Soil Classification and Potentiality Assessment for Some Rainfed Areas at West of Matrouh, Northwestern Coast of Egypt

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ABSTRACT

Desert development is the key role of enhancing agricultural production in Egypt. The northwestern coast is one of the most attractive desert regions for sustainable agrarian development due to its abundant qualifications which have not sufficiently used yet. This investigation was carried out in El-Qasr - Um El-Rakham area as a model for rainfed pattern at the northwestern coast, to assess both of types and capability of the soils representing dominant land forms in the area. Studied area extends over about 159603 feddan including 12 drainage basins. The extent of landforms was spatially identified using geological and topographic maps in integration with DEM. The area represented by 6 main land forms; (1) Coastal plain (17.8%) which include: Alluvial fans (9.1%), Lagoonal depression and salt marsh (3.5%), Oolitic longitudinal sand dunes (2.2%) and Oolitic sand beach (2.8%) – (2) Alluvial terraces and Interfluves wadis (9.7%) – (3) Wadi course (2.7%) – (4) Escarpment (4.3%) – (5) Piedmont plain (13.6%) – (6) Plateau (52.1%) which include: Lower plateau (18.6%) and Higher Libyan plateau (33.5%).

Soils of the area were surveyed through 261 soil profiles which spatially distributed upon ETM+ LANDSAT 7 image classification to represent achieved landforms. Twenty four representative soil profiles were selected in this study. A digital vector database was created using GIS, consequently, soil and evaluation maps were generated. Results indicated that ten soil mapping units were differentiated according to differences in profile depth, texture and topography properties in the area under study. Further, 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 undulated 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 differentiated. These are *Typic Torrifluvents* (24259 F – 15.2%), *Typic Torripsamments* (28728 F – 18.0%), *Lithic Torripsamments* (36070 F – 22.6%), *Lithic Torriorthents* (56978 F – 35.7%), *oolitic Torripsamments* (7980 F - 5.0%), *Typic Aquisalids* (5586 F - 3.5%), and *Typic Haplosalids* (260 F -0.15%). Soils of oolitic sand beach were classified as *Oolitic Torripsamments*, while soils of the lagoon depressions and salt marsh were classified as *Typic Aquisalids*. Soils of alluvial fans were classified as *Typic Torrifluvents*. As well, soils of the alluvial terraces and interfluves wadis, piedmont plain and wadi courses are generally belong to the subgroups *Typic* and *lithic Torripsamments* and *Torriorthents,* except small areas in the alluvial terraces and interfluves wadis and the lower portions of wadi courses were classified as *Typic Torrifluvents* and *Typic Haplosalids.* Generally, soils of plateau are classified as *lithic Torriorthents.*

The study concluded that, soil potentiality classified as "Good" over 13.6% of the area, including soils of alluvial fans, partially alluvial terraces and down streams of wadi courses landforms, where the potentiality index varied between 60.9 and 68.1%. Meanwhile, the potentiality was classified as "Fair" on 19.6% of the area, representing some soils of alluvial fans, alluvial terraces, wadi middle streams and piedmont plain landforms, where the potentiality index ranged from 42.5 to 57.0%. "Poor" potentiality unit extend over 22.6% of the area occupying some soils of alluvial terraces, wadi upper streams and piedmont plain landforms, as the potentiality index ranged from 30.5 to 36.8%. Potentiality indices ranged between 1.2-11.5% indicating "Very poor" and "Non agricultural" units over the rest of the area, which may be relevant to other land utilization types. Low soil potentiality associated with limitations related to; limited soil profile depth, poor drainage, coarse texture, low clay content, high salinity, high lime content and low fertility status.

Key words: northwest coast, rainfed agriculture, landforms, soil classification, land potentiality.

INTRODUCTION

Reclamation of desert lands is one of the most important strategic initiatives in Egypt. In this light, the national interest of desert development became greater to release high population pressure on cultivated land. Significant efforts have been devoted to the proper management of the desert regions (Ismail *et. al.,* 1986). However, limited water resources affect the agrarian development in the desert environments, therefore, alternatives sources of water have to be considered.

Among the most promising lands for agricultural expansion beyond the Nile Delta and Valley are the soils of the northwestern coastal region. In this light, the agriculture development in the northwestern coastal region using rainfed systems became one of the most important incomes in the area. At present, northwestern coastal zone of Egypt is enjoying more attention for future sustainable development (Shaaban, 2010). Future

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of agricultural expansion in the region demands that all soil resources should be carefully studied and appraised with the aim of estimating their potentialities, (Abd El-Rahman *et. al.,* 1986).

Calcareous type of soil predominates such region, where only few thousands out of about 2-3 million acres are cultivated mainly under the dry farming agricultural systems. Rainfed areas depend on the scanty winter rainfall and in limited areas on supplemental irrigation with rather saline water of shallow wells (Abdel-Kader, *et. al*., 1994, 2002 and 2004). From Pedology point of view, Abd El-Rahman *et al.* (1986 & 1987) carried out a regional soil and land capability maps of the northwestern coastal region. It is concluded that soils of the region were found to be very much associated with the types and locations of the defined geomorphic units. Further, about 35-40% of the soils were marginal to moderate suitable for agricultural land utilization practices. Khalifa (2013) have used terrain analysis to prove that soils of the northwestern drainage basins were formed according to topography. During the last 10 years, Desert Research Center staff (DRC staff, 2007 – 2015) investigated a variety of comprehensive studies for integrated development of some selected watershed basins located mainly west of Matrouh.

El-Qasr - Um El-Rakham area represents the catchment basins of twelve drainage patterns located west of Matrouh city at the northwestern coast of Egypt. That area receives appreciable amounts of rainwater runoff during rainy periods. This study is a trial to shed more lights on the soils associated with the different landforms at this area. Soil classification, types, and capabilities were investigated for agricultural expansion. It is hopefully that present study could be useful as a sound basis for agriculture development of the area under consideration.

MATERIALS AND METHODS

1- Physiographic features of the studied area:

Studied area is located west of Mersa Matrouh at the northwestern coastal region of Egypt between El-Qasr and Um El-Rakham areas. It occupies an area of about 159,603 feddan representing the catchment basins of twelve drainage lines namely from east to west; Kharouba, Raml, Medwer, Majed, Washka, Sanab, Um Moshtan, Jowidate, Habes, Um El-Rakham, Ageeba, and Abu Lahu. The area is bounded by latitudes 31° 09' - 31° 26' N and longitudes 26° 56' - 27° 14' E as seen in map (1).

Considered region is one of the mildest over Mediterranean zone. Its climate is characterized by long hot dry summer and short cool rainy winter typical of sub-arid region, defined as "Arid Mediterranean". In general, monthly temperature varied between 14.4 and 26.8 ^{o}C, wind speed averaged at 18.9 km/hr, and the average annual rainfall ranged from 100 to 190 mm (DRC staff, 2010). According to the limits outlined by Soil Survey Staff (2010), soils are characterized by torric moisture and hyperthermic temperature regimes.

Lithologically, area under investigation is dominated by a sedimentary succession ranging from Tertiary period (Middle Miocene) to Quaternary. Middle Miocene sediments are widely spread in the table land. Quaternary deposits are differentiated into Pleistocene and Holocene formations. They have wide distribution and constitute the bulk of the coastal plain (El-Shazely *et. al*., 1975). For details, area between the present shoreline and Libyan plateau is mostly constituted of calcareous Pliocene and Pleistocene formations and covered by Recent deposits (Shata, 1971).

The main source of irrigation water in the area is rainfall. Rain distribution along the coastal zone is not even. The amount of rainfall shows steady decrease in the inland direction where it reaches about 50 mm at the southern limit of the catchment zone (FAO, 1970). Consequently, deep wadis found in the area cutting the table land and drain its water towards the northern coastal plain. Temporary surface run off occurs immediately after rainy periods and represents a definite percentage of the rainfall. Water run off differs from one locality to another depending on some factors such as slope, topography, nature of cap rock, field water capacity and the catchment area. Therefore, water harvesting systems are applied through the construction of soily, cemented and/or stony dykes established between different levels along the streams. In limited areas, supplemental irrigation with shallow well water is used (DRC, 2010).

The region is mainly characterized by different features namely; 1) Southern table land, characterized by an uniform relief and shallow rocky soils; 2) Escarpment of table land, characterized by a rough relief and occurrence of barren rocks; 3) Coastal plain, consists of alluvial fans, beach ridges, inland dunes and depressions of the drainage channels; 4) Littoral belt, consists of lagoons and salt marshes; 5) Wind blown sand accumulated in different forms of sand sheets, dunes and hummocks (Abu El-Izz, 1971). Considered area could be characterized as a coastal plain bounded inland by first escarpment of the northern elevated plateau as a part of Marmarica formation belonging to Lybian Plateau.

Ecologically, many natural plants were recorded in wadis differing in their type, economical use and palatability for animals. They include pereminal and

annual species as well as various range aromatic and medicinal types (DRC, 2014).

