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LAND RESOURCES EVALUATION OF THE PALEODARAINAGE DELTA IN WESTERN DESERT OF EGYPT USING REMOTE SENSING DATA

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ABSTRACT

The study area was selected to represent the sediments of paleodrainage delta in the Western Desert of Egypt, covering about 15615653 feddans (6561199 hectars). The data of Landsat Enhanced Thematic Mapper (ETM) 2002 were used for delineating the physiographic units to be a base for the soil taxonomic units (all are hyperthermic). These taxonomic units were potentially evaluated for barley and wheat (grain crops), alfalfa (fodder crop), maize, sun flower and olives (oil seed crops). The illustrated flow of the paleodrainage delta starts from the south as undulating delta apex, which most probably was deposited by the paleodrainage from Eastern Desert through the different rock structures. This apex includes soils of Calcic Petrogypsids loamy skeletal, gypsic; Typic Clacigypsids, loamy skeletal, gypsic and Typic Calcigypsids, sandy skeletal, mixed. The unit is profitable for drip irrigated olives as moderately to marginally suitable and for quarrying Oligocene gravel. Gently undulating inter delta includes sediments that was most probably received by reworking and out washing the slopes of delta apex in relatively more recent fluvial eras. The soils are Typic Calcigypsids, fine loamy, mixed; Typic Calcigypsids, loamy skeletal, mixed and Typic Calcigypsids, sandy, mixed. This unit is profitable for drip irrigated olives as highly suitable and sprinkly irrigated alfalfa, maize and sun flower as marginally suitable. Gently undulating to almost flat inter delta is most probably received its sediments from the southern physiographic units by the paleodrainage erosion. The soils are Leptic Haplogypsids, fine loamy, mixed and Leptic Haplogypsid, sandy, mixed. This unit is profitable for drip irrigated olives as moderately suitable. In the middle front of this unit, a township is proposed to be constructed “Al Qattara Town”. Flat depressed pro delta includes interfered sediments of different paleodrainage eras being received medium soil matrix over relatively old sediments of weathered gypsifreous clays (shales). The soils are Leptic Haplogypsids, fine loamy, mixed, which can be utilized for drip irrigated olives as highly suitable and sprinkly irrigated alfalfa, barley, maize, sun flower and wheat, as marginally suitable. This unit can be used for quarrying Miocene clays (shales) as well as for constructing compounds for producing evaporites, distilled water and fish preserving manufactories as resources from the detectable Al Qattara Lake. Water logged and submerged pro delta composed of poorly drained soils partly submerged by brackish lake or covered by wind-blown sands. This unit (-65 to -134 bsl) includes soils of Gypsic Aquisalids, fine loamy, mixed. It is highly recommended to be filled with sea water for a massive hydroelectric project as well as creating extra water resources and enhancing the local climate. Aeolian deposits were most probably the resultant of depositing sand over the paleodrainage lines, having soils of Typic Torripsamments, mixed (calcareous). This unit can be utilized for drip irrigated olives as moderately suitable and for sprinkly irrigated alfalfa, sun flower and maize as marginally suitable.

Keywords: land resources, paleodrainage delta, land evaluation, Western Desert remote sensing data.

INTRODUCTION

The objectives of this study are to identify the landscapes and their soil attributes in an area that has important situation for the environmental and demographic development in Egypt. It is also to convey a concept related to a techno-kratic view, which means that Egypt needs a big and great national development based on a project rivaling the High Dam one. This project can be collectively processed as utilizing promising areas for agricultural land use as well as generating power by a massive hydroelectric project. The main challenge facing the national development in Egypt is being located within the zone of aridic moisture regime and the water resources are limited. Also the land resources are limited being the lands of Egypt is dominated by rocky structures, which must excite us to accelerate the facing of this challenge by find a new methods for water resourceful as well as managing these limited land resources. The study area is considered as a main region that represents most of these limited land resources in the Western Desert of Egypt, which is needed for the agricultural development facing the pressure of the inevitable food requirement. Desalination of sea water must become a profound part of our interests to formulate a firm policy of building up experience of tracing water for the renaissance of Western Desert in Egypt. It has become a serious option of water production for both drinking and industrial purposes, but in future will be much needed as irrigation water for the managed agriculture. With a complementary benefit, removing out the landmines streaks in the northern outskirts of this study area, will give the opportunity for desert demographic encroachments to an area of very low to absent human population. The study area extends from the west of Dayrout aligning the western outskirts of Al Menia and Al Fayoum provinces. The northern portion, which is terminated by Al Qattra Depression, was delineated south of Al Alamain westwards near Siwa outskirts. This depression can be used for an economic project for generating hydro-electrical power by flooding the depression with sea water through a channel from the Mediterranean Sea, utilizing the difference in elevation to a lake that will eventually be formed. The perpetual of power generation can be based on the evaporation from the lake surface when it rises to a certain level after filling the depression. It is a call to introduce the study area to be collectively studied for some other purposes of investments and to return Al Qattara project to be as a profound concept of the public spirit in order to utilize this promising area for agricultural land use as well as for generating power, creating extra water resources and enhancing the local climatic attributes. The proposed development corridor by EL Baz (2007) is crossing the southern portion of the study area, bathing northwards via a wing surrounding its north-eastern part to reach Al Alamain town (Figure 1). This study and that proposed corridor proved that the study area must be under the demand for many development purposes. Water resources in the study area is defined by Allam et al (2003) as ground water, that are dominated by El Moghra aquifer system, located west of the Cairo-Alexandria Desert Road with an average thickness of 300m, is also considered a non-renewable aquifer system (200 million m^3/y) with salinity of >3000 ppm. The water-bearing beds belong to an ancient delta dating back to early Miocene times. The other associated aquifers are fissured system of fractured carbonate aquifers and Nubian Sandstone aquifer.

MATERIALS AND METHODS

Satellite Data

The data of Landsat Enhanced Thematic Mapper (ETM), acquired in the year 2002, were used for delineating the physiographic units of the study area by the visual analysis, using the physiographic approach as proposed by Goosen (1967). This approach was based on the spectral signature of the land features on the Landsat - ETM images, having spatial resolution of 30 m. and spectral resolution of the bands 7, 4 and 2. For these used data and the output maps, the parameters for GIS displays are Transverse Mercator projection, Spheroid name of Helmert and Datum Name is Old Egyptian 1907.

Field Work

The physiographic map was checked for the study area (Figure 1) during the ground truth as well as excavating of 23 pedons representing the different physiographic units for a full soil description according to Soil Survey Manaul (USDA, 2003).

Laboratory Analyses

Laboratory analyses were carried out for particle size distribution, using the pipette method (Piper, 1950); calcium carbonate content using calcimeter (Black et al., 1965); gypsum content by precipitation with acetone, and soil pH in the soil paste using pH meter (USDA, 1954); salinity as electrical conductivity (EC) in the soil paste extract was assessed in the 1:1 soil water extract for salic horizon identification; cation exchange capacity (CEC) and the exchangeable sodium percentage (ESP) according to Tucker (1954).

Soil Classification and Land Evaluation

Soils were categorized to the level of soil family, using the keys to Soil Taxonomy (USDA, 2006). Land evaluation for the purpose of the agricultural use was assessed according to Sys et al, (1993).

Terminology and Etymology Contemplation

Some scientific terms were simplified for the research users by tracing them with reference to the Compton's Illustrated Science Dictionary (Richardson et al., 1968), Glossary of Geology (Bates and Jackson, 1980) and the Latin-English Dictionary (Smith and Locckwood, l996).

