Egypt. J. Soil Sci. **45**, No. 1, pp. 15 - 30 (2005)

Modeling of Land Capability and Agricultural Use Priority for some Abandoned Oases, Western Desert of Egypt

A. H. El - Nahry
National Authority for Remote Sensing and Space Sciences (NARSS), Cairo, Egypt.

ABANDONED OASES represented by El-Arag, El-Bahrein, El-Numessa, and Setra oases are located in the northern part of the Western Desert of Egypt to the South of El-Qattara Depression. Those depressions lie between longitudes 26° 15′ 00" & 27° 18′ 45" E and Latitudes 28° 37′ 30" & 29° 00′ 00" N. They represent small and inconspicuous oases characterized by scattered natural vegetation and some wild palm tress. The oases lie within the arid zone. The aim of this study is to apply the powerful capabilities of advanced Remote Sensing (RS) and Geographic Information System (GIS) techniques through managing and integrating spatial modeling data for land capability evaluation and agricultural use priorities. Terrain units were identified using draped satellite ETM+ image over Digital Terrain Model (DTM) to express the landscape and the associated landforms. The major landforms of the area under consideration could be grouped and described as basins, sandy flats, sandy plains, peneplains, bolsons, alkali flats, footslopes, plateau, sand dunes, inter-dunal sand strips, isolated hills, mesas, rock out crops, salt efflorescence and corrosion forms. Using US Taxonomy bases, soils of the abandoned oases could be classified into Typic Aquisalids, Typic Torrifluvents, Gypsic Haplosalids, Lithic Torripsamments, Lithic Haplocalcids, Typic Torripsamments, Typic Haplocalcids, Typic Haplosalids, Calcic Aquisalids, and Typic Psammaquents. Land capability evaluation was performed using Cervatana capability model. Six capability classes could be recognized as follows $S2_{lrb}$, $S3_{l}$, $S3_{r}$, $S3_{b}$, $S3_{lr}$, $S3_{lrb}$, N_{l}. Agricultural Use Priorities Spatial Model (AUPSM) was designed for getting the available grades of agricultural use priorities .

Keywords: Abandoned oases, Land capability, Spatial modeling, Remote Sensing and GIS.

Abandoned Oasis lies in the northern part of the Western Desert of Egypt, south of Qattara Depression and situated about 168 km to the east of Siwa Oasis. The study area is bounded by longitudes 26° 15′ 00" & 27° 18′ 45" E and Latitudes 28° 37′ 30" & 29° 00′ 00" N (Fig .1.). They occupy areas of about 41.89,197.7 and 292.27 km^2 for El-Arag, El-Bahrein& El-Numessa and Setra respectively. The availability of advanced technologies, for managing significant quantities of data, should help the planners and decision makers to organize the information, understand their spatial association, and provide a powerful means for analyzing and synthesizing the related information. Moreover, the launching of space-born satellite for gathering information about the state of land over time allows planners and decision makers to view the changes in land use and land cover during different periods. These advanced technologies are termed Remote Sensing (RS) and Geographic Information System (GIS).Applying the powerful capabilities of advanced RS and GIS techniques through managing and integrating spatial data enabled us to analyze terrain and associated soils of Abandoned Oases for producing digital geomorphological soil, and capability maps as a base of defining agricultural use priorities.

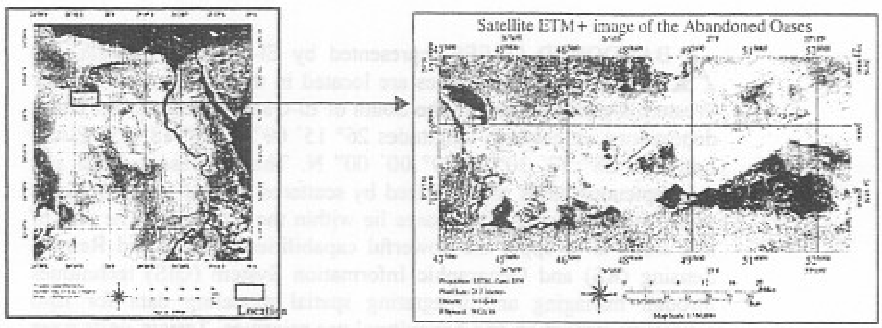


Fig. 1. Location of the study area .

Material and Methods

To achieve the objectives of the current study, the following processes were applied

Digital image processing

Digital image processing was performed using ENVI software version 4.1.Data manipulation including image stretching, filtering, and histogram matching were performed according to Lillesand & Kiefer (2000).

Data fusion was processed to enhance the spatial resolution from 30m to 15m, fusion methodology was applied according to Ranchin & Wald (2000).

Field studies

A rapid reconnaissance survey was made throughout the investigated area in order to identify the major landforms and to gain an appreciation of the broad soil patterns and landscape characteristics. The primary mapping units were verified based on the pre-field interpretation and the information gained during the survey. Twenty five soil profiles were dug to fulfill the requirements of the digital soil maps in addition to 220 testing augers for the purpose of recognizing the boundary among the different mapping units. Four water samples were obtained for analyses. A detailed morphological description of soil profiles was noted based on the basis outlined by FAO (1990).

Laboratory analysis

Physical analyses: Soil color (wet & dry) was identified with the aid of Munssel color charts, Soil Survey Staff (1951), Particle size distribution was determined due to Rowell (1995).

Chemical analyses:

Chemical analyses were executed for both soil and water as follows;

Soils: Electric conductivity (EC), soluble cations and anions, pH, $CaCO_3$ %, and gypsum were determined according to Rowell (1995).

Water: Soluble cations and anions, electric conductivity (EC) and pH were determined according to Rowell (1995).

Land capability model

A land capability evaluation was applied using MicroLEIS- Cervatana model, De La Rosa *et al.* (2004).

