SOIL TAXONOMY AND LAND EVALUATION OF THE NORTH NILE DELTA SOILS

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ABSTRACT

Twenty six soil profiles represent the different soils of North Nile Delta were chosen for this study. The dommonant soil were nonsaline soils followed by saline, moderately and strongly saline according to Soil Survey Staff, (1993). Data obtained indicated that soils of the studied area had no diagnostic horizon or pedogenic process except the slickenside feature. Wherease, soil had not calcic or gypsic or salic horigons, due to their low contentt of both calaum carbonate, gypsum and solube salts, respectively. Therefore they were classified as Entisol and Vertisol soil orders according to **Soil Survey Staff System, (1998).** Therefore the dommonant soil taxa was Typic Haplotorrerts which was occurred in the most studied area followed by Typic Torrifluvents and Vertic Torrifluvents, then the Typic Torripsamments According to Sys and Verhey's method of land evaluation (1978), all soils of the studied area could be classified as suitable for agriculture (S) including the classes: moderately suitable highly and marginal suitable. The dommont soils were moderately suitable (S_2), wherease, both highly suitable (S_1) and marginally suitable (S_3) were as a minor areas according to Sys and Verhey (1979). The limitation factors for agirctulture wewe soil texture, soil salinity and soil depth.

Key words: Soil Taxonomy and Land evaluation.

INTRODUCTION

The objective of Soil Taxonomy is to have hierarchies of classes that permit us to understand, as fully as existing knowledge permits, the relationships between soils and also factors responsible for their character, Soil Taxonomy (1975).

Erain (1981) and Omar (1999) classified some soils of North Delta to fluvents, psamments and Haplotorrerts.

Sys (1979a) stated that land evaluation is a concept describes the interpretation process of the principle inventories belong to soil characteristics, vegetation cover, environmental conditions, climatic status and many other aspects related to the land to identify the best land use. He added that the objective of land evaluation is to select the optimum land use for each defined land unit, taking both physical and socio –economic considerations. **Nasr El-Din (2001)** classified the soils of Kafr-El-Sheik into three capability classes; excellent (I), good (II) and fair (III) and showed that most of the studied soils are on class (II).

With the principle of land evaluation, the suitability for a given land utilization type in a particular area is based on a limiting factor. Current suitability means the present condition of soil in a certain area with minor improvement, while "potential suitability" refers to soil conditions after using

major improvements. Then matching is simply the process in which the land quality is compared to the land utilization type (LUT) requirements expressed in terms of ratings.

Omar, (1999) evaluated soils of North Delta as suitable soils (S) including highly suitable (S_1) moderately suitable (S_2) and marginally suitable (S_3).

The present work aims to classify the soils of North Delta according to the USDA Soil Survey Staff System (1998) in addition to their evaluation for agriculture use on basis of Sys and Verhey's method

MATERIAL AND METHODS

Twenty six soil profiles representing the different soils of north Nile Delta (map 1) were described in the field and sampled according to Soil Survey Staff System, (1993). The studied area is located between Rosetta branch in the west and Dometta branch in the east and north of Monofia Governorate. Collected soil samples were analyzed for particle size distribution, soil pH, soluble ions, calcium carbonate and gypsum contents and electrical conductivity (ECe) according to **Page (1982).** Soil Taxonomy was performed according to the Soil Survey Staff System, (1998). Land evaluation was done following the Sys and Verhey method (1978). The limitation factors were topography (t), soil texture (s_1), calcium carbonate (s_2) and gypsum contents (s_3), soil depth (s_4) and soil salinity and alkalinity (n). Suitability indices were calculated as (Ci). The soil was classified in orders suitable (S) when Ci was > 25 and non suitable when Ci < 25. The order (S) was classified into three classes according the values of Ci between 25 to 100. high suitable (S_1) when Ci > 75, moderately suitable (S_2), when Ci =50-75 , and marginally suitable (S_3) when Ci =25-50

RESULTS AND DISCUSSION

Soil Taxonomy is considered as a key to know both the physical and chemical characteristics of the studied soil. The studied area have four geomorphic features; Alluvial plain, Fluvio marine plain, Costal plain and Levee, (map 1). The studied soil profiles Nos. 2, 3, 4, 6, 9, 12, 15, 16, 18, 20, and 21 were non saline according to Soil Survey Staff, (1993). The saline soils were occured in the studied soils Nos. 1, 8, 10, and 17. Wherease, the moderately saline were in the studied soils Nos. 25 and 26. The strongly saline was in the subsurface horizon of the studied soil No. 14, Table No.3. According to Soil Survey Staff, (1998), the studied soils of North Nile Delta were classified as Vertisol and Entisol orders. There were no genetic horizons due to the absence of the soil geneses processes except the slickensides process, which need a short time to be performed **(Wilding, 1995).**

