

## **MONITORING CHANGES IN AGRICULTURE AREAS IN A PART OF THE EASTERN NILE DELTA-EGYPT, USING HIGH RESOLUTION IMAGES AND ITS IMPACT ON CROP ROTATION**

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**ABSTRACT:** *Agricultural production in Egypt is limited by urban encroachment and soil salinity. On the other hand, continuous reclamation efforts in the desert and coastal regions succeeded in establishing new agricultural communities and increased the area of cultivated land and the amount of final product in the last two decades. Land use/land cover change particularly that of agriculture and new reclaimed areas have been occurring at an unprecedented rate and scale in east of Nile delta. The rapid rate of economic development, demographics and poverty are believed to be the underlying forces responsible for the change. Accurate and up-to-date information to support the above statement is needed. The overall goal of this paper is to monitor the major land cover types and identify areas undergoing major land cover (agriculture areas), in east of Nile Delta.*

*Visual interpretation method was used to determine the cultivated, water, urban and desert areas using TM, 1984 and Spot images 1991 and 2008. Generally, the results showed a noticeable increase in agriculture areas with decrease in desert lands. Agricultural land increased by 36.0 % from 1984 to 1991, by 34.1% from 1991 to 2008 and by 52.26% from 1984 to 2008. The capability of GIS and the statistical values which represent the highest price of crops suitable for the studied area were valid to calculate the expected return. The results indicated that the first rotation crop of cotton as a main crop has its high return. The other two years have low return due to the price of other crops.*

*The results, also, indicated that the average of coast benefit ratio in summer season is higher (5.74) than in winter season (2.87). The results designated that the three years crop rotation has the same coast benefit ratio in both summer and winter seasons and gives a good indication for sustainable land use. It can be concluded that sorghum gives high coast benefit ratio followed by grapes, citrus, mangoes, Egyptian Clover. Wheat, beans, sugar beet, groundnuts, rice, and cotton area have moderately coast benefit ratio. This work could be used as a model for the evaluation of land cover changes in one of the most important agricultural areas in Egypt.*

**Key words:** *Monitoring, agriculture area, high resolution, image GIS, remote sensing.*

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### **INTRODUCTION**

Remote sensing is the science art of obtaining information about objects, area, or phenomenon through the analysis of data acquired by a device. It has provided a new impetus for the earth, resource and environmental scientists (Sabins, 1997). Application of Remote Sensing techniques for land cover study has considerable attention especially during the last decade all over the world. It is useful for inundation mapping. Land cover and its change is a key to many diverse applications such as environment, forestry, hydrology, agriculture, geology and ecology. Various

natural resource management, planning and monitoring programs depend on accurate information about the land cover in a region.

Urban encroachment, soil salinity and reclamation of desert to be cultivated represent three main circumstances, which negatively or positively affect the total cultivated area in Egypt. Increasing agricultural land is a national goal in Egypt. The Ministry of Agriculture and Land Reclamation has a mandate to increase agricultural yields, bring new reclaimed land, monitoring and protection of agricultural land. Thus better information

concerning all agriculture land must be collected to improve land management. Remote Sensing satellite images is the best tool for many applications such as produced land cover / land use maps and thematic maps as well as monitoring of variations & land cover over certain period of time. Change detection involves the use of multi-temporal data sets to discriminate areas of land cover variations at different dates of imaging. The multi-data classification approach entails the simultaneous classification of different images to be merged into a single multi-date set. Therefore, determining the trend and the rate of land cover conversion is very necessary for development planners in order to build up the best land use policy. For this purpose, the temporal dynamics of remote sensing data can play a very important role in monitoring and assessing land cover changes.

Many studies have been conducted on the land cover / land use changes in arid, semi-arid and agricultural productive land. El Kattib and Hawela (1991) applied digital image processing for studying the spectral signatures of the main crops under Egyptian conditions. The same technique was used by Abdel Hady *et al.* (1983) to measure and to classify the cultivated area in Egypt. Al Cibahy (1992) applied different techniques of digital image processing to explore the potential of remote sensing in detecting vegetation and in assessing vegetation attribute such as the vegetation ratio of agro-ecosystem of Northern Egypt. Lenney *et al.* (1996) assessed land cover changes in Egypt using field calibrated, multi temporal NDVI features derived from 10 Landsat TM images dating from 1984 to 1993. High rate of reclamation was identified from the period between 1986 and 1993, with low rate of conversion from agricultural productive land to new urban areas between 1984 to 1990. Ram and Kolarkar (1993) studied land use changes in arid areas in India by visual comparison of satellite imagery, maps and aerial photographs. Sadek (1993) used satellite imagery to highlight agricultural boundaries

