LAND EVALUATION MODEL OF PHYSIOGRAPHIC-SOIL UNITS FOR SPECIFIC AGRICULTURE LAND USE IN BENI SUIF AREA, EGYPT

Afify A. Afify, Ashraf A. Mohammed, Ibrahim A. El Gammal and Samy M. Abd Allah*
Soils, Water and Environment Research Institute, Agricultural Research Center, Giza, Egypt.
* Soils Dept., Fac. of Agric., Ain Shams Univ., Egypt

ABSTRACT:

The area of Beni Suif is considered a good model for representing many of the landscape features in Egypt. So, it was selected to be identified within the context of physiography, soil classification and land evaluation for specific agriculture land use. This area includes both the continental alluvium of River Nile and desert sediments, that were derived from local parent rocks. The physiographic features were identified, using visual interpretation of aerial photographs and Landsat data ETM7 (Enhanced Thematic Mapper 7), according the applied physiographic approach, and found to be as pediplain, bajada, alluvial terraces, wadis, aeolian plain and River Nile deposits. The meandering River Nile deposits were subdivided as Nile meandering belt (river bank, ox-bow bars and levees) and Nile alluvial plain, the later landforms whether is flat or almost flat slightly depressed. The rock structures were delineated as dissected cuesta of summits and fronts or as rock outcrops. Forty mini pits were located and studied for setting up a characteristic map legend. The differences were represented by twelve soil profiles to be fully described and soil samples were selected for laboratory analyses.

Soil taxa were categorized according to the key of Soil Taxonomy (USDA, 2003) till the soil family level into:

i)The *Aridisols*, soil families are a) *Lithic Haplocalcids*, *loamy skeletal* in pediplain and b) *Typic Calcigypsids*, *sandy skeletal* in bajada.

ii) The *Vertisols* include a) *Typic Haplotorrerts*, *clayey* (semectitic) in the flat alluvial plain and b)*Halic Haplotorrerts, clayey,* (semectitic) in the slightly depressed alluvial plain.

iii) The *Entisols* include a) *Typic Torriorthents*, *fine loamy* in the river bank, b) *Typic Torriorthents*, *clayey over fine loamy* in levee and c) *Typic Torriorthents*, *loamy skeletal* in alluvial terraces.

In the ox-bow bars the soils are in a complex pattern of a) *Typic Torriorthents*, *sandy* and *b) Typic Torriorthents*, *coarse loamy.*

Soils of wadis, soils are found in a complex pattern of a) *Typic Torrifluvents*, *fine loamy over sandy*, *(calcareous) and b) Typic Torrifluvents*, *loamy skeletal.* As for aeolian plain, the soils *are Typic Torripsamments*. All the studied soils are mixed, except those of *Vertisols*, and *hyperthermic.*

The physiographic-soil units were evaluated for agriculture specific use of certain crops to asses the supreme current and potential suitability for the different crops to give the maximum output. The land suitability is presented on the physiographic-soil units as land suitability guide maps for alfalfa, barley, cotton, maize, sorghum, sunflower, tomato, wheat, banana, citrus, guava, mango and olive.

Key words: Land evaluation, Physiographic units, Beni Suif region and Soil taxa.

INTRODUCTION

The data of the current study were created to update and support the local knowledge, concerning the best use of land whether be under demand for agriculture use or be planned for later on use. 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. It is also to find the best adaptation between certain land unit with specific crop to give the maximum output. For this purpose, the harmony of descriptive and processing systems, established by **Sys (1991) and Sys *et al*. (1993)** were considered, being highly required in this study. The collective finding of this study creates and document digital geospatial data sets, using GIS During processing and integrating digital layers of Landsat image, basic topographic maps, physiographic-soil map and land suitability maps. The result is a comprehensive digital land evaluation database for certain area in Egypt. These data can be matched with the other products, produced as the same global standard.

MATERIAL AND METHODS:

1.Aerospace image-interpretation:

Aerial photo-interpretation was performed to delineate the different physiographic units based on the physiographic analysis as proposed by **Burnigh (1960) and Gossen (1967)**. This approach is to identify soil bodies on the context of dynamic processes, as the deposition types and development modes. This step was helpful for detecting the differences of the micro relief within the almost flat areas as using the stereoscopic vision of the land surfaces.

