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Land Suitability for Agriculture of Certain Crops in East of Nile Delta Region,Egypt

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ABSTRACT

Land evaluation is crucial for sustainable farming, land-use planning, and resource management. This work investigates soil properties, land use cpotential, and crop appropriateness in Egypt's Eastern Nile Delta Region by employing Remote Sensing (RS), Geographic Information Systems (GIS), and the Applied System of Land Evaluation (ASLE) model. The study area, located between latitudes 30.45.00-30.55.00 north and latitudes 31.40.00-32.00.00 east, was analyzed by collecting soil samples from 16 profiles to classify the lands in terms of capability and suitability. Six geomorphic units were identified: *Low Decantation Basin, High Decantation Basin, Overflow Basin, Aeolian Plain, Relatively High Clay Flats, and Relatively Low Clay Flats.*With capability percentages ranging from 21.35% to 47.41%, the land capability assessment divided the area into Fair (C3) and Poor (C4) categories. The evaluation of crop suitability revealed moderate suitability for wheat, maize, sorghum, and barley, while fig, olive, and pea required specific management techniques. A traditional assessment of land suitability was carried out for onion, maize, potato, alfalfa, and soybean. The study emphasizes the efficacy of GIS-based automated land evaluation tools in enhancing land use and promoting sustainable agricultural practices.

Keywords: Land evaluation, ASLE, East Nile Delta Region, Egypt.

INTRODUCTION

In Egypt, cultivated land makes up only around 4% of the total area of the country. Initiatives for land reclamation in desert areas have become essential due to the rapid population growth. The Egyptian government is actively reclaiming areas near freshwater sources, such as the North Sinai and Eastern Nile Delta, which have substantial agricultural potential, in response to the growing demand for agricultural self-sufficiency (Abosafia *et al*., 2022). The Eastern Nile Delta area encounters various agricultural issues, such as soil deterioration, salinization, water shortages, and declining soil fertility. In this area, sustainable land use entails employing sophisticated land evaluation methods to enhance crop choice and refine management approaches. The combination of Remote Sensing (RS) and Geographic Information Systems (GIS) has become crucial for evaluating soil characteristics, determining appropriate crops, and creating land suitability maps. Technologies of remote sensing able to tailor management decisions for regions, boosting productivity while ensuring environmental sustainability (Zhang and Zhu, 2023; Khanal *et al*., 2020).

Additionally, GIS provides an effective plant form for processing and visualizing spatial data, offering critical insights into land-use planning.into land-use planning. Recent studies focus on the ability to integrate remote sensing with Artificial Intelligence (AI) and GIS for more accurate land evaluation. monitoring and management strategies are developed by Satellite imagery from softwares such as Landsat and Sentinel for offering detailed assessments of soil health and agricultural fields (Chatrabhuj *et al*., 2024).

Understanding land capability is necessary to identify both opportunities and constraints in in agricultural regions . Land suitability evaluation includes analyzing soil characteristics regarding capability levels and limitations (Mohamed *et al*., 2023; Fadl *et al*., 2023).

The Food and Agriculture Organization (FAO, 2021) defines land suitability as the process of assessing whether a particular land area is appropriate for specific uses, including agriculture, urban development, and conservation. According to El Baroudy *et al*., (2020)land sustainability analysis has a major role in ensuring food security by enhancing land use and predicting agricultural yields.

Therefore, the objectives of this study are to evaluate soil characteristics, land classification, and capability using the ASLE model, while assessing crop suitability such as wheat, maize, sorghum, barley, soybean, alfalfa, fig, olive, pea, potato, and onion. GIS-based maps will be developed for supporting sustainable land-use planning. This study focuses on key questions related to soil properties, salinity effects, and crop suitability aiming for enhancing agricultural planning, promoting sustainability, and contributing to Egypt's food security strategy.

MATERIALS AND METHODS

Study area:

The study area is located in the the Eastern Nile Delta Region of Egypt, between latitudes 30°45'00"–30°55'00"N and longitudes 31°40'00"–32°00'00"E, covering an area of approximately 592 km², as shown in Fig. 1. The land is almost flat, with elevations from 1 to 5 meters above sea level. The climate in this region is characterized by average temperatures ranging from 20°C to 28°C, with October being relatively

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cool due to the autumn season. The region receives an annual rainfall of 100 to 200 mm, with an average daily evaporation rate of approximately 1 to 2 mm.

