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USING REMOTE SENSING AND CHANGE DETECTION TECHNIQUES IN MONITORING LAKE EDKU PROBLEMS

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ABSTRACT

Lake Edku is one of the most important northern delta lakes, where the production of fish annually about 10910 tons/year and supports the living conditions for more than 4000 fishermen. Lake Edku was continuously exposed to many changes that causing deterioration in its fish production, area and quality as about 40% of lake area has been disappeared and lake water quality become worst. The aim is achievement the sustainable use of Lake Edku, this could be achieved through the collection of reliable and comprehensive set of scientific data using remote sensing technology. Also for analyzing the trends and estimating the temporal changes change detection techniques were used in this study. The results revealed that During1973-1988, the aquatic vegetation increased gradually and many islands were filled and connected to ground. While during 1988-2005 urban areas and roads are expanded, in addition it was observed that water areas gradually increased as it were used in the operation of fish farms; in the same time many areas are dredged for establishment new canals and drains. For protect the lake water from the deterioration, it was recommended 1) establishment of fish farms within this surface area and removal of fish farms that violated the law.2) taking effective and urgent actions to stop dumping the sewage of neighboring villages in the lake and create units and sanitation systems for maadeya villages, and increase and raise the productivity of the lake in line with water area by rate 1 ton per acre per year and providing the necessary fish fry from the output of hatcheries as a solution to maintain and raise the productivity

Key words: *Lake Edku, pollution, remote sensing, change detection, principal components analysis*

INTRODUCTION

The history of the Lake Edku goes to ancient time. It was a large fresh water lake with connection to the canaopic branch from River Nile. Figure (1) shows Lake Edku at 1866. In the beginning of 19th century, after disappearance of Canopic Branch, the lake water became brackish as it depended on the sea water and drainage water from surrounding drains. These drains are Edku, Bossily and Berserk drains Figure (2). Berserk drain enters the lake from the central part of the southern area while bossily drain enters in the northeast corner, in addition large part of edku drain passing through the eastern part of the lake. The Edku Drain mainly discharges agricultural drainage water, while the drainage water of bossily subs drain is composed mainly from domestic drainage water. The drainage water of Edku, Bossily and Berserk drains annually supply the lake with 1836.55 × 106 m3 of drainage water (Shakweer,

2006). Nowadays these drains have been used intensively in the operation of fish farming activities.

Fish farming activities appeared at 1985 and continuously extended on the shallow areas of lake water so far. Fish farming takes many types that include extensive, semi-intensive, intensive and integrated using technology like cage, pond and rice field (Fisheries & Aquaculture Department, 2003). At 70’s and 80’s new agriculture activities are flourished, also the establishment of different roads and railways begun to develop since 40’s up to present time(Alex -rachid rail way, Khat -rachid road, International coastal road) Figure (2&3).

Since 70’s lake water suffered from heavily populated with different species of aquatic vegetation (Samaan, 1974; El Sarraf 1976) includes Ceratopyllum, Najas armata, Typha Australis, reeds and Potamogeton pectinatus Figure (4). These species were distributed at eastern, western and southern areas of lake body. The Heavily distribution of rooted plants and submerged aquatic vegetation causing disturbance in lake water circulation, enhancing sediment accumulation, which causing decrease in lake depth and basins. (Ecological Fishery Management Plan Report, 2010).

