

"Impact of Soil Degradation on Land Qualities of Some Cultivated Areas at East Nile Delta -Egypt."

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Abstract: Most forms of degradation are man-made problems, although there are some physical environmental factors evolved, but misuse and mismanagement are important factors. Quantitative assessment of human induced land degradation and monitoring the changes in land qualities in EL Dakhlyia Governorate during the period of 1976 to 2008 are the main objective of this study. Geometrically corrected physiographic-soils map of scale 1: 100.000 reduced to the attached map of scale 1: 250.000 were produced for the studied area. The comparison between the data extracted from the RISW reports, (1976) and the data of this study were carried out in the year 2008 for 13 selective profiles in 9 representative districts of EL Dakhlyia Governorat to determine the rate of land degradation. Aerial photo-interpretation, fieldwork and laboratory analysis data were used to produce the physiographic - soil ma of EL Dakhlyia Governorat. Land degradation rate, relative extent, degree, and severity level in the study area were assessed. The results indicate that the most active land degradation features are; water logging salinization, alkalization and compaction. The main causative factors of human induced land degradation types in the studied area are over irrigation, human intervention in natural drainage, improper time use of heavy machinery and the absence of conservation measurements.

Key words: Physiographic – soil map, land degradation, land qualities, EL DAKHALYIA Governorate.

INTRODUCTION

Soil degradation is defined as the process, which lowers (quantitatively or qualitatively) the current and/or the potential capability of soil to produce goods or services. Soil degradation implies a regression in capability from a higher to lower state; a deterioration in soil productivity and land capability, (Mashali, 1991; Ayoub, 1991; UNEP, 1992 and wim & Elhadji; 2002). The food gap due to increasing population puts more pressure on the use of land, resulting in serious forms of land degradation which are considered irreversible processes particularly with the severe and continued misuse and poor management. The intensification of agriculture coupled with poor management accelerates the rate of land degradation. Food supply situation will be worse in the future if the current trend of land degradation does not change drastically. The livelihoods of more than 900 million people in some 100 countries are now directly and adversely affected by land degradation (United Nations, 1994). Unless the current rate of land degradation is slowed and reversed, food security of humanity will be threatened and the ability of poor nations to increase their wealth through improved productivity will be impeded. Land degradation can be observed in all agro-climatic regions on all continents. Although climatic conditions, such as drought and floods, contribute to degradation, the main causes are human activities. Land degradation is a local problem in vast number of locations, but it has cumulative effects at regional and global scales. The countries of the developing world, and particularly those in the arid and semi-arid zones, are the most seriously affected, (UNEP, 1986).The status of soil degradation is an expression of the severity of the process. The severity of the processes is characterized by the degree in which the soil is degraded and by the relative extent of the degraded area within a delineated physiographic unit (UNEP, 1991).

The studied area incorporates an area of approximately 3470.90 km², It is bounded by longitudes 31° 15' and 32° 00' E & latitudes 31° 30' and 30° 00' N, Fig. (1). This area belongs to the late Pleistocene which is represented by the deposits of the neonile broke into Egypt sometime in the earlier part of this age and also by the deposits accumulated during the recessional phases of this river. Through its history the neonile in this region has been continuously lowering its course at a rate of 1m/1000 years, (Said, 1993). Based on the Egyptian Meteorological Authority (1996) data and the American Soil Taxonomy (USDA, 2003), the soil temperature regime of the studied area is defined as Thermic and soil moisture regime as Torric.

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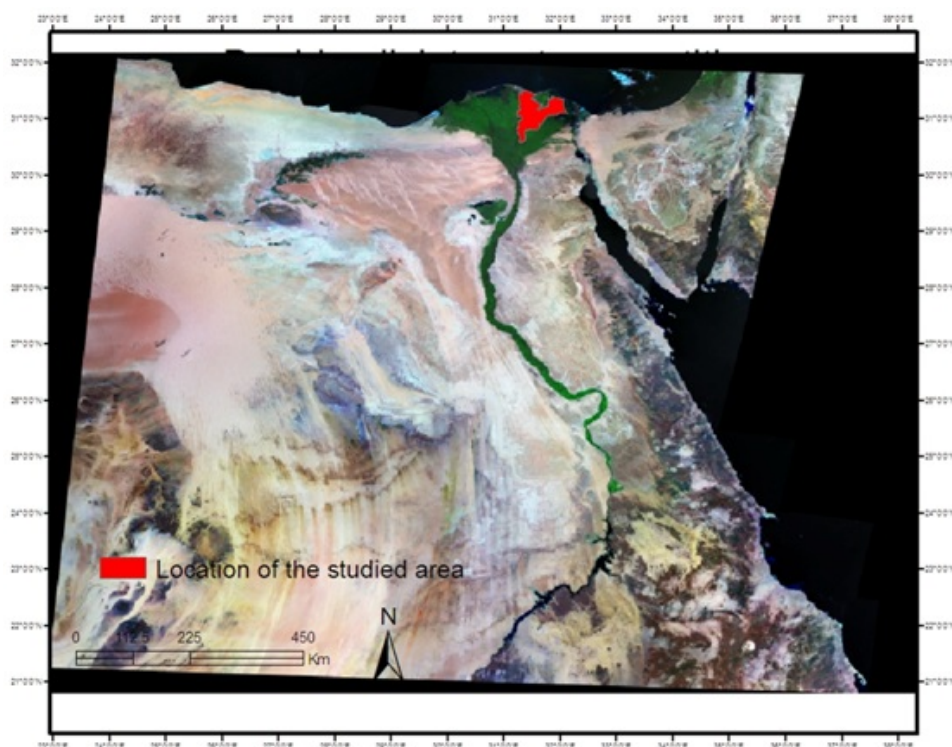