The study area's geomorphology was mapped and categorized using the Global Positioning System (GPS) into six main physiographic units, as shown in Fig. 2: *Low Decantation Basin, High Decantation Basin, Overflow Basin, Aeolian Plain, Relatively High Clay Flats, and Relatively Low Clay Flats.* Each unit has distinct soil properties and characteristics: the Low Decantation Basin (Profiles 1, 5, 7 and 9) is slightly saline to non-saline, moderately alkaline, and low in organic matter; the High Decantation Basin (Profiles 2, 4, 6, 8 and 10) is moderately saline, highly alkaline, and exhibits sodic conditions; the Overflow Basin (Profile 3) is moderately saline with high carbonate content; the Aeolian Plain (Profiles 14 and15) has moderate salinity and low organic matter; the Relatively High Clay Flats (Profiles 11, 12 and 13) have low to moderate salinity and slight calcareousness; and the Relatively Low Clay Flats (Profile 16) are moderately saline, alkaline, and low in organic matter.

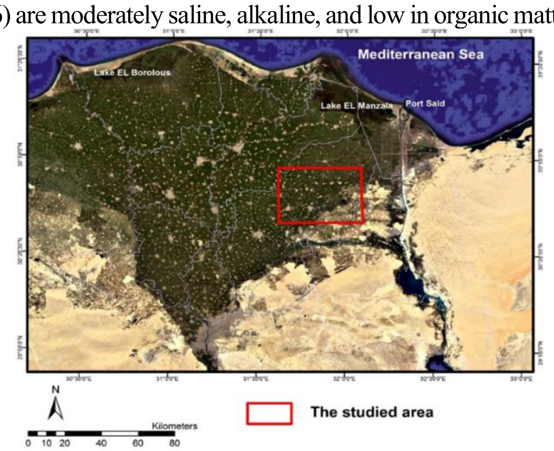

Fig. 1. Spatial distribution of studied area location

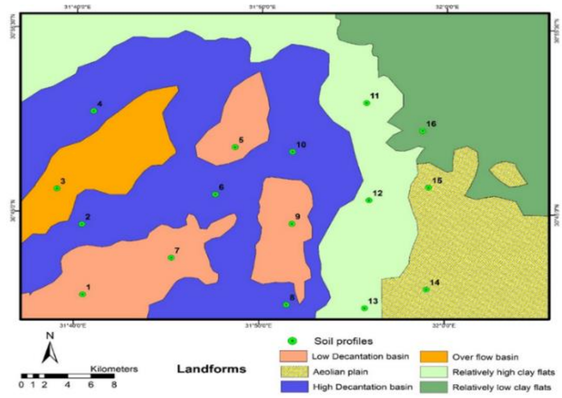

Fig. 2. Soil physiographic units in the studied area

Field and laboratory analyses:

The field study was planned in six geomorphic map units. Based on the USDA 2020 Field Book for Soil Description and Sampling, the geomorphological units of the study area were represented by 16 field sections and 34 soil samples representing these sections were collected (Fig. 2), in addition to 16 irrigation water samples for analysis.

The analyses of laboratory were conducted according to the 2020 manual of the U.S. Department of Agriculture (USDA) as mentioned in Table 1, which standardizes soil analysis methods and serves as a principal reference in soil science. Electrical conductivity (EC) and pH were measured in soil saturation extracts to assess soil salinity and acidity. Recent advances in techniques for assessing and monitoring soil salinity were also considered to ensure accuracy and reliability of the measurements (Ding *et al*., 2022; Hendershot *et al*., 2021). Meanwhile, water samples were examined to determine salinity, pH, and major ions (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, HCO_3^-, Cl^-, and SO_4^{2-}) using standard reference methods (APHA, 2021).

Table 1. Chemical analysis of selected groundwater samples in the studied area

Water sample No.	Soluble cations meq. L-1				Soluble anions meq. L-1				EC dSm^{-1}	pH	Adj. SAR
	Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	CO_3^-	HCO_3^-	Cl^-	SO_4^{-2}			
1	6.11	5.65	1.28	0.67	0	2.71	10.97	0.03	1.87	7.44	1.16
2	7.2	3.67	3.16	0.64	0	3.31	11.25	0.11	1.97	7.55	3.12
3	10.89	8.41	2.41	0.84	0	5.23	16.98	0.33	3.05	7.36	2.02
4	9.63	5.64	1.81	0.81	0	4.4	12.5	0.99	2.59	7.28	1.64
5	7.71	6.69	1.16	0.69	0	3.92	11.95	0.38	2.42	7.41	1.08
6	6.12	7.6	1.44	0.74	0	2.72	12.45	0.73	2.39	7.31	1.21
7	6.11	7.21	1.28	0.64	0	2.41	11.85	0.98	2.32	7.14	1.09
8	8.14	5.84	2.76	0.76	0	3.98	13.13	0.39	2.55	7.58	2.5
9	9.1	7.56	1.77	0.64	0	5.31	12.41	1.35	2.41	7.47	1.59
10	7.98	6.25	1.36	0.74	0	4.42	10.65	1.26	2.13	7.48	1.27
11	7.13	6.74	1.32	0.76	0	3.54	12.32	0.09	2.09	7.39	1.2
12	6.56	5.95	2.75	0.74	0	2.93	11.96	1.12	2.1	7.45	2.53
13	8.72	6.54	1.24	0.84	0	3.64	13.35	0.35	2.23	7.59	1.12
14	5.63	6.3	3.44	0.71	0	4.11	10.89	1.08	2.11	7.74	3.38
15	7.32	6.86	2.89	0.67	0	5.45	11.36	0.93	2.27	8.03	2.93
16	6.9	5.54	3.72	0.75	0	3.72	12.7	0.49	2.19	7.91	3.58

The soil types were sorted by the sub-great group level based on the *Keys to Soil Taxonomy*, published by the USDA Natural Resources Conservation Service (NRCS) in 2022.