The absence of genetic horizons such as salic, gypsic and calcic horizons in the studied North Delta soil was observed through field description, physical and chemical analysis. ECe values were lower than 30 dS/m, gypsic contents lower than 5% and $CaCO_3$ lower than 15% as shown in (tables 1,2 and 3 respectively). The absence of genetic soil horizons indicates that the studied soils were undeveloped soils. This undevelopment of soils was related to the flood process of the Nile river and the yearly deposition system which did not stop except after the construction of High Dam. Therefore, this studied soils were classified to undeveloped soil orders of Entisols and suborder Haplotorrerts of the Vertisols order, which are called as baby soils due to their

undevelopment. Most of the studied soils were classified into Typic Haplotorrerts constituted 82.4% of the whole studied area. These soils have a wide cracks more than 5cm in width and up to 50 cm depth from the soil surface, clay content in clayey soil texture, ranged from 42.0% to 59.4% at Css horizon, soil profile No. 26 table (2) and have slickensides more than 25cm, as shown in tables 1 and 2. Their mineralogical composion is dominated by montmorllonite mineral according to **Omar (1999).** Therefore its family taxa level is Clayey; montmorillonitic; thermic Typic Haplotorrerts, and represented by soil profiles Nos. 1,4,5,6,7,8,9,13,14,17,18,19,20,22,23,24 25 and 26 table (4) and map (2). The order of Entisols constitute 17.6% the studied area and included both suborder levels of fluvents and psamments table (4), as following:

1- Coarse loamy; montmorillonitic; Typic Torriorthents, soils represented by the studied soil profiles Nos. 2 and 15. They are dominated by loamy to sandy loam soil texture.
2- Fine loamy; montmorillonitic; thermic Typic Torritorrert, soils represented by the studied soil profiles Nos. 3, 11, and 21. They are dominated by clay loam soil texture.
3- Clayey; montmorllonitic; thermic; Vertic Torriflvents. They have clayey soil texture, cracks on the soil surface and few slickensides not qualified to be Vertisols. They were represented by the studied soil profiles Nos.10 and 16, tables (4) and map (2); the soil taxonomy of the studied area.
4- Sandy slicious, thermic, Typic Torripsamments. It had sandy texture, represented by the studied soil profile No. 12

Land evaluation of the studied area:

Using Sys and Verhey's method of land evaluation (1978), all the studied area of North Nile Delta was classified as suitable order (S) for agricultural use, and included the following classes:

1- Highly suitable (S_1); without limitation factors for agriculture and constitute 35.1% of the studied area as shown in table 5 and map (3); the land evaluation map of the studied area and represented by the studied soil profiles Nos. 2, 3,10,16,18,20,21,and 23.
2- Moderately suitable (S_2); with some limitation factors for agriculture constituted 57.3% of the studied area. The limitation factors were soil texture, relatively high content of salts and calcium carbonate contents. Therefore, the subclass of this class were s_1: soil texture, s_2: soil salinity and S_3: calcium carbonate contents, and represented by the studied soil profiles Nos. 1, 4, 5, 6, 7, 8, 9, 11, 12, 14, 15, 17, 19, 22 and 24.
3- Moderately suitable (S_3); had some moderate limitation factors and /or one severe limitation that does not exclude the use of the land for agriculture. The limitation factor was soil texture in part of area, soil salinity and s_5: soil depth. These soils included 7.6% of the all studied area, and represented by the studied soil profiles Nos. 25 and 26.

Both the moderate limitation factors and severe limitation factors can be improved, therefore all the studied area of North Delta could be improved to highly suitable soils in the future.

Table1. Field description of the studied soils.

No.	Horizon	Depth	Color	Texture	Structure	Common features	Boundry	Soil Taxonomy
1	A	0-20	10YR3/4	Clay	wg	Soft lime, mottles	gs	Typic
	Cs	20-50	10YR3/2	Clay	wg	stong slickensides	gs	Haplotorrerts
	Css_2	50-100	10YR3/2	Clay	abl	stong slickensides	gs	
	C	100-150	10YR3/2	Clay	f sub	few shells		
2	A	0-25	10YR3/2	Clay	wg	-	gs	Typic
	C_1	25-60	10YR3/2	Sandy loam	massive	-	gs	Torrifluvents
	C_2	60-110	10YR3/2	Sandy loam	massive	-	gs	
	C_3	110-150	10YR4/3	loamy	massive	-	gs	
3	A	0-25	10YR3/2	Clay	wfsub	-	gw	Typic
	C_1	25-55	10YR4/3	loamy	massive	-	gs	Torrifluvents
	C_2	35-85	10YR3/3	Clay loam	massive	-	gs	
	C_3	85-120		Clay loam	massive	-		
4	A	0-25	10YR3/2	Clay	wfsub	soft lime segregation	gs	Typic
	Css	25-60	10YR3/2	Clay	wfsub	stong slickensides	gs	Haplotorrerts
	Css_2	60-100	10YR3/2	Clay	wfsub	stong slickensides	gs	
	C	100-150	10YR3/2	Clay	wfsub	soft lime segregation		
5	A	0-20	10YR3/2	Clay	wfg	soft lime segregation	gs	Typic
	Css	20-45	10YR3/2	Clay	wfsub	strong slickensides	gs	Haplotorrerts
	C	45-100	10YR3/2	Clay	wfsub	soft lime segregation	gs	
	C_2	100-150	10YR3/2	Clay	wfsub	soft lime segregation		
6	A	0-20	10YR3/2	Clay	g		gs	Typic
	Css	20-55	10YR3/2	Clay	mfsub	stong slickensides	gs	Haplotorrerts
	Css_2	55-110	10YR3/2	Clay	m msub	strong slickensides	gs	
	C	110-150	10YR3/2	Clay	wfsub	few manganize nodules		
7	A	0-20	10YR3/2	Clay	wg	soft lime segregation	gs	Typic
	Css	20-60	10YR3/2	Clay	mmsub	strong slickensides	gs	Haplotorrerts
	Css_2	60-110	10YR3/2	Clay	mmab	strong slickensides	gs	
	C	110-150	10YR3/2	Clay	wfsub			
8	A	0-25	10YR3/2	Clay	wg	few lime segregation	gs	Typic
	Css	25-100	10YR3/2	Clay	mfsub	strong slickensides	gs	Haplotorrerts
	C	100-150	10YR3/2	Clay	mfsub	few soft lime		
9	A	0-25	10YR3/2	Clay loam	massive	few soft lime	gw	Typic
	Css	25-60	10YR3/2	Clay loam	mmab	strong slickensides	gs	Haplotorrerts
	Css_2	60-100	10YR3/2	Clay	wfsub	strong slickensides		
10	A	0-25	10YR3/2	Clay	massive	wide cracks	gw	Vertic
	C_1	25-70	10YR3/2	Clay	wfsub	strong slickensides	gw	Torrifluvents
	C_2	70-150	10YR3/2	Clay	massive	few soft lime		
11	A	0-25	10YR3/2	Loamy sand	massive	wide cracks	gw	Typic
	C	25-100	10YR3/2	Sandy loam	massive	strong slickensides	gw	Torrifluvents
	C_2	100-150	10YR3/2	Loamy sand	massive	diffuse mottles		
12	A	0-25	10YR3/2	Loamy sand	massive	wide cracks	gw	Typic
	C	25-50	10YR3/2	Loamy sand	massive	strong slickensides	gw	Torrifluvents
	C_2	50-65	10YR3/2	Loamy sand	massive	few soft lime		
13	A	0-25	10YR3/2	Clay	fg	few hard lime	gs	Typic
	Css	25-60	10YR3/2	Clay	mmsub	strong slickensides	gs	Haplotorrerts
	Css_2	60-110	10YR3/2	Clay	mfsub	strong slickensides		
14	A	0-25	10YR3/2	Clay	fg	wide cracks	gs	
	Cs	25-60	10YR3/2	Clay	wfsub	strong slickensides	gs	Typic
	Css2	60-110	10YR3/2	Clay	mmsub	strong slickensides	gs	Haplotorrerts
	C	110-135	10YR3/2	Clay	massive	few line concretion	gs	

