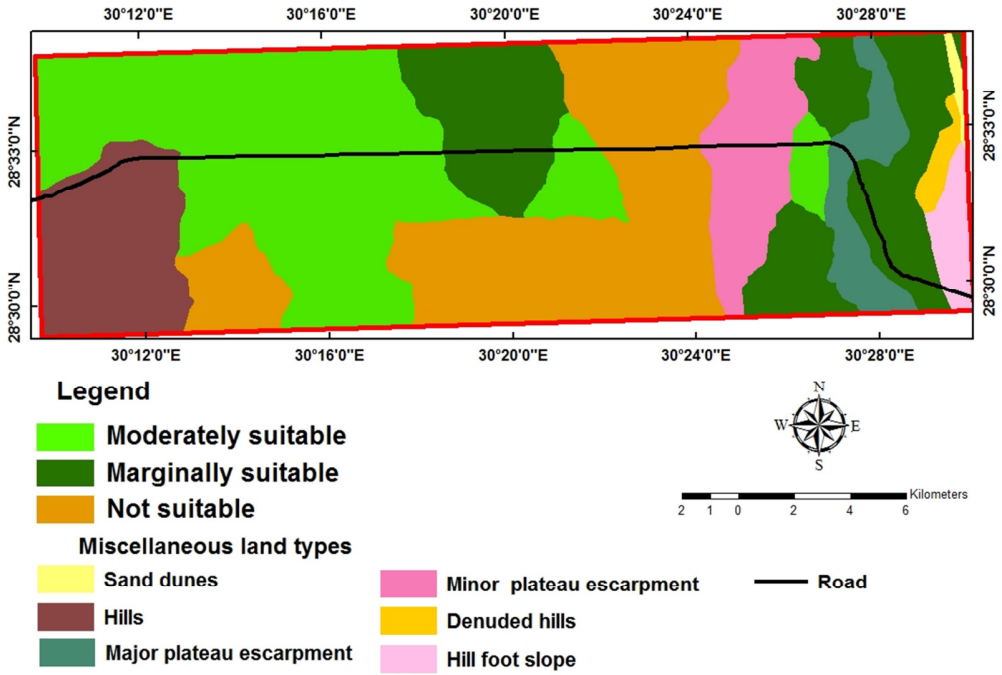
Table (6). Suitability classes for the selected land uses and their areas (acre) in the investigated area.

Suitability class*	Land use									
	Wheat	Maize	Melon	Potato	Sunflower	Sugar beet	Alfalfa	Peach	Citrus	Olive
S2								2286	2286	2286
S3	22225	22225	22225	22225	22225	26549	26549	12884	12884	19192
S4	4324	4324	4324	4324	4324	15776	15776	21782	21782	22320
S5	36314	36314	36314	36314	36314	20442	20442	28602	28602	19065

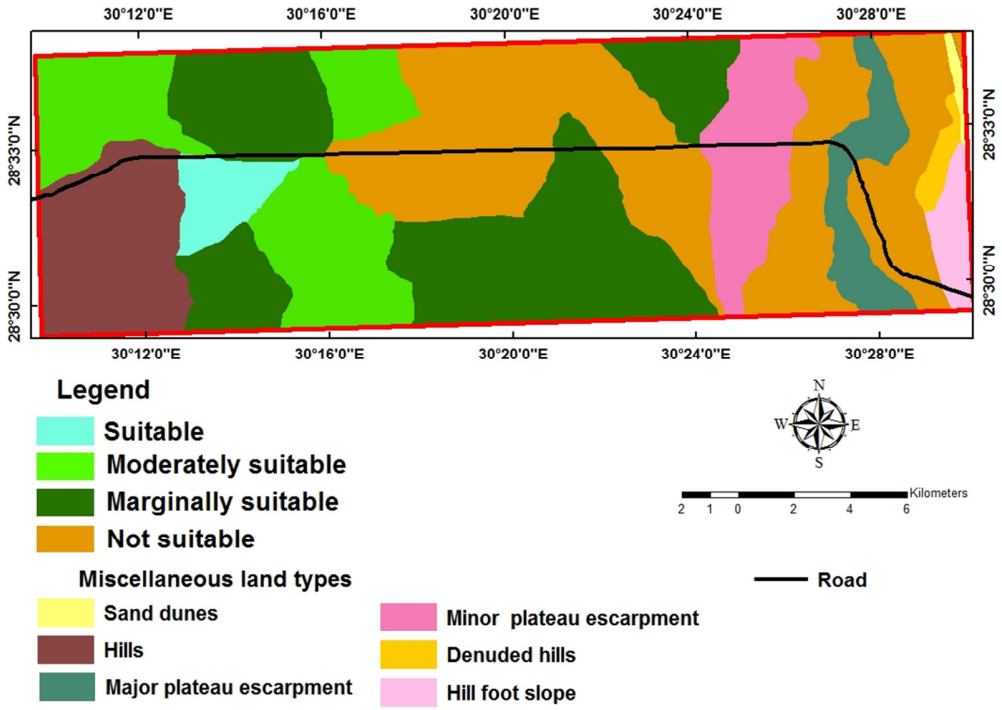
* Suitability classes: (S1) high suitable soils – (S2) suitabe soils – (S3) moderate suitable s – (S4) marginal suitable soils – (S5) not suitable soils