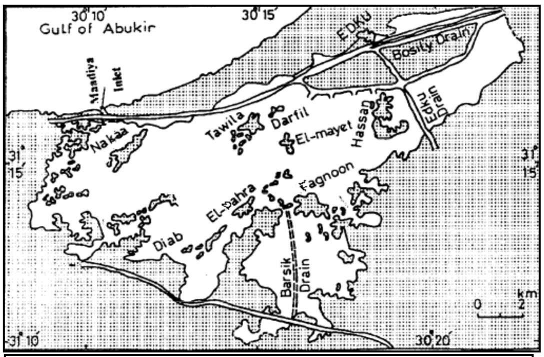

Figure (2) Main connected drains in the lake

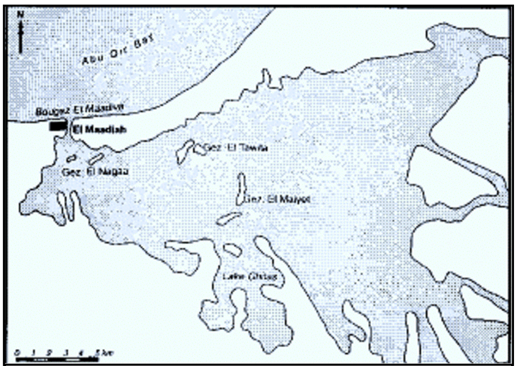

Figure (1) Lake Edku at 1866.

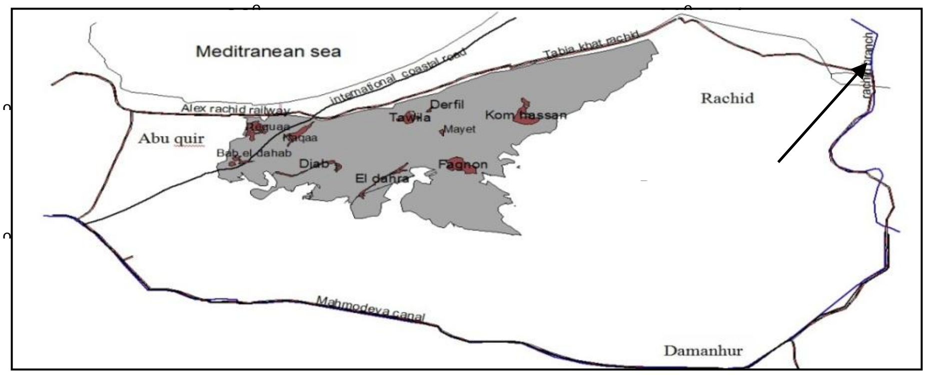

Figure (3): Location of Lake Edku.

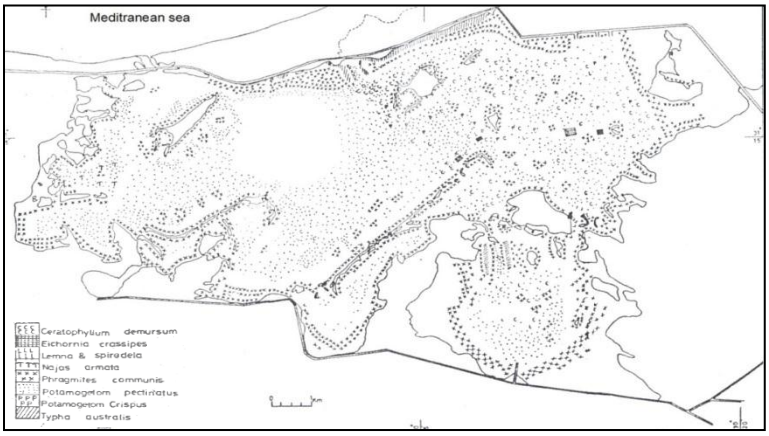

Figure (4): Distribution of vegetation in the Lake

The main aim is studying and assessing the Lake Edku environment through: Identify the different land covers, activities at different dates using remote sensing and change detection techniques, from 1973 to 1988 up to 2005.

METHODS AND ANALYSIS

1-Classification techniques

i. Supervised classification

Supervised classification is a procedure for identifying spectrally similar areas on an image by identifying training areas of known targets and then extrapolating those spectral signatures to other areas of unknown target. The objective of training data is to obtain a set of statistics that describe the spectral pattern for each land-use/land-cover category to be classified. The decision rules for the supervised classification process are multi-level, for parametric signatures the following decision rules are provided maximum likelihood, mahalanobis distance, and minimum distance. Maximum likelihood classifier algorithm found to be a desirable classification algorithm. As it proved to give the best results after trying many supervised classification techniques.

ii. Unsupervised classification

Unsupervised classification was used to cluster pixels in a data set without any user-defined training classes. Although the method requires no user input to create the classified image, the output tends to require a great deal of post classification operations to make the results more meaningful. The clustering algorithm (Tou & Gonzalez., 1974) aggregates pixels in clusters, as it repeats the clustering of the image until the maximum number of iterations was performed. The output of this technique could be affected by the choice of initial parameters and their interactions with each other (Vanderzee & Ehrichlich, 1995).