Table1. Cont Field description of the studied soils.

No.	Horizon	Depth	color	Texture	Structure	Common features	Boundry	Soil Taxonomy
15	A	0-25	10YR3/2	Sandy loam	massive	few hard lime concretion	gw	Typic Torrifluvents
	C	25-60	10YR3/2	Sandy loam	massive	few hard lime concretion	gw	
	C_2	60-100	10YR3/2	Sandy loam	massive	few hard lime concretion	gs	
	C_3	100-150	10YR3/2	Sandy loam	massive	few hard lime concretion		
16	A	0-25	10YR3/2	Clay	massive	soft lime segregation	gs	Vertic torrifluvent
	C	25-110	10YR3/2	Clay	wfsub	soft lime segregation	gs	
	C_2	110-150	10YR3/2	Clay	massive	diffuse mottles	gs	
17	A	0-25	10YR3/2	Clay	fg	wide cracks	gw	Typic Haplotorrerts
	Css	25-60	10YR3/2	Clay	wfsub	strong slickensides	gs	
	Css_2	60-100	10YR3/2	Clay	m mang	strong slickensides	gs	
	C	100-150	10YR3/2	Clay	massive	strong slickensides	gs	
18	A	0-25	10YR3/2	Clay	massive	Wide cracks	gs	Typic Haplotorrerts
	Css	25-55	10YR3/2	Clay	wfsub	strong slickensides	gs	
	Css_2	55-90	10YR3/2	Clay	mmsub	strong slickensides	gs	
	C	90-120	10YR3/2	Clay	mmsub	few lime segregation	gs	
19	A	0-25	10YR3/2	Clay	fg	Wide cracks	gs	Typic Haplotorrerts
	Css	25-60	10YR3/2	Clay	wfsub	strong slickensides	gs	
	Css_2	60-100	10YR3/2	Clay	mmsub	strong slickensides	gs	
	C	100-140	10YR3/2	Clay	massive	strong slickensides	gs	
20	A	0-25	10YR3/2	Clay	massive	Wide cracks	gw	Typic Haplotorrerts
	Css	25-60	10YR3/2	Clay	mf sub	strong slickensides	gs	
	Css_2	60-100	10YR3/2	Clay	mmsub	strong slickensides	gs	
	C	100-150	10YR3/2	Clay	massive	strong slickensides	gs	
21	A	0-30	10YR3/2	Clay loam	fg	few lime segregation	gs	Typic Torrifluvents
	C	30-70	10YR3/2	Clay loam	mmsub	few lime segregation	gs	
	C_2	70-120	10YR3/2	Clay loam	massive	few lime concration	gs	
	C_3	120-150	10YR3/2	Clay	massive	few lime concration	gs	
22	A	0-25	10YR3/2	Clay	massive	wide cracks	gw	Typic Haplotorrerts
	Css	25-60	10YR3/2	Clay	wfsub	strong slickensides	gs	
	Css_2	60-100	10YR3/2	Clay	mmsub	strong slickensides	gs	
	C	100-150	10YR3/2	Clay	wfs	few soft lime	gs	
23	A	0-25	10YR3/2	Clay	massive	wide cracks	gw	Typic Haplotorrerts
	Css	25-60	10YR3/2	Clay	wfsub	strong slickensides	gs	
	Css	60-100	10YR3/2	Clay	mmsub	strong slickensides	gs	
	C	100-150	10YR3/2	Clay	massive	few soft lime	gs	
24	A	0-25	10YR3/2	Clay	massive	wide cracks	gw	Typic Haplotorrerts
	Css	25-60	10YR3/2	Clay	wfsub	strong slickensides	gs	
	Css_2	60-100	10YR3/2	Clay	mmsub	strong slickensides	gs	
	C	100-150	10YR3/2	Clay	massive	difuse mottles	gs	
25	A	0-20	10YR3/2	Clay	Massive	wide cracks	gs	Typic Haplotorrerts
	Css	20-65	10YR3/2	Clay	wm sub	strong slickensides	gs	
	Css_2	65-130	10YR3/2	Clay	mm sub	strong slickensides		
26	A	0-20	10YR3/2	Clay	Massive	wide cracks	gw	Typic Haplotorrerts
	Css	20-60	10YR3/2	Clay	f sub	strong slickensides	gw	
	Css_2	60-130	10YR3/2	Clay	mm sub	strong slickensides		