Agricultural Use Priorities Spatial Model (AUPSM)

AUPSM was designed with the aid of geomorphology, soil units, capability classes, slope, slope gradient and both of water availability& quality to produce grades of agricultural use priorities.

Maps production

ArcMap 9.0 (Environmental Systems Research Institute, ESRI (2004) was used to produce geomorphologic, soil, land capability and agricultural use priorities maps.

Results and Discussion

Image data fusion

An image data fusion procedure was applied to have a high differential accuracy and desired resolution quality. The satellite ETM+ multispectral bands (28.5 m spatial resolution) were sharpened using ETM+ panchromatic band (14.25 m spatial resolution). The Hue and Saturation of the multispectral bands were merged with the Value of the panchromatic band to produce a new enhanced multispectal image with 14.25 m resolution, ENVI 4.1 manual (2005). Data fusion could be shown in Fig. 2 .

Digital terrain model

The Digital Terrain Model (DTM) was extracted for getting the feeling of terrain three dimensions. It is defined as continuous variation of relief over space (Burrough, 1986).

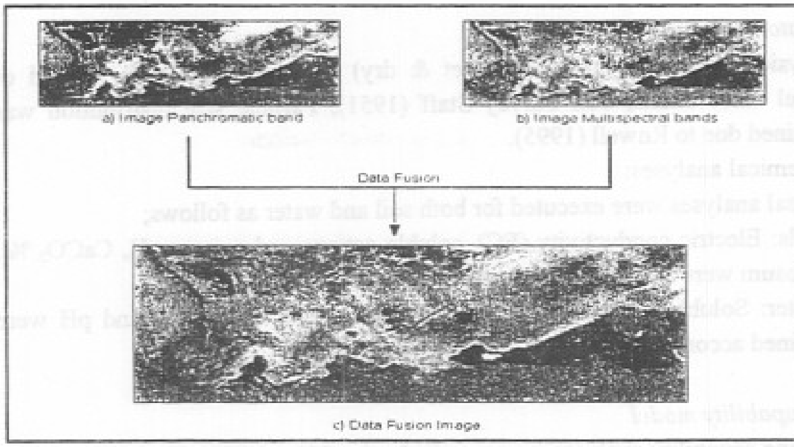


Fig. 2. Image data fusion .

DTM is consisting of a sampled array of regularly spaced elevation values referenced horizontally to a geographic coordinate system, U. S. Geological Survey (1998). Extracted DTM of abandoned oasis has a profile of 28.5m square grid spacing along and between each profiles, grid columns and rows. The 28.5 meter spatial resolution was essential in order to coincide with that of the Landsat ETM+ imagery to identify the geomorphology and terrain analysis as shown in Fig. 3 .

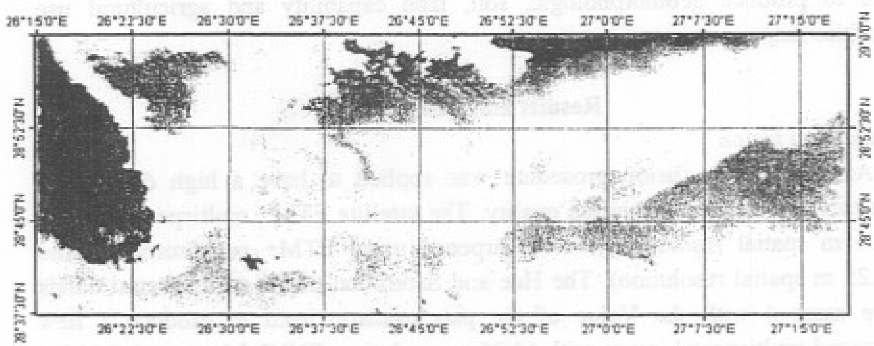


Fig. 3. Digital Terrain Model (DTM) .

Geomorphology of the investigated area

Satellite ETM+ image was draped over the Digital Terrain Model (DTM) to get the feel of natural 3D terrain, to get the better understanding of the geomorphologic units and to facilitate extracting of these units. Geomorphologic units are shown in Fig. 4 and could be categorized as follows:

1-Plateau 2- Sand dunes 3- Alkali Flats 4- Depressions 5- Bolsons 6- Peneplains 7- Basins 8- Mesas 9- Footslopes 10- Sandy plains11- Inter-dunal sand strips 12- Sandy flats 13- Rock out crops 14- Mantle overlain bedrock 15- Efflorescence forms 16- Isolated hills17- Corrosion forms.