Land Evaluation

The Applied System of Land Evaluation (ASLE) frame work is shown in Fig. 3. for arid areas, executed applied the ArcGIS framework, was utilized to assess land capability (LC) and land Suitability (LS) as mentioned in Table 2 and 4 of the soils and water in the study area. The ASLE model aided in the land evaluation process and the creation of associated maps (Ismail and Morsy 2001). The ASLE model evaluates the characteristics and interactionswithin each soil unit to determine (LC) and (LS) Classes :

Table 2. The land capability & suitability classes(Sayed *et al*, 2016).

Land Capability classes	Land Suitability classes
C_1(class 1)=Excellent.	S_1=Very suitable.
C_2(class 2)=Good.	S_2=Suitable.
C_3(class 3)=Fair.	S_3=Moderately suitable.
C_4(class 4)=Poor.	S_4=Marginally suitable.
C_5(class 5)=Very poor.	N_1=Currently unsuitable.
C_6(class 6)=Non-agriculture.	N_2=Permanently unsuitable.

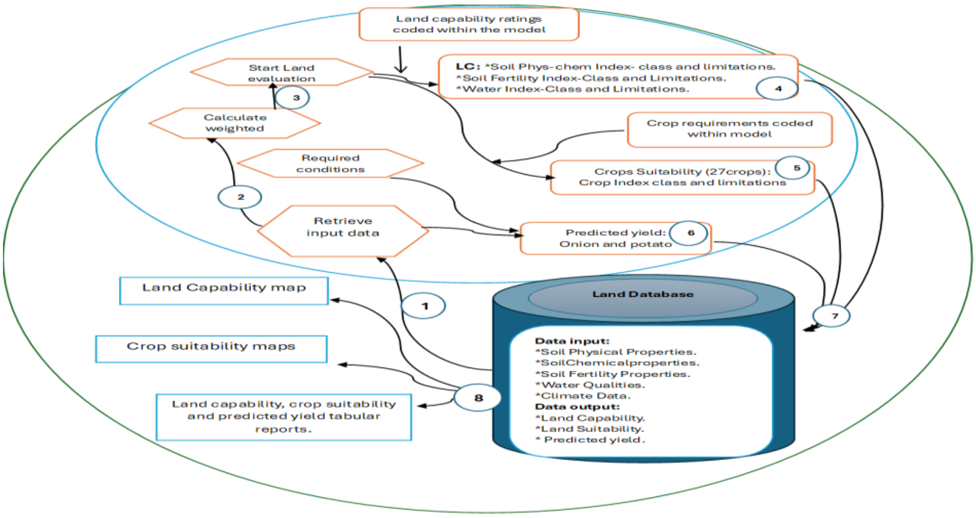

Fig. 3. The structure of ASLE. The small circle explain evaluation processes, while the huge circle explain the platform of ArcMap

RESULTS AND DISCUSSION

Soils of study area:

Low Decantation Basin

This type of soil is characterized by by soil profiles 1, 5, 7, and 9. These soils are characterized by deep profiles, ranging between 100 and 110 cm. They are slightly saline to non-salinewith EC values varying from 0.96 to 3.39 dS m^{-1} as mentioned in fig 4. The soils in this unit range from slightly to moderately alkaline (pH 7.89–8.75) as shown in Fig 5, with ESP values between 2.8% and 8.35%.

