Evaluation of Agri-Limitations for Sustainable Development at The Area between El-Dabaa and El-Alamain, Mediterranean Region, Egypt

Adel A. Elwan and Mohamed E. A. Khalifa
Pedology Department, Water resources and desert soils division, Desert Research Center, Egypt

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ABSTRACT

Many of agricultural expansion projects in Egypt have not been succeeded due to the associated miss-definition of actual constrains for land productivity. This study was carried out at the area between El-Dabaa and El-Alamian, the North Western Mediterranean coastal zone of Egypt over an area of about 148000 feddans to characterize and evaluate the agro-limitations for land productivity. The area was surveyed through a total of 103 geo-referenced pedons based on 2 km – resolution systematic grid. Horizon-wise soil samples were collected for physical, chemical and fertility laboratory analyses. Environmental services and socio-economic concerns were considered and recorded using appropriate questionnaires.

The lands were evaluated using both of PLES-Arid model (Parametric Land Evaluation System in arid regions) and Q_LDLPE approach (Qualitative desert land potentiality evaluation). PLES model deals with the soil technical concerns, while Q_LDLPE used to assess the socio-economic aspects. Applied models emphasized the integration of all limiting criteria affecting productivity in addition to assessment of utilization priority.

Four main soil mapping units were distinguished; very deep to deep sandy soils (12.5%), moderately deep sandy soils (60.6%), shallow sandy soils (11.4%), and very shallow sandy soils (15.5%). Results indicated that limitations for land productivity which prevent optimum land productivity varying from site to others, however, they could be concluded as: rough topography, appearance of surface coarse weathered rock fragments and outcrops, shallowness of pedon depth, general low levels of soil organic matter and macronutrients. The area was generally characterized by dominancy of coarse texture with low percentage of clay content, low salinity, and high calcium carbonate content.

Socioeconomic constrains for agricultural development were allied with different elements. The area is threatened by water dearth due to surface irrigation discontinuous through El-Hammam extension canal. Infrastructure including some roads is deteriorated due to the lacking of continuous maintenance. The access to markets, storage facilities and labors were somewhat omitted in some locations. The knowledge base, machinery and technology transfer were not available at some sites. Generally, the area is suffered from a worth degree of safety and non-steady status between owners and governorate.

Accordingly, studied lands were grouped into four categories based on their limitations intensity and consequently the priority of land use. The first priority of land use was for the high potential lands which occupied 45.4% of the total studied area and had potentiality index varied from 72.5 to 56.4%. The moderate potential lands have the second priority for land utilization and spread over 40.2% of the area where potentiality index ranged from 56.8 to 37.5%. The third priority was for marginal potential land which covers an area of 5.3% with potentiality index values ranged between 36.1 and 16.9%. Low potential lands with fourth priority were over 9.1% with index ranged from 16.0 to 14.2% in which non-agricultural activities could be undertaken.

Applied models, PLES and Q_LDLPE, had reflected the actual agro–constrains of land potentiality. The study presents a priority of utilization commensurate with each land potentiality to decision makers for successful land use planning, economically profitable and environmentally sustainable.

Key words: Land evaluation, Potentiality, PLES, Q_LDLPE, Mediterranean Region, Egypt.

INTRODUCTION

Soil researches during the last double decades emphasized that inefficient exploitation of natural resources at desert areas leads to inappropriate land use and destruction of resources. Agricultural planners must ensure that land is not degraded and used according to its capacity with relevance to a specific land use to satisfy potential human needs parallel to maintaining the earth's ecosystems (De la Rosa *et al.,* 2004). Land Evaluation may be defined as "all methods to explain or predict the use potential of lands on the basis of their attributes" (Van Diepen *et al.,* 1991). Land-use issue was undertaken by many land evaluation procedures through rational planning for appropriate and sustainable use of desert natural and human resources (Sys *et al.,* 1991). Once the land potentiality is determined, land use planning can proceed on a land utilization type (LUT) basis with respect to what the land resources can offer (FAO, 1976). Land evaluation models considered as tools for strategic land use planning referring to current or potential suitability and ranging from qualitative to quantitative (Rossiter, 1995).

According to Sys *et al.* (1991 and 1993) a multiplication method was suggested to calculate land productivity based on soil physical, chemical, topographic, fertility and irrigation water parameters. Rossiter (1995) suggested a simple economic land evaluation system named Automated Land Evaluation System (ALES). The Microcomputer Land Evaluation Information System (MicroLEIS) which introduced by De la Rosa *et al.* (2004) were designed to combine agriculture and land resource sciences together to the decision makers. On the other hand, many local evaluators' attempts were carried out for land assessment. Among them, Abd El-Motteleb and Hussein (1985) were identified soil chemical and physical properties as well as environmental conditions to be evaluated and classified for land capability classification. Present land evaluation systems didn't reflect the actual performance of desert lands and seem inadequate for assessing their potential productivity, leading to place most of them in non-suitable classes (Elwan, 2013).

Khalifa (2004) designed Parametric Land Evaluation System (PLES) which aimed to identify the main limiting factors for land productivity as well as identifying the different degrees of land suitability for several field crops. The Qualitative desert land potentiality evaluation approach (Q_LDLPE) is an improved procedure particularly for sustainable management planning of desert land resources. This approach takes into account all the factors affecting the potentiality of desert lands, as a geographic area, including environment, soils, socio-economic and political factors (Elwan, 2013). That model interested in demonstrating the applicability and the particular advantages in utilizing its resources. The partial usage of PLES and Q_LDLPE models is one of their most powerful advantages.

