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# Soil Calssification and Land Evaluation Studies of Some Soil in The North –East Asyut Governorate Egypt Useing Remote Sensing and Gis

**Wahdan, M. E. M.**
**Soils Water and Environment Research Instituted, Agricultural, Resarch Center, Giza , Egypt.**



## ABSTRACT

The North-East desert outskirt of Asyut Governorate. Egypt ,i.e. adjacent to both sides of Cairo-Asyut Eastern Desert road is considered a promising area for agricultural .utilization as well as a model for representing some landscape features in the Eastern Desert, Egypt, So ,it selected to be identified within the content of soil geomorphic units ,soil morphological physic-chemical, soil classification and evaluation for agriculture irrigated .Based on the guidelines of landsate data ETM 7(Enhanced Thematic Mapper7) and the geomorphic units approach for the studied area were identified . The investigated area includes the main geomorphic units are wadies, Bajada, Pediplain and Rocky plateau. Seventy –five mini pits were located and studied for setting up the geomorphic boundaries and characteristic of soil map legend. Also, the variation of soil characteristics between the main identified. geomorphic units were represented by twenty soil profiles which to be full morphologically described . According to morphological ,physical and chemical properties the studied soils have been classified and could be categorized into order"Aridisols"and two sub group leveles as Typic Haplocalcids ,and Lithic Haplocalcids and order Entisols which corresponded to Typic Torriorthents .Land capability evaluation of the identified geomorphic units were evaluated to assess the supreme current and potential suitability for giving the maximum out puts.The current land suitability could be categorized into three suitability classes ,i,e moderately suitable (S2),marginally suitable (S3)and not suitable(N), besides eight subclasses (S2s$_2$,s$_3$,s4); (S3s$_2$,s$_3$,s4); (S3s1,s$_2$,s$_3$,n) ;(S3s$_2$,s$_3$,s4,n); (S3s$_2$,s$_3$,s4); (S3s$_2$,s4,n);(N t,s1,s$_2$,s$_3$,s4,n) and (Nt,s1,s$_2$,s$_3$,n) which are suffering from some soil properties i.e. soil texture (s2),soil profile depth (s1),$CaCO_3$(s3);Gypsum(s4) topography (t)salinity and alkalinity (n)as soil limitations with different intensity degrees (slight to severe).By applying the improvement practices for achieving the potential condition ,the suitable classes would be become three classes (S2), (S3), and (N) ,besides seven subclasses i,e (S2s$_2$,s4. S2s$_2$,s$_3$,s4; S2s1, s$_2$, s$_3$, s4; S3s$_2$,s4,; S3s$_2$,s$_3$,s4; S3s1, s$_2$,s$_3$,s4 and N1s1,s$_2$,s$_3$,s4.

**Keywords**: Remote Sensing, GIS, Soil classification, Land evaluation.

## INTRODUCTION

One of the major aims of the Governmental authorities of Arab Republic of Egypt is to provide food security for over increasing population. Consequently, the agricultural policy in Egypt has been directed intensively toward the development of the desert areas of Egypt. In this accord, the area east of Asyut Governorate, Eastern Desert is considered as one of the principle regions that have the potentialities to show in producing food and life requirements.

Said (2000) mentioned that the Eastern Desert extends east ward from the Nile Valley to Suez Canal and Red Sea and cover about 223,000km² ,22.3% from area of Egypt .

The studied area is part of the Eastern Desert, where it runs parallel to the alluvial soils of the Nile valley between Asyut and Qwsiya cities **.**

**Location :** The study area lies between six points i,e ,South West 27°25¯ 06.25“N and 31°8.51¯15“E ,North West 27°46¯40.92“N and31°8¯ 48.05“E,North East 27°46¯4o.02“N and31°19¯19“E, South East 27°29¯06.27“N and 31°30¯14.36“E and South East 27°25¯05.43“N covering an area of about 277699 feddans as shows in (Fig1).

The study area is characterized by good labour resource in the southern Egypt , and is accessible through numerous paved roads.

**Geology:**According to Said (2000), the area under investigation formed from the Eocene, Pliocene and Pleistocene. The Eocene deposits formed a large portion of high desert plateaus that rise to hundreds meters above sea level from Cairo south wadies to Qena and they consist of limestone, marls, and clay and some beds are crowded with marines fossils and foraminifera.

The Pliocene deposits occupy some lower courses of wadies of the Eastern Desert and content of primarily sands and gravels .The Pleistocene formation cover large area in Egypt and it forms from a great amounts of silt derived from the mountains and deposited in the lower area of dry valleys.

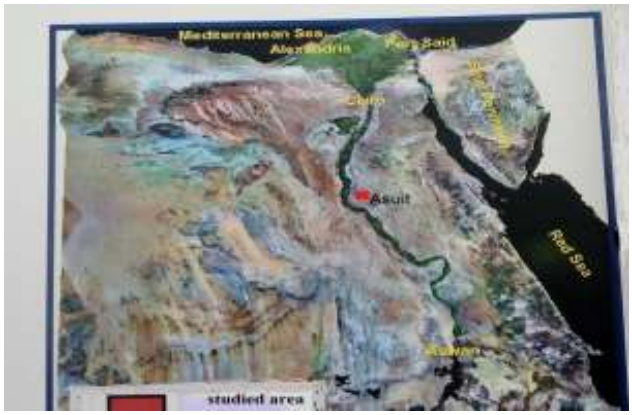


**Fig. 1. Location of the study area**

**Geomorphology:** According to FAO/SF :16/VAR (1963) and Abo El-Ezz(2000),the area in the Eastern side of Asyut and El-Miniya Governorates divided into different physiographic features ,i, e. wadi bottom ,River terraces, wadi plain ,alluvial fan and rock lands.

**Water resources:** Hydrologically, the only source of water for irrigation and other purposes are the Nile water and ground water. According to National Water Research Center (NWRC), (1999) subdivided ground water of the study area into two classes as follows; 1)Extensive and moderately to low productive aquifers insignificant surface recharge and limited sub-surface recharge deeper highly productive .aquifers not excluded ,and .2) Non auriferous clays and shales , generally underlain by deeper more productive aquifers.

The climate Data in Table(1) reveal that the arid climate is prevailing in the investigated area according

to the mean annual precipitation is about 4.5mm/year, The mean annual temperature is 22,7C°.The mean maximum temperature is about 28.4C°,while the mean minimum temperature is about 15.3C°.

**Table 1. The climatolgical data of the study area**

| Month | Temperature | | | Relative Humidity (%) | Rain (mm/day) | Evaporat-ion (m) |
|---|---|---|---|---|---|---|
| | Highest | Lowest | Mean daily Tem | | | |
| January | 20.6 | 7.0 | 13.2 | 37 | 0.9 | 6.0 |
| February | 22.7 | 7.6 | 15.1 | 27 | 1.1 | 5.4 |
| March | 26.5 | 10.5 | 18.5 | 19 | 1.0 | 6.0 |
| April | 31.8 | 15.0 | 23.2 | 17 | 0.0 | 5.4 |
| May | 35.8 | 19.0 | 27.5 | 15 | 0.0 | 8.0 |
| June | 38.0 | 21.5 | 30.0 | 14 | 0.0 | 10.4 |
| July | 36.7 | 22.2 | 29.6 | 16 | 0.0 | 8.7 |
| August | 36.6 | 22.2 | 29.7 | 17 | 0.0 | 9.1 |
| September | 34.8 | 21.1 | 27.3 | 20 | 0.0 | 9.9 |
| October | 31.5 | 17.6 | 24.3 | 23 | 0.0 | 9.9 |
| November | 26.4 | 12.5 | 19.0 | 36 | 0.5 | 7.7 |
| December | 22.0 | 8.3 | 14.7 | 38 | 1.0 | 6.6 |
| Average | 28.4 | 15.3 | 22.7 | 23.3 | | 7.76 |
| Total | - | - | | - | 4.5 | - |

The mean annual relative humidity is about 23.3%.The annual evaporation values 7.76mm/year (CLAC 2010) . According to the soil temperature, rainfall and evaporation aspiration values ,the soil moisture regime is Torric or Aridic and the soil temperature regime is Hyperthermic

Remote sensing techniques have rapidly developed in the last two decades, as the sensors that capture the data have been developed giving improved spectral and spatial reductions of the images, it has been identified as a powerful tool-producing information in spatial and temporal domain instead of point measurement, with high resolution. The efficiency of remote sensing applications has rapidly evolved , providing information with varying degree of success and accuracy on land use /cover classification, physiographic, irrigated area and crop type(sprakash *et al* 2000 )

The current work aimed at studding the morphological ,physical and chemical properties of the area east between Asyut and El Minya Governorates in the Eastern Desert as well as their land capability classification .These soils criteria represent a base for making a proper agricultural utilization and could be considered as promising items in soil potentiality and its sustainable agriculture on the long –term

## MATERIALS AND METHODS

The area under investigation is located in the Eastern Desert adjunct to the alluvial soil of the Nile Valley in Asyut Governorate. The methods used in this study can be broadly classified as follows:

**1-Pre-field work** :Pre-field work was started by training on soil survey methodology, collection of all existing data and information on topography ,geology, land resource maps ,digital elevation model (DEM)and satellite image about the study area .

