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TREATISE OF DIFFERENT PHYSIOGRAPHIC UNITS IN SINNURIS DISTRICT-FAYOUM GOVERNORATE – EGYPT

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ABSTRACT

Sinnuris District is bounded by Lake Qarun (north), Fayoum District (south), Tamia District (east) and Ibshwai District (west). The geopedological physiographic units and its taxonomic units of the studied area could be summarized as follow:

1. Fluvio-Lacustrine, moderately low terraces:
   - Typic Torripsamments, siliceous, hyperthermic.
   - Sodic Haplotorrerts, fine, smectitic, hyperthermic.
   - Typic Torrifluvents, coarse loamy, mixed, hyperthermic.
2. Fluvio-Lacustrine, low terraces:
   - Typic Torrifluvents, coarse loamy, mixed, hyperthermic.
   - Sodic Haplotorrerts, fine, smectitic, hyperthermic.
3. Fluvio-Lacustrine, low terraces (basin cover with sand sheet):
   - Sodic Haplotorrerts, fine, smectitic, hyperthermic.
   - Typic Torrifluvents, fine loamy over sandy, mixed, hyperthermic.
4. Fluvio-Lacustrine, high terraces:
   - Typic Haplotorrerts, clayey, mixed, hyperthermic.
5. Alluvial, moderately high terraces (basin):
   - Typic Haplotorrerts, fine, smectitic, hyperthermic.
   - Vertic Torrifluvents, fine loamy, mixed, hyperthermic.
   - Typic Torrifluvents, fine loamy, mixed, hyperthermic.
6. Nile Alluvial, high terraces:
   - Typic Torrifluvents, sandy, mixed, hyperthermic.
   - Typic Haplotorrerts, very fine, smectitic, hyperthermic.
   - Vertic Torrifluvents, fine loamy, mixed, hyperthermic.
7. Alluvial plain, Vales:
   - Typic Torrifluvents, fine loamy, mixed, hyperthermic.

Data of land evaluation revealed that, soils under consideration, mainly, suffering from texture, salinity and sodicity, can be recorded highly suitable class with regard to potential suitability by application more suitable irrigation systems, favorable managements and cultivation appropriate crops.

More suitable crops follows the following descending order:
Sorghum > barley > cotton > olive > wheat > alfalfa > maize.

Keywords: Sinnuris, physiographic unit, taxonomic unit, evaluation.

INTRODUCTION

Fayoum Oasis is a deep depression in the limestone plateau of the Libyan Desert, into which in the coarse of time, the Nile waters have obtained access. It has thus affinities in the one hand with the oasis and other great depressions of the Libyan Desert, and on the other hand with the Nile Valley and Delta, which are watered by the river. The total thickness of the Nile mud in El-Fayoum is seldom more than 4-5 meters and is generally very much less. Fayoum is +25 meters above sea level; while the north and west parts which are adjacent to Lake Qarun are between -40 to -45 meters under sea level.

This shows that the slope is from south to north and from east to west Fayoum Governorate (Moustafa et. al., 1965). El-Fayoum Governorate floor is covered mainly by Fluvio-lacustrine deposits that belong to Pleistocene/ Halocene period (Shendi et. al., 2010). Sinnuris District is located in the eastern-north part of Fayoum depression and covers an area about 24334.8 hectars.

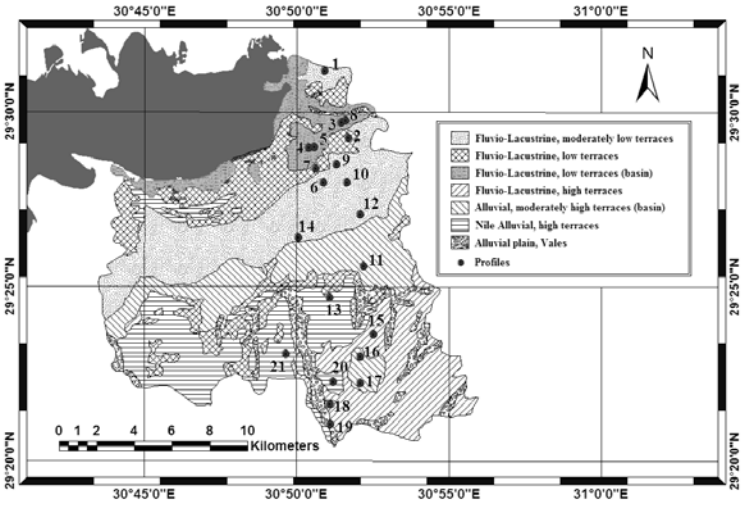
The meteorological data of the studied area indicate that the mean annual temperature ranges from 11.6 to 28.1 ^{o}C in the south of district, while the mean annual temperature in the north district between 10.5 and 30.7 ^{o}C with an average temperature value of higher than 22 ^{o}C. The precipitation appears a scanty rainfall drops that may occurs between December – April with an average of 8-17 mm/year, whereas the evaporation rates average ranging between 3.5 to 10 mm/day. The mean annual relative humidity varies from 32 to 67%. The previous data reveal to the soil moisture regime is "Torric" and the temperature regime is "Hyperthermic" according to USDA, 2014.

The study under consideration aimed to achieve the boundary of physiographic units of the studied area, identify the main physical and chemical characteristics, classification and evaluation of these units.

MATERIALS AND METHODS

Sinnuris District is one of six districts of El-Fayoum Governorate i.e. Yousef El-Sedeek, Ibshwai, Sinnuris, Tamia, Fayoum and Itsa. It is located in the eastern north part of Fayoum depression. It is bounded by Lake Qarun (north), Fayoum District (south), Tamia District (east) and Ibshwai District (west) and lies within latitude 29^{o} 20' and 29^{o} 30' north and longitude 30^{o} 43' and 30^{o} 56' east.

