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GEOMATICS FOR DIGITAL EGYPTIAN SOILS MAPPING, CASE STUDY OF NORTHWESTERN COAST

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ABSTRACT

The northwestern coast of Egypt is characterized by an international interest due to its history and magnificent environment, thus worth to be referred as “Bread basket” during the Greek and Roman periods. Recently, drastic changes in land use resulted in destructing many of water harvesting tools, thus diminution agriculture importance. Restoring and planning self-sufficient communities need to develop a sustainable land resources database. The medium scale space data provide a spatial resolution of 30 meters, in addition to multi-temporal imaging. Moreover, Geographic Information System (GIS) permits to store, merge, and manipulate the huge amounts of thematic maps and attribute data.
A number of 7 Landsat 8 OLI of June 2019 scenes, and 53 topographic maps at scale 1:50000, covering the whole study area, were acquired and merged. ENVI 5.1 software was used for image processing while ArcGIS 10.4.1 to generate thematic layers relevant to land resource, Field investigation was carried out to represent different soil units and collect ground control points. Chemical and physical soil properties were determined, upon which soil classification was based. Soil map was produced including dominant geographic units and soil association. The Mediterranean Land Evaluation Information System (Micro-LEIS) system was employed to define soil suitability classes for practiced cultivations.

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The results showed that the soils are generally characterized by the presence of Calcic, Petrogypsic and Salic horizons. The identified great groups include Torripsamments, Torriorthents, Haplosalids, Petrogypsids and Haplocalcids. Soils of the alluvial fans and watershed basins are deep to moderately deep. The salinity is relatively low whereas the $CaCO_3$ content is mostly high. Land suitability limiting factors found in the piedmont and coastal plains include salinity, soil depth and texture.
It can be concluded that the digital mapping, encouraged by the progress of GIS and satellite imaging, preserve in the investment spent in soil and other thematic mapping.

Key words: Soils, Space data, GIS, Digital soil mapping, Egypt

INTRODUCTION

With the great progress in computation and information technology come vast amounts of data and tools in all fields of endeavor. Soil science is no exception, with the ongoing creation of regional, national, continental and worldwide databases. The current study aimed basically to build a georeferenced thematic database of the study area. Such databases will be a trustable ground truth resource to analyze different agro environmental aspects (e.g. environmental sensitivity to desertification). Land use/ cover were mapped, on bases of multi concept of satellite images (Landsat 8 OLI June 2019, field checks and available thematic maps).
The histogram equalization stretching process was used and resulted in the maximum contrast between features. Geomatics refers to the integrated approach of measurement, analysis, and management of the descriptions and locations of geo-spatial data.
False color composite enhanced images were produced using the combination of different spectral bands to analyze lU/LC bands. The created FCC's and their visual interpretations were used as guides for field work survey. The challenge of understanding these large stores of data has led to the development of new tools in the field of statistics and spawned new areas such as data mining and machine learning (Edeki and Pandya, 2012). In addition to this, in soil science, the increasing power of tools such as geographic information systems (GIS), GPS, remote and proximal sensors and data sources such as those provided by digital elevation models (DEMs) are suggesting new ways forward. Fortuitously, this comes at a time when there is a global clamour for soil data and information for environmental monitoring and modelling. Consequently, worldwide, organisations are investigating the possibility of applying the new spanners and screwdrivers of information technology and science to the old engine of soil survey. The

principal manifestation is soil resource assessment using geographic information systems (GIS), i.e., the production corresponding to national to global, catchment to landscape and local extents. In the language of digital soil maps, different from that of conventional cartography, scale is a difficult concept, and is better replaced by resolution and spacing (Stumpf et al., 2017).

The northwestern coast represents a promising region for extensive development both for local and expected new inhabitants. The concern of coastal resources has increasingly risen during the last two decades mainly because of the great pressure of human actions (urban expansion, industry, tourism, infrastructure, aquaculture, fisheries ports and marinas, energy production and transportation) but also due to the ineffective information, policies, planning and management tools for controlling or regulating human actions and natural processes (natural risks or hazards) in such sensitive environments as that of coastal zones.

The study area dominates the northwestern coast of Egypt between Burg El Arab and El Sallum (figure 1). It is bounded by latitudes 30o 30’ N and 31o 45’ N and longitudes 25o 00’ E and 29o 30’ E. The distance from Alexandria to the extreme east of the study area is about 390 km, while extending for some 600 km to the extreme west.

The cultivable soils in the northwestern coast are originated from transferred sedimentary rocky material. The sediments have been transported by water to alluvial fans and flood plains. Soils were formed also by Aeolian sediments in some locations. The subsoil layers are formed locally from the marine limestone. The soil depth varies according to its location, found shallow in the sloping and plateau landscape, and deep in the coastal plain and alluvial fans. The occurrence of calcium carbonates ranges from 30 to 70% and may reach 99% in the calcareous sands (Hammad et. al. 1981).

