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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 27º48´ and 28º30´N and longitudes 28º29´ and 29º 08´ E. It comprises an area of approximately 2250 km2. 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.

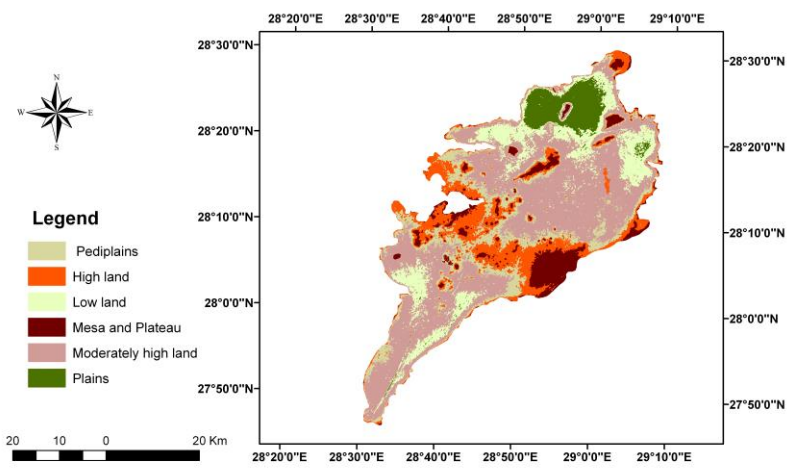

Fig. 1: Location and geomorphic units of the Bahariya Oasis

MATERALS 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*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 are 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° 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 AgrcGIS software. The root mean square error (RMSE) for the rectified image was less than 0.4 pixels. The D TM 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.

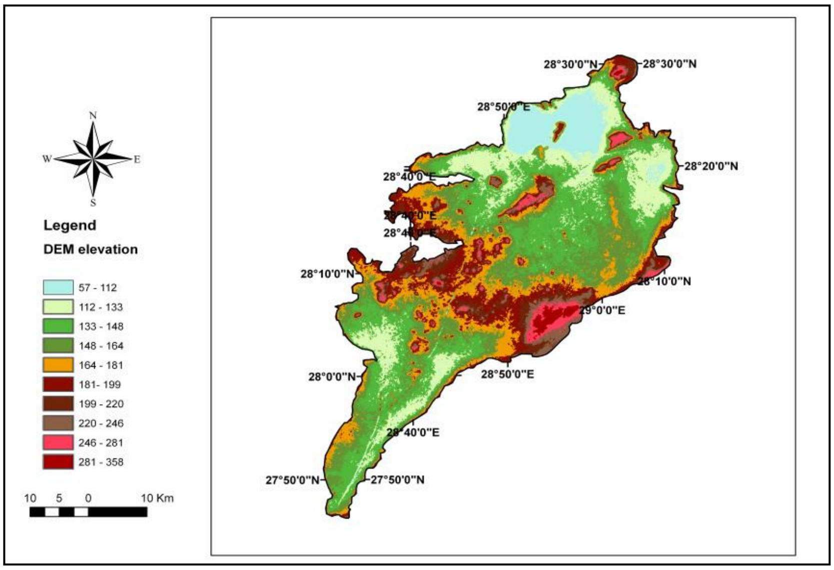

Fig. 2: Generated digital elevation model (DEM)

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 NH_4 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:

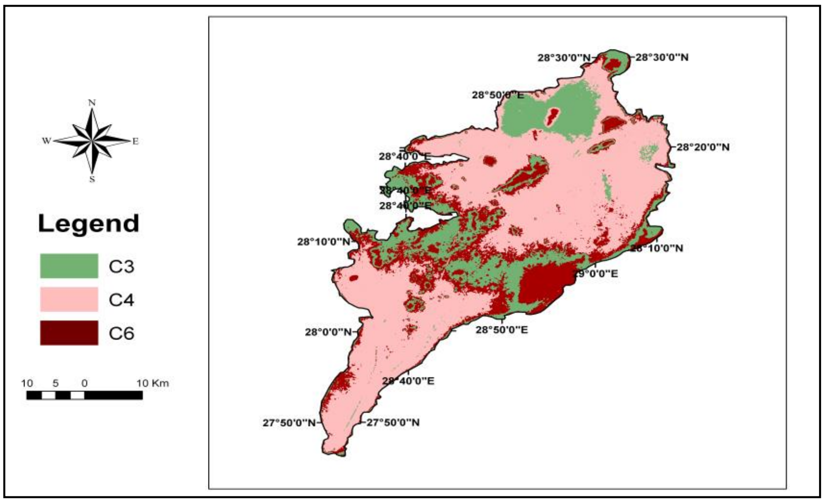

Figure 3: Land capability classes in the studied area

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	Haplogypsids	57.0	C3 (Fair)
		12	Torriorthents	59.75	C3 (Fair)
		13	Haplogypsids	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)
		16	Calcigypsisalids	50.78	C3 (Fair)
	High land	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)
Pediplains		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
									4.6	Citrus
	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
	15	Gypsisalids							4.8	Date palm
									4.8	Fig
									4.8	Olive
									4.8	Citrus
Pediplains	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	Torripsamments					55.8	Watermelon		
							55.8	Tomato		
							52.0	Potato		
	7	Haplogypsids			62.6	Tomato			4.9	Watermelon
									4.6	Potato
	12	Torriorthents	94.8	Watermelo						
			94.8	Potato						
			94.8	Tomato						
	13	Haplogypsids							4.9	Watermelon
									4.9	Potato
									4.9	Tomato
	18	Torriorthents					49.7	Watermelon		
							49.7	Tomato		
							49.7	Potato		
Lowland	1	Gypsisalids								
									5.3	Watermelon
									4.9	Potato
									5.3	Tomato
	2	Torripsamments	84.6	Watermelo	78.7	Potato				
			84.6	Tomato						
	9	Haplosalids							4.6	Watermelon
									4.6	Tomato
									4.6	Potato
	10	Torripsamments	87.6	Tomato	79.1	Watermelon				
					66.5	Potato				
	19	Torripsamments	84.8	Watermelo	72.0	Potato				
			84.8	Tomato						
Moderately High land	4	Haplosalids			62.7	Tomato			4.9	Watermelon
									4.9	Potato
	11	Torripsamments			70.8	Watermelon				
					70.8	Tomato				
					65.9	Potato				
	14	Haplosalids							4.3	Watermelon
									4.3	Tomato
									3.6	Potato
	16	Calcigypsisalids							5.2	Watermelon
									5.2	Tomato
									4.8	Potato
High land	3	Torripsamments	89.5	Watermelo						
			89.5	Tomato						
			83.3	Potato						
	17	Haplosalids							4.5	Watermelon
									4.5	Tomato
									4.5	Potato
	20	Torripsamments							4.6	Watermelon
									4.6	Tomato
									4.1	Potato
Mesa and Plateau	8	Calcisalids							4.4	Watermelon
									4.4	Tomato
									4.0	Potato
	15	Gypsisalids							4.8	Watermelon
									4.8	Tomato
									4.5	Potato
Pediplains	6	Torripsamments			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 uitable (S	Deg. (%)	Suitable (S2)	Deg. (%	loderately Suitable (S3)	Deg. (%)	Permane-ntly non-Suitable
Plain	5	Torripsamments					58.3	Wheat		
							58.3	Barely		
							52.7	Alfalfa		
							47.4	Maize		
	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	Torripsamments			67.1	Wheat				
					67.1	Barely				
					67.1	Alfalfa				
					71.8	Maize				
	9	Haplosalids					46.1	Barely	3.6	Wheat
									3.6	Alfalfa
									3.9	Maize
	10	Torripsamments			74.7	Wheat				
					74.7	Barely				
					69.5	Alfalfa				
					67.2	Maize				
	19	Torripsamments			67.3	Wheat				
					67.3	Barely				
					67.3	Alfalfa				
					72.0	Maize				
Moderately High land	4	Haplosalids			65.5	Barely	59.2	Wheat	4.2	Maize
							49.8	Alfalfa		
	11	Torripsamments			66.8	Wheat	56.1	Alfalfa		
					66.8	Barely				
					60.1	Maize				
	14	Haplosalids					43.2	Wheat	3.4	Alfalfa
							51.3	Barely	3.6	Maize
	16	Calcigypsisalids					52.0	Barely	4.1	Wheat
									4.1	Alfalfa
									4.4	Maize
High land	3	Torripsamments			71.0	Wheat				
					71.0	Barely				
					71.0	Alfalfa				
					76.0	Maize				
	17	Haplosalids					44.8	Wheat	3.5	Alfalfa
							53.3	Barely	3.8	Maize
	20	Torripsamments					45.8	Barely	3.9	Wheat
									3.9	Alfalfa
									3.9	Maize
Mesa and Plateau	8	Calcisalids					44.8	Barely	3.8	Wheat
									3.8	Alfalfa
									3.8	Maize
	15	Gypsisalids							4.3	Wheat
									4.3	Barely
									4.3	Alfalfa
									4.6	Maize
Pediplains	6	Torripsamments			62.1	Wheat				
					62.1	Barely				
					62.1	Alfalfa				
					66.5	Maize				

