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A Pedological Study on some Soils of Farafra Oasis, Egypt

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ABSTRACT

Farafra Oasis is a natural depression which located in the Egypt western desert. The whole area is under hot arid circumstance. There, the lands conferred indications of promising agricultural expansion. Study of the landforms and soils related with them can give a general survey of soil attributes. The investigated landforms include; depression floor (Peni plain- Chalky plain-Sand sheets-Playa).Eight soil profiles were selected to represent the identified physiographic units according to the information obtained during the reconnaissance field survey and the pre-field interpretation. A total of 14 soil samples, representing the different soil horizons of the selected profiles were collected, air-dried, crushed to pass through a 2 mm sieve, and stored for physical and chemical analyses. The soils were classified as following : ((*Calcisalids – Gypsisalids – Haplogypsids - Haplosalids – Calcigypsisalids - Quartzipsamment - Torryluvants – Torriorthents - Aquisalids - Gypsiargids -Torripsamment*)). Gypsum and calcium accumulations were found in salinity condition in most of the investigated soil samples. The drainage problem and the groundwater presence are common in most of the depression. The challenge is to be knowing of the problems and to design a suitable management system of water and soil.
Keywords: Landforms, peni plain, chalky plain, playa, sand sheets, Farafra Oasis, Egypt.

INTRODUCTION

About a third of the world,s land surface has arid or semi-arid climate. Africa is one of the continents with the most dry land .in the largest desert in the world,the Sahara. Oases are a characteristic element of it, Oases are groundwater-sustained is-lands of verdant fertility in a barren and relatively isolated landscape (Powell *et al.,* 2015 and Powell and Fensham 2016). El-Farafra Oasis (26°30′–29°00′E, 26°00′–27°30′N), is one of the smallest Oases (10,000 km^2) on the limestone plateau occupying the central region of western Egypt. It located 650 km southwest of Cairo city (El Bastawesy and Ali 2013). El-Farafra Oasis is bounded from three sides; west, north and eastby escarpments of the nearby desert plateaus (270-300 m a.s.l with residual hills as high as 350 m asl) (Hassan *et al*., 2001). This natural depression is in a hyper-arid area with a hot desert climate. This oasis has 22°C mean annual air temperature and 10 mm or less average annual precipitation (Elsheikh 2015). In El-Farafra Oasis, the source of ground water is from artificial and natural wells discharging from the world's biggest nonrenewable groundwater resource (the Nubian Sandstone Aquifer) (Voss and Soliman 2014). The Dakhla Shale (Maastrichtian) is outcropped on the floor of the Farafra Depression, and it is intertonguing horizontally into the Maastrichtian Khoman Chalk in the north and center of the oasis (Hassan *et al*., 2001 and Plyusnina *et al*., 2016). The main objectives of this is investigation is study the, chemical, physical and morphopedological attributes of some soils representing the different land forms in El-Frafra depression.

MATERIALS AND METHODS

- Location and general description

Farafra oasis is the most isolated depression in the Western Desert of Egypt. In1978 the asphalt road was paved to open new prospects where dozens of cities are exist now despite the fact that the Farafra oasis and a few tiny oases dispersed all over the depression in addition were the only inhabited region for long time. It's including Abu Monquar depression which lies in the center desert of the Libya, 300 kilometers west of Assiut in the midway between El- Bahariya Oasis and El- Dakhla Oasis. Geographic coordinates of Farafra oasis between longitude 27 ^{0} 20' and 29 ^{0} 00'E and latitudes 26 ^{0} 00' and 27 ^{0} 30'N (Fig1). According to (Al-Baraa, 2011), Farafra oasis is existing in Cairo southwest, is connected with it through Giza Governorate and El- Bahariya Oasis by approximately 600 km paved road and is linked with El-Dakhla Oasis to the south by this road, about 200 km, through (Abu Monquar depression) as well as with Siwa Oasis to the northwest by a desert track (Al-Baraa, 2011).

