STUDY AND EVALUATE EL GABAL EL ASFAR SOILS WHICH IRRIGATED BY SEWAGE SLUDGE

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ABSTRACT

The investigated area is located to the east of the Nile Delta; it is bounded by latitudes 30° 11' 15" & 30° 14' 10" N and longitudes 31° 22' 05" & 31° 24' 20" E. According to period of irrigated by sewage effluents the soils of the area were divided into four grades. These include i) non-irrigated and barren, ii) irrigated for (24 years), iii) irrigated for (49 years) and iv) irrigated for 82 years until 2009 and after this changed to irrigated by ground water. Four soil profiles were taken to represent the soils of the area. Morphological description and soil sampling were conducted during the field work. The soil properties including texture, depth, organic matter (OM), EC, CaCO₃, pH, CEC, and ESP have been determined. The soils were classified as: Typic Torripsamments and Typic Torriorthents according to the American soil taxonomy. The soil capability classes ranged between (2) good and (5) very poor. The soil suitability ranged between S1 and S3. The soils of the area are suitable for field crops (Wheat, Barley, Faba bean, Sugar beat, Sun flower, Maize, Soya bean, Peanut, Cotton, Sugar Cane), vegetable (Tomato, Pepper, Watermelon, Alfalfa, Sorghum), and fruit (Citrus, Grape, Olive, Apple, Pear, Figs, Date palm). The soils are in general not suitable for Cabbage, Onion, Rice and Banana.

INTRODUCTION

The studied area located in south-eastern edge of the Qaliubiya governorate in Belbes Desert, it is bounded by latitudes 30° 11' 15" & 30° 14' 10" N and longitudes 31° 22' 05" & 31° 24' 20" E (Fig. 1).



The climate of the area is the same desert climate of the Cairo area, which is moderated by A proximally of the Mediterranean Sea African Development Bank (2008). The soils at EI –Khanka city are classified xeric moisture regime and Aridic moisture regime and the soil temperature regime of the area is Thermic USDA (2010). According to Shata and El Fayoumy (1970), El Diary (1980). and RIGW (1989). The Pleistocene and Holocene epoch of the Quaternary period mainly cover the study area. Miocene and Pliocene sediments of the Neogene period outcrop at the eastern portions.

Since 1900, Egypt began to apply the use of sewage water in farming as unconventional source of water to reduce the water shortage and achieve the block of the food gap between the product and the overpopulation. Sewage water contains useful nutrients for the soil fertility and plants nutrition. The benefits of these nutrients depend on the concentrations of the nutrients in wastewater, the quantities of wastewater applied, the times of application, the type and the target yield of the crop grown, and the fertility of the soil (Janssen *et al.*, 2005). On the other hand it contains high percentage of heavy metals which cause toxicity of plant and a harmful effect on humans. Acording to EI-Fakharany and Mansour (2009) The Quaternary aquifer classified into two hydrogeological units; the upper unit is the Holocene aquitard and the lower one is the Pleistocene aquifer.

MATERIALS AND METHODS

Four soil profiles choosing to representative the soils of the four areas non-irrigated, irrigated for 29 years, irrigated for 49 years and 82 years, were duge and detailed description were done based on USDA (2010) and collected the different samples for the different morphological layers of soil profiles for another analysis. The particle size distribution determined according dry sieving method, USDA (1991). Soil pH determined according to klute (1986). EC dS m⁻¹, CaCO₃ %, OM% determined according to USDA (1991), Cation exchange capacity (CEC), exchangeable sodium determined according to Robert (2008). Based on the morphological, physical, chemical and climatologically data classified the soil of the area according to USDA (2010).

Land capability and suitability Soil classes.

Based on the physical, chemical, fertility, climatologically and crops requirements according to FAO (1981). The (ASLE) software (Ismail et al, 1994) was used to producing land capability and suitability classes. The Arc-GIS 9.3 software was used for mapping the land capability and suitability of the studied area.

