ASSESSMENT OF CHANGES OF LAND USE/LAND COVER OF A COMMAND AREAE IN NILE DELTA, EGYPT, USING REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM TECHNIQUES

ISMAIL M. I. , M. M. SHOMAN and Y. K. EL GHONAMEY

RS and GIS Unit; Soils, Water, and Environment Research Institute, ARC, Giza

(Manuscript received 12 July 2017)

Abstract

This study aimed to detect the changes of land use of Meet Yazid commend area, in Kafr Al-Shikh and Al-Gharbia governorates during the period from summer 2013 to winter 2015 using remote sensing and GIS techniques. In this study, RapidEye images, dynamic GPS and IMAGINE objective feature extraction module were used. The results showed an increase of cultivated areas of rice from 30.06 % to 31.57 %, while wheat increased in the year 2014 and 2015 from 27.3 % to 37.9 % of the total area respectively. On the other hand, there was a decrease of cultivated areas of maize and cotton in years 2013 and 2014 from 24.64 % to 23.29 % and from 15.26 % to 14.68 % of the total area, respectively. Clover cultivated areas decreased in years 2014 and 2015 from 21.5 % to 18.5 % of the total area, respectively. The changes of the crops in these areas may be due to the change in the social and agricultural economics. The results also showed that the rate of urban encroachment increased during the study periods where results recorded increasing in urban areas from 13.64 % of total areas in summer 2013 to 14.85 % of total area in winter 2015. The study cleared that increasing in total cultivated area of crops throughout the period from summer 2013 to winter 2015 except the period summer 2014 where occurred decreasing in total cultivated areas of crops for the previous sessions. The changes in cultivated area was accompanied by changes in the areas of fish ponds in the same period, which is due to transformation in the pattern of land use from crop cultivation to aquaculture, in some areas. The results also show the ability of RapidEye images of high differentiation for land use classes as well as obtained results with high accuracy more than 90 % for all studied seasons.

INTRODUCTION

Remote sensing and Geographical Information Systems (GIS) are powerful tools to derive accurate and timely information on the spatial distribution of land use/land cover changes over large areas. Past and present studies conducted by different organizations and institutions around the world, mostly, has concentrated on the application of land use/land cover (LU/LC) changes. GIS provides a flexible environment for collecting, storing, displaying and analysing digital data necessary for change detection. Remote sensing imagery is the most important data resources of GIS. Satellite imagery used for recognition of synoptic data of earth's surface. The rich archive and spectral resolution of satellite images are the most important reasons for their use.

Land use/land cover change, as one of the main driving forces of global environmental change, is central to the sustainable development debate. Land use/land cover change reviewed from different perspectives in order to identify the drivers of land use/land cover change, their process and consequences. The rapid changes of land use/land cover than ever before, particularly in developing nations are characterized by rampant urban sprawling, land degradation, or the transformation of agricultural land to shrimp farming ensuing enormous cost to the environment (Sankhala and Singh, 2014). This kind of changes profoundly affects local and/or regional environment, which would eventually affect the global environment. Human induced changes in land cover for instance, influence the global carbon cycle, and contribute to the increase in atmospheric CO_2 (Alves and Skole, 1996). It is therefore indispensable to examine the changes in land use/cover, so that its effect on terrestrial ecosystem can be discerned and sustainable land use planning can be formulated (Muttitanon and Tripathi, 2005).

Attempts have been made in improving agricultural statistics using area frame sampling techniques with the consideration that the classical methods for generating agricultural statistics are time consuming, costly and subject to a variety of errors (Pradhan, 2001). Due to the enormous problems related to crop identification using remote sensing imagery, many researchers have attempted to estimate land use area using an integration of sampling techniques and satellite sensor images (Loveland *et. al.*, 2002). In fact, the estimation based on the ratio between the numbers of pixels classified into the specific crop and the total number of classified pixels known is strongly biased. Similar problems arise when photo-interpretation of satellite images used for land use area, since photo-interpretation errors tend to be systematic (Ayala-Silva *et. al*, 2009). Errors of the area estimation with coarse resolution sensors result from aggregation effects, whose magnitude and scale-dependence, are related to the proportions of the classes and their landscape pattern (Moody and Woodcock, 1994). The aggregation effects lead to changes in the size and shape of land cover patches and to the disappearance of small objects at critical thresholds of resolution (Mayaux and Lambin, 1995 and 1997).

Jambally (2013) illustrated in a study in Dohuk City, Kurdistan, Iraq that spatial patterns of land use/land cover (LU/LC) change were identified through LU/LC classification and change detection analyses conducted on multi-temporal Landsat Thematic Mapper (TM) data. The results show a remarkable increase in the urban/built-up area with corresponding decreases in the barren land and vegetation areas during 1998 to 2011.