Landsat image composite of Enhanced Thematic Mapper (ETM7) with bands 2,3 and 4 was used to add an extra landscape assessment to the photo-interpretation map. The image was helpful for getting a collective overall view of the studied area as well as using the spectral signatures of the used bands in detecting the cultivated areas and drainage conditions.

2. Field work:

The preliminary interpretation map was checked in the field to confirm the boundaries of the physiographic units. Twelve pedons and 40 mini pits were located to represent the different physiographic units. Their soil taxa were categorized according to Soil Taxonomy (USDA, 1999) and the key of Soil Taxonomy (USDA, 2003). Soil profiles were dug to 150 cm, or to lithic contact and were described according to the nomenclature of USDA (2003) and the Mmunsell Colour **Chart (1975)** they are shown in Table (1).

3. Laboratory analyses:

Particle size distribution was carried out according to method undertaken by **Piper (1950)**, $CaCO_3$ content by using the Collin's Calcimeter **(Black *et al*., 1965).** The water extract components in the soil paste extract were determined according to **Jackson (1969).** Soil pH was measured in the saturated soil paste **(Richards, 1954).** Gypsum was determined by the acetone method **(Bower and Huss, 1948)**.

Tab. 1

Cation exchange capacity (CEC) and the exchangeable cations were determined, according to **Tucker (1954)**.

4. Producing digital maps:

The geocoded layer of base maps were used to rectify the ETM image and the photo-interpretation map. The vector layer of the delineated physiographic units from the aerial photographs was fused with the corresponding one on the used image. This physiographic map layer has been clipped per ETM (Egyptian Transfer Mercator) zone for easy overlaying with image. It is projected to the specified ETM zone and use the WGS84 spheroidis. The land suitability maps were digitally built on the physiographic one

5. Land suitability classification:

land suitability classification for specific crops was done according to **Sys *et al.* (1991)**, which based on matching the land characteristics with the crop requirements, considering the limitation intensity .

RESULTS AND DISCUSSION:

1. Physiographic-soil units:

Physiographic-soil legend has been set up as shown in Table (1), associated with the morphological description of the representative soil profiles. Soil taxa after soil physical and chemical analyses are presented in Tables (2 and 3), respectively. The physiographic-soil units were delineated in Map (1). They were categorized as follows :

i) Pediplain:

This physiographic unit was formed under the prevailing aridic conditions through an action of physical weathering processes on the limestone parent rock. This unit has sloping to gently sloping, gravely and stony surfaces including somewhat well drained soils. Its polygons are the remnants of weathered limestone rock, including residual parent material over limestone lithic contact at the depth of 40-50 from soil surface. This parent material developed to *Aridisols*, being with calcic horizon (BK). They are very gravely with control sections, dominated by sandy loams. The soils were classified as *Lithic Haplocalcids, loamy skelatal, mixed hyperthermic.* These soils were represented by soil profile No.1.

ii) Bajada:

This unit is a depositional belt, in the studied area, along the elevated rock structures of cuestas when the fans coalesce laterally to form that bajada. It is broad and gently inclined, alluvial piedmont slope extending from the base of cuesta range out into a relatively low basin east and north-eastwards. Bajada surface is gullied, gently sloping and gravelly. The soils are well drained, classified as *Typic Calcigypsids sandy skelatal, mixed, hyperthermic*. These soils are more developed than those the pediplain, being with calcic "Bk" and gypsic "By" horizons. They are represented by soil profile No.2.

iii) Alluvial terraces:

These terraces are located adjacent west of the aeolian plain. According to **Said (1990)**, they are remnants of formerly deposited floodplain during a process preceded the recent River Nile deposits of Holocene Era.

Table 2: Particales size distribution %, calcium carbonate and gypsum contents of the studied profiles.