gs = gradual smooth gw = gradual wave, wg = weak grain, ab angular blocky, fsb = fine subangular blocky, m = moderate, m = medium.

Table 2. Particle size distribution, $CaCO_3$ and Gypsum content

Profile No.	Depth cm	Particle size distribution				$CaCO_3$ %	Gypsum %	Soil texture
		Coarse Sand %	Find Sand %	Silt %	Clay %			
1	0-25	3.55	19.28	33.02	44.15	2.63	1.5	clay
	25-60	2.26	11.09	29.93	56.72	2.15	1.6	clay
	60-110	1.18	16.42	30.35	52.05	0.50	1.8	clay
	110-135	0.36	15.37	36.17	48.10	1.26	2.0	clay
2	0-25	0.97	41.48	15.28	42.27	0.81	-	clay
	25-65	1.35	51.03	31.20	16.42	1.01	-	Sandy Loam
	65-100	2.05	49.21	35.04	13.70	0.64	-	Loam
	100-150	3.95	41.85	39.65	14.55	1.01	-	Loam
3	0-25	1.17	28.71	16.02	54.10	4.20	-	clay
	25-60	0.99	33.24	27.07	38.70	2.94	-	Clay Loam
	60-110	4.93	37.50	31.72	25.85	1.43	-	Loam
	110-150	0.44	40.29	29.82	29.45	1.68	-	Clay Loam
4	0-25	1.10	26.18	30.72	42.00	1.62	-	clay
	25-60	3.99	28.14	23.52	44.35	1.01	-	clay
	60-100	2.39	17.66	27.25	52.70	0.34	-	clay
	100-150	1.90	12.17	28.12	57.81	0.40	-	clay
5	0-25	0.5	29.00	17.00	53.28	1.62	-	clay
	25-55	1.13	21.17	29.50	48.20	2.10	-	clay
	55-90	1.78	25.97	24.93	47.32	1.26	-	clay
	90-120	2.18	18.87	32.85	46.10	0.12	1.5	clay
6	0-25	3.12	23.23	31.68	41.97	1.57	-	clay
	25-60	1.20	24.38	30.35	44.07	0.12	-	clay
	60-100	1.19	20.79	21.80	56.22	0.42	-	clay
	100-140	3.21	19.09	19.08	58.62	0.40	-	clay
7	0-25	12.22	21.18	22.63	43.97	2.94	-	clay
	25-60	4.00	18.30	28.73	48.97	1.37	-	clay
	60-100	4.01	16.88	23.29	55.82	1.01	-	clay
	100-150	8.19	12.46	21.48	57.87	0.25	-	clay
8	0-30	3.80	26.30	23.58	46.32	0.89	1.3	clay
	30-70	1.91	17.89	22.48	57.72	1.01	1.4	clay
	70-120	1.03	25.67	24.30	49.00	0.50	1.7	clay
	120-150	0.63	28.95	18.75	51.67	0.25	0.1	clay
9	0-25	2.42	26.63	27.68	43.27	1.85	-	clay
	25-60	2.13	22.95	29.52	45.40	1.01	-	clay
	60-100	5.24	13.69	25.82	55.25	1.01	-	clay
10	0-25	4.88	21.12	28.38	45.62	0.28	1.5	clay
	25-70	2.50	27.15	23.05	47.30	0.28	1.7	clay
	70-95	0.37	32.96	31.25	35.42	0.36	1.9	Clay Loam
11	0-25	72.00	7.90	11.30	8.80	0.25	-	Loamy Sand
	25-50	46.50	13.35	22.00	18.15	0.17	-	Sandy Loam
	50-60	62.15	8.65	14.48	14.72	0.12	-	Sandy Loam
12	0-25	74.68	7.02	8.73	9.57	0.40	-	Loamy Sand
	25-50	76.07	4.51	10.92	8.50	0.36	-	Loamy Sand
	50-65	73.75	9.75	3.88	12.62	0.48	-	Loamy Sand
13	0-25	1.25	32.70	32.05	42.75	2.22	0.5	clay
	25-60	1.49	30.81	23.50	44.20	1.69	0.4	clay
	60-110	0.80	23.55	35.08	40.57	1.86	0.7	clay