RESULTS AND DISCUSSION

General description of the area

The parent material of the area under investigation is Pliocene and plectocen deposits. The Relief is flat and flat to almost flat. The drainage condition is well. The land use field crops and vegetable crops.

The soil of the area was developed according to the application period of sewage effluents. The morphological features were changed with the time of the application Table (1).

The area under investigation based on period of irrigated with sewage effluent could be divided into four classes as the following:-

Non-irrrigated soils

The soils non-irrigated and barren and representative by soil profile No (4) and (fig.2).

The morphological features as colour, texture, structure, consistence, pores, effervescence with Hcl, and boundary indicated there are no changed from layer to another. From table (2) the texture class is sand, cation exchange capacity values are low and ranged between 1.12 and 0.61 mg/100g soil. ESP values are low than 15%. From table (3) pH values are ranged between 7 and8. CaCO₃ content is high in the surface and decrease with depth. Organic mature content is low and decrease with depth. Electrical conductivity (EC dS m⁻¹) values are high in the surface (6.62 dS m⁻¹) and decrease with to reach 1.40 dS m⁻¹.



Fig.2. Photography Image Barren Soil Profile No. (4).

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ofile No	Jepth n cm	se Sand %	ie sand %	Silt %	Clay %	exture Class	CEC g/100g		Cations	mg/100g		ESP %
brc		Cor	Fin			ĔŪ	Ē	Ca⁺	™g™	Na⁺	₽ţ	
	0 - 40	64.9	34.4	0.42	0.28	Sand	1.12	0.49	0.23	0.11	0.19	9.82
4	40 - 90	76.3	22.9	0.48	0.32	Sand	0.82	0.48	0.31	0.02	0.01	2.4
	90 - 130	80.8	19.1	0.06	0.04	Sand	0.61	0.35	0.24	0.01	0.01	1.6

Table 2. Particle size distribution analysis of barren soil.

Table 3. Some	chemical	characteristics	of barren	soil.
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Profile	Depth in	PH	C-CO	OM EC Soluble Cations mq/l Soluble an								ions mq/l		
No	cm	(1:1)	CaCO ₃	%	dS m ⁻¹	Ca ^{⁺+}	Mg ⁺⁺	Na⁺	K⁺	Co [−] ₃	Hco ₃	CI.	So ⁻⁴	
	0 - 40	7.65	6.23	0.53	6.62	20.3	12.8	30.9	2.2	0.0	15.2	36.9	14.1	
4	40 - 90	7.89	5.82	0.26	2.48	8.6	3.8	11.2	1.2	0.0	5.2	18.1	1.5	
	90 - 130	8.01	5.96	0.15	1.40	4.1	2.9	6.0	1.0	0.0	2.1	8.2	3.7	

Soils irrigated with Sewage Sludge for 29 years

The soil irrigated for (29) years and representative by soil profiles No. (1) and fig. (3). The morphological features does not changed from layer to another which indicated that there is no effects for sewage effluent. From table (4) the texture is sand, Cation Exchange capacity still low and ranged between 6.21 mg/100g soil in the surface and 0.72 mg/100g soil in the deep, ESP values are low than 15%. From table (5) pH values are ranged between 8.06 and 8.13, CaCO₃ content is varied from layer to another and ranged between 4.24 and 8.00. Organic mature content is moderately high in the surface and decrease with depth. Electrical Conductivity (EC dS m⁻¹) is low than another.