Then preliminary interpretation of image ,selection locations of sample areas and preparation of working sheets was carried out .

**2- Geomorphology map using GIS**: Geomorphology map was carried out using Digital image processing of land Sat Enhanced Thematic Mapper plus (ETM+) image (path 176,row 42) data of 2010,Fig(2) executed using ENVI 4.7 software ITT(2009).Image was stretched using linear 2% smoothly filtered ,and their his togranus were matched according to Lillesand and Kiefr (2007) . Image was atmospherically corrected using FLAASH module ITT(2009).The different landform were initially determined from the satellite image and the digital elevation model (DEM) extracted from the contour map, following the methodology developed by Dobos *et al* (2002) and Kalogirous (2002).

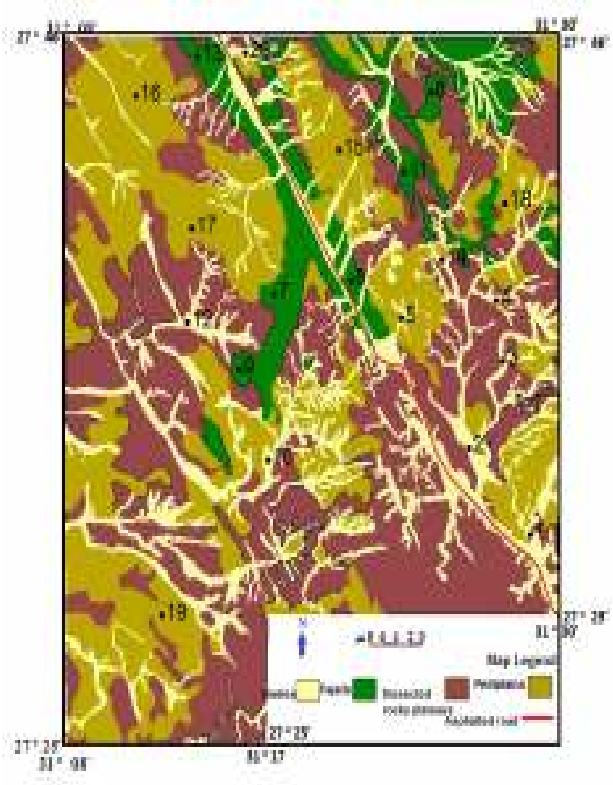

**Fig. 2. physiographic map of the study area**

**3-Field work and laboratory analyses** .

The first stage includes mini pits 75 sits in order to check the validity and accuracy of boundaries and to field out new boundaries based on field work to cover all the different landforms. Detailed morphological description of 20 soil profiles (Fig2) representing the different geomorphic units were recorded on the basis outlied by FAO guideline (2006)(Fig2). Sixty five disturbed soil samples were collected for laboratory analysis i.e. particle size distrubtion, $CaCO_3$ content, gypsum content, SAR ESP, the chemical characteristics such as soil reaction (pH), electric conductivity (EC),soluble cations and anions in soil paste extract were determined according to USDA(2004).

The Keys to Soil Taxonomy (2014) were used to classified the different soil profiles. The soils under investigation were evaluated using the system for land

evaluation namely land Capability classification of Storie (1964) and Sys *et al* (1991

## RESULTS AND DISCUSSION

Based on the visual analysis and interpretation of satellite image data as well as the field observation the studied area map is divided into four major geomorphic units namely, Wadis ,Bajada, Pediplain and rocky plateau. A brief note about the identified geomorphic units ,and morphological description, physical and chemical properties which are carried out as follows :

**1-Wadis**: This geomorphic unit in the resultant of dissection action of the surrounding landscapeas the interaction of erosional and depositional processes in fluvial period (Robertand Julia,1983).: Wadis and their tributaries are found at the lowest level of the study area compared with the other landforms. The highlands which are sedimentary limestone rocks comprise the main catchments area for water harvesting. Wadis extend from the highland eastwards to the Nile valley and are filled with alluvial material developed through weathering the parent rock structure and transported by flood water to the lowlands. Its surface is almost flat to nearly level, covers about 48115 feddans which represent 17.37% of the studied area .

It represented by profiles 1,2,3,4,5,10,12,14 and 20,the morphological description of the representative soil profiles are shown in Table(2).These soil profiles have topographic features characterized by almost flat to very gentlly undulating .The effective soil profile depth was 130cm.Soil texture varied from Sand to sandy loam , the colour is brown (7.5YR5/4)to yellow (10YR8/6)dry.Soil structure varied from single grain to massive and these soils are calcareous reacts vigorously with HCl .It contains 5 to 45%,fine to medium gravels while the surface layers have very few stons.

Physical analysis of the fine fraction( Table3)reveal that the soils is calcareous sand to sandy loam ,where calcium carbonate content ranged from 13.70 to 34.10%.The distribution pattern of $CaCO_3$ does not portray any specific pattern with depth ,except soils of profiles 10 and 12, where carbonate tends to increase with depth, while in profile 20 the calcium carbonate tends to decrease with soil profile depth. Gypsum content is very low and varies from 0.05 to 0.34 %and their contents are not enough to the requirements of gypsic horizon .

Concrning chemical characteristics of wadis unit,(Table4),the soil has slightly to moderately alkaline reaction (pH from 7.4 to 8.1),non saline to moderately saline ,where ECe of soil paste extract ranged from 0.44 to 13.75 $dSm^{-1}$.

Exchangeable sodium percent varied from 0.12 to 14.47% indicating that these soils were non sodic .The distribution pattern of soluble cations in the studied soils are in general followed the descending order: $Na+$and/or$Ca^{2+}>Mg^{2+}>K+$,while the soluble anions of $Cl^-$and /or$SO_4^{2-}>HCO_3^-$.

According to Keys of Soil Taxonomy(2014)as well as soil morphological,physical and chemical properties, the studied soils belong to Entisols order as well as their followed sequence classification levels up to the family as follows :

a-Typic Torriorthents, sandy ,mixed ,hyperthermic (profiles 1,12, and 14).

(b-TypicTorriorthents, sandy skeletal, mixed ,hyperthermic (profiles2,4,5,and10)(c-Typic-Torriorthents,coarse loamy ,mixed ,hyperthermic(profiles3).d)-Typic Torriorthents ,loamy-skeletal, mixed,hyperthermic (profile,20)

**2-Bajadas:** A board, gently inclined detail surface extending from the base of mountain ranges out into in land basin formed by lateral coalescence of a series of alluvial fans ,and having an undulating character due to the convexities of the component fans .It occurs most commonly in semiarid and desert region (Robert and Julia,1983). Bajadas geomorphic units cover about 26477 feddans, which represent 9.56% of the total area, This units is distributed in the north eastern and north western part of the studied area near the Eastern desert rood. The sediments of bajadas are formed by lateral coalescence of a series of alluvial fans which are transported by the action of the flush floods , that running through feeder channels , intersecting the mountain front are pointed by NSSH(2001, the surface is nearly level, gentlly sloping and detritus the units is represented by the soil profiles 6,7,8,9,11 and 13.

