MONITORING LAND COVER CHANGES OF THE NORTH-WESTERN AREA AT EL FAYOUM DEPRESSION AND ITS SOIL SUITABILITY FOR AGRICULTURAL PURPOSES

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ABSTRACT:

This study is a trail for monitoring land cover changes by using Landsat Imagery technique as well as determining soil suitability for irrigated agriculture at the north-western outskirt of El-Fayoum depression during a period of 1984-2005. The studied area lies between latitudes of 29^o 19" and 29^o 26" N and longitudes of 30^o 24" and 30^o 34"E. To achieve this target, Landsat Imagery technique was carried out using two Landsat Thematic Mapper and Enhance Thematic Mapper scenes acquired on 1984 and 2005 covering the north-western part of El-Fayoum depression have been processed. A supervised Spectral Angler Mapper approach was also applied to classify the images into four land use/cover classes, *i.e*., urban, agriculture, water and desert areas. It was observed that some desert areas had been transformed into agriculture and settlement during the investigated period of twenty one year (1984-2005).

This study clarified that the reclaimed area for agriculture purposes during the studied period reached 1726.91 ha, which constitute about 8.15 % of the total area under study and nation settlement (arbanization) increased with about 310.06 ha, which couple nearly 1.46% of the total area. Whereas, the water area was promoted with 31.48 ha, which equal about 0.22 %. All the land cover units were increased account on the expanse of desert unit, which decreased with 2097.20 ha (9.78% of the total studied area). These increases are more attributed to the geophysical and anthropogenic processes such as salinity, alkalinity, water logging, wind erosion, reclamation of new agricultural land and urbanization.

The satellite image interpretation map of the year 2005 was identified into two main landscapes and thirteen landform units, based on the visual interpretation of Landsat data ETM7 (Enhanced Thematic Mapper 7) and applying the Landscape feature approaches. The validity of physiographic map bounders were field checked to represent the different soil mapping units with model soil profiles. Thirty-two mini pits were located and studied for setting up the physiographic boundaries and characteristic of soil map legend. Also, the variations of soil characteristics between the main identified physiographic units were represented by eighteen soil profiles, which chosen to be full morphologically described according to **USDA (2003).**

Soil taxa were surveyed according to the **USDA (1975 and 2010),** and the studied soils could be categorized into three orders and six sub-groups, as follows: Aridisols (Typic Calcigypsids, Lithic Calcigypsids, and Typic Haplocalcids), Entisols (Typic Torriorthents and Typic Torrifluvents) and Vertisols (Typic Haplotorrierts). According to the parametric system undertaken by **Sys and Verheye (1978),** soil suitability classes of the studied area could be categorized into four classes, *i.e.*, highly (S1), moderately (S2), marginally (S3) and not suitable (N1 & N2).

Key words: El-Fayoum soils, land cover changes detection, monitoring land reclamation process and land evaluation.

INTRODUCTION:

The rapid population growth in Egypt will probably be the most important reason for the horizontal expansion in agriculture and achieving sustainable agricultural development. The strategy of El Fayoum Governorate for the horizontal expansion in agriculture needs more suitable land resources to meet progressive increase of human pressure on the limited cultivated area. Fortunately the governmental policy has already taken great strikes towards the agricultural expansion; espically in the areas adjacent and surrounding the old cultivated areas and urbanizing the desert. Many private and public sectors investments were paid in reclaiming soils around El Fayoum depression, especially with the facilities of irrigation water. The north-western desert outskirt of the closed internal drainage Fayoum depression represents one of the main promising land resources, due to the availability of supplementary irrigation water which could be partly balanced by the reuse of drainage water of El Rayan drain after mixing with the Nile water from Bahr kasr El Gebaly and Bahr Qaroun canals. Due to the fast expansion in reclamation and the excessive urbanization, El-Fayoum governorate has created a new governmental district (Youssif El Sedeek) to be distinct to the area.

It is well known that the outskirts of El Fayoum Governorate are mainly desert areas and have less productive desert sandy or calcareous soils. Such promising areas of virgin sandy and calcareous soils are commonly known to have a poor soil structure, low water holding capacity and limited fertility. This is due to the fact that their main mechanical constituents are sand fraction and its high content of active CaCO3 that affect distinctly different soil properties related to plant growth, i.e., crusting, soil-water relations, availability of plant nutrients, etc… **(Ragab, 2001).** The studied area lies within the arid desert belt and characterized by the continental climate. The climatelogical data indicate that the area under investigation is dry and hot in summer and slightly cold in winter, the principal meteorological data recorded at El-Fayoum Station as the last sixth years average reveal that the mean annual temperature ranges between 12.3 and 33.1°C, the annual maximum temperature differs from 22.2 to 37.6°C and the minimum ranges from 9.2 to 13.7°C. The studied area receives a very low amount of rainfall, where the average rate ranges from 14 to 21 mm/year. The mean annual relative humidity ranges from 47 to 60%. Wind velocity ranges from 3.0 to 4.1 km/hr. The rate of evaporation ranges from 3 mm/day in winter to 11-13 mm/day in summer.

Remotely sensed data have been widely used for environment change study in the past decades and large collections of remote sensing imagery have made it possible to analyze long-term change of environmental elements and impact of human activities. Research has been widely reported on methodology of remote sensing change detection and monitoring (i.e., **Singh 1989, MacLeod and Congalton 1998, Mas 1999,** Liu et al. 2004). The Spectral Angle Mapper (SAM) method allows single-step matching of pixel spectra to reference spectra in n-dimensional spectral space **(Kruse, 1999).** The effects of shadow on the final classification image can essentially be eliminated using this technique. Moreover, this method can also be applied to discrimination of vegetated surfaces which reflect incident solar radiation anisotropically **(Yuhas *et. al*, 1992).** On the other hand, the basic idea of the object-based classification is to classify group of pixels that represent real objects. Neighboring pixels are grouped into regions or segments based on similarity criteria - digital number, texture - in a process referred to as segmentation, **(Congalton,1991).**

Change detection approaches can be characterized into two broad groups, namely, bi-temporal change detection and temporal trajectory analysis **(Coppin *et***

***al.* 2004).** The former measures land cover changes based on a 'two-epoch' timescale, i.e. the comparison between two dates. Even if land cover information sometimes is acquired for more than two epochs, the changes are still measured on the basis of pairs of dates. The latter analyses the changes based on a 'continuous' timescale, i.e. the focus of the analysis is not only on what has changed between dates, but also on the progress of the change over the period. At present, most change detection methods belong to bi-temporal change detection approach including, for example, image differencing **(Weismiller *et al.* 1977),** vegetation index differencing **(Liu *et. al.*, 2002),** change vector analysis (CVA) **(Malila, 1980, Lunetta *et al.* 2004),** principal component analysis (PCA), **(Liu *et al.* 2004),** post-classification comparison **(Weismiller *et al.* 1977),** multi-temporal composite and classification **(Zhao *et al.* 2003),** and artificial neural network (ANN) **(Dai and Khorram 1999).**

From a scientific point of view, the data of the current work must come from the identified physiographic features of a unique area in Egypt by mapping them to be in a harmony of physiography and soil data set, serving the extrapolation approach when other areas will be under study. It is also to find the best adaptation between certain land units with agricultural utilization projects to give the maximum output. The evaluation of soil potentialities of the identified main physiographic units through determining their main characteristics may be helpful in supporting the local knowledge, especially for identifying the best land use under irrigated agriculture for achieving an agricultural utilization policy of the region under consideration. For this purpose, the harmony of descriptive and processing systems, established by **Sys and Verheye (1978)** can be used.

The current study aims to monitor desert and cultivated land degradation processes in the north-west outskirt of El Fayoum depression. Satellite visual-interpretation, integrated with geographic information system (GIS) was employed in the current study. A special attention will be paid to the expansion in cultivated areas, urban expansion of the main towns or villages, soil degradation due to salinization and sand encroachment over the arable lands during the period of 1984 -2005. In addition, the present work is undertaken to evaluate the soil potentialities of the identified main physiographic units through determining their main soil characteristics and to update and support the local knowledge, particularly the best use of land whether be under demand for agriculture use or be planned for later on use.

MATERIALS AND METHODS

The studied area lies at the north-western outskirt of El Fayoum depression, adjacent to Qaroun Lake between latitudes of 29o 19" and 29^o 26" N and longitudes of 30^o 24" and 30^o 34"E, within the arid desert belt and characterized by the continental climate, Figure (1).

