Journal of Soil Sciences and Agricultural Engineering

Journal homepage: www.jssae.mans.edu.eg
Available online at: www.jssae.journals.ekb.eg

Evaluation of Land Capability and Suitability Crop Production: Case Study in Halaib and Shalatien Region, South East Desert of Egypt

Heba S. A. Rashed*[1] and F. O. Hassan[2]

[1]Soil and Water Department, Faculty of Agriculture, Moshtohor, Benha University, Egypt.
[2]National Authority for remote sensing and Space Science (NARSS), Cairo, Egypt.

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ABSTRACT

The current study was carried out on the soils of Halaib and Shalatien to estimate their capability and suitability for growing some crops (maize, wheat, alfalfa, potato, sugar beet, citrus, peach and olive). The studied area lies between latitudes 22 ˚ 20 `10`` and 22 ˚ 45 ` 11.5`` N, and longitudes 35 ˚ 55 ` 4.4`` to 36 ˚ 21 ` 4.6`` E. For this purpose, 17 soil profiles were dag and collect of soil samples. The soils were classified as Typic Torrifluvents, Typic Torripsamments, Lithic Torriorthents and Typic Haplosalids. The geomorphologic units of Halaib and Shalatien region are divided into three groups: (1) Bahada Plains (alluvial fans and deltas, alluvial plains, wadis, sand sheets, sand dunes and plains with rock outcrops), (2) Coastal Forms (alkali flats), and (3) Faulted Mountains and Hills (mountains, mountain foot slopes, hills and hill foot slopes). The Automated Land Evaluation System program (ALES program) and Geographic Information System (GIS) were used to evaluate the land suitability in the studied area. Rock land and sand dunes occupied 57.68% of the total area. According to ALES program, the capability of the lands in the study area are grouped into four classes; Class (3) occupied 8.46% of the study area and represented by alluvial fans and deltas mapping units, Class (4) occupied 24.72% of the study area and included alluvial plains, wadis and sand sheets mapping units, Class (5) occupied 7.82% of the study area and included plain with rock outcrops and sand dunes mapping units and Class (6) occupied 1.16% of the study area and represented by only one soil map unit (Alkali flats). According to ALES program, the suitability of the study area classified into four classes: high suitability class (S2) occupying 16.39% of the study area, moderate suitability class (S3) occupying 13.27% of the study area, marginal suitability class (S4) occupying 8.26% of the study area, no suitability class (S5) occupying 3.23% of the study area. The main limitation factors for crop production in the studied area were soil texture, depth and salinity. These limitations are none permanent and can be improved through applied appropriate management practices.

Keywords: Capability Index, Suitability Index, ALES program and Halaib and Shalatien

INTRODUCTION

Land resources in Egypt face pressures from land degradation and increasing number of people (Hamza and Mason, 2004). The main problem in Egypt is growing population very rapidly against food production during the last three decades (Hamza and Mason, 2004 and Abdel-Hamid *et al*., 2010). Therefore, the efficient management of natural resources in Egypt is essential for ensuring food supplies and sustainability in agricultural development (FAO, 1993 and Bodaghabadi *et al*., 2015). For that governorate exerts great efforts to recover the gap between population and food production (Sayed, 2013).

Sustainable developments in Egypt need managing and planning of natural resources (AbdelRahman, 2014). Egypt has a lot of promising areas which are not developed yet. Halaib and Shalateen area is considered as one of the areas which suffer from lack of sustainability development. It is located on the Red Sea coast at the southeastern part of the Eastern Desert. (Mohamaden and Ehab, 2017). Shalatien area received more attention as a promising region for different developmental activities, such as; tourism, fishery, animal husbandry, agriculture and mining, and for its importance as a trading route between Egypt and Sudan (Ageeb *et al*., 2007).

Land evaluation is a tool of land use planning for agriculture development (Shahbazzi *et al*., 2009). The fitness of land for a defined use is termed as land suitability (Shyju1 and Kumaraswamy, 2019). Land suitability assessment is defined as the process of land performance assessment to predict the potential land for crop production (FAO, 1976; FAO, 1978; Pan and Pan, 2012; Darwish and Abdel Kawy, 2014; Ahmed, 2016; AbdelRahman *et al*., 2016 and Abd El-Aziz, 2018), and identifying the main limiting factors for the agricultural production and enables decision makers to increase the land productivity (AbdelRahman *et al*., 2016). Assessment of land suitability potentials is an important step to detect the environmental limit for sustainable land management (SLM) (Zolekar and Bhagat, 2018). There are different models for conducting land evaluation in land use planning (FAO, 1993). There are many of these systems, such as APT (Agricultural Planning Tool-kit), CRIES (Comprehensive Resource Inventory and Evaluation System), LECS (Land Evaluation Computer System) and ALES (Automated

*** Corresponding author.**
E-mail address: heba.abdelmaabood@fagr.bu.edu.eg
DOI: 10.21608/jssae.2019.79574

Land Evaluation System) (Rossiter, 1990 and Elaalem, 2010a). Abdel-Kawy *et al*. (2010) stated that the use of ALES arid-model in arid and semi-arid regions facilitates finding of the most suitable agriculture system to be adopted. Land evaluation applied to evaluate land capability and land suitability for a specific use in different conditions, can be done automatically by the use of ALES program and GIS technique (Ganzorig and Adyasuren, 1995 and Gouda etal., 2018). The MicroLEIS with an Almagra model has been used to assess the suitability of different soils (De La Rosa *et al*., 1992), this program aims at defining production levels for arable crops and forests under Mediterranean conditions (De la Rosa and Moreira, 1987).

Remote sensing imagery is a powerful tool for studying the surface of earth and cropping systems analysis (Sadeghi *et al*., 2015 and Rozenstein *et al*., 2016). The Geographic Information System (GIS) plays a major role in suitability analysis for crop production (Ekanayaki and Dayawansa, 2003). These technologies have been used to assess the criteria required to define land suitability (El Baroudy, 2016). Remote sensing and GIS were used in many studies in Egypt for land resources mapping and management (Saleh *et al*., 2013; Mohamed *et al*., 2014; Saleh and Belal, 2014). RS data coupled with soil survey information can be integrated in the GIS to assess crop suitability for various soil (FAO, 1991, and AbdelRahman *et al*., 2016).

The main objectives of this study are to (1) evaluate land resources of Halaib and Shalatien area, (2) assess the main land use limitations and (3) to prepare land capability map and land suitability maps for different crops using GIS technique and ALES program for help in establishing a decision making framework and future planning of the studied area.

