Annals of Agric. Sci., Moshtohor **ISSN 1110-0419**
Vol. 60(3) (2022), 939 – 948 **https://assjm.journals.ekb.eg**

Change detection of urban sprawl of some areas in Kafr El-Sheikh Governorate, Egypt.

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Abstract

Urban spraw1 is one of the main problems that led to the reduction of the limited fertile land in the Nile Delta in Egypt. The total area of the study area is 118685.81 ha. The purpose of this study was to estimate the changes in Agriculture are a due to urban sprawl in Kafr El-Sheikh Governorate, Egypt. It is delimited by latitudes 30°57′00″ 31°29′00″N and longitudes 30°35′00″ 31°05′00″E. Software's (ENVI 5.1) have been used for processing and analyzing remote sensing data. Satellite data monitoring of land use –land cover changes in the study area. Three periods have been set in the studied area in 1981, 2001 and 2021, to study the agricultural area and urban sprawl. This study was carried out over three periods. The first case from 1981 to 2001, the urban increase in 2001 was greater than in 1981 by 2630 ha. The area cultivated during that period decreased by 2734.9 ha. The second case from 2001 to 2021.The urban increase in 2021 was greater than in 2001 by 1048.8 ha. The area cultivated during that period decreased by 1048.8 ha. The third case from 1981 to 2021, The urban increase in 2021 was greater than in 2001 by 3783.7 ha. The area cultivated during that period decreased by 3783.7ha.

Keywords: Land degradation, Kafr El-Sheikh Governorate, Arc GIS, Remote sensing and GIS

Introduction

Egypt's agriculture is the core of the national economy and the soils in the Nile Delta is most suitable for Egyptian agriculture. Only approximately 4% of Egypt's total area are agricultural land. The remaining 96% of the land is arid desert. Seen from this perspective, the need for reclamation of the desert appears inevitable in light of continuing population growth and increasing congestion in the long-settled lands in the Nile valley and the delta **(Hamdi and Abdelhafez, 2001)**. Arable land in the Nile Delta is 1.85 million hectares that represent 51.2% of the total cultivated land, and 73.3% of the old fertile alluvial soils in Egypt. This region houses half of Egypt's inhabitants and about two thirds of the agricultural activities **(Mohamed, 2017a)**.The government also aims to transfer the driving force of agricultural land away from the old and high-yielding agricultural land in the Nile Delta through effective horizontal urban expansion and the reclamation of more desert areas and land near the edge of the Nile Delta**. (Bella, 2014)**.

In Egypt, the management of different natural resources (land and water) is necessary to maintain food supply and achieve the sustainability of agricultural development; however, unfortunately, natural resources are under severe pressure from increasing population and continuing land degradation **(El-Baroudy et al., 2011)**.

Change detection has become the main application of remote sensing data. Satellite remote sensing is a potentially powerful means to monitor land use changes with high time resolution and at a lower cost than using traditional methods **(Jensen, 1983; Martin, 1986; Martin and Howarth, 1989 and El-Raey et al., 1995)**. Land degradation and urban expansion are the most common problems that threaten ongoing agricultural activities and prohibit further reclamation expansion **(AMohamed E.S et al., 2011; and Mohamed et al., 2013)**.Urban growth has led to changes in land use /land cover in many parts of the world, especially in developing countries. Egypt's unprecedented population growth coupled with unplanned development activities has led to the destruction of agricultural land. Change detection is the process of identifying differences in states by observing objects or phenomena remotely at different times. The changes caused by human forces are the result of humans changing the environment **(Pilon et al., 1988)**.Land degradation (LD) is a temporary or permanent decline in the productive capacity and quality of land, leading to a decline in its ecological and economic functions. This is one of the biggest challenges in the world, especially for developing countries in Asia and Africa **(Mahala, 2017)**.Because human activities exaggerate natural events, land degradation is often described as a significant decline in the biological productivity of the land system **(Johnson and Lewis 2007)**.Land degradation is not only one of the most serious environmental problems in the world, but also one of the major social and economic problems. Food and energy security **(Reed et al., 2011)**, land desertification **(Salih et al., 2017. Liu et al., 2008)**, sustainable socio-economic system development and human living environment **(Winslow et al., 2011)**. Land degradation has become one of the biggest challenges facing mankind in the world today **(VelmourouganeandBlaise, 2017)**.

The aim of this study is to identify the change in the cultivated area and the urban sprawl on agricultural lands during different time periods in Kafr El-Sheikh Governorate by using remote sensing and GIS techniques.