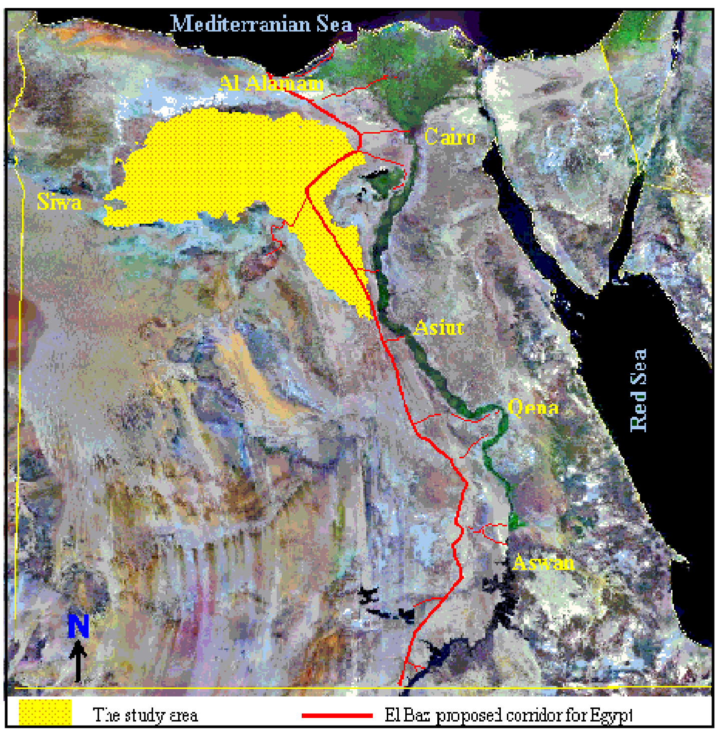

Figure 1: Location map of the study area in Western Desert of Egypt.

RESULTS AND DISCUSIOTION

Physiographic Units

The approach of tracing the landscape genesis is valuable for facilitating the clue to define the land attributes as associated with different physiographic units for such vast region that covers about 15615653 feddans (6561199 hectars). This approach led to the tracing of the fluvitiles, which had been originated by the flows of the paleodrainage. As the fluvitiles of the paleodrainage were traced, this delta has been delineated. For the same purpose, using remot sensing data is also helpful element when the spatial resolution (28 to 30 metres) and spectral resolution (bands 7, 4 and 2) are selected for delineasting the border between these fluvitiles and their outskirts of the rocky structures and for a well recognition of waterlogged areas and paleodrainage lines. The delineated physiographic units are shown in Figure (2) and are described as follows:

i. Undulating delta apex

This physiographic unit forms the southern slice of the the delineated paleodrainage delta, which seems as armed triangle south of the inter delta, covering approximate area of 4230250 feddans (1777416 hectars) with undulating surface and locally covered by petrified forest. This physiographic unit was most probably deposited by the paleodrainage from the Eastern Desert through the different rock structures. These drainage channels were partly detected to be buried under the recent alluvium of River Nile, but can be traced again as appeared in the west of that recent alluvium. This drainage seemed as sub parallel drainage in the delta apex. Issawi and McCauley (1992) attributed the origin of these paleodrainage to the downstream parts of the Qena System, which formed by northward lateral erosion in the early Oligocene as the Red Sea mountains rise. The eroded materials removed from the Red Sea mountains to the northwest of Al Fayoum basin depositing a delta across Al Fayoum in huge quantities of deep fossiliferous Oligocene fluvial sands and gravel.

ii. Inter delta

This part of the paleodeltaic sediments is located north of the delta apex and south of the pro delta. According to Issawi et al (2001), this area represents the Miocene transgression reached to about 60km south of Cairo, and its sediments make up the surface of the desert to the north of Al Fayoum basin. The degradation first removed the Oligocene sands and conglomerates of the Gebel Qatrani Formation, and the Eocene bedrock of the depression bottom. It was accomplished when the Mediterranean was desiccated in the late Miocene and streams cut deep canyons towards the sea bed, and the final phase took place in the Quarternary. This unit was divided in two sub units as follows:

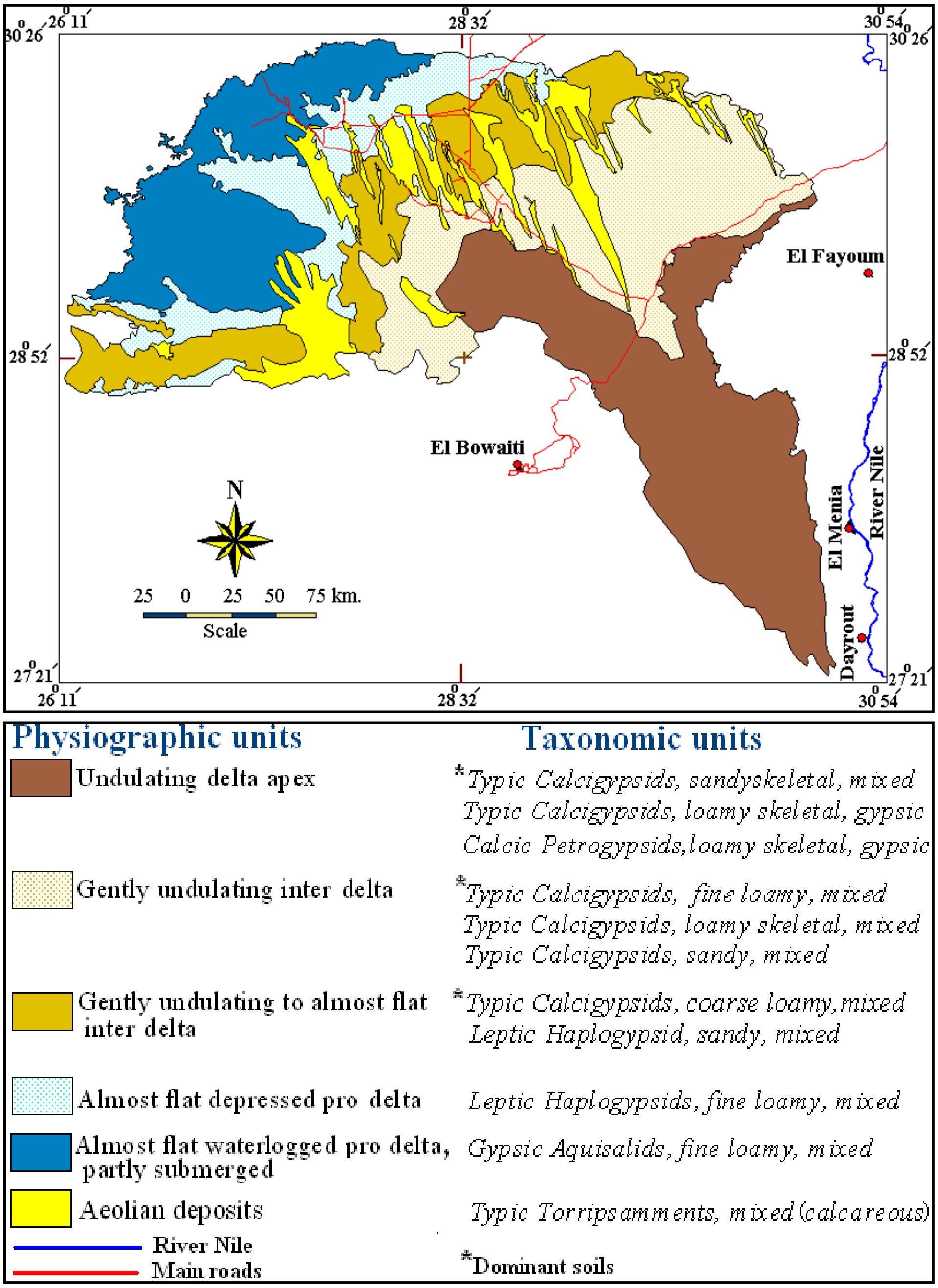

Figure 2: Physiographic soil map of the paleodrainage delta in the Western Desert of Egypt.

