DELINEATION, CLASSIFICATION AND EVALUATION OF PHYSIOGRAPHIC SOIL UNITS IN SOME PROMISING AREA FOR AGRICULTURE UTILIZATION IN THE WESTERN DESERT, EGYPT.

Soliman,Y.R. A.,RiadM.H.and E.E. Massoud

Soils, water and Environment Res, Institute, Agric, Res. Center, Egypt.

ABSTRACT

The magnificence of the studied desert soils has been increased fast due to scale efforts to bring additional areas under the agricultural utilization projects in recent decades. The studied area is located in the western side of 6 October city, adjacent to both sides of El-Giza and El Bahriya Oasis desert road, Western Desert, Egypt. It is considered a promising area for agricultural utilization as well as a model for representing some landscape features in the Western Desert, Egypt. So, the current work has been undertaken to evaluate the constraints for ameliorating these desert soil under the prevailing condition of the Western Desert region. The proposal scheme should be overcome three aspects, i.e. delineation of physiographic soil units, soils classification and soil evaluation. The technique of space images interpretation plays an important role for tracing the prevailing physiographic units as well as identifying the promising sites for agricultural purposes.

The obtained data of the images of Landsat interpretation indicate that the area under consideration is occupied by seven main physiographic units namely; piedmont plain (P111), alluvial- plain (Almost flat) (T111) alluvial plain (undulating) (T131), reworked alluvial plain (T122), dry valley (W111), sandy sheet plain (A211) and rock outcrops.

Soil taxa were surveyed according to the key of Soil Taxonomy (USDA,2014) and could be categorized into two order's Entisols and Aridisols and nine sub great groups as follows:

i) Aridisols include six sub great groups of Lithic Haplogypsids, (i.e. piedment plain), Calcic Haplosalids (Alluvial plain almost flat and undulating), Gypsic Haplosalids (alluvial plain almost flat, undulating and reworked);Typic Haplosalids (dry vally),Typic Calcigypsids (alluvial plain undulating) and Typic Haplocalcids (Alluvial plain of almost flat and reworked alluvial plain).

ii) Entisols include three sub great groups of Lithic Torriorthents (piedmont plain), Typic Torriorthents (dry valley) and Typic Torripsamments (dry valley and sand sheet plain).

According to land evaluation system undertaken by Sys and Verheye (1978) and Sys et.al. (1991), the current suitability for agriculture irrigated soils could be categorized into two suitability classes; i.e. marginally suitable (S3) and not suitable (N) besides three subclasses (Ns1, S2n Ns1,n and S3si,n), Which are suffering from some soil properties, i. e, soil texture (s1), soil depth (s2) and salinity and alkalinity (n) as soil limitations with different intensity degrees (i.e. moderate, severe and very severe). By executing the suitable soil improvement practices, the potential suitability classes assessed three classes, i.e moderately suitable (S2), marginally suitable (S3) and not suitable (N), besides four subclasses (S2s1, S3s1, Nsi and Ns1,s2).

INTRODUCTION

The Agriculture expansion in the desert area is one of the most objectives of the national plan to meet food requirements for the tremendous increase in population. Therefore, attention is focused in the present time to the desert lands.: Accordingly, comprehensive pedological studies have been conducted. Programming any reclamation plan needs knowledge of nature, formation, and classification of soils.

The study aims to clarify the positive effects of different land management and cultivation practices on soils characteristics, i.e., soil morphology, physical and chemical properties as well as land evaluation their potentiality for agriculture and their favorable management practices on the short and long terms.

Location: the investigated area is situated in the Western Desert of Egypt west of 6 October city. It is bounded by:

1- longitude $30^{o/}25^{//}38.35$ and latitude $29^{o/}35^{//}34.60$
2- longitude $30^{o/}18^{//}47.06$and latitude $29^{o/}35^{//}34.60$
3- longitude $30^{o/}53^{//}25.15$ and latitude $30^{o/}04^{//}2.93$
4- longitude $31^{o/}00^{//}7.06$ and latitude $29^{o/}47^{//}37.79$

The studied area covering a total area of 1577.37 Km^2(about 375414 feddans).

Climate:

Based on the Egyptian Meteorological Authority (2010) and American Soil Taxonomy (USDA 2014), the soil temperature regime of the studied area was defined as Thermic and soil moisture regime as Torric. The mean annual temperature reaches its maximum in June, July and August interval and does exceed 35.5^{o} but the temperature average reaches its minimum in January, February and March recording $7.5^{o}C$. The precipitation is not equally distributed through the rainy season in the studied area. The amount of annual rainfall is very low and mostly falls in winter, reaching about 1.1mm/ year

Geology

Said (1990) stated that the oldest sedimentary rocks in the studied area are represented by Late Cretaceous rocks, which have localized occurrence on the crest of a complicated folded structure. The younger rocks of Miocene, Pliocene and Quaternary epochs are the most outcropping sediments dominating the studied area. Middle Tertiary basalt sheets are the only exposed volcanic rock in the area, particularly in the southwestern part. The sedimentary rocks succession starts from base by Triassic rocks resting on the basement rocks and ends at top with the recent deposits belonging to the Quaternary.

Water Resources

Hefny (1993) stated that the studied area can be distinguished by two aquifer layers in which ground water flow may take places.

1- Wadi El-Natrun Aquifer is the upper layer which underlying the ground surface and consists of alteration of loose sand and clay which belong to Pliocene.

2- El Maghra Aquifer is the lower layer which composed of sand and gravel.

El -Shazly et al (1975) applied some of the remote sensing techniques on the western Nile Detla. Diab et al. (1980) have studied the ground water along Cairo - Alexandria Desert road to the axis south of wadi-El Natrun and El-Tahrir province.The recent studies including Dawoud et al (2005) and Fadlellmawla and Dawoud (2006) indicate that the main recharge source for the groundwater in Wadi El -Farigh and Wadi El- Natrun was recent to old Nile waters as well as some contributions from Western Desert palaeo water. Sharaky et al (2007) reveals that the hydrochemical composition reflects the $NaHC0^3$ Water type for the delta (Quaternary) Aquifer, indicating recent meteoric water. Another major water type (NaCl) is recorded in the high salinity area of northern and western parts Na_2So_4 – Water type was recorded, indicating deep meteoric genesis.

This study was carried out to identify the main physiographic units by using the remote sensing techniques and their soil taxonomy ones as well as the nature constraints of the environments factors, then the role of land evaluation system as a guide parameter for economical laud use for the agricultural utilization in some promising areas in the western Desert of Egypt.

Material and Methods

Image interpretation

Space images interpretation performed using the physiographic analysis as proposed by Burnigh (1960) and Goosen (1967). Landsat Image composite of Enhanced Thematic Mapper (ETM7), with bands 2, 3 and 4 was used to add an extra landscape assessment to the photo interpretation map Fig.(1 and 2). The image was helpful for getting a collective overall view of the studied area as well as using the spectral signatures of the used bands in detecting roods and the urban conditions. Digital Elevation Model (DEM) were grouped and processed in Arc GIS 9.3 software to define the different landforms of the studied area. The extracted of data generates a preliminary physiographic map which was checked and completed through field observation. Resolution merge is used for imagery integration of different spatial resolutions. This improves the interpretability of the data by having high resolution information which is also in color.