Fig.3. Profile No.(1). 433

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Profile	Depth	Corse	Fine	Silt	Clay	Toxturo	CEC ma	Cat	tions n	ng/10	0g	FSD
No	in cm	Sand %	sand %	%	%	Class	/100g	Ca⁺⁺	Mg⁺⁺	Na⁺	K⁺	%
	0 – 15	70.00	14.02	10.05	5.02	Sand	6.21	2.56	1.65	0.86	0.90	13.85
1	15 – 40	76.8	22.1	0.66	0.44	Sand	1.35	0.52	0.43	0.11	0.19	8.15
1	40 – 80	52.8	46.7	0.3	0.2	Sand	1.12	0.55	0.19	0.12	0.16	10.71
	80 -120	44.7	55.2	0.06	0.04	Sand	0.72	0.43	0.27	0.01	0.01	1.39

Table 4. Particle size distribution analysis of second area.

Table 5. Some chemical characteristics of second area

Profile	Depth	PH	C-CO	OM	EC	Solu	ble Ca	tions	mq/l	Soluble anions mq/l				
No	in cm	(1:1)		%	dSm ^{⁻1}	Ca ⁺⁺	Mg⁺⁺	Na⁺	K⁺	Co ₃	Hco ₃	CI.	So ⁻ ₄	
	0 – 15	8.13	4.65	2.98	0.68	2.35	1.05	2.20	1.20	0.00	1.33	3.25	2.22	
1	15 – 40	8.06	5.23	1.56	0.30	0.98	0.52	1.10	0.40	0.00	0.89	1.87	0.24	
	40 - 80	8.11	4.54	0.89	0.27	0.79	0.56	1.10	0.25	0.00	0.30	1.32	1.08	
	80 -120	8.12	8	0.65	0.28	0.88	0.52	0.91	0.49	0.00	0.25	1.15	1.40	

Soils irrigated with Sewage Sludge for 49 years

The soil irrigated for (49) years and representative by soil profile No. (6). From table (6) the texture class is loamy sand in the surface and changed to sand the deep layer, Cation Exchange capacity (mg/100g soil) varied from layer to another as 13.78 in the surface, 16.89 in the subsurface, 1.21 in the third layer and 0.61 mg/100g soil in the deepest layer. ESP values are low than 15%. From table (7) pH values are ranged between 7.78 and 8.22, CaCO₃ content is 4.01 in the surface and increase with depth to reach 5.15. Organic mature content is high in the surface and decrease with depth. Electrical Conductivity is low than another.

Table (6) Particle size distribution analysis of third area

Profile	Denth	Corse	Fine	Silt	Clav	Toyturo	CEC	Cat	ions n	ng/10	0g	FSP
No	in cm	Sand %	sand %	%	%	Class	mg/100g	Ca⁺⁺	Mg⁺⁺	Na⁺	K⁺	%
	0 – 15	50.20	18.46	20.56	10.87	loamy sand	13.78	7.23	4.30	1.26	0.99	9.1
6	15 – 30	49.72	16.88	19.95	13.45	loamy sand	16.89	8.98	5.78	1.28	0.85	7.6
	30 – 70	82.00	17.80	0.12	0.08	Sand	1.21	0.51	0.31	0.20	0.14	6.5
	70 – 120	95.50	4.20	0.18	0.12	Sand	0.61	0.39	0.19	0.02	0.01	3.3

Table 7. Some chemical characteristics of third area

Profile	Depth	PH	0.00	OM	EC	Solub	le Cat	ions	mq/l	Solu	ıble ani	ons n	nq/l
No	in cm	(1:1)	CaCO ₃	%	dSm ⁻¹	Ca⁺⁺	Mg ⁺⁺	Na⁺	K⁺	Co 3	Hco ₃	CI.	So ₄
	0 - 15	7.78	4.01	5.78	0.61	2.1	1.0	2.6	0.5	0.0	2.7	3.8	-0.4
6	15 – 30	8.01	4.57	3.12	0.52	1.9	0.8	2.0	0.6	0.0	1.9	2.9	0.5
0	30 - 70	8.12	4.98	1.35	0.40	1.3	0.8	1.3	0.7	0.0	0.6	1.9	1.5
	70 – 120	8.22	5.15	0.98	0.30	1.1	0.9	1.1	0.4	0.0	0.2	1.0	2.3

