

## **GIS BASED LAND EVALUATION IN BAHARYIA OASIS, WESTERN DESERT, EGYPT**

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### **ABSTRACT**

Sustainable agriculture is the main goal of land evaluation. The current study deals with land evaluation of El-Bahariya Oasis, located in western desert of Egypt. The Agricultural Land Evaluation System for arid and semi-arid Regions (ALES) software, was used to evaluate the capability and suitability for some selected fruit trees (date palm, fig, olive and citrus), vegetable crops (watermelon, tomato, potato) and field crops (wheat, maize, barely, alfalfa). This software was adapted under Egyptian conditions. Therefore, ASLE software was selected in order to make strategies related to land capability and suitability evaluation at a regional level. Soil morphological and analytical data were carried out for 20 soil profiles. Land capability classes range from Fair (C3) to Non Agriculture area (C6). On the other hand, land suitability for selected fruit trees show that the date palm, Fig and Olive were high (S1) to suitable (S2) in most soils. On the contrary, citrus was permanently none suitable in these soils. The selected vegetable crops range from highly suitable to permanently none suitable. Selected field crops range from suitable (S2) to permanently none suitable (N2). Overall capability and suitability are recognized by the ALES software in preference to interpolation by IDW in ArcGIS to produce the maps. In this paper, the main recognized soil limitation factors were texture, soil salinity and calcium carbonate content.

**Keywords:** ALES, Land Evaluation. GIS., Bahariya Oasis, Egypt

### **INTRODUCTION**

In the last fifty years, the rapid population growth in Egypt caused a great demand for food and other agriculture products. Only 50% of the food needs are produced locally. Therefore, much attention is being paid to increase agriculture production in Egypt. This could be realized by two main strategies; experience of desert cultivation and applying proper management. In both cases it is important to have knowledge on the characteristics and distribution of the soils on these areas. Accordingly, there is a pressing need for an accurate system that can deliver accurate, useful and timely information on soil and water resources to decision makers and policy planners.

The Bahariya depression is a natural excavation in the central part of the Egyptian Western Desert, located some 130 km west of El-Minia governorate in the Nile valley and about 360km S-W of Cairo. It is situated essentially between latitudes 27°48' and 28°30'N and longitudes 28°29' and 29° 08' E. It comprises an area of approximately 2250 km<sup>2</sup>. Bahariya Oasis is facing a sever constraint in the availability of good agricultural land, in spite of the presence of moderately suitable groundwater.

According to Metwally (1953) and Said (1962), the major part of the oasis floor is a flat or gently undulating composed of sandstone and intercalated layers of clay, strewn with fragments of rocks derived from the hills. The lowest part of the oasis floor appears to be in the neighborhood of El-Qasr and El-Bawiti.

The most important geomorphic features include: The alternating weak and strong beds and their influence on topography, the marked parallelism of NE-SW ridges, the geologic structure and its control of the small wadis and the position and outlines of the folds, exemplified in the ridges formed by the alternating weak and strong beds.

The most striking feature in the geomorphology of Bahariya is the large number of hills within the depression. These hills impede the view and give the oasis an entirely different appearance from that characterizing other Oases. Most parts of these hills have a black shape due to the nature of the rock capping them. The darkness of Gebel Mandisha is due to the eruptive rocks that cap its flat top. Similar hills are found in Gebel Mayesara to north of Gebel Mandisha. Gebel Ghorabi in the north of the oasis is black because of the presence of considerable quantities of iron. Gebel El-Hufhuf has a narrow ridge similar to that of the hills in the center of the Oasis. It also has a black appearance as it is composed of dolerite. However, the rest areas are entirely capped with brown limestone. The most strongly marked group of hills is extending in a nearly straight direction across the center of the Oasis.

Land evaluation is an approach applied to the assessment of land suitability for a specific use. Land evaluation is itself knowledge-based and requires an extensive knowledge and different conditions to be fulfilled. This can be done automatically by the use ALES, LECS and GIS systems (Ganzorig, 1995).

Land capability evaluation refers to a range of major kinds of land uses, such as agriculture, forestry, livestock production, and recreation. The most widely used categorical systems for evaluating agricultural land is termed land capability classification. The capability classification provides three major categories of soil grouping: classes, subclasses and units. Capability classes are groups of land units according to their degree of limitations and the risks of soil damage. The limitations increase progressively from class I to class VIII. Capability subclasses are defined on the basis of major conservation problems, such as: Subclass 1 (e): Erosion and runoff. Subclass 2 (w): Excess water. Subclass 3 (s): Root zone limitations. Subclass 4 (c): Climatic limitations. A capability unit is a subdivision of subclass on the basis of potential productivity belongs to the same capability units. This means that soils in a capability unit are sufficiently uniform to: a) produce a similar kind of cultivated crops and pasture plants with similar management practices; b) require similar conservation treatment and management; c) have comparable potential productivity (Sys, et al. 1991).

