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PEDIOLOGICAL STUDIES AND LAND EVALUATION OF WADI El-FARIGH SOILS, EGYPT.

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ABSTRACT

Seven soil profiles represent the soils of Wadi El-Farigh were chosen for this study. This study indicated that soil texture of the studied area was gravelly sand to sandy clay loam. Some of the studied soils contained calcic and gypsic horizons and was classified as Typic Torriorthents, Typic Haplocalcids , Typic Torripsamments and Typic Haplogysids .

Also the studied soils were evaluated as (S2) moderately Suitable and (S3) which was the marginally class of the suitable order (S). Whereas, some studied soils were classified as non-suitable (N) according to Sys and Verheye method of land evaluation.

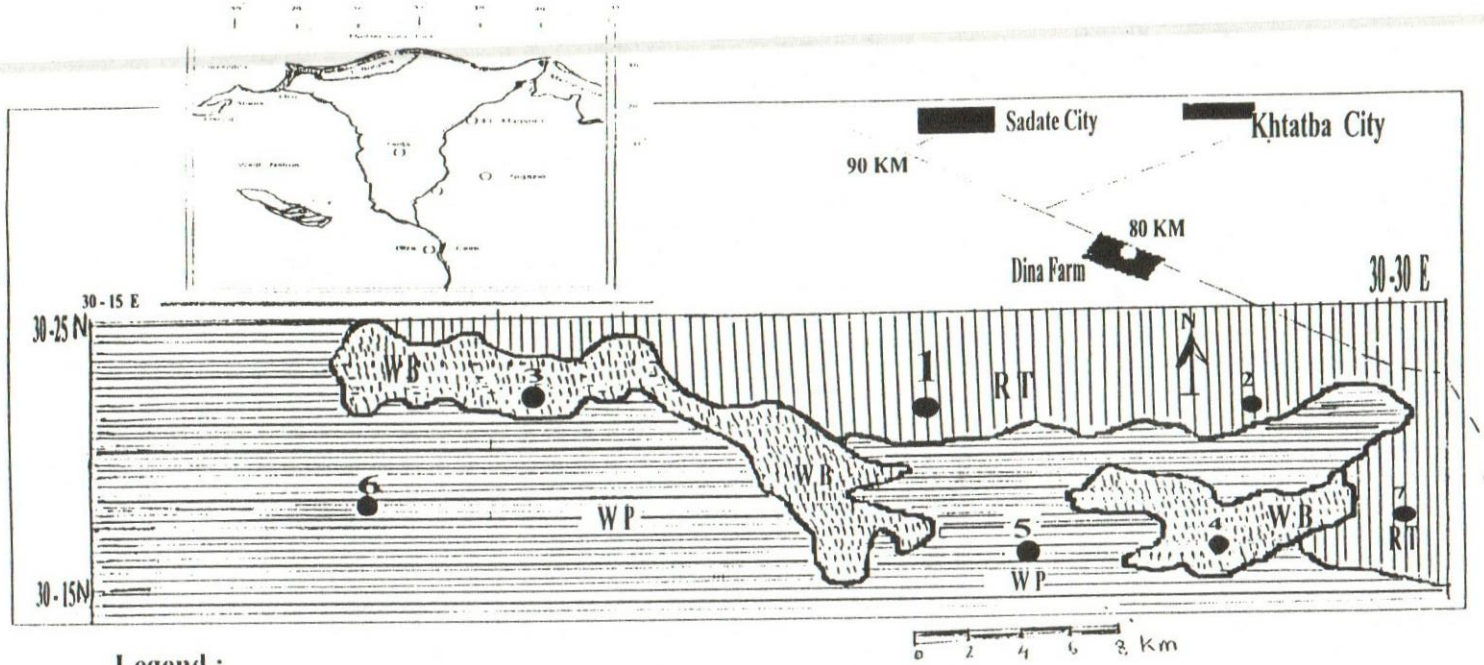
INTRODUCTION

Wadi El-Farigh is located between Cairo and Wadi El-Natrun, about 15 km south of Wadi El-Natrun. The lowest point in the valley is – 4 m; while the highest one is +100 m or more than 100 m a.s.l. It extends for about 70 km in east-west direction, with a width of 7 – 10 km. Veanbose and Westerveld (1963) classified the soils of Wadi El-Farigh into five land types, 1) complex of sandy, gravely, loamy and rocky soils locally shallow shelly clay in depressions, 2) gypsiferous coarse sand soils locally loam and clay loam soils, 3) loose coarse sand soils locally with low sheet, 4) like the first type with small and thin sheet of windblown sand and 5) loose sand soil of medium and low dunes. Borowiec (1961) showed the occurrence of the following soils in Wadi El-Farigh: loose dust soils, loamy soils, fine loamy soils and clayey dust soils. Buckman and Boady (1964) reported that soils of Wadi El-Farigh composed of particles vary in size and shape and the sand contents make up 70 % or more, by weight. Mahar (1996) indicated that soils of Wadi El-Farigh is generally sandy and gravelly with loamy to clay loam in some layers. Their electrical conductivity values reach to more than 31.1 dSm^{-1} and classify under suitable order (S) and non-suitable one (N) of land evaluation.

The aim of this study was to investigate the soils of Wadi El-Farigh; studying their morphological, physical and chemical properties; classifying it to their taxonomic units and studying their land evaluation.

MATERIALS AND METHODS

The studied area is located between longitudes 30° 15, 30° 30 E and latitudes 30° 15, 30° 25 N. This studied area included Wadi El-Farigh Depression (Map 1). In the field work, High Dam soil survey maps, FAO (1963) were used to represent the geomorphic soil units in the studied area. Also, a recent satellite images (SPOTS, 1990) were overlaid to prepare a new soil map, which had been checked and verified in the field. Seven soil profiles represent the dominant geomorphic units in the studied area were chosen.