Physiographic units	Profile No.	Depth (cm)	Gravel %	Particle size distribution %				Modified texture class	$CaCO_3$ %	$CaSO_4.2H_2O$ %
				C. sand	F. sand	Silt	Clay			
Pediplain	1	0-20	35	20.3	29.7	18.8	31.2	VGSCL	50.0	1.8
		20-40	35	34.9	30.1	14.5	20.5	VGSL	50.9	1.5
		40-	Limestone hard parent rock							
Bajada	2	0-20	35.0	49.0	20.0	13.5	17.5	VGSL	44.5	1.9.00
		20-50	40.0	46.7	35.7	6.9	10.7	VGLS	11.1	32.90
		50-150	45.0	43.5	39.5	8.2	8.8	VGLS	21.3	19.10
Alluvial terraces	3	0-15	35.0	36.6	20.1	12.4	30.9	VGSCL	9.8	0.35
		15-40	40.0	35.2	28.4	16.1	20.3	VGSC	9.8	0.40
		40-75	35.0	25.8	26.8	17.4	30.0	VGSCL	8.4	0.41
		75-150	30.0	33.6	19.8	15.7	30.9	GSCL	9.0	0.35
Wadi	4	0-15	5.0	60.0	23.1	7.7	9.2	SGLS	30.0	1.10
		15-35	10.0	26.4	24.6	18.3	30.7	SGSCL	32.0	1.10
		35-65	5.0	28.5	27.0	13.9	30.6	SGSCL	35.6	0.70
		65-150	5.0	54.3	33.9	3.7	8.1	SGS	30.5	1.00
	5	0-15	40.0	29.8	25.3	14.4	30.5	VGSCL	8.8	0.25
		15-45	35.0	34.0	28.5	17.0	30.5	VGSCl	10.1	0.44
		45-70	30.0	24.5	29.6	20.3	25.6	GSCL	8.5	0.51
		70-150	35.0	60.0	7.8	10.2	22.0	VGSL	7.5	0.63
River bank	6	0-30	0.0	10.5	40.0	19.0	30.5	SCL	1.1	0.25
		30-60	0.0	9.7	42.0	17.3	31.0	SCL	0.9	0.34
		60-120	0.0	10.0	39.6	19.5	30.9	SCL	1.1	0.35
Ox-bow bar	7	0-10	0.0	12.7	70.1	5.6	11.6	LS	1.2	0.36
		10 40	0.0	30.5	49.7	6.7	12.1	LS	0.6	0.35
		40-60	0.0	52.3	28.0	10.0	9.7	LS	0.6	0.64
		60-150	0.0	60.0	20.6	5.9	13.5	LS	0.4	0.66
	8	0-10	0.0	49.1	37.5	5.9	7.5	LS	1.1	0.80
		10 40	0.0	30.9	53.2	11.1	4.8	LS	1.0	0.48
		40-60	0.0	23.1	45.4	13.8	17.7	SL	1.1	0.30
		60-150	0.0	20.7	47.5	12.3	19.5	SL	0.8	0.55
Levees	9	0-15	0.0	2.0	53.4	14.0	30.6	SCL	1.4	0.40
		15-30	0.0	1.0	56.1	12.0	30.9	SCL	1.3	0.70
		30-75	0.0	2.0	51.8	10.7	35.5	SC	1.2	0.40
		75-150	0.0	1.9	49.8	17.9	30.4	SCL	1.2	0.35
Alluvial plain (flat)	10	0-10	0.0	3.5	28.3	23.6	44.6	C	2.4	0.32
		10- 40	0.0	2.9	23.4	25.5	48.2	C	1.6	0.70
		40-60	0.0	1.9	25.6	20.6	51.9	C	2.2	0.64
		60-150	0.0	1.8	22.6	23.7	51.9	C	2.6	0.55
Alluvial plain (slightly depressed)	11	0-20	0.0	3.5	19.6	14.5	62.4	C	2.0	0.96
		20-50	0.0	3.7	20.4	12.8	63.1	C	1.9	0.97
		50-100	0.0	2.9.0	18.7	12.6	65.8	C	2.4	0.93
Aeolian plain	12	0-20	0.0	83.7	7.8	3.4	5.1	S	6.7	0.40
		20-60	0.0	78.6	9.9	4.6	6.9	S	8.1	0.70
		60-150	0.0	81.6	7.5	4.4	6.5	S	8.9	0.60

Table 3: Chemical analysis od soil paste extract of the studied soil profiles.