The area from the coast to the Libyan plateau includes calcareous formation belong to the Pliocene and Pleistocene covered with recent sediments. The existence of parallel ridges along the coast characterizes the area. The ridges are absent in some locations, and consist of calcareous sedimentary material differ in there coherence. The Libyan plateau occupies huge area and extends southwards (CONOCO, 1989).

The area includes a narrow coastal plain, followed at the south by a sand dune area. Southwards of the dunes, the plain rises gradually till the altitude of the plateau this reaches 50 to 150 meters above sea level. The coastal plain stretches in east-west direction, bounded by the sea to the north and the pediment plain to the south. Its width varies, controlled by the geologic formations from some meters to about 10 km. This plain mainly consists of alluvial fans, descending from the plateau, wad's extensions, rocky plains sabkhas, sand sheets and sand dunes. The pediment plain is clear between

Ras El-Hekma to Ras Alam El-Room. It is a low lying plain where rain water, descending from the plateau is collected. This area has a considerable potentiality for agriculture expansion. The plateau is rocky, covered mostly by a thin depth of soil. It plays an important role in distributing winter rainfall (FAO, 1970).

Most of the cultivable soils in the northwestern coast are alluvium. The sediments have been transported by water to alluvial fans and flood plains. However, aeolian sediments in some locations are being cultivated. The subsoil layers are formed locally from the marine limestone. The soil depth varies according to its location, found shallow in the sloping and plateau landscape, and deep in the coastal plain and alluvial fans (NARSS, 2005).

According to Egyptian Meteorological Authority, (1996) the average annual rainfall ranges between 156 – 180 mm. and the mean minimum and maximum annual temperatures are 16.4 and 23.0 C° respectively. The evaporation rates are coinciding with temperatures where the lowest evaporation rate (6.9 mm/day) was recorded in January while the highest value (8.8 mm/day) was recorded in September.

This study aims to use the remote sensing data and Geographic Information system to produce the land resources digital maps of the Northwestern Coast of Egypt, which can be used as a base for land use planning and sustainable development.

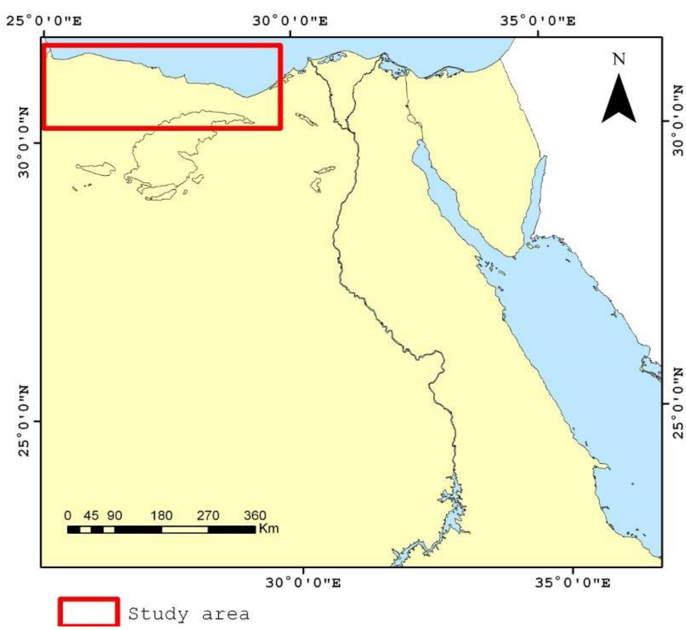

Figure (1) Location map of study area

MATERIALS AND METHODS:

This study is based on the multi concept of remote sensing data and techniques, thus, materials and methods of different sources are used as the following:

- Sven LANDSAT 8- OUI images, dated in June 2019 (i.e. 178-38, 178-39of June 15, 2019; 179-38, 179-39 of June 22, 2019; 180-38, 180-39 of June 29, 2019 and 181-38 of June 20, 2019) were used to obtain the Landsat OUI mosaic of the studied area (figure 2).
- A number of thematic maps were obtained from different sources. (eg. 53 Topographic maps of Military survey authority (MSA) at scale 1: 50000). Other maps were extracted from different sources and were input as separate layers. These thematic layers includes water bodies, altitude points, contour lines, roads, railways, tracks, pipelines, telephone lines network and mine fields distribution.
- Field missions were carried out with the purpose of collecting ground truth information concerning landscape, soil and vegetation. A number of 149 observation sites were comprehensively field studied, where different environmental parameters were described according to FAO (2006). Representative soil and water samples were also collected from different horizons for laboratory analysis using the soil survey laboratory methods manual (USDA, 2004).
- Digital Elevation Model (DEM) of the study area has been obtained from the SRTM images (figure 3).
- Rectification of studied scenes, (Landsat 8 OLI) was performed using sufficient number of GCP's, which are distributed randomly all over the images. The root mean square (RMS) error was found to be 0.74, the process was applied first on the ETM of 1990 and hence, image to image registration was accomplished.
- Arc GIS 10.4.1 software was used to create GIS coverage's from the CAD file of thematic layers. The same system was used for map features coding, editing, building topology, creating feature attribute tables FAT, edge matching and map projection. Generating check plots, compared with source maps, was fulfilled for quality assurance. This helped in detecting and editing digitizing mistakes. Join item function was used to link the tabular attributes with the spatial features.
- Arc GIS 10.4.1 software was used in data analysis, the first step in analysis began with locating the field observation sites on the thematic layers with their attributes (i.e. soils and landscape properties). Using the 3D module of Arc View the interpolation of the spatial distribution of the land

use classes was performed. Spatial analyst of Arc View was used to classify the soil parameter ranges on the map and deduct the relation between the soil conditions and the land features. Also, the 3D analyst was used for generating digital Elevation Model (DEM) from the contour lines and spot heights .The DEM creation depends on the nearest neighboring function. Statistical parameters and presentations were used to find out the relation between ground truth and image classification.

• Arc- GIS 10.4.1 software was used for this function. Landsat ETM+ images and Digital Elevation Model (DEM) were grouped and processed in ENVI 5.1 software to define the different landforms of the studied area (de Carvalho et. al., 2002 & Adam, and Gangopadhyay 2012).

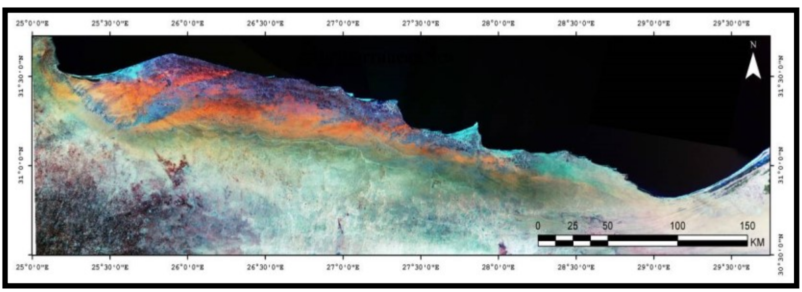

Figure (2): Landsat ETM mosaic of June 2019, covering the

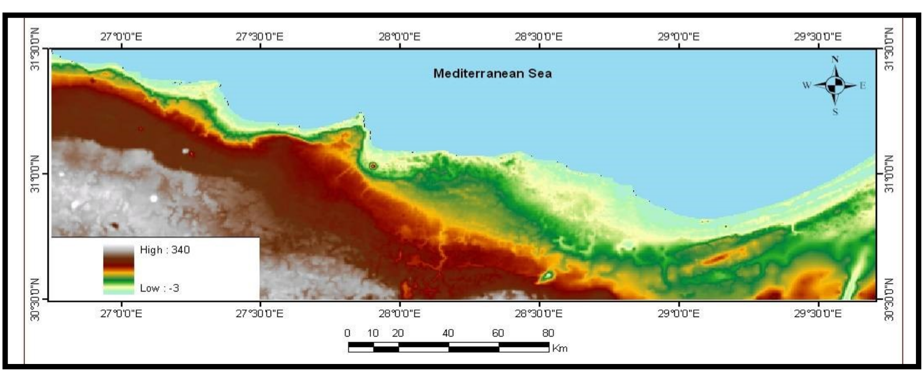

Figure (3) digital elevation model of the studied area, based on SRTM satellite mages

RESULTS AND DISSCUSSION

Producing base layers:

The planed schedule was completely fulfilled for this task, as it includes digitizing of 53 topographic map sheets. The maps performed to be available in the digital format; however their preparation as GIS ready maps has been completed. The mosaic of database layers are represented in figures (4 to 10)