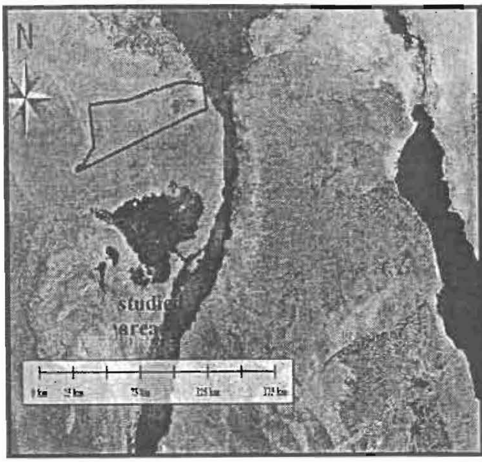

Fig (1) Satellite image of the studied area

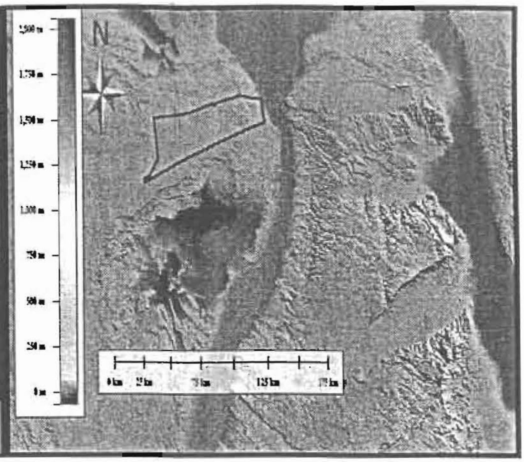

Fig (2) digital elevation model in the study area

Laboratory analysis

Nineteen soil profiles were taken to represent different physiographic units (Fig 3), however, soil profiles were dug to depth 150 cm or Lithic contact and their locations are shown in Fig. (3). The morphological description of these profiles (table 1), was carried out according to USDA (2003).Representative disturbed samples have been collected and air dried, crushed with wooden hammer, sieved through a 2 mm sieve to obtain the fine earth used for physical and chemical analysis. The elements of soil color description, i.e., the color name and notations were determined using the Munsell Soil Color Chart (2010).

Particle size distribution was determined using the international pipette method (USDA 2004) and sodium hexametaphosphats as dispersing agent. Calcium carbonate content was measured using the Collin's Calcimeter method (USDA 2004). Gypsum was determined by the acetone method (Bower and Huss, 1948). Soil pH was determined in the soil paste using pH meter and total salinity was expressed as electrical conductivity (ECe ds/m) According to (USDA 2004).

Sodium Adsorption ratio was calculated as follows (Richards, 1954)

$SAR = Na\ (meq/L)\ /\{(Ca+ Mg)\ meq/L\}^{0.5}$

Soil Classification and Evaluation:

The soils were classified to the family levels, based on the American soil Taxonomy (USDA, 1975) and its keys (USDA 2014). Soil under investigation was evaluated using the parametric system undertaken by Sys and Verheye (1978) and Sys et al (1991).

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

Physiographic units	Soil Taxonomy	Profile No.	Depth (cm)	Gravel %	Slope gradient	Color	Structure	Consistency	Effervescence	Secondary formation %		Boundary
						dry				$CaCo_3$	$CaSO_4.2H_2O$	
Piedmont plain (P111)	Lithic Torriorthents	1	0.30	35	Gently undulating	2.5YR6/8 d	m	so	mo	-	few	-
			Rock									
	Lithic Haplogypsids	2	0-15	30	Gently undulating	7.5YR6/6	m	so	st	v.few	Many	cs
			15-40	45		10YR8/2	m	sh	st	few	Many	-
			>40	Rock								
		3	0-10	20	Gently undulating	10YR6/6	m	so	st	v.few	Many	cs
			10-40	40		10YR6/2	m	sh	st	few	common	-
			>40	Rock								
Alluvial almost flat to gently undulating (T111)	Typic Haplocalcids	4	0-10	10	Very Gently undulating	7.5YR8/6	sg	lo	st	Few	-	cw
			10-80	35		7.5YR8/6	sg	lo	st	common	-	gw
			80-120	40		7.5YR6/6	m	sh	st	few	-	
	Gypsic Haplosalids	5	0-10	5	Very Gently undulating	7.5YR8/6	m	so	st	few	-	aw
			10-30	35		7.5YR8/6	sg	lo	st	common	V.few	gw
			30-70	40		7.5YR6/6	m	sh	st	few	-	aw
			70-130	35		7.5YR6/6	m	sh	st	common	-	-
	Calcic Haplosalids	6	0-15	15	Very Gently undulating	10YR6/8	sg	lo	st	common	-	aw
			15-60	40		5YR6/8	sg	lo	mo	common	-	gw
			60-110	35		5YR6/8	m	sh	st	common	v.few	-
Alluvidal plain (undulating) (T131)	Calcic Haplosalids	7	0-25	38	...	7.5 YR8/6	sg	lo	st	common	-	cw
			25-60	40		7.5 YR7/6	m	sh	st	many	few	cw
			60-80	45		7.5 YR7/6	m	sh	st	common	many	aw
			80-120	35	Level	7.5 YR7/6	m	h	st	common	-	-
		8	0-10	5		7.5 YR8/6	m	lo	st	few	few	aw
			10-25	35		7.5 YR8/6	m	lo	st	few	com	cw
			25-70	45		7.5 YR7/6	m	sh	st	many	com	cw
			70-130	42		7.5 YR7/6	m	h	mo	many	-	-
	Gypsic Haplosalids	9	0-10	5	Level	7.5 YR6/8	m	sh	st	few	-	aw
			10-35	40		7.5 YR6/8	m	h	st	common	common	gw
			35-110	45		7.5 YR7/8	m	h	mo	Few	few	-
		10	0-20	35	Level	7.5YR8/6	m	sh	sl	common	common	gw
			20-40	40		7.5YR6/6	m	sh	mo	common	common	gw
			40-75	37		7.5YR6/6	m	sh	st	few	-	cw
			75-150	43		7.5YR6/8	m	sh	mo	few	-	-
		11	0-20	10	Nearly level	7.5YR8/6	sg	lo	mo	few	v.few	gw
Rworked alluvial plain (T122)	Gypsic Haplosalids	11	20-40	15	Nearly level	7.5YR7/6	m	sh	st	common	v.few	cw
			40-70	35		7.5YR5/8	m	sh	st	common	-	gw
			70-120	40		7.5YR5/8	m	sh	mo	few	-	-
		12	0-10	10	Nearly level	7.5YR8/6	sg	lo	st	few	-	aw
			10-30	40		7.5YR7/6	m	sh	st	common	v.few	cw
			30-70	35		7.5YR6/6	m	sh	st	common	few	cw
			70-120	40		7.5YR7/6	m	sh	mo	few	few	-
		13	0-10	3	Nearly level	7.5YR8/6	sg	lo	st	few	v.few	aw
			10-40	10		7.5YR 6/6	m	sh	st	common	few	cw
			40-80	25		7.5YR 7/6	m	sh	st	common	common	gw
			80-130	30		7.5YR6/6	m	sh	mo	few	common	-
Dry Valley (W111)	Typic Haplosalids	14	0-10	3	Nearly level	7.5YR8/6	sg	lo	sl	-	-	aw
			10-50	5		7.5YR6/8	sg	lo	st	few	-	cw
			50-75	-		7.5YR7/6	sg	lo	mo	-	-	cw
			75-150	4		7.5YR7/6	m	sh	sl	-	-	-
	Typic Torripsamments	15	0-10	7	Nearly level	7.5YR7/6	sg	Lo	mo	-	-	aw
			10-30	2		7.5YR8/6	sg	Lo	mo	-	-	aw
			30-50	8		7.5YR7/6	sg	Lo	st	few	-	cw
			50-80	10		7.5YR6/6	m	So	st	few	-	cw
			50-150	-		7.5YR8/6	sg	lo	st	few	-	-
	Typic Torriothents	16	0-15	4	Nearly level	7.5YR6/6	sg	lo	st	few	-	cw
			15-50	3		7.5YR5/6	sg	lo	mo	v.few	-	cw
			50-150	-		7.5YR6/6	m	sh	sl	-	-	-
Sand Sheet Plain (A211)	Typic Torripsamments	17	0-15	3	Nearly level	7.5YR7/6	sg	lo	sl	-	-	gw
			15-40	-		7.5YR6/6	sg	lo	st	few	-	aw
			40-80	5		7.5YR7/8	sg	lo	sl	-	-	cw
			80-110	-		7.5YR6/8	m	so	sl	-	-	-
		18	0-25	-	Nearly level	7.5YR8/6	sg	lo	sl	-	-	cw
			25-65	-		7.5YR6/6	sg	lo	sl	-	-	cw
			65-150	-		7.5YR6/8	sg	lo	mo	V.few	-	-
		19	0-25	-	Nearly level	7.5YR8/6	sg	lo	mo	-	-	cw
			25-75	2		7.5YR6/6	sg	lo	sl	-	-	gw
			75-150	-		2.5YR6/8	m	so	mo	few	-	-