(The map was delineated by using the visual interpretation of Landsat ETM 2002, using the physiographic approach and applying the Key to Soil Taxonomy 2006.)

a. Gently undulating inter delta

This physiographic unit is the southern land slice of the inter delta, covering approximate area of 3406658 feddans (1431369 hectars). Its surface is gently undulating and is locally covered by petrified forest. It is most probably that the sediments of this unit had been eroded from the delta apex when the slopes of this apex were reworked and outwashed by the paleodrainage agent in relatively more recent eras. Many of the original Oligocene coarse fragments were partly eroded northwards to be deposited in the gently undulating inter delta.

b. Gently undulating to almost flat inter delta

This physiographic unit is the northeren land slice of the inter delta, covering approximate area of 2071449 feddans (870357 hectars). The surfaces are gently undulating to almost flat and locally covered by petrified forest. In this unit, the sediments are generally including less soil fragments as compared to the southern slice of the inter delta. It is most probably that these sediments were eroded from the southern slice of the gently undulating inter delta, as well as from the delta apex. These sediments were resorted by the paleodrainage and shifted to form the gently undulating to almost flat inter delta with less coarse fragments.

iii. Pro delta

This unit is delineated along the southern and south eastern borders of the consolidated cuesta scarp, that bordering the study area in the north. It represents the landscape of Qattara Depression within elevations from 0 to -134 m below sea level. Albriton et al (1990) proposed that Qattara Depression originated as a stream valley that was dismembered by karstic processes during the late Miocene epoch, and afterwards it was deepened by fluviale processes. A major stream issuing from the Gilf Kebir highlands in the south, flowed northward may have done so by a route through the Qattara area to an exit near the head of the Ras Alam er Rum submarine canyon offshore near Alexandria. In either case, the stream was responsible for the Qattara cuesta formation, whether a tributary of the “Gilf River” or a part of that river’s descending course into the Mediterranean Basin. This pro delta was subdivided in two sub units as follows:

a.Almost flat depressed pro delta

This unit represents an outskirt of the water logged pro delta, aligning its southern and eastern borders with almost flat surface, covering approximate area of 1720104 feddans (722733 hectars). This unit is depressed below sea level within the elevations from 0 to-65 m below the sea level (bsl), including sediments of shales and abundant gypsum veins. These sediments are representing the interference of different paleo drainage eras, being include two parent materials of medium soil matrix over weathered soft rocks (shales) as clays and fine loams.

b- Almost flat waterlogged pro delta partly submerged

This unit covers approximate area of 250527feddans (1052635 hectars) with elevations range from -65 to-134 m bsl. The area is composed of poorly drained hard crust and sticky mud partly submerged by brackish lake and covered by wind blown sands. The sediments partly seem as tufa features of calcareous crust. According to Smith et al (2004), the fossil-spring carbonates (tufas) occurred in hyperarid Western Desert of Egypt but during prior pluvial phases that were mostly in the Pleistocene era, which represents wetter conditions than have existed during Holocene time. These sediments are partly covered by aeolian deposits and it is most probably that the surface of this unit had been peneplained by wind erosion till the level of the ground water surface.

iv. Aeolian deposits

These deposits are forming local plains intersected by aeolian parallel longitudinal low dunes, which are locally associated with high content of shale blocks on the pro delta. These deposits cover about 1681919 feddans (1777416 hactars). They were most probably a resultant of depositing sand over the paleodrainage pathes. Albriton (1990) proposed that a major stream issuing from Gilf El Kebir highlands flowed northward with its alluvium, which are mostly covered by aeolian deposits of the Great Sand Sea. El-Baz (1998) suggested that groundwater resources may be inferred from large accumulations of sand in the Eastern Sahara sand-buried courses of paleorivers that lead to depressions. The hypothesis relates the origin of the sand to fluvial erosion of the Nubian Sandstone, which is exposed in the southern part of the desert. Haynes et al. (1993) stated that during the hyperarid periods, aeolian processes differentially lowered the landscape and inverted the topography to gravel stream beds, representing the lowest parts of the landscape. They became elevated features protected from deflation by gravel spreads and sand sheets that armored the surface, while adjacent depressions were being lowered.

Soil Taxonomy

The USDA Soil Taxonomy (USDA, 2006) was applied in this work to identify soil map units. According to the climatic data of the Meteorological Authority of Egypt (2005), the moisture regime of the study area is "torric" and the temperature regime is "hyperthermic". Soil characteristics of the study area (Tables 1 and 2) were classified in the two orders of Aridisols and Entisols (Figure 2) to the soil family level. Their taxonomic classes are sequently described according to their descending development order as follows:

i. Aridisols

These soils were developed under the aridic moisture regime and hyperthermic temperature regime. They include one or more of the diagnostic horizons as salic, petrogypsic, gypsic and calcic. These Aridisols were categorized to the family level as follows:

Gypsic Aquisalids, fine loamy, mixed, hyperthermic

These Aquisalids occurred in almost flat waterlogged pro delta and are permanently saturated with water in one or more layers within 100 cm of the soil surface with redoxmorphic features, underlain by ground water table at 25 to 80 cm. They have salic horizon expressed as EC from 131.7 to 172.9 dSm^{-1} in the soil paste or 50.8 to 75.8 dSm^{-1}in 1:1 soil water extract. It is associated with gypsic horizon in surface and sub surface layers that include 10.8 to 25.6 % gypsum and 10 to 20 % gypsum by volume as secondary visible gypsum "Byzg". As the soil control section is dominated by sandy clay loams, the soil family was described as fine loamy (Profiles 17 and 18).

Calcic Petrogypsids, loamy skeletal, gypsic, hyperthermic

These Petroypsids developed in the undulating delta apex, having idurated layers of petrogypsic horizon "Bym" cemented by gypsum including 43.0 % gypsum, underlying gypsic horizon with 28.1 to 33.2 % gypsum and 20-25 % gypsum by volume as secondary visible gypsum and also calcic horizon with 21.5 to 45.6 % $CaCO_3$ equivalent and 15% to 30 % by volume "ABky" and "Bky". These Calcic Petrogypsids have soil control section dominated by very gravely sandy loams " loamy skeletal". Their soil matrix have total weight of carbonates plus gypsum more than 40% and gypsum is more than 35 percent "gypsic" (Profile No. 1).

Typic Clacigypsids, loamy skeletal, gypsic, hyperthermic

These Clacigypsids developed in the undulating delta apex associated with the aformentioned Petrogypsids. The soils have gypsic horizon "By" developed throughout the solum including 15.1 to 21.6 % gypsum and 10 to 30 % by volume as secondary visible gypsum. Calcic horizon devloped in the surface and sub surface layers associated with the gypsic horizon "ABky" and "Bky", including 14.2 to 39.3 % $CaCO_3$ equivalent and 5 to 15 % by volume identifiable $CaCO_3$. These Clacigypsids are "Typic", being represent the central concept of their great group. Since they have very gravely sandy loams and sandy clay loams, they were categorized as loamy skeletal. (Profiles 2, 3 and 4).

Table 1: Morphological description of the Soil profile in the study area.

Physiographic units	Profile No..	Depth (cm)	Horizon	Gravel %	Color		Structure	Consistency	Effervescence	Secondary formation %		Boundary
					dry	moist				$CaSO_4.2H_2O$	$CaCO_3$	
Udulating delta apex	1	0 – 25	ABky	40	10YR6/6	10YR5/8	m	sh	st	25	15	cw
		25 – 75	BKy	40	7.5YR6/8	7.5YR4/8	m	h	st	20	30	cw
		75-120	Bym	70	10YR6/6	10YR5/8	m	eh	st			
	2	0 – 15	ABky	25	10YR6/6	10YR4/6	m	sh	st	10	10	cw
		15 – 50	Bky1	40	10YR6/8	10YR5/8	m	h	st	25	25	cw
		50 – 50	By	40	7.5YR6/8	7.5YR5/8	m	h	st	20	5	
	3	0 – 15	ABky	10	10YR4/6	10YR5/6	m	sh	st	10	10	cw
		15 – 50	Bky	45	10YR5/8	10YR5/6	m	sh	st	20	15	gs
		50 –150	By	40	7.5YR5/8	7.5Y4/6	m	h	st	15	<5	
	4	0 – 10	ABky	20	10YR7/6	10YR5/6	m	h	st	10	5	cw
		15 – 45	Bky1	45	10YR7/4	10YR4/6	m	h	st	15	15	gs
		45 – 80	By1	45	10YR6/6	10YR4/6	m	h	st	30	5	gs
		80 –150	By2	65	7.5YR5/8	7.5Y5/6	m	h	st	25	5	
	5	0 – 10	ABky	25	10YR6/8	10YR5/6	m	h	st	10	10	cw
		10 – 40	Bky1	45	7.5YR5/4	7.5YR4/4	m	h	st	15	15	gw
		40 –150	By	70	7.5YR5/4	7.5YR4/4	m	eh	st	10	5	
Gently undulating Inter delta	6	0-20	ABy	10	10YR7/2	10YR6/2	m	sh	st	5	<5	cs
		20-60	Bky1	10	10YR8/3	10YR7/3	m	sh	st	10	10	gs
		60-80	By2	5	10YR7/3	10YR6/3	m	h	st	10	<5	gs
		80-100	By3	5	10YR6/6	10YR5/6	m	h	st	10	<5	gs
		100-150	By4	5	10YR7/3	10YR6/3	m	h	st	5	<5	
	7	0-15	ABy	20	10YR6/6	10YR4/4	m	sh	st	15	<5	gs
		15-70	Bky	35	7.5YR8/6	7.5YR4/6	m	h	st	10	5	gs
		70-150	Bky	35	7.5YR8/6	7.5YR4/6	m	h	st	5	5	
	8	0 – 25	ABky	15	10YR6/6	10YR5/6	m	sh	st	5	10	cw
		25 – 65	By1	15	10YR8/6	10YR6/6	m	h	mo	10	<5	gs
		65 –150	By2	20	10YR8/6	10YR7/4	m	h	mo	5	<5	
Gently undulating toAlmost flat inter delta	9	0 – 20	ABky	10	10YR6/3	10YR5/6	m	so	st	10	10	cs
		20 – 50	By	20	10YR7/3	10YR6/3	m	sh	st	10	<5	gs
		50-150	C	10	10YR7/4	10YR6/4	m	h	st	<5	<5	
	10	0 – 25	ABy	10	10YR6/6	10YR4/6	m	so	mo	5	<5	cs
		25 – 60	By1	15	10YR7/6	10YR6/3	m	sh	mo	5	<5	gs
		60 –150	By2	15	10YR7/4	10YR6/3	m	h	mo	5	<5	
	11	0 – 20	ABy	10	10YR5/6	10YR5/6	m	so	mo	5	<5	cs
		20 – 70	By1	5	10YR7/4	10YR7/3	m	sh	st	10	<5	cw
		70 –150	By2	-	10YR8/4	10YR7/4	m	h	mo	10	<5	