Legend :

Soils of Wadi Plain (W P)

Soils of River Terraces (R T)

Soil of Wind Blown Sand (W B)

(1) – Prfiles location

Map (1) Geomorphic Features and Location of the studied Soil Profiles .

The soil profiles were described at the field according to Soil Survey Staff (1993) and sampled for the laboratory analysis. Both particles size distribution, total carbonates, gypsum, organic matter content, ECe and soluble ions in soil paste extract were determined according to Page (1982). Soil reaction (pH) was determined electrometrically in the saturation soil paste using Beckman pH-meter. Soil taxonomy was performed according to Soil Survey Staff (1999).

Land evaluation technique according to Sys and Verheye (1978) was done according to the equation: $Ci = t \times w/100 \times s_1/100 \times s_2/100 \times s_3/100 \times s_4/100 \times n/100$, whereas, t = topography, w = drainage, s_1 = texture and gravel, s_2 = soil depth, s_3 = carbonate contents, s_4 = gypsum content, n = salinity. This method evaluates the soils into two orders, the first order, which is suitable (S) for agricultural use and the second order is notsuitable (N). The suitable order (S) includes three classes; S1 which is highly suitable with no limitations, S2 which is moderately suitable with slight to moderate limitation and S3 which is marginally suitable with moderate limitations.

RESULTS AND DISCUSSION

1 – Characteristics of soil mapping units :

The field Studied indicated that the investigated area can be divided to three main geomorphic features namely , the wadi plain , the river terraces and the wind blown sand .

Soils of the Wadi Plain (WP)

The wadi plain occur on a great extended area and south of the river terraces soils . Three soils were represented by the studied soil profils Nos. 5 and 6 . The topogrophy of this unit is gently undulating and the soil profiles were very deep, massive structure (Table 1) . All Studied Soils were sandy texture , the sand contents ranged between 93, 97 % (Table 2) . Most of these soils were non saline whereas , the Ece values of the between horizons of the soil profiles Nos . 5 and 6 were lower than 2. 0 dSm^{-1} . The A horizon of both the studied soils were moderately saline class a ccording to Soil Survey Staff (1993) . Their Ece values were 6.73 and 5.33 $dSm^{-1}$for soil profiles Nos .5 and 6 respectively (Table 3) .