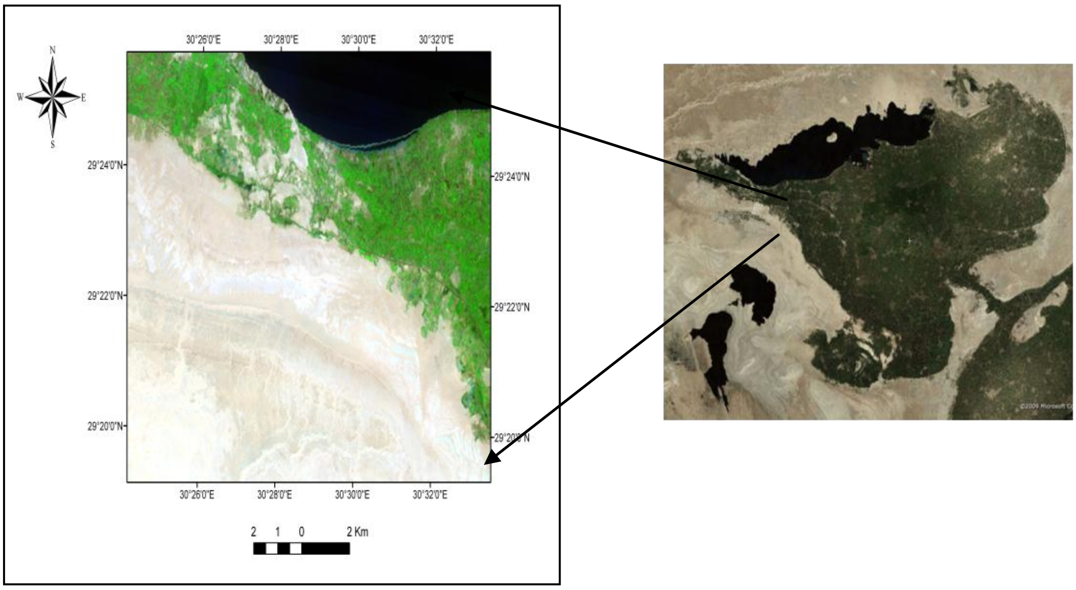

Figure (1); location of the study area.

Satellite image interpretation:

Data: Earth Observation data were used for this study: the Landsat TM 5 and 7 Images were acquired in 1984 and 2005 respectively. The Landsat images had a spatial resolution of 30 m. Auxiliary information was obtained through field surveys. GPS was used to collect Ground Control Points and ground truth data pertaining to the different land use classes. The digital interpretation of the satellite data was performed using the following software:

Erdas Imagine 9.1: Image pre-processing and accuracy assessment.

ENVI 4.7: Spectral Angle Mapper (SAM) approach.

ARCGIS 9.3: Design the data base, layout of maps.

Image Pre-processing: Before the classification process, Landsat images were geometrically corrected, Atmospheric correction (FAASH using ENVI software) and spectrally enhanced. The Landsat data was georeferenced to UTM zone 36 N, with the datum WGS 1984.

Image Classification: To get information about the land use and land cover inventory in the study area the classification methods was preformed based on both Spectral Angle Mapper (SAM) approach, which bears the potential to classify pixels not only based on their spectral information, but also by their texture and local context. The results of the classification method was discussed and compared and an accuracy assessment was performed. The accuracies were determined through a pixel to pixel comparison and expressed as overall, producer, user and in class accuracy **(Congalton, 1991 and Story and Congalton, 1986).**

Spectral Angle Mapper (SAM): The Spectral Angle Mapper **(Yuhas, *et al*., 1992)** is a technique to classify hyperspectral data by determining the similarity between an endmember spectrum and a pixel spectrum in a n-dimensional space. This technique can also be used for multispectral data sets. Smaller angles represent closer matches to the reference spectrum. Since this method uses only the direction of a vector and not its length, it is insensitive to illumination and albedo effects. Image-based endmember spectra of the land use types in the study area were used as input for Spectral Angle Mapper classification. For the SAM classification a threshold (rang between 0.05 and 0.40 radian) based on the spectral angle was set. Pixels with an angle larger than this value were not classified. To identify image-derived endmember, Pixel Purity Index (PPI) algorithms were performed on the TM data sets; these spectra were associated to specific land use classes and used to perform the Spectral Angle Mapper classification.

Post Classification Comparison Change Detection: The Post-Classification comparison change detection was done after classifying the rectified images separately from the two time periods (1984 and 2005). The classified images were then, compared and analyzed using ENVI software to create the change-detection matrix and construct change maps.

Field work:

After the interpretation of satellite images (2005), reconnaissance survey tracks were planned to cross the majority of the different mapping units and to cover the significant land features that occur in the area. Thirty-two mini pits were located and studied for setting up the physiographic boundaries and characteristic of soil map legend. The sample areas were selected so that they cut across the different mapping units and the significant features observed in the area. Eighteen soil profiles were examined along the different sample areas. Detailed morphological description was recorded for each of the studied soil profiles, on the bases outlined by **USDA (2003)** and classified according to **USDA (1975) and (2010)**.

Re-Interpretation satellite images:

Detailed re-interpretation analysis was done, on satellite image, to finalize the interpretation boundaries after the establishment of the ground truth in the field. A comparison was done to recognize and compare the different landcover landuse in reality and the corresponding appearance on the TM image and on the aerial photographs, the collected information was used later for the establishment of the landcover landuse legend phases. Map legend was finalized and the physiographic units of the aerial photos were finally translated in terms of soils, the finalized tabular legend was constructed with the help of terminology instructions given by, **Zinck (1989)**.

Laboratory analysis:

A total of 46 disturbed and undisturbed soil samples were collected ,air dried, crushed, 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 colour name and notations were determined using the Munsell Soil Colour Chart (1975). Particle size distribution was carried out according to Gee and Bander (1986) using sodium hexameta phosphate as dispersing agent. Some soil physical and chemical analyses were carried out according the outlines of **Page *et al.* (1982) and Klute (1986)**. Soils under investigation were evaluated using the parametric system undertaken by **Sys and Verheye (1978)**.

RESULTS AND DISCUSSIONS:

1- Land cover/land changeS detection:

a. Spectral Angle Mapper (SAM) Image Analysis:

As previously mentioned, four land use &land cover classes (Urban, Agriculture, Water and Desert) on the studied area were defined and classified using the Spectral Angle Mapper (SAM). Thematic maps were created for each of the satellite images considered in this study. Figures (2 and 3) and table (1) show the maps established from the Spectral Angle Mapper (SAM) for Landsat TM images in 1984 and 2005 respectively.

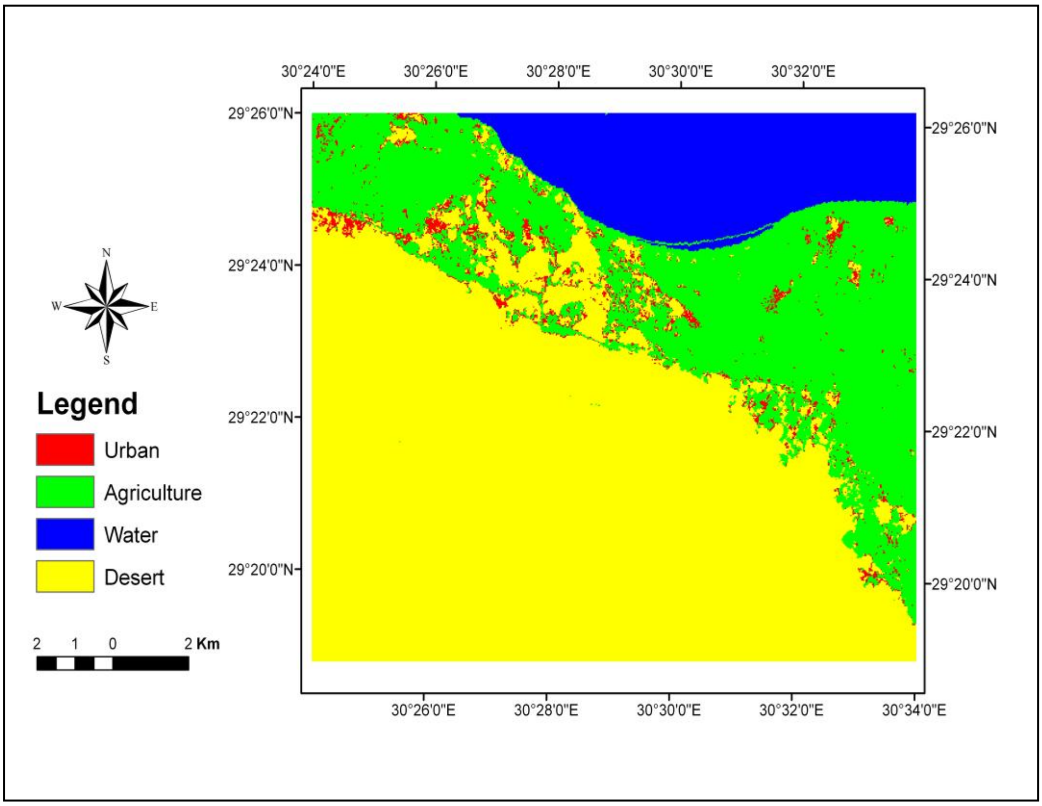

Figure (2): Land use/ land cover map (1984).

