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AGROECOLOGICAL ASSESSMENT OF LAND RESOURCES IN NORTHERN NILE DELTA: A CASE STUDY IN KAFR EL-SHEIKH GOVERNORATE

Gaber, H.M.; M. H. Bahnassy; A. S. Suliman and T. A. El-Bana
Soil and Water Science Department, College of Agriculture (El-Shatby), Alexandria University

ABSTRACT

An agro-ecological land quality evaluation of an area in Kafr El-Sheikh Governorate was determined using the MicroLEIS IP (Integrated Package) which included the assessment of the general land use capability (Cervatana model), land suitability for different agricultural crops (Almagra model), prediction of the productivity of maize and wheat (Albero model), and assessment of the vulnerability of land and groundwater to agrochemical contaminations (Arenal model). According to the model prediction, most of the study area was classified as S2l, which indicate good capability with soil being the limiting factor. Land included in this class has certain topographic and edaphic limitation, which somewhat reduce the productive capability of certain crops. The geo-spatial distribution of the soil suitability in the study area indicated that more than 80% of the area is classified as moderately suitable soils (S2) for cotton cultivation. On the other hand, more than 77% is classified as S2 for corn cultivation, however two soil profiles (9 and 10) indicated poor suitability for corn (S4 and S5) due to their high soil salinity. Furthermore, the model predicted that approximately 59 and 64% of the study area has marginally suitability (S3) for wheat and sugar beet respectively. Since MicroLEIS model does not include soil suitability for rice cultivation, it was carried out manually according to the same principles applied in MicroLEIS model. The result indicated that more than 55% of the study area has high suitability for rice cultivation. Soil productivity prediction (Albero Model) was performed for corn and wheat assuming best management practices (BMPs). The model predicted an average yield for corn to be 5,174 Kg/ha, which is in agreement with the local average (4,970 Kg/ha.), however the national average is 10,420 Kg/ha. It was noticeable that farmers, using their indigenous and local knowledge, stay away from corn cultivation in this area. The model predicted that average yield for wheat to be 6,275 Kg/ha, which is close to being equal to the national average (6,041 Kg/ha), while the actual local average yield is 4,068 Kg/ha. Vulnerability of land and groundwater to contamination by agrochemical compounds was predicted using Arenal model. The model predicted that 81.68% of the study area was classified as low vulnerability (V2) while the rest of the area (18.32%) was classified as moderate vulnerability (V3). Detection of land use changes using two satellite images acquired in 1985 and 1999, indicated that cultivated soil was the dominant land use, which increased from 47.50% in 1984 to 68.35% in 1999 due to the new land reclamation projects in the area. The urbanization area increased from 3.08% in 1985 to 7.94% in 1999. Two types were introduced to the area and detected in the 1999 image only, which were the fish farms (6.17%) and citrus trees (4.93%).

INTRODUCTION

Land capability evaluation refers to a range of major kinds of land uses, such as agriculture, forestry, livestock production, and recreation. The most widely used categorical systems for evaluating agricultural land is termed land capability classification (Klingebiel and Montgomery, 1961). Soils in a capability unit are sufficiently uniform to: a) produce a similar kind of cultivated crops and pasture plants with similar management practices; b) require similar conservation treatment and management; and, c) have comparable potential productivity (Sys *et al.*, 1991-Part II). The system is concerned with the fitness of land to support land use, rather than productivity, emphasizing soil erosion.

Land suitability is the fitness of a given land-mapping unit for a land utilization type (FAO, 1976). Land suitability classification is based on four levels of generalization:

- Land suitability orders reflecting kinds of suitability; i.e., "suitable" (S) or "not suitable" (N).
- Land suitability classes indicating the degree of suitability within an order.
- Land suitability subclasses specifying kind(s) of limitation or kind(s) of required improvement measures within classes.
- Land suitability units indicating differences in required management within subclasses.

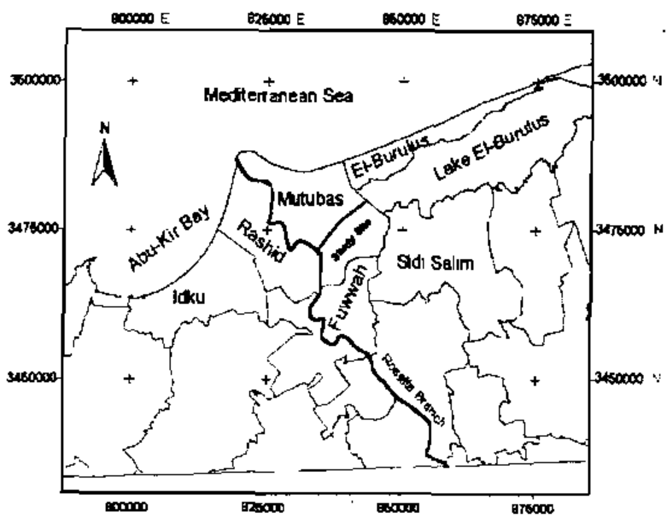
Capability is viewed by some as the inherent capacity of land to perform at a given level for a general use, and suitability as a statement of the adaptability of a given area for a specific kind of land use; others see capability as a classification of land primarily in relation to degradation hazards, whilst some regard the terms "suitability" and "capability" as interchangeable.