The total calcium carbonate contents ranged between 0.83 to 2. 4 % . Soil profiles No .5 had not any contents of gypsum , on the other hand 3.1 and 2.9 % gypsum contents (Table 3) .

Regarding to Soil Taxonomy , the studud soil profile Nos. 5 and 6 of this wadi plain soils can be classified as typic Torriorthents, Sand , mixed , thermic according to Soil Survey Staff, (1999) . This due to that there soils had not many diagonastic horizon , salic , gypsic nor calcic .

Soils of the River Terraces (RT)

This geomorphic unit accupy the northern and eastern part of the study area . These soil mapping were represented by the soil profiles Nos . 1,2 and 7 . Topogrophically , this unit are characterized by an olmost flat , soil profile No.1 and gently undulating soil profiles No 5,2 and 7 .

Table (1) : Field description of the studied soil profiles.

Geomorphic Units	Profile No.	Horizon	Depth	Topography	Texture	Structure	Consistence	Common feature	Effervesce	Boundary	Colour	Soil taxonomy
1 - Wadi Plain Soils	5	A	0-30	Ge. Undnalting	S	Massive	Slightly hard	Few of $CaCO_3$	Moderate	cs	7.5 YR 7/6	Typic Torriorthents
		C_1	30-80		S	Massive	Loose	–	Weak	cs	7.5 YR 7/6	
		C_2	80-150		S	Massive	Loose	–	Weak	–	7.5 YR 6/5	
	6	A	0-15	Ge. Undualting	S	Massive	Slightly hard	Few of soft $CaCO_3$	Moderate	dw	7.5 YR 6/4	Typic Torriorthents
		Cky_1	15-60		S	Massive	Loose	Few of soft $CaCO_3$ and few gypsum	Weak	dw	7.5 YR 5/3	
		Cky_2	60-100		S	Massive	Loose	Few of soft $CaCO_3$ and few gypsum	Weak		7.5 YR 5/3	
		C	100-150		S	Massive	Loose	-	Weak	–	7.5 YR 5/3	
2 - River Terraces Soils	7	A	0-20	Ge. Undualting	G.L.S	Massive	Slightly hard	Few of $CaCO_3$	Moderate	cs	10 YR 6/3	Typic Haplogypcids
		Ck	20-60		S.L	Massive	Hard	Common of soft $CaCO_3$	Strong	dw	10 YR 6/1	
		Cky_1	60-110		S.C.L	Massive	Slightly hard	Few of soft $CaCO_3$, Common gypsum crystal	Strong	dw	10 YR 6/1	
		Cky_2	110-150		L.S	Massive	Soft	Few of soft $CaCO_3$ and few gypsum	Moderate	–	10 YR 6/1	
2- River Terraces soils	1	A	0-25	Almost flat	G.L.S	Massive	SL. hard	Few of soft $CaCO_3$	Weak	cw	10 YR 7/6	Typic Torriorthents
		Ck_1	25-60		G.L.S	Massive	SL. hard	Few of soft $CaCO_3$ and gypsum	Weak	cs	10 YR 5/6	
		Ck_2	60-100		G.L.S	Massive	SL. hard	Few of soft $CaCO_3$	Weak	cw	10 YR 3/5	
		C	100-150		G.S	Massive	Loose	-	Weak	–	7.5 YR 3/3	
	2	A	0-25	Ge. Underlting	G. L.S	Massive	Friable	Common of soft $CaCO_3$	Strong	dw	7.5 YR 5/6	Typic Haplocalcids
		Ck_1	25-60		G. L.S	Massive	Friable	Common of soft $CaCO_3$	Strong	cs	7.5 YR 5/6	
		Ck_2	60-100		G. L.S	Massive	Friable	Few of soft $CaCO_3$	Moderate	gw	7.5 YR 5/6	
		Ck_3	100-150		S	Single grain	Loose	Few of soft $CaCO_3$	Moderate	–	7.5 YR 3/3	
3- Soil of Wind blown Sand	3	A	0-25	Rolling	S	Single grain	Loose	–	Weak	ds	10 YR 5/3	Typic Torripsamments
		C_1	25-70		S	Single grain	Loose	–	Weak	ds	10 YR 5/3	
		C_2	70-150		S	Single grain	Loose	–	Weak	–	10 YR 5/3	
	4	A	0-30	Rolling	S	Single grain	Loose	–	Weak	dw	7.5 YR 5/6	Typic Torripsamments
		C_1	30-80		S	Single grain	Loose	–	Weak	dw	7.5 YR 5/6	
		C_2	80-150		S	Massive	Soft	Few of $CaCO_3$	Weak	–	7.5 YR 5/6	