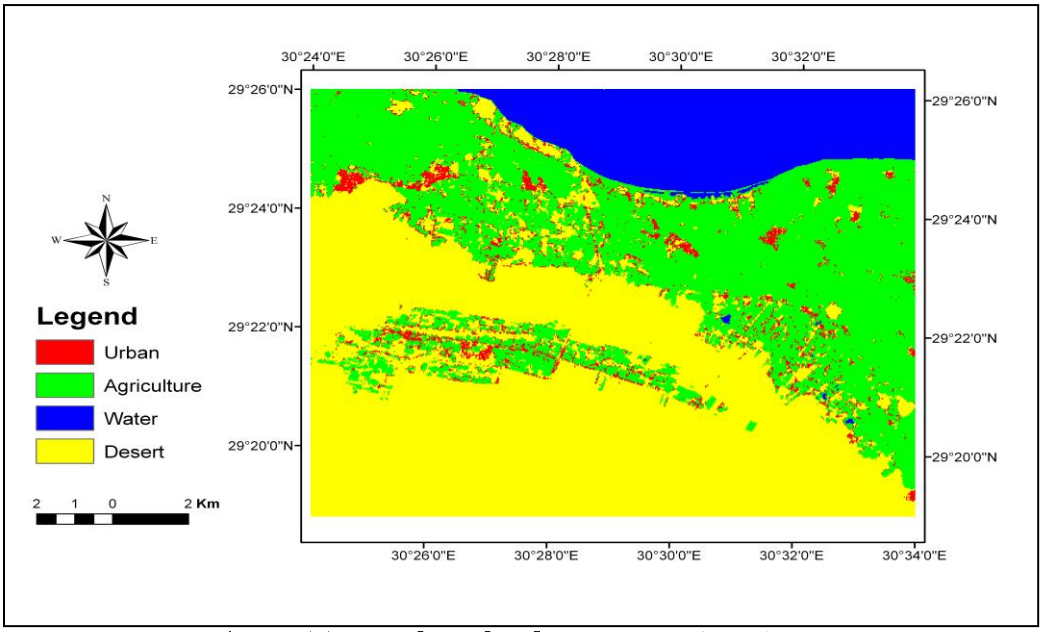

Figure (3): Land use/land cover map (2005).

Table (1): Land use/land cover and area changes in hectare and %.

Land use/land cover	Area at1984		2005		Area changes from 1984 to 2005	
	Fed	%	Fed	%	Fed	%
Urban	1212.49	2.29	1982.40	3.75	769.73	1.46
Water	6805.33	12.87	6883.54	13.04	78.18	0.22
Agriculture	13645.97	25.81	17933.91	33.97	4287.91	8.15
Desert	31192.88	59.01	25984.59	49.22	-5207.34	-9.78

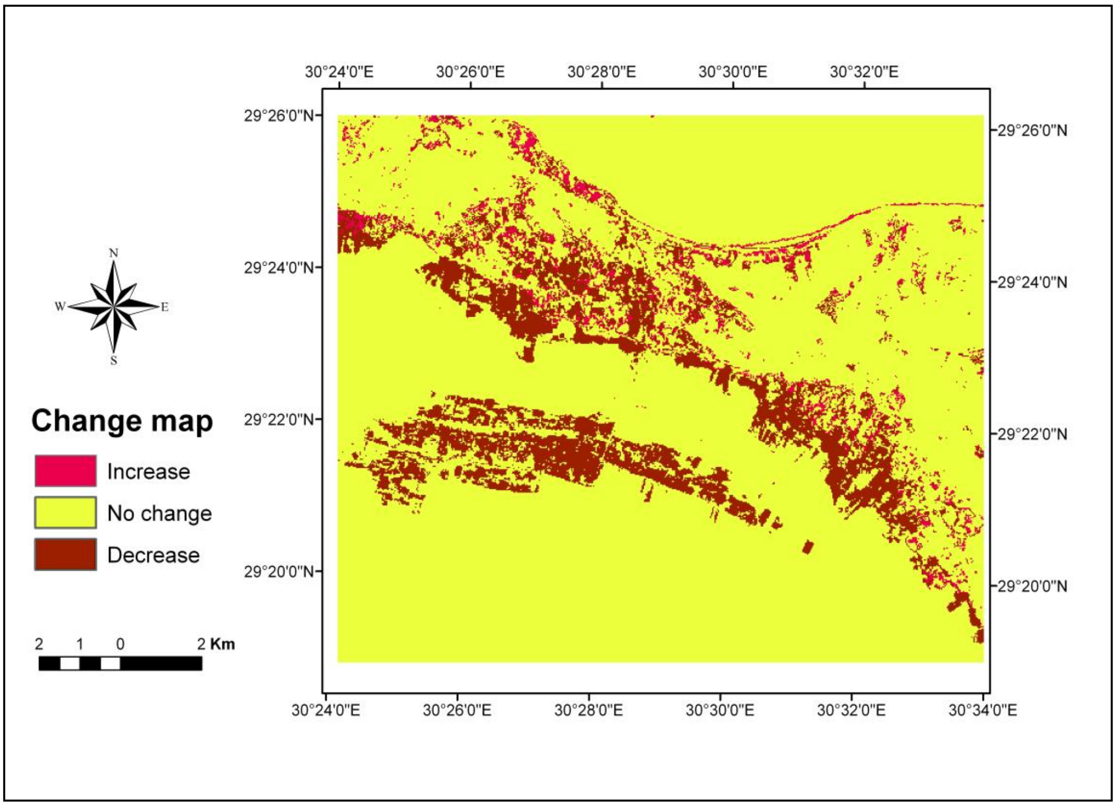

Figure (4): Land use and land cover changes map from 1984 to 2005.

Changes in the land cover were unidirectional for all land use and land cover, Fig. (4), the absolute rates of change for desert decreased during the entire studied period (1984-2005). The decrease in this land use class is as a result of a corresponding increase in agriculture and urban areas. Agriculture increases from 25.817% to 33.975 during the twenty one years (21 years) period probably due to government's program for the reclamation of new agricultural land. The proportion of urban areas increased from nearly 2.294% to 3.756% mainly as a result of population growth. Water increased by 12.875 to 13.041%. The increase of water bodies may be rendered mainly to fish cultivation in big pools adjacent to Qaroun lake shoreline and also may be that corresponding canals on the reclaimed land possibly led to an increase in water bodies. Desert decreased from 59.014 to 49.229%. Conversation the reclaimed land to other land use types agriculture and settlement explains the decrease of desert.

II. Assessment of Land Physiography:

Physiographic units were delineated in Fig. (5) and their legend has been set up as shown in Table (2), associated with the morphological description of the representative soil profiles, Table (3). The studied area comprised the north-western shoulder of El-Fayoum depression with alluvium and lacustrine parent materials and their natural extension towards the desert with limestone formations. So, the area is rich with alternative sets of interferences from these deposits. The identified physiographic-soil units were delineated in two main formations, *i.e.* the Nile alluvial plain deposits (flat or almost flat Nile alluvial terraces in different elevations) and desert pediplain which includes (elongated hills, toe slopes, foot slopes, and terraces in different elevations beside to depressed slopes and depression bottom units.

