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Evaluation of Land Degradation in Agricultural Areas within Damietta Governorate, Egypt Caused by Urban Encroachment, Salinity, Sodicity and Loss of Fertility

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ABSTRACT

Land degradation is one of the most serious problems over time, where it is the main cause of declining agricultural productivity worldwide. The main objectives of this work were to monitor and evaluate land degradation of agricultural area in Damietta Governorate caused by urban encroachment, salinity, sodicity and loss of fertility. Accordingly, Landsat images were collected at four periods of time (1989, 2000, 2014 and 2019) to study the spatio-temporal changes in agricultural land over time. The soil adjusted vegetation index (SAVI) was used for studying the vegetation cover. Soil samples were also collected from 30 soil-profiles at three soil depth intervals (0-30, 30-60, and 60-90 cm). They were analyzed for pH, EC, ESP and available NPK values. Ordinary Kriging (OK) was used for the surface interpolation of these soil properties. The obtained results indicated a significant reduction in agricultural land within Damietta Governorate from 502.45 km^2 (78.94%) in 2000 to 463.66 km^2 (72.85%) in 2019. Salt affected soils (SASs) were dramatically increased (particularly in subsurface layers) due to the poor drainage in the area and sea-water intrusion either from the Mediterranean Sea and/ or Manzala Lake. The status of available nitrogen and phosphorous ranged between low and moderate, whereas available potassium was very high in most of the studied locations. In conclusion, agricultural lands in Damietta Governorate are seriously affected by land degradation resulted from urban sprawl, salinity, sodicity and loss of fertility. Therefore, they need to enact laws and develop a special program for their management and remediation.

Keywords: Land degradation, soil salinity, soil sodicity, soil fertility remote sensing, GIS.

INTRODUCTION

Land degradation is defined as a negative trend in land condition, caused by direct or indirect human-induced processes including anthropogenic climate change, which can be expressed as long-term reduction or loss of at least one of the following: biological productivity, ecological integrity or value to humans (Bai *et al*., 2008; Vogt *et al*., 2011; Montanarella *et al*. 2018; Olsson *et al*., 2019). It represents one of the most serious problems over time, where it is the main cause of declining agricultural productivity either locally or globally. Thus, if kept uncontrolled, it will result in food security crisis, where land is the most valuable natural resource for the production of food, fuel and fiber (Alaguraja *et al*. 2010).

The increasing population made food security a major challenge that is facing this population worldwide (Bents and Silova, 2017). Therefore, increasing food production through crop intensification and increasing crop yield is much-needed to meet the growing food demand and relieve poverty in the developing countries (Ciaian *et al*., 2017). This results in putting intensive pressure on the available land resources and decreasing its fertility and sustainable productivity (Murphy, 2017). This increase in population also results in a significant decline in the area of agricultural land due to urban sprawl. Thousands of hectares of productive and highly fertile agricultural lands are converted into built-up areas every year to meet housing requirements (Elbeih *et al*., 2013; Elnaggar *et al*., 2014; Abuzaid, 2017).

Water logging and consequentially salinization are the major land degradation problems especially under the arid and semi-arid climates (Dwivedi *et al*., 1999; Elnaggar *et al*., 2017). El-Baroudy and Moghanm (2014) found that the productivity of more than 70% of soils in the middle part of the Nile- Delta was declined due to the improper land management practices. These practices results in increasing soil salinity, sodicity and upraised water table.

Evaluation of land degradation is usually performed either directly or indirectly. Direct methods for instance depend mainly on sampling and analysis approach to evaluate the quality indices of soil. However, these traditional methods consume lots of time, effort and money. On the other hand, the indirect methods depend on using remotely sensed data and developing GIS models for estimating land productivity index (Wahab *et al*., 2010; Dengiz and Saglam, 2012, Zhang *et al*., 2014; El-Gammal *et al*., 2015; Stellmes *et al*., 2015; Baskan *et al*., 2017). Currently, remotely sensed data play an important role in monitoring strategies, where they provide objective, repetitive and synoptic observations at global, national and sub-national scales (Graetz, 1996; Hill *et al*., 2004; Vogot *et al*., 2011). Thus, current studies of land degradation and its driving factors depend mainly on using time-series analyses of vegetation indices derived from these data (Khalil *et al*., 2014; Abdel-Kader, 2019). Among the most

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common vegetation indices used in monitoring changes in vegetation cover and consequently land degradation are the normalized difference vegetation index (NDVI) and the Soil-adjusted vegetation index (SAVI). These indirect methods are more effective when compared with the traditional ones.