Soil structure gr= granular, bw: blocky wreak grain, bm: blocky medium, pm: platy medium. Consistency: h=hard, f=friable, lo-loose, so=soft, vs=very sticky, ss=slightly sticky, vp= very plastic and sp= slightly plastic. Effervescence: st: strong, mo: moderate, sl; slightly effervescence. Consistency: vh: very hard, h= hard, sh= slightly hard, so= soft, lo=loose. Lower boundary. cs= clear smooth, cs: clear smooth, cw: clear wavy, aw: abrupt wavy, as: abrupt smooth, and gw: gradual wavy.

Results and Discussion

Identification of the physiographic unite

The remotely sensed data was subjected to the different image processing techniques in order to produce the physiographic map. Digital Elevation model (DEM) can be employed to offer varieties of data that can assist in mapping of land forms and soil types. Information derived from a DEM, i.e. surface, elevation, slope % and slope direction could be used with the satellite images to increase, their capabilities for soils mapping.

The physiographic analysis technique is followed to perform the image interpretation. Such image analysis is based upon the knowledge of the relation between physiographic and soils as well as upon the studied features, which are results from some dynamic processes (Goosen, 1967).

The interpretation of face color composite image provides information for mapping the main land unit in the study area. A physiographic analysis using visual interpretation was carried out, to delineate the different physiographic units of the studied area. The pre-interpretation procedure was used as described by Zinck (1988) The land forms of the study area were delineated by using the digital elevation model, Landsat ETM and ground truth data.

The produced map was important into a Geo - database, as a base map (Fig 3). The data extracted from satellite images and digital elevation model indicate that the area under investigation includes that seven main physiographic units.

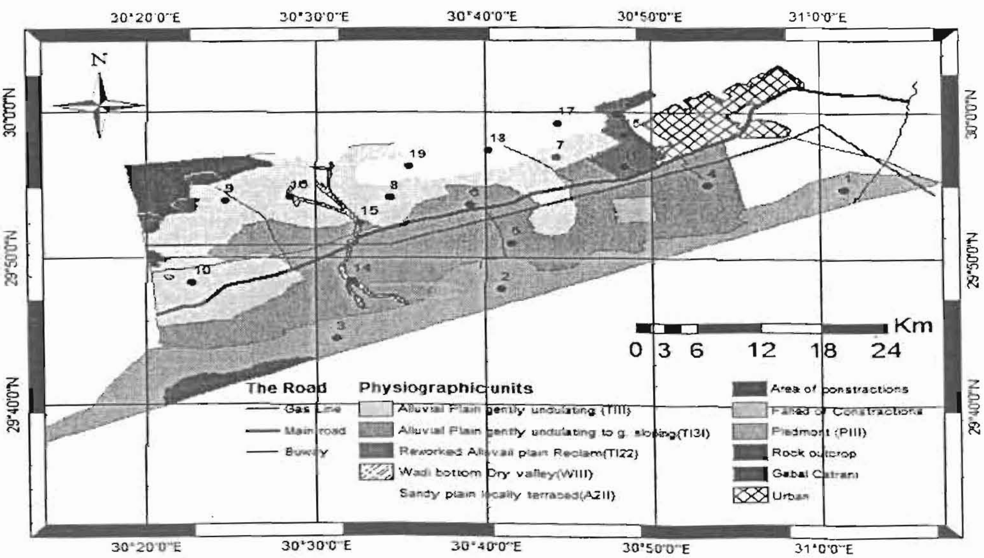

Fig. (3): Physiographic units map of the studied area. (Scale 1 : 250 000)

The distribution of landforms characterizing can be outlined in Table (2). A brief note about the identified physiographic units which are occupied the previous desert formations of the studied area were carried out as follows:

Table (2) legend of physiographic- soil map of the studied area

Landscape	Origin	relief	landforms	mapping unit	soil profiles	area feddans	area %
Terraces (T)	Alluvial deposits (1)	Almost flat to gently undulating	Alluvial plain (1)	T111	4, 5, 6	130026	34.64
	Alluvial deposits (1)	Almost flat (2)	Reworked alluvial plain reclam (2)	T122	11, 12, 13	12825	3-42
	Alluvial deposits (1)	Undulating (3)	Alluvial plain (1)	T131	7,8,9,10	108670	28.95
Aeolian plain (A)	Aeolian deposits (1)	Undulating (1)	Sandy plain locally terraces (1)	A211	17,18,19	33707	8.98
Plateau (P)	Limestone (1)	Sloping (1)	Piedmont (1)	P111	1, 2, 3	47240	12.58
Wadi (W)	Alluvial deposits (1)	Undulating (1)	Dry valley	W111	14, 15, 16	29043	7.74
Rocky land	Limestone (1)	Sloping (1)	Rock outcrop urban (1)	R111	-	559+ 13344	0.15 3.54
Total						375414	100

(1) piedmont plain:

Pediplain is a plain & low relief formed in arid and semi-arid regions at the base of a receding mountain front and underlain by bedrock that is typically covered by a thin discontinuous veneer of soil (USGS, 2009).