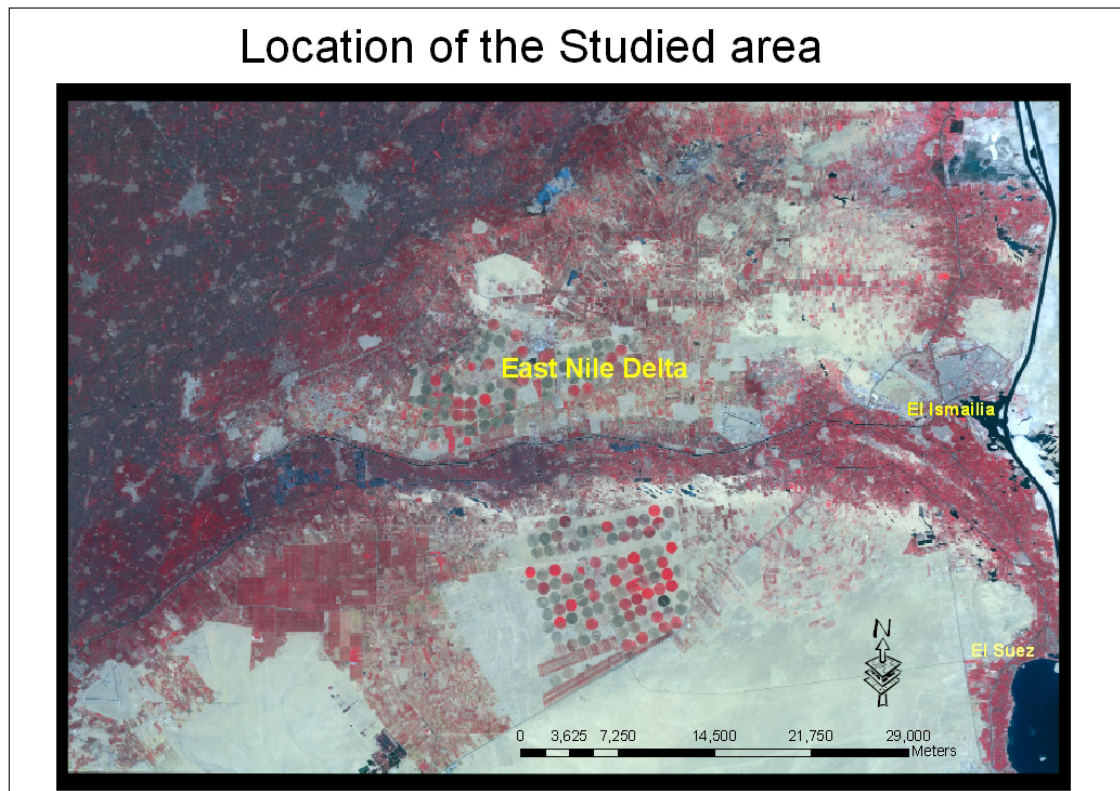
and monitor reclamation process in Egypt. Lambin and Ehrlich (1997) far ten – years data of NOAA-AVHRR to assess and analyze land cover changes in the African continent from 1982 to 1991. The study showed that continuous unidirectional change process affected less than 4% of Sub - Saharan regions during the study period. Rembold *et al.* (2000) studied land cover changes in lake regions of central/ south Ethiopia using aerial photographs dated 1972 and 1994 Landsat TM image. Mendoza and Etter (2002) combined black and white aerial photographs with fieldwork and GIS to monitor land cover changes covering 56 years (1940-1996) in parts of Bogota, Colombia.

The objectives of this work is to have general view about agricultural area changes in the last twenty years (from 1984 up to 2008); and proposed crop rotation to calculate the cost benefit ratio and its impact on the new cultivated area.

## **MATERIALS AND METHODS**

### **1- Study area**

The study area is part of the east Nile Delta region and it bounded on the western side of the Suez Canal. It is bounded by Latitudes 30° 17' 00" to 30° 50' 00" N and Longitudes 31° 36' 00" to 32° 20' 00" E as shown in Figure (1). The studied area covers about 900,000 Feddans. The western part of the studied area is a part of the new cultivated land of Ismailia, Sharkiya and Dakahliya Governorates and cover 717535 feddans contains cultivated area, urban, water bodies and desert areas after separating the old cultivated land. In this study we focus of monitoring cultivated areas only through the three periods. According to Land Master Plan (LMP, 1986) the soils are mainly desert land medium to coarse sandy soils slightly to moderately saline soils, slightly calcareous and well drained. The area is flat to almost flat with small part undulating and the water holding capacity is ranged from 20 to 50 mm/m. therefore, the modern irrigation systems (Drop and sprinkler irrigation).