Monitoring and evaluating land productivity helps in managing the agricultural practices to sustain soil capacity for producing food, fibers, and essential goods (Kudrat and Saha, 1993 and Field, 2017). In Egypt, the major causes of land degradation are salinity, sodicity, water logging, loss of soil fertility and total loss of land productivity due to urban encroachment (El-Nahry *et al*., 2008; Hereher, 2012; Elbeih *et al*., 2013; Elnaggar *et al*., 2014; Gouda *et al*., 2016). They result in gradual or total loss of land productivity. This sounds an alarm and alerts us about the urgent need for monitoring and evaluating land degradation and its causes in more effective ways. This is in order to provide decision makers and stakeholders with up-to-date information about this valuable and to some extent non-renewable natural resource. Consequently, the core objectives of this work were to monitor and evaluate land-degradation of agricultural areas in Damietta Governorate due to urban encroachment, salinity, sodicity and loss of fertility.

MATERIALS AND METHODS

Study area and its description

The studied area (636 km^2) covers the majority of the dry land area in Damietta Governorate (about 62% of the total area). Damietta Governorate is located at the Mediterranean Sea in the northeastern part of Egypt. It is positioned between these coordinates 31 º 09' 28" to 31 º 31' 45" N and 31º 28' 29" to 32 º 03' 32" E as illustrated in Fig. (1). It has an area of about1029 km^2 (about 1.22% of the total area of Egypt). It has a population of about 1,496,765 people in 2017 (Egypt Census, 2017). Damietta Governorate is famous for its guava farms, in addition to the palm trees. It also produces wheat, cotton, rice, potatoes, lemons, grapes and tomatoes.

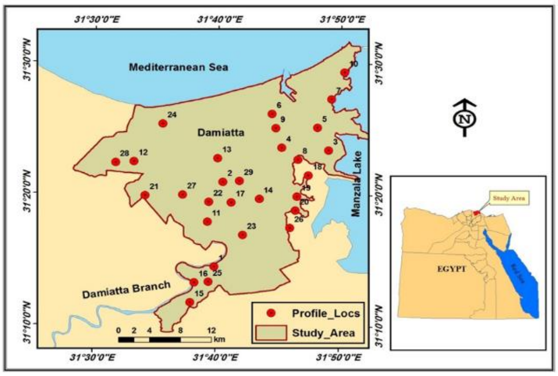

Fig.1.Location map of the studied area and distribution of soil profiles in Damietta Governorate.

Damietta follows the Mediterranean region in terms of climate, as it has a hot and dry summer and a moderate and rainy winter. Minimum temperature ranges between 9°C in January and 21.8°C in July, while the maximum temperature varies from 17.9°C in January to 30.6°C in July (unpublished data, the general authority of Meteorology). The annual precipitation is about 125 mm. The topography of the studied area is relatively flat, where it varies from 0 to 2 m above the sea level. The majority of the area is covered by Nile silt deposits followed by sand-dunes, stabilized sand-dunes, undifferentiated quaternary-deposits and Sabkha-deposits (Conoco, 1987).

Soil samples

Soil samples were collected from 30 randomly distributed soil profiles. Samples were taken at three soil depths intervals (0 – 20, 20 – 30, and 40 – 60 cm). These samples were prepared for the subsequent soil analyses.

Soil analyses

The collected soil samples were analyzed for soil pH, Electrical conductivity (EC), Exchangeable sodium percentage (ESP) and available NPK using the following methods:

- Soil-pH was determined in the saturated soil paste using the pH-meter (Lutron, Model YK-2001) as described by Hesse (1971).
- EC was determined in the soil-paste extract using the EC-meter (Jenco EC, model 3173) according to Hesse (1971).
- Available soil-potassium was determined through extracting soil with 1.5 N ammonium-acetate solution at pH 7.0 (Dewis and Freitas, 1970).
- Available soil-nitrogen was determined in the form of NH^+_4 or NO^-_3 by extracting soil with KCl (Dewis and Freitas, 1970).
- Available soil-phosphorus was determined using Olesen's method as described by Dewis and Frietas (1970).
- ESP was calculated as described by (Hesse, 1971) using the following equation:

ESP= Exchangeable Na (Cmol/kg) *100 / CEC (Cmol/kg) (1)

Spatial interpolation

Surface interpolation of the studied soil properties was performed using ordinary Kriging (OK) under the geo-statistical analyst-extension in ArcGIS desktop (ver. 10.5). Kriging weights the surrounding measured values to derive a prediction for an unmeasured location. The general formula for Kriging is formed as a weighted sum of the data:

$$Z(S_o) = \sum_{i=1}^{n} \lambda_i Z\ (S_i) \qquad (2)$$

Where:

Z(Si) is the measured value at the ith location, λi is an unknown weight for the measured value at the ith location, s0 is the prediction location and N = the number of measured values.

Remote sensing data

Spatio-temporal alternations in land use/ cover within Damietta Governorate were evaluated using Landsat data at four different periods of time (1989, 2000, 2014 and 2019). The study area is covered by only one Landsat image (path 176, row 38). Accordingly, four Landsat images were used in this study. These images were downloaded from the US geological survey website called earth explorer: http://earthexplorer.usgs.gov/. The studied images were acquired during the summer season, where the vegetation cover is at its maximum extent and to obtain cloud-free images. The sensor type and acquisition-date for each of the studied images is shown in Table (1).