The geopedological physiographic map of the studied area was produced by Soil, Water and Environment Research Institute (1998), which is the base of current study (Map 1).



Map 1: Physiographic units and locations of representative soil profiles.

The exact location of the studied profiles were registered with help of GPS (Global Positioning System) to achieve representation of different physiographic units.

Twenty one soil profiles were dug to 150 cm or lithic contact to represent the predominate characteristics of the identified physiographic units of the studied area. Soil profiles were described in the field according to FAO (2006). Soil colour is defined according to Munsell Color (2009).

Soil samples were collected, air dried, crushed, sieved through a 2 mm sieve and subjected to different physical and chemical analysis. Gravel contents were determined as percent by volume.

- Particle size distribution was carried out according to Black (1982) using hexametaphosphate as dispersing agent.
- pH values were measured in the saturated soil paste according to Richard (1954).
- Total salinity (ECe) and soluble cations and anions were determined in saturated soil paste extract (Jackson, 1975).
- Sulphate was calculated by subtracting total anions from total cations.
- Organic matter was determined according to the modified procedure by Jackson (1958).
- Gypsum content was determined by precipitation with acetone (Richard, 1954).
- Calcium carbonate content was determined volumetrically using Collin's Calcimeter (Richard, 1954).

RESULTS AND DISCUSSION

Updating soil survey is a vital important for decision makers and for management plans. The soil under considerations have seven physiographic units which were illustrated in map 1. The review revealed that most of Fayoum Governorate cover by Fluvio-lacustrine deposits but these soils were submitted to agricultural activities which reduce most differences in their characteristics except their positions or elevations.

Field description, physical and chemical properties of the representative soil profiles are shown in Tables 1, 2 and 3, respectively.

The subsequent is the main characteristics of different physiographic units:

1. Fluvio-Lacustrine, moderately low terraces:

Total area of this unit covers about 53.08 km^2 (21.81% of total area of Sinnuris district). This unit are represented by soil profiles 1, 6, 9, 10, 12 and 14. These soils show nearly level sloping except soils of profile 1 appear gently sloping class. Surface features vary between few to common weeds, fine cracks or low salt accumulations. Distribution of texture classes are sand in the north, loam in the south and clay between them, so, soil structure is single grain in the north, massive in the south and blocky between them. The soils which have fine texture appear common distinct slickensides. The contents of gravel, organic mater, gypsum and lime are 0-2%, 0.08-1.23%, 1.2-1.9% and 1.3-11.8%,

Table 1 : Morphological description of the studied soil profiles.

Physiographic unit		Prof. No.	Location	Depth (cm)	Slope gradient	Surface features	Crops	Cutanic feature	Soil colour (moist)	Soil texture	Soil structure	Consistence	Gravel (%)	Secondary formation				Effervescence	Boundary
														Abundance	Hardness	Type	Nature		
Fluvio - Lacustrine	Moderatly low Terraces	1	29° 31' 10.98" N 30° 50' 56.25" E	0 – 30 30 – 150	Gently sloping	few weed	uncultivated	- -	10YR 7/6 10YR 7/8	S S	Sg Sg	L, NS, NP L, NS, NP	0 2	- -	- -	- -	- -	+ +	AS
		6	29° 28' 00.08" N 30° 50' 54.00" E	0 – 25 25 -55 55–120	Nearly level	many weeds & fine cracks	maize	- CDS CDS	10YR 3/3 10YR 5/3 10YR 5/3	C C C	B B B	F, S, P F, S, P F, S, P	0 0 0	- F C	- S S	- C C	- L L	+++ +++ ++E16	CW CW
		9	29° 28' 31.00" N 30° 51' 20.00" E	0 – 25 25 -45 45–120	Nearly level	fine cracks	cotton	- CDS CDS	10YR 4/3 10YR 5/3 10YR 6/3	C C C	Mas B B	F, S, P F, S, P F, S, P	0 0 0	- - F	- - S	- - C	- - L	++ +++ ++	AS AS
		10	29° 28' 00.06" N 30° 51' 40.00" E	0 – 30 30 -70 70–120	Nearly level	-	clover	- CDS CDS	10YR 4/2 10YR 4/3 10YR 4/3	C C C	B B B	F, S, P F, S, P F, S, P	0 0 0	- F -	- S -	- C -	- L -	+++ +++ +++	AS CW
		12	29° 27' 05.00" N 30° 52' 06.00" E	0 – 30 30 -80 80–120	Nearly level	low surface salts	maize	- CDS CDS	10YR 6/3 10YR 5/3 10YR 5/3	C C C	B B B	F, S, P F, S, P F, S, P	0 0 0	- - -	- - -	- - -	- - -	+++ +++ +++	AS AS
		14	29° 26' 24.75" N 30° 50' 04.06" E	0 – 20 20 -70 70–120	Nearly level	common weeds	olive	- - -	10YR 6/3 10YR 6/4 10YR 6/4	L L L	Mas Mas Mas	Fr, SS, SP Fr, SS, SP Fr, SS, SP	0 0 0	- - F	- - S	- - C	- - L	++ ++ ++	CW CW
	Low Terraces	2	29° 29' 16.87" N 30° 51' 42.99" E	0 – 20 20 -50 50–120	Nearly level	-	maize	- - -	10YR 8/6 10YR 8/4 10YR 7/4	SL SL SL	Mas Mas Mas	VFr, SS, SP VFr, SS, SP VFr, SS, SP	0 0 0	- - -	- - -	- - -	- - -	+++ + ++	CW G
		7	29° 28' 23.91" N 30° 50' 37.95" E	0 – 35 35 -65 65–85	Nearly level	fine cracks	maize	- CDS CDS	10YR 6/3 10YR 6/3 10YR 6/3	C C C	B B B	F, S, P F, S, P F, S, P	0 0 0	- F F	- S S	- C C	- L L	+++ +++ +++	CW G
	Low Terraces (basin)	3	29° 29' 43.00" N 30° 51' 29.00" E	0 – 25 25 -60 60–120	Nearly level	-	maize	- CDS CDS	10YR 3/2 10YR 4/2 10YR 5/2	C C C	B B B	F, S, P F, S, P F, S, P	0 0 0	- - -	- - -	- - -	- - -	+++ +++ +++	CW G
		4	29° 28' 59.50" N 30° 50' 24.06" E	0 – 25 25 -75 75–120	Nearly level	-	maize	- CDS CDS	10YR 3/3 10YR 4/3 10YR 5/3	C C C	B B B	F, S, P F, S, P F, S, P	0 0 0	C C F	S, H S, H S	C C C	L L L	+++ ++ ++	CW G
		5	29° 29' 00.95" N 30° 50' 35.43" E	0 – 30 30 -70 70–120	Nearly level	fine cracks	maize	- CDS CDS	10YR 4/3 10YR 5/3 10YR 6/3	C C C	B B B	F, S, P F, S, P F, S, P	0 0 0	F - -	S - -	C - -	L - -	+++ +++ +++	CW CW
		8	29° 29' 46.77" N 30° 51' 37.56" E	0 – 35 35 -60 60–100	Nearly level	many weeds	mango	- - -	10YR 6/4 10YR 7/6 10YR 7/8	SCL S S	Mas Sg Sg	VFr, SS, SP L, NS, NP L, NS, NP	0 0 0	- - -	- - -	- - -	- - -	+ + +	AW G
	H.T.	15	29° 23' 38.60" N 30° 52' 33.10" E	0 – 30 30 -80 80–120	Nearly level	upland	cotton	- CDS -	10YR 3/3 10YR 3/3 10YR 6/8	C C SL	B B Mas	F, S, P F, S, P Fr, SS, SP	0 0 0	- - -	- - -	- - -	- - -	++ ++ +	CW AS

