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# A Physiographic Study and Land Evaluation of The Soils of some Eastern Desert Wadies , Egypt, Using Landsat Images Interpretation

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## ABSTRACT

The soils of both wadies Qift and Zeidun are considered one of the promising parts of Eastern Desert, due to a wide area of arable land and the high potential of ground water. Additionally, the area is considered a good model for representing many of the landscape features, in the Eastern Desert. So this study aims to identify the different physiographic units including soil developed in this area by interpretation landsat ETM 8 image, as to determine soil suitability class that have closely relationships with physiographic characteristics. This technique plays an important role for utilizing these scanned promising areas. The area under consideration lies between latitudes ($26^{o}$ 00¯) and ($25^{o}$ 50¯) North and longitude ($32^{o}$ 45¯) and ($33^{o}$ 05¯) East and covered by Landsat TM8 image bands 2,4 and 7. The data obtained show that the studied area were identified physiographically, as:(1) Rubble Terraces (stony pediment soils), old alluvial terraces (high & low),young alluvial plain terraces (high & low) , fan and outwash plane, wadies (wadi bottom and wadi plain) and Miscellaneous land types (Rock land). According to the morphological features and analytical data, the soils developed on the main physiographic units are classified till the family level into: A: *Aridisols* , soil families are : 1-*Typic Calcigypsids*, sandy skeletal, mixed , hyperthermic, (old and young alluvial terraces (high) 2- *Gypsic Haplosalids*, sandy-skeletal (low young alluvial terraces). 3- *Typic Calcigypsids,* loamy skeletal, mixed ,hyperthermic at the soils of old alluvial terraces (high) and wadi bottom soils. 4- *Lithic Haplocalcids,* loamy skeletal, mixed , hyperthermic, (Rubble terraces stony pediment). 5- *Typic Haplocalcids,* sandy, skeletal, mixed, hyperthermic at old and young alluvial terraces (high) and wadi bottom soils. 6- *Typic Haplocalcids,* loamy skeletal (young high terraces) and wadi bottom. B: *Entisols* included: *Typic Torriorthents,* sandy, mixed, hyperthermic (fan out wash plain and wadi plain soils). The soil evaluation results of the studied soils revealed that the soils of wadi bottom and wadi plain soils currently marginally suitable lands ($S_3$) and moderately suitable ($S_2$). Fan and out wash plain and some soil of low young alluvial terraces currently are marginally suitable lands (S3). Whereas, Rubble terraces stony pediment soils, and some soil of old alluvial terraces, and high young alluvial terraces are currently not suitable (N1). In addition, the limiting factors for soil productivity are topography, soil texture effective, soil depth, $CaCO_3$ content, salinity and alkalinity. Potential suitability was identified after required land improvements and reveal that all the studied soils are placed between marginally and moderate suitable ($S_3$ & $S_2$). The limiting factors for soil productively are soil texture and soil depth.


**Keywords :** physiographic unit , Remote sensing , Land evaluation

## INRODUCTION

Egypt's strategy sustainable agricultural development aims to attain food security to cope with the over population, which reached an alarming rate. These strategic goals could be approached only by the optimal allocation and utilization of the available natural resources, including land, water and human resources. In this context, horizontal expansion of land, then reclamation and increasing soil potentiality through vertical expansion are solutions to meet the population demands. The Eastern Desert of Egypt occupies the area extending from the Nile Valley east ward to the Gulf of Suez and the Red Sea which is about 223.000 $Km^2$, eie 21% of the total area of Egypt It is higher than the Wester Desert as it consists essentially of abockbove of high rugged mountain running parallel to and at a relatively short distance from the coast. Wadies Qift and zeidun are the largest wadies in the southern part of the Eastern Desert of Egypt. These wadies extend from more than 250 Km along a north - West to south - east oxis from its highest tributaries in the Red Sea Hills to its downstream confluence with the Nile Valley. Wadi Qift is extended about 35 Km from east Qift then Joius with its major tributaries namely wadi Hammamat, wadi Zeidun and wadi EL -Mishash. Therefore, tracing more promising areas to be under demand for the agriculture development must become the supreme interest of pedologist. The objectives were to identify the physiographic features of an unique area in Egypt by mapping them to be a digital model in a harmony of physiography and soil data set .Serving the extrapolation approach when other areas will be under study. Such a modern technique helps in delineating soil potentialities for agricultural purposes of these promising areas.

**Location:** The investigated areas of wadi Qift and wadi Zeidun are located between latitudes ( 26° 00¯ ) and ( 25° 90¯ ) North and longitudes (32° 45¯ ) and( 33° 5¯ ) East (Fig 1).

**Climate:** The climate data of Qena region, that issued by the (CLAC, 2017) is characterized by an extreme aridity, high evaporation, low relatively humidity and a short rainy cool winter. The mean maximum temperature is $22.7^{o}$, and minimum range between $14.7^{o}$ and $32.4^{o}$. The mean annual rainfall is about 5.5mm. The highest values of relative humidity are 66%. These climatic data were processed to be used with the soil taxa for the classification of soils according to the Keys of soil taxonomy (USDA ,2014).The soil of the studied area have hyperthermic temperature regime and torric moisture regime.

**Geology:** The mentioned area geologically appear that the surfaces soil is accupied by different types of rocks belonging to different ages from the Precambrian to Cenoizic eras Said (1962), EL-Shamy (1988). El Hussaini and Ibrahim *(*1994), and The Egyptian General Petroleum Coporation (1987) eras and covered by Nubian formation (sand stone) and sandy soils, Eocene limestone and calcareous soils, Pliocene (gravel and sands), and Quaternary Pleistocene (silt, sand and gravel).

**Geomorphology:** This zone overlooks the Nile with high scarps, cut by wadies flowing towards the river and Red Sea Mountains. The main landform of the Easter Desert wadies are Plateau, Rubble Terraces, Wadi Bottom, Out wash Plain, Alluvial fans, Sand Sheets, and Dunes (Academy of Scientific Soil map, 1982, Moeyerson et. al., 1999, and DRS, 2005).

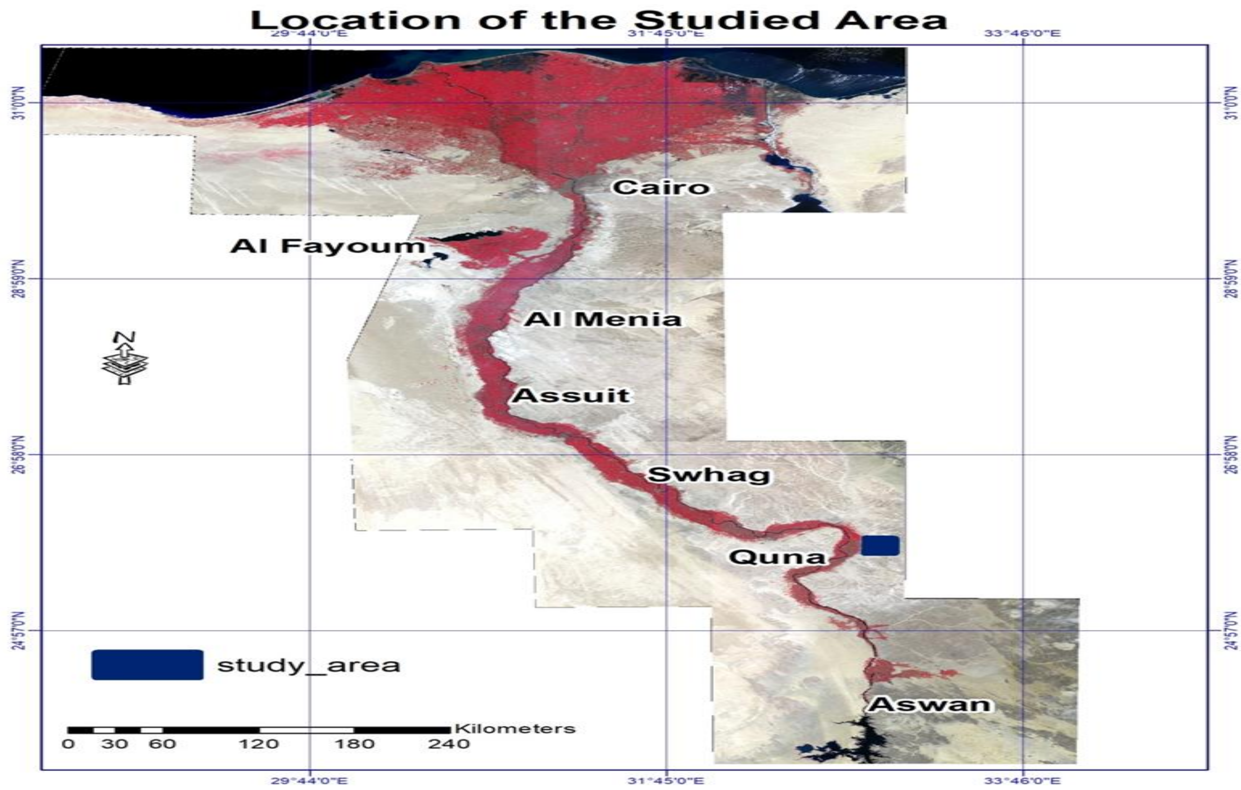


**Figure 1.The General Location of the study area**

**Water Resources:** Abd El-Moneim (2005) reported that the water resources of Eastern Desert are very limited when compared to those of the Nile Valley, the Delta, the Western Desert, and Sinai, this is mostly due to the fact that the area is covered in most parts by crystalline rocks (mostly igneous and metamorphic). Shallow groundwater occurs in the alluvial deposits and shallow carbonate rocks and is discharged either naturally through springs, or through drilled wells of shallow depth. The deeper waterboarding formations are more extensive and generally provide layer more reliable well yields.