**Figure (1) Location of the studied area on FCC432 image 2008**

The climate exhibits extreme aridity with very low rainfall (average of 7.6 mm/year), high evaporation (15.7 mm/day in June to 7.2 mm/day in January) and high summer temperature (maximum 30.1°C in August), while the minimum temperature (15.3°C) was recorded in January. Values of wind speed range from 7.4 Km/h in January to 14.3 Km/h in July, with an annual mean of 11.4 Km/h according to the metrological data of El Salhia station, (CNE, 2008).

**2- Sources of Data**

- 2.1- Spot4 Image Multispectral scenes covering the study area:  
 k, j: 112/288 dates: summer 1991  
 k, j: 112/289 dates: summer 1991  
 k, j: 113/289 dates: summer 1991
- 2.2- Spot5 Image Multispectral scenes covering the study area:  
 k, j: 112/288 dates: summer 2008  
 k, j: 112/289 dates: summer 2008

k, j: 113/289 dates: summer 2008

- 2.3-LandSat scene of:  
 Path / Row: 176 / 39, date: summer 1984
- 2.4-Topomaps provided by the Egyptian Survey Authority (EGSA), of date: 1986, with scale 1: 25 000
- 2.5-Land cover maps produced during ALIS Phase I Project, of scale 1: 100 000, using Spot images (P+XS) acquired in summer 1991.
- 2.6- The Producer Price by Local Currency/tonne (LCU) of years 1984, 1991, and 2008 after FAOSTAT (2010), data in Table (1).
- 2.7- The average crops production of Delta area of new cultivated land in Ton/Feddan, and crop costs (source: EAS, 2008) is included in Table (1).

**Table (1): The Producer Price by Local Currency (LCU) /tone and the average crops production of new cultivated land in part of east Delta in Ton/Feddans, and crop costs**

Crops Type	Price by Local Currency (LCU)/tone FAOSTAT FAO, 2010			Economic Affairs Sector of Agriculture and Land Reclamation, 2008		
	1984	1991	2008	Production Ton/Feddans	Crop costs without rent in L.E./Feddans	Crop costs with rent in L.E./Feddans
Apples	430	650	2558	7.88	-----	-----
Barley	136	362	2083	1.55	1067	1798
Beans, dry	620	1850	4136	1.42	1364	2291
Chilies, green	180	400	694	6.81	2086	2695
Cotton lint	1170	7627	15931	0.42	1799	3437
Clover	21	109	286	29.55	958	1866
Figs	400	600	1721	5.29	-----	-----
Grapes	300	550	1692	7.7	1100	-----
Groundnuts	600	1137	4720	1.35	1588	2233
Maize	173	441	1414	3.47	1786	2624
Mangoes,	870	1300	3363	4.57	1650	-----
Olives	450	950	1549	5.53	-----	-----
Oranges	140	471	1067	9.76	1050	-----
Potatoes	123	306	1222	10.57	6979	8014
Rice, paddy	131	400	1465	4.3	1665	3065
Sorghum	177	443	1436	32.99	958	1866
Soybeans	285	850	2161	1.41	1191	1790
Sugar beet	23	55	230.6	21.55	1196	1959
Sugar cane	24	58	200	36.97	3856	5348
Sunflower seed	350	850	2121	1.02	921	1225
Sweet potatoes	94	219	468	13.63	-----	-----
Wheat	124	498	2553	2.72	1469	2444

### 3- Hardware and software

Hardware are PC`s, printer and plotter. Software contains ARC-GIS 9.2, ERDAS Imagine 9.1, and office 97

### 4- Methodology:

4-1 The references for the old cultivated areas were topographic maps of the

Egyptian Survey Authority (EGSA) together with land use maps produced during ALIS I project.

4-2 The Spot scenes and Landsat TM scene which are covering the study area from 1984 to 2008 were re-projected, mosaiced and interpreted

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using visual interpretation techniques. The TM scene was registered using the Spot level 2B scenes of the same area acquired on 1991 using an Image-to-Image registration process with ERDAS Imagine 9.1 software.