The framework of land evaluation of FAO (1976) recognizes four levels of generalization in classification of land suitability:

-Land suitability orders: A suitability order is simply a statement as to whether an evaluation unit is at all fit for a use or not. It gives no information about

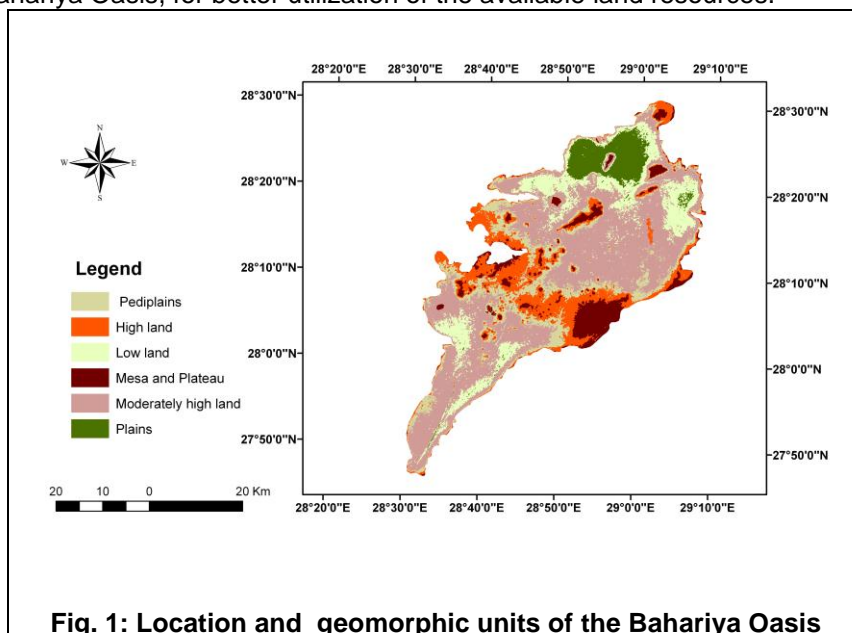
limitations or characteristics. 'S'= Suitable, 'N'= Not suitable for the land use.

- Land suitability classes indicating the degree of suitability within an order.
- Land suitability subclasses specifying the kind(s) of limitation or kinds of required improvement measures within classes
- Land suitability units indicating differences in required management within subclasses

Geographical information systems (GIS) are systems for the storage, analysis and presentation of spatial data (Bregt, 1997). These are used in many applications as a tool for spatial analysis (Nehme and Simões, 1999). Consequently, they are used to support spatial aspects of knowledge based systems for land evaluation.

Soil mapping was depending on digital terrain model (DTM) to construct relation between landform and soil. Field work and laboratory analysis with special reference to soil constrains were the main targets to reach land evaluation and land suitability goals.

Primary aim of this study would be an appraisal of land attributes in Bahariya Oasis, for better utilization of the available land resources.



## MATERIALS AND METHODS

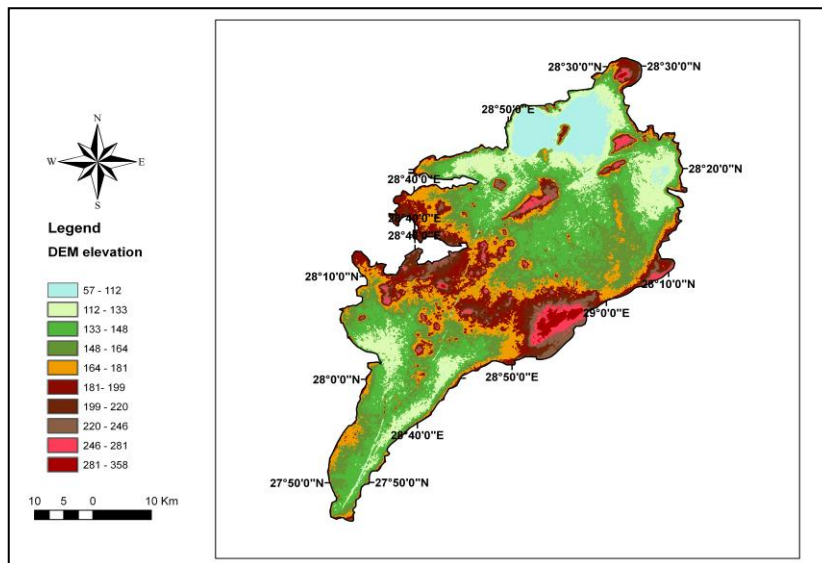
### Studied area:

The studied area is characterized by arid climate, and lies between latitudes 27° 48' and 28° 30' N and longitudes 28° 35' and 29° 10' E . Bahariya Oasis is natural depression in the southern portion of the Egyptian desert. Some 130 km west of Samalot in the Nil valleys and about 300 km southwest of Cairo. The values of aridity degree for El-Bahariya Oasis are calculated as (0.30) is determined by the applications of Embergers formula

(1955).  $Q = 100R / (M \cdot m)$  (M-m). This reflects well a desert condition according to the classification posted by Emberger when the values of aridity between (0-20) reflect desert condition. The very low values also indicate extreme arid condition. It is comprising a total area of approximately is 0.36 mm and mean evaporation 10.50 mm. The mean annual temperature was 14.25. The Bahariya Oasis is one of the well known features in the western desert. It attracted the attention of geologists and some soil scientists, and gained special interest in recent years as a result of containing iron ore deposits of economic importance. The Bahariya Oasis forms a large elliptical depression in the northern part of the western desert trends towards a NE-SW direction for nearly 95 Km, the width ranges from 3 km to about 45 Km; the greatest width is near latitude  $28^{\circ} 10'$ .

**Digital soil mapping**

The remotely sensed data and soil maps were geometrically rectified to the projection of Universal Transverse Mercator (UTM) coordinate system optimally enhanced and histogram matched to be comparable during the visual interpretation through AgrGIS software. The root mean square error (RMSE) for the rectified image was less than 0.4 pixels. The DTM data of the study area are shown in the Figs 2. After eliminating the speckle effects by smooth filtering, a vector map of the slope classes was produced by screen digitizing. The produced vector format slope class map was overlaid by the color composite Landsat image of the studied area to delineate soil boundaries and other land features by visual interpretation. A 3D perspective view map and a hill shade relief map were generated using the DTM where the 3D presentation of the landscape is required to detect the soil and landform relationships.



**Fig. 2: Generated digital elevation model (DEM)**

### **Site selection and morphological description**

Based on the distribution of physiographic units, twenty soil profiles were selected to represent the studied soil units and to collect samples for analysis.

Detailed morphological description and classification of the selected soil profiles were recorded on the basis outlined by FAO (1990) and Soil Survey Staff (2006). The collected disturbed samples were air dried; ground gently, sieved through 2 mm sieve. The soil samples were mechanically analysed according to the international method of Rowell (1995) using  $\text{NH}_4\text{OH}$  as a dispersing agent. Soil colour in both wet and dry samples were determined with the aid of Munsel colour charts, C.U.S.D.A. and Soil Survey manual (1999). The soil chemical analysis was carried out according to Rowell (1995)

### **Land Evaluation**

#### **Land Capability Modeling**

A land capability modeling procedure was applied following the generally accepted Agricultural Land Evaluation System for arid and semi-arid Regions (ALES) capability model (Ismail, et al., 2001). ALES 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), the ALES model forecasts the general land use capability for a broad series of possible agricultural uses. The methodological criteria refer to the system adapted earlier by Ismail, et al., 2001.

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. For each diagnostic criterion or limiting factor, the land characteristics were selected, and the corresponding levels of generalization were established and related with the capability classes by means of gradation matrices. The procedure of maximum limitation was used with matrices of degree to relate the land characteristics directly with capability classes. Matching tables were used and linked to the GIS modeling environment using relational database fields which have identifier key attribute property.

#### **Land Suitability Modeling**

Land suitability evaluation modeling was applied following the well known ALES suitability model Ismail, et al., 2001. ALES model is a physical soil suitability evaluation model indicates the degree of suitability for a land use, without respect to economic conditions.

The land use requirements were matched to the land characteristics of each mapping unit to determine its suitability. Depending on the gradations considered for selected criteria (gradation matrices) and on the different agricultural uses. The suitability classes for each crop are: soils with High suitability (S1), soils with suitability (S2), soils with moderate suitability (S3), soils with marginal suitability (S4), and soils with no suitability (N). The main soil limitations are: useful depth, texture, drainage condition, carbonates content, salinity, sodium saturation, CEC, SP. For each diagnostic criterion or limiting factor, the land characteristics were selected, and the

corresponding levels of generalization were established and related with the suitability classes by means of gradation matrices. Matching tables were used and linked to the GIS modeling environment using relational database fields which have identifier key attribute property.