Table 1 : Cont.

Physiographic unit		Prof. No.	Location	Depth (cm)	Slope gradient	Surface features	Crops	Cutanic feature	Soil colour (moist)	Soil texture	Soil structure	Consistence	Gravel (%)	Secondary formation				Effervescence	Boundary
														Abundance	Hardness	Type	Nature		
Alluvial	Moderatly high Terraces (basin)	11	29° 25' 36.36" N	0 – 25	Nearly level	-	ploughing	-	10YR 6/3	C	B	F, S, P	0	-	-	-	-	+++	G
			30° 52' 12.96" E	25 -60				CDS	10YR 5/3	C	B	F, S, P	0	-	-	-	-	+++	G
				60–120				CDS	10YR 5/3	C	B	F, S, P	0	-	-	-	-	+++	
		16	29° 22' 32.10" N	0 – 30	Nearly level	-	maize	-	10YR 3/3	C	B	F, S, P	0	-	-	-	-	++	AS
			30° 52' 05.00" E	30 -70				CDS	10YR 5/3	C	B	F, S, P	0	-	-	-	-	++	G
				70–120				-	10YR 4/3	C	B	F, S, P	0	-	-	-	-	++	
		17	29° 22' 13.94" N	0 – 45	Nearly level	-	maize	CDS	10YR 3/3	C	B	F, S, P	0	-	-	-	-	++	AS
			30° 52' 06.13" E	45–120				-	10YR 6/3	CL	Mas	F, SS, SP	0	F	S	C, m	L, G	++	
		18	29° 21' 38.06" N	0 – 30	Nearly level	few weed	mango & olive	-	10YR 6/4	L	Mas	Fr, SS, SP	0	-	-	-	-	++	CW
			30° 51' 05.88" E	30 - 70				-	10YR 6/6	SCL	Mas	Fr, SS, SP	0	-	-	-	-	++	CW
				70–120				-	10YR 6/8	CL	Mas	Fr, SS, SP	0	-	-	-	-	++	
N.A.	H.T.	13	29° 24' 42.18" N	0 – 25	Nearly level	many weeds	fruit trees	-	10YR 4/3	C	B	F, S, P	0	-	-	-	-	+	AS
			30° 51' 06.77" E	25 -60				-	10YR 6/3	S	Mas	L, NS, NP	0	-	-	-	-	+	CW
				60–120				-	10YR 6/8	S	Mas	L, NS, NP	0	-	-	-	-	+	
		20	29° 22' 16.93" N	0 – 30	Nearly level	fine cracks	maize	-	10YR 4/6	C	B	F, S, P	0	-	-	-	-	++	CW
			30° 51' 13.69" E	30 - 80				CDS	10YR 4/4	C	B	F, S, P	0	-	-	-	-	++	GW
				80–150				CDS	10YR 4/4	C	B	F, S, P	0	-	-	-	-	++	
		21	29° 23' 04.99" N	0 – 25	Nearly level	fine cracks	cotton	-	10YR 5/3	C	B	F, S, P	0	-	-	-	-	++	CW
			30° 49' 39.16" E	25 -75				-	10YR 5/6	CL	B	F, S, P	0	-	-	-	-	++	GW
				75–120				-	10YR 5/8	SCL	Mas	Fr, SS, SP	0	-	-	-	-	+++	
A.P.	V.	19	29° 21' 04.00" N	0 – 20	Nearly level	-	vegetables	-	10YR 5/4	CL	Mas	Fr, SS, SP	0	-	-	-	-	++	CW
			30° 51' 08.00" E	20 -90				-	10YR 5/6	CL	Mas	Fr, SS, SP	0	-	-	-	-	++	CW
				90–120				-	10YR 5/8	CL	Mas	Fr, SS, SP	0	F	S	C	L	+++	