In Egypt, scarcity and degradation of land and water resources have become the main constraint to development. In agriculture, cultivated land is being further reduced by industrial and urban expansion resulting in vertical agricultural expansion *"intensification"*, which depends heavily on the use of chemical fertilizers and pesticides. Agricultural land quality/health is deteriorating due to water pollution, soil salinization, water-logging sand encroachment, and non-point sources of pollution by agrochemicals from the extensive use of pesticides and fertilizers as well as domestic waste (Kishk, 2002). The North Coastal region of the Nile Delta is a case in point. Government planners and managers are becoming increasingly interested in developing and protecting the resources of the North Coastal region of the Nile Delta. There have been several national mega projects, the International Coastal Road and the Damietta Harbor to name a few, implemented to help develop the area by attracting investments and protecting the region from further environmental deterioration using an Integrated Coastal management (ICM) approach. In this context, we must refer to the two important studies. The first study was carried out by the General Authority for Urban Planning (GAUP) producing an Action Plan for Integrated Development of the North Coast of the Nile Delta where the protection of the coastal line was part of the development plans (GAUP, 2002). The second was a comprehensive research effort that was carried out by the Soil and Water Sciences Department, Faculty of Agriculture, Alexandria University over the past four years and was supported by the Egyptian Academy of Scientific Research and Technology. The purpose of this three-year research project was to develop different scenarios for the integrated development and protection of the North Coast of Delta (Kishk, 2003). It is this later one that the present study is quoting from. The present paper addresses one aspect of this comprehensive effort. Specifically, the paper deals with an agro-ecological assessment of land resources in a representative area in the Motobus District, Kafr El-Sheikh Governorate. The MicroLEIS IP (Integrated Package) which includes an assessment of the general land use capability, land suitability for different agricultural crops, prediction of the productivity of maize and wheat, and estimation of the vulnerability of land to agrochemical compounds was used in this study.

MATERITLAS AND METHODS

Study Area

The study area is located in the northwestern of Kafr El-Sheikh governate; between 834703 - 847693 E, and 3465647 - 34870797 N (UTM zone 36). The total area covered by the study was about 108.34 km^2 located in the southern part of Mutubas district (Markaz). Map (1) illustrates the location of the study area.



Map 1. The Location of the study area

The study area is characterized by a Mediterranean climate, and can be considered as a semi-arid zone. Table (1) shows the average climatic parameters collected from Sakha meteorological station over a thirty years period (FAO, 1993).

Table 1: Average climatic data (over 30 years) collected from Sakha meteorological station (FAO, 1993).

Month	Max. Temp(°C)	Min. Temp(°C)	Rainfall (mm)	Relative Humidity(%)	Wind Speed (m/s)	Sunshine (Hours)	ET_o¶ (mm/d)
Jan	19.3	6.0	14	82	1.29	7.0	1.7
Feb	20.5	6.2	13	82	1.40	7.7	2.28
Mar	23.0	7.8	7	76	1.70	8.6	3.33
Apr	27.0	10.3	3	68	1.50	9.6	4.48
May	31.1	14.1	3	59	1.50	10.6	5.61
June	32.0	17.0	0	65	1.50	11.9	6.01
July	34.0	19.0	0	68	1.29	11.6	5.99
Aug	33.5	18.3	0	75	1.29	11.3	5.49
Sept	32.0	17.6	0	75	1.10	10.3	4.47
Oct	29.8	15.5	4	75	0.99	9.3	3.3
Nov	25.8	12.5	7	76	1.10	8.0	2.25
Dec	21.5	8.2	14	81	1.10	6.6	1.6
Average	27.5	12.7	5.58	73.5	1.31	9.4	3.68

¶: EET_o calculated from Penman-Montieth equation using Cropwat 4.2 model (FAO, 1993).

Geomorphic Soil Units

Based on morphological studies from a semi-detailed soil survey that was carried out for the Nile Delta by El -Nahal *et al.* (1977), the Nile Delta soil could be classified into the following geomorphological units:

- Soil of the recent Nile alluvium
- Soils of the marine alluvium
- Soils of the sub-Deltaic
- Soils of desert plains
- Soils of the river terraces
- The sandy beaches

Soil Classification

Several researchers (Wahab, 1977; Hanna and Maged, 1979; Hamdi et al, 1980; Erian, 1981) had studied the soil taxonomy of the Nile Delta. They reported that the dominant soil orders are Aridisols and Entisols. The sub-orders prevailing in the Nile Delta are aquents, Ffluvents, orthents, and psamments. Great groups could be classified as uUsti, Xxero, tTorri, hydra, Qquartzi, Hhapl, psamm, and sal. On that basis, the following soil taxonomic units are recognized: Psammaquents, Haplaquents, Qquartzipassments, Torrifluvents, Salorthids, and Xerofluvents. The sub groups could be classified on the basis of moisture and temperature regimes as TTypic, Aquic, and Xeric.

Soil Sampling

Based on the unsupervised classification for the 1999 TM image, fifteen soil profiles were dug in the field representing the different soil units in the study area. Soil profiles were described morphologically in the field according to FAO (1990) and sampled for laboratory analyses. Each soil profile was geo-referenced using the Garmin 12XL GPS (Garmin corporation, 1997). The geo-spatial distribution of the soil profiles collected is shown in Figure (1).

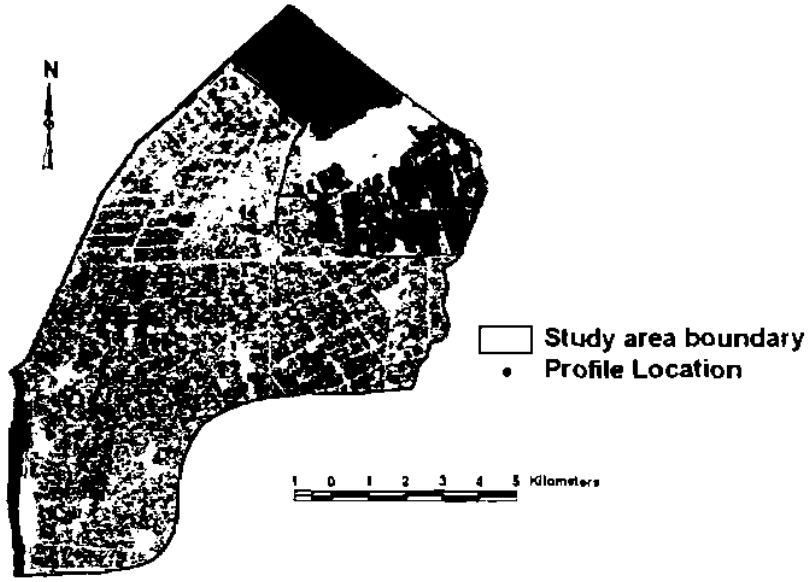


Fig. 1. Geo-spatial distribution of soil profiles in the study area

Soil Analyses

The soil samples were air-dried, grounded, and passed through a 2 mm sieve then stored for further analysis. The complete chemical and physical analyses were carried out in order to characterize and assess the soil resources. Main chemical properties were measured according to Page *et al.*, (1982) and, included soil salinity (dS/m) using Jenway conductivity meter model 4310; soluble cations and anions were determined by titration; and soil reaction (pH) was measured in 1:2.5 soil:water suspension by Jenway pH-meter model 3305, In addition, total carbonates equivalent was determined by Collin's calcimeterand, organic matter according to Walkely-Black method. Sodium adsorption ratio (SAR) was calculated according to U.S. Salinity Laboratory Staff (1954).

