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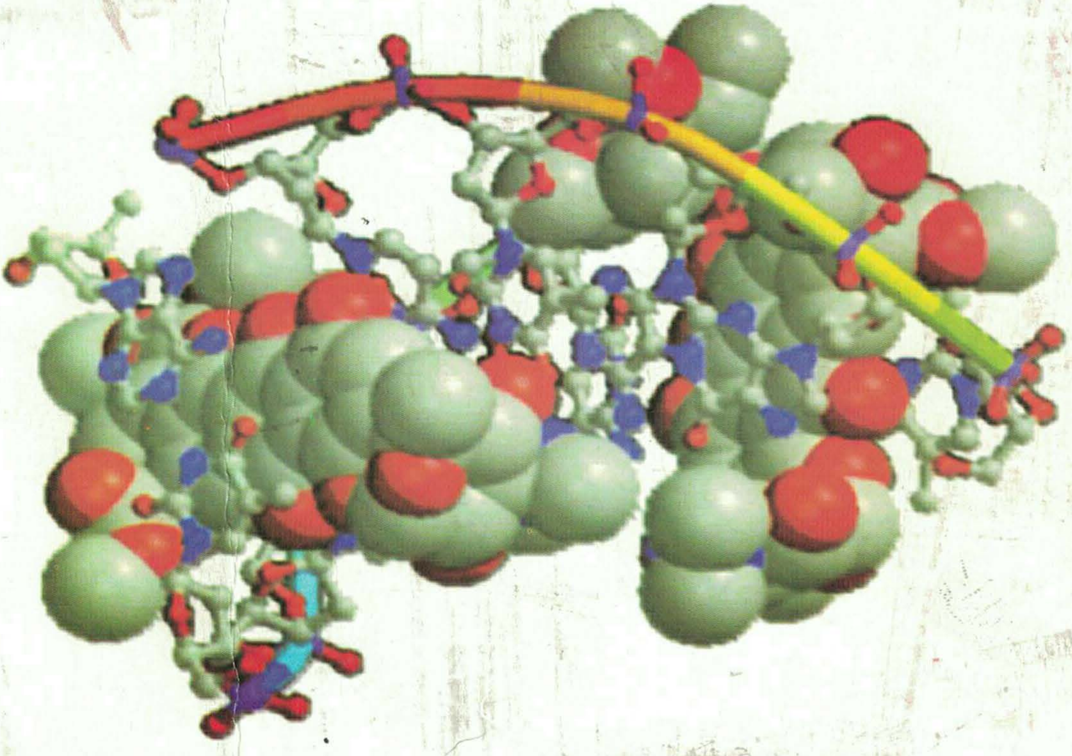

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LAND EVALUATION FOR SOME REPRESENTATIVE PHYSIOGRAPHIC UNITS IN THE EASTERN DESERT OF EGYPT USING REMOTE SENSING DATA

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LAND EVALUATION FOR SOME REPRESENTATIVE PHYSIOGRAPHIC UNITS IN THE EASTERN DESERT OF EGYPT USING REMOTE SENSING DATA

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ABSTRACT

The study area was selected to represent most of the physiographic units in the eastern desert of Egypt. It was situated east of Beni suef District in Beni Suef Governorate and North West of Sannur cave protectorate covering 169512.1 ha (403438.7 feddans). Remote sensing data of satellite TM8 acquired in the year 2016 were used for this study. The delineated physiographic units in the study area were described as follows: (a) Dissected rock lands of limestone covering 31806.5 ha; (b) Pediplain of residuum parent material underlain by limestone that with area of is dominated by soils of *Sodic Haplocalcids, loamy skeletal, mixed, hyperthermic.*; (c) Bajada of alluvial parent material occurred as coalescing pattern forming alluvial fans cover 41182.1 ha and dominated by soils of *Typic Haplocalcids, loamy skeletal, mixed, hyperthermic.*; (d) Alluvial terraces extend to 36337.2 ha including limited cultivated areas in the eastern part of the study area covering 1336.3 ha. The main soils in these alluvial terraces are *Typic Haplocalcids, coarse loamy, mixed, hyperthermic.*; (e) Wadis are forming a net of dry channels covering 32714.2 ha. The main wadi in the study area is wadi Sanur that associate with rather smaller ones such as wadi Bayad, and wadi Ghurab. The main soils in these wadis are *Typic Torrifluvents, coarse loamy, mixed (calcareous), hyperthermic.* Land utilization types were proposed to meet food requirements in Egypt for the main edible and fodder crops

and oil seed crops considering the types of irrigation practices. The major limiting factors in the study area is salinity that is mostly associating with CaCO3 and coarse fragment and sodocity. The limiting factor of soil depth is partly prevailing the pediplain. By correcting the levels of limitations of salinity and sodicity, the most profitable utilizations can be S1 for canola and olive in bajada, wadis and alluvial terraces; S2 for canola in pediplain; S2 for sesame in bajada; S2 for alfalfa, barley, cabbage, guava, maize and sesame in alluvial terraces; S2 for alfalfa, barley, cabbage, date palm, guava, maize and sesame in wadis
Key words: land evaluation remote sensing data, Physiographic units, soil classification.

INTRODUCTION

Although the government of Egypt has paid a great attention to introduce virgin land to be under agricultural development, vast areas of these virgin lands in the eastern desert still out of demand. The selection of the study area for this current investigation based on introducing a new productive land that adjacent to an old highly populated rural one. **Afify *et al* (2010)** stated that the identification of the land resources of Egypt for the agricultural development justifies the importance of producing a collective physiographic-soil map of Egypt. This map is highly required for building up database of land information system to be preserved for the agriculture development. Whatever the current land limitations for the agricultural land use, the limitations can be currently corrected or be overcome by advanced practices in the future These promising areas, which may having relatively low quality, their situations should be considered. For the current study , this situation was considered as the study area include a good existing network of the infra-structure and easy access to the markets as well as the adjacent rural area of skilled agriculture labor can be easily utilized. Data set concerning the water resources in the study area and its surrounding outskirts were indicated by **Saadeldin *et al* (2015).** The water resource was identified as Eocene aquifer of limestone strata having ground water depths range between 70 m to 95 m. The discharges are ranging from 6 to 30 m^3 / hour by drilling wells of mean depths that range from 180 to 200 m. The transmissivity ranges between 2.47 to 1248.7 m^2 / day. Water quality was assessed as salinity levels that are ranging from 1000 to 3300 mg/L dominated by sodium sulphate as 43 % of the total salts.