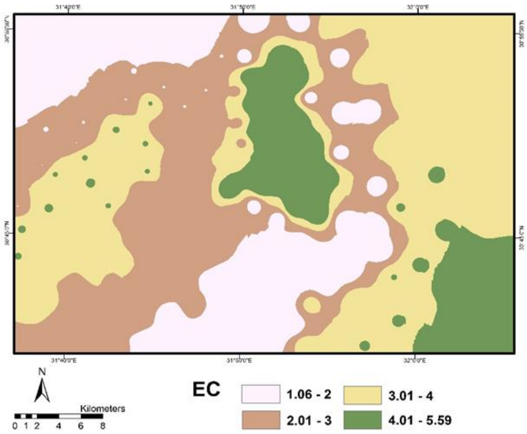

Fig.4. Spatial distribution of EC values (dS m^{-1})in the study area

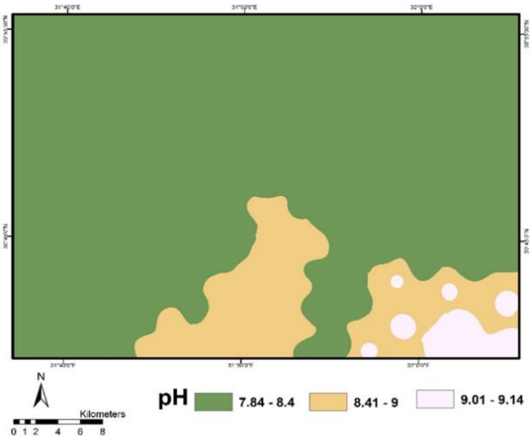

Fig.5. Spatial distribution of pH values in the study area

These soils are slightly to moderately calcareous, with total carbonate content as mentioned in Fig 6 ranging from 3.16% to 6.69%. They also have a low organic matter content, ranging from 0.14% to 1.08%. Table 3 show the different physiographic units, and their percentage of the total studied area.

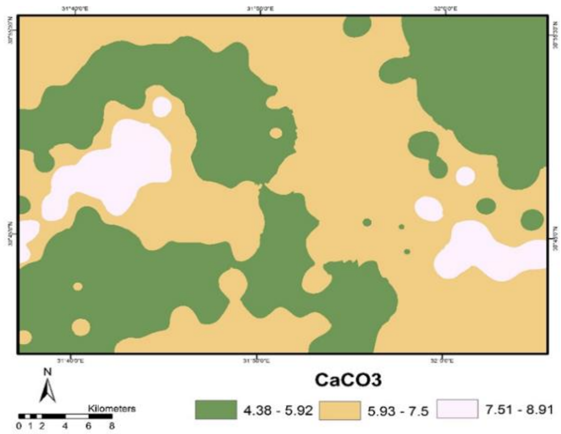

Fig. 6. Spatial distribution of $CaCO_3$% in the study area

Table 3. Identified physiographic units, and their percentage of the total area.

physiographic units	Area in percentage
Low Decantation Basin	approximately (30-35)% of the total study area.
High Decantation Basin	Approximately (30-40) % of the total study area.
Overflow basin	approximately (10-15)% of the total study area.
Aeolian Plain	approximately (10)% of the total study area.
Relatively High Clay Flats	approximately (5-10)% of the total study area.
Relatively low Clay Flats	approximately (5-10)% of the total study area.

High Decantation Basin

This type of soil is characterized by soil profiles 2, 4, 6, 8, and 10. These soils have deep profiles ranging between 100 and 110 cm. They are non-saline to moderately saline, with EC values ranging from 0.9796 to 6.55 dS m^{-1}. The pH values range from slightly to highly alkaline, with some sodic samples (pH 7.91–9.11), while ESP values range from 2.32% to 28.54%. as shown in Fig 7.

These soils are slightly to moderately calcareous, with total carbonate content ranging from 4.45% to 7.68%. They also have a low organic matter content, ranging from 0.43% to 1.06%. as shown in Fig 8.

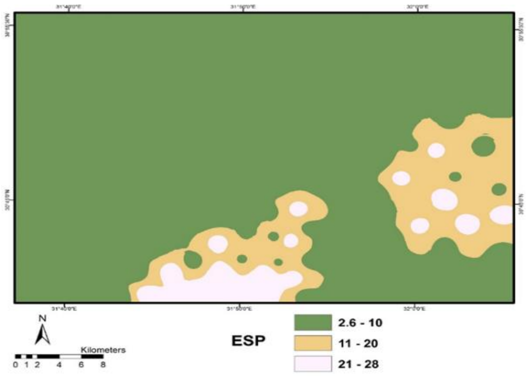

Fig.7. Spatial distribution of ESP% in the study area

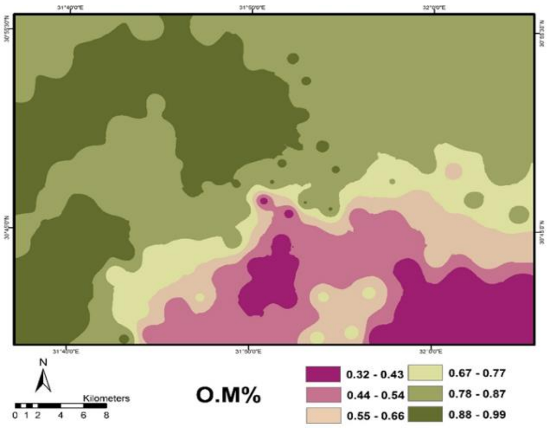

Fig.8. Spatial distribution of O.M% in the study area

Overflow Basin

This type of soil is represented by soil profile 3. These soils have deep profiles ranging between 100 and 110 cm. They are slightly to moderately saline, with EC values between 3.83 and 4.32 d S m⁻¹. The soils in this unit are saline, with pH values ranging from 8.22 to 8.45, while ESP values range from 5.19% to 5.64%.