Fig. 1: Location map for the studied area

MATERIALS AND METHODS

Physiography and soils:

The study area is covered by a number of 63 panchromatic aerial photographs of scale 1: 40,000, which are acquired in 1991. They have been used to produce the physiographic map of the area of interest, using the physiographic analysis method, (Zink and Valenzuela 1990). To fulfill the objective of this study 15 soil profiles were chosen in seven districts to represent the different soil units. Morphological description was carried out following the guidelines edited by FAO(1990). The laboratory analysis of 13 soil profiles represents the study area, were carried out using the soil survey laboratory methods manual, USDA 2004 and Robert (2008). The American Soil Taxonomy, (USDA, 2003) was used to classify the different soil profiles to sub great group level. Then the correlation between the physiographic and taxonomic units was established, after Elberson and Catalan (1986). Arc-GIS 9.2 software has been used for geometric correction and mapping as the main software of Geographic Information System.

Soil Degradation Assessment:

This study is based on comparing between the data extracted from RISW report, (1976) and the data resulting from this study. The FAO/UNEP (1978)&(1979) methodology for assessing soil degradation was used and the results were evaluated and confirmed with the physiographic units, The rating used are present in Tables (1&2). Moreover, the soil degradation classed and rates are shown in (Table 3). The status of soil degradation is an expression of the severity of the process. The severity of the processes is characterized by the degree in which the soil degraded and by the relative extent of the degraded area with in a delineated physiographic unit. Degree, relative extent, severity level and causative factors were defined and described by using the GLASOD approach (UNEP,1991) as the following:

- Degree of Soil Degradation:

The criteria used to determined the degree of land degradation are shown in (Table 4).

- Relative Extent of the Degradation Type:

It is not possible to separate areas of soil degradation individually on the map. It is however possible to estimate the relative extent of each type of soil degradation within the mapped unit.

-The Severity Level of Soil Degradation:

The severity level is indicated by the combination of the degree and the relative extent as shown in (Table5).

Table 1: Rating for physical vulnerability.

Factor	Index	Class			
		Low	Moderate	High	Very high
Climate	$\sum p2/p-$	0-50	50-500	500-1000	>1000
Soil	Slit%/Clay%	<0.2	0.2-0.3	0.3-0.7	>0.7
Topography	Slope %	0-2	2-8	>8	-

p= monthly precipitation, p-=annually precipitation

Table 2: Rating for chemical vulnerability

Factor	Index	Class			
		Low	Moderate	High	Very high
Climate	PET/(P+Q)10	<0.1	0.1-0.3	0.3-0.5	>0.5
Soil	Texture class	Clay	Silt	Sand	-
Topography	Slope %	0-2	2-8	>8	-

PET= potential evapo-transpiration p= precipitation/year Q=irrigation water.

Table 3: Soil degradation types, classes and rates

Chemical degradation	Salinization (Cs) increase in (EC) per dS/m/year	Alkalinization (Ca) increase in ESP/Year
Non to slight	<0.5	<0.5
Moderate	0.5 – 3	0.5 – 3
High	3 – 5	3 – 7
Very high	>5	>7
Physical degradation	Compaction/increase in bulk density per g/cm ³ /year	Water logging/increase in water table in cm/year
Non to slight	<0.1	<1
Moderate	0.1 – 0.2	1 – 3
High	0.2 – 0.3	3 – 5
Very high	>0.3	>5

Table 4: Criteria used to determine the degree of the different degradation types

Hazard type	Indicator	Unit	Hazard class			
			Low	Moderate	High	Very high
Salinization	EC	dS/m	4	4 – 8	8 – 16	>16
Alkalinization	ESP	value	10	10 – 15	15 – 30	>30
Compaction	Bulk density	g/Cm ³	1.2	1.2 – 1.4	1.4 – 1.6	>1.6
Water Logging	Water Table level	cm	150	150 – 100	100-50	<50