The aims of this study were to delineate a promising area for the agricultural land use using recent remote sensing data with the aid of Geographic Information System (GIS) technique. By these applications, land units were delineated and then revised by the ground truth. The study also aimed to set up an updated soil legend that reflects soil Taxonomy for recent soil taxa of the study area with a high correlation with their physiographic units that can be spatially specified for profitable alternatives of land utilization types. The units and. These highly correlated physiographic and soil taxonomic units can be later on used for the purpose of extrapolation in the case of investigating other areas and also to be within the mosaic of soil map of Egypt.

MATERIALS AND METHODS

1-Selected study area

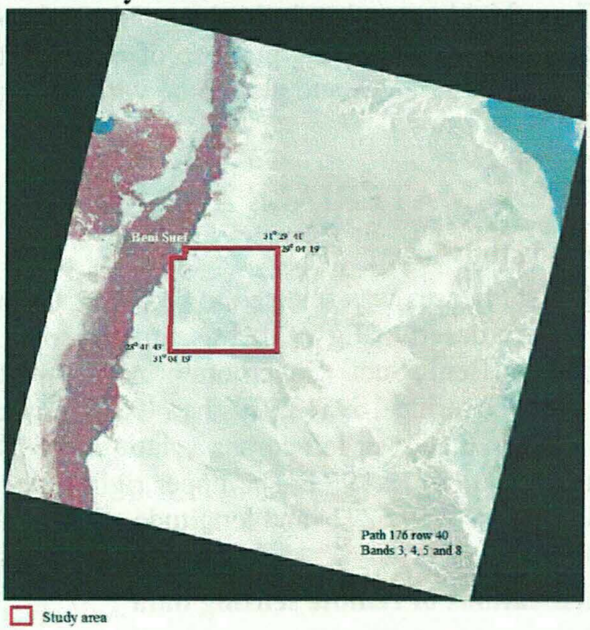
The study area was selected to represent the physiographic units in the eastern desert of Egypt. It was situated south east of Beni Suef Disdtrict in Beni Suef Governorate north west of Sannur cave protectorate covering 169512.079 ha (403438.7 feddans). The area is coordinated in the lower left corner as latitude of 28^{o} 41^{-} $43.51^{=}$ N and longitude of 31^{o} 4^{-} $19.19^{=}$ E The upper right corner is coordinated as latitude of 29^{o} 04^{-} $19.62^{=}$ N and longitude of 31^{o} 29^{-} $41.80^{=}$ E. (Figure 1)

2- Specifications of remote sensing data

Remote sensing data acquired by Operational Land Imager (OLI) of the satellite TM8 were used for this study. These data were acquired in the year 2016 to be used for producing the final physiographic map. The data were recorded within the path 176 and row 40 having pixel size (spatial resolution) of 30 meters for the multispectral bands, while 15 meters for panchromatic band. The selected multispectral band combination included the bands of Green (530-590 nm), Red (640-670 nm), and Near-Infrared (850-880 nm). This band combination was merged with panchromatic band of 500-680 nm.

3- Manipulating GIS layers and geometric correction

The cartographic software of **ERDAS Field Guide (2002)** was used for manipulating the GIS layers of different types to produce band combination. The data in different layers were geometrically corrected using geographic maps scaled as 1:50000 by the **Egyptian Survey Authority of Egypt (1990)**. The correction was based on the Egyptian Transfer Mercator (ETM) projection (Spheroid name of Helmert and Datum Name Old Egyptian 1907). The mask function of the operating cartographic software was used for clipping the full scene to cover the study area.



Figur 1 Full scene of satellite TM8 (OLI) including the study area segments

4- Physiographic units delineation

Physiographic units were delineated considering the physiographic approach of **Zinck and Valenzuela (1990)**. The units were delineated as polygons in shape file and the linear features (roads) were delineated as lines and buffered to be calculated in areas as polygons that were subtracted from the areas of physiographic polygons.

5- Ground truth

Ground observations (Figure 2) were located to represent the features of different physiographic units, using the Global Positioning System (GPS). Seventeen soil profiles were dug to a depth of 150 cm or to bed rock and were described using the nomenclature of the Soil Survey Manual (**USDA 2003**). Soil samples of different soil layers were collected for the soil analyses.

6- Laboratory analyses

Soil texture was measured and calculated using the pipette method as described by **(Jackson 1969)**. Calcium carbonate was measured using the calcimeter according to **Black *et al.*, (1965)**. according to **Richards (1954),** gypsum content was determined by precipitation with acetone. In soil paste extract, salinity was expressed as electrical conductivity (EC). Exchangeable Sodium Percentage (ESP) was carried out using ammonium acetate.