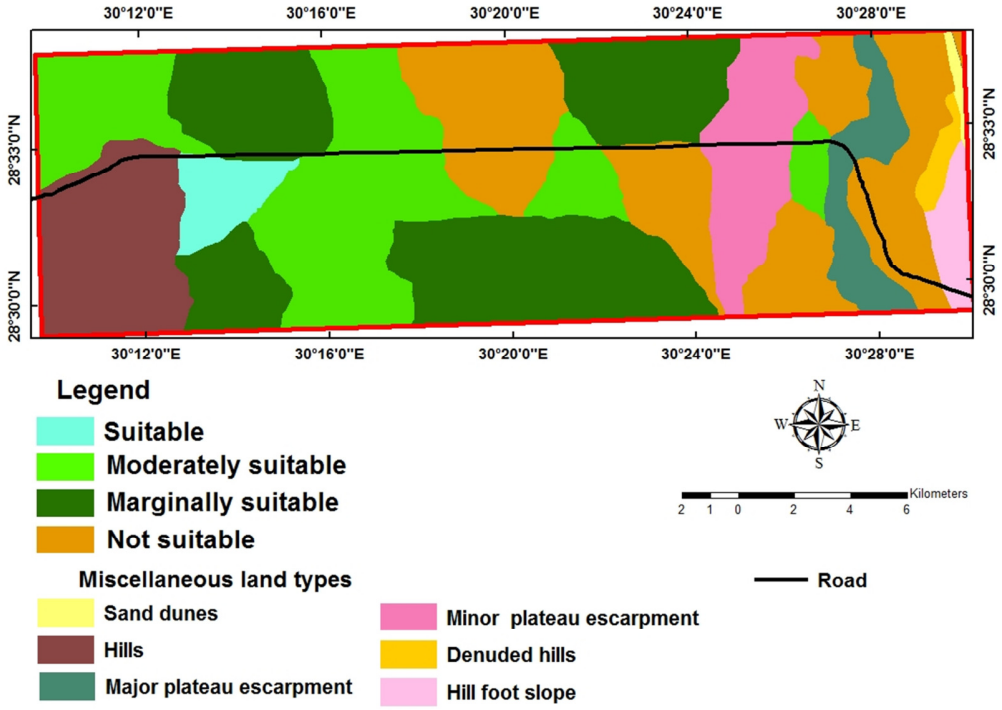
Map (6). Land suitability grades for wheat, maize, melon, potato, sunflower of the investigated area.



Map (7). Land suitability grades for sugar beet, alfalfa of the investigated area.



Map (8).Land suitability grades for peach, citrus of the investigated area.



Map (9). Land suitability grades for olive of the investigated area.

CONCLUSIONS

This study dealt mainly with the geomorphologic setting, soil condition, its classification and land evaluation of potentialities of some land resources located adjacent to Bani Mazar-El-Boiety Road, West of El-Minia, for their optimum agricultural use. It is based on remote sensing data, GIS facilities, and physical and chemical characteristics of the different soil units. The present study indicates the following:

1- The study area has different geomorphic units; i.e. plateau foot slope, depression and the tableland with varying topography i.e, undulating, gently undulating, and almost flat topography, showed detectable amount of secondary formations of carbonates and gypsum throughout some layers without any characteristics of diagnostic horizons. So, they are classified as *Typic Torripsamments*, *Typic Torriorthents* and *Lithic Torriorthents.* It is concluded that there is no relationship between the geomorphic units and the existed soil taxa.

2- With regard to the evaluation of soil resources potentialities; the most severe limitations are; salinity, texture and graveled subsurface stoniness followed by the useful depth and internal drainage. Whereas the carbonate and sodium saturation are the least influential ones but not generally associated with specific geomorphic units except the plateau foot-slope unit that is characterized by high salinity level that hinders agricultural use for the time being..

3- In general, the soils within the study area can be classified into four (4) suitability classes, i.e. suitable (S2) with 2,286 acres (2.75% of the total area), moderately suitable (S3) 12,884 acres (for some orchards) to 26,549 acres (for alfalfa and sugerbeet) amounting to about 25.23 % of the total area, marginally suitable (S4) which ranged from 4,324 to 22,320 acres, representing roughly (14.36 %) of the total area for the crops under study and not suitable (S5) that reached around 33.36 % of the total area.