G = gravelly L= loamy S = sandy s = smooth w = wavy d = diffuse g = gradual SL : Slightly

Table (1): Cont.

Profile No.	Horizon	Depth	Topography	Texture	Structure	Consistence	Common feature	Effervesce	Boundary	Colour	Soil taxonomy
5	A	0-30	Undnalting	S	Massive	Slightly hard	Few of $CaCO_3$	Moderate	cs	7.5 YR 7/6	Typic Torripsaments
	C_1	30-80		S	Massive	Loose	–	Weak	cs	7.5 YR 7/6	
	C_2	80-150		S	Massive	Loose	–	Weak	–	7.5 YR 6/5	
6	A	0-15	Undualting	S	Massive	Slightly hard	Few of soft $CaCO_3$	Moderate	dw	7.5 YR 6/4	Typic Torripsaments
	Cky_1	15-60		S	Massive	Loose	Few of soft $CaCO_3$ and few gypsum	Weak	dw	7.5 YR 5/3	
	Cky_2	60-100		S	Massive	Loose	Few of soft $CaCO_3$ and few gypsum	Weak		7.5 YR 5/3	
	C	100-150		S	Massive	Loose	-	Weak	–	7.5 YR 5/3	
7	A	0-20	Undualting	G.L.S	Massive	Slightly hard	Few of $CaCO_3$	Moderate	cs	10 YR 6/3	Gypsic Torrisalids
	Ck	20-60		S.L	Massive	Hard	Common of soft $CaCO_3$	Strong	dw	10 YR 6/1	
	Cky_1	60-110		C.S.L	Massive	Slightly hard	Few of soft $CaCO_3$, many gypsum crystal	Strong	dw	10 YR 6/1	
	Cky_2	110-150		L.S	Massive	Soft	Few of soft $CaCO_3$ and few gypsum	Moderate	–	10 YR 6/1	

G = gravelly L= loamy S = sandy s = smooth w = wavy d = diffuse g = gradual

The surface is covered by a gravel reached to 19.0 % and the soil of this unit had gravelly loamy sand to sandy clay loam texture .

The contents ranged between 65.0 to 95.0 % ,Table (2). The clay content ranged between 2.0 to 27.0 % . The soil profiles were very deep , massive , slightly hard ,a secondary accumulation of calcium carbonate or gypsun was few of soft Ca CO3 and gypsum contents reached to 9.1 % at Cky 1 , of the studied soil profile No .7. The calcium carbonate content ranged between 2.62 to 16.12 % , Table (3). Profiles Nos 2,7 and 1 their Ece values reached to 7.95 , 32.3 and 32.8 dSm^{-1} for A horizon respectively and decreasd with incresing soil depth, Table 3 is indicating that the source of accumulation of salts on soil surface was the capillary rasing . This studied soil profile No.1 can be classified as Typic Torriorthents , Sandy, mixed, thermic due to the absence of the diagonostic horizons.

On the other hand, the studied soil profiles Nos 2 and 7 can be Typic Haplocalcids , sandy, mixed, thermic and Typic Haplogypsids, fine - loany, mixed, thermic, respectively. This related to the occur of the calcic horizon in soil profile No.2 and the gypsic horizon of the studued soil profile No . 7 according to Soil Survey Staff, (1999) .

Table (2) : Particle size distribution for the studied soils.