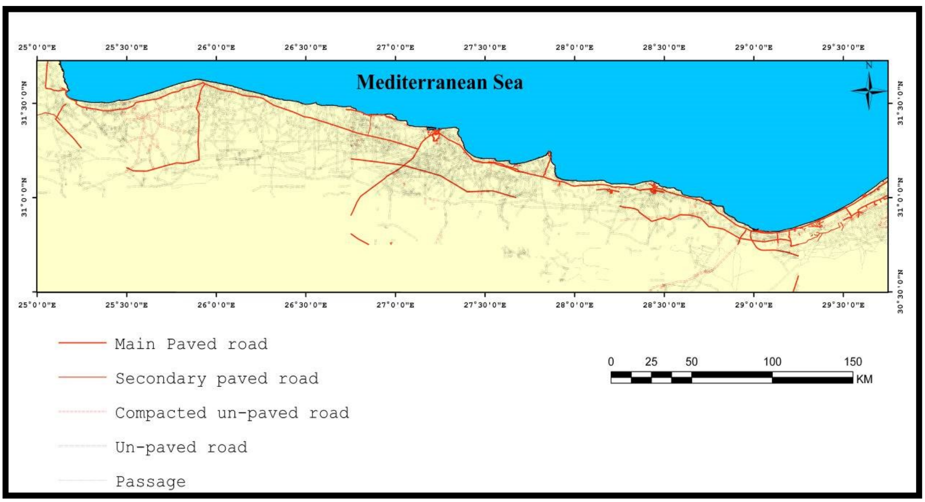

Figure (4) Roads networks in the Northwestern Coast

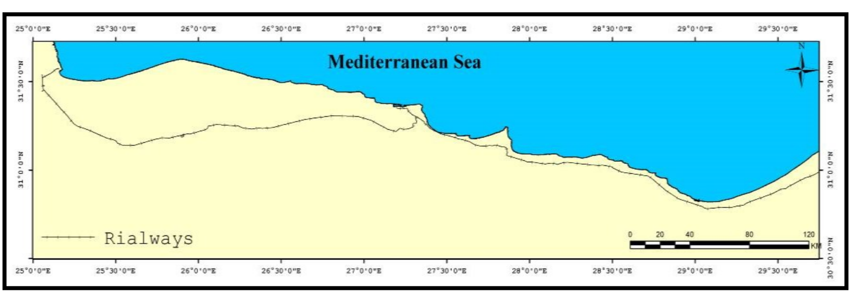

Figure (5) Railways networks in the Northwestern Coast

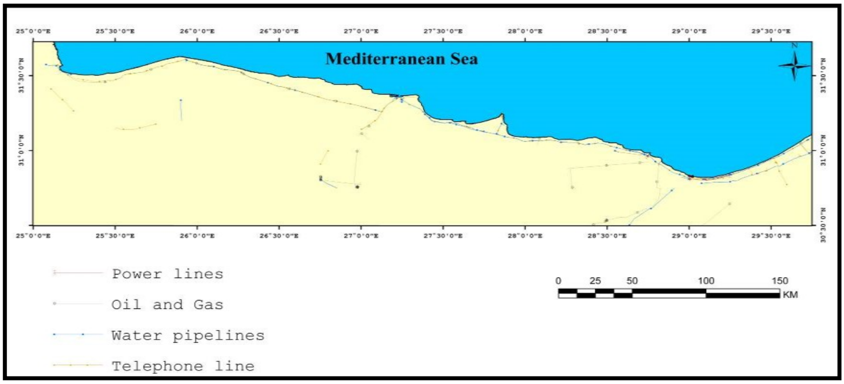

Figure (6) *Utilities layer in the Northwestern Coast*

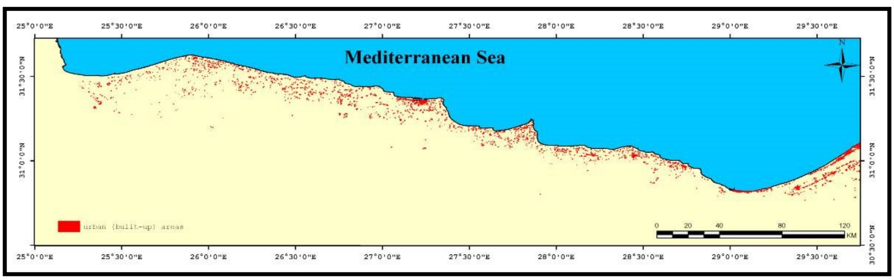

Figure (7) *Urban areas in the Northwestern Coast*

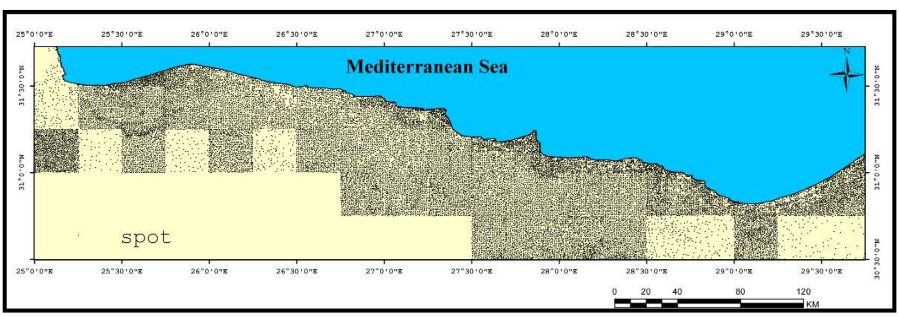

Figure (8) *Spot heights layer in the Northwestern Coast*

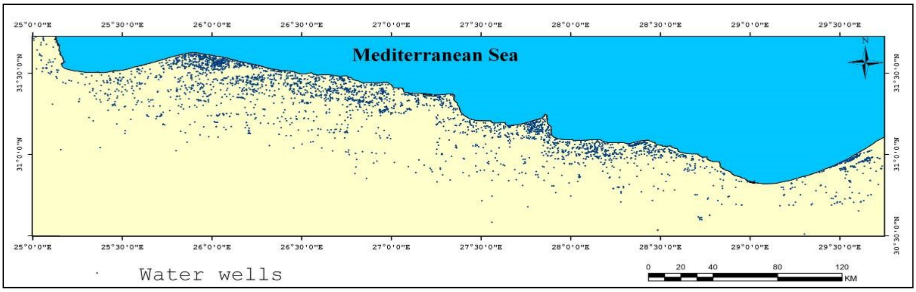

Figure (9) ***Wells distribution layer in the*** **Northwestern Coast**

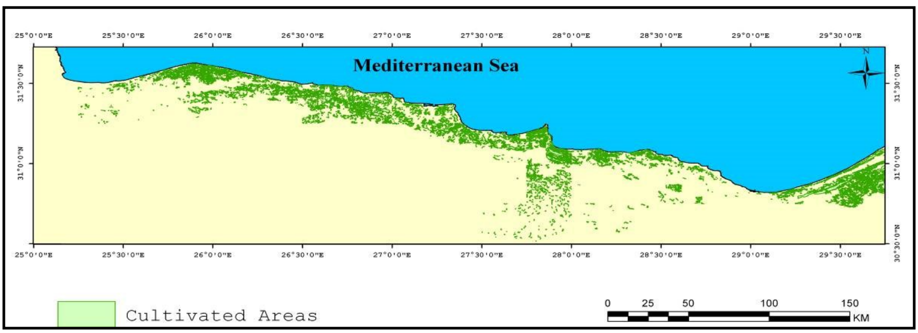

Figure (10) ***Cultivated areas in the Northwestern Coast***

Defined physiographic units of the studied area:

Physiography is assumed to be one of the driving soil forming factors and soil mapping criteria, concepts provided by this discipline can conveniently be used for soil data structuring. The combination of the geomorphic approach as a hierarchic classification system of geoforms using the existing body of knowledge in geomorphology, with the satellite data and field observations improved the results and allow using the computer-assistance procedures.

The delineation of the physiographic units from the satellite data needs a high spatial resolution images; therefore the spatial resolution of the used Landsat ETM+ was enhanced through the data merge process. This process is commonly used to enhance the spatial resolution of multi-spectral datasets using higher spatial resolution panchromatic data or single band (band 8). In this study merged data were performed using multi-spectral bands (28.50 m) as a low spatial resolution with panchromatic band 8 of ETM+ satellite image as a high spatial resolution (14.25 m) resulting in multi-spectral data with high spatial resolution (14.25 m). The enhanced image was draped over the Digital Elevation Model (DEM) of the area to delineate the physiographic map. The physical and chemical analyses of the studied soils were linked to the attribute table of the mapping units.