Materials And Methods

Location of the study area

The investigated area is located south of Lake Burullus in Kafr El-Shikh and extends to Kafr El-Shikh down administrative border. It is delimited by latitudes 30°57′00″ 31°29′00″N and longitudes 30°35′00″ 31°05′00″E (Fig. 1). The total area of the study area is 118685.81 ha.The location is located at a height of around 1- 15 metres above sea level. It has a semi-arid climate with an annual rainfall of 100 mm on average. The area's highest daily evapotranspiration is 4.5 mm, while the mean annual maximum and minimum temperatures are 27.6 and 15.2 degrees Celsius, respectively.

The detection of land cover/use change in study area 1981 to 2021 was evaluated through the specification of a multi-time classification joint model.

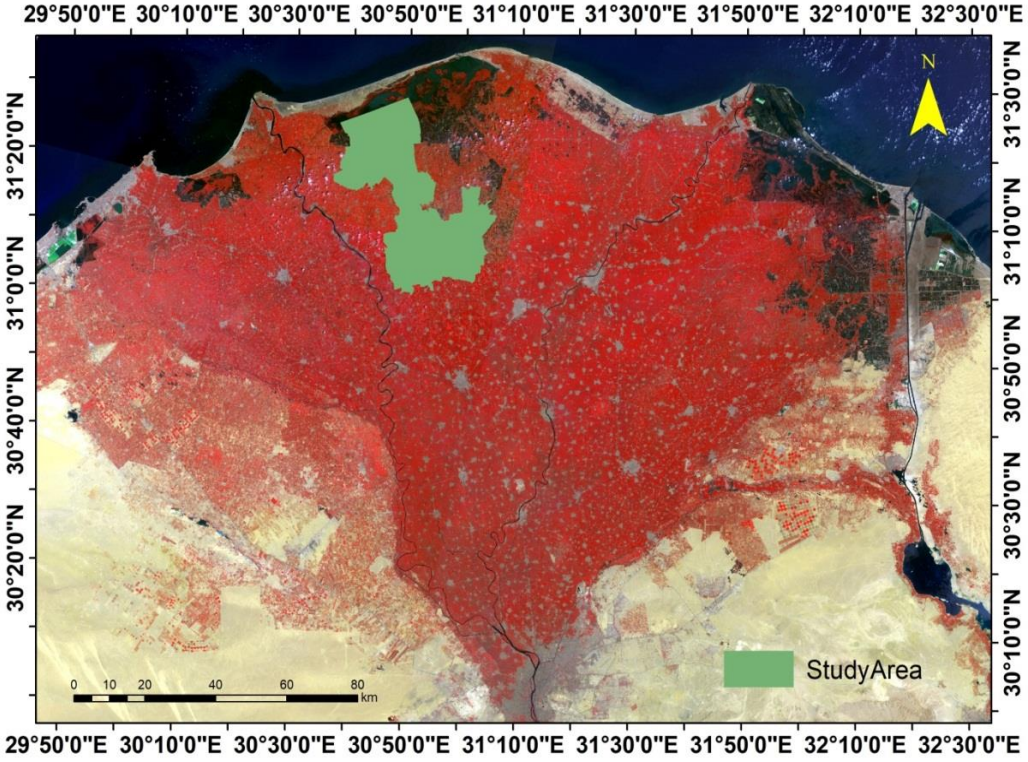

Fig. 1.Location map of the study area.

Data collection

Three different types of Landsat imagery (Landsat-TM, Landsat-ETM and Landsat-OLI TIRS) are obtained from the USGS earth explorer website through ENVI version 5.1 and ArcGIS version 10.2. The Landsat-TM image consists of seven spectral bands with wavelengths from 0.45 m to 2.35 m. The spatial resolution of band 1 to band 5 and band 7 is 30 m, while the spatial resolution of band 6 (thermal infrared) is 120 m. Landsat-ETM consists of 8 bands with wavelengths ranging from 0.45 m to 2.35 m. The spatial resolution of bands 1, 2, 3, 4, 5, and 7 is 30, while bands 6 and 8 are 60 and 15 m, respectively. Land sat OLI TIRS TIRS consists of 11 bands with a spatial resolution of 30 m in bands 1-7, band 9 has a spatial resolution of 30 m, bands 10 and 11 (thermal bands) (TIRS) have 100 m, and band 8 The (panchromatic) spatial resolution is 15 m. In order to achieve the research goals, images of three different dates in 1981, 2001 and 2021 were used.