m: massive, sg: single grain, h; hard, sh; slightly hard, eh; extremely hard, so: soft, st: strong, mo:moderate, cs: clear smooth, cw : clear wavey, gs: gradual smooth , g: redox morphic horizon, k: calcic horizon, y: gypsic horizon z: salic horizon

Table 1 contd,

Physiographic units	Profile No..	Depth (cm)	Horizon	Gravel %	Color		Structure	Consistenc	Effervesce	Secondary formation%		Boundary
					dry	moist						
Gently undulating to almost flat inter delta	12	0 – 20	ABy	5	10YR7/6	10YR5/6	m	so	st	5	<5	cs
		20 – 45	By1	5	10YR7/6	10YR4/5	m	sh	mo	10	<5	cw
		45 –150	By2	5	10YR7/4	10YR4/5	m	sh	mo	10	<5	
	13	0 – 20	ABy	5	10YR6/6	10YR5/6	m	so	mo	5	<5	gs
		20 – 70	By	5	10YR6/6	10YR5/6	m	sh	mo	5	<5	gs
		70-150	C	5	10YR6/6	10YR4/6	m	sh	mo	<5	<5	
Almost flat depressed Pro delta	14	0 – 30	ABy	5	10YR6/4	10YR5/6	m	sh	mo	10	<5	cs
		30 – 60	By	20	10YR7/3	10YR5/4	m	sh	st	10	<5	cs
		60 – 95	2By1	-	10YR7/6	10YR6/4	m	h	mo	10	<5	abs
		95 – 150	2By2	-	10YR4/4	10YR4/3	m	h	mo	15	<5	
	15	0 – 25	ABy	10	10YR6/4	10YR5/6	m	sh	st	15	<5	cs
		25 – 60	By	25	10YR6/4	10YR5/4	m	sh	st	10	<5	cs
		60 – 95	2Byz1	-	10YR7/6	10YR6/5	m	h	mo	15	<5	abs
		95 – 15	2Byz2	-	10YR7/6	10YR6/6	m	h	st	15	<5	
	16	0 – 30	ABy	5	10YR6/4	10YR5/6	m	sh	mo	10	<5	cs
		30 – 60	By	20	10YR7/4	10YR6/4	m	sh	st	10	<5	cs
		60 – 100	2By1	-	10YR6/6	10YR6/4	m	h	mo	15	<5	abs
		100 – 150	2By2	-	10YR7/6	10YR6/6	m	h	mo	15	<5	
Water logged pro delta	17	0 – 25	AByz	10	10YR5/6	10YR5/4	m	fr	st	10	<5	cs
		25 – 60	Byz	5	-----	10YR5/4	m	sh	mo	20	<5	cs
		60 – 80	2Bygz	-	----	10YR4/2	m	sh	mo	15	<5	abs
	18	0 – 25	ABygz	5	-----	10YR4/2	m	fr	mo	10	<5	ds
		25--	Water	table								
gently undulating aeolian plain	19	0-15	C1	-	10YR6/4	10YR5/6	sg	lo	mo	<5	<5	cs
		15-90	C2	-	10YR7/3	10YR5/4	sg	o	st	<5	<5	gs-
		90-150	C3	-	10YR7/6	10YR6/4	sg	lo	mo	<5	<5	
	20	0-20	C1	-	10YR6/4	10YR5/6	sg	lo	mo	<5	<5	cs
		20-60	C2	-	10YR7/3	10YR5/4	sg	lo	st	<5	<5	gs
		60-150	C3	-	10YR7/6	10YR6/4	sg	lo	mo	<5	<5	
	21	0-25	C1	-	10YR7/4	10YR7/5	sg	lo	st	<5	<5	cs
		25-70	C2	-	10YR7/6	10YR7/4	sg	lo	mo	<5	<5	gs
		70-150	C3	-	10YR7/5	10YR6/4	sg	lo	mo	<5	<5	
	22	0– 20	C1	-	10YR7/6	10YR6/5	sg	lo	st	<5	<5	cs
		20-150	C2	-	10YR7/3	10YR6/3	sg	lo	mo	<5	<5	gs
										<5	<5	
	23	0 – 50	C1	-	10YR7/4	10YR6/4	sg	lo	mo	<5	<5	cs
		50 – 150	C2	-	10YR7/3	10YR6/3	sg	lo	mo	<5	<5	

m: massive, sg: single grain, h; hard, sh; slightly hard, eh; extremely hard, so: soft, st: strong, mo:moderate, cs: clear smooth, cw : clear wavey, gs: gradual smooth, g: redox morphic horizon, k: calcic horizon, y: gypsic horizon z: salic horizon

Table 2: Physiographic soil attributes of the study area.