The physiographic description of the investigated observation sites shows that the relief in the study area ranges between almost flat to slope, while the lithology varies from marine deposits in the coastal plain to Aeolian deposits in plateaus landscape and colluvium in the basins, terraces and slope ones. The dominant land cover is sandy sheets in the coastal plain. Scattered areas are cultivated with figs and olives trees in both coastal plain and plateau. Gravel surface and low dense shrubs exhibit the plateau, while highly dens shrubs exist in the basins. Boulders and stony fragments often exist in the ggraphy aently sloping areas. It should be highlighted that the morphometric analyses agree with (Abou-Shleel et. al. 2020) who referred that the geomorphology of the study area is characterized by the presence of Coast units (i.e. Coastal plain bordered by the Mediterranean Sea to the north and by the plateau to the south, controlled by the geologic formation. It is found that the altitudes in the coastal plain ranges between 12 and 19 meters a.s.l., while in the plateau ranges between 92 and 185 meters a.s.l. Figure (11) represents the different physiographic units in the studied area; the obtained data reveal that the area includes three main landscape units as the following**:**

- **COASTAL PLAIN:**

This type of landscape is found near to the coast of the Mediterranean Sea and includes different types of land forms such as sand sheets, terraces, vales and basins. It is characterized by the low elevation as the elevation differ from zero to 20 m a.s.l. the elevation increases generally in the southern parts of the costal plain. This type of landscape contains sand and colluvial deposits with almost flat to gently undulating relief type.