Texture class: S = Sand, SL = Sandy Loam, C = Clay, SCL = Sandy Clay Loam, CL = Clay Loam, L = Loam
Soil structure: Sg = Single grain, Mas = Massive, B = Blocky
Effervescence: + = Slight, ++ = Moderate, +++ = Strong
Boundary Distinctness: A = Abrupt, C = Clear, W = Wavy, S = Smooth, G = Gradual
Secondary Formation: (Abundance: F = Few, C = Common), (Hardness: S = Soft, H = Hard), (Type: C = Concretion, m = mycelium) & (Nature: L = Lime segregation, G = Gypsum)
Consistence (Moist): L = Loose, F = Firm, Fr = Friable, VFr = Very Friable
(Wet): NS = Non Sticky, NP = Non Plastic, S = Sticky, P = Plastic, SS = Slightly Sticky, SP = Slightly Plastic
CDS = Common Distinct Slickensides
Physiographic unit: H.T = High Terraces, N.A. = Nile Alluvial, A.P. = Alluvial Plain, V. = Vales

Table 2 : Particle size distribution, O.M., $CaCO_3$ and gypsum contents of the representative soil profiles.

Physiographic unit		Prof. No.	Depth (cm)	Gravel (%)	Partcle size distribution (%)			Texture class	O.M (%)	Gypsum (%)	$CaCO^3$ (%)
					Sand	Silt	Clay				
Fluvio - Lacustrine	Moderatly low Terraces	1	0 – 30	0	91.0	6.5	2.5	S	0.22	1.9	2.35
			30 – 150	2	90.0	7.0	3.0	S	0.08	1.8	2.51
		6	0 – 25	0	17.9	29.7	52.4	C	0.88	1.4	9.6
			25 -55	0	14.5	30.4	55.1	C	0.56	1.5	9.8
			55–120	0	7.9	33.5	58.6	C	0.47	1.5	4.1
		9	0 – 25	0	27.4	26.3	46.3	C	1.13	1.8	11.8
			25 -45	0	10.2	32.6	57.2	C	1.22	1.6	10.8
			45–120	0	10.0	31.4	58.6	C	0.79	1.7	7.6
		10	0 – 30	0	8.9	27.7	63.4	C	1.15	1.2	10.2
			30 -70	0	10.6	29.8	59.6	C	0.83	1.4	1.4
			70–120	0	4.8	30.5	64.7	C	0.67	1.3	1.3
		12	0 – 30	0	23.8	28.3	47.9	C	0.77	1.8	10.2
			30 -80	0	17.1	29.7	53.2	C	0.65	1.7	11.0
			80–120	0	11.8	32.6	55.6	C	0.49	1.6	10.1
		14	0 – 20	0	45.8	40.7	13.5	L	1.23	1.5	4.9
			20 -70	0	41.3	42.5	16.5	L	0.75	1.4	5.8
			70–120	0	37.6	45.3	17.5	L	0.68	1.5	4.8
	Low Terraces	2	0 – 20	0	65.2	20.1	14.7	SL	0.63	1.4	8.0
			20 -50	0	67.3	16.8	15.9	SL	0.25	1.5	2.2
			50–120	0	62.3	20.3	17.4	SL	0.21	1.3	6.4
		7	0 – 35	0	20.8	31.6	47.6	C	0.87	1.6	11.0
			35 -65	0	14.4	35.2	49.4	C	0.63	1.8	11.8
			65–85	0	19.0	28.3	52.7	C	0.51	1.7	11.3
	Low Terraces (basin)	3	0 – 25	0	23.7	24.6	51.7	C	1.31	1.3	9.4
			25 -60	0	19.0	24.8	56.2	C	0.67	1.4	8.0
			60–120	0	9.4	30.2	60.4	C	0.52	1.5	9.2
		4	0 – 25	0	23.2	28.3	48.5	C	0.88	1.4	9.56
			25 -75	0	24.5	21.2	54.3	C	0.76	1.2	8.36
			75–120	0	20.0	22.9	57.1	C	0.56	1.1	5.91
		5	0 – 30	0	18.1	32.4	49.5	C	1.12	1.7	12.9
			30 -70	0	12.5	35.1	52.4	C	0.74	1.5	11.2
			70–120	0	10.2	28.7	61.1	C	0.65	1.3	12.0
		8	0 – 35	0	52.9	14.5	32.6	SCL	0.48	1.4	4.2
			35 -60	0	90.2	6.3	3.5	S	0.36	1.5	4.8
			60–100	0	90.3	5.1	4.6	S	0.33	1.5	3.6
	H.T.	15	0 – 30	0	35.9	19.5	44.6	C	0.87	1.2	3.4
			30 -80	0	37.5	23.6	41.9	C	0.46	1.1	2.8
			80–120	0	58.3	23.2	18.5	SL	0.31	1.2	0.52
Alluvial	Moderatly high Terraces (basin)	11	0 – 25	0	22.7	29.6	47.7	C	0.69	1.7	10.8
			25 -60	0	22.9	27.5	49.6	C	0.55	1.8	9.6
			60–120	0	18.1	28.4	53.5	C	0.46	1.7	8.2
		16	0 – 30	0	31.5	17.8	50.7	C	1.44	1.9	3.9
			30 -70	0	27.4	22.8	49.8	C	1.02	1.6	3.9
			70–120	0	20.1	23.6	56.3	C	0.68	1.6	4.2
		17	0 – 45	0	35.7	15.7	48.6	C	0.74	1.4	3.1
			45–120	0	33.9	33.4	32.7	CL	0.25	1.5	4.4
		18	0 – 30	0	41.1	38.7	20.2	L	1.12	1.3	4.6
			30 - 70	0	55.5	16.9	27.6	SCL	0.78	1.5	6.4
			70–120	0	38.9	28.7	32.4	CL	0.36	1.7	6.0
N.A.	H.T.	13	0 – 25	0	38.5	18.6	42.9	C	1.36	1.3	1.88
			25 -60	0	89.3	3.1	7.6	S	0.57	1.6	1.71
			60–120	0	89.2	5.8	5.4	S	0.22	1.8	0.44
		20	0 – 30	0	18.2	22.9	58.9	C	1.71	1.7	2.13
			30 - 80	0	12.7	26.0	61.3	C	1.44	1.8	2.74
			80–150	0	10.8	25.2	63.4	C	1.18	1.8	2.77
		21	0 – 25	0	22.3	29.3	48.4	C	1.62	1.9	1.96
			25 -75	0	26.6	40.9	32.5	CL	1.33	1.6	1.53
			75–120	0	55.4	16.8	27.8	SCL	1.12	0.7	0.81
A.P.	V.	19	0 – 20	0	42.1	28.3	29.6	CL	0.89	1.5	7.3
			20 -90	0	34.9	32.6	32.5	CL	0.56	1.4	7.6
			90–120	0	31.3	34.1	34.6	CL	0.33	1.9	9.2