Soils irrigated with Sewage Sludge for 82 years

The soil irrigated for (82) years and representative by soil profile No. (13) and fig. (4). From table (8) the texture class is clay loam in the surface and subsurface and sand in the deep layers, Cation Exchange **434**

capacity (mg/100g soil) varied from layer to another as 30.34 in the surface, 34.25 in the subsurface, 0.32 in the third layer and 0.30 mg/100g soil in the deep layer. ESP values are low than 15%. From table (9) pH values ranged between 7.67 and 8.01, CaCO₃ content ranged between 3.01 and 5.12% and increase with depth. Organic mature values high in the surface and decrease with depth and ranged between 6.79 and 0.34. Electrical Conductivity (EC dS m⁻¹) ranged between 0, 43 and 0.57dS m⁻¹.



Fig.4. Profile No. (13).

Profile	Donth	Corse	Fine	Cilt	Clay	Toxturo	CEC	Cat	ions m	ig/10)g	ESD
No	in cm	Sand %	sand %	%	%	Class	mg /100g	Ca⁺⁺	Mg⁺⁺	Na⁺	K⁺	<u>к</u>
	0 – 20	20.08	18.00	35.04	25.07	Clay loam	30.34	15.75	9.49	3.10	1.45	10.2
13	20 – 40	19.01	15.01	37.02	28.03	clay loam	34.25	18.52	10.41	3.32	2.00	9.7
	40 – 80	75.8	24.1	0.06	0.04	Sand	0.32	0.20	0.10	0.01	0.01	3.1
	80 – 120	72.7	27.1	0.06	0.04	Sand	0.3	0.16	0.12	0.01	0.01	3.3

Table 8. Particle size distribution analysis of fourth area

Generally, the climate of the area is arid led to the initial soil content of organic matter is poor and low level of cation exchange capacity that affect on soil fertility. The impact of sewage water on soil was not significant on irrigated soil for 29 years, while the effect of sewage explained on irrigated soil for 49 and 80 years old. This effect represents the high values of the organic material that contain colloidal substances have a negative active

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surfaces Intensify the positive elements leads to high cationic exchange capacity of the soil and the soil texture changed from sandy to loamy sand clay.

Table 9. Chemical ana	lysis of fourth area
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Profile	Depth	PH	<u> </u>	ОМ	EC	Solub	le Cati	ons	mq/l	Solut	ole ani	ons	mq/l
No	in cm	(1:1)	CaCO ₃	%	dSm⁻¹	Ca ⁺⁺	Mg ⁺⁺	Na⁺	K⁺	Co _3	Hco ⁻ 3	Cl	So ₄
	0 - 20	7.86	3.01	6.79	0.57	1.4	0.9	2.9	0.6	0.0	1.1	3.1	2.0
10	20 - 40	7.67	4.32	4.23	0.50	1.5	0.9	2.0	0.6	0.0	0.8	2.6	2.1
13	40 - 80	7.98	4.78	2	0.44	1.4	0.9	1.8	0.4	0.0	0.6	2.0	2.2
	80 - 120	8.01	5.12	0.98	0.43	1.3	0.8	1.8	0.4	0.0	0.6	2.1	2.0

Soil capability

The Land capability classification of the soils of the studied area was carried out according to soil depth, texture class, cations exchange capacity (CEC), available moisture content, CaCO₃, exchangeable sodium percentage (ESP), soil salinity (EC) and drainage condition. The results showed that land capability ranges between classes 2 (good) to class 5 (very poor) and most of it sites under class 2. The low capability class C4 and C5 is related to drainage condition, soil salinity and alkalinity, CEC and soil texture. The highly capability class correlation with highly soil fertility, improved of soil texture and highly organic matter. Land capability class enhanced with time these results showed in table (10) and fig. (5).

Table (10) the class of land capability.