4- In conclusion, one third of the study area is not suitable for growing any crop under study.

5- It is recommended that a good land management program be designed to overcome some of the temporarily limiting factors that impede the optimum agricultural use.

REFERENCES

Abu El-Izz. (2000). Landforms of Egypt. American University, Press, Cairo, Egypt, p. 281.

De la Rosa, D., Moreno J.A., and Garcia, L.V. (1992). MicroLEIS: a microcomputer-based Mediterranean land evaluation information system. Soil Use Manag, 8: 89-96.

De la Rosa, D., Mayol, F., Fernandez, M.,and Diaz-Pereira, E. (2004). A land evaluation decision support system (MicroLEIS DSS) for agricultural soil protection with special reference to the Mediterranean region. Environ Model Software, 19: 929- 942.

Dent, D. and Young, A. (1981). Soil survey and land evaluation. Allen and Unwin Ltd.

Egyptian General Petroleum Corporation – Conco Coral staff,(1987). Geological Map of Egypt, sheet of Bani Sweef, Scale 1: 500000.

Egyptian Meteorological Authority. (2009). Climate Atlas of Egypt – El-Minia station, Cairo, Egypt.

ERDAS Inc. (2010). ERDAS Field Guide (ERDAS Imagine). Eight Edition. Atlantic, Georgia, USA.

ESRI (2010). Arc GIS Spatial Analyst: Advanced-GIS Spatial Analysis Using Raster and vector data , ESRI, 380 New york, USA.

FAO (1976). A framework for land evaluation. Soils Bulletin 32. Rome.

FAO (2006). Guide lines for soil profile description. FAO, Rome.

Foote, K.E., and Lynch, M. (1996). Geographic information systems as an integrating technology: context, concepts and definition. University of Texas, Austin

Ghafari, A., Cook, H.F., and Lee, H.C. (2000). Integrating climate, soil and crop information: a land suitability study using GIS. In: 4th International Conference on Integrating GIS and Environmental Modeling (GIS/EM4). Problems, Prospects and Research Needs, Banf, Alberta.

Klingebiel, A.A. and Montgmery, P.H. (1961). Land capability classification. USDA agricultural Handbook 210. US Government Printing Office, Washington, DC.

Lillesand, T.M., and Kiefer, R.W.,(2000). Remote sensing and image interpretation. John Wiley & Sons, New York.

ONERN. (1982). Clasificación de lastierrasdel Peru. Pub.Ofic.Nac.Ev. Rec. Nat. Lima.

Palacios-Orueta, A.P., and Ustin, S.L., (1998). Remote sensing of soil properties in the Santa Monica mountains, spectral analysis. Remote Sens. Environ. 65: 170–183.

Said, R. (1993). Geology of Egypt: Netherlands, A. A. Balkema, Rotterdam.

Sys, C., Van Ranst, E., and Debaveye, J. (1991a). Land Evaluation, Part I. Principles in Land Evaluation and Crop Production Calculations. Inter. Training Center for Post-graduate Soil Scientists, Univ. Gent, Belgium.

Sys, C., Van Ranst, E., Debaveye, J. and Beernaert, F. (1993). Land evaluation, Part III. Crop Requirements. Inter. Training Center for Post-graduate Soil Scientists, Univ. Gent, Belgium.

USDA, Soil Survey Staff. (2014a). Key's to Soil Taxonomy. A basic system of soil classification for making and interpreting soil surveys, U.S. Department of Agriculture, Natural Resources Conservation Service, U.S.D.A.

USDA, Soil Survey Staff. (2014b). Kellogg Soil Survey Laboratory Methods Manual. Soil Survey Investigations Report No. 42, Version 5.0. R. Burt and Soil Survey Staff (ed.).U.S. Department of Agriculture, Natural Resources Conservation Service.

Verheye, W. (1986). Land evaluation and land use planning in the EEC. CEC-DG. VI. Draft. Rep. Brussels.

World Food Program, (2013). The Status of Poverty and Food Security in Egypt: Analysis and Policy Recommendations. World Food Program.
Zinck, J. A. (1989). "Physiography and soils. Soil survey course, ITC lecture note, K6 (SOL 41)".1988/1989, Enschede, The Netherlands.

الملخص العربى

إمكانات الموارد الأرضية لبعض المناطق المتاخمة لطريق بنى مزار– البويطى، غرب المنيا ، مصر

طاهر مصطفى حامد يوسف

قسم البيدولوجى – شعبة مصادر المياه والأراضى الصحراوية – مركز بحوث الصحراء.