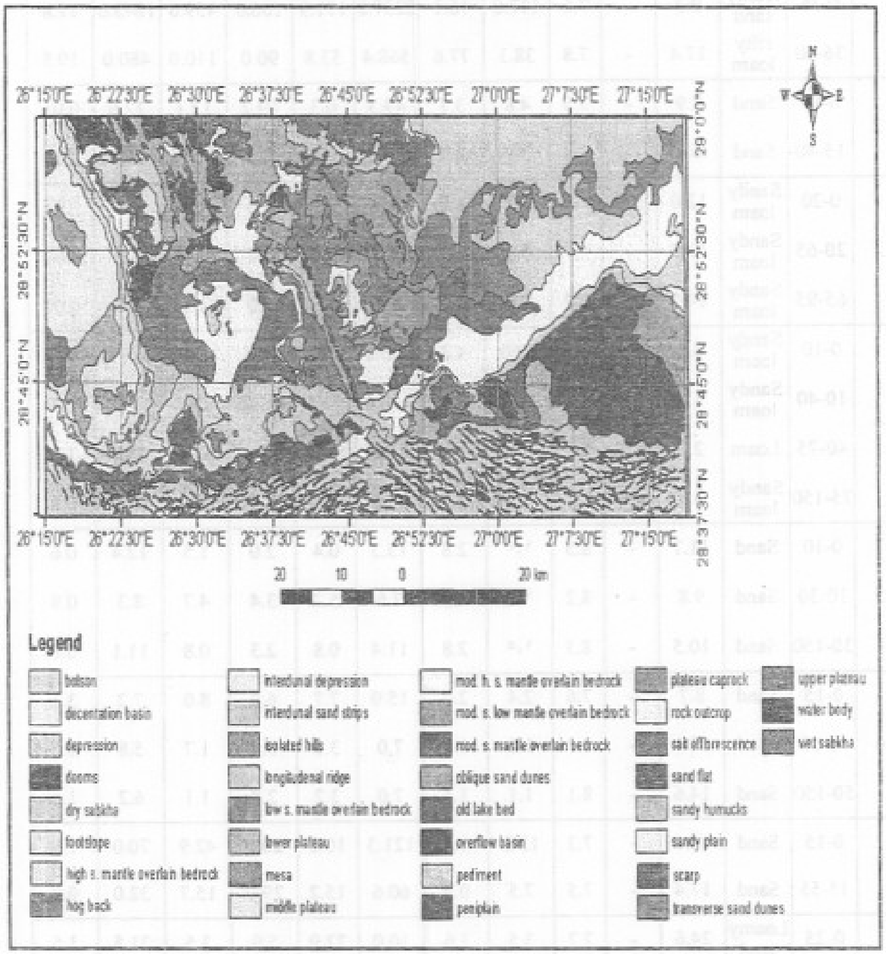


Fig. 4. Geomorphologic map .

Soils of the investigated area

Soil characteristics of the study area could be discussed and classified according to American Soil Taxonomy (Soil Survey Staff, 1999) based on data in Table 1 as well as Fig. (5 - 8) .Some of these characteristics could be summarized in the following lines :-

TABLE 1. Some physical and chemical analysis of the investigated area.

Pro. No.	Depth cm	Texture	CaCo3 %	Gyp. %	pH 1:2.5	EC (dS/m)	Anions (meq/l)			Cations (meq/l)			
							CO_3& HCO_3^-	Cl^-	SO4$^-$	Ca^{++}	Mg^{++}	Na^+	K^+
1	0-36	loamy sand	9.3	-	7.6	117.0	16.1	2237.8	171.9	106.0	459.0	1843.0	17.8
	36-50	silty loam	17.4	-	7.8	38.3	77.6	568.4	53.8	90.0	110.0	480.0	19.8
2	0-15	Sand	7.9	-	7.5	4.8	3.7	49.3	0.3	19.2	12.1	22.0	0.01
	15-40	Sand	6.4	-	7.4	3.9	2.7	38.1	0.2	13.9	7.1	20.0	0.01
3	0-20	Sandy loam	12.0	-	7.5	0.7	1.7	3.2	3.1	2.0	1.9	4.0	0.01
	20-65	Sandy loam	13.0	-	7.7	0.8	1.8	6.0	0.6	2.0	1.9	4.5	0.01
	65-95	Sandy loam	14.0	-	7.7	1.0	1.4	8.0	1.6	1.0	1.0	9.0	0.01
4	0-10	Sandy loam	3.2	2.3	7.7	52.0	4.2	705.0	170.8	97.3	130.3	611.0	41.4
	10-40	Sandy loam	1.8	5.6	8.1	19.2	2.8	168.0	54.8	35.0	63.4	117.0	10.2
	40-75	Loam	2.7	6.3	8.1	5.6	3.2	49.8	1.0	15.0	22.0	15.7	1.3
	75-150	Sandy loam	0.9	4.6	8.3	3.6	4.1	13.0	11.6	8.9	14.1	4.8	0.8
5	0-10	Sand	11.7	-	8.5	١,٧	2.8	13.3	0.4	2.0	1.5	12.4	0.6
	10-30	Sand	9.8	-	8.2	١,٧	4.0	7.6	5.7	3.4	4.7	8.3	0.9
	30-150	Sand	10.5	-	8.3	١,٥	2.8	11.4	0.8	2.3	0.8	11.1	0.8
6	0-15	Sand	8.7	-	7.6	2.4	2.0	15.0	7.7	6.0	8.0	7.2	3.5
	15-50	Sand	12.1	-	8.4	1.2	1.3	7.0	3.2	3.0	1.7	5.8	1.0
	50-150	Sand	14.6	-	8.1	1.1	1.4	7.0	3.2	2.8	1.1	6.2	1.5
7	0-15	Sand	10.6	-	7.3	12.3	1.8	121.3	10.8	20.0	42.9	70.0	1.0
	15-55	Sand	17.4	-	7.5	7.5	0.9	60.6	15.2	29.0	15.7	32.0	0.0
8	0-25	Loamy sand	24.6	-	7.7	3.5	1.6	10.0	22.9	5.9	3.6	21.5	3.5
	25-70	Silty loam	30.2	-	7.9	4.5	4.0	15.0	25.5	7.9	6.5	22.7	7.4
	70-150	Silty loam	-50.4	-	7.9	5.6	3.6	15.0	37.1	17.6	11.3	22.9	3.9
9	0-15	Sand	8.7	-	7.4	2.6	2.0	14.0	10.0	7.0	8.0	9.5	1.5
	15-50	Sand	11.0	-	8.1	2.4	2.5	10.0	4.0	5.5	3.5	6.5	1.0
	50-150	Sand	14.5	-	8.2	1.4	2.0	8.2	5.4	2.5	3.0	8.6	1.5

TABLE 1. Contd .

