Egyptian Journal of Agricultural Research

ORIGINAL ARTICLE
Egypt. J. Agric. Res., (2020), 98 (3), 548-558

Study of some soils South El-Amiria, Alexandria Governorate, Egypt using two soil classification systems

Zayed, A. M. A., El-Tapey, H.M.A. and Al-Toukhy, A.A.
Soils Water and Environment Research Institute, Agricultural Research Center, Giza, Egypt

(Manuscript received 22 Oct. 2020)

ABSTRACT

A pilot area south El-Amiria, Alexandria Governorate, Egypt was studied by using remote sensing techniques to define its main physiographic units. The soil studies were carried out by two classification systems; USDA (USDA, 2014) and FAO (FAO, 2006 b). The area locates between longitudes 29º47`55``and 30º 30`05`` East and latitudes 29º29`30`` and 30º30` 05`` North and comprise an area of about 571168 Feddan. Two physiographic units were recognized in the studied area as follows: I) Lacustrine plains, which includes four sub-units differ in their soil depths, i.e., moderately deep, deep, very deep, and rock outcrops. 2)Windblown sand, which includes three sub-units, i.e.sand sheets soils, BarchanDunes and Barchan dunes with partial $CaCO_3$ cementations.By comparing the two systems of soil classification used in this study, it is observed that FAO system (FAO, 2006 b) includes different levels of soil properties which have a direct effect on soil reclamation, suitability and land use. On the other hand, USDA system (USDA, 2014) gives importance for texture, mineralogy, soil temperature …etc. in family level which adds more detailed information for soil management. Consequently, applications of the two classification systems, is necessary or preferable due to their compilation.

Keywords: El-Amiria, physiographic unit, Soil classification.

Introduction

The first step in land use is to select the more suitable investment, therefore, soil survey and classification must use. Soil is not static, many of soil properties such as soil reaction, soluble salts, amount of organic matter and carbon-nitrogen ratio, numbers of micro-organisms, soil fauna, temperature and moisture are changed with seasons as well as with more extended periods, consequently, the soil must be viewed from short term and long-term perspectives (USDA, 1999).

Remote sensing is the science and art of obtaining information about an area through the analysis of data acquired by a device which is not in contact with the studied area (Colwell et. al., 1983). Remote sensing observations of soil reflectance in the visible and infrared region of the electromagnetic spectrum are important for covering mostly the land surface of the earth, influencing the reflectance of the composite land surface and to obtain some information about soil (Ghassem, 1989).

The area belongs to Mamura formation which is limestone and calcareous shale sequence which is the marine equivalent of the Moghra. The formation is of uniform lithology. It rests above the Dabaa formation and is conformably over line by the middle Miocene Marmarica formation (Said, 1990).

The windblown sand in the South area has high permeability and lower rainfall. The natural drainage of the central and Northern part, East of Cairo-Alexandria Desert road, is towards the swamps of lake Mariut to the Northeast. West of the road, the natural drainage of the Mariut tableland is towards the Abu Mena valley, which itself drains into lake Mariut. After a shower, the rainwater collects in depressions. The occasional drainage ways have a very smooth appearance and no pronounced erosion gullies were observed (UNDP / FAO 1963 a).

The present study aims to identify the main physiographic units and sub-units, its features and properties for more suitable investment. Also, it is an attempt to compare the use of two soil classification systems which corresponds to the Egyptian conditions.