Table 1. Sensor type, acquisition date, path and row of the collected Landsat images.

Sensor Type	Acquisition date	Path	Row
Landsat 8 (OLI)	03/07/2019	176	38
Landsat 8 (OLI)	06/08/2014	176	38
Landsat 7 (ETM+)	22/07/2000	176	38
Landsat 5 (TM)	16/07/1989	176	38

Radiometric, atmospheric and geometric corrections

Radiometric, atmospheric and geometric corrections were carried out on the studied Landsat images by using ENVI software package (ver. 5.3). Radiometric correction was done to covert the pixel values form digital numbers (DNs) to at surface reflectance. This is to represent actual reflectance from features in the studied area. Atmospheric correction was done using the dark object subtraction method (DOS) to minimize the atmospheric interferences. Geometric corrections were done at the end using the polynomial method to align all images to a reference image, which is the oldest image in 1989. The Universal Transverse Mercator (UTM, Zone 36N, Datum WGS 1984) was used to project all of the studied images. The projected images were clipped at the boundaries of studied area. A false-color composite (FCC) of the studied images is demonstrated in Fig. (2).

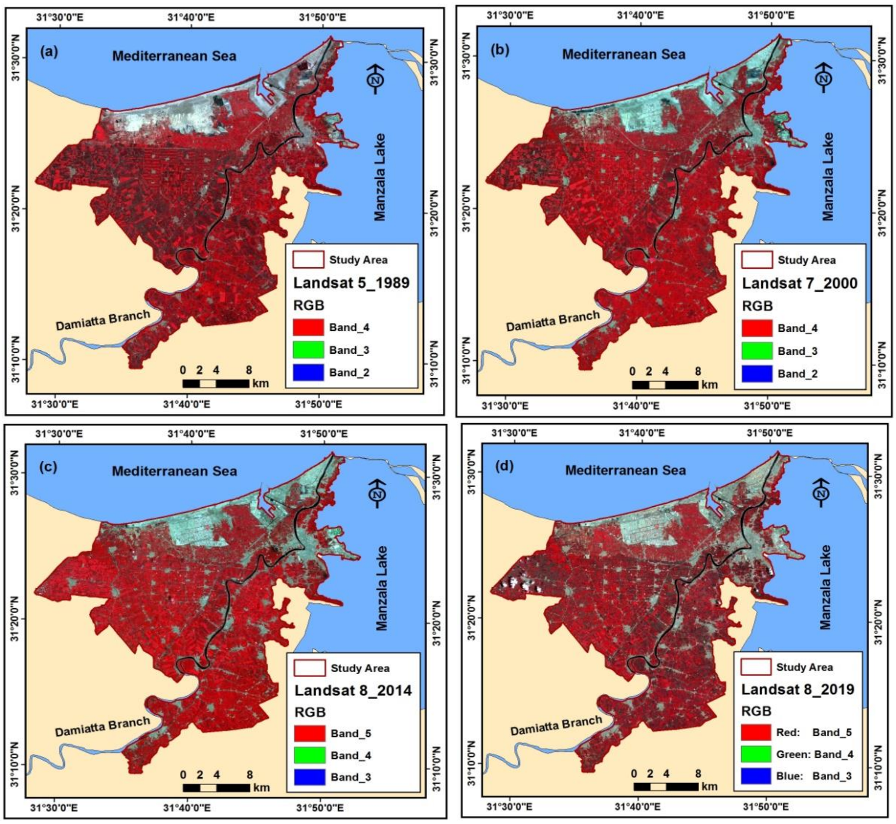

Fig. 2. False-color composite of the studied Landsat images in: a) 1989, b) 2000, c) 2014 and d) 2019.

Soil adjusted vegetation index (SAVI)

The SAVI was used in this work to monitor and evaluate changes in agricultural areas within Damietta Governorate. This vegetation index was developed as a modification of the NDVI to correct the influence of soil brightness under low-vegetation cover. In the studied area the majority of vegetation cover represents agricultural crops; therefore the SAVI was used in this work as an indicative of agricultural areas. The SAVI is calculated using the same formula as the NDVI after adding a correction factor for soil-brightness (L) according to the subsequent equation (Huete, 1988):

$$SAVI = (NIR - Red) \times (1 + L) / (NIR + Red + L)$$

Where,

Red is the reflectance in the red portion of spectrum, NIR is the reflectance in the near infrared portion of spectrum, and L is the soil brightness correction-factor. The L value varies from 0 to 1 based on the vegetation cover density. A value of 0.5 was used in this work. The SAVI was used in this work because it has a better performance when compared with the NDVI especially under vegetation cover less than 15% (Xu, 2008).

Estimation of agricultural areas

The obtained SAVI images were filtered using a majority filter in ArcGIS software (ver. 10.5). This filter was used to remove the individually scattered pixels in the produced SAVI images. After that, each SAVI image was interpreted to come up with a threshold value that distinguishes agricultural from non-agricultural areas. This value was 0.13 for 1989, 0.15 for 2000, 0.22 for 2014 and 0.16 for 2019 SAVI images. A binary or a two-class image was produced for each of the studied years based on its threshold value. Agricultural area was given a value of one, whereas non-agricultural area was given a zero value.