Post classification change detection

The images were classified from three time periods (1981, 2001, and 2021) and then compared and detected. Use support vector machine technology to classify each date of the image. Export the classified images to ArcGIS 10.2 software for vectorization, calculation, and area comparison between different dates to identify various changes in land use/land cover increase or decrease. The applied framework of methodology is presented in Figure 2

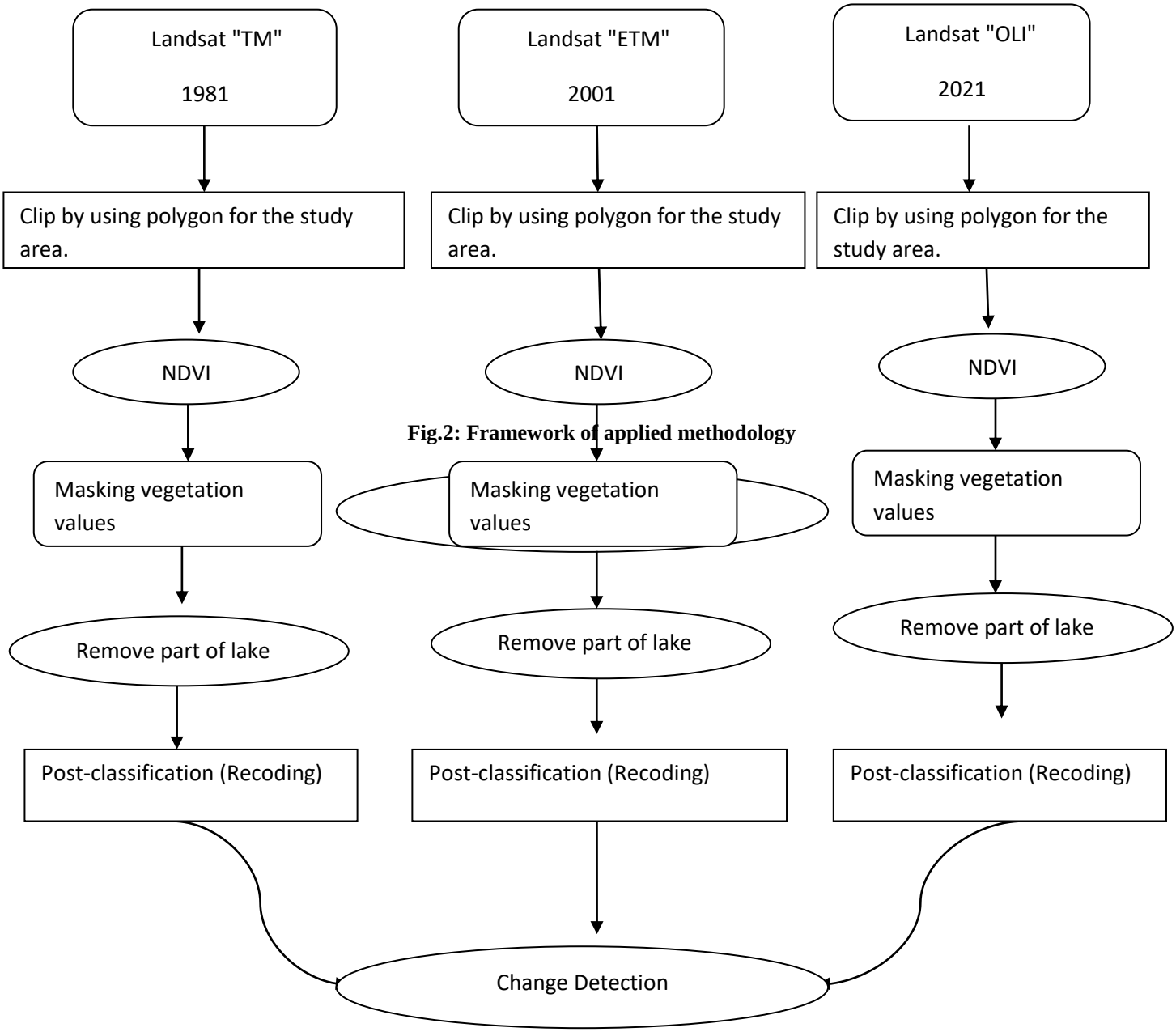

Fig.2: Framework of applied methodology

Land use/land cover change detection in the study area.

The obtained classification images, after preprocessing and supervised classification, indicate different land use and land cover patterns in the study area. From 1981 to 2021, changes in different land use/land cover types in the study area increased and decreased with changes in different activities such as urban expansion. The main impact of human activities on land degradation in the survey area is urban expansion. The results show that all land use and land cover types change regularly.