2- Change detection techniques:

Change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different times (Singh, 1990). Timely and accurate change detection of earth's surface features provides the foundation for better understanding relationships and interactions between human and natural phenomena to better manage and use resources. Many different change detection techniques include principal component analysis,

post classification comparison, have been used for studying temporal changes analysis (Jensen *et al*., 1993; Mas, 1999; Tardie & Congalton, 2002; Kumar *et al*., 2005).

i. Principal Components Analysis

Principal components analysis (PCA) technique is mostly used when the multi-temporal data are highly correlated, and so, change information can be highlighted in new components. The advantages of PCA method are reducing data redundancy between bands and emphasize different information in the derived components. While the main disadvantages of this method are the difficulty to interpret and label the change detection results between different dates. In the same time this method cannot provide a complete matrix of change class information and the changed areas.

ii.Post-classification Comparison

Post-classification techniques are iterative and require further refinement in order to produce more accurate change-detection results. Post-classification comparison technique could be implemented by separately classifies multi-temporal images into thematic maps, and then implements comparison of the classified images pixel by pixel, by properly coding the classification results with helping of cross tabulation analysis a complete matrix of change is obtained, and change classes can be defined by the analyst. Post-classification comparisons of derived thematic maps go beyond simple change detection and attempt to quantify the different types of change.

RESULTS AND DISCUSSION

A. Classification analysis

The classification techniques are almost used for easily identifying the different features, land cover at different dates and for following up the changes at different intervals. The classification in this study was started by choosing appropriate training areas, maximum as it can. The facilities of the unsupervised technique (clustering method) were applied to all selected training areas for redistributing them. The redistributed pixels/classes were used as new training areas for supervised technique (MLC). This method was more useful for increasing the accuracy of the classification, reducing the number of training areas, and lowering the number of iterations that controlled the training areas and classification proceedings.

i. Selecting and testing the training areas:

To represent each land cover accurately, enough number of training areas have been selected (about 15-30 training areas for each class) from each date of satellite images. These training areas were defined based on field visits and topographic maps. After selecting the training areas and estimating their required statistical parameters, the unsupervised classification was applied to these training areas. The resulted classes must confirm good and enough separation between the chosen training areas of different land covers. So, to test the separation quality of these classes at different band combinations, the scatter plot analysis was used. Next sections will illustrate the scatter plot analysis at different dates.

Figures (5. A, B & C) introduced the scatter plots (six classes) of different MSS bands combination (b3, b4), (b2, b3), (b1, b4). These scatter plots showed that the combinations

between (b2 - b3 and b1 - b4), (Fig.5. B and C) were the better for next step (classification). Also the classes with white and cyan colors represent areas that are covered by vegetation and islands. These two classes had good separation as shown in Figures (5. B, C) but overlapped as shown at figure (5. A). Also the other classes with magenta and yellow that represent different types of land cover, green and blue color that represent clear and turbid water had good separation at figure 5. B and C.