7- Soil classification and land evaluation

Soils were classified following the system of the keys to Soil Taxonomy (**USDA, 2014**), covering the levels from soil order to soil family. Land evaluation for irrigated agricultural agriculture in arid and semi-arid regions was estimated using the system of **Sys *et al* (1993).**

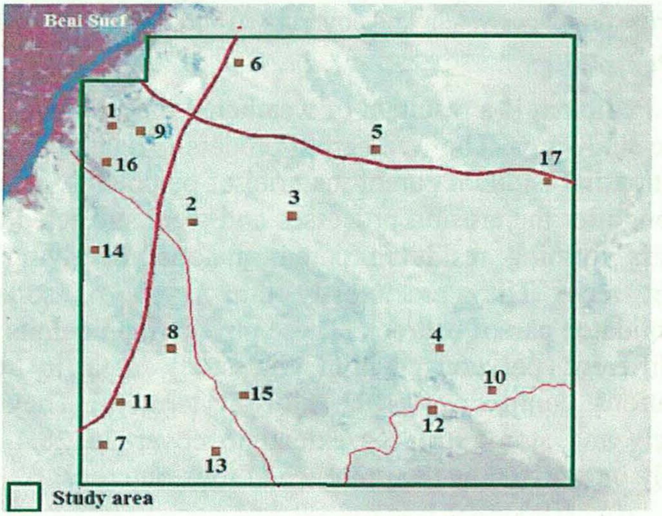


Figure 2 Soil profile distribution within the landscape features

RESULTS AND DISCUSSION

1-Physiographic units

Afify *et al* (2007) stated that the physiographic genesis was performed to find a land attribute illustration for a vast area, considering the parent rock and the inherited parent material. This parent material can be traced by paleo and recent drainage patterns, which are traced as mediators between the highlands and lowlands. Using physiographic approach leads to a well understanding of landscape genesis for defining the drainage patterns that link the parent rocks in the highlands and the derived soil parent materials to the relatively lowlands giving a reliable relationship between the physiography and soils. The traced boundaries are associated with different geomorphic processes that are emphasized by their spectral signature as reflected in the merged multispectral bands with the panchromatic one the delineated physiographic units in the study area are shown in figure 2. the physiographic units are delineated in figure 3 and are described as follows:

1.1 Dissected rock land

Dissected rock lands are elevated platuex and are mostly distributed as isolated polygons of rugged dissected limestone by dendritic drainage system and covering 31806.5 ha (75699.5057 feddans).

1.2 Pediplain

Pediplain is a resultant of weathered limestone rock in the region of the study area. The weathering process is related to the arid climate resulting in residuum parent material of pediments. These plains were left out after the erosion processes and were subjected the weathering process forming residuum parent material overlying its limestone parent rock. They are mostly thin layers of soils overlying a consolidated pan of bedrock. These physiographic units are distributed in different polygons within the study area in relatively high elevations comparing to the alluvial terraces. They have sloping gravely and stony surfaces extend to cover 26128.4 ha, which are locally interrupted by the presence of rock outcrops.

1.3 Bajada

Bajada polygons are characterized by descent slopes formed by transforming the inner weathered materials by water to the outer sides of highlands. These materials were transported via the highlands but deposited when the runoff velocity decreased during the flow along surfaces of less slope gradients. The resultants are alluvial fans in a lateral coalescence, which are named as bajadas. They are delineated as depositional broad slope of sediments covering the lower slopes forming gently sloping gullied and gravelly surfaces on adjacent alluvial fans of coalescing patterns. They are covering 41182.1 ha aligning the western side of the dissected rock land. They were derived from limestone parent rocks having gravelly surfaces that are gently sloping westwards forming a coalescing pattern of alluvial fans.

1.4 Alluvial terraces

These alluvial terraces of alluvial parent material were derived from the highlands of limestone parent rock and moved downwards during the fluvial periods covering area of 36337.2 ha of this area are managed for agricultural land use. The surfaces are gravelly, gently undulating and slightly dissected by rills. **Afify *et al* (2007)** attributed the parent materials of these terraces to the sedimentation process of the paleo-drainage flows during fluvial periods that preceded the current status of an intermittent flush flooding. The resultant was dissected surfaces by channels and gullies that follow the general slopes. The relatively more recent streams had partly eroded these sediments leaving remnants of older surfaces along the sides of the running streams. Accordingly, the surfaces of these sediments had become in isolation from stream erosion and were preserved from erosion to be under the pedogenic development.