Available trace elements (Fe, Zn, Mn, Cu, Cd, Pb, Ni, and Cr) were determined by ammonium bicarbonate DTPA method according to Soltanpour *et al.*, (1979) and measured by atomic absorption spectrometry using Varian Spectr AA 220. Cation exchange capacity was determined by ammonium acetate method according to U.S. Salinity Laboratory Staff (1954). Available and total nitrogen were determined as described in Page *et al.*, (1982), and available phosphorus was determined by sodium bicarbonate method. Available potassium was determined by ammonium bicarbonate DTPA method according to Soltanpour *et al.*, (1979) and measured by flam photometer (Corning 400). Furthermore, some physical characteristics of the soil were determined include: soil texture by hydrometer (FAO, 1970), bulk density according to Klute, (1986).

Land Resources Assessment

Agro-ecological Land Quality Evaluation was determined using MicroLEIS IP (Integrated Package) Pro&Eco model (De la Rose, 2000) and included the following assessment:-

- General land use capability,
- Land suitability for different agricultural crops,
- Predicting the productivity of maize and wheat, and;
- Estimating the vulnerability of land to agrochemical compounds.

MicroLEIS does not provide land suitability for rice and since rice is one of the most common crops in the study area, the land suitability for rice was carried out manually by select specific criteria (drainage, texture, soil depth, CEC, pH, soil organic carbon, and salinity) according to Sys *et al.* (1993) where five suitability classes were established. Following the maximum limitation method which is used in MicroLEIS, each of the previously mentioned soil criterion has a definite action and role in agriculture production and the verification of the degree of a single variable is sufficient to classify the soil in the corresponding category. Thus, it is not necessary that all the classification factors are present in each class (Cardoso, 1970).

Spatial Analyses:

a) Geographic Information System (GIS)

The spatial data were input by digitizing the topographic map sheets using TerraSoft GIS software (Digital Resource Systems, 1991). Attribute data were maintained in database management system represented by Arc View's table module and Excel spreadsheet. Maps were layered into a group of features each of them comprises a homogenous dataset. This step yields a digital vector database for the study area. Interpolation is used to convert data from point observations to continuous fields. Inverse distance weighting (IDW) module (Burrough and McDonnell, 1998) was used to interpolate the different soil attributes (e.g., EC, CEC, OM, N., P, K... etc) to produce the geo-spatial distribution maps. Map calculator (ESRI,1997) was used to reclassify the interpolated maps in order to group the continuous data into contiguous units, then calculate the areas of each unit. Overlay analysis was used to produce the salinity-sodicity map of the study area. Addition operation was performed and the output was reclassified to get the different classes. Voronoi polygons represent the region of influence around each polygon. Land suitability for different crops, as well as land vulnerability was mapped using this technique. The output from MicroLEIS software was linked to the Voronoi polygons for further processing. Voronoi (Theissen) polygons are constructed as perpendicular equidistant areas around each soil profile (ESRI, 1997). This technique for mapping the land suitability was used since the data were represented as string data (e.g. S2c, S2sd...etc), and could not be interpolated.

b) Remote Sensing (RS)

Two Thematic Mapper (TM) satellite images were acquired on 1985 and 1999 in order to assess the change detections in the study area between the two dates. The first one (1985) is Landsat 5 image while the second one

(1999) is Landsat ETM+. ArcView image analyst extension was used to carry out the image classification. The following steps were used for image processing: Image Registration (Geometric Correction, Map-to-Map and Image-to-Image registration), Clipping the Area of Interest, and Unsupervised and Supervised Image Classification.

c) Land use / land cover change detection

The classified land use in 1985 and 1999 TM images were subtracted to obtain the quantified changes in the land use. The images were converted to grid file in Arc View and subtraction was carried out using map calculator.

RESULTS AND DISCUSSION

Soil Analyses

Based on the unsupervised classification obtained from satellite images for the study area, fifteen soil profiles locations were identified *representing the land* units dominated in the area. Soil samples were collected and analyzed for determining the main chemical characteristics including: pH, EC, soluble cations and anions, available NPK, CEC, total Nitrogen, $CaCO_3$ equivalent, and Heavy Metals. Moreover, some main soil physical characteristics were determined including: soil texture and bulk density The soil analyses data were imported into ArcView-GIS software for manipulation and production of geo-spatial maps for the distribution of soil characteristics. The digital interpolated maps were obtained from the weighted average for each soil property then reclassified into classes *representing each soil attribute and the area and its percentage were* calculated.

The geo-spatial distribution of salinity-alkalinity where the acreage of none saline-none alkaline class occupied 43.41% of the total acreage mainly in the south portion of the study area while the saline-alkaline class represent 8.85% of the total acreage (Fig. 2).