Table 2. Cont. Particle size distribution, $CaCO_3$ and Gypsum content

Profile No.	Depth cm	Particle size distribution				$CaCO_3$ %	Gypsum %	Soil texture
		Coarse Sand %	Find Sand %	Silt %	Clay %			
14	0-25	2.20	9.48	33.97	54.35	4.25	0.1	clay
	25-60	0.85	9.23	37.12	52.80	1.82	0.2	clay
	60-110	1.35	24.45	27.13	47.07	6.30	0.3	clay
	110-135	1.30	4.85	35.58	58.27	3.32	0.3	clay
15	0-25	27.45	42.70	11.15	18.70	1.49	-	Sandy Loam
	25-65	57.83	13.87	11.25	17.05	1.82	-	Sandy Loam
	65-100	54.87	15.28	9.75	20.10	1.21	-	Sandy Loam
	100-150	45.95	21.38	11.55	21.12	3.03	-	Sandy Loam
16	0-25	2.15	17.38	37.80	42.67	2.10	-	clay
	25-60	1.65	8.95	39.70	49.70	2.38	-	clay
	60-110	1.20	14.28	39.50	45.02	1.13	-	clay
	110-150	2.80	6.77	38.93	51.50	0.76	-	clay
17	0-25	1.80	27.53	23.40	47.17	1.62	1.5	clay
	25-60	1.40	23.31	23.77	51.52	2.22	2.5	clay
	60-100	1.48	10.40	37.17	50.95	1.26	1.5	clay
	100-150	0.73	21.32	34.38	43.97	1.28	1.5	clay
18	0-25	2.25	21.45	33.15	43.10	1.09	-	clay
	25-55	1.98	19.50	37.35	41.17	2.27	-	clay
	55-90	4.25	12.25	33.65	49.85	1.62	-	clay
	90-120	2.54	10.19	34.27	53.00	0.84	-	clay
19	0-25	3.35	23.65	27.53	45.47	3.44	1.5	clay
	25-60	3.37	18.41	35.12	43.10	2.27	1.7	clay
	60-100	4.40	15.33	37.27	43.00	2.22	-	clay
	100-140	7.50	17.25	33.43	41.82	1.94	-	clay
20	0-25	6.35	30.45	31.98	31.22	1.41	-	clay
	25-60	2.70	28.98	29.87	39.45	1.82	-	clay
	60-100	2.65	23.40	37.25	36.70	1.82	-	clay
	100-150	3.45	26.13	26.65	43.77	1.05	-	clay
21	0-30	1.15	38.93	21.82	38.10	2.30	-	Clay Loam
	30-70	1.32	40.13	30.50	28.05	2.77	-	Clay Loam
	70-120	0.60	33.10	35.50	30.80	2.10	-	Clay Loam
	120-150	2.00	17.55	36.58	43.87	1.17	-	clay
22	0-25	1.50	19.10	37.90	41.45	3.15	1.5	clay
	25-60	2.00	24.13	31.82	42.05	1.66	1.1	clay
	60-110	12.00	16.08	28.37	43.55	1.82	1.1	clay
	110-150	2.50	27.76	28.87	40.87	1.33	1.2	clay
23	0-25	4.07	27.16	32.57	36.20	0.42	-	Clay Loam
	25-50	2.85	20.80	34.25	42.10	0.62	-	clay
	50-100	1.45	19.15	30.25	49.15	0.17	-	clay
	100-150	1.40	18.03	38.60	41.97	1.09	-	clay
24	0-25	1.05	25.23	40.75	32.97	1.82	1.5	Clay Loam
	25-60	2.07	17.01	39.57	41.35	1.60	-	clay
	60-100	1.39	12.19	32.18	53.52	0.59	-	clay
	100-150	1.03	14.75	31.20	53.02	0.42	-	clay
25	0-25	2.40	20.80	31.30	45.50	2.10	2.5	clay
	25-65	1.60	19.30	31.80	47.30	2.60	3.1	clay
	65-125	0.80	17.40	36.90	44.90	1.90	3.1	clay
26	0-20	1.80	15.81	27.10	55.20	0.70	2.5	clay
	20-60	1.20	14.10	25.30	59.40	0.70	2.3	clay
	60-120	1.10	17.90	24.50	56.50	0.10	1.7	clay