10	0-10	Loamy sand	8.9	-	8.3	75.0	4.2	698.0	245.8	230.0	350.0	346.2	21.8
	10-15	Loamy sand	6.6	-	8.5	45.0	2.5	438.0	169.1	139.0	209.0	247.0	14.6
	15-60	Loamy sand	7.6	-	8.5	90.0	4.8	989.0	214.6	113.0	136.0	954.0	5.4
	60-110	Sand	8.9	-	8.4	26.0	4.1	149.2	151.2	69.8	64.9	102.0	67.8
11	0-15	Sand	10.0	-	7.2	12.4	2.6	124.0	12.4	21.0	46.0	71.0	1.0
	15-50	Sand	16.0	-	7.7	8.4	1.0	51.4	19.5	25.0	15.0	31.0	1.0
12	0-15	Sand	8.2	-	7.6	4.2	3.7	49.3	0.3	19.2	12.1	22.0	0.0
	15-35	Sand	6.7	-	7.8	2.8	2.7	25.1	0.2	13.9	7.1	7.0	0.0
13	0-35	Sand	6.0	-	7.2	2.1	1.6	15.5	3.5	2.6	2.4	15.6	0.1
	35-100	Sand	5.5	-	7.3	1.9	1.3	16.8	2.6	7.0	8.7	5.0	0.0
	100-150	Sand	5.0	-	7.7	1.4	1.4	6.3	5.7	3.0	2.9	7.5	0.0
14	0-15	Sand	8.7	-	7.5	2.5	1.0	14.0	10.7	5.0	9.0	8.2	3.5
	15-50	Sand	7.4	-	8.3	1.2	2.0	6.0	3.0	5.0	2.0	3.0	1.0
	50-150	Sand	8.6	-	8.1	1.2	1.0	4.0	7.4	2.5	3.0	5.4	1.5
15	0-15	Sand	11.0	-	7.4	12.1	2.8	123.0	12.2	22.0	44.0	71.0	1.0
	15-55	Sand	15.4	-	7.5	7.4	1.2	55.8	17.0	26.1	15.7	31.0	1.2
16	0-25	loamy sand	9.7	-	7.5	99.0	21.1	2227.8	196.9	111.0	464.0	1848.0	22.8
	25-35	silty loam	18.4	-	7.7	52.0	77.2	548.0	53.8	90.0	109.0	460.0	20.0
17	0-15	Loamy sand	12.9	-	7.8	104.0	2.8	978.2	315.0	66.5	100.2	1072.0	57.3
	15-40	Loamy sand	27.7	-	8.2	38.0	1.6	413.0	101.4	34.6	50.4	404.0	27.0
18	0-15	Sand	8.4	-	8.4	3.4	3.3	28.2	2.9	8.4	7.2	17.4	1.4
	15-30	Sand	6.6	-	8.5	6.7	4.1	48.8	19.7	21.5	17.5	32.4	1.1
	30-50	Sand	6.2	-	8.5	2.7	2.8	21.0	2.7	4.4	2.6	18.6	0.9

TABLE 1. Contd .

19	0-30	Sand	7.4	-	7.4	2.5	2.5	7.5	12.5	5.4	2.6	13.3	1.2
	30-55	Sand	8.4	-	7.7	2.2	2.2	12.8	6.4	3.5	2.0	14.4	1.5
	55-150	Sand	12.3		8.3	1.6	1.5	10.2	3.3	4.5	1.5	7.5	1.5
20	0-10	loamy sand	14.2	-	7.9	1.5	2.0	14.0	1.9	1.4	3.5	11.5	1.6
	10-35	Sand	35.0	-	7.2	2.3	3.5	13.5	3.5	3.5	4.0	11.5	1.5
21	0-20	Sandy loam	7.8	-	7.4	0.7	1.6	3.2	3.0	2.0	1.9	4.0	0.01
	20-60	Sandy loam	4.6	-	7.7	0.8	1.7	5.7	0.8	2.0	1.9	4.5	0.01
	60-150	Sandy loam	7.3	-	7.8	1.2	1.3	8.0	1.6	1.0	0.9	9.0	0.01
22	0-10	Sand	2.8	-	7.1	2.6	1.3	55.3	27.7	26.0	28.4	30.0	0.05
	10-30	Sand	9.0	-	7.4	1.7	1.2	16.8	2.6	7.0	8.7	5.0	0.02
23	0-10	Sandy loam	3.8	-	7.7	5.2	4.5	10.5	37.5	15.5	13.0	22.5	1.5
	10-45	Sandy loam	6.8	-	8.1	5.6	3.2	49.8	0.9	15.0	22.0	15.7	1.3
	45-80	Sandy loam	8.9	-	8.3	3.6	4.0	13.0	11.5	8.9	14.1	4.8	0.8
24	0-10	Sand	14.3	-	7.9	1.4	2.0	21.0	10.9	12.3	9.1	11.0	1.6
	10-35	Sand	40.1	-	7.2	2.4	3.0	13.5	2.5	2.0	3.0	10.5	3.5
25	0 - 35	Sand	12.0	-	8.0	72.5	2.2	740.9	121.5	49.8	14.7	800.0	0.20
	35 - 50	Sand	16.0	-	8.4	43.2	22.3	428.7	4.10	52.2	66.1	335.7	1.07

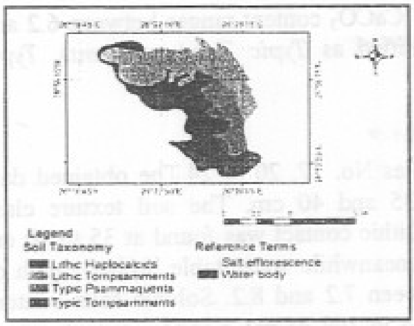


Fig. 5. Soil map of El-Arag.

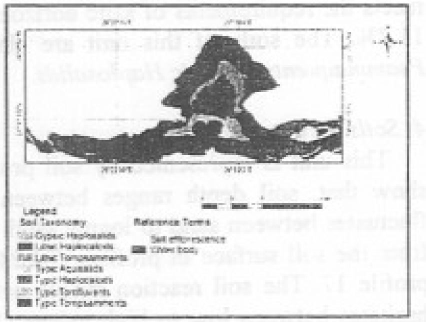


Fig.6. Soil map of El-Bahrein .

