LAND SUITABILITY EVALUATION OF PHYSIOGRAPHIC UNITS IN WADI EL-FARIGH, WESTERN DESERT, EGYPT.

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ABSTRACT:

The studied area is located between Latitude 30^0 06\ 59\\ to 30^0 12\ 56\\North and Longitude30^0 36\ 31\\ to 30^0 45\ 44\\ East covering about 151 km^2. The object of this study is evaluate the physiographic soil units including soil classification and its suitability for agriculture.

The physiographic units of Wadi El- Farigh soils were attributed as:

(1)Dry Valley including soil taxonomic units;

a-TypicTorriorthents, coarse loamy, mixed, hyperthermic.

b- TypicTorriorthents, sandy over loamy, mixed, hyperthermic.

c- TypicTorriorthents, fine loamy, mixed, hyperthermic.

d- TypicHaplocalcids, sandy, mixed, hyperthermic

(2)Alluvial Terraces including soil taxonomic units;

a-TypicTorriorthents, fine loamy over sandy, mixed, hyperthermic.

b- TypicTorriorthents, coarse loamy, mixed, hyperthermic

c-TypicTorriorthents, sandy, mixed, hyperthermic.

(3) Wadi plain including taxonomic units;

a - ***TypicTorriorthents, fine loamy, mixed, hyperthermic***.

(4)Piedmont plain including taxonomic units;

a-TypicHaplocalcids, loamy skeletal, mixed, hyperthermic.

Land suitability of physiographic units could be categorized into three classes as; highly suitability (S1) for some soils in Wadi plains, moderately suitability (S2) for dry valley and Wadi plains and marginally suitable (S3) for Terraces and Piedmont plains.

Land suitabilities were sorted by matching rates of its characteristics and limitations with crop water requirements to give the maximum output. The proposed crops are classified as potential land suitability as;

A)Highly suitable (S1) in dry valley and wadi plains for olive.

B)Moderately suitable (S2) in dry valley and wadi plains for wheat, barley, maize, cotton, sesame, sunflower, sorghum, onion, watermelon, citrus, guava and mango. While, it is moderately suitable in terraces and piedmont plains for olive, sesame and sorghum.

C)Marginally suitable (S3) in dry valley and wadi plains for banana. While, it is marginally suitable in terraces and piedmont plains for wheat, barley, maize, sunflower, onion, watermelon, citrus and mango.

D)Not suitable (N) in terraces soils for tomato and banana.

Key Words: Western Desert, GIS, Land Evaluation, Soil Taxonomy,Wadi El-Farigh.

INTRODUCTION

Since few years ago, the agricultural policy in Egypt has been proportional directed to develop the desert areas. In the western desert, Wadi El-Farigh is consider an important situation covered about 151 km^2 (36000 fed.) and promising area for agricultural development.

Abu Khadrah (1973) mentioned that the physiographic units of Wadi El- Farigh soils were attributed as gravel plains, upland and low land areas. While, Said (2000) stated that soil surface of Wadi El- Farigh soils is essentially formed of sedimentary rocks and deposits belonging to the late tertiary (Pliocene, Miocene, Oligocene and Eocene) and Quaternary (recent deposits and crust formation).

Rashed *et al.*(2006) concluded that field investigation based on analysis of satellite image and GIS produce relatively cheap, fast and accurate maps.

The metrological data of Wadi El-Natrun station (from 2000-2010) recorded that its soil moisture regions is torric, and its soil temperature regime is Hyperthermic, (CLA 2010).El-Barkouky (1979) reported that aquifer water lies between 29^0 28\ to 38^0 o\ longitude and 22^0 45\to 23^0 o\latitude are classified as suitable for agriculture purpose. While, Abdel Aziz *et al.* (2004) stated that Nubian sandstone aquifer in the Western Desert reaching more than 1000 m depth. Where ground water exists under high artesian conditions. The upper most layers represent a free aquifer water with shallow depth.

The aims of the present study.

(1)Integrate GIS and modeling to create and utilize the detailed physiographic map of Wadi El-Farigh.

(2)Evaluate the soils of Wadi El-Farigh from morphological, and chemical viewpoints.