Changes in Agricultural areas

Changes in agricultural areas within Damietta Governorate were detected throughout subtracting the binary images obtained from the previous step for each two consecutive years. The obtained triple images contain three values (0, +1 and -1), where each value refers to the type of change. Zero refers to no change in land cover, +1 indicates positive changes toward agricultural areas and -1 indicates the opposite.

RESULTS AND DISCUSSIONS

Evaluation of agricultural areas in Damietta Governorate based on the SAVI Index.

Agricultural areas in Damietta Governorate were evaluated depending on the SAVI index. These areas were about 473.45, 502.45, 470.35 and 463.66 km^2 in 1989, 2000, 2014 and 2019; respectively as represented in Table (2). They represent the following percentage of the studied area within the Governorate: 74.39, 78.94, 73.90 and 72.85%; respectively. These results indicate that agricultural areas were first increased from 1989 to 2000; which could be attributed to the interest in land reclamation projects during this period of time. After that, agricultural areas showed a reduction over the time; which could be attributed to the increase in population and consequently urban encroachment.

On the other hand, non-agricultural areas were about 163.02, 134.02, 166.12 and 172.81 km^2 in 1989, 2000, 2014 and 2019; respectively and their percentages were about 25.61, 21.06, 26.10 and 27.15%, respectively. The spatial-distribution of agricultural areas depending on the SAVI index in 1989, 2000, 2014 and 2019 is represented in Fig. (3).

Table 2. Estimated agricultural and non-agricultural areas and their percentage of the studied area in Damietta Governorate from 1989 to 2019.

Land	1989		2000		2014		2019	
Cover	**Area (km^2)**	**(%)**	**Area (km^2)**	**(%)**	**Area (km^2)**	**(%)**	**Area (km^2)**	**(%)**
Non-agric. Land	163.02	25.61	134.02	21.06	166.12	26.10	172.81	27.15
Agric. Land	473.45	74.39	502.45	78.94	470.35	73.90	463.66	72.85
Total	636.47	100.00	636.47	100.00	636.47	100.00	636.47	100.00

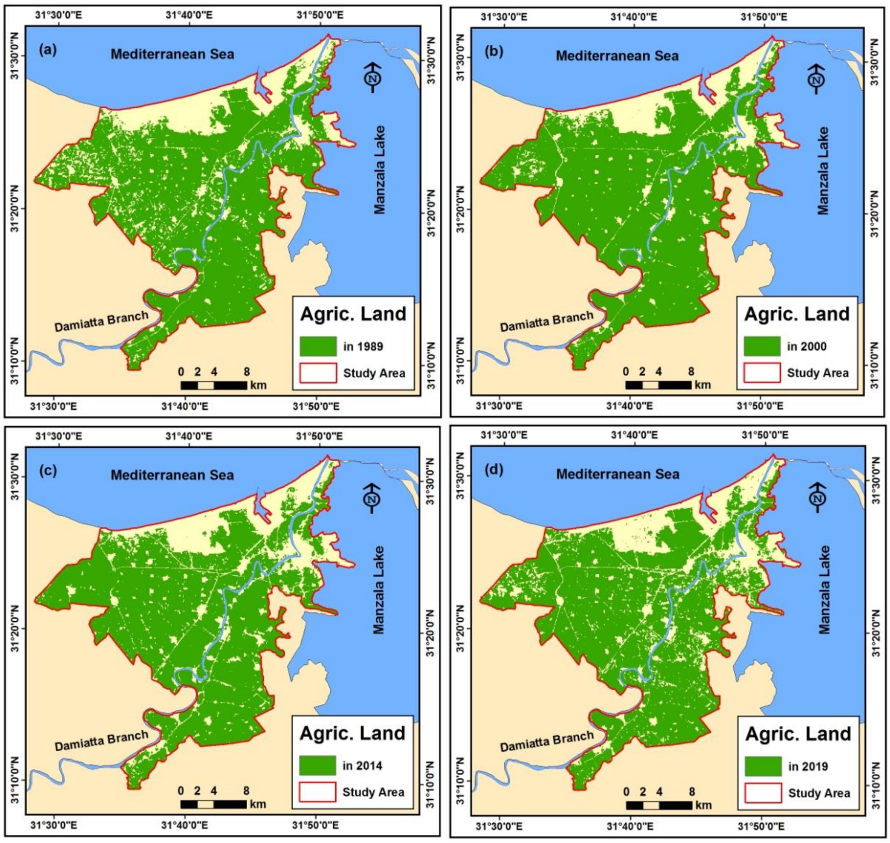

Fig. 3. Spatial-distribution of agricultural land in the studied area depending on the SAVI index in: a) 1989, b) 2000, c) 2014 and d) 2019.