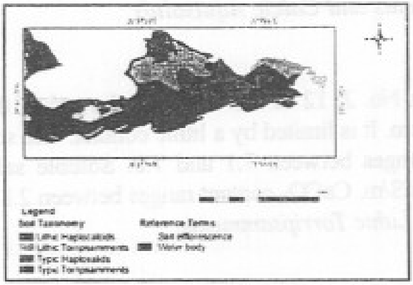


Fig.7. Soil map of El- Nuwemisa .

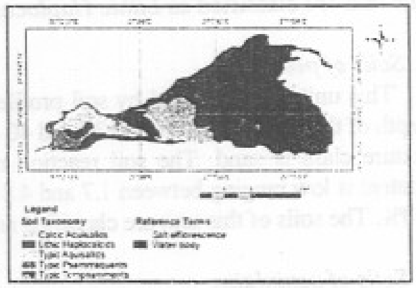


Fig.8. Soil map of Sitra .

1. Soils of sandy plains

This unit is represented by soil profile No. 13. The analytical data show that, depth of these soils lies around 150 cm. Soil texture class is sand. Lamellae phenomena was found during morphological description . The soil reaction (pH) is mild as it ranges between 7.2 and 7.7. Soluble salts content is low ranging between 1.4 to 2.1 dS/m. $CaCO_3$ content is few to moderate as it ranges between 5.0 and 6.0 %. Soils of this unit are classified as *Typic Torripsamments* .

2. Soils of sand strips

This unit is represented by soil profiles No. 6, 9, 14 & 19. The analytical data show that, soil depth is lying around 150 cm. The soil texture class is sand. The soil reaction is ranging between 7.4 and 8.4. Soluble salts content is low ranging between 1.1 and 2.6 dS/m. $CaCO_3$ content ranges between 7.4 – 14.6 %. The soils of this unit are classified as *Typic Torripsamments.*

3. Soils of Hummucks

This unit is represented by soil profiles No. 5, 10 & 18. The data show that, depth of these soils is ranging between 50 and 150 cm. These soils have different patterns of sedimentation showing sand to loamy sand texture classes. The soil reaction ranges between 8.2 and 8.5. Electric conductivity EC ranges between 1.5 and 90 dS/m. The upper limit of EC regarding the third layer of soil profile No.10

meets the requirements of salic horizon. $CaCO_3$ content ranges between 6.2 and 11.7%. The soils of this unit are classified as *Typic Torripsamments, Typic Psammaquents& Typic Haplosalids.*

4. Soils of footslopes

This unit is represented by soil profiles No. 17, 20 & 24.The obtained data show that, soil depth ranges between 35 and 40 cm. The soil texture class fluctuates between sand to loamy sand. Lithic contact was found at 35 to 40 cm from the soil surface in profiles 20&24 meanwhile water table limited depth of profile 17. The soil reaction ranges between 7.2 and 8.2. Soluble salts content hesitates between low to high values (1.4 to 104 dS/m). $CaCO_3$ content ranges between 12.8 and 40.1% meeting the requirements of calcic horizon. The soils of this unit are classified as *Lithic Haplocalcids and Calcic Aquisalids.*

5. Soils of pediments

This unit is represented by soil profiles No. 2, 12 & 22. The data show that, the depth of these soils lays around 30 and 40 cm. It is limited by a lithic contact. The soil texture class is sand. The soil reaction ranges between 7.1 and 7.8. Soluble salts content is low ranging between 1.7 and 4.8 dS/m. $CaCO_3$ content ranges between 2.8 – 9.0%. The soils of this unit are classified as *Lithic Torripsamments.*

6. Soils of peniplains

This unit is represented by soil profiles No. 7, 11 & 15. The analytical data show that, the depth of these soils is lying around 50 - 55 cm. Lithic contact was found at 40 cm limiting profile depth .The soil texture class is sand. The soil reaction ranges between 7.2 – 7.7. Soluble salts content is moderate to high (7.4 - 12.4 dS/m). $CaCO_3$ content ranges between 10.0 and 17.4 %. Common $CaCO_3$ segregation was found during the morphological description. The soils of this unit are classified as *Lithic Haplocalcids.*

7. Soils of overflow basins

This unit is represented by soil profiles No. 3 & 21. The analytical data show that, the depth of these soils is lying between 95 and 150 cm. Soil texture class is sandy loam. The soil reaction is ranging between 7.4 and 7.8. Soluble salts content is very low, where it ranges between 0.7 to 1.2 dS/m. $CaCO_3$ content ranges between 4.6 – 14.0%. The soils of this unit are classified as *Typic Torrifluvents.*

8. Soils of decantation basins

This unit is represented by soil profiles No. 4 & 23. The obtained results show that, the depth of these soils is between 80 and 150 cm. The soil texture class is sandy loam in the different layers of the representative soil profiles, except for the third layer of soil profile No.4, where it is loam. Common needle shaped gypsum crystals were found in the different layers of profile No.4. The soil reaction is ranging between 7.7 and 8.3. Soluble salts content ranges between 3.6 and 52.0 dS/m. $CaCO_3$ content ranges between 0.9 and 8.9 %. The soils of this unit are classified as *Aquic Torrifluvents and Typic Haplogypsid.*

9. Soils of old lake beds

This unit is represented by soil profile No. 8. Data show that, deep soils (150 cm). The soil texture class is loamy sand in the surface layer; meanwhile it is silty loam in the rest of layers. The soil reaction is between 7.7 – 7.9. Soluble salts content ranges between 3.5 and 5.6 dS/m. $CaCO_3$ content ranges between 24.6 and 50.4%.White common rounded nodules of $CaCO_3$ was noticed clearly in the lower two layers during profile description. The soils of this unit are classified as *Typic Haplocalcids.*