2- Soil mapping using image classification and GIS processing:

A LANDSAT 7 ETM+ scene captured in 2014 representing the study area was cropped, rectified, and geometrically corrected by IMAGINE 8.6 (2001). Produced image was spectrally classified using the unsupervised classification. Ten spectral classes were achieved defining the ground surface as shown in map (2). Digitized data from physiographic maps (1:50000) concerning topography include contour lines and spot heights. They were transformed into digital girded raster DEM as shown in map (3) by using Inverse Distance Weighted Average (IDWA) interpolation method (ESRI, 2006). The information listed at the geological map (EGPC, 1988) integrated with created DEM to differentiate several dominated landforms in the area in which observation sites were spatially distributed. Further, created DEM used to delineate the watershed drainage system concerning both of wadi course and basin borders (map 4). A digital vector database for the study area was created using Arc-GIS 9.2 (ESRI, 2006) software. Locations, areas and longest flow length of the studied watershed basins are shown in table (1). Locations of soil observations were digitized, as a unique identifier for each location linked to associated attribute data using the Database Management System (DBMS). Soil mapping units were created by overlapping the most variable soil data. Final soil and evaluation maps were generated.

3- Field work and laboratory analysis:

Soils of the studied area were surveyed through 261 soil profiles. From which, 24 were selected to represent the present landforms and the associated different soil-mapping units. Detailed morphological descriptions of these soil profiles were recorded on the basis of guidelines for soil description, FAO (2006). According to required data input for applied land evaluation model the collected soil samples were subjected to physical, chemical and fertility analyses. Soil laboratory analyses performed according to Page *et al,* (1982) such as soil texture, total carbonates, electrical conductivity of soil paste extracts (EC), soil reaction (pH), and total nitrogen. While organic carbon content was determined according to Jackson, (1973).

Soils were evaluated using Parametric Land Evaluation System (PLES - Khalifa, 2004), after some modification of ratting gradients as listed by Sys *et. al.* (1991 – I). As well, the guidelines listed by FAO (1983) for rainfed agriculture. Evaluated soil properties in the current study include physical (P.I), chemical (C.I) and fertility properties (F.I). The final index of land evaluation (F.I.L.E) described as percentage to characterize the land potentiality of the area according to the following equation:

$$F.I.L.E. = \frac{3}{\frac{1}{P.I} + \frac{1}{C.I} + \frac{1}{F.I}}$$

Land potentiality was achieved by classifying the land under study into classes of productivity based on the final index value of land evaluation as shown in table (2).

RESULTS AND DISCUSSION

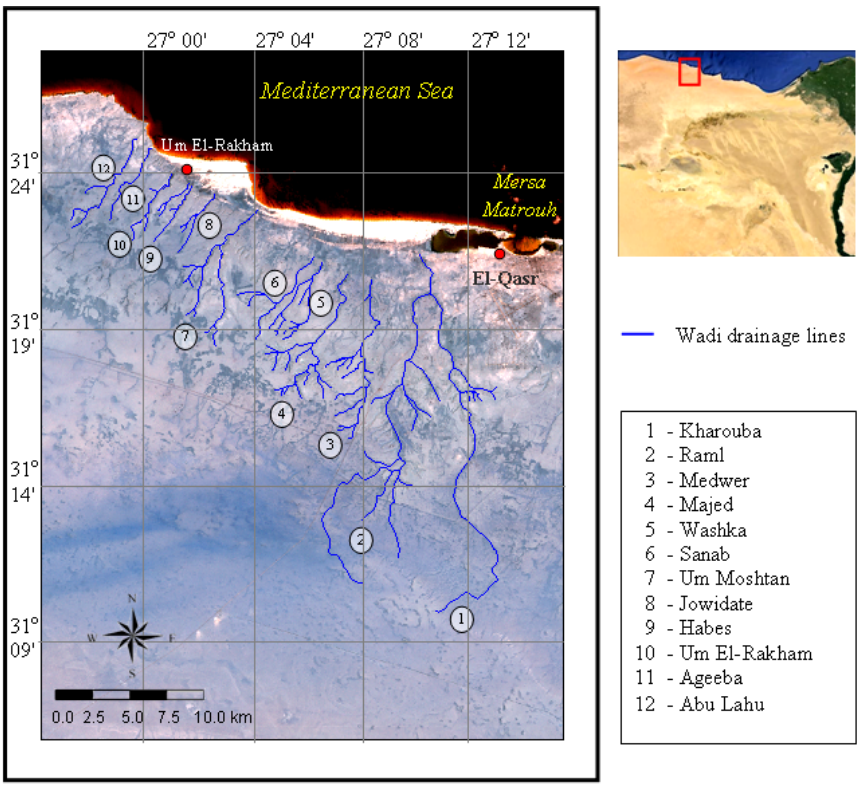
El-Qasr -Um El-Rakham area covers a wide range of altitudes varying from zero level to 200 m a.s.l. encompassing ten landform units. Areas and the spatial distribution of predominant landform units are shown in table (3) and map (5), respectively. Soil observations were distributed among achieved landforms with respect to studied basins as seen in table (4) and map (6). Some morphological, physical, and chemical properties of the studied soil profiles are set out in table (5) and classified according to Soil Survey Staff (S.S.S, 2010) as shown in table (6) and map (7). Based on the variations in profile depth, texture and topography the main soil mapping units in the area are delineated, (map 8). The main landform units and associated different soil types can be discussed as following:

Soils of oolitic sand beach (OSB) and longitudinal sand dunes (OSD)

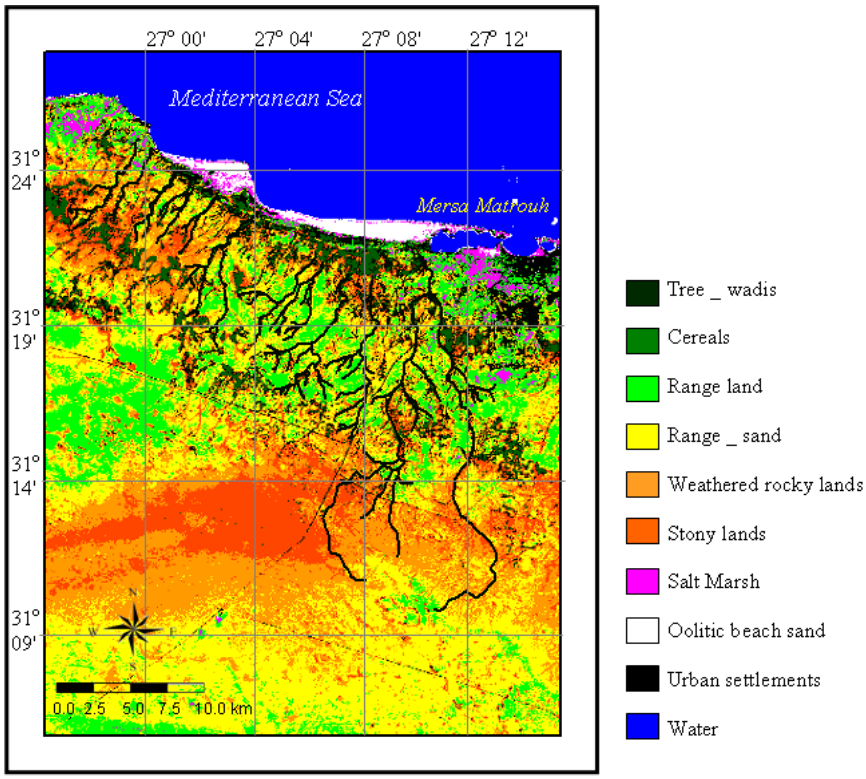
These units occupy about 7980 feddan (5.0%) in the coastal part of the area. Sediments of these landforms formed of white oolitic carbonates deposited under marine environmental conditions. Recognized soil type in the sand beach is shallow to deep oolitic coarse - textured soils with almost flat topography (pedon 77). Soils have loose oolitic coarse sand throughout, carbonatic ($CaCO_3$ from 45 to 60 %), moderately alkaline (pH range between 8.1 and 8.3), and extremely affected with salts (EC vary from 6.8 to 18.4 dSm^{-1}). Effective soil depth is deep in general and sometimes being shallow due to water table limitation. On family level, recognized soil Taxonomic unit is *Carbonatic, hyperthermic; oolitic Torripsamments*. (Harga and Rabie, 1974).