Change detection Land use/land cover during the survey period from 1981 to 2001.Urban growth caused serious losses of agricultural land in Egypt **(Hegazy and Kaloop, 2015)** Fig.3 show image of Land sat- TM acquired in 1981 and image of Landsat -ETM+ in 2001 .Urban expansion In the study area during 1981 to 2001 was considerable .The impact of this urban expansion land was evaluated, and the statistical data are illustrate table (1) and fig (4). Urban area increased from being 4507.2 ha in 1981 to 7242.10 ha in 2001 increasing by 2630 ha. Agricultural area decreased from being 103496.6 ha in 1981 to 100761.7 ha in 2001 decreasing by 2734.9 ha.

Table1. Changes in the areas of different soils and urban in the study area in 1981 and 2001

Land type	Totalareain1981 (ha.)	Totalareain2001 (ha.)	Change area (ha.)
Agriculture	103496.6	100761.7	-2734.9
Urban	4507.2	7242.10	+2734.9
Water bondes	10682.01	10682.01	00
Total area	118685.81	118685.81	00

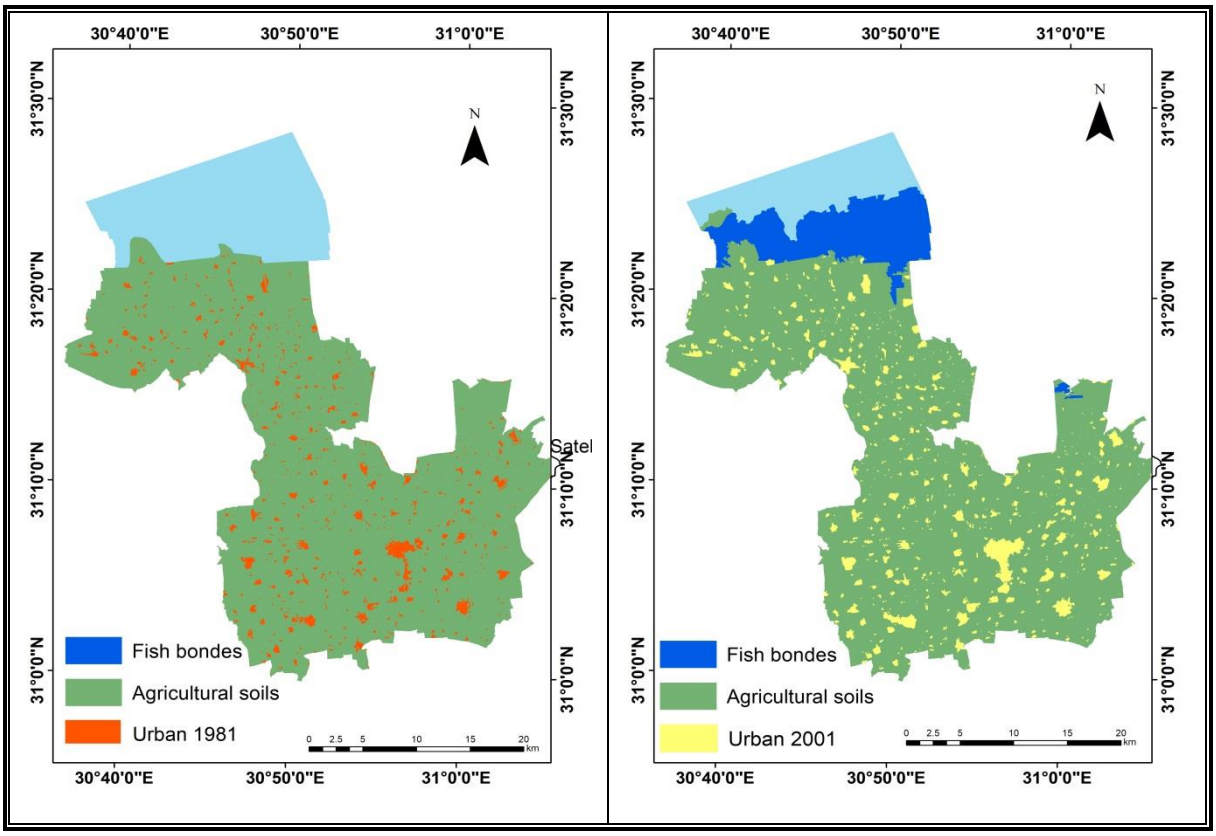

Fig.3 .Landuse/landcover classes in year of 1981and 2001 in the studied area.