Table 3 : Some chemical properties of the representative soil profiles in paste extract.

Physiographic unit		Prof. No.	Depth (cm)	pH	Ece (dSm^{-1})	Soluble ions (me/L)								SAR
						Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$	
Fluvio - Lacustrine	Moderatly low Terraces	1	0 – 30	7.7	24.18	110	51	120	3.1	0	2.4	217	64.7	13.4
			30 – 150	7.9	22.07	96	45	112	2.6	0	3.7	189	62.9	13.3
		6	0 – 25	7.82	7.08	17.56	11.65	40.8	0.83	0	2.5	34	34.34	10.7
			25 -55	7.85	7.59	19.28	13.87	41.7	0.75	0	2.5	29	44.10	10.3
			55–120	7.88	12.0	38.11	21.19	78.1	1.25	0	2.5	63	73.15	14.3
		9	0 – 25	7.85	15.12	43.61	34.49	98.5	1.92	0	2.5	74	102.02	15.7
			25 -45	7.91	18.22	56.72	35.13	126.4	1.55	0	2.5	96	120.85	18.6
			45–120	7.93	23.10	78.91	58.79	149.8	1.25	0	3.0	112	173.75	18.0
		10	0 – 30	7.65	3.74	8.86	6.38	21.70	0.48	0	1.5	17	18.92	7.9
			30 -70	7.72	4.88	9.12	8.86	30.41	0.50	0	1.5	20	27.39	10.1
			70–120	7.81	5.15	8.63	4.99	37.55	0.41	0	2.0	21	28.58	14.4
		12	0 – 30	7.84	4.08	5.44	3.88	31.42	0.46	0	2.0	19	19.98	14.8
			30 -80	7.75	4.19	8.97	6.80	25.93	0.29	0	1.5	18	22.49	9.3
			80–120	7.74	4.58	11.14	7.21	27.18	0.29	0	1.5	19	25.32	8.8
		14	0 – 20	7.49	2.37	6.18	3.69	13.72	0.15	0	1.0	8.5	14.24	6.2
			20 -70	7.46	2.34	6.21	4.39	12.50	0.32	0	1.0	8.0	14.42	5.4
			70–120	7.51	2.85	8.17	5.88	14.00	0.50	0	1.5	9.5	16.55	5.3
	Low Terraces	2	0 – 20	7.83	4.66	6.45	4.15	36.6	1.48	0	1.5	22	23.18	15.0
			20 -50	7.76	3.45	4.17	2.89	26.7	0.75	0	1.0	13	20.51	11.2
			50–120	7.96	3.33	6.84	4.58	21.2	0.70	0	1.0	14	18.32	8.9
		7	0 – 35	7.35	7.65	21.23	14.02	40.2	1.10	0	2.0	33	41.55	9.6
			35 -65	7.49	7.26	18.40	10.82	42.5	0.92	0	2.0	32	38.64	11.1
			65–85	7.52	5.44	15.83	8.08	29.8	0.75	0	1.5	23	29.96	8.6
	Low Terraces (basin)	3	0 – 25	7.92	2.40	1.10	2.30	21.15	0.45	0	3.2	6.9	14.90	16.3
			25 -60	7.62	6.62	12.25	8.11	45.1	0.83	0	2.5	27.0	36.79	14.1
			60–120	7.68	6.11	7.86	5.82	46.9	0.58	0	2.0	25.0	34.16	17.9
		4	0 – 25	7.9	3.88	9.3	6.4	22.6	1.70	0	1.2	22.5	16.3	8.1
			25 -75	8.3	2.80	1.6	2.3	22.75	0.55	0	3.4	8.1	15.7	16.2
			75–120	8.3	3.15	1.84	1.17	31.5	0.30	0	3.5	10.8	20.51	20.9
		5	0 – 30	7.49	3.93	5.33	3.12	30.3	0.51	0	1.5	18	19.86	14.7
			30 -70	7.67	8.51	12.17	10.82	61.2	1.00	0	2.0	32	51.19	18.1
			70–120	7.96	6.86	14.33	9.16	44.6	0.58	0	2.0	29	37.67	13.0
		8	0 – 35	7.68	11.01	28.54	20.55	72.4	1.88	0	2.0	67	54.37	14.6
			35 -60	8.30	3.42	1.86	1.18	32.8	0.40	0	3.6	11.2	21.44	26.6
			60–100	7.56	1.89	2.02	1.00	15.9	0.50	0	1.0	7.5	10.92	13.0
	H.T.	15	0 – 30	8.1	1.38	2.7	0.31	9.55	0.22	0	3.0	6.0	3.78	7.8
			30 -80	8.0	3.06	8.3	4.00	18.5	1.2	0	3.5	10.8	20.51	20.9
			80–120	7.6	3.92	1.86	1.18	32.8	0.4	0	3.6	11.2	21.44	26.6
Alluvial	Moderatly high Terraces (basin)	11	0 – 25	7.65	5.07	9.37	6.74	34.12	0.50	0	2.0	19	29.73	12.1
			25 -60	7.85	3.71	6.39	3.89	26.50	0.37	0	1.5	14	21.65	11.7
			60–120	7.72	5.39	11.16	7.17	35.20	0.41	0	1.5	21	31.44	11.7
		16	0 – 30	8.1	3.3	10.2	4.1	19.1	0.4	0	0.9	15.6	17.3	7.1
			30 -70	8.2	2.4	6.3	2.5	15.5	0.3	0	0.3	13.7	10.6	7.4
			70–120	8.2	1.2	3.1	1.2	7.6	0.3	0	0.2	6.9	5.1	5.2
		17	0 – 45	8.2	2.35	8.6	7.4	8.9	0.4	0	0.5	9.4	15.4	3.1
			45–120	8.2	1.84	6.1	2.5	10.0	0.3	0	0.4	8.7	9.8	4.8
		18	0 – 30	7.84	1.27	3.92	2.10	6.52	0.18	0	1.5	4.5	6.72	3.8
			30 - 70	7.76	1.12	3.64	2.46	4.98	0.15	0	1.5	3.5	6.23	2.9
			70–120	7.68	2.16	7.16	4.24	9.86	0.35	0	1.5	8.0	12.11	4.1
N.A.	H.T.	13	0 – 25	8.1	1.7	3.5	3.9	10.40	0.20	0	2.1	6.2	9.3	5.4
			25 -60	7.6	2.8	6.91	4.72	16.30	0.50	0	1.5	9.5	17.43	6.8
			60–120	8.1	2.75	10.1	3.6	14.70	0.80	0	0.6	17.2	7.80	5.6
		20	0 – 30	7.6	2.6	12.83	4.61	9.33	0.23	0	0.46	10.01	16.53	4.15
			30 - 80	7.8	1.9	7.66	3.43	8.72	0.19	0	0.33	9.12	10.55	3.71
			80–150	7.9	1.7	7.12	3.14	7.55	0.19	0	0.35	7.96	9.69	2.96
		21	0 – 25	7.8	2.9	14.64	5.32	9.70	0.34	0	0.52	10.50	18.98	3.07
			25 -75	7.9	1.8	7.70	3.35	7.78	0.17	0	0.27	8.44	10.29	3.31
			75–120	8.1	1.1	5.42	2.15	4.32	0.11	0	0.20	5.25	6.55	2.22
A.P.	V.	19	0 – 20	7.85	5.02	8.94	5.44	35.47	0.41	0	2.5	19.5	28.26	13.2
			20 -90	7.84	2.18	6.55	4.55	10.63	0.10	0	1.5	7.5	12.83	4.5
			90–120	7.85	1.78	5.15	3.09	9.35	0.25	0	1.0	6.5	10.34	4.6