Materials and methods

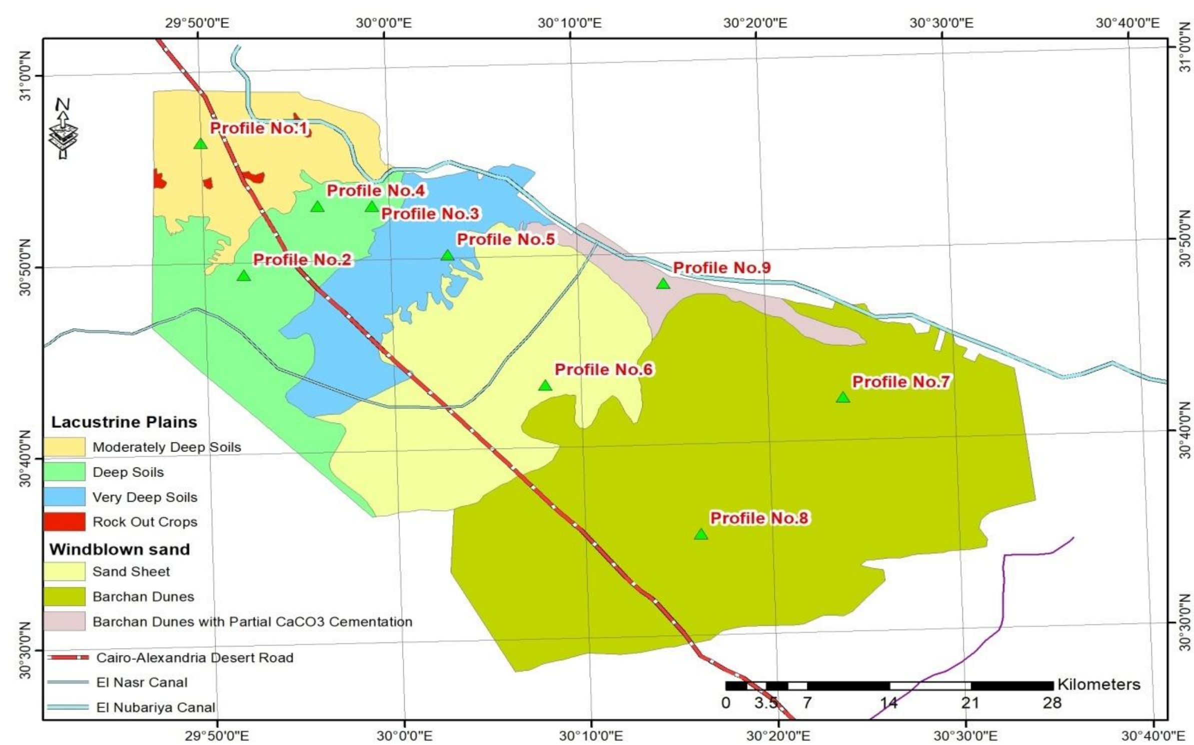
The study area of the present work is located South El-Amiria between longitudes 29º 47` 55``and 30º 30` 05`` East and latitudes 29º 29` 30`` and 30º 30` 05`` North in the Western Desert adjoin for the alluvial soils of Western Nile Delta and comprise an area of about 571168 Feddan.

Physiographic analysis: The physiographic map was carried out by using digital image processing of land sat Enhanced Thematic Mapper plus (ETM+) image (path 178, raw 39) data of 2010, executed using ENVI 4.7 software ITT (2009). The different landforms were initially determined from the satellite image. The digital elevation model (DEM) was extracted from the contour map, following the methodology of Dobos et al. (2002) and Kalogirous (2002). The main two physiographic units are illustrated in Map 1.

Fieldwork: Many mini pits were dug to check the validity and accuracy of boundaries of the different physiographic units, and nine representative soil profiles (Map 1) were dug down to 150 cm or bedrock contact. The field description was done (FAO, 2006 a). Representative soil samples were taken. The morphological description of soil profiles (Table 3).

Laboratory work: Soil samples of the different representative profiles were collected, air-dried, crushed and pass through 2 mm sieve, and analyzed for physical and chemical analyses as follows:

Physical properties include particle size distribution and contents of organic matter, gypsum and total carbonate were determined (Burt, 2004) and illustrated in Table 4.
Chemical characteristics include saturation percent, soluble cations and anions and exchangeable sodium percentage were determined according to the procedures of Burt (2004). Soluble sulphate anion which was calculated by subtracting total anions from total cations (Table 5).
Soil classification was conducted following both the USDA system (USDA, 2014) and FAO system (FAO, 2006 b).



Map 1. Area location, Physiographic units and sub-units (representative soil profiles).

Results and Discussion

The study area is characterized by relatively cold and rainy winter, hot and dry summer. Meteorological data are presented in Table 1.

The climatic data of studied area indicate that the mean maximum and mean minimum annual temperature are 30.6 C^o in August and 9.1 C^o in January, respectively. Natural evaporation rate ranges between 2.2 mm d^{-1} during January to 5.8 mm d^{-1} during July, The relative humidity ranges between 72 % in July and 65 % in March and April. The total rainfall varied between 55.6 mm in December and nil in June and July. The mean monthly minimum wind velocity is 10.1 Km h^{-1} in October, while the mean maximum is 14.8 Km h^{-1} in March.

The climatologically data show that the study area belongs to “Thermic” temperature regime and “torric” moisture regime (USDA, 2014).

The Physiographic analysis: The visual analysis and interpretation of satellite image show two main physiographic units in the studied area and are illustrated in Map 1; while their sub-units are shown in Table 2.

1.Soils of lacustrine plains physiographic unit.

Soils of these plains have coarse and fine loamy texture classes and consider as calcareous. They are probably old Pleistocene deposits underwater environment. They have almost flat topography and nearly level slope. Most of these soils are cultivated with fruits (figs and grapes) and field crops (sugar beet), while other soils are barren, appear salinity features such as salt crusts and saline natural vegetation i.e. salicornia and tamarix. However, these lacustrine plains unit includes four sub-units.