This physiographic unit is located in the south of the studied area and extended from east to west and covering about 47240 feddans (12.58% of total area). This unit has gently sloping topography to sloping. Somewhat gravely or basalt stony surfaces and including well drained soils. Its landforms are the remnants of weathered limestone rock, including residual parent materials over limestone lithic contact.

(2) Terraces

Terraces are remnants of formerly deposited flood plain during a process that preceded the recent River Nile deposited of Holocene Era. On these terraced plains consequent streams were rejuvenated, resuming down-catting, thereby forming terraces (Said 2001).

The area of this physiographic-soil unit occupied a relatively large area and divided into three subunits i.e. alluvial plain almost flat to undulating, alluvial plain (undulating) and reworked alluvial plain (flat). It's located in the north of weathered limestone. Also, this unit has topographic landscape of almost flat to undulating.

(2-1) alluvial plain (almost flat) located in middle of the studied area and adjusted to the piedmont plain and covering about 130026 feddans (34.64%). Topography is almost flat to gently undulating and the surface is covered with coarse to fine gravels.

2.2. Alluvial plain (undulating)

Its located in northwestern part of the studied area and covered about 108670 feddans (28.95% of total area). Topography of this physiographic unit is gently undulating to undulating and has undulating gullied and gravely surfaces.

2.3 Reworked alluvial plain:

This physiographic unit is located in the north eastern side of the studied area and covered about 12825 feddons (3.42% of total area) the surfaces is almost flat topography and were mostly managed and cropped but are locally still under the reclamation processes; the surface is covered with few fine to medium gravels.

***3. Aeolian plain*:**

The origin of the sand in related to the fluvial erosion of the sandy plain in the western part of north Nile delta transported toward the south. This aeolian plain was deposited in the study area by wind action in the open landscapes having gently undulating, surface, including loose sand. This physiographic unit is located in the north part of the studied area and covered about 33707 Feddans (8.98% of the total area:

***4.Wady*:**

This physiographic unit is the resultant of dissention of the surrounding landscapes as the interaction of erosional and depositional processes in the fluvial period. They appear as dry wadis that seasonally receive flush flooding running south to north. The surface is almost flat to gently undulating and sloping to the north direction it is covered about 29042 feddans, (7.74 of total area)

5- Rocky land:

It is located in the south western part of the studied area (Gabal Qatraini) and covered about 559 feddans (0.15% of total area) the parent material of this physiographic unit is derived from either marine deposits intercalated with marl or shallow marine limestone and shale.

Phisico – chemical properties

1- Piedmont plain

These soils are represented by the studied three soil profiles No 1, 2 and 3. Data illustrated in tables, (2 and3) show that the topographic features of soil surface are sloping to gently sloping to the north. These soil profiles are shallow (<40 cm) soils have coarse textural class (sandy and loamy Sand) where total sand content varied from 80.72 to 88.66%. The gravel/ content in these soils reached a maximum value of 20 to 45% (table 1). The studied soil profiles are characterized by slightly alkaline to moderately alkaline where pH values ranged from 7.79 to 8.1. ECe values ranged between 9.74 and 25.6 dsm^{-1} indicating that these soils are moderately saline to strongly saline. CaCO3 Content is very low in this unit and ranged from 2.14 to 6.02%, while gypsum content is high and varied from 2.14 to 11.62 %. SAR Values are differing from 2.85 to 7.1 indicating that these soils are non sodic soils. Therefore, the pedo-secondary formations of gypsum in profiles 2 and 3 are enough qualified the requirements of some diagnostic horizon formation such as gypsic horizon.

2- Soils alluvial plain (Almost flat)

These soils are represented by profiles 4, 5 and 6. Data in Tables (1, 2 and 3) reveal that the representative soil profiles are characterized by skeletal nature as soils texture is predominated with slightly gravely loamy sand to very gravely sandy loam. Where gravel content varied from 5to 40 % .The soil reaction is slightly to moderately alkaline, where pH values ranged from 7.7 and 8.1. Soil salinity as indicated by (ECe) were is the range of 10.78 to 26.35 ds/m (moderate to strongly saline). CaCO3 contents are widely varied from 6.9 to 25.5% with as irregular distribution pattern with depth. Gypsum content varied from 0.19 to 101%. The studied soil profiles are enriched with expanding salts,CaCO3 and gypsum enrichments that satisfy the requirements of salic, gypsic and calcic horizons as well as Aridisols. SAR values varied from 2.22 to 11.58 (non Sodic soils).

3- Alluvial plain (undulating)

These soils are represented by the studied soil profiles Nos. 7, 8, 9 and 10. Tables (1,2 and 3) reveal that soil texture is ranged between very gravely loamy sand to very gravely sandy loam. The studied soil profiles are classified as slightly alkaline to moderately alkaline, where pH value ranged from 7.54 to 8.05. The soils are slightly saline to extremely saline whereas ECe values varied between 6.57 and 33.21 ds/m, Table (3). $CaCO_3$ and gypsum contents ranged from 6.54 to 27.68% and 0.52 to 9.64% respectively. Depth wise distribution of $CaCO_3$ and gypsum content does not portray any specific pattern with soil depth. On the other hand, the pedo- secondary formation of salts and $CaCO_3$ throughout the studied profile Nos. 7 and 8, Salic and gypsum in profile No. 10 and gypsum and calcium in profile No. 8. Therefore, these pedosecondary accumulations in these profiles horizons are enough qualified the requirements of some diagnostic horizon formation such as salic, gypsic, calci- gypsic and calcic.

4- Reworked alluvial plain:

These soils and represented by the studied three soil profiles Nos. 11, 12 and 13. Date illustrated in Tables (1, 2 and 3) show that soil texture is loamy sand to gravely sandy clay loam, where gravel content varied from 3.0 to 40.0%. pH values ranged from 7.54 to 8.01 indicating that the soils are slightly to moderately alkaline. According to USDA (2004), salinity levels of these soils are classifies as slightly saline to extremely saline, where ECe values varied from 5.79 to 33.65 dsm^{-1}. In general, salts distribution entire soils profiles tends to increase in the deepest layers, due to the salt leaching process from the upper layers to the deepest ones, Total calcium and gypsum contents are relatively moderate and varied from 9.89 to 30.19 and 0.54 to 10.5%, respectively. Sodium adsorption ratio (SAR) values varied widely within the studied soils and ranged from 5.68 to 13.5 (non sodic soils).