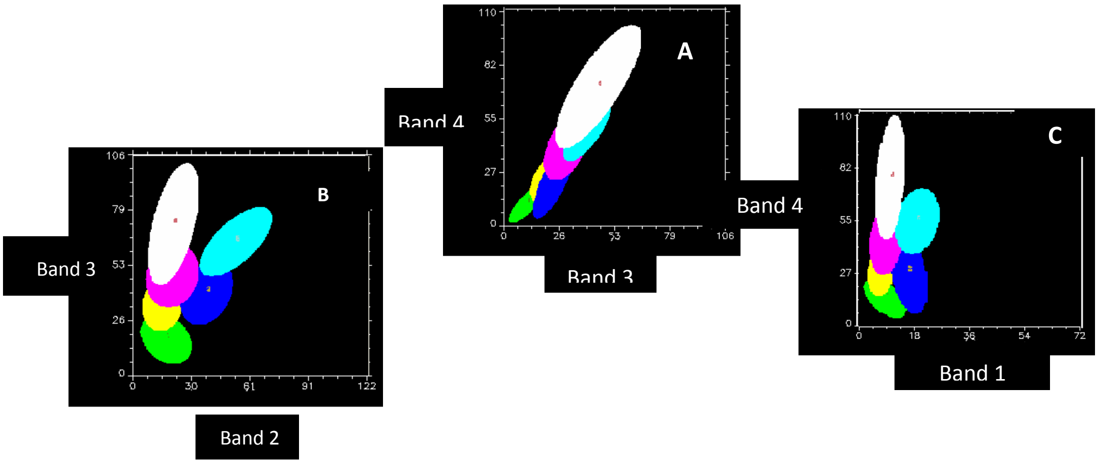

Figure (5.10): **Scatter plots of MSS bands combination.**

Figures (6. A, B & C) introduced the scatter plots (seven classes) of TM bands combination (b2, b4), (b4, b7), (b2, b7). These scatter plots showed that the combination between (b2-b4) (Fig.6. A) was the better for next step classification. Also, the white, yellow, cyan and green classes represent different types of vegetation cover. These types are graduated from Ceratophyllum with lower DN values to Typha Australis with higher DN values. The red class represents urban area, and it was noticed that this class had good separation in all band combinations. While the classes with blue and magenta represented clear and turbid waters, respectively. These classes appeared clearly with better separation at Figure 6. A.

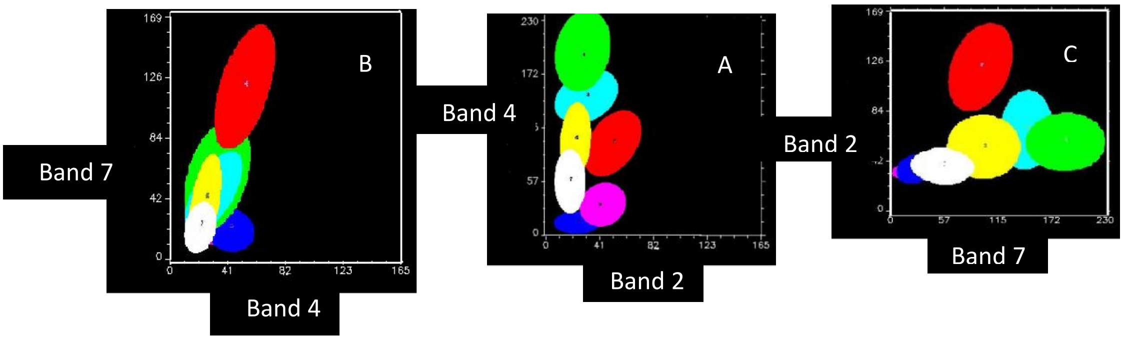

Figure (6.). **Scatter plot analysis of TM bands combination.**

Figures (7 A, B & C) introduced the scatter plots (seven classes) of ETM bands combinations (b1 - b4), (b2 - b4) and (b2 - b3). These scatter plots showed that the combinations b2-b4 and b1-b4 (Fig 7 A & B) had good separation between red and green classes that represent vegetation and urban areas, while the other classes with cyan and blue colors, showed lower overlapping at combination (b2-b4, Fig. 3. B) and higher overlapping at combination (b2-b3, Fig. 7 C). These two classes represented two different texture of the same land cover. The other

classes with magenta, white and yellow are highly overlapped at all combinations, these classes represent three different types of water.