(3)Soil classification as well as their land capability, classification and suitability for specific crops; for the studied area as a base for optimum land use and its crop requirements in wadi El-Farigh.

MATERIALS AND METHODS

Location of studied area:

Wadi El-Farigh area is located between Latitude 30^0 06\ 59\\ to 30^0 12\ 56\\ North and Longitudes 30^0 36\ 31\\ to 30^0 45\ 44\\East. Figure (1), shows the location map of the studied area on the satellite images with roads network covering about 151 km^2 (36000 fed).

Remote sensing data and GIS techniques:

The physiographic units of the studied area were identified using data of Landsat Thematic Mapped (TM7), acquired during the year of 2009. The data are a composite of the band 2 (greed) band 3 (red) and band 4 (near infrared) with a pixel sizes of 28.5m and 30.0 m. GIS Integration based on the displays of topographic data (raster maps of 1:100,000 scale) to be

manipulated for the delineating the physiographic units by visual analysis as proposed by lueder (1959), Goosen (1967)and Sabins (1978).

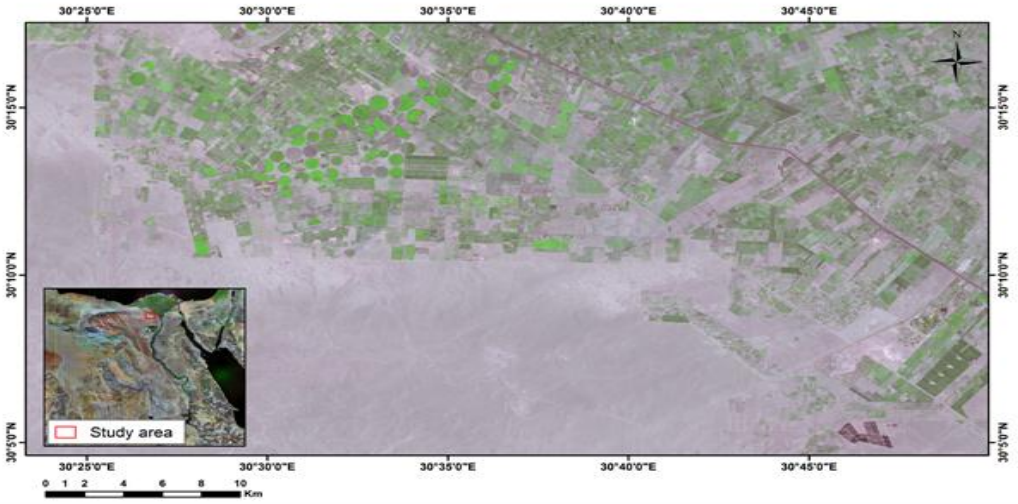

Fig (1): Location map of the studied area.

Field work:

Twelve representative soil profiles were selected to represent the main physiographic units of Wadi El- Farigh soils Fig. (2). The profiles were dug up to 150 cm depth, unless hindered by bedrock and the morphological description was done according to soil survey Manual of USDA (1993).

Laboratory analyses:

- Practical size distribution, soil reaction (pH) in saturated soil paste,electrical conductivity (E.c.) in soil saturation extract, soluble ions in soil saturation extract, gypsum contents, organic matter contents and total carbonate contents were determined volumetrically by using Collin's Calcimeterwere measured according to Black (1982).
- Sodium adsorption ratio (SAR) was calculated based on Page *et al*. (1982).

Soil classification and land evaluation:

Soils were categorized to the level of soil family using the keys to soil Taxonomy (USDA, 2010). Land evaluation and its suitability for the purpose of the agriculture use were assessed according to Sys and Verheye (1978) and Sys *et al* (1993).

RESULTS AND DISCUSSION:

Physiographic and soil Taxonomic units:

The identified physiographic units of the studied area are attributed as Dry valley, Alluvial Terraces, Wadi plain, Piedmont plain and Plateau rockland. These physiographic units of the studied area are shown in Fig (2).