The objective of this study is to identify the physiographic units of the chosen area using landsat images interpretation such a modern technique help in delineating soil potentialities for agricultural purposes of these promising area.

## MATERIALS AND METHODS

**Interpretation of space images:**

Preliminary space images interpretation was performed using the physiographic analysis which based on the dynamic process rather than the static ones as proposed by Burnigh (1960) and Goosen (1967).The goal of this method is to identify boundaries, which are correlated to the differences of the physiographic processes...

**Visual analysis of land sat (ETM8):**

The base map obtained from the image analysis was checked in the field by different ground observations to confirm the boundaries of the units or to revise what were shifted (Fig.2). The image of landsat thematic mapper (TM8) was used for visual analysis. The overall view for delineating the promising areas in the Eastern Desert was characterized by the spectral signature of an orthorectified land sat thematic mapper (TM8) mosaic. The spectral signatures of bands 7.4.2.were used as a composite output for the purposes of visual analysis...

**Field work**

Fifteen soil profiles representing the predominant different Physiographic units of the studied area were dug to a depth of 150 cm or lithic contact or to the level of water table, as shown in Fig.(3). Soil profiles were morphologically described nomenclature of (USDA, 2003, as shown in Table (1).The Soil samples were air dried crushed with the wooden hammer, sieved through a 2mm sieve to obtain the fine earth used for some physical and chemical analysis

**Laboratory work:**

Practical size distributions was carried out by dry sieving for the coarse fractions and by the pipette method for fine ones, Piper (1950) Calcium carbonate and gypsum content were determined according to Page *et al* (1982). pH and EC, were performed in soil suspension and soil saturation extract according to Black., *et al* (1985). CEC and the exchangeable sodium percentage (ESP) were determined according to (Tucker, 1954) and organic matter content was determined by the modified method of Walkley and Black (Jackson, 1969).

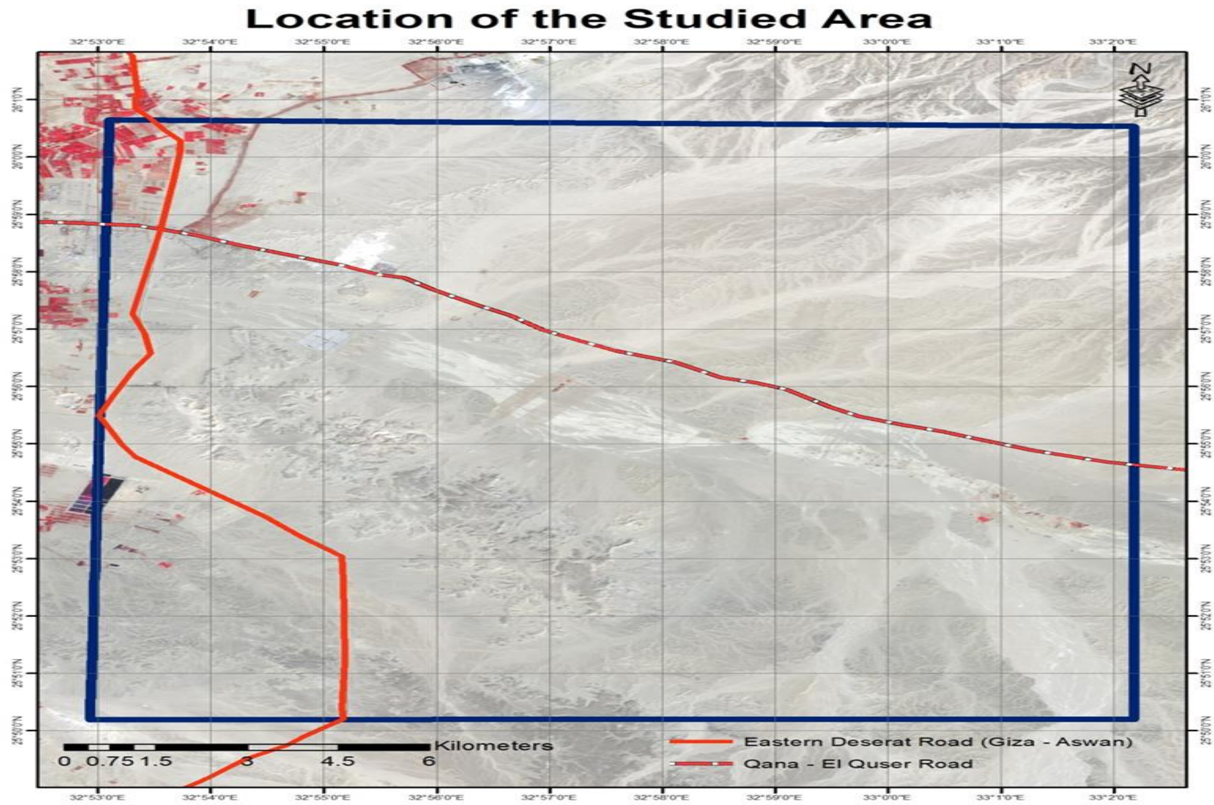


Figure 2. the location of the study area overlay on satellite image

**Soil classifications:**

The studied soils were categorized in the taxonomic units up to the family level according to the (USDA, (1999) and using the Keys of soil Taxonomy USDA,(2014).

**Suitability classification:**

The parametric land evaluation systems undertaken by FAO (1976) and Sys & Verheye (1978) are used to determine soil limitations and suitable classes of the studied area.

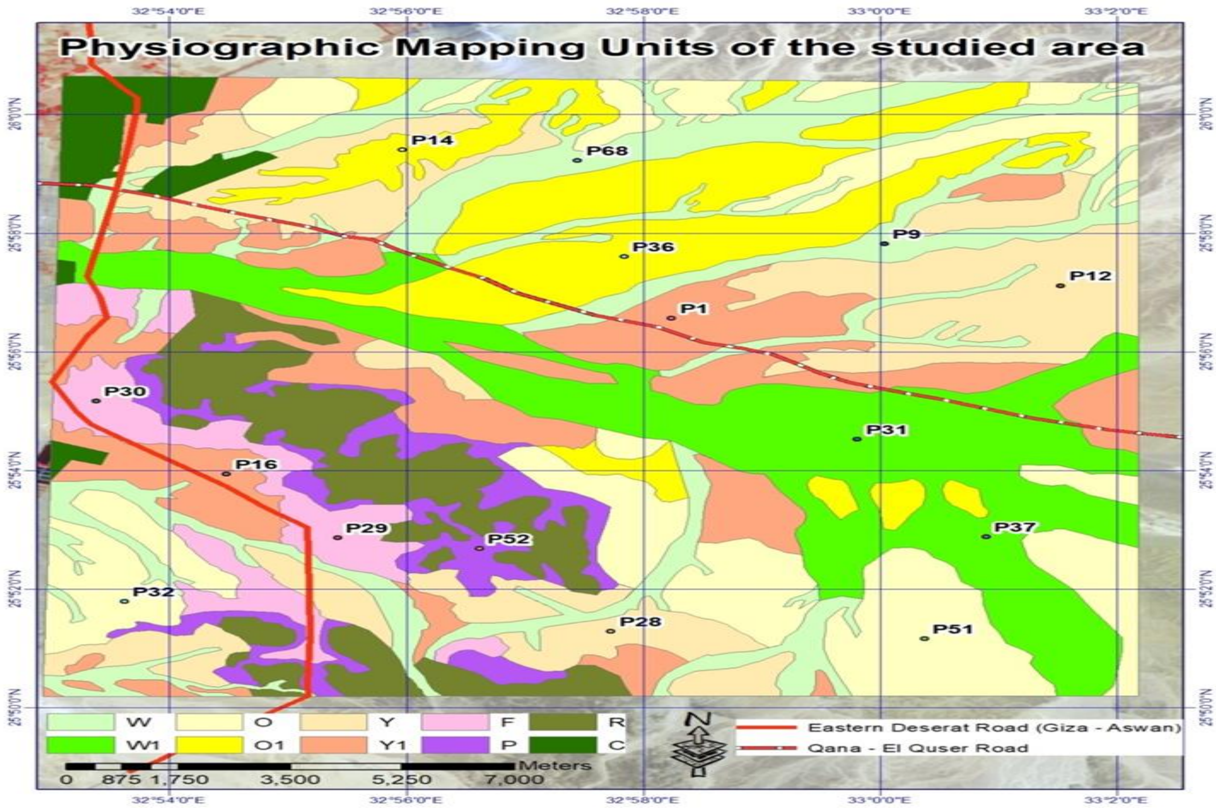


Figure 3. The Physiographic mapping units and location of the studied soil profiles in the study area