Physiographic units	Profile No.	Depth (cm)	pH	EC (dS/m)	Cations (meq / L)				Anions (meq / L)		
					Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	$SO4^{--}$
Pediplain	1	0-20	7.7	37.6	81.0	39.5	250.00	6.50	3.90	301.4	71.70
		20-40	7.5	33.0	83.0	44.1	236.70	4.00	3.50	3.1	361.18
Bajada	2	0-20	7.9	7.3	18.6	12.5	40.40	2.10	2.40	55.4	15.80
		20-50	7.8	14.1	29.3	17.7	102.50	4.20	3.00	93.7	57.00
		50-150	7.3	20.1	43.8	29.9	137.20	4.50	2.90	133.9	78.60
Alluvial terraces	3	0-15	7.6	4.9	15.6	9.3	24.20	1.70	2.50	35.7	12.60
		15-40	7.8	3.7	10.0	4.6	23.70	1.30	3.10	30.6	5.90
		40-75	7.9	4.9	13.8	3.9	33.40	1.90	4.50	32.9	15.60
		75-150	7.5	4.8	16.6	6.9	27.00	1.90	2.90	36.3	13.20
Wadi	4	0-15	7.3	3.6	7.5	4.6	27.00	1.20	2.80	25.6	11.90
		15-35	7.2	3.9	8.4	2.9	26.00	1.90	3.60	28.7	6.90
		35-65	7.1	2.5	6.0	2.5	15.00	1.50	3.90	18.5	2.60
		65-150	7.3	3.8	7.4	3.6	24.50	2.10	2.50	19.1	16.00
	5	0-15	7.6	3.9	12.2	8.3	17.90	2.70	2.10	34.7	4.30
		15-45	7.8	3.8	9.9	4.6	20.70	1.20	3.20	31.6	1.60
		45-70	7.9	4.5	12.8	3.9	30.40	1.50	4.20	32.6	11.80
		70-150	7.5	4.6	16.4	6.9	26.70	2.00	2.80	35.3	13.90
River bank	6	0-30	7.5	1.2	3.0	2.2	6.10	0.65	1.25	8.1	2.60
		30-60	7.3	1.0	2.9	2.7	5.00	0.45	1.40	6.3	3.35
		60-120	7.6	1.2	2.8	2.8	5.90	0.55	1.40	7.9	2.75
Ox-bow bar	7	0-10	7.3	1.2	3.4	2.9	5.20	0.65	1.30	8.1	2.75
		10 40	7.4	1.9	6.9	2.3	9.50	0.70	1.70	10.2	7.50
		40-60	7.4	1.8	4.5	2.1	10.90	0.55	1.25	12.3	4.50
		60-150	7.6	3.3	7.9	5.3	19.70	1.40	2.10	23.0	9.20
	8	0-10	7.1	1.2	3.5	3.5	5.00	0.25	1.40	7.5	3.35
		10 40	7.3	1.5	3.9	2.1	8.50	0.65	1.60	9.9	3.65
		40-60	7.6	0.9	2.9	1.7	4.90	0.45	1.50	5.1	3.35
		60-150	7.3	1.2	4.1	1.3	6.25	0.35	1.80	7.7	2.50
Levee	9	0-15	7.9	1.3	4.3	3.2	5.10	0.55	2.10	8.0	3.05
		15-30	7.7	1.5	3.6	2.9	8.20	0.45	2.20	9.7	3.25
		30-75	7.5	1.2	3.1	2.4	6.20	0.35	1.90	7.5	2.65
		75-150	7.6	1.7	4.2	1.8	10.50	0.65	2.30	9.3	5.55
Alluvial plain (flat)	10	0-10	7.3	3.2	7.7	5.1	19.30	1.30	2.90	24.0	6.50
		10- 40	7.5	1.1	3.4	2.6	5.40	0.50	1.90	7.2	2.80
		40-60	7.6	1.5	3.9	2.5	8.10	0.60	1.60	10.0	3.50
		60-150	7.4	1.3	4.6	2.9	4.90	1.10	2.10	7.7	3.70
Alluvial plain (slightly depressed)	11	0-20	7.6	19.0	55.3	27.4	120.00	3.40	4.10	124.5	77.50
		20-50	7.4	16.3	28.3	14.9	123.00	3.40	3.50	107.0	59.10
		50-100	7.5	178	27.5	13.6	140.60	5.60	3.50	132.4	51.40
Aeolian plain	12	0-15	7.6	1.3	4.4	1.2	6.70	0.70	1.25	9.2	2.55
		15-35	7.6	1.7	5.7	1.2	9.37	0.73	1.70	13.1	2.20
		35-65	7.9	1.5	4.6	2.1	7.65	0.65	2.10	10.6	2.30
		65-150	7.4	1.6	5.3	1.6	8.20	1.00	1.85	11.3	2.85