Soils of lagoon depressions and salt marshes (LGSM)

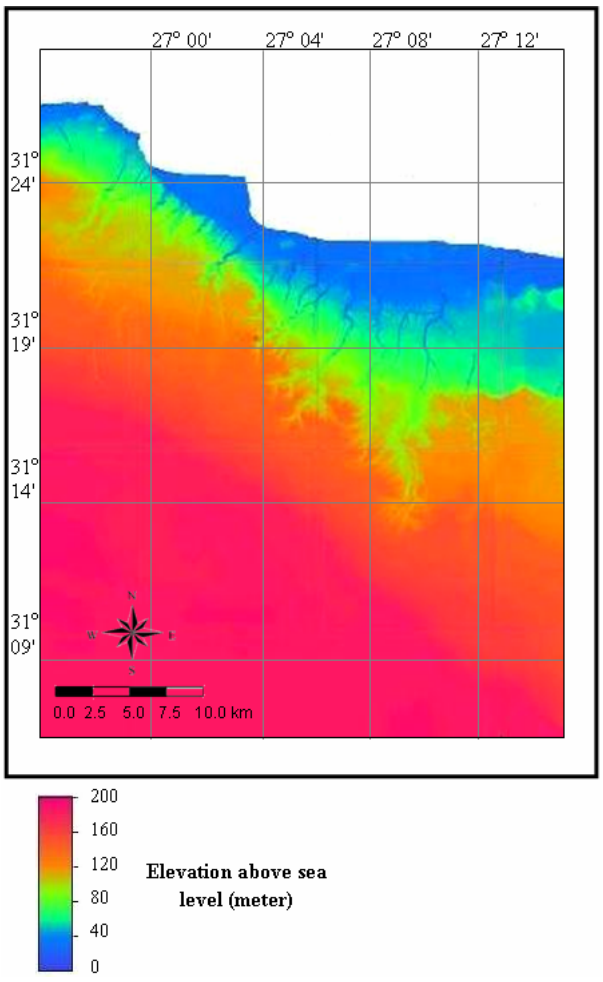
These landforms are formed under lacustrine conditions and located as scattered patches in the coastal part over about 5586 feddan (3.5%). Dominant soil type is shallow to deep, medium to coarse - textured soils with interlayering salts and almost flat topography (pedon 183).



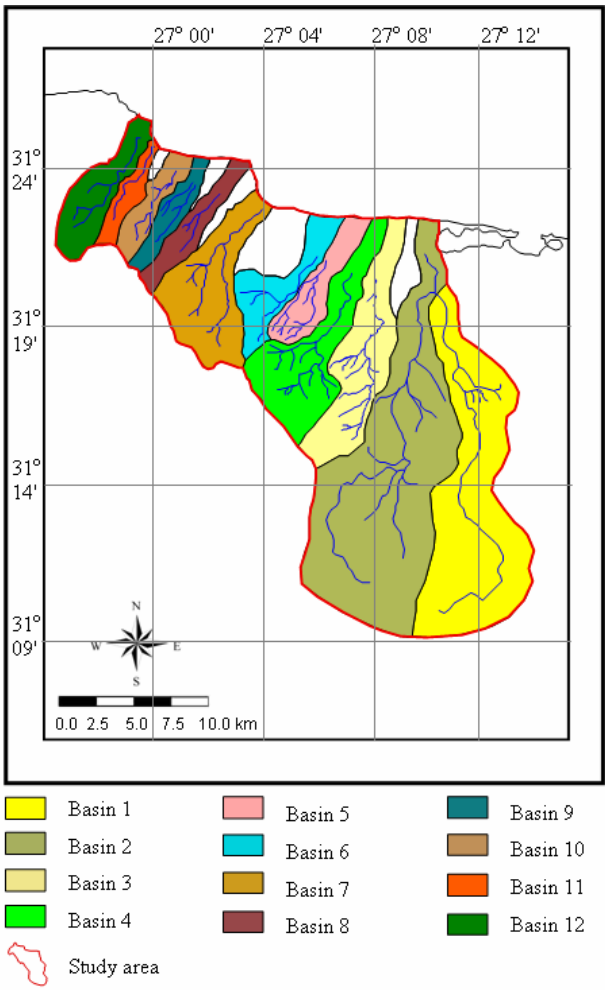
Map 1. Location of the studied area at west or Matrouh.



Map 2. Spectral land cover calssification of the studied area.



Map 3. Digital Elevation Model (DEM) of the studied area.



Map 4. Watershed basins in the studied area.

Table 1. Locations, areas and longest flow length of the studied watershed basins

Watershed Basin	Longest Flow Length (m)	Center of catchment area Lat. (N) , Long. (E)	Area	
			Feddan	%
Kharouba	23450	3455962 , 518299	39396	24.7
Raml	26240	3458974 , 515988	50381	31.6
Medwer	13600	3463315 , 512837	16320	10.2
Majed	14250	3464576 , 510246	13680	8.6
Washka	8740	3467657 , 510176	5244	3.3
Sanab	9150	3467027 , 508005	6149	3.9
Um Moshtan	12500	3468988 , 504293	9000	5.6
Jowidate	7400	3470879 , 503103	3552	2.2
Habes	6200	3471929 , 501772	2678	1.7
Um El-Rakham	7350	3472069 , 500512	2999	1.9
Ageeba	7200	3472839 , 499461	2765	1.7
Abu Lahu	12400	3473189 , 497851	7440	4.7
Total			159603	100

Table 2. Land potentiality classification according to PLES

Potentiality class	Intensity of limitation	Land Potentiality Class	F.I.L.E (%)
P1	No	Excellent	100 - 80
P2	Slight	Good	79 - 60
P3	Moderate	Fair	59 - 40
P4	Sever	Poor	39 - 20
P5	Very sever	Very poor	19 - 10
P6	Extremely sever	Non-agricultural	< 10

Table 3. Landform units in the studied area

No	Main Landform Units	Sub Landform Mapping Units	Symbol	Area %
1	Coastal Plain	Oolitic sand beach	OSB	2.8
		Oolitic longitudinal sand dunes	OSD	2.2
		Lagoonal depression and salt marsh	LGSM	3.5
		Alluvial fans	AFN	9.1
2	Alluvial Terraces and Interfluves Wadis		AT-IW	9.7
3	Wadi Course		WCRS	2.7
4	Escarpment		ESC	4.3
5	Piedmont Plain		PDP	13.6
6	Plateau	Lower table plateau	LPL	18.6
		Libyan higher plateau	HPL	33.5

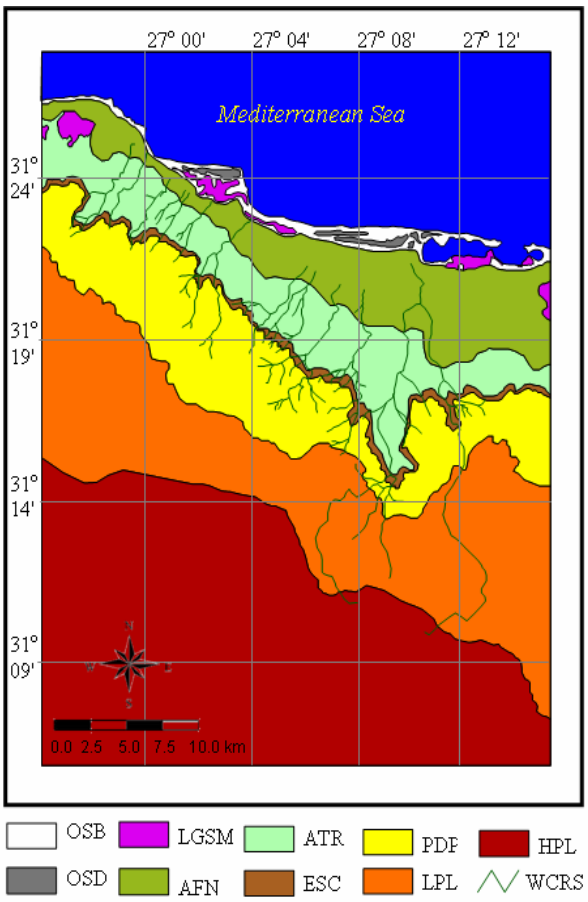
Table 4. Distributions of soil profiles within recognized landforms referring to catchment basins

Landform units \ Basin	Kharouba	Raml	Medwer	Majed	Washka	Sanab	Um Moshtan	Jowidate	Habes	Um El-Rakham	Ageeba	Abu Lahu	Total
Sand beach							1					1	2
Lagoonal salt marsh								1					1
Alluvial fans	7	6	5	4	3	6	4	2	2	2	1	4	46
Alluvial terraces	6	14	6	5	8	7	7	4	4	5	7	8	**81**
Wadi course	2	3	2	1	3	2	2		2	2		2	21
Piedmont plain	3	7	4	10	2	5	19	7	4	5	4	7	77
Lower plateau	7	12	4										23
Higher plateau	2	8											10
Total	27	**50**	21	20	16	20	33	14	12	14	12	22	261