El Ghonamey *et.al.,* (2014) estimated land use classes such as crop areas in some villages in Al-Gharbia governorate – Egypt in winter season using high resolution satellite data (worldview-2) and powerful classification method (IMAGINE Objective

Feature classification) where the obtained results have overall accuracy about 91% and wheat estimate accuracy have 92%.

In general, land use detection using remote sensing technique always face the following problems: (1) Some methods that have great precision at small area become invalid at country level; (2) Some methods that successfully are applied in small area cannot be applied because of their high-cost.

Therefore, land use study methodology, at country level, must have the following properties:

- Accurate enough to support decision.
- Speedy enough to meet the time that application section required.
- Frugal enough not to go beyond the ability that application section could bear.
- Having unified criterion and can be operated easily.
- Finally, choosing the suitable date to acquire the satellite data for more differentiation between various land use/ land cover features.

Mid-resolution satellite images from RapidEye sensors classified, usually with the help of the information obtained from the ground survey, into different land use categories. In the early years of remote sensing, the term "Spectral Signature" became common to indicate the reflectance behavior of a land cover type in different wavelength intervals (channels of the sensor). The choice of this term indicated that there was a belief that, someday it would be possible to identify land use classes by its reflectance with a negligible rate of error. Today we are still very far from reaching this goal, but we can classify, reasonably well, satellite images. A careful image classification often gives an average accuracy of 80-90% when the region is not too complex and the classification nomenclature is not too detailed.

The utility of RapidEye data for developing data in land use class's area statistics was demonstrated. Generally, such studies had proof of concept in a research and development mode as their primary objective. Obtaining timely results for consumption by agricultural data users have been a secondary importance in most research and development studies.

The objective of this work is detecting changes of some main classes of land use (winter and summer seasons) of Meet Yazid commend area using Mid-resolution satellite data, dynamic GPS and powerful classification methods for obtaining high accuracy results.

MATERIALS AND METHODS

1. Study area:

Meet Yazid command area is located and extended between longitudes 30° 46′ 10.28" to 31° 8′ 0.97" East and latitudes 30° 52′ 45.94" to 31° 22′ 2.46" North along two governorates Kafr Al-Shikh and Al-Gharbia (Figure 1). This command area include nine districts namely Al-Mahalla Al-Kubra, Qotour and Tanta (Al-Gharbia Governorate) Al-Reyad, Al-Hamoul, Sidi Salem, Desouq, Beyela and Kafr Al-Shikh (Kafr Al-Shikh Governorate). The study area covers about 209751Feddans (about 88095Hectares).

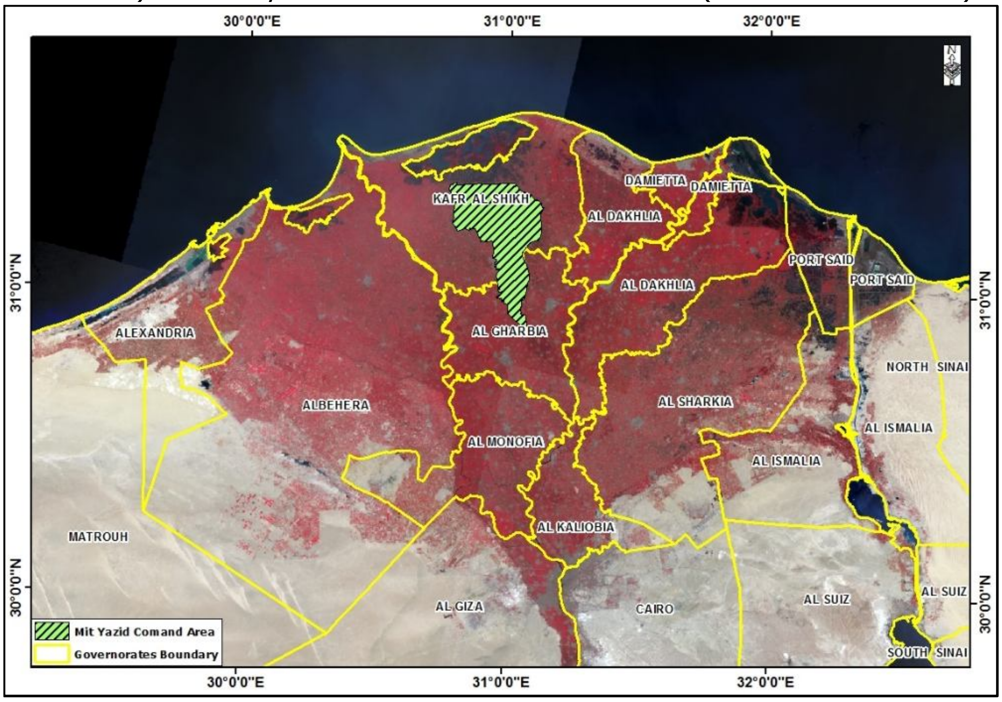


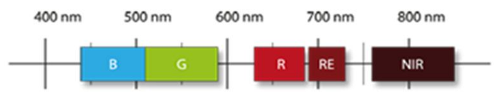
Figure 1. Location of Meet Yazid command area.

