Integration Gis and Modeling to Characterize Soil Units and Land Evaluation in Banger Elsokkar Region

Zeid, H. A.[1]; I. M. Morsy[2]; M. A. Hussin[1]; W. H. Mohamed[1]; Hoda, A. Abd El Meged[1]

(1) Soil and Agricultural Chemistry Dep.; Faculty of Agriculture, Saba Basha, Alexandria University, Egypt.

(2) Soil Salinity and Alkalinity Dep. Soil Water and Environment Research Institute, Agriculture Research Center, Alexandria, Egypt.

Keyword: GIS, GPS, Evaluation, ALES-Arid

ABSTRACT

The study aims to build up a geographic digital database related to Banger Elsokar area for evaluation the characteristics and prosperities of the soil. This plays a great role in choosing the best suitable kinds of crops to be grown on the study area through integration of the Geographic Information System (GIS) and the Evaluation Program used (ALES-Arid) and also using the (GPS). ALES-Arid aimed to evaluate the fitness of different land types to produce different crops (field crops, vegetables, forage crops, and fruit trees) to identify the optimum land use. A total of 91 soil observations were made (9 profiles and 82 augers); which soil covers a total area of 1521 hectars. Soil profiles were morphologically described in the field and soil samples were collected for laboratory determinations. Also, irrigation water samples were collected from EL- Nasr canal.

The results indicated that the studied area could be divided into five soil units as: 1) Non saline, very calcareous, deep, 2- Non saline, very calcareous, moderately deep, 3- Non saline, extremely calcareous, deep, 4- Saline, extremely calcareous, deep, and 5- High saline, extremely calcareous, deep. The investigated soils mainly classified as C2 (good capability), the main limiting productivity factors of Banger Elsokar area soils were soil texture (t), and calcium carbonate content (Ca).Also, the results of this work indicated that the investigated soils mainly classified as C4 (poor capability) to C5 (very poor capability), the main limiting productivity factors were organic matter (om), available nitrogen (n), and available potassium (k).

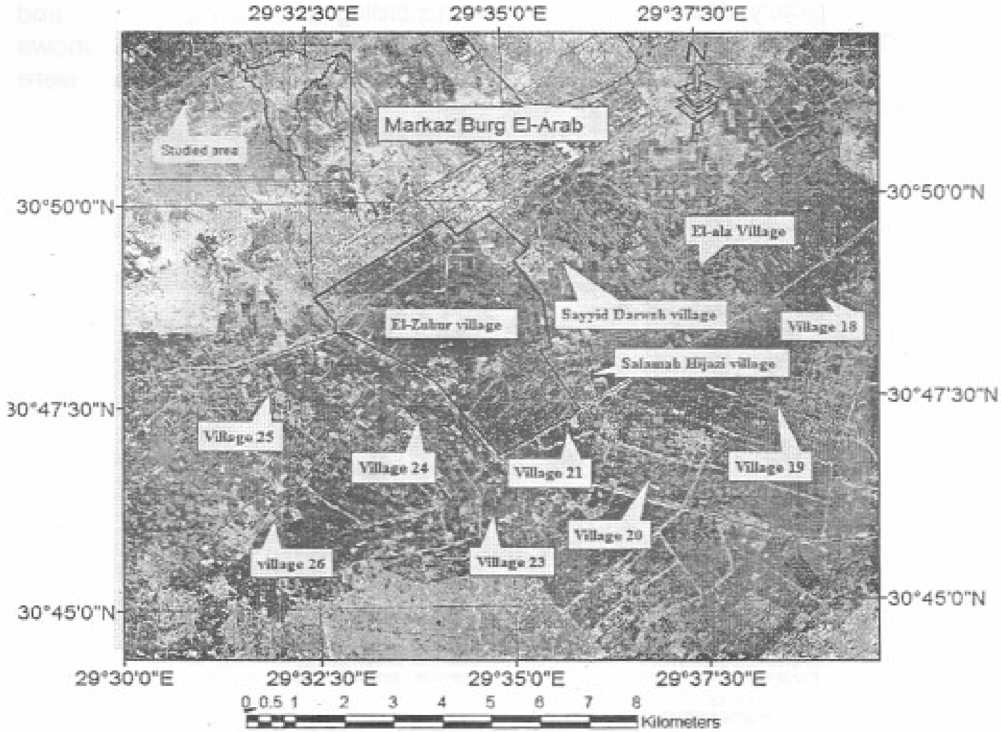
Different land suitability classes and indices for several crops were predicted based on the matching between land qualities and characteristics and crop slandered requirement using ALES-Arid program. The land suitability for sex crops (field crops, vegetables, and fruit trees) was investigated. The main limitations in the studied area are soil texture (t), hydraulic conductivity (Kh), soil salinity (ece), available potassium (k), calcium carbonate content (ca), and soil depth (dp).