Table 3. Some chemical properties of the studied soil profiles

Profile No	Depth (cm)	pH	EC ds/m	Soluble anions and cations (meq/L)**								SAR
				$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	
1	0-20	7.88	5.52	--	2.50	22.00	11.70	15.99	13.96	28.00	0.25	7.24
	20-50	7.60	6.97	--	2.30	33.00	11.60	16.59	12.86	27.00	0.25	7.03
	50-100	7.70	7.04	--	2.30	37.50	26.45	14.39	16.11	35.50	0.25	9.08
	100-150	8.19	8.25	--	3.00	50.00	38.63	13.59	12.21	65.50	0.33	18.25
2	0-25	7.73	1.11	--	2.50	3.50	6.53	7.69	2.28	2.40	0.16	1.07
	25-60	7.63	1.23	--	3.50	5.00	5.37	7.14	1.78	4.90	0.05	2.32
	60-110	7.85	1.54	--	1.00	7.50	7.68	8.34	2.21	5.50	0.13	2.39
	110-130	7.8	1.54	--	2.50	7.50	7.16	8.79	2.91	5.30	0.16	2.19
3	0-25	8.39	0.76	--	3.00	5.00	0.15	2.35	1.65	4.10	0.05	2.05
	25-55	8.26	0.75	--	2.00	6.00	0.45	4.39	1.21	2.80	0.05	1.67
	55-85	8.28	0.86	--	2.00	4.00	2.85	5.88	0.72	2.20	0.05	1.21
	85-120	8.15	1.23	--	2.00	8.00	3.30	6.86	3.34	3.00	0.10	1.32
4	0-25	7.90	1.03	--	3.50	2.50	5.33	5.49	3.01	2.70	0.13	1.31
	25-60	7.89	1.44	--	3.00	4.00	8.27	6.04	3.93	5.20	0.10	2.33
	60-100	8.15	1.60	--	3.00	4.00	10.13	3.48	3.02	10.50	0.13	2.83
	100-150	8.20	2.03	--	3.50	7.50	9.86	3.29	3.01	14.40	0.16	8.09
5	0-20	7.97	2.31	--	2.50	9.00	13.11	7.69	1.76	15.00	0.16	6.91
	20-45	8.39	2.28	--	3.50	12.00	9.98	3.92	5.51	15.00	0.05	6.91
	45-100	9.00	2.52	--	4.00	10.00	11.47	2.94	0.83	21.60	0.10	15.77
	100-150	9.10	5.51	--	4.10	7.00	14.20	2.19	0.96	22.10	0.05	17.54
6	0-20	7.81	1.25	--	3.30	5.00	5.05	5.49	3.96	4.00	0.10	1.84
	20-55	8.30	0.96	--	3.00	3.50	4.10	3.29	3.01	4.20	0.10	2.36
	55-110	8.91	0.91	--	2.00	6.00	1.42	3.92	0.80	4.60	0.10	2.99
	110-150	8.70	0.93	--	2.50	3.50	4.17	4.12	2.00	4.00	0.05	2.28
7	0-20	7.78	1.02	--	4.00	3.50	3.40	5.49	3.01	2.30	0.10	1.11
	20-60	8.75	3.14	--	3.50	12.00	20.05	3.29	3.01	29.00	0.25	16.29
	60-110	8.70	2.06	--	3.50	12.50	14.70	1.09	1.01	28.50	0.10	22.67
	110-120	7.68	1.03	--	2.00	6.00	2.12	3.92	0.80	5.30	0.10	3.44
8	0-25	7.60	5.95	--	2.50	27.50	34.31	12.69	15.06	36.20	0.36	9.70
	25-60	7.70	5.63	--	2.40	26.00	28.78	14.24	15.09	27.80	0.05	7.26
	60-110	8.29	6.37	--	3.00	38.00	13.12	4.90	8.30	40.80	0.12	15.88
	110-150	7.70	2.77	--	2.30	19.00	8.90	4.39	6.11	19.40	0.30	8.47
9	0-25	8.26	1.25	--	2.50	6.00	4.65	6.16	3.34	3.50	0.15	1.60
	25-60	8.65	0.85	--	2.00	3.00	4.53	4.88	2.60	2.00	0.05	1.03
	60-100	9.02	0.87	--	2.00	4.00	3.13	3.92	2.56	2.60	0.05	1.44
10	0-25	7.60	5.28	--	2.50	24.00	27.50	15.49	12.91	25.50	0.10	6.76
	25-40	7.80	6.98	--	2.50	32.00	15.95	13.84	12.46	24.00	0.15	6.61
	40-50	8.21	8.46	--	3.50	53.00	27.75	16.59	10.91	56.50	0.25	16.34
11	0-25	7.88	3.30	--	3.50	20.00	12.31	8.79	5.81	19.50	1.71	7.22
	25-50	8.20	1.98	--	3.00	9.00	10.79	6.59	3.91	10.80	1.49	4.71
	50-60	8.12	2.50	--	3.00	12.00	13.65	5.49	10.26	11.50	1.40	4.09
12	0-25	8.69	1.63	--	3.50	7.50	6.57	6.59	2.33	8.20	0.45	3.88
	25-50	8.68	1.25	--	3.00	5.00	6.69	3.29	3.21	7.8	0.39	4.33
	50-65	8.32	1.56	--	2.50	10.00	3.70	4.94	2.41	8.80	0.05	4.58
13	0-25	7.8	3.72	--	2.50	22.50	14.07	5.49	6.58	26.75	0.25	10.87
	25-60	7.6	3.62	--	2.50	25.00	12.30	8.79	6.96	23.80	0.25	8.46
	60-110	8.50	5.36	--	3.50	35.00	18.97	9.89	5.33	42.00	0.25	15.22
14	0-25	8.07	4.11	--	3.50	26.00	14.17	8.79	5.38	28.00	0.50	10.52
	25-60	8.29	4.35	--	3.50	34.00	7.15	4.39	4.01	36.00	0.25	17.56
	60-110	8.57	4.90	--	3.70	43.50	7.00	4.39	6.11	42.00	0.90	18.68
	110-135	9.50	17.37	--	4.00	94.00	59.97	15.49	14.98	125.5	2.00	32.18