respectively. Chemical characteristics i.e. pH, ECe and SAR are 7.46-7.93, 2.34-24.18 dSm^{-1} and 5.3-18.6, respectively.

According to USDA (2014) the soil of the unit under studying are classified into:

- Typic Torripsamments, siliceous, hyperthermic (profile 1).
- Sodic Haplotorrerts, fine, smectitic, hyperthermic (profiles 6, 9, 10 and 12).

- Typic Torrifluvents, coarse loamy, mixed, hyperthermic (profile 14).

2. Fluvio-Lacustrine, low terraces:

It represents about 37.6 km^2 (15.45% of total area of the district). Soils of profiles 2 and 7 are the representative profiles of the unit. The soils appear nearly level slope with fine cracks. Texture class through soil profile 2 is sandy loam, while, clay through profile 7, so, soil structure is massive in the first profile and blocky in the second. The main soil components of gravel, organic matter, gypsum and lime are nil, 0.21-0.87%, 1.3-1.8% and 2.2-11.8% respectively. Values of pH, ECe and SAR are 7.35-7.96, 3.33-7.65 dSm^{-1} and 8.6-15.0, respectively.

The soils under consideration, according to USDA, 2014 can classify as:

- Typic Torrifluvents, coarse loamy, mixed, hyperthermic (profile 2).
- Sodic Haplotorrerts, fine, smectitic, hyperthermic (profile 7).

3. Fluvio-Lacustrine, low terraces (basin cover with sand sheet):

The unit covers about 14.11 km^2 (5.8% of total area of the district). It is represented by profiles 3, 4, 5 and 8. The soils show nearly level slope, clay texture class, except soil of profile 8 which have sand texture with cap of sandy clay loam, and blocky structure with single grain and massive in upper layer of profile 8. Main physical properties are nil gravel, 0.33-1.31% organic matter, 1.1-1.7% gypsum and 3.6-12.9% lime. Main chemical properties are 7.49-8.3 pH values, 1.89-11.01 dS/m salinity and 8.1-26.6 SAR values. According to USDA, 2014, the soils under consideration classify as follows:

- Sodic Haplotorrerts, fine, smectitic, hyperthermic (profiles 3, 4 and 5).
- Typic Torrifluvents, fine loamy over sandy, mixed, hyperthermic (profile 8).

4. Fluvio-Lacustrine, high terraces:

It is about 37.62% km^2 (15.46% of area of the district). Soils of profile 15 is the representative one. The slope gradient is nearly level. The texture class is clay in upper layers follows by sandy loam. The structure varies between firm which associated with slickenside and friable. The main soil constituents of gravels, organic matter, gypsum and lime contents were nil, 0.31-0.87%, 1.1-1.2% and 0.52-3.4%, respectively. The chemical soil characteristics were 7.6-8.1 pH values, 1.38-3.92 dSm^{-1} salinity, and 7.5-7.8 SAR values. Soil characteristics of the representative profile reveal to soil classification according to USDA, 2014 as follows:

- Typic Haplotorrerts, clayey, mixed, hyperthermic.