These soils are moderately calcareous, with total carbonate content ranging from 7.92% to 9.89%. They also have a very low organic matter content, ranging from 0.73% to 0.88%.

Aeolian Plain

This type of soil is represented bysoil profiles 14 and 15. These soils have deep profiles ranging between 100 and 110 cm. They are moderately saline, with EC values varying from 4.00 to 4.15 dS m⁻¹. The soils range from slightly to moderately alkaline (pH 7.00–9.25), while ESP values range from 6.26% to 26.39%.

These soils are moderately calcareous, with total carbonate content ranging from 5.29% to 9.19%. They also have very low organic matter content, ranging from 0.29% to 0.95%.

Relatively High Clay Flats

This type of soil is represented bysoil profiles 11, 12, and 13. These soils have deep profiles ranging between 100 and 110 cm. They are non-saline to moderately saline, with EC values ranging from 1.14 to 4.24 dS m⁻¹. The soils are slightly to moderately alkaline (pH 7.61–8.33), while ESP values range from 3.03% to 6.23%.

These soils are slightly to moderately calcareous, with total carbonate content ranging from 3.66% to 8.47%. organic matter content ranges from very low to low, ranging from 0.26% to 1.10%.

Relatively Low Clay Flats

This type of soil is represented bysoil profile 16.These soils have deep profiles ranging between 100 and 110 cm. They are slightly to moderately saline, with EC values ranging from 2.95 to 4.32 dS m⁻¹. The soils are moderately alkaline (pH 8.21–8.34), while ESP values range from 8.09% to 9.35%.

These soils are slightly to moderately calcareous, with total carbonate content ranging from 3.46% to 6.98%. They also have a low organic matter content, ranging from 0.74% to 0.94%.

Capability Indices

Soil Index

The following nine parameters were used as indicators for soil evaluation: clay percentage, available water (AW), hydraulic conductivity (Ks), soil depth (SD), acidity (pH), total carbonate, exchangeable sodium ratio (ESP), cation exchange capacity (CEC), and electrical conductivity (EC). The results showed that the soils representing the study area were divided into three groups according to their soil suitability and soil index, as shown in Table 4 and Fig. 9:

Table 4. Percentage Coverage of Land Suitability Classes (C2, C3, C4) Based on Multi-Criteria Evaluation in the Studied Area

• Good (C2)	– covering 60.51% of the studied area.
• Fair (C3)	– covering 41.81% of the studied area.
• Poor (C4)	– covering 38.04% of the studied area.

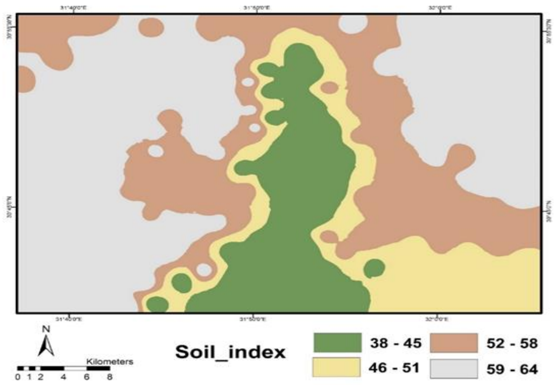

Fig. 9. Spatial distribution of soil Index in the study area

Fertility index (Fert.)

The results and analyses

The results indicated that soils in the study area were categorized based on fertility into two classes in terms of its fertility into two categories: poor (C4) and very poor (C5), as shown in Fig.10. Poor soil represents about 21.14% of the study area, while very poor soil represents about 13.8%.

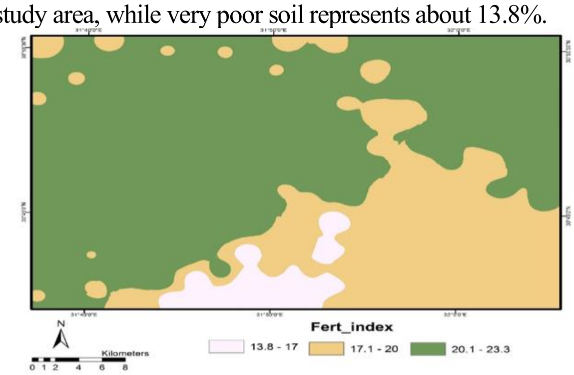

Fig. 10. Spatial distribution of fertility Index in the study area

Water index (Irrigation water quality (IWQ))

The water index for the study area indicates that irrigation water falls into two quality classes: excellent (C1) and very poor (C5).

Final index

The soils in the research area were classified into two capability classes: fair (C3) and poor (C4), as illustrated in Fig. 11. Land capability percentages vary from 21.35% to 47.41%, where fair soils account for 21.35% and poor soils make up 47.41% of the region. The soil index was determined for each soil map unit, as shown in
in Table 4.