2. Materials:

2.1 Remote sensing data:

Multi temporal of RapiedEye images acquired in Aug. 2013, April 2014, July 2014 and April 2015. (Table 1 and Figure 2), were used to provide up to date land use information for better production management and monitoring of agricultural areas. The benefits of using RapidEye are cost effective, daily revisit capability. With 5 satellites in the RapidEye constellation capture is rapid and reliable used (Haboudane *et. al.,* 2002, Vinal and Gitelson, 2005).

Table 1. RapidEye satellite imagery specification

Product Attribute	Description
Orbit Altitude	630 km in Sun-synchronous orbit
Global Revisit Time	1 Day
Ground sampling distance (nadir)	6.5 m
Pixel size (orthorectified)	5 m
Swath Width	77 km
Spectral Bands	 440 – 510 nm (Blue) 520 – 590 nm (Green) 630 – 685 nm (Red) 690 – 730 nm (Red Edge) 760 – 850 nm (Near IR)

2.2 Topographic maps

Seven topographic maps of the study area with a scale of 1:50,000 produced by the Egyptian General Survey Authority (EGSA, 1990) were used to collect information about the study area and geo-reference the RabidEye satellite images. The topographic maps name: Idfina, Sidi Salim, Al-Hamoul, Disouq, Kafr El-Shiekh, Biyala and Tanta West

2.3 Remote sensing and GIS software:

- ERDAS IMAGINE 2014 software (ERDAS, 2014) for geospatial applications with IMAGINE objective feature extraction module which, enabling geospatial data layers to be created and maintained using remotely sensed imagery.
- ArcGIS V. 10.4.1 software (ESRI, 2016) as GIS software.

3. Methods:

3.1 Field Work

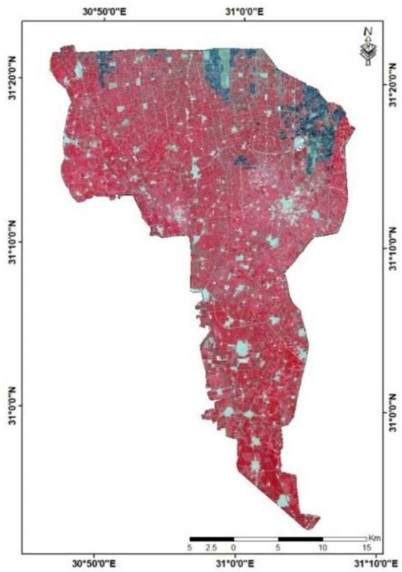
About 150 observation areas were collected each season by Global Positioning System (GPS) devices from the study area divided in two groups; the first group about 100 training areas used as training samples for classification, while the remaining training areas used in accuracy assessment process. The training samples represent the selected land use classes such as cultivated areas (wheat, clover and onion in winter season and rice, cotton and maize in summer season and other crops) in addition to urban areas, Bare soils, main Infrastructures (roads, Canals, drains and airport) and fish ponds.

3.2 Image Possessing

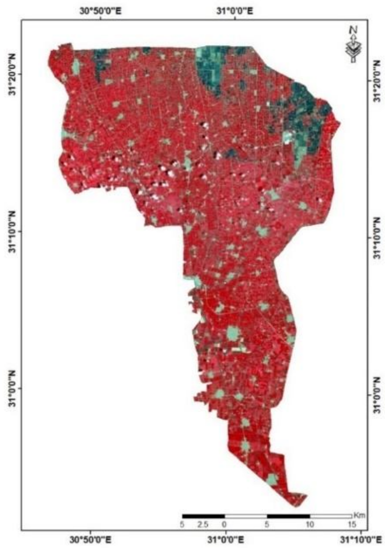
- **Geometry Correction**: Geometric correction process depends on using ground control points (GCPs) collected from topographic maps done to register the satellite images. Images defined as Egyptian Transverse Mercator, with Datum: Old Egyptian 1907, Central Meridian: 31E, Origin Latitude: 30N, False Easting: 615000 m, and False Northing: 810000 m.
- **Subset image**: Subset image used to extract the study area of each satellite images.
- **Objective Feature classification** (ERDAS, 2014): The IMAGINE Objective framework was used to produce the feature classification from imagery automatically. Three steps were used to classify the satellite images (Figure 3) started by object-based feature extraction and classification, then texture analysis and ended by feature classification. Also, attribute database was created. (ERDAS, 2014).
- **Apply raster object creators (segmentation)** using the minimum value difference and applying edge detection technique prior to segmentation function with one time pre smoothing with threshold equals to 30% and minimum length

equals to 3 pixels then eliminating all segments less than 100 meter square. Following that, extracted land use parcels were converted (pixel groups) into closed polygons in (vector format) to measure areas in square Km, or acres using polygon trace.