1.1. The first sub-unit is moderately deep soils (profile 1): The morphological description is illustrated in Table 3. The soft and hard lime segregations and concretions are observed in all soil layers, while gypsum as crystals and mycelium constituents are recorded in subsurface one. The bedrock was observed and recorded at a depth of 90 cm.

The pedogenesis of the area is limited mainly to the movement and precipitation of lime and gypsum, through the alternate seasonal wetting and drying through soil profile. The lime segregations in the fine soils were probably washed from eroded older Pliocene formations.

In the sub-soils, the formations of the white crystals or mycelium–like precipitations which are observed in the representative profile may be due to ground-water formations from a wetter era. These probabilities are common in all soils of lacustrine plains (UNDP/FAO, 1963 a). Data in Table 4 show that the texture class

of profile 1 is silty loam, contents of total carbonate are between 30.03 and 45.26 % and increases with depth. Gypsum content ranges from 1.72 to 7.91 % and is concentrated in the subsurface layer, while organic matter content is very low less than 0.2 % and decreases with depth.

Table 1. Average meteorological data (ten years 2006 –2015) of El-Nubariya meteorological station *(CLAC, 2017)

Month	Temperature (C°)			Relative humidity (%)	Rainfall (mm)	Evaporation per day (mm)	Mean wind speed (Km h^{-1})
	Max.	Min.	Mean				
January	18.4	9.1	13.5	70	54.9	2.2	14.3
February	19.3	9.3	14.1	68	26.6	2.6	14.3
March	21.3	10.8	15.8	65	12.9	3.4	14.8
April	23.5	13.1	18.3	65	4.2	4.1	13.9
May	26.6	16.4	21.2	67	1.5	4.9	12.9
June	28.6	20.2	24.3	69	Nil	5.7	12.9
July	29.7	22.0	25.9	72	Nil	5.8	14.1
August	30.6	22.7	26.5	71	0.3	5.5	12.9
September	29.6	21.1	25.6	68	1.0	4.9	11.8
October	27.6	17.6	22.5	68	9.3	3.7	10.1
November	24.2	14.4	19.1	69	33.1	2.7	11.1
December	20.3	10.8	15.2	70	55.6	2.3	13.3

*El-Nubariya meteorological station: longitude 29° 50` 45``East and latitude 30° 35` 55`` North.

Table 2. The areas of the sub-units for each soil physiographic unit.

Physiographic mapping units	Area	
	Feddan	**%**
1- Lacustrine plains sub-units		
Moderately Deep Soils	49293	8.63
Deep Soils	68859	12.06
Very Deep Soils	50968	8.92
Rock Out Crops	1394	0.25
2- Windblown sand sub-units		
Sand Sheet	106641	18.67
Barchan Dunes	278049	48.68
Barchan Dunes with Partial $CaCO_3$ Cementation	15964	2.79
Total Area	571168	100.00

Table (3) :Some morphological description of the representative soil profiles.

Physiographic units	Profile No.	Location	Vegetation (Crop)	Depth (Cm)	Pedogenic Feature	Boundary
Lacustrine plains						
Moderately deep	1	30° 56′ 17.614″ N 29° 49′ 59.773″ E	Barren	0 - 20	Many soft lime segregations	Gw
				20 - 60	Many soft lime segregations , Some gypsum crystals & mycelium	Gw
				60 - 90	Many hard lime concretions	--
				> 90		
Deep	2	30° 49′ 22.104″ N 29° 52′ 06.290″ E	sugar Beet	0 - 50	Many soft lime segregations , few gypsum crystales & mycelium	Gw
				50 - 110	Common lime segregations	--
	3	30° 52′ 49.155″ N 29° 59′ 05.977″ E	Common Salicornia, Tamarix and salt crust	0 - 45	Common lime segregations & very few gypsum crystals	Cw
				45 - 110	Common lime segregation & very few gypsum crystals	--
	4	30° 50′ 22.688″ N 30° 01′ 49.721″ E	Grapes	0 - 30	Many soft lime segregations , few gypsum crystales & mycelium	Gw
				30 - 70	Common lime & gypsum segregations	Gw
				70 - 130	Common lime segregations & gypsum crystals	--
Very deep	5	30° 46′ 50.966″ N 29° 56′ 30.310″ E	Fig	0 - 30	Common lime nodules	Cw
				30 - 80	Few lime nodules	Cw
				80 - 160	Common lime nodules	--
Windblown Sand						
Sand Sheets	6	30° 43′ 15.965″ N 30° 08′ 05.558″ E	Peanut	0 - 50	Few lime segregations	Cw
				50 - 100	Few lime segregations	--
Barchan dunes	7	30° 42′ 13.67″ N 30° 24′ 01.59″ E	Few shrubs	0 - 20	--------	Gw
				20 - 100	--------	--
	8	30° 35′ 17.84″ N 30° 16′ 10.676″ E	Barren	0 - 20	--------	D
				20 - 100	--------	--
Barchan dunes with partial $CaCO_3$ cementations	9	30° 48′ 24.764″ N 30° 14′ 36.273″ E	Clover	0 - 40	Very few lime segregations	Cw
				40 - 80	--------	Aw
				80 - 120	Few lime concretions	--

Boundary : GW = Gradual Wavy CW = Clear Wavy D = Diffuse AW = Abrupt Wavy
Moderatlely deep : 50 - 100 cm Deep : 100 - 150 cm Very deep > 150 cm.