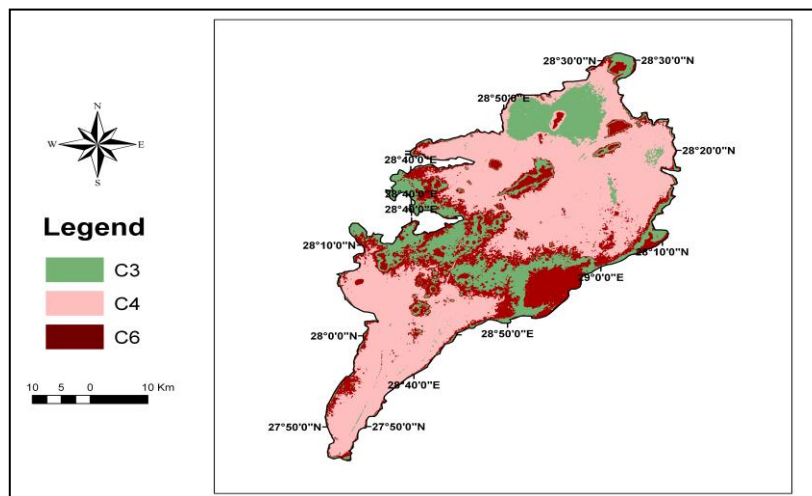
**Maps production.** Soils, land capability, land suitability, and agricultural priority maps were layouted, annotated, projected and finally produced using Arc GIS software.

**ALES-integration with GIS:** The Agriculture Land Evaluation System for arid and semi arid regions, ALES, has been adapted by Abd El-Kawy *et al.*2001 to estimate the agriculture land evaluation ALES.

## RESULTS AND DISCUSSIONS

### Land Capability:

A land capability evaluation of the soils of studied areas as demonstrated in Fig. (1) of Al-Ashrei and Belal (2010) was performed following ALES land capability model. Evaluation procedure was done through matching soil characteristics and qualities with capability limiting factors using the maximum limiting factor method in ALES software. The capability evaluation gives three capability orders for lands in the studied area which are Fair (C3), Poor (C4) and Non Agriculture (C6). The outputs of the model were linked to the GIS modeling environment using relational database fields which have identifier key attribute property through matching Tables to obtain the final maps for land capability, Figure 3 and Table 1 shown the result of the capability classes in the studied area. The results of the capability model revealed the following:



**Figure 3: Land capability classes in the studied area**

Lands of capability order fair soils (C3): capability order (C3) includes most of the soil profiles in the studied area. This land is of fair capability and can be managed with little difficulty. These lands require good and proper

management. Under good management, they are high in productivity for fair range of crops. Lands of capability order Poor (C4): include four soil profiles in the studied area. The main limitation of these lands (C4) is soil salinity. These lands require good and proper management. Under good management, they are moderately high in productivity for fair range of crops. Lands of capability order non agriculture soils (C6): are represented by two soil profiles in the studied area. These lands have moderately severe limitations that restrict the range of crops and require special conservation practices. The main limitation of these lands differs from soil salinity. These lands are low in productivity for a fair range of crops while improvement practices can be feasible.

**Land Suitability:** ALES software was used as a Decision Support System (DSS) based on the main factor(s) that limit the soil suitability for certain land use potentiality of the environment (i.e. the dominant soil characteristics). The overall soil suitability of a soil component (unit) was assessed through the maximum limitation method. Eleven traditional crops are considered as follows: date palm, fig, olive, citrus as perennials, watermelon, tomato, potato, maize, wheat, barley and alfalfa as annuals and alfalfa as semiannual. These crops were selected to be used in evaluation in under soil conditions of the study area. The outputs of the model were linked to the GIS modeling environment. Tables 2, 3 and 4 gave information of capability and suitability evaluations and Figures 3, 4, 5 and 6 demonstrate the distribution of suitability classes in the different identified landforms and the soils occupying them.