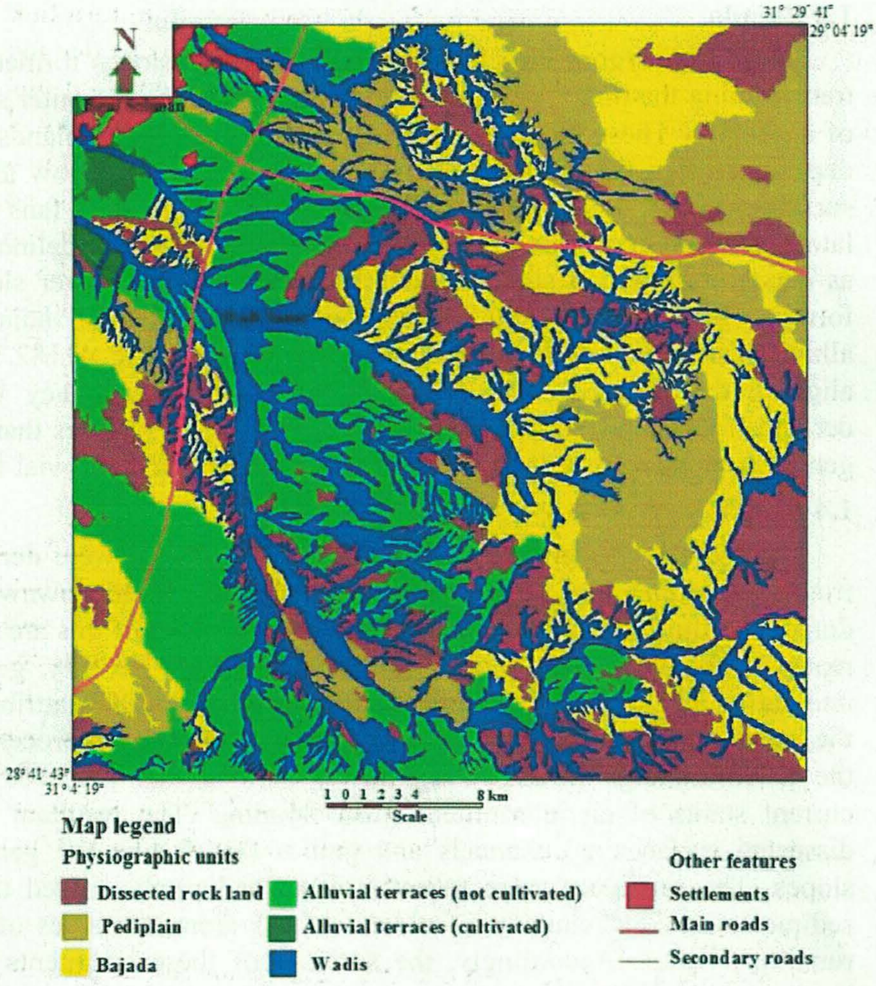


Figure 3 Physiographic map of the study area

1.5 Wadis

These wadis were delineated as opening engraved lines that reflect the slope directions from the high to low lands as dry channels of seasonal water flow during the flash flooding action. They are crossing most of the physiographic units in the study area within dissected rock land, bajada, pediplain and alluvial terraces covering 32714.2 ha. These wadis initiated and running over elevated limestone parent rocks linking to watersheds, which are dissected by the runoff. They start with relatively shorter channels with more branches forming a dendritic drainage pattern. The drainage system in turn link the watershed area to the main wadis with seasonal runoff after the intermittent rains. During the frequent water flow, the land along the drainage system are subjected to erosion hazard as a result of annual flush flooding. Accordingly, their channels are filled by alluvium that were transported and deposited by water agent. The process resulted in an infilled bottom network with alluvium as the most recent soils in the study area comparing to the other physiographic unit. The surfaces are gravelly with a very open terrestrial scattered herbaceous natural vegetation. The main wadi in the study area is Wadi Sannur that associated with rather smaller ones such wadi Bayad, and wadi Ghurab.

2- Soil classification

Categorization to the family level

According to the Key to Soil Taxonomy **(USDA 2014)** and the climatic data of the region of the study area, the moisture and temperature regimes are *torric* and *hyperthermic* respectively. Soil taxa of the study area (Table 1) were categorized under two soil orders of either developed soils of *Aridisols* or recent ones of *Entisols.* Till the level of soil family, soil taxa are categorized in nine families. The dominant soil taxonomic units with minor ones as inclusions within each physiographic units express the levels of soil development and the mechanism of parent material. Soil taxa of the study area and their taxonomic units are described as follows:

Aridisols

These soils were developed under an aridic moisture regime and a hyperthermic temperature regime havind the diagnostic and calcic horizon including the following soil families:

Sodic Haplocalcids, loamy skeletal, mixed, hyperthermic.

These *Haplocalcids* developed within a residual parent material in the pediplain of limestone parent rock. The soils are moderately deep with soil depth range from 75 t0 80 cm. over a bed rock "R". The soil layers have calcic horizon"ABk" "BCk" with $CaCO_3$ contents of 229.4 to 300.2 g/kg soil and 15 to 25 % by volume as secondary visible lime. These soils are *sodic* since they have layers at least 25 cm thick within 100 cm of the soil surface with an Exchangeable Sodium Percentage (ESP) of 15 or more (profiles 4 and 5).

This taxonomic unit includes soil inclusions that were categorized as *Lithic Haplocalcids, sandy skeletal, mixed, hyperthermic*. The soils have shallower soil stratum derived from the same parent rock as the same parent material. Soil layers include calcic horizon"ABk" "BCk" with $CaCO_3$ contents of 398.4 to 414.2 g/kg soil and 20 to 25 % by volume as secondary visible lime. They are *Lithic* as of limited depth to a hard pan of limestone "R" at 45 cm. They are sandy *skeletal* as their soil control section is dominated by very gravelly loamy sands (profile 7).

Typic Haplocalcids, loamy skeletal, mixed, hyperthermic.

These Haplocalcids occur in bajada having layers of calcic horizon "ABk" and "Bk" with $CaCO_3$ contents of 150.5 to 202.0 g/kg soils and 10 to 20 % by volume as secondary visible lime. They are loamy skeletal since the soil control section is dominated by very gravelly sandy loams, (profiles 3, 10 and 11). The soils of this taxonomic unit have soil inclusion with more development as include gypsum accumulation that formed the gypsic horizon in sandy strata to be classified as *Typic Calcigipsids sandy skeletal mixed, hyperthermic* (profile 17).

Typic Haplocalcids, coarse loamy, mixed, hyperthermic.

These *Haplocalcids* occurred in the alluvial terraces. The soils have calcic horizons "ABk" and "Bk" with $CaCO_3$ contents of 95.4 to 268.0 g/kg and 10 to 20 % by volume as secondary visible lime. Since the soil control section is dominated by gravelly coarse sandy loams, they are coarse loamy (profiles 1, 8, 12 and 13). These soils have soil inclusions of very gravelly sandy loams (*loamy skeletal*) including layers at least 25 cm thick within 100 cm of the soil surface of ESP range from 15.4 to 30 (*Sodic*). Accordingly, the soils are classified as *Sodic Haplocalcids, loamy skeletal, mixed, hyperthermic* (profile14).

Entisols

According to **Smith (1986)**, Entisols as either are losing material rapidly through truncation or receiving additions rapidly for horizons to form. The suborder level is first sorted out according to the reasons as why they had no subsurface diagnostic horizon. Soils were defined under the suborder *Fluvents* as formed under the deposition and erosion processes having stratified layers of C horizons. As these soils formed under a *torric moisture regim,* they are *Torrifluvents*.

According to **Afify (2016)**, the soils of wadis are the most recent ones under the order *Entisols* that still affected by seasonal flooding agent They are *Fluvents* as having stratified layers of C horizons. The status express the risk of flooding over the soils within the drainage network.

In the study area, Entisols are categorized as the following soil families:

Typic Torrifluvents, coarse loamy, mixed (calcareous), hyperthermic.