Map. 1

On this plain, consequent streams, that follows the initial slope of the land (eastwards) were rejuvenated, resuming down-cutting, thereby forming terraces, resulting in gullied surfaces of concave convex complex slopes (gently undulating topography). The soils are classified as: *Typic Torriorthents, loamy skeletal, mixed hyperthermic.* This soil family is characterized by sandy clay loams including more than 35% by volume coarse fragments. The soils are represented by profile No.3

iv) Wadis:

The surface of wadi is almost flat, partly vegetated with very open zerophytic herbaceous as natural vegetation on well drained soils. This physiographic unit is the resultant of dissection action of the surrounding landscape as the interaction of erosional and depositional processes in the fluvial period. They appear as dry wadis, that seasonally receive flush flooding, running from east to west or northwest, draining into the River Nile, causing seasonally flooding hazards. The soils of these wadis occur in a complex pattern and dominated by two taxonomic units of *Torrifluvents*. They are classified as *soil complex of Typic Torrifluvents, fine loamy skeletal over sandy, mixed, (calcareous).* The *Fluvents* have two contrasting particle size classes within the control section, sandy clay loam in the upper part and loamy sands in the underlying one (profile 4). The other *Fluvents* are *Typic Torifluvents, loamy skeletal, mixed, hyperthermic.* This soil family is characterized by sandy clay loams including rock fragments make up 35 percent or more (by volume). The soils are represented by profile No.5

v) Nile alluvium:

The Nile alluvium occurred under a specific depositional actions of meandering river resulting in different physiographic units. Mount (1995) stated that, in the case of meandering river, where channel reaches inundate its floodplains, depositional processes, rather than erosional processes, can act to expand the channel capacity. Discharge that is fully confined to a channel maintains high competence. When discharge exceeds channel capacity, there is a dramatic increase in cross-sectional area associated with expansion into the floodplain. The velocity and depth of water flowing outside of the channel declines rapidly with distance away from the channel. The coarsest sediment (usually fine sand and silt) undergoes rapid deposition immediately adjacent to the channel, while the finest sediment is deposited away from the channel out on the floodplain.

In this study, the physiographic units formed by the meandering River Nile were categorized under meandering belt deposits and the in-undated plain, as follows:

a) Meandering belt:

This meandering belt is either located, aligning the two sides of the river (levees and river banks) or standing in the river course (ox-bow bars). It is categorized in the following:

a-1) River bank:

According to **Mount (1995)**, in asymmetric channels, the velocities and gradients are always located adjacent to the steep-walled cut banks. The concentration of bed shear stress along the cut bank margin of asymmetric channels will cause them to erode the channel wall and expand laterally. In asymmetric channels, deposition is usually restricted to the low-velocity margin of the channel opposite the most intense erosion.

In the studied area, these river banks are cultivated, flat, having well drained soils. They occupy strips aligning the River Nile coarse, including soils of *Typic Torriorthents, fine loamy, mixed hyperthermic.* The profile control section is dominated by sandy clay loams textural class. They are represented by profile No.6.

a-2) Oxbow bar:

This bar appears inside meander bends as asymmetrical islands, surrounded by water, with different elevations. It is associated with a narrow channels (abandoned) in a side and wide one in the other side. The bar is cultivated, and consists of coarse-grained parent material, having soil complex of excessively well drained soils of *Typic Torriorthents, sandy, mixed hyperthermic*. The soils are sandy, being the textural class is dominated by loamy sands. They are represented by profile 7. The other taxonomic unit includes *Typic Torriorthents, coarse loamy, mixed hyperthermic*. They are represented by profile (8).

a-3) Levee:

The levee is raised embankment of a river with a very gentle slopes westwards. It appears adjacent to the River banks and Nile channel as a result of multiple flooding above the level of its outer floodplain and are immediately located near the river banks The levee was formed by the periodic flooding, including coarser sediments, that were immediately deposited due to a flow reduction. It is cultivated on very gently sloping, well drained soils. The taxonomic unit is *Typic Torriorthents, clayey over fine loamy, semectitic, hyperthermic,* and it is represented by profile No 9.

b) Alluvial plain:

This broad alluvial plain was formed after the receding floodwaters, seasonal and periodic flooding of the stream after seasonal and periodic flooding of the River Nile coarse, resulting in a low-lying flat to almost flat plains with somewhat well drained soils of heavy- textured parent material. They are subjected to the swelling and shrinkage process fitting the main requirement to be *Vertisols*. The plain is cultivated and separated from the River Nile channel by levees. This plain is subdivided as follows:

b-1) Flat relatively young plain:

The soils of this plain are classified within the *Vertisols* to be *Typic Haplotorrerts, clayey, semectitic, hyperthermic*. The soil family is clayey, being the control section is fully characterized by clayey layers. These soils are represented by profile No. 10.

b-2) Almost flat relatively developed slightly depressed plain

The polygons of this unit occupy the far west areas of the broad alluvial plain as slightly depressed spots , which are most probably represent an old river bed of decayed River Nile branch. The soils are classified as *Halic Haplotorrerts, clayey, semectitic, hyperthermic*. This soil family is similar to the aforementioned one but the soils are strongly saline (EC more than 15 dS/m). The salinization process shift the taxonomic unit to be *Halic* rather than *Typic* (profile 11).

vi) Aeolion plain:

The parent material of this physiographic unit is deposited by wind action. This plain is located on the margins of the clayey plain (Nile alluvium), immediately bordering the old cultivated area in the western side. It is most probably that, these aeolian deposits are covering an old river bed that was naturally vegetated. The plain is recently cultivated and is locally occupied by sinuous clustered dunes occur south-northeast trending, which are currently retreated as subjected to the man-made excavation. This plain includes excessively well drained coarse textured soils, that classified as *Typic Torripsamment, mixed hyperthermic*. Its soils are represented by profile No. 11.

vii) - Miscelaneoud landtypes:

These structures are divided into two physiographic units, as follows:

a) Cuesta (C):

This physiographic unit represents the remnants of a structural plateau, subjected to severe dissection resulting in a rocky structure, that be divided into two sub units as:

a-1) Cuesta summit:

This summit represents the original elevation of the limestone body before the dissection processes.

a-2) Cuesta front:

These fronts are lobated rocky slopes covered by talus and pediments with a complex pattern of steep and rolling concave convex surfaces.

b) Rock outcrops:

These rock outcrops are found as isolated local structures, that are mostly located in the pediplain

II. Land evaluation:

In this study, the physiographic soil map was used as a base for presenting land suitability classes. The simple approach that proposed by **Sys (1991)** was selected for land suitability evaluation of the studied area, since it is valid for irrigation purposes in arid and semi arid regions. By this approach, the classification was processed according to the FAO framework (1976), at the level of sub-classes.

The evaluation of land characteristics was done by rating them and specifying their limitations by matching the calculated rating with the crop requirements in different suitability levels as proposed by **Sys *et al.* (1993)**. These assessments based on the soil taxa, included in Tables (1-4).

i) Current land suitability classification (CS):

Without major land improvement, the crop requirements were matched with the present land qualities for assessment the current land suitability of the different physiographic units in the studied area.

Table 4: Cation exchange capacity and exchangeabl cations ($cmol_c$ kg^{-1}soil) of the studied soil profiles.