**Table 1. Morphological description of the studied soil profiles.**

| Physiographic units | Profile No. | Depth (cm) | Soil taxonomic unit | Topography | Horizon | Color dry | Color moist | Texture class | Structure class | Consistency | Effervescence ($CaCO_3$) | Boundary |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P (rubble terrace stony pediment soils) | 52 | 0 - 10 | Lithic | U | ABK | 7.5yR8/6 | 7.5yR7/6 | VGSL | m | sh | st | Cs |
| | | 10- 25 | Haplocalcids Loamy skeletal | | BK | 7.5yR7/6 | 7.5yR6/6 | VGSL | m | sh | st | --- |
| O (Old high terraces) | 51 | 0 -15 | Typic | U | ABY | 10yR8/6 | 10yR7/6 | VGSL | m | sh | st | Cw |
| | | 15-40 | caligypsids | | BK | 10yR8/6 | 10yR6/6 | VGSL | m | sh | st | Cw |
| | | 40-80 | loamy Skeletal mixed | | BK | 10yR8/8 | 10yR6/8 | VGSL | m | sh | st | ---- |
| | 32 | 0-35 | Typic | GU | ABK | 10yR7/6 | 10yR5/6 | VGS | s.g | lo | st | Cs |
| | | 35-60 | Calcigypsds | | $BKY_1$ | 10yR7/8 | 10yR6/6 | VGS | s.g | 1o. | st | Cw |
| | | 60-90 | sandy skeletal | | $BKY_2$ | 10yR6/6 | 10yR7/8 | VGS | m | 1o. | st | ----- |
| O1 (old low terraces) | 36 | 0-25 | Typic | GU | ABK | 10yR7/6 | 10yR5/8 | VGS | m | 1o. | st | Cs |
| | | 25-60 | Calcigypsds | | BKY | 10yR7/8 | 10yR6/6 | VGLS | m | sh | st | Cw |
| | | 60-120 | sandy skeletal | | BK | 10yR6/8 | 10yR6/8 | VGS | m | sh | st | --- |
| | 14 | 0-20 | Typic | AF | ABK | 10yR7/6 | 10yR5/8 | VGS | s.g | 1o. | st | Cs |
| | | 20-50 | Haplocalcids | | $BK_1$ | 10yR7/8 | 10yR7/8 | VGS | s.g | 1o. | st | c.w |
| | | 50-120 | sandy skeletal | | $BK_2$ | 10yR6/8 | 10yR5/8 | VGS | s.g | 1o. | st | ---- |
| Y (young high terrace) | 28 | 0-25 | Typic | AF | ABK | 10yR8/3 | 10yR5/6 | GLS | m | So | st | c.w |
| | | 25-70 | Calcigypsds | | BK | 10yR6/8 | 10yR5/8 | GS | m | So | st | c.w |
| | | 70-120 | sandy skeletal | | BK | 10yR6/6 | 10yR5/6 | VGS | m | So | st | --- |
| | 12 | 0-25 | Typic | GU | ABK | 10YR7/6 | 10YR6/6 | GSL | m | sh | st | c.w |
| | | 25-80 | Haplocalcids, | | BK | 10Yr8/6 | 10YR7/6 | VGSL | m | sh | st | c.w |
| | | 80-120 | loamy Skeletal | | BK | 10yR7/6 | 10YR5/6 | GSL | m | sh | st | --- |
| Y1 (young low terrace) | 16 | 0-30 | Gypsic | AF | ABK | 10yR6/8 | 10yR5/4 | GSL | m | sh | st | Cs |
| | | 30-80 | Haplosalids | | $BKY_1$ | 10yR6/6 | 10yR5/6 | GS | m | sh | st | Cw |
| | | 80-150 | sandy skeletal | | $BKY_2$ | 10yR6/4 | 10yR5/4 | VGS | m | sh | st | ---- |
| | 1 | 0-15 | Typic | AF | AKY | 10YR6/6 | 10YR5/6 | $S_i$GLS | m | sh | ms | c.w |
| | | 15-70 | Haplogypsids, | | $BKY_1$ | 10Yr8/6 | 10YR8/8 | GLS | m | sh | ms | c.w |
| | | 70-130 | sandy skeletal | | $BKY_2$ | 10yR7/6 | 10yR7/8 | $S_i$GS | s.g | so | ms | --- |
| F (Fan an outwash plain) | 30 | 0-20 | Typic | AF | $C_1$ | 10yR6/6 | 10yR5/6 | VGS | m | 1o. | st | c.s |
| | | 20-80 | Torriorthents, | | $C_2$ | 10yR6/8 | 10yR5/8 | VGS | m | sh | st | c.w |
| | | 80-150 | sandy mixed | | $C_3$ | 10yR5/6 | 10yR4/6 | VGS | m | sh | st | --- |
| | 29 | 0-30 | Typic | AF | $C_1$ | 10yR8/6 | 10yR7/6 | GS | m | sh | st | Cs |
| | | 30-70 | Torriorthents | | $C_2$ | 10yR7/6 | 10yR6/6 | VGS | m | sh | st | Cw |
| | | 70-140 | sandy skeletal mixed | | $C_3$ | 10yR8/8 | 10yR7/8 | GS | m | sh | st | --- |
| Soil of wadies: W (waadi bottom) | 9 | 0-25 | Typic | AF | A | 10yR7/6 | 10yR6/6 | GS | s.g | Lo | st | Cs |
| | | 25-80 | Haplocalcids | | BK | 10yR7/8 | 10yR6/8 | VGS | m | sh | st | Cw |
| | | 80-130 | sandy skeletal | | C | 10yR6/8 | 10yR5/8 | GS | m | sh | st | ---- |
| | 68 | 0-25 | Typic | AF | ABY | 10yR8/6 | 10yR7/6 | GS | s.g | 1o. | st | c.s |
| | | 25-75 | Haplocalcids | | BK | 10yR8/8 | 10yR7/8 | GSL | m | sh | st | c.w |
| | | 75-120 | coarse loamy skeletal | | C | 10yR7/6 | 10yR6/6 | VGSL | m | sh | st | --- |
| Soil of wadies: W1 (wadi plain) | 31 | 0-30 | Typic | AF | ABK | 10YR7/6 | 10YR7/8 | $S_i$GSL | m | sh | st | c.w |
| | | 30-75 | Haplocalcids, | | $BK_1$ | 10YR6/6 | 10YR6/8 | $S_i$GLS | m | sh | st | c.w |
| | | 75-150 | sandy mixed | | $BK_2$ | 10YR5/6 | 10yR5/8 | $S_i$GLS | m | sh | st | --- |
| | 37 | 0-25 | Typic | AF | $C_1$ | 10YR8/6 | 10YR8/8 | $S_i$GS | s.g | 1o. | st | c.w |
| | | 25-80 | Torriorthents, | | $C_2$ | 10YR7/6 | 10yR7/8 | $S_i$GLS | s.g | 1o. | st | c.w |
| | | 80.130 | sandy mixed | | $C_3$ | 10YR5/6 | 10yR5/6 | $S_i$GLS | s.g | 1o. | st | c.w |

**AF: Almost flat U: undulating GU: gently undulating V: Very**
**G: Gravely S: Sand L: Loam m: massive s.g: single grain sh: slightly hard lo: loose so: soft st: slightly ms:moderate**

## RESULTS AND DISCUSSION

### Physiographic unit genesis:

Greek"physis" = nature and "graphein"= to draw. It is description of physical earth surface feature, including the processes responsible for parent material development Goosen (1967) stated that, physiographic approach can provide a good basis for explaining geomorphology through aerospace in age interpretation. The physiographic units as reflected in the spectral signature of the land sat data are shown in fig (3). The physiographic genesis was performed to find a collective and quick land attributed illustration for a vast area, using a harmony of knowledge (parent rock, parent material of the paleo and recent drainage patterns as mediators between the high and low lands). This approach successfully helps as detection, which was in true confirmed by the representative ground truth observation.

Physiographic-soil legend has been set up as shown in Table (2) associated with the morphological description of the representative soil profiles. Soil taxa after soil physical and chemical analysis are presented in Tables (3 and 4), respectively. The physiographic features and genesis are characterized as follows:

**1-Rubble Terraces:**

The rubble terraces are mostly characterizing the study area. These are remnants of the piedmont alluvial plains (P), built up by gravelly, sandy or coarser detritus brought down from the slopes of the higher land. The surface of all the rubble terrace soils shows a gravel desert pavement. Subsequent up lifts of the land in relation to level of the sea has resulted in a number of terrace levels. Which are distinguished according to the age elevations and the degree of parent material development as follows:

**1-Rubble Terraces (RT):** ( Stony pediment soils sloping)

Small portions of the survey area are occupied by the remnant of ancient "rubble terraces" at the immediate edge of the Cretaceous and lower Eocene upland. This unit is covering an area of about 2676.62 Feddans (3.83% of the total studied area). The sloping stony soils of the pediment slopes are isolated flat-topped hills about 20 high and strongly affected by erosion, resulted in gullied surface of concave convex complex slopes rolling to the topography. Soils of this unit represented by profile No. (52), are shallow deep (35cm), very gravelly moderately textured, moderately saline non alkaline. These soils are more developed, being with calcic horizon (BK), there for classified as *Lithic Haplocalcids* loamy skeletal, mixed, hyperthermic, shallow.