The North-Western coastal soils of Egypt - as a part of the Mediterranean Agroecological zone- was considered one of the most important regions for land reclamation and agricultural expansion development projects (DRC, 2010). Study area was chosen as a portion of the coastal plain along with the Mediterranean Sea to represent soils in vicinity to El-Hammam extension canal between El-Dabaa and El-Alamain. That area was incorporated in the Egyptian strategic development plan (Long-term comprehensive development plan 2002-2022) due to its accessibility and attaining the most promising lands for agricultural expansion beyond the Nile Valley and Delta of Egypt.

This study aimed to evaluate the soils between El-Dabaa and El-Alamain coastal plain using PLES and Q_LDLPE models to assess the potential production of the considered desert lands based on identifying the dominant agri-limitations.

STUDY AREA

1- Location

Studied soils were chosen to represent the northwestern Mediterranean Agroecological Zone which located in the lower western desert of Egypt. Studied site is located at the area between El-Dabaa and El-Alamian over 148,000 feddans. Geographically, studied site is bounded by Longitudes 29° 00' and 29° 30' Easting, and by Latitudes 30° 45' and 30° 50' Northing, Map (1). The area was recently reclaimed expectantly to be irrigated mainly by El-Hammam extension canal which stretched along 57 km towards the west from El-Alamin to El-Dabaa and passes through the studied area in vicinity to its south border.

2- Climate

The study area lied in the semi-arid zone, characterized by low rainfall with high evaporation and evapotranspiration rates. The annual minimum and maximum temperatures were 9.1°C and 30.6°C recorded in January and August, respectively. The Mediterranean coastal zone of Egypt received annual average amounts of 178.9 mm rainfall, especially in winter. Unfortunately, the scanty rainfall in winter was considered as insufficient for growing up the cereal crops *i.e.* wheat and barley (IPCC, 2011).

3- Geology and Geomorphology

The geologic formations of the study area were essentially dominated by sedimentary rocks belongs to Tertiary and Quaternary ages. The Pleistocene sediments during Quaternary were formed as Oolitic limestone at the coastal plain and as course sand mixed with gravel at Abu Mena basin with 100 m depth. The Pliocene and Miocene during the Tertiary age were occupying major part of the inland plateau as sand stone, clayey or sandy lime stone with some clayey interrelation till 30 m depth, Zahran (2008). The hills and basins which characterized the area were evolved by the varying of sea level during the Pleistocene period, Fehlberg and Stahr (1985).

Geomorphologically, area under investigation occupies a southern inland portion from the coastal region with four main physiographic units, El-Bastwasy (2008). The coastal plain stretched from east to west direction parallel to shore line, its width varied from some meters to about 10 km under the control by geologic formations. Abu Mena Basin stretched longitudinally among inner ridges and hills. Maryout plateau bounded the area from the south and formed by elevated lime stone with height up to 100 m A.S.L. The pediment plain to the south connected to the higher Libyan plateau.

4- Hydrology and Irrigation

Hydrologically, the groundwater in the area exists under free water table condition where saturated thickness of the coastal aquifer was about 30 m in Pleistocene oolitic limestone. The groundwater flow was mostly towards the Mediterranean Sea coast. The coastal aquifer mostly contained brackish water that has been recharged annually by local rainfall and the Nile seepage water from El-Nasr, El-Hammam and Maryout canals (Atta *et al.,* 2005). Detected high salinity of the ground water could be due to the long residence time in the marine Miocene sediments in El-Dabaa and the Pleistocene aquifers in El-Alamein area (Sayed, 2012). The Nile water reached the Northwestern Coast lands via four irrigation canals; El-Nubaria, El-Nasr, Bahieg and El-Hammam canals. The first stage of El-Hammam canal has been constructed recently along 50 km aiming to reclaim and cultivate about 72,000 feddans in El-Hammam region. El-Hammam extension canal had been implemented along 57 km to irrigate 148,000 feddans as a second stage for agricultural development of the area between El-Dabaa to El-Alamain.

MATERIALS AND METHODS

1- Field Work

The pedological field study was conducted at the area between El-Dabaa and El-Alamian at the North West coastal zone of Egypt over about 148,000 feddans. Regular grid system with resolution of 2 km × 2 km signatory to the available cadastral maps at 1: 50,000 scale was designed to cover whole variations of the study area. One hundred and three geo-referenced representative soil profiles were dug to a depth of 150 cm or more unless opposed by bedrock or extremely hard layer (Map 2). Soil profiles were described for their morphological features and properties as per the methods outlined by USDA-NRSC (2002) and FAO (2006).

2- Questionering

Questionnaire sheets were interpolated at sampled area. Collected data were concerned with farm acreage, crop production, and other environmental aspects based on field observations. These conditions are: (1) Irrigation system; (2) Drainage efficiency; (3) Managements status (agronomical processes, degree of mechanization and crop rotation); and (4) socioeconomics status (Land tenure, roads, labor force, marketing, safety and distance from the main city)

3- Laboratory Analysis

Three hundred and five soil samples were collected from the studied soil profiles for further laboratory analysis to determine some physical, chemical and fertility characteristics as per standard procedures suggested by following methods: Piper (1966) for soil texture; Richards (1954) for ESP; Jackson (1973) for organic carbon content, ECe and pH (pH was determined using 1:1 soil water extract; FAO (1970) for available nitrogen; as well as Soltanpour and Schwab (1977) for available contents of phosphorus and potassium.

4- GIS processing

Observation sites and associated resultant data were georeferenced using UTM coordination units. For mapping, data were exported to be processed using Arc-GIS, 9.2, ESRI (2006). Soil mapping units and land priority evaluation maps were generated and processed using GIS. Surface slops were calculated based on digital elevation model.

5- Land Evaluation

According to Parametric Land Evaluation System (PLES) as designed by Khalifa (2004), land productivity indices were calculated. Evaluated parameters include; Soil physical, chemical, topographic, fertility, irrigation water and climatic parameters, table (1). Every property was evaluated and described as a percentage to formulate a land group index. The final index of land productivity (F.I.L.P) was calculated by multiplying the logarithmic mean of land groups and assigned to one of the productivity classes as shown in table (2).