Profile No.	Depth	Gravel %	Coarse sand %	Fine sand %	Silt %	Clay %	Texture Class
1	0-25	19	28	55	10	7	L.S
	25-60	12	33	50	9	8	L.S
	60 - 100	9	38	44	9	9	L.S
	100 - 150	11	30	62	5	3	S
2	0 - 25	17	22	63	7	8	L.S
	25 - 60	27	18	67	8	7	L.S
	60 - 100	14	11	73	8	8	L.S
	100 - 150	13	7	88	3	2	S
3	0 - 25	-	11	82	4	3	S
	25 – 70	-	9	86	3	2	S
	70 - 150	-	15.5	80	3	1.5	S
4	0 - 30	-	15	82	1	2	S
	30 - 80	-	10	87	1.5	1.5	S
	80 – 150	-	12	84.5	2.5	1	S
5	0 – 30	2	29	66	2	3	S
	30 - 80	-	38	55	4	3	S
	80 -150	-	36.5	60	2	1.5	S
6	0 - 15	2	32	63	3	2	S
	15 – 60	4	15	80	2	3	S
	60 – 100	4	25	72	1.5	1.5	S
	100 - 150	3	11	86	1	2	S
7	0 – 20	17	25	58	9	8	L.S
	20 - 60	12	30	45	15	10	S.L
	60 - 110	4	31	24	18	27	S.C.L
	110 - 150	5	27	54	9	10	L.S

S : Sand L . S : Loamy Sand
S . L : Sandy Loam S . C . L : Sandy Clay Loam

Table (3): Chemical analysis for the studied soils.

Profile No.	Depth	pH	EC	Soluble cations and anions (meq/L)								$CaCO_3$ %	O.M %	SAR	Gypsum %
				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	Cl^{-}	HCO_3^{-}	$CO_3^{=}$	$SO_4^{=}$				
1	0-25	7.8	32.8	114.8	53.9	158.3	0.91	300	2.3	–	25.7	6.51	0.53	17.23	–
	25-60	7.8	29.3	72	54	192	0.76	288	6.0	–	25	5.23	0.32	34.2	2.5
	60-100	7.7	7.95	14	6.9	59.1	0.78	70	3.5	–	7.4	3.42	0.15	25.8	–
	100-150	7.7	7.1	19.6	14.5	35.1	1.8	41	2.8	–	27.2	3.11	0.16	9.5	–
2	0-25	7.6	7.95	14	6.9	59.1	0.73	70	3.5	–	7.4	8.73	0.15	25.2	–
	25-60	7.7	4.69	30.15	1.77	14.38	0.45	17.2	4.5	–	25.2	16.12	0.12	3.52	–
	60-100	7.5	2.54	9.53	2.79	12.12	0.96	14.63	1.99	–	8.72	7.35	0.09	4.28	–
	100-150	7.5	1.37	4.18	0.94	8.45	0.16	6.18	1.0	–	6.52	6.95	0.11	5.18	–
3	0-25	7.4	1.62	4.18	1.87	10.63	0.22	5.12	4.75	–	6.33	1.22	0.20	6.11	–
	25-70	7.5	0.83	2.25	0.95	5.34	0.18	3.65	0.50	–	4.15	0.91	0.17	4.22	–
	70-150	7.4	1.34	3.25	0.87	8.82	0.09	7.51	0.50	–	4.39	0.63	0.11	6.14	–
4	0-30	7.4	1.44	7.2	2.32	4.74	0.18	5.72	0.50	–	8.13	0.95	0.11	2.17	–
	30-80	7.4	1.17	2.22	0.93	8.32	0.19	7.18	0.70	–	3.34	0.76	0.06	6.62	–
	80-150	7.3	1.08	2.32	0.93	7.49	0.22	8.12	0.50	–	2.12	069	0.04	5.84	–
5	0-30	7.7	6.73	12.5	3.7	50.3	0.75	54.4	4.60	–	8.3	1.83	0.06	8.35	–
	30-80	7.5	3.97	10.7	5.58	27.6	0.84	35.5	4.08	–	5.14	1.15	0.08	13.66	–
	80-150	7.4	1.64	6.04	1.39	8.33	0.74	10.5	4.06	–	1.85	0.83	0.03	6.05	–
6	0-15	7.5	5.33	13.37	1.72	39.4	0.16	21.32	2.25	–	30.33	2.41	0.09	30.36	–
	15-60	7.5	4.51	12.72	6.41	26.3	0.15	13.18	1.25	–	30.67	1.53	0.23	8.48	3.1
	60-100	7.4	3.81	9.22	3.9	25.73	0.1	18.12	1.0	–	18.88	0.96	0.22	10.05	2.9
	100-150	7.4	1.37	4.18	0.94	8.45	0.16	6.12	1.0	–	6.52	0.93	0.09	5.28	–
7	0-20	7.6	32.3	85.1	21.52	214.9	1.47	285.9	3.3	–	33.8	3.81	0.62	29.43	–
	20-60	7.7	30.8	98.9	48.5	158.9	1.53	206.0	3.2	–	98.6	7.27	0.51	18.5	–
	60-110	7.5	22.3	74.3	52.2	95.35	1.15	142.5	4.6	–	75.9	4.35	0.19	12.0	9.1
	110-150	7.5	18.4	63.1	45.2	74.43	1.27	115.6	3.0	–	65.4	2.62	0.21	10.11	3.3

