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GEOMORPHOLOGY, CHARACTERISTICES AND CLASSIFICATION OF SOILS IN SOME AREAS IN ISMAILIA GOVERNORATE, EGYPT

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ABSTRACT: **The current work aims to identifying the geomorphological, characteristics and classification of soils in some areas in Ismailia governorate, Egypt. The study area is located between longitudes 32º 06′ 45" and 32º 22′ 30" E and latitudes 30º 22' 30" and 30º 57' 00" N. The integration of Remote Sensing (RS) and Geographic Information System (GIS) techniques was used to achieve this work.**

The geomorphic map produced by processing and identifying the Landsat 8 image indicated that, the studied area has six main geomorphic units with different landforms. These units are: 1) Depressions, 2) Terraces (including Low, and High Terraces), 3) Basins (over flow basins and Decantation basins), 4) peneplains (Low and High), 5) Sandy plains (High, Moderate and Low) and 6) Mountain (Foot slope and Crest).

Twenty soil profiles were selected representing these units. The land and site features are observed and registered. The soil profiles were dug, morphologically described, and then samples were collected representing the subsequent layers in each profile for integrated physical and chemical analyses.

The studied area has almost flat with deep to very deep and well drained soils. Most of the studied soils have loamy sand texture and some parts have clay loam texture. The analytical data revealed that, the studied soils are slightly alkaline, mostly non-saline and haven't sodicity effect. The soils are moderately calcareous having Low gypsum and organic matter contents.

All studies soils haven't any diagnostic horizons, therefore they affiliated to Entisols and classified as *Typic Torripsaments* for 89.4% and as *Typic Torriorthents* for 10.6% from the studied area.

Key words: **RS, GIS, geomorphic units, landforms, soil characteristics, soil classification.**

INTRODUCTION

The balance between the land and human resources is the most critical problem in Egypt. Accordingly, the major challenge of Egyptian government today is facing the need for better development and management of natural resources, to meet requirements of the fast-growing population. Therefore, horizontal expansion is considered the main focus for sustainable agricultural development in Egypt. Ministry of Agriculture and Land Reclamation (MALR) formulated a strategy for sustainable agricultural development. One of the strategy objectives is to sustain the use of natural agricultural resources and to increase the productivity per units of both land and water. This strategy includes plans to cultivating about 1.5 million feddan in the year 2017 and increases to five million feddan by the year 2030 (FAO, 2013). One of the susceptible lands occurs mainly in the fringes of the Nile

valley and Delta. Fringes of the Nile Delta are considered to be the most important location of the ambitious projects. These fringes have the most of best potentially suitable agricultural land resources for future expansion and development in Egypt (Noseir, 2014).

The identification of geomorphological characteristics is from the important initial stages for studying any areas (Dawoud et al., 2005). Remote sensing (RS) is now recognized as an important tool in monitoring and managing natural resources (Lillesand and Kiefer, 2007). They added that, RS technique is one of the important methods that used for soil survey, mapping and environmental investigation. ESRI (2003) stated that, geographic information system (GIS) is a system for the management, analysis, and displaying geographic information, which is represented by a series of geographic datasets that model geography using simple, generic data structures.

The aim of the present work is to study the geomorphological, physiochemical characteristics and classification of the soils in some areas of Ismailia governorate. The integration of remote sensing (RS) and geographic information system (GIS) techniques was used perform all results and produce the spatial digital maps of this work.

MATERIALS AND METHODS

Study area

The study area occupies a part of Ismailia governorate, between longitudes 32º 06′ 45 " and 32º 22′ 30" E and latitudes 30º 22' 30" and 30º 57' 00" N as shown in Fig (1). Ismailia governorate is bordered from the north by Port Said governorate, from the east by North Sinai governorate, from the west by El-Sharkia governorate and from the south by Suez governorate. It covers an area of 1014.2 km^2 (241481.4 feddans). The studied area is characterized by a hot dry summer and warm winter with few rainfalls.

Geomorphology of the study area

The digital elevation model (DEM) of the study area was extracted from the Shuttle Radar Topography Mission (SRTM) and a topographic map with a scale of 1:25,000 covering the study area using Arc-GIS 10.7.1 software (ESRI, 2003). The Landsat 8 (path 178 / row 39) image acquired in 2018 and SRTM data were processed in ENVI 5.1 software (ITT, 2012) to identify the geomorphology and landforms of the studied area according to the approach developed by Dobos et al. (2002). The map legend was designed according to Zinck and Valenzuela (1990). ArcMap 10.7.1 software was used to display and produce geomorphic map of the study area with help of its DEM features and field observations (ESRI, 2014).

Field work.

Reconnaissance soil survey was conducted throughout the investigated area in order to acquire an appreciation of its broad soil patterns and characteristic landscape. The primary mapping units resulting from analysis of the DEM and interpretation information gained during unsupervised classification of Landsat images were verified.

Twenty soil profiles were chosen from three sample areas (Fig, 2) representing the geomorphic and landform units of the studied area. The soil profile's locations and elevations were defined in the field by using GPS system. The morphological description of these soil profiles was recorded on the basis outlined by FAO (2006). Soil samples were collected

based on the vertical variations of each soil profile for the laboratory analyses of soil physical and chemical properties.

Laboratory analyses

Particle size distribution, electrical conductivity (EC), pH, organic matter (OM), calcium carbonate ($CaCO_3$), gypsum contents, cation exchange capacity (CEC), exchangeable Na^+ percentage (ESP) were determined according to Burt and Soil Survey Staff (2014). Identify class terms of each soil property was done according to Soil Science Division Staff (2017).