5- Soils of dry valley:

These soils are represented by the studied soil profiles Nos. 14, 15 and 16, and their texture is sandy to sandy loam texture class, where clay content ranged from 4.68 to 18.43%. Soil reaction varied from 7.5 to 8.01 indicating that these soils are slightly to moderately alkaline. Soils of dry valley are classified as very slightly saline to very extremely saline where ECe values varied from 3.45 to 64.35 dsm^{-1}. Total calcium carbonate content ranged from 2.5 to 15.67$dsm^{-1}$with an irregular distribution pattern with soil depth. Gypsum content is very low not exceeds 2.04%. Also, these soils are not affected with sodification as the SAR values not exceed 13%, except for the soils of profiles 14, where SAR more than 13 (Sodic soils)

6- Soils of sand sheet plain:

The soils of this physiographic unit are represented by three soils profiles Nos. 17, 18 and 19. The soil relief of these soils is almost flat to gently undulating, Table (1), and their texture is sandy to loamy sand, where the sand fraction reached to 96%, Table (3). The studied soil profiles are characterized by slightly to moderately alkaline, and slightly to strongly saline where pH and ECe values varied from 1.55 to 8.02 and 3.65 to 27.35 dsm^{-1} , respectively. Calcium carbonate and gypsum contents are very low and varied from 0.47 to 6.2 and 0.33 to 1.12% respectively. Sodium adsorption ratios are very low not exceed 13 indicating that these soils are non sodic soils. In addition those are characterized by young without sings that satisfy the requirement diagnostic horizons, so they are classified as Entisols (profiles 17, 18 and 19).

Table (3): Particle size distribution, texture class, and some chemical properties of the studied soil profiles

Physiographic units	Soil Taxonomy	Profile No.	Depth (cm)	Grain size distribution C.sand %	F.Sand %	Slit %	Clay %	Modified texture class	SAR	pH	ECe (dS/m)	$CaSO_4$ (%)	$CaCO_3$ (%)
Piedmont plain (P111)	Lithic Torriorthents	1	0-30	25.8	60.3	7.10	6.8	GLS	2.85	7.91	23.1	7.54	2.14
			>40	Rock land									
	Lithic Haplogypsids	2	0-15	21.75	67.13	5.11	6.01	GS	4.8	7.81	11.4	8.49	5.91
			15-40	34.3	48.18	8.4	9.12	GLS	7.1	8.04	25.6	11.62	4.7
			>40	Rock land									
		3	0-10	45.54	35.18	7.78	9.17	GLS	3.06	8.1	9.74	9.11	4.81
			10-40	58-55	30.11	5.18	6.16	VGS	4.78	7.79	18.5	7.21	6.02
			>40	Rock land									
Alluvial gently undulating (T111)	Typic Haplocalcids	4	0-10	60.12	23.37	5.17	11.34	SGLS	4.79	7.9	17.68	0.26	18.5
			10-80	39.9	33.56	10.29	16.25	GSL	2.22	8.0	16.34	1.02	12.1
			80-120	45.74	29.89	9.19	15.18	GSL	2.79	8.1	11.05	0.61	6.9
	Gypsic Haplosalids	5	0-10	36.86	45.41	8.38	9.35	SGLS	5.60	7.7	10.78	1.88	12.7
			10-30	28.35	50.46	10.65	10.54	GSL	6.77	7.8	21.59	7.73	25.5
			30-70	28.88	41.20	12.55	17.37	VGSL	11.58	8.0	24.87	10.1	16.1
			70-130	32.02	40.14	11.31	16.53	GSL	8.91	7.9	22.56	5.27	8.95
	Calcic Haplisalids	6	0-15	29.67	42.88	11.33	16.12	GSL	11.24	7.9	20.77	0.19	12.3
			15-60	26.55	45.18	10.12	18.15	VGSL	6.49	8.1	18.74	0.37	17.7
			60-110	31.36	38.13	15.40	15.11	GSL	5.26	7.8	26.35	1.55	15.6
Alluvial plain (undulating) (T 131)	Cacic Haplosalids	7	0-25	38.75	52.35	4.1	4.8	VGLS	1.25	7.54	31.5	2.14	13.58
			25-60	28.45	42.25	12.5	16.8	VGLS	8.64	7.69	33.21	3.55	23.54
			60-80	26.86	45.64	11.9	15.6	VGSL	4.64	7.87	24.28	0.89	27.68
			80-120	20.12	36.54	19.64	23.7	GSCL	7.38	7.89	29.87	0.52	18.97
		8	0-10	29.1	42.31	11.7	16.89	SL	10.31	8.01	20.21	3.15	10.32
			10-25	29.7	40.06	12.37	17.87	GSL	8.61	7.87	26.87	5.64	17.82
			25-70	30.1	42.78	11.89	15.23	VGSL	9.48	7.59	30.47	2.14	25.26
			70-130	18.64	49.67	13.02	18.67	VGSL	10.65	7.86	30.26	1.47	13.34
	Calcigpsids	9	0-10	35.54	39.64	11.02	13.8	SL	11.31	8.00	6.9	0.74	6.54
			10-35	35.22	41.01	11.37	12.4	VGSL	12.5	7.89	17.64	8.55	19.64
			35-110	44.46	35.65	7.99	11.9	VGLS	8.35	7.68	24.35	7.21	12.34
Alluvial plain (undulating) (T 131)	Calcigpsids	10	0-20	39.44	31.7	9.89	18.97	GSL	11.32	8.05	6.57	1.44	17.64
			20-40	34.67	40.99	11.58	12.76	VGSL	10.09	7.58	20.31	9.64	20.65
			40-75	38.99	54.58	5.03	1.4	VGLS	5.68	7.98	26.57	5.99	10.47
			75-150	29.43	52.53	7.02	11.02	VGLS	4.71	7.87	30.24	3.01	13.38
Reworked alluvial plain (T122)	Haplocalcids	11	0-20	34.67	40.31	9.78	15.24	SGSL	9.54	7.54	23.5	0.54	9.99
			20-40	33.78	41.35	10.21	14.66	GSL	8.7	7.68	12.35	1.02	14.6
			40-70	41.27	43.47	6.79	8.47	GLS	11.1	7.89	17.6	0.64	24.3
Reworked alluvial plain (T122)	Gygpsic Haplosalids	11	70-120	25.81	55.06	10.05	9.08	VGLS	12.54	8.01	20.14	2.01	30.1
		12	0-10	31.31	53.69	6.4	8.6	SGLS	7.54	7.68	18.77	2.74	12.3
			10-30	35.16	35.04	11.5	18.3	VGSL	13.5	7.87	25.64	10.5	10.2
			30-70	27.16	41.54	13.4	17.9	GSL	9.89	7.75	24.67	8.64	15.5
			70-120	34.97	44.86	9.87	10.3	VGLS	10.21	7.98	33.65	7.89	11.9
		13	0-10	29.6	55.24	6.58	8.58	LS	8.57	7.57	5.79	5.34	15.8
			10-40	24.25	45.65	12.14	17.96	SGSL	7.68	7.88	26.58	7.35	20.4
			40-80	20.32	42.6	12.5	24.58	GSCL	5.68	7.64	28.97	10.45	10.2
			80-130	19.46	47.76	14.01	18.77	VGSL	10.54	7.94	25.44	6.54	9.89
Dry Valley (T122)	Haplosalids	14	0-10	41.19	44.58	7.89	6.34	LS	15.34	7.89	24.04	0.84	12.37
			10-50	25.51	56.67	6.57	11.25	LS	18.67	7.75	48.25	0.57	15.67
			50-75	36.3	48.69	4.67	10.34	LS	25.34	7.58	64.35	1.48	14.67
			75-150	49.75	39.68	5.89	4.68	S	17.35	7.7	51.68	2.01	11.24
	Torripsamments	15	0-10	39.4	45.36	9.48	5.76	SGLS	5.88	8.01	3.45	0.67	3.11
			10-30	36.38	48.59	8.59	63.44	LS	10.24	7.99	6.89	0.59	2.57
			30-50	37.79	50.54	6.89	4.78	SGS	12.34	7.86	13.54	1.02	4.65
			50-80	46.74	39.88	7.79	5.59	SGLS	11.89	7.65	17.68	2.04	5.08
			50-150	36.49	49.57	9.05	4.89	LS	8.68	7.5	25.37	0.78	3.73
	Torriorthents	16	0-15	35.52	48.37	5.64	10.47	LS	11.37	7.68	5.66	0.89	4.65
			15-50	36.02	46.99	6.35	10.64	LS	9.78	7.84	10.88	1.06	6.89
			50-150	18.47	51.38	11.72	18.43	SL	7.65	7.97	16.54	1.88	5.79
Sand Sheets Plain (A211)	Torripsamments	17	0-15	34.55	50.14	6.57	8.74	LS	4.25	7.98	4.47	0.75	4.91
			15-40	38.22	47.65	6.99	7.14	LS	5.14	7.65	14.71	0.85	4.21
			40-80	52.09	37.25	6.31	4.35	S	7.05	7.58	25.14	0.49	1.56
			80-150	45.18	44.37	4.44	6.01	S	11.3	8.01	19.68	0.33	6.15
		18	0-25	55.28	38.59	3.89	2.24	S	3.21	7.89	3.65	0.42	5.74
			25-65	53.17	37.59	6.05	3.19	S	9.65	7.66	11.23	0.66	3.47
			65-150	43.76	40.32	6.77	9.15	LS	7.87	7.88	7.65	1.12	4.88
		19	0-25	57.19	33.57	5.89	3.35	S	7.48	7.84	9.34	0.94	6.2
			25-75	47.83	40.18	8.08	3.91	LS	10.2	8.02	19.67	1.05	3.57
			75-150	48.50	38.44	7.65	5.41	S	6.58	7.55	27.35	0.87	0.47