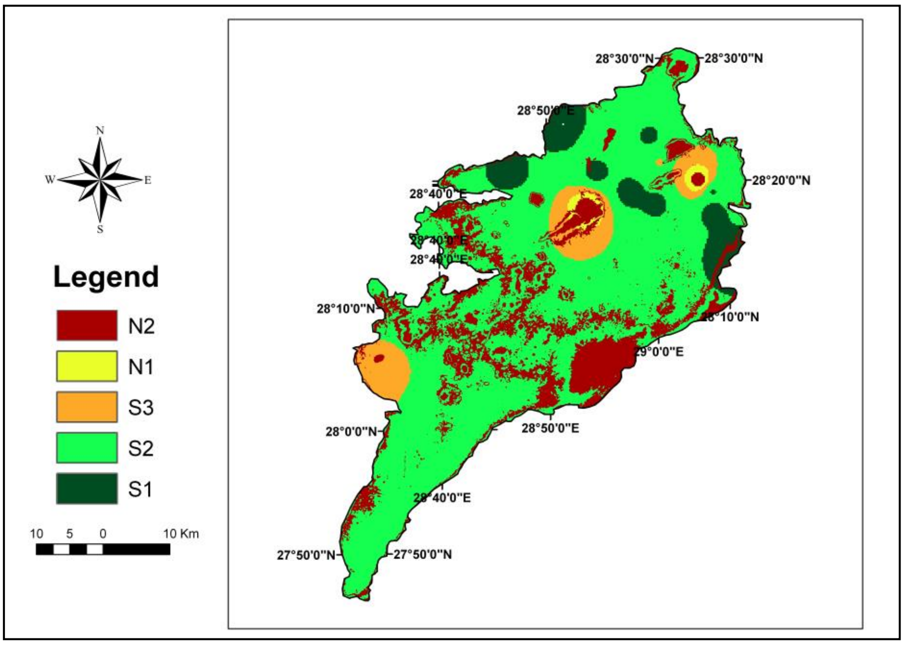

Figure 4: Suitability map for date palm in Bahariya Oasis.

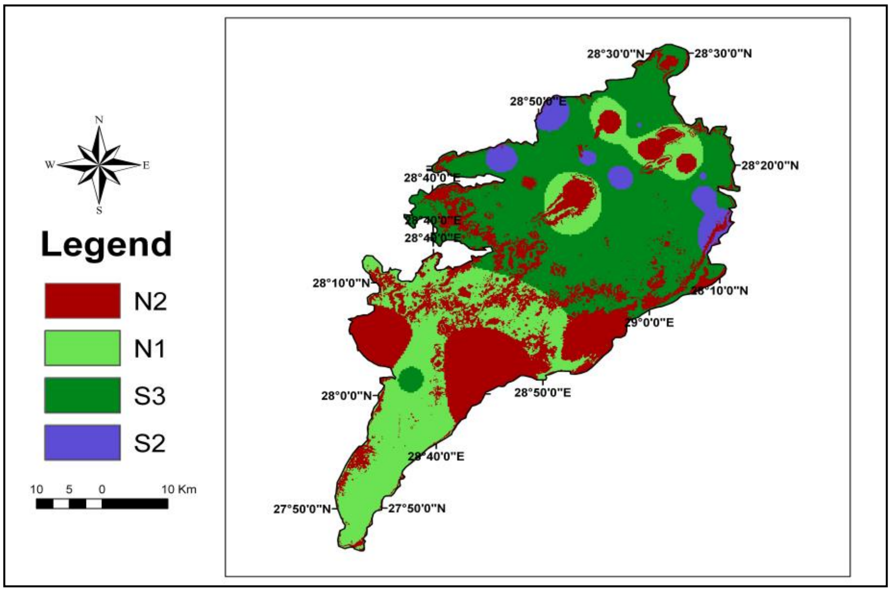

Figure 5: Suitability map for wheat in Bahariya Oasis.