MATERIALS AND METHODS

The study area

Halaib and Shalatien area is situated in the south east desert of Egypt between latitudes 22 ˚ 20 `10`` and 22 ˚ 45 ` 11.5`` N, and longitudes 35 ˚ 55 ` 4.4`` to 36 ˚ 21 ` 4.6`` E, (Figure 1) with a total area is around 1718100 ha. A texture which varies from sandy clay loam to sandy. The area lies in semi-arid to arid with less than 0.5 mm annual rainfall and with an annual temperature of 24°C, having a wide difference between summer and winter (EMA, 2010). The average temperature ranges between 18.92 °C to 30.38 °C. The highest monthly average temperature is 37.5°C in July and August, while the lowest is 7.5 °C in January. The relative humidity ranges from 44% to 71% and the mean annual potential evapotranspiration varies from 8.1 mm in summer to 1.33 mm in winter. In Halaib and Shalatien rock outcrops are visible.

Geology and Geomorphology

According to Said (1990), El-Rakaiby *et al*., (1996), El-Alfi, (1997) and CONCO (1987) Halaib and Shalatien area is occupied by fourteen rock formations belonging to Precambrian, Cretaceous, Miocene, and Quaternary ages. In Halaib and Shalatien, five geomorphologic units were identified including; wadis, alluvial deposits, terraces, coastal plain and sabkhas (Riad, 1999 and Grias 2002). According to Elewa (2000), Halaib and Shalatien area can be classified into the following geomorphic units: mountains and hills, alluvial fan and delta, sand dunes, wadi and alluvial deposits, sabkhas and sand sheets. According to El-Shaboury (2003), landforms in this area as follows: 1) the high rocky lands: these parent rock structures are considered the origin of the soil parent materials, and 2) the sedimentary plateau: this is compost of sedimentary deposits and consists of six landforms as follow: a) alluvial fans, b) alluvial terraces, c) foot slopes, d) alluvial plains and f) Marine deposits. Nine landforms in this area were identified according to Ageeb *et al*. (2007); delta plains, sandy plains, wadis, alluvial plains, tributaries, marine terraces, denuded hills, rock out crop plain and alluvial fans.

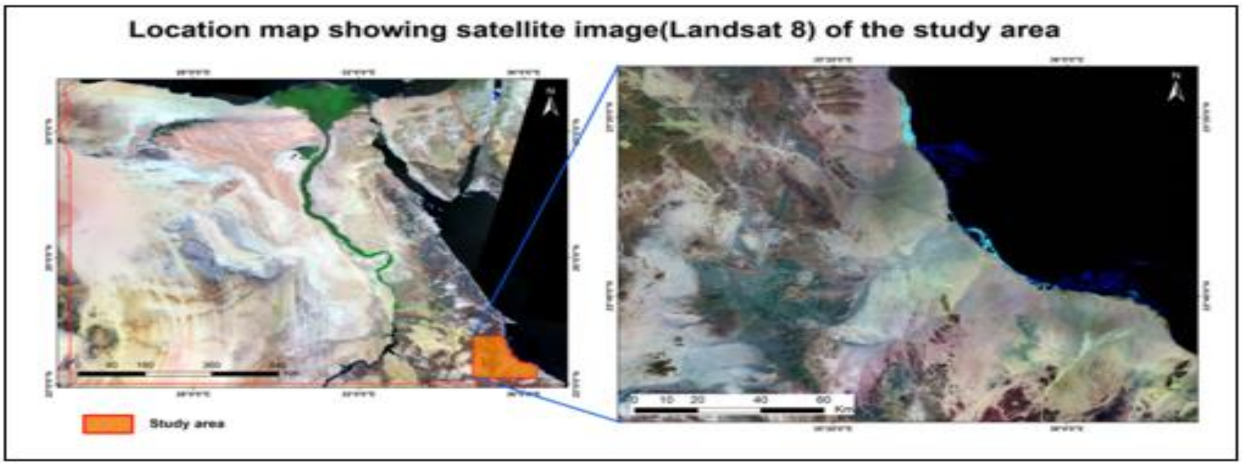

Fig. 1. Location map of the study area

Image processing and Software used

Landsat-8 images (acquired in 2019) and digital elevation model of the Halaib and Shalatien (developed from the Shuttle Radar Topography Mission data) were used to define the physiographic map in the studied area. All further digital image processing and analyses were executed using the standard approaches provided by the ENVI 5.1 and the Arc-GIS 10.2 software.

Soil survey and field work

A semi detailed survey covering the study was to acquire the main features of its soils, landforms and landscapes. The GPS (NAV DLX-10 ETM) was used to define the longitudes and latitudes. A number of 17 soil profiles were taken to represent the different mapping units of the study area. The soil profiles represented the different units of landform. The collected soil samples, amounted 34 of the different layers of soil profiles were taken for laboratory analyses. Morphological descriptions were worked out for the soil profiles in the field according to the FAO guidelines FAO (2006) and classified according to the Soil Taxonomy System (USDA, 2014). Soil color was defined by Munssel Color Charts (USDA, 1975).

Laboratory Analyses

The soil samples were air-dried, crushed softly, and passed through a 2-mm sieve to get the ‘‘fine earth.’’ The fine earth was analyzed in the laboratory for physical and chemical analyses. Laboratory analyses (*i.e.* Soil texture, $CaCO_3$ content, $CaSO_4.2H_2O$ content, CEC, pH, EC, ESP, soluble cations and anions, organic matter content and available N, P, K) were carried out according to (Sparks *et al*., 1996 and USDA, 2004).

Method of Land Evaluation

Classifications of land evaluation were undertaken according to the FAO (1976) system to assess land capability and suitability of the studied area soils for sustainable agriculture. The studied soils were evaluated for land capability and suitability using Automated Land Evaluation System (ALES) program (Ismail etal., 2001).

Model of land capability classification using ALES program.

The ALES capability model forecasts the general land use capability for a broad series of possible agricultural uses. The methodological criteria refer to the system designed by (Ismail etal., 2001). The capability evaluation includes six capability orders for reclamation and agriculture land capability which are excellent (C1), good (C2), Fair (C3), poor (C4), very poor (C5) and Non-agriculture (C6) (Table 1).

Table 1. Land capability index classes and ratings using ASLE program.

Class	Description	Rating (%)
C1	Excellent	> 80
C2	Good	< 80 - > 60
C3	Fair	< 60 - > 40
C4	Poor	< 40 - > 20
C5	Very poor	< 20 - >10
C6	Non-agriculture	< 10

Model of land suitability classification for selected crops using ALES program.