INTRODUCTION

Geographic information system, commonly referred to as a GIS, is a computer system designed for input, storage, retrieval analysis, and display of interpreted geographic data (Burrough, 1986). On the other words, GIS is a powerful set of tools for capturing, storing, management, retrieving, analysis, and displaying spatial data from the real world for a particular set of purposes (Burrough and McDonnell, 1998). Applications of GIS technology in soil survey indirectly impact land use and natural resource planning. Soil survey is often a layer in GIS applications, which range from land use and natural resource planning at local municipality levels to global resource inventory (Driessen and Konijn, 1992). Land evaluation is defined as "the process of assessment of the performance of land when used for specific purposes, involving the execution and interpretation of surveys and studies of land forms, soils, land use, vegetation, climate and other aspects of land in order to identify and make a comparison of promising land use types in terms applicable to the objectives of the evaluation" (FAO, 1983). Another definition for land evaluation is "the assessment of the suitability of land for man's use in agriculture, forestry, engineering, hydrology, regional planning, recreation, etc.," (Stewart, 1968 and Van Diepen et al., 1991). The aim of land evaluation is to provide information on the opportunities and constraints for the use of land as a basis for making decisions on its use and management (Songcai, 1997). The main product of land evaluation investigations is a land classification that indicates the suitability of various kinds of land for specific land uses, usually depicted on maps with accompanying reports (FAO, 2008). Ramadan (1992) and Abdel-Kader and Ramadan (1995) used ILWIS/GIS software in their studies, and found that the capability classes in Dabaa and Fuka areas comprised four classes: class 2, class 3, class 4, and class 5. They applied the FAO system to evaluate the lands for different land uses, namely, wheat, barley, and fig plantation, and concluded that the prevailing land use classes are S2, S3, and N. Bahnassy et al., (2001) used coupling GIS with modeling tools to support land use planning and management of Sugar Beet area, west Nubaria. They found that the output from both SALTMOD and MicroLEIS models were linked to the ARC View/GIS software to show spatial-temporal distribution of soil salinity, water table depth and suitability of wheat plantation. Fayed (2003), evaluated the land capability of El-Bostan region west Nile Delta, according to the system elaborated by Ismail *et al.* (2001), and found that some of the studied soils belong to land capability class 4 (weak or marginal), while others belong to class 3, which reflect fair or moderate degree of land capability. Also he used the MicroLEIS software to determine the soil suitability for crops. The Banger El Sokkar region of the western coastal of Egypt has recently been subjected to attention for increasing the agricultural land use. The main goals of this study is to: characterize the main soil units and evaluate the land for different land uses throughout integration of Geographical Information System (GIS) and modeling.

Location of studied area

El-Banger region is located 55 km south west of Alexandria city. It is bounded by Alex-Cario desert road from the East, El-Nasr Canal from the South and the West, and Bahig Canal from the North. It lies approximately between latitudes 30 45 and 30 55 N and longitudes 29 30 and 29 50 E. El Banger region runs west and North West covering an approximately 113,750 feddans. The study area extends to cover El-Zuhur village (urban and agricultural areas) which represent the first stage of reclamation with total acreage of 1521 hectare (3650 feddan). It lies approximately between latitudes 30 47 and 30 50 N and longitudes 29 32.30 and 29 36 E., map (1).

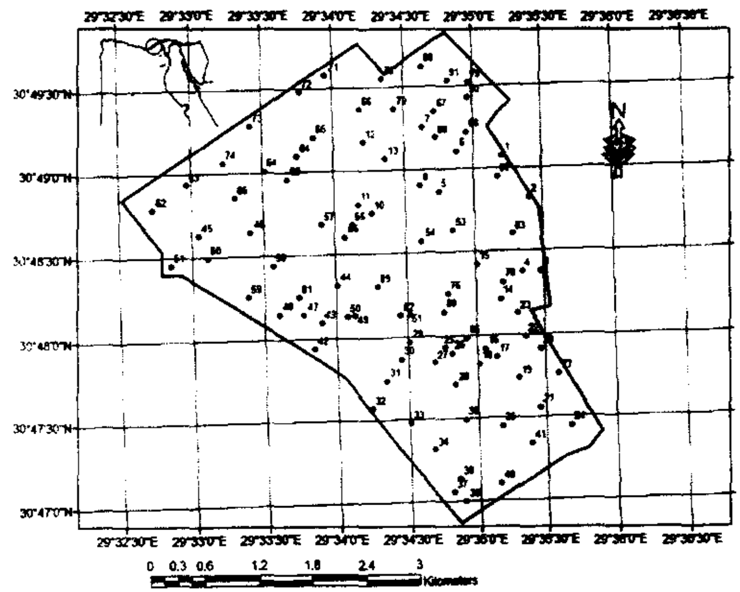


Map(1): The location of the study area

Main characteristics of the climate in the study area are the long dry summer and the scarce winter rainfall. According to Koppen's classification, the climate of the region is described as a hot desert climate. The amount of annual rainfall is low and reaches about 160 mm. Most of precipitation falls in winter between October and March. The mean annual temperature is around 23.5°C. Average relative humidity over the year is 66%. The geological history of El Banger region had been studied by the FAO/SF (1964). The most striking structural feature shows that the study area is sandwiched by two series of bridges.