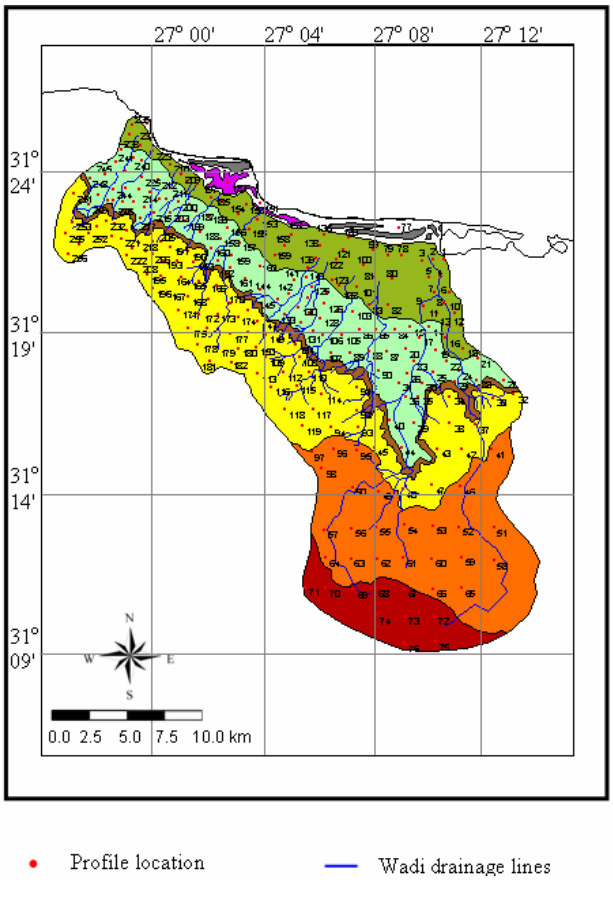
Soil material varies in both of texture from sand to loam and the effective depth from deep to shallow. Soils sometimes were saturated with saline water as salts accumulated throughout the profile horizons. Salt percentage and horizon thickness in these soils are identified as Salic horizon. (Soil Survey Staff, 2010). Accordingly, these soils are classified on the family level as *Coarse loamy, calcareous, hyperthermic; Typic Aquisalids.*

Soils of alluvial fans (AFN)

This unit extends over about 14524 feddan (9.1%) to the south following the coastal line. It is mainly resulted from the coalescence of alluvial fans which were formed through deposition of fines through drainage lines. The landscape is almost flat to gently undulating with a slope of less than 1%. Natural vegetation is dense, removed in some sites for cultivation of olives, figs, wheat, barely, and vegetables. Main soil types of this unit are; (1) Deep moderately coarse to coarse-textured soils, sometimes with finer surface or substratum and almost flat to gently undulating topography, (pedons 136, 8) – (2) Deep coarse textured soils with almost flat to gently undulated topography, (pedon 19) – (3) Moderately deep moderately coarse to coarse - textured soils with almost flat to gently undulating topography, (pedon 82).



Map 5. Landform Mapping Units in the studied area.



Map 6. Locations of 261 studied soil profiles distributed over main landforms.

Results show that soil effective depth is deep to moderately deep underlined by limestone bedrock. Soil materials are formed of alternating layers of SCL, SL and / or LS mixed with few fine gravels (< 7.2 %). Carbonates are found either in segregated or unsegregated forms, where $CaCO_3$ ranged between 14.79 – 32.5%. pH values (7.8-9.1) indicate a moderately to strongly alkaline reaction. Soil salinity generally is slightly saline as EC varied from 0.303 to 7.0 dS m^{-1}. Organic carbon percentage is low (1.15 – 0.221%) and decreases with depth. The majority of soils are classified as *fluvents* where the sedimentary environment is mainly alluvial and its organic carbon decrease with depth, while other ones were classified as *psamments*. Further, soils were classified at the family levels as (a) *Coarse loamy, calcareous, hyperthermic; Typic Torrifluvents* (pedons 8 & 82) – (b) *Calcareous, hyperthermic; Typic Torripsamments* (pedon 19) - (c) *Fine loamy, calcareous, hyperthermic; Typic Torrifluvents* (pedon136).

Soils of alluvial terraces and interfluves wadis (AT-IW)

These soils cover an area of about 15482 feddan (9.7%), adjacent to the main channels separating them and their tributaries. Their landscape is almost flat to gently undulating, developed into conspicuous terraces in places. Gravelly – sized limestone fragments forming the desert pavement and covering the land surface. Natural vegetation is scanty or absent. Soil profiles vary widely in their effective depth from very shallow to deep, texture from coarse to moderately coarse changed to more fines at some places and salinity varies from slightly to extremely saline (EC from 0.6 to 32.3 dS m^{-1}). Soils generally are slightly to moderately alkaline (pH varied between 7.25 and 8.3), and being strongly calcareous as values of $CaCO_3$ varied from 15.58 to 35.7%.

In terms of soil depth, texture, and topography five soil types are recognized; (1) Deep moderately coarse to coarse- textured soils, sometimes with finer surface or

substratum and almost flat to gently undulating topography, (pedon 43) – (2) Deep coarse textured soils with almost flat to gently undulated topography, (pedon 241) - (3) Moderately deep moderately coarse to coarse - textured soils with almost flat to gently undulating topography, (pedons 261, 32) - (4) Shallow moderately coarse to course - textured soils with almost flat to undulating topography, (pedon 212) - (5) Very shallow coarse - textured soils with almost flat to gently undulating topography, (pedon 245).

These soils are formed from recent water or wind - deposited sediments or of recent eroded surfaces and lack any evidence of development, which qualify them to be classified under the Entisol order. The following soil families were concluded: (a) *Calcareous, hyperthermic; Typic Torripsamments* (pedons 241, 261) – (b) *Coarse loamy, calcareous, hyperthermic; Typic Torrifluvents* (pedons 32) – (c) *Fine loamy, calcareous, hyperthermic; Typic Torrifluvents* (pedon 43) – (d) *Calcareous, hyperthermic; Lithic Torripsamments* (pedon 212) – (e) *Sandy, calcareous, hyperthermic; Lithic Torriorthents* (pedon 245).

Soils of wadi courses (WCRS)

Land form of wadi courses represents the narrow streams and doesn't exceed 2.7% (4309 feddan) of the studied area. Drains start cutting the upper calcareous plateau in which soils formed over eroded limestone. Sediments moved downward along the stream and forming soils with ascended profile depths. Soils have dense vegetation cover and cultivated with rainfed olive, figs, barley and wheat. Soils vary in their properties according to stream location. Accordingly, four soil types dominate this unit, namely: (1) Deep moderately coarse to coarse – textured soils with almost flat to gently undulating topography (pedons 127, 100, 31) - (2) Moderately deep moderately coarse to coarse – textured soils, with almost flat to gently undulating topography (pedon 33) - (3) Shallow coarse textured soils with gently undulated topography (pedon 150) - (4) Very shallow coarse textured soils with undulated topography (pedons 205, 179).

Soils formed on middle and upper streams, mostly characterized by a rocky or very shallow to shallow soil depth, sandy texture and rough relief. On the family level, they are classified as (a) *Sandy, calcareous, hyperthermic; Lithic Torriorthents* (pedons 179, 205) – (b) *Calcareous, hyperthermic; Lithic Torripsamments* (pedon 150). Contrarily, soils in the downstream areas, mostly characterized by a uniform relief and deep to moderate deep profiles. Based on soil characteristic differences and soil profile development, three family levels are recognized: (a) Soils have sandy loam texture within the profile control section, strongly saline, and have a surface salic horizon or within 40-75 cm from the soil surface are classified as *Coarse loamy, calcareous, hyperthermic; Typic Haplosalids* (pedons 127& 31) - (b) Soils have sandy texture, non-saline and more than 40 % carbonate content within the profile control section are classified as *Carbonatic, hyperthermic; Typic Torripsamments* (pedon 33) - (c) Soils have non-uniform layers of texture (LS/SCL), non-saline, strongly calcareous ($CaCO_3$ ranged from 16.72- 22.18%), low O.M percentage increasing with depth, and lack any evidence of profile development are classified as *Coarse loamy, calcareous, hyperthermic; Typic Torrifluvents* (pedon 100)

Soils of piedmont plain (PDP)

Piedmont plain stretched over 21706 feddan (13.6%) occupying a southern part of the study area adjacent to the plateau and its escarpment. Landscape is undulating, dissected by many dry gullies and wadis, barren from natural vegetation, and covered by gravels and boulders. Soils are very shallow to moderately deep due to the prevailing destructive erosion forces caused by both water and wind. On basis of soil depth, texture and topography three soil types are identified namely; (1) Moderately deep coarse - textured soils with gently undulated topography (pedon 115) - (2) Shallow moderately coarse to coarse - textured soils with almost flat to undulated topography (pedon 173) - (3) Very shallow coarse - textured soils with undulated topography (pedon 192).

Collected data and analytical results indicate that soil profiles are moderately deep to very shallow limited by limestone bedrock. Soils mostly are sandy, moderately alkaline (pH ranged between 7.8 – 8.3), slightly to moderately affected with salts (EC varied from 2.5 to 8.5 dS m-1), and highly calcareous ($CaCO_3$ values were between 22.4 - 35.7%). According to Soil Survey Staff (2010), three family levels could be defined; (a) *Calcareous, hyperthermic; Typic Torripsamments*, (pedon 115) - (b) *Coarse loamy, calcareous, hyperthermic; Lithic Torriorthents* (pedon 173) – (c) *Sandy, calcareous, hyperthermic; Lithic Torriorthents* (pedon 192)

Soils of the plateau (PL)

It occupies the extreme southern portion forming the wildest landform of the study area over about 83153 feddan (52.1%). Ground elevation ranges between 120 and 200 m a. s. l. encompassing two main districts namely lower plateau and Libyan higher plateau. Surface is almost flat to gently undulating covered by desert pavement. Soils are mainly pseudo-rocky with few natural vegetation, except areas that are covered by alluvial deposits or sand sheets.