Physiographic units	Profile No..	Depth (cm)	Horizon	Grain size distribution %			Modified Texture Class	PH	EC (dS/m)		CEC meq/ 100g	ESP	$CaSO_4$%	$CaCO_3$%
				Sand	Silt	Clay			Soil paste	Exract 1:1				
undulating delta apex	1	0 – 25	ABky	58.7	23.5	17.8	VGSL	7.6	18.8	9.3	13.8	36.4	33.2	21.5
		25 – 75	BKy	57.7	24.8	17.5	VGSL	7.8	45.4	16.8	12.9	39.2	28.1	45.6
		75-120	Bym	58.1	25.8	16.5	EGSL	7.7	75	28.5	12.7	43.3	43.0	33.5
	2	0 – 15	ABky	71.0	9.2	19.8	GSL	7.9	15.6	7.4	14.8	19.5	17.3	25.7
		15 – 50	Bky1	70.3	12.8	16.9	VGSL	7.7	20.2	8.6	12.9	30.5	19.6	25.5
		50 – 150	By	65.2	16.5	18.3	VGSL	7.9	48.5	19.5	14.6	40.8	15.1	26.3
	3	0 – 15	ABky	85.0	5.2	9.8	SGLS	7.7	15.4	6.4	4.8	22.0	14.5	14.2
		15 – 50	Bky	69.6	13.3	17.1	VGSL	7.6	50.1	16.8	12.9	41.7	20.3	16.5
		50 – 150	By	65.2	16.5	18.3	VGSL	7.9	90.6	38.9	14.2	32.2	19.1	21.8
	4	0 – 10	ABky	56.4	23.8	18.8	GSL	7. 7	7.5	2.8	14,9	17.5	18.6	21.8
		15 – 45	Bky	51.7	23.1	25.2	VGSCL	7.8	25.8	9.5	18.5	29.9	20.2	39.3
		45 – 80	By1	36.6	26.1	37.3	VGCL	7.9	30.2	12.6	33.2	29.2	21.6	29.0
		80 – 150	By2	36.7	29.2	34.1	VGCL	7.9	41.9	18.3	30.4	25.8	19.3	30.0
	5	0 – 10	ABky	72.8	11.1	16.1	GSL	7.6	6.8	2.9	12.1	20.9	15.5	12.7
		10 – 40	Bky1	70.1	12.4	17.5	VGSL	7.8	18.6	8.2	13.4	24.2	20.3	29.1
		40 – 150	By	81.7	8.1	10.2	EGLS	7.5	24.1	9.4	5.8	30.2	16.9	14.9
Gently undulating inter-delta	6	0-20	ABy	26.0	38.2	35.8	SGCL	7.8	27.9	10.1	31.6	34.7	8.2	3.7
		20-60	Bky1	55.8	25.1	19.1	SGSL	7.6	19.3	6.8	14.8	35.5	15.0	10.1
		60-80	By2	31.6	30.1	38.3	SGCL	7.7	26.6	9.8	30,6	41.6	10.5	3.3
		80-100	By3	44.6	25.2	30.2	SGSCL	7.4	13.1	4.6	25.2	35.2	10.3	3.9
		100-150	By4	65.0	16.4	18.6	SGSL	7.3	18.9	5.7	14.1	41.1	8.8	4.2
	7	0-15	ABy	72.4	11.3	16.3	GSL	7.2	8.2	3.4	12.5	22.8	15.6	9.4
		15-70	Bky	76.3	12.2	11.5	GSL	7.1	19.7	9.1	8.4	39.3	14.5	15.1
		70-150	Bky	84.7	5.1	10.2	GLS	7.8	42.9	14.9	7.7	47.6	7.8	10.5
	8	0 – 25	ABky	64.6	16.5	18.9	GSL	7.3	34.8	12.4	13.7	46.8	9.6	18.7
		25 – 65	By1	83.2	10.6	6.2	GS	7.3	80.4	29.7	4.1	52.7	15.6	4.8
		65 –150	By2	81.8	10.1	8.1	GLS	7.9	46.8	15.5	6.2	40.3	8.5	5.3

VG: very gravely, G: gravely, SG: slightly gravely, S: sand, LS: loamy sand, SL: sandy loam, SCL: sandy clay loam, CL: clay loam, SC: sandy clay, C: clay, C.E.C: cation exchange capacity, ESP: exchangeable sodium percent, g: redox morphic horizon, k: calcic horizon, y: gypsic horizon z: salic horizon

Table 2 contd,

Physiographic units	Profile No.	Depth (cm)	Horizon	Grain size distribution %			Modified Texture Class	PH	EC (dS/m)		CEC meq/ 100g	ESP	$CaSO_4$ %	$CaCO_3$ %
				Sand	Silt	Clay			Soil past	Exract 1:1				
Gently undulating to almost flat Inter delta	9	0 – 20	ABky	45.8	28.1	26.1	SGSCL	7.4	29.6	10.8	17.8	44.0	10.0	17.9
		20 – 50	By	64.6	18.3	17.1	GSL	7.2	85.8	28.6	12.3	52.7	9.6	4.1
		50-150	C	63.3	16.5	20.2	SGSL	7.6	43.2	13.6	15.1	39.7	4.5	5.0
	10	0 – 25	ABy	84.3	5.9	9.8	SGLS	7.9	7.1	2.4	7.1	15.1	8.3	3.3
		25 – 60	By1	86.3	6.2	7.5	GLS	7.7	8.2	3.2	4.5	14.8	7.2	3.2
		60 –150	By2	94.3	2.6	3.1	GS	7.8	5.9	2.2	2.8	12.7	9.5	2.1
	11	0 – 20	ABy	83.4	10.3	6.3	SGLS	7.2	14.2	4.7	4.5	15.7	6.8	3.2
		20 – 70	By1	94.6	3.0	2.4	SGS	7.3	5.9	2.3	2.1	11.6	14.5	4.9
		70 –150	By2	95.7	1.4	2.9	S	7.9	9.6	3.9	2.4	15.0	10.8	2.6
	12	0 – 20	ABy	85.0	8.2	6.8	SGLS	7.3	14.1	4.8	4.7	18.2	7.8	6.6
		20 – 45	By1	94.5	2.2	3.3	SGS	7.8	25.3	10.5	2.8	20.3	16.4	4.5
		45 –150	By2	93.3	2.5	4.2	SGS	7.9	21.8	8.7	3.2	25.9	11.2	3.2
	13	0 – 20	ABy	83.0	6.2	10.8	SGLS	7.6	2.5	1.0	6.8	10.1	6.0	1.9
		20 – 70	By	92.8	3.7	3.5	SGS	7.9	11.8	2.6	2.3	15.1	6.8	1.5
		70-150	C	92.6	3.7	3.7	SGS	7.8	10.8	2.9	2.2	4.5	4.4	2.5
Almost flat depressed Pro delta	14	0 – 30	ABy	72.9	9.5	17.6	SGSL	7.6	40.7	15.8	13.1	38.8	14.5	1.8
		30 – 60	By	77.0	12.2	10.8	GSL	7.1	50.5	16.9	7.9	34.9	10.2	5.0
		60 – 95	2By1	27.5	37.3	35.2	CL	7.3	60.7	20,8	31.5	38.1	12.2	2.3
		95 – 150	2By2	34.3	20.5	45.2	C	7.2	80.8	28.9	40.7	34.8	17.2	2.2
	15	0 – 25	ABy	72.9	8.6	18.5	SGSL	7.5	40.88	13.4	13.9	39.1	20.4	3.6
		25 – 60	By	78.2	10.5	11.3	GSL	7.2	50.9	18.6	8.1	35.9	15.2	2.6
		60 – 95	2Byz1	28.5	36.1	35.4	CL	7.3	60.3	19.8	32.5	35.6	10.2	4.3
		95 – 150	2Byz2	29.0	24.8	46.2	C	7.2	70.3		42.2	30.6	20.2	2.8
	16	0 – 30	ABy	69.9	10.5	19.6	SGSL	7.7	70.4	22.5	13.8	44.9	14.4	1.8
		30 – 60	By	78.4	10.2	11.4	GSL	7.1	80.1353.1	27.9	8.1	41.1	16.2	5.3
		60 – 100	2By1	28.6	35.2	36.2	CL	7.4	75.5	18.7	31.2	38.8	15.2	2.3
		100 –150	2By2	34.7	20.1	45.2	C	7.3		22.7	41.8	38.4	17.2	2.5

VG: very gravely, G: gravely, SG: slightly gravely, S: sand, LS: loamy sand, SL: sandy loam, SCL: sandy clay loam, CL: clay loam, SC: sandy clay, C: clay, C.E.C: cation exchange capacity, ESP: exchangeable sodium percent, g: redox morphic horizon, k: calcic horizon, y: gypsic horizon z: salic horizon