Soil classification

The soils of the studied area were classified up to sub great group level based on Soil Survey Staff (2014).

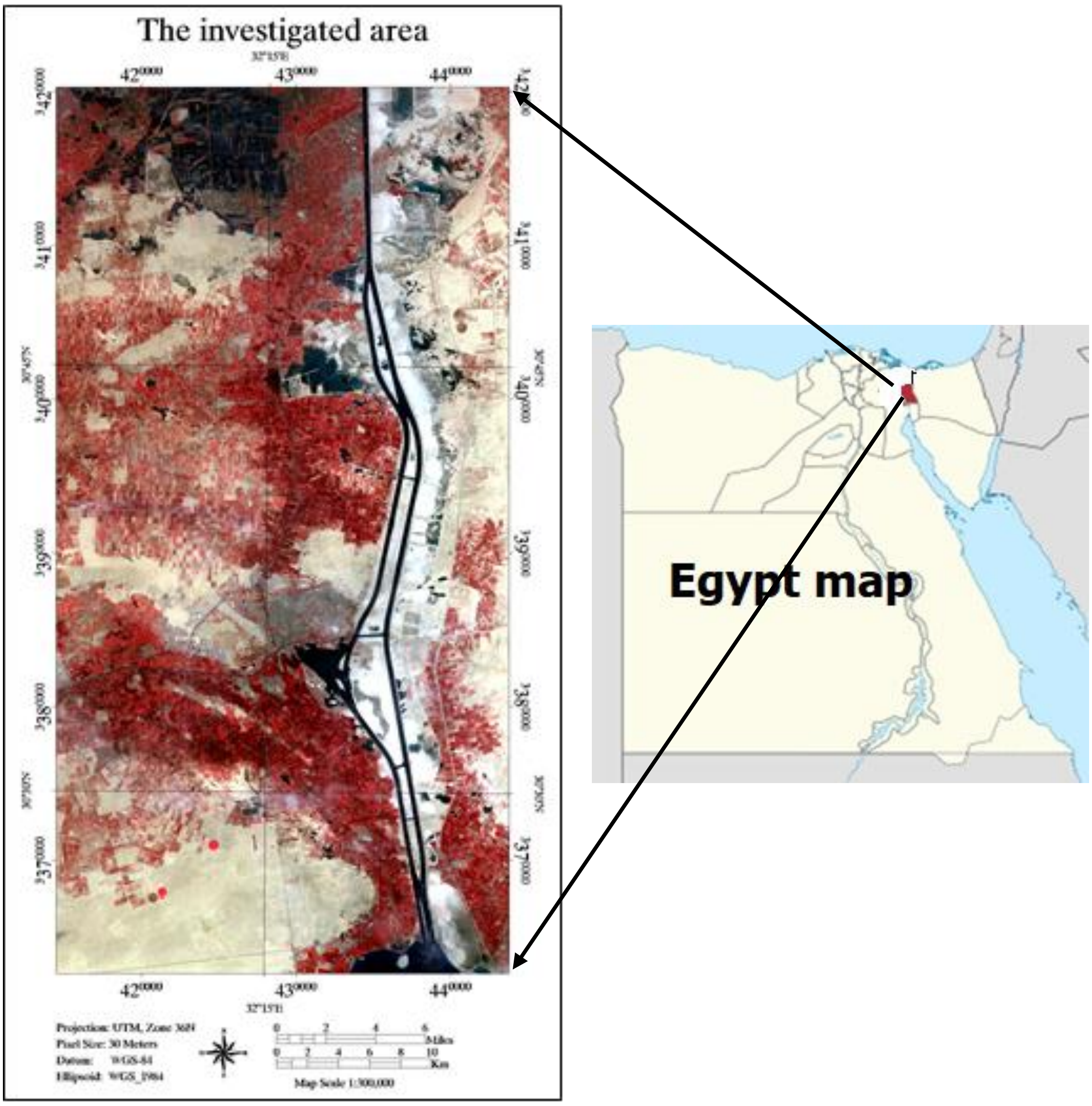
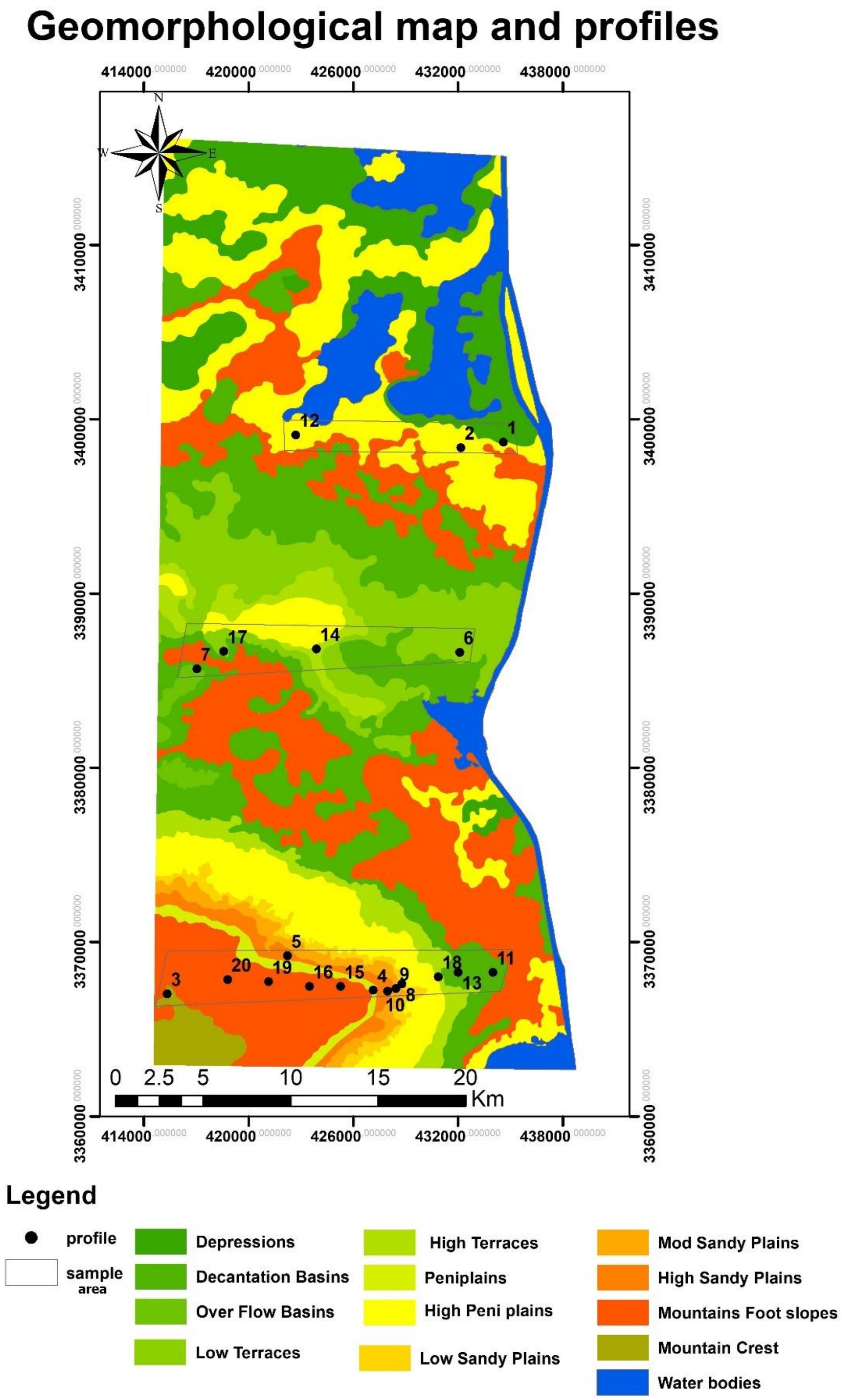