Data in Table(2) reveal that the studied soil profiles of the bajada unit have topographic features characterized by almost flat surface , The effective soil depth varied from 120 cm to 130 cm. Soil dry colour ranged from yellow (10YR 8/8) to brown colour (7.5 YR 5/4) , these soils have a coarse texture classes varied from loamy sand to sandy loam , while gravel, fine to coarses content ranged from 5 to 50 % .

The secondary formation of $CaCO_3$ as soft and hard lime nodules or accumulation.(concretions and segregation) are formed and its content is enough to the requirements of calaic horizon, where $CaCO_3$ content ranged from 19.80 to 38.2 % (Table 3) . Gypsum content is very low not exceeds 1.03 % and their content are not enough to the requirements of gypsic horizon.

With regard to the chemical composition of the soil extracts , data in Table (4) indicate that the pH values varied from7.20 to7.83 showing that these soils were neutral to Slightly alkaline, The soils are non saline to extremely saline where ECe values ranged from 1.9 to 59.0 $dSm^{-1}$. The cationic composition of the soil saturations extract were dominated with $Na+$ followed by $Ca^{2+}$ and $Mg^{2+}$,while $K+$ was the least abundant soluble cations.

The anionic composition was dominated by $Cl^-$ and/or $SO4^{2-}$,while $HCO_3^-$ is the least abundant soluble anion .Soil taxa of the studied soil profiles could be classified into Aridisols order as well as their sequence classification levels up to family one(three families)as follow :

1-Typic Helpocalcids, coarse loamy , mixed, hyperthermic (profiles 6,9,11,13).

2-Typic Haplocalcids ,loamy skeletal, mixed ,hyperthermic (profile7);

3-Typic Haplocalcids, sandy ,loamy ,mixed,hyperemic (profile 8)

**Table 2. Morphological description of the studied soil profiles**

| geomorphic unit | Profile No. | Topography | Slope | Coarse fregment | Native Vegetation | Depth (cm) | Colour (Dry) | Texture | Structure | Consis-tence Dry | Consis-tence Moist | Gravel % | Effervescence | Boundary | Pedogenic |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wadis | 1 | AF | Vgs | Mg | FW | 0-20 | 10 Y7/6 | S | Sg | L | LO | 10 | +++ | CS | – |
| | | | | | | 20-35 | 10 YR 7/6 | LS | M | S | VF | 35 | +++ | CW | |
| | | | | | | 35-70 | 10 YR7/6 | LS | M | Sh | VF | 5 | +++ | CW | |
| | | | | | | 70-120 | 10yR7/6 | SL | M | Sh | F | 10 | +++ | – | |
| | 2 | AF | Vgs | Mg | FW | 0-50 | 7.5 YR7/8 | LS | M | Sh | VF | 5 | ++ | CS | – |
| | | | | | | 50-120 | 7.5 YR 8/6 | LS | M | Sh | VF | 35 | + | CW | |
| | | | | | | 120-150 | 7.5 YR 8/6 | LS | M | Sh | VF | 10 | ++ | – | |
| | 3 | AF | Vgs | Mg | FW | 0-20 | 7.5 YR 7/6 | LS | M | Sh | VF | 5 | +++ | CW | – |
| | | | | | | 20-80 | 7.5 YR 8/6 | SL | M | Sh | F | 5 | +++ | CW | |
| | | | | | | 80-130 | 7.5 YR 7/6 | LS | M | Sh | VF | 5 | +++ | – | |
| | 4 | AF | Vgs | Mg | FW | 0-50 | 7.5 YR 7/4 | LS | M | S | VF | 25 | +++ | CS | – |
| | | | | | | 50-100 | 7.5 YR 8/6 | LS | M | S | VF | 35 | +++ | GW | |
| | | | | | | 100-150 | 7.5Y R7 /6 | LS | M | Sh | VF | 20 | +++ | – | |
| | 5 | AF | Vgs | Mg | FW | 0-40 | 7.5 YR 7/6 | LS | M | Sh | VF | 5 | +++ | CW | – |
| | | | | | | 40-80 | 7.5 YR 7/6 | LS | M | Sh | VF | 35 | +++ | CW | |
| | | | | | | 80-120 | 7.5 YR 7/6 | LS | M | Sh | VF | 5 | +++ | – | |
| | 10 | AF | Vgs | Mg | FW | 0-50 | 10yR6/6 | SL | M | Sh | F | 35 | +++ | CS | – |
| | | | | | | 50-100 | 7.5yR5/6 | S | M | Sh | LO | 45 | +++ | GW | |
| | | | | | | 100-130 | 10yR5/6 | S | M | Sh | LO | 25 | +++ | – | |
| | 12 | AF | NL | Mg | FW | 0-50 | 7.5yR5/6 | SL | M | Sh | F | 5 | +++ | CW | – |
| | | | | | | 50-90 | 7.5yR6/6 | LS | M | Sh | VF | 25 | +++ | CW | |
| | | | | | | 90-130 | 7.5yR7/8 | LS | M | Sh | VF | 15 | +++ | – | |
| | 14 | AF | Vgs | Mg | FW | 0-18 | 7.5yR8/4 | LS | M | S | VF | 20 | +++ | GS | – |
| | | | | | | 18-60 | 7.5yR6/8 | LS | M | Sh | VF | 17 | +++ | CW | |
| | | | | | | 60-130 | 7.5yR7/6 | LS | M | h | VF | 30 | +++ | – | |
| | 20 | AF | Vgs | Cg | FW | 0-20 | 7.5yR7/4 | S | M | Sh | LO | 30 | +++ | CS | – |
| | | | | | | 20-70 | 7.5yR5/4 | SL | M | Sh | F | 40 | ++= | GW | |
| | | | | | | 70-130 | 7,5yR5/4 | SL | M | Sh | F | 35 | +++ | – | |
| Bajada | 6 | AF | Vgs | Mg | B | 0-30 | 10 YR 6/6 | SL | M | S | F | 10 | +++ | GW | Common soft segregation |
| | | | | | | 30-90 | 10 YR 6/6 | SL | M | S | F | 10 | +++ | GW | Common concretion&soft segregation |
| | | | | | | 90-130 | 10 YR 6/6 | LS | M | Sh | VF | 20 | +++ | – | |
| | 7 | AF | Vgs | Mg | B | 0-30 | 10 YR 5/4 | SL | M | S | F | 15 | +++ | CS | Many concretion &soft segregation |
| | | | | | | 30-90 | 7.5 YR 5/4 | SL | M | Sh | F | 35 | +++ | CW | Common concretion&soft segregation |
| | | | | | | 90-120 | 10 YR 8/8 | SL | M | Sh | F | 50 | +++ | – | |
| | 8 | AF | GS | Mg | B | 0-20 | 7.5 YR 6/6 | SL | M | S | F | 10 | +++ | GW | Common concretion&soft segregation |
| | | | | | | 20-70 | 7.5 YR 6/4 | LS | M | S | VF | 5 | +++ | GW | Few concretion&soft segregation |
| | | | | | | 70-100 | 7.5 YR 6/8 | LS | M | Sh | VF | 10 | +++ | GW | |
| | | | | | | 100-130 | 7.5YR6/8 | SL | M | h | F | 10 | +++ | – | |
| | 9 | AF | Vgs | Mg | B | 0-25 | 7.5YRR6/4 | SL | M | S | F | 10 | +++ | GW | Common soft segregation |
| | | | | | | 25-75 | 7,5YR6/8 | SL | M | S | F | 15 | +++ | CW | many concretion&soft segregation |
| | | | | | | 75-125 | 7.5YR5/8 | SL | M | h | F | 30 | +++ | – | Common concretion&soft segregation |
| | 11 | AF | GS | Mg | B | 0-40 | 10YR8/6 | LS | M | S | VF | 15 | +++ | GS | Common soft segregation |
| | | | | | | 40-90 | 10YR8/6 | SL | M | S | F | 5 | ++ | GS | Common concretion& soft segregation |
| | | | | | | 90-120 | 10YyR7/6 | SL | M | h | F | 10 | ++ | – | Few concration |
| | 13 | AF | Vgs | Cg | Vfw | 0-40 | 7.5YR7/6 | SL | M | S | F | 10 | ++ | CW | Common concretion& soft segregation |
| | | | | | | 40-90 | 7.5YR7/6 | SL | M | Sh | F | 25 | +++ | CW | Common concretion |
| | | | | | | 90-130 | 7.5YR7/6 | SL | M | h | F | 10 | ++ | – | Common concretion& soft segregation |
| | 15 | GU | GS | Mg | B | 0-30 | 7.5YR7/6 | LS | M | S | VF | 35 | +++ | CW | many concretion&soft segregation |
| | | | | | | 30-75 | 7.5YR7/8 | LS | M | S | VF | 10 | +++ | – | Common concretion& soft segregation |
| | | | | | | 75- | | | | Rock | | | | | |
| Pediplains | 16 | GU | GS | Mg | B | 0-20 | 7.5YR7/6 | LS | M | S | VF | 45 | +++ | GW | Common concretion& soft segregation |
| | | | | | | 20-60 | 7.5YR6/6 | LS | M | S | VF | 50 | +++ | GW | many concretion& soft segregation |
| | | | | | | 60-80 | 7.5YR7/6 | S | M | S | LO | 40 | +++ | – | Common concretion& soft segregation |
| | | | | | | 80- | | | | Rock | | | | | |
| | 17 | GU | GS | Mg | B | 0-30 | 7.5YR6/6 | LS | M | Sh | VF | 25 | +++ | CW | many concretion& soft segregation |
| | | | | | | 30-45 | 7.5YR5/6 | S | M | Sh | LO | 50 | ++ | – | Common concretion& soft segregation |
| | | | | | | 45- | | | | Rock | | | | | |
| | 18 | GU | GS | Mg | B | 0-15 | 10YR6/6 | SL | M | S | F | 25 | + | CW | Common concretion& soft segregation |
| | | | | | | 15-40 | 10YR7/6 | S | M | S | LO | 25 | +++ | CW | many concretion&soft segregation |
| | | | | | | 40-70 | 10YR7/6 | S | M | S | LO | 35 | +++ | GW | Common concretion& soft segregation |
| | | | | | | 70-90 | 10YR6/8 | LS | M | Sh | VF | 40 | +++ | – | Few concration& soft segregation |
| | | | | | | 90- | | | | Rock | | | | | |
| | 19 | GU | GS | Mg | B | 0-20 | 10YR6/4 | LS | M | S | VF | 25 | + | GW | Few concration& soft segregation |
| | | | | | | 20-45 | 10YR7/6 | LS | M | S | VF | 35 | ++ + | GW | many concretion&soft segregation |
| | | | | | | 45-70 | 10YR7/6 | LS | M | S | VF | 45 | ++ + | | |
| | | | | | | 70- | | | | R0ck | | | | | |