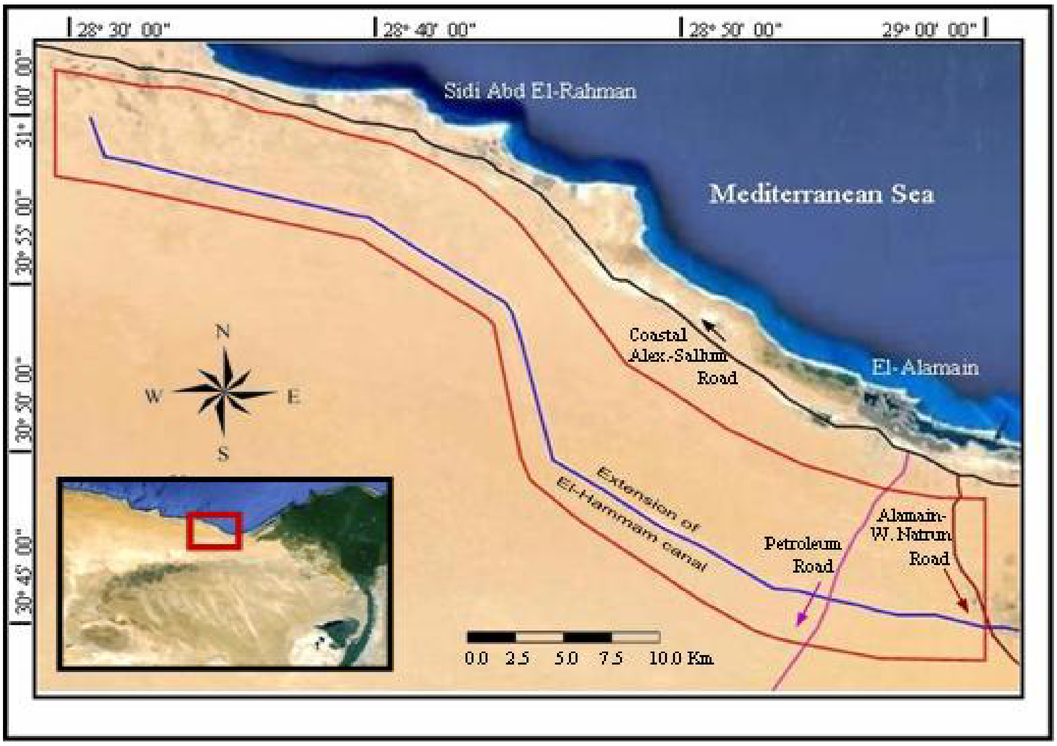
Qualitative desert land potentiality evaluation approach (QLDLPE) is considered as interdisciplinary system for sustainable management of desert land resources, Elwan, (2013). It took into account four main criteria related to environment, soils, socio-economic and politic. The current study takes into consideration only socio-economic factors from Q_LDLPE to be incorporated with technical ones driven from PLES for further plan implementation, table (1). Every criterion of those which are not equal in importance (weight) contribute towards the potentiality assessment with referring to a kind of constrains or limitations which reflects the type of required management. The final potentiality index was calculated by multiplying the score rating for each criterion in its weight to find out the criterion percentage.

Q_LDELPE involves major decisions at various levels starting from choosing a major land utilization types (LUTs), identifying suitability limits and selection of specific management based on interventions of suitable technologies for each class of the criteria. The land potentiality classes were identified as seen in table (3) based on that approach.

