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تاثير نحر الشواطئ على بعض الملامح الارضيه لمنطقة رشيد باستخدام تقنيات الاستشعار عن بعد ونظم المعلومات الجغرافيه

محمد إسماعيل ، محمد محمد حسنى شومان ، يوسف قطب الغنيمى

وحدة الاستشعار عن بعد – معهد بحوث الاراضى والمياه والبيئة – مركز البحوث الزراعية – جيزة – مصر

الملخص العربي

منذ انشاء السد العالى باسوان فى عام ١٩٦٤ اصبح الشريط الساحلى للبحر الابيض المتوسط عرضه بشكل اوسع لعمليات النحر والانجراف. حيث اوقف السد العالى الامداد بالرواسب التى يحملها نهر النيل وترك ساحل البحر بدون اى عوامل بناء للساحل. فى هذه الدراسه تم استخدام نوعين من بيانات الاقمار الصناعيه فى تاريخين مختلفين حيث تم استخدام بيانات القمر الصناعى SPOT-2 لسنة ١٩٩١ وبيانات القمر الصناعى QuickBird لسنة ٢٠١١، وعند تحليل صور الاقمار الصناعيه فائقة الدقه لمنطقة الدراسه لسنة ١٩٩١ وسنة ٢٠١١ اوضحت النتائج انه عند عمل التصنيف للمرئيه الفضائيه لسنة ١٩٩١ امكن الحصول على ٥ اقسام وهى المناطق الزراعيه – المناطق الحضريه – الفرشات الرمليه والاراضى البور – الاراضى المبتله – المسطحات الساحليه والنهريه. بينما عند اجراء عمليات التصنيف للمرئيه الفضائيه لسنة ٢٠١١ أمكن الحصول على ٩ اقسام وهى المناطق الزراعيه – المناطق الحضريه– الفرشات الرمليه –الاراضى البور – الاراضى الغدقه – المسطحات الساحليه والنهريه – marshes - المزارع السمكيه – الطرق والقنوات والمصارف. بعض من الملامح الارضيه التى تواجدت عام ١٩٩١ قد تحولت بفعل زيادة مستوى ماء البحر بفعل التغيرات المناخيه الى ملامح اخرى فى عام ٢٠١١ مثل تحول الاراضى المبتله الى أراضى غدقه بنحو مساحه ١,١٢ كم٢ و مزارع سمكيه بمساحة ٧,٠٥ كم٢– ايضا زياده الامداد بماء البحر فى بعض المناطق ادى الى زيادة تركيز الاملاح وتكون مناطق marshes فى شمال منطقة الدراسه حيث قدرت مساحتها بنحو ٣,١٠ كم٢.

عمليه اعاده تشكيل الساحل الشمالى لمنطقة الدراسه يعزى الى العديد من العوامل مثل نحر الرياح والامواج البحريه خاصة بعد نقص الامداد بالرواسب النهريه حيث اظهرت النتائج ان المساحه المنجرفه من ساحل البحر ما بين عامى ١٩٩١ الى ٢٠١١ هى ٤,٣٢ كم٢ بينما المساحه المترسبه فى نفس الفتره كانت ١,١١ كم٢.

ايضا اوضحت النتائج حدوث تغيير فى درجات الملوحه بمنطقة الدراسه ما بين عامى ١٩٦٠ الى ٢٠١١حيث قسمت منطقة الدراسه الى ثلاث اقسام حسب التغير فى درجة الملوحه الى مناطق حدث لها تحسين فى درجة الملوحه ومناطق حدث لها تدهور فى درجة الملوجه ومناطق لم يحث لها تغيير فى درجة الملوحه.

IMPACT OF COASTAL EROSION ON SOME SOIL FEATURES OF ROSETTA AREA, EGYPT USING REMOTE SENSING AND GIS TECHNIQUES

M. Ismail, M. M. Shoman and Y. K. El Ghonamey
RS and GIS Unit, Soils, water, and Environment Research.Institute.,Agric.Res.Center, Giza