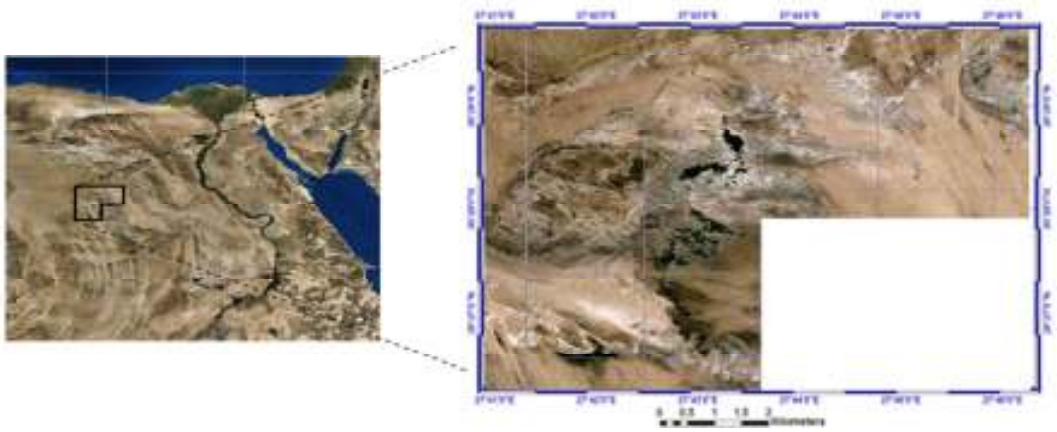

Fig. 1. Farafra Oasis location in western desert in Egypt.

- Soil mapping and sampling

Eight soil profiles were selected based on differences in geomorphic units. The studied soil profiles were classified according to soil taxonomy (Soil Survey Staff, 2010) and were described in the field based on Soil Survey Staff (2006) The location of these different profiles is showed Fig 2.

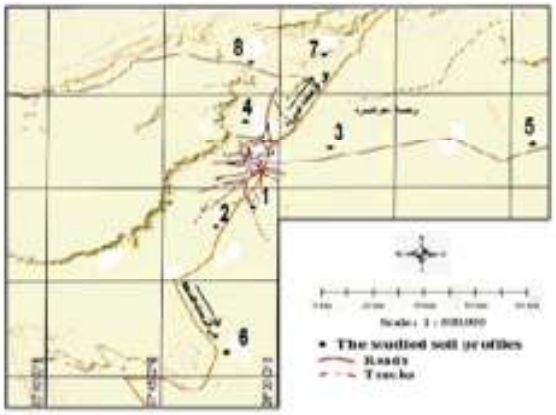

Fig. 2. Location of the studied soil profiles.

- Laboratory analysis

Soil selected samples were air-dried and sieved through a 2 mm seive. Particle- size distribution analysis was carried out by method as described by Day (1965). The pH was measured in the saturated paste while EC was measured in soil paste extract according to Hesse (1971). CEC was determined by method as described by Chapman, (1965). O.M content was determined by Walkely's Black method according to Mathieu and Pieltain, (2003). Gypsum ($CaSO_4.H_2O$) was determined by acetone method (Salinity Laboratory Staff, 1954). Total carbonates were determined using Calcimeter method, (Salinity Laboratory Staff, 1954). Soluble ions in the saturation extracts were measured based on the procedures described by Hesse (1971).

- Geology of Farafra Depression

The investigated region belongs to Pleistocene sediments. Upper Cretaceous Nubian Formations made up of cross-bedded sandstones essentially occupied the surface of the region with interbedded shale. According to (UNDP/ UNESCO 2001), the extrusive rocks that belong to the Precambrian age are exposed in scattered patches. Paleocene limestone and Tertiary Eocene and shale overlie the Nubian Formation that is locally intruded by basalts believed to be of early pleistocene or late tertiary age Said on the limestone plateau.

- Geomorphology of Farafra Depression

El-Shazly (1976) and UNDP/UNESCO (2001) reported that the geomorphologic lineaments exhibited in the studied region are the elevated plateau, Farafra Oasis depression and the foothill slopes. The latter includes local marshes, ridges, lacustrine deposits, sand dunes, crescentic, sand sheets and hills.

- Farafra Formation:

Farafra formation capsules convex precipices surrounding the semi-closed depression. These depressions are consisted of interconnected and separate local basins, that differed in size in region from several tens of meters to hundreds of square kilometers. such as Al Gunnah playa, that is located at the northeast foot slope of Al Quss Abu Said plateau, it represents one of the oldest settlement and agricultural reagions in the Farafra depression and covers alone an region of more than 100km^2 (El-Azabi and El-Araby,2000;Hassan *et al*., 2001 and Embabi, 2004).

RESULTS AND DISCUSSION

Geomorphological units (landforms): to identify the exiting landforms, geological maps of Farafra Oasis with the generated digital elevation modal were used. Field work verified the presence of these units and described it. Location of studied different soil profiles were preliminary estimated to characterize the soils which occupy these units' surfaces. Anyway, the field circumstances chose their areas the landforms recognized are given in Table 1, where 4 major geomorphic units were formed.

Table1. Stratigraphic correlation, landforms, soil taxonomy and location of soil profiles.