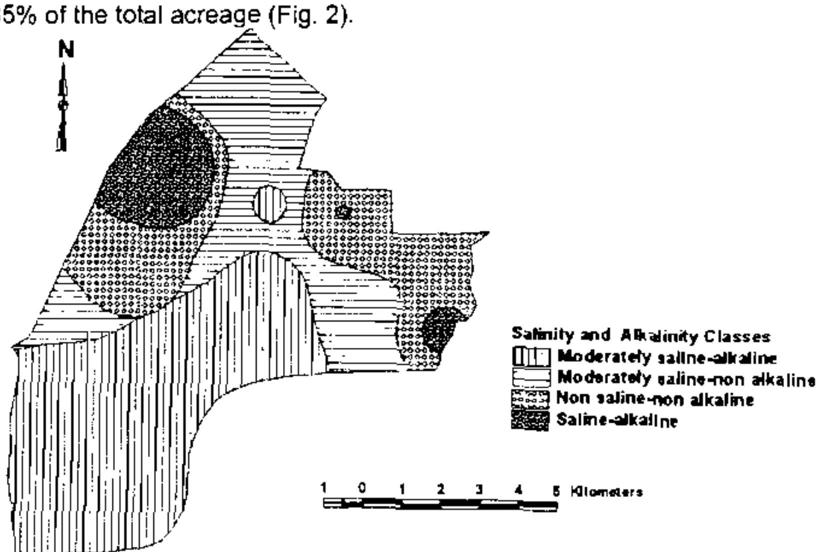


Fig. 2. Geo-spatial distribution of soil salinity and alkalinity.

The water table depth showed that 79.25% of the total acreage has water table depth more than one meter and located in the south portion of the study area. Soil texture analysis showed that more than 59% of the study area is heavy clay where clay percentage ranged between 40 and 50%.

The soil characteristics related to nutritional capacity were determined. The dominant cation exchange capacity values ranged between 40 and 60 meq/100g soil (Fig. 3), which could contribute to the high content of clay and soil organic matter (SOM) content. As for the SOM, it was found that more than 70% of the study area has SOM content between 1.5 and 3% which consider as reasonable values.

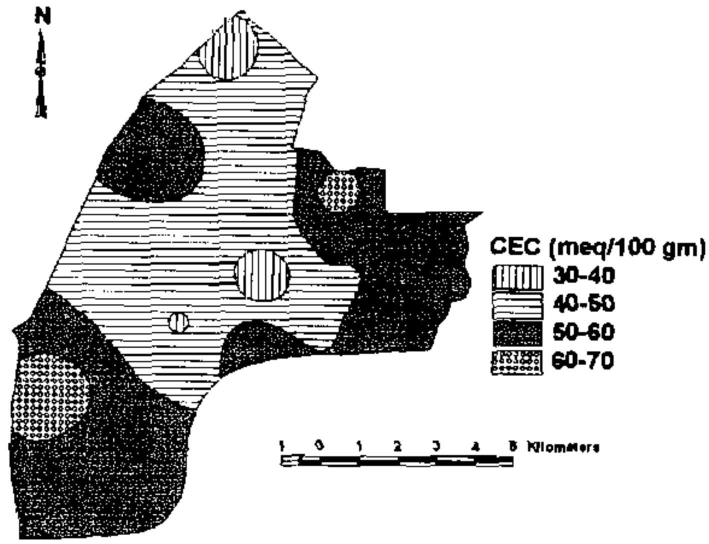


Fig. 3. Geo-spatial distribution of cation exchange capacity.

Regarding the spatial distribution of the available NPK, it was found that about 80% of the study area has available nitrogen values ranged from 20-40 ppm (Fig. 4) while the more than 50% of the study area has available phosphorus content between 15-30 ppm (Fig. 5)

As for the available potassium, the data indicated that the majority of the study area has high potassium content. In general, the geo-spatial distribution of the soil nutritional properties showed that the south portion of the study area is classified as healthier and better quality soils. This trend was true for most of the studied soil attributes.

All soil characteristics were used to create the InfoBase needed for processing the Agro-ecological Land Quality Evaluation, using MicroLEIS IP (Integrated Package) software.

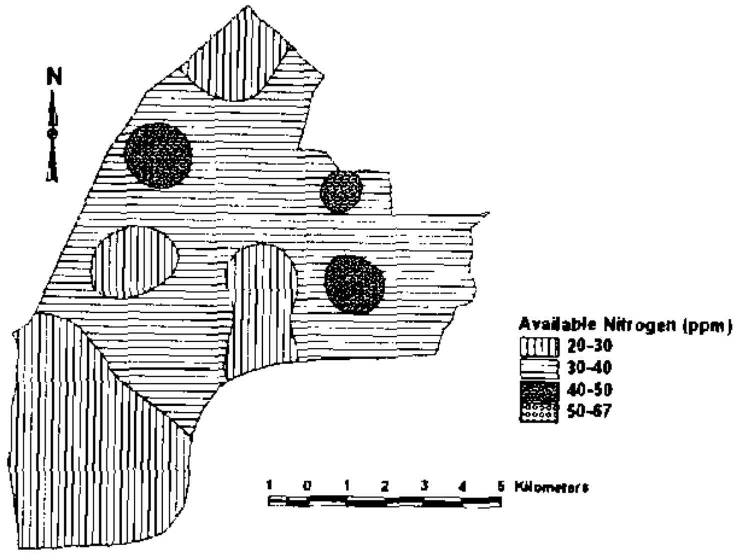


Fig. 4. Geo-spatial distribution of available nitrogen.

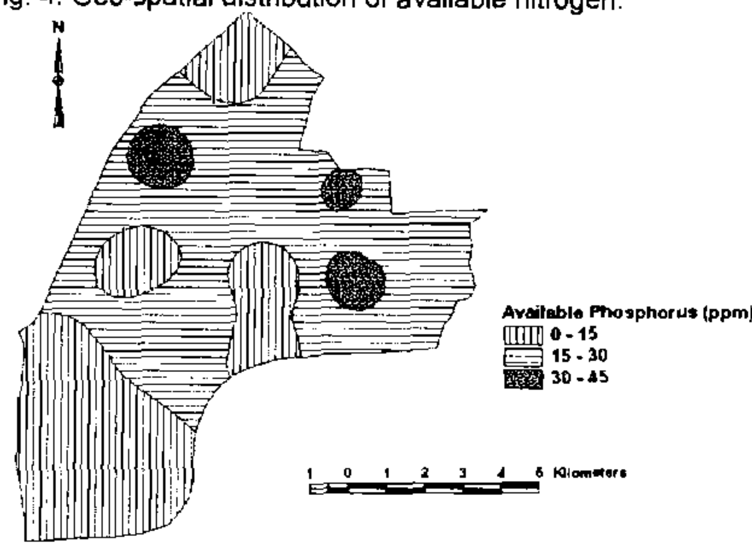


Fig. 5. Geo-spatial distribution of available phosphorus..