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ABSTRACT: *Since the construction of the Aswan High Dam in 1964, there has been concern that the Egyptian coastline along the Mediterranean Sea would suffer from increased erosion. The dam effectively stopped the supply of sediment carried by the River Nile to the Mediterranean and so left the coastline without a shore building capability. In this study two types of data were used; SPOT-2 satellite data acquired in 1991 and QuickBird satellite Data acquired in 2011. Through analysis of high resolution satellite images of the studied area in period from 1991 to 2011. The results showed in 1991 the SPOT-2 image was classified into 5 classes cultivated areas, urban areas, bare soil+Sand sheet areas, wetland areas, and Marine and Riverine parts. While in 2011 the high resolution QuickBird image was classified into 9 classes cultivated areas, urban areas, sand sheet, bare soil, marshes, fish farms, canals + roads, logged water, and Marine and Riverine parts. Some classes which presence in 1991 such as wetland class was converted in 2011 to fish farms class with an area of about 7.05 km^2 and logged water class with an area of about 1.12 km^2. Also the increase in sea water supply led to increase in the salt concentration and create marshes area of about 3.10 km^2 in the north part of the studied area.*

Reshaping process of the north shoreline of the studied area could be results of wind and sea waves' erosion especially after reduce the Nile sediment supplement. The obtained results showed that the eroded area from 1991 to 2011 was 4.32 km^2 while the accreted area in the same period was 1.11 km^2.

The results also showed a change in the degree of salinity in the studied area from 1960 to 2011, where the studied area was classified into 3 classes according to the changes in the salinity degree to improved areas, degraded areas and not changed areas.

Key words: *Satellite data, GIS, North coast, Rosetta, erosion.*

INTRODUCTION

The coastal zone of Egypt extends for more than 2450 km and about 40% of the population lives there. Most of these people live in and around a number of major industrial and commercial cities: Alexandria, Port Said, Damietta, Rosetta, and Suez (El-Raey, 1999). Most of the coastal zone is less than 2 m above sea-level and it is protected from flooding by a 1 to 10 km wide coastal sand belt only. This protective sand belt is facing rapid erosion, which has been a serious problem since the construction of the High dam (Inman, *et al.*, 1992, Fanos, 1995, Stanley J., 1996, Stanley and Warne, 1998 & Douglas, 2005). Rising sea level is expected to destroy weak parts of the sand belt, which is essential for the protection of lakes and the low-lying reclaimed lands.

Before construction of the High Dam, the Nile delta shore was in a fluctuating equilibrium between sediment supplied by the river and the transport along the coast (Douglas, 2005). During the last decades, after the construction of the High dam in 1964, sediment input in the delta has been strongly reduced. This resulted in serious shore erosion and salt-water intrusion (Jelgersma, 2005 & Ericson, *et al.* 2006). Currently, the Nile delta experiences erosion waves driven by the currents of the east Mediterranean gyre that sweep across the shallow shelf with speed up to 1 m/s. Moreover, the construction of human-made water ways for irrigation and transportation has trapped an already depleted sediment supply to the Nile delta. This entrapment of sediment is a key contributor to coastal erosion and land loss occurring in the Nile delta and the Nile's two projections, Rosetta and Damietta (Inman, *et al.,* 1992, Fanos, 1995, Stanley J., 1996, Stanley and Warne, 1998, El-Raey, 1999).At present, erosion is a significant environmental problem affecting Damietta city at coastal zone, which has retreated more than 500m in over 10 years from 1983 to1995 (SEAM, 2005).

The variations in sediment volume along the coast show severe erosion along the Nile promontories (Rosetta, Burullus and Damietta) where waves are more concentrated. The other parts of the shore at Abu Quir Bay, Abu Khashaba, Hanafi, Kitchener Drain, and behind Port Said break water receive the eroded material by eastward sediment transport resulting from the prevailing wave approach from the northwest (Lotfy and Frihy, 1993).

El-Baz *et al* (1991) in their study on

Rosetta promontory found that the eroded area between 1934 to 1977 was about 0.7 km^2 while the eroded area between 1977 to 1990 was about 1.3 km^2.

This study aims to evaluate the current situation of some features located in Rosetta area using high resolution satellite images and topographic maps with different scales in different periods for monitoring the changes in shorelines of Mediterranean Sea in the studied area and the effects of that on the soil salinity at studied area.

MATERIALS AND METHODS

1. Materials

a. Location of the studied area:

The studied area is located in the northern part of Egypt 65 km east of Alexandria, in Beheira and Kafr El-Sheakh governorates. It is bounded by latitudes 31° 17` 9.3" and 31° 29` 28.5"North, and longitudes 30° 19` 8.8" and 30° 29` 59.8" East. Fig. (1).The studied area covers about 308.0 Km^2 (about 73333.0 fed.).