- 4-3 The land cover maps (produced 1992 through ALIS project) were taken as a guide. Then, the images were classified into four main land cover types. The four main land cover types were named Water, Desert, Urban areas and Agricultural lands.
- 4-4 Many field trips were carried out to the study area and collect the required field information and data, (as ground truth), necessary for the identification and classification process. Urban, water, agriculture land, and desert data were collected based on the main characteristics of the training areas which must be homogenous and clear.
- 4-5 The proposed crop rotation in the study area based on four categories: 1) soil types; 2) Irrigation types used; 3) Geographical location and climatic conditions, and 4) Benefit of cultivated spatial crops rotation in the study area. Twenty two different crop types were selected based on the main cultivated crops in the summer and winter seasons in the studied area to determine the most valuable crops and calculated cost benefit ratio for the proposed crop rotation.

## **RESULTS AND DISCUSSION**

### **4.1. Image Classification**

The Landsat TM scene 1984 and Spot scenes which are covering the study area from 1991 to 2008 were re-projected and interpretation using visual interpretation techniques. TM, 1984 and Spot images (1991, and 2008) were classified into four main land cover classes namely: agricultural, water, urban and desert areas. Generally, the results show a noticeable increase in agriculture areas with decrease in desert lands. Figures (2 and 3) and Table (2 and 3) show the change of agriculture areas in years 1984, 1991, and 2008. The

results illustrated that the new cultivated area in year 1984 were 174,350 feddans, in year 1991 were 284,912 feddans, and in year 2008 were 357,870 feddans. The difference of changes in the agriculture areas from 1984 to 1991 is higher (110,889 feddans) than the area from 1991 to 2008 (90,958 feddans) for agriculture. Agricultural land increased by 19.54 % from 1984 to 1991, by 31.99% from 1991 to 2008 and by 42.2% from 1984 to 2008.

### **4.2 Estimating of agriculture return using FAO Data**

Figure (4) show the data of FAOSTAT (2010) for the producer price by Local Currency (LCU) /tone of the different crops years 1984, 1991, and 2008. The results show that, the prices of cotton linnet, groundnuts, beans, wheat, mangoes, rice, soybean, and sorghum were developed and became highly values. To estimate the return of each crop rotation the cultivated areas of year 2008 were divided into three areas. The first cultivated area of main crops covered 60% of the total cultivated areas. The second cultivated area of secondary crops covered 30% of the total cultivated areas, the third cultivated area of other crops covered 10% of the total cultivated areas. Tables (4, 5, and 6) show the estimated return for each crop rotation and for each year. The results show that the first rotation has the highest value due to the high price of the cotton crop (main crop). The other two years have low return due to their crops prices.

The results show that the average of coast benefit ratio in summer season is higher (5.74) than in winter season (2.87). It is also illustrated that the three years crop rotation have the same coast benefit ratio in both summer and winter seasons and give good indication for sustainable land use when applying this three year crop rotation system. It can be concluded that sorghum give high coast benefit ratio followed by grapes, citrus, mangoes, Egyptian clover. Wheat, beans, sugar beet, groundnuts, rice, and cotton area have moderately coast benefit ratio.