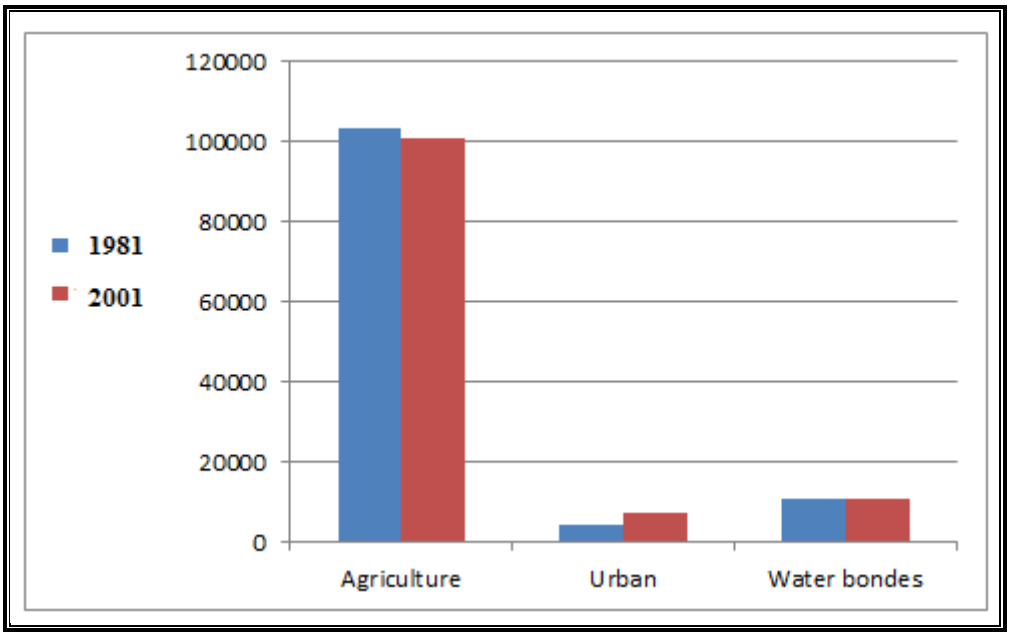

Fig.4. Change detection in agriculture land and urban area during the 1981–2001 in the study area

Change detection the land use/land cover in the study area from 2001 to 2021

The changes in different characteristics of the survey area from 2013 to 2019 increased or decreased as cities occupied cultivated land and other activities. Figure 5 show maps of land use/ land cover of Land sat- ETM+ acquired in 2001and image of Land sat-OLI in 2021. Area of agriculture land decreased during the period of 2001to 2021. In 2001 the area was cultivated 100761.7 ha while in 2021 the cultivated area became99712.9 ha a decrease of 1048.8 ha. The area of urban land 7242.10 ha in 2001and become 8290.9 ha in 2021 increased by 1048.8 ha. Table (2) and Figure (6) show the change during the period of 2001–2021 in study area.

Table 2. Changes in the areas of different soils and urban in study area in 2001 and 2021.

Land type	Totalareain2001 (ha.)	Totalareain2021 (ha.)	Change area (ha.)
Agriculture	**100761.7**	**99712.9**	**-1048.8**
Urban	**7242.10**	**8290.9**	**+1048.8**
Water bondes	**10682.01**	**10682.01**	**00**
Total area	**118685.81**	**118685.81**	**00**