These recent soils have no A horizon as their *epipedons* are mostly reworked by seasonal water runoff. Accordingly, *Fluvents* require certain land management to be protected. The soils are stratified layers reflecting an irregular decrease in organic matter within depth 25 cm to 125 cm. The soil control section is dominated by gravelly sandy loams, therefore these soils are coarse loamy. They are calcareous as their matrix effervesces in all parts between 25 to 50 cm. (profiles 2, 6 and 9). Within these soils rather similar ones are inclusions that are relatively including more gravel content to be classified as *Typic Torrifluvents, loamy skeletal, mixed (calcareous), hyperthermic* (profile15). The other inclusion was classified as *Typic Torrifluvents, sandy skeletal, mixed (calcareous), hyperthermic* being the soil control sectionis dominated by loamy sands. (profile 16).

Table 1 Required soil analyses for soil classification and land evaluation

physiographic unit	Profile No.	Horizon	Depth (cm)	EC (dS/m)	ESP	Organic matter	Gravel % (vv)	Grain size distribution (%)			Modified Texture class	$CaSO_4$		$CaCO_3$	
								Sand	Silt	Clay		g/kg.	Visibale % (vv)	g/kg.	Visibale % (vv)
Pediplain	4	ABk	0-30	35.5	15.9	0.2	35	70.4	12.7	16.9	VGSL	16.6	<5	236	15
		BCk	30-80	47.6	14.8	0.8	37	78.2	11.5	14.3	VGSL	10.7	<5	229.4	15
		R	80--	Bed rock of limestone											
	5	ABk	0-15	27.5	20.2	0.5	50	68.8	12	18.2	VGSCL	14.1	<5	287	20
		BCk	15-75	57.3	12.7	0.6	45	76.8	12.3	10.9	VGSL	16.3	<5	300.2	25
		R	75--	Bed rock of limestone											
	7	ABk	0-20	33.2	5.3	0.3	40	74.4	15.5	4.2	VGLS	39.1	<5	300.4	25
		BCk	20-45	34.8	6	0.1	55	77.4	8.6	6.5	VGLS	42.1	<5	344.2	20
		R	45--	Bed rock of limestone											
Bjada	3	A	0-15	14.4	10.5	0.9	30	74.2	8.3	17.5	GSL	3.8	<5	142	5
		Bk	15-45	10	13.2	0.8	35	83	5.8	11.2	VGLS	1.5	<5	159.4	20
		C	45-80	13.1	12.5	0.7	40	76.7	10.4	12.9	VGSL	2.6	<5	108.1	10
	10	A	0-25	13.9	15.7	1	30	69.6	20.6	9.8	GSL	5	<5	105	5
		Bk	25-50	14.7	16.1	0.9	40	64.8	15.5	19.7	VGSL	11.9	<5	159.7	15
		C	50-115	12.1	19.8	0.8	35	63.3	20.2	16.5	VGSL	6.3	<5	128	10
	11	A	0-20	7.2	9.6	1.5	15	77.3	10.4	12.3	GSL	5.1	<5	99.4	10
		Bk1	20-45	13.7	20.1	1.1	30	69.2	17.3	13.5	GSL	7.4	<5	202	15
		Bk2	45-85	8.9	16.2	0.9	35	76.1	12.6	11.3	VGSL	3.5	<5	150.5	10
		C	85-120	8.4	7.8	0.2	35	79.5	9.8	9.7	VGLS	3.5	<5	100.2	5
	17	ABk	0-20	10.9	11.7	1.5	35	68.4	15.5	10.2	VGSL	40.7	5	157.6	15
		Bky	20-55	11.7	16.1	1.2	40	76.4	8.6	75	VGLS	102.3	9	198.5	10
		CBkC	55-120	10.1	19.8	1.8	40	72.4	9.5	6.2	VGLS	49.8	3	156.9	5
Alluvial terraces	1	Abk Bk	0-30	3.2	3.9	0.3	10	77.5	10.4	12	SGSL	9	<5	220.1	20
		Bk1	30-50	2.5	4.3	0.2	30	83.5	4.8	11.7	GLS	8.6	<5	169.4	20
		Bk2	50-120	3	2.4	0.1	15	72.2	10.2	17.6	GSL	10.5	<5	205	15
	8	ABk	0-20	13.6	13.1	0.5	15	78.3	11.1	10.6	GSL	9	<5	177	15
		Bk1	20-75	18.7	12.9	0.3	25	71.4	9.1	19.5	GSL	7.8	<5	205.1	15
		Bk2	75-110	18.9	11.2	0.1	25	68.5	11.1	20.4	GSCL	7.5	<5	155.3	10
	12	ABk	0-15	9.6	9.3	0.6	15	75	13.8	11.2	GSL	6.2	<5	95.4	15
		Bk1	15-60	15.5	12.8	0.4	20	53.5	25.4	21.1	GSCL	8.7	<5	15.7	10
		Bk2	60-125	18.4	11.7	0.6	20	75	11.5	13.5	GSL	11.2	<5	160.4	10
	13	ABk	0-20	8.1	6.8	0.5	25	72.1	17.3	12.6	GSL	4.7	<5	268	10
		Bk1	20-55	9.4	11.2	0.6	15	73.6	9.6	16.8	GSL	3.3	<5	257.4	15
		Bk2	55-75	15.3	13.5	0.2	30	71	13.6	15.4	GSL	2.3	<5	244.8	15
		Bk3	75-120	19.2	14	0.1	15	77.5	9.4	13.1	GSL	4	<5	215	10
	14	ABk	0-25	21.2	17.4	0.7	[illegible]	66.5	18.2	15.3	GSL	10.8	<5	156.1	15
		Bk1	25-65	20.6	15.9	0.8	35	75.1	14.7	10.2	VGSL	15.3	<5	139	10
		Bk2	65-120	22.9	9.8	0.1	35	73.6	12.9	13.5	VGSL	11.6	<5	154.5	10

Table 1 Cont.