Table 4 : Particle size distribution,texture class , $CaCO_3$, gypsum and O.M contents of the representative soil profiles .

Physiographic unit	Profile No.	Depth cm.	Particle size distribution (%)			Texture class	$CaCO_3$ %	Gypsum %	O.M %
			Sand	Silt	Clay				
Lacustrine plains									
Moderately deep	1	0 - 20	29.91	52.97	17.12	SiL	30.03	2.58	0.19
		20 - 60	26.01	55.12	18.87	SiL	37.22	7.91	0.14
		60 - 90	28.02	52.90	19.08	SiL	45.26	1.72	0.08
Deep	2	0 - 50	18.83	50.51	30.66	SiCL	37.64	6.71	0.51
		50 - 110	17.71	49.42	32.87	SiCL	37.22	4.13	0.30
	3	0 - 45	18.05	48.18	33.77	SiCL	28.76	5.68	0.28
		45 - 110	15.02	50.21	34.77	SiCL	29.61	3.10	0.14
	4	0 - 30	28.41	40.88	30.71	CL	30.03	38.18	0.44
		30 - 70	33.12	38.87	28.01	CL	34.26	18.20	0.35
		70 - 130	36.73	33.62	29.65	CL	30.87	12.90	0.31
Very deep	5	0 - 30	71.87	13.22	14.91	SL	38.00	1.03	0.35
		30 - 80	70.70	15.31	13.99	SL	27.00	0.69	0.27
		80 - 160	67.74	19.14	13.12	SL	36.37	1.20	0.11
Windblown sand									
Sand Sheet	6	0 - 50	89.22	7.12	3.66	S	9.30	1.72	0.24
		50 - 100	89.13	6.13	4.74	S	11.18	1.72	0.11
Barchan dunes	7	0 - 20	96.67	2.27	1.06	S	2.53	1.55	0.13
		20 - 100	96.83	2.11	1.06	S	2.53	1.55	0.09
	8	0 - 20	97.19	1.67	1.14	S	3.38	0.69	0.16
		20 - 100	97.14	1.72	1.14	S	3.38	1.72	0.07
Barchan dunes with partial $CaCO_3$ cementations	9	0 - 40	83.36	8.72	7.92	LS	13.18	1.38	0.33
		40 - 80	86.01	10.12	3.87	LS	9.75	1.20	0.14
		80 - 120	87.58	6.61	5.81	LS	14.38	1.72	0.08

Table 5 : Chemical properties of the representative soil profiles.

Physiographic unit	Profile No.	Depth cm.	SP	pH	EC dS/m.	Cations me./l				Anions me./l				ESP
						Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO3^{=}$	$HCO3^{-}$	Cl^{-}	$SO4^{=}$	
Lacustrine plains														
Moderately deep	1	0 - 20	37	8.20	4.98	6.58	6.46	34.96	0.25	0.0	2.36	26.27	19.62	15.92
		20 - 60	40	8.00	83.03	47.37	117.85	840.00	4.18	0.0	3.77	758.47	247.15	57.46
		60 - 90	54	8.00	1.61	2.63	2.80	11.00	0.25	0.0	1.42	12.71	2.56	7.90
Deep	2	0 - 50	60	8.47	3.28	13.16	8.58	12.94	0.25	0.0	1.42	9.32	24.20	4.33
		50 - 110	64	8.22	6.76	32.89	8.41	22.43	0.66	0.0	1.18	14.41	48.81	5.68
	3	0 - 45	62	7.60	267.95	110.53	1015.56	2652.2	8.22	0.0	2.12	1685.6	2098.8	62.06
		45 - 110	72	7.59	39.22	69.74	53.09	239.13	2.53	0.0	0.94	70.34	293.21	30.43
	4	0 - 30	65	7.50	7.59	28.95	21.05	31.83	2.38	0.0	1.42	67.80	14.99	7.52
		30 - 70	62	8.26	4.31	18.42	4.41	15.90	0.25	0.0	1.42	9.32	28.24	5.38
		70 - 130	66	8.32	3.93	23.68	4.58	14.21	0.25	0.0	1.42	9.32	31.99	4.14
Very deep	5	0 - 30	28	7.65	0.58	1.97	1.29	2.81	0.13	0.0	1.42	3.39	1.40	1.95
		30 - 80	27	7.55	0.92	2.63	2.26	4.08	0.50	0.0	1.18	5.08	3.21	2.52
		80 - 160	26	7.56	1.38	3.95	4.75	4.92	0.50	0.0	1.18	5.93	7.01	2.17
Windblown sand														
Sand Sheet	6	0 - 50	23	7.69	4.68	9.21	17.96	12.52	3.34	0.0	3.30	27.12	12.62	3.62
		50 - 100	24	7.08	1.27	3.95	3.66	4.92	0.25	0.0	1.42	8.47	2.89	2.40
Barchan dunes	7	0 - 20	18	8.00	4.78	18.42	5.49	22.96	2.96	0.0	1.42	21.19	27.22	7.86
		20 - 100	19	7.75	0.97	1.97	1.83	7.03	0.50	0.0	1.42	6.78	3.15	5.89
	8	0 - 20	19	7.54	2.43	6.58	2.12	13.37	4.46	0.0	0.94	20.34	5.24	7.57
		20 - 100	20	7.26	3.96	13.16	5.32	17.59	4.31	0.0	1.89	4.24	34.25	6.78
Barchan dunes with partial $CaCO_3$ cementations	9	0 - 40	25	7.66	1.13	3.95	3.12	4.08	0.55	0.0	1.42	7.63	2.65	1.90
		40 - 80	24	7.87	1.96	5.26	5.61	8.72	0.35	0.0	1.89	11.02	7.03	4.08
		80 - 120	25	7.58	1.27	3.95	4.75	4.92	0.50	0.0	1.42	8.47	4.23	2.17