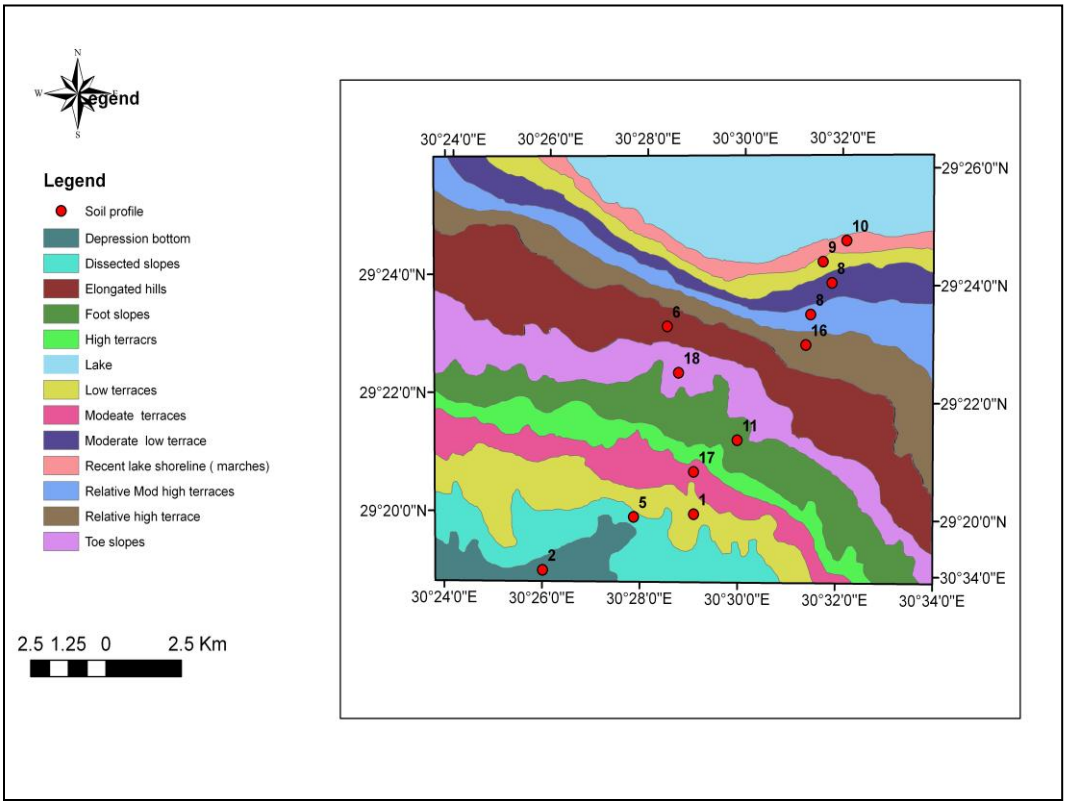

Figure (5): Physiographic units of the studied area

Table (2): Physiographic units, soil legend and the corresponding areas.

Landscape	relief	Lithology	Landform	Map unit	Profile No.	Area Fed	Area %
Pediplain	**Ridges**	**Eocene limestone**	**Elongated hills**	**pp 111**	**6**	**7929.22**	**15.02**
			Toe slopes	**pp 112**	**3**	**4905.40**	**9.29**
			Foot slopes	**pp 113**	**11**	**5239.08**	**9.92**
			High terraces	**pp 211**	**13**	**2429.80**	**4.62**
	Depressed terraces		**Moderately terraces**	**pp 212**	**17**	**2955.23**	**5.60**
			Low terraces	**pp 213**	**1**	**3940.61**	**7.46**
			Dissected slopes	**pp 214**	**5**	**3553.25**	**6.73**
			Depression bottom	**pp 215**	**2**	**1566.18**	**2.96**
Alluvial plain	**Terraces**	**Alluvium**	**Relatively high terraces**	**P1 111**	**16**	**4192.39**	**7.95**
		F. lacustrine	**Relatively mod. High. terraces**	**P1 112**	**18**	**2966.44**	**5.63**
		Alluvium	**Moderately low terraces**	**P1 113**	**8**	**2576.01**	**4.88**
			Low terraces	**P1 114**	**9**	**1838.33**	**3.48**
		F. lacustrine	**Recent lake shoreline**	**P1 116**	**10**	**1534.96**	**2.91**

F. lacustrine =Fluvio-lacustrine

Thus, an injection was occurred between fluvial deposits and local lacustrine ones, which were richer in secondary formations of $CaCO_3$ and gypsum. **Said (1990)** stated that, in the case of Lake Moeris, where El-Fayoum depression fell completely with the fresh Nile water, that reaches in undate its flood basin. Due to the depositional processes rather than erosional processes, hence the Nile suspended matter was deposited in different physiographic-soil units from the seasonal and periodic flooding. Discharge that is fully confined to El-Fayoum basin maintains high competence, and when discharge exceeds basin capacity, there is a dramatic increase in cross-sectional area associated with expansion into the flood basin. This physiographic-soil unit comprised an area of 13106 fed and includes many land forms which attain graded terraces from high to low terraces and marches. This physiographic unit was represented by soil profiles Nos. 8,9,10,16 and 18 which are deep contain low amounts of $CaCO_3$ in the alluvial deposits of profile16 and, moderately high amounts through fluvio-lacustrine deposits of profiles 8, 9, 10 and 18 (Tables 3,4 and 5) .

a. Depressed plain:

Such depressed plain includes soils of heavy-textured materials, which are subjected to the swelling and shrinkage processes, fitting the requirement to be Vertisols of the Nile alluvial very fine sediments for soil profile No. 8 and saline feature that not adequate to shift the taxonomic unit to be Halic but stell Typic Hapolcalcids for profile (10).

Table (3): Morphological description of the studied physiographic units.

Mapping unit	Slope gradient	Profile No	Soil Parent material	Soil Depth (cm)	Horizon	Soil color	Modified Texture class	Soil structure	Soil consistency
Pu 21	Sloping	1	Eocene limestone	0-20	Ap	2.5Y 6/4	G S	Single g	Loose
				20-60	C1	2.5Y 6/4	ExG SL	Massive	Friable
				60-80	C2	2.5Y8/2	ExG LS	Massive	V hard
Pu 42	Nearly level	2	Aeolian over alluvium	0-25	Ap	10YR 6/4	SL	Massive	Slight. hard
				25-55	C	2.5Y8/2	LS	Massive	Slight. hard
				55-150	2C	10YR 7/1	C	Massive	hard
Pu 24	Gently undulating	3	Aeolian - limestone	0-25	Ap	10YR 5/4	SL	Massive	Slight. hard
				25-50	Cy	10YR 6/4	S	Single g	Loose
				50-150	Cky	10YR	G S	Single g	Loose
Pu 23	Sloping	4	Eocene limestone	0-25	Ap	2.5Y 6/4	VG SL	Massive	Slight. hard
				25-50	Ck1	2.5Y 6/4	ExG LS	Single g	Loose
				50-70	Ck2	2.5Y7/4	ExG S	Single g	Loose
Pu31	Gently undulating	5	Aeolian-limestone	0-20	Cky1	2.5Y6/4	G SL	Massive	Slight. hard
				20-60	Cky2	2.5Y 7/4	ExGLS	Massive	hard
Pu 12	Almost flat	6	Eocene limestone	0-30	Ckyz1	2.5Y7/6	ExG LS	Single g	Loose
Pu 11		7		0-30	Cky1	2.5Y 7/4	ExG SL	Massive	Friable
				30-60	Cky2	2.5Y7/4	ExG LS	Single g	Loose
Pl 13	Gently undulating	8	Alluvium and old lacustrine	0-30	Ap	10YR 4/4	CL	Massive	Slight. hard
				30-60	C1	10YR 5/3	CL	M m sbk	Hard
				60-150	2C	10YR 5/2	C	M m sbk	V. hard
Pl 12	Almost flat	9	Eocene limestone	0-30	Apk	10YR 6/4	SCL	Massive	Hard
				30-60	C1	10YR 7/3	C	M m sbk	V. hard
				60-150	C2	10YR 6/4	SCL	M m sbk	Hard
Pl 14	Gently undulating	10	Fluvio-lacustrine	0-30	Apk	10YR 5/3	CL	Massive	Slight. hard
				30-60	Ckz1	10YR 6/2	CL	Massive	Slight. hard
				60-120	2Ck	10YR 6/2	C	Massive	V hard
Pu 41	Almost flat	11	Alluvium-colluvium	0-30	Apky	10YR 6/3	SCL	Massive	hard
				30-50	Cky1	2.5Y 5/4	G SL	Massive	Friable
				50-150	Cky2	10Yr7/3	G LS	Single g	Loose
Pu 22	Almost flat	12	Eocene limestone	0-30	Cky	2.5Y 7/4	VG LS	Massive	V hard
Pu 32	Sloping	13		0-30	Ck	2.5Y7/4	G LS	Single g	Loose
				30-60	Cky2	2.5Y 6/2	ExG LS	Massiv e	Loose
Pl 21	Almost flat	14		0-25	Ckyz1	2.5Y 7/4	SCL	Massive	V hard
				25-40	Ckyz2	2.5Y7/4	ExG SC	Massive	V hard
Pu 33	Nearly level	15		0-30	Cky1	2.5Y 5/3	G LS	Single g	Loose
				30-60	Cky2	2.5Y 6/4	G SL	Massive	Slight. hard
Pl 11	Nearly level	16	Alluvium	0-30	Ap	10YR 5/3	SCL	Massive	Slight. hard
				30-60	C1	10YR 6/3	SCL	M m sbk	Hard
				60-90	C2	10YR 8/3	SCL	Massive	V hard
				90-150	C3	10YR 7/3	C	M m sbk	Hard
Pl 16	Gently undulating	17	Fluvio-lacustrine	0-30	Ap	10YR 4/3	SCL	Massive	Hard
				30-60	Ck1	10YR 5/4	SC	M m sbk	Hard
				60-110	Ck2	10YR 6/4	LS	Massive	Hard
Pl 15	Nearly level	18	Aeolian - alluvium	0-30	Ap	10YR 4/2	SCL	Massive	Hard
				30-60	C1	10YR 6/3	LS	Massive	Hard
				60-150	2C	2.5Y 6/2	S	Single g	Loose