**Table 2. Some Physical analysis of the studied Soil profiles.**

| Physiographic units | | Profile No. | Depth (cm) | Horizon | Gravel % | Coarce sand% | Find sand% | Silt % | Clay % | Modified texture class | $CaSO_4$ 2H2O % | $CaCO_3$ % | O.M. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P (Pediment) | | 52 | 0 - 10 | ABK | 40 | 29.81 | 39.99 | 10.9 | 19.3 | VGSL | 1.04 | 17.5 | 0.07 |
| | | | 10-25 | BK | 50 | 31.14 | 43.66 | 8.1 | 17.1 | VGSL | 1.99 | 15.9 | 0.06 |
| O (Old high terrace) | | 51 | 0 -15 | ABY | 35 | 30.4 | 36.3 | 16.9 | 16.46 | VGSL | 7.66 | 22.1 | 0.02 |
| | | | 15-40 | BK | 40 | 28.1 | 40.1 | 14.7 | 17.1 | VGSL | 1.96 | 19.7 | 0.01 |
| | | | 40-80 | BK | 40 | 25.6 | 41 | 15.3 | 18.1 | VGSL | 1.77 | 20.1 | 0.01 |
| | | 32 | 0-35 | ABK | 50 | 38.4 | 51.3 | 3.8 | 6.5 | VGS | 1.09 | 15.6 | 0.07 |
| | | | 35-60 | $BKY_1$ | 55 | 55.4 | 37.1 | 3.2 | 4.3 | VGS | 10.84 | 16 | 0.01 |
| | | | 60-90 | $BKY_2$ | 50 | 56.2 | 36.1 | 2.9 | 4.8 | VGS | 11.64 | 20 | 0.01 |
| O1 (old low terrace) | | 36 | 0-25 | ABK | 45 | 33.6 | 53.5 | 6.6 | 6.3 | VGS | 2.68 | 14.5 | 0.04 |
| | | | 25-60 | BKY | 50 | 40.2 | 41.1 | 11.5 | 7.2 | VGLS | 6.16 | 15.3 | 0.02 |
| | | | 60-120 | BK | 40 | 41.9 | 48.7 | 3.2 | 6.2 | VGS | 2.28 | 8.5 | 0.01 |
| | | 14 | 0-20 | ABK | 50 | 40.1 | 50.5 | 4.2 | 5.2 | VGS | 1.9 | 17 | 0.08 |
| | | | 20-50 | $BK_1$ | 50 | 40.8 | 51.2 | 4.3 | 3.7 | VGS | 2.26 | 20 | 0.02 |
| | | | 50-120 | $BK_2$ | 55 | 32.3 | 59.8 | 4.7 | 3.2 | VGS | 2.08 | 18.2 | 0.01 |
| Y(youn high terrace) | | 28 | 0-25 | ABK | 35 | 34.3 | 50.2 | 4.3 | 11.2 | GLS | 2.02 | 18.5 | 0.07 |
| | | | 25-70 | BKY | 30 | 39.2 | 48.6 | 7.1 | 5.1 | GS | 7.78 | 17.8 | 0.06 |
| | | | 70-120 | BK | 45 | 33.9 | 58.2 | 3.2 | 4.7 | VGS | 2.78 | 15.5 | 0.03 |
| | | 12 | 0-25 | ABK | 20 | 45.3 | 25.6 | 15.1 | 14 | GSL | 2.5 | 16 | 0.02 |
| | | | 25-80 | BK | 40 | 31.4 | 35.1 | 15.3 | 18.2 | VGSL | 2.3 | 30 | 0.01 |
| | | | 80-120 | BK | 25 | 32.5 | 35.2 | 18.7 | 13.6 | GSL | 4.1 | 20 | 0.01 |
| Y1(young low terrace) | | 16 | 0-30 | ABK | 25 | 33.2 | 35.4 | 16.2 | 15.2 | GSL | 10.4 | 21.6 | 0.03 |
| | | | 30-80 | $BKY_1$ | 30 | 40.3 | 50.1 | 4.4 | 5.2 | GS | 11 | 34 | 0.02 |
| | | | 80-150 | $BKY_2$ | 45 | 34.5 | 55.7 | 5.5 | 4.3 | VGS | 12.14 | 22 | 0.02 |
| | | 1 | 0-15 | AKY | 10 | 22.2 | 39.4 | 10.3 | 8.1 | S:GLS | 10.2 | 2.3 | 0.02 |
| | | | 15.7 | BKY1 | 35 | 40.1 | 38.5 | 13.2 | 8.2 | GLS | 8.7 | 2.1 | 0.03 |
| | | | 70.13 | BKY2 | 15 | 48.4 | 42.7 | 3.6 | 5.3 | S:GS | 5.4 | 1.8 | 0.02 |
| F (Fan an outwash plain) | | 30 | 0-20 | $C_1$ | 40 | 28.8 | 61.3 | 4.7 | 5.2 | VGS | 2.18 | 7.8 | 0.02 |
| | | | 20-80 | $C_2$ | 50 | 34.2 | 57.4 | 4.2 | 5.2 | VGS | 3.83 | 8.5 | 0.02 |
| | | | 80-150 | $C_3$ | 55 | 36.1 | 57.3 | 2.2 | 4.4 | VGS | 3 | 9.2 | 0.01 |
| | | 29 | 0-30 | $C_1$ | 25 | 36.9 | 51.4 | 6.4 | 5.3 | GS | 1.26 | 2.6 | 0.02 |
| | | | 30-70 | $C_2$ | 40 | 37.2 | 52.4 | 4.3 | 6.1 | VGS | 1.63 | 4.8 | 0.02 |
| | | | 70-140 | $C_3$ | 30 | 31.3 | 57.2 | 5.2 | 6.3 | GS | 1.43 | 3.5 | 0.01 |
| Soil of wadies | W (wadi bottom) | 9 | 0-25 | A | 30 | 34.4 | 56.1 | 4.1 | 5.4 | GS | 1.04 | 9.6 | 0.2 |
| | | | 25-80 | BK | 45 | 40.6 | 52.3 | 3.4 | 3.7 | VGS | 2.37 | 15 | 0.1 |
| | | | 80-130 | C | 35 | 29.3 | 61.8 | 5.7 | 3.2 | GS | 0.19 | 11.58 | 0.08 |
| | | 68 | 0-25 | ABY | 25 | 35.7 | 55.4 | 5.1 | 3.8 | GS | 6.39 | 11.2 | 0.1 |
| | | | 25-75 | BK | 35 | 28.8 | 41.3 | 15.6 | 14.3 | GSL | 3.84 | 16.8 | 0.08 |
| | | | 75-120 | C | 40 | 31.2 | 30.9 | 19.8 | 18.1 | VGSL | 5.5 | 7.5 | 0.02 |
| | W1 ( wadi plain) | 31 | 0-30 | ABK | 10 | 38.3 | 36.7 | 11.3 | 13.7 | $S_i$GSL | 1.1 | 20 | 0.09 |
| | | | 30.75 | $BK_1$ | 15 | 37.3 | 52.1 | 2.1 | 8.5 | $S_i$GLS | 1.3 | 16.4 | 0.08 |
| | | | 75-150 | $BK_2$ | 15 | 41.2 | 40.4 | 8.7 | 9.7 | $S_i$GLS | 2.1 | 18.1 | 0.06 |
| | | 37 | 0-25 | $C_1$ | 15 | 38.3 | 52.3 | 4.1 | 5.3 | $S_i$GS | 1.1 | 8 | 0.1 |
| | | | 25-80 | $C_2$ | 25 | 36.2 | 54.4 | 3.3 | 6.1 | $S_i$GLS | 0.3 | 9 | 0.09 |
| | | | 80-130 | $C_3$ | 20 | 38.3 | 43.3 | 10.7 | 7.7 | $S_i$GLS | 1.5 | 10 | 0.08 |