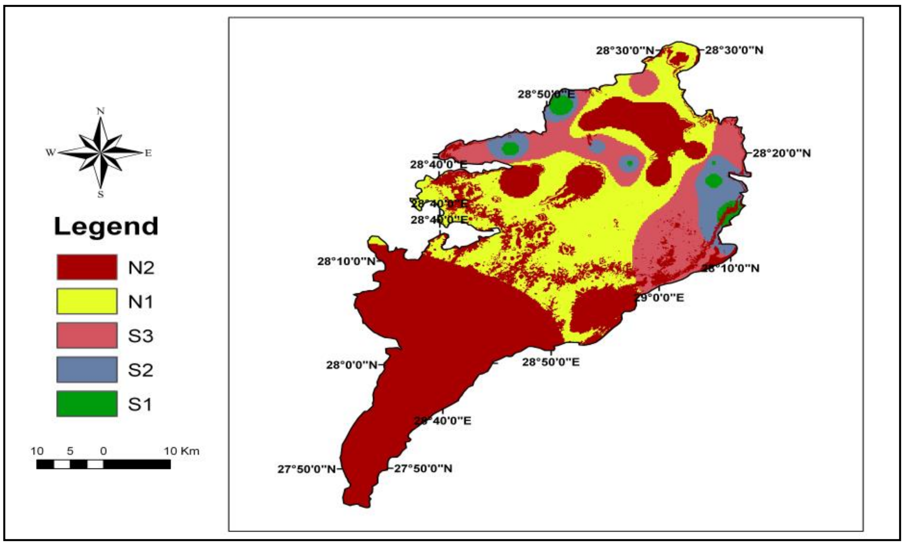

Figure 6: Suitability map for watermelon in Bahariya Oasis.

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.

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تقييم أراضى الواحات البحرية الصحراء الغربية - مصر إعتمادًا على نظم المعلومات الجغرافية

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تعتبر الزراعة المستدامة هى الهدف الرئيسي من تقييم الأراضي. وتتناول الدراسة الحالية تقييم الأراضـي للواحات البحرية والتى تقع في صحراء مصر الغربية بإستخدم برنامج تقييم الاراضى الجافة والشبة جافة (ALES) لتقييم قدرة و مدى ملاءمة الأراضي على الزراعة. ولذلك إختير بعض أشجار الفاكهة مثل النخيل والتين والزيتون والموالح وبعض محاصيل الخضر مثل البطيخ والطماطم والبطاطس وبعض المحاصيل الحقلية مثل القمح والذرة والشعير والبرسيم لتقييم قدرتها مدى ملاءمتها للزراعة بمنطقة الدراسة . وقد تم تطوير هذا البرنامج تبعا للظروف المصرية ولذا تم اختيارة من أجل وضع استراتيجيات لتقييم قدرة الأرض ومدى ملاءمتها على الإنتاج على المستوى الإقليمي. وأجرى الوصف المورفولوجى والتحاليل المعملية لعشرون قطاع تربة . وتبين من الدراسة ان قدرة الاراض على الإنتاج تتراوح ما بين ضعيفة (C3) إلى غير قابلة للإنتاج الزراعى (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 فى معظم اراضى منطقة الدراسة. على العكس من ذلك ، كانت أشجارالموالح غير مناسبة للزراعة بصفة دائمة فى تلك الاراضى. أما بالنسبة لمحاصيل الخضر المختارة كانت تتروواح مابين مناسبة بدرجة عالية (S1) إلى غير مناسبة بصفة دائمة. على الجانب الاخر فإن مجموعة المحاصيل الحقلية المختارة كانت تتراوح مابين مناسبة (S2) إلى (N2) غير مناسبة بصفة دائمة. تم التعرف على القدرة الإنتاجية للأراضى ومدى ملاءمتها للزراعة من خلال برنامج (ALES)بالتداخل مع برنامج ARCGIS لإنتاج خرائط تقييم الاراضى فى صورة ورقية وكان من أبرز العوامل المحددة للقدرة الإنتاجية للأراضى ومدى ملاء متها للزراعة هى قوام وملوحة التربة والمحتوى من كربونات الكالسيوم.

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