**Table 1: Land Capability Classes in the studied area**

Land form	Profile Number	Soil Tax. of great group	Capability Classes		
			Degree %	Classes	
Plain	5	Torripsamments	37.77	C4 (Poor)	
	7	Haplogypsid	57.0	C3 (Fair)	
	12	Torriorthents	59.75	C3 (Fair)	
	13	Haplogypsid	41.37	C3 (Fair)	
	18	Torriorthents	35.33	C4 (Poor)	
Depression Floor	Lowland	1	Gypsisalids	4.3	C6 (Non Agriculture)
		2	Torripsamments	48.77	C3 (Fair)
		9	Haplosalids	3.16	C6 (Non Agriculture)
		10	Torripsamments	55.54	C3 (Fair)
		19	Torripsamments	48.8	C3 (Fair)
	Moderately High land	4	Haplosalids	49.6	C3 (Fair)
		11	Torripsamments	41.17	C3 (Fair)
		14	Haplosalids	28.83	C4 (Poor)
	High land	16	Calcigypsisalids	50.78	C3 (Fair)
		3	Torripsamments	54.96	C3 (Fair)
		17	Haplosalids	36.5	C4 (Poor)
		20	Torripsamments	31.35	C4 (Poor)
	Mesa and Plateau	8	Calcisalids	40.5	C3 (Fair)
15		Gypsisalids	4.48	C6 (Non Agriculture)	
Pediaplains	6	Torripsamments	41.99	C3 (Fair)	

Table 2: Land suitability for the selected fruit trees

Land form	Profile No.	Soil Tax. of great group	Suitability classes							
			Deg. (%)	Highly Suitable (S1)	Deg. (%)	Suitable (S2)	Deg. (%)	Moderately Suitable (S3)	Deg. (%)	Permanently non-Suitable
Plain	5	Torripsamments			73.5	Date palm			3.5	Citrus
					73.5	Fig				
					73.5	Olive				
	7	Haplogypsids	82.4	Date palm	74.5	Fig			4.0	Citrus
					74.5	Olive				
	12	Torriorthents	94.8	Date palm						
			94.8	Fig						
			94.8	Olive						
			80.5	Citrus						
13	Haplogypsids			74.4	Date palm			3.9	Citrus	
				62.4	Fig					
				62.4	Olive					
18	Torriorthents			65.5	Date palm			3.1	Citrus	
				65.5	Fig					
				65.5	Olive					
Lowland	1	Gypsisalids							Date Palm	5.31
									Fig	5.31
									Olive	5.31
									Citrus	4.44
	2	Torripsamments	84.6	Date palm	66.86	Citrus				
			84.6	Fig						
			84.6	Olive						
	9	Haplosalids					58.1	Date palm	4.6	Fig
									4.6	Olive
	10	Torripsamments	87.6	Date palm			56.5	Citrus		
94.1			Fig							
94.1			Olive							
19	Torripsamments	84.8	Date palm	67.0	Citrus					
		84.8	Fig							
		84.8	Olive							
Moderately High land	4	Haplosalids	82.63	Date palm	74.66	Fig			3.9	Citrus
					74.66	Olive				
	11	Torripsamments	84.2	Fig	78.3	Date palm	47.0	Citrus		
			84.2	Olive						
	14	Haplosalids			64.7	Date palm	54.4	Fig	3.0	Citrus
						54.4	Olive			
16	Calcigypsisalids			65.5	Date palm			5.2	Fig	
								5.2	Olive	
								4.1	Citrus	
High land	3	Torripsamments	89.51	Date palm	70.74	Citrus				
			89.51	Fig						
			89.51	Olive						
	17	Haplosalids			67.2	Date palm	56.5	Fig	3.8	Citrus
						56.5	Olive			
20	Torripsamments					49.3	Date palm	3.9	Fig	
								3.9	Olive	
								2.8	Citrus	
Mesa and Plateau	8	Calcisalids			60.7	Date palm			4.8	Fig
									4.8	Olive
									3.4	Citrus
									4.8	Date palm
	15	Gypsisalids							4.8	Fig
								4.8	Olive	
Pediaplains	6	Torripsamments			78.3	Date palm				
					78.3	Fig				
					78.3	Olive				
					61.9	Citrus				