**Topography:AF Almost flat .GU:Gently Undulating.Slope: Vgs Very gently sloping NL Nearly level GS Gently sloping .Coarse fragment :Mg many different size of gravel. Cg Common different size of gravel .Native Vegetation: FW Few weeds.B Barren.Vfw Very few weeds Texture: S Sand SL Sandy Loam Structure : Sg Single grain M massive .Consistence: LO loose S soft Sh slightly hard h hard Effervescence: + week ++ moderate +++ strong Boundary: CS Clear smoth CW Clear Wavy GW Gradual wavy**

**3-Pediplain**:

According to Robert and Julia (1983),pediplain is an extensive thinly alleviated erosion surface formed in a desert region by the coalescence of two more unit is situated along the mountains escarpments, has stony surface ,rolling though gently undulating complex sloping and dissected by narrow channels and gullies .pediments cover about 87423 feddans ,which represent about 31.56% of total area .It is identified in the studied area adjacent the highlands in the north western and South western parts of the study area .

**Table 3.Some physical properties of the studied area.**

| geomorphic Unit | Profile No. | Depth (cm) | Particle size distribution (%) C.Sand | F.Sand | Total Sand | Silt | Clay | Texture class | Gypsum (%) | $CaCO_3$ % |
|---|---|---|---|---|---|---|---|---|---|---|
| Wadis | 1 | 0-20 | 5.66 | 88.14 | 93.80 | 2.18 | 4.02 | S | 0.05 | 22.50 |
| | | 20-35 | 6.00 | 77.00 | 83.00 | 8.00 | 9.00 | LS | 0.09 | 25.77 |
| | | 35-70 | 0.79 | 81.38 | 82.17 | 9.33 | 8.50 | LS | 0.10 | 25.44 |
| | | 70-120 | 20.00 | 60.25 | 80.25 | 7.73 | 12.02 | SL | 0.13 | 26.75 |
| | 2 | 0-50 | 15.04 | 68.63 | 83.67 | 8.53 | 7.80 | LS | 0.09 | 25.44 |
| | | 50-120 | 42.24 | 40.51 | 82.75 | 9.55 | 7.70 | LS | 0.02 | 33.27 |
| | | 120-140 | 3.40 | 80.35 | 83.75 | 8.45 | 7.80 | LS | 0.09 | 20.88 |
| | 3 | 0-20 | 19.09 | 61.86 | 80.95 | 10.85 | 8.20 | LS | 0.10 | 30.01 |
| | | 20-60 | 44.54 | 34.31 | 78.85 | 8.85 | 12.30 | SL | 0.29 | 33.84 |
| | | 60-120 | 30.63 | 51.59 | 82.22 | 7.91 | 9.87 | LS | 0.14 | 29.02 |
| | 4 | 0-50 | 13.98 | 74.32 | 88.30 | 2.50 | 9.20 | LS | 0.41 | 25.10 |
| | | 50-100 | 28.87 | 58.65 | 87.52 | 1.71 | 10.77 | LS | 0.25 | 29.32 |
| | | 100-130 | 2.08 | 76.72 | 78.80 | 18.20 | 3.00 | LS | 0.14 | 13.70 |
| | 5 | 0-40 | 6.27 | 78.23 | 84.50 | 14.28 | 1.22 | LS | 0.16 | 25.11 |
| | | 40-80 | 22.16 | 61.98 | 84.14 | 6.11 | 9.75 | LS | 0.20 | 27.80 |
| | | 80-130 | 6.62 | 75.60 | 82.22 | 8.43 | 9.35 | LS | 0.09 | 24.79 |
| | 10 | 0-50 | 30.14 | 51.98 | 82.12 | 5.78 | 12.10 | SL | 0.22 | 21.80 |
| | | 50-100 | 28.21 | 61.74 | 89.95 | 2.45 | 7.60 | S | 0.21 | 28.10 |
| | | 100-130 | 48.39 | 40.43 | 88.82 | 3.33 | 7.85 | S | 0.34 | 28.10 |
| | 12 | 0-50 | 15.85 | 48.10 | 63.95 | 20.20 | 15.85 | SL | 0.13 | 29.10 |
| | | 50-90 | 19.00 | 61.05 | 80.05 | 10.85 | 9.10 | LS | 0.09 | 30.00 |
| | | 90-130 | 31.08 | 49.42 | 80.50 | 11.10 | 8.40 | LS | 0.16. | 31.00 |
| | 14 | 0-18 | 41.66 | 44.66 | 86.32 | 5.20 | 8.48 | LS | 0.24 | 33.00 |
| | | 18-60 | 42.85 | 46.50 | 89.35 | 1.10 | 9.55 | LS | 0.14 | 31.00 |
| | | 60-130 | 34.93 | 52.32 | 87.25 | 5.71 | 7.04 | LS | 0.14 | 29.00 |
| | 20 | 0-20 | 20.01 | 68.79 | 88.80 | 6.10 | 5.10 | S | 0.21 | 34.10 |
| | | 20-70 | 41.18 | 36.89 | 78.07 | 2.58 | 19.35 | SL | 0.16 | 32.00 |
| | | 70-120 | 12.62 | 65.40 | 78.02 | 5.71 | 15.80 | SL | 0.28 | 20.00 |
| Pajada | 6 | 0-30 | 6.30 | 69.95 | 76.25 | 8.40 | 15.35 | SL | 0.15 | 27.40 |
| | | 30-90 | 13.88 | 63.42 | 77.30 | 13.50 | 9.20 | SL | 0.63 | 22.50 |
| | | 90-130 | 16.47 | 64.35 | 80.82 | 10.38 | 8.80 | LS | 0.23 | 22.26 |
| | 7 | 0-30 | 9.95 | 58.32 | 68.27 | 15.83 | 15.90 | SL | 0.40 | 26.42 |
| | | 30-90 | 19.83 | 56.42 | 76.25 | 14.40 | 9.35 | SL | 1.03 | 29.50 |
| | | 90-120 | 14.04 | 56.38 | 70.42 | 21.05 | 8.53 | SL | 0.86 | 28.10 |
| | 8 | 0-20 | 14.17 | 60.68 | 74.85 | 9.45 | 15.70 | SL | 0.23 | 19.80 |
| | | 20-70 | 14.92 | 69.34 | 84.26 | 4.77 | 10.97 | LS | 0.33 | 38.20 |
| | | 70-100 | 18.92 | 65.18 | 84.10 | 6.00 | 9.90 | LS | 0.29 | 25.05 |
| | | 100-130 | 18.11 | 55.66 | 73.77 | 15.78 | 10.45 | SL | 0.42 | 27.08 |
| | 9 | 0-25 | 24.40 | 55.32 | 79.72 | 9.85 | 10.43 | SL | 0.15 | 28.10 |
| | | 25-75 | 13.20 | 48.24 | 61.48 | 29.04 | 9.48 | SL | 0.78 | 21.85 |
| | | 75-120 | 18.55 | 54.97 | 73.52 | 17.53 | 8.95 | SL | 0.70 | 21.80 |
| | 11 | 0-40 | 33.32 | 50.99 | 84.31 | 7.21 | 8.48 | LS | 0.25 | 30.10 |
| | | 40-90 | 2.27 | 67.87 | 70.14 | 15.41 | 14.45 | SL | 0.53 | 29.00 |
| | | 90-130 | 4.89 | 72.70 | 77.59 | 14.01 | 8.40 | SL | 0.73 | 30.10 |
| | 13 | 0-40 | 13.51 | 65.31 | 78.82 | 10.98 | 10.20 | SL | 0.08 | 20.23 |
| | | 40-90 | 22.69 | 55.29 | 77.98 | 12.80 | 9.22 | SL | 0.08 | 31.15 |
| | | 90-130 | 19.26 | 60.01 | 79.27 | 10.90 | 9.83 | SL | 0.06 | 27.00 |
| | 15 | 0-30 | 23.28 | 61.37 | 84.65 | 8.12 | 7.23 | LS | 0.81 | 31.00 |
| | | 30-75 | 32.12 | 50.03 | 82.15 | 9.02 | 8.83 | LS | 1.71 | 28.20 |
| | 16 | 0-20 | 28.62 | 54.69 | 83.31 | 5.51 | 11.18 | LS | 0.18 | 33.00 |
| | | 20-60 | 40.93 | 44.22 | 85.15 | 4.12 | 10.73 | LS | 0.24 | 34.00 |
| | | 60-80 | 37.64 | 48.89 | 86.53 | 7.12 | 6.35 | LS | 0.34 | 30.10 |
| pedidlains | 17 | 0-30 | 35.05 | 53.25 | 88.30 | 6.10 | 9.60 | LS | 0.12 | 32.10 |
| | | 30-45 | 57.89 | 31.32 | 89.21 | 4.12 | 6.67 | S | 0.14 | 33.30 |
| | 18 | 0-15 | 11.56 | 64.65 | 76.21 | 7.97 | 15.82 | SL | 0.22 | 28.10 |
| | | 15-40 | 6.82 | 81.45 | 88.27 | 6.10 | 5.63 | S | 0.05 | 28.70 |
| | | 40-70 | 25.33 | 64.45 | 90.14 | 5.31 | 4.55 | S | 0.84 | 29.00 |
| | | 70-90 | 28.12 | 55.60 | 83.72 | 2.10 | 14.18 | LS | 0.89 | 30.00 |
| | 19 | 0-20 | 20.96 | 63.74 | 84.70 | 7.10 | 8.20 | LS | 0.32 | 29.00 |
| | | 20-45 | 39.72 | 43.98 | 83.70 | 8.20 | 8.10 | LS | 0.20 | 31.00 |
| | | 45-70 | 13.51 | 70.39 | 83.90 | 6.20 | 9.90 | LS | 0.18 | 28.00 |