Land suitability evaluation, modeling was applied following the ALES suitability model (Ismail etal., 2001). The ALES suitability model is a physical soil suitability evaluation model indicates the degree of suitability for a land use. The suitability evaluation for each crop includes five suitability classes are: soils with optimum suitability (S1), soils with high suitability (S2), soils with moderate suitability (S3), soils with marginal suitability (S4), and soils with no suitability (S5) (Table 2). The main soil limitations or suitability subclasses are: sodium saturation (a), carbonate content (c), drainage condition (d), degree of development of the profile (g), useful depth (p), salinity (s), and texture (t). Eight crops (maize, wheat, alfalfa, sugar beet, potato, citrus, peach and olive) were selected to assess their suitability to be grown in the studied area.

Table 2. Land suitability index classes and ratings using ASLE program.

Class	Description	Rating (%)
S1	soils with optimum suitability	> 80
S2	soils with high suitability	< 80 > 60
S3	soils with moderate suitability	< 60 > 40
S4	soils with marginal suitability	< 40 > 20
S5	soils with no suitability	< 20

RESULTS AND DISCUSSION

Digital Elevation Model

The digital elevation model (DEM) is downloaded from the Shuttle Radar Topography Mission (SRTM). Elevation varies between -21 m and 1578 m above sea level (Figure 2). Slope varies from flat to very steep (Figure 3). Aspect analyses are the steepest down slope direction and varies from 22.5 (north) to 360 (north). Figure 4 shows the aspect analyses of the study area.

Geomorphologic features

According to Hassan et al. (2017), there are three landscape units of Halaib and Shalatien region were delineated, i.e. Bahada Plains (BP), Coastal Forms (CF) and Faulted Mountains and Hills (FMH) (Table 3 and Figure 5). The area of Bahada plains landscape is about 704500 ha. (41.0 % of the total area) and contains six mapping units, i.e. Wadis (W), Alluvial fans and Delta (AFD), Alluvial plains (AP), Sand sheets (SS), Sand dunes (SD) and Plain with rock outcrops (PRo). The landscape of BP was represented by 15 soil profiles. Costal forms landscape represents small part adjacent to Bahada plain in study area and contains one mapping unit, i.e. Alkali flats (AF) (19900 ha., 1.16 %) and represented by 2 soil profiles. Faulted Mountains and Hills landscape represents an area of about 991000 ha. (57.68 % of the total area) and contains four mapping units i.e. Mountains (M), Mountain foot slopes (MFs), Hills (H) and Hill foot slopes (HFs). The landscape unit MFH is out of soil profiles as rock lands.

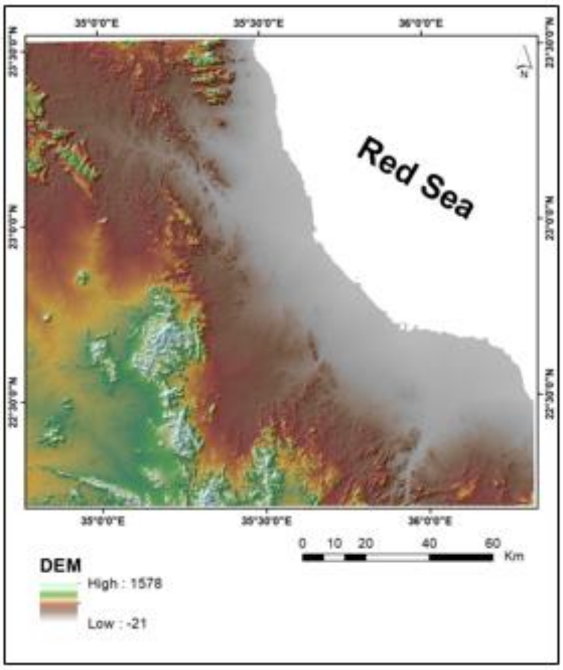

Fig. 2. Digital Elevation Model (DEM) of Halaib and Shalatien area.

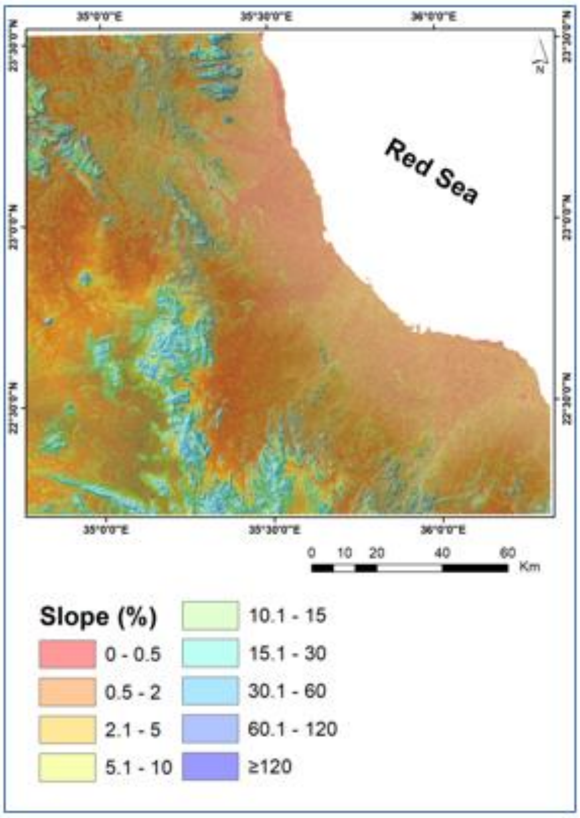

Fig. 3. Slope analysis of Halaib and Shalatien area

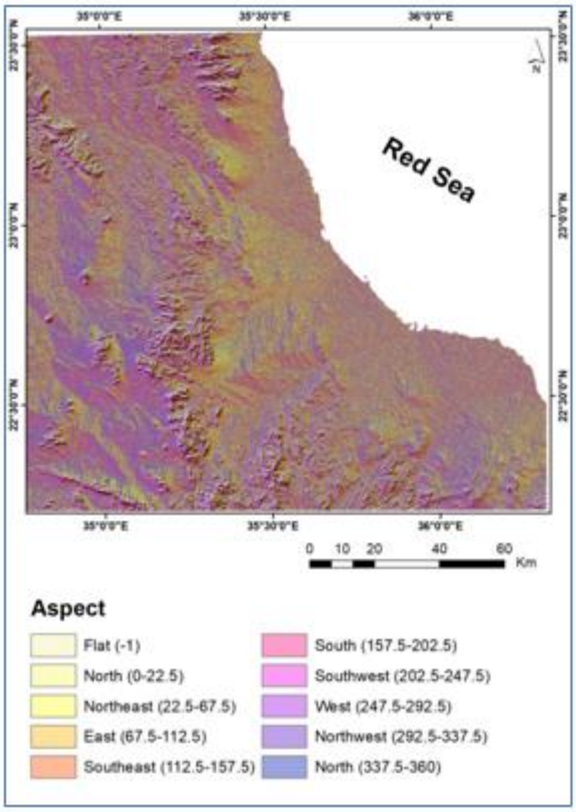

Fig. 4. Aspect analysis of Halaib and Shalatien area.