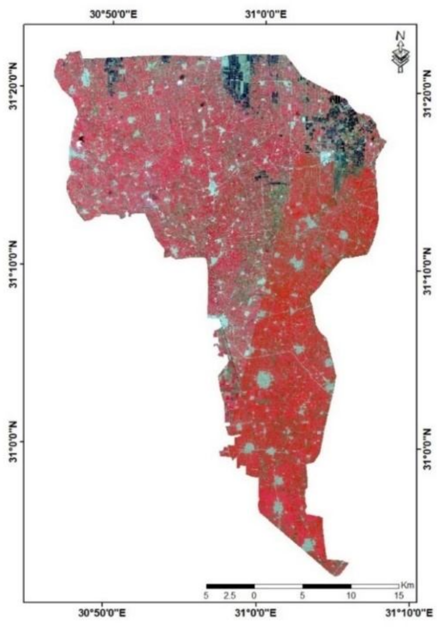
- **Detect and calculate the areas of land use classes from year 2013 to year 2015:** The results of land use pattern of different seasons used to detect the changes of land use occurred in Meet Yazid commend area of years 2013, 2014 and 2015.



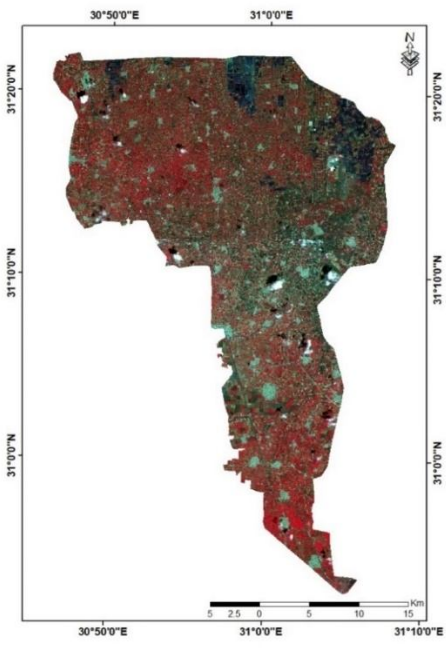
RapidEye image (August 2013)



RapidEye image (July 2014)



RapidEye image (April 2014)



RapidEye image (April 2015)

Figure 2. Multi temporal of RapidEye images of Meet Yazid command area

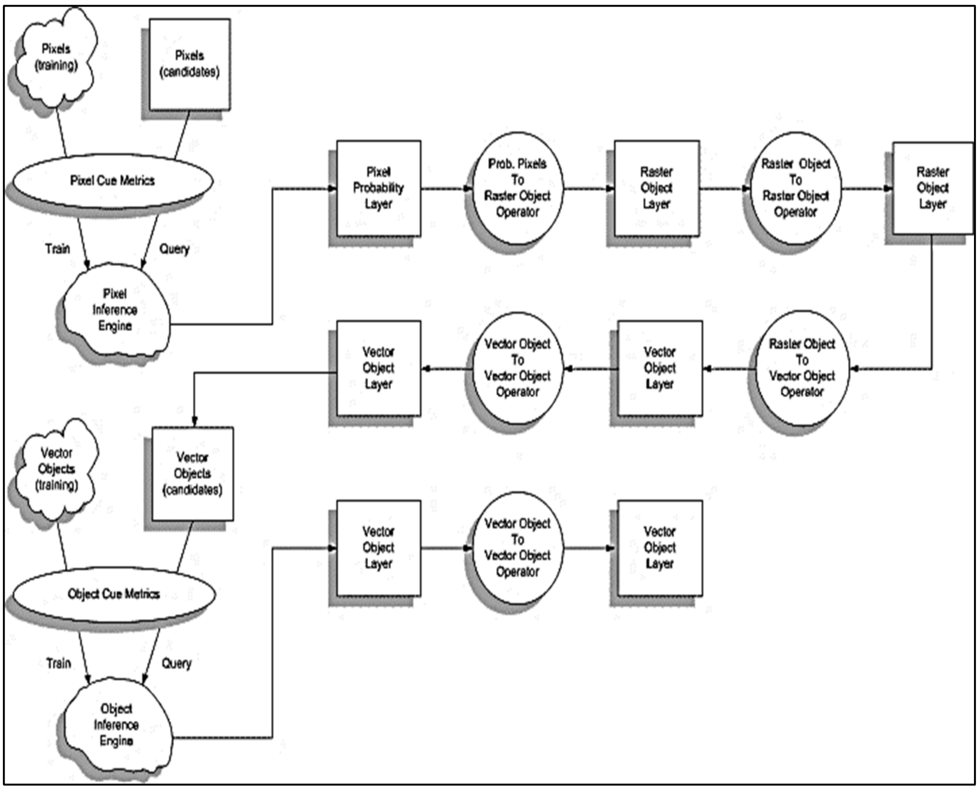
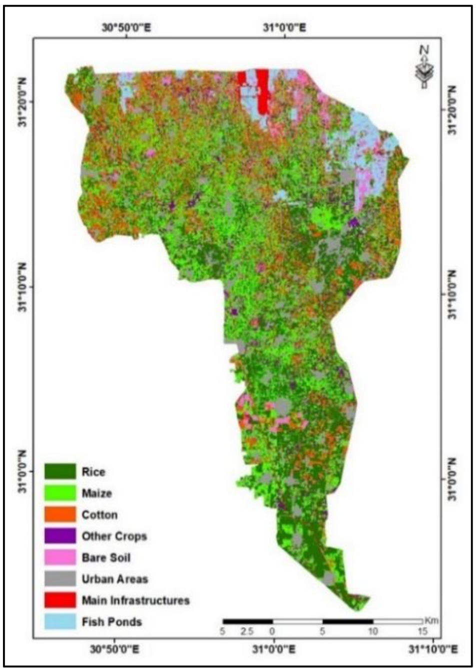