- **PIEDMONT:**

This type is located between the plateau and the coastal plain and has an elevation ranges between 20 to 65 m a.s.l. The main land forms in this type of landscape are terraces, basins and sand sheets of gently slopping to undulating relief type.

- **PLATEAU:**

The plateaus are found in the south of the study area and have an elevation ranging from 65 up to 275 m a.s.l. and characterized by the limestone deposits as desert pavement and rock outcrops. It was possible to confirm that the rocky surfaces exhibit the plateau landscape. It was found that the surface relief of the plateau type differs from almost flat to undulating relief.

The detailed description of the landscape, relief, lithology, land forms and laboratory analyses are attached to the attribute table of the physiographic digital units (figure 12). The cultivations in the investigated area are wheat, barley, figs and olives trees as rain fed cultivation. The cultivated lands are found in the coastal plain and large parts of the piedmont because of the relatively high amount of annual rains and the absence of rock outcrops. The cultivation activity is found in the vales, basin, terraces and sand sheet area. The grazing activity is found in different areas depending on the density of the natural vegetation.

Compilation of digital soil map:

The northwestern coastal region attracted the attention of several investigators and with the advantages of satellite images of the earth, reviewing of the previous work was necessary. In view of available resolution (30m) and on regional scale, the soil maps produced formerly were modified (FAO 1970, el shazly 1978 and Hammad et. al. 1981).

Since 1960, several researchers of the Desert Institute studied separate parts. Most of there studies were accomplished by aerial photo interpretation. The modern technique at that time provided an adequate and excellent tool as base maps and for interpretation. The soil maps presented were highly predictable and credible.

The current study proved great correspondence with previous findings, as proved that e soils of the region are highly calcareous as the dominant rock is limestone. However; existence of sandstones and shales is reported, the following origins of these soils were identified as follows;

1. Marine origin for the oolitic sands of the ridges and dunes either consolidated or loose.
2. Alluvial and /or fluvio-marine origins, for the soils of the coastal plains, alluvial fans and depressions
3. Lacustrine origin for the sediments of lagoons and the deep lagoonal deposits

4. Aeolian origin for the sand dunes, hummocks and sheets of some tracts along the region.

The soils of the studied region are classified according to the Soil Taxonomy, Table (1) and figures (13) show the geographical distribution of soil units in the Northwestern coastal region. Both *Arididsols* and *Entisols* soil orders are found covering 42.1 and 57.9% of the mapped soils respectively. The *Calcids* sub-order is mostly clustered in areas of Burg El-Arab, Marsa Matrouh and Sidi Barani exhibiting 14.45% of the area. The *Salids* sub-order exists around both Matiout and Salum lagoons representing an 6.11% of soils The Gypsids sub-order soils is restricted in the area between El-Hammam and Sedi Heneish covering 21.54 % of the maped soils.

The *Entisols* soil order includes the sub-orders *Orthents* and *Psamments* representing 33.99 and 23.91% of the mapped soils respectively. It can be noticed that the area from Burg El-Arab to Matrouh is characterized by variability of soil units (e.g. *Torripsamments*, *Torriorthents*), while the area from Matrouh to El-Saloum is occupied by the *Torriorthents* great group soils.

Khalifa and Beshay (2015) indicated that ten soil mapping units were differentiated at West of Matrouh, Northwestern Coast of Egypt according to differences in profile depth, texture and topography. Integrated data emphasized that 13.6% and 19.6% of the total area, respectively have deep and moderately deep profile depth. Coarse to moderately coarse texture classes dominated whole soils. Almost flat topography to gently undulate conquered the area over 69.3%. Based on field check and laboratory analysis, soils were classified into 10 family classes, while at sub great group level seven classes were differ (i.e. *Typic Torrifluvents, Typic Torripsamments, LithicTorripsamments, Lithic Torriorthents, Oolitic Torripsamments, Typic Aquisalids and Typic Haplosalids* exhibiting 15.2%, 18.0%, 22.6%, 35.7%, 5.0%, 3.5% and - 0.15% of study areas, respectively).