Profile No.	Land capability class	Final index
1	C 4 (poor)	33.21
4	C 5 (very poor)	12.93
6	C 3 (fair)	58.18
13	C 2 (good)	79.29

Soil Suitability class

According to environmental requirements for 28 crops (Wheat, Barley, Faba bean, Sugar beat, Sun flower, Rice, Maize, Soya bean, Peanut, Cotton, Sugar Cane) as failed crop, (Onion, Cabbage, Pea, Potato, Tomato, Pepper, Watermelon, Alfalfa, Sorghum) as vegetable and forage crops and (Citrus, Banana, Grape, Olive, Apple, Pear, Figs, Date palm) as fruit trees The results showed that The most suitable crops to grow in the study area are Cotton, Date palm, Olive, Alfalfa, Barley, Wheat, Maize, Faba been, Soya been, Sugar beet, and Citrus. The suitability for Cabbage, Onion, Rice and Banana is ranges between currently non suitable to permanently non suitable. The soil suitability for Cabbage, Onion, Rice and Banana is limited in some area by soil salinity and alkalinity, exchangeable sodium percentage, drainage condition and soil texture. fig. (6).



Fig.5. Land Capability Classes of the Investigated Area.



Fig.6. Soil Suitability Map.

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دراسة وتقيم أراضي الجبل الأصفر التي تروى بمياه الصرف الصحي مجدي محمد مكاوي عودة* ، علي عبد الحميد عبد الهادي* ، وائل أحمد عبد القوي* ، رأفت رمضان علي** *قسم الأراضي - كلية الزراعة - جامعة القاهرة - القاهرة - مصر. **قسم الأراضي واستغلال المياه - المركز القومي للبحوث - الجيزة.

منطقة الدراسة تقع شرق دلتا النيل بين خط عرض "10 '14 °30 & "15 '11 °30 شمالاً وخط طول "20 '24 30 '20 '20 °31 شمالاً وخط طول "20 '24 30 '20 '20 °31 شمالاً وخط طول "20 '24 30 '20 '20 °31 شمالاً وفقا لفترة الري بمياه الصرف الصحي قسمت الأرض بالمنطقة إلى أربع مناطق. المنطقة الأولى غير مروية وقاحلة غير مزروعة ، (28) ماما دارض بالمنطقة الدائية رويت (49) عاما والمنطقة الرابعة رويت (28) عاما من مياه الصرف الصحي عام من مياه الصرف الصحي عام المنطقة الثالثة رويت (49) عاما والمنطقة الرابعة رويت (28) عاما من مياه الصرف الصحي، حتى عام 2009 وبعد ذلك تغيرت للري بالماء الأرضي. اربعة عما من مياه الصرف الصحي، حتى عام 2009 وبعد ذلك تغيرت للري بالماء الأرضي. اربعة قطاعات ارضية أخذت لتمثيل ترب المنطقة والوصف المور فولوجي خلال العمل الحقلي. صفات التربة متضمنة تحليل فيزيائي (قوام التربة) , العمق, المادة العضوية OM ، ملوحة التربة CaCO كربونات الكالسيوم EC ، درجة الحموضة PH ، السعة التبادلية الكانيونية CEC ، موجوم المربولية التربة OF كربونات الكالسيوم ESP ، درجة الحموضة PH ، السعة التبادلية التربية التربية OF كربونات الكالسيوم ESP ، درجة الحموضة PH ، المادة العضوية OF ، موجوم كربونات الكالسيوم و ESP ، درجة الحموضة PH ، السعة التبادلية الكانيونية CEC ، موجوم للوجي معات الصوديوم المتبادل PH ، العمق المور يو الماد الحموم المربولية OF ، نوب المادة العضوية OF ، الموجوم المربولية CEC ، موجوم الحموم المربولية PH ، العمق المور يوم المتبادل PH ، العموم المربولية PH ، العموم المتبادل ESP ، نوب الموجوم الحموم المربولية الكانيونية ESP ، نوب الموديوم المتبادل ESP ، وي ESP ، نوب الموديوم المربوم المتبادل ESP ، درجة الحموم PH ، العموم الحموم الحموم PH ، العموم الحموم PH ، العموم PH ، العموم الحموم PH ، العموم الحموم PH ، وي ESP ، نوب الحموم PH ، العموم PH ، العموم PH ، وي ESP ، نوب الحموم PH ، العموم PH ، وي PH ، وي