Region	Landforms		Soil profile	Soil. Tax of great group
Farafra Oasis	Depression floor(D)	Chalky Plain	1	Torriorthents
			2	Haplosalids
		Peni plain	5	Calcigypsids
			6	Haplogypsids
		Sheet sand	3	Torripsamments
			4	Quartzipsamment
		Palaya	7	Aquisalids
			8	Gypsiargids

Soils of depression floor: The depression floor landform demonstrates the most appropriate unit for developmental plans.

Thus, eight soil profiles were described and 14 soil samples were chosen to determine the chemical and physical properties of the sub units of this land form as demonstrated in Tables 1,2,3,4 and 5.

The four major geomorphic units are:

a- Soils of chalky plain: They are found in the Farafra depression floor as erosional leftovers of the chalk in various size and shape. Chalky plain is uncovered on the floor of this depression and stretches out over a wide region near El-Gunna plateau, Ain Hinnis Bir Bidni and north Ain El-Maqfi. This geomorphic unit is represented by profiles 1and 2 as shown in Table2.

The chalky plain unit was represented by profile 1and profile2. Concerning morphological and physical properties of the soils, data of Table 1, indicate that surface of land is almost leveled, studied soils are poorly drained, texture differs from sand lomy(S.L) to lomy sand(L.S), C. sand fraction percentage ranges from 26.29 to 33.28%,F. sand fraction from 28.01 to 57.04%, silt fraction from 4.84 to11.29%, clay fraction from 11.40 to 27.42%, color of soil dry ranges from very pale brown (10YR8/3) to Brownish yellow (10YR7/6), moist color varied from Very pale brown (10YR7/4) to Brownish yellow (10YR6/6). Content of calcium carbonate ranges from28.93to 72.34% with tends to reduce with tends to raise with the depths of soil profiles, O.M was low and ranged between 0.18 to 0.34 %.

Concerning chemical properties of the soils, chalky plain Table 2 demonstrate that soil reaction(pH) varied (from 7.97 to 8.24) showing that the different investigated soils are from nutral to slightly alkaline, strongly to very extremely

saline ECe of soil past extract ranges between and 50.90 to 182.9 dSm^{-1}. Na^{+} was the predominant cation in all horizons followed by Mg^{++}, Ca^{++} then K^{+}. On the other hand, Cl^{-1} ions dominate the anions, followed by SO_4^{--}then HCO_3^{-}. Exchangeable cation percent differs from 46.80 to 93.19%, content of gypsum is very low and ranged from 28.93 to 72.34%. CEC ranged between13.01 to 29.03meq 100 g $soil^{-1}$.

This map unit is low to moderate in available N and K, where the values of nitrogen ranged between 72.8 to 145.6 ppm as well as the values of potassium ranged between 17.55 to 30.9 $mgKg^{-1}$In contrast, available P is from low to moderate and ranged between 3 to 4.2 $mgKg^{-1}$.

Table 2. Some physical,chemical and morphological characteristics of the studied soils (chalky plain).

Particle size distribution and texture classes, of soil map unit (chalky plain).

Profile No	Depth Cm	Particle size distribution (%)				Texture	Location
		Coarse sand	Fine sand	Silt	Clay		
1	0-25	26.29	57.04	4.84	11.83	Loamy sand	26º 58' 90.4" N
	25-40	33.28	28.01	11.29	27.42	Sandy loam	27º 57' 39.7" E
2	0-25	30.11	53.01	5.48	11.40	Loamy sand	26º 58' 90.4" N 27º 57' 39.7" E

Soluble cations, soluble anions, electric conductivity (EC) and pH in soil paste extract of soil map unit (chalky plain).

Profile No	Depth Cm	Soluble cations $meqL^{-1}$				Soluble anions $meqL^{-1}$				EC (dSm^{-1})	pH
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$		
1	0-25	110.3	64.8	486.4	10.2	-	9.5	389.6	272.6	67.1	8.04
	25-40	65.5	90.5	346.5	6.8	-	8.5	295.4	205.4	50.9	8.24
2	0-25	175.8	352.7	1276.8	21.9	-	2.5	1059.8	764.9	182.9	7.97

Available nutrient (NPK), cation exchange capacity (CEC), ($CaCO_3$), gypsum and organic matter (O.M) of soil map unit (chalky plain).