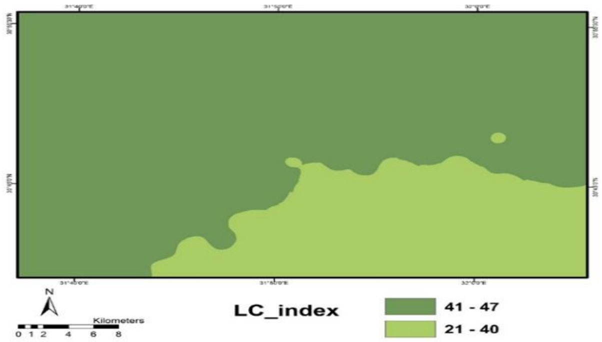

Fig. 11. Spatial distribution of Land Capability in the study arae

Based on the ASLE arid and semi-arid classification, the research area was divided into two capability classes as mentioned in Table 5 to :

• Moderate (C3) land suitability: This category encompasses the majority of the soil map units, namely units 1, 2, 3, 4, 5, 6, 7, 10, 11, and 15. Soils in this group have constraints that necessitate intermediate management techniques or moderately limit the variety of appropriate crops. The fertility index for these soils varies from 13.8% to 23.31%.

• Low (C4) land potential: This group encompasses soil map units 8, 9, 12, 13, and 14, exhibiting soil indices that vary from 21.35% to 39.33%. These constraints are viewed as non-permanent, indicating that with appropriate management, these soils can be enhanced to fair or good capability.

Effective land management is crucial for improving the productivity of these soils. Given that the limitations are not permanent, adopting suitable agricultural methods can enhance soil quality, rendering it better for farming.

Land suitability classification

When applied to field crops such as wheat, rice, maize, and barley, ASLE evaluates key soil characteristics, including fertility index, soil drainage, pH values, organic matter content, and effective soil depth. These factors are crucial in determining the productivity potential of different crops. For instance, ASLE assesses the drainage index, which is essential for distinguishing between water-demanding crops like rice and those that thrive in well-drained soils, such as wheat.

Beyond field crops, ASLE also plays a crucial role in evaluating land suitability for fruit trees and vegetables as shown in Table 6. In these cases, additional factors, such as the water availability index and climate index, are considered. By integrating multiple indices, ASLE offers a comprehensive, data-driven approach to land evaluation, optimizing agricultural land use and promoting sustainable farming practices.

Table 5. Land capability classes in the studied area

prof No	Phys. index	Chem. index	Soil index	Soil class	Fert. index	Fert. class	IWQ index	IWQ class	Env. index	Env. class	LC index	LC index
1	66.54	96.5	64.22	C_2	19.73	C_5	90.00	C_1	74.55	C_2	44.07	C_3
2	67.29	92.08	61.96	C_2	21.33	C_4	87.65	C_1	74.55	C_2	45.54	C_3
3	63.68	91.28	58.13	C_3	23.08	C_4	74.01	C_2	74.55	C_2	45.74	C_3
4	64.47	98.02	63.19	C_2	23.31	C_4	81.72	C_1	74.55	C_2	47.41	C_3
5	62.75	95.4	59.86	C_3	22.42	C_4	87.35	C_1	74.55	C_2	46.42	C_3
6	57.64	96.75	55.77	C_3	21.79	C_4	86.32	C_1	70.84	C_2	44.68	C_3
7	65.7	95.14	62.51	C_2	22.77	C_4	86.03	C_1	70.84	C_2	46.7	C_3
8	44.66	85.17	38.04	C_4	13.8	C_5	86.05	C_1	67.44	C_2	31.94	C_4
9	43.13	94.93	40.94	C_3	18.92	C_5	87.13	C_1	77.22	C_2	39.33	C_4
10	43.13	90.34	38.96	C_4	22.27	C_4	89.92	C_1	62.58	C_2	40.95	C_3
11	55.35	98.06	54.28	C_3	19.13	C_5	87.61	C_1	74.39	C_2	41.86	C_3
12	57.03	96.36	54.95	C_3	17.41	C_5	88.35	C_1	66.18	C_2	39.19	C_4
13	45.36	92.18	41.81	C_3	19.23	C_5	13.02	C_5	28.89	C_4	21.35	C_4
14	53.64	90.2	48.38	C_3	19.08	C_5	13.4	C_5	28.48	C_4	21.88	C_4
15	66.48	83.28	55.36	C_3	17.29	C_5	88.87	C_1	66.18	C_2	39.12	C_4
16	65.85	91.88	60.51	C_2	21.14	C_4	87.15	C_1	66.18	C_2	44.24	C_3