Fig (1): Study area.


Geomorphological map and profiles
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Depressions
Decantation Basins
Over Flow Basins
Low Terraces
High Terraces
Peniplains
High Peni plains
Low Sandy Plains
Mod Sandy Plains
High Sandy Plains
Mountains Foot slopes
Mountain Crest
Water bodies

Fig (2): Geomorphic units map and representative soil profile's locations of the study area.

RESULTUS AND DISCUSSION

Geomorphology

Based on the satellite image treating, processing and interpretation with the aid of produced Digital Elevation Model (DEM), topographic maps and field observations, the integration of RS and GIS was used to identify the geomorphic and landform units of the study area. Produced DEM map of the study area presented in Fig (3) indicated that, the elevation for the whole of the study area is varied between -4 m below sea level (b.s.l.) and increased gradually to 134 m above sea level (a.s.l.) at the south of the area.

The interpretation of satellite image of the study area indicated that, there are six main identified geomorphic units including seven subunits in this area. These units are 1) Depressions, 2) Terraces (Low and High), 3) Basins (over flow basins and Decantation basins), 4) Peneplains (Low and High), 5) Sandy plains (Low, Moderate and High) and 6) Mountain (foot slope and Crest). These units with their representative soil profiles (Fig, 2) and their areas are presented in Table (1).

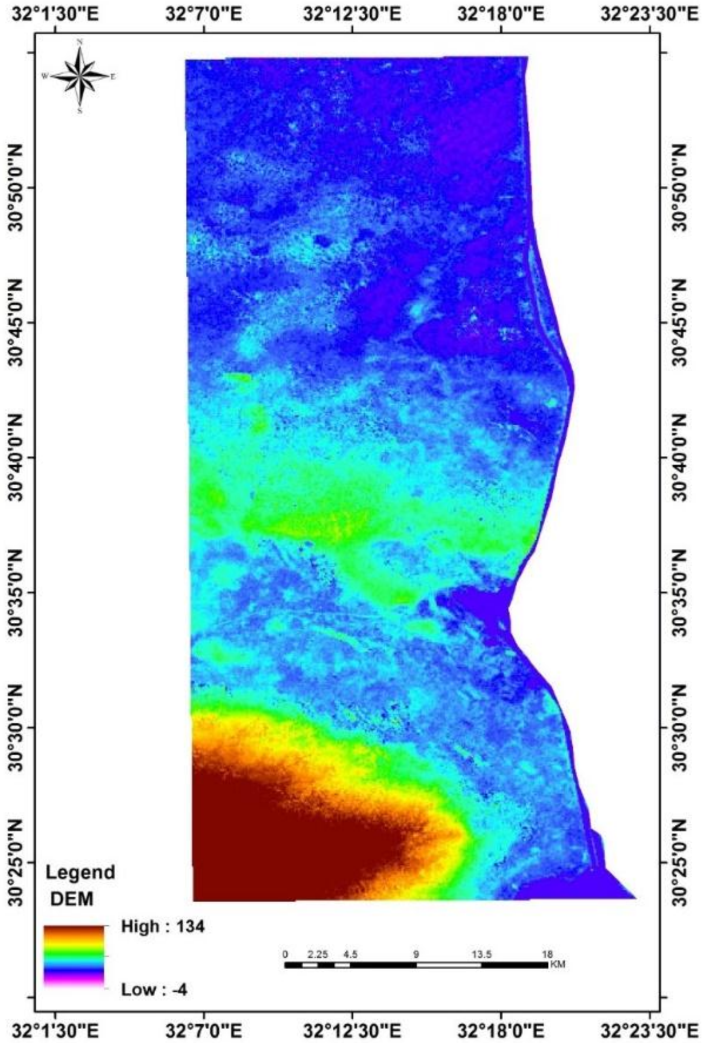

Fig (3): DEM map of the study area.