1-**Dry valley.**

These land units are covering about 26 km^2 (17.2% of the total study area). They are formed as a result of action though the annual rainfall and surface runoff are active. These soils are represented by soil profiles from1 to five. Data in Tables 1, 2 and 3 show that the slope gradient varied between nearly levels to gently sloping. The soils are characterized by deep loamy sand to clay loam texture in massive structure and soft to slightly hard consistency. The gravel contents ranged from less than 2 to 30%, organic matter contents from 0.02 to 0.51 %, soil salinity (E.c) from 2.75 to 35.47 dS/m, soil pH from 7.68 to 8.0 and sodium adsorption ratio (SAR) from 6.41 to 25.98.

Feg 2

Tepl 1

Tepl 2

Tepl 3

TypicTorriorthents that blong to the recently formed soils (Entisols order) mainly dominate the Taxonomy units of these soils (Table 4). Three soil families were identified namely; coarse – loamy, fine –loamy and sandy over loamy, mixed hyperthermic in associations kind. However, the ***TypicHaplocalcids***, ***sand, mixed hyperthermic***, family that blong to Aridisols order was identified as miner soils (profile 5) in this physiographic unit.

Table (4):Dry valley taxonomic unites.

	Physiographic unit (Dry Valley)				
Order	**Sub order**	**Great group**	**Sub group**	**Taxonomic unit (Family)**	**Prof No**
Entisols	*Orthents*	*Torriorthents*	*Typic Torriorthents*	*TypicTorriorthents, coarse loamy, mixed, hyper- thermic.*	*1*
				TypicTorriorthents, sandy over loamy, mixed, hyperthermic.	*2*
				TypicTorriorthents, fine loamy, mixed, hyper- thermic	*3, 4*
Aridisols	*Calcids*	*Haplocalcids*	*Typic Haplocalcids*	*TypicHaplocalcids, sandy, mixed, hyperthermic.*	*5*

2-Alluvial Terraces.

These Alluvial Terraces are covering about 21km^2 (13.9% of the total study area). They are mostly distributed in north and south of Dry valley soils. Their elevation is generally higher than that of Dry Valley soils. Soil surface of Alluvial Terraces covered partly with Aeolian deposits, representing by profiles 6,7 and 8in Tables (1, 2 and 3). Its slope gradient varied between nearly levels to gently sloping. Their soil texture classes ranged from sandy to sandy clay loam, gravel contents from nil to 9.00%, organic matter contents from 0.04 to 0.22 %, gypsum content from 0.78 to 2.54%, total calcium carbonates from 1.49 to 12.35%, soil salinity (E.c) from 2.02 to 43.49 dS/m, soil pH from 7.25 to 8.34 and sodium adsorption ratio (SAR) from 6.17 to 34.42.

By using the soil Taxonomy (2010) and as shown in Table (5), the Alluvial Terraces soils also dominated by three soil families that blongto ***Typic Torriorthents*** family; fine- loamy over sandy, coarse–loamy and sandy, mixed, hyperthermic in associations kind.

Table (5): Alluvial Terraces taxonomic units.

Physiographic unit (**Alluvial Terraces**)					
Order	**Sub-order**	**Great group**	**Sub-group**	**Taxonomic unit (Family)**	**Prof No**
Entisols	*Orthents*	*Torriorthents*	*Typic Torriorthents*	*TypicTorriorthents, fine loamy over sandy, mixed, hyperthermic.*	8
				TypicTorriorthents , coarse loamy , mixed, hyperthermic	6
				TypicTorriorthents , sandy, mixed, hyperthermic.	7

3-**Wadi Plains.**

Soils of Wadi Plains are covering about 39 km^2 (25.38 % of the total study area). They are distributed in irregularforms alongthe Alluvial Terraces.These soils are represented in Tables (1, 2, 3). Their slopes is nearly level pertinent soil surface covered with desert pavement and sand sheets. Soil textural classes ranged from loamy sand to sandy clay loam, gravel contents from nil to 11%, organic matter contents from 0.06 to 0.19 %, gypsum contents from 0.65 to 1.01 %, total calcium carbonate from 1.48 to 4.02 %, soil salinity (E.c) from 0.98 to 11.35 dS/m, soil pH from 7.58 to 8.16 and sodium adsorption ratio (SAR) values from 4.2 to 14.44.Wadi Plains soils also haven't any diagnostichorizons. Soil Taxonomic units of these soils are attributed as ***TypicTorriorthents, fin loamy, mixed, hyperthermic,*** Table (6) and represented by profiles 9 and 10.