Table 3. Cont. Some chemical properties of the studied soil profiles

Profile No	Depth (cm)	pH	EC ds/m	Soluble anions and cations (meq/L)**								SAR
				$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	
15	0-25	7.69	2.55	--	4.00	9.50	13.70	10.99	7.96	8.00	0.25	2.59
	25-65	8.01	1.03	--	3.00	3.50	5.55	2.19	2.53	7.20	0.13	4.68
	65-100	8.14	1.21	--	3.00	3.50	6.80	3.29	3.01	6.80	0.20	3.82
	100-150	7.53	4.12	--	4.00	4.00	37.95	25.77	15.03	5.00	0.65	1.11
16	0-25	7.97	1.30	--	3.00	4.00	6.95	3.29	4.06	6.50	0.10	3.39
	25-60	8.18	1.24	--	2.50	3.50	7.20	2.19	5.16	5.65	0.20	2.94
	60-110	8.19	2.21	--	2.50	6.00	14.50	4.39	11.36	7.00	0.25	2.49
	110-150	8.21	1.40	--	3.00	4.50	7.40	4.39	4.01	6.20	0.30	3.02
17	0-25	7.60	6.73	--	2.50	32.37	31.37	18.79	18.53	29.80	0.25	6.90
	25-60	7.80	6.90	--	3.00	33.50	23.78	16.59	14.96	28.60	0.13	7.20
	60-100	7.70	6.38	--	3.00	32.00	30.28	15.80	14.12	35.20	0.16	9.09
	100-150	8.41	6.80	--	4.00	34.00	22.63	7.90	7.53	45.00	0.20	16.19
18	0-25	8.20	1.04	--	4.00	4.00	2.85	5.66	2.34	2.80	0.05	1.40
	25-55	8.09	1.08	--	3.50	2.50	5.33	5.49	2.91	2.80	0.13	1.36
	55-90	8.50	0.97	--	4.00	3.00	3.48	4.56	1.87	4.00	0.05	2.23
	90-120	8.40	0.88	--	6.00	2.50	0.95	3.84	1.41	4.10	0.10	2.53
19	0-25	7.65	6.74	--	5.50	40.50	21.87	23.69	18.06	26.00	0.12	5.69
	25-60	7.50	7.16	--	3.00	59.00	10.78	19.38	18.07	35.00	0.33	8.08
	60-100	9.35	0.95	--	4.50	3.00	2.65	1.64	0.46	7.50	0.05	7.28
	100-140	8.35	1.10	--	4.00	4.00	3.45	2.74	1.46	7.20	0.05	4.97
20	0-25	7.90	1.99	--	3.00	6.50	11.18	7.99	4.86	7.50	0.33	2.96
	25-60	8.16	0.86	--	3.00	3.50	2.55	2.74	1.46	4.80	0.05	3.31
	60-100	8.15	0.86	--	3.00	4.00	1.84	2.19	1.25	5.30	0.10	4.04
	100-15	8.49	0.94	--	4.00	3.00	4.00	2.19	0.96	7.80	0.05	6.19
21	0-30	7.97	.079	--	3.50	3.50	1.15	4.94	1.36	1.80	0.05	1.01
	30-70	7.98	0.78	--	3.00	2.50	2.73	3.49	1.84	2.80	0.10	1.72
	70-120	8.21	0.87	--	4.00	3.00	2.60	3.39	3.11	3.00	0.10	1.66
	120-150	8.21	0.83	--	3.00	4.00	1.90	3.29	0.91	4.60	0.10	3.17
22	0-25	7.97	3.39	--	2.50	7.00	24.92	9.89	9.53	12.50	2.50	4.01
	25-60	8.50	3.12	--	4.00	10.00	19.39	3.48	2.29	27.50	0.12	16.18
	60-110	8.90	3.85	--	4.00	16.00	20.30	3.29	3.01	33.75	0.25	18.96
	110-150	7.60	2.80	--	2.50	10.50	15.79	2.74	0.93	25.00	0.12	18.46
23	0-25	7.73	2.06	--	4.00	8.00	8.96	8.79	3.81	8.20	0.160	3.27
	25-50	8.00	1.87	--	3.50	9.00	6.60	4.94	3.46	10.60	0.10	5.17
	50-100	8.10	2.40	--	4.00	12.00	8.82	6.86	6.11	11.80	0.05	4.63
	100-150	8.10	2.10	--	4.00	14.00	3.57	6.86	4.46	10.20	0.05	4.29
24	0-25	7.71	7.05	--	3.50	34.00	25.74	14.83	8.79	39.50	0.12	9.00
	25-60	8.10	2.33	--	4.50	10.10	9.77	6.88	4.29	13.00	0.10	5.50
	60-100	8.10	2.06	--	3.00	8.00	10.48	5.92	4.51	11.00	0.05	4.82
	100-150	8.10	1.37	--	3.00	8.00	4.29	3.92	1.74	8.50	1.13	5.05
25	0-25	8.20	9.83	--	3.70	38.00	47.90	22.12	18.48	48.80	0.20	10.83
	25-65	8.15	10.45	--	3.70	46.00	46.88	21.11	28.97	46.20	0.30	9.23
	65-125	8.50	18.39	--	4.00	49.00	73.15	27.68	18.07	80.00	0.40	16.73
26	0-20	8.20	13.80	--	3.75	52.50	67.10	32.83	32.12	67.00	0.40	11.76
	20-60	8.23	9.60	--	2.50	41.00	67.72	30.81	11.61	68.50	0.30	14.87
	60-120	8.22	9.88	--	4.25	51.00	60.37	31.31	11.61	72.40	0.30	15.63

* pH in the saturated soil paste.