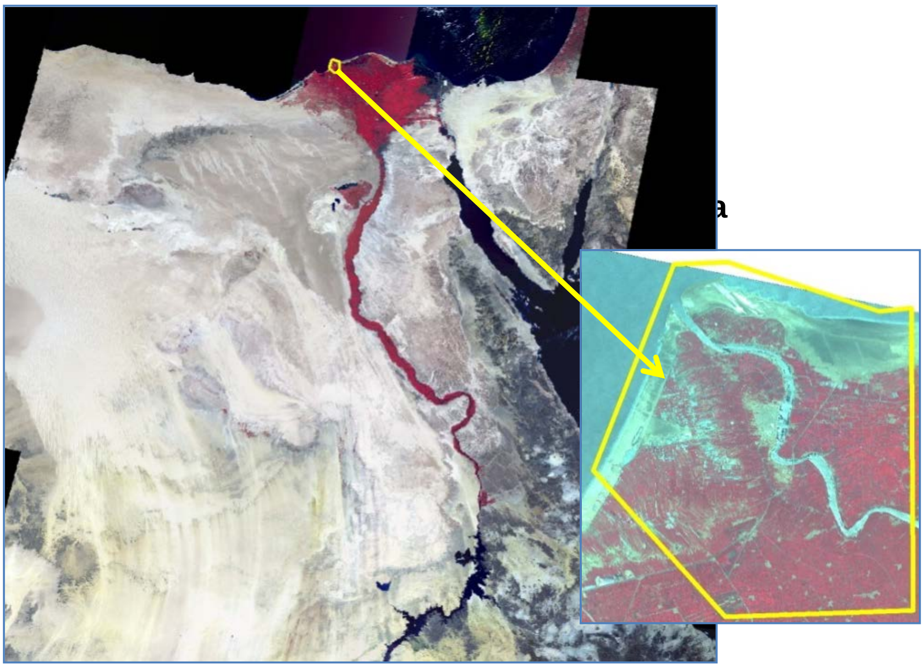


Fig. (1): Location of the studied area

b. Satellite Images

1. SPOT 2 satellite Image (Fig 2-A)

Satellite Name	SPOT 2
Acquisition Date	26 Sept.1991
Cell Size	10.0 m
K, J	109, 287 and 109, 288
Projection	Egyptian Transfer Mercator (ETM)

2. QuickBird satellite image(Fig 2-B)

Satellite Name	QuickBird
Acquisition Date	29 May 2011
Cell Size	0.60 m
Projection	Egyptian Transfer Mercator (ETM)
Extent	• Top = 975619.49 • Left = 549954.59 • Right = 567245.39 • Bottom = 952638.89

c. Salinity map of 1960 produced by Soil, Water and Environment Research Institute (SWERI)

d. Software:

1. ERDAS Imagine software Ver. 9.2.
2. Arc/GIS software Ver. 9.3.

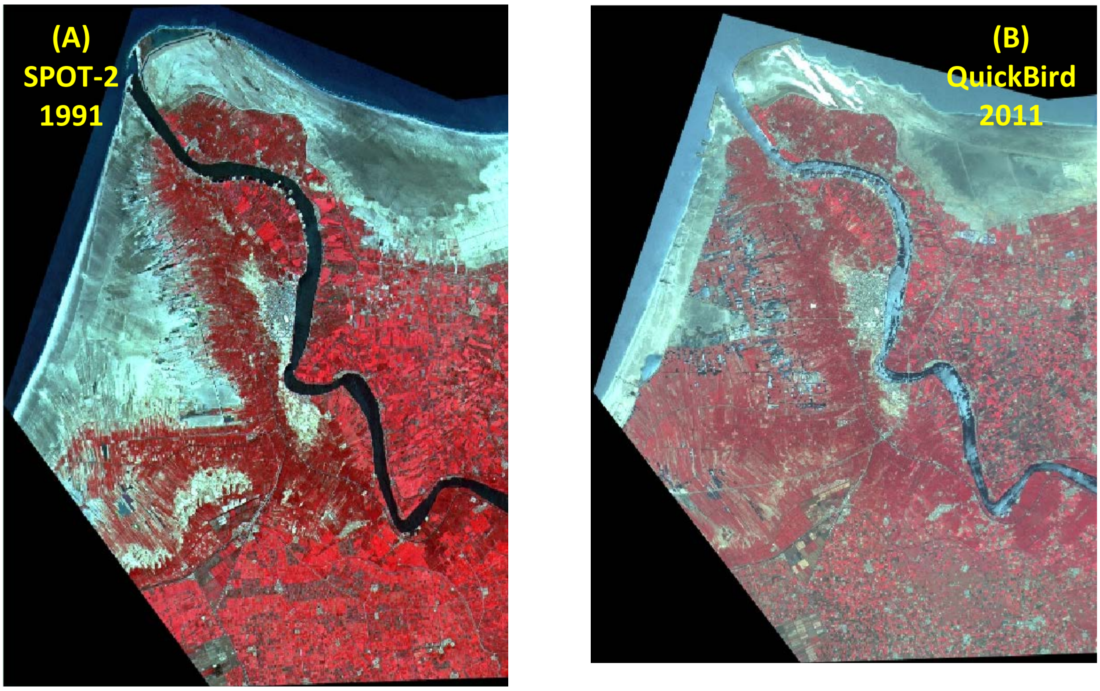
2. Methods:

a. Geo-reference :

Geometric Correction for topographic map for the studied area with scale 1:50000 (Rashid map) produced by Egyptian survey authority (ESA, 1990) was corrected by using grid system and used it to correct the raw data of SPOT-2 and QuickBird images. Geometric correction process depends on using ground control points (GCPs) which collected from topographic map to registration the images. These GCPs can be accurately located on the digital imagery. Erdas Imagine software (version 9.2) was used in Geometric correction processes for topographic, and image with specifications Egyptian Transverse Mercator (ETM).

b. Mosaicing:

QuickBird data was delivered by in 12 parts. These parts were mosaiced to be one image.SPOT-2 Image was located in two SPOT-2 scenes 109-287 and 109-288. These scenes were mosaiced.



Fig(2): (A) SPOT-2 Image (1991) and (B) QuickBird Image (2011)

c. Pansharpened Data:

SPOT-2 image produced by merging 10m resolution panchromatic and 20m resolution multispectral imagery to create a 10m resolution color image. Also QuickBird image produced by merging 0.6m resolution panchromatic and 2.44m resolution multispectral imagery to create a 0.6m resolution color image.

d. Classification:

Supervised classification was applied to the images. Supervised classification is based on prior knowledge of the number and spectral characteristics of the classes to be identified. The supervised classification method involves polygon (training area) creation and statistical computation.

Training areas representative of each type of feature were delineated and the values of each image layer (band, RGB) were recorded for all pixels in the area. A class signature for each class was statistically computed from this data. Unknown pixels can be allocated to the most suitable class using maximum likelihood classification. This process was applied on both of SPOT-2 and QuickBird images.

e. Reclassification

The resulted classes were recoded into “Water” which take code 0 and “Land” which take code 1 where the water class represented the shoreline of this area.

f. GIS Analysis:

The recoded maps were converted to vector layer to monitor the changes in the shoreline and other features in both of SPOT-2 and QuickBird data. The salinity maps were created using the geostatistical analysis and electrical conductivity values.

g. Field Work:

Fifteen soil profiles were collected (Fig 3) to represent the different salinity classes. The profile sites are detected in the field by means of the Global Positioning System (G.P.S).

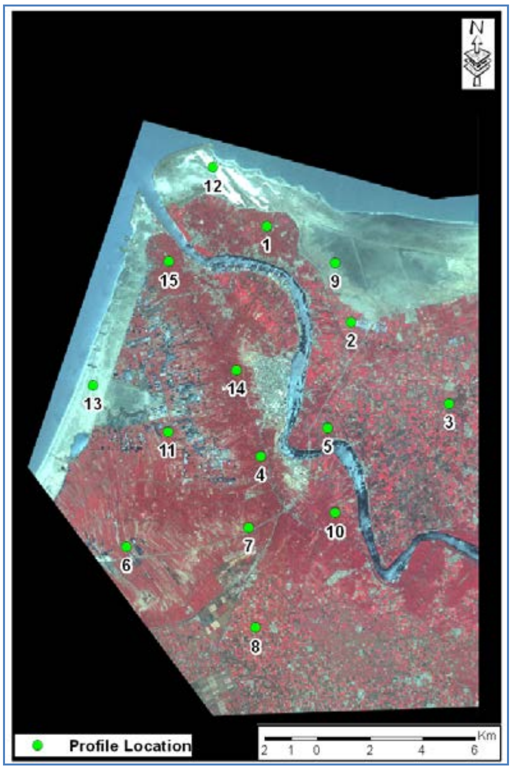


Fig. (3): Location map of the collected soil profiles

The soil profiles were described morphologically according to FAO (1973). The different soil layers were sampled, air-dried, sieved through a 2 mm sieve and kept for analyses.

h. Laboratory Analyses:

Total soluble salts of the soil paste extracts expressed as ECe was measured using electrical conductivity meter(Black, 1965).Soil salinity was classified according (USDA, 2006) to 4 Classes as follows: Normal Saline (EC 0-4 dS/m), Moderately Saline (EC 4-8 dS/m), Highly Saline (EC 8-16 dS/m), and Very Highly Saline (EC >16 dS/m).