10. Soils of wet sabkhas

This unit is represented by soil profiles No. 1 &16. The analytical data show that, depth of these soils is ranging between 35 and 50 cm. Both representative profiles have the same pattern of sedimentation in the successive two layers, as soil texture class is loamy sand, and silty loam. The soil reaction pH values range between 7.5 and 7.8. Soluble salts content ranges between 38.3 and 117.0 dS/m. common patches of NaCl are noticed during morphological description. $CaCO_3$ content ranges between 9.3 – 18.4 %.Soils of this unit are classified as *Typic Aquisalids.*

11. Soils of dry sabkhas

This unit is represented by soil profile No. 25 .Data show that ,the depth of these soils is 50 cm. Soil texture is sand.Soil reaction is mildly alkaline (pH values are 8.0 – 8.4). Soluble salts content ranges between 43.2 to 72.5 dS/m. $CaCO_3$ content ranges between 12.0 and 16.0 %. Soil characteristics of the second horizon meet the requirements of both salic and calcic horizons. Soils of this unit are classified as *Calcic Aquisalids.*

Water availability & quality

There are two sources of water for irrigation purposes in the abandoned oasis 1-water of springs that discharge to the surface under hydrostatic pressure .2-Water of deep wells. Table 2 illustrates characteristics of irrigation water of existing springs and wells. According to Richards, 1954, irrigation water was classified considering salinity and alkalinity hazards, where C2-S1 class (medium salinity and low sodium water) represents water of 1 km deep wells (El-Arag& El-Bahrien).Most salt tolerance plants can be grown in most cases without special practices for salinity control. This water can be used in irrigation with little danger of SAR harmful level. On the other hand water of springs was classified as C4-S2 (very high salinity and medium sodium water). It represents water of Setra and El-Nuwimesa oases. This water can not be used on soils with restricted drainage. It is advised to drill new deep wells especially in El-Nuwimesa and Setra oases for the irrigation purposes.

TABLE 2. Chemical analyses of the abandoned oases water .

Spring (s) / well (w)	pH	EC dS/m	Soluble cations mg/l				Soluble anions mg/l			SAR
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO3^{--}$& $HCO3^{-}$	Cl^{-}	$SO4^{--}$	
Setra (s).	8.2	228	260.0	250.0	203.2	12.6	7.0	470.0	248.8	12.72
El-Nuwemisa (s).	8.1	100.7	138.5	147.5	124.3	6.48	2.8	167.68	246.3	10.39
El-Bahrien (w)	7.6	0.45	0.4	0.3	3.7	0.10	0.6	2.0	1.9	6.25
El-Arag (w)	7.7	0.75	1.0	0.7	5.2	0.60	1.3	3.0	3.2	5.64

Land capability modeling

Cervatana model works interactively, comparing the values of the characteristics of the land-unit to be evaluated with the generalization levels established for each use capability class. Following the generally accepted norms of land evaluation (FAO, 1976; Dent & Young, 1981; ONERN, 1982 and Verheye, 1986), the Cervatana model forecasts the general land use capability for a broad series of possible agricultural uses. The methodological criteria refer to the system designed earlier by De La Rosa & Magaldi (1992) and modified for computing purposes by De La Rosa *et al.* (2004). The prediction of general land use capability is the result of a qualitative evaluation process or overall interpretation of the following biophysical factors: relief, soil, climate, and current use or vegetation. Fig.9 represents a flowchart of Cervatana model.

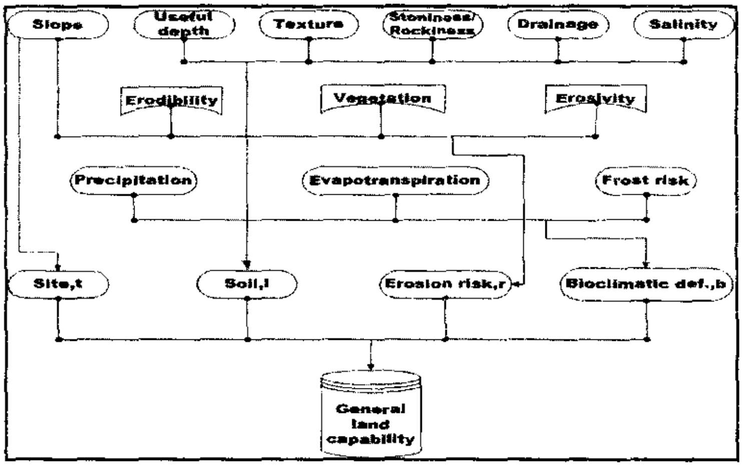


Fig. 9. Flowchart of Cervatana model (After De La Rosa *et al.*, 2004) .

According to Cervatana model as show in Fig. 10 -13, three capability classes were recognized (S2, S3, and N).-Class S2 represents land with good use capability.-Class S3 expresses land with moderate use capability, meanwhile

Class N. is related to marginal or non-productive land. On the other hand subclasses or limiting factors could be expressed as : l (soil) ,r (erosion risk) and b (bioclimatic deficit) .

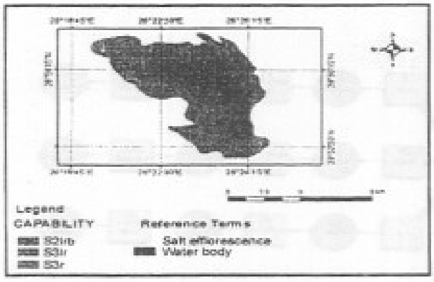


Fig.10.Capability map of El-Arag.