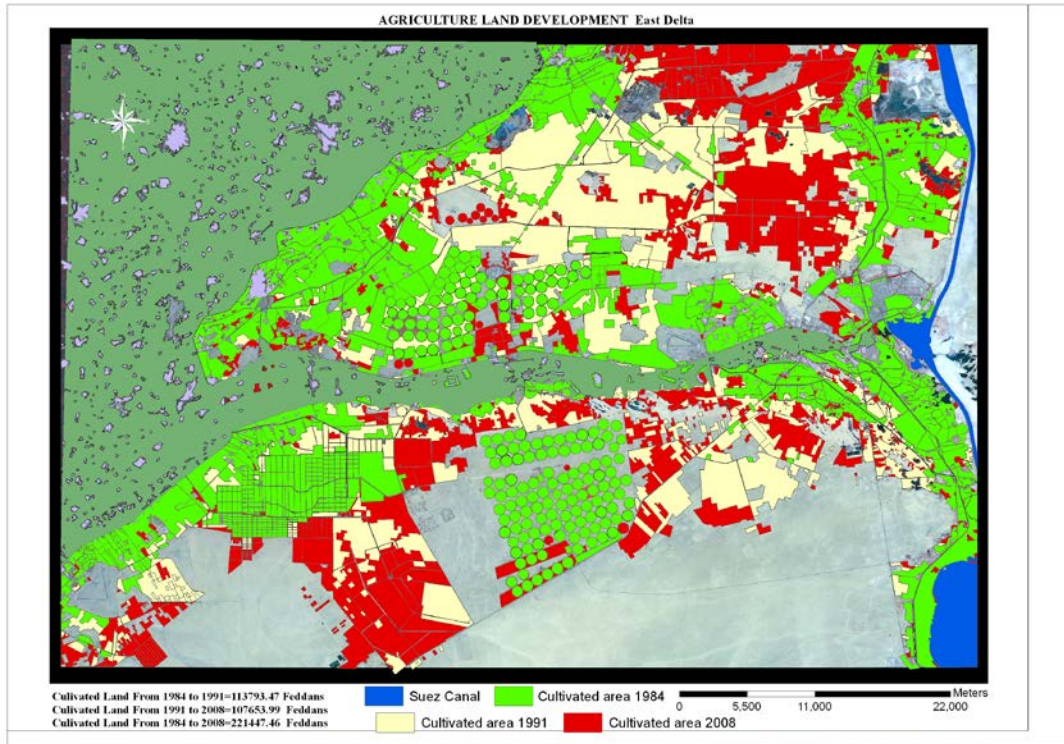


Fig (2): The Cultivated areas 1984, 1991, and 2008 of study area.