RESULTS AND DISCUSSION

1. Classification maps:

As shown in Fig. (4-A) and Table (1), SPOT-2 image was classified into 5 classes: Cultivated area, Urban area, Sand sheet+ Bare soil, Wetland, and Marine and Riverine parts (Included Sea and Nile river).

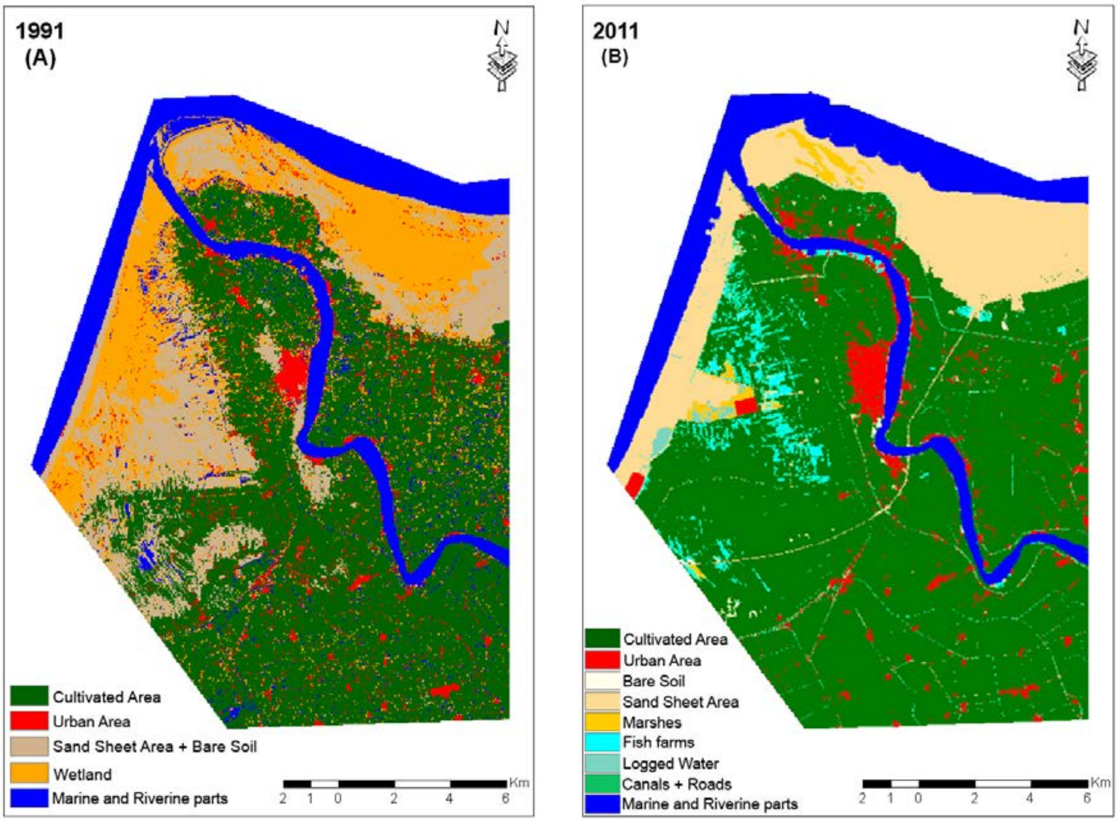


Fig (4): Classification map A): SPOT-2 satellite image (1991) and B): QuickBird satellite Image in (2011).

Table (1): Spectral classes of SPOT-2

No	Class Name	Area (Km^2)	Area (Fed.)
1	Cultivated Area	146.78	34947.62
2	Urban Area	14.77	3516.67
3	Sand Sheet Area + Bare Soil	45.38	10804.76
4	Wetland	58.14	13842.86
5	Marine and Riverine parts	42.92	10219.05

QuickBird image was classified into 9 classes (Fig 4-B and Table 2) as follows: Cultivated area, Urban area, Sand sheet, Bare soil, Marshes, Fish farms, Canals + Roads, Logged Water, and Marine and Riverine parts (Included Sea and Nile river).