Soil of the Wind Blown Sand (W B)

The Soil of this geomorphic unit occupy a long narrow between the wadi plain and the river terraces soils rolling. Its soils are characterized by Single grain, loose, sand very deep (Table 1) . The soils of this mapping unit are represented by profiles Nos. 3 and 4 the sand contents ranged between 93.0 to 97.0 % (Table 2) and Ece values were 0.83 and 1.62 dSm^{-1} (Table 3). Which classified as nonsaline soils accorrding to Soil Survey Staff , (1993). The calcium carbonate was lower than 1.22 % and had not any gypsum contents .

Regarding to soil taxonomy , these studied soils can be classified as Typic Torripsamments , Silicous , thermic.

2 - Land Evaluation

According to Sys and Verheye (1978) method of land evaluation, the studied soils can be classified to the suitable order (S) and not suitable one (N) as shown in Tables 4 and 5, and Map 2.

The land of suitable order (S) is sustained use of agricultural use under consideration and is expected to yield benefits, which justify the inputs without an acceptable risk of damage to land resources. This order of suitable soils included the studied soil profiles Nos. 1, 2, 5, 6 and 7. The studied soil profile No. 7 can be classified as S2 which is moderately sutable and subclass of S2sn Which indicated that the limitation factors were the soil texture and the relatively high of soil salinity .