physiographic unit	Profile No.	Horizon	Depth (cm)	EC (dS/m)	ESP	Organic matter	Gravel % (vv)	Grain size distribution (%)			Modified Texture class	$CaSO_4$		$CaCO_3$	
								Sand	Silt	Clay		g/kg.	Visibale % (vv)	g/kg.	Visibale % (vv)
Wadi	2	C1	0-10	3.7	5.1	2.1	25	78.2	10.9	10.9	GSL	11.4	<5	67	<5
		C2	10-55	2.1	4.6	1.3	15	82	8.7	9.3	GLS	10.9	<5	95.2	<5
		C3	55-110	2.3	4.1	1.6	30	78.6	10.9	10.5	GSL	0.8	<5	105.7	<5
	6	C1	0-20	6.5	7.3	3.9	25	77.8	9.9	12.3	GSL	12.5	<5	151.1	<5
		C2	20-70	5.2	2.5	0.9	20	74.1	12.7	13.2	GSL	14.1	<5	96.2	<5
		C3	70-130	3.3	5.7	2.1	30	54	25.5	20.5	GSCL	11	<5	115	<5
	9	C1	0-25	5.7	7.1	3.8	15	77.1	10.8	12.1	GSL	138	<5	125.3	<5
		C2	25-40	4.1	2.8	2.5	15	63.9	14.2	21.9	GSCL	9.3	<5	115.4	<5
		C3	40-70	2.3	3.8	0.4	20	69.4	14.5	16.1	GSL	7.8	<5	138.2	<5
		C4	70-120	3.5	6.9	0.9	15	82.7	9.6	7.7	GLS	4.2	<5	140	<5
	15	C1	0-30	8.7	2.8	1.8	35	76.1	9.6	14.3	GSL	10.3	<5	278.4	<5
		C2	30-50	9.4	3.6	1.3	40	83.4	8.5	8.1	VGLS	19	<5	179.2	<5
		C3	50-130	5.2	8.5	0.4	35	70.5	14.2	15.3	GSL	12.3	<5	146.5	<5
	16	C1	0-25	8.7	2.8	1.8	35	76.1	9.6	14.3	GSL	10.3	<5	278.4	<5
		C2	25-80	9.4	3.6	1.3	40	83.4	8.5	8.1	VGLS	19	<5	179.2	<5
		C3	80-130	5.2	8.5	0.4	35	70.5	14.2	15.3	GSL	12.3	<5	204.5	<5

GLS = gravelly loamy sand , GSCL= gravelly sandy clay loam , GSL= gravelly sandy loam ,
VGLS = very gravelly loamy sand , ESP=exchangeable sodium percent.

Land evaluation

The physiographic units in the study area were evaluated for the irrigated agriculture considering the management of certain land utilization types in soils different levels of land qualities. Setting up legend of land suitability classes based on the system of **Sys et al (1991)** and mapped as delineated polygons. These polygons are dominated by certain soil taxonomic units. Fitting each of land utilization type in certain physiographic unit allow more land use adaptation to be more promising for agricultural land use and for maximizing land productivity .

This land evaluation was processed to be valid for irrigation purposes in arid and semi-arid regions. This approach was based on the guideline framework of orders, classes, and subclasses for the definition of **(FAO 1976)**. The limitations of land qualities as based on their soil characteristics were matched with the crop requirements in different suitability levels as proposed by **Sys *et al.* (1993)** considering the main soil characteristics. The land quality ratings were introduced by the symbols c for $CaCO_3$, "d" for drainage, "g" for coarse fragment "n" for alkalinity, "p" for depth, "s" for salinity, "t" for slope, "x" for texture and "y" for gypsum. Land suitability was established as orders of suitable (S) and not suitable (N). The orders are sub-categorized as classes of highly suitable (S1) moderately suitable (S2) and marginally suitable (S3), currently not suitable (N1) and potentially not suitable (N2). These sub-classes were distinguished by associated kinds of limitations as lower-case letters indicating certain limitation of the abovementioned ones. In this study land utilization types were proposed to meet food requirements in Egypt for the main edible and fodder crops and oil seed crops considering the certain irrigation practices as follows:

- Alfalfa, barley, sesame, and wheat using sprinkler irrigation.
- Cabbage, Canola, Green pepper, maize, potatoes, tomato, citrus, date palm, guava, mango and olives using drip irrigation

Current versus potential land suitability

For current land suitability (Tables 2 and 3), the virgin land qualities of each land unit were matched to the crop requirements for the current land suitability assessment. The major limiting factor in the study area is salinity that is mostly associating with $CaCO_3$ and coarse fragment. These limitations are proportionally inhibiting the growth of the proposed crops as land utilization types. The current land suitability of the virgin land can be improved by correcting the levels of limitations concerning salinity and sodicity (potential land suitability). The improvement can increase the ability of extra crops to be more suitable.

Soils of pediplain improved to be moderately suitable (S2) for canola, while can be marginally suitable (S3) for barley, cabbage, sesame, tomato and guava. Bajadas can be highly suitable for canola and olive, moderately suitable for sesame but can be marginally suitable (S3) for alfalfa, barley, cabbage, green pepper, maize, potatoes, tomato, wheat, citrus, date palm and mango. Alluvial terraces can be highly suitable for canola and olive, moderately suitable for alfalfa, barley, cabbage, maize, sesame, and guava but can be marginally suitable (S3) for green pepper, potato, tomato, wheat, citrus, date palm and mango. Soils of wadis can be highly suitable for canola and olive, moderately suitable for alfalfa, barley, cabbage, maize, sesame, date palm and guava but can be marginally suitable (S3) for green pepper, potatoes, tomato, wheat, citrus and mango. Tables 2and 3 including the current and potential land suitability of different physiographic for each proposed utilization indicating certain limitations. The most profitable utilizations in the study area can be concluded as S1 for canola and olive in bajada, wadis and alluvial terraces; S2 for canola in pediplain; S2 for sesame in bajada; S2 for alfalfa, barley, cabbage, guava, maize and sesame in alluvial terraces; S2 for alfalfa, barley, cabbage, date palm, guava, maiz and sesame in wadis.