**Table 3: Land suitability for the selected vegetable crops**

Land form	Profile No.	Soil Tax. of great group	Suitability classes							
			Deg. (%)	Highly Suitable (S1)	Deg. (%)	Suitable (S2)	Deg. (%)	Moderately suitable (S3)	Deg. (%)	Permanently non-Suitable
Plain	5	Torripsammets					55.8	Watermelon		
							55.8	Tomato		
							52.0	Potato		
	7	Haplogypsid			62.6	Tomato			4.9	Watermelon
									4.6	Potato
	12	Torriorrhents	94.8	Watermelon						
			94.8	Potato						
			94.8	Tomato						
	13	Haplogypsid							4.9	Watermelon
									4.9	Potato
									4.9	Tomato
	18	Torriorrhents					49.7	Watermelon		
						49.7	Tomato			
						49.7	Potato			
Lowland	1	Gypsisalids							5.3	Watermelon
									4.9	Potato
									5.3	Tomato
	2	Torripsammets	84.6	Watermelon	78.7	Potato				
			84.6	Tomato						
	9	Haplosalids							4.6	Watermelon
									4.6	Tomato
									4.6	Potato
	10	Torripsammets	87.6	Tomato	79.1	Watermelon				
					66.5	Potato				
19	Torripsammets	84.8	Watermelon	72.0	Potato					
		84.8	Tomato							
Moderately High land	4	Haplosalids			62.7	Tomato			4.9	Watermelon
									4.9	Potato
	11	Torripsammets			70.8	Watermelon				
					70.8	Tomato				
					65.9	Potato				
	14	Haplosalids							4.3	Watermelon
									4.3	Tomato
High land	3	Torripsammets	89.5	Watermelon						
			89.5	Tomato						
			83.3	Potato						
	17	Haplosalids							4.5	Watermelon
									4.5	Tomato
20	Torripsammets							4.6	Watermelon	
								4.6	Tomato	
								4.1	Potato	
Mesa and Plateau	8	Calcisalids							4.4	Watermelon
									4.4	Tomato
	15	Gypsisalids							4.0	Potato
									4.8	Watermelon
Pediplains	6	Torripsammets			78.3	Watermelon				
					78.3	Tomato				
					72.9	Potato				

Table 4: Land suitability for the selected field crops

land form	Profile No.	Soil Tax. of great group	Suitability classes							
			Deg. (%)	Highly suitable (S1)	Deg. (%)	Suitable (S2)	Deg. (%)	Moderately Suitable (S3)	Deg. (%)	Permanently non-Suitable
Plain	5	Torripsammments					58.3	Wheat		
							58.3	Barely		
							52.7	Alfalfa		
	7	Haplogypsids			61.1	Wheat	51.4	Alfalfa	4.3	Maize
					67.6	Barely				
	12	Torriorthents	80.5	Maize	75.2	Wheat				
					75.2	Barely				
					75.2	Alfalfa				
	13	Haplogypsids					49.5	Wheat	4.2	Maize
							58.9	Barely		
						49.5	Alfalfa			
18	Torriorthents					51.9	Wheat			
						51.9	Barely			
						39.4	Alfalfa			
						42.2	Maize			
Lowland	1	Gypsisalids							4.4	Wheat
									4.4	Barely
									4.4	Alfalfa
									4.7	Maize
	2	Torripsammments			67.1	Wheat				
					67.1	Barely				
					67.1	Alfalfa				
	9	Haplosalids					46.1	Barely	3.6	Wheat
									3.6	Alfalfa
	10	Torripsammments							3.9	Maize
				74.7	Wheat					
				74.7	Barely					
				69.5	Alfalfa					
19	Torripsammments									
				67.2	Maize					
				67.3	Wheat					
				67.3	Barely					
Moderately High land	4	Haplosalids					59.2	Wheat	4.2	Maize
					65.5	Barely	49.8	Alfalfa		
	11	Torripsammments			66.8	Wheat	56.1	Alfalfa		
					66.8	Barely				
14	Haplosalids					43.2	Wheat	3.4	Alfalfa	
						51.3	Barely	3.6	Maize	
						52.0	Barely	4.1	Wheat	
								4.1	Alfalfa	
High land	3	Torripsammments			71.0	Wheat				
					71.0	Barely				
					71.0	Alfalfa				
					76.0	Maize				
Mesa and Plateau	8	Calcsalids					44.8	Barely	3.8	Wheat
									3.8	Alfalfa
	15	Gypsisalids							3.8	Maize
									4.3	Wheat
Pediaplains	6	Torripsammments			62.1	Wheat			4.3	Barely
					62.1	Barely			4.3	Alfalfa
					62.1	Alfalfa			4.3	Maize
					66.5	Maize			4.6	