The results showed an increase in cultivated area in the studied area from 146.78 km^2 in 1991 to 204.10 Km^2 in 2011with an average of 3.01 km^2 per year. This is a result of the reclamation process in the study area.

The results also showed that some parts of wetland areas in western part of the studied area in 1991 converted to logged water with area 1.12Km^2 and fish farms areas with area 7.05 Km^2. That is due to rise of ground water level results of sea water intrusion through the sand area. Therefore, these areas have failed by the reclamation process.

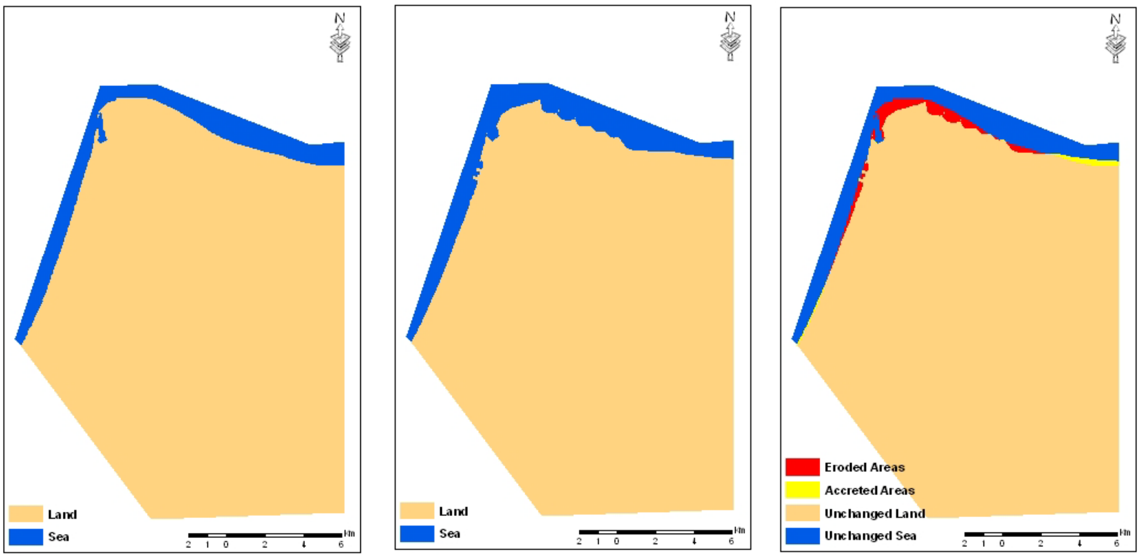
Results also showed that some wetland areas in 1991 converted to marshes areas in 2011with an area 3.1Km^2.

2. Recoded map:

By conversion the spectra classification map of SPOT-2 and QuickBird data to vector layers by ArcGIS software the shoreline in date 1991 and 2011 could be detected as shown in Fig (5).

Table (2): Spectral classes of QuickBird

No	Class Name	Area (Km2)	Area (Fed.)
1	Cultivated Area	204.10	48595.24
2	Urban Area	19.64	4676.19
3	Bare Soil	0.51	121.42
4	Sand Sheet Area	31.50	7500.00
5	Marshes	3.10	738.0952
6	Fish farms	7.05	1678.57
8	Logged Water	1.12	266.67
7	Canals + Roads	4.04	961.90
9	Marine and Riverine parts	36.94	8795.24



(A) (B) (C)

Fig (5): The shoreline in the studied area: (A) SPOT Satellite image 1991, (B) QuickBird satellite image 2011 and (C) the eroded area and accreted area from 1991 to 2011.

The results presented in Fig (5) and Table (3) showed that about 4.33 km^{2}were eroded from the studied area during the period from1991 to 2011. The most shoreline changes were found in north and east of the study area. On the other hand about 1.11 km^2 were accreted in the same period.

Former accretion coastal areas are now eroded by winds and sea waves. The eastward-flowing Mediterranean long shore currents resulted in sorting and re-depositing of the newly eroded detritus seaward or further eastward along the coast. This predominance of erosion provided an increasingly severe threat to the shore development. This phenomenon become clearing especially after construction of the High Dam in 1964 where sediment deposition during annual flooding is reducing and action of wind and sea waves become the dominant.