Land degradation degree, relative extent, severity level and causative factors were defined and described using the UNEP, (1991) approach. The relative extent of each type of soil degradation within the mapped unit is recognized as:

Category	% of the mapping unit
1. Infrequent	up to 5%
2. Common	6-10%
3. Frequent	11-25%
4. Very frequent	26-50%
5. Dominant	over 50%

Table 5: The severity level of soil degradation:

Degree of soil degradation	Relative extent (%)				
	0-5	6-11	11-25	26-50	50-100
Slight	1.1	1.2	1.3	1.4	1.5
Moderate	2.1	2.2	2.3	2.4	2.5
Strong	3.1	3.2	3.3	3.4	3.5
Extreme	4.1	4.2	4.3	4.4	4.5
The severity classes:					
Low	Moderate	High	Very high		

- Causative Factors:

The dominate causative factors of the different types of land degradation were identified in the field and also collected from the available technical reports.

RESULTS AND DISCUSSION

Physiography and Soils:

(Table 6) and (Map 1) show the main physiographic units and soil sets of the studied area. The obtained data show that the physiographic units in the studied area include, clay flats (CF1 & CF2), sand deposits (OS1 & OS2), dry and wet sabkha (DS & WS), over flow mantle (OM1 & OM2), over flow basins (OB1 & OB2), decantation basins (DB1 & DB2), river terraces (T1 & T2) and turtle backs (TB). The water bodies (WB), swamps (S), fish ponds (FB) and the gypsiferrous flat (GF) dominating the northeastern part of the area. The main soil sub-great groups in the studied area are: Typic Torrifluvents, Vertic Torrifluent, Typic Torripsamment, Gypsic Haplosalids, Typic Paleargids and Typic Natrargids.

Land Degradation Assessment:

Natural Vulnerability of the Studied Area:

(Table 7) represents the natural vulnerability and its relative extent (%) of the different mapping units in the studied area. The obtained data reveal that, the soils of (OS,O.M, T.B & T) have a physical degradation ranging from mod. to high risk. The high risk of the physical degradation type is related to high content of silt and low percentage of organic matter. While, the soils of (CF,O.B & D.B) have a slight physical degradation related to low content of silt and high percentage of organic matter.

Besides, the soils of (OS,O.M, T.B & T) have a chemical degradation risk ranging from slight to mod. Risk .While, the soils of (CF,O.B & D.B) have a high chemical degradation risk due to the high evapotranspiration value compare with the amount of precipitation and irrigation water. The relative extent (%) of the natural vulnerability classes in the studied area are shown in (Table 8).

Human Induced Soil Degradation:

The soil degradation parameters (rate, degree, relative extent, causative factors and severity level) were investigated for the different soil classes to assess water logging, compaction, salinization, and alkalization in the studied areas. The rate of land degradation was estimated by the comparison between the main land characteristics as studied in 1976 and 2008 (Table, 9). Soil degradation rates for each mapping unit are illustrated in(Table, 10). The obtained data reveal that, the rate of salinization, alkalization, water logging and compaction, are slight to moderate, where the annual increases of EC, ESP, water table level and bulk density ranges from 0.01 to 0.14 dS/m, 0.01 to 0.05 %, 0.0 to1.1 Cm and from 0.0 to 0.01 g/cm³ per year respectively. The moderate degradation rates affect 41.68% of the studied area; it found in the relatively low decantation and overflow basins (DB2 & OB2), overflow mantles (OM1 & OM2) in the flood plain and clay flats units (CF1 & CF2) in the fluvio – lacustrine plain. The hazards of the different types of soil degradation are low to high, where the values of electric conductivity, exchangeable sodium percent, bulk density and the depth of water table are ranges between 1.48 and 20.34 dS/m, 10.23and 25.42 %, 1.13 and 1.50 g/cm³ and 70 to 150 cm. respectively. The data indicate that the high degree of salinization, Alkalinization, water logging and compaction are found in the units of over flow mantles (OM1 & OM2), high elevation clay flat (CF₁), low elevation clay flat (C.F₂) and decantation basins (DB1 & DB2) respectively. The relative extent of each

type of human induced soil degradation in the studied areas were estimated based upon the correlation between the physiography and soils in the different mapping units, as shown in (Table 11). The results indicate that 77329 feddans of the studied area have a high degree of water logging as the soil depth ranges from 50 to 75 cm. the high degree of water logging affect only the soils of clay flats of various elevations in the fluvio – lacustrine plain. An area of 235702 feddans have a high hazard of compaction as the bulk density are located in the range of 1.35 to 1.50 g/cm³, this degree of compaction affects the fine textured soils in the clay flats, overflow mantels and decantation and overflow basins. The soils, which affected by a high degree of salinity (EC ranges from 8 to 16 dS/m) are found in clay flats, over flow mantles and overflow basins landforms, the total area of these units is 222974 feddans. The results indicate that the moderate hazard of alkalinity (ESP, 15 – 25 %) affects the soils of relatively high overflow mantle (OM2), which represent 19471 feddans.