Table 2 contd,

Physiographic units	Profile No.	Depth (cm)	Horizon	Grain size distribution %			Modified Texture Class	PH	EC (dS/m)		CEC meq/100g	ESP	$CaSO_4$ %	$CaCO_3$ %
				Sand	Silt	Clay			Soil past	Exract 1:1				
Water-logged pro delta	17	0 – 25 25 – 60 60 – 80	AByz Byz 2Bygz	66.5 77.0 45.7	18.2 10.8 25.1	15.3 12.2 29.2	SGSL SGSL SCL	7.9 7.8 7.7	172.9 131.7 152.6	50.8 60.9 75.8	12.5 8.1 27.4	37.0 44.2 42.2	13.5 25.6 20.5	5.3 3.7 2.8
	18	0 – 25 25--	ABygz Water	77.4 table	25.2	22.6	SGSCL	7.1	173.7	68.5	15.1	51.4	10.8	3.6
Gently undulating Aeolian deposits	19	0-15 15-90 90-150	C1 C2 C3	96.0 96.4 93.4	2.1 1.9 3.7	1.9 1.7 2.9	S S S	7.5 7.6 7.7	2.2 5.7 4.8	1.0 2.2 1.8	1.5 1.2 2.3	2.7 13.9 11.7	1.9 1.5 1.8	4.1 5.6 4.6
	20	0-20 20-60 60-150	C1 C2 C3	95.0 96.7 93.4	2.1 1.4 3.7	2.9 1.9 2.9	S S S	7.6 7.5 7.8	7.9 8.5 3.8	2.8 3.1 1.9	2.7 1.2 2.5	11.1 15.1 7.9	2.2 1.5 2.8	4.5 6.4 5.2
	21	0-25 25-70 70-150	C1 C2 C3	95.1 96.2 94.1	2.3 1.9 2.6	2.6 1.9 3.3	S S S	7.4 7.6 7.5	8.6 8.8 4.8	3.2 3.5 1.9	2.1 1.7 2.9	14.8 14.5 12.7	3.2 3.5 2.6	5.5 4.4 3.8
	22	0– 20 20-150	C1 C2	93.4 92.0	3.7 2.8	2.9 5.2	S S	7.4 7.6	6.4 5.4	2.0 2.3	2.6 4.2	14.9 11.0	4.4 4.5	5.4 4.5
	23	0 – 50 50 – 150	C1 C2	95.6 95.6	1.3 1.8	3.1 2.6	S S	7.4 7.6	2.3 6.2	1.1 23	2.8 2.1	2.8 14.8	3.5 3.4	3.5 3.4

VG: very gravely, G: gravely, SG: slightly gravely, S: sand, LS: loamy sand, SL: sandy loam, SCL: sandy clay loam, CL: clay loam, SC: sandy clay, C: Clay, C.E.C: cation exchange capacity, ESP: Exchangeable sodium percent, g: redox morphic horizon, k: calcic horizon, y: gypsic horizon z: salic orizon

Typic Calcigypsids, sandyskeletal, mixed, hyperthermic

These Clacigypsids are dominating the soils in the delta apex associatd with the aformentioned soils. The soils have gypsic horizon "By" developed throughout the solum including 15.5 to 20.3 % gypsum and 10 to 15 % by volume as secondary visible gypsum. Calcic horizon devloped within the soil surface and sub-surface associated with gypsic horizon "ABky" and "Bky", including 12.7 to 29.1 % $CaCO_3$ equivalent and 10 to 15 % by volume identifiable $CaCO_3$. Since they are dominated by extremely gravely loamy sands, they were categorized as sandy skeletal (Profile 5).

Typic Calcigypsids, fine loamy, mixed, hyperthermic

These Calcigypsids, occurred in the gently undulating inter delta and are dominating its soils. The soils have gypsic horizon "By" developed throughout the solum, including 8.2 to 15.0 % gypsum and 5 to 10 % by volume as secondary visible gypsum. Calcic horizon devloped in the soil sub surfae associated with the gypsic one "Bky", including 10.1 % $CaCO_3$ equivalent and 10 % by volume identifiable $CaCO_3$. Since the soil control section is dominated by slightly gravely clay loams and sandy clay loams, these soils were classified at the family level as fine loamy (Profile 6).

Typic Calcigypsids, loamy skeletal, mixed, hyperthermic

These Clacigypsids developed in the inter delta of gently undulating surfaces. The soils have gypsic horizon “By” developed throughout the solum, including 7.8 to 15.6 % gypsum and 5 to 20 % by volume as secondary visible gypsum. Calcic horizon devloped in the soil sub surface layers associated with the gypsic horizon “Bky”, including 9.4 to 15.1 % $CaCO_3$ equivalent and 5 % by volume identifiable $CaCO_3$. As these soils are dominated by very gravely sands and loamy sands, their soil family is sandy (Profile 7).

Typic Calcigypsids, coarse loamy,mixed, hyperthermic

These Clacigypsids developed in the inter delta of gently undulating to almost flat surfaces and are dominating its soils. The soils have gypsic horizon "By" developed in the soil surface and sub surface layers, including 9.6 to 10.0 % gypsum and 10 % by volume as secondary visible gypsum. Calcic horizon devloped only in the soil surface associated with the gypsic horizon "ABky", including 17.9 % $CaCO_3$ equivalent and 10 % by volume identifiable $CaCO_3$. As these soils are dominated by slightly gravely sandy loams, they are coarse loamy (Profile 9).

Typic Calcigypsids, sandy, mixed, hyperthermic

These Clacigypsids developed in the inter delta of gently undulating surfaces. The soils have gypsic horizon "By" developed throughout the solum including 8.5 to 15.6 % gypsum and 5 to10 % by volume as secondary visible gypsum. Calcic horizon devloped only in the soil surface associated with the gypsic horizon "ABky", including 18.7 % $CaCO_3$ equivalent and 10 % by volume identifiable $CaCO_3$. As these soils are dominated by gravely sands and loamy sands, they are sandy (Profile 8).

Leptic Haplogypsids, fine loamy, mixed, hyperthermic

These Haplogypsids occurred in the depressed pro delta with almost flat surfaces. The soils have only gypsic horizon "By" to be "Haplo". [etymology: Greek "haplus" = simple] This horizon developed in the soil surface to be "Leptic" and also in the soil sub suface, including 10.2 to 20.4 % gypsum and 10 to 15 % by volume as secondary visible gypsum. Since the soil control section is dominated by sandy clay loams, they were classified as fine loamy (Profiles14, 15 and16).

Leptic Haplogypsid, sandy, mixed, hyperthermic

These Haplogypsids occurred in the inter delta with gently undulating to almost flat surfaces. The soils have only gypsic horizon "By", which developed in the soil surface and also in the soil sub suface, including 6.0 to 16.4 % gypsum and 5 to 10 % by volume as secondary visible gypsum. Since the soil control section is dominated by slightly gravely sands and loamy sands, they were classified as sandy (Profiles 10, 11, 12 and 13).

ii. Entisols

[Ent. Implying recent, the last 3 letters of the word "recent"] Smith (1986) considered the Entisols as either losing material rapidly through truncation or receiving additions rapidly for horizons to form. The suborder level is first sorted out according to the reasons as why they had no subsurface diagnostic horizon. Entisols distribution in the study area are related only to the deposition process of the wind agent resulting in the following soil family.

Typic Torripsamments, mixed(calcareous), hyperthermic

[Psamment; etymology: Greek "Psamos" = sand].These Psamments suborder have been deposited in hot landscape to be Torripsamments [Torric; etymology: Latin "torridus" = hot]. They include only sandy soils and lacking rock fragments, being transported and deposited by wind action. These Torripsamments represent the central concept of their great group to be "Typic" At the level of soil family, these soils are "calcareous" since their fine earth of the control section between the depth of 25 cm to 50 cm, effervesces strongly with cold dilute HCl. (Profiles 19 ,20, 21, 22 and 23).

Potential Land Suitability Classification

In this study, the physiographic soil map has been used as a base to represent the land suitability in polygons. Some land utilization types are proposed for profitable production of food grain crops as barley and wheat, fodder crops as alfalfa and food oil seed crops as maize, sun flower and olives. In this study, land potential suitability classification was based on finding out the suitability of certain land unit for these proposed specific utilizations after proposed major land improvements according to their necessity. These major land improvements were considered for the land qualities of drainage, salinity and sodocity, which are conditonally to be managed within the initiation phase of utilizing the study area (exept for the waterlogged pro delta as potentially not suitable). The land evaluation was done by rating the land characteristics of slope, drainage condition, soil texture, stoniness (gravel contents), soil depth, fertility (CEC), $CaCO_3$ status and gypsum status. The ratings were matched with certain crop requirements, that proposed by Sys et al (1993), resulting in suitability indices. The intensity of limitations were used for specifying land suitability as the order suitable [highly suitable "S1", moderately suitable "S2" and marginally suitable "S3"] and not suitable [currently not suitable "N1" and potentially not suitable "N2"]. Suitability subclasses that reflect the associated limitations are indicated in symbols, using lower-case letters synonymous with those limitations (Table 3). Some of land attributes are characterising the defined suitability level as limitating factors. These limiting factors as soil fragments "g" and gypsum "y" in the delta apex, gypsum in the gently undulating inter-delta and depressed pro-delta, soil texture "x" in the gently undulating to almost flat inter delta and in the gently undulating aeolian deposits. The potential land characteristics of these units can be more adapted to the proposed utilization after improving some of these limiting factors, which will be easy being the soils have medium and coarse texture classes as well as high contents of gypsum. The study indicates that the best utilization of the different physiographic units can be defined as follows:

-The units of gently undulating inter delta, gently undulating to almost flat inter-delta, almost flat depressed pro delta and the gently undulating aeolian deposits can be utilized for olives as highly to moderately suitable. These units can be considered as olive cultivation belt in the Western Desert of Egypt

-Depressed pro delta can be used for alfalfa, barley, maize, sun flower and wheat, as marginally suitable

-Gently undulating inter-delta and eolian deposits can be used for alfalfa, maize and sun flower, as marginally suitable.