Table 6. Land Suitability Classes in the Studied Area

Profile No	onion	maize	Potato	Alfalfa	soyabean	pea	Fig	sorghum	olive	wheat
1	S_4	S_1	S_4	S_2	S_2	S_1	S_4	S_1	S_1	S_1
2	S_4	S_1	S_4	S_2	S_2	S_2	S_4	S_1	S_4	S_1
3	S_4	S_2	S_4	S_4	S_2	S_2	S_4	S_1	S_4	S_1
4	S_4	S_2	S_4	S_1	S_2	S_2	S_4	S_1	S_4	S_1
5	S_4	S_1	S_4	S_2	S_2	S_2	S_4	S_1	S_4	S_2
6	S_4	S_2	S_4	S_2	S_2	S_2	S_4	S_1	S_3	S_2
7	S_4	S_1	S_4	S_2	S_2	S_2	S_4	S_1	S_4	S_1
8	S_4	S_4	N_2	S_2	N_1	S_2	N_2	S_4	N_1	S_2
9	S_4	S_2	S_4	S_2	S_2	S_2	S_4	S_2	S_4	S_2
10	S_4	S_2	S_4	S_2	S3	S_2	S_4	S_2	S_4	S_2
11	S_4	S_2	S_4	S_2	S_2	S_2	S_4	S_2	S_3	S_2
12	S_4	S_2	S_4	S_2	S_2	S_2	S_4	S_1	S_3	S_2
13	S_4	S_2	S_4	S_2	S_2	S_2	S_4	S_2	S_4	S_1
14	S_4	S_2	S_4	S_2	S_2	S_2	S_4	S_2	S_4	S_1
15	S_4	S_2	S_4	S_2	S_3	S_2	S_4	S_2	S_4	S_2
16	S_4	S_2	S_4	S_2	S_2	S_2	S_4	S_2	S_4	S_2

In brief, the objectives of this study is to evaluate soil properties, land classification and potential using the ASLE model, while assessing crop suitability, based on GIS maps to support sustainable land use planning. Results obtained for classifying land capacity and land suitability for some major crops in the study area using ASLE software developed by Ismail *et al*. (2005).

The depth of the soil under study ranges between (100-110) meters, which is considered deep compared to other studies that have been identified. The geomorphological map of the studied area (Fig.2).Moreover data of Table.3. shows these physiographic units and their % of the studied area. (Heba S. A. Rashed, 2016).

Soil salinity values were slightly to moderately salinized, and most parts of the soil profiles reached this value which ranged between (2.95) to (6.55) dS m^{-1}., as shown in the current results (Fig.4), with a few scattered unsalted parts ranged between (0.96) to (1.14) dS m^{-1}, these results could be enhanced with those obtained by each of Rasheed, 2020; Youssef and Taher, 2020 and Zakaria *et al*., 2021. The similarity between these studies may be due to the climatic similarities between the two areas under study. It is believed that the source of the salinity is the predominance of aridity and lack of rainfall throughout most of the year, except for rare flash floods that occur once every few years. In addition, some irrigation ground water samples are close to moderately salinity levels (Table.1).

The pH values of the soils ranged from 7.00 to 9.25, indicating that they were slightly to moderately alkaline in reaction (Fig. 5). Calcium carbonate contents varied from 3.16% and 9.19%, where the studied soils classified as slightly calcareous and moderately calcareous soils (Fig. 6) These results may be due to the same reasons mentioned above (Heba S. A. Rashed,2016).

The (ESP%) ranged between 2.32 and 28.54%, and the (SAR%) ranged between 1.083 and 3.58% in the studied section horizons. These soils suffer from slight to moderate degradation in some properties, respectively. This could be attributed to their exposure to Lake Manzala. Furthermore, the low and medium clayey flats have been severely degraded due to groundwater salinization and seepage from Lake Manzala (El Baroudy , 2005).

The organic matter content of the samples taken from the soil profiles under study ranged between 0.05 and 1.19%. This is expected in our soils, which are poor in organic matter due to the prevalence of dry climate among many other reasons.by those record by (Mohamed *et al*,2012). The modified Storey Index

(O'geen,2008) was used to evaluate the land capability of the studied area.