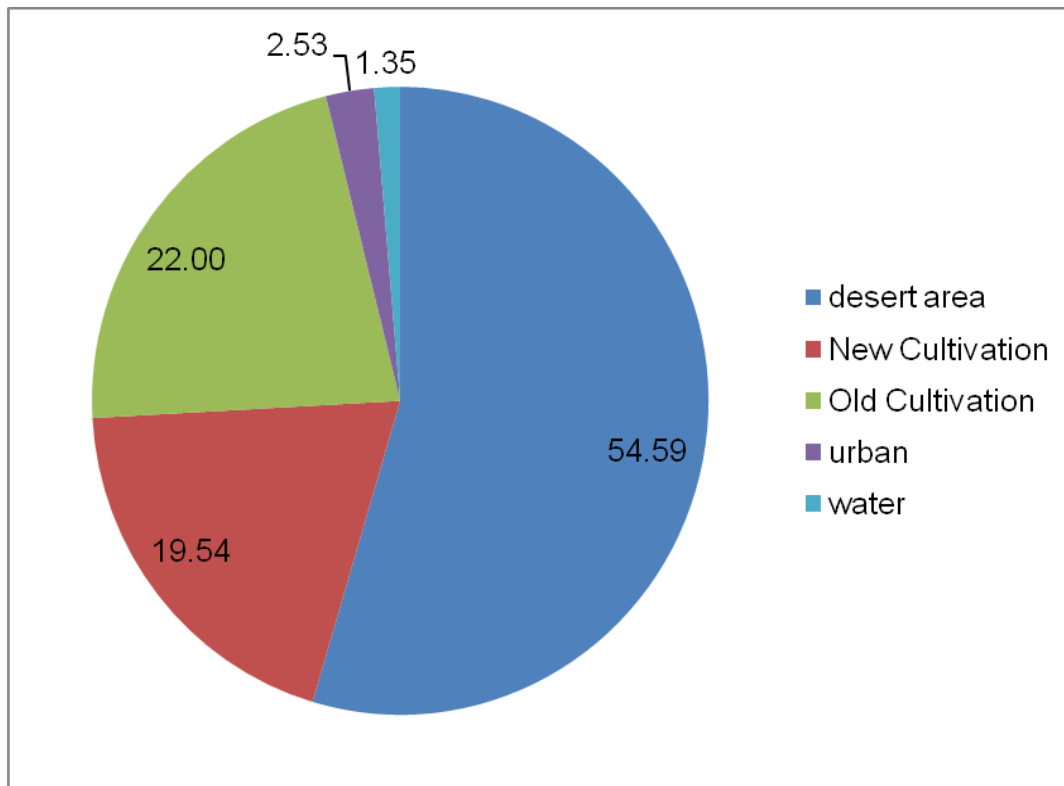


Figure (3): The Agriculture areas in years 1984, 1991, and 2008

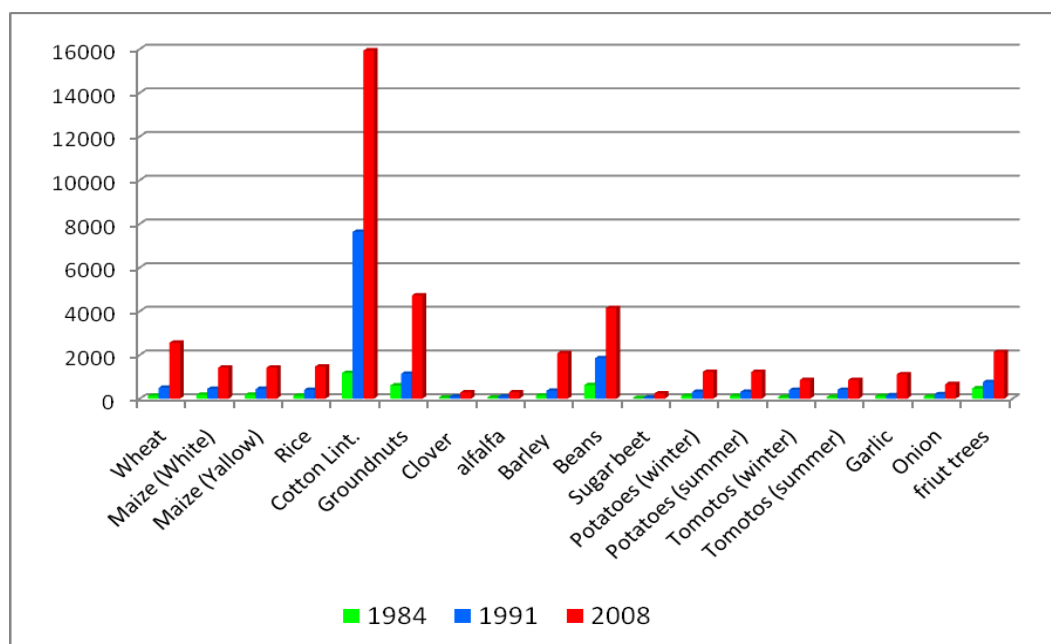
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**Table (2): The differences of land cover classes for three dates 1984, 1991, and 2008**

Classes	The classification of the study area in year 1984		The classification of the study area in year 1991		The classification of the study area in year 2008	
	Area in Feddan	Area %	Area in Feddan	Area %	Area in Feddan	Area %
Desert area	486156	54.59	357969	40.19	275760	30.96
New Cultivation	174023	19.54	284912	31.99	375870	42.20
Old Cultivation	195908	22.00	194425	21.83	194471	21.84
Urban	22489	2.53	44344	4.98	40530	4.55
Water	12037	1.35	8963	1.01	3981	0.45
Total area	890612		890612		890612	

**Table (3): The differences of new cultivated area for three dates 1984, 1991, and 2008**

Classes		The differences of new cultivated area					
		1984-1991		1991-2008		1984-2008	
		Area in Feddan	Area %	Area in Feddan	Area %	Area in Feddan	Area %
New Cultivation	1984	174023	19.54				
	1991	284912	31.99	110889	63.72		
	2008	375870	42.20			90958	52.27
Total area		890612					



**Figure (4): The Producer Price by Local Currency(LCU)/tone of years 1984, 1991, and 2008**

Table 4



**Monitoring changes in agriculture areas in a part of the eastern.....**

Table 5

Table 6

## **Monitoring changes in agriculture areas in a part of the eastern.....**

This work could be used as a model for estimation the present and future land use changes in one of the most important agricultural areas in Egypt.

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## تتبع التغيرات فى الأراضى المنزرعة فى مساحة بشرق الدلتا - بمصر باستخدام صور اقمار صناعية عالية الدقة وتأثيرها على دورة زراعية مقترحة

محمد اسماعيل ، رأفت كمال يعقوب ، يوسف قطب الغنيمى

وحدة الأستشعار عن بعد ونظم المعلومات الجغرافية - معهد بحوث الأراضى والمياه والبيئة.

### المخلص العربى

يتأثر الانتاج الزراعي فى مصر من خلال الزحف العمراني وملوحة التربة ، ومن ناحية أخرى فإن الجهود المستمرة فى استصلاح الصحراء والمناطق الساحلية نجحت فى إقامة مجتمعات زراعية جديدة وزيادة مساحة الأراضى المزروعة وبالتالي كمية المنتج الزراعى النهائى فى العقدين الماضيين. لقد حدث تغير كبير فى استخدامات الأراضى او الغطاء الأرضي ولا سيما فى مجال الزراعة والمناطق المستصلحة الجديدة بمعدل لم يسبق له مثيل بمناطق شرق دلتا النيل. والمعدل السريع للتنمية الاقتصادية ، والتركيبة السكانية والفقر من الأسباب القوية الأساسية والمسؤولة عن التغيير فى استخدامات الأراضى ، وهناك حاجة شديدة لتجميع معلومات حديثة وموثقة ودقيقة عن هذا التغير لدعم الأمن الغذائى بمصر. والهدف العام من هذه الورقة هو رصد أنواع الغطاء الأرضي الرئيسية ، وتحديد المجالات الرئيسية التي تميز الغطاء الأرضي (مناطق الزراعة) فى شرق دلتا النيل.