**BK: Calcic horizon  BY: Gypsic horizon  A: first horizon  C: parent material**

**Table 3. Some Chemical analysis of the studied Soil profiles.**

| Physiographic units | Profile No. | Depth (cm) | Horizon | pH | EC $dsm^{-1}$ | Anions $HCO_3^-$ | Anions $Cl^-$ | Anions $SO_4^=$ | Cations $Ca^{++}$ | Cations $Mg^{++}$ | Cations $Na^+$ | Cations $K^+$ | CEC Cmol $kg^{-1}$ | ESP % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Meq/L | | | Meq/L | | | | | |
| P (Pediment) | 52 | 0 - 10 | ABK | 7.97 | 5.05 | 2.2 | 22 | 27.25 | 17.78 | 1.42 | 29.01 | 3.21 | 15.1 | 8.5 |
| | | 10-25 | BK | 7.95 | 5.6 | 2 | 31 | 24.45 | 16.67 | 1.47 | 35.71 | 3.6 | 13.1 | 7.2 |
| O (old high terrecs) | 51 | 0 -15 | ABY | 7.87 | 6.07 | 2.4 | 38 | 20.59 | 25.55 | 2.17 | 26.78 | 6.49 | 12.2 | 6.3 |
| | | 15-40 | BK | 7.82 | 7.27 | 3.4 | 40 | 29.38 | 20.84 | 8.25 | 37.2 | 6.49 | 13.1 | 7.1 |
| | | 40-80 | BK | 7.82 | 7.72 | 1.8 | 45 | 31.88 | 22.78 | 5.49 | 44.64 | 5.77 | 14.1 | 8.1 |
| | 32 | 0-35 | ABK | 7.6 | 4 | 1 | 18 | 23.6 | 20.7 | 8.2 | 12.1 | 1.6 | 2.1 | 7.1 |
| | | 35-60 | $BKY_1$ | 7.7 | 1.8 | 1 | 5.6 | 12.2 | 7.8 | 2.4 | 7.8 | 0.8 | 1.8 | 6.5 |
| | | 60-90 | $BKY_2$ | 7.8 | 1.3 | 1.5 | 4 | 8 | 5.5 | 1.1 | 6.2 | 0.7 | 1.9 | 7.1 |
| O1 (old low terrecs) | 36 | 0-25 | ABK | 7.8 | 3.9 | 1.5 | 36.2 | 3.7 | 22.1 | 2.6 | 15.5 | 1.2 | 2.2 | 7.8 |
| | | 25-60 | BKY | 7.8 | 7.5 | 2 | 17.1 | 61.4 | 38.9 | 9.6 | 30.4 | 1.6 | 2.1 | 9.1 |
| | | 60-120 | BK | 7.8 | 5.9 | 1.5 | 21 | 39.5 | 28.9 | 6.9 | 24.7 | 1.5 | 3.0 | 8.2 |
| | 14 | 0-20 | ABK | 7.4 | 9.5 | 2.5 | 59.45 | 39.7 | 46.45 | 13.9 | 37.3 | 4 | 2.3 | 7.3 |
| | | 20-50 | $BK_1$ | 7.3 | 7.3 | 2 | 52.85 | 21.8 | 39.35 | 14.1 | 19.5 | 3.7 | 1.8 | 6.3 |
| | | 50-120 | $BK_2$ | 7.4 | 8.2 | 2 | 66.94 | 23.8 | 49.04 | 19.7 | 20.2 | 3.8 | 1.7 | 8.1 |
| Y (young high terraces) | 28 | 0-25 | ABK | 7.8 | 5.2 | 2 | 18.1 | 35 | 25.6 | 4.4 | 23.3 | 1.8 | 6.2 | 6.5 |
| | | 25-70 | BK | ٧.٨ | 8.5 | 2 | 36.2 | 51.1 | 37.8 | 8.5 | 40.2 | 2.8 | 2.1 | 9.1 |
| | | 70-120 | BK | ٧.٨ | 7.6 | 1.5 | 34.3 | 43.5 | 29.3 | 7.7 | 39.5 | 2.8 | 3.1 | 6.2 |
| | 12 | 0-25 | ABK | 7.5 | 3.6 | 2 | 18.3 | 18.6 | 9.1 | 4.8 | 20.1 | 2.7 | 13.2 | 8.3 |
| | | 25-80 | BK | 7.4 | 7.4 | 2.1 | 30.1 | 30.1 | 40.1 | 8.3 | 32.3 | 3 | 15.2 | 9.1 |
| | | 80-120 | BK | 7.5 | 10.1 | 1.9 | 55.4 | 55.4 | 40.8 | 12 | 55.3 | 2.1 | 16.8 | 11.2 |
| Y1 (young low terraces) | 16 | 0-30 | ABK | 7.4 | 14.9 | 2.5 | 81.7 | 79.7 | 63.1 | 17.3 | 77.5 | 6 | 14.2 | 8.3 |
| | | 30-80 | $BKY_1$ | 7.3 | 31.2 | 3 | 56.09 | 22 | 38.03 | 18.32 | 21.4 | 6.4 | 4.3 | 6.3 |
| | | 80-150 | $BKY_2$ | 7.3 | 30.1 | 3.5 | 15.24 | 20.42 | 82.8 | 49.3 | 22 | 8 | 6.2 | 4.3 |
| | 1 | 0-15 | AKY | 7.2 | 7.9 | 2.1 | 30.41 | 57.3 | 28.2 | 17.3 | 46.7 | 3.1 | 7.8 | 7.2 |
| | | 15-70 | BKY1 | 7.3 | 7.8 | 2.3 | 40.1 | 32.8 | 26.9 | 16.4 | 30.1 | 2.1 | 6.1 | 7.5 |
| | | 70-130 | BKY2 | 7.5 | 3.4 | 1.8 | 15.4 | 13.48 | 11.2 | 2.1 | 15.8 | 1 | 4.3 | 6.3 |
| F (Fan and outwash plain) | 30 | 0-20 | $C_1$ | 7.9 | 5.8 | 2 | 26.7 | 32.7 | 31.3 | 6.4 | 22 | 1.4 | 5.6 | 7.1 |
| | | 20-80 | $C_2$ | 7.8 | 5.8 | 1.5 | 26.7 | 32.5 | 30 | 5.6 | 23 | 1.4 | 6.3 | 6.2 |
| | | 80-150 | $C_3$ | 7.9 | 7.6 | 2 | 36.2 | 40.8 | 41.9 | 7.3 | 28 | 1.5 | 5.2 | 6.8 |
| | 29 | 0-30 | $C_1$ | 7.8 | 3.4 | 1.5 | 9.5 | 24.7 | 12.9 | 1.6 | 19.2 | 2 | 6.1 | 7.5 |
| | | 30-70 | $C_2$ | 7.7 | 4.3 | 1.5 | 21 | 22.2 | 16.7 | 8.2 | 18.6 | 1.2 | 5.3 | 6.8 |
| | | 70-140 | $C_3$ | 8 | 2.7 | 2 | 11.4 | 16.3 | 10.8 | 3 | 14.9 | 1 | 6.4 | 6.5 |

**Table 3. Some Chemical analysis of studied Soil profiles**

| Physiographic units | | Profile No. | Depth (cm) | Horizon | pH | EC $dsm^{-1}$ | Anions $HCO_3^-$ | Anions $Cl^-$ | Anions $SO_4^=$ | Cations $Ca^{++}$ | Cations $Mg^{++}$ | Cations $Na^+$ | Cations $K^+$ | CEC Cmol $kg^{-1}$ | ESP % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Meq/L | | | Meq/L | | | | | |
| Soil of wadies | W (wadi pottom) | 9 | 0-25 | A | 7.5 | 2.44 | 1.5 | 16 | 6.97 | 3.25 | 2.58 | 18 | 0.64 | 6.6 | 7.1 |
| | | | 25-80 | BK | 7.49 | 9.77 | 1.5 | 38 | 58.98 | 39.44 | 30.92 | 27 | 1.12 | 5.9 | 6.5 |
| | | | 80-130 | C | 7.65 | 6.48 | 2 | 21 | 42.12 | 26.12 | 19.28 | 18.6 | 1.12 | 4.8 | 7.4 |
| | | 68 | 0-25 | ABY | 7.71 | 2 | 2 | 17 | 2.49 | 15 | 1 | 4.16 | 1.33 | 6.5 | 7.3 |
| | | | 25-75 | BK | 8.17 | 0.9 | 3 | 5 | 1.36 | 5 | 0.33 | 3.42 | 0.61 | 16.3 | 9.1 |
| | | | 75-120 | C | 8.28 | 0.7 | 3 | 4 | 0.72 | 4.44 | 0.36 | 2.67 | 0.25 | 17.4 | 9.8 |
| | W1 ( wadi plain) | 31 | 0-30 | ABK | 7.85 | 1.3 | 2.9 | 4.9 | 6.1 | 5.6 | 1.8 | 4.8 | 0.8 | 18.2 | 8.3 |
| | | | 30-75 | $BK_1$ | 7.9 | 1 | 3 | 5 | 3.4 | 6.1 | 1.4 | 3.1 | 0.6 | 14.3 | 7.6 |
| | | | 75-150 | $BK_2$ | 7.9 | 1.2 | 3 | 5 | 4.1 | 5.9 | 1.5 | 4.1 | 0.4 | 13.8 | 6.8 |
| | | 37 | 0-25 | $C_1$ | 7.7 | 0.9 | 1.3 | 2.9 | 5.8 | 2.7 | 1 | 5.2 | 0.9 | 6.3 | 8.3 |
| | | | 25-80 | $C_2$ | 7.8 | 1 | 0.8 | 2.7 | 4.9 | 3.9 | 1.1 | 4.9 | 0.6 | 13.1 | 7.6 |
| | | | 80.13 | $C_3$ | 7.5 | 1.3 | 2 | 3.1 | 6.5 | 4.6 | 0.9 | 5.8 | 0.5 | 12.8 | 6.1 |

**Table 4. Rating of limitations and suitability of the studied area.**

| Physiographic unit | Profile No. | Topography (t) | Wetness (w) | Soil physical conditions(s) Texture $S_1$ | Depth $S_2$ | $CaCO_3$ $S_3$ | Gypsum $S_4$ | Salinity & Alkalinity (n) | Suitability Index ( c ) Cs | Ps | Suitability Class Cs | Ps | Suitability sub classes & units Cs | Ps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P | 52 | 80 | 100 | 50 | 55 | 100 | 100 | 90 | 19.80 | 27.5 | N | $S_3$ | $N_1s_1s_2$ | $S_3s_1s_2$ |
| O | 51 | 85 | 100 | 45 | 75 | 100 | 100 | 85 | 24.38 | 33.7 | $S_3$ | $S_3$ | $S_3\ s_1s_2$ | $S_3s_1s_2$ |
| | 32 | 95 | 100 | 40 | 75 | 100 | 100 | 100 | 28.5 | 30 | N | $S_3$ | $N_1s_1s_2$ | $S_3s_1s_2$ |
| $O_1$ | 36 | 95 | 100 | 30 | 90 | 100 | 100 | 90 | 23.09 | 27.0 | $S_3$ | $S_3$ | $N_1s_1$ | $S_3s_1$ |
| | 14 | 95 | 100 | 35 | 95 | 100 | 100 | 85 | 26.8 | 33.25 | $S_3$ | $S_3$ | $N_1s_1$ | $S_3s_1$ |
| Y | 28 | 95 | 100 | 35 | 90 | 100 | 100 | 95 | 28.4 | 34.5 | $S_3$ | $S_3$ | $N_1s_1$ | $S_3s_{11}$ |
| | 12 | 100 | 100 | 65 | 90 | 95 | 100 | 85 | 47.24 | 55. | $S_3$ | $S_3$ | $S_2s_{1yn}$ | $S_1s_1$ |
| $Y_1$ | 16 | 100 | 100 | 45 | 100 | 95 | 90 | 80 | 30.70 | 35.48 | $S_3$ | $S_3$ | $S_3s_{1n}^{yL}$ | $S_3s_1$ |
| | 1 | 100 | 100 | 50 | 100 | 95 | 100 | 90 | 40.75 | 47.5 | $S_3$ | $S_3$ | $S_3s_{1yL}$ | $S_2s_1$ |
| F | 30 | 100 | 100 | 30 | 100 | 95 | 100 | 90 | 25.65 | 28.5 | $S_3$ | $S_3$ | $S_3s_{1f}$ | $S_2s_1$ |
| | 29 | 95 | 100 | 40 | 100 | 95 | 100 | 95 | 36.1 | 38.0 | $S_3$ | $S_3$ | $S_3s_1$ | $S_2s_1$ |
| W | 9 | 100 | 100 | 35 | 100 | 100 | 100 | 90 | 31.5 | 35 | $S_3$ | $S_3$ | $S_3s_1$ | $S_2s_1$ |
| | 68 | 100 | 100 | 65 | 90 | 95 | 100 | 100 | 52.8 | 55.6 | $S_2$ | $S_2$ | $S_2s_1$ | $S_1s_1$ |
| W1 | 31 | 100 | 100 | 55 | 100 | 100 | 100 | 100 | 55 | 55 | $S_2$ | $S_2$ | $S_2s_1$ | $S_1s_1$ |
| | 37 | 100 | 100 | 50 | 100 | 95 | 100 | 100 | 47.5 | 47.5 | $S_3$ | $S_3$ | $S_2s_1$ | $S_1s_1$ |