Physiographic unit	Prof.ile No.	Depth (cm)	C.E.C	Exchangeable cations ($cmol_c$ kg^{-1}soil)				ESP
				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	
Pediplain	1	0-20	15.89	9.19	3.99	2.27	0.44	14.30
		20-40	14.39	8.63	3.80	1.63	0.34	11.28
Bajada	2	0-20	13.38	7.90	3.56	1.24	0.68	9.30
		20-50	5.12	2.30	1.35	1.12	0.35	21.80
		50-150	4.91	1.90	1.85	0.79	0.37	19.30
Alluvial terraces	3	0-15	16.52	8.32	5.90	1.65	0.65	9.99
		15-40	14.65	7.50	6.20	0.75	0.20	5.12
		40-75	16.80	9.30	6.00	1.30	0.20	7.74
		75-150	15.50	8.25	6.00	0.95	0.30	6.13
Wadi	4	0-15	4.85	2.49	1.80	0.25	0.31	5.00
		15-35	16.95	8.10	6.10	1.20	1.55	7.10
		35-65	17.10	7.92	6.81	1.07	1.30	6.30
		65-150	3.18	1.83	1.10	0.14	0.11	4.30
	5	0-15	15.30	7.32	5.83	1.63	0.52	10.65
		15-45	15.50	8.12	6.21	0.59	0.58	3.85
		45-70	15.01	6.92	6.19	1.30	0.60	8.66
		70-150	11.91	5.80	4.11	1.28	0.72	10.74
River bank	6	0-30	26.27	14.10	11.27	0.57	0.42	2.18
		30-60	29.18	17.64	10.18	0.54	0.82	1.82
		60-125	28.21	16.25	11.06	0.60	0.30	2.11
Ox-bow bar	7	0-10	8.30	3.10	3.38	0.34	0.20	4.15
		10-40.	9.40	3.08	3.48	0.41	0.10	4.44
		40-60	7.03	2.08	2.49	0.45	0.10	6.45
		60-150	10.14	3.10	3.65	0.41	0.08	4.10
	8	0-10	4.50	2.90	1.20	0.25	0.15	5.55
		10-40.	3.86	2.08	1.10	0.22	0.40	5.73
		40-60	12.27	8.79	5.24	0.66	0.58	4.30
		60-150	14.83	8.30	5.21	0.82	0.500	5.53
Levee	9	0-15	27.35	19.81	7.93	0.94	0.58	3.52
		15-30	30.02	21.11	7.43	0.71	0.77	2.37
		30-75	33.15	23.15	8.89	0.65	0.46	1.98
		75-150	28.13	20.09	7.43	0.96	0.65	3.41
Alluvial plain (flat)	10	0-10	42.90	20.30	15.65	3.77	2.05	8.80
		.10-40	45.20	22.90	16.04	4.29	1.89	9.50
		40-60	49.30	25.91	15.60	5.18	2.61	10.50
		60-150	49.50	24.80	17.10	3.61	1.99	7.60
Alluvial plain (slightly depressed)	11	0-20	49.30	23.15	15.15	10.03	0.97	20.35
		20-50	51.21	24.13	15.09	10.90	1.09	21.29
		50-100	54.89	25.31	15.95	11.19	2.44	20.39
Aeolian plain	12	0-20	6.30	3.50	2.20	0.45	0.15	7.14
		20-60	4.10	1.63	2.10	0.23	0.14	5.80
		60-150	4.58	2.88	1.20	0.30	0.20	6.55

Map. 2

This approach enables management of different alternatives for specific utilizations These utilizations are adapted to the existing limitations to give maximum output. The overall current suitability assessments are shown in Table (5), whereas the supreme current land suitability assessments were sorted and presented in Map (2).

ii) Potential land suitability classification (PS):

For this purpose, the land suitability classification was based on the suitability of certain land for specific utilization. It is applicable after executing specified major land improvements as proposed in this study according to their necessity. For establishing potential land suitability classification, the main land improvements for the studied area are considered for the land qualities of drainage, salinity and sodicity. The minor limitations can be improved under specific land management, concerning each of them.

The obtained potential land suitability sub-classes were sorted for the maximum productive levels (supreme potential land suitability). These levels were designed to be guide charts and maps for the best land utilization alternatives, giving a possible maximum output. The potential land suitability data are shown in Table 5. The selected crop-land adaptations to be the supreme land suitability for specific utilized crop are shown in Map (3). These adaptations can be described as follows:

a. Highly suitable (S1) adaptations:

Soils of Nile meandering belt (river bank and levees), Nile alluvial plain (the flat and slightly depressed) are highly suitable for alfalfa, barley, cotton, maize, sorghum, sunflower, tomato, wheat, banana, citrus, guava, mango and olive.

Soils of Nil meandering belt (ox-bow bar) are highly suitable for alfalfa, maize, sorghum, sunflower citrus, mango and olive. Cotton, tomato and guava are partly highly suitable within the complex pattern of these ox-bow bars

Soils of Wadis are highly suitable for sorghum and olive but partly for sunflower

Soils of alluvial terraces are highly suitable for sunflower and olive.

Soils of Aeolian plain are highly suitable for olive

b. Moderately suitable S2 adaptations:

Soils of bajada are moderately suitable for olive

c. Marginally suitable S3 adaptations:

Soils of pediplain are marginally suitable for barley, sorghum and wheat.

Tab. 5

Map. 3

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نموذج تقييمى لوحدات التربة الفيزيوجرافية لاستخدام زراعي معين
في منطقة بني سويف- مصر

عفيفى عباس عفيفى، أشرف عبد الغنى محمد، ابراهيم عبد العزيز الجمال، سامى محمد عبدالله*
معهد بحوث الأراضى والمياه والبيئة - مركز البحوث الزراعية - جيزة - جمهورية مصر العربية
* كلية الزراعة، جامعة عين شمس - جمهورية مصر العربية.