Table (6): Wadi Plains **taxonomy units**

Physiographic unit (Wadi Plains)					
Order	Sub-order	Great group	Sub-group	Taxonomic unit (Family)	Representative soil profiles
Entisols	***Orthents***	***Torriorthents***	***Typic Torriorthents***	***TypicTorriorthents, fine loamy, mixed, hyper- thermic.***	9 and 10

4-Piedmont Plain.

Piedmont Plain soils are covering about 40 km^2 (26.5% of the total study area), in which represented by profiles 11 and 12. Thy mostly surround both of Dry Valley and Alluvial Terraces. Soils having nearly level to gently

sloping gradient. Their soil texture classes ranged from sandy loam to sandy clay loam in deep to moderately, gravel contents from 16 to 45%, organic matter contents from 0.08 to 0.2%, gypsum contents from 1.48 to 2.3%, total calcium carbonate from 5.67 to 22.34%, soil salinity (E.c) from 10.81 to 31.02 dS/m, soil pH from 7.46 to 7.93 and sodium adsorption ratio (SAR) values from 15.52 to 41.42, Tables (1, 2, 3).These soils have diagnostic horizons; calcic in which developed in the soil surface and sub- surface layers including 22.34%; profile 12 and 16.35%; profile 11 of the total calcium carbonate, resp.Pertinent secondary formation calcium carbonates (10 to 15% by volume). Piedmont Plain soils are classified due to Soil Taxonomy as ***TypicHaplocalcids, loamy skeletal, mixed, hyperthermic.***

Table (7) :PiedmontTaxonomic units

Physiographic unit (Piedmont Plain)					
Order	**Sub-order**	**Great group**	**Sub-group**	**Taxonomic unit (Family)**	**Representative soil profiles**
Aridisols	*Calcids*	*Haplocalcids*	*Typic Haplocalcids*	*TypicHaplocalcids, loamy skeletal, mixed, hyperthermic.*	11and 12

Land evaluation:

The virgin lands of Wadi El- Farigh Physiographic units were evaluated to be utilized for agricultural land use without improving process. Accordingly, the integrated soil limitations may reduce its current suitability. The current and potential land suitability associated with soil limitations are shown in Table (8). Data reveal that the suitability index (Ci) of the studied Physiographicunit ranged from 28.57 to 77.16 and from 49.59 to 85.50 due to current and potential suitability, resp. Soil profiles could be categorized into three classes, according to Sys and Verhye (1978) as;

- Highly suitable soils (S1), However Ci > 75; representing by profile 9 (Wadiplain).
- Moderately suitable soils (S2), However Ci 75 -50; representing by profile 4 and 10; (Dry Valley and Wadi Plain, resp).
- Marginally suitable soils (S3), However Ci 50 -25; representing by profiles (1, 2, 3, and 5) for Dry Valley, profiles (6, 7 and 8) forAlluvial Terraces andprofiles(11 and 12) for Piedmont plain.

Current and potential suitability of the studied profiles; according to **Sys *et al* (1993)** were sorted in Table (9). Data is considered a guide chart for the best land utilization pertinent alternatives for the maximum output.

The proposed crops to be cultivated under modern irrigation system either annual or perennial are classified as the potential land suitability as follows;

1-High potential suitability (S1): soils of Dry Valley and Wadiplains are highly suitable for Olive.

2-Moderate potential suitability (S2): soils of Dry Valley and Wadiplains are moderately suitable forWheat, Barley, Maize, Sunflower, Sorghum, Onion, Watermelon, Citrus, Guava and Mango. While, soils of Terraces and Piedmont Plains are moderately suitable for Olive,Sesame, and Sorghum.

3- Marginal potential suitability (S3): soils of Dry Valley and Wadiplains are marginal suitable for Banana. While, soils of Terraces and Piedmont plains are marginal suitable for Wheat, Barley, Maize, Sunflower, Onion, Watermelon, Citrus, and Mango.

4-Not potential suitability (N): soils of Terraces are not suitable for Tomato and Banana.

CONCLUSION AND RECOMMENDATIONS

The profitable potentialities were sorted as a guide charts for the best land utilization along its alternatives.