General land Use Capability

The MicroLEIS model provides prediction for general land use capability for a broad series of possible uses. According to the model prediction, most of the study area was classified as S2l which indicate good capability with soil is the limiting factor. Land included in this class has certain topographic and edaphic limitation, which somewhat reduce the productive capability of certain crops. Table (2) showed the land use capability for each soil profile.

Table 2: Land use capability classes

Profile No	Capability class	Profile No	Capability class	Profile No	Capability Class
1	S2l	6	S3l	11	S2l
2	S2l	7	S2l	12	S2l
3	S2l	8	S2l	13	S3l
4	S2l	9	S3l	14	S2l
5	S2l	10	N	15	S2l

Agricultural Soil Suitability

The Pro&Eco Model was used to predict soil suitability for some common crops cultivated in the study area including: wheat, maize, melon, potato, soybean, cotton, sunflower and sugar beet as annuals; alfalfa as semiannual; and peach, citrus fruits and olive as perennials.

The geo-spatial distribution of the soil suitability in the study area for cotton cultivation showed that more than 80% of the area is classified as highly suitable soils (S2). On the other hand, more than 77% is classified as highly suitable soils for corn cultivation (Fig. 6), however two soil profiles (9 and 10) indicated poor suitability for corn (S4 and S5) due to their high soil salinity. As for soil suitability for wheat (Fig. 7), the model predicted that approximately 59% of the study area has moderate suitability (S3) while the geo-spatial distribution of soil suitability for Sugar beet indicated that 64% of the study area was classified as moderate suitability (S3).

Since MicroLEIS model does not include rice suitability for rice cultivation and due to the dominance of this crop in the study area, soil suitability for rice was carried out manually according to the same principles applied in MicroLEIS model. The result indicated that more than 55% of the study area has high suitability for rice cultivation.

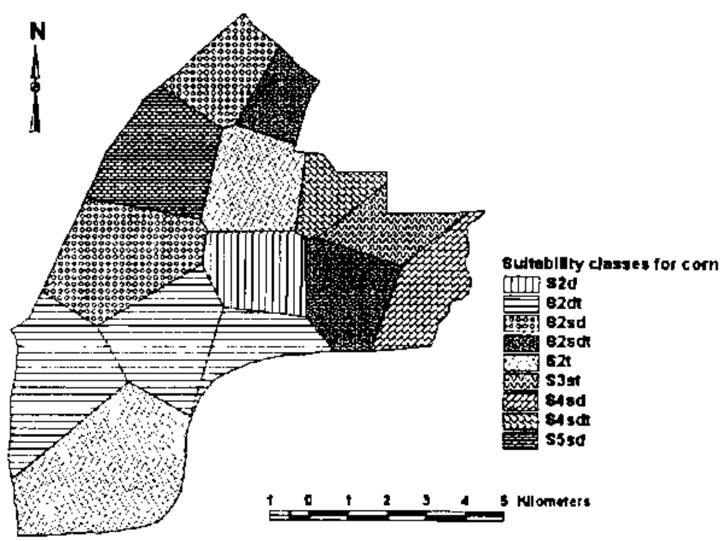


Fig. 6. Geo-spatial distribution of corn suitability classes

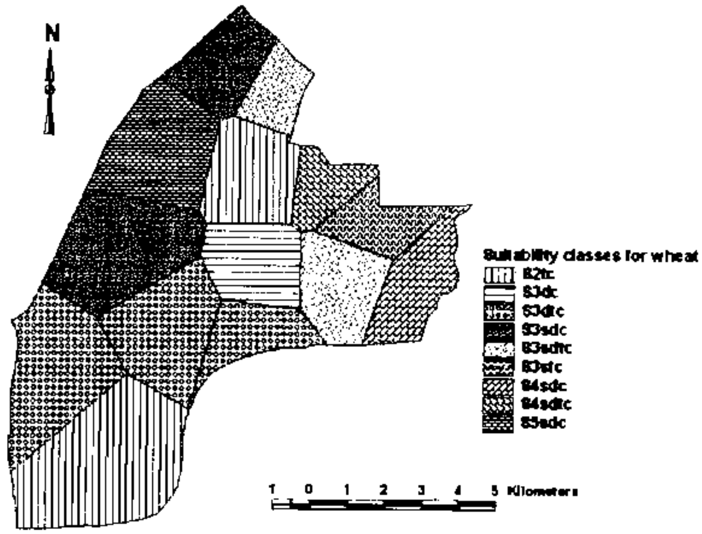


Fig.7. Geo-spatial distribution of wheat suitability classes

Table (3) represents the soil suitability classes for melon, potato, soybean, sunflower, alfalfa, peach, citrus, and olive predicted by MicroLEIS model. It was evident that most of tha study araa has high to moderate suitability for potato, melon, sunflower, soybean, and alfalfa cultivation, while it showed marginal suitability for perennials in general (e.g., citrus, peach, olive).

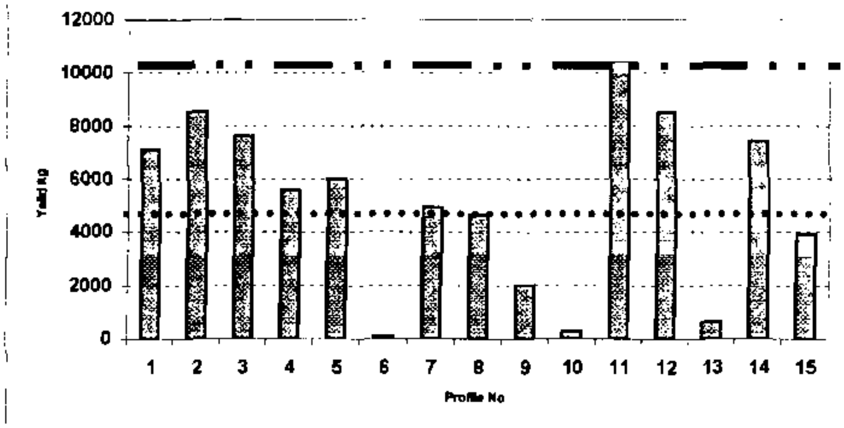
Table 3: soil suitability classes for different crops.