5. Alluvial, moderately high terraces (basin):

It occupies about 35.54% km^2 (14.6% of total area of the district). These soils are represented by soil profiles 11, 16, 17 and 18. The soils appear nearly level slope and few weeds. The soil texture class is clay in soil profiles 11 and 16 and varies between loam and clay in others. Soils which have clay texture appear blocky structure and slickenside phenomena in the subsurface layers, while other have massive one. The soils of this unit have 0.25-1.44% organic matter, 1.3-1.9% gypsum, 3.1-10.8% lime, 7.65-8.2 pH values, 1.12-5.39 dS/m salinity and 2.9-12.1 SAR values. According to the

previous characteristics and USDA (2014) the soils under investigation can classify as:

- Typic Haplotorrerts, fine, smectitic, hyperthermic (profiles 11 and 16).
- Vertic Torrifluvents, fine loamy, mixed, hyperthermic (profile 17).
- Typic Torrifluvents, fine loamy, mixed, hyperthermic (profile 18).

6. Nile Alluvial, high terraces:

This unit takes up about 43.57 km^2 (17.9% of total area of the district). Soils of profiles 13, 20 and 21 are the representative profiles. The surface appear nearly level slope, fine cracks and many weeds. There are clay texture class through profile 20 or in the surface layer of the rest, while the others have clay loam & sand clay loam or sand. The main soil components are 0.22-1.71% organic matter which decrease irregular with depth, 0.7-1.9% gypsum, 0.44-2.77% lime and 1.1-2.9 dSm^{-1} salinity. Values of pH vary from 7.6 to 8.1, while values of SAR change between 2.22 and 6.8. Data of different soil characteristic indicate that the soil under consideration classify according to USDA (2014) as follows:

- Typic Torrifluvents, sandy, mixed, hyperthermic (profile 13).
- Typic Haplotorrerts, very fine, smectitic, hyperthermic (profile 20).
- Vertic Torrifluvents, fine loamy, mixed, hyperthermic (profile 21).

7. Alluvial plain, Vales:

About 15.87 km^2 are covered by these deposition (6.52% of total area of the district). This unit are represented by profile 19, which have nearly level slope, clay loam texture class and massive soil structure. Organic matter contents change from 0.33 to 0.89%. Gypsum contents vary from 1.4 to 1.9%. Lime contents differ from 7.3 to 9.2%. Soil pH values are from 7.84 to 7.85. Soil salinity records 1.78-5.02 dSm^{-1}, while values of SAR are observed between 4.5 and 7.5. According to USDA (2014) the soils of alluvial plain (vales) belong to:

- Typic Torrifluvents, fine loamy, mixed, hyperthermic (profile 19).

Land evaluation:

Different representative soil profiles were evaluated according to Sys and Verheye (1978) system. Data in Table 4 show that soils of fluvio-lacustrine, moderately low terraces vary widely from not suitable to highly suitable in current suitability. These soils appear highly suitable class in potential except soils of profiles 1 and 10 show marginal and moderately suitable classes, respectively.

Soil of fluvio-lacustrine, low terraces record moderately suitable class in both current and potential in profile 2 and marginal raise to highly suitable in profile 7.

Soils of fluvio-lacustrine, low terraces (basin cover with sand sheet) have moderately current suitable class promote to highly potential suitable class except soil of profile 8 which appear less levels.

Soils of fluvio-marine, high terraces appear moderately current suitability and highly potential suitability.

Table 4 : Soil limitations and land suitability for irrigated agriculture.

Physiographic unit	Prof. No.	Topography (t)		Wetness (w)		Texture (S1)	Depth (S2)	CaCO3 (S3)	CaSO4.2H2O (S3)	Salinity & Alkalinity		Suitability Index		Suitability Class		Suitability and intensity limitation	
		Cs	Ps	Cs	Ps					Cs	Ps	Cs	Ps	Cs	Ps	Current	Potential
Fluvio - Lacustrine	1	95	100	95	100	30	100	95	100	75	100	19.3	28.5	N1	S3	Slight t,w,S3, modrate n, very sever S1	Slight S3, very sever S1
	6	100	100	90	100	85	100	95	100	60	100	43.6	80.8	S3	S1	Slight w,S1,S3, moderate n	Slight S1,S3
	9	100	100	90	100	85	100	95	100	50	100	36.3	80.8	S3	S1	Slight w,S1,S3, sever n	Slight S1,S3
	10	100	100	90	100	65	100	100	100	90	100	52.7	65.0	S2	S2	Slight w,n, moderate S1	Moderate S1
	12	100	100	90	100	85	100	100	100	80	100	61.2	85.0	S2	S1	Slight w,S1,n	Slight S1
	14	100	100	95	100	90	100	95	100	100	100	81.2	85.5	S1	S1	Slight w,S1,S3	Slight S1,S3
	2	100	100	95	100	75	100	95	100	96	100	65.0	71.3	S2	S2	Slight w,S3, moderate S1	Slight S3, moderate S1
	7	100	100	80	100	85	90	100	100	80	100	49.0	76.5	S3	S1	Slight S1,S2, moderate w,n	Slight S1,S2
	3	100	100	90	100	85	100	95	100	80	100	58.0	80.8	S2	S1	Slight w,S1, modeate n	
	4	100	100	90	100	85	100	95	100	100	100	72.7	80.8	S2	S1	Slight w,S1,S3	Slight S1,S3
	5	100	100	90	100	85	100	100	100	70	100	53.6	85.0	S2	S1	Slight w,S1, modeate n	Slight S1
	8	100	100	90	100	60	90	95	100	90	100	41.6	51.3	S3	S2	Slight w,S2,S3,n, sever S1	Slight S2,S3, sever S1
	15	100	100	90	100	80	100	95	100	90	100	61.6	76.0	S2	S1	Slight w,S3,n, moderate S1	Slight S3, moderate S1
Alluvial	11	100	100	90	100	85	100	95	100	85	100	61.8	80.8	S2	S1	Slight w,S1,S3,n	Slight S1,S3
	16	100	100	90	100	85	100	95	100	100	100	72.7	80.8	S2	S1	Slight w,S1,S3	Slight S1,S3
	17	100	100	95	100	95	100	95	100	100	100	85.7	90.3	S1	S1	Slight w,S1,S3	Slight S1,S3
	18	100	100	95	100	95	100	95	100	100	100	85.7	90.3	S1	S1	Slight w,S1,S3	Slight S1,S3
N.A.	13	100	100	95	100	60	100	95	100	90	100	48.7	57.0	S3	S2	Slight w,S3,n, moderate S1	Slight S3, moderate S1
	20	100	100	95	100	65	100	95	100	100	100	58.6	61.7	S2	S2	Slight w,S3, moderate S1	Slight S3, moderate S1
	21	100	100	95	100	100	90	95	100	100	100	81.2	85.5	S1	S1	Slight w,S2,S3	Slight S2, S3
A.P.	19	100	100	95	100	100	100	95	100	96	100	86.6	95.0	S1	S1	Slight w,S3	Slight S3