Spatio-temporal changes in agricultural areas within Damietta Governorate from 1989 to 2019

Spatio-temporal changes in agricultural areas within Damietta Governorate were studied from 1989 to 2019 depending on the results derived from the SAVI Index. Data in Table (3) show temporal changes in agricultural areas between each two subsequent periods from 1989 to 2019. It is found that conversions from non-agricultural to agricultural areas were about 45.36 km^2 (7.13%) from 1989 to 2000, about 10.88 km^2 (1.71%) from 2000 to 2014 and about 25.05 km^2 (3.94%) from 2014 to 2019.The total change from non-agricultural to agricultural areas during the whole studied period of time 1989 to 2019 was about 46.16 km^2 (7.25%). Most of the increase in agricultural areas or newly reclaimed soils took place in the northwestern part of the studied area as represented in Fig. (4).

On the other hand, changes from agricultural to non-agricultural areas were about 16.39 km^2 (2.58%) from 1989 to 2000, 42.84 km^2 (6.73%) from 2000 to 2014 and 31.76 km^2 (4.99%) from 2014 to 2019. The overall change from agricultural to non-agricultural areas within the whole investigated period of time from 1989 to 2019 was about 55.84 km^2 (8.77%), which indicates a considerable loss in agricultural areas over the time. This loss in agricultural areas could be mainly attributed to urban encroachment. This increase in urban areas took a random pattern especially after 2014, which agree with those results obtained by Elnaggar el al. (2014).

Table 3. Changes in agriculture areas within Damietta Governorate from 1989 to 2019 depending on the SAVI index.

Type of change	From 1989 to 2000		From 2000 to 2014	
	Area(km^2)	(%)	Area(km^2)	(%)
To non-agric. Land	16.39	2.58	42.84	6.73
No change	574.72	90.30	582.75	91.56
To Agric. Land	45.36	7.13	10.88	1.71
Type of change	From 1989 to 2014		From 2000 to 2019	
To non-agric. Land	46.03	7.23	53.69	8.44
No change	547.41	86.01	567.73	89.20
To Agric. Land	43.03	6.76	15.05	2.36
Type of change	From 1989 to 2019		From 2014 to 2019	
To non-agric. Land	55.84	8.77	31.76	4.99
No change	534.46	83.97	579.64	91.07
To Agric. Land	46.16	7.25	25.08	3.94
Total	636.47	100.00	636.47	100.00

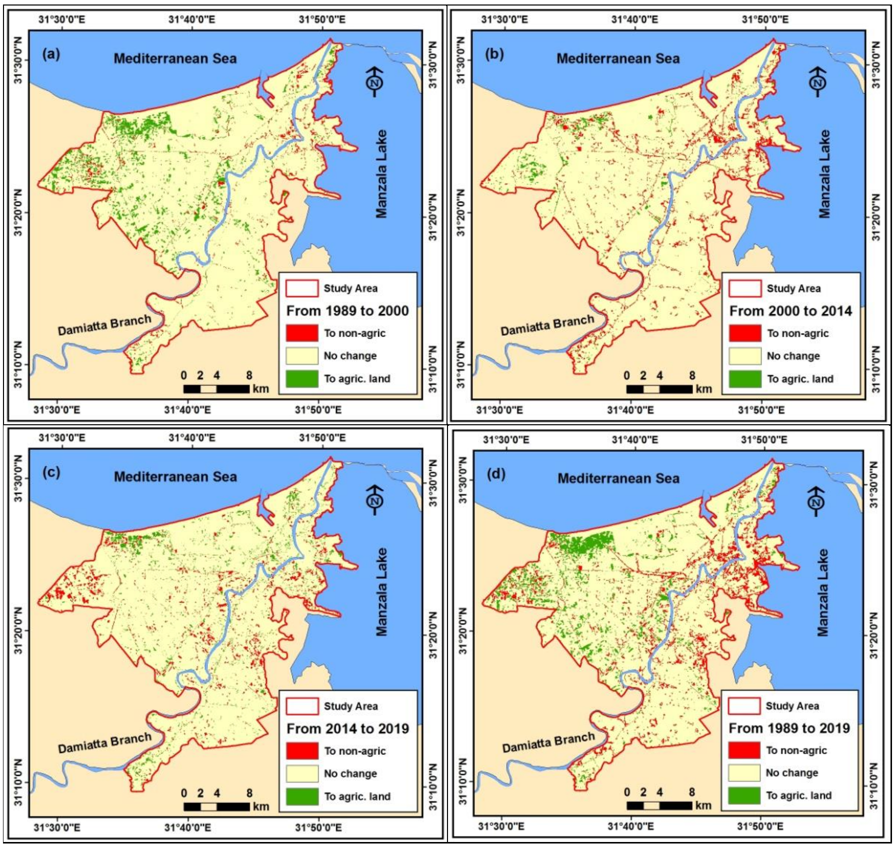

Fig. 4. Spatial distribution of changes in agricultural area within Damietta Governorate between each two periods of time from 1989 to 2019.