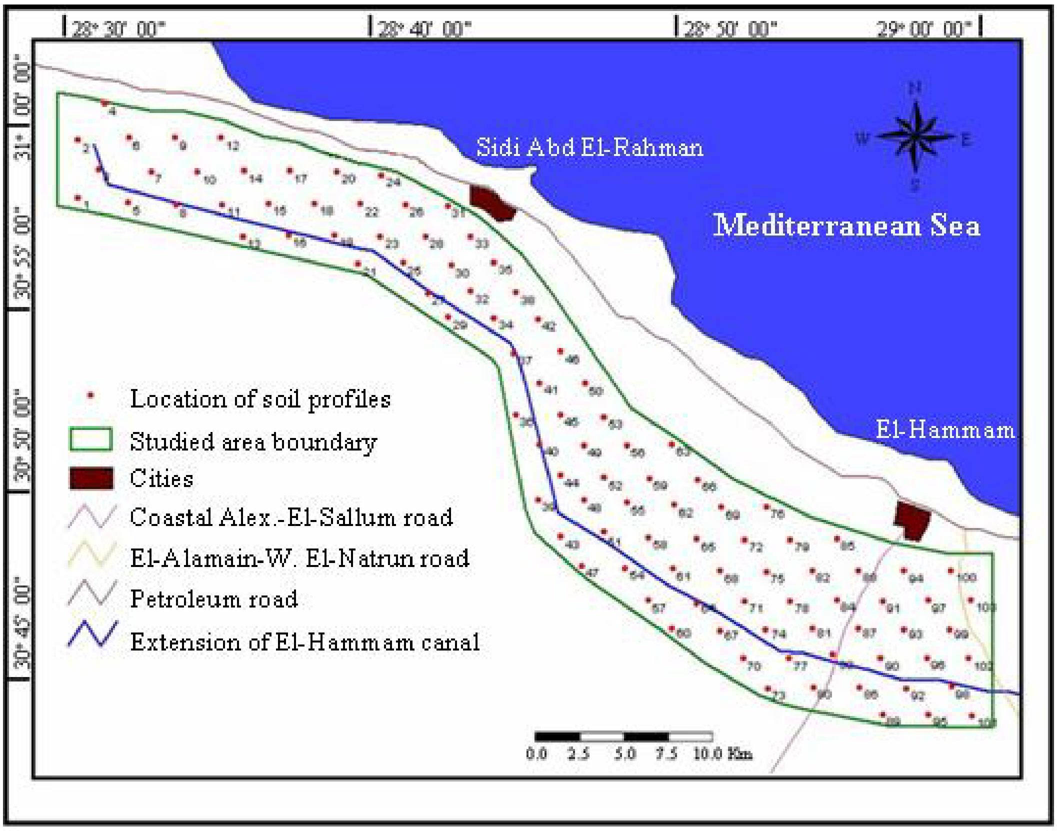
RESULTS AND DISCUSSION

1- Site description and soil mapping units

Investigated area was cultivated partially with cereals crops (wheat and barley) depending on rainfall (rainfed agriculture). Vegetable (Tomatoes and Green paper) and fruit trees (Apple, Olive and Citrus) were cultivated over scattered areas using drip irrigation system (irrigated agriculture) based on ground water availability.



Map 1: Location of the studied area, North Western Coast of Egypt



Map 2: Location of the representative soil profiles at studied area

Table 1: Applied land evaluation parameters and criteria.

PLES	QLDLPE
Physical parameters (P):	**Socio-economic criteria**
Soil depth, cm	Availability of infrastructure (i)
Soil texture class	Access to markets (m)
Soil stoniness.	Availability of labors (b)
Drainage status.	Knowledge and technologies (e)
Calcium carbonate, %.	Human management (h)
Chemical parameters (C):	
Soil salinity (ECe), dS/m.	
Soil alkalinity (ESP).	
Soil reaction (pH).	
Topographic parameters (T):	
Overall slope, %.	
Micro-relief, %.	
Fertility parameters (F):	
Soil organic matter, %.	
Available nitrogen, ppm.	
Available phosphorus, ppm.	
Available potassium, ppm.	

Table 2: Final land productivity classes and ratings according to PLES.

Productivity class	Suitability for agricultural use	F.I.L.P (%)
P1	Excellent	100 - 80
P2	Good	79 - 60
P3	Fair	59 - 40
P4	Poor	39 - 20
P5	Very poor	19 - 10
P6	Non-agricultural	< 10

Table 3: Final land potentiality classes and rated index according to QLDLPE.

Potentiality class	Land potentiality	Rated Index
C1	High potential land (H)	81-100 %
C2	Moderate potential land (M)	66-80 %
C3	Slight potential land (S)	46-65 %
C4	Low potential land (L)	26-45 %
C5	Non-potential land (N)	< 25 %

Most of the cultivable soils in the area were of mixed marine and aeolian sediments origin. The subsoil layers were formed locally from weathered marine limestone. The soil depth varied accordingly, being shallow to very shallow in the sloping and plateau landscapes, and very deep to deep in the coastal plain.

Landscape topography was generally almost flat (0.5-2.0 %) to gently undulating (2.0-5.0%) with nearly level sloping (0.5- 1.0 %) to gently sloping surface (2.0-5.0%) as shown in table (4). Land surface was covered with a few to abundant coarse rock fragments. Calcareous aeolian deposits and in-situ weathered lime stone dominate the surface pavement. Soil texture throughout the entire depths was found to be coarse-textured and sometimes medium to coarse textured. However, soil texture varied from loamy sand to sandy loam, except for some layers was found to be sandy clay loam. Gravel content varied from very few to common (0.50-11.25%) throughout the entire depth of soil.

Based on soil solum depth and texture, studied soils were classified into four mapping units named as very deep to deep sandy soils, moderately deep sandy soils, shallow sandy soils and very shallow sandy soils, map (3). Common morphological features and analytical data were summarized as shown in tables (4 and 5). Very deep to deep sandy soils unit represented by 17 pedons having effective solum depths varied from 200 –110 cm and occupy an area of about 18,500 feddans (12.5 % of the total area). The moderately deep sandy soils unit had an area of 89,700 feddans (60.6 % of whole study area), represented by 44 pedons having depths ranged from 55 to 100 cm. The effective depth of shallow sandy soils was ranged from 30 to 45 cm which covered an area of 16,850 feddans (11.4 % of the total area), and was represented by 18 pedons. Twenty two pedons were very shallow soils where depths ranged from 5 – 25 cm over an area of 26,900 feddan (15.5% of the total area).

Table 4: Origin and morphometric characteristics of differentiated soil mapping units

Pedon No.	Soil depth (cm)	Parent material	Slope (%)	Coarse surface fragments	Current land use
1st soil mapping unit: **Very deep to deep sandy soils**					
4	200	Calcareous eolian deposits	2.0-5.0	Few, gravels and stones	Prepared for
18	150		1.0-2.0	Very few, varysized gravels	Wheat
102	110	In-situ weathered limestone	0.5-1.0		Tomatoes
2nd soil mapping unit: **Moderately deep sandy soils**					
9	100	In-situ weathered limestone	2.0-5.0	Common, coarse gravels	Barley, wheat and
53	75		1.0-2.0	Few, varysized gravels and stones	Wheat
100	55		0.5-1.0		Barren / rock exposure
3rd soil mapping unit: **Shallow sandy soils**					
8	45	In-situ weathered limestone	2.0-5.0	Abundant, gravels and stones & rock exposure	Barren
77	30		1.0-2.0		
4th soil mapping unit: **Very shallow sandy soils**					
41	25	In-situ weathered limestone	0.2-0.5	Common, stones & rocky	Olive
71	15		2.0-3.0	dominant, stones and boulders	Barren
86	5		0.5-1.0		

Narrow range of soil salinity values (ECe) was achieved, table (5). Soils, in general, varied from non saline (0.31-0.70 dS m^{-1}) to moderately saline (2.25 – 3.95 dS m^{-1}). Soil reaction (pH) values varied considerably between 7.55 and 8.87, indicating neutral status with obvious tendency to alkalinity. The ESP values of the soils under investigation varied from 3.41 to 17.15 %, which indicate moderate alkaline conditions with low sodicity hazard, whilst the highest values were associated with high salinity due to dominance of soluble sodium in the soil extract. Results showed that soils were extremely calcareous, where CaCO3 contents varied from 33.50 - 41.5 %; 45 - 59.5 %; 51.5 - 74.5 % for the mapping units of very deep to deep soils, moderately deep soils and shallow to very shallow sandy soils, respectively. The highest values were recorded in the soils originated mainly from carbonate-rich limestone parent materials (Miocene plateau).