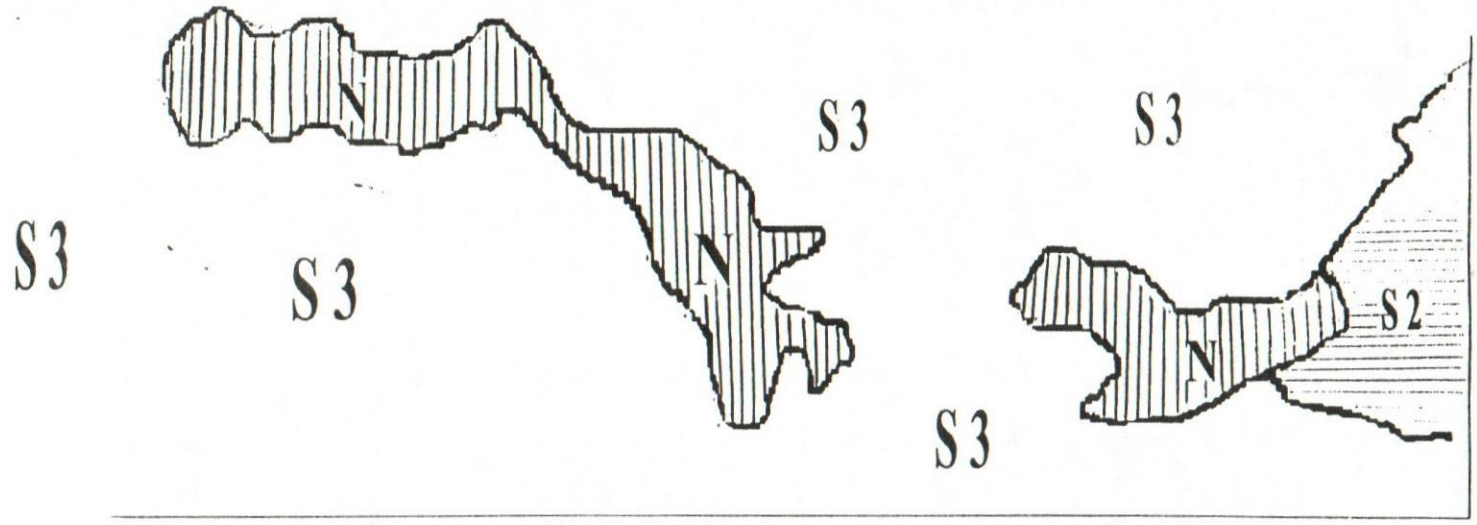
Whereas, the studied soil profiles Nos.1,2,5 and 6 were classified to the class (S3), which was marginally suitable. These landhaving limitations sever the sustained application of a given agricultural use and reduce the productivity or benefits or increase required inputs. Also, the studied soils under this order were classified to subclasses of S3s and S3 sn , whereas the limitation factor was the sandy texture (Table 4 and 5), in soil profiles Nos. 2,5 and 6, in addition to highly contents of salts in soil profile No. 1.

On the other hand, the studied soils, which included under the not-suitable order (N), were the soil profiles Nos. 3 and 4 (Table 4 and 5). They were not suitable under the current conditions. These results of land evaluation for the studied soils were in agreement with Mahar (1996). The limitation factors were sandy texture in the studied soil profiles Nos. 3and 4 .

Table 4: Intensity of limitations and suitability classes of the studied soils according to Sys and Verheye (1978).

Prof. No	t	W	s_1	s_2	s_3	s_4	n	Ci	Suitability class
1	100	100	50.0	100	95	100	85	40.38	S3
2	95	100	50.2	100	95	100	100	45.12	S3
3	85	100	30.0	100	85	90	100	16.06	N
4	85	100	30.0	100	85	90	100	16.06	N
5	95	100	30.0	100	95	95	100	25.72	S3
6	95	100	31.3	100	95	100	100	28.25	S3
7	95	100	82.0	100	95	100	85	62.9	S2

t = topography, w = wetness, s_1 = soil texture, s_2 = soil depth, s_3 = carbonate calcium contents, s_4 = gypsum contents, n = salinity



Legend

S2 — **Moderately Sutable**

S3 — **Morginallu Sutable**

N — **Not Sutable**

Map (2) Land Evaluation Map of the Studied Soils

Table 5: Land evaluation of the studied soils according to Sys and Verheye (1978).

Profile No.	Order	Class	Subclass
1	S	S3	S3 sn
2	S	S3	S3s
3	N	N1	N1 st
4	N	N1	N1 st
5	S	S3	S3s
6	S	S3	S3s
7	S	S2	S2 sn

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دراسات بيدولوجية وتقييم أراضى لوادى الفارغ بمصر

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اختيرت لهذه الدراسة سبعة قطاعات أرضية تمثل أراضى وادى الفارغ وقد أظهرت هذه الدراسة أن قوام أراضى وادى الفارغ يتراوح من رملى حصوى إلى رملى طمي طيني وأن بعض هذه الأراضى تحتوى على أفق من كربونات الكالسيوم وأفق من الجبس وإنها تقسم إلي

Typic Torriorthents, Typic Haplocalcids, Typic Torripsamments and Typic Haplogypsids .

وأما من ناحية التقييم فإنها تتبع قسم الأراضى متوسطة الصلاحية (S 2) والأراضي الحدية (S3) من الرتبة الصالحة للزراعة (S) وبعضها الأخر يتبع الأراضى غير الصالحة (N) طبقا لنظام Sys and Verheye لتقيم الأراضى.