**S: Sand . LS: Loamy sand . SL: Sand loam**

This geomorphic unit was represented by profiles 15,16,17,18 and 19.Table(2),reveals that topography is gently undulating.All representative profiles have hindered bedrock at levels between 45 and 90 cm. Soil structure is undeveloped hence its massive .Soil dry colour varied from yellow (10YR7/6) to reddish yellow (7.5YR6/6).These soils are characterized by coarse texture (sand to sandy loam).Calcium carbonate contents ranged widely from 28.0 to 34.0% which detected as soft and hard concretion and segregation and its content is enough to the requirements of calcic horizon . Gypsum content was considerably very low ranging from 0.05 to 1.71%(Table 3). The analytical data of the soil saturation extract (Table 4).

**Table 4. Some Chemical properties of the studied soil profiles**

| geomorphic unit | Profile No. | Depth (cm) | pH | EC (dS/m) | Soluble Anions (me/L) | | | | Soluble Cations (me/L) | | | | SAR | ESP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $CO_3^{2-}$ | $HCO_3^-$ | $CL^-$ | $SO_4^{2-}$ | $Ca^{2+}$ | $Mg^{2+}$ | $Na^+$ | $K^+$ | | |
| Wadies | 1 | 0-20 | 7.78 | 1.60 | - | 2.50 | 8.0 | 6.93 | 6.18 | 3.60 | 7.50 | 0.15 | 3.39 | 3.61 |
| | | 20-35 | 7.96 | 2.93 | - | 2.00 | 11.0 | 18.30 | 11.28 | 4.42 | 15.25 | 0.35 | 5.44 | 6.34 |
| | | 35-70 | 7.94 | 3.85 | - | 2.00 | 19.0 | 20.41 | 12.30 | 9.20 | 19.50 | 0.41 | 5.95 | 6.99 |
| | | 70-120 | 7.95 | 4.98 | - | 1.50 | 27.0 | 25.47 | 19.48 | 6.04 | 28.00 | 0.45 | 7.84 | 9.34 |
| | 2 | 0-50 | 8.18 | 0.60 | - | 1.50 | 2.0 | 2.85 | 2.15 | 0.89 | 3.21 | 0.10 | 2.60 | 2.52 |
| | | 50-120 | 8.12 | 1.60 | - | 1.00 | 2.0 | 3.10 | 2.05 | 0.65 | 3.30 | 0.10 | 2.84 | 2.85 |
| | | 120-140 | 7.96 | 1.05 | - | 1.00 | 7.0 | 3.28 | 3.59 | 1.00 | 6.50 | 0.15 | 4.29 | 4.82 |
| | 3 | 0-20 | 7.94 | 1.65 | - | 2.00 | 9.0 | 6.46 | 7.18 | 1.50 | 8.63 | 0.15 | 4.14 | 4.63 |
| | | 20-60 | 7.98 | 4.95 | - | 1.50 | 26.0 | 25.67 | 19.40 | 6.02 | 27.00 | 0.75 | 7.57 | 9.02 |
| | | 60-120 | 7.60 | 3.68 | - | 1.00 | 21.0 | 17.39 | 19.48 | 1.12 | 18.33 | 0.46 | 5.71 | 6.69 |
| | 4 | 0-50 | 7.75 | 10.90 | - | 3.00 | 550 | 62.85 | 46.13 | 18.55 | 55.46 | 0.71 | 9.75 | 11.60 |
| | | 50-100 | 7.58 | 11.35 | - | 2.50 | 66.0 | 58.71 | 46.13 | 9.73 | 70.10 | 1.25 | 13.26 | 14.47 |
| | | 100-130 | 7.63 | 9.22 | - | 2.00 | 42.0 | 54.70 | 41.00 | 17.80 | 38.90 | 1.00 | 7.17 | 8.53 |
| | 5 | 0-40 | 7.44 | 8.00 | - | 0.80 | 47.2 | 52.00 | 33.08 | 21.00 | 44.44 | 1.48 | 8.90 | 10.61 |
| | | 40-80 | 7.63 | 3.30 | - | 2.00 | 19.0 | 14.27 | 9.60 | 5.40 | 19.72 | 0.55 | 7.20 | 8.56 |
| | | 80-130 | 7.70 | 2.85 | - | 2.00 | 20.0 | 7.61 | 6.20 | 2.40 | 20.60 | 0.41 | 9.93 | 11.81 |
| | 10 | 0-50 | 7.67 | 13.75 | - | 2.50 | 84.0 | 80.90 | 71.75 | 16.45 | 77.90 | 1.30 | 11.73 | 13.82 |
| | | 50-100 | 7.55 | 9.90 | - | 2.00 | 24.0 | 82.88 | 59.50 | 14.90 | 33.38 | 1.10 | 5.47 | 6.38 |
| | | 100-130 | 7.55 | 13.35 | - | 1.50 | 66.0 | 78.82 | 63.60 | 16.80 | 65.00 | 0.92 | 10.25 | 12.17 |
| | 12 | 0-50 | 7.61 | 1.15 | - | 1.50 | 3.9 | 6.50 | 6.15. | 2.30 | 3.35 | 0.10 | 1.63 | 1.13 |
| | | 50-90 | 7.82 | 2.58 | - | 1.00 | 11.0 | 15.10 | 13.30 | 3.40 | 10.25 | 0.15 | 3.55 | 3.82 |
| | | 90-130 | 8.13 | 0.67 | - | 1.00 | 3.0 | 2.73 | 2.15 | 1.38 | 3.10 | 0.10 | 2.33 | 2.14 |
| | 14 | 0-18 | 7.65 | 1.51 | - | 2.00 | 8.0 | 6.00 | 6.20 | 2.50 | 7.19 | 0.11 | 3.45 | 3.68 |
| | | 18-60 | 7.40 | 3.75 | - | 1.50 | 13.0 | 26.08 | 22.10 | 5.20 | 13.00 | 0.28 | 3.52 | 3.78 |
| | | 60-130 | 7.74 | 1.36 | - | 1.00 | 6.0 | 6.97 | 6.20 | 2.60 | 5.00 | 0.17 | 2.38 | 2.21 |