MATERIALS AND METHODS

Field work: Systematic intensive soil survey was carried out in the area throughout digging soil pits and auger observations (Ministry of Agriculture, 1995). A total of 91 soil observations were made (9 pits and 82 soil augers); which cover a total area of 1521 hectars. Soil pits were morphologically described in the field according to the FAO (1990), and soil samples were collected for laboratory determinations. Map (2) shows the location of the soil observations. Irrigation water samples were collected from EL- Nasr canal.



Map(2): Location of soil observations in studied area

Satellite Image:

A window of Landsat7 ETM+ (Enhanced Thematic Mapper) image acquired in May 2002 was selected to represent the studied area.

Topographic Maps

The study area is covered by four topographic map sheets at scale 1:50000. The ArcGIS software (ESRI, 2008) using georeferencing model in

Spatial analysis extension to project a topographic map to Universal Transverse Mercator (UTM) coordinates (Easting-Northing) system.

Generation of DEM

DEM is defined as any digital representation of the continuous variation of relief over space (Burrough, 1986 by means of digitized contour lines of 1:50000 scaled topographic maps in every 10 m interval as well as spot heights, DEM of the study area was performed by using interpolation procedure. Topo to raster model in 3D extension was used to generate the Digital Elevation Model (DEM) within ArcGIS 9.3 (ESRI, 2008). DEM was analyzed to generate the degree of slope classes and Aspect.

Laboratory analyses:

Chemical and physical analyses of soils were carried out according to Page et al. (1982).

Descriptive statistical parameters:

Minimum, maximum, mean, standard deviation and coefficient of variance were calculated using SPSS software Ver. 12 (2003).

Building up Digital Georeference Database:

Data input process is the operation of entering the spatial and non-spatial data into GIS using ArcGIS software (ESRI, 2008). Each soil observation was geo-referenced using the Global Positiong Systems (GPS) and digitized. The different soil attributes were coded, and new fields were added to the profile database file in ArcGIS software.

Soil Units:

Map overlay is the hallmark of GIS. It could be done in2 ways, either using a vector or raster data. The raster operation is more preferred as it makes the calculation easier using map calculator. Addition operation was used to overlay the reclassified maps of EC, $CaCO3$ and depth to explain soil complexity and variability and to evaluate the land for specific uses.

Land evaluation:

Agriculture land Evaluation System for arid region (ALES-Arid) (Abd El-Kawy *et al.*, 2010) is a new approach for land capability and suitability evaluation. ALES-Arid is described as a land use decision support system, which is linked directly with integrated databases and coupled indirectly (loose coupling) with GIS. Through ALES-Arid program, land evaluation algorithms are expressed in notation forms that can be understood by a calculating device. Optimization tools based on land evaluation models are considered very important to formulate decision alternatives.The calculation of capability index by ALES-Arid is an indication of land capability according to multiplication method. Three main groups of parameters were included:

1- Soil physical and chemical parameters.
2- Soil fertility parameters, and
3- Water irrigation parameters.

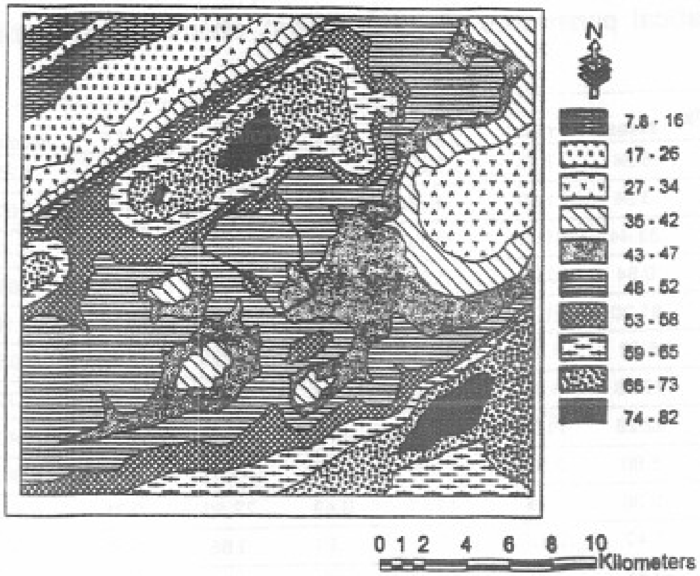
Each grope consists of number of characteristics (or qualities); which are evaluated and described as an index that takes value from zero (minimum value) to 100% (maximum value) then the logarithmic value of each characteristic was calculated from its index value. After that the final capability index of each group was calculated by multiplying the logarithmic mean of its characteristics, and then the anti-logarithmic value (capability index) calculated. The ALES-Arid aimed to evaluate the fitness of different land types to produce different crops (field crops, vegetables, forage crops, and fruit trees) to identify the optimum land use. Land suitability calculations have taken into consideration most of land capability related parameters, as well as, climatic data (temperature). The land suitability classes were identified using the matching between standard crop requirements (Sys, 1975; FAO, 1977, 1985 and Sys et al., 1993) and actual land characteristics. The crop requirements were listed against soil properties and rated to give classes of land suitability for theses crops.

The successful application of ALES-Arid implies the respect of following rule: the number of land characteristics to consider has to be reduced (minimum dataset) to avoid repetition of related characteristics in the formula (Sys et al., 1993).