**S1: Highly suitable**

**$S_1$: Highly suitable $S_2$: Moderately suitable S3: Marginally suitable N: Not suitable**

**2- Old terraces soils:**

The sediments of these terraces were deposited by the fluvial periods. Issawi and McCauley (1992) attributed the origin of these sediments to both the Red Sea mountain since the begin to rise in the early Oligocene and through the Oligocene river sediments. The soils of these unit associations are pure rubble terrace soils, forming tongues or islands in the landscape at low elevation compared with the rule terraces (stony pediments soils solving) and accrue below them, two types of these old terraces were identified according to the landscape genesis and parent material developments as follows:

**1- High Old terraces of undulating developed sediments (O):**

These terraces are like the rubble terraces but it exposed to the regional erosion processes as a result of other later fluvial area and becoming strongly denuded. These terraces are standing now as old terraces undulating (high), relatively elevated with more developed parent material, having more fragments as a result of the out wash process compared with their outskirts and covered an area of about 10111.23 Feddans (14.47% of the total studied area). Soils of this unit represented by two profiles, profile No. (51), are moderating deep (80m), very gravelly moderating coarse textured, moderately saline non alkaline, having calcic (BK) and gypsic horizons (BY), classified as *Typic Calcigypsids* loamy skeletal, mixed hyperthermic moderately deep.

While profile No. (32) is moderately deep (90cm), very gravelly coarse textured, non to moderately saline non alkaline, having calcic horizon(BK),and gypsic horizons(BY) therefor classified as *Typic Calcigypsids* Sandy skeletal, mixed , hyperthermic, moderately deep.

**2- Low Old terraces of gently undulating relatively developed sediment (O1):**

This unit is covering about 8411.33 Feddans (12.039% of the studied area). The sediment of these terraces were derived from the oldest terraces of undulating relatively developed sediment (high) and transported by water during rather periods in relatively recent areas. According to the geological map of Egyptian General Petroleum Corporation (1987).These sediment are mostly located within the Oligocene to Pleistocene eras. The surface level of these terraces is a resultant of the erosion processes which deepened the former higher surfaces that preceded the present level of the terraces. This erosion action also sorted finer parent material during the dissection in the higher and shifting the loads to the lower one, having rilled and gravelly surfaces of gently undulating pattern. Relief, low elevation compared with the old terrace soils (high) markedly incised gullies, this indicated as the severely eroded phase of the old terraces (high). This unit represented by two profiles, profile No. (36), deep (120cm) moderately saline non alkaline, very gravelly coarse textured , having calcic horizon (BK), and gypsic horizons (BY) therefore classified as *Typic Calcigypsids*, sandy skeletal mixed hyperthermic, deep. While profile No. (14), deep (120cm) moderately saline non alkaline, very gravelly coarse texture having calcic horizon (BK), therefore classified as *Typic Haplocalcids*, sandy skeletal mixed hyperthermic, deep.

**3-Young terraces:**

These units are mostly deposited in the western part of the study area. They are relatively low, gently undulating, having parent materials of less fragments compared with those of the old terrace soils. The sediments of these units were deposited by the old streams of the fluvial periods that derived the parent materials by reworking the formerly deposited sediments on the adjacent higher location. This unit can be divided into two types as follow:

**1- High Young terraces (Y)**:

This unit is covering about 9793.06 Feddans (14.01% of the studied area). The erosion action on these sediments resulted in gullied gravelly surfaces of gently undulating topography. The land scape mode of recent parent material caused locally a somewhat parent material development. This unit represented by two profiles, (28) deep (120cm) very gravelly coarse textured, moderately saline non alkaline, having calcic and gypsic horizon, therefore it's classified ***Typic Calcigypsids***, sandy skeletal, mixed hyperthermic deep .While profile No.(12) deep (120 cm) very gravelly moderately textured, saline alkaline, having calcic horizon (BK) there for classified as ***Typic Haplocalcids***, loamy skeletal mixed hyperthermic deep.

**2- Low Young terraces (Y1):**

This unit are like the young high terrace soil in their orgin but it's deposits have not yet been incised by gullies and the relief is practically level, having more fragments as a result of the out wash process with less developed parent material compared to that of the young high terraces and covering about 9758.31 Feddans (13.96% of the total studied area). The soils are represented by two profiles, No.(16) very deep (150 cm) very gravelly coarse textured, highly saline, alkaline having calcic (BK) and gypsic horizons (BY) therefor classified as *Gypsic Haplosalids,* sandy, skeletal, mixed, hyperthermic, very deep. While profile No. (1) Deep (130 cm) very gravelly coarse texture moderately saline non alkaline, and have Gypsic diagnostic horizon there classified *Typic Haplogypsids,* sandy skeletal, mixed hyperthermic, deep.

**2-Fans and out wash plains (F):**

This unit covering about 3086.02 Feddans (4.42% of the studied area). These units are accumulation of debris at the foot of the escarpments, brought down from the desert plateau by steep tributary streams descending through, so that the detrital material spreads out in the shape of a fan. The outwash deposits, usually gravelly and sandy fragments occupy an important area between the rubble terrace remnant, where the sand are washed down and deposited at the base of the fan and wash plain fans and outwash plains (gravelly, stony) represented by profile (30) are very deep (150cm), moderately saline non alkaline, very gravelly coarse textured, the soils were classified as *Typic Torriorthents,* sandy, mixed, hyperthermic, very deep. Locally the gravel content is so much less that a differentiation of the sand soils of the out wash plains was described as (fan and out wash plain(sandy), represented by profile(29), are deep, (140 cm)non saline, non-alkaline, sandy texture, classified as *Typic Torriorthents*, sandy-skeletal, mixed, hyperthermic, deep.

**3- Soils of the Wadis:**

Wadis and their tributaries indicate the most recent floor in the studies area. Their surface lies at the lowest level as compared with the other surrounding land forms wadi bottom (W) of Wadi Qifi and Zeidun and covering about 9037.79 Feddans (12.93% of the total studied area). The parent materials of these wadies were transported deposited from by water which formed an infilled drainage network with alluvial deposits. The presence of numerous gullies and there a more irregular relief are the main characteristics by which these soils have been distinguished from the sandy gravelly outwash plain soils. These soils were represented by soil profiles (9) and (68) are deep (130cm, 120cm), very gravelly coarse textured, non to moderately saline, non alkalin, both the two profiles having a calcic horizon, while the profile No. (68) having a gypsic horizon, there for , they are classified as *Typic Haplocalcids,* sandy skeletal, mixed hyperthermic, deep and *Typic Calcgypsids* , coarse loamy skeletal, mixed hyperthermic, deep respectively. The areas where Wadi plain (W1) soils are the wide plain o wadi Zeidun, east of the Lakeita wells, which come from the Eocene loam stone plateau, are characterized by fine dendritic patterns with narrow drainage lines, but those running from Nubian sand stone plateau have coarse dendritic patterns with wide drainage line (Wadi Qift). It is covering about 10517.82 Feddans (15.05% of the total studied area). These soils are almost flat and represented by profiles No.31 and 37, are deep (130 cm , 150 cm), slightly gravelly coarse texture, non-saline, non-alkaline, soils of profile 31 have calcic horizon and classified *Typic Haplocalcids*, sandy , mixed, while the soils of profile 37 are no having diagnostic horizon therefor classified as *Typic Torriorthents*, sandy, mixed hyperthermic, very deep.

**4- Miscellaneous land typed rock land(R):**

Although these physiographic units have no potentiality for agriculture, they are considered the origin of different parent materials that were derived from them and transported to the low land and still reflecting the geogenitic characteristics of these parents' rocks. It is covering about 5000.41 Feddans (7.15% of the total studied area).

On the other hand, the study of dissection and orientation of the drainage system on these rock structures can be used as clues for extra understanding of their potentialities, relating to the runoff, either as a risk of flooding hazard or/as a source of water supplies. This unit includes the dissected mountains of sedimentary structure.