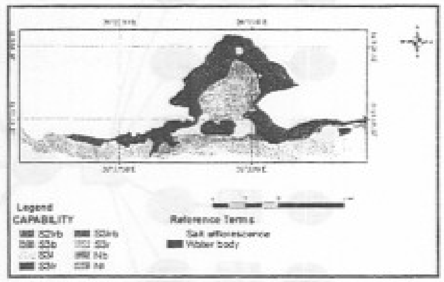


Fig.11. Capability map of El-Bahrein .

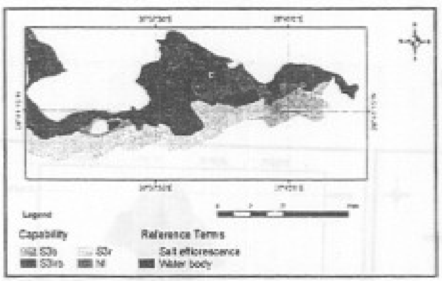


Fig.12. Capability map of El-Nuwemisa.

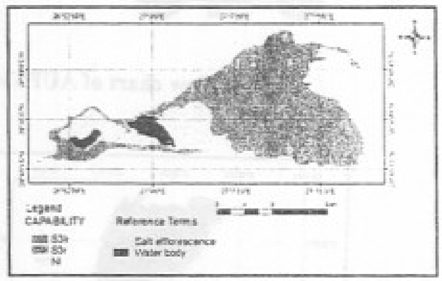


Fig.13. Capability map of Sitra.

Agriculture use priority

Agricultural use includes but is not limited to the following activities: cultivating the soil, producing crops for human food, animal feed, planting seed or for the production of fibers, Texas constitution (2005). Agricultural use priority in the investigated area could be planned and categorized as: irrigated cropland, orchard, improved pastureland and native pastureland. To define the best agricultural use in the abandoned oases, an Agricultural Use Priorities Spatial Model (AUPSM) was designed and processed in ArcGIS spatial modeling environment, Fig. 14. The model was based on the following parameters: geomorphological units, soil units, capability classes, water availability& quality, slope, and slope gradient. The first step in that process model is data inputs; the second step is to extract and gain new information. The new information were classified to common scales, where the higher values were given to the more suitable locations for agricultural use. In the third step, the classified data were weighted according to their influence in the process. Finally, the data were combined using conditional statements and data filtering to produce a graded map of agricultural use priority. AUPSM resulted in four grades of agricultural use priorities *i.e.* first, second, third and not suitable as shown in Fig. 15-18 .

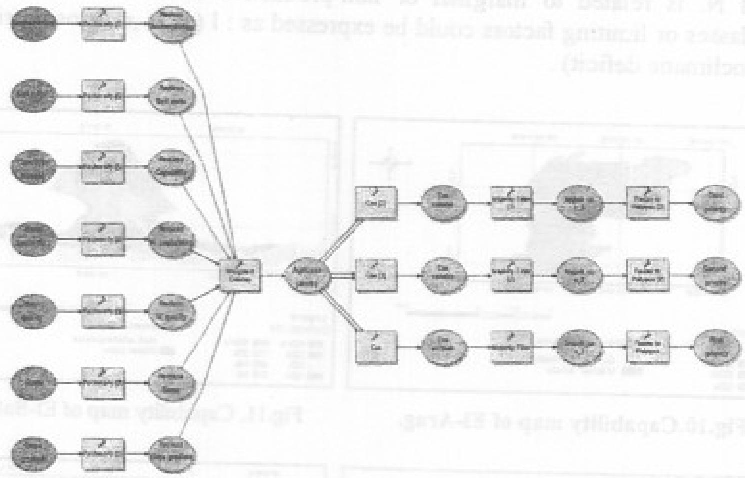
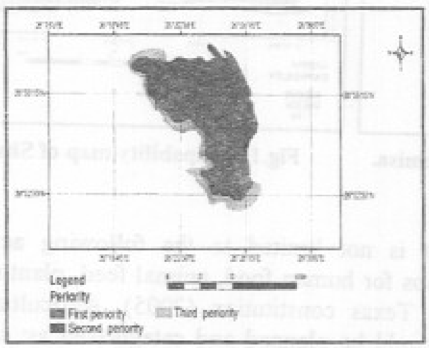


Fig. 14. Flow chart of AUPSM.



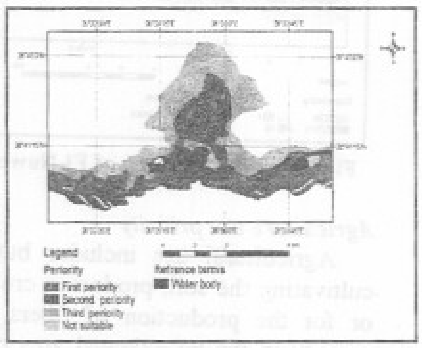
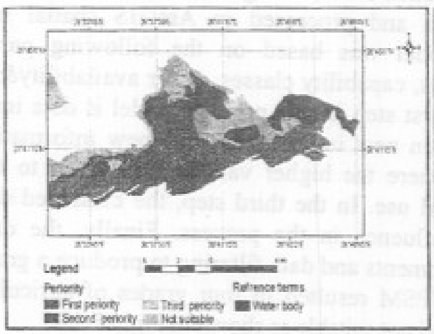


Fig.15. Agric.Use priorities of El-Arag. **Fig.16. Agric.Use priorities of El-Bahrein.**



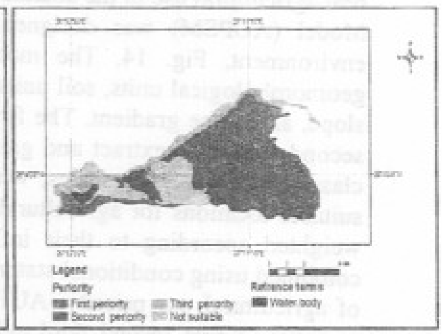


Fig.17.Agric.Use priorities of El-Nuwemisa. **Fig. 18.Agric.Use priorities of Setra.**

References

Burrough, P.A. (1986) *"Principles of Geographical Information Systems for Land Resources Assessment"*, Oxford University Press, New York.