S= Sand, LS=Loamy sand, SL=Sandy loam, SCL=Sandy clay loam, CL= Clay loam and C=Clay, G= *Gravel*:VG=Very gravelly, and ExG= Excessively Gravelly Mmsbk=Medium moderate subangular blocky, Cstsbk=Coarse strong subangular blocky.

b. Pediplain (pp):

This physiographic unit represents the biggest unit in the studied area, and its representative soils occupy an area of about 32700 fed. These soils recognized by quite clear relief and the light greytone according to the soil surface cover (limestone fragments and blown sands). According to the surface features of this unit, it could be categorized into nine landforms, i.e., elongated hills, toe slopes, foot slopes, and many graded terraces beside to depressed slopes and bottom. This unit extends from the depression western side with a parallel direction to its border towards Birket Qaroun at the southern part. The soils developed on this unit represent the foot-slope of the rock structure, the disintegrated weathered rock fragments, surface pavements, and different formations of limestone, marl and sand cover. The representative soil profiles have different soil depths varied from deep for soil profile Nos. 2, 3 and 11 to moderate for soil profile Nos.1, 4, 5, 7, 13 and 15 and shallow for soil profile Nos. 6 and 12.

The high content of gravel (lime fragments) associated with the disintegration of limestone bedrock and their contents increased with shallow soil depths, Tables (3, 4 and 5). The deep soils of toe slopes, and terraces landform units characterized by the depositional deposits of sands and weathered limestone within some of coarse materials. The representative area has been artificially modified in order to change the landscape into depressed terraces to suite-irrigated agriculture soils, these units have topographic landscape ranges between almost flat to gently undulating. The soils of these units are represented by soil profile Nos. 3, 4, 11, 13, 14 and 17. The elongated hill unit covers an area of about 7929 fed and located at the south-western side of the studied area (pp 111) has shallow depth and gravelly coarse texture and was represented by soil profile Nos. 6 and 7.

Its elevation reaches 17-20 m above sea level forming ridge area. It is also occurred as barren limestone (original structure) outcrops with a gently sloping surface associated with the rolling slope. The toe slopes (pp112) unit is more deep soil (profile Nos. 3 and 4), also the foot slope unit (pp 113) of profile No. 11.

Table (4): Some physico- chemical properties of the studied soil profiles.

Profile No.	Depth (cm)	Gravel %	Particle size distribution %				Modified texture class	Organic matter %	$CaCO_3$ %	Gypsum %	CEC (C mole kg-1)	Soil sodicity (ESP)
			Coarse sand	Fine sand	silt	clay						
1	0-20	31.20	52.37	36.19	7.21	4.23	G S	1.04	12.47	6.21	5.11	6.34
	20-60	68.20	37.37	29.33	14.85	18.45	Ex G SL	0.13	10.75	4.36	16.67	7.58
	60-80	70.30	44.36	39.46	9.10	7.08	Ex G LS	0.13	11.52	5.61	9.37	7.22
2	0-25	4.50	34.68	40.92	12.36	12.04	SL	0.58	4.94	2.21	11.53	5.32
	25-55	0.00	37.56	42.38	9.81	10.25	LS	0.16	8.54	1.33	8.94	6.21
	55-150	0.00	11.04	29.32	8.31	48.65	C	0.12	6.97	1.35	46.75	6.84
3	0-25	5.00	36.34	39.25	11.36	13.05	SL	0.64	8.02	6.28	15.76	4.59
	25-50	5.11	38.36	51.46	4.82	5.36	S	0.16	11.38	7.14	6.27	5.27
	50-150	18.32	40.25	51.45	3.69	4.61	G S	0.11	16.56	7.65	4.18	4.96
4	0-25	48.34	28.70	42.34	10.57	18.39	VG SL	0.85	4.01	4.91	21.87	7.35
	25-50	52.98	38.96	40 .48	11.05	9.51	Ex G LS	0.44	5.43	3.21	9.42	6.84
	50-70	68.04	48.37	41.61	3.91	6.11	Ex G S	0.11	5.68	4.24	7.57	6.24
5	0-20	31.1	36.98	39.64	12.05	11.33	G SL	0.53	17.63	13.21	13.24	4.95
	20-60	74.64	39.19	42.87	12.53	5.41	Ex LS	0.28	28.71	16.25	7.53	5.21
6	0-30	73.10	52.92	28.48	12.37	6.23	Ex LS	0.12	16.53	10.82	8.643	11.54
7	0-30	63.54	24.46	40.82	16.35	18.37	Ex G SL	0.85	16.35	6.22	20.14	8.33
	30-60	68.43	39.35	36.76	11.08	12.81	Ex G LS	0.33	23.22	7.17	13.28	7.94
8	0-30	0.00	12.32	18.09	28.91	40.68	CL	0.96	7.46	1.24	40.51	10.14
	30-60	0.00	9.82	18.39	30.11	41.68	C	0.65	9.11	0.96	43.36	11.32
	60-150	0.00	6.94	17.15	26.37	49.54	C	0.54	11.48	3.11	48.21	12.56
9	0-30	0.00	8.64	38.08	24.94	28.34	SCL	1.21	10.3	1.24	30.45	14.34
	30-60	0.00	7.18	23.57	26.97	42.28	C	1.11	8.85	0.52	40.72	12.64
	60-150	0.00	12.37	45.90	17.38	24.35	SCL	0.65	6.72	0.95	26.64	10.07
10	0-30	0.00	11.12	27.32	28.94	32.62	CL	1.16	10.63	3.62	33.64	11.38
	30-60	0.00	12.39	18.96	30.28	38.37	CL	1.06	16.25	3.25	40.92	11.57
	60-150	0.00	9.35	13.27	31.46	45.92	C	0.73	13.56	2.45	46.48	10.84
11	0-30	3.22	10.92	29.14	23.59	36.35	CL	1.31	8.92	7.32	38.21	8.56
	30-50	10.13	23.66	45.27	14.22	16.85	G SL	0.65	15.43	15.39	14.36	7.35
	50-150	28.64	28.63	51.14	11.02	9.21	G LS	0.23	16.72	11.23	8.25	7.68
12	0-30	52.24	42.32	40.72	12.84	4.12	VG LS	0.38	31.84	7.20	5.14	9.22
13	0-30	36.71	46.58	33.59	13.45	6.38	VG LS	0.64	12.33	6.24	7.18	10.32
	30-60	67.24	47.62	33.81	6.27	12.30	Ex G LS	0.23	27.69	7.32	12.24	10.94
14	0-25	5.21	34.96	28.53	12.86	23.65	SCL	0.84	16.28	10.85	22.11	8.94
	25-40	64.28	27.28	19.91	13.54	39.27	Ex G SC	0.14	36.12	11.32	37.39	8.71
15	0-30	14.32	45.67	34.36	12.68	7.39	G LS	0.31	13.94	6.22	6.34	7.33
	30-60	19.97	38.47	31.27	17.22	13.04	G SL	0.26	27.54	7.25	11.48	8.14
16	0-30	0.00	6.15	41.54	19.47	32.84	SCL	1.05	4.95	1.23	33.51	12.35
	30-60	0.00	11.38	31.95	21.04	35.63	SCL	1.11	5.22	2.64	37.39	12.28
	60-90	0.00	14.40	29.55	21.68	34.37	SCL	0.95	3.28	1.45	36.24	11.35
	90-150	0.00	8.34	23.95	23.79	43.92	C	0.65	5.32	0.66	45.36	11.95
17	0-30	0.00	7.51	44.67	13.24	3458	SCL	1.36	6.05	1.22	36.52	12.35
	30-60	0.00	11.95	33.98	8.76	45.31	SC	1.04	13.59	2.14	46.37	13.25
	60-150	0.00	27.85	55.74	7.84	8.57	LS	0.56	17.38	2.25	7.08	12.95
18	0-30	0.00	14.16	44.07	17.66	24.11	SCL	1.64	8.20	1.65	27.10	10.28
	30-60	0.00	27.32	57.03	6.24	9.41	LS	1.42	4.92	2.28	8.94	12.65
	60-150	0.00	38.94	51.73	3.69	5.64	S	0.68	6.72	2.54	4.83	11.94