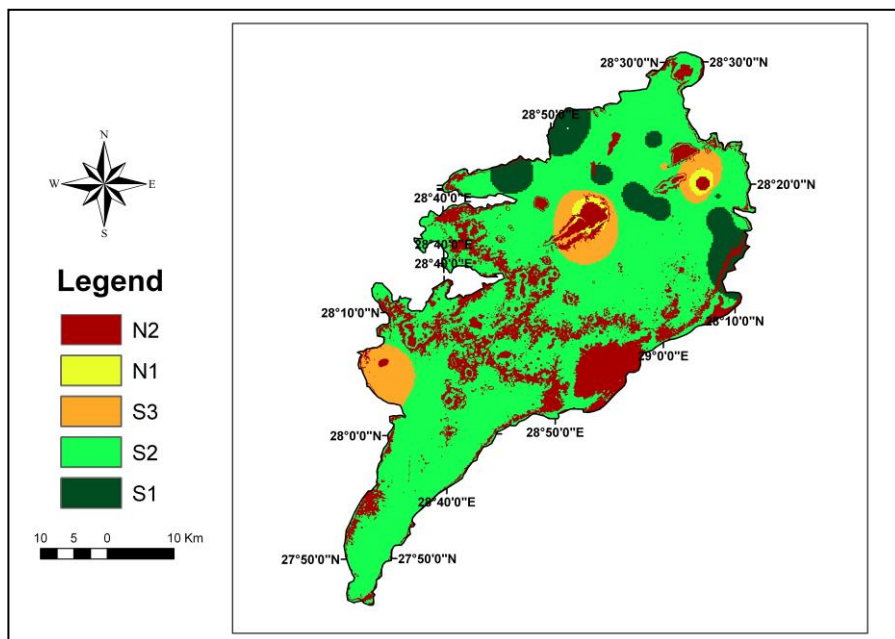


Figure 4: Suitability map for date palm in Bahariya Oasis.

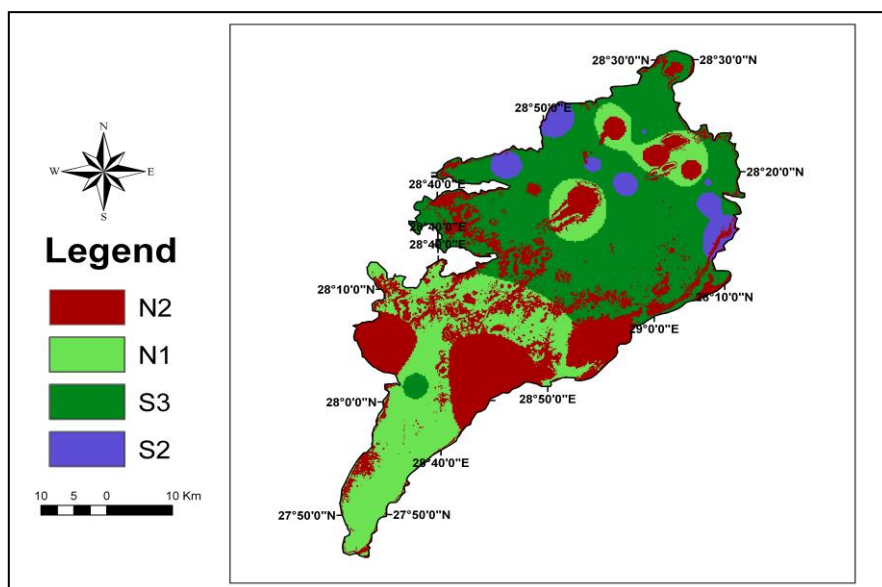


Figure 5: Suitability map for wheat in Bahariya Oasis.

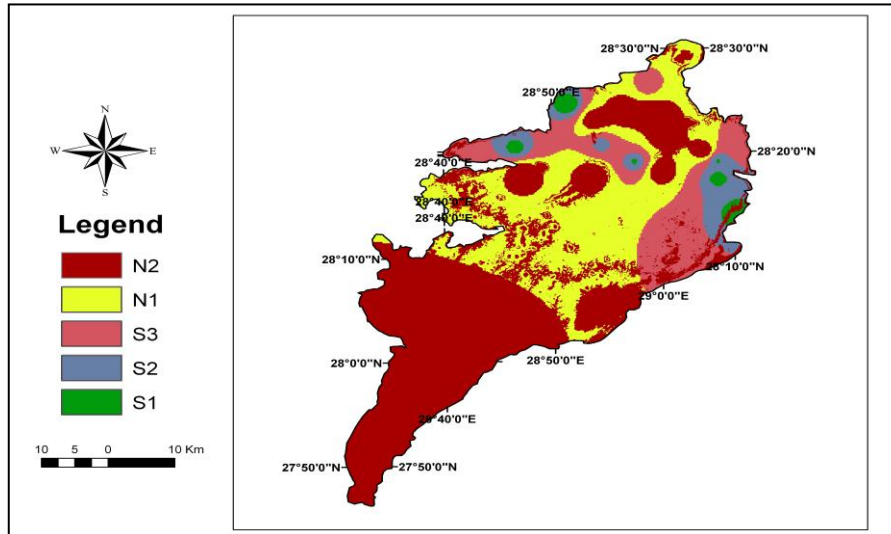


Figure 6: Suitability map for watermelon in Bahariya Oasis.