RESULTS AND DISCUSSIONS

Land surface analyses:

Digital elevation model (DEM) of the studied area contributes to the storage of elevation data as digital map and 3-D, (Map 3). The most advantage of the GIS is the ability to process elevation data in a digital format, and obtains valuable information about the land surface; (Carter, 1988). DEM was obtained from the digital contour map, using the interpolation technique. The lowest elevation in the study area is -13 m A.S.L. and the highest one is 1 m, A.S.L



Map(3): the Digital Elevation Model (DEM) of the study area

Descriptive statistical estimates:

The descriptive statistical analysis for the main variables at the studied area is summarized in Table (1). The data show that the soil samples were characterized by a wide range of salinity where the maximum values of EC are 15 dS/m, and the minimum dropped to 1 dS/m, with a median of 2.6 dS/m. Such over-spread salinity is expressed by distinguished coefficient of variation (C.V.) value of 0.79 for soil samples. It is also noticed that the higher EC variation is associated with the dominated soluble ions variation, i.e., Na^+ and Cl^-. Sodium adsorption ratio (SAR) represents a high variation where the maximum SAR values are 9.36 and the minimum SAR values are1.11 in soil samples.

Table (1): Statistical parameters of soil physical, chemical and fertility properties

	Soil Property	Mean	min	Max	S.D.	Var.	C.V	Median
	pH	8.24	7.88	8.59	0.15	0.02	0.02	8.25
	EC, dS/m	3.54	1.00	15.00	2.80	7.84	0.79	2.60
	$CaCO_3$, %	33.44	19.05	51.82	7.19	51.69	0.21	33.33
	OM, %	0.64	0.21	1.32	0.32	0.10	0.49	0.61
	Sand, %	81.20	61.20	94.80	9.16	83.93	0.11	83.10
	Silt, %	6.22	1.30	18.30	4.31	18.58	0.69	5.05
	Clay, %	12.58	3.00	26.65	6.31	39.80	0.50	11.70
Soluble cations and Anions	Ca, meq/l	22.28	16.00	40.20	5.61	31.52	0.25	20.40
	Mg, meq/l	5.90	2.00	18.00	4.94	24.44	0.84	4.00
	Na, meq/l	9.38	3.70	49.58	8.49	72.16	0.91	6.63
	K, meq/l	1.47	0.13	8.18	1.91	3.66	1.30	0.97
	HCO_3, meq/l	3.51	2.10	12.40	1.74	3.03	0.50	3.10
	Cl, meq/l	15.27	8.75	47.50	7.35	53.95	0.48	12.50
	SO_4, meq/l	20.25	8.82	53.97	11.81	139.38	0.58	17.34
	SAR	2.36	1.11	9.36	1.60	2.56	0.68	1.87
	ESP%	2.13	0.38	11.15	2.14	4.57	1.01	1.47
Available macro-nutrient	K, ppm	88.97	7.99	276.10	82.26	6766.83	0.92	74.16
	P, ppm	14.57	5.72	27.57	5.18	26.81	0.36	13.79
	N, ppm	23.45	6.63	60.06	12.22	149.33	0.52	22.43
Available micro-nutrients	Zn, ppm	0.50	0.10	2.60	0.47	0.22	0.94	0.29
	Cu, ppm	0.28	0.02	0.69	0.17	0.03	0.62	0.22
	Fe, ppm	2.07	0.81	6.24	1.23	1.51	0.59	1.61
	Mn, ppm	2.85	0.29	10.08	2.56	6.56	0.90	1.83
	Soil depth, cm	114.67	90.00	120.00	11.53	133.03	0.10	120.00
	SP %	37.59	14.62	54.15	7.70	59.35	0.20	37.66
	FC %	10.37	6.15	17.61	2.33	5.45	0.23	9.94
	WP %	5.56	2.56	10.26	1.58	2.50	0.28	5.13
	Kh (cm/hr)	3.97	0.33	13.17	2.70	7.31	0.68	3.60
	Bulk density (g/cm3)	1.31	1.08	1.68	0.10	0.01	0.08	1.31
	Available water (mm/m)	48.10	35.80	73.49	8.35	69.67	0.17	46.59

Soil mapping Units:

The final soil map was compiled by GIS software (Arc GIS) after the completion of the field work and laboratory analysis of the soil properties for the entire study area. Generally, studied area could be divided into five soil units (Map 4): -