The data present in Tables (4) and (5) show the comparison between salinity map of the studied area (Fig 6-B) with soil salinity map which produced in 1960 (Fig.6-A) could be concluded the following:

1. The area of normal saline soil increased from 10646.6 fed. in 1960 to 32024.6 fed. in 2011. This increase represents about 29.15% of total area in 1960. That is due to improving in soil characteristics by creation of drainage lines to decrease water table levels.
2. Moderately saline soil decreased from 15988.8 fed. in 1960 to 7799.2 fed. in 2011 constituting about 11.17 % of total area in 1960.
3. Highly saline soil area increased from 5096.3 fed. in 1960 to 11476.7 fed. in2011. This increase represents about 8.62% of total area in 1960.
4. Very highly saline soil area decreased from 41601.5 fed in 1960 to 18489.6 fed. in 2011 constituting about 31.52 % of total area in 1960. Most of decreasing areas were eroded by Mediterranean Sea water.

Table (3): Eroded and accreted areas of Rosetta area during the period from 1991 to 2011

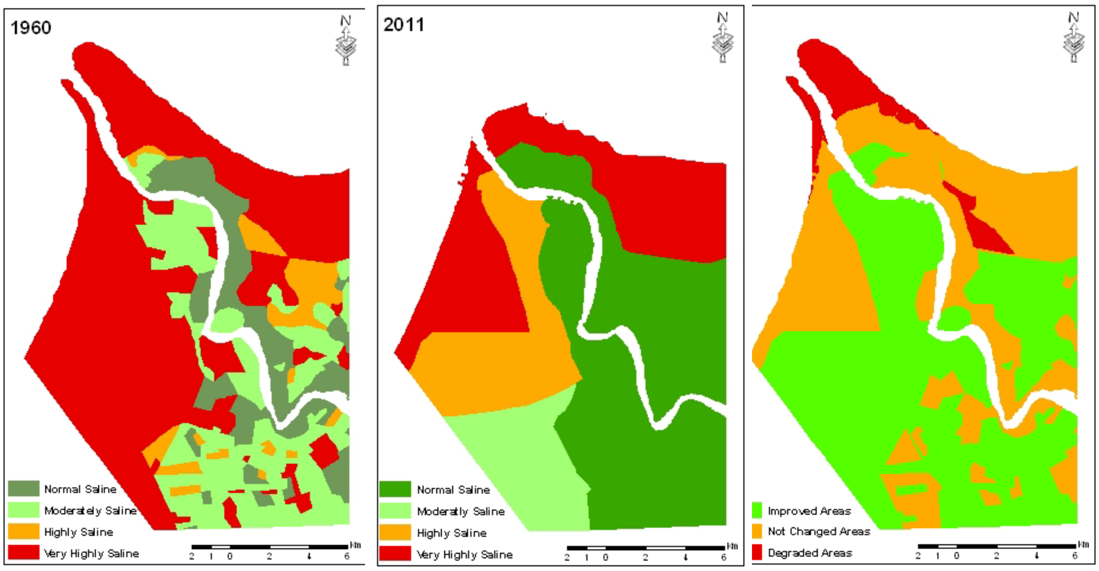
Class in 1991	Class in 2011	Name	Area (Km^2)
Land	Sea	Eroded Area	4.331673
Sea	Land	Accreted Area	1.112999
Land	Land	Unchanged Land	279.7439
Sea	Sea	Unchanged Sea	22.81147

Table (4): ECe Values of the studied soil profiles

Profile No	Profile ECe	Profile No	Profile ECe	Profile No	Profile ECe
1	1.78	6	8.61	11	20.17
2	48.12	7	8.27	12	69.71
3	1.47	8	6.71	13	40.90
4	1.39	9	40.94	14	0.48
5	0.61	10	0.77	15	10.72

Table (5): Salinity classes of the studied area in 1960 and 2011 and the eroded area from 1960 to 2011

Salinity Class	Area (fed.)			% of area 1960
	1960	2011	Change from 1960 to 2011	
Normal Saline	10646.6	32024.6	21378.0	29.15
Moderately Saline	15988.8	7799.2	-8189.6	-11.17
Highly Saline	5096.3	11416.7	6320.4	8.62
Very Highly Saline	41601.5	18489.6	-23111.9	-31.52
Total	73333.0	69730.1	-3603.1	



(A) (B) (C)

Fig (6): Salinity map of the studied area: (A) 1960, (B) 2011 (C) the changes from 1960 to 2011.