The severity levels of land degradation were indicated by a combination of the degree and the relative extents of the degradation types (Table 12). The severity level in the studied area varies from low to very high, where the relative extent in the different mapping units is dominant (affect over 50% of the units) while the degree of degradation varies from low to high. The high severity levels of soil degradation are associated with the landforms of clay flat, decantation and overflow basins, and over flow mantle. The soils of sandy remnants, turtle backs and river terraces are facing low severity levels of degradation.

The main causative factors of soil degradation in the studied area were observed during the fieldwork, these factors are over irrigation (i), improper use of heavy machinery (m), and human intervention in natural drainage (d) and the absence of conservation measurements (o). These factors are found in the different units in the area, where the same traditional managements are practices.

The status of land degradation in the different mapping units of the studied area are shown in(Table 13) and (Map 2). The results indicate that the northwestern parts of the area are facing complex types of soil degradation, where the water logging, soil compaction, salinity and alkalinity characterize the soils of overflow mantles and overflow basins. The moderate to high hazard of soil compaction affects the middle parts of the area, the moderate hazards of water logging and alkalinity are found in the same area. The soils of sandy remnants and turtle backs in the middle and southern parts facing a moderate hazard of alkalinity, the hazards of compaction, salinization and water logging in these soils are low. Map 2 Shows the land degradation status in the studied area.

Causative Factors of Human Induced Land Degradation:

The main causative factors of human induced land degradation types in the studied area, Except some environmental processes witch occur without human interference, the soil degradation is resulted when soils are not properly managed or not used in the right way. The main types of human induced land degradation in the investigated areas are, salinization, alkalinization, Soil compaction and water logging , these types are affected by the human activities as the following :-

-Salinization and alkalinization /the human induced salinization and alkalinization can result of the three causes, first, it can be the result of poor management of irrigation schemes. A high salt, content of the irrigation water or too little attention given to the drainage of irrigated fields can easily lead to rapid salinization and or alkalinization. This type of salt accumulation mainly occurs under arid and semi-arid condition. Second, salinization and or alkalinization will occur if sea water or fossil saline ground water bodies that intrude the ground water reserves of good quality. This some times happens in the coastal regions with an excessive use of ground water but can also occur in closed basin with aquifers of different salt content.. A third type occurs where human activities lead to an increase in evapo-transpiration of soil moisture in areas of high salt-containing parent materials or with saline ground water.

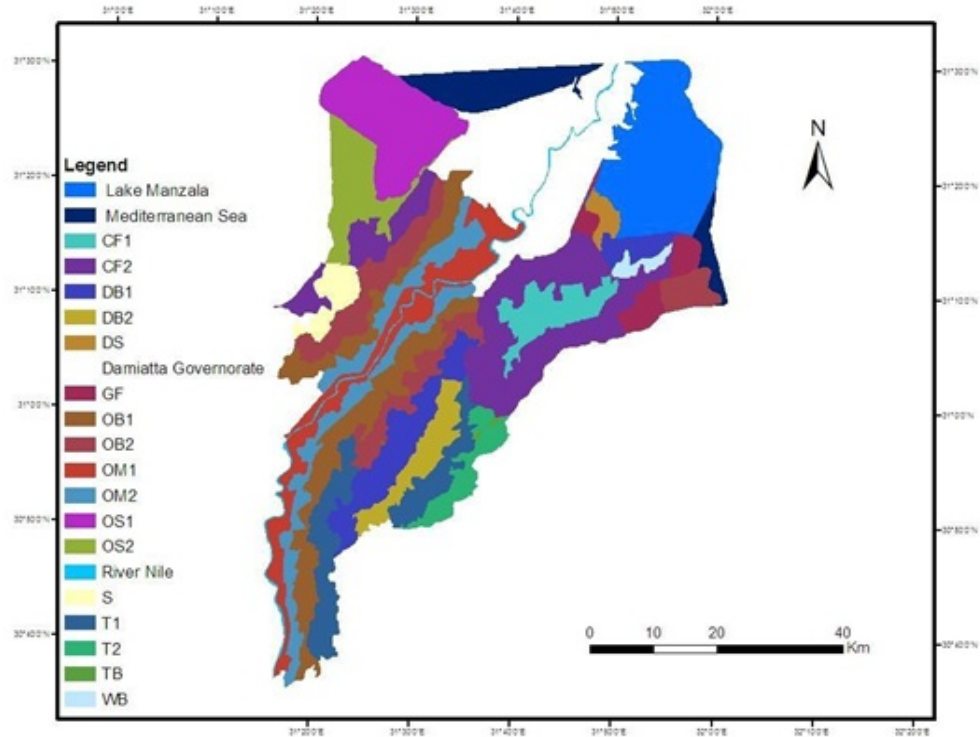
-Compaction /compaction mainly occurs in the soils with a low structural stability, under the improper human activities. In the studied areas soil compaction was resulted from improperly timed use of heavy machinery, misuse of irrigation, absence of conservation measurements, shorting of the fallow period, and the excessive use of chemical fertilizers.