Chemical properties of profile 1 are shown in Table (5), pH values are between 8.0 and 8.2, i.e. moderately alkaline class. Soil salinity values range widely from 1.61 to 83.03 $dS.m^{-1}$ and also concentrated in subsurface layer. This distribution of salts in different layer may be reflect the effect of precipitation of soluble salts from surface layer to subsurface one by leaching, while, the aridic or torric soil moisture regime encourage salts accumulation by evaporation. The upper two surface layers have values of ESP more than 15 which reveal to sodic reaction.
According to USDA (USDA, 2014) soils of this representative profiles are classified as follows:

- Gypsic Haplosalids, fine loamy, mixed, thermic.

On the other hand, FAO (FAO, 2006 b) classified these soils as follows:

- Calcic Hypersalic Solonchaks (Sodic, Chloridic, Aridic, Siltic).

1.2. The second sub-unit is deep soils (profiles 2, 3 and 4): These soils are calcareous with soft lime segregations, on the other hand, these soils considers as a sub-unit of gypsum crystals accumulation (Table3). The texture class through depths of representative soil profiles 2 and 3 were silty clay loam, while soils of profile 4 is clay loam. Contents of total carbonate varied from 28.76 to 37.64 % and to be in soft segregation kind. Gypsum contents differs between 3.1 and 38.18 % and decreases with depth in crystal and mycelium kinds. Organic matter is very low contents and below 0.5 % and not exceeds 0.51 % (Table 4). Soil pH values range from 7.59 to 8.47 indicating that these soils are moderately alkaline in soil of profiles 2 and 4, and slightly alkaline in soil of profile 3. Soil salinity differs from 3.28 to 267.95 $dS.m^{-1}$ which recorded very slightly saline class to slightly saline one in surface and subsurface layer of profile 2, and so all layers of profile 4.Strongly saline is observed in soil of profile 3 in which sodicity was determined. On the other hand, it no sodicity is observed in soils of profiles 2 and 4 (Table 5).

According to USDA (USDA, 2014), soils of these representative profiles are classified as follows:

- Typic Calcigypsids, fine loamy, mixed, thermic (profile 2)
- Gypsic Haplosalids, fine loamy, mixed, thermic (profile 3)
- Typic Calcigypsids, fine loamy, mixed, thermic (profile 4)

On the other hand, FAO (FAO, 2006 b) classified these soils as follows:

- Calcic Hypogypsic Gypsisols (Aridic, Siltic) (profile 2)
- Calcic Hypersalic Solonchaks (Sodic, Aridic, Siltic) (profile 3)
- Calcic Hypogypsic Gypsisols (Aridic) (profile 4)

1.3. The third sub-units very deep soils: which represented by profile 5 and this unit is calcareous too. Calcic horizon is observed from nodules kind while, gypsic horizon is not observed (Table3). Soil texture is sandy loam class. Up to 80 cm the coarse sand is predominant constituent. Total carbonate varied from 27.0 to 38.0 %, gypsum contents change between 0.69 and 1.20 %. Organic matter contents decreased with depthanddiffered from0.11 and0.35%(Table 4). Data of chemical properties in
Table (5) showed that soils of this subunit tend to be slightly alkaline where pH values are between 7.55 and 7.65 and are non-saline class where electric conductivity is 1.38 dS/m or less and tends to increase with depth. Distribution of soluble cations values and ESP reveal to non-sodic class.