Table (1): Detailed geomorphic units of the study area.

Geomorphic units	Landform	Mapping Units	Profile No	Area			Total %
				Km^2	Fed	%	
Depressions	Depressions	D	1	103.1	24541.9	10.16%	10.16%
Basins	Decantation	BD	11, 13	196.0	46669.2	19.33%	20.08%
	Over Flow	Bo	7	7.6	1814.6	0.75%	
Terraces	High	Th	14, 18	96.2	22907.1	9.49%	13.86%
	Low	TL	6, 17	44.3	10550.0	4.37%	
Peneplains	Low	P	4	9.5	2259.6	0.94%	23.80%
	High	PH	2, 12	231.9	55209.7	22.86%	
Sandy Plains	Low	SL	8	11.0	2622.8	1.09%	3.70%
	Moderately	SM	9, 10	14.4	3430.0	1.42%	
	High	SH	5	12.1	2879.9	1.19%	
Mountain	Foot slopes	MF	15, 16, 19, 20	273.7	65157.3	26.98%	28.40%
	Crest	ML	3	14.4	3439.3	1.42%	
Water bodies*		WB		107.1	25497.7	Reference term	
Total				1014.2	241481.4	100%	100%

* The different landforms areas % are calculated considering the water bodies as reference term.

Soil morphology

The morphological features of the studied soil profiles presented in Table (2) revealed that, the elevation of the studied soils is between 5 m to 112 m above sea level. The soils have almost flat topography with mostly deep and well-drained soil materials. The main hue notation of studied soil color is around brown notation (10YR). The soils have mostly weak to moderate medium to fine sub angular to granular structure with soft dry and friable consistence. The studied soils are moderately calcareous.

Physiochemical properties

The physiochemical properties of the studied soils are calculated as weighted profiles means (w.p.m.) and registered in Table (3). Data in this Table show that, most of the studied soils have loamy sand texture except few of them (profile, 4 and 11) that have sandy loam texture (w.p.m.). Most of the studied soils are non-saline to very slightly saline (EC < 2 to < 4 dSm^{-1}; w.p.m.). Only soils of profile 15 in Mountain Foot Slope are slightly saline having 5.5 dSm^{-1} (w.p.m.). All studied soils haven't sodicity effect and having slightly alkaline reaction having pH between 7.7 to 7.8 (w.p.m.). These soils are moderately calcareous having < 7% $CaCO_3$ content (w.p.m.). Gypsum content is very low (< 1%). Organic matter (OM) is very low (< 1%, as w.p.m.). The cation exchange capacity (CEC) is, also, low depending on the fine fractions and organic matter contents.

Soil classification.

Based on climatic condition, soil morphological, physiochemical characteristics the studied soils are classified up to sub great group level according to Soil Survey Staff (2014). According to FAO (1977) and USDA-NRCS (1997), the dominant soil moisture regime of this area is "*Torric*" with "*Thermic*" soil temperature regime. The studied area has mineral soils with *Ochric* Epipedon. All studied soils haven't any sub-surface diagnostic horizons. Therefore, they are affiliated to Entisols Order. Most of these soils (89.4% from the study area) have about 80% or more sand fractions with sand to loamy sand texture and classified as *Typic Torripsamments* sub great group as presented in Table (4) and showed in Fig. (4). Only soils of profiles 4 in the Low Peneplains unit and 11 in the Decantation Basins (10.6% from the study area have sandy loam texture (w.p.m) and classified as *Typic Torriorthents*.

Table (2): Morphological features of the studied soil profiles.

Geomorphic units	Land forms	Profile No.	Elevation m asl	Depth cm	Color		Structure[1]	Consistence[2]		Boundary[3]
					Dry	Moist		Dry	Moist	
Depression		1	+ 8	0-10	10YR 5/1	3/1	1 f sbk	s hard	v friable	clear
				10-50	10YR 6/6	5/4	1 gr	soft	v friable	diffuse
				50-100	10YR 6/6	5/4	1 gr	soft	v friable	-
Basins	Decantation	11	+ 11	0-40	10YR 5/2	4/2	1 m to f sbk	s hard	friable	gradual s
				40-60	10YR 4/2	3/2	1 m to f sbk	soft	v friable	diffuse
				60-100	10YR 4/2	3/2	2 gr	soft	v friable	-
		13	+15	0-30	10YR 6/4	5/4	1 m to f sbk	soft	Friable	clear
				30-50	10YR 7/6	5/6	1 gr	soft	v friable	gradual s
				50-70	10YR 7/4	6/4	1 gr	soft	v friable	gradual s
				70-120	10YR 7/3	6/3	1 gr	soft	v friable	-
	Over flow	7	+17	0-30	10YR 6/4	5/4	1 m to f sbk	Soft	friable	gradual s
				30-50	10YR 6/6	5/4	1 m to f sbk	soft	v friable	clear
				50-120	10YR 6/4	5/4	1 m to f sbk	s hard	s hard	-
Terraces	Low	6	+ 13	0-30	10YR 5/6	4/6	2 m to f sbk	S hard	loose	diffuse
				30-80	10YR 5/6	4/6	2 m to f sbk	s hard	loose	diffuse
				80-90	10YR 6/6	5/6	1 m to f sbk	soft	loose	diffuse
				90-120	10YR 6/6	5/6	1 m to f sbk	soft	loose	diffuse
				120-150	10YR 6/6	5/6	1 f sbk	soft	loose	-