Profile No.	Melon	Potato	Soybean	Sunflower	Alfalfa	Peach	Citrus	Olive
1	S2t	S2t	S2tc	S2tc	S2tc	S4tp	S4tp	S4tpc
2	S2dt	S2dt	S3dlc	S2dlc	S3dtc	S4dtp	S4dtp	S4dtpc
3	*S2sdt*	*S2sdt*	*S3sdtc*	*S2stdc*	*S3sdtc*	*S4sdtp*	*S4sdtp*	*S4sdtpc*
4	S3sdt	S2sdt	S3sdc	S2sdc	S3sdc	S4sdtp	S4sdtp	S4sdtpc
5	S3sdt	S2sdt	S3sdtc	S2sdtc	S3sdtc	S4sdtp	S4sdtp	S4sdtpc
6	S4sdt	S4sdt	S4sdc	S4sdc	S3sdc	S5sdtp	S5sdtp	S4sdtpc
7	S3st	S3st	S3stc	S3stc	S3stc	S4stp	S4stp	S4stp
8	S3sdp	S2sd	S3dstpc	S2sdplc	S3sdtpc	S4sdp	S4sdp	S4sdpc
9	S4sdt	S4sdt	S4sdtc	S4sdtc	S3sdtc	S5sdtp	S5sdtp	S4sdtpc
10	S5sdt	S5sdt	S5sdc	S5sdc	S4sdc	S5sdtp	S5sdtp	S5dtpc
11	S2dt	S2sdt	S3sdtc	S2sdtc	S3sdtc	S4sdt	S4sdt	S4sdtc
12	S2dt	S2dt	S3dc	S2dc	S3dc	S4tp	S4tp	S4tpc
14	S2stp	S2st	S2stpc	S2stpc	S2stpc	S4sdtp	S4sdtp	S4sdtpc
15	S3sdtp	S2sdt	S3sdpc	S2sdpc	S3sdpc	S4sdtp	S4sdtp	S4sdtpc

Where; S1: Soils with optimum suitability, S2: Soils with high suitability, S3: Soils with moderate suitability, S4: Soils with marginal suitability, S5: Soils with no suitability.
Limitation factors; p: useful depth, t: texture, d: drainage, c: carbonate, s: salinity,

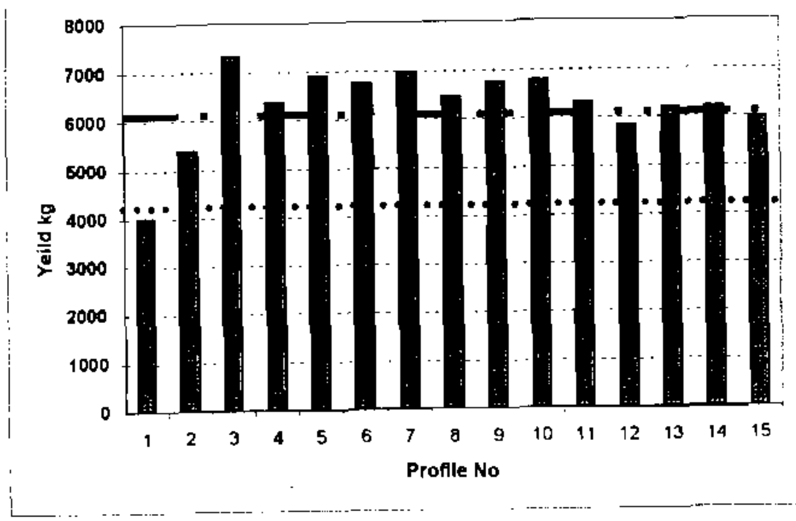
Soil Productivity Prediction

MicroLEIS software (Albero Model) allow predictions for productivity for three main crops (corn, wheat, and cotton) based on a limited number of soil properties and assuming best management practices (BMPs). We used the model to predict the yield for corn and wheat in the study area. The model predictions (Figs 8 & 9) could be summarized as follows:



Local yield Level .... National yield level -··-··-··-

Fig. 8. The corn yield prediction for each profile



Local yield Level .... National yield level -··-··-··-

Fig. 9. The Wheat yield prediction for each profile.

The model predicted an average yield for corn to be 5,174 Kg/ha. This value is in agreement with the local average (4,970 Kg/ha.), however the national average is 10,420 Kg/ha. This may be due to the low soil suitability in the study area for corn cultivation. It was noticeable that farmers, using their endogenous and local knowledge, stay away from corn cultivation in this area.

These data was in agreement with the high soil salinity in the area It was predicted that soil units represented by profiles with high salinity resulted in very poor corn production (e.g., profiles 6, 9, 10, and 13; Fig. 8).

The model predicted that average yield for wheat to be 6,275 Kg/ha which is close to being equal to the national average (6,041 Kg/ha), while the actual local average yield is 4,068 Kg/ha (Fig. 9). This result may be contributed to the poor management practices in the study area.

Soil profile No. 13 represented a special case in the area where surprisingly the soil pH was very low especially in the subsurface layer (3.6). It was observed during the sampling of this specific profile that the farmer used huge amount of chicken manure. We have to go back to the area to confirm our findings by obtaining an extra profile (No. 15), which located in the same vicinity. We observed the absence of the area where we obtained profile No. 13 where the farmers change it to fish farm and when asked they replied that this is one common practice they used to reclaim land in this area. The new profile (No. 15) also exhibited low soil pH at the subsurface layer (6.18). It was realized that switching land between fish farming and cultivation is a common land reclaiming practice depending on the availability of water.

Land Vulnerability

Vulnerability of land and water to contamination by agrochemical compounds was predicted using Arenal model. The predicted data by the model showed that 81.68% of the study area was classified as V2, which represents low vulnerability to agrochemical compounds in terms of soil and water table contamination (Fig. 10).

The rest of the area (18.32%) represented by profiles 6, 9, and 10 was classified as V3, which poses moderate vulnerability to contamination.