-Water logging/ human intervention in the natural drainage systems by the misuse irrigation water quality may lead to flooding especially in heavy clay soils. Over irrigation ,insuffctient drainage, and destruction of subsurface drainage networks (in some parts) are the main causes of water logging in the studied areas.

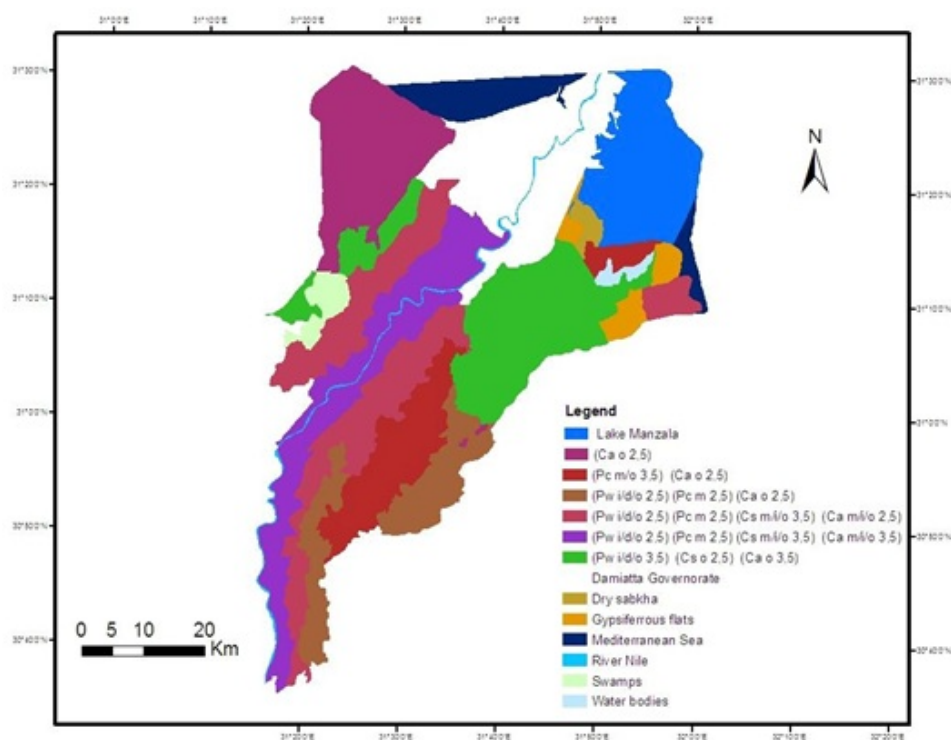
Table 6: Physiographic and Soil map Legend of the Investigated Area:

Landscape	Relief	Lithology /Origin	Land form	Mapping unit	Profile no.	Area %	Soil sets	Type of soil sets
Fluvio-lacustrine plain	Almost flat to gently undulating	Fluvio-lacustrine deposits	Relatively high clay flats	CF1	1	15.20	Vertic Torrifluvents	Cons.
			Relatively low clay flats	CF2	2	7.73	Vertic Torrifluvents	Cons.
			Dry sabkha	DS		0.45	Gypsic Haplosalids	Cons.
			Wet sabkha	WS	6	0.62	Typic Aquisalids	Cons.
			Fish bounds	FB	--	1.28	--	--
			Swamps	S	--	0.74	--	--
			Gypsiferous flats	GF	--	1.89	--	--
			Water bodies	WB	--	0.37	--	--
Aeolian plain	Gently undulating	Marine deposits	High sandy remnants	OS1	3	7.43	Typic Torripsamments	Cons.
			Low sandy remnants	OS2	4	5.67	Typic Torripsamments	Cons.
Flood plain	Almost flat to gently undulating	Alluvial deposits	Over flow Mantle					
			Relatively low	OM ₁	5	13.85	Typic Torrifluvents	Cons.
			Relatively high	OM ₂	6	6.94	Typic Paleargids	Assoc.
			Over flow basin					
			Relatively low	OB ₁	7	11.89	Vertic Torrifluvents	Cons.
			Relatively high	OB ₂	8	5.11	Typic Natrargids	Assoc.
		Decantation basin						
		Relatively high	DB ₁	9	8.18	Typic Torrifluvents	Cons.	
		Relatively low	DB ₂	10	6.48	Typic Torrifluvents	Cons.	
		Alluvial deposits	Relatively High	T ₁	11	3.94	Vertic Torrifluvents	Cons.
			Relatively low	T ₂	12	2.12	Vertic Torrifluvents	Cons.
			Turtle backs	TB	13	0.11	Typic Torripsamments	Cons.
				Sub deltaic deposits				

Cons. = consociation, Assoc. = association



Map. 1: Physiographic and soil map of the investigated area .