The maximum output could be achieved by cultivating the most promising physiographic units;Wadi plain and dry valley. These units are covering about 27000 fed (43% of the total stadied area). They are highly suitable for olive and moderately suitable for wheat, barley, maize, sunflower, sorghum, onion, guava, and mango.

When these physiographic units become under demand for agriculture land use, we need more studies and details dealing with water resources quality pertinent modern irrigation systems. It could be recommended to use trickle and sprinkler irrigations in order to avoid land levelingprocess in which lead not only to deteriorate the soil physio-chemical properties but also to enhance its costs.

Tebl 8

Tebl 9

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تقييم صلاحية الأراضي للوحدات الفيزيوجرافية بوادي الفارغ، الصحراء الغربية، مصر.

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تقع منطقة الدراسة مابين خط عرض $30^0\ 12\backslash 56\backslash\backslash$ **الي** $30^0\ 06\backslash 59\backslash\backslash$ **شمالا وخط طول** $30^0\ 45\backslash 44\backslash\backslash$ **الي** $30^0\ 36\backslash 31\backslash\backslash$ **شرقا - وتقدر مساحتها بحوالي ١٥١ كم^2 .**

والهدف من هذه الدراسة هو تقييم الوحدات الفيزيوجرافية الأرضية وتصنيفيها وتحديد مدي صلاحيتها للزراعة.وتشير النتائج ان المنطقة تحت الدراسة تشتمل على أربعة وحدات فيزيوجرافية وهي:

١ -الوادي الجاف :Dry Valley والتي تتكون من أربعة وحدات تصنيفية هي:

a.-***TypicTorriorthents, coarse loamy, mixed, hyperthermic.***

b- TypicTorriorthents, sandy over loamy, mixed, hyperthermic.

c- TypicTorriorthents, fine loamy, mixed, hyperthermic.

d- TypicHaplocalcids, sandy, mixed, hyperthermic.

٢– الشرفات الرسوبية: Alluvial Terrace والمغطاه جزئيا بالترسيبات الريحية وبها ثلاث وحدات تصنيفية هي:

a-***TypicTorriorthents, fine loamy over sandy, mixed, hyperthermic.***

b- TypicTorriorthents, coarse loamy, mixed, hyperthermic

c- TypicTorriorthents, sandy, mixed, hyperthermic.

٣- سهول الوديان Wadi plain : والتي تحتوي علي وحدة تصنيفية واحدة هي :

a- TypicTorriorthents, fine loamy, mixed, hyperthermic.

4- السهل السفحي PlainPiedmont : وهي تحتوي ايضا على وحدة تصنيفية وهي:

e-TypicHaplocalcids, loamy skeletal, mixed, hyperthermic.

وقد أمكن تقسيم صلاحية أراضي تلك الوحدات الفيزيوجرافية الى ثلاث درجات وهي:

أراضي جيدة الصلاحية (S1) لبعض أراضي سهول الوديان، متوسطة الصلاحية(S2) لإراضي الوادي الجاف وسهول الوديان، حدية الصلاحية (S3) لإراضي الشرفات والسهل السفحي.

وتشير دالة توافق التقييم الأراضي بصفات ومحددات التربة للمحاصيل التي تم اختيارها للزراعة لتعطي أعلي عائد الي درجات صلاحية هي:

ا- جيدة الصلاحية (S1) وتوجد في بعض الأراضي الوادي الجاف وسهول الوديان لزراعة الزيتون.

ب- متوسط الصلاحية (S2): وتوجد في بعض الأراضي الوادي الجاف وسهول الوديان لزراعة القمح، الشعير، الذرة، القطن، السمسم، عباد الشمس، السورجم، البصل، البطيخ، الموالح، الجوافة، المانجو. كما يوجد في بعض الشرفات والسهل السفحي لزراعة الزيتون، السورجم، السمسم.

ج- حدية الصلاحية (S3): وتوجد في بعض الأراضي الوادي الجاف وسهول الوديان لزراعة الموز. كما يوجد في بعض الشرفات والسهل السفحي لزراعة القمح، الشعير، الذرة، عباد الشمس، البصل، البطيخ، الموالح، المانجو.

د- غير صالحة للزراعة (N): وتوجد في بعض الأراضي الشرفات لزراعة الطماطم والموز.