Figure 3. IMAGINE Objective Process Flow Diagram

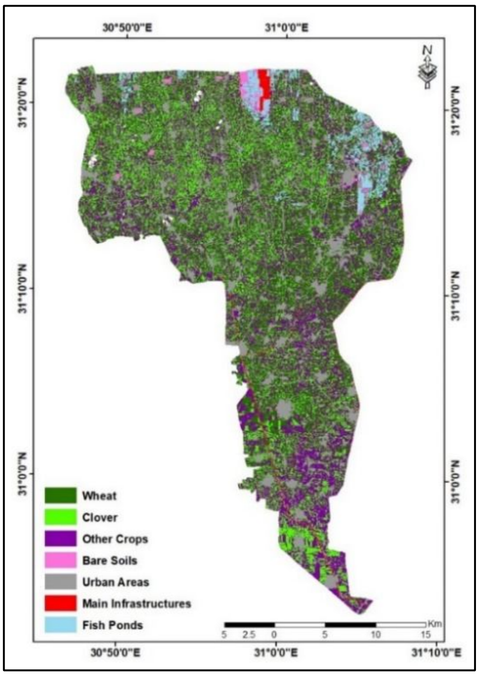
RESULTS AND DESCUSSION

1. Land use area estimations:

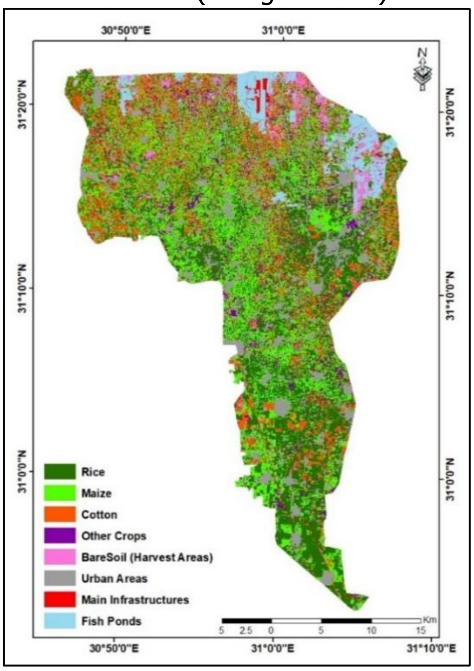
Four land use maps were created for August 2013 and July 2014 (summer seasons), April 2014 and April 2015 (winter seasons) and used to monitor the changes in land use classes in the Meet Yazid command area. Some land use classes were in one class, i.e. Main Infrastructures contains roads, canals and drain lines (Figure 4 and Table 2).



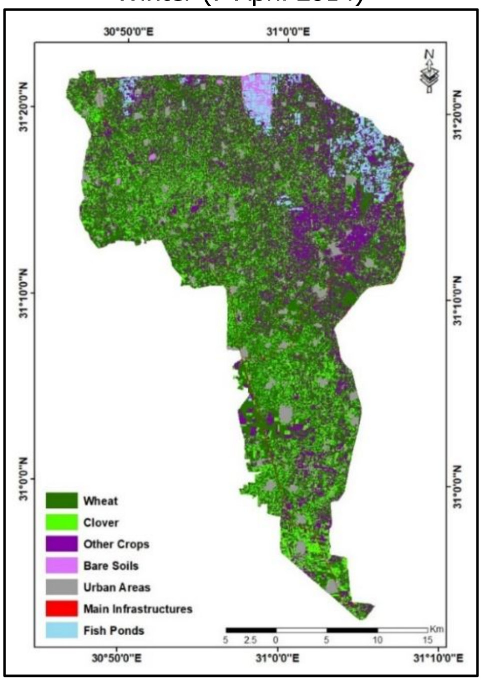
Summer (7 August 2013)



Winter (7 April 2014)



Summer (29 July 2014)



Winter (22 April 2015)

Fig. 4. Land use maps of the studied area

Table 2. Land use map classes of Meet Yazid command area in summer 2013, winter 2014, summer 2014 and winter 2015