		17	+ 15	0-30	10YR 5/4	4/4	sg	loose	loose	gradual s
				30-50	10YR 6/4	5/4	1 gr	soft	v friable	gradual s
				50-120	10YR 7/4	6/4	sg	loose	loose	-
	High	14	+32	0-30	10YR 7/6	6/6	1 gr	soft	v friable	diffuse
				30-60	10YR 7/6	6/6	1 gr	soft	v friable	diffuse
				60-90	10YR 7/6	6/6	1 gr	soft	v friable	diffuse
				90-150	10YR 8/4	7/4	1 gr	soft	v friable	-
		18	+17	0-30	10YR 4/4	3/3	1 f sbk	soft	v friable	gradual s
				30-60	10YR 6/4	5/4	1 f sbk	soft	v friable	gradual s
				60-120	10YR 7/3	5/3	1 f sbk	soft	v friable	-
Pen plains	Low	4	+8	0-60	10YR 5/3	5/2	2 m sbk	hard	friable	abrupt
				60-100	10YR 5/6	4/4	1 f sbk	soft	v friable	abrupt
				100-150	10YR 8/2	6/2	sg	loose	loose	-
	High	2	+13	0-70	10YR 6/4	5/4	1 m to f sbk	soft	v friable	diffuse
				70-130	10YR 6/3	5/2	1 m to f sbk	soft	v friable	-
		12	+10	0-30	10YR 5/2	4/2	1 m to f sbk	s hard	Friable	abrupt
				30-50	10YR 6/3	5/3	1 m to f gr	soft	v Friable	abrupt
				50-130	10YR 4/2	3/2	1 m to f gr	soft	v friable	-
Sandy Plains	Low	8	+5	0-45	10YR 5/8	5/6	1 m to f sbk	soft	v friable	diffuse
				45-65	10YR 5/8	5/6	1 m to f sbk	soft	v friable	gradual s
				65-110	10YR 5/6	5/6	1 m to f sbk	soft	v friable	gradual s
				110-140	10YR 6/8	5/6	1 m to f sbk	soft	v friable	-
	Moderately	9	+27	0-50	10YR 6/4	5/4	2 m sbk to gr	soft	v friable	clear
				50-120	10YR 6/6	5/6	1 m to f sbk	soft	v friable	-
		10	+19	0-30	10YR 4/2	3/2	2 m to f sbk	s hard	friable	abrupt
				30-80	10YR 6/3	5/3	1 m to f gr	soft	v friable	gradual s
				80-120	10YR 6/2	5/2	1 m to f gr	soft	v friable	-
	High	5	+49	0-30	10YR 5/4	4/3	1 f sbk to gr	soft	friable	clear
				30-50	10YR 6/4	5/3	1 m to f gr	soft	v friable	clear
				50-120	10YR 6/6	5/6	sg	loose	loose	-
Mountain	Foot slopes	15	+78	0-40	10YR 6/6	5/4	1 m to f gr	soft	v friable	gradual s
				40-60	10YR 6/4	5/4	1 m to f gr	soft	friable	gradual s
				60-130	10YR 7/4	6/4	1 m to f gr	soft	v friable	-
		16	+85	0-30	10YR 6/6	5/6	1 m to f gr	soft	v friable	gradual s
				30-60	10YR 7/4	6/4	1 m to f gr	soft	v friable	gradual s
				60-150	10YR 6/4	5/4	1 m to f gr	soft	v friable	-
		19	+88	0-30	10YR 6/6	5/6	1 m to f gr	soft	v friable	gradual s
				30-50	10YR 6/4	5/4	1 m to f gr	soft	v friable	gradual s
				50-120	10YR 6/4	5/4	1 m to f gr	soft	v friable	-
		20	+81	0-30	10YR 5/3	4/3	1 m to f gr	soft	v friable	gradual s
				30-60	10YR 6/4	5/4	1 m to f gr	soft	v friable	gradual s
				60-130	10YR 6/4	5/4	1 m to f gr	soft	v friable	-
	Crest	3	+112	0-25	10YR 5/4	4/3	1 m to f gr	soft	v friable	abrupt
				25-50	10YR 6/6	5/4	1 m to f gr	soft	v friable	clear
				50-85	10YR 6/7	5/4	1 m to f gr	soft	v friable	-

Abbreviations: Texture*: Structure[1]: 1=weak, 2 =moderate, f = fine, m = medium, gr = granular, sbk = subangular blocky, sg= single grains; Consistence[2]: v = very, Boundary[3]: s = smooth

Table (3): Some physical and chemical properties of studied soil profiles.