Soil organic matter contents of the entire soils were very low, being in the range from 0.13 to 0.31 %. Available nitrogen contents ranged from 40.48 to 80.90 ppm, while available phosphorus varied from 4.71 to 6.97 ppm, indicating considered requirements of N and P applications are needed. Generally, potassium was found in sufficient amounts (more than 120 ppm) with no need for fertilization.

2- Argo-limitations

Topography, soil depth, soil texture, soil salinity, soil fertility and socio-economic criteria have distributed with different sever levels as limitations for agricultural development at the study area as showed in tables (4, 5 & 7).

2.1- Topography of the landscape: Based on the slope (%), erosion status and the average of wind speed in the windy season of 3 month duration, the evaluation score rating was high (80-90 %) due to the flattens of most landscapes of study area. Some scattered sites located at the east side of the area over 15.5 % of the total area having downward scores (40-60 %) due to moderately sloped surfaces.

2.2- Soil depth: Soils of about 12.5 % of the studied area were very deep to deep (≥110 cm), therefore, it given the maximum score rating (100 %) due to allowance of wide range from agrarian land utilization types (horticultural trees, field crops, forage crops, etc.). The majority of studied area (60.6 %) belonging to moderately deep soils with no sever limitation. While the solum depth was the major limiting factor in the shallow and very shallow soils over about 26.9 % of the total area in which the evaluated rating scores varied from 2 % to 35 %. However, shallow and very shallow soils were placed in lower potentiality classes.

2.3- Soil texture: Results indicate that 84.5 % of the studied soils have coarse texture classes over finer ones (sand over loamy sand or loamy sand over sandy loam). Moderate textured soils (sandy clay loam or sandy loam) occupy about 15.5 % of the area. Consequently, soil texture in the studied area could not be considered as vital constrain for potentiality. Thus, moderate rating scores were achieved (35 -75 %) due to soil texture influence on poor nutrition and rapid water flow.

Table 5: Summarized soil properties of achieved mapping units in the studied area

Properties	Soil unit	A				B			C		D
	Pedon No.	**3**				**50**			**89**		**93**
	Depth to, cm	**25**	**60**	**100**	**150**	**20**	**55**	**95**	**25**	**50**	**15**
Physical	Gravel (%)	19.0	3.0	11.0	4.0	2.5	1.5	3.5	5.5	9.5	14.5
	Sand (%)	95.5	86.5	83.5	83.0	87.00	89.00	79.5	85.5	86.5	78.0
	Silt (%)	3.0	6.0	8.0	1.5	3.00	5.00	6.0	3.5	4.5	3.0
	Clay (%)	1.50	7.50	8.5	15.5	10.00	6.00	14.5	11.0	9	19.0
	Text. class	S	LS	LS	SL	LS	LS	SL	LS	LS	SL
Chemical	EC ($dS\ m^{-1}$)	2.95	2.50	3.27	0.95	3.09	2.19	2.57	1.15	3.69	3.89
	pH	8.01	7.97	7.81	8.35	8.39	8.17	8.27	8.86	8.93	8.90
	ESP (%)	5.54	5.83	6.33	6.33	4.12	9.09	9.97	6.36	5.85	4.31
	$CaCO_3$ (%)	51.00	48.00	37.00	55.00	59.00	51.00	44.00	78.00	87.00	79.00
Fertility	O.M (%)	0.14	0.37	--	--	0.16	0.28	--	0.20	0.17	0.14
	N (ppm)	59.83	48.40	--	--	55.20	63.68	--	45.9	37.6	44.3
	P (ppm)	3.39	2.02	--	--	6.12	1.97	--	2.38	2.13	6.13
	K (ppm)	215.0	131.2	--	--	286.8	149.8	--	136.8	155.3	178.2

A: Very deep to deep sandy soils B: Moderately deep sandy soils C: Shallow sandy soils
D: Very shallow sandy soils S: Sand SL: Sandy loam LS: Loamy sand

2.4- Stoniness: Varisized surface coarse fragments were noticed over most of the landscapes under study, particularly at shallow and very shallow soil units. Rating scores were near the null values in very shallow soils due to the dominance of the stones and boulders on the ground surface. In addition to soil depth, this criterion was considered one of the most important limitations for the agricultural development of some eastern sites at studied area.

2.5- Electrical conductivity: Soils of the whole area could be considered non to moderately saline, where the highest ratings were given to deeper soils since it is non saline while the lowest ones were assigned to moderately saline which characterized shallower or the rocky areas. However, salt affected soils could be reclaimed by leaching using non saline water.

2.6- Lime content: Presence of high carbonate condition is a common soil character at the whole studied area. Relevant managements minimized the effects of high lime on grown crops, thus moderate rating scores described the lime status were considered.

2.7- Soil fertility: Soils of studied area is suffering from nutrient deficiency as usual at north western coastal zones, therefore they have low rating scores in which fertilization is an obligatory process.