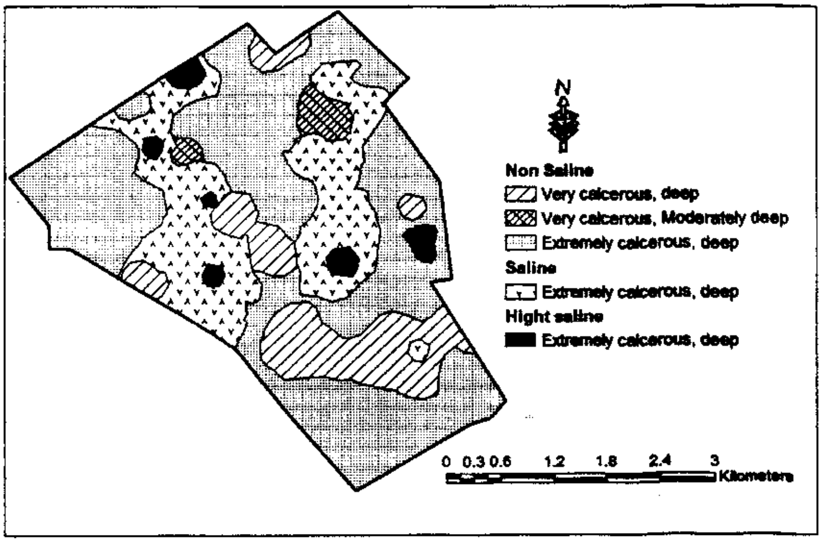
1- Non saline, very calcareous, deep: the soil unit area 568.9 fed. (15.6%) from the study area, soil salinity varied between 1.2 – 3.1 dS/m, calcium carbonate content varied between 19 - 29%, and depth > 100 cm.

2- Non saline, very calcareous, moderately deep: the soil unit area 84.5 fed. (2.3%) from the study area, soil salinity varied between 2 – 3.5 dS/m, calcium carbonate content varied between 28.4 – 30.5%, and depth < 100 cm.

3- Non saline, extremely calcareous, deep: the soil unit area 1987.6 fed. (54.5%) from the study area, soil salinity varied between 1 – 4.2 dS/m, calcium carbonate content 30 – 51.8%, and depth > 100 cm.

4- Saline, extremely calcareous, deep: the soil unit area 905.8 fed. (24.8%) from the study area, soil salinity varied between 4 – 7.9 dS/m, calcium carbonate content varied between 29.9 – 47.9%, and depth > 100 cm.

5- High saline, extremely calcareous, deep: the soil unit area 100.8 fed. (2.8%) from the study area, soil salinity varied between 8.7 - 15 dS/m, calcium carbonate content varied between 30.2 – 40.9%, and depth > 100 cm.



Map(4): Soil units of the study area

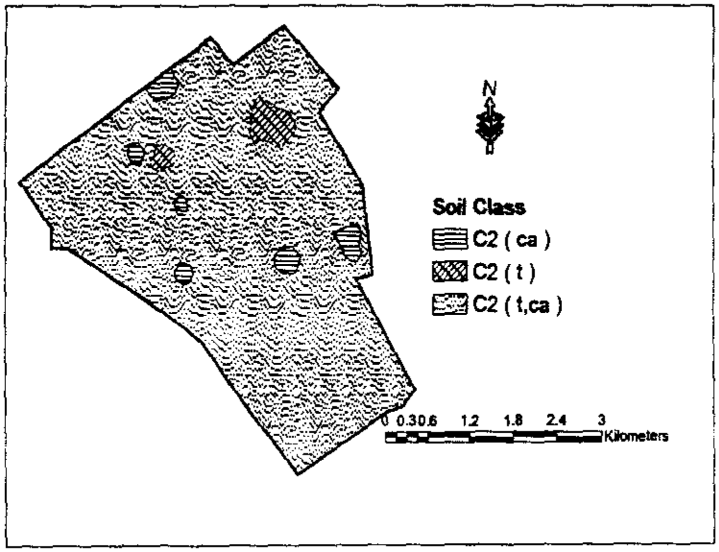
Evaluation Parameters:

Soil capability indices:

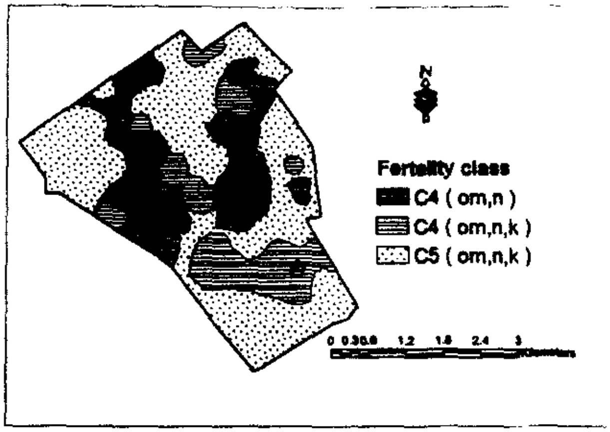
Results (in Map. 5) indicated that the investigated soils mainly classified as C2 (good capability), the main limiting productivity factors of Banger Elsokar area soils were soil texture (T), and calcium carbonate content (Ca). Results (in Map. 6) indicated that the investigated soils mainly classified as C4 (poor capability) to C5 (very poor capability), the main limiting productivity factors were organic matter (OM), available nitrogen (N), and available potassium (K).