تعتبر الأراضى الواقعة فى غرب محافظة المنيا أحد المناطق الواعدة فى الصحراء الغربية المصرية للتوسع الزراعى ضمن المشروع القومى لاستصلاح مليون ونصف مليون فدان لامتلاكها موارد تنموية تجعلها منطقة ذات انتاجية زراعية عالية اذا ما أحسن استغلالها. لذلك تهدف هذه الدراسة الحالية الى تقييم إمكانات الموارد الأرضية لبعض المناطق المتاخمة لطريق بنى مزار – البويطى بالظهير الصحراوى الغربى لمحـــــافظة المنيا، حيث أختيرت منطقة الدراسة بين خطى طول ٠٠" ٠٩ ٣٠° و ٠٠" ٣٠ ٣٠° شرقا ودائرتى عرض ٠٠" ٣٠ ٢٨° و ٠٠" ٣٥ ٢٨° شمالا، لتغطى مساحة 82,883 ايكر. وبناءا على الدراسة الحقلية والتحليلات المعملية والتحليل الطيفى للمرئية الفضائية Landsat 8 OLI مع التحليل الطبوغرافى للنموذج الرقمى للإرتفاعات بإستخدام GIS، أمكن تمييز عدد (١١) وحدة أشكال أرضية بالخريطة الجيومورفولوجية للمنطقة منها ٣ أشكال لسطح الهضبة مختلفة فى التنوع الطبوغرافي (الشبه مستوى – خفيف التموج – المتموج) ومنطقة منخفضة فى سطح الهضبة وأقدام منحدرات الهضبة والمنحدرات الشديدة والمتوسطة الانحدار والتلال المتقطعة ومنحدراتها الموجودة اسفل الهضبة والتلال الصخرية الموجودة على سطح الهضبة بالاضافة الى الكثبان الرملية. تم حصر أراضى المنطقة بإستخدام ٢٢ قطاع أرضى ممثل للاختلافات الطيفية لسطح التربة للأشكال الأرضية السائدة بها ووصفت مورفوبيدولوجيا، وتم تجميع عينات التربة منها لإجراء التحليلات المعملية اللازمة لتقدير صفات وخصائص التربة الطبيعية والكميائية، كما أمكن تقسيم تربة هذه الأشكال الأرضية السائدة لعدد (٣) تحت مجموعة عظمى طبقا للتصنيف الأمريكى الحديث هى

Lithic Torriorthents – Typic Torripsamments – Typic Torriorthents

كذلك تم تقييم القدرة الإنتاجية للأراضى بإستخدام نموذج CERVATANA لبرنامج MicroLEIS حيث وجد أن الاراضى التى تم دراستها تتبع قسمين من أقسام القدرة الإنتاجية وهما "متوسطة S3 و "وغير منتجة N على إمتداد ٦١.٩ ، ١٣.٩٣ % من إجمالى المساحة على الترتيب وان ٢٤ % المتبقية من اجمالى المساحة تشكل وحدات شكل الارض من الكثبان الرملية والمنحدرات والتلال الصخرية. كما أمكن تحديد تحت أقسام القدرة الانتاجية لثلاث وحدات

هى S3 r ، S3 lr ، N l، تبعا لنوع وشدة المحدات الأرضية السائدة. وحددت الدراسة أنواع ومواقع المحدات الأرضية ببعض المساحات بالمنطقة والتى تركزت فى وعورة السطح وشدة الميول – ضحالة قطاع التربة – سوء الصرف – إرتفاع الملوحة – إرتفاع نسبة الحصى – زيادة مخاطر التعرية . كما تم تقييم صلاحية الأراضى لزراعة بعض المحاصيل بأستخدام نموذج ALMAGARA لبرنامج MicroLEIS الذى أوضح أن الأراضى التى تم دراستها يمكن زراعتها بالمحاصيل وفقا لذلك الترتيب وهو الزيتون، بنجر السكر، البرسيم، الخوخ، الموالح، القمح، الذرة، البطيخ، البطاطس، عباد الشمس. كما اتضح من الدراسة ان ٢.٧٥ % من أجمالى المساحة صالحة بدرجة عالية لزراعة كلا من الخوخ والموالح الزيتون فى حين ان مساحة ٢٥.٢٣ % صالحة بدرجة متوسطة وأن ١٤.٣٦ % من منطقة الدراسة صالحة بدرجة هامشية وأن ٣٣.٣٦ % غير صالحة لزراعة المحاصيل تحت الدراسة. كما تم استخدم برنامج Arc–GIS 9.3 لانتاج الخرائط المعلوماتية المختلفة لوحدات الاشكال الارضية وانواع التربة ووحدات القدرة الانتاجية والصلاحية لزراعة المحاصيل تحت الدراسة لأيضاح توزيعها المكانى. وفى العموم قدمت الدراسة دلائل كمية قد تكون من الأهمية بمكان لمتخذ القرار الزراعى فى إدارة الموارد الطبيعية بإقليم الظهير الصحراوى لمحافظة المنيا كنموذج لمناطق استصلاح واستزراع المليون ونصف فدان.