Where: S = Sand, LS = loamy sand, SL = Sandy loam, SCL = Sandy cay loam, SC = Sandy clay, CL = Clay loam, and C. = Clay.G= Gravelly, VG= Very gravelly Ex G=Extremely gravelly

Table (5): Chemical analysis of soil paste extract of the studied soil profiles.

Profile No	Depth (cm)	Soil pH	ECe (dS/m)	Soluble cations (m mole L^{-1})				Soluble anions (m mole L^{-1})			
				Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	CO_3^{2-}	CO_3^{2-}	Cl^{-}	SO_4^{2-}
1	0-20	7.67	3.26	10.58	6.14	14.46	0.32	31.5	0.00	14.14	17.01
	20-60	8.01	4.28	14.28	9.14	18.47	0.41	42.3	0.00	18.20	22.41
	60-80	8.11	4.09	13.51	7.37	17.95	0.39	39.22	0.00	16.44	21.17
2	0-25	7.51	7.88	24.96	12.65	30.84	0.66	69.11	0.00	29.39	38.70
	25-55	7.59	5.42	18.28	11.98	24.31	0.51	55.08	0.00	24.39	29.74
	55-150	7.57	4.96	16.64	8.85	23.09	0.37	48.95	0.00	22.34	25.94
3	0-25	7.54	3.24	10.92	7.12	14.08	0.29	32.41	0.00	14.25	17.54
	25-50	7.43	4.28	13.44	8.20	19.32	0.39	41.35	0.00	16.95	23.15
	50-150	7.43	5.27	16.57	11.72	23.24	0.42	51.95	0.00	22.55	28.05
4	0-25	7.66	3.21	10.87	6.03	14.37	0.38	31.65	0.00	13.28	17.72
	25-50	7.84	3.65	12.24	7.62	15.84	0.41	36.11	0.00	16.19	18.98
	50-70	7.67	4.18	13.12	8.47	18.86	0.50	40.95	0.00	18.40	21.70
5	0-20	7.78	11.68	35.96	22.11	53.35	0.94	112.36	0.00	50.25	60.07
	20-60	7.61	12.85	39.68	25.45	58.67	1.04	124.84	0.00	55.56	66.96
6	0-30	8.11	67.18	224.72	132.42	301.95	3.05	662.14	0.00	313.63	344.27
7	0-30	7.49	7.88	26.52	13.28	35.87	0.87	76.54	0.00	33.84	41.08
	30-60	7.73	9.64	31.67	16.40	45.12	0.89	94.08	0.00	39.60	52.64
8	0-30	8.23	3.17	8.60	6.43	15.95	0.27	31.25	0.00	13.46	16.74
	30-60	8.41	2.85	7.41	6.76	14.16	0.28	28.61	0.00	12.07	15.17
	60-150	8.12	2.90	8.29	6.33	14.05	0.29	28.96	0.00	11.81	15.02
9	0-30	8.01	8.62	24.13	20.51	38.28	0.72	83.64	0.00	37.51	44.31
	30-60	8.12	5.18	14.25	12.63	22.95	0.64	50.47	0.00	22.55	26.24
	60-150	8.16	4.83	13.28	11.08	23.17	0.58	48.11	0.00	21.27	25.49
10	0-30	7.87	7.15	28.32	15.80	26.38	0.46	50.96	0.00	23.65	26.47
	30-60	7.86	15.30	48.97	28.89	70.87	1.12	149.85	0.00	66.22	81.46
	60-150	7.92	10.37	32.62	20.33	47.36	0.92	101.23	0.00	43.57	55.58
11	0-30	7.84	4.35	14.38	9.01	19.35	0.54	43.28	0.00	18.40	24.19
	30-50	7.85	4.07	12.35	8.55	18.47	0.39	39.76	0.00	17.85	21.43
	50-150	8.05	4.63	14.73	8.79	21.16	0.61	45.29	0.00	20.59	24.18
12	0-30	7.16	14.74	51.45	24.31	67.63	1.23	144.62	0.00	61.60	80.67
13	0-30	7.35	6.28	21.36	12.29	27.17	0.56	61.38	0.00	26.02	34.17
	30-60	7.30	15.42	52.34	28.40	69.30	1.03	151.07	0.00	63.91	84.58
14	0-25	7.36	17.89	62.31	31.39	80.64	1.05	175.39	0.00	75.12	97.25
	25-40	7.30	20.81	66.35	37.04	92.76	2.09	198.24	0.00	86.13	108.46
15	0-30	7.82	4.81	14.29	8.89	24.13	0.51	47.82	0.00	21.37	25.81
	30-60	7.75	5.47	17.28	10.86	25.31	0.63	54.08	0.00	23.87	29.74
16	0-30	8.35	6.73	20.18	14.63	30.82	0.64	66.27	0.00	29.98	34.32
	30-60	8.23	6.87	20.37	15.27	30.64	0.56	66.84	0.00	30.06	35.24
	60-90	8.29	5.84	19.43	13.15	25.08	0.53	58.19	0.00	26.62	30.29
	90-150	7.98	5.93	18.29	13.14	27.14	0.59	59.16	0.00	26.32	31.56
17	0-30	7.94	7.01	22.04	14.28	31.57	0.78	68.67	0.00	30.80	37.09
	30-60	8.14	5.33	18.32	10.17	23.85	0.48	52.82	0.00	23.75	27.46
	60-110	8.12	3.85	12.17	7.74	18.72	0.31	38.94	0.00	17.45	20.21
18	0-30	8.34	3.93	11.57	8.83	18.55	0.26	39.21	0.00	17.19	20.38
	30-60	8.01	7.23	22.04	13.66	33.37	0.67	69.74	0.00	32.50	35.89
	60-150	7.97	10.54	34.65	20.45	45.35	0.89	101.38	0.00	46.91	53.52

It is worthy to mention that most of the soil chemical properties are more related to the nature of soil origin, relief, texture, land use period, management practices, cropping pattern, irrigation water suitability and system through the different periods of cultivation. In general, soil salinity tended to increase in the most of the studied soil profiles, except of some scattered areas such as those represented by soil profile Nos. 8 (alluvial moderately low terraces), 1, 3, 4 (low pediplain terraces and toe slopes) which represent extension areas.

On the other hand, the rest of the studied soils that developed on the physiographic units under investigation are suffering from salinity (ECe > 12 dS/m). The later conditions are more associated with inherited salts during chemical weathering (profile Nos. 6 and 14), miss-management practices such as the absence of adequate soil drainage system and continuous lateral seepage from the relatively high areas (soil profile No. 10). Also, the distinct pattern of soil moisture distribution throughout the irrigation with saline water may produce a pronounced effect on soil salinization (soil profile No. 9). The distribution patterns of soluble ions and soil sodicity (ESP) were more associated with the intensive of weathering and dominance of soluble Na^+ that stimulated more displacement of Ca and Mg by Na on soil colloidal complexes.