Fine Earth: S= Sand LS= Loamy sand, Sl= Sandy loam and SCL= sandy clay loam

Classification

Soil Classification

Data In table (4) Show the prevailing taxonomic units of the studied area according to USDA (2014).By using the obtained data of soil morphology, physical and chemical data, which are presented is tables (1,2 and 3), it could be classified the studied soil profiles into two orders, i.e Aridisols and Entisols, as well as their followed sequence classification levels up to family one (thirteen families), as follows and shown in Table (4).

Soil Taxa of the identified two orders and the sequence taxonomic levels up to family could be summarized as follows:

1) Aridisols: include Nine families:

1- Lithic Haplogypsids, Sand Skeletal, mixed, hyperthermic (profiles 2 and 3).
2- Calcic Haplosalids , Loamy Skelete, mixed hyperthermic (profiles 4, 7 and 8).
3- Gypsic Haplosalids, Loamy Skeletal, mixed hyperthermic (profile 5).
4- Gypsic Haplosalids, Loamy over sand, mixed hyperthermic (profile 10 and 12).
5- GypsicHaplosalids, coarse Loamy, mixed hyperthermic (Profile 13).
6- Typic Haplosalids, sandy, mixed, hyperthermic (profile 14).
7- Typic Calcigypsids, loamy over sand skeletal, mixed, hyperthermic (profile 9).
8- Typic Haplocalcids, loamy skeletal, mixed, hyperthermic (profile 6).
9- "Typic Haplocalcids, loamy over sand, mixed, hyperthermic (profile 11).

2- Entisols

There are four families belong to this order as following:

1- Lithic Torriorthents, sandy, skeletal, mixed, hyperthermic (profile 1).
2- TypicTorripsamments, sandy, mixed, hyperthermic (profile 15).
3- Typic, Torriothents sandy over coarseloamy, mixed, hyperthermic (profile 16).
4- TypicTorripsamment, siliceous, mixed, hyperthermic (profiles 17, 18 and 19).

Land suitability for agricultural irrigated soils

a) Current land suitability:

The current suitability of the studies soils was estimated by matching between the present land characteristics and their ratings outlined by Sys and Verheye (1978) and Sys etal (1991).

Suitability indices and classification of the studied soil developed on the studied different physiographic units was shown in Table (5) and Fig 4, revealed that two suitability classes, i.e., marginally suitable (S3) and not suitable (N) besides three subclasses (Ns1, s2, n, Ns1, n and S3s1,n) were, recognized in the studied area. These subclasses, represent some soils suffering from soil limitations, i.e. some soil properties, i.e., soil texture (S1),soil depth(S2) and salinity alkalinity (n) as soil limitations with different intensity degrees (moderate, severe and very severe).

B) Potential Land Suitability

Further land improvements are required to correct or reduce the severity of limitation exiting in the studied area, such as a) leaching of soils salinity and reclamation of soil sodicity existing in the soils, b) continuous application of organic, manure to improve soil physico-chemical properties and fertility status, c) application of modern irrigation system, i.e. drip and sprinkler in the newly reclamation desert soils to save pronounced amount of irrigation water as well as rise the irrigation efficiency.

By applying the previous improvement practices, potential suitability Fig 4,of the studied soils indicator the existing of three classes, i.e., moderately suitable (S2), marginally suitable (S3) and not suitable (N), beside five subclasses ($S2_{S1}$, $S3_{S1}$, $Ns_{1,}$ N_{s1} and (N_{s1s2}) were recognized in the studied area as shown in Table (5) and Fig (5). These subclasses represent some soil profiles developed on all the different studied physiographic units with moderate to severe and very severe intensity for soil limitation. The severity of relatively soil coarse texture can be corrected in these subclasses by application of organic and inorganic soils amendments as well as either drip or sprinkler irrigation system to sustain soil moisture content at a favorable condition or grown plants in the relatively coarse textures soils.

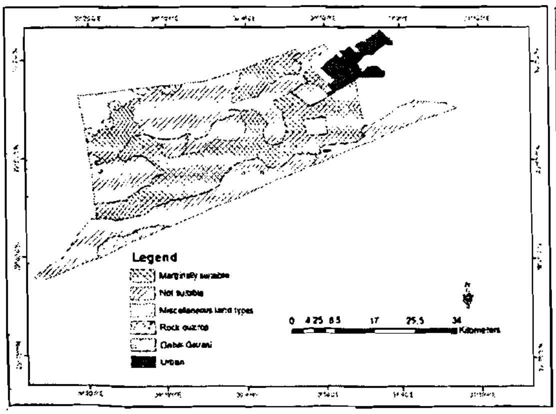

Fig (4) Current suitability of studied area

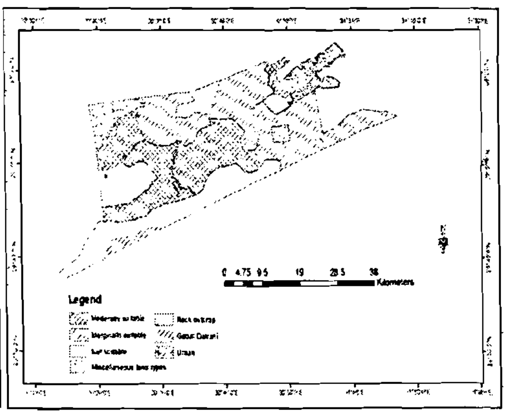

Fig (5) Potential suitability of studied area

Table (4): Soil classification categories of the studied area according to USDA soil Taxonomy (2014).