Table 5. Morpho-topographic and soil properties of representative profiles in the studied area

Landform Unit	Prof. no. (wadi)	Lat. ° ' "	Long. ° ' "	Topo.	Slope (%)	Surface cover	Depth (cm)	Physical Properties						Chemical Properties			Fert. Properties	
								Grv.(3) %	$CaCO_3$ %	Sand %	Silt %	Clay %	Text.(4)	EC dS/m	pH	ESP %	O.M %	T. N %
Sand Beach	77 (Raml)	31 22 21	27 08 56	Almost flat	1.10	Common shell frag. and few fine gravel	0-50	1.2	48.3	95.2	3.4	1.4	S	6.8	8.1	8.4	0.06	0.009
							50-100	0.0	45.7	94.2	4.3	1.5	S	11.7	8.1	11.2	0.04	0.007
							100-120	0.0	57.3	95.8	3.0	1.2	S	13.5	8.2	12.0		
							120-150	0.0	60.0	91.3	7.4	1.3	S	18.4	8.3	14.6		
Lagoon Salt marsh	183 (Jowdat)	31 23 42	27 02 55	Almost flat	0.50	Com shells. and Halophytes plants	0-20	0.8	12.5	90.2	3.4	6.4	S	15.7	7.6	12.5	1.08	0.008
							20-60	0.0	22.8	89.7	2.5	7.8	S	22.8	7.8	10.6	0.87	0.001
							60-90	0.0	35.7	88.0	1.1	10.9	S	11.2	8.1	15.8		
Alluvial fans	136 (Majed)	31 22 02	27 06 06	Gently undulated	0.20	None	0-25	3.5	24.5	50.4	21.2	28.4	SCL	2.8	7.8	6.4	1.15	0.071
							25-55	7.2	30.2	54.0	18.4	27.6	SCL	4.6	7.8	9.2	0.68	0.034
							55-110	0.8	27.4	61.3	25.2	13.5	SL	5.7	8.0	9.6		
							110-150	0.0	32.5	78.2	15.7	6.1	LS	7.0	8.1	13.0		
	8 (Raml)	31 20 00	27 11 30	Almost flat	0.25	Vary sized R.F (2)	0 - 15	-	21.9	90.0	6.30	3.7	S	0.3	8.5	1.19	0.25	0.006
							15–50	-	21.7	66.0	18.9	15.0	SL	0.5	8.5	3.04	0.31	0.007
							50 – 85	-	14.7	69.2	19.0	11.7	SL	0.8	8.8	6.49	0.22	0.006
							85 - 125	-	52.1	85.8	6.0	8.1	LS	0.8	9.1	4.79	0.23	0.005
	19 (Khroba)	31 19 02	27 10 45	Gently undulated	0.30	Few shell frag. and com. fine gravel	0-40	14.5	20.4	92.5	1.6	5.9	S	4.5	8.0	5.7	0.34	0.002
							40-95	10.2	18.7	90.6	1.9	7.5	S	2.8	8.2	4.5	0.25	0.001
							95-150	5.8	22.6	91.7	2.4	5.9	S	1.2	8.2	8.5		
	82 (Medwr)	31 19 57	28 08 25	Almost flat	0.25	V. few V. fine D.P (1)	0-20	5.8	22.7	62.8	21.8	15.4	SL	3.7	8.1	7.8	0.84	0.027
							20-45	1.7	20.8	66.7	19.3	14.0	SL	4.3	7.9	7.5	0.68	0.026
							45-90	0.6	28.8	81.5	10.4	8.1	LS	5.7	8.0	8.7		
Alluvial terraces and Interfl--uves wadis	241 (Ageba)	31 24 42	26 59 18	Gently undulated	0.40	Few fine to med. D.P (1) with few R.F (2)	0-20	14.2	20.4	58.7	21.6	19.7	SL	2.9	7.7	5.3	0.74	0.019
							20-60	6.5	28.4	75.8	15.9	8.3	LS	0.8	8.0	4.1	0.55	0.017
							60-100	8.2	30.2	82.4	10.1	7.5	LS	0.6	7.8	4.0		
							100-150	0.7	31.5	90.5	6.8	2.7	S	0.6	8.2	3.8		
	261 (Abu Lahu)	31 22 05	26 56 51	Gently undulated	0.45	Common Varisized D.P (1)	0-15	2.5	18.7	92.5	5.1	2.4	S	1.2	8.3	3.5	0.83	0.011
							15-45	11.8	24.8	81.3	11.2	7.5	LS	5.4	8.2	8.9	0.45	0.015
							45-85	3.4	33.1	78.6	15.7	5.7	LS	6.6	8.3	9.9		
	212 (Um Elrkham)	31 23 35	27 00 33	Almost flat	0.70	Abundant Varisized D.P	0-10	3.6	27.5	65.1	22.4	12.5	SL	4.5	7.9	7.7	0.45	0.015
							10-40	0.4	33.6	84.0	9.2	6.8	LS	3.4	7.9	8.6	0.35	0.013
	245 (Abu Lahu)	31 23 58	26 58 21	Gently undulated	0.85	Com. fine D.P with few R.F	0-5	6.4	28.2	80.3	16.8	2.9	LS	0.8	8.1	5.5	0.40	0.014
							5-20	0.8	35.7	82.7	14.7	2.6	LS	0.4	8.2	3.2	0.32	0.010

(1) D.P = Desert Pavements - (2) R.F = Rock Fragments - (3) Grv.= Gravel - (4) Text.= Texture ; S = Sand, LS = Loamy Sand, SL = Sandy loam, SCL = Sandy Clay Loam.

Table 5. Continued.

Landform Unit	Prof. no, (wadi)	Lat.	Long.	Topo.	Slope (%)	Surface cover	Depth (cm)	Physical Properties						Chemical Properties			Fert. Properties	
								Grv.(3)	$CaCO_3$	Sand	Silt	Clay	Text.(4)	EC	pH	ESP	O.M	T. N
		o , ,,	o , ,,					%	%	%	%	%		dS/m		%	%	%
Cont. Alluvial terraces	43 (Khroba)	31 16 45	27 11 30	Gently undulated	0.25	Vary sized R.F	0-10	-	20.4	59.5	27.4	13.0	SL	3.1	7.9	9.0	0.21	0.0068
							10-25	-	22.7	57.9	28.2	13.7	SL	14.8	7.4	24.6	0.22	0.0049
							25-60	-	21.6	44.3	30.1	25.5	L	11.3	7.5	20.8		
							60-100	-	20.6	54.2	24.3	21.2	SCL	10.0	7.5	21.5		
	32 (Raml)	31 21 0.4	27 06 11	Gently undulated	0.65	V. sized R.F (2)	0 - 20	-	8.84	70.4	25.5	3.9	SL	32.3	7.3	18.3	0.41	0.087
							20 - 37	8.1	16.0	69.5	27.6	2.7	SL	23.5	7.5	23.4	0.36	0.010
							37 - 90	8.5	15.5	66.3	30.9	2.6	SL	19.5	7.6	24.8		
Wadi Course	31 (Khroba)	31 19 20	27 05 54	Gently undulated	0.60	cultivated few R.F (2)	0 – 25	9.4	32.0	67.1	27.8	4.9	SL	37	7.1	35.8	0.46	0.0095
							25 – 80	7.4	25.9	64.5	23.7	11.6	SL	9.0	7.7	26.2	0.42	0.0092
							80 - 95	6.3	28.0	64.9	32.2	2.8	SL	7.0	7.9	12.0		
							95 - 120	5.7	44.6	67.4	28.5	4.0	SL	5.3	7.9	16.6		
	100 (Majed)	31 20 22	27 07 12	Almost flat	0.25	cultivated	0 – 15	4.5	21.7	82.0	7.8	10.2	LS	0.55	8.1	9.4	0.09	0.0081
							15 – 60	-	22.1	83.6	7.5	8.8	LS	0.37	8.5	5.2	0.14	0.0070
							60 - 120	4.7	16.7	56.8	23.1	20.0	SCL	0.52	8.1	5.5		
	33 (Raml)	31 04 50	27 04 50	Gently undulated	0.65	cultivated corn R.F (2)	0 – 15	11.1	30.7	73.7	23.5	2.6	LS	0.96	8.0	3.1	0.47	0.0080
							15 – 50	15.0	38.1	74.9	22.9	2.0	LS	0.46	8.0	0.41	0.41	0.0060
							50 – 75	8.5	53.9	76.4	21.3	2.1	LS	0.51	7.9	1.16		
	127 (Wshka)	31 20 58	27 06 26	Gently undulated	0.90	cultivated few R.F (2)	0 – 20	6.9	14.1	63.4	32.4	4.0	SL	22.2	7.5	23.5	0.33	0.0165
							20 – 75	8.1	16.2	64.4	32.7	2.7	SL	40.8	7.3	15.3	0.30	0.0086
							75 - 120	6.6	15.1	69.5	27.7	2.7	SL	31.6	7.2	15.0		
	150 (Sanab)	31 20 10	27 06 10	Gently undulated	0.85	cultivated Corn R.F	0 – 25	-	23.7	65.1	28.7	6.0	SL	1.9	7.4	4.1	0.38	0.0114
							25 - 40	15.1	21.9	74.6	20.4	4.8	LS	2.1	7.4	4.7	0.36	0.0089
	205 (Hab)	31 23 05	27 01 30	St. diss.	1.80	Corn R.F	0-20	-	20.7	84.7	8.5	6.2	LS	3.5	7.3	4.6	0.22	0.016
	179 (Um Moshtan)	31 19 09	27 06 53	undulated	1.55	few R.F (2)	0 – 25	32.5	30.2	81.2	11.5	7.2	LS	0.19	9.0	20.4	0.35	0.018
Piedmont Plain	115 (Majed)	31 17 32	27 04 03	Gently undulated	1.75	Common Varisized D.P (1)	0-25	0.8	22.4	79.1	12.8	8.1	LS	3.8	7.8	4.6	0.54	0.018
							25-50	0.0	25.6	82.9	10.7	6.4	LS	7.1	8.2	11.4	0.34	0.016
							50-75	0.0	25.0	93.7	4.2	2.1	S	8.4	8.3	13.8		
	173 (Um Moshtan)	31 19 32	27 03 00	Undulated	2.25	Abundant Varisi. D.P (1)	0-15	1.0	24.8	68.2	17.4	14.4	SL	2.5	8.1	6.4	0.36	0.016
							15-35	0.6	26.1	71.6	13.5	14.9	SL	2.6	8.1	5.2	0.30	0.015
	192 (Jowdat)	31 21 42	27 00 55	Undulated	3.20	Many R.F (2)	0-10	0.6	32.2	81.5	11.1	7.4	LS	3.5	8.3	4.3	0.28	0.015
							10-20	0.0	35.7	82.6	10.9	6.5	LS	3.0	8.0	3.8	0.28	0.012
Lower Plateau	98 (Khroba)	31 15 00	27 06 00	Gently undulated	1.75	Many fine D.P with com. R.F	0-5	4.8	22.5	65.2	21.8	13.0	SL	5.2	7.6	7.2	0.22	0.008
							5-20	1.2	25.9	80.7	10.2	9.1	LS	2.1	7.8	4.3	0.18	0.010
Higher Plateau	76 (Raml)	31 09 32	27 09 02	Almost flat	1.00	Com fine to med. DP	0-5	6.5	20.7	79.5	12.3	8.2	LS	3.4	8.1	5.8	0.24	0.012
							5-20	5.2	30.4	81.0	14.1	4.9	LS	3.0	8.3	5.2	0.16	0.010