III. Soil Taxonomy:

Using the aforementioned analytical data as well as Classification System of **USDA (1975)** and Keys to Soil Taxonomy **(USDA, 2010),** the obtained data in Table (6) show that the studied soil profiles could be classified into three orders, i.e., Aridisols, Entisols and Vertisols as well as their followed sequence classification levels. Most of the representative soil profiles for pediplain landscape (profile Nos. 1, 3, 5, 6, 7, 11, 13, 14 and 15), in addition to some localities developed on alluvial terraces unit (soil profile No.10) could be classified into order of Aridisols, which has two sub-orders of Gypsids and Calcids, and two great groups of Calcigypsids and Haplocalcids; three sub-groups of Typic Calcigypsids Lithic Calcigypsids and Typic Haplocalcids as well as eight families, as follows:

a. Typic Calcigypsids loamy skeletal, mixed, hyperthermic (profile Nos. 1 and 7), sandy, mixed, (profile Nos. 3 and 11), sandy skeletal, mixed, hyperthermic (profile Nos. 5 and 13) and sandy mixed, hyperthermic (profile No.15).
b. Lithic Calcigypsids, sandy skeletal, mixed, hyperthermic (profile Nos. 6, and 12) and loamy skeletal, mixed, hyperthermic, (profile No.14) in the pediplain unit.
c) Typic Haplocalcids, clayey over sandy, mixed, hyperthermic of fluvio-lacutrine deposits (profile No.17) and Typic Haplocalcids, clayey, mixed, hyperthermic in the alluvial marches unit (profile No. 10).

Most of the alluvial plain soils and the sandy ones of pediplain are characterized by no evidence of development for pedogenic horizons and could be distinguished under Entisols. The Entisols order has two sub-orders of Orthents and Fluvents, two great groups of Torriorthents and Torrifluvents and two sub-groups of Typic Torriorthents and Typic Torrifluvents, as well as five families, as follows:

a. Sandy over clayey, mixed, hyperthermic (profile No. 2), Sandy skeletal, mixed, hyperthermic, moderately deep over limestone (profile No. 4) and sandy, mixed, hyperthermic (profile No. 18).
b. Fine loamy, mixed, hyperthermic (profile No. 9) and clayey, mixed, hyperthermic (profile No. 16).

Soils of the alluvial plain moderately low terraces (Pl 113) have the evidence of clayey soil and slickensides phenomenon that meeet the requirements of Vertisols order (profile No. 8).

Table (6): Soil taxonomic units of the studied soil profiles.

Order	Sub-order	Great group	Sub-group	Family	Parent material	Soil profiles
Aridisols	Gypsids	Calcigypsids	Typic Calcigypsids	Loamy skeletal, mixed, hyperthermic, moderately deep over limestone	Eocene limestone	1 and 7
				Sandy, mixed, hyperthermic		3 and 11
				Sandy skeletal, mixed, hyperthermic, moderately deep over limestone		5 and 13
				Sandy, mixed, hyperthermic, moderately deep over limestone		15
			Lithic Calci-gypsides	Sandy skeletal, mixed, hyperthermic, shallow over limestone		6 and 12
				Loamy skeletal, mixed, hyperthermic		14
	Calcids	Haplo-calcids	Typic Haplo-Calcids	Clayey over sandy, mixed, hyperthermic	Fluvio-lacustrine	17
				Clayey, mixed, hyperthermic	Alluvium	10
Entisols	Orthents	Torri-orthents	Typic Torri-orthenths	Sandy over clayey, mixed, hyperthermic	Fluvio-lacustrine	2
				Sandy skeletal, mixed, hyperthermic, moderately deep over limestone		4
				Sandy, mixed, hyperthermic,		18
	Fluvents	Torri-fluvents	Typic Torri-fluvents	Fine loamy, mixed, hyperthermic,	Alluvium	9
				Clayey, mixed, hyperthermic		16
Vertisols	Torrerts	Haplo-torrerts	Typic Haplo-torrerts	Clayey, smectitic, hyperthermic		8

IV. Land suitability for agricultural irrigated soils:

a. Current land suitability:

The current suitability of the studied soils was estimated by matching between the present soil characteristics and their ratings as calculated by using the parametric system outlined by **Sys and Verheye (1978),** as shown in Table (7). Suitability indices and classification of the studied soils developed on the studied different physiographic units reveal that there are four soil suitablility classes, *i.e.*, highly (S1), moderately (S2), marginally (S3) and not suitable (N1), besides nine subclasses, *i.e.*, $N1s_1s_2s_3n$, $S3s_1s_2s_4n$, $S3s_1n$, $S3s_1$, S2n, $S2s_1$, $S2ws_1s_2$, $S2s_4n$ and S1 were recognized in the studied area. The soils of these sub-classes are suffering from some soil properties as soil limitations, *i.e.*, soil texture (s_1), soil depth (s_2), $CaCO_3$ content (s_3) and gypsum content (s_4) as well as salinity/alkalinity (n), with different intensity degrees. Also, it is evident that some localities of pediplain units (soil profile Nos. 1, 4 and 13) have a slight intensity of topography (≈90). The obtained values of suitability indices show that some of the soils developed on the physiographic units of the alluvial high terraces (soil profile No. 16) could be evaluated as highly suitable (S1).

Table (7): Soil limitations and rating indices for the studied soil profiles.

Profile No	Suitability condition	Topography (T)	Wetness (W)	Physical characteristics				Salinity/alkalinity	Rating (C)	Land suitability	
				Texture (s_1)	Soil depth (s_2)	$CaCO_3$%(s_3)	Gypsum (s_4)			Class	Subclass
1	Current	80	100	50	60	75	90	100	11.34	N 2	T, s_1, s_2, s_3, s_4
	Potential	100	100	50	60	75	90	100	17.21	N2	s_1, s_2, s_3, s_4
2	Current	100	100	90	100	100	100	95	85.50	S1	--
	Potential	100	100	90	100	100	100	100	90.00	S1	--
3	Current	90	100	60	100	90	85	100	45.90	S3	T, s_1, s_2, s_3, s_4
	Potential	100	100	60	100	90	85	100	45.90	S3	s_1, s_2, s_3, s_4
4	Current	80	100	30	50	70	90	100	5.59	N2	T, s_1, s_2, s_3, s_4
	Potential	100	100	30	50	70	90	90	2.74	N2	s_1, s_2, s_3, s_4
5	Current	90	100	40	35	55	55	60	2.28	N2	T, s_1, s_2, s_3, s_4, n
	Potential	100	100	40	35	55	85	100	6.45	N2	s_1, s_2, s_3, s_4
6	Current	100	100	30	25	65	90	75	3.29	N2	s_1, s_2, s_3, s_4, n
	Potential	100	100	30	25	65	90	100	4.38	N2	s_1, s_2, s_3, s_4
7	Current	100	100	40	35	60	80	90	3.63	N2	s_1, s_2, s_3, s_4, n
	Potential	100	100	40	35	60	100	100	7.34	N2	s_1, s_2, s_3, s_4
8	Current	90	100	90	100	80	100	90	58.32	S2	s_1, s_2, s_3, s_4, n
	Potential	100	100	90	100	85	100	100	76.50	S1	--
9	Current	100	100	90	90	80	100	90	58.32	S2	s_1, s_2, s_3, s_4, n
	Potential	100	100	90	90	80	100	100	64.80	S2	s_1, s_2, s_3, s_4
10	Current	90	100	100	100	75	100	85	57.38	S3	T, s_1, s_2, s_3, s_4, n
	Potential	100	100	100	100	75	100	100	75.00	S2	s_1, s_2, s_3, s_4
11	Current	100	100	70	100	75	55	90	23.39	N1	s_1, s_2, s_3, s_4, n
	Potential	100	100	70	100	75	80	100	37.80	S3	s_1, s_2, s_3, s_4
12	Current	100	100	30	25	50	85	85	1.08	N2	s_1, s_2, s_3, s_4, n
	Potential	100	100	30	25	50	100	100	3.75	N2	s_1, s_2, s_3, s_4
13	Current	80	100	40	35	65	85	85	3.16	N2	T, s_1, s_2, s_3, s_4, n
	Potential	100	100	40	35	65	100	100	5.46	N2	s_1, s_2, s_3, s_4
14	Current	100	100	60	30	65	60	80	4.49	N2	s_1, s_2, s_3, s_4, n
	Potential	100	100	60	30	65	80	100	7.49	N2	s_1, s_2, s_3, s_4
15	Current	100	100	40	35	65	80	95	5.53	N2	s_1, s_2, s_3, s_4, n
	Potential	100	100	40	35	65	100	100	7.28	N2	s_1, s_2, s_3, s_4
16	Current	100	100	100	100	100	100	90	90	S1	--
	Potential	100	100	100	100	100	100	100	100	S1	--
17	Current	90	100	100	90	90	100	90	59.05	S2	T, s_2, s_3, s_4, n
	Potential	100	100	100	90	90	100	100	81.00	S1	--
18	Current	100	100	100	100	95	100	90	85.50	S1	--
	Potential	100	100	100	100	95	100	100	95.00	S1	--