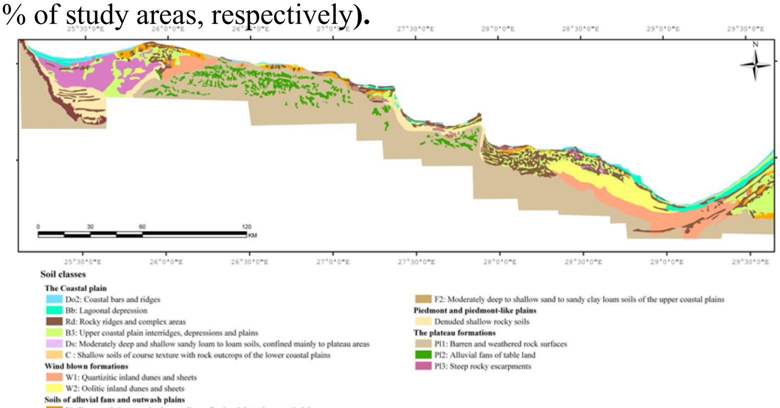

Figure (11) M*ain physiographic units in the Northwestern Coast*

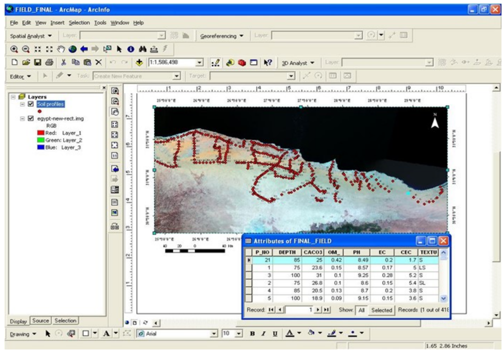

Figure (12) Physiographic digital units and related attribute table

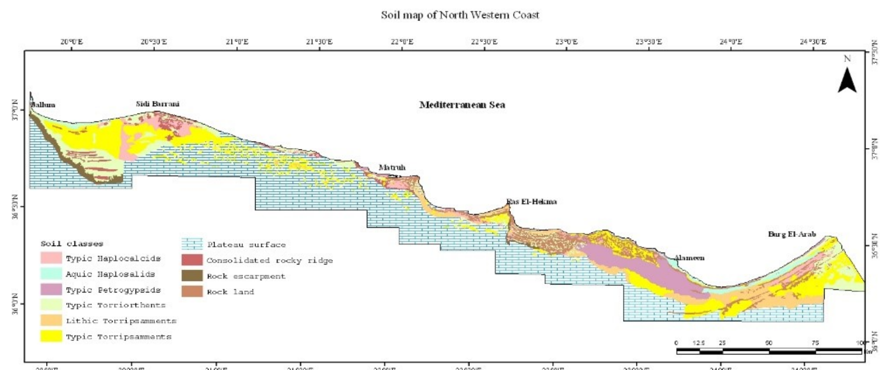

Figure (13) ***Soil map of the North Western Coast region***

Table (1) Areas of sub-great groups, in the Northwestern coast of Egypt

Order	Sub-Order	Type (Great group)	Area (Km2)	%
Aridisols	*Calcids*	*Haplocalcids*	542.17	14.45
	Salids	*Haplosalids*	229.4	6.11
	Gypsids	*Petrogypsids*	808.45	21.54
Entisols	*Orthents*	*Torriorthents*	1275.57	33.99
	Psamments	*Torripsamments*	897.14	23.91
Total area			3752.73	100.00

Usage of the digital soil map in crop suitability classification:

Land suitability for some crops (i.e. wheat, melon, sunflower, olive, peach and alfalfa) was determined using MicroLeis software. The obtained data were linked to the attribute tables of the established database for defining the land suitability, Arc-GIS spatial analyst was used perform this task.

The soil characteristics such as soil depth, texture, calcium carbonate content, salinity, natural drainage and development of the soil profile were used in this system to determine the suitability class. Results of this determination are demonstrated in table (2). The suitability of 67 soil profiles representing the different soil types in the studied area was carried out; the results indicate that the olive, peach, wheat, melon and sunflower are the most suitable crops in the study area. Figs trees and barley are already found in the area with a good productivity. The soils in the area were classified to five groups (S2, S3, S4, S5 and N) according to their suitability classes and limiting factors. The map shows that the southern part of the study area is non suitable (N) for cultivation due to its very shallow depth and very high content of calcium carbonates as well as the domination of rock outcrops. The soils of piedmont and coastal plain have a good potentiality for cultivating by the selected crops, as they are classified S2 to S5. These classified soils are characterized by the following:

- Useful depth: 25 to 100 cm
- Soil texture: sandy to sandy clay loam
- Salinity: 0.25 to 31.5 dS/m
- $CaCO_3$: 10 to 57.1%
- Natural drainage: poor to excessively
- Stoniness: 0.2 to 25%
- Development of the soil profiles: incipient

The limiting factors in the soils of the piedmont and coastal plain are salinity, soil depth and texture. These factors decrease the suitability class to S2, S3, and S4 and sometimes to S5. The classes of S2, S3 are found mainly in the coastal plain where the classes of S4, S5 are exhibited in the soils of the piedmont.
In general, the investigated area could be cultivated by wheat, olive and peach with a suitability class (S2), however melon, sunflower and citrus with suitability classes S3, S4 and S5.
The barren lands are covered with gravels, stones, boulders and few patches of natural vegetation (small shrubs). These patterns of land cover are found mainly in the plateaus and the high parts of the piedmont.