Profile No	Depth Cm	Available Nutrient $mgKg^{-1}$			CEC meq 100 g $soil^{-1}$	$CaCO_3$	Gypsum	O.M
		N	P	K		%		
1	0-25	145.6	4.2	17.55	13.44	63.83	1.10	0.29
	25-40	72.8	3	30.9	29.03	72.34	5.50	0.18
2	0-25	182	3.6	19.6	13.01	28.93	4.00	0.34

Description Morphology profile 1

Depth (cm)	Description Morphology
0-25	Brownish yellow (10YR6/6, moist); Brownish yellow (10YR7/6, dry); Loamy sand ; structure less; sticky; plastic; many fine to coarse pores; few soft lime accumulation; many fine to medium roots; strongly calcareous; clear wavy boundary; strongly effervescence with HCl.
25-40	Light gray (10YR7/2, moist); very pale brown (10YR8/3, dry) Sandy loam ; structure less; soft; non sticky; non plastic; many coarse pores; moderate soft and hard lime accumulation; few fine roots; strongly calcareous; strongly effervescence with HCl.
40-ᾱ	Hard pan (sand stone).

Cont. Table 2.

Description Morphology profile 2

Depth (cm)	Description Morphology
0-25	Very pale brown (10YR7/4, moist); very pale brown (10YR8/2, dry) Loamy sand; structure less; slightly hard; friable; slightly sticky; slightly plastic; many fine to medium pores; many soft and hard lime accumulation; many fine to medium roots; strongly calcareous; strongly effervescence with HCl.
25-ᾱ	Hard Pan

b- Soil of sand sheets.

One of the most characteristics topographic features of El-Farafra oasis is the presence of sand dunes patches of sand dunes and drifts cover huge areas of the farfra depression in the form of longitudinal dunes oriental parallel to the prevailing wind. These sand dunes are characteristic of an open relatively flat desert which is almost flat from rainfall and which is swept by a relatively constant, unidirectional wind blowing from an unlimited source of sand. Some sand accumulations cover the floor of the depression in the northern past especially at Wadi Hemis and Wadi Maqfi. In the southern parts of the oasis, these are patches of sand dunes along the slopes of Abu Monqar scarps in the NNW-SSE direction. The unit of sand sheet is represented by profiles 3 and 4 Table 3.

The unit of sand sheet is represented by profiles 3 and 4 (Table 3). Land surface is almost leveled. Soils are poorly drained, with loamy sand texture. Coarse sand fraction ranges from 85.81 to 86.67%, fine sand from 2.04 to 2.9%, silt from 4.30 to 4.84% and clay fraction from 6.44 to 6.99., Soil dry color ranges fromt Brownish yellow (10YR7/6)to brownish yellow (10YR 6/8, dry), while moist color varied from Yellow (10YR 7/8)to Brownish yellow (10YR6/6) ,Calcium carbonate content ranges from1.11 to 17.96 % with tends to decrease with tends to increase with soil profiles depths. They are low in their content of soil organic matter from 0.27 to 0.39 concerning chemical properties of the sand sheet soils, Table 3 reveals that soil reaction values ranged from 8.19 to 8.23, indicating that these soils are slightly alkaline, strongly to very extremely

saline ECe of soil past extract ranges between 14.80 and 52.4 dSm^{-1}. Sodium was the dominant cation in all horizons followed by magnesium, calcium and potassium. On the other hand, chloride ions are the dominate anions, followed by $SO_4^{--}$and HCO_3^-. Exchangeable cation percent varies from 8.06 to 8.6 %, while gypsum content is very low and ranged from 0.90 to 6.30 %. It can be easily detected, as mentioned previously, that the parent material is sandstone and weathering is physical rather than chemical, leaching processes are weak thus the fine fractions are very low. The morphological description of the representation soil profiles are given her after.

Table 3. Some physical,chemical and morphological characteristics of the studied soils (sand sheets).

Particle size distribution and texture classes, of soil map unit (sand sheets).

Profile No	Depth Cm	Particle size distribution (%)				Texture	location
		Coarse sand	Fine sand	Silt	Clay		
3	0-100	85.81	2.9	4.84	6.445	Loamy Sand	27º05' 06.2"N 27º 58'44.8" E
4	0-100	86.67	2.04	4.30	6.99	Loamy Sand	27º00'89.2" N 27º56' 82.4" E

Soluble cations, soluble anions, electric conductivity (EC) and pH in soil paste extract of soil map unit (sand sheets).

Profile No	Depth Cm	Soluble cations $meqL^{-1}$				Soluble anions $meqL^{-1}$				EC (dSm^{-1})	pH
		Ca^{++}	Mg^{++}	Na^+	K^+	$CO_3^=$	HCO_3^-	Cl^-	$SO_4^=$		
3	0-100	58.6	43.3	415.7	5.9	-	3.5	303.7	216.4	52.4	8.23
4	0-100	37.9	13.0	94.1	2.8	-	5.0	85.7	57.1	14.8	8.19

Available nutrient (NPK), cation exchange capacity (CEC), ($CaCO_3$), gypsum and organic matter (O.M) of soil map unit (sand sheets).