Table(2):Areas of Soil capability classes

Soil Classes	Area (fed.)	fertility Classes	Area (fed.)
C2 (Ca)	100.8	C4 (OM, N)	1006.5
C2 (T)	84.5	C4 (OM, N,K)	653.4
C2 (T, Ca)	3462	C5 (OM, N, K)	1987.6



Map (5): Soil physical and chemical capability class and limitation of the area



Map (6): soil fertility capability class and limitation factors of the studied area

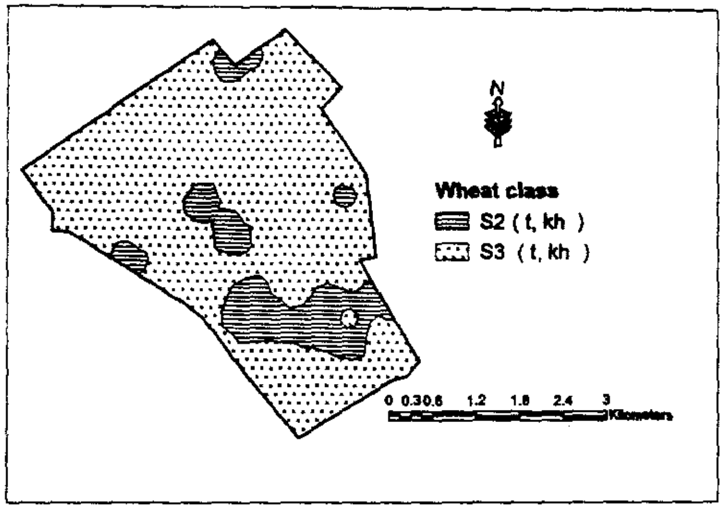
Suitability classes for different crop:

Different land suitability classes and indices for several crops were suggested basing on the matching between land qualities and characteristics and crop standered requirement using ALES-Arid program (Table, 3). The land suitability for six crops (field crops, vegetables, and fruit trees) was investigated. The main limitations in the studied area are soil texture (T), hydraulic conductivity (K_h), soil salinity (EC_e), available potassium (K), calcium carbonate content (Ca), and soil depth (dp). The maps 7, 8, 9, 10, 11 and 12 summarized the land capability and suitability classes and the area suitable for each crop.

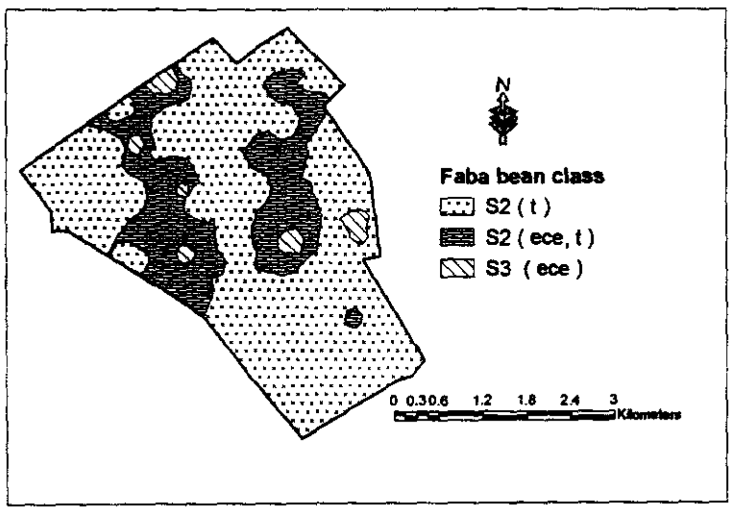
Table (3): Areas of land suitability classes for different crops grown in the area

Faba bean		wheat		Tomato		Watermelon	
Classes	Area (fed.)	Classes	Area (fed.)	classes	Area (fed.)	classes	Area (fed.)
S2 (T)	2640,9	S2(T,K_h)	568.9	S1( )	905.8	S1( )	2640.9
S2(EC_e,T)	905.8	S3(T,K_h)	3078.6	S1(K_h)	1987.6	S2 ( )	905.8
S3 (EC_e)	100.8			S2(K_h)	185.3	S2(EC_e)	100.8
				S3(K_h)	568.9		

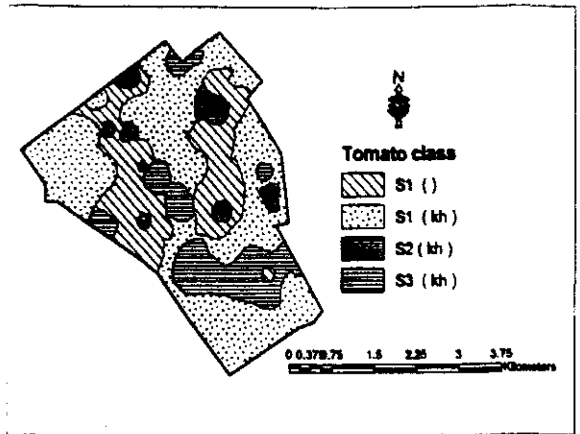
Apple		Date palm	
Classes	Area (fed.)	Classes	Area (fed.)
S1 (T)	568.9	S1 ( )	905.8
S2 (T)	1987.6	S2(dp,K_h)	84.5
S2(dp,T)	84.5	S2 (K_h)	2088.3
S2(EC_e)	1006.5	S3 (K_h)	568.9