استخدمت طريقة التفسير المرئى للصور الجوية التي تغطى منطقة الدراسة خلال ثلاث سنوات هى 1984 ، 1991 ، و 2008 وذلك لتقدير مساحات الأراضى الزراعية الرئيسية والمياه ، والمناطق الحضرية والمناطق الصحراوية. حيث اظهرت النتائج بشكل عام زيادة ملحوظة فى مساحات الأراضى المستصلحة فى مجال الزراعة مع انخفاض فى مساحات الأراضى الصحراوية.

وقد زادت الأراضى الزراعية بنسبة 19,54 ٪ من 1984 حتى 1991 وبنسبة 31,99 ٪ من 1991 حتى 2008 و 42,2 ٪ من 1984 حتى 2008. كما تظهر النتائج أن محصول القطن كان له أعلى قيمة استفادة نظرا لارتفاع سعره كمحصول رئيس وانخفاض الدخل فى اخر سنتين من الدورة لانخفاض اسعار محاصيلها. وأظهرت النتائج أن متوسط نسبة الدخل بالنسبة للتكاليف فى موسم الصيف كان أعلى (5,74) مما كانت عليه فى فصل الشتاء (2,87). وأتضح أيضا أن نسبة الأستفادة المادية من محاصيل الدورة الزراعية الثلاثية كانت متساوية فى كل من فصلي الصيف والشتاء وتعطي مؤشرا جيدا للاستخدام المستدام للأراضى . كما أوضحت النتائج أن زراعة السورجم كان له أعلى قيمة استفادة لقلّة تكاليف زراعتة يليه العنب والحمضيات والمانجو والبرسيم المصري، اما القمح والفاصوليا وبنجر السكر والذرة السوداني والأرز والقطن تميزت باعتدال نسبة العائد.

**Table (4): The proposed first year crop rotation based on the producer price by Local Currency/tonne (LCU) of the different crops.**

Alternative rotation	Season	Crops		proposed area to cultivated Area in %	Area in Feddans	First year							
		Production	Type			Production Ton/Feddans	Local Currency /tone (LCU).	Expected return in Local Currency	Crop costs without rent in L.E./Feddans	Crop costs without rent in L.E./proposed area	Benefit	Cost benefit ratio	
1th Rotation	Summer	Main crops	Cotton	20	84764.2	0.42	15931	567158690	1799	152490724	414667966	2.72	
			maize	20	84764.2	3.47	1414	415902132	1786	151388790	264513342	1.75	
			Rice	20	84764.2	4.3	1465	533971826	1665	141132326	392839500	2.78	
		Secondary crops	Groundnuts	9	38143.9	1.35	4720	243052752	1588	60572469	182480284	3.01	
			Sunflower seed	9	38143.9	1.02	2121	82521216	921	35130506	47390709	1.35	
			Sorghum	9	38143.9	32.99	1436	1807014060	958	36541829	1770472231	48.45	
		Other	Mangoes	5	21191.0	4.57	3363	325683187	1650	34965216	290717971	8.31	
			Grapes	4	16952.8	7.7	1692	220868276	1100	18648115	202220161	10.84	
			Citrus	4	16952.8	9.76	1067	176545436	1050	17800474	158744963	8.92	
		Total of Summer Season				100	375870			4372717575		648670449	3724047126
	Winter	Main crops	Wheat	20	84764.2	2.72	2553	588615889	1469	124518551	464097338	3.73	
			Beans	20	84764.2	1.42	4136	497830083	1364	115618314	382211769	3.31	
			Egyptian Clover	20	84764.2	29.55	286	716367345	958	81204065	635163280	7.82	
		Secondary crops	Barley	9	38143.9	1.55	2083	123153212	1067	40699511	82453701	2.03	
			Potatoes	9	38143.9	10.57	1222	492686848	6979	266206083	226480766	0.85	
			Sugar beet	9	38143.9	21.55	231	189553302	1196	45620071	143933231	3.16	
		Other	Mangoes	5	21191.0								
			Grapes	4	16952.8								
			Citrus	4	16952.8								
	Total of Winter Season				100	375870			2608206681		673866596	1934340085	2.87
Total 1 <sup>st</sup> year								6980924256					

**Table (5):The proposed second year crop rotation based on the producer price by Local Currency(LCU)/tone of the different crops.**