Table 3. Geomorphic and Mapping units and their area and percentages of the total area according to Hassan *et al.*, (2017)

Landscape unit	Landform	Mapping unit	Area (ha)	total area (%)
Bahada Plains (BP)	Wadis	W	111300	6.48
	Alluvial fans and Delta	AFD	145400	8.46
	Alluvial plains	AP	157700	9.18
	Sand sheets	SS	155700	9.06
	Sand dunes	SD	17400	1.01
	Plain with rock outcrops	PRo	117000	6.81
Coastal Forms (CF)	Alkali flats	AF	19900	1.16
Faulted Mountains and Hills (FMH)	Mountains	M	715300	41.63
	Mountain foot slopes	MFs	94500	5.50
	Hills	H	171600	9.99
	Hill foot slopes	HFs	9600	0.56
Beach			2700	0.16
Total area			1718100	100.00

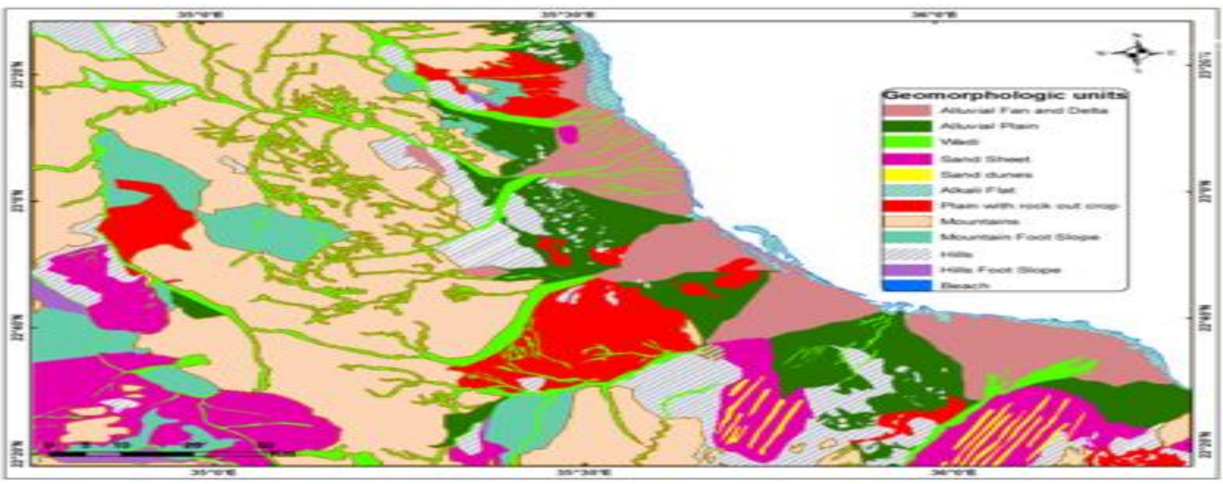

Fig. 5. Geomorphologic map of study area.

Soil mapping and classification

The soil classification due to the USDA (2014) of the American Soil Survey Staff is applied up to the sub great group for mapping unit, and to family level for the profile description. Soils in the studied area are classified under two soil orders, Aridisols and Entisols. Matching geomorphologic units with land characteristics and soil taxonomy, the final soil map is produced. Soil map was reduced to scale 1: 100.000 as shown in Figure (6). The identified taxonomic units of the studied area are summarized in Table (4).

Table 4. Soil classification according to USDA (2014) for Halaib and Shalatien area.

Soil Order	Soil Sub-order	Soil great groub	Soil sub-great groub	Mapping Unit	Profile No.	Area (ha)	Area %
Aridisols	Salids	Salorsids	Typic Haplosalid	AF	1 and 9	19900.00	1.16
Entisols	Psamments	Torripsamments	Typic Torripsamments	SS and SD	4, 7 and 15	173100.00	10.07
	Fluvents	Torrifluvents	Typic Torrifluvents	W, AFD and AP	2, 3, 5, 6, 8, 10, 12, 13, 14 and 16	414400.00	24.12
	Orthents	Torriorthents	Lithic Torriorthents	PRo	11 and 17	117000.00	6.81

Land evaluation using ALES program model.

Qualitative land evaluation studies were conducted using Automated Land Evaluation System (ALES) program. Quantitative estimation of soil characteristics such as topography, drainage conditions, texture, soil depth, calcium carbonate content, gypsum status, salinity and sodicity were used in this program (Figure 7).

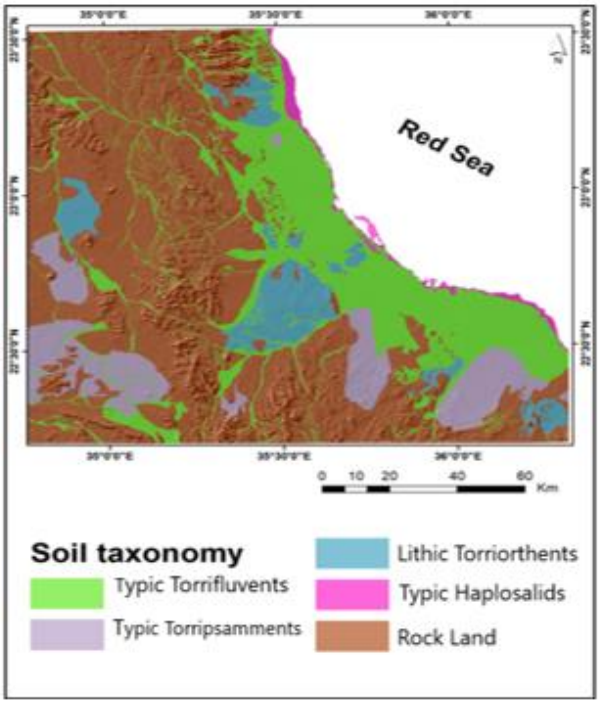

Fig. 6. Soil map of the studied area.

Evaluation of land capability classification using ALES program.