| | 20 | 0-20 | 7.52 | 2.98 | - | 2.00 | 12.0 | 18.56 | 18.45 | 3.10 | 10.70 | 0.31 | 3.26 | 3.43 |
| | | 20-70 | 7.77 | 0.78 | - | 1.50 | 3.0 | 3.41 | 3.10 | 1.27 | 3.44 | 0.10 | 2.33 | 2.13 |
| | | 70-120 | 7.90 | 0.44 | - | 1.50 | 1.5 | 1.60 | 2.10 | 1.20 | 1.20 | 0.10 | 0.93 | 0.12 |
| Pediplains | 15 | 0-30 | 7.39 | 24.70 | - | 2.50 | 290.0 | 129.9 | 71.8 | 55.6 | 290.0 | 5.00 | 36.34 | 34.35 |
| | | 30-75 | 7.46 | 11.50 | - | 3.10 | 40.9 | 84.0 | 29.73 | 26.13 | 64.77 | 8.00 | 12.12 | 14.25 |
| | 16 | 0-20 | 7.60 | 8.80 | - | 2.50 | 52.0 | 41.2 | 32.8 | 11.1 | 50.0 | 1.80 | 10.67 | 12.65 |
| | | 20-60 | 7.57 | 11.40 | - | 2.00 | 65.0 | 56.45 | 34.9 | 13.0 | 66.8 | 8.75 | 13.65 | 15.88 |
| | | 60-80 | 7.65 | 13.14 | - | 1.50 | 110.0 | 52.26 | 43.05 | 19.71 | 100.0 | 1.00 | 17.85 | 20.05 |
| | 17 | 0-30 | 7.74 | 5.90 | - | 1.50 | 39.0 | 20.53 | 16.4 | 3.4 | 40.6 | 0.63 | 12.9 | 15.09 |
| | | 30-45 | 7.63 | 6.94 | - | 1.00 | 51.5 | 47.50 | 27.82 | 25.6 | 44.58 | 2.00 | 10.86 | 12.86 |
| | 18 | 0-15 | 7.33 | 9.00 | - | 2.50 | 50.0 | 47.28 | 41.0 | 9.96 | 48.0 | 0.82 | 9.51 | 11.32 |
| | | 15-40 | 7.48 | 25.60 | - | 2.00 | 288.0 | 76.6 | 46.13 | 17.57 | 300.0 | 2.90 | 53.16 | 43.55 |
| | | 40-70 | 7.17 | 55.80 | - | 1.50 | 700.0 | 304.8 | 235.75 | 48.45 | 716.5 | 5.60 | 60.11 | 46.64 |
| | | 70-90 | 7.08 | 56.20 | - | 1.50 | 810.0 | 545.8 | 430.5 | 118.8 | 800.0 | 8.00 | 48.27 | 41.16 |
| Pajada | 19 | 0-20 | 7.75 | 6.35 | - | 2.50 | 32.0 | 32.4 | 26.65 | 9.61 | 29.44 | 1.20 | 6.91 | 8.20 |
| | | 20-45 | 7.50 | 9.30 | - | 2.00 | 54.0 | 44.49 | 41.0 | 21.72 | 36.67 | 1.10 | 6.55 | 7.75 |
| | | 45-70 | 8.01 | 7.95 | - | 0.80 | 53.0 | 46.0 | 28.0 | 32.14 | 37.44 | 2.44 | 7.56 | 9.0 |
| | 6 | 0-30 | 7.83 | 6.40 | - | 2.50 | 39.0 | 27.77 | 23.6 | 4.82 | 40.2 | 0.65 | 10.66 | 12.64 |
| | | 30-90 | 7.20 | 27.00 | - | 2.00 | 220.0 | 253.64 | 112.75 | 142.09 | 217.5 | 3.30 | 19.27 | 21.36 |
| | | 90-130 | 7.48 | 18.50 | - | 1.50 | 120.0 | 152.36 | 103.0 | 36.16 | 133.4 | 1.30 | 15.99 | 18.25 |
| | 7 | 0-30 | 7.44 | 40.50 | - | 3.00 | 750.0 | 240.65 | 286.0 | 65.6 | 635.8 | 6.25 | 47.95 | 40.99 |
| | | 30-90 | 7.42 | 26.25 | - | 2.50 | 340.0 | 135.50 | 76.7 | 21.3 | 375.0 | 5.00 | 53.57 | 43.74 |
| | | 90-120 | 7.30 | 24.15 | - | 2.00 | 350.0 | 143.30 | 153.75 | 66.75 | 270.7 | 4.10 | 25.78 | 26.88 |
| | 8 | 0-20 | 7.60 | 9.75 | - | 3.00 | 42.0 | 60.06 | 41.0 | 8.96 | 52.0 | 3.10 | 10.40 | 12.35 |
| | | 20-70 | 7.59 | 21.80 | - | 2.00 | 224.0 | 123.00 | 61.5 | 60.0 | 220.0 | 7.50 | 28.23 | 28.76 |
| | | 70-100 | 7.39 | 19.50 | - | 2.00 | 164.0 | 168.18 | 143.5 | 19.16 | 170.0 | 1.52 | 18.85 | 20.98 |
| | | 100-130 | 7.24 | 12.85 | - | 1.50 | 76.0 | 73.0 | 61.5 | 18.85 | 68.75 | 1.40 | 10.85 | 12.85 |
| | 9 | 0-25 | 7.54 | 25.25 | - | 3.00 | 246.0 | 243.7 | 143.5 | 52.5 | 291.7 | 5.00 | 29.47 | 29.68 |
| | | 25-75 | 7.24 | 32.00 | - | 2.50 | 400.0 | 271.6 | 317.8 | 59.5 | 291.8 | 5.00 | 21.25 | 23.12 |
| | | 75-120 | 7.29 | 59.00 | - | 2.00 | 1000.0 | 458.0 | 435.6 | 54.4 | 960.0 | 10.00 | 61.33 | 47.15 |
| | 11 | 0-40 | 7.44 | 16.50 | - | 2.50 | 120.0 | 127.4 | 92.3 | 31.2 | 125.0 | 1.40 | 15.91 | 18.17 |
| | | 40-90 | 7.27 | 26.00 | - | 2.00 | 225.0 | 292.7 | 256.3 | 47.5 | 214.3 | 1.60 | 17.39 | 19.61 |
| | | 90-130 | 7.32 | 33.00 | - | 2.00 | 310.0 | 289.2 | 153.75 | 130.45 | 315.0 | 2.00 | 26.42 | 27.39 |
| | 13 | 0-40 | 7.76 | 1.90 | - | 2.00 | 10.0 | 8.45 | 8.20 | 1.7 | 10.45 | 0.10 | 4.70 | 5.36 |
| | | 40-90 | 7.80 | 5.80 | - | 1.50 | 39.0 | 20.53 | 16.4 | 3.4 | 40.6 | 0.63 | 12.90 | 15.09 |
| | | 90-130 | 7.72 | 3.18 | - | 1.00 | 4.0 | 29.45 | 21.6 | 8.6 | 4.0 | 0.25 | 1.03 | 0.26 |