Geomorphic units	Landforms	Profile N°	Depth Cm	Particle size distribution % Sand	Silt	Clay	Texture Class	pH 1:2.5	EC dSm^{-1}	CEC meq/100 g soil	ESP	$CaCO_3$ %	Gypsum %	OM g/kg
Depression		1	0-10	63.6	22.8	13.6	Sandy Loam	7.7	1.0	16.2	6.8	5.7	0.17	0.11
			10-50	79.2	14.5	6.3	Sandy Loam	7.7	1.3	15.2	6.9	6.2	0.21	0.13
			50-100	84.5	10.9	4.6	Loamy Sand	7.7	1.2	15.0	8.9	6.5	0.23	0.13
			W.P.M	80.3	13.5	6.2	Loamy Sand	7.7	1.2	15.2	7.9	6.3	0.22	0.13
Basins	Decantation	11	0-40	63.5	23.8	12.7	Sandy Loam	7.7	1.5	11.3	7.6	5.8	0.12	0.23
			40-60	73.3	12.3	14.4	Sandy Loam	7.7	1.0	14.0	7.9	5.0	0.17	0.14
			60-100	85.5	10.9	3.6	Loamy Sand	7.8	1.2	12.5	8.3	5.9	0.11	0.28
			W.P.M	74.3	16.3	9.4	Sandy Loam	7.7	1.3	12.3	7.9	5.7	0.13	0.23
		13	0-30	84.0	11.5	4.5	Loamy Sand	7.7	1.3	15.0	10.4	5.5	0.12	0.16
			30-50	86.1	10.6	3.3	Loamy Sand	7.8	0.9	14.5	8.6	5.4	0.15	0.13

			50-70	85.8	11.7	2.5	Loamy Sand	7.8	1.2	13.9	9.4	6.4	0.11	0.11
			70-120	84.2	11.5	4.3	Loamy Sand	7.7	2.0	15.0	10.4	4.0	0.13	0.12
			W.P.M	84.7	11.4	3.9	Loamy Sand	7.7	1.5	14.7	9.9	5.0	0.13	0.13
	Over flow	7	0-30	81.1	13.2	5.7	Loamy Sand	7.8	1.2	15.2	8.1	5.70	0.19	0.17
			30-50	82.8	13.0	4.2	Loamy Sand	7.8	1.6	14.3	9.4	4.9	0.22	0.13
			50-120	77.9	19.0	3.1	Loamy Sand	7.8	2.8	12.6	12.0	3.3	0.18	0.14
			W.P.M	79.5	16.6	3.9	Loamy Sand	7.8	2.2	13.5	10.6	4.2	0.19	0.15
Terraces	Low	6	0-30	85.2	10.8	4.0	Loamy Sand	7.8	1.3	14.2	8.5	4.9	0.22	0.15
			30-80	85.3	11.2	3.5	Loamy Sand	7.7	1.0	15.6	6.8	3.6	0.09	0.13
			80-90	78.1	14.9	7.0	Loamy Sand	7.8	0.9	15.2	7.0	7.2	0.22	0.17
			90-120	85.2	10.8	4.0	Loamy Sand	7.7	1.2	14.0	7.6	4.2	0.16	0.12
			120-150	82.0	12.7	5.3	Loamy Sand	7.7	1.4	14.8	9.3	4.0	0.21	0.16
			W.P.M	84.1	11.6	4.3	Loamy Sand	7.7	1.2	14.8	7.8	4.3	0.16	0.14
		17	0-30	86.6	10.2	3.2	Sand	7.7	1.1	12.8	6.9	3.0	0.14	0.11
			30-50	86.3	10.4	3.3	Loamy Sand	7.7	0.9	15.2	6.7	4.6	0.11	0.22
			50-100	85.8	11.0	3.2	Loamy Sand	7.7	1.1	14.6	7.1	4.0	0.13	0.11
			W.P.M	86.2	10.6	3.2	Loamy Sand	7.7	1.1	14.2	7.0	3.8	0.13	0.13
	High	14	0-30	85.4	11.4	3.2	Loamy Sand	7.7	1.3	14.6	8.9	4.3	0.15	0.13
			30-60	85.4	10.6	4.0	Loamy Sand	7.7	0.9	15.2	6.6	3.4	0.11	0.16
			60-90	85.5	11.2	3.3	Loamy Sand	7.8	0.7	14.8	6.4	4.6	0.10	0.15
			90-150	86.1	10.6	3.3	Loamy Sand	7.7	1.4	13.5	8.3	3.3	0.12	0.11
			W.P.M	85.7	10.9	3.4	Loamy Sand	7.7	1.1	14.3	7.7	3.8	0.12	0.132
		18	0-30	82.7	12.0	5.3	Loamy Sand	7.7	0.8	14.2	7.4	5.3	0.12	0.19
			30-60	86.4	10.3	3.3	Sand	7.7	2.0	14.3	11.8	4.5	0.11	0.17
			60-120	85.3	11.0	3.7	Loamy Sand	7.7	1.8	15.6	12.2	4.7	0.09	0.11
			W.P.M	84.9	11.1	4.0	Loamy Sand	7.7	1.6	14.9	10.9	4.8	0.10	0.15
Pen plains	Low	4	0-60	68.1	18.9	13.0	Sandy Loam	7.8	2.8	15.2	13.0	5.2	0.12	0.21
			60-100	65.1	21.5	13.4	Sandy Loam	7.7	1.7	14.3	14.2	5.6	0.13	0.14
			100-150	87.1	10.2	2.7	Sand	7.7	1.5	12.4	9.6	3.2	0.11	0.08
			W.P.M	73.6	16.7	9.7	Sandy Loam	7.7	2.1	14.0	12.2	4.6	0.12	0.15
	High	2	0-70	78.0	15.0	7.0	Loamy Sand	7.7	1.4	14.6	9.4	7.4	0.15	0.15
			70-130	81.7	13.0	5.3	Loamy Sand	7.7	1.0	16.1	8.1	5.0	0.11	0.11
			W.P.M	79.7	14.1	6.2	Loamy Sand	7.7	1.2	15.3	8.8	6.3	0.13	0.13
		12	0-30	67.5	22.6	9.9	Sandy Loam	7.7	1.0	12.9	7.4	4.6	0.10	0.19
			30-50	83.8	11.7	4.5	Loamy Sand	7.8	1.9	12.4	10.2	8.0	0.23	0.17
			50-130	85.2	11.2	3.6	Loamy Sand	7.7	1.5	11.9	9.2	6.3	0.24	0.15
			W.P.M	80.9	13.9	5.2	Loamy Sand	7.7	1.4	12.2	8.9	6.2	0.21	0.16

W.P.M = weighted profile means, L.= loam, S.= Sand

Table (3): Cont.