Estimation of salt-affected soils (SASs) in Damietta Governorate

Data in Table (4) show the estimated areas of salt-affected soils in Damietta Governorate and their percentage from agricultural area in 2019. Area of saline soils based on the spatial interpolation of the EC values in the surface layer (0-30 cm) was about 242.15 km^2 and its percentage of the estimated agricultural area in 2019 was about 52.23%. This area was increased with soil depth. It was about 327 km^2 (70.56%) at 30-60 cm and about 345.24 km^2 (74.46%) at 60-90 cm. Area of sodic soils based on the spatial interpolation of the ESP values in the surface layer were about 45.02 km^2 (about 9.71% of agricultural area in 2019). This area was about 59.75 km^2 (12.89%) at 30-60 cm and about 38.17 km^2 (8.23%) at 60-90 cm. The area of saline-sodic soils was about 65.59 km^2 (14.15%) at 0-30 cm, about 11.01 km^2 (2.37%) at 30-60 cm and about 64.03 km^2 (13.81%) at 60-90 cm. The total area of SASs was increased with soil depths. It was about 352.77 km^2 (76.08%) at 0-30 cm, about 397.92 km^2 (85.82%) at 30-60 cm and about 447.44 km^2 (96.50%) at 60-90 cm. This could be attributed to the poor drainage in the area and sea-water intrusion either from the Mediterranean Sea or Manzala Lake (Essawy, 2013). This is in addition to the higher clay content in soils developed on Nile-silt deposits. These soils have higher water-holding capacity and higher surface activity, resulting in increasing the salinity hazard (El-Gammal *et al*., 2015; Daibes, 2018). The results also indicate that the majority of agricultural lands in the studied area are salt-affected as illustrated in Fig. (5).

Table 4. Estimated areas of salt-affected soils and their percentage from agricultural area in 2019.

Type of soil	Layer A(0-30 cm)		Layer B(30 - 60 cm)		Layer C(60 - 90 cm)	
	Area(km^2)	%	Area(km^2)	%	Area(km^2)	%
Saline-soils	242.15	52.23	327.17	70.56	345.24	74.46
Sodic-soils	45.02	9.71	59.75	12.89	38.17	8.23
Saline-Sodic	65.59	14.15	11.01	2.37	64.03	13.81
Total SASs	352.77	76.08	397.92	85.82	447.44	96.50

SASs: salt-affected soils

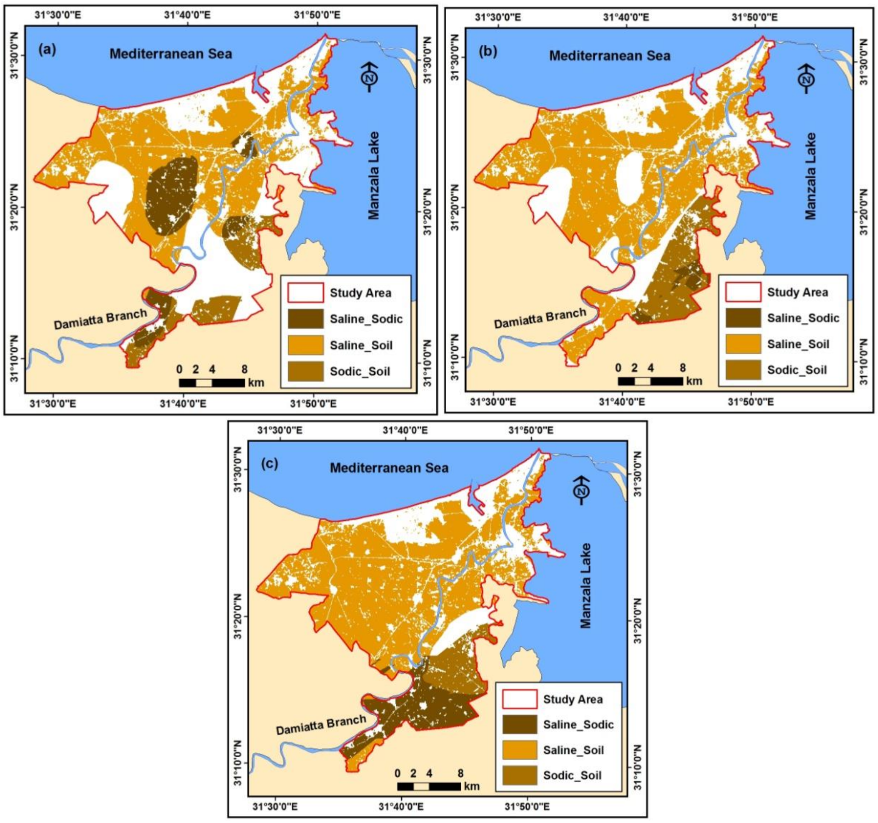

Fig. 5. Spatial distribution of salt-affected soils in the studied agricultural area at these soil depths: a) 0-30 cm, b) 30-60 cm and c) 60-90 cm.