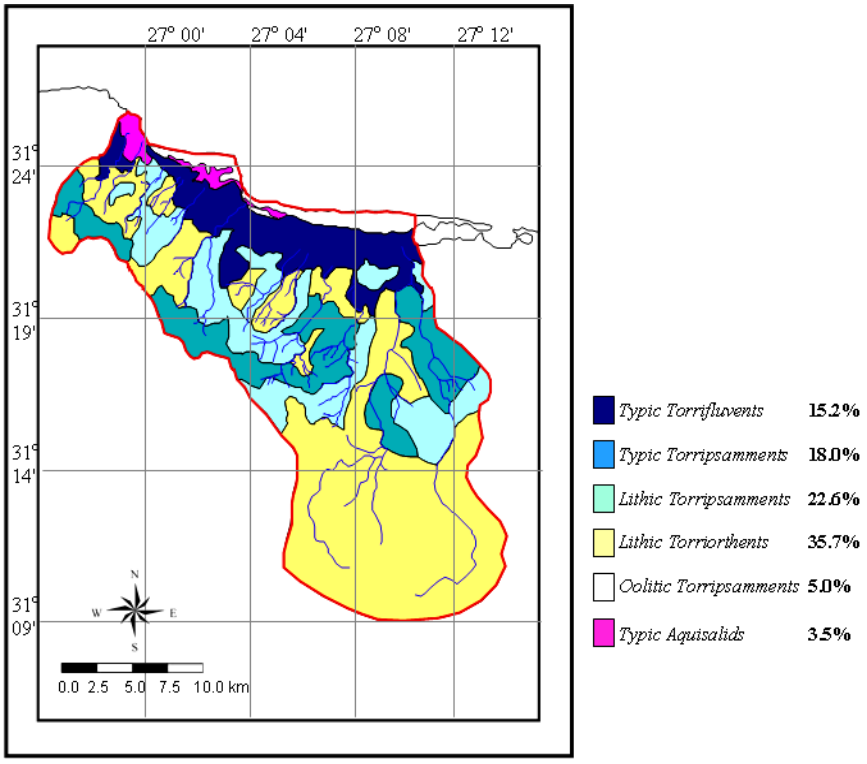
(1) D.P = Desert Pavements - (2) R.F = Rock Fragments - (3) Grv.= Gravel - (4) Text.= Texture ; S = Sand, LS = Loamy Sand, SL = Sandy loam, SCL = Sandy Clay Loam.

The latter could be defined as very shallow coarse – textured soils with almost flat to gently undulating topography (pedons 98 & 76). On the family level, this soil is classified as *Sandy, calcareous, hyperthermic; Lithic Torriorthents*

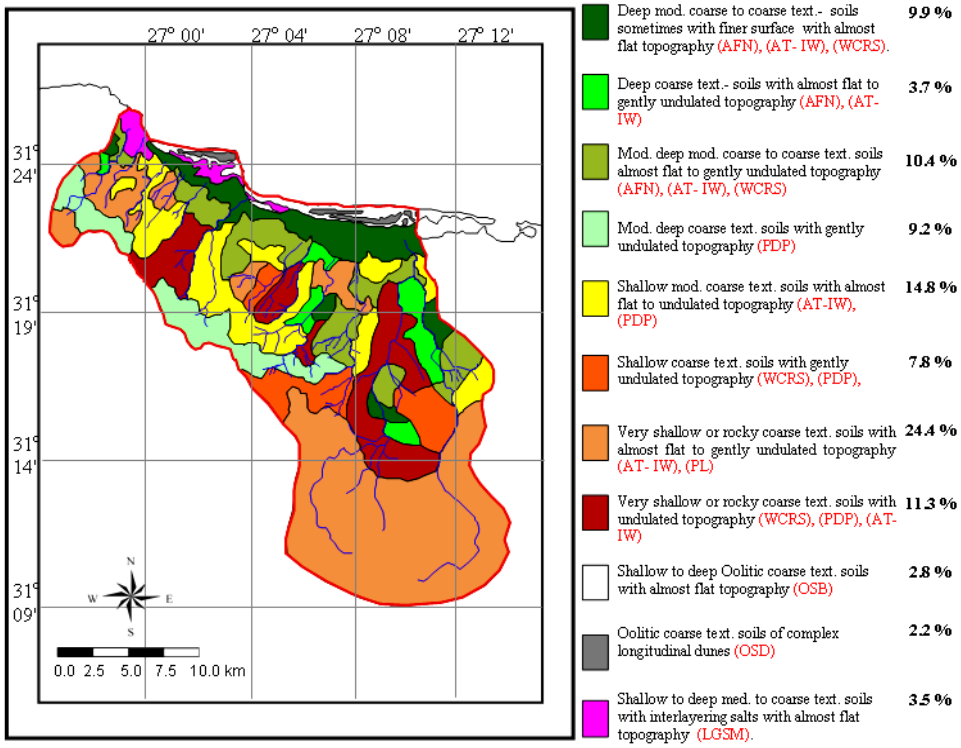
In general, soils of investigated area were classified to follow one of six sub groups; *Typic Torrifluvents* (24259 F – 15.2%), *Typic Torripsamments* (28728 F – 18.0%), *Lithic Torripsamments* (36070 F – 22.6%), *Lithic Torriorthents* (56978 F – 35.7%), *oolitic Torripsamments* (7980 F - 5.0%), *Typic Aquisalids* (5586 F - 3.5%), and *Typic Haplosalids* (260 F -0.15%) as shown in table (6) and map (7).