According to USDA (USDA, 2014), soils of this representative profile are classified as follows:

- Typic Haplocalcids, coarse loamy, mixed, thermic.

On the other hand, FAO (FAO, 2006 b) classified these soils as follows:

- Haplic Calcisols (Aridic, Arenic).

1.4. The fourth subunit is rock outcrops: which is a within lacustrine plain. The relief is rather rough and rolling, with large areas of sand, sandstones, shales, shaly clays, soft lime- stones and gravel of Miocene and Oligocene age. Most of the formations are extremely rich in gypsum, (UNDP/FAO,1963 a).

2- Soils of windblown sand physiographic unit.

The wind-blown sand tended from the North and North-West of deltaic soils of the various terraces and South plains of lacustrine deposits. Most of the dunes of the study area have some vegetation of desert shrubs or cultivated by different crops such as peanut and clover or still barren. Topography of these soils varies from undulating to almost flat, while slope ranges from sloping to nearly level. The dunes may have a barchan shape or sand sheet. The soils under consideration consist of three subunits as follows:

2.1. The first sub-unit is sand sheet soil (profile 6): These soils are located in the North-West of wind-blown sand area, and there are scattered low longitudinal dunes occur nearer to the barchan dunes.

Data of physical properties(Table 4) reveal that sand texture class through the profile. Coarse sand is predominated while another fractions, fine sand, silt and clay, are associations. Total carbonate tends to increase with depth and recorded 9.3 % in the surface layer and 11.18 % in the subsurface one. Gypsum content is very low, where they are 1.72 % in both layers. Organic matter contents are very low. Their values are between 0.11 and 0.24 %. Soil chemical properties (Table 5), showed that soil reaction was slightly alkaline in the surface layer which pH 7.69 and almost pH 7.08 neutral in the subsurface one. Soil salinity is slight in the surface layer (EC4.68 $dS.m^{-1}$) and non-saline (EC 1.27 $dS.m^{-1}$) in subsurface one, while there is no sodicity is unreliable where ESP values are below 15.

According to USDA (USDA, 2014), soils of this representative profiles are classified as follows:

- Typic Haplocalcides, sandy, mixed, thermic.

On the other hand, FAO (FAO, 2006 b) classified these soils as follows:

- Haplic Arensols (Calcaric, Hyposalic, Aridic).

2.2.The second subunit is Barchan dune (profiles 7 and 8): Barchan dunes is defined according to Robert and Julia (1983) as a dune having a crescentic ground plan, with the convex side facing the wind, the gentler slope is on the convex side between the horns. These soils have undulating and gently undulating topography and sloping to gently sloping slope. Usually, these dunes are without any vegetations. The soils of this subunit haven't gravel on the surface or through their different layers of representative profiles. The data of physical properties (Table 4) showed that sand is the texture class. Total carbonate varies between 2.53 and 3.38 %, with homogenous distribution through both representative soil profiles. Contents of gypsum are between 0.69 and 1.72 % with homogenous distribution in soil of profile 7, while, it increases with depth in soils of profile 8. Organic matter contents is very low (less than 0.16). Data in Table (5) show that the soil reaction varies between 7.26 and 8.00 i.e. neutral and moderately alkaline. Salinity classes differ between non-saline and slightly saline whereas EC values are between 0.97 and 4.78 dS/m^{-1} There is no sodicity phenomenon, whereas ESP values are between 5.89 and 7.86.

According to USDA (USDA, 2014), the soils of both representative profiles 7 and 8 can are classified as follows:

- Typic Torripsamments, siliceous, thermic

On the other hand, FAO (FAO, 2006 b) classified these soils as follows:

- Haplic Arensols (Calcaric, Hyposalic, Aridic) (profile 7)
- Haplic Arensols (Calcaric, Aridic) (profile 8)

2.3. The third subunit is Barchan dunes with partial $CaCO_3$ cementations (profile 9): These soils occupy only a rather small area near the cultivated land in the north, where they form a low sand sheets or low ripple dunes of coarse wind-blown sand. Coarse loamy sand to sandy loam soils occurs in a small depression between dunes. It is associated with soft and hard lime segregations with reddish sub soils. The soil is almost of flat topography and nearly level slope in location of the representative profile, which is cultivated with clover. The soil profile is loamy sand texture class, with very few to few lime segregations. These soils are rich in lime and more or less have cementation by lime. Total carbonate varied from 9.30 to 14.38 % and the deepest layer has higher contents. Gypsum content is very few, and varies between 1.20 and 1.72 %. On the other hand, contents of organic matter change from 0.08 to 0.33 % with decreasing with depth (Table 4). Data of chemical properties in Table (5) showed a slightly alkaline class for soil reaction whereas their values differ from 7.58 to 7.87 and recorded non-saline class, whereas their EC values are varied between 1.13 and 1.96 $dS.m^{-1}$. Data of exchangeable sodium percentage (ESP) clear that no-sodicity of the studied soils (ESP below 15).