For the proposed annual crops, the limitations can be improved by the perpetual managements, once the land will be introduced for cultivation. Holders of high capital-intensity and large-scale land tenures will be highly recommended for this difficult task rather than those of low-capital intesity with small-scale land tenures.

Table 3: Potential land suitability of the study area.

Physiographic unit	Profile No.	Potential land suitability sub classes					
		Sprinkling irrigation					Drip irrigation
		Alfalfa	Barley	Maize	Sunflower	Wheat	Olive
Undulating delta apex	1	N1g,y	N1g,y	N1g,y	N1g,y	N1g,y	N1d,y
	2	N1g,y	N1g,y	N1g,y	N1g,y	N1g,y	S3g,y
	3	N 1g,y	N 1g,y	N 1g,y	N 1g,y	N 1g,y	S3g,y
	4	N1g,y	N1g,y	N1g,y	N1g,y	N1g,y	S3g,y
	5	N1y	N1y	N1y	N1y	N1gxy	S2
Gently undulating inter delta	6	S3y	S3y	S3y	S3y	S3y	S1
	7	S3y	N1x,y	S3y	S3y	N1x,y	S1
	8	S3y	N1xy	S3y	S3y	N1xy	S1
Ggently undulating to almost flat Inter delta	9	S3y	S3y	S3y	S3y	S3y	S2
	10	S3y	N1x,y	S3y	S3y	N1xy	S2
	11	N1xy	N1x	N1x	N1x	N1x	S2
	12	N1xy	N1x	N1x	N1x	N1x	S2x
	13	S3x	N1x	S3x	S3x	N1x	S2x
Depressed Pro delta	14	S3y	S3y	S3y	S3y	S3y	S1
	15	S3y	S3y	S3y	S3y	S3y	S1
	16	S3y	S3y	S3y	S3y	S3y	S1
Water logged pro-delta	17	N2d,s	N2d,s	N2d,s	N2d,s	N2d,s	N2d,s
	18	N2d,p,s	N2d,p,s	N2d,p,s	N2d,p,s	N2d,p,s	N2d,p,s
Gently undulating Aeolian deposits	19	S3x	N1x	S3x	S3x	N1x	S2x
	20	S3x	N1x	S3x	S3x	N1x	S2x
	21	S3x	N1x	S3x	S3x	N1x	S2x
	22	S3x	N1x	S3x	S3x	N1x	S2x
	23	S3x	N1x	S3x	S3x	N1x	S2x

S1: higly suitable, S2: moderately suitable, S3: marginally suitable N1: not suitable can be improved, N2: potentially not suitable and can not be improved. d:drainage, g : gravel % , p : soil depth, x: texture y : gypsum %.

Detectable Gross Profit Land Use of The Study Area

The supreme potential suitability for each crop and the other proposed profit utilizations are adapted for the physiographic units as shown in Figure (3) and as follows

i. Undulating delta apex is profitable land for:

a. Drip irrigated olives as moderately to marginally suitable (S2 toS3)

b. Quarrying for Oligocene gravel

ii. Gently undulating inter delta is profitable for:

a. Drip irrigated olives of highly (S1) and sprinkly irrigated alfalfa, maize and sun flower as marginally suitable (S3)

iii. Gently undulating to almost flat inter delta is profitable for

a. Drip irrigated olives as moderately suitable (S2)
b. Proposed modern township area which is proposed to be nominated “Al Qattara Town” in the middle front of this unit, covering about 12660 feddans (5319 hectars). It was delineated to have descending slopes to the surrounding outskirts from 25m asl to the inland and zero level facing the changeable weather of the detectable artificial water body of Al Qattara Lake.

iv. Almost flat depressed pro delta is profitable for

a. Drip irrigated olives as highly suitable (S1) and sprinkly irrigated alfalfa, barley, maize, sun flower and wheat as marginally suitable (S3).

b. Quarrying of Miocene clays (shales)

c. National and international combinations for producing evaporites, distilled water and fish

d. Fishery sites and developed settlements for the fisher people and fish mongers associated with the proposed local ports.

v. Waterlogged pro delta

This part of the pro delta is representing the deeper part of Al Qattara Depresion which was mostly delineated at levels between-65m to -134m below sea level. It is highly recommended to be filled with sea water for the hydroelectric purposes and for improving the local climatic conditions.

vi. Gently undulating aeolian plain is profitable for

Drip irrigated olives as moderately suitable (S2) and for sprinkling irrigated alfalfa, sun flower and maize as marginally suitable (S3).

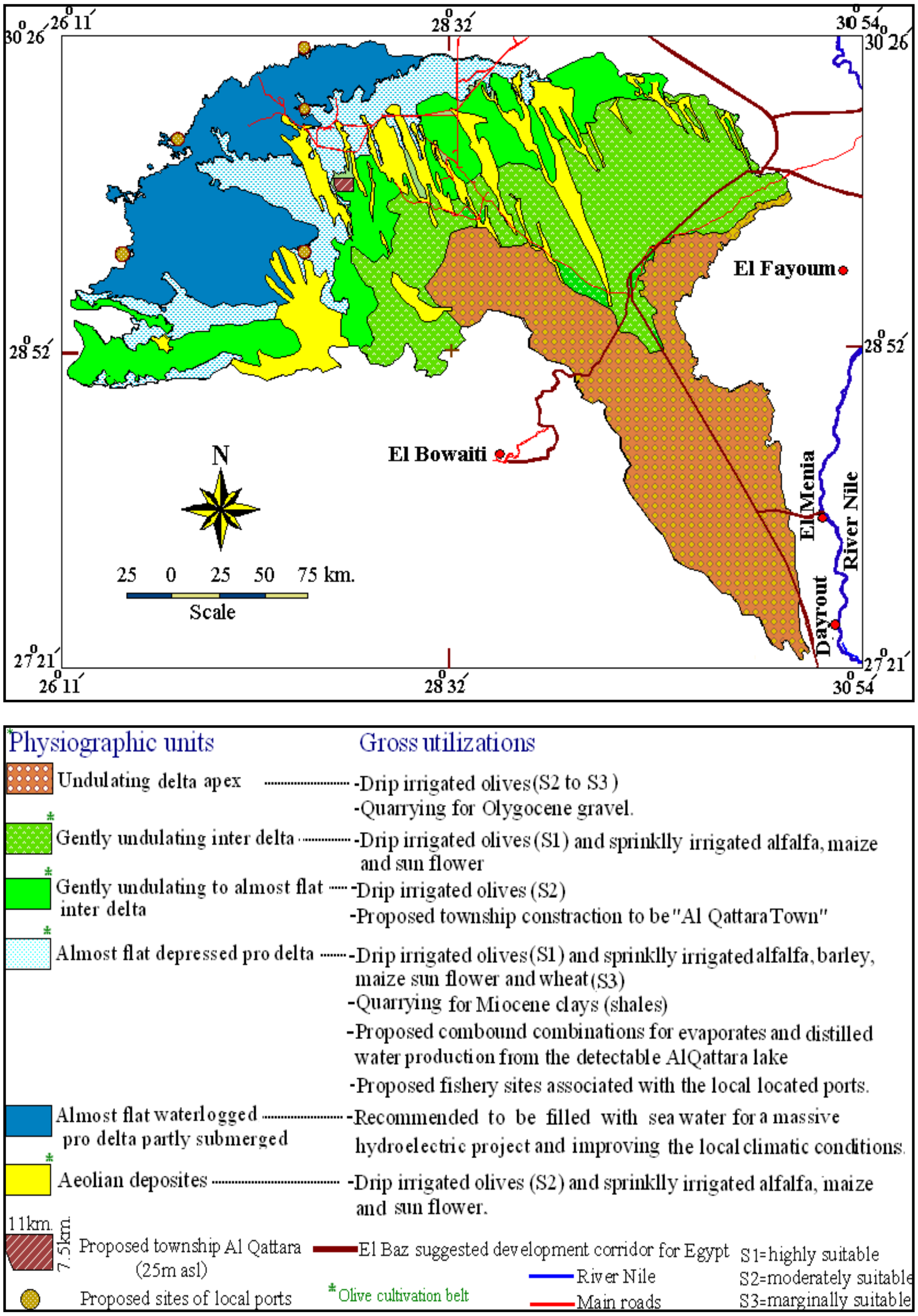

Figure 3: Detectable gross profit land use of the study area according to the proposed utilizations.