Table 6. Main landforms, associated soil mapping units and soil Taxa of the studied area

Landform units	Soil Mapping Units	Soil Taxa (Family level)
OSB & OSD	Shallow to deep Oolitic coarse - textured soils with almost flat topography.	*Carbonatic, hyperthermic; oolitic Torripsamments.*
LGSM	Shallow to deep, med. to coarse - textured soils with interlayering salts, and almost flat topography	*Coarse loamy, calcareous, hyperthermic; Typic Aquisalids.*
AFN	(1) Deep moderately coarse to coarse- textured soils, sometimes with finer surface or substratum and almost flat topography,	(1) *Coarse loamy, calcareous, hyperthermic; Typic Torrifluvents,*
	(2) Deep coarse textured - soils with almost flat to gently undulated topography,	(2) *Calcareous, hyperthermic; Typic Torripsamments.*
	(3) Moderately deep moderately coarse to coarse - textured soils with almost flat to gently undulating topography.	(3) *Fine loamy, calcareous, hyperthermic; Typic Torrifluvents*
AT - IW	(1) Deep moderately coarse to coarse- textured soils, sometimes with finer surface or substratum and almost flat to gently undulating topography,	(1) *Fine loamy, calcareous, hyperthermic; Typic Torrifluvents,*
	(2) Deep coarse textured - soils with almost flat to gently undulated topography,	(2) *Calcareous, hyperthermic; Typic Torripsamments,*
	(3) Moderately deep moderately coarse to coarse - textured soils with almost flat to gently undulating topography,	(3) *Coarse loamy, calcareous, hyperthermic; Typic Torrifluvents,*
	(4) Shallow moderately coarse to course - textured soils with almost flat to undulating topography,	(4) *Calcareous, hyperthermic; Lithic Torripsamments,*
	(5) Very shallow coarse - textured soils with undulating topography.	(5) *Sandy, calcareous, hyperthermic; Lithic Torriorthents.*
WCRS	(1) Deep moderately coarse to coarse- textured soils, sometimes with finer surface or substratum and almost flat to gently undulating topography,	(1) *Coarse loamy ,calcareous, hyperthermic; Typic Torrifluvents,* (1) *Coarse loamy ,calcareous, hyperthermic; Typic Haplosalids,*
	(2) Moderately deep moderately coarse to coarse – textured soils, with gently undulating topography,	(2) *Carbonatic, hyperthermic; Typic Torripsamments,*
	(3) Shallow coarse – textured soils, with gently undulating topography.	(3) *Calcareous, hyperthermic; Lithic Torripsamments,*
	(4) Very shallow coarse – textured soils, with undulating to steeply dissected topography.	(4) *Sandy, calcareous, hyperthermic; Lithic Torriorthents.*
PDP	(1) Moderately deep coarse texture soils with gently undulated topography,	(1) *Calcareous, hyperthermic; Typic Torripsamments,*
	(2) Shallow moderately coarse to course - textured soils with almost flat to undulated topography,	(2) *Coarse loamy, calcareous, hyperthermic; Lithic Torriorthents,*
	(3) Very shallow or rocky coarse - textured soils with undulated topography.	(3) *Sandy, calcareous, hyperthermic; Lithic Torriorthents.*
PL	Very shallow or rocky coarse textured - soils with almost flat to gently undulated topography.	*Sandy, calcareous, hyperthermic; Lithic Torriorthents.*



Map 7. Soil Taxa of the studied area.



Map 8. Soil Mapping Units in the studied area.

2- Land potentiality classification

Soils of different landforms were evaluated to assess their potentiality for rainfed agriculture. Potentiality indices and classes were calculated as shown in table (7) and map (9). Further, limitations of each soil potentiality class were identified. Five potentiality classes were differentiated; Good (21706 feddan – 13.6%) – Fair (31282 feddan – 19.6%) – Poor (36070 feddan – 22.6%) Very Poor (61447 feddan – 38.5%) – Non agriculture (9097 feddans – 5.7%)

Good soil potentiality

Soils of this unit are characterized as: (1) deep moderately coarse to coarse- textured soils sometimes with finer surface or substratum with almost flat to gently undulating topography, or (2) Deep coarse textured - soils with almost flat to gently undulated topography. They are formed on alluvial fans, alluvial terraces and interfluves wadis, and lower portions of wadi courses. Soils of this class have the most suitable conditions as their potentiality index ranges between 60.9 - 68.1%. The potentiality index varies in relation to differences in soil taxa. The higher value is mainly associated with soils belonging to the soil families *Fine loamy or coarse loamy, calcareous, hyperthermic; Typic Torrifluvents*. They are followed by soil families *Calcareous, hyperthermic; Typic Torripsamments,* and *Coarse loamy, calcareous, hyperthermic; Typic Torrifluvents*. Meanwhile, soil family *Coarse loamy, calcareous, hyperthermic; Typic Haplosalids* has shown the lower values. These soils display moderate constraints related to the low clay content and low fertility status, in addition to sever salinity located in some scattered patches in the down streams where soils are irrigated supplementary with rather saline shallow well water. Orchards of fig, olive as well as some vines and almond trees are the dominant which were interpolated with some vegetables like tomato, piper and cantaloupe. Field winter crops like barley and wheat are cultivated sometimes in scattered rainfed patterns.

Fair soil potentiality

This unit includes soil types (1) moderately deep moderately coarse to coarse - textured soils with almost flat to gently undulating topography which formed within the alluvial fans, alluvial terraces and interfluves wadis and middle portions of wadi course landforms, and (2) moderately deep coarse - textured soils with gently undulating topography which formed on piedmont plain. Soils in this unit have potentiality index ranges between 42.5 and 57.0%, reflecting fair soil potentiality. They are belonging to the family *Coarse loamy, calcareous, hyperthermic; Typic Torrifluvents* and have the higher values followed by soils belonging to *Calcareous, hyperthermic; Typic Torripsamments*. Whereas, soils belonging to the family *Carbonatic, hyperthermic; Typic Torripsamments* have shown the lower conditions. Soil limitations include moderate effective soil depth, imperfect drainage, low available water and low fertility status. These soils are plowed for rainfed barely and wheat in addition to vegetables, i.e. tomato, piper and cantaloupe. Most of the wadi courses especially at down streams are fully occupied by fig and olive trees, among which vegetables are interpolated. Some scattered areas in this unit are supplementary irrigated by ground water. As lots of cemented and / or stony dykes are established between different levels along the streams for water harvesting (DRC, 2013).

Poor soil potentiality

Such class of potentiality includes the shallow soils belonging to subgroups *Lithic Torriorthents* and *Lithic Torripsamments*. Particularly, poor potentiality exists over mapping units (1) shallow moderately coarse - textured soils with almost flat to undulating topography, and (2) shallow coarse - textured soils with gently undulating topography. As they are formed on the piedmont plain, wadi courses and alluvial terraces and interfluves landforms. Their potentiality index ranges from 30.5 to 36.8 %. They display very sever limitations concerning with the limited root zone affected by the soil shallowness due to the appearance of limestone bedrock, very low clay content and low fertility status. These soils are suggested to be cultivated by barely and wheat crops under rainfed system.

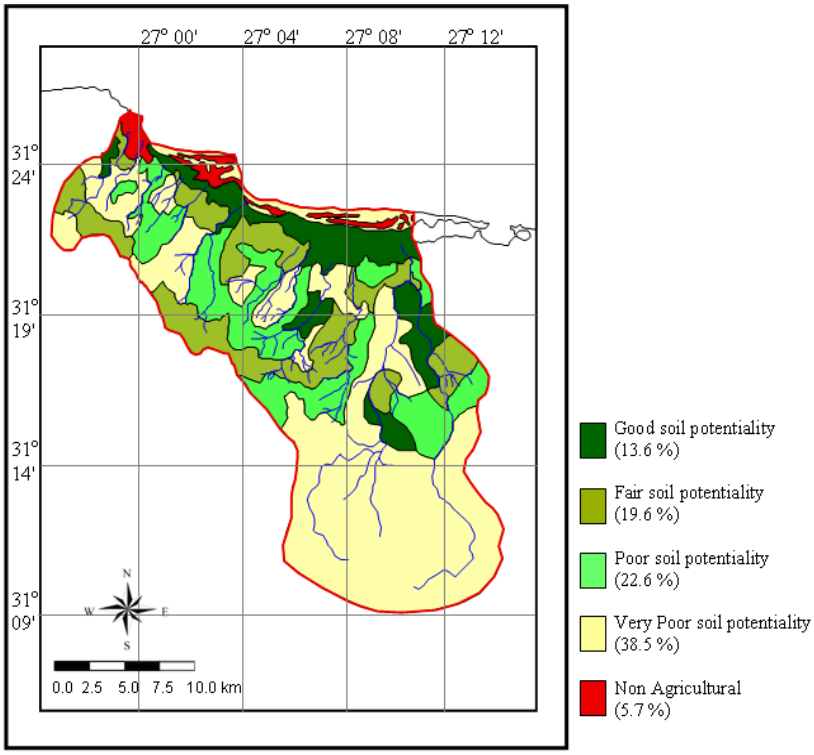
Very poor or non-agriculture potentiality

Soils having very low or non-agriculture potentiality classes include the following soil units: (1) very shallow coarse - textured soils with undulating topography, formed on the upper portion of wadi courses and the piedmont plain, (2) rocky and very shallow coarse - textured soils with almost flat to gently undulated topography formed on the plateau and alluvial terraces and interfluves wadis, (3) shallow to deep Oolitic coarse - textured soils with almost flat topography formed on the beach sand, (4) oolitic coarse textured soils of complex longitudinal dunes, (5) shallow to deep medium to coarse - textured soils with interlayering salts with almost flat topography formed in the Lagoon depressions and salt marshes. From which, soils belonging to soil families *sandy, calcareous, hyperthermic; Lithic Torriorthents and carbonatic, hyperthermic; oolitic Torripsamments,* have potentiality index ranges from 10.2 to 11.5% and their potentiality classified as very poor.