3- Land evaluation:

In general, rainfed farming is the main land use at the area under studying. The main annual field crops were barley and wheat, while figs and olive trees were spread successfully on the calcareous soils as else where on the coastal zones. Based on the results given in tables (6 & 7) and map (4) lands were classified into four groups on the basis of land potentiality index value and priority of utilization as the following;

(1) First priority (high potential lands)

The land productivity indices varied from 72.5 to 56.4% representing fair to good land productivity. They covered an area of about 45.4 % of the whole studied area including very deep to deep unit and parts of moderately deep unit which had effective depth more than 75 cm. Soils belong to this group had potential production especially for crops which require significant deep soil depth like olive and figs trees (map 4).

(2) Second priority (moderate potential lands)

The moderately deep soils which had depth between 55 and 75 cm and shallow ones which had depth ranged from 45 to 50 cm were considered in this group. Resultant land index values for this group varied between 56.8 and 37.5 % reflecting poor to fair land productivity. It occupy about 40.2% of the area under investigation, in which moderate rooting depth crops are suite, map (4).

(3) Third priority (marginal potential lands)

This group includes land productivity indices ranged between 36.1 and 16.9 % which cover an area of 5.3% of the total studied area. That potentiality include partially shallow and very shallow sandy soils which suggested to be planted with barley and wheat as well as other crops which having shallow rooting system, map (4).

(4) Fourth priority (low potential lands)

This group includes the rest of very shallow soils over 9.1 % of the total area with index values ranged from 14.2 to 16.0 %. They were not economically feasible to be corrected with existing knowledge and technology. These lands can be used for other non-agricultural activities such as buildings and livestock, map (4).

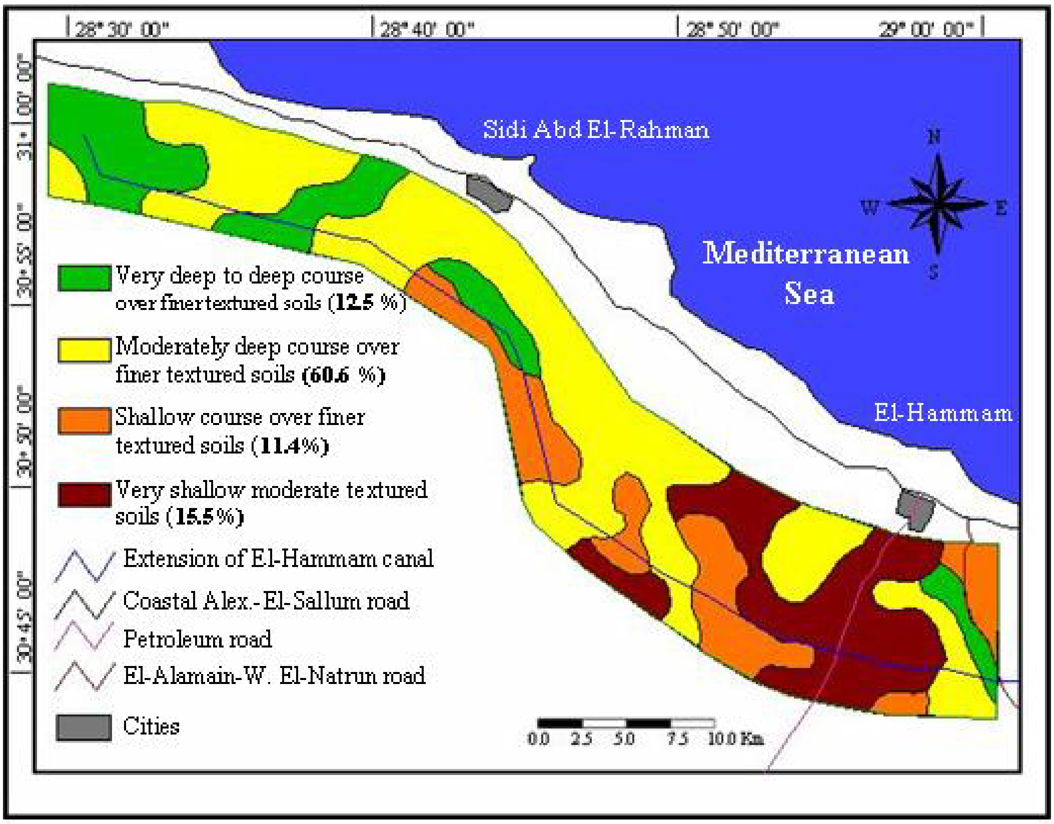
Table 6: Socio-economics evaluation of the studied lands according to Q_LDLPE

Soil unit	A	B	C	D
Socio-economic criteria (%)				
Infrastructure (i)	65-85	40-70	20-50	0-30
Access to markets (m)	40-55	35-40	35-40	0-25
Availability of labors (b)	50-75	40-55	35-50	35-50
Technology (e)	30-70	30-50	30-50	30-50
Human management (h)	35-50	30-45	30-40	10-30
Land potentiality index (%)	60-75	50-65	40 - 50	0 - 30
Land potentiality class	S - M	S	L - S	N - L