Geomorphic units	Landforms	Profile N°	Depth Cm	Particle size distribution %			Texture Class	pH 1:2.5	EC dSm^{-1}	CEC meq/100 g soil	ESP	$CaCO_3$ %	Gypsum %	OM g/kg
				Sand	Silt	Clay								
Sandy Plains	Low	8	0-45	80.8	13.2	6.0	Loamy Sand	7.7	2.2	13.5	12.9	4.3	0.23	0.15
			45-65	80.4	15.0	4.6	Loamy Sand	7.7	1.5	15.4	9.9	4.5	0.21	0.17
			65-110	80.1	14.9	5.0	Loamy Sand	7.8	1.7	14.2	10.0	5.3	0.27	0.16
			110-140	81.8	13.7	4.5	Loamy Sand	7.7	1.9	13.6	10.4	5.0	0.17	0.11
			W.P.M	80.7	14.1	5.2	Loamy Sand	7.7	1.9	14.0	11.0	4.8	0.23	0.15
	Moderate	9	0-50	81.3	13.5	5.2	Loamy Sand	7.7	1.2	12.4	8.2	5.2	0.19	0.13
			50-120	83.1	12.3	4.6	Loamy Sand	7.7	1.3	12.3	9.1	4.6	0.13	0.15
			W.P.M	82.4	12.8	4.8	Loamy Sand	7.7	1.3	12.3	8.7	4.8	0.16	0.14
		10	0-30	67.1	23.6	9.3	Sandy Loam	7.8	1.5	10.3	8.7	5.5	0.11	0.23

			30-80	85.2	11.6	3.2	Loamy Sand	7.7	1.0	11.5	7.4	5.4	0.21	0.11
			80-120	81.8	12.8	5.4	Loamy Sand	7.7	1.2	15.2	8.2	5.7	0.23	0.13
			W.P.M	79.5	15.0	5.5	Loamy Sand	7.7	1.2	12.4	8.0	5.5	0.19	0.15
	High	5	0-30	83.0	12.8	4.2	Loamy Sand	7.7	0.8	13.8	6.1	4.5	0.21	0.17
			30-50	77.3	15.8	6.9	Sandy Loam	7.7	0.9	14.5	6.8	4.7	0.23	0.15
			50-120	86.7	10.0	3.3	Sand	7.8	1.5	13.0	9.5	5.2	0.50	0.22
			W.P.M	84.2	11.7	4.1	Loamy Sand	7.8	1.2	13.4	8.2	4.9	0.38	0.20
Mountain	Foot slopes	15	0-40	80.8	13.9	5.3	Loamy Sand	7.7	8.3	13.5	13.0	5.0	0.11	0.12
			40-60	85.2	10.8	4.0	Loamy Sand	7.7	7.3	14.2	12.2	4.2	0.13	0.11
			60-130	85.8	10.5	3.7	Loamy Sand	7.7	3.3	15.4	6.3	4.3	0.11	0.14
			W.P.M	84.2	11.6	4.2	Loamy Sand	7.7	5.5	14.6	9.3	4.5	0.11	0.13
		16	0-30	80.1	14.3	5.6	Loamy Sand	7.7	2.5	15.3	9.9	4.2	0.12	0.11
			30-60	85.8	11.0	3.2	Loamy Sand	7.7	1.9	16.2	9.9	3.6	0.13	0.13
			60-150	85.3	10.3	4.4	Loamy Sand	7.7	1.9	15.3	9.1	3.2	0.11	0.09
			W.P.M	84.4	11.2	4.4	Loamy Sand	7.7	2.0	15.5	9.4	3.5	0.12	0.10
		19	0-30	81.4	13.0	5.6	Loamy Sand	7.8	2.5	15.9	12.4	7.3	0.15	0.14
			30-50	82.6	12.6	4.8	Loamy Sand	7.7	2.3	12.3	10.9	5.0	0.11	0.12
			50-120	85.8	11.0	3.2	Loamy Sand	7.8	1.7	16.5	10.1	4.6	0.15	0.13
			W.P.M	84.1	11.8	4.1	Loamy Sand	7.8	2.0	15.6	10.8	5.3	0.14	0.13
		20	0-30	85.7	10.3	4.0	Loamy Sand	7.8	2.6	16.1	11.9	5.2	0.13	0.11
			30-60	85.8	11.2	3.0	Loamy Sand	7.8	2.4	14.2	10.6	4.0	0.12	0.13
			60-130	82.3	13.6	4.1	Loamy Sand	7.7	2.0	15.3	9.7	4.3	0.11	0.14
			W.P.M	83.9	12.3	3.8	Loamy Sand	7.7	2.2	15.2	10.4	4.4	0.12	0.13
	Crest	3	0-25	85.8	10.2	4.0	Loamy Sand	7.7	1.3	15.3	8.1	5.2	0.23	0.09
			25-50	80.2	13.8	6.0	Loamy Sand	7.8	1.8	15.5	12.1	7.8	0.21	0.11
			50-85	80.7	14.3	5.0	Loamy Sand	7.7	2.6	12.3	12.5	6.3	0.17	0.13
			W.P.M	82.0	13.0	5.0	Loamy Sand	7.7	2.0	14.1	11.1	6.4	0.20	0.11

Table (4): Soil classification in the study area.