Table (2): ***Limitation factors and land suitability classes of the studied soil profiles***

Profile no.	Limiting factors	Suitable crops	Class
1	Useful depth, Texture, Drainage	Wheat	3, 4
2	Useful depth, Texture, Salinity	Wheat	3, 4
3	Texture, Carbonate %	Olive, Peach,	2
4	Useful depth, Texture, Drainage	Non	5
5	Useful depth, Drainage	Wheat	3, 4
6	Useful depth, Texture	Olive, Wheat, Melon, Peach	2, 3
7	Texture	Olive, Wheat, Melon, Peach	2, 3
8	Useful depth, Texture	Non	5
9	Useful depth, Texture, Drainage	Non	5
10	Useful depth	Wheat	3, 4
11	Texture	Olive, Peach, Alfalfa, Melon, Wheat	2, 3
12	Useful depth	Wheat	3, 4
13	Texture, Carbonate %	Olive, Peach, Wheat, Melon	2, 3
14	Texture, Carbonate %	Olive, Peach, Wheat, Melon	2, 3
15	Texture	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2
16	Non	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2
17	Carbonate %	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2, 3
18	Useful depth, Texture, Carbonate%	Olive, Peach, Wheat, Melon	3
19	Texture	Olive, Peach	4
20	Salinity, Useful depth,	Non	5

	Drainage		
21	Texture, Salinity	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	3
22	Non	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2
23	Texture	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2, 3
24	Texture	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2, 3
25	Non	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2
26	Texture	Olive, Peach	3
27	Carbonate %	Olive, Peach, Wheat, Melon,	2, 3
28	Non	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2
29	Non	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2
30	Texture, Carbonate %	Olive, Peach, Wheat, Melon	2, 3
31	Texture	Olive, Peach	3
32	Useful depth, Texture, Carbonate%	Olive, Peach, Wheat, Melon	3, 4
33	Carbonate %	Olive, Peach, Wheat, Melon,	2
34	Texture, Carbonate %	Olive, Peach, Wheat, Melon	3, 4
35	Useful depth, Texture, Salinity	Non	5
36	Useful depth	Olive, Peach, Wheat, Melon	2, 3
37	Texture	Olive, Peach, Wheat,	2, 3

		Melon, Alfalfa, Sunflower	
38	Texture, Carbonate %	Olive, Peach, Wheat, Melon	2, 3
39	Useful depth, Drainage, Carbonate%	Non	5
40	Useful depth, Carbonate%, Salinity	Wheat, Melon, Sunflower	2, 3
41	Texture	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2, 3
42	Useful depth, Carbonate%, Salinity	Wheat, Melon, Sunflower	2, 3
43	Texture	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2, 3
44	Useful depth, Texture, Drainage	Non	5
45	Useful depth, Carbonate%, Salinity	Wheat, Melon, Sunflower	2, 3
46	Useful depth, Texture, Drainage	Non	5
47	Useful depth, Texture, Drainage	Non	5
48	Useful depth	Wheat	3
49	Useful depth, Drainage	Non	5
50	Useful depth, Texture, Drainage	Non	5
51	Texture	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2, 3
52	Texture, Salinity	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2, 3
53	Texture	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2, 3
54	Useful depth, Texture, Carbonate%	Wheat, Melon, Sunflower	2, 3

55	Useful depth, Drainage	Non	5
56	Useful depth, Drainage	Non	5
57	Useful depth, Drainage	Non	5
58	Useful depth	Non	5
59	Carbonate%	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	2, 3
60	Carbonate%	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	3, 4
61	Carbonate%	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	3, 4
62	Useful depth	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	3, 4
63	Useful depth	Olive, Peach, Wheat, Melon, Alfalfa, Sunflower	3, 4
64	Useful depth, Drainage	Non	5
65	Useful depth, Drainage	Non	5
66	Useful depth, Drainage	Non	5
67	Carbonate%	Olive, Peach, Wheat and Melon	3, 4

CONCLUSIONS

It can be concluded that the digital mapping of land resources encouraged by the progress of Geographic Information System (GIS) and data provided by satellite images. Such approach may preserve in the investment spent in soil and other thematic mapping, as the digital maps are more granted compared with analogue ones. Updating and manipulating the digital thematic maps are accessible and economically effective. Usage of the digital maps and their attribute tables assist the decision support systems and may result in obtaining maps required for controlling sustainable development projects. The digital format of the soil map facilitate the linkage with the different software, this allow the integration of data for defining the optimum land uses of the studied region. The obtained results from the established database recommend that the soils of alluvial fans and watershed basins are most suitable for olives, peach, wheat, beans, and sunflower cultivation.

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