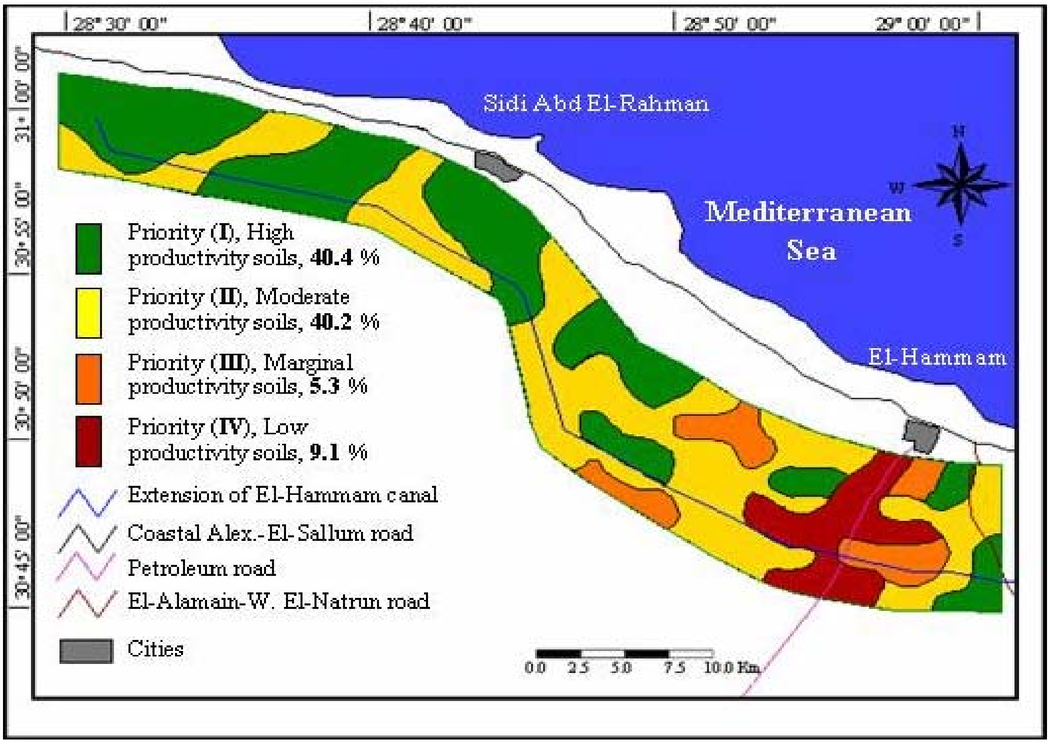
A: Very deep to deep soils B: Moderately deep soils C: Shallow soils D: Very shallow soils
M: Moderate potential land; S : Slight potential land; L: Low potential land;

Table 7: Land productivity classes according to PLES

Soil Unit	Limitations	Average Index (%)	Productivity class
A	$P_{2\ P\ (tex,\ CO3)\ F\ (O.M,\ N,\ P,\ K)}$	72.5 – 61.2	Class 2 (Good)
B	$P_{3\ P\ (tex,\ CO3)\ F\ (O.M,\ N,\ P,\ K)}$	45.3 - 58.4	Class 3 (Fair)
C	$P_{4\ P\ (P.D,\ tex,\ CO3)\ F\ (O.M,\ N,\ P,\ K)}$	30.1 - 39.2	Class 4 (Poor)
D	$P_{5\ P\ (P.D,\ tex,\ CO3)\ C\ (EC)\ T,\ F\ (O.M,\ N,\ P,\ K)}$	14.2 - 18.2	Class 5 (V. Poor)



Map 3: Soil mapping units of the studied area



Map 4: Utilization priority based on land potentiality of the studied area

The socio-economics factors were incorporated with considered criteria sustainably within the aspiration limits of people. It adjusted to fit within the long-term objectives of society's options and policies for sustainable land use planning and development of the studied area.

As it becomes clear that PLES and QLDLPEA models were very suitable for evaluating such investigated area and exploring land constrains with certain productivity identification. In fact, both of production and conservation components have to be undertaken for successful land use planning in the study area using proper way based on the former assessment.

In conclusion, sever soil limitations in the area have moderate significant influence on general land potentiality, on the other hand, the technical-political decision of passing the Nile water to the investigated area will redraw the agro-social map at the North Western coast of Egypt.

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الملخص العربى

تقييم المُحددات الزراعية بغرض التنمية المستدامة بالمنطقة ما بين الضبعة- العلميين، إقليم البحر المتوسط - مصر

عادل عبد الحميد علوان، محمد عزت عبد الهادى خليفة

قسم البيدولوجى- شعبة مصادر المياة والأراضى الصحراوية – مركز بحوث الصحراء – مصر

هناك العديد من برامج ومشروعات التوسع الزراعى الأفقى بالأراضى الصحراوية لم تلقى النجاح المتوقع نتيجة وجود أخطاء فى تحديد وتعريف معوقات الإنتاج بها كأولى خطوات تخطيط الإستغلال الزراعى. وعليـه فالبحـث يهدف إلى إستخدام المفاهيم الأرضية المستحدثة فى تقييم نموذج لأحد مشروعات التنمية الزراعية والذى يقـع فـى زمام أراضى إمتداد ترعة الحمام بالساحل الشمالى الغربى لمصر ما بين العلمين والضبعة على إمتداد مسـاحة ١٤٨ ألف فدان ممثلا للظهير الصحراوى لمنطقة (محافظة) العلمين. حيث تم حصر أراضى المنطقة بإستخدام عـدد ١٠٣ قطاع أرضى ممثل حددت مواقعها عبر شبكة منتظمة الأبعاد تغطى كافة المساحة تحت الدراسة، مع تجميع عينـات التربة الممثلة للتعاقب الطبقى بها بهدف التقدير المعملى لصفات التربة الطبيعية، الكيميائيـة، والخصـوبية، وذلـك إستيفاءا لمدخلات نظم التقييم المطبقة. كما إشتملت الدراسة الحقلية على إستيفاء إستمارات إستبيان لتجميـع بيانـات العناصر الإجتماعية والإقتصادية المؤثرة على الإنتاجية الزراعية بالمنطقة.

ولقد إستخدم لتقييم أراضى المنطقة المستهدفة نظام PLES-ARID (نظام تقييم الأراضـى متعـدد المتغيـرات بالمناطق الجافة) ونظام Q_LDLPE (النظام الكيفى لتقدير القدرة الإنتاجية بالأراضى الصحراوية) إعتمادا على دمـج نتائج تقييم بعض متغيرات النظامين لتقييم الأراضى آليا فى ظل ظروف المنطقة، حيث تم تقدير شدة تأثير معوقـات إنتاجية الأراضى وحساب معايير القدرة الإنتاجية بالمساحة المدروسة إضافة لتحديد أولويات الإستزراع المبنية على صلاحية الأراضى. حيث عالج نظام PLES تقييم المتغيرات الفنية للأراضى بينمـا إهـتم نظـام Q_LDLPE بتقيـيم العناصر الإجتماعية والإقتصادية السائدة.