Map. 2: Land degradation in the investigated area .

Table 7: Physical and chemical degradation classes according to the natural factors in the studied area:

profile No.	Mapping unit	Location	Physical degradation				Chemical degradation					
			C	S	T	Value	Class	C	S	T	Value	class
1	CF1	Bani abed	1.0	0.48	1	0.06	Slight	0.22	1.1	1	0.21	High
2	CF2	El asafra	1.0	0.46	1	0.06	Slight	0.22	1.2	1	0.22	High
3	OS1	Abu mady	1.0	1.83	1	0.21	High	0.22	0.2	1	0.06	Slight
4	OS2	El masara	1.0	1.81	1	0.21	High	0.22	0.2	1	0.06	Slight
5	O.M1	Spenkhet	1.0	0.91	1	0.10	Mod.	0.22	0.6	1	0.10	Mod.
6	O.M2	Dafadous	1.0	0.90	1	0.10	Mod.	0.22	0.5	1	0.10	Mod.
7	O.B1	Nasha	1.0	0.69	1	0.07	Slight	0.22	1.0	1	0.21	High
18	O.B2	Kfir El wekala	1.0	0.67	1	0.07	Slight	0.22	1.0	1	0.21	High
9	D.B1	Belgay	1.0	0.58	1	0.05	Slight	0.22	1.2	1	0.22	High
10	D.B2	Osh El hagar	1.0	0.51	1	0.05	Slight	0.22	1.2	1	0.22	High
11	T1	El hagabza	1.0	1.46	1	0.20	Mod	0.22	0.4	1	0.08	Slight
12	T2	El basten	1.0	1.19	1	0.14	Mod.	0.22	0.3	1	0.07	Slight
13	T.B	Mahset salam	1.0	1.82	1	0.23	Mod.	0.22	0.2	1	0.06	Slight

Slight (<0.1), moderate (0.1-0.2), High > (0.2); C=Climate, S=Soil, T=Topography

Table 8: Relative extent (%) of the natural vulnerability classes in the studied area:

mapping unit	Area feddan	Relative extent %					
		Physical degradation			Chemical degradation		
		Slight	Moderate	High	Slight	Moderate	High

Table 8: Continue

CF	189024	87.2	12.4	0.4	0.3	16.4	83.3
OS	107990	0.8	23.4	75.8	84.5	15.1	0.4
O.M	171383	2.1	78.5	19.4	1.1	81.4	17.5
O.B	140141	75.2	24.5	0.3	0.4	30.3	69.3
D.B	120850	85.0	14.8	0.2	0.1	17.3	82.6
T.B	49956	0.8	16.6	82.6	29.0	70.4	0.6
T	907	4.1	75.3	20.6	71.4	28.4	0.2

Table 9: Monitoring of the main land characteristics in the studied area:

Profile No.	Mapping unit	Water table level (cm)		Bulk density* g/cm^3		EC*dS/m		ESP*%	
		1975	2008	1975	2008	1975	2008	1975	2008
1	CF1	110	90	1.35	1.40	10.36	15.45	24.31	25.42
2	CF2	100	70	1.35	1.40	7.92	11.40	16.17	17.82
3	OS1	130	110	1.12	1.14	14.89	20.34	11.36	13.82
4	OS2	140	120	1.10	1.13	11.26	17.42	11.62	13.96
5	O.M ₁	130	115	1.35	1.42	8.41	11.62	20.16	22.42
6	O.M ₂	150	130	1.36	1.45	9.17	12.53	17.26	19.34
7	O.B ₁	150	140	1.25	1.40	1.40	2.57	14.80	16.18
8	O.B ₂	130	120	1.20	1.37	2.74	4.68	13.42	14.17
9	D.B ₁	150	150	1.30	1.45	1.30	3.71	8.41	10.23
10	D.B ₂	150	150	1.30	1.50	2.84	5.17	9.37	10.14
11	T1	120	120	1.10	1.18	0.76	1.48	10.18	11.10
12	T2	110	100	1.25	1.33	5.11	6.75	12.19	13.25
13	T.B	120	100	1.30	1.35	1.45	3.77	10.43	12.16

*Calculated till the depth to 100 cm.