Table 7. Soil mapping units and their corresponding potentiality

Unit	Description	Area Feddan (%)	Land Potentiality Classification					Area (%)
			Physical Index (Class)	Chemical Index (Class)	Topography Index (Class)	Fertility Index (Class)	Potentiality Index (Class)	
1	Deep moderately coarse to coarse- textured soils, sometimes with finer surface or substratum and almost flat topography	2296.4 (9.9)	71.4-77.2	55.2-61.9	75.1-88.6	41.8-44.8	60.9-68.1 Good (P2)	13.6
2	Deep coarse textured soils with almost flat to gently undulated topography	5799.0 (3.7)	(P2) *	(P2-P3)	(P2-P1)	(P3)		
3	Moderately deep moderately coarse to coarse - textured soils with almost flat to gently undulating topography	16299.9 (10.4)	42.5-51.9	39.3-58.2	62.3-78.6	25.4-39.4	42.5-57.0 Fair (P3)	19.6
4	Moderately deep coarse texture soils with gently undulated topography	14419.2 (9.2)	(P3)	(P4-P3)	(P2)	(P4)		
5	Shallow moderately coarse - textured soils with almost flat to undulating topography	23196.1 (14.8)	25.3-31.6	32.8-39.5	38.7-46.3	25.2-29.4	30.5-36.8 Poor (P4)	22.6
6	Shallow coarse textured - soils with gently undulated topography	12225.0 (7.8)	(P4)	(P4)	(P4-P3)	(P4)		
7	Very shallow or rocky coarse textured - soils with almost flat to gently undulated topography	38242.2 (24.4)	10.6-12.8	11.4-16.3	20.1-22.8	7.6-9.2	10.2-11.5 Very Poor (P5)	38.5
8	Very shallow or rocky coarse - textured soils with undulated topography	17710.5 (11.3)	(P5)	(P5)	(P4)	(P6)		
9	Shallow to deep Oolitic coarse - textured soils with almost flat topography (Sand beach)	4388.4 (2.8)						
10	Oolitic coarse textured soils of complex longitudinal dunes	3448.1 (2.2)	1.3-5.4	0.0-2.7	0.0-4.9	3.4-7.6	1.2-5.2 Non Agric (P6)	5.7
11	Shallow to deep, medium to coarse - textured soils with interlayering salts, and almost flat topography (Sabkha)	5485.6 (3.5)	(P6)	(P6)	(P6)	(P6)		

* Potentiality class; P1= Excellent, P2= Good, P3= Fair. P4= Poor, P5= Very Poor, P6= Non Agricultural.



Map 9. Soil potentially in the studied area.

Meanwhile, Soils belong to soil families *coarse loamy, calcareous, hyperthermic; Typic Aquisalids* and *Carbonatic, hyperthermic; oolitic Torripsamments* have potentiality index varied from 1.2 to 5.2 %, therefore they are classified as non-agriculture soils. These units have various very severe constraints, i.e. very limited effective root zone, very poor drainage, very coarse texture, extreme high carbonates, sever high salinity and very poor soil fertility. Thus, they are considered non useful from agricultural point of view, meanwhile, could be relevant to other land utilization types.

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الملخص العربي

تقسيم الأراضى وتقييم قدرتها الإنتاجية لبعض مناطق الزراعات المطرية بغرب مطروح- الساحل الشمالى الغربى لمصر

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إن تنمية الأقاليم الصحراوية تعـد أهـم أدوات الدولـة لزيادة الإنتاج الزراعى، ويأتى إقليم الساحل الشمالى الغربى لمصر فى مقدمة المناطق الصحراوية الواعدة للإستـصلاح والإستزراع والتنمية، والذى لم يستغل للآن بالشكل المناسب رغم وفرة المقومات والإمكانيات الإنمائية الهائلة التى يزخر بها.

وقد أجرى هذا البحث بهدف تحديد أنـواع الأراضـى السائدة وقدرتها الإنتاجية لكافة الوحدات الجيومورفولوجيـة بمنطقة القصر– أم الرخم كأحد نماذج الزراعات المطريـة بالساحل الشمالى الغربى، فى محاولة للمعاونة فـى صـنع قرارات الإستصلاح بالمنطقة. حيث تمتد منطقـة الدراسـة على حوالى ١٥٩ ألف فدان شاملة لعدد ١٢ حوض تجميـع مائى. تم تحديد التوزيع المكانى للأشكال الأرضية الـسائدة بالمنطقة بإستخدام الخرائط الجيومورفولوجية والطبوغرافية تكاملا مع نموذج الإرتفاعات الرقمى DEM، حيث إشتملت المساحة على عدد ٦ أشكال أرضية رئيسية هى: (١) السهل الساحلى (١٧,٨%) والذى يشمل كل من المراوح الرسوبية (٩,١%)، السبخات الملحيـة (٣,٥%)، الكثبـان الرمليـة (٢,٢%)، الشاطئ الرمـلى البطروخـى (٢,٨%) – (٢) المصاطب الرسـوبية (٩,٧%) – (٣) مجـارى الأوديـة (٢,٧%) – (٤) الحوائط الصخرية (٤,٣%) – (٥) السهل التحـاتى (١٣,٦%) – (٦) الهـضبة (٥٢,١%) وتـشمل الهضبة الدنيا (١٨,٦%) والهضبة الليبية العليا (٣٣,٥%).

وقد درست أراضى المنطقة من خلال عدد ٢٦١ قطـاع تربة تم توزيعها بناءا على تقـسيم مرئيـة LANDSAT 7 ETM+ الفضائية لتمثيل جميع الأشكال الأرضـية. وبنـاءا

على الدراسات الحقلية والمعملية أمكن تقسيم أراضى المنطقة على مستوى العائلة Soil Family إلى عدد (١٠) عائلة، إلا أنه يمكن القول بأن تربة المساحة تحت الدراسة قسمت لتتبع أحد سبع تحت مجاميع كبرى Sub Great group هى: *Typic Torrifluvents* (١٥,٢%) - *Typic Torripsamments* (١٨,٠%) - *Lithic Torripsamments* (٢٢,٦%) - *Lithic Torriorthents* (٣٥,٧%) - *Typic Aquisalids* (٣,٥%) - *Oolitic Torripsamments* (٥,٠%) – *Typic Haplosalids* (٠,١٥%). حيث صنفت أراضى الشاطئ الرملى البطروخى لتحت مجموعة *Oolitic Torripsamments*، وأراضى السبخات الملحية إلى *Typic Aquisalids*. وقسمت أراضى المراوح الرسوبية عموما إلى تحت مجموعة *Typic Torrifluvents* وأحيانا إلى *Typic Torripsamments*. بينما صنفت أراضى كل من المصاطب الرسوبية ومجارى الوديان والسهل التحاتى فى العموم كـ Typic أو Lithic لكل من *Torripsamments* أو *Torriorthents*، وأحيانا ما قسمت مساحات محدودة منها إلى تحت المجموعة *Typic Torrifluvents* أو *Typic Haplosalids*. وقد صنفت أراضى الهضبة إلى *Lithic Torriorthents*.

وبناءا على صفات عمق القطاع الأرضى وقوام التربة وطبوغرافية السطح قسمت أراضى المنطقة لعدد عشرة وحدات تربة. حيث أوضحت الدراسة أن ١٣,٦و ١٩,٦% من الأراضى المدروسة ذات قطاع تربة عميق ومتوسط العمق، على الترتيب. وساد القوام الخشن إلى متوسط الخشونة كافة أنواع الأراضى بالمنطقة، مع سيادة الطبوغرافية ذات السطوح المستوية تقريبا إلى هينة التموج على ٦٩,٣% من إجمالى المساحة.

ولقد خلصت الدراسة إلى تصنيف قدرة التربة الإنتاجية بالمنطقة بالجيدة على إمتداد مساحة ١٣,٦% من منطقة الدراسة لتشمل وحدات المراوح الرسوبية وبعض مساحات المصاطب الرسوبية والأجزاء الدنيا من مجارى الأودية، حيث تراوح الـ Potentiality Index ما بين ٦٠,٩-٦٨,١%. بينما صنفت قدرة التربة الإنتاجية على إمتداد مساحة ١٩,٦% بالمتوسطة ممثلة لبعض أجزاء وحدات المراوح الرسوبية والمصاطب الرسوبية والأجزاء الوسطى من مجارى الأودية إضافة للسهل التحاتى، حيث تراوح الـ Potentiality Index ما بين ٤٢,٥-٥٧,٠%. وإمتدت قدرة التربة الإنتاجية الفقيرة على مساحة ٢٢,٦% من إجمالى المساحة الكلية لتشغل أجزاء من وحدات المصاطب الرسوبية والأجزاء العليا لمجارى الأودية والسهل التحاتى، حيث تراوح الـ Potentiality Index ما بين ٣٠,٥-٣٦,٨%. ولقد أعتبرت المساحة المتبقية فقيرة جدا أو غير صالحة للإستغلال الزراعى حيث تدنى دليل القدرة الإنتاجية ليتراوح بين ١,٢-١١,٥%، حيث أوصت الدراسة بضرورة إستغلال هذه المساحات فى أوجه إنتفاع أخرى. كما أوضح البحث وخلص إلى أن محدات الإستغلال الزراعى تنحصر ببعض المساحات فى ضحالة قطاع التربة، سوء حالة الصرف، قوام التربة الخشن ونقص المكون الطينى، إرتفاع نسب الجير والملوحة، الفقر فى خصوبة التربة.