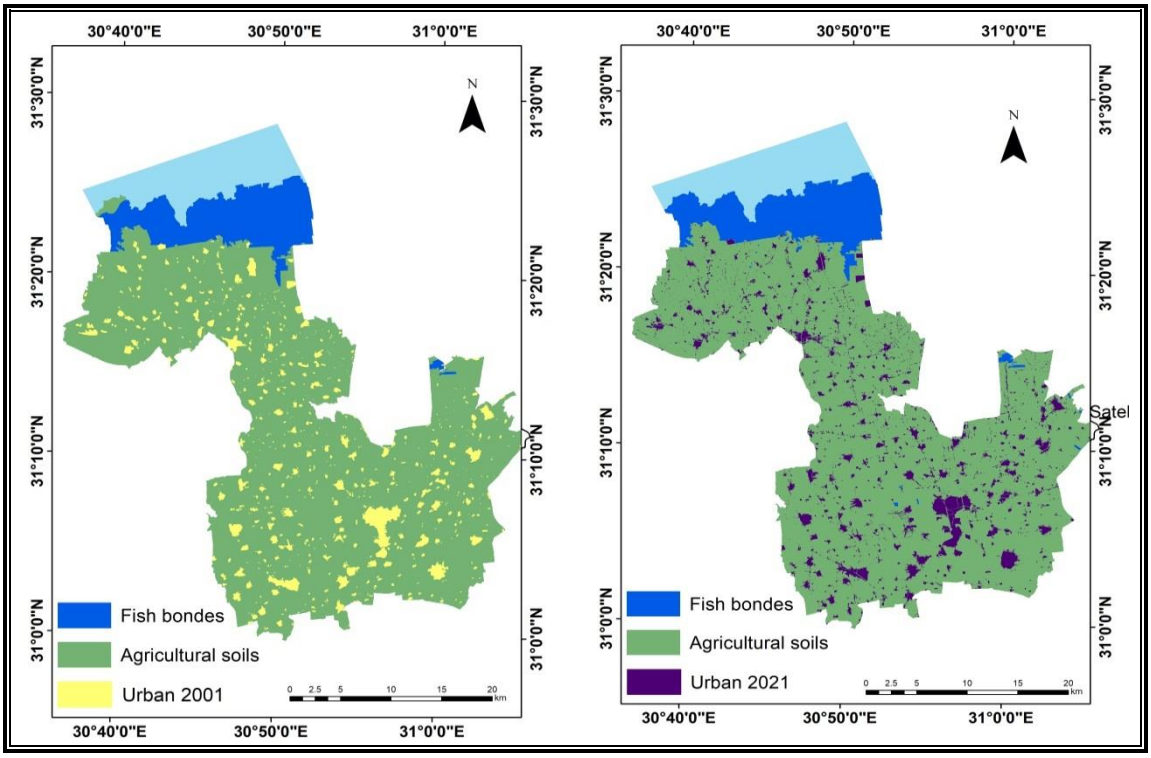

Fig.5 . Land use/land cover classes in year of 2001and 2021 in the studied area

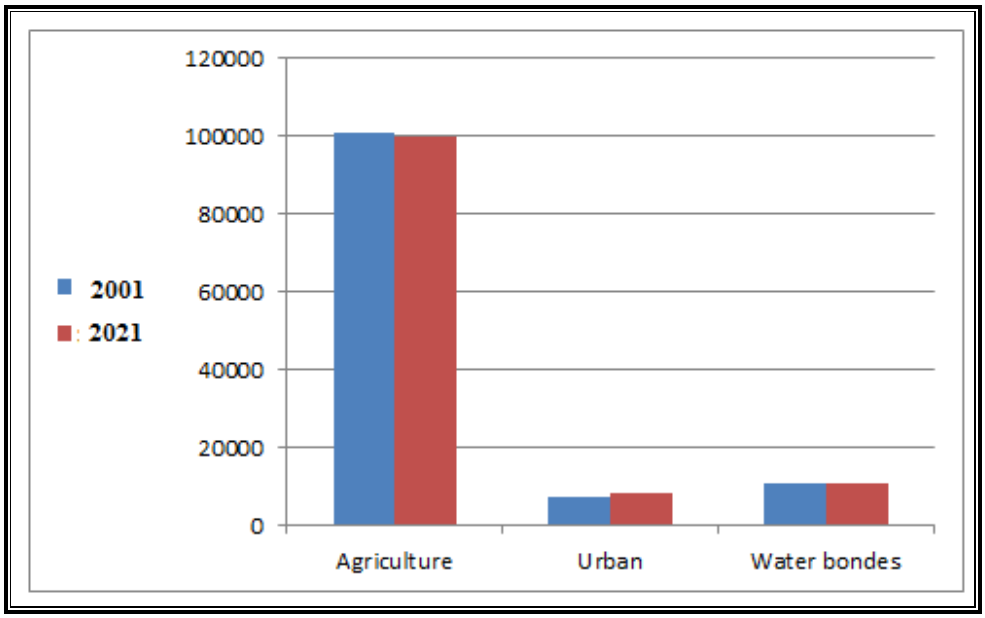

Fig.6. Change detection in agriculture land and urban area during the 2001–2021 in study area

Change detection the land use/land cover in the study area from 1981 to 2021

Figure 7 show maps of land use/ land cover of Land sat- TM acquired in 1981 and image of Land sat-OLI in 2021. Area of agriculture land decreasing during the period of 1981 to 2021. In 1981the 103496.6 ha become 99712.9 ha in 2021 decreasing by 3783.7ha. The area of urban land was 4507.2 ha in 1981 and become 8290.9 ha in 2021 increasing by 3783.7 ha. Table 3 and Figure 8 show the change during the period of 1981 –2021 in the study area

Table 3. Changes in the areas of different soils and urban areas in the study area in 1981 and 2021