shows that soil reaction was neutral to moderately ,alkaline .The soils are slightly saline to extremely saline as shown by ECe values which ranged from 5.9 to 56.2 $dSm^{-1}$.Soluble cations of the saturation extract follows the order :$Na^{+} > Ca^{2+} > Mg^{2+} > K^{+}$ while soluble anions follows the order. $Cl^{-} > SO4^{2-} > HCO3^{-}$.Exchangeable sodium percent (ESP) in the investigated soils was generally more than 15% .

Except for the soils of profile 19 where ESP values less than 15%.

By appling the Keys of soil Taxonomy (2014) as well as soil morphological ,physical and chemical data , the studied soil profiles classified into the order "Aridsols"Three families can be identified under this order:

1-Typic Haplocalcids sandy, mixed, hyperthermic (profile 15)

2-Typic Haplocalcids ,sandy, skeletal, mixed, hyperthermic (profile16,18,19) .

3-ithic,Haplocalcidssandy,skeletal,mixed,hyperthermic (profile17,)

**Land suitability for agricultural irrigated soils :**

**a-current land suitability**:The current suitability of the studied soils was estimated by matching between the present land properties and their ratings outlined by Sys and Verheye (1978).Suitability indices and classification of the studied soils developed on the studied different geomorphic units are shown in Table (5) and reveal that three suitability classes ,i,e, moderately suitable (S2),marginally suitable (S3)and not suitable (N),besides eight subclasses (S2sz,s3,s4); (S3sz,s3,s4);(S3s1,sz,s3,n);(3,sz,s3,s4,n);(S3sz,s3,s4);(S3 sz,,s4,n);(Nts1,sz,s3,s4,n);and(Nts1,sz,s3,n);wererecognized in the studied area .These subclasses represent some soils suffering from soil limitation ,i,e, some soil properties ,i,e, soil texture (sz),soil profile depth (s1) ,topography (t) and salinity and alkalinity (n) as soil limitations with different intensity degrees (slight to severe**).**

**Table 5. Current land suitability and soil limitations for irrigated agriculture of the studied soil profiles**

| geomorphic unit | Profile No. | Topography (t) | Wetness(W) | Depth(S1) | Texture(S2) | Lime(S3) | Gypsum (S4) | Salinity Alkalinity (n) | Suitability Index | Suitability class | Soil Limitations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Wadis | 1 | 95 | 96 | 90 | 55 | 90 | 90 | 100 | 36.57 | S3 | Texture(S2),Depth(S1),Lime(S3),and gypsum |
| | 2 | 95 | 96 | 100 | 50 | 90 | 90 | 100 | 36.90 | S3 | Texture(S2), Lime(S3),and gypsum |
| | 3 | 95 | 95 | 100 | 75 | 90 | 90 | 100 | 54.80 | S2 | Texture(S2), Lime(S3),and gypsum |
| | 4 | 95 | 96 | 100 | 50 | 90 | 90 | 85 | 31.4 | S3 | Texture(S2), Lime(S3), gypsum &Salinity and alkalinity (n) |
| | 5 | 95 | 96 | 90 | 50 | 90 | 90 | 85 | 28.3 | S3 | Texture(S2), Lime(S3), gypsum,Depth &Salinity and alkalinity (n) |
| | 10 | 95 | 100 | 100 | 50 | 100 | 90 | 85 | 36.3 | S3 | Texture(S2)), gypsum &Salinity and alkalinity(n) |
| | 12 | 95 | 96 | 100 | 65 | 90 | 90 | 100 | 48.0 | S3 | Texture(S2), Lime(S3),and gypsum |
| | 14 | 95 | 96 | 100 | 50 | 90 | 90 | 100 | 36.9 | S3 | Texture(S2), Lime(S3),and gypsum |
| | 20 | 95 | 95 | 100 | 65 | 90 | 90 | 100 | 47.5 | S3 | Texture(S2), Lime(S3),and gypsum |
| Bajada | 6 | 95 | 95 | 100 | 75 | 100 | 90 | 75 | 45.7 | S3 | Texture(S2)), gypsum &Salinity and alkalinity (n) |
| | 7 | 95 | 95 | 90 | 65 | 90 | 90 | 45 | 19.2 | N1 | Texture(S2), Lime(S3), gypsum,Depth &Salinity and alkalinity (n) |
| | 8 | 95 | 95 | 100 | 55 | 90 | 90 | 75 | 30.2 | S3 | Texture(S2), Lime(S3), gypsum &Salinity and alkalinity (n) |
| | 9 | 95 | 95 | 100 | 65 | 100 | 90 | 58 | 30.6 | S3 | Texture(S2)), gypsum &Salinity and alkalinity (n) |
| | 11 | 95 | 95 | 90 | 75 | 90 | 90 | 75 | 37.0 | S3 | Texture(S2), Lime(S3), gypsum,Depth &Salinity and alkalinity (n |
| | 13 | 95 | 95 | 100 | 65 | 90 | 90 | 96 | 45.6 | S3 | Texture(S2), Lime(S3),and gypsum |
| Pediplains | 15 | 90 | 96 | 75 | 55 | 90 | 100 | 75 | 24.1 | N1 | Texture(S2), Lime(S3),Topography(t)a Depth &Salinity and alkalinity (n) |
| | 16 | 90 | 100 | 75 | 45 | 90 | 90 | 80 | 29.7 | N1 | Texture(S2), Lime(S3),Topography(t),gypsum, Depth &Salinity and alkalinity (n) |
| | 17 | 90 | 100 | 55 | 50 | 90 | 90 | 85 | 17.0 | N2 | Texture(S2), Lime(S3),Topography(t),gypsum, Depth &Salinity and alkalinity (n) |
| | 18 | 90 | 100 | 90 | 50 | 90 | 90 | 58 | 19.03 | N1 | Texture(S2), Lime(S3),Topography(t),gypsum, Depth &Salinity and alkalinity (n) |
| | 19 | 90 | 96 | 75 | 50 | 90 | 90 | 90 | 23.6 | N1 | Texture(S2), Lime(S3),Topography(t),gypsum, Depth &Salinity and alkalinity (n) |

**b-Potential land suitability**:Further land improvements are required to correct or reduce the severity of limitations exiting in the studied area,such as:

a) Leaching of soil salinity and reclamation of soil sodicity existing in the soils. b)Continuous application of organic manure to improve soil physico-chemical properties and fertility status, c)Application of modern irrigation systems, i,e, drip and sprinkler in the newly reclaimed desert soils to save pronounced amount of irrigation water as well as to rise the irrigation efficiency .Potential suitability of the studied area after completed required land improvements was estimated by their ratings outlined by Sys *et al* (1991),using the aforementioned parametric method of storie are illustrated in ,Table(6).