Profile No	Depth Cm	Available Nutrient $mgKg^{-1}$			CEC meq 100 g $soil^{-1}$	$CaCO_3$	Gypsum	O.M
		N	P	K		%		
3	0-100	218.4	1.8	6.05	8.06	17.96	6.30	0.39
4	0-100	145.6	9	3.2	8.60	1.11	0.90	0.27

Cont. Table 3.

Description Morphology profile 3

Depth (cm)	Description Morphology
0-100	Brownish yellow (10YR6/6, moist); yellow (10YR7/6, dry) Loamy sand; single grain; loose; non sticky; non plastic; many coarse pores; manyfine to medium roots; slightly calcareous; clear wavy boundary; slightly effervescence with HCl.

Description Morphology profile 4

Depth (cm)	Description Morphology
0-100	Yellow (10YR 7/8, moist) ; brownish yellow (10YR 6/8, dry); Loamy Sand; Single grain; loose; non-sticky, non-plastic ; slightly effervescence with HCl.

c- Soils of peni plain.

They are identified in the southwest of El-Frafra oasis of the faulted escarpments of the sedimentary rock structure. The sediments are transported and deposited by flush floods, which intersect El-Quss abu-Saad plateau. Topography is generally gently undulating and the surface is covered by fine gravels mostly dissected by narrow channels and gullies. The unit is represented by soil profiles 5 and 6 (Table 4).

Table 4. Some physical, chemical and morphological characteristics of the studied soils (Peni plian).

Particle size distribution and texture classes, of soil map unit (Peni plian).

Profile No	Depth Cm	Particle size distribution (%)				Texture	Location
		Coarse sand	Fine sand	Silt	Clay		
5	0-30	62.63	4.03	11.83	21.51	Sandy loam	26º 58' 64.2" N 28º 14' 00.0" E
	30-40	91.24	1.77	2.15	4.84	Sand	
	40-55	27.74	28.17	5.81	38.28	Sand Clay Loam	
6	0-25	79.14	4.03	5.11	11.72	Sandy loam	26º 51' 80.1" N 28º 01' 83.5" E
	25-80	60.22	27.96	5.70	6.13	Loamy sand	

Soluble cations, soluble anions, electric conductivity (EC) and pH in soil paste extract of soil map unit (Peni plian).

Profile No	Depth Cm	Soluble cations $meqL^{-1}$				Soluble anions $meqL^{-1}$				EC (dSm^{-1})	pH
		Ca^{++}	Mg^{++}	Na^+	K^+	$CO_3^=$	HCO_3^-	Cl^-	$SO_4^=$		
5	0-30	34.5	67.4	379.3	7.1	-	5.5	283.2	199.5	48.8	9.37
	30-40	20.7	20.7	54.3	2.8	-	3.5	57.1	37.8	9.7	9.03
	40-55	31.0	23.1	222.6	3.9	-	3.0	162.8	114.9	28.0	8.83
6	0-25	41.4	22.3	606.0	6.8	-	2.0	392.3	282.1	67.4	8.47
	25-80	117.2	86.5	435.8	10.2	-	1.5	376.9	271.4	64.8	8.14

Cont .Table 4.

Available nutrient (NPK), cation exchange capacity (CEC), ($CaCO_3$), gypsum and organic matter (O.M) of soil map unit (Peni plian).

Profile No	Depth Cm	Available Nutrient ppm			CEC	$CaCO_3$	Gypsum	O.M
		N	P	K	meq100 g $soil^{-1}$	%		
5	0-30	291.2	4.8	7.95	23.12	34.89	1.30	0.6
	30-40	254.8	4.2	4.15	6.45	16.17	5.20	0.5
	40-55	254.8	7.2	11.25	39.89	47.66	1.40	0.52
6	0-25	72.8	2.4	17.55	13.33	38.47	4.10	0.14
	25-80	109.2	3.0	22.15	7.74	19.40	1.50	0.18

Description Morphology profile 5

Depth (cm)	Description Morphology
0-30	Yellowish brown (10YR5/4, moist); pale brown (10YR6/3, dry) Sandy loam; structure less; slightly hard; friable; very sticky; very plastic; many fine to medium pores; very few soft lime accumulation; many fine to medium roots; strongly calcareous; strongly effervescence with HCl; clear wavy boundary.
30-40	Brownish yellow (10YR6/6, moist); yellow (10YR7/6, dry) Sandy; structure less; hard; firm; very sticky; very plastic; few fine to medium pores; very few soft lime accumulation; many fine roots; strongly calcareous; strongly effervescence with HCl; clear wavy boundary.
40-55	Yellowish brown (10YR5/6, moist); yellowish brown (10YR5/4, dry); Sand Clay Loam; structure less; hard; firm; very sticky; very plastic; few fine pores; very few soft lime accumulation; strongly calcareous; strongly effervescence with HCl.
55-ᾱ	Hard pan.