Obtained research results showed that the third and fourth classes are the dominant land use capability classes in the research area, where the (C3) class occupied about (21.35%) and the (C4) class also about (47.41%) of the total studied area respectively, as shown in Fig. 11, Class 3 encompasses areas with constraints that necessitate moderately intensive management approaches or moderately limit the variety of crops, or both. The restrictions influence the variety of crops, primarily limiting them to cereals, forage crops, as well as fruits and vegetables. Limitations are harder to rectify and they encompass steeply sloped terrain, inadequate drainage, or extreme weather conditions. Perhaps if they are terraced, their productivity could improve, allowing for the planting of fruit trees. At the same time, Class 4 denotes land with significant constraints that limit crop selection and/or demand extremely careful management techniques,which need the same thing in the other class also,might need land reclamation in some areas ,but land reclamation requires large investment cost.these results concluded that the most suitable fruit crops in the study area are fig and olive, while other crops are studied, and most of the results for both were in the range of "marginal" and "unsuitable" (S3) (S4), Some sites in the study area are unsuitable for agriculture due to several factors, including high temperatures, scarce rainfall, and poor soil quality. Other factors include shallow soil depth, poor organic matter, poor drainage in some areas, high levels of sodium and salinity in some areas, and poor irrigation water quality. respectively. While the results of field crop suitability indicated that alfalfa, maize, soybean, wheat, and sorghum are in the range between moderate and highly suitable (S2) and (S1), maybe the main reason for the high suitability of the soil for agriculture is the high quality of soil fertility, which is reflected in the fact that most of the study area consists of lands that are somewhat cultivated, but with specific crops whose conditions are suitable for obtaining high productivity.Meanwhile, some vegetable crops such as onion, potatoe and pea showed suitability ranging between unsuitable and moderate suitable (S4) and (S2), these results could be supported with the conclusion of (Belal *et al*,2014).

CONCLUSION

Land evaluation is a critical process For determining the suitability of land for various objectives, such as agriculture, forestry, urban development, and environmental conservation. This process includes evaluating key factors, including soil characteristics, topography, climate conditions, and water availability to ensure optimal land use while maintaining sustainability. Using advanced technologies in this research such as Remote Sensing (RS) and Geographic Information Systems (GIS) improves the accuracy and efficiency of the evaluation process. These tools allow for comprehensive analysis and the land classification according to both physical and chemical properties.

The Applied System of Land Evaluation (ASLE) has an important role in evaluating land suitability, particularly for fruit trees and vegetables, by incorporating additional factors like water availability and climate conditions. By integrating various evaluation criteria, ASLE provides a robust, data-driven by integrating various evaluation criteria leading to land assessment easily, facilitating optimal agricultural land use and promoting sustainable farming practices.

The study region falls under Fair (C3) and Poor (C4) land capability categories, requiring moderate to intensive soil management. Soil fertility and productivity depend on salinity and low organic matter content. GIS and Remote Sensing technologies offer valuable tools for land evaluation and planning. In this region, Soil management recommends enhancing organic matter by composting, utilizing modifications of gypsum for decreasing sodicity, and using salt-tolerant crop varieties for saline regions. In case of strategies of irrigation, efficient water management should be accomplished to enhance the soil structure quality, with regular monitoring of EC and pH values. In addition, future research should highlight exploring the utilization of AI and machine learning in land evaluation, along with conducting long-term monitoring of soil quality through Remote sensing technologies. The research demonstrated that examining soil characteristics and utilizing methods to evaluate land potential and appropriateness are effective resources that can aid in making decisions.

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ملائمة الأراضي لزراعة بعض المحاصيل في منطقة شرق دلتا النيل، مصر

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الملخص

تقييم الأراضي ضروري للزراعة المستدامة، وتخطيط استخدام الأراضي، وإدارة الموارد. تبحث هذه الدراسة في خصائص التربة، وإمكانات استخدام الأراضي، ومدى ملاءمة المحاصيل في منطقة دلتا النيل الشرقية في مصر من خلال استخدام الاستشعار عن بعد(RS) ، ونظم المعلومات الجغرافية(GIS) ، ونموذج النظام التطبيقي لتقييم الأراضي .(ASLE) تم تحليل منطقة الدراسة، الواقعة بين دوائر العرض ٣٠,٤٥,٠٠-٣٠,٥٥,٠٠ شمالاً ودوائر الطول ٣١,٤٠,٠٠-٣٢,٠٠,٠٠ شرقاً، من خلال جمع عينات التربة من ١٦ بروفايل لتصنيف الأراضي من حيث القدرة والملاءمة. تم تحديد ست وحدات جغرافية: حوض الترسيب المنخفض، حوض الترسيب العالي، حوض الفيضان، السهول الهوائية، الأراضي الطينية المرتفعة نسبياً، والأراضي الطينية المنخفضة نسبياً. بنسب قدرات تتراوح بين ٢١,٣٥٪ و٤٧,٤١٪، قسم تقييم قدرة الأراضي المنطقة إلى فئات متوسطة (C3) وضعيفة .(C4) أظهر تقييم ملاءمة المحاصيل ملاءمة متوسطة للقمح والذرة والدخن والشعير، بينما تطلبت التين والزيتون والبازلاء تقنيات إدارة محددة. تم إجراء تقييم تقليدي لملاءمة الأرض للبصل والذرة والبطاطس والبرسيم وفول الصويا. تؤكد الدراسة على فعالية أدوات تقييم الأراضي الآلية المعتمدة على نظم المعلومات الجغرافية في تحسين استخدام الأراضي وتعزيز الممارسات الزراعية المستدامة.