The alluvial plain and moderately high terraces, *i.e.*, Pl 112, (soil profile No. 18) and pediplain low terraces (pp 213) could be evaluated as moderately suitable

(S2), with slight soil limitations. On the other hand, some soils of alluvial plain terraces (profile Nos. 8 and 9), toe slopes and foot slopes of pediplain (profile Nos. 3 and 11) are evaluated as marginally suitable for irrigated agriculture. In addition, the index value indicates a currently not suitable class for some soils of marches Pl 116 (soil profile No. 10) and some soils of pediplain elongated hills and slopes piedmont unit (soil profile Nos. 6, 5 and 17), however, the representative soils have slight intensity of topography, severe intensity of soil texture and effective soil depth as well as moderate intensity for both $CaCO_3$ content and soil salinity/alkalinity limitations.

b. Potential land suitability:

Land improvements are activities, which cause beneficial changes in the qualities of the land itself. They are classified as major land improvements. Further land improvements are required to correct or to reduce the severity of limitations exiting in the studied area, such as: a) Leveling of undulating surfaces, b) Leaching of soil salinity and reclamation of alkalinity existing in the soils, c) Construction of efficient open drainage ditches to enhance leaching process of the excess soluble salts as well as to accelerate the chemical remediation of soil sodicity, d) Continuous application of organic manure to improve soil physico-chemical properties and fertility status, e) Application of modern irrigation systems, i.e., drip and sprinkler to save a pronounced amount of irrigation water as well as to rise the irrigation efficiency.

It is applicable after executing specified major land improvements as proposed in the aforementioned agro-management practices according to their necessity. For establishing potential land suitability classification, the main land improvements for the studied area are considered for the land qualities of drainage, salinity and sodicity. The minor limitations can be improved under specific land management, concerning each of them. So, the obtained potential land suitability sub-classes were sorted for the maximum productive levels (supreme potential land suitability). These levels were designed to be guide charts and maps for the best land utilization alternatives, giving a possible maximum output. The potential land suitability data are shown in Table (7).

These adaptations can be described by applying the previous improvement practices, and in turn potential suitability of the studied soils indicates the existing of two suitability classes, *i.e*., highly (S1) and moderately (S2), however, soil suitable sub-classes of both alluvial flood plain terraces (soil profile Nos. 8,16 and 18) and pediplain foot slope and depression bottom (soil profile Nos. 2 and 11) improved from moderately suitable (S2) to highly suitable (S1).Soils of profiles Nos. 9 and 3 could be improved from marginally suitable (S3) to moderately suitable (S2). The later subclass represents some soil profiles developed on some of the different studied physiographic units with severe to moderate intensity of soil texture (relatively coarse) as soil limitations. The severity of soil texture (sand) can be corrected in these subclasses by application of organic and inorganic soil amendments as well as drip irrigation system to sustain soil moisture content at favourable conditions for grown plants.

CONCLUSION:

This work was carried out in order to study the possibility of using the Spectral Angler Mapper technique to classify different land covers in the studied area and to identify major changes that have taken place during 21 years (the period of the study). The study area was classified into four classes and a confusion matrix based on ground truth data used to verify the thematic maps. A post classification comparison approach was used to detect land use and cover changes.

The results showed considerable potential of the Spectral Angler Mapper technique in classifying land use and cover. The main land cover changes in the study area could be summarized thus: agricultural areas, water and settlement increased considerably with a high rate of annual increase during the entire study period; there is a substantial decrease in the other land use and land cover. Such base information can help decision-makers and land planners in the process of determining priority areas for the implementation of management plans or soil reclamation measures at regional level to avoid adverse environmental effects. Moreover, the data of the current study were created to update and support the local knowledge, particularly the best use of land whether be under demand for agriculture use or be planned for later on use. It means that the obtained findings represent the best adaptation between certain land units with specific soil properties to give the maximum outputs. Also, identifying the physiographic features of an unique area in the north-western desert outskirt of El-Fayoum depression by mapping them to be a digital model in a harmony of physiographic and soil data set, serving the extrapolation approach when other areas will be under study.

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متابعة التغيرات في الغطاء الارضي لمنطقة شمال-غرب منخفض الفيوم ومدي صلاحية تربته للاغراض الزراعية

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تعتبر هذه الدراسة محاولة لتتبع التغيرات الحادثة في الغطاء الارضي باستخدام تكنيك تفسير صور الاقمار الفضائية، وكذا تحديد مدي ملائمة التربة للزراعة المروية في منطقة الظهير الصحراوي شمال - غرب منخفض الفيوم خلال الفترة من ١٩٨٤ الي ٢٠٠٥، وتقع منطقة الدراسة بين خطي عرض ١٩" °٢٩ الي ٢٦" °٢٩ شمالا وخطي طول ٢٤" °٣٠ الي ٣٤" °٣٠ شرقا. وتم استخدام نظام Spectral Angler Mapper لتقسيم المنطقة الي أربعة أقسام هى المناطق السكنية، المناطق الزراعية، المسطحات المائية، المناطق الصحراوية.

ولقد لوحظ تحول بعض المناطق الصحراوية الي مجال التنمية الزراعة والسكن في خلال الفترة المدروسة. كما أوضحت الدراسة أيضا ان المساحات المستصلحة زادت بمقدار ٤٤١٠.٠٤ فدان والتي تمثل حوالي ٨.١٥ ٪ من المنطقة المدروسة كما زادت مساحة مناطق التوسع العمراني الي ٧٦٨,٨ فدان والتي تمثل حوالي ١.٤٦ ٪، بينما زادت المسطحات المائية بمقدار ٧٧.٨٧ فدان والتي تمثل

حوالي ٢٢.٠٪، هذه الزيادة ربما تعزي الي التغيرات الجيوفيزيائية والاجتماعية مثل الملوحة والقلوية والتعرية الهوائية وإستصلاح أراضي صحراوية جديدة والتوطين.

وقد تم تمييز الصور الفضائية المنتجة لعام ٢٠٠٥ الي مظهرين أرضيين أساسيين، قسمت إلي ١٣ وحدة باستخدام تكنيك التفسير المرئي لصورة الأقمار الفضائية:

ETM7 (Enhanced Thematic Mapper 7) and applying the Landscape feature approaches.

وقد تم مراجعة حدود الوحدات الأرضية للخريطة الفيزوجرافية حقليا مع التمثيل بقطاعات ممثلة، حيث أستخدمت ٣٢ حفرة صغيرة لتوقيع وضبط الحدود بين الوحدات الفيزيوجرافية وإستنتاج دليل الخريطة، أيضا الاختلافات في خواص التربة للوحدات الفيزوجرافية تم تمثيلها بأخذ ١٨ قطاعا أرضيا تم وصفها مورفولوجيا بدقة تبعا (2003) USDA.

وقد تم تقسيم التربة تبعا (1975 and 2010) USDA، حيث وجد أن أراضيها تنتمى إلى ثلاث رتب، ست تحت مجموعة كما يلي:

Aridisols (Typic Calcigypsids, Lithic Calcigypsids, and Typic Haplocalcids), Entisols (Typic Torriorthents and Typic Torrifluvents) and Vertisols (Typic Haplotorrierts).

وتبعا لنظام التقييم الخاص بالأراضى الزراعية المروية لـ Sys and Verheye (1978) ، فقد أمكن تمييز أربعة رتب تبعا انظام التقييم الحالي والمستقبلى (الكامن) هى:

Highly (S1), moderately (S2), marginally (S3) and not suitable (N1 & N2).