Estimation of soil characteristics such as slope, drainage conditions, soil depth, texture, calcium carbonate content, gypsum content, salinity and sodicity were used in the land evaluation. The rating of capability classes of Halaib and Shalatien area are present in Table 5 and illustrated in Figure 8. Accordingly, the studied area could be classified into four capability classes as follow:

a- Lands of capability class (C3): This class includes the soils which are moderate capability and a moderate severe limitation with capability index (Ci) that is varies between 40 and 60 %. The soils there are in the alluvial fans and deltas and occupy 8.46 % of the total area. The soils of this class are moderately affected by some limitations such as soil, erosion risks, and bioclimatic deficiency. These soils have moderate productivity for various crops, can be feasible improvement practices and require proper management.

a- Lands of capability class (C4): This class comprises the soils that are poor capability and have high limitations with capability index (Ci) that is varies between 20 and 40%. This class there is in the alluvial plains, wadis and sand sheets, and employs an area of 24.72% of the total area. The soils of this class are highly affected by some limitations such as texture, salinity and bioclimatic deficiency. These soils have poor productivity but can be feasible improvement practices and recommended for producing forage crops.

b- Lands of capability class (C5): This class includes the soils which are very poor capability and have very high limitations with capability index (Ci) that varies between 10 and 20 %. The soils of this class there are in plain with rock outcrops and sand dunes, and occupy 7.82% of the studied area. The soils of this class are very highly affected by some limitations such as texture, salinity and bioclimatic deficiency. These soils have very poor productivity and recommended for producing forage crops and agroforestry systems.

c- Lands of capability class (C6): This class includes the soils which are non agriculture with capability index (Ci) that less than 10 %. The soils of this class there are in alkali flats (sabkhas) and occupy 1.16% of the studied area. The soils of this class are severe limitations that cannot be corrected. According to ALES program this class comprises the soils which are not suitable for agricultural use and non productivity, but suitable for pasture.

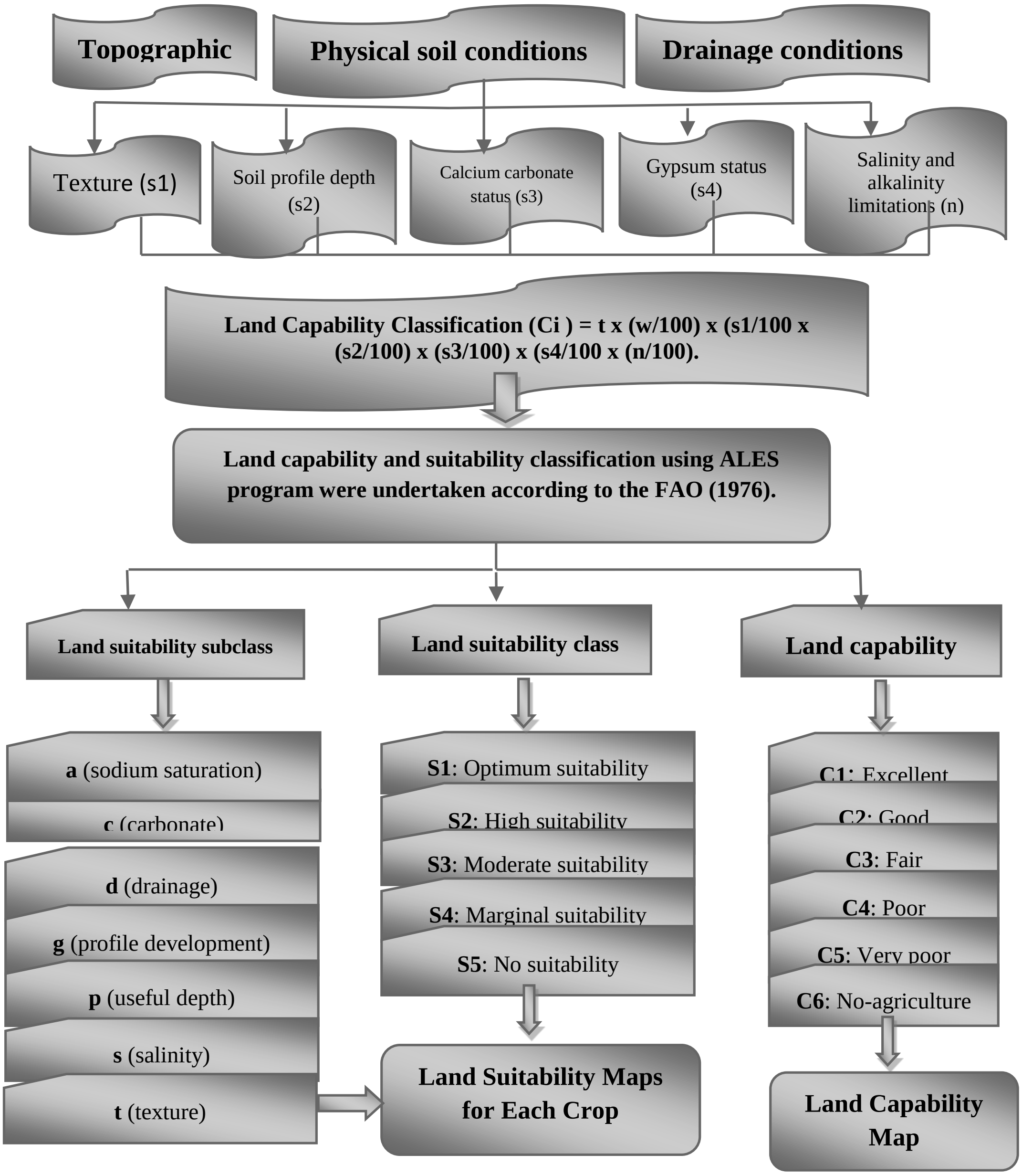

Fig. 7. Flowchart of the ALES program model.

Table 5. Land capability classification for the Halaib and Shalatien using ALES program.

Land Capability Class	Landform	Degree	Occupied Area	
			ha	%
C3	Alluvial fans and deltas	Fair	145400	8.46
C4	Alluvial plains, wadis and sand sheets	Poor	424700	24.72
C5	Plain with rock outcrops and sand dunes	Very poor	134400	7.82
C6	Alkali flats (sabkhas)	Non agriculture	19900	1.16
Rock land			991000	57.68
Beach			2700	0.16
Total area			1718100	100.00

Distribution of land suitability classes and subclasses in Halaib and Shalatien using ALES program.