According to USDA (USDA, 2014), the soils of both representative profiles 7 and 8 can are classified as follows:

- Typic Haplocalcids, sandy, mixed, thermic.

On the other hand, FAO (FAO, 2006 b) classified these soils as follows:

- Haplic Arensols (Calcaric, Aridic).

With respect to USDA system (USDA, 2014) and FAO system (FAO, 2006 b) systems of soil classification of the current study, results show differences between them in the limits of diagnostic horizons or different qualifiers which affect soils use suitability. Table 6 presented some observations about the two systems.

Table 6. Some observations about FAO (FAO, 2006 b) and USDA (USDA,2014) classification systems.

Terms	FAO (2006 b)	USDA (2014)
Calcic horizon	≥15 % $CaCO_3$	≥15 % $CaCO_3$
	Not recorded	≥ 5 % $CaCO_3$ When clay < 18 %and texture: sand, sandy skeletal, coarse loamy or loamy skeletal.
Calcaric	≥ 2 % $CaCO_3$ In between 20 – 100 cm from surface.	Not recorded
Hypocalcic	Calcic horizon < 25 % $CaCO_3$ through 100 cm from surface	Not recorded
Hypercalcic	Calcic horizon ≥ 50% $CaCO_3$ through 100 cm from surface	Not recorded
Salic horizon	≥ 15 dS/m	≥ 30 dS/m
	≥ 8 dS/m When pH ≥ 8.5	Not recorded
Halic	Not recorded	≥ 15 dS/m In vertisols only
Protosalic	≥ 4 dS/m Within 100 cm from surface	Not recorded
Hypersalic	≥ 30 dS/m Within 100 cm from surface	Not recorded
Texture	May be	In family level clearly
Mineralogy	Not recorded	In family level clearly
Temperature regime	May be	In family level clearly

The two soil classification systems of USDA (USDA, 2014) and FAO (FAO, 2006 b) agreed that calcic horizon has a calcium carbonate equivalent in the fine earth fraction of ≥ 15 %. USDA system is excluded the soils which have less than 18 % clay content and its particle size class, i.e. sandy, sandy-skeletal, coarse loamy or loamy-skeletal, to require ≥ 5 % calcium carbonate content to identify calcic horizon. Meanwhile, FAO system used some terms in the second level of suffix qualifiers such as:

1. Calcaric: Having Calcaric material that contains ≥ 2 % calcium carbonate equivalent between 20 and 100 cm from soil surface.
2. Hypocalcic: Having a calcic horizon with a calcium carbonate equivalent in the fine earth fraction of < 25 % (by mass) and starting ≤ 100 cm from soil surface.
3. Hypercalcic: Having a calcic horizon with a calcium carbonate equivalent in the fine earth fraction of ≥ 50 % (by mass) and starting ≤ 100 cm from soil surface.

The USDA (2014) system gave importance to 30 dS/m or more an electrical conductivity of soil saturation extract at 25 C^o for salic horizon requirements. While, FAO (2006 b) system gave values of ≥ 15 dS/m, or ≥ 8 dS/m when the pH of soil saturation extract≥ 8.5. FAO system referred to the following terms:

1. Hypersalic: Having within ≤ 100 cm of the soil surface a layer that has an EC of ≥ 30 dS/m at25 C^o.
2. Protosalic: Having within ≤ 100 cm of the soil surface a layer that has an EC of ≥ 4 dS/m at25 C^o.
3. The family category of USDA system refers to texture, mineralogy, temperature regime of soil…etc., while, FAO doesn't clear them clearly.

Finally, we can conclude that both systems have many advantages which are related to soil management, suitability, and land use. So, applications of two classification systems is necessary or preferable due to their compilation.

REFERENCES

Burt, R. (Ed). 2004. " Soil Survey Laboratory Methods Manual". Soil Survey Investigation Report No. 42 Version 4.0 November (2004).

CLAC, 2017. Central laboratory for Agriculture of Climate. Agric. Res. Cent (CLAC). Website http://W.W.W.calc;edu.eg.L.

Colwell, R. N., D. S. Simonett, F.T. Ulaby, J.E. Estes and G.A. Thorley (Eds). 1983. Manual of Remote Sensing. American Society of Photo grammetry, 210. Little Fall, Falls Church, Virginia, USA.