Land Use/Land Cover Change Detection

The analysis of Thematic Mapper (TM) 1999 satellite image was sued to obtain the land use/land cover in the study area (Fig. 11). The land covers in the area could be classified into: water bodies include the lake and the river in addition the fish farms, cultivated land (traditional crops and citrus), and urban and bare soil. Moreover the analysis was able to distinguish water plants in the lake. The 1999 image processing data indicated that most of the study area represented by cultivated soil (68.35%) followed by urban (7.94%) and fish farms (6.17%). On the other hand, the analysis of Thematic Mapper (TM) 1985 satellite image (Fig. 12) was used at that date in order to detect and determine the change in land use/land cover (Fig. 13).

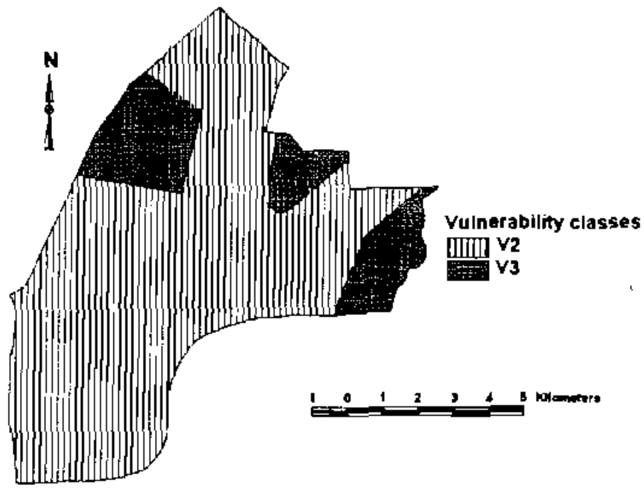


Fig. 10. Vulnerability of land and water table to contamination agrochemical compounds

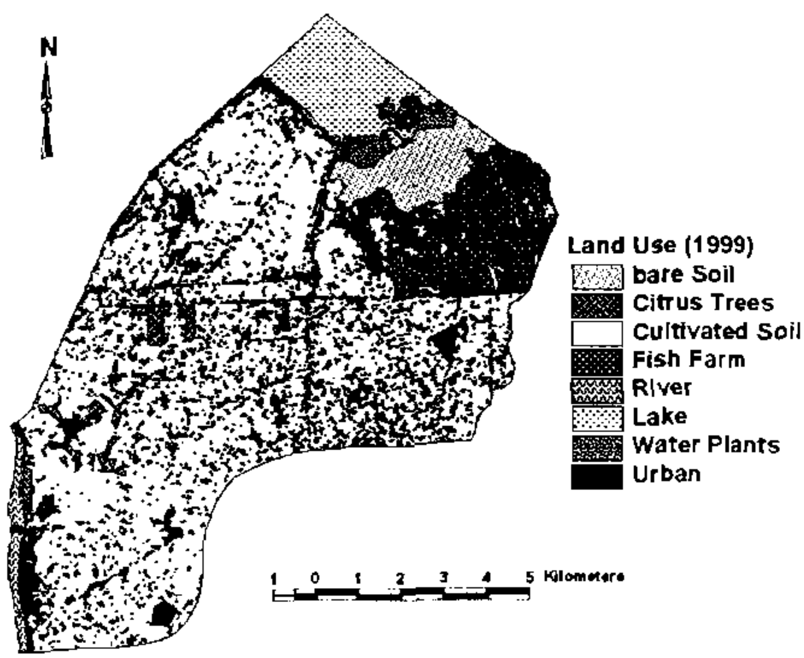


Fig. 11. Land use/Land cover 1999.

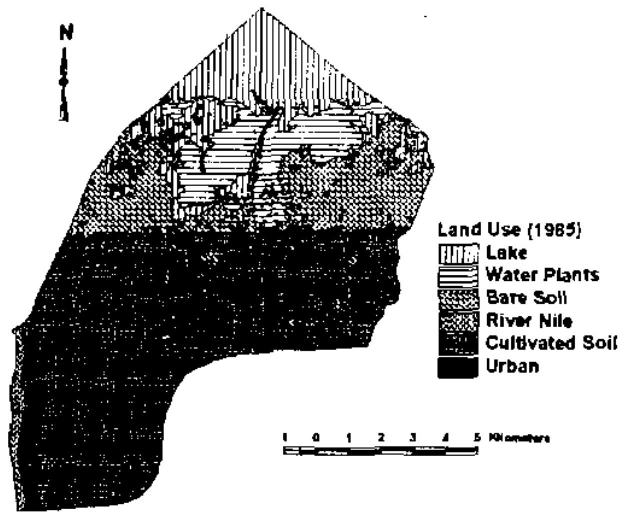
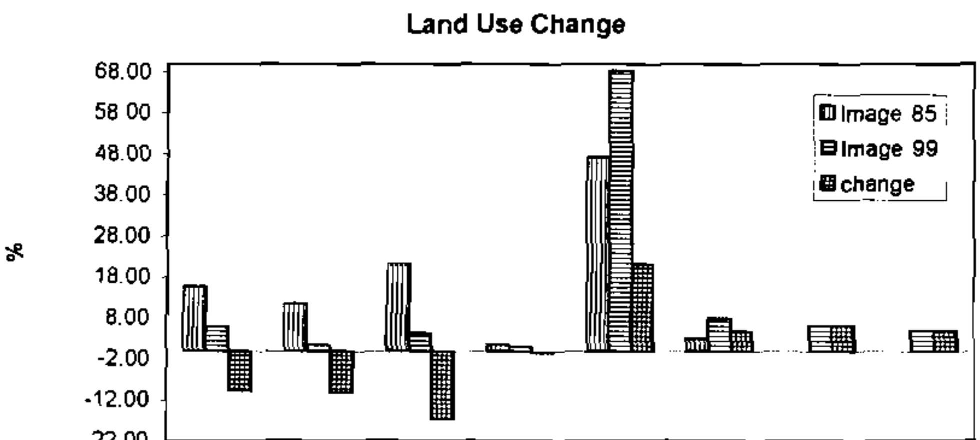


Fig. 12. Land use/Land cover 1985.