Table 10: Land degradation rates in the different mapping units of the studied area

Profile No.	Mapping unit	Location	W	C	S	A
1	CF1	Bani abed	2	1	1	1
2	CF2	El asafra	2	1	1	1
3	OS1	Abu mady	1	1	1	1
4	OS2	El masara	1	1	1	1
5	O.M ₁	Spenkhet	1	1	2	1
6	O.M ₂	Dafadous	1	1	2	2
7	O.B ₁	Nasha	1	1	1	1
8	O.B ₂	Kfr El wekala	1	1	2	1
9	D.B ₁	Belgay	1	1	1	1
10	D.B ₂	Osh El hagar	1	2	1	1
11	T1	El hagabza	1	1	1	1
12	T2	El basten	1	1	1	1
13	T.B	Mahset salam	1	1	1	1

Where:

W= Water logging, C = Compaction, S = Stalinzation, A = Alkalinization.

1= Low, 2= Moderate, 3= High.

Table 11: Relative extent (%) of the land degradation types in the studied area:

Mapping unit	Area (Feddan)	Water logging Depth of water table (cm)			Compaction (bulk density (g/cm^3))			Salinization (EC in dS/m)			Alkalinization (ESP %)		
		150 -100	100-75	75-50	<1.2	1.2 -1.35	1.35 -1.50	<4	4-8	8 -16	<15	15-25	25-35
CF	189024	1.68	69.22	29.10	0.68	90.42	8.90	1.42	91.31	7.27	1.27	95.11	3.62
OS	107990	91.34	4.69	3.97	93.13	4.18	2.69	95.43	3.54	1.03	96.18	2.43	1.39
O.M	171383	94.12	1.48	4.40	0.89	98.40	2.79	0.14	8.32	91.54	1.03	97.14	1.83
O.B	140141	91.27	3.16	5.57	5.99	25.10	74.17	59.21	4.68	36.11	96.42	1.17	2.41
D.B	120850	98.41	0.64	0.95	3.66	8.30	90.11	97.14	2.64	0.22	95.15	2.36	2.49
T	49956	11.40	85.16	3.44	91.45	3.26	5.29	98.00	1.40	0.60	96.20	0.62	3.18
T.B	907	94.26	4.49	1.25	3.21	95.42	1.37	31.42	61.29	7.29	97.38	0.84	1.78

Table 12: Land degradation severity level in the studied area:

Profile No.	Mapping Unit	Water logging			Compaction			Salinization			Alkalinization		
		Degree	Extent	Severity level	Degree	Extent	Severity level	Degree	Extent	Severity level	Degree	Extent	Severity level
1	CF1	3	5	3,5/ VH	2	5	2,5/ H	2	5	2,5/ H	3	5	3,5/ VH
2	CF2	3	5	3,5/ H	2	5	2,5/ H	2	5	2,5/ H	3	5	3,5/ VH
3	OS1	1	5	1,5/ L	1	5	1,5/ L	1	5	1,5/ L	2	5	2,5/ H
4	OS2	1	5	1,5/ L	1	5	1,5/ L	1	5	1,5/ L	2	5	2,5/ H
5	O.M ₁	2	5	2,5/ H	2	5	2,5/ H	3	5	3,5/ VH	3	5	3,5/ VH
6	O.M ₂	2	5	2,5/ H	2	5	2,5/ H	3	5	3,5/ VH	3	5	3,5/ VH
7	O.B ₁	2	5	2,5/ H	2	5	2,5/ H	1	5	1,5/ L	2	5	2,5/ H
8	O.B ₂	2	5	2,5/ H	2	5	2,5/ H	3	5	3,5/ VH	2	5	2,5/ H
9	D.B ₁	1	5	2,5/ H	3	5	3,5/ VH	1	5	1,5/ L	2	5	2,5/ H
10	D.B ₂	1	5	1,5/ L	3	5	3,5/ VH	1	5	1,5/ L	2	5	2,5/ H
11	T.B	2	5	2,5/ H	2	5	2,5/ H	1	5	1,5/ L	2	5	2,5/ H
12	T ₁	2	5	2,5/ H	2	5	2,5/ H	1	5	1,5/ L	2	5	2,5/ H
13	T ₂	2	5	2,5/ H	1	5	1,5/ L	1	5	1,5/ L	2	5	2,5/ H

L= low, H= high, VH= very high

Table 13: Land degradation status in the different mapping units:

Mapping unit	Land degradation status*
CF	(Pw i/d/o 3,5) (Cs o 2,5) (Ca o 3,5)
OS	(Ca o 2,5)
O.M	(Pw i/d/o 2,5) (Pc m 2,5) (Cs m/i/o 3,5) (Ca m/i/o 3,5)
O.B	(Pw i/d/o 2,5) (Pc m 2,5) (Cs m/i/o 3,5) (Ca m/i/o 2,5)
D.B	(Pc m/o 3,5) (Ca o 2,5)
T	(Pw i/d/o 2,5) (Pc m 2,5) (Ca o 2,5)
T.B	(Ca o 2,5)

The first two letters = degradation types where, Pw = physical degradation/ water logging, Pc= physical degradation/ soil compaction, Cs= chemical degradation/ Salinization, Ca = chemical degradation/ alkalization. The following one or two letters= causative factors where, i = over irrigation, d = human intervention in natural drainage, m = improperly time use of heavy machinery, o= absence of conservation measurements. The first digit= degree of land degradation; the second digit = relative extent of degradation.