According to ALES program, there is not any area that is classified as optimum suitability (S1). About, 16.39% of the study area is high suitability (S2), 13.27% are moderate suitability (S3), 8.26 % are marginal suitability (S4) and only 3.23% are no suitability for agriculture (S5). Most of the soils of this study are rocky lands that are permanently not suitability (57.68 %). The rating of suitability classes and the limiting factors (subclasses) of Halaib and Shalatien area are present in Table 6. The soil texture that is mostly sand, soil depth and soil salinity are the mainly limiting factors in the study area and in some cases, are drainage condition and calcium carbonate content. The soils of the studied area are considered promising for agriculture development. On the other hand, the soil maps of agricultural suitability can be helpful in the management processes.

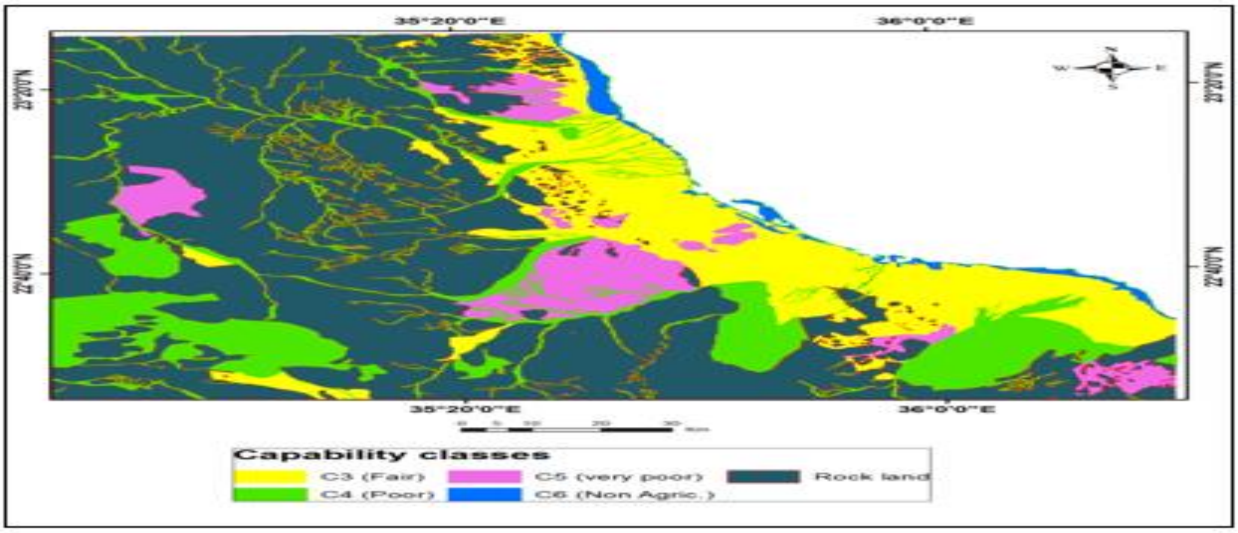

Fig. 8. Land capability classes of Halaib and Shalatien area.

Table 6. Suitability classes and subclasses distribution in the study area using ALES program.

Land suitability Class	Subclass (Soil limitations)	Area %	Area ha
S2	S2tdc	7.60	130575
	S2td	4.71	80923
	S2dsg	2.04	35049
	S2dcs	2.04	35049
Total		16.39	281596
S3	S3t	10.41	178854
	S3tc	2.86	49138
Total		13.27	227992
S4	S4t	5.75	98791
	S4tds	0.36	6185
	S4ptd	2.15	36939
Total		8.26	141915
S5	S5s	0.36	6185
	S5t	2.15	36940
	S5sa	0.36	6185
	S5ds	0.36	6185
Total		3.23	55495
	Rocky lands	57.68	1011102
	Beach	0.16	2700

Note: S2 (high suitability), S3 (moderate suitability), S4 (marginal suitability), S5 (no suitability), a (sodium saturation), c (carbonate content), d (drainage condition), g (development of the profile), p (depth), s (salinity), and t (texture).

Evaluation of land suitability classification for growing different crops using ALES program.

The ALES Land Suitability model is based on crop suitability that affected by potentiality of the dominant soil characteristics. The studied mapping units were evaluated to determine their suitability for growing different crops according to ALES program, which to stand on the factors that govern the land suitability. Eight crops are considered as follows: maize, wheat, alfalfa, potato, sugar beet, citrus, peach and olive growing in the study area. The outputs of the ALES model were linked, to the GIS modeling to obtain the final maps for land suitability of the study area. Soil suitability classes and percentage for selected crops are present in Table 7. According to the ALES program, the results indicated that 6.48% of the total study area is high suitability (S2), 8.46% is moderate suitability (S3), 18.24% is marginal suitability (S4) and 7.96% is no suitability (S5) for maize, wheat and potato, respectively. A small area (6.48%) is high suitability (S2), 17.52% is moderate suitability (S3), 10.34% is marginal suitability (S4) and 6.82% is no suitability (S5) for alfalfa. About 6.48 % of the study area is high suitability (S2), 15.26% is moderate suitability (S3) and 19.40% is marginal suitability (S4) for sugar beet. About 14.94, 18.24 and 7.96 % are high suitability (S2), moderate suitability (S3), and no suitability (S5), respectively for growing citrus. For peach cropping, 24.00% of the area is high suitability (S2), while 9.18% and 7.96% are moderate suitability (S3) and no suitability (S5), respectively. About 14.94, 18.24, 6.80 and 1.16 % are high suitability (S2), moderate suitability (S3), marginal suitability (S4) and no suitability (S5), respectively for olive cropping. Most of the area (57.68%) is rocky lands. Figures 9, 10, 11, 12, 13, 14, 15 and 16 were selected to show the spatial distributions for suitability of selected crops.

Table 9. Soil suitability classes and percentage for growing selected crops in Halaib and Shalatien area using ALES program.

Land suitability	Field crops				Vegetables	Fruit trees		
class	Maize	Wheat	Alfalfa	Sugar beet	Potato	Citrus	Peach	Olive
S1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S2	6.48	6.48	6.48	6.48	6.48	14.94	24.01	14.94
S3	8.46	8.46	17.53	15.26	8.46	18.24	9.18	18.24
S4	18.24	18.24	10.35	19.40	18.24	0.00	0.00	6.80
S5	7.96	7.96	6.82	0.00	7.96	7.96	7.96	1.16
Rocky lands	57.68	57.68	57.68	57.68	57.68	57.68	57.68	57.68
Beach	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16

Note: S2 (high suitability), S3 (moderate suitability), S4 (marginal suitability), S5 (no suitability).