وبناءا على ما أسفرت عنه الدراسات الحقلية والمعملية أمكن تمييز أربعة وحدات أرضية رئيسية مختلفـة فـى عمق قطاع التربة بالمساحة تحت الدراسة وهى وحدة الأراضى الرملية العميقـة علـى مسـاحة ١٨ الـف فـدان (١٢.٥%)، وحدة الأراضى الرملية متوسطة العمق والتى سادت المنطقة على مساحة ٨٩.٧ الف فـدان (٦٠.٦%)، وحدة الأراضى الرملية الضحلة على مساحة ١٦.٨٥ الف فدان (١١.٤%)، وحدة الأراضى الرملية الضـحلة جـدا على مساحة ٢٦.٩ الف فدان (١٥.٥%). وقد أوضحت الدراسة بأن أهم محـددات الإنتاجيـة تركـزت فـى حـدة الطبوغرافيا على ١٥.٥% من إجمالى المساحة بما حقق دليل إنتاجية ٤٠-٦٠%، وضحالة عمق التربة على إمتـداد ٢٦.٩% من إجمالى المساحة والذى عكس تدنى واضح فى دليل الإنتاجية تراوح ما بـين ٢ - ٣٥%، مـع سـيادة الفتات الصخرى على ١٥.٥% بالأراضى شديدة الضحالة والذى أثر سلبيا على دليل الإنتاجية مقتربا مـن الصـفر

بتلك المساحات. وإتسمت تربة المنطقة عموما بكافة وحداتها بسيادة القوام الخشن (أقسام القوام الرملى) وبإنخفـاض الملوحة وإرتفاع المحتوى الجيرى والفقر الواضح فى مادتها العضوية وعناصرها الغذائية.

كما حاول البحث إلقاء الضوء حول محددات المنطقة المتعلقة بالظروف الإجتماعية والإقتصادية، حيث تم إدراج المساحة ضمن مناطق الزراعة المطرية لعدم توصيل مياة النيل عبر ترعة إمتداد الحمام حتى تاريخ الدراسـة ممـا يؤثر سلبا على توفر مياة الرى. كما تبين وجود شبكة متكاملة من الطرق شاملة لطريق ساحلى دولى وآخر للسـكك الحديدية لا يشوبها إلا بعض التدهور لتوقف أعمال الصيانة ببعضها. المنطقة قريبة من بعض المطارات المحليـة أو الدولية مما يوفر مع النقل البرى فرص جيدة للنقل السريع. إتسمت المنطقة بتواجد العمالة وإمكانية تخزين المـوارد الزراعية والتسويق ببعض المساحات وغيابها بمساحات أخرى. كما أكدت الدراسة على بداية نمو إستخدام التقنيـات والمعارف الزراعية الحديثة ببعض المساحات وإغفالها بمساحات أخرى. المنطقة عموما على درجـة متدنيـة مـن السلامة الأمنية فضلا عن منازعات ملكية الأراضى بين واضعى اليد وإدارة محافظة مطروح، حيث توصى الدراسة بضرورة تقنين إستخدام الأراضى فى صورة حقوق إنتفاع مؤقتة لضمان جدية الإستصلاح والإستزراع.

ولقد خلصت الدراسة إلى تصنيف قدرة التربة الإنتاجية مع أولوية الإنتفاع الأرضى بمنطقة الدراسة إلى أربعـة أقسام هى أراضى القدرة الإنتاجية المرتفعة ذات الأولوية الأولى والممتدة على مساحة ٤٥.٤% حيث تراوح دليـل الإنتاجية ما بين ٧٢.٥-٥٦.٤%، بينما صنفت قدرة التربة الإنتاجية بالمتوسطة مع أولوية ثانية للإنتفاع الأرضـى على ٤٠.٢% حيث تباين دليل الإنتاجية ما بين ٥٦.٨-٣٧.٥%، ووصفت قدرة التربة الإنتاجية بالحدية عندما بلـغ دليل الإنتاجية فى مدى ٣٦.١-١٦.٩% على مساحة ٥.٣، % من المنطقة ممثلة للأولويـة الثالثـة مـن درجـات الإنتفاع، بينما صنفت باقى المنطقة والممتدة على ٩.١% من إجمالى المساحة كآخر أولويات الإنتفاع الأرضى لتتبع قسم القدرة الإنتاجية المتدنية مع دليل إنتاجية يتراوح بين ١٦.٠-١٤.٢% حيث أوصت الدراسة بإستغلالها فى أوجه إستخدام غير زراعية.

وأوصت الدراسة بأنه بناءا على تقييم أراضى المنطقة ما بين الضبعة والعلمين وتحديـد معوقـات الإسـتغلال الزراعى على مسار إمتداد ترعة الحمام بضرورة إتباع سبل التخطيط الزراعى الأمثل بما يضمن الإرتقاء بالقـدرة الإنتاجية وصيانة الموارد الأرضية بالمنطقة على حد سواء. كما أكدت الدراسة على كون محددات التربة الشديدة ذات تأثير محدود على عموم قدرة التربة الإنتاجية نظرا لكونها محدودة فى مساحات صغيرة، إلا أن القرار السياسـى - الفنى الخاص بإنطلاق مياة النيل للمنطقة عبر ترعة إمتداد الحمام بمثابة إعادة ترسيم للخريطة الزراعية والإجتماعية بها فضلا عن خلق إقتصاد نوعى جديد بإقليم الساحل الشمالى الغربى لمصر.