Description Morphology profile 6

Depth (cm)	Description Morphology
0-25	Brownish yellow (10YR 6/8, moist); yellow (10YR 7/6, dry); Sandy loam; Single grain; slightly hard; slightly sticky, slightly plastic; moderately effervescence with HCl; bubbles on the surface; clear smooth boundary.
25-80	Dark yellowish brown (10YR 4/6, moist); yellowish brown (10YR 5/8, dry); Loamy sand; Single grain; slightly hard; slightly sticky, slightly plastic; moderately effervescence with HCl; fine to medium few gypsum crystals; clear smooth boundary.
80-ᾱ	Hard pan

The unit represented by soil profiles5 and 6 has soil texture in general sandy loam and sand. Soil dry color varied from yellowish brown (10YR5/4) to yellow (10YR7/6) while moist color ranges from Dark yellowish brown (10YR 4/6) to Brownish yellow (10YR 6/8). The coarse sand fraction ranges from 27.74 to 91.24%, fine sand from 1.77 to 28.17%, silt from 2.15to 11.83% and clay fraction from 4.84 to 38.28%. Calcium carbonates content ranges from 16.17to 47.66%, while organic matter content is very low from 0.14 to 0.60%

Chemical analysis of the fine earth (Table 4) reveals that the soil are slightly alkaline as indicating by pH values which ranges from 8.14 to 9.37. the soils are slightly saline to extremely saline where ECe of soil past extract ranges from 9.7 to 67.4 dSm^{-1}. Sodium ions are the dominate soluble cations followed by Ca++, Mg++ and K+. On the other hand, chloride and/or sulfate dominate the soluble anions followed by HCO_3^-. Exchangeable sodium percent varies from 14.60 to 127.24%, while gypsum content ranges from 1.30 to 5.20%. The morphological description of the representative soil profiles are given after.

d- Soil of Playa.

They occupy three portions located between El-Guss Abu Said plateau, northern Gunna and Qasr El Farafra village. Moreover, several small scattered places in the depression floor are also encountered by the playa formation. They exist mostly at the outlet of the Wadie whose sediment is derived mainly from the surrounding plateau. Playas are characterized by smooth flat surface with very gentle slope towards their edges. Therefore, they have convex shapes an elevation ranging from 40-60 masl and cracks on their surface and brownish color with few shrubs and grasses especially near their edges. The unit is represented by soil profiles7 and 8 (Table 5).

The unit represented by soil profiles7 and 8 has soil texture in general loamy sand. Soil dry color varied from yellow (10YR 7/6) to yellowish brown (10YR 5/6) to while moist color ranges from Brownish yellow (10YR 6/6) to Dark yellowish brown (10YR 4/6). The coarse sand fraction ranges from 82.96 to 75.13%, fine sand from 7.26 to 3.34%, silt from 6.45 to 2.96% and clay fraction from 14.57 to 9.57%. Calcium carbonate content ranges from 4.77 to 22.13%, while organic matter content is very low from 0.20 to 0.70% .

Chemical analysis of the fine earth (Table 5) reveals that the soil has natural to slightly alkaline as indicating by pH values which ranges from 7.87 to 8.44, the soils are slightly saline to extremely saline where ECe of soil past extract ranges from 6.60 to 106.8 dSm^{-1}. Sodium ions dominate the soluble cations followed by Ca^{++}, Mg^{++} and K^+. On the other hand, chloride was the dominant anions followed by sulphates and bicarbonate. Exchangeable sodium percent varies from 4.77 to 83.17% (non to sodic soils), while gypsum content ranges from 3.70 to 4.60%, Cation exchange capacity ranged between

11.18 to 16.18 meq100 g soil^{-1} due to their coarse texture. This map unit is moderate in available N and K, where the values of nitrogen between 109.2 to 364 mgKg^{-1}and the values of potassium between 7.5 to 15 mgKg^{-1} respectively. On the other hand, available P content is low and ranged between 2.4 to 4.8 mgKg^{-1}.

Table 5. Some physical , chemical and morphological characteristics of the studied soils (playa)

Particle size distribution and texture classes, of soil map unit (playa).

Profile No	Depth Cm	Particle size distribution (%)				Texture	Location
		Coarse sand	Fine sand	Silt	Clay		
7	0-15	77.42	5.65	4.41	12.53	Loamy sand	26º48'44.3" N
	15-70	82.98	4.49	2.96	9.57	Loamy sand	27º50'27.5" E
8	0-15	75.63	3.34	6.45	14.57	Loamy sand	26º40'73.5" N
	15-50	76.13	7.26	5.38	11.24	Loamy sand	27º48'88.3" E

Cont. Table 5.