**2- Land suitability classification:**

In this study the physiographic units has been used as a base for presenting land suitability unit. The approach proposed by Says and Verheye (1978), was selected for land suitability evaluation, since it is valid or irrigation purposes in Egypt. By this approach, the classification was processed according to the FAO (1976) at the level of land unit. The different suitability units of the studied area are presented in Table (4) and Figures (4), (5) the area are characterized as follows:

**1- Current land suitability:**

**$S_2s_1$:**

This unit represents a part of soils of wadi bottom and the young high terraces also the soils of wadi plain, which are moderately suitable ($S_2$) , suitability index of 52.8 to 55. The subclass $S_2S_1$ has moderate intensity of calcium carbonate. Table (5) and Figure (4) showed the distribution of the current capability classes of the studied area.

**$S_3s_1$-1**

This unit represents a part of both soils of young low terraces, and wadi bottom, also the soils of fan and outwash plain. These soils are marginally suitable ($S_3$), with the suitability index valued ranged from 25.65 to 40.75. It subclass $S_3s_1$ has a severe intensity of texture limitation. It has a slight intensity of calcium carbonate, salinity, and alkalinity.

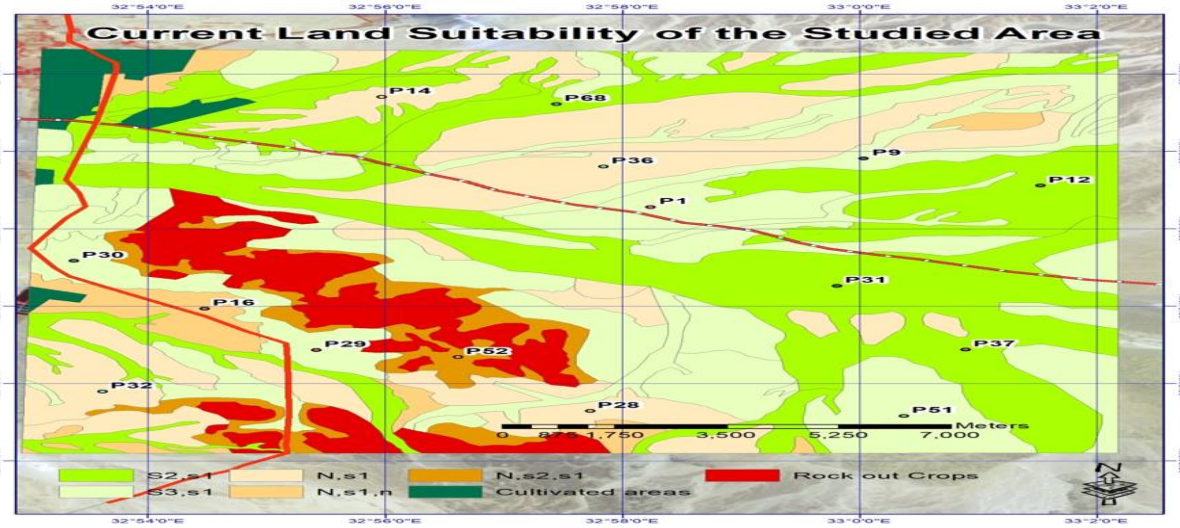


**Figure 4. Current Land suitability of the studied area**

**$S_3s_1$-n**

This unit represents a part of soils of young low terraces. It is marginally suitable ($S_3$) with the suitability index 30.7. It subclass $S_3s_1$-nis defined by moderate intensity of texture limitation and moderate intensity of salinity and alkalinity limitation. It has a slight intensity of calcium carbonate and gypsum limitations.

**$S_3s_1s_2$:**

This unit represents a part of soils of old high terraces. It is marginally suitable ($S_3$) with a suitability index of 35.22. It subclass $S_3S_1S_2$ has a moderate intensity of texture and depth limitation. It has a slight intensity of topography limitation.

**$N_1s_1s_2$:**

This unit represents soils of rubble terraces stony pediment and a part of old high terraces. Soils are currently not suitable ($N_1$) with a suitability index of 17.28 to 19.00 which Indicates moderate to slight sever intensity of texture and soil depth limitation. This unit is distinguished by slight to moderate intensity of slope, salinity and alkalinity limitations.

**$N_1 s_1$-2**

This unit represents soils of old low terraces and part of young high terraces soils wadi plain. The soils are currently not suitable ($N_1$) with suitability index values ranged from 24.22 to 24.3%. The subclasses $N_1$ $s_1$ have a moderate intensity of texture limitation. It has a slight intensity of calcium carbonate, and salinity & alkalinity limitations.

**Table 5. Current and Potential Suitability classes of the studied area**

| Current Suitability classes | area in Feddan | % | Potential Suitability classes | area in Feddan | % |
|---|---|---|---|---|---|
| S1 | 0 | 0 | S1 | 21851.30 | 31.26 |
| S2,s1 | 21851.30 | 31.26 | S2,s1 | 13749.06 | 19.67 |
| S3,s1 | 21933.10 | 31.38 | S2,s2 | 8184.04 | 11.71 |
| N,s1 | 14231.88 | 20.36 | S3,s1,n | 2699.39 | 3.86 |
| N,s1,n | 2699.39 | 3.86 | S3,s1,s2 | 14231.88 | 20.36 |
| N,s2,s1 | 2676.62 | 3.83 | S3,s2 | 2676.62 | 3.83 |
| Rock out Crops | 5000.41 | 7.15 | Rock out Crops | 5000.41 | 7.15 |
| Cultivated areas | 1501.73 | 2.15 | Cultivated areas | 1501.73 | 2.15 |
| Total area | 69894.42 | 100.00 | Total area | 69894.42 | 100.00 |

**2- Potential land suitability:**

A Potential suitability term refers to the suitability of units, for a defined use, in their conditions at some future data, after specified major improvements have been completed where necessary ( FAO,1976). Table (5) and Figure (5) showed the distribution of the potential capability classes of the studied area.

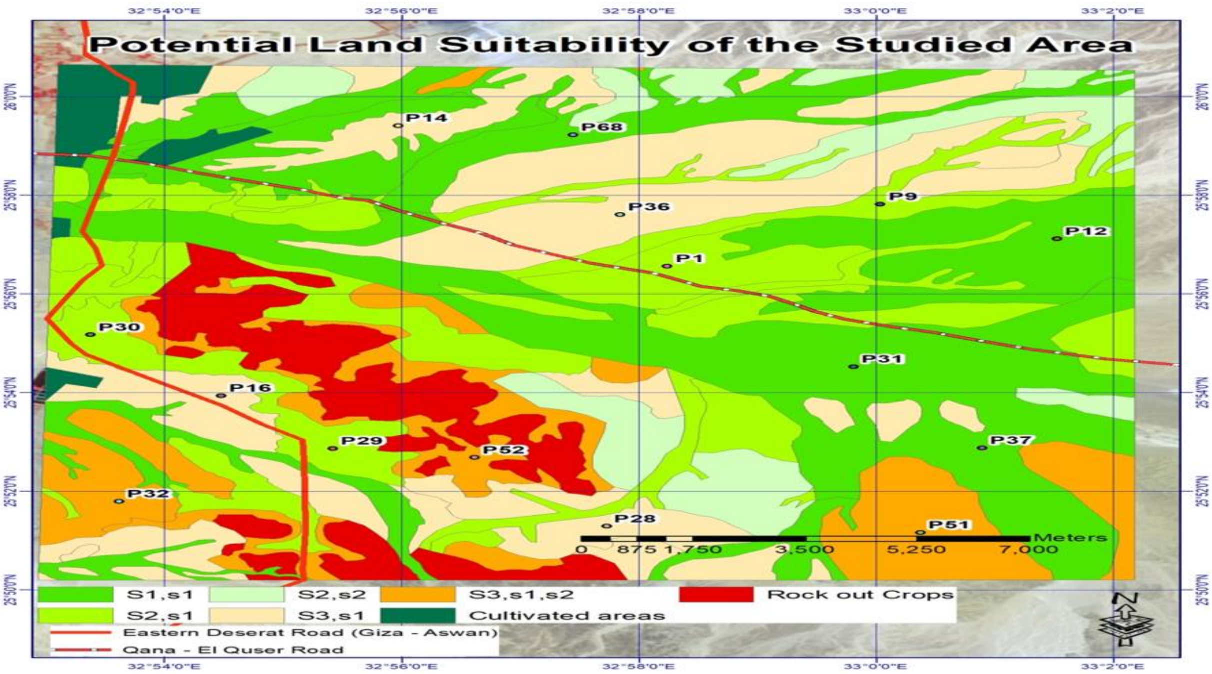


**Figure 5. the distribution of potential capability classes of the studied area**

Further land improvements are required to reduce the severity of limitations exiting in the area under consideration. Examples are, leveling of undulating surface of high and low terraces, leaching of salinity and reclamation of alkalinity exiting in the soils, application of chemical and organic fertilizers, green manures and soil conditioners to increase soil fertility and to improve the physical and chemical soil properties application systems (drip and sprinkler) to save irrigation water to prevent the formation or the rise of ground water table. Potentially suitability was identified after required land improvements as follow:

**$S_1s_1$:**

This unit represents a part of both low young terraces and wadi bottom soils, also the soils of wadi plan, with a suitability index of 75 to 80. It subclass $S_1s_1$has a slight sever intensity of texture limitation.