	Lake	Water Plants	Bare Soil	River	Cultivated Soil	Urban	Fish Farm	Citrus Trees
Image 85	15 60	11.53	21.00	1.55	47.25	3.08	0.00	0.00
Image 99	5.88	1.40	4.31	1.03	68 35	7.94	6.17	4.93
change	-9.72	-10 13	-16.69	-0 52	21.10	4.86	6.17	4.93

Land UseClass

Fig. 13. Land use change between 1985 and 1999.

The percentage change in the area for each land use unit is shown in the Table attached to Figure (5-25). The major change detected in land use was the increase urban area from 3.08% in 1985 to 7.94% in 1999. Two new land uses were introduced to the area and detected in the 1999 image only, which are the citrus trees (4.93%) and the fish farms (6.17%). These two new units were mainly introduced on the expenses of the lake. The other major change detected was the increase in the cultivated land from 47.5% in 1985 image to 68.35% in 1999 image with an increase in this land use of about +21.1%. This was due to the land reclamation projects in the area. These results manifested the impact of human activity on the ecosystem and its power to convert lake and bare soils into fish farms and/or cultivated Lands.

CONCLUSION

The southern part of the study area showed healthier soil quality than the northern half. These results manifested the impact of human activity on the ecosystem and its power to convert unusable area to usable as happened for south eastern part of Burullus lake and some bare soils into fish farms and/or cultivated lands. There is a great need to improve drainage system to increase land capability and consequently the productivity of the study area. Implementing best management practices (BMPs) is required to minimize resources vulnerability for agrochemicals contamination and maintain sustainable agriculture. Human impact on the ecosystem and incorporating indigenous knowledge must be considered if any sustainable development to be successful

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تقييم زراعي بيئي للموارد الأرضية في شمال الدلتا: دراسة حالة في محافظة كفر الشيخ

هشام محمد جابر ، محمد بهنسى ، احمد سعيد سليمان ، تامر عبد الحميد البنا
قسم علوم الأراضى والمياه، كلية الزراعة (الشاطبى)، جامعة الإسكندرية

تم تقييم زراعي بيئي للموارد الأرضية لمنطقة مطوبس بمحافظة كفر الشيخ كدراسة حالة لشمال دلتا نهر النيل باستخدام برنامج MicroLEIS IP (Integrated Package) 2000. يتكون هذا البرنامج من أربعة نماذج رياضية لتقدير قدرة إستغلال الأرض , مدى الملائمة للزراعة , التنبؤ بإنتاجية المحاصيل الحقلية و درجة إمكانية التلوث للأرض والماء الأرضي نتيجة استخدام الكيماويات الزراعية. وقد أوضحت النتائج أن معظم أراضي المنطقة ذات قدرة جيدة على الإنتاجية الزراعية (S2l) وأن أهم عامل محدد للإنتاجية هو حالة الأرض. كذلك أوضحت توقعات الملائمة للمحاصيل المختلفة أن ٨٠ % من منطقة الدراسة متوسطة الملائمة (S2) لزراعة القطن في حين أن ٧٧ % متوسطة الملائمة للذرة. وكانت الاراضى الممثلة بقطاعى ٩ , ١٠ منخفضة الملائمة للذرة نتيجة ارتفاع ملوحة الأرض. هذا بالاضافه إلى أن ٥٩ , ٦٤ % من المساحة وجدت حدية الملائمة لمحصولى القمح و بنجر السكر على التوالى. وقد تم تقييم ملائمة الأراضي لمحصول الأرز بالطريقة اليدوية العادية باستخدام نفس الأسس التي بني عليها البرنامج حيث أنه لا يعطى تقييما لمحصول الأرز. وأشارت النتائج إلى أن ٥٥ % من مساحة المنطقه تعتبر عالية الملائمة لمحصول الأرز والذى يسود فى المنطقة. تم كذلك التنبؤ بإنتاجية أراضى منطقة الدراسة لمحصولى الذرة والقمح باستخدام البرنامج والذى يفترض إتباع أفضل أساليب الإدارة. وقد وجد من نتائج التنبؤ بالإنتاجية أن متوسط إنتاج الهكتار المتوقع لمحصول القمح كان ٦٢٧٦ كجم وذلك يقترب من متوسط الإنتاجية على مستوى القطر المصري (٦٠٤١ كجم / هكتار) مع أن الإنتاج المحلى لمنطقة الدراسة كان ٤٠٦٨ كجم/هكتار بينما متوسط إنتاجية الهكتار المتوقعة للذرة كان ٥١٧٤ كجم والتي هي أقل من متوسط الإنتاجية على مستوى الدولة البالغ ١٠٥٠٠ كجم / هكتار ينما الناتج المحلى للمنطقة كان ٤٩٧٠ كجم/هكتار، مما يفسر عزوف المزارعين عن زراعة الذرة بمنطقة الدراسة. كما أوضحت نتائج التقييم أن ١٨,٣٢ % من المساحة متوسطة الحساسية للتلوث بالمركبات الكيماوية الزراعية بينما ٨١,٦٨ % تعتبر منخفضة الحساسية لمثل هذا التلوث. وللتعرف على وتقدير التغيرات فى استخدامات الأراضي بين عامى ١٩٨٥ و ١٩٩٩ فقد أوضحت تحليلات الصور الفضائية أن استخدامات الأراضي بمنطقة الدراسة تتركز أساسا في الزراعة حيث كانت الأراضي المنزرعة تمثل ٤٧,٥ % في ١٩٨٥ والتي بلغت ٦٨,٣٥ % في ١٩٩٩ يليها أراضى البناء العمراني وكانت ٣,٠٨ % واصبحت ٧,٩٤ % في عامى ١٩٨٥ و ١٩٩٩ على الترتيب. بينما ظهرت فى عام ١٩٩٩ المساحات المستغلة كمزارع سمكية تمثل ٦,١٧ % والمساحة المزروعة بساتين الموالح بلغت ٤,٩٣ % والتي لم تكن من ضمن استخدامات الأراضي في صورة عام ١٩٨٥.