CONCLUSION AND RECOMMENDATIONS

The approach of tracing the landscape genesis is valuable for facilitating the clue to define the land attributes as associated with different physiographic units for such vast region. This approach led to the tracing of the fluvitiles, which had been originated by the flows of the paleodrainage. As the fluvitiles of the paleodrainage are traced, the related physiographic units can be delineated. For the same purpose, using remot sensing data is also helpful element when the spatial resolution (28 to 30 metres) and spectral resolution (bands 7, 4 and 2) are selected for delineating the border between these fluvitiles and their outskirts of the rocky structures and for a well recognition of waterlogged areas and paleodrainage lines.

Tte physiographic soil map has been used as a base to represent the land suitability. In this study, land potential suitability classification was based on finding out the suitability of certain land unit for proposed specific utilizations after proposing major land improvements. These major land improvements were considered for the land qualities of drainage, salinity and sodocity, which are conditonally to be managed within the initiation phase of utilizing the study area. This study area is highly recommended for the following proposals:

1- Introduce the area to be collecvtively studied for other purposes of investments as well as mapping the area at the level of detailted soil survey to enrich the area data base in order to be developed.

2-Investigating the possibility of utilizing the northern part of the study area "Qattara Depression" for hydroelectric purposes by creating an artificial lake at the proper elevation below sea level. This lake will develop the environmental attributes by changing the local climate for better temperature and moisture regimes

3- Introducing the study area to be utilized as olive cultivation belt in Egypt after a feasibility study considering the high tolerance of olive trees against higher levels of soil limitating factors comparing to the other crops. It is also to be considered that Egypt is suffering from a big deficiency of food oil production, which has been supported by importing its products

4- Attempts should continue for de-mining, the northern outskits of the study area, confirming the Egyptian right to remove these mines by those countries responsible for planting them during the World War II.

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تقييم الموارد الأرضية لدلتا الصرف القديم بالصحراء الغربية بمصر باستخدام معلومات الاستشعار عن بعد

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اختيرت منطقة الدراسة لتمثل ترسيبات دلتا الصرف القديم بالصحراء الغربية والتى تعتبر من المناطق الواعدة للاستغلال الزراعى وتقدرمساحتها بحوالى 15615653 فدان. تم تعريف الوحدات الفزيوجرافية عن طريق تحليل مرئيات القمر الاصطناعي لاند سات لعام 2002 وقدرت الصلاحية الكامنة للأراضى بغرض زراعة محاصيل معينة وهى الشعير والقمح كمحاصيل حبوب , البرسيم الحجازي كمحصول علف حيوانى، الذرة ودوار الشمس والزيتون لانتاج بذور زيت الطعام وقد تم تحديد الوحدات الفزيوجرافية وهى رأس الدلتا ومن الأرجح أن رواسبها قد تكونت عن طريق الصرف القديم الذى مر بأراضى الصحراء الشرقية وتتميز بالوحدات التصنيفية:

Typic Clacigypsids, loamy skeletal, gypsic;
Calcic Petrogypsids, loamy skeletal, gypsic;
Typic Calcigypsids, sandy skeletal, mixed.

هذه الأراضى متوسطة الى حادية الصلاحية لزراعة الزيتون بالرى بالتنقيط كما يمكن تطويراستخراج الزلط الذى يميز العصر الاوليجوسينى لهذه الوحدة. الدلتا الداخلية خفيفة التموج من الأرجح أنها تكونت عن طريق خلخلة ميول رأس الدلتا ونقل الرواسب منها الى الدلتا الداخلية فى عصور أحدث من التى كونت رأس الدلتا وقد صنفت أراضيها الى:

Typic Calcigypsids, fine loamy, mixed;
Typic Calcigypsids, loamy skeletal, mixed;
Typic Calcigypsids, sandy, mixed.

تعتبر هذه الأراضى عالية الصلاحية لزراعة الزيتون بالرى بالتنقيط وحادية الصلاحية لزراعة البرسيم الحجازي, الذرة ودوار الشمس بالرى بالرش. بالنسبة الى الدلتا الداخلية ذات التموج الخفيف الى الشبه مستو فمن الأرجح أنها تكونت عن طريق تجوية ونقل الرواسب من الدلتا الداخلية التى تقع فى جنوب هذه الوحدة وقد صنفت اراضى هذه الوحدة الى:

Leptic Haplogypsid, sandy, mixed;
Leptic Haplogypsids, fine loamy, mixed.

وتعتبر هذه الأراضى متوسطة الصلاحية لزراعة الزيتون بالرى بالتنقيط ويقترح انشاء مدينة حديثة تسمى مدينة القطارة فى المنطقة الوسطى بشمال هذه الوحدة الأرضية بحيث تقع فى محيط المناخ المتوقع تحسنه بعد تنفيذ مشروع منخفض القطارة وبالنسبة الى مقدمة الدلتا ذات السطح المستوى والمنخفضة عن سطح البحر فانها تحتوى على ترسيبات متداخلة من مادتى أصل مختلفتا المصدر حيث توجد طبقات من الطمى الرملى تعلو طبقات مجواة من الطفلة وقد صنفت أراضى هذه الوحدة الى

Leptic Haplogypsids, fine loamy, mixed وتعتبر هذه الأراضى عالية الصلاحية لزراعة الزيتون بالرى بالتنقيط وحادية الصلاحية لزراعة الشعير والقمح والبرسيم الحجازي والذرة ودوار الشمس بالرى بالرش كما يمكن تطوير استغلال هذه الوحدة الفزيوجرافية فى استخراج الطفلة الميوسينية وانشاء مجمعات كبيرة لانتاج المتبخرات والمياه المقطرة وحفظ الاسماك وذلك من بحيرة القطارة التى يتوقع تكونها شمال هذه الوحدة الفزيوجرافية. بالنسبة الى مقدمة الدلتا المتاثرة بوجود الماء الأرضى فانها تتكون من اراضى رديئة الصرف ومنغمرة اومغطاة جزئيا بمياه مالحة اوترسيبات هوائية ويتراوح مستوى هذه الوحدة من -65 الى -134 متر تحت مستوى سطح البحر وقد صنفت أراضى هذه الوحدة الى Gypsic Aquisalids, fine loamy, mixed وتمثل هذه الوحدة موقعا مناسبا لتكوين بحيرة صناعية لتوليد الطاقة الكهربائية وتحسين المناخ المحلى لمنطقة الدراسة. بالنسبة للترسيبات الهوائية فانه من المرجح انها ترسبت على مسارات الصرف القديم وتضم الوحدة التصنيفية Typic Torripsamments, mixed (calcareous) وتعتبر هذه الاراضى متوسطة الصلاحية لزراعة الزيتون بالرى بالتنقيط وحادية الصلاحية لزراعة البرسيم الحجازي والذرة ودوار الشمس بالرى بالرش. وبصفة عامة فان معظم الوحدات الفزيوجرافية يمكن استغلالها كحزام لزراعة اشجار الزيتون كما تعتبر منطقة الدراسة ذات اهمية كبيرة تستدعى ادخالها ضمن استثمارات متعددة الأهداف وأن يتم دراسة متكاملة لمشروع منخفض القطارة.