Loss of soil fertility in agricultural lands

Soil fertility of the studied area was evaluated based on its content of available NPK. The status of NPK was evaluated in the surface layer (0-30 cm) of agricultural lands within Damietta Governorate. Table (5) represents the determined values of NPK in the studied area and their assigned classes. It also shows the area and percentage within each class. Also, the spatial distribution of NPK classes within the agricultural area in Damietta Governorate is illustrated in Fig. (6). Soils in the studied area fall in two classes according to their content of available nitrogen. These classes are low (< 20 mg kg^{-1}) and moderate (20-40 mg kg^{-1}). The first class covered an area of about 156.19 km^2 (33.69% of agricultural area) and the second class covered an area of about 307.47 km^2 (66.31%).

Available soil phosphorus also falls in two classes; which are low (5-10 mg kg^{-1}) and moderated (10-15 mg kg^{-1}). Low soils in available phosphorus covered an area of about 210.48 km^2 (45.39% of agricultural area) and moderate soils covered an area of about 253.19 km^2 (54.61%). This decline in soil available N and P could be mainly attributed to the intensively used cropping system in Egypt, where soils are cultivated in three seasons (summer, winter and the Nile seasons) around the year. This is in addition to the sustainable or annual crops whose growing season extends to a full year or several years, such as fruit and wood trees.

On the contrary, soils in the studied area fall in four classes based on their content of available potassium. These classes are: 1) low (50-100 mg kg^{-1}); 2) moderate (100-150 mg kg^{-1}); 3) high (150-200 mg kg^{-1}) and very high (> 200 mg kg^{-1}). The very high class covers the majority of the area (about 400.05 km^2, 86.28%, whereas the three other classes cover about 63.61 km^2 (about 13.72% of agricultural area). The higher class was observed in the fine-textured soils (alluvial soils) in the central and southern parts of the area, whereas the lower classes were observed in coarse-textured soils in the northern parts**.**

These results indicate that agricultural areas in Damietta Governorate don’t have sufficient amounts of both available N and P to meet the needs of most growing crops. Consequently these soils need continuous applications of those two major plant nutrients. On the other hand, most soils in the studied area are rich in available potassium. This could be attributed to the Nile-silt deposits, which are rich in k-bearing minerals such as mica and feldspars (El-Agrodi *et al*., 1998; Abdo, 2012; Daibes, 2018).

Table 5. NPK classes and their areas and percentage from agricultural area in 2019.

Available Nitrogen(mg kg^{-1} soil)	**Class**	**Area (km^2)**	**%**
< 20	Low	156.19	33.69
20 - 40	Moderate	307.47	66.31
Available Phosphorus(mg kg^{-1} soil)	Class	Area (km^2)	%
5 - 10	Low	210.48	45.39
10 - 15	Moderate	253.19	54.61
Available Potassium(mg kg^{-1} soil)	Class	Area (km^2)	%
50 - 100	Low	8.77	1.89
100 - 150	Moderate	16.95	3.66
150 - 200	High	37.90	8.17
200 - 250	Very High	400.05	86.28
Total		463.66	100.00