De la Rosa, D. and Magaldi, D. (1992) "Rasgos metedologicos de un sistema de evaluacion de tierras para regions mediterraneas". Soc. Esp. Cien. Suelo. Madrid.

De la Rosa, D.; Moreno, J.A.; Garcia, L.V. and Almorza, J. (2004) MicroLEIS: A micro computer-based Mediterranean land evaluation information system. *Soil Use and Management* **8**, 89.

Dent, D. and Young, A. (1981) *"Soil Survey and Land Evaluation "*, Allen and Unwin Ltd. Londres.

ESRI (2004) "ArcMap version 9.0 user manual", Redlands, CA, USA.

FAO (1976) "A framework for land evaluation", Soils Bulletin 32, Rome.

FAO (1990) *"Guidelines for Soil Profile Description"*, 3rd ed., (Revised), FAO, Rome.

Lillesand, T.M. and Kiefer, R.W. (2000) *"Remote Sensing and Image Interpretation"*, p. 579, John Wiley & Sons, New York .

ONERN. (1982) "Classification de Las Tierras del peru ", Pub. Ofic. Nae. EV. Rec. Nat. Lima.

Ranchin, T. and Wald, L. (2000) "Comparison of different algorithms for the improvement of the spatial resolution of images." *Proceeding of the third conference*, "Fusion of Earth data: merging point measurements, raster maps and remotely sensed images", Sophia Antipolis, France, January 26-28, 2000, pp. 33-41.

Rowell, D.L. (1995) *"Soil Science Methods & Applications"*, Library of Congress Cataloging- in- Publication data, New York, NY 10158, U.S.A.

ERSI, (2004) "ENVI 4.1 user manual", Research Systems Inc., 4990 Pearl East Circle Boulder, CO 80301.

Soil Survey Staff (1951) *"Soil Survey Manual"*, U.S. Dept. Agric., Hand book, No. 18, Government printing office, Washington, D.C.

Soil Survey Staff (1999) *"Soil Taxonomy"*, A basic system of soil classification for making and interpreting surveys, Second edition, Agriculture Hand Book No. 436.U.S.D.A., Nat. Res. Cons. Service.

Texas Constitution (2005) "appraisal of agricultural land based on the land's ability to produce agricultural products".http://www.window.state.tx.us/taxinfo/taxforms/50-129.pdf

U. S. Geological Survey (1998) "USGS Fact Sheet", No. 102-96. April, 1998.

Verheye, W. (1986) "Land evaluation and land use planning in EEC", CEC-DG. VI. Draft. Rep. Brussels.

(*Received* 10/2004;
accepted 2/2005)

نمذجة القدره الانتاجيه للاراضي واولويات الاستخدام الزراعي لبعض الواحات المهجورة – الصحراء الغربية – مصر

علاء الدين حسن النهرى
الهيئة القومية للأستشعار من البعد وعلوم الفضاء – القاهرة – مصر.

تهدف الدراسة الى تطبيق التقنيات المتقدمة للاستشعار من البعد و نظم المعلومات الجغرافية بغرض تقييم القدرة الانتاجية للاراضى وأولويات استخداماتها للزراعة وذلك من خلال تصميم نموذج فراغي لبعض الواحات المهجورة المتناثره بصحراء مصر الغربيه. تقع الواحات المهجورة جنوب منخفض القطارة بين خطى طول ٢٦° ١٥' ٠٠" – ٢٧° ١٨' ٤٥" شرقا و خطى عرض ٢٨° ٣٧' ٣٠" – ٢٩° ٠٠' ٠٠" شمالا. وتتكون الواحات المهجورة من واحات العرج والبحرين والنوميسة وسترة وهى عبارة عن واحات صغيرة تتميز بوجود بعض النباتات الطبيعية المتناثره والتى تعكس الظروف البيئيه المحيطه وكذلك وجود بعض اشجار النخيل البرى. ومن تحليل مظاهر السطح من خلال اسقاط الصورة الفضائية للمنطقة من نوعيه ETM+ على نموذج التضاريس الرقمى DTM تم التعرف على اربعة عشر وحدة جيومورفولوجية على النحو التالى : الأحواض ، المسطحات الرملية ، السهول الرملية ، السهول البينية ، البولسون ، المسطحات القلوية ، المنحدرات الجبلية ، الهضاب ، الكثبان الرملية ، القطاعات الرملية بين الكثبان ، التلال المعزولة ، الميزا ، السهول الصخرية ، مسطحات الاملاح المتزهرة ، و أخيرا أشكال التأكل الصحراوية. ولقد أمكن باستخدام نظام تصنيف الاراضى الامريكى حصر عشره تحت مجموعات للتربة على النحو التالى : Typic Aquisalids, Typic Torrifluvents, Gypsic Haplosalids, Lithic Torripsamments, Lithic Haplocalcids, Typic Torripsamments, Typic Haplocalcids, Typic Haplosalids, Calcic Aquisalids, and Typic Psammaquents. هذا ولقد تم تقييم القدرة الأنتاجية لأراضى الواحات المهجورة باستخدام نموذج Cervatana لتقييم الأراضى وتبين أنها تتبع الرتب التالية: $S2_{lrb}$, $S3_l$, $S3_r$, $S3_b$, $S3_{lr}$, $S3_{lrb}$, N_l. وأخيرا تم تحديد ثلاثه درجات أولوية لاستخدام الأراضى للزراعة عن طريق تصميم نموذج فراغي(AUPSM) .