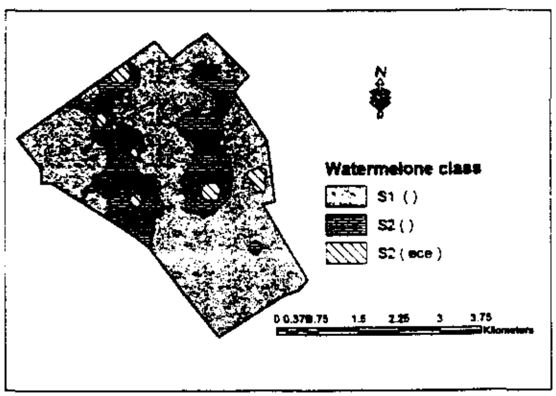
Map(7): Soil suitability class for wheat



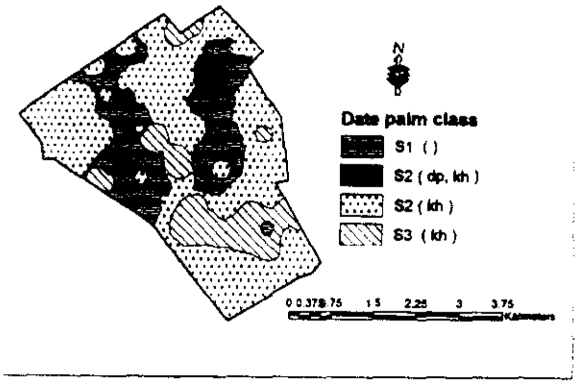
Map(8): Soil suitability class for faba bean.



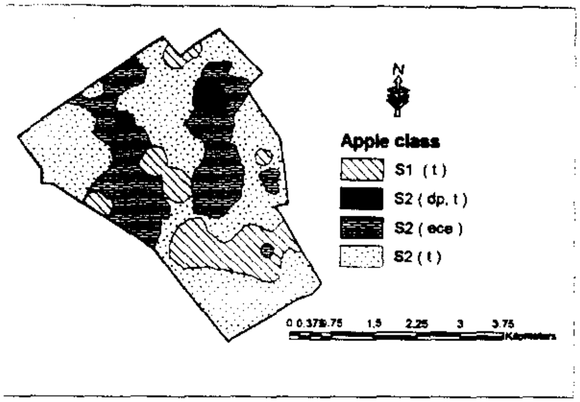
Map(9): Soil suitability class for tomato.



Map(10): Soil suitability class for watermelon.



Map(11): Soil suitability class for Date palm.



Map (12): Soil suitability class for apple.

REFERENCES

Abdel-Kader, F. H. and H. M. Ramadan. 1995. Land evaluation of Dabaa-Fuka area, North Western Coast, Egypt, using geographical information system (GIS). Egypt. J. Soil Sci. 35, No;2, pp. 203-214.

Abd Ell-Kawy O.R., H.A. Ismail, J.K.Rod, A.S. Suliman 2010. A developed GIS-based land evaluation model for agricultural land suitability assessments in arid and semi arid regions. Res. J. of Agric. And Biological Sci. 6 (5): 589-599.

Bahanassy, M., H. M. Ramadan, F. Abdel-Kader and H. Y. Yehia. 2001. Coupling GIS with modeling tools to support l and use planning and management of sugar Beet area, west Nubaria, Egypt. Alex. Jour. Agric. Res. Vol. 46 No.1 pp.169180

Burrough, P.A. and R.A. McDeonnell. 1998. Principles of Geographic Information Systems. Oxford University Press. London, UK.

Burrough, P.A., 1986. Principles of Geographical Information Systems for Land Resources Assessment. Clarendon Press, Oxford, United Kingdom.

Carter, J.R. (1988). Digital representation of topographic surfaces. PE&RS, Vol. 54, No. 11, 1577-1580.

Driessen P.M. and N.T. Konijn (1992). Land-use system analysis. Indonesia.

ENVI, 2003. The Environment for visualizing images, version 4, Colorado, USA.

ERDAS 2001. Geographic imaging Made Simplesm. ERDAS Version 8.50 Inc. Atlanta, Georgia.

Esri (2008). Arc-GIS 9.3 spatial analyst. Redlands. CA, USA.

FAO, 1977. Guidelines for predicting cropwater requirements, FAO, Rom.

FAO, 1985. Guidelines: land evaluation for irrigated agriculture. Soils Bulletin. No.55, FAO, Rome.

FAO, 1990 Global and national soils and terrain digital databases procedures manual. World Soil Resources Report No. 74.

FAO, 2008. Guidelines: land evaluation for irrigated agriculture, Natural Resources Management and Environment Department. http://www.fao.org/.

FAO, Rome. FAO. 1983. Guidelines: Land evaluation for rainfed agriculture, Soils Bulletin 54.

FAO/SF. 1964. High dam soil survey. Volumes 1 and 2. Rome

Fayed, R. 1. M., 2003. Impact of land management practices on soil quality in sandy soils, El-Bostan region- Egypt. Ph. D. Thesis, Faculty of Agriculture, University of Alexandria, Egypt.

Ministry of Agriculture. (1995), Soil survey of Zemam Shubrakhit. In Arabic.