Land type	Totalareain1981 (ha)	Totalareain2021 (ha)	Change area (ha)
Agriculture	**103496.6**	**99712.9**	**-3783.7**
Urban	**4507.2**	**8290.9**	**+3783.7**
Water bondes	**10682.01**	**10682.01**	**00**
Totalarea	**118685.81**	**118685.81**	**00**

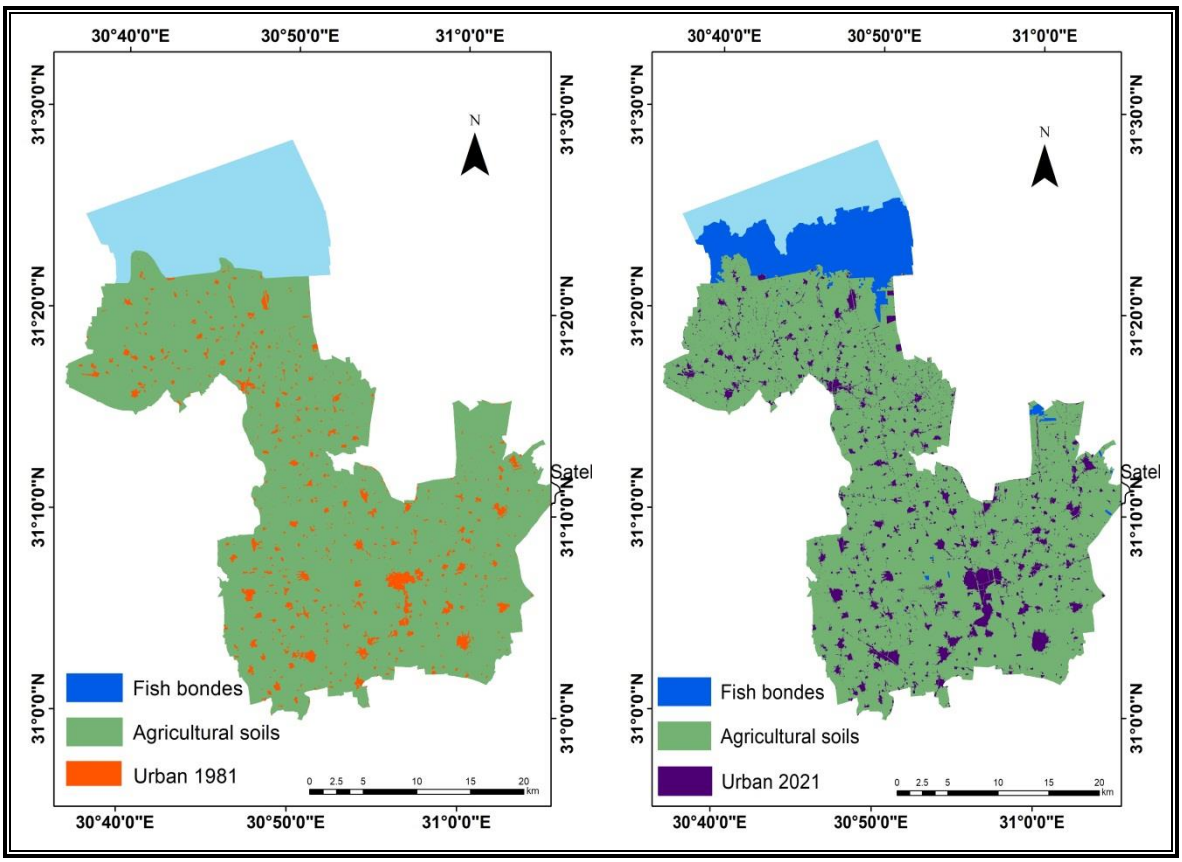

Fig. 7 . Land use /land cover classes in year of 1981and 2021 in the studied area.