Profile No	Order	Sub order	Great group	sub group	soil families	physiographic unit
1	Entisols	Orthents	Torriorthents	Lithic	Sandy skeletal mixed, shallow, hyperthermic	Plain (P111)
2	Aridisols	Gypsids	Haplogypsids	Lithic	Sandy skeletal mixed shallow hyperthermic	
3	Aridisols	Gypsids	Haplogypsids	Lithic	Sandy skeletal mixed shallow, hyperthermic	
4	Aridisols	Salids	Haplosalids	Calcic	Loamy, skeletal, mixed, hyperthermic	Alluvial plain (Almost flat) (T111)
5	Aridisols	Salids	Haplosalids	Gypsic	Loamy skeletal mixed , hyperthermic	
6	Aridisols	Calcids	Haplocalcic	Typic	Loamy skeletal mixed hyperthermic	
7	Aridisols	Salids	Haplosalids	Calcic	Loamy skeletal, mixed, hyperthemic	Alluvial plain Undulating (T131)
8	Aridisols	Salids	Haplosalids	Calcic	Loamy skeletal mixed, hyperthermic	
9	Aridisols	Gypside	Calcigypsids	Typic	Loamy over sand skeletal, mixed, hyperthermic	
10	Aridisols	Salids	Haplosalids	Gypsic	Loamy over sand, skeletal, mixed, hyperthermic	
11	Aridisols	Calcids	Haplocalcids	Typic	Loamy over sand, mixed, hyperthermic	Reworked alluvial Plain (T122)
12	Aridisols	Salids	Haplosalids	Gypsic	Loamy over sand mixed, hyperithermic	
13	Aridisols	Salids	Haplosalids	Gypsic	Coarse loamy, mixed, hyperthermic	
14	Aridisols	Salids	Haplosalids	Typic	Sandy, mixed, hyperthermic	Dry valley (V/111)
15	Entisols	Psamments	Torripsamments	Typic	Sandy, mixed, hyperthermic	
16	Entisols	Orthents	Torriorthents	Typic	Sandy over coarse loamy, mixed, hyp	
17	Entisols	Psamments	Torripsamments	Typic	Siliceous, mixed, hyperthermic	Sand sheet plain (A211)
18	Entisols	Psamments	Torripsamments	Typic	Siliceous, mixed, hyperthermic	
19	Entisols	Psamments	Torripsamments	Typic	Siliceous, mixed, hyperthermic	

Table (5): land capability classification of the studied soils profiles:

Physiographic unit	profile No.	Topography (t)		Wetness (w)		physical properties				Salinity and Alkalinty		Suitability Index (ci)	suitability class		
		Ci	Pi	C	P	Texture (S1)	Soil depth (S2)	CaCo3 (S_3)	Gypsum (S_4)	C	P	Ci	Pi	C	P
Piedmont plain (P111)	1	70	100	95	100	50	55	95	100	80	100	13.90	26-13	$N_{S1,S2,n}$	$S_{3S1,S2}$
	2	80	100	90	100	30	55	90	90	75	100	7.22	13.37	$N_{Su1S2,n}$	$N_{S1,S2}$
	3	80	100	90	100	50	55	95	90	60	100	10.16	23.51	$N_{S1S2,n}$	$N_{S1,S2}$
Alluvial plain (T111)	4	95	100	95	100	55	100	100	90	85	100	37.97	49.5	$S_3s_{1,n}$	S_{3S1}
	5	90	100	95	100	50	100	100	100	75	100	32.06	50.0	$S_{3S1,n}$	S2s5
	6	95	100	95	100	30	100	100	100	75	100	20.31	30.0	Ns_1, n	S_3 s_1
Alluvial plain (Ti31)	7	95	100	90	100	50	90	100	100	60	100	23.09	45.0	Ns_1, n	S_3 s_1
	8	95	100	95	100	50	100	100	100	45	100	20.31	50.0	Ns1, n	S_3 s_1
	9	100	100	95	100	65	100	95	100	75	100	43.99	61.75	$S3s_1$, n	S_2 s_1
	10	95	100	90	100	30	90	95	90	75	100	14.80	23.09	Ns_1, n	Ns_1
Reworked alluvial plain (T122)	11	100	100	95	100	25	90	95	100	70	100	14.21	21.38	Ns_1, n	Ns_1
	12	100	100	95	100	50	100	100	100	45	100	21.38	50.0	Ns_1, n	S_3s_1
	13	100	100	90	100	50	90	100	100	75	100	30.38	45.0	$S3s_1$, n	$S3s_1$
Dry Valley (W111)	14	95	100	90	100	30	90	95	90	75	100	14.80	23.09	Ns_1, n	Ns_1
	15	90	100	95	100	55	90	95	90	70	100	25.33	42.32	S_3s_1, n	S_3s_1
	16	95	100	90	100	50	90	95	90	55	100	18.09	38.48	Ns_1, n	S_3s_1
Sand sheet plain (A211)	17	95	100	95	100	50	100	100	100	70	100	31.59	50.0	$S3s_1$, n	$S5s_1$
	18	90	100	90	100	60	90	100	100	80	100	34.99	54.0	$S3s_1$, n	$S5s_1$
	19	90	100	65	100	25	75	100	100	80	100	8.78	18.75	Ns_1,S_1	Ns_{1S2}

Soil limitation:

S1: Soil Texture S2: soil depth S3: Calcium carbonate S4: Gypsum C: Current suitability

Suitability class: N: Not suitable S2: Moderate suitable S3: Marginally suitable p: potential suitability

REFERENCES

Bower, C.A. and Huss, R.B. (1948). A rapid conductometric method for estimating gypsum in soils. Soil Sci. 66:199-240.

Burnigh, P. (1960). The applications of aerial photographs in soil surveys.Man. of Photogr.Interpr., Washington, D.C., USA.

Dawoud, M.A; Darwish, M.M. and El-kady, M.M. (2005): GIS – based groundwater management model for western Nile Delta, Water Resources Management, 19: 585-604.

Diab, M. Sh; Abd El Latifa, A.T and Abdel Baki, A.A. (1981) Groundwater Occurrence in the southern sector of Cairo - Alexandria desert Road. Annals of Geological Survey of Egypt V.X. pp 797-805.

Egyptian Metrological Authority (2010) Climatic Atlas of Egypt published Ministry of Transport Arab Republic of Egypt.

El- Shazly, E.M, Abdel Hady, M.A., El- Ghawaby, M.A.; El-Kassas, I.A.; El-Khawasik, S.M.; El-shazly, M.M. and Sanad, S. (1975) Geological interpretation of landsat Sateilite images for west Nile Delta area, Egypt. "Remote Sensing Research project, Academy of Scientific Research and Technology" Egypt, 66P.