**$S_2s_1$**

This unit represents an art of soils of young low terraces and wadi plain, also the soils of fan and out wash plain the suitability of index 51 to 55. It subclass $S_2s_1$ has a moderate to slight sever intensity of texture limitation.

**$S_3s_1$**

This unit represents soils of old low terraces and a part of young terraces (high & low), with suitability index of 30 to 28.47 which indicates moderate to slight sever intensity of texture limitation.

**$S_3s_1s_2$:**

This unit represents soils of stony pediment and the high old terraces with a suitability index valued ranged from (30 to 44.62). It subclass $S_3s_1s_2$ moderate to severe intensity of texture and depth limitation.

## REFERENCES


Abd El-Moneim, A. A., (2005): Overview of the geomorphological and hydrogeological charactristics of the Eastern Desert, Egypt Hydrogeology, J. Springer Berlin/Heidelberg Vol. 13, No. 2.

Academy of Scientific Soil Map (1982): Soils of the Western Desert and its depressions and the Eastern Desert soil map of Egypt. Project Academy of Scientific Research and Technology, Cairo, Egypt.

Black,C.A, D.D. Evans; L.E. Ensminger; J.L. White and F.E. Clarlk (1985): Methods of Soil Analysis. Am. Soc. Of. Agron. Inc., Madison, Wisconsin, USA

Burnigh, P. (1960) . The applications of aerial phothographs in soil surveys, Man. of Photogr. Interpr., Washington, D.C.,USA.

CLAC (2017): Central laboratory for Agriculture of Climate, Agric. Res. Center.

DRC, Desert Research Center (2005): Egyptian national program of compact Desertification, June 2005, Online.

El-Hussaini,A.; Ibrahim, H.A.(1994) Interpretation off geoelctrical data on a part of the entrance o Wadi Qena, Eastern Desert, Egypt.*Bull Fac. Sci., Assiut Univ*. 23 (1-F).271.

El-Shamy,I.Z.(1988) *Quantitative geomorphometry and surface runoff control or Wadi Qena Central Easter Desert*,C. S. E. Proc. 6th Ann Mtg.,pp. 13-26.

Egyptian General Petroleum Corporation (1987) .Geological map of Egypt, scale1:500,000.The Egyptian General Petroleum corporation, Cairo, Egypt.

FAO(1976): A frame work for land evaluation. Soil Bull., No.32, FAO, Rome,Italy.

Goosen, D(1967): "Aerial photo interpretation in soil survey ". Soils Bull. 6, FAO, Rome.

Issawi, Bahay, and McCauley, J.F., (1992), The Cenozoic rivers of Egypt: The Nile problem: in Friedman, R., and Adams, B. (eds.), The followers of Horus: Studies in memory of M.A. Hoffman: Egyptian Studies Association Publication no. 2, Oxbow Monograph 20, Oxbow Books, Oxford, England, p. 121-138

Jackson M.L. (1969):Soil Chemical Analysis advanced course. Puble. By Author,Deo. of Soils, Univ. Wisc., Madion. Wisc. USA.

Moeyerson, J., P. M. Vermeersch, H. Beeckman, and P. Van Pear, (1991): Holocene environmental change in Gebel Umm Hammad, Eastern Desert, Egypt, Geomorphology, Vol., 26, NO., 4.

Page, A.L. ; H. Miller and D.R. Kenney (1982) "Methods of Chemical Analysis", 2nd ed.Am.Soc., Agric, Inc., USA.

Piper,C.S.(1950) Soil and Planr Analysis. Interscience Puplishers,Inc.New York,USA.

Said, R.(1962) "The Geology of Egypt", Elsevier Pub.Comp., Amsterdam.

Sys, C. and W.Verheye (1978):An attempt to the evaluation of physical land characteristics for irrigation according to the FAO frame work for land evaluation. Int. Train. Cent. For Post Graduate, Soil Scientists

Tucker,B.M.(1954).The determination of Exchangeable Calcium and Mangnesium in Calcareous Soils Aust.J.Agric.Res.,5:706-715

USDA(1999)Soil Taxonomy:Abasic system of soil classification for making and interpreting soil survey (a revisede 2nd edition) United States Department of Agriculture(USDA), Hand book 4362U.S. Gov. Off., Washington,D.C.,USA.

USDA (2003): Soil survey Manual. United States Department of Agriculture, Hand book No.18, U.S. Gov. Print. Off., Washington, D.C., USA.

USDA(2014). Keys to Soil Taxonomy. 9th Edition, United States Department of Agriculture,(USDA),USA.


## دراسات فيزوجرافية وتقييم لبعض اودية اراضى الصحراء الشرقية – مصر باستخدام تفسير صور الاقمار الصناعية


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تعتبر منطقتى وادى قفط ووادى زيدون من المناطق الواعد فى الصحراء الشرقية المصرية لامكانات التوسع الزراعى من حيث توافر مصادر المياه والتربة المناسبة لهذا التوسع . بالاضافة الى كونها نموذجا معتبرا ممثلا لاودية الصحراء الشرقية من حيث المتغيرات الفيزيوجغرافية والبيدولوجية . الهدف من هذه الدراسة هو تحديد مختلف الوحدات الفيزوجغرافية لتلك الاراضى باستخدام تحليل وتفسير صور الاقمار الصناعية Land sat TM8 مع تحديد اهم صفات تلك الوحدات وتقييمها ولملائمة مدى امكانية استغلالها زراعيا. وتلعب هذه الطريقة دورا هاما فى مجال التنمية الشاملة لتلك المناطق الواعدة. حيث تقع منطقة الدراسة مابين خطى عرض 50¯ 25° و 00¯ 26° شمالا وخطى طول 45¯ 32° 5¯ 33°شرقا . ومن نتائج تحليل وتفسير صور الاقمار الصناعية اتضح ان اهم الوحدات الفيزيوجغرافية تتمثل فى: - اراضى المصاطب المكونة لسفح الجبل ,اراضى الشرفات القديمة ذات رسوبيات متطورة (العليا والمنخفضة , اراضى الشرفات الرسوبية الحديثة (العليا والمنخفضة). - اراضى المروحيات وسهول الغسيل – اراضى الاودية ( قيعان الاودية سهول الاودية) وكذلك الاراضى المرتفعة والتى تمثل البناء الصخرى. وطبقا للصفات المورفولوجية والتحليلات المعملية فقد امكن تقسيم اراضى تلك الوحدات حتى مستوى العائلة : أ- الاراضى الجافة (Aridisols)- *Typic Calcigypsids* sandy skeletal, mixed, hyperthermic وتمثل اراضى الشرفات القديمة والحديثة (العليا) *Gypsic Haplosalids*, sandy skeletal- وتمثل أراضي الشرفات (المنخفضة) - *Typic Calcigypsids* loamy skeletal, mixed, hyperthermic اراضى الشرفات القديمة والعليا وكذلك اراضى قيعان الاودية - *Lithic Haplocalcids* loamy skeletal, mixed, hypothermic وتمثل اراض المرتفعات الصخرية *Typic Haplocalcids* loamy skeletal, mixed, hyperthermic وتمثل اراض الشرفات الحديثة العليا. *Typic Haplocalcids* hyperthermic sandy skeletal, mixed, وتمثل اراضى الشرفات القديمة (منخفضة) وكذلك اراضى قيعان الاودية ب- الاراضى الحديثة (Entisols): *Typic Torriorthents* sandy, mixed, hyperthermic, وتمثل اراضى المروحيات وسهول الاودية. وباستخدام نظم تقييم الاراض المقترح بواسطة Sys and Verheye (1978) فقد امكن تقسيم اراضى منطقة الدراسة تحت ظروف الصلاحية الحالية كالتالى:Current suitable اراضى الاودية (قيعان الاودية- سهول الاودية) تقع ضمن اراضى هامشية الصلاحية(S3) Marginally suitable وكذلك متوسط الصلاحية (S2) Moderately suitable بعض اراضى الشرفات الحديثة المنخفضة واراضى المروحيات وسهول الغسيل تقع ضمن اراضى هامشية الصلاحية (S3)بينما اجزاء من ارضى الشرفات الحديثة العليا تقع ضمن اراضى متوسطة الصلاحية (S2). الاراضى الصخرية (السفوح) و الشرفات القديمة المنخفضة واجزاء من العليا وكذلك بعض اراضى الشرفات الحديثة العليا تعتبر اراضى غير صالحة تحت ظروفها الحالية Current unsuitable (N1) "حيث يمكن اصلاح المعوقات الموجود بها" كما وجد اهم المعوقات المؤثرة على انتاجية التربة تتمثل فى الطبوغرافية– قوام التربة عمق قطاع التربة الفعال المحتوى من كربونات الكالسيوم – الملوحة والقلوية . كما تم تقييم الصلاحية الكامنة (Potential suitability) بعد اتمام عمليات التحسين المطلوبة للصفات الطبيعية والكيميائية للتربة والتخلص من معوقات التربة الغير دائمه خصوصا قوام التربة بإضافة محسنات التربة من مواد عضوية وغير عضوية وعمليات غسيل الملوحة وكذلك المغذيات من عناصر صغرى وكبرى والتى ادت الى تغير الاراضى الغير صالحة (N1) وكذلك لاراضى هامشية الصلاحية (S3) الى اراضى متوسطة الصلاحية(S2) واراضى جيدة الصلاحية (S1) على التوالى , كما وجد ان من اهم المعوقات التى تحد من انتاجية الاراضى هى قوام التربة وعمق القطاع الارضى