Land use Classes		Summer 2013		Summer 2014		Land use Classes		Winter 2014		Winter 2015	
		Area		Area				Area		Area	
		Fed.	%	Fed.	%			Fed.	%	Fed.	%
1	Rice	63044	30.1	66214	31.6	1	Wheat	57248	27.3	79540	37.9
2	Maize	51691	24.6	48855	23.3	2	Clover	45184	21.5	38723	18.5
3	Cotton	32011	15.3	30783	14.7	3	Other Crops	63717	30.4	48422	23.1
4	Other Crops	14091	6.7	12992	6.2						
Cultivated Areas (Total area)		160837	76.7	158844	75.7	Cultivated Areas (Total area)		166149	79.2	166685	79.5
Bare Soils		9850	4.7	9339	4.5	Bare Soils		4102	2.0	1918	0.9
Urban Areas		28606	13.6	30764	14.7	Urban Areas		29086	13.9	31249	14.9
Main Infrastructures		1439	0.7	1468	0.7	Main Infrastructures		1586	0.8	1521	0.7
Fish Ponds		9019	4.3	9336	4.5	Fish Ponds		8829	4.2	8379	4.0
Total Area		209751	100.0	209751	100.0	Total Area		209751	100.0	209751	100.0

The results showed that in the summer seasons there was an increase in the cultivated areas of rice from 30.1 % in 2013 to 31.6 % of in 2014, of the total area. On the other hand, there was a decrease in the cultivated areas of maize from 24.6 % in 2013 to 23.3 % in 2014 and cotton from 15.3 % in 2013 to 14.7 % in 2014, of the total cultivated area.

As for the winter seasons, there was an increase in the cultivated areas of wheat from 27.3 % in 2014 to 37.9 % in 2015, of the total cultivated area. In addition, there was a decrease in the cultivated areas of clover from 21.5 % in 2014 to 18.5 % in 2015, of the total area (Fig 7).

The results showed that urban areas had an increase trend during the study period where they were 13.6% in summer 2013, 13.9% in winter 2014, 13.9% in winter 2014, 14.7% in summer 2014 and 14.9% in winter 2015, of the total area (Figure 5).

Regarding the bare soils, their areas were very high in summer seasons compared with winter seasons (Table 2). This was the same in the areas of fishponds, with relatively less variation,

In general, total areas of cultivated crops are increasing throughout the studied seasons where their percentages was 76.7%, 79.2% and 79.5% in summer 2013, summer 2014 and winter 2015, of the total area, respectively. Except in summer 2014 total areas of cultivated crops were 75.7%. This decrease was accompanied by increasing in fish pond areas in the to 4.5%.

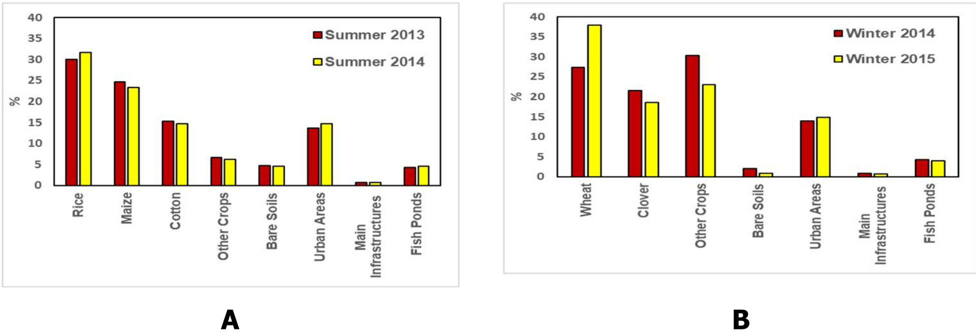


Figure 5. land use class areas percentage (A) summer 2013 and 2014 and (B) winter 2014 and 2015.

2. Accuracy assessment

Accuracy assessments done by a confusion matrix (Kohavi and Provost, 1998) which contains information about actual and predicted classifications done by IMAGINE Objective module (ERDAS, 2014). Performance of such systems evaluated using the data in the matrix. About 50 training areas used in accuracy assessment process as a check samples (Tables 3-6).

Table 3. Confusion matrix with checkpoints for IMAGINE Objective classification (Summer 2013).

		Classified Satellite Image								Producer Accuracy
		Rice	Maize	Cotton	Other Crops	Urban	Bare Soils	Main Infrastructures	Total	
Ground truth	Rice	12	1	-	-	-	-	-	13	92.3
	Maize	-	6	-	-	-	-	-	6	100.0
	Cotton	-	-	9	-	-	-	-	9	100.0
	Other Crops	-	-	-	5	-	-	-	5	100.0
	Urban	-	-	-	-	6	-	-	6	100.0
	Bare Soils	-	-	-	-	-	5	-	5	100.0
	Main Infrastructures	-	-	-	-	-	-	6	6	100.0
	Total	12	7	9	5	6	5	6	50	
User Accuracy		100.0	85.7	100.0	100.0	100.0	100.0	100.0		

Table 4. Confusion matrix with checkpoints for IMAGINE Objective classification (Winter 2014).