تعتبر منطقة بنى سويف نموذجا ممثلا لمعظم ملامح الوحدات الارضية فى مصر وقد اختيرت هذه المنطقة لتعريفها من خلا ل المفهوم الفيزيوجرافي وتصنيف التربة وتقييمها بغرض استخدامات زراعية معينة. وتضم هذة المنطقة الترسيبات القارية لنهر النيل وأيضا الترسيبات الصحراوية المتاخمة لها والتي اشتقت من صخور الأم المحلية. ولقد تم تعريف الوحدات الفيزيوجرافية عن طريق تحليل الصور الجوية وصور القمر الاستطناعي (ETM 7) مع تطبيق المنهج الفيزيوجرافى. ومن خلال هذا التحليل وجد ان منطقة الدراسة تتكون من سهل تجوية والذي يحتوي على مادة اصل متبقية، الباجادا، المصاطب الرسوبية، الوديان، سهل الترسيبات الهوائية وترسيبات نهر النيل.وقد قسمت ترسيبات نهر النيل الي النطاق المتعرج لنهر النيل ويضم ضفاف النهر، القواطع المنحنية داخل مجري النهر والاكتاف النهرية. اما السهل الرسوبي فيضم جزءا مستويا وآخر منخفضاً نسبيا. بالنسبة للتكوينات الصخرية فتتكون من كويستا وبروزات صخرية.

تم تحديد أربعين موقعا لحفر نقاط ملاحظة أرضية صغيرة من اجل تصميم مصطلحات الخريطة حيث تم تمثيل تبايناتها بدراسة تفصيلية لاثني عشرة قطاعا للتربة اخذت منها عينات للتربة وتم تحليلها معمليا. صنفت خواص التربة حسب دليل نظام التصنيف الأمريكي لعام (٢٠٠٣) حتي مستوي عائلات التربة حيث وجد ان الأراضي المتكونة تتبع ثلاثة رتب تشتمل على العائلات التالية:

i)The *Aridisols*, soil families are a) *Lithic Haplocalcids, loamy skeletal* in pediplain and b) *Typic Calcigypsids, sandy skeletal* in bajada.

ii) The *Vertisols* include a) *Typic Haplotorrerts, clayey* (semectitic) in the flat alluvial plain and b)*Halic Haplotorrerts, clayey,* (semectitic) in the slightly depressed alluvial plain.

iii) *Entisols* include a) *Typic Torriorthents, fine loamy* in the river bank, b) *Typic Torriorthents, clayey over fine loamy* in levee and c) *Typic Torriorthents, loamy skeletal* in alluvial terraces.

وبالنسبة للقواطع المنحنية داخل مجري النهر فان تداخلات التربة نتج عنها وحدتان تصنيفيتان لعائلتي التربة هما:

a) *Typic Torriorthents, sandy* and b) *Typic Torriorthents, coarse loamy.*

وفى المصاطب الرسوبية فقد صنفت عائلة التربة*Typic Torriorthents, loamy skeletal*

أما بالنسبة لأراضى الوديان الحديثة فإنها تضم عائلات التربة والتي توجد في نظام ارضي متداخل مثل *Typic Torrifluvents, fine loamy over sandy, (calcareous)*، حيث تتواجد متداخلة مع *Typic Torrifluvents, loamy skeletal*، أما في السهل المتكون بالرياح فان عائلة التربة عبارة عن *Typic Torripsamments.*

تم تقييم أراضى الوحدات الفيزيوجرافية بغرض زراعة محاصيل معينة لتحديد درجة الصلاحية الأعلي لكل محصول في كل وحدة فيزيوجرافية سواء بالنسبة لصفات التربة الحالية او بعد تحسينها، وقد اختير لهذا التقييم الحاصلات الحقلية (البرسيم الحجازي، الشعير، القطن، الذرة، الذرة العويجة، دوار الشمس، القمح)، الخضر (الطماطم)، الفاكهة (الموز، الموالح، الجوافة، المانجو والزيتون)، حيث قدمت هذه الموائمات بين الوحدات الفيزيوجرافية والمحاصيل المختلفة في جداول وخرائط لتكون دليلا للاستخدام الأفضل لأراضي منطقة الدراسة.