Dobos, E., B. Norman, W. Bruee, M. Luca, J. Chris and M. Enka. 2002. The use of DEM and Satellite Images for Regional Scale Soil Database. 17 th World Congress of Soil Science (WCSS). 14 -12 August 2002, Bangkok, Thaila

FAO 2006 a.” Guidelines for Soil Description”, 4 th Ed., FAO, Rome, Italy. ISBN92 -5-105521-1.

FAO2006 b. "World Reference Base for Soil Resources "A Framework for International classification, correlation and communication. World Soil Resources Reports .103, Rome, Italy.

Ghassem, A.1989. Theory and Application of Optical Remote Sensing. Wiley Series for Remote Sensing John Wiley & Sons. Printed in USA.

ITT 2009. ITT corporationENVI 4.7 software 1133 Westchester, While plains, NY,10604, USA.

Kalogirous, S. 2002. Expert Systems and GIS, An application of Land Suitability. Comput. Environ. Urban Syst. 26: 89 – 112.

Robert, L.B. and A.J. Julia.1983. " Dictionary of Geological Terms “. Doubleday, New York, USA.

Said, R. 1990. “The Geology of Egypt”. Published by A. A. Balkema, Old Post Road, Brookfield, VT 05036, USDA.

Soil Survey Staff,1993." Soil Survey Manual “. USDA Handbook 18 U.S.Government Printing Office, Washington, D.C., USA.

UNDP/FAO1963 a. High Dam Soil Survey, United Arab Republic Volume II FAO /SF:16/UAR, The Reconnaissance Soil Survey, United Nations Development Program (SpecialFund).

UNDP/FAO31963 b. “High Dam Soil Survey “, United Arab Republic, Vol. III. The Semi – Detailed Soil Survey. FAO / SF: 16 /UAR.

USDA 1999. " Soil Taxonomy “A Basic System of Soil Classification for Makingand Interpreting Soil Surveys. Agric. Handbook 436,2 nd Edition by Soil Survey Staff,Washington, DC 20402, USA.

USDA2014. " Keys to Soil Taxonomy”. Prepared by Agronomy Department Cornelluni. Ithaco, New York, USA.

دراسة لبعض أراضي جنوب العامرية محافظة الإسكندرية – مصر بإستخدام نظامين لتصنيف الأراضي

عادل محمد عبد الرحمن زايد هانئ محمد احمد التابعي عبدالمنعم عبدالمجيد الطوخي
معهد بحوث الأراضي و المياه و البيئة – مركز البحوث الزراعية- جيزة – مصر

تقع منطقة الدراسة جنوب العامرية بجمهورية مصر العربية , وقد تمت هذه الدراسة بإستخدام تكنولوجيا الإستشعار عن بعد لتمييز الوحدات الفزيوجرافية الأساسية بالمنطقة و التى تقع بين خطى طول``55 `47 29º و ``05 `30 30º شرقا و دائرتى عرض ``30 `29 29º و ``05 `30 30º شمالا و تشغل مساحة حوالى571168 فدان. و قد تم استخدام نظامى الفاو (2006 b) و الأمريكى USDA (2014) لتصنيف الأراضى .

وقد دلت دراسة صور الأقمار الصناعية على وجود وحدتين فيزيوجرافيتين تم التعرف عليهما و هما كما يلى :

1-السهول البحيرية و التى اشتملت على أربعة أنواع من الأراضى والتى تباينت فيما بينها بناءا على الإختلاف فى أعماقها بصفة أساسية . وكان النوع الأول لأراضى ذات عمق متوسط اما النوع الثاني فهو الأراضي العميقة و النوع الثالث فهو الأراضى العميقة جدا و النوع الرابع فهو أراضى البروزات الصخرية .

2 - الأراضى الرملية المنقولة بالرياح و قد تميزت إلى ثلاثة أنواع الأول منها أراضى الكثبان الرملية ذات تجمعات فى شكل رقائق أما النوع الثانى فهى أراضى ذات الشكل المتموج المعروفة بالBarchan

أماالنوع الأخير فهى أراضى كثبان الـ Barchan ذات الإلتحام الجزئى بالجير .

وقد لوحظ عند تطبيق نظامى التصنيف فى الدراسة أن نظام FAO (2006, b) قد أعطى أهمية لمختلف مستويات الخصائص الأرضية و الذى يؤثر مباشرة على عمليات استصلاح الأراضى و مدى صلاحيتها و مختلف استخداماتها و من ناحية أخرى فإن نظام USDA (2014) يعطى فى مستوى العائلة Family level وبصفة مباشرة أهمية لخصائص القوام و التركيب المعدنى و النظام الحرارى للتربة ...الخ . لذا فإننا نوصى بتطبيق كلا النظامين معا حيث أنهما يتكاملان .

الكلمات المفتاحية: العامرية ، الوحدة الفيزيوجرافية ، تصنيف التربة