Suitability classes: S1 = Highly suitable, S2 = Moderatly suitable, S3 = Marginal suitable, N1 = Not suitable (be correct)
H.T = High Terraces, N.A. = Nile Alluvial, A.P. = Alluvial Plain, V. = Vales, Cs = Current Suitability, Ps = Potential Suitability

Soils of alluvial-moderately high terraces (basin) show moderately current suitability and highly potential suitability for profiles 11 and 16 and highly suitability in both current and potential suitability for profiles 17 and 18.

Soils of Nile-alluvial, higher terraces appear marginal to high suitable class for current suitability and moderately and high suitable class for potential.

Soils of alluvial plain (vales) record highly suitable class for both current and potential suitability.

Generally, soils under consideration mainly, suffering from texture, sodicity and salinity, can be recorded highly suitable class with regard to potential suitability by application more suitable irrigation systems, favorable managements and cultivation appropriate crops.

More suitable crops:

According Sys et. al. (1993), data reveal to more suitable crops follows the descending order:

Sorghum > barley > cotton > olive > wheat > alfalfa > maize.

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دراسة مختلف الوحدات الفيزيوجرافية لمركز سنورس – محافظة الفيوم – مصر

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معهد بحوث الأراضى والمياه والبيئة – مركز البحوث الزراعية – جيزة – مصر

يقع مركز سنورس بمحافظة الفيوم حيث يحده من الشمال بحيرة قارون ومن الجنوب مركز الفيوم ومن الشرق مركز طامية ومن الغرب مركز إبشواى. تلخصت الوحدات الجيوبيدولوجية الفيزيوجرافية والوحدات التقسيمية لمنطقة الدراسة فيما يلى:

١. رسوبيات نهرية بحيرية (مصاطب متوسطة الإنخفاض)

1. Fluvio-Lacustrine, moderately low terraces:
   - Typic Torripsamments, siliceous, hyperthermic.
   - Sodic Haplotorrerts, fine, smectitic, hyperthermic.
   - Typic Torrifluvents, coarse loamy, mixed, hyperthermic.

٢. رسوبيات نهرية بحيرية (مصاطب منخفضة)

2. Fluvio-Lacustrine, low terraces:
   - Typic Torrifluvents, coarse loamy, mixed, hyperthermic.
   - Sodic Haplotorrerts, fine, smectitic, hyperthermic.

٣. رسوبيات نهرية بحيرية (مصاطب منخفضة مغطاة بطبقات رملية – حوض)

3. Fluvio-Lacustrine, low terraces (basin cover with sand sheet):
   - Sodic Haplotorrerts, fine, smectitic, hyperthermic.
   - Typic Torrifluvents, fine loamy over sandy, mixed, hyperthermic.

٤. رسوبيات نهرية بحيرية (مصاطب مرتفعة)

4. Fluvio-Lacustrine, high terraces:
   - Typic Haplotorrerts, clayey, mixed, hyperthermic.

٥. رسوبيات نهرية (مصاطب متوسطة الارتفاع)

5. Alluvial, moderately high terraces (basin):
   - Typic Haplotorrerts, fine, smectitic, hyperthermic.
   - Vertic Torrifluvents, fine loamy, mixed, hyperthermic.
   - Typic Torrifluvents, fine loamy, mixed, hyperthermic.

٦. الرسوبيات النيلية (مصاطب مرتفعة)

6. Nile Alluvial, high terraces:
   - Typic Torrifluvents, sandy, mixed, hyperthermic.
   - Typic Haplotorrerts, very fine, smectitic, hyperthermic.
   - Vertic Torrifluvents, fine loamy, mixed, hyperthermic.

٧. السهل الرسوبى (أودية)

7. Alluvial plain, Vales:
   - Typic Torrifluvents, fine loamy, mixed, hyperthermic.

- دلت نتائج تقييم الأراضى بمنطقة الدراسة على أنها تعانى من مشاكل فى القوام والملوحة والقلوية (الصودية) ويمكن أن تسجل أراضى هذه الوحدات أعلى قيم تقيمية بتطبيق نظم الرى الملائمة واختبار وسائل إدارة الأراضى المناسبة وزراعة أكثر المحاصيل ملائمة.
- تبين من دراسة مدى ملائمة المحاصيل للخصائص الأرضية أن أنسب المحاصيل يمكن ترتيبها بنظام تنازلى كما يلى:

السورجم > الشعير > القطن > الزيتون > القمح > البرسيم الحجازى > الأذرة