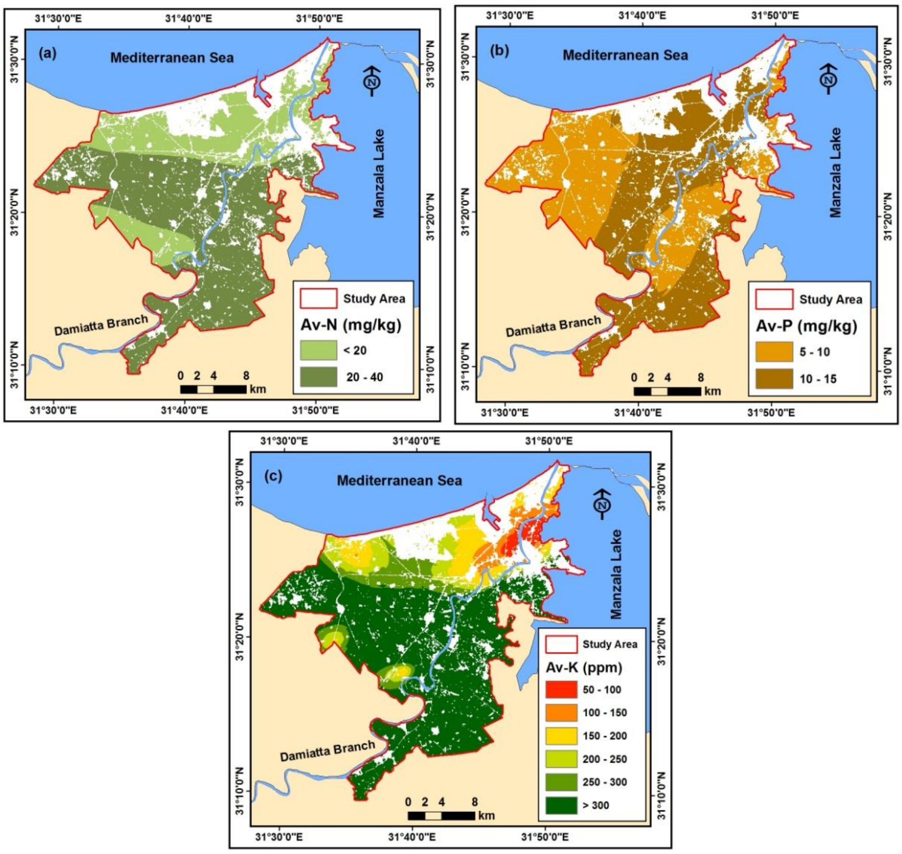

Fig. 6. Assigned classes for available NPK and their distribution at surface layer within the studied agricultural area: a) available N, b) available P and c) available K.

CONCLUSIONS

Land degradation is one of the most serious problems over time, where it is the main cause of declining or total loss of agricultural productivity worldwide, therefore it has to be monitored and evaluated. Evaluation of land degradation can be performed either directly or indirectly. Indirect methods depend mainly on remotely sensed data, which are currently available and provide more accurate, time-wise and low-cost information. On the other hand, direct methods depend on collecting soil samples and analyzing them for their physiochemical and fertility properties. These traditional methods take lots of effort, money and time. These two methods were integrated in this work.

Agricultural lands in Damietta Governorate were first increased from 1989 then continually declined over time from 2000 to 2019. This could be due to the interest in agricultural projects at the first period and to urban encroachment after that. The total area of salt affected soils (SASs) was prevailing and increased with soil depths. This could be attributed to the poor drainage in the area and sea-water intrusion. The majority of agricultural lands in the studied area were salt-affected soils and they need proper management. Soil fertility depending on the status of available soil-NPK ranged between low and moderate for N and P, whereas it was very high for K. Soil fertility in the studied area was highly connected with its parent-material either alluvial or aeolian deposits.

In conclusion, agricultural lands in Damietta Governorate are seriously degraded. This is mainly due to urban sprawl, increase of soils salinity and sodicity and loss of fertility. Accordingly, there is an urgent need for putting a strict regulation that forbids urban sprawl over agricultural land. They also need to developing a popper management program, which takes into account remediating salt-affected soils and improving soil fertility.

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تقييم تدهور الأراضي في المناطق الزراعية داخل محافظة دمياط نتيجة الزحف العمراني والملوحة والقلوية وفقدان الخصوبة

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يعد تدهور الأراضي من أخطر المشكلات على مر الزمن حيث يعد السبب الرئيسي لانخفاض الإنتاجية الزراعية في جميع أنحاء العالم. وتتمثل الأهداف الرئيسية لهذا العمل في رصد وتقييم تدهور الأراضي الزراعية في محافظة دمياط بسبب الزحف العمراني وملوحة وقلوية وفقد خصوبة التربة. ولهذا الغرض تم جمع صور لاندسات في أربع فترات زمنية (1989 و 2000 و 2014 و 2019) لدراسة التغيرات المكانية والزمانية في الأراضي الزراعية خلال تلك الفترات. وتم استخدام مؤشر الغطاء النباتي المعدل للتربة (SAVI) لدراسة الغطاء النباتي. كما تم جمع عينات تربة من 30 قطاعا أرضيا على ثلاث أعماق (0-30 30-60 60-90 سم). حيث اجريت عليها تحليلات (الأس الهيدروجيني pH والنسبة المئوية للصوديوم المتبادل ESP والتوصيل الكهربى EC كما تم تقدير النيتروجين والفوسفور والبوتاسيوم NPK الميسر). و استخدام التحليل الجيو أحصائى كريجنج العادى Ordinary Kriging في عملية الاستكمال السطحي لخصائص التربة المدروسة. وقد أشارت النتائج التي تم الحصول عليها إلى وجود انخفاض معنوي في مساحة الأراضي الزراعية داخل محافظة دمياط من 502.45 كيلومتر مربع (78.94٪) عام 2000 إلى 463.66 كيلومتر مربع (72.85٪) عام 2019. وقد زادت مساحة التربة المتأثرة بالاملاح بشكل كبير (خاصة في الطبقات التحت سطحية) بسبب سوء الصرف في منطقة الدراسة وتسرب مياه البحر سواء من البحر المتوسط و/ أو بحيرة المنزلة. وتراوحت حالة النيتروجين والفوسفور الميسريين بين منخفضة ومتوسطة بينما كان حالة البوتاسيوم الميسر مرتفعًة جدًا في معظم المنطقة. وفي الختام تتأثر الأراضي الزراعية في محافظة دمياط بشكل خطير بتدهور الأراضي الناتج عن الزحف العمراني والملوحة والقلوية وفقدان الخصوبة. لذلك فهى بحاجة ماسه إلى سن قوانين ووضع برنامج خاص لإدارتها ومعالجتها.