قام بتحكيم البحث

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كلية الزراعة – جامعة المنصورة مركز البحوث الزراعية

Applicat.	Profile	Depth	Land		Colo	r	Toytura		Consi	s Efferv.	_	s Boundary New formation	
Périod (year)	No.	ln (cm)	Use	Symbole	Dry	Moist	class	Structure	-tence Dry	With Hcl	Roots	Boundary	New formation
		0-40	Barren	C1	10YR 6/2	10YR 5/3	S.	SG.	sh.	h.	N.	ms.	
Zero	4	40-90		C2	10YR 6/2	10YR 5/3	S.	SG.	L.	mh.	N.	SS.	
		90-130		C3	10YR 6/2	10YR 5/3	S.	SG.	L.	mh.	N.		
		0-15	After citrus	Ар	10YR 6/2	10YR 5/3	S.	SG.	sh.	m.	csm.	md.	
29	1	15-40		C1	10YR 6/2	10YR 5/3	S.	SG.	sh.	m.	Ffm.	SS.	
25		40-80		C2	10YR 6/4	10YR 5/2	S.	SG.	sh.	m.	csm.	s.	
		80-120		C3	10YR 6/4	10YR 5/2	S.	SG.	L.	mh.	Ν		
		0-15	Alfalfa	Ар	10YR 6/2	10YR 4/3	LS.	Smmss	sh.	m.	csm.	cs	common small residual parts and humified of organic compound.
49	6	15-30		C1	10YR 6/2	10YR 4/3	LS.	Mmssb	mh	m.	Fm	CS.	few humified of organic compound
		30-70		C2	10YR 6/2	10YR 5/3	S.	SG.	L.	m.		sd.	
		70-120		C3	10YR 6/4	10YR 5/2	S.	SG.	L.	m.			
		0-20	Tomato	Ар	10YR 5/3	10YR 4/2	CL.	smlsb.	h.	m.	csmm.	CS.	common small to medium mixed from residual and semihumified organic material.
82	13	20-40		C1	10YR 5/3	10YR 4/2	CL.	smlsb.	h.	m.	Fm	CS.	common small humified organic material.
		40-80		C2	10YR 6/2	10YR 5/3	S.	SG.	L.	m.		CS.	
		80-120		C3	10YR 6/2	10YR 5/3	S.	SG.	L.	m.			
Structure	e tion			Texture c	lass	Consis abbrev	stence viation	B a	oundai bbrevia	ry ation	Roots a	bbreviation	I
SG:	Single g	grains		S:	sand		sh: sli	ghtly rd	ms: r	nedium sharp	N:	non	
smmss:	small modera angular	to r tely stro	nedium ng sub	LS:	Loamy sar	d	L: Lo	ose	ss: s	smooth sharp	csm:	common s	mall to medium roots
mmssb:	mediun strong blocky	n moo sub a	derately angular	CL:	Clay loam		mh: Mo	derately d	md: r	noderately liffuse	Ffm:	few fine to	medium roots
smlsb:	strong sub ang	medium t jular bloc	o large ky				h: Ha	rd	SS: S	Slightly smooth	Fm:	few mediu	m roots
efferveso with Hcl	cence								s: s	smooth	csmm:	common s roots	small to medium mixed
h: mh:	High modera high	tely							cs: c sd: c	clear smooth slightly liffuse	I		

Table 1. Morphological feature of the soil profiles of the area.

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