Soluble cations, soluble anions, electric conductivity (EC) and pH in soil paste extract of soil map unit (playa).

Profile No	Depth Cm	Soluble cations meqL^{-1}				Soluble anions meqL^{-1}				EC (dSm^{-1})	pH
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$		
7	0-15	41.4	31.9	343.1	4.5	-	2.0	244.1	174.8	42.2	8.44
	15-70	12.9	34.8	17.2	2.8	-	2.0	39.3	26.4	6.6	8.4
8	0-15	37.9	64.0	187.9	3.3	-	2.5	170.0	120.6	29.4	8.02
	15-50	182.7	78.3	800.4	5.9	-	2.5	619.1	445.8	106.8	7.87

Available nutrient (NPK), cation exchange capacity (CEC), ($CaCO_3$), gypsum and organic matter (O.M) of soil map unit (playa).

Profile No	Depth Cm	Available Nutrient mgKg^{-1}			CEC meq 100 g soil^{-1}	$CaCO_3$	Gypsum	O.M
		N	P	K		%		
7	0-15	145.6	4.2	9.85	14.14	10.38	4.60	0.24
	15-70	109.2	3.6	15	11.18	22.13	3.70	0.2
8	0-15	145.6	4.8	7.5	16.18	9.02	4.60	0.3
	15-50	364	2.4	13.45	12.85	4.77	4.20	0.71

Description Morphology profile 7

Depth (cm)	Description Morphology
0-15	Brownish yellow (10YR 6/6, moist); yellow (10YR 7/6, dry); Loamy sand; Single grain; slightly hard; slightly sticky, slightly plastic; slightly effervescence with HCl; desert varnish; clear smooth boundary.
15-50	Dark yellowish brown (10YR 4/6, moist); yellowish brown (10YR 5/6, dry); Loamy sand; moderate fine granular structure; moderately hard; moderately sticky, moderately plastic; slightly effervescence with HCl; clear smooth boundary.

Description Morphology profile 8

Depth (cm)	Description Morphology
0-15	Brownish yellow (10YR 6/6, moist); very pale brown (10YR 7/4, dry); Loamy sand; Single grain; Single grain; slightly effervescence with HCl.
15-70	Light yellowish brown (10YR 6/4, moist); brownish yellow (10YR 6/6, dry); loamy sandy; massive; loose; non-sticky, non-plastic; slightly effervescence with HCl; clear smooth boundary.

CONCLUSION

Recognizing land forms helped in understanding of the intrelations between physical, chemical and morphological characteristics of soil attributes. Some physical and chemical characteristics of the soils were affected by location on landforms.

The differences in physical and chemical properties of the studied soils are reflecting the circumstances of the landforms. different degrees of studied pedogenic features are tied to the relationship between the soil and age of the landform. Most of the examined soil profiles are derived from the clayey and sandy members of Farafra formations, overlying hard calcareous beds and in places on the basaltic rocks. The high $CaCo_3$ content of some profiles are associated with calcareous parent material. The presence of groundwater and the problem of drainage are common in most of the depression. The challenge is to be aware of the problems and to design a proper and appropriate soil and water management system.

REFERENCES

Al-Baraa, S. M (2011).Vegetation and environmental changes in two oases,Western Deset, Egypt, M.Sc. Thesis, Fac. of Sci., Al-Azhar Univ.

Chapman, H. D (1965). Cation exchange capacity, In: Blacks, C.A. (Ed.), Methods of Soil Analysis: part 2. American Society of Agronomy, Madison, Wisconsin, USA, pp. 891-900.

Day, P. R (1965) Particle fraction and particle-size analysis. In: Blacks, C.A. (Ed.), Methods of Soil Analysis: part 1. American Society of Agronomy, Madison, Wisconsin, USA, PP. 545-566.Egypt.

El-Azabi, M. H and A. El-Araby (2000). Depositional cycles: an approach to the sequence stratigraphy of the Dakhla Formation, west Dakhla-Farafra stretch, Western Desert, Egypt. Journal of African Earth Sciences. 30: 971-996.

El-Bastawesy, M and R. R. Ali (2013). The use of GIS and remote sensing for the assessment of waterlogging in the dryland irrigated catchments of Farafra oasis, Egypt. Hydrological Processes 27: 206–216.

EL-Shazly, E. M (1976).Geology and ground water potential of Kharga and Dakhla Oases area, Western Desert, Egypt from NASA landsat-1 satellite images. Academy of Scientific Research, Cairo.