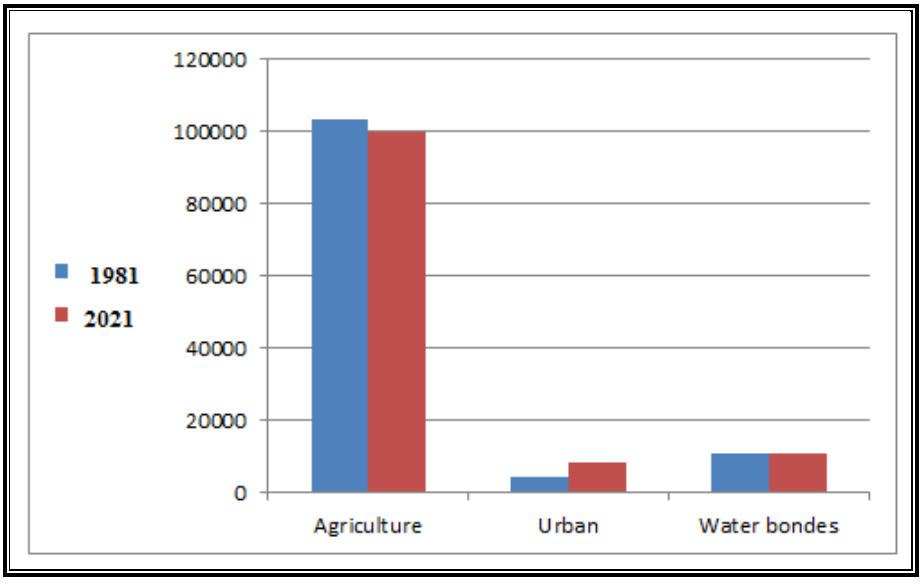

Fig.8. Change detection in land cover and urban area during the 1981 –2021 in the study area

Conclusion

Urban spraw1 is one of the main problems that led to the reduction of the limited fertile land in the Nile Delta in Egypt. Remote sensing and GIS are effective tools to map and analyze urban sprawl using three Landsat images (Landsat-TM acquired in 1981, Landsat-ETM+ acquired in 2001 and Landsat-OLI acquired in 2021). This study was carried out over three periods. The first case from 1981 to 2001, urban area increased from being 4507.2 ha in 1981 to 7242.10 ha in 2001 increasing by 2630 ha. Agricultural area decreased from being 103496.6 ha in 1981 to 100761.7 ha in 2001 decreasing by 2734.9 ha. The second case from 2001 to 2021, in 2001 the area was cultivated 100761.7 ha While in 2021 the cultivated area became 99712.9 ha a decrease of 1048.8 ha. The area of urban land 7242.10 ha in 2001 and become 8290.9 ha in 2021 increased by 1048.8 ha. The third case from 1981 to 2021, in 1981the 103496.6 ha become 99712.9 ha in 2021 decreasing by 3783.7ha. The area of urban land was 4507.2 ha in 1981 and become 8290.9 ha in 2021 increasing by 3783.7 ha.

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الكشف عن التغيرات فى الزحف العمرانى فى بعض المناطق فى محافظه كفر الشيخ ,مصر

وفاء سمير حسن إبراهيم , هبه شوقي عبد الله راشد, إبراهيم محمد السيد, محمد عبد الرحمن السيد عبدالرحمن

1-قسم الأراضي والمياه -كلية الزراعة -جامعة بنها -مصر

2-الهيئه القوميه لإستشعار عن بعد وعلوم الفضاء -القاهره -مصر

يعد الزحف العمراني أحد المشاكل الرئيسه التى تؤدى إلى الحد من الأراضى الخصبه فى دلتا النيل فى مصر.والغرض من هذه الدراسة هو تقدير التغيرات فى الزراعة نتيجة الزحف العمرانى فى محافظة كفر الشيخ ,مصر. ولمعالجة وتحليل بيانات الإستشعار عن بعد تم استخدام برنامج ENVI 5.1 . ومراقبة الأقمار الصناعيه فى إستخدامات الأراضى وتغيرات الغطاء النباتى فى منطقة الدراسه . وتم تحديد ثلاث فترات فى منطقة الدراسه عام 1981 و2001 و2021 لدراسة المساحه المنزرعه والزحف العمرانى.وأجريت هذه الدراسه على ثلاث فترات الحالة الأولى من 1981 إلى 2001وكانت الزياده العمرانيه فى عام 2001 أكبر مما كانت عليه فى عام 1981 بمقدار 2630 هكتارا .وإنخفضت المساحة المنزرعه خلال تلك الفتره بمقدار 2734.9 هكتار.والحاله الثانيه من عام 2001 إلى عام 2021 وكانت الزياده العمرانيه فى عام 2021 أكبر مما كانت عليه فى عام 2001 بمقدار 1048.8 هكتارا.وإنخفضت المساحه المنزرعة خلال تلك الفتره بمقدار 1048.8.أما الحاله الثالثه من عام 1981 إلى عام 2021,فقد كانت الزياده العمرانيه فى عام 2021 أكبر مما كانت عليه فى عام 1981 بمقدار 3783.7 هكتار.وإنخفضت المساحه المنزرعه خلال تلك الفتره بمقدار 3783.7 هكتار.