Page, A. L, Miller, R. H. and Keeny, D. R. (1982). Methods of Soil Analysis, Part 2 Chemical and Microbiological Properties.Agronomy No. 9. ASA, SSSA,

Ramadan, H. M. 1992. Land variability and evaluation of Dabaa-Fuka area, North Western Coast, Egypt. Ph.D. Thesis, Univ. of Alexandria.

Songcai, Y. (1997). Soil information for land use planning, Red earth hills, Taihe county, Jiangxi province, China. M.Sc. Thesis, ITC, Enschede, The Netherlands.

SPSS for windows. 2003. Copyright, Version (12), standard license

Stewart, G. A. (1968). Land Evaluation. Papers of A CSIRO Symposium. (CSIRO/UNESCO, Canberra), MacMillan of Australia, Melbourne.

Sys, C., 1975. Guidelines for the interpretation of land properties for some general land utilization types. In report on the technical consultation land evaluation in Europe. Soils Bulletin No. 29 FAO, Rom p 107 – 118.

Sys, C., Van Ranst, E., and Debaveye, J. (1993). Crop requirements. International Training Center (ITC) for post-graduate soil scientistis (part III). University Ghent.

Tim, U. S. 1996. Coupling vados zone models with GIS: Emerging trends and potential bottlenecks. Journal Environmental quality. (25) 3: 535-544.

Van Diepen, C. A.; Van Keulen, H.; Wolf, J. And Berkhont, J. A. A. (1991). Land evaluation: from intuition to quantification. Advances in Soil Science 15:140-204.

الملخص العربى

التكامل بين نظم المعلومات الجغرافية والنمنجة لوصف وحدات التربة وتقييم الأرض بمنطقة بنجر السكر

حسين أحمد زيد[1] ، إيهاب محرم مرسى[2] ، ماجدة أبو المجد حسين[1] ، وفاء حسن محمد[1] ، هدى عبد الفتاح محمود عبد المجيد[1]

(1) قسم الأراضى والكيمياء الزراعية – كلية الزراعة سابا باشا - جامعة الإسكندرية

(2) قسم بحوث الاراضي الملحية والقلوية، معهد بحوث الأراضي والمياه، مركز البحوث الزراعية.

تهدف هذه الدراسة إلى إنشاء قاعدة بيانات جغرافية رقمية مسجلة لأراضى بمنطقة البنجر وحفظها في الحاسب الآلي ثم إجراء تقييم خواص وصفات الأرض وذلك للمساعدة في اختيار أنسب أنواع المحاصيل التي يمكن زراعتها في منطقة الدراسة وذلك عن طريق التكامل بين نظم المعلومات الجغرافية (GIS) وبرنامج التقييم المستخدم ALES – Arid وكذلك استخدام النظام العالمي لتحديد المواقع الأرضية (GPS) . يهدف برنامج ALES – Arid لتقييم ملائمة أنواع الأراضى المختلفة لإنتاج محاصيل مختلفة (سواء حقلية أو خضر أو فاكهة أو علف) لتحقيق أفضل إستفادة للأرض. تم معاينةالأرض بأخذ عدد من العينات لتغطية مساحة كلية

1521 هكتار. تم وصف القطاعات مورفولوجياً بالحقل تبعاً لمنظمة الأغذية والزراعة 1990. تم تحليل عينات التربة لتقديرات المعملية وتم أخذ عينات ماء الري من ترعة النصر وتحليلها كيماوياً.

وتم تقسيم منطقة الدراسة لخمس وحدات تربة 1) غير ملحية , جيرية جداً وعميقة. 2) غير ملحية , جيرية جداً وعميقة لحد ما. 3) غير ملحية , جيرية لحد بعيد وعميقة. 4) ملحية , جيرية لحد بعيد وعميقة. 5) ملحية جداً , جيرية لحد بعيد وعميقة. تشير نتائج القدرة الإنتاجية لأراضي موضع الدراسة تنقسم إلى1) C2 (قدرة جيدة) بحيث يكون العامل الرئيسي المحدد لإنتاجية هو قوام التربة ومحتوى كربونات الكالسيوم. 2) C4 (قدرة ضعيفة) , 3) C5 (قدرة ضعيفة جداً) وكانت العوامل المحددة فى C5 , C4 : المادة العضوية والمحتوى من النيتروجين والبوتاسيوم المتاح.

تم تحديد مستويات ملاءمة الأرض المختلفة للمحاصيل إعتماداً على العلاقة ما بين جودة الأرض وصفاتها من ناحية والإحتياجات القياسية للمحاصيل من ناحية أخرى وذلك بإستخدام برنامج ALES – Arid. تمت دراسة ملائمة الأرض لستة زراعات (حقلية – خضر – فاكهة). وكانت العوامل الأساسية المحدد لمنطقة الدراسة عموماً هو قوام التربة والتوصيل الهيدروليكي وملوحة التربة والبوتاسيوم المتاح والمحتوى من كربونات الكالسيوم وعمق التربة. وأخيراً إنتاج الخرائط التي تمثل مدى ملائمة الأرض للاستخدامات المختلفة وذلك عن طريق إدخال جميع البيانات المتحصل عليها من برنامج التقييم إلى برنامج Arc GIS.