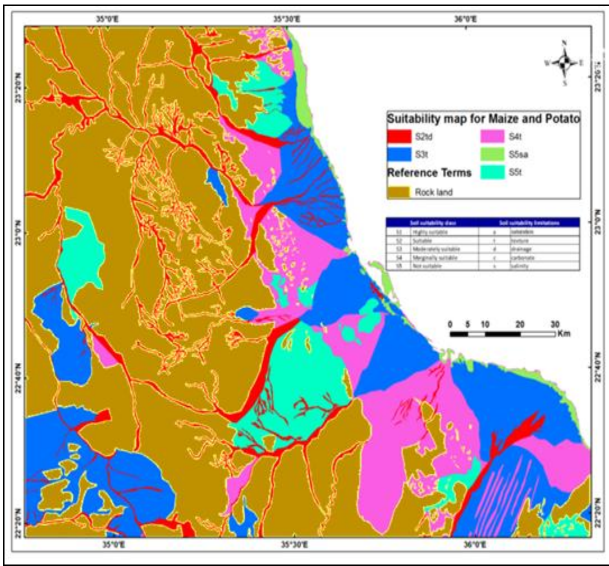

Fig. 9. Suitability map for Maize in the study area.

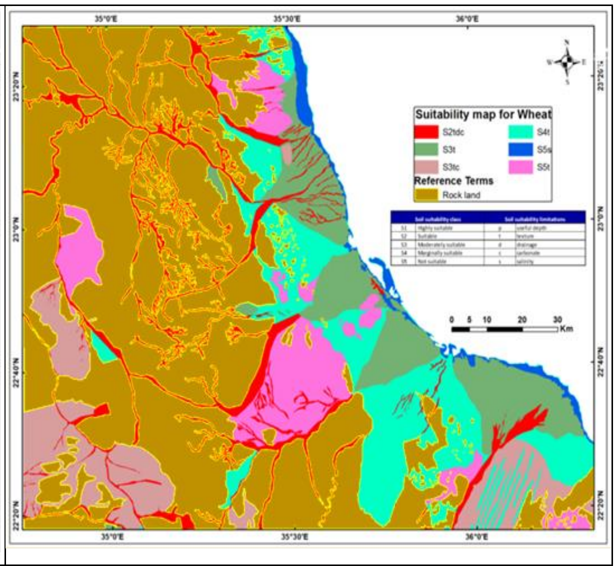

Fig. 10. Suitability map for Wheat in the study area.

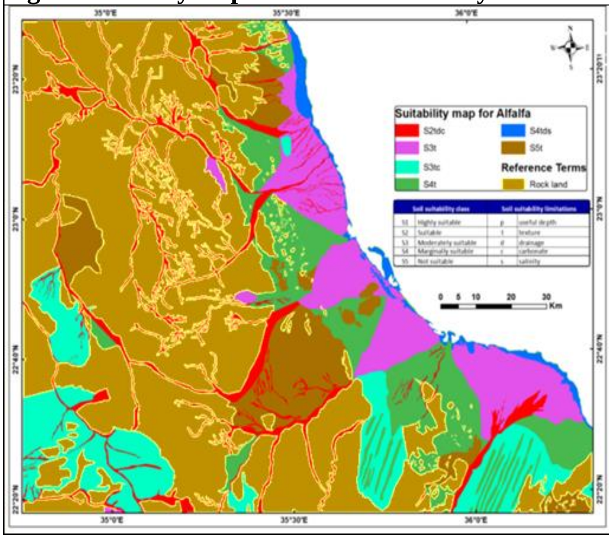

Fig. 11. Suitability map for Alfalfa in the study area.

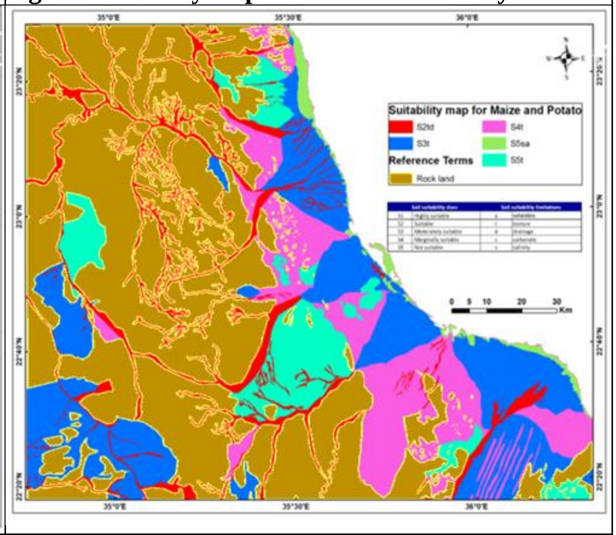

Fig. 12. Suitability map for Potato in the study area.

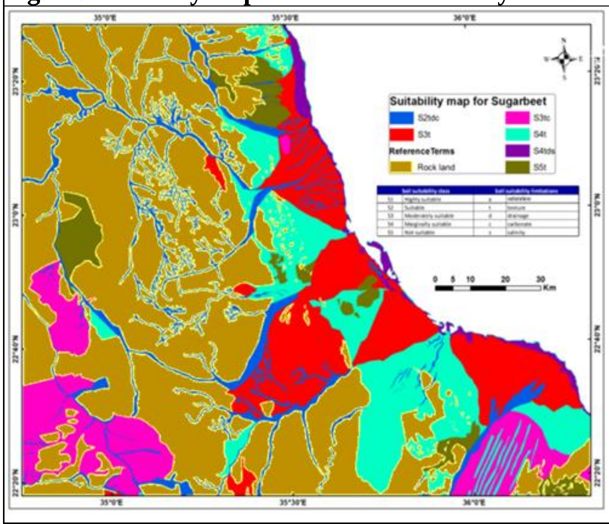

Fig. 13. Suitability map for Sugarbeet in the study area.

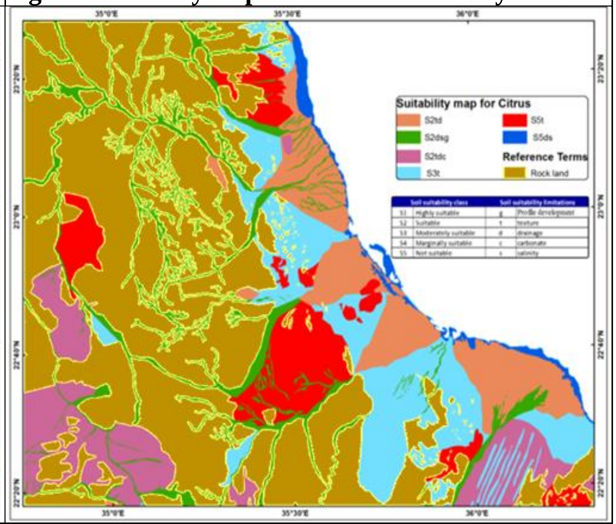

Fig. 14. Suitability map for Citrus in the study area.