Table (6): Improved, degraded and not changed areas by salinity of the studied area from 1960 to 2011

Class	Area (fed.)	% of area in 1960
Improved Area	40084.98	54.66
Degraded Area	4676.67	6.38
Not changed Area	28571.68	38.96
Total	73333.0	100

In general the results as present in Fig (6-C) and Table (6) showed that the studied area was classified to 3 classes according to the changes in salinity classes in the period from 1960 to 2011 as follows:

1. Improved areas: improve of salinity is due to creation of drainage lines. The area of this class is about 40084.98 fed.
2. Degraded areas: This is due to two reasons increasing the degree of salinity resulting from sea water intrusion. The area of this class is about 982.47 fed., and areas were eroded by Mediterranean Sea water. The area of this class is about 3694.2 fed.
3. Not changed areas: These areas not have any changes in salinity class. The area of this class is about 28571.68 fed.

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تاثير نحر الشواطئ على بعض الملامح الارضيه لمنطقة رشيد باستخدام تقنيات الاستشعار عن بعد ونظم المعلومات الجغرافيه

محمد إسماعيل ، محمد محمد حسنى شومان ، يوسف قطب الغنيمى

وحدة الاستشعار عن بعد – معهد بحوث الاراضى والمياه والبيئة – مركز البحوث الزراعية – جيزة – مصر

الملخص العربي

منذ انشاء السد العالى باسوان فى عام ١٩٦٤ اصبح الشريط الساحلى للبحر الابيض المتوسط عرضه بشكل اوسع لعمليات النحر والانجراف. حيث اوقف السد العالى الامداد بالرواسب التى يحملها نهر النيل وترك ساحل البحر بدون اى عوامل بناء للساحل. فى هذه الدراسه تم استخدام نوعين من بيانات الاقمار الصناعيه فى تاريخين مختلفين حيث تم استخدام بيانات القمر الصناعى SPOT-2 لسنة ١٩٩١ وبيانات القمر الصناعى QuickBird لسنة ٢٠١١، وعند تحليل صور الاقمار الصناعيه فائقة الدقه لمنطقة الدراسه لسنة ١٩٩١ وسنة ٢٠١١ اوضحت النتائج انه عند عمل التصنيف للمرئيه الفضائيه لسنة ١٩٩١ امكن الحصول على ٥ اقسام وهى المناطق الزراعيه – المناطق الحضريه – الفرشات الرمليه والاراضى البور – الاراضى المبتله – المسطحات الساحليه والنهريه. بينما عند اجراء عمليات التصنيف للمرئيه الفضائيه لسنة ٢٠١١ أمكن الحصول على ٩ اقسام وهى المناطق الزراعيه – المناطق الحضريه– الفرشات الرمليه –الاراضى البور – الاراضى الغدقه – المسطحات الساحليه والنهريه – marshes - المزارع السمكيه – الطرق والقنوات والمصارف. بعض من الملامح الارضيه التى تواجدت عام ١٩٩١ قد تحولت بفعل زيادة مستوى ماء البحر بفعل التغيرات المناخيه الى ملامح اخرى فى عام ٢٠١١ مثل تحول الاراضى المبتله الى أراضى غدقه بنحو مساحه ١,١٢ كم^{2} و مزارع سمكيه بمساحة ٧,٠٥ كم^{2}– ايضا زياده الامداد بماء البحر فى بعض المناطق ادى الى زيادة تركيز الاملاح وتكون مناطق marshes فى شمال منطقة الدراسه حيث قدرت مساحتها بنحو ٣,١٠ كم^{2}.

عمليه اعاده تشكيل الساحل الشمالى لمنطقة الدراسه يعزى الى العديد من العوامل مثل نحر الرياح والامواج البحريه خاصة بعد نقص الامداد بالرواسب النهريه حيث اظهرت النتائج ان المساحه المنجرفه من ساحل البحر ما بين عامى ١٩٩١ الى ٢٠١١ هى ٤,٣٢ كم^{2} بينما المساحه المترسبه فى نفس الفتره كانت ١,١١ كم^{2}.

ايضا اوضحت النتائج حدوث تغيير فى درجات الملوحه بمنطقة الدراسه ما بين عامى ١٩٦٠ الى ٢٠١١حيث قسمت منطقة الدراسه الى ثلاث اقسام حسب التغير فى درجة الملوحه الى مناطق حدث لها تحسين فى درجة الملوحه ومناطق حدث لها تدهور فى درجة الملوجه ومناطق لم يحث لها تغيير فى درجة الملوحه.