A delailed description of the potential land suitability units and subclasses of the studied soils indicating the existence of two orders (S,N)three classes (S2,S3,N1), seven subclasses( S2s2,s4); (S2s2,s3,s4); (S2s1,s2,s3,s4); ( (S3,s2,,s4,) ( S3s2,s3,s4) ; (S3s1,s2,s3,s4,) and;(N1s1,s2,s3,s4,) ; These subclasses represent some soil profiles developed on all the different studied geomorphic units with slight to moderate intensity for soil limitations .The severity of relatively soil coarse texture (Sand) can be corrected in these subclasses by application of organic and in organic soil amendments as well as either drip or sprinkler irrigation systems to sustain soil moisture content at a favourable .condition for grown plants in the relatively coarse texture soil .

**Table 6. Potential land suitability and soil limitations for irrigated agriculture of the studied soil profiles**

| geomorrphic unit | Profile No. | Topography (t) | Wetness(W) | Depth(S1) | Texture(S2) | Lime(S3) | Gypsum(S4) | Salinity Alkalinity(n) | Suitability Index | Suitability class | Soil Limitations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Wadis | 1 | 100 | 100 | 90 | 55 | 90 | 90 | 100 | 40.1 | S3 | Texture(S2),Depth(S1),Lime(S3),and gypsum |
| | 2 | 100 | 100 | 100 | 50 | 90 | 90 | 100 | 40.5 | S3 | Texture(S2), Lime(S3),and gypsum |
| | 3 | 100 | 100 | 100 | 75 | 90 | 90 | 100 | 60.8 | S2 | Texture(S2), Lime(S3),and gypsum |
| | 4 | 100 | 100 | 100 | 50 | 90 | 90 | 100 | 40.5 | S3 | Texture(S2), Lime(S3), gypsum.) |
| | 5 | 100 | 100 | 90 | 50 | 90 | 90 | 100 | 36.5 | S3 | Texture(S2), Lime(S3), gypsum,Depth . |
| | 10 | 100 | 100 | 100 | 50 | 100 | 90 | 100 | 45.0 | S3 | Texture(S2)),Lime(S3). |
| | 12 | 100 | 100 | 100 | 65 | 90 | 90 | 100 | 52.7 | S2 | Texture(S2), Lime(S3),and gypsum |
| | 14 | 100 | 100 | 100 | 50 | 90 | 90 | 100 | 40.5 | S3 | Texture(S2), Lime(S3),and gypsum |
| | 20 | 100 | 100 | 100 | 65 | 90 | 90 | 100 | 52.7 | S2 | Texture(S2), Lime(S3),and gypsum |
| Bajada | 6 | 100 | 100 | 100 | 75 | 100 | 90 | 100 | 67.5 | S2 | Texture(S2)), gypsum . |
| | 7 | 100 | 100 | 90 | 65 | 90 | 90 | 100 | 47.4 | S3 | Texture(S2), Lime(S3), gypsum,Depth . |
| | 8 | 100 | 100 | 100 | 55 | 90 | 90 | 100 | 44.6 | S3 | Texture(S2), Lime(S3), gypsum. |
| | 9 | 100 | 100 | 100 | 65 | 100 | 90 | 100 | 58.5 | S2 | Texture(S2)), gypsum. |
| | 11 | 100 | 100 | 90 | 75 | 90 | 90 | 100 | 54.7 | S2 | Texture(S2), Lime(S3), gypsum,Depth . |
| | 13 | 100 | 100 | 100 | 65 | 90 | 90 | 100 | 52.7 | S2 | Texture(S2), Lime(S3),and gypsum |
| Pediplains | 15 | 100 | 100 | 75 | 55 | 90 | 100 | 100 | 37.1 | S3 | Texture(S2), Lime(S3), Depth . |
| | 16 | 100 | 100 | 75 | 45 | 90 | 90 | 100 | 27.3 | S3 | Texture(S2), Lime(S3),gypsum, Depth. |
| | 17 | 100 | 100 | 55 | 50 | 90 | 90 | 100 | 22.3 | N2 | Texture(S2), Lime(S3), gypsum, Depth . |
| | 18 | 100 | 100 | 90 | 50 | 90 | 90 | 100 | 36.5 | S3 | Texture(S2), Lime(S3), gypsum, Depth. |
| | 19 | 100 | 100 | 75 | 50 | 90 | 90 | 100 | 30.4 | S3 | Texture(S2), Lime(S3),gypsum, Depth) |

**S2:Moderately suitable (50-75). S3:Morginally suitable. N1:not suitable**

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## دراسات تقسيم وتقيم بعض أراضى الشمال الشرقى لمحافظة أسيوط –مصر بإستخدام الإستشعار عن البعد ونظم المعلومات الجغرافية

**مصطفى عيسى مصطفى وهدان**

**معهد بحوث الأراضى والمياة والبيئة –مركز البحوث الزراعية - مصر**

تعتبر أراضى الظهر الصحراوى فى الجزء الشمالى الشرقى لمحافظة أسيوط والممتدة على جانبى الطريق الصحراوى الشرقى بين القاهرة وأسيوط من المناطق الواعدة فى مجال التنمية الزراعية بالإضافة إلى وجود بعض الملامح والأشكال الجيومورفولوجية المنتشرة بهذة المنطقة ولذلك تم إختيار هذة المنطقة لتحليلها جيومورفولوجيا ودراسة الخواص المورفولوجية والفيزيوكميائية وتصنيف وتقسيم تربتها وكذا تقيمها من وجهة إستغلالها للزراعة المروية .وطبقاً لتحليل صور الأقمار الصناعية ( ETM7) لمنطقة الدراسة تم التعرف على الوحدات الجيومورفولوجية السائدة فى منطقة الدراسة وقد أمكن تحديد الوحدات الجيومورفولوجية التالية وهى الأودية , البجادا, السهل التحاتى, والهضبة الصخرية. وقد تم عمل ٦٥ نقطة ملاحظة أرضية لتحديد والتأكد من حدود الوحدات الجيومورفولوجية وكذلك عمل عشرون قطاعاً أرضياً لتحديد الإختلافات فى خصائص التربة بين هذة الوحدات المورفولوجية وقد تم وصف هذة القطاعات وصفاً مورفولوجياً دقيقاً.وطبقاً للوصف المورفولوجى والتحليلات الطبيعية والكميائية تم تقسيم التربة طبقاً للنظام الأمريكى (٢٠١٤) حيث وجد أن الأراضى تقع تحت رتبة الأراضى الجافة Aridisols وتحت أربعة تحت المجموعات الكبري كما يلى -1-Typic Haplocalcids. 2- Sodic Haplocalcids. 3- Calcic Haplosalisds, 4-Lithic Haplocalcids تم تقيم أراضى الوحدات الجيومورفولوجية بغرض تحديد مدى ملائمتها للزراعة المروية بصورتها الحالية أو المستقبلية بعد معالجة محددات التربة وتشير نتائج أدلة ملائمة الأراضى تحت الدراسة الى إنتمائها إلى ثلاث تحت رتبة وهى متوسطة الصلاحية ( S3) وغير صالحة حالياً (N) بجانب ثمانية تحت رتب للأراضى موضوع الدراسة وهى (S3sz,s4,n) ; (S3sz,s3,s4,n); (S3sz,s3,s4); (S3s1,sz,s4,n); (S3sz,s3,s4); ( S2sz,s3,s4); and(Nts1,sz,s3,n); (Nts1,sz,s3,s4,n) ;(S3sz,s3,s4,) هذة الأراضى تعانى من محددات التربة والتي تشمل على القوام والعمق الفعال للتربة, كربونات الكالسيوم, الجبس والملوحة والقلوية كمحددات لصلاحية التربة وبدراجات شدة مختلفة (من خفيفة إلى شديدة ) وبإجراء عمليات تحسين للتربة فى هذة الأراضى تصبح دراجات صلاحية التربة الكامنة (المستقبلية) فى هذة الأراضى ثلاث رتب هى متوسطة الصلاحية (S2) هامشية الصلاحية S3) وغير صالحة (N1 ) بجانب سبعة تحت رتب هى ;(S2sz,s3,s4) (S2sz,s3,s4); (S2s1,sz,s3,s4); (S3,sz,,s4,) ( S3sz,s3,s4) ;(S3,sz,s4,) (N1s1,sz,s3,s4,)