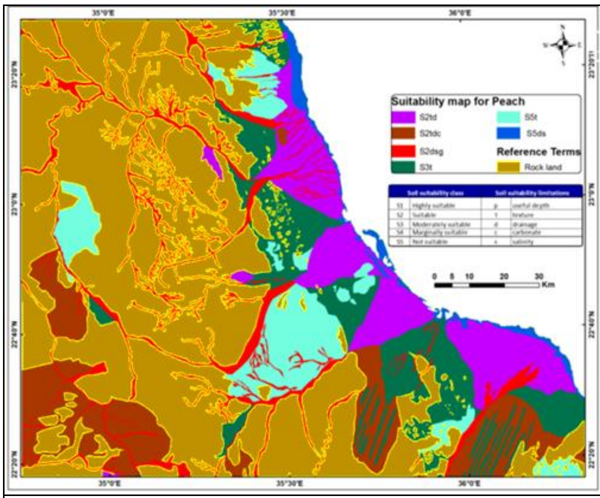

Fig. 15. Suitability map for Peach in the study area.

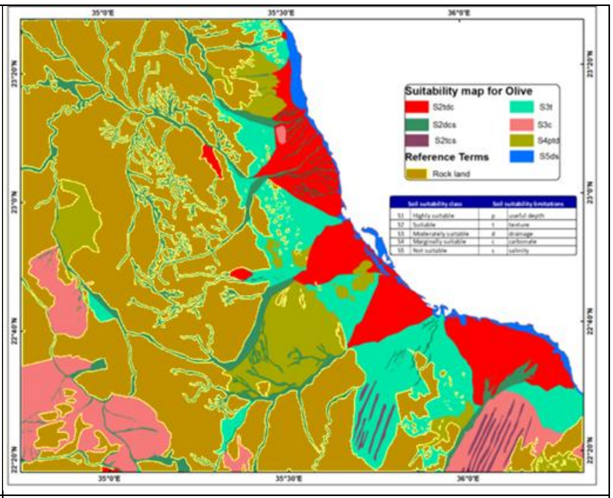

Fig. 16. Suitability map for Olive in the study area.

CONCLUSION

Analysis of land suitability can help to achieve sustainable crop production for agriculture development in Halaib and Shalatien region. The ALES program was more effective in assessing the land capability and land suitability of arid and semi arid regions. The aim of this study is to use GIS and Automated Land Evaluation System (ALES) to assess land capability and crop suitability for various soils conditions. Some selected crops such as maize, wheat, alfalfa, potato, sugar beet, citrus, peach and olive are recommended to be grown in the study area. According to ALES program, the soils of the studied area varied in the suitability index between high suitability (S2) to no suitability (S5). However, the capability index, ranged from fair (C3) for agriculture to non-agricultural (C6). Poor land capabilities were found to be associated with poor soil texture, poor fertility and high salinity. However, these limitations can be improved through proper management practices. Only 41% of the soils understudy was suitable for agricultural use. The study area is promising for agricultural development and land reclamation projects due to availability of groundwater resources for crop irrigation.

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تقييم قدرة الأراضى ومدى ملائمتها لنمو المحاصيل: حالة الدراسة فى منطقة حلايب وشلاتين، جنوب الصحراء الشرقية من مصر.

هبة شوقى عبدالله راشد[1] و فرج عمر حسن[2]

[1]قسم الأراضى والمياه - كلية الزراعة - مشتهر- جامعة بنها - مصر.

[2]الهيئة القومية للاستشعار من بعد وعلوم الفضاء (نارس) - القاهرة - مصر.

الدراسة الحالية تم تنفيذها على أراضى منطقة حلايب وشلاتين لتقدير مدى قدرتها وملائمتها لإنتاج بعض المحاصيل (الذرة – القمح – البرسيم – البطاطس – قصب السكر – الموالح – الخوخ – الزيتون). منطقة الدراسة تقع بين دائرتى عرض 22 20 10 ، 22 45 11.5 شمالا و خطى طول 35 55 44، 36 214ز6 شرقا. وتم حفر 17 قطاع وتم الحصول على عينات التربة. وصنفت أراضى منطقة الدراسة تحت رتبتين وهما رتبة الاراضى الجافة ورتبة الأراضى الحديثة. الوحدات الجيومورفولوجية فى منطقة حلايب وشلاتين مقسمة الى ثلاث مجاميع وهى(1) سهول الباهادا: وتضم تحتها المراوح الفيضية، والدلتاوات الفضية، والسهول الفيضية والأودية والفرشات الرملية والكثبان الرملية والنتوءات الضخرية.، و(2)الاشكال الساحلية التى تضم السبخات، و(3) الجبال والتلال ومنحدراتهم. تم استخدام برنامج تقييم الأراضى الآلى(ALES) مع نظم المعلومات الجغرافية لتقييم مدى ملائمة أراضى منطقة الدراسة لنمو المحاصيل المختلفة. الأراضى الضخرية تحتل 57.68% من منطقة الدراسة. وطبقا للبرنامج المستخدم فإن قدرة الأراضى تنقسم الى أربعة اقسام وهى القسم الثالث ويحتل 8.46% من منطقة الدراسة ويوجد فى المراوح الفيضية والدلتاوات، القسم الرابع ويحتل 24.72% من منطقة الدراسة ويوجد فى السهول الفيضية والأودية والفرشات الرملية. والقسم الخامس ويحتل 7.82% من منطقة الدراسة ويوجد فى النتوءات الصخرية والكثبان الرملية. والقسم السادس ويحتل 1.16% من منطقة الدراسة ويوجد فى اراضى السبخات. وطبقا لبرنامج تقييم الأراضى الآلى فان مدى ملائمة الأرض لنمو المحاصيل المختلفة فإن أراضى منطقة الدراسة مقسمة الى أربعة اقسام: قسم الملائمة العالية ويحتل 16.39% من منطقة الدراسة. قسم الملائمة المتوسطة ويحتل 13.27% من منطقة الدراسة. وقسم الملائمة الحدية وتحتل 8.26% من منطقة الدراسة، وقسم عدم الملاتمة ويحتل 3.23%. والعوامل الأساسية المحددة لإنتاج المحاصيل بمنطقة الدراسة هى قوام التربة، وعمق القطاع الأرضى، وملوحة التربة. هذة المحددات ليست دائمة ويمكن تحسينها بإتباع ادارة مناسبة.