Alternative rotation	Season	Crops		proposed area to cultivated Area in%	Area in Feddans	Second year							
		Production	Type			Production Ton/Feddans	Local Currency/tonne (LCU).	Expected return in Million Local Currency	Crop costs without rent in L.E./Feddans	Crop costs without rent in L.E./proposed area	Benefit	Cost benefit ratio	
2sd Rotation	Summer	Main crops	Rice	20	84764.16	4.3	1465	533971826	1665	141132326	392839500	2.78	
			Cotton	20	84764.16	0.42	15931	567158690	1799	152490724	414667966	2.72	
			maize	20	84764.16	3.47	1414	415902132	1786	151388790	264513342	1.75	
		Secondary crops	Sorghum	9	38143.872	32.99	1436	1807014060	958	36541829	1770472231	48.45	
			Groundnuts	9	38143.872	1.35	4720	243052752	1588	60572469	182480284	3.01	
			Sunflower seed	9	38143.872	1.02	2121	82521216	921	35130506	47390709	1.35	
		Other	Mangoes	5	21191.04	4.57	3363	325683187	1650	34965216	290717971	8.31	
			Grapes	4	16952.832	7.7	1692	220868276	1100	18648115	202220161	10.84	
			Citrus	4	16952.832	9.76	1067	176545436	1050	17800474	158744963	8.92	
		Total of Summer Season				100	375870			4,372,717,575		648,670,449	3,724,047,126
	Winter	Main crops	Egyptian Clover	20	84764.16	29.55	286	716367345	958	81204065	635163280	7.82	
			Wheat	20	84764.16	2.72	2553	588615889	1469	124518551	464097338	3.73	
			Beans	20	84764.16	1.42	4136	497830083	1364	115618314	382211769	3.31	
		Secondary crops	Sugar beet	9	38143.872	21.55	230.6	189553302	1196	45620071	143933231	3.16	
			Barley	9	38143.872	1.55	2083	123153212	1067	40699511	82453701	2.03	
			Potatoes	9	38143.872	10.57	1222	492686848	6979	266206083	226480766	0.85	
		Other	Mangoes	5	21191.04								
			Grapes	4	16952.832								
			Citrus	4	16952.832								
		Total of Winter Season				100	375870			2,608,206,681		673,866,596	1,934,340,085
Total 2sd year								6,980,924,256					

Monitoring changes in agriculture areas in a part of the eastern.....

**Table (6):The proposed third year crop rotation based on the producer price by Local Currency (LCU) /tone of the different crops.**

Alternative rotation	Season	Crops		proposed area to cultivated Area in %	Area in Feddans	Third year							
		Production	Type			Production Ton/Feddans	Local Currency/tonne (LCU).	Expected return in Million Local Currency	Crop costs without rent in L.E./Feddans	Crop costs without rent in L.E./proposed area	Benefit	Cost benefit ratio	
3rd Rotation	Summer	Main crops	maize	20	84764.16	3.47	1414	415902132	1786	151388790	264513342	1.75	
			Rice	20	84764.16	4.3	1465	533971826	1665	141132326	392839500	2.78	
			Cotton	20	84764.16	0.42	15931	567158690	1799	152490724	414667966	2.72	
		Secondary crops	Sunflower seed	9	38143.872	1.02	2121	82521216	921	35130506	47390709	1.35	
			Sorghum	9	38143.872	32.99	1436	1807014060	958	36541829	1770472231	48.45	
			Groundnuts	9	38143.872	1.35	4720	243052752	1588	60572469	182480284	3.01	
		Other	Mangoes	5	21191.04	4.57	3363	325683187	1650	34965216	290717971	8.31	
			Grapes	4	16952.832	7.7	1692	220868276	1100	18648115	202220161	10.84	
			Citrus	4	16952.832	9.76	1067	176545436	1050	17800474	158744963	8.92	
		Total of Summer Season				100	375870			4,372,717,575		648,670,449	3,724,047,126
	Winter	Main crops	Beans	20	84764.16	1.42	4136	497830083	1364	115618314	382211769	3.31	
			Egyptian Clover	20	84764.16	29.55	286	716367345	958	81204065	635163280	7.82	
			Wheat	20	84764.16	2.72	2553	588615889	1469	124518551	464097338	3.73	
		Secondary crops	Potatoes	9	38143.872	10.57	1222	492686848	6979	266206083	226480766	0.85	
			Sugar beet	9	38143.872	21.55	230.6	189553302	1196	45620071	143933231	3.16	
			Barley	9	38143.872	1.55	2083	123153212	1067	40699511	82453701	2.03	
		Other	Mangoes	5	21191.04								
			Grapes	4	16952.832								
			Citrus	4	16952.832								
	Total of Winter Season				100	375870			2,608,206,681		673,866,596	1,934,340,085	2.87
Total 3rd year								6,980,924,256					