Elsheikh, A. E (2015). Mitigation of groundwater level deterioration of the Nubian Sandstone aquifer in Farafra Oasis, Western Desert, Egypt. Environmental Earth Sciences 74(3): 2351–2367.

Embabi, N. S (2004). The geomorphology of Egypt: landforms and evolution.Volume1, The Nile Valley and the Western Desert, The Egyptian Geographical Society, Cairo, 447 pp.

Hassan, F. A; B. Barich, M. Mahmoud and M. A. Hemdan (2001) Holocene playa deposits of Farafra Oasis, Egypt, and their Palaeoclimatic and Geoarchaeological significance. Geoarchaeol Int J. 16(1):29–46

Hesse, P. R., (1971). "A Text Book of Soil Chemical Analysis ". John Murry (publishers) Ltd, 50 Albermarle Street, London.

Mathieu, C., and F. Pieltain, (2003). "Chemical Analysis of Soils". Selected methods, France, pp; 387.

Plyusnina, E. E; E.S. Sallam and D. A. Ruban (2016). Geological heritage of the Bahariya and Farafra Oases, the central Western Desert, Egypt. J. Afr. Earth Sci. 116:151–159.

Powell, O and R. Fensham(2016). The history and fate of the Nubian Sandstone Aquifer springs in the oasis depressions of the Western Desert, Egypt. Hydrogeology Journal 24(2): 395–406.

Powell, O; J. Silcock and R. Fensham (2015). Oases to oblivion: the rapid demise of springs in the south-eastern Great Artesian Basin, Australia. Groundwater 53(1):171–178.

Salinity Laboratory Staff (1954). Diagnosis and Improvements of Saline and Al-Kali Soils. USDA Handbook, Vol.60.Washington, DC.

Soil Survey Staff, (2006).Keys to Soil Taxonomy, USDA, 10th Edn., USA., 341.

Soil Survey Staff, (2010). " Keys to Soil Taxonomy". 11th edition, Natural Resources Conservation Service, USDA, USA.

UNDP/UNESCO, United Nations Development Programme/United Nations Educational, Scientific and Cultural Organization (2001). Joint project for the Capacity Building of The Egyptian Geology Survey and Mining Authority and The National Authority for Remote Sensing Space Science for The Sustainable Development of The South Valley and Sinai.

Voss C. I and S. M. Soliman (2014). The transboundary non-renewable Nubian Aquifer System of Chad, Egypt, Libya and Sudan: classical groundwater questions and parsimonious hydrogeologic analysis and modelin. Hydrogeology Journal. 22: 441-468.

دراسة بيدولوجية علي بعض الأراضي بواحة الفرافرة – مصر

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واحة الفرافرة منخفض طبيعي يقع في الصحراء الغربية بجمهورية مصر العربية حيث تقع المنطقة كلها تحت ظروف مناخية قاحلة. وتعد منطقة واعدة لمشاريع التوسع الزراعي بسبب وفرة وجودة المياة الجوفية وملائمتها للأنشطة الزراعية. يهدف هذا البحث الي اجراء دراسة بيدولوجية علي بعض الأراضي بواحة الفرافرة ودراسة التضاريس المرتبطة بها وإعطاء تصنيف عام لخصائص التربة. وعليه تم استخدام صور Landsat لدراسة الأشكال الأرضية والتربة . الوحدات الفيزيوجرافية لمنطقة الدراسة كانت (Chalky plain, peni plain, Sand Sheets and Playa). وإستناداً إلى تفسير المعلومات التي تم الحصول عليها أثناء المسح الميداني للإستطلاع ، تم اختيار عدد ٨ قطاع أرضى لتمثل الوحدات الفيزيوجرافية سابقة الذكر. تم جمع ١٤ عينة تربة تمثل مختلف الأفاق للقطاعات الأرضية المختارة ، تم تجفيفها هوائيا ثم طحنها وامرارها من خلال منخل ٢ مم ، ثم تخزينها للتحاليل الفيزيائية والكيميائية. وتم توصيف هذه القطاعات في الحقل . وقد تم تصنيف التربة في منطقة الدراسة تبعا للتقسيم الأمريكى للأراضى إلي التصنيف التالي *((Calcisalids* : *– Haplogypsids -Gypsisalids Haplosalids - Aquisalids – Calcigypsisalids - Torryluvants – Torriorthents - Quartzipsamment - Gypsiargids - Torripsamment))*كما وجدت تراكمات واضحة جدا من الكالسيوم والجبس والأملاح في معظم الأراضى بمنطقة الدراسة. كما لوحظ وجود تراكمات قليلة من الطين السليكاتى في مناطق محدودة بالمنخفض.