Order	Sub Great Group	Soils of profiles No.	Area %
Entisols	*Typic Torripsamments*	1, 2, 3, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20	89.4
	Typic Torriorthents	4, 11	10.6
Total			100

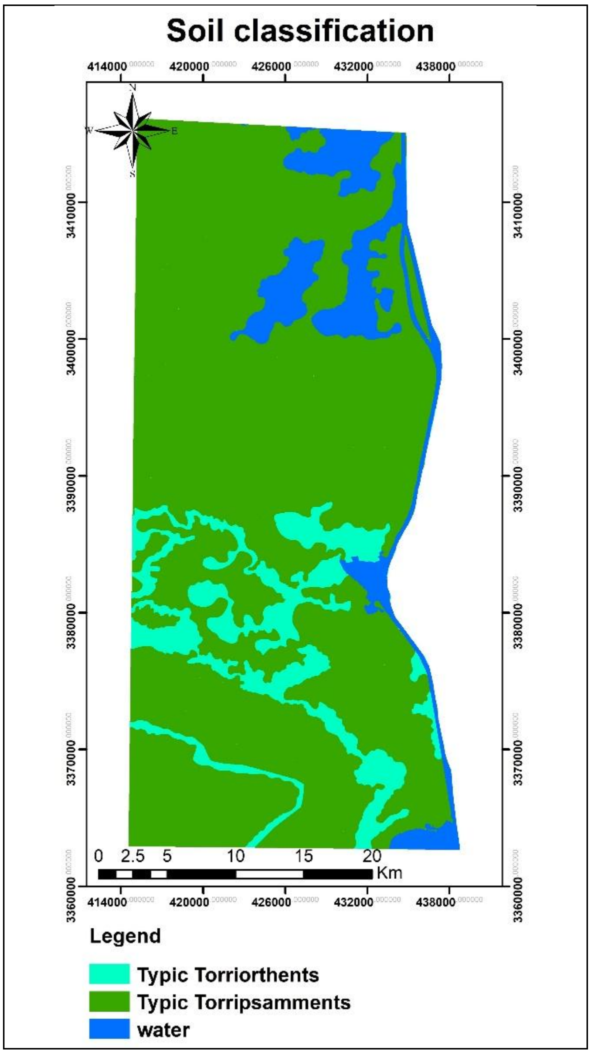

Fig (4): Spatial distribution of sub great groups in the study area.

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جيومورفولوجيا وخصائص وتقسيم أراضي بعض مناطق محافظة الاسماعيلية، مصر

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الملخص:

أجري هذا البحث بهدف دراسة الخصائص الجيومرفولوجية والفيزيوكيميائية وكذلك تقسيم أراضي بعض مناطق محافظة الاسماعيلية، مصر، ولقد استخدم تكامل التقنيات الحديثة للاستشعار من البعد (RS) مع نظم المعلومات الجغرافية (GIS) في اجراء هذا العمل، وتقع منطقة الدراسة بين خطي عرض 30° 22′ 30″ و30° 57′ شمالاً، وخطي طول 32° 6′ 45″ و32° 22′ 30″ شرقاً

ولقد أوضحت الخريطة الجيومرفولوجية الناتجة من معالجة وتفسير الصور الجوية أن منطقة الدراسة تتميز بوجود ست وحدات جيومرفولوجية رئيسية متضمنة أشكال أرضية فرعية هي: 1) المنخفضات، 2) الشرفات (مرتفعة ومنخفضة)، 3) الأحواض (حوض جريان الماء، والمصب)، 4) السهول المعراه (المنخفضة، والمرتفعة)، 5) السهول الرملية (ذات الشرفات المنخفضة والمتوسطة والعالية)، 6) الهضاب (سفح المنحدر، قمة المنحدر).

ولقد تم تحديد مواقع وحفر عشرون قطاعاً أرضياً لتمثل أراضي تلك الأشكال الأرضية، ودرست وسجلت الملامح الطبوغرافية المميزة لهذه الأراضي، كما وصفت القطاعات مورفولوجياً وجمعت منها عينات ممثلة للأفاق المختلفة، لإجراء التحليلات المعملية لتقدير الخواص الطبيعية والكيماوية.

وأوضحت الدراسات الحقلية أن طبوغرافية المنطقة شبه مستوية، والأراضي عميقة، وحالة الصرف جيدة، وقوام هذه الأراضي يغلب عليه الطمي رملي وبعض الأراضي رملية طميية، وبناءها ضعيف من النوع الحبيبي.

يميل تأثير هذه الأراضي إلى القلوية، معظمها غير ملحية، وغير صودية، متوسطة المحتوى من الكربونات الكلية، ونسبة الجبس والمادة العضوية ضئيلة، وبالتالي السعة التبادلية الكاتيونية منخفضة.

ونظراً لأنه لم يتضح في معظم الأراضي أي آفاق تشخيصية فلقد تم تقسيمها تبعا للتقسيم الأمريكي الحديث تحت رتبة الأراضي غير المتطورة Entisols، حتى مستوى تحت المجموعة الرملية Typic Torripsaments (حوالي 89,4% من منطقة الدراسة) والمجموعة الطميية Typic Torriorthents (10,6%).

الكلمات الدالة:

الاستشعار من البعد، نظم المعلومات الجغرافية، الوحدات الجيومورفولوجية، الخصائص الفيزيوكيميائية للأراضي، تقسيم الأراضي.

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