Conclusion:

The soils of the studied area have a low rate of degradation for different types of human induced factors due to the low changes in the land characteristics during the period of 1976 to 2008. According to present value of soil depth, bulk density, electric conductivity and exchangeable sodium percentage these soils are threatened by a low to high degree of water logging, compaction, salinity and alkalinity. The high Values of these types are due to the over irrigation, improper use of heavy machinery and the absence of conservation measurements. The severity levels of the different types of degradation in these soils are low to very high. Generally, the studied area is considered as unstable ecosystem due to active degradation resulting from climate, relief, soil properties and improper farming system.

Soil Improvement Program and Recommendation:

- 1-Water logging :In this aspect, aeration can be improved by sub-soil ploughing and adding organic materials like compost.
- 2-Soil compaction: There are four strategies commonly used in dealing with compaction control
 - Avoidance is the most desirable where it is physically and economically possible.
 - Alleviation, there is two ways of alleviating and lessening the damage caused by compaction,
 - a-Attempt to remove the compaction causes
 - b- Attempt to reduce the adverse effects of the compaction by applying fertilizer in a way that increases the availability.
- Controlled traffic
- Acceptance is waiting for the detrimental effects to be removed by natural forces.
- 3-Salinity control: is defined as physical control, management, and use of water and related land resources in such a way as to maintain or reduce salt loading and concentrations of salt in water supplies.
- 4-Soil sodicity: sodicity is represented by dominance of sodium on exchangeable sites of the clay mineral. This can be controlled by gypsum addition considering gypsum requirement is urgent after leaching processing.

REFERENCE

- Ayoub, A.T., 1991. "An assessment of human induced soil degradation in Africa." U.N. environmental program, Second Soil Sci. conf. Cairo Egypt.
- Egyptian Meteorological Authority, 1996. "Climatic Atlas of Egypt". Published., Arab Republic of Egypt. Ministry of Transport.
- Elbersen, G.W.W. and R. Catalan, 1986. "Portable computer in physiographic soil survey." Proc. Intemat soil Sci., Cong. Homburg.
- FAO/UNEP, 1978. "Methodology for assessing soil degradation" Rome, 2527.
- FAO/UNEP, 1979. "A Provisional methodology for degradation assessment" Bul. No. 48., FAO, Rome, Italy.
- FAO, 1990. "Profile description guidelines" 14. Rome, Italy.
- Mashali, A.M., 1991" Land degradation and desertification in Africa 2nd African Soil Sci. Soc. Conf. RISW, 1976" Soil survey of El-DAKHLIYA Governorate". Report No. 228.
- Robert, W.D., 2008."soil testing manual:procedures,Classification Data,and sampling practices" Pined by press of ohio.
- Said, R., 1993. "The river Nile geology and hydrology and utilization". Oxford. Britain. Pergman press 320p.
- USDA, 2003. "Keys to Soil Taxonomy" United State Department of Agriculture, (NRCS), ninth edition 2003.

USDA, 2004. "Soil Survey Laboratory Methods Manual" Soil Survey Investigation Report No. 42 Version 4.0.

UNEP Staff, 1986. "Sands of change: Why land becomes desert and what can be done about it". UNEP Environmental Brief No 2, United Nations Environment Program, Nairobi, Kenya.

UNEP Staff, 1991. "Global assessment of soil degradation" UNEP. UN. GLASOG. Project.

UNEP Staff, 1992. "World atlas of decertification" Publ. E. Arnold, London, pp: 69.

United Nations, 1994. "Earth Summit - Convention on Desertification. Proceedings of the United Nations" Conference on Environment and Development (UNCED), Rio De Janeiro, Brazil, 3-14 June 1992. Department of Public Information, United Nations, New York, USA.

Wim, G. and M. El Hadji, 2002. "Causes, general extent and physical consequence of land degradation in arid, semi arid and dry sub humid areas" Forest conservation and natural resources, forest dept. FAO, Rome, Italy.

Zink, J.A. and Valenzuala, 1990. "Soil geographic database: Structure and application examples." ITC J., 3, ITC. Enshed, the Netherlands.