### CONCLUSION

Bahariya Oasis is a promising area for Agriculture extension and the associated industrial activities. The importance of these lands is due to the availability of ground water for irrigation and other vitalizations. The benefits will for the whole country, but primarily for their inhabitants. Separate localities are already cultivated with palm trees. The production of good quality dates is extensively exported. The expansion in irrigation agriculture required soil mapping and the assessment of suitable land use. Geographic information system is a powerful tool used for storage, analysis, and presentation of spatial data concerning the distribution of different soils plotted on maps and the capability and suitability of these soils for different land uses, demonstrated on appropriate maps. The system for land evolution is the adapted ALES of (Ismail *et al.*2001). Accordingly, most of the soils are of fair and poor capability, but by suitable reclamation methods together with appropriate management, these lands are suiting a promising future of certain suitable cultivations, the suitability of the soils in this Oasis is assessed by the same system for several land use. Highly suitable lands for date palm and olive cultivations are recognized. Wheat and watermelon could also be cultivated. Highly suitable and suitable areas are distinguished in the Oasis. Several other areas were poor or most suitable for other recommended cultivations. The soils as recognized in the occupying landforms are better evaluated as for as concerning soil and water management.

### **Acknowledgment**

The writers wish to express their deep appreciation and gratitude to Prof. Dr. M. A. Hammad, soil and water department, faculty of Agriculture, Al-Azhar University for continuous encouragement and guidance. Thanks are also due to the staff members of the department for their encouragement and cooperation.

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تقييم أراضي الواحات البحرية الصحراء الغربية - مصر اعتماداً على نظم المعلومات الجغرافية

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تعتبر الزراعة المستدامة هي الهدف الرئيسي من تقييم الأراضي. وتتناول الدراسة الحالية تقييم الأراضي للواحات البحرية والتي تقع في صحراء مصر الغربية باستخدام برنامج تقييم الأراضي الجافة والشبة جافة (ALES) لتقييم قدرة ومدى ملاءمة الأراضي على الزراعة. ولذلك إختير بعض أشجار الفاكهة مثل النخيل والتين والزيتون والموايح وبعض محاصيل الخضار مثل البطيخ والبطاطس والبطاطس وبعض المحاصيل الحقلية مثل القمح والذرة والشعير والبرسيم لتقييم قدرتها مدى ملاءمتها للزراعة بمنطقة الدراسة. وقد تم تطوير هذا البرنامج تبعاً للظروف المصرية ولذا تم اختياره من أجل وضع استراتيجيات لتقييم قدرة الأرض ومدى ملاءمتها على الإنتاج على المستوى الإقليمي. وأجرى الوصف المورفولوجي والتحليل المعملية لعشرون قطاع تربة. وتبين من الدراسة ان قدرة الاراض على الإنتاج تتراوح ما بين ضعيفة (C3) إلى غير قابلة للإنتاج الزراعي (C6).

من ناحية أخرى، بالنسبة لمدى ملاءمة الأراضي لزراعة بعضى نباتات الفاكهة المختارة تبين من الدراسة أن النخيل والتين والزيتون كانت مرتفعة (S1) إلى مناسبة (S2) في معظم اراضي منطقة الدراسة. على العكس من ذلك، كانت أشجار الموايح غير مناسبة للزراعة بصفة دائمة في تلك الأراضي. أما بالنسبة لمحاصيل الخضار المختارة كانت تتراوح ما بين مناسبة بدرجة عالية (S1) إلى غير مناسبة بصفة دائمة. على الجانب الآخر فإن مجموعة المحاصيل الحقلية المختارة كانت تتراوح ما بين مناسبة (S2) إلى (N2) غير مناسبة بصفة دائمة. تم التعرف على القدرة الإنتاجية للأراضي ومدى ملاءمتها للزراعة من خلال برنامج (ALES) بالتداخل مع برنامج ARCGIS لإنتاج خرائط تقييم الأراضي في صورة ورقية. وكان من أبرز العوامل المحددة للقدرة الإنتاجية للأراضي ومدى ملاءمتها للزراعة هي قوام وملوحة التربة والمحتوى من كربونات الكالسيوم.

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