Fadlemawla, A.A. and Dawoud, M.A. (2006): An Approach for delineating drinking water Welihead protection areas at the Nile Delta, Egypt, Journal of Environmental Management, 79: 140-149.

Goosen, D. (1967): "Aerial photo-interpretation in soil survey". Soil Bull. No.6, FAO, Rome, Italy.

Hefiny, K. (1993) The role of ground and water in the sustainable development planning of the region of Wadi – El Natrun. The Research Institute for ground water, Bull Fac Agri Alex Univ Egypt, 7: 79-91.

Munsell Soil Color Charts (2010). Edition Munsell Color, Macbeth Division of Kollmorgen Corp., 2441 North Calvert Street, Baltimore, Maryland, USA.

Richards, L.A. Ed. (1954). Diagnosis and Improvement of Saline and Alkali Soils. U.S.D.A. Hand Book No. 60.

Said, R. (1990): "The Geology of Egypt". Published for the Egyptian Central Petroleum Corporation, Conoco Hurghada, Inc. by Balkema, A.A., Roterdam, the Netherlands.

Said, R. (2001). The River Nile, "Genesis and water use in the past and future". Dar El-Helal Press, Cairo, Egypt, pp. 78-80 (in Arabic).

Sharaky, A.M., Atta, S.A.; El- Hassanein A.S.; and khallaf, K.M.A. (2007) Hydrogeochemistry of groundwater in the western Nile Delta Aquifers, Egypt.2nd international conference on the geology of Tethys, 19-21 March, 2007, Cairo University.

Sys, C. and W. Verheye (1978): An attempt to the evaluation of physical land characteri-stics for irrigation according to the FAO framework for land evaluation. Int. Train. Center for post Grade. Soil Sci., Ghent, Belgium.

Sys, C.; E. Van Ramst; J. Debaveye and F. Beernaert (1991): "Land Evaluation". Parts I, II and III. Agric. Puplic. No. 7, GADC, Brussels, Belgium.

U.S.D.A. (1975). Soil Taxonomy Basic System of Soil Classification. U.S. Dept., Agric. Handbook No. 436, USDA. Washington, D.C. 20402.

USDA (2003). Soil Survey Manual. United State, Department of Agriculture, Handbook 18, U.S. Gov. Print Off., Washington, DC.,USA.

USDA (2004) Soil Survey Laboratory Methods Manual, Soil Survey Investigation Report No. 42, Version 4.0, November (2004).

USDA (2014): "Keys to Soil Taxonomy". 12th (Ed), NRCS; USA.

USGS, (2009) Pediments and alluvial fans: Western region and Geophysics Science Center. World wide web; /1http://pubs.Us95.gov/of/2004/1007/fans.html1.

Zink, J.A. and Valenzuala (1990). Soil Geographic Database" Vol. 3 ITC.Ensched, Netherlands.

تحديد وتقسيم وتقييم وحدات التربة الفيزيوجرافية في بعض المناطق الواعدة في مجال التنميةالزارعية في الصحراءالغربية – مصر

ياسرربيع أمين سليمان مجدي حسين رياض إيهاب السيد مسعود

معهد بحوث الأراضي والمياه والبيئة – الجيزة، مركزالبحوث الزراعية

تظهر الدراسةأن هناك جهوداعلى نطاق واسع متزايدة وسريعة تبذل بهدف إدخال وإضافة مساحات جديدة من الأراضي الصحراوية في مشاريع التنمية الزراعية خلال العقود الحديثة .وتعتبر المنطقة الواقعة في الجزءالغربي من مدينة 6 أكتوبر وعلى جانبي الطريق الصحراوي الواصل بين محافظةالجيزة والواحات البحرية من المناطق الواعدة في مجال التنمية الزراعية والتي تشتمل على بعض المظاهر الفزيوجرافيةالممثلة للصحراء الغربية بمصر.

وتهدف هذه الدراسة إلى تحديد وتقييم المعوقات المرتبطة بتحسين صفات هذه الأراضي الصحراوية تحت الظروف البيئية السائدة في الصحراءالغربية بمصروهذا المقترح يغطي من خلال ثلاث اتجاهات ممثلة في تحديدالوحدات الفيزيوجرافية وتقسيم وتقييم التربة.

حيث وجدأن تحليل وتقسيم صور الأقمار الصناعية يلعب دورا مهما وكبيرا في تحديد الوحدات الفيزيوجرافية السائدة وكذلك المواقع الواعدة لاستغلالها في مشاريع التنمية الزراعية.

وتشيرنتائج تحليل وتفسيرصور الأقمار الصناعية إلى أن الوحدات الفيزيوجرافية المنتشرة في منطقة الدراسةهي:

1- Piedmont plain (P111)
2- Alluvial Plain (Almost Flat T111)
3- Alluvial Plain (undulating T131)
4- Reworked alluvial plain (T122)
5- Dry valley (W111)
6- Sandy sheet plain (A211)
7- Rock outcrops (R)

من نتائج الوصف المورفولوجي ونتائج التحليلات الطبيعية والكيميائية تم تقسيم التربة طبقا للنظام الأمريكي العام 2014 /حتى مستوى العائلات حيث وجدأن الأراضى تحت الدراسة تتبع رتبتين هما رتبة الأراضى الجافة Aridisols ورتبة الأراضى الحديثة Entisols وكذلك تسعة تحت مجاميع كبرى كالتالي :

1- Aridisols
- Lithic Haplogypsids, Calcic Haplosalids, GypsicHaplisolids,Typic Halplosalids, Typic Calcigypsids, Typic Haplocalcids.
2-Entisols: Lithic Torriorthents, TypicTorriorthents, and Typic Torripsomments

وطبقا لنظام تقييم الأراضي المتبع بواسطة Sys and Verheye (1978) ، Sys et.al. (1991)تم تقييم أراضي الوحدات الفيزيوجرافية بغرض تحديد مدى ملائمتها للزراعات المروية بصورتها الحالية أو بعد معالجة محددات التربة للحصول على أعلى عائد وتشير نتائج أدلة الملائمة للأراضي المكونة على انتمائها الي رتتبين هما أراضي هامشية الصلاحية (S3) وغير صالحة للزراعة بصورتها الحالية (N) بجانب ثلاثة تحت رتبة للأراضي موضع الدراسة وهى Ns1, s2, n, Nsi and S3s1,n) والتى تعانى من بعض معوقات التربة وهى القوام ،عمق قطاع التربة الفعال والملوحة والقلوية ،كمحددات لصلاحية التربة وبدرجات شده مختلفة.
(متوسطة، شديدة، شديدة جدا) وبرفع القدرة الإنتاجية لهذه الأراضي عن طريق عمليات تحسين التربة تصبح درجات الصلاحية الكامنة المستقبلية للأراضي هي متوسطة الصلاحية(S2) ، هامشية الصلاحية (S3) وغيرصالحة (N) بجانب أربعة تحت رتبة رئيسة هي (Ns1, S3 s1, and S2si Nsi s2).