**Soluble anions and cations in the saturation extract.

Table 4. Soil Taxonomy of the studied soils

Profile No.	Soil Taxonomy
1	Clayey; montmorllonitic; thermic ;Typic Haplotorrerts
2	Carse lomy; mixed; thermic ; Typic Torrifluvents
3	Fine lomy ; montmorllonitic ; thermic ; Typic Torrifluvents
4	Clayey ; montmorllonitic ; thermic ; Typic Haplotorrerts
5	Clayey; montmorllonitic ; thermic ; Typic Haplotorrerts
6	Clayey; montmorllonitic ; thermic ; Typic Haplotorrerts
7	Clayey; montmorllonitic ; thermic ; Typic Haplotorrerts
8	Clayey; montmorllonitic ; thermic ; Typic Haplotorrerts.
9	Clayey; montmorllonitic ; thermic ; Typic Haplotorrerts
10	Clayey; montmorllonitic ; thermic ; Typic Torrifluvents.
11	Coarse loamy; mixed ; thermic ; Typic Torrifluvents.
12	Sandy; siliceous ;thermic Typic Torripsamments.
13	Clayey; montmorllonitic ; thermic ; Typic Haplotorrerts.
14	Clayey; montmorllonitic ; thermic ; Typic Haplotorrerts.
15	Coarse loamy; mixed ; thermic ; Typic Torrifluvents.
16	Clayey; montmorillonitic ; thermic ;Vertic Torrifluvents.
17	Clayey; montmorillonitic ; thermic ; Typic Haplotorrerts.
18	Clayey; montmorillonitic ; thermic ; Typic Haplotorrerts.
19	Clayey; montmorillonitic ; thermic ; Typic Haplotorrerts.
20	Clayey; montmorillonitic ; thermic ; Typic Haplotorrerts.
21	Clayey; montmorillonitic ; thermic ; Typic Torrifluvents.
22	Clayey; montmorillonitic ; thermic ; Typic Haplotorrerts.
23	Clayey; montmorllonitic ; thermic ; Typic Haplotorrerts.
24	Clayey; montmorillonitic ; thermic ; Typic Haplotorrerts.
25	Clayey; montmorillonitic ; thermic ; Typic Haplotorrerts.
26	Clayey; montmorillonitic ; thermic ; Typic Typic Haplotorrerts.

Table 5. Intensity of limitation factors according to Sys and Verhey (1978)

Profile No.	Texture (s 1)	Salinity (n)	CaCO3 (s 3)	Gypsum (s 3)	Depth (s4)	Topography (t)	Ci	Soil order
1	85	87	92	100	100	100	68	S_2
2	98	90	85	100	100	100	75	S_1
3	110	90	90	100	100	100	90	S_1
4	85	90	90	100	100	100	69	S_2
5	85	90	93	100	100	100	71	S_2
6	85	90	90	100	100	100	69	S_2
7	85	90	90	100	100	100	69	S_2
8	85	90	97	100	100	100	66	S_2
9	85	100	81	100	90	100	62	S_2
10	87	138	85	100	90	100	93	S_1
11	91	100	85	100	60	100	43	S_2
12	53	143	85	100	75	100	47	S_2
13	85	100	95	100	100	100	81	S_1
14	85	76	95	100	100	100	61	S_2
15	75	100	95	100	100	100	71	S_2
16	85	100	95	100	100	100	80	S_1
17	85	87	95	100	100	100	70	S_2
18	85	100	93	100	100	100	79	S_1
19	85	92.5	95	100	100	100	74	S_2
20	85	100	95	100	100	100	81	S_1
21	98	100	95	100	60	100	93	S_1
22	85	87.9	95	100	100	100	70	S_2
23	90	100	86	100	100	100	77	S_1
24	90	92.1	89	100	100	100	73	S_2
25	85	57.7	95	100	100	100	45	S_3
26	85	65	85	100	100	100	45	S_3

Map 1

Map 2

Map 3

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تقسيم وتقييم أراضى منطقة شمال الدلتا نهر النيل

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تم اختيار ٢٦ موقعا لدراسة قطاعات تمثل الأراضى المختلفة فى منطقة شمال الدلتا وتقييم صلاحيتها للزراعة والأراضى السائدة فى منطقة الدراسة كانت غير ملحية ثم اراضى ملحية فمتوسطة وعالية الملوحة فى مساحات قليلة طبقا لـ Soil Survey Staff Syatem (١٩٩٣). وقد أظهرت هذه الدراسة أن أراضى تلك المنطقة لا تحتوى على آفاق تشخيصيه أو عمليات بيدوجينية سوى عملية الـ slickenside حيث كانت الأراضى المدروسة خالية من الآفاق الكالسية والجبسية والملحية وذلك يرجع الى احتوائها على كميات قليلة من كل من كربونات الكالسيوم والجبس والاملاح الذائبة على التوالى ولذلك فقد تم تقسيمها بحيث تتبع رتبة الفرتيزول Vertisols والانتيزول Entisol طبقا لتقسيم وزراعة الزراعة الأمريكية عام ١٩٩٨ Soil Survey Staff Syatem (١٩٩٨) وايضاً فان الاراضى السائدة طبقاً لهذا التقسيم تتبع Typic Haplotorrerts التى كانت تشغل معظم المساحة المدروسة يليها Typic Torrifluvents و Typic Torripsamments فى مساحات قليلة وقد تم تقييم صلاحية هذه الأراضى للزراعة باستخدام طريقة Verhey, Sys (١٩٧٨) وعلى أساس هذه الطريقة أمكن تقييم أراضى منطقة الدراسة بأنها تتبع رتبة الأراضى الصالحة للزراعة (S) ومعظم المساحة المدروسة كانت اراضى متوسطة الصلاحية (S_2) بينما الأراضى العالية الصلاحية (S_1) والحدية (S_3) كانت تشغل مساحات قليلة وكانت العوامل المحددة للزراعة هى قوام التربة والملوحة وعمق القطاع الأرضى.