		Classified Satellite Image						Producer Accuracy
		Wheat	Clover	Other Crops	Urban	Fish Farms	Total	
Ground truth	Wheat	14	-	-	2	-	16	87.5
	Clover	-	24	-	1	-	25	96.0
	Other Crops	-	-	8	-	-	8	100.0
	Urban	-	-	-	0	-	-	0.0
	Fish Farms	-	-	-	-	1	1	100.0
	Total	14	24	8	3	1	50	
User Accuracy		100.0	100.0	100.0	0.0	100.0		

Table 5. Confusion matrix with checkpoints for IMAGINE Objective classification (Summer 2014).

		Classified satellite image								Producer Accuracy
		Rice	Maize	Cotton	Citrus	Urban	Bare soils	Fish farm	Total	
Ground truth	Rice	28	1	1	-	-	-	-	30	93.3
	Maize	1	4	-	-	-	-	-	5	80.0
	Cotton	1	-	12	-	-	-	-	13	92.3
	Other Crops	-	-	-	1	-	-	-	1	100.0
	Urban	-	-	-	-	0	-	-	0	0.0
	Bare soils	-	-	-	-	-	1	-	1	100.0
	Fish farm	-	-	-	-	-	-	0	0	0.0
	Total	30	5	13	1	0	1	0	50	
User Accuracy		93.3	80.0	92.3	100.0	0.0	100.0	0.0		

Table 6. Confusion matrix with checkpoints for IMAGINE Objective classification (Winter 2015).

		Classified Satellite Image						Producer Accuracy
		Wheat	Clover	Other Crops	Urban	Fish Farms	Total	
Ground truth	Wheat	17	-	-	-	-	18	96.0
	Clover	1	17	-	-	-	18	94.1
	Other Crops	2	1	8	-	-	11	73.7
	Urban	-	-	-	3	-	3	100.0
	Fish Farms	-	-	-	-	1	1	100.0
	Total	20	18	8	3	1	50	
User Accuracy		100.0	85.0	94.4	100.0	88.9	100.0	

The results (Tables 3-6) showed that in summer seasons rice, maize and cotton crops recorded 92.3 %, 100.0 % and 100.0 % respectively and the overall accuracy is 98.0 % in year 2013, while the same crops recorded 93.3%, 96.0% and 92.3% respectively and the overall accuracy is 92.0 % in year 2014. As for the winter seasons wheat and clover crops recorded 87.5% and 96.0% respectively and the overall accuracy is 94.0 % in year 2014, while the same crops recorded 96.0% and 94.1% respectively and the overall accuracy is 92.0 % in year 2015.

CONCLUSION

The obtained results indicated that the high differentiation of RapidEye Satellite images as a mid-resolution data give high accurate results close to the field results especially with data acquired in suitable time and powerful classification method for the differentiation for varies crops. In addition, results cleared significant changes in land use in the studied area due to changing farming pattern and agricultural policy.

RECOMMENDATION

It is recommended to continue follow up of changes of land cover/land use, whether these changes are due to changes in agricultural policy of farmers or governments because these changes have negative or positive effects on agricultural productivity.
It is also recommended that using modern techniques such as remote sensing and geographic information system in monitoring these changes because they have great credibility in obtaining accurate results that are near to realistic results.

REFERENCES

1. Alves, D. and D. Skole. 1996. Characterizing land cover dynamics using multi-temporal imagery. Int. J. Remote Sen. 17 (4),: 835–839.
2. Ayala-Silva, T., G. Gordon and R. Heath. 2009. Use of satellite data to study the impact of land-cover/land-use change in madison county ala-bama. American Journal of Applied Sciences, 6(4): 656-660.
3. EGSA. 1990. Topographic maps scale 1:50,000, edition by Egyptian general survey authority 1990.
4. ERDAS. 2014. IMAGINE handbook, Features Next-Generation Spatial Modeller. Retrieved 2014-03-11.
5. El Ghonamey Y. K., M. M. Shoman and A. D. Abdellatif. 2014. Estimation of crop area in some villages in Al-Gharbia governorate using GIS and Remote Sensing techniques. Minufiya J. Agric. Res. Vol.39 No. 2(2): 853 – 872.
6. ESRI. 2016. Environmental Systems Research Institute, http://www.esri.com/