The spatial distribution of potential land suitability of different physiographic units are shown in figure 4

Table 2 Gross current and potential land suitability for annual crops

Physiographic unit	Suitability status	Alfalfa	barley	Cabbage	Canola	Green pepper	Maize	Potatos	Sesame	Tomato	Wheat
Dissected rock land	CS	N1p									
	PS	N2p									
Pediplain	CS	N1s	N1s	N1s	N1s	N1c, s	N1s	N1c,g,s	N1 s	N1s	N1s
	PS	N1c,g,p	S3g	S3g	S2m	N1c	N1c,g	N1c, g	S3g	S3c	N1c,g
Bajada	CS	N1s	N1g,s	N1s	N1s	N1s	N1s	N1s	N1s	N1s	N1s
	PS	S3c, g	S3 g	S3g	S1	S3c	S3g	S3c,g	S2g	S3c	S3g,x
Alluvial Terraces	CS	N1s	S3g,s	N1s	N1s	N1s	N1s	N1s	N1s	N1s	N1s
	PS	S2c, g	S2g	S2c, g	S1	S3c	S2c,g	S3c,g	S2g	S3c	S3g, x
Wadis	CS	S3m	S2g	S3c,g	S2m	N1c,g, s	S3m	N1c,g,s	S2g, s	N1c	N1g,s,x
	PS	S2m	S2g	S2c, g	S1	S3c,g	S2m	S3c, g	S2g	S3c	S3g,x

CS= Current suitability PS= Potential suitability

Table 3 Gross current and potential land suitability for trees

Physiographic unit	Suitability status	Citrus	Date palm	Guava	Mango	Olives
Dissected rock land	CS			N1p		
	PS			N2p		
Pediplain	CS	N1c,p,s	N1c,s	N1s	N1s	N1p,s
	PS	N2c,p	N1c,g	S3p	N2c,g,p	N2p
Bajada	CS	N1c,s	N1s	N1s	N1s	S2m
	PS	N1c,g	S3c,g	S3g	S3c	S1
Alluvial Terraces	CS	N1s	N1s	N1s	N1s	S3s
	PS	S3c,g	S3c	S2m	S3c	S1
Wadis	CS	N1c,g,s	S3c,s	N1s	N1c,s	S2s
	PS	S3c,g	S2c	S2g	S3c	S1

c : calcium carbonate % , g : gravel % , m: minor limitations , p : soil depth, s : salinity, x : texture

SI: Highly suitable, S2 Moderately suitable, S3: Marginally suitable, NI: Currently not suitable

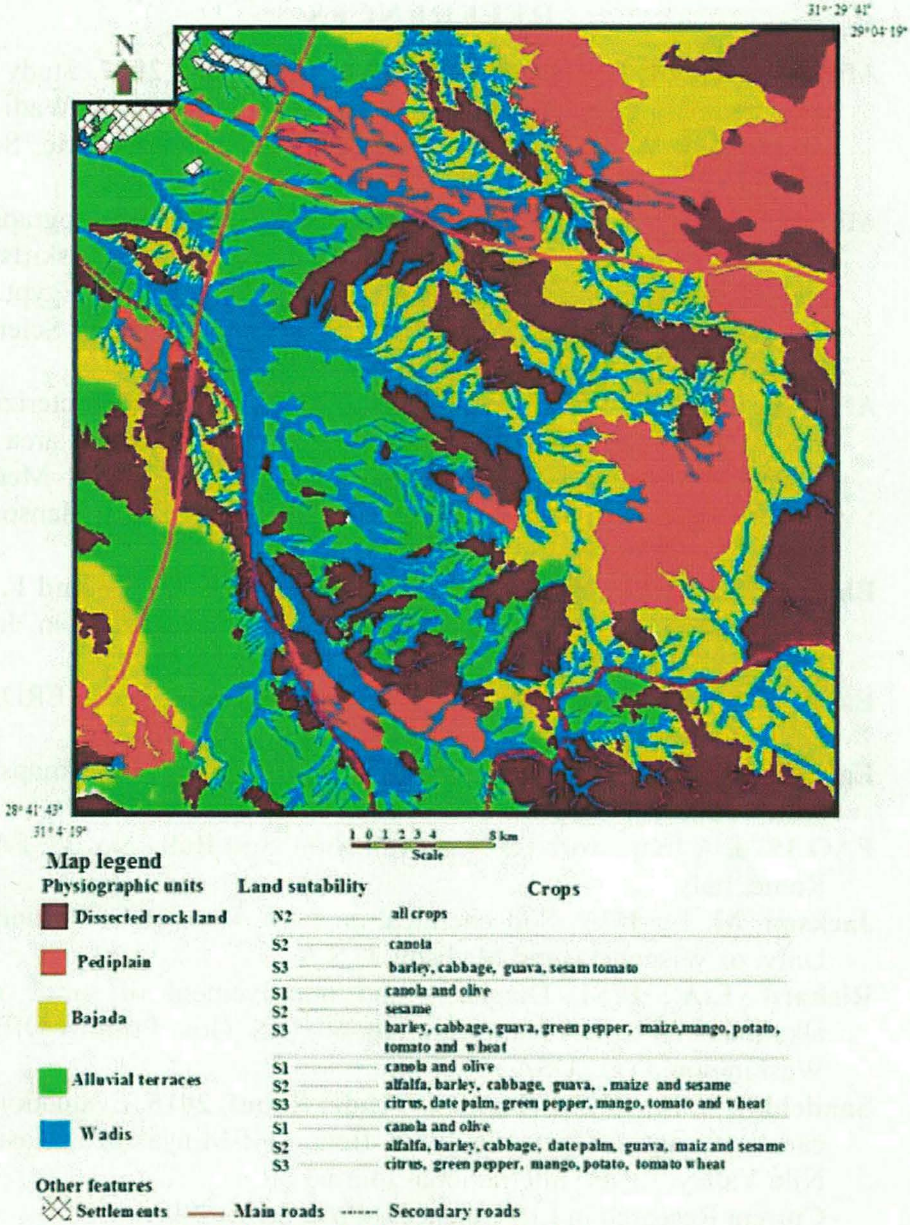


Figure 4 Potential land suitability map of the study area

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تقييم بعض الوحدات الفيزيوجرافية الممثلة لصحراء مصر الشرقية باستخدام معلومات الاستشعار من البعد

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اختيرت منطقة الدراسة لتمثل معظم الوحدات الفيزيوجرافية فى صحراء مصر الشرقية حيث تقع فى شرق مركز بنى سويف بمحافظة بنى سويف وشمال غرب محمية كهف سنور فى مساحة تقدر ب 169512.1 هكتار (0 403438 فدان) استخدم فى هذه الدراسة معلومات الاستشعار من البعد التي التقطت في عام 2016 وقد تم وصف الوحدات الفيزيوجرافية التي تم تحديدها كالتالي:

ا – أراضى صخرية متقطعة من الصخور الجيرية تمتد إلى 31806.5 هكتار

ب– سهل التجوية ذو مادة أصل متبقية تعلو الحجر الجيري مساحته 26128.4 هكتار

وتغلب فيه أراضى ذات الوحدة التصنيفية :

Sodic Haplocalcids, loamy skeletal, mixed, hyperthermic.

ج- الباجادا ذات مادة أصل رسوبية في نظام متداخل لمروحيات رسوبية مساحتها 41182.1 هكتار ويسود بها اراضى الوحدة التصنيفية :

Typic Haplocalcids, loamy skeletal, mixed, hyperthermic

د- الشرفات الرسوبية وتقدر مساحتها بحوالي 36337.2 هكتار ولكنها تضم مساحات منزرعة محدودة تغطى 1336.3 هكتارا فى الجزء الغربى لمنطقة الدراسة ويسود فى هذه الشرفات الرسوبية أراضى الوحدة التصنيفية:

Typic Haplocalcids, coarse loamy, mixed, hyperthermic

هـ- الوديان تشكل شبكة من القنوات الجافة التي تمتد إلى 32714.2 هكتار ويعتبر وادي سنور هو الوادي الرئيس في منطقة الدراسة مع أودية مصاحبة منها وادي بياض ووادي غراب وتسود في هذه الوديان أراضى ذات الوحدة التصنيفية :

Typic Torrifluvents, coarse loamy, mixed (calcareous), hyperthermic

تم اقتراح انماط لاستخدامات الاراضى تواكب احتياجات مصر من المحاصيل الرئيسة للغذاء والعلف والزيوت مع الأخذ فى الاعتبار نظام الرى وقد وجد ان المحدد السائد للنمو هو ملوحة التربة والتى ارتبطت غالبا بمحددات أخرى مثل كميات الحصى وكربونات الكالسيوم وقد اتضح أن محدد عمق التربة يوجد في مساحات من أراضى سهل التجوية وبافتراض معالجة محددي الملوحة والقلوية فان أنماط استخدامات الاراضى تكون أكثر ربحية حيث تكون عالية الصلاحية فى الباجادا والشرفات الرسوبية والوديان بالنسبة للكانولا والزيتون بينما تكون متوسطة الصلاحية فى سهل التجوية للكانولا وفى الباجادا للسمسم وفى الشرفات الرسوبية بالنسبة للبرسيم الحجازي ، الشعير، الكرنب، الجوافة ، الذرة والسمسم وتكون الوديان أيضا متوسطة الصلاحية بالنسبة إلى للبرسيم الحجازي ، الشعير، الكرنب، نخيل البلح الجوافة ، الذرة والسمسم.

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كلية الزراعة – جامعة عين شمس

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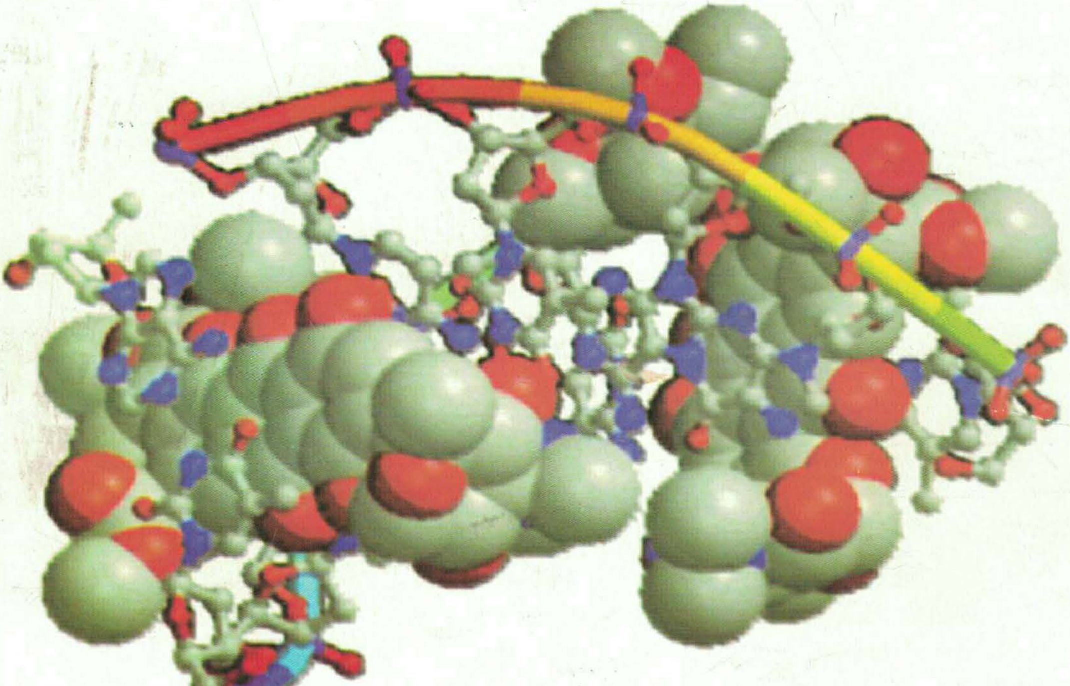

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