7. Haboudane, D., J. R. Miller, N. Tremblay, P. J. Zarco-Tejada and L. Dextraze. 2002. Integrated narrow-band vegetation indices for prediction of crop chlorophyll content for application to precision agriculture. Remote Sensing of Environment 81(2),: pp. 416–426.
8. Jambally M. 2013. Land use and cover change assessment using Remote Sensing and GIS, Intentional Journal of Geomatics and Geosciences Volume 3, No 3.
9. Kohavi, R. and F. Provost. 1998. The Case against Accuracy Estimation for Comparing Induction Algorithms. Learning machine vv. (1-6), USA
10. Loveland, T. R., T. L. Sohl, S. V. Stehman, A. L. Gallant, K. L. Sayler and D. E. Napton. 2002. A strategy for estimating the rates of recent United States land-cover changes. Photogrammetric Engineering and Remote Sensing, 68: 1091–1099.
11. Moody, A. and A. H. Strahler. 1994, Characteristics of composited AVHRR data and problems in their classification. Int. J. Remote Sens. 15(17):3473–3491.
12. Mayaux, P. and E. F. Lambin. 1995. Estimation of tropical forest area from coarse spatial resolution data: a two-step correction function for proportional errors due to spatial aggregation. Remote Sensing of Environment, v.53, p.1-15.
13. Mayaux, P. and E. F. Lambin. 1997. Tropical forest area measured from global land-cover classifications: inverse calibration models based on spatial textures. Remote Sensing of Environment, v.59, p.29-43.
14. Muttitanon, W., and N. Tripathi. 2005. Land use/cover changes in the coastal zone of Bay Don Bay, Thailand using Landset 5 TM data. Int. J. Remote Sen. 26 (11), 2311–2323.
15. Pradhan, S. 2001. Crop Area Estimation using GIS, remote sensing and area frame sampling. International Journal of Applied Earth Observation and Geo-information, 3(1): 86 - 92.
16. Sankhala, S. and B. Singh. 2014. Evaluation of urban sprawl and land use land cover change using remote sensing and GIS techniques: a case study of Jaipur City, India. Int. J. Emerging Technol. Adv. Eng. 4 (1),
17. Vinal, A. and A. A. Gitelson. 2005. New developments in the remote estimation of the fraction of absorbed hotosynthetically active radiation in crops. Geophysical Research Letters.

تقييم التغيرات في بعض الاستخدامات الاراضى الرئيسية بمنطقة زمام ترعة ميت يزيد – مصر باستخدام تقنيات الاستشعار عن بعد ونظم المعلومات الجغرافية

محمد إسماعيل سيد احمد، محمد محمد حسنى شومان ، يوسف قطب الغنيمى

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

أقيمت هذه الدراسة لعدة اهداف تتمثل فى تعيين التغيرات فى استخدامات الاراضى بزمام ترعة ميت يزيد بمحافظتي كفر الشيخ والغربية وذلك خلال الفترة من الموسم الصيفى ٢٠١٣ إلى الموسم الشتوى ٢٠١٥ باستخدام تقنيات الاستشعار عن بعد ونظم المعلومات الجغرافية. في هذه الدراسة تم استخدام مرئيات RapidEye كبيانات متوسطة الدقة ونظام تحديد المواقع الجغرافية العالمية الديناميكي أساليب تصنيفية عالية الدقة.

أوضحت النتائج حدوث زيادة في مساحات زراعة الأرز والقمح حيث ارتفعت مساحة زراعة الأرز من ٣٠,١ % للعام ٢٠١٣ الى ٣١,٦ % للعام ٢٠١٤ وارتفعت مساحة زراعة القمح من ٢٧,٣ % للعام ٢٠١٤الى ٣٧,٩ % للعام ٢٠١٥ ومن ناحية أخرى انخفضت مساحات زراعة كل من الذرة والقطن من ٢٤,٦ % و١٥,٣ % بالترتيب للعام ٢٠١٣ الى ٢٣,٣ % و١٤,٧ % بالترتيب للعام ٢٠١٤ وأيضا انخفضت مساحات زراعة البرسيم من ٢١,٥ % للعام ٢٠١٤ الى ١٨,٥ % للعام ٢٠١٥. وأن معدل الزحف العمراني ازداد خلال فترات اجراء الدراسة سجلت النتائج زيادة المناطق الحضرية من نسبة ١٣,٦٤ % من المساحة الكلية لمنطقة الدراسة في صيف ٢٠١٣ الى ١٤,٨٥ % من المساحة الكلية في شتاء ٢٠١٥. أيضا أوضحت الدراسة تزايد المساحة المنزرعة بالمحاصيل خلال الفترة من صيف ٢٠١٣ الى شتاء ٢٠١٤ ما عدا الفترة في صيف ٢٠١٤ حيث حدث انخفاض في المساحة المنزرعة الكلية للمحاصيل عن المواسم السابقة له وصاحب هذا الانخفاض ارتفاع في مساحة المزارع السمكية في نفس الفترة مما يرجح التحول في نمط الاستخدام من زراعة المحاصيل الى الاستزراع السمكى ببعض المساحات. أيضا اظهرت النتائج القدرة التفريقية العالية للمرئيات الفضائية حيث أعطت نتائج عالية الدقة تجاوزت ٩٠ % من النتائج الحقلية لكل المواسم الزراعية المدروسة.