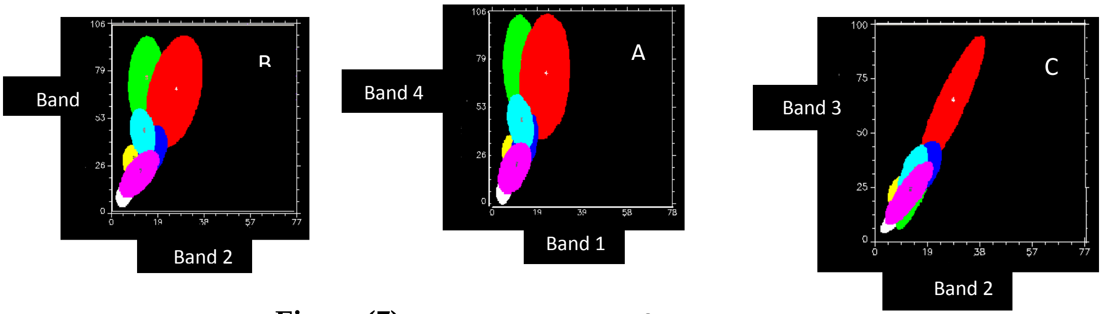

Figure (7): Scatter plot analysis of ETM bands combination.

ii.Maximum likelihood classifier

The maximum likelihood classifier was executed to the resulted training areas, from the first step. Once the classification procedure (maximum likelihood classifier) was finished, the classified images were produced for each date and the appellations of these classes are verified using USGS scheme (Anderson, 2001). These classified images and the spectral signatures of all classes were used for identifying the different classes, i.e. land and water covers in each date.

Figures (8 and 9) showed the classified image of MSS 1973 and the spectral signatures. Six classes and their spectral signatures have been identified at this date. These classes were mixed scrubland and grassland, turbid water, clear water, and islands, also the classified image at this date characterized by presence of new areas named submerged and wetland .

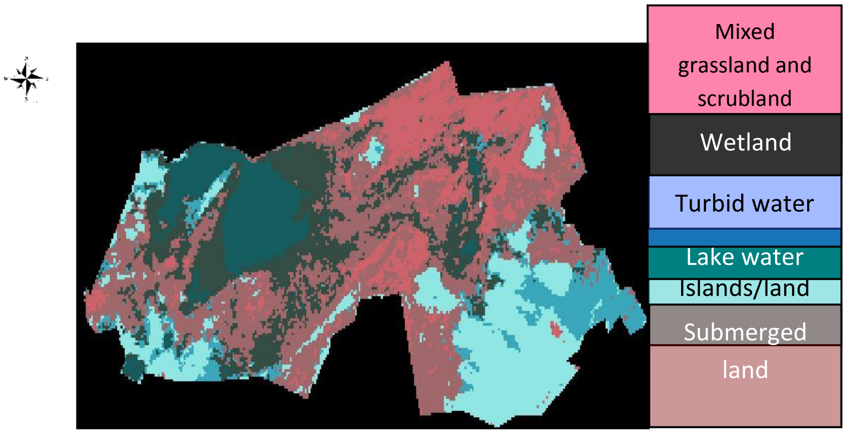

Figure (8): Classified image of MSS 1973.

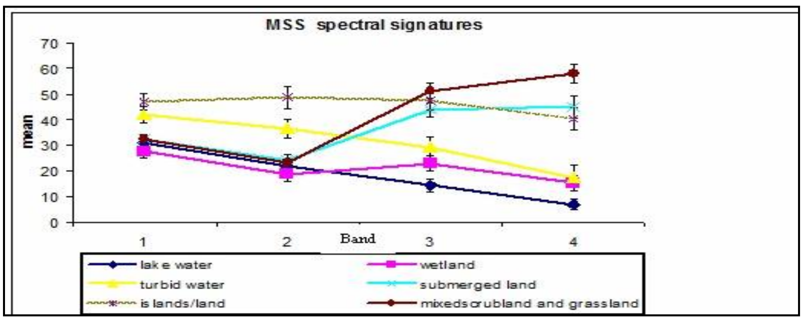

Figure (9): Spectral signatures of MSS 1973

a. Mixed scrubland and grassland

This class gives higher mean values in (band 3) and (band 4) infrared bands (Fig. 9), its spectral pattern indicate a type of vegetation cover that called mixed scrubland and grassland (Fung and Lo, 1980) this class represented as red color in the classified image as it much distributed in eastern area (Fig. 8).

b. Wetland

This area comprises mudflats areas (Fung and Lo, 1986) as it gives higher mean values in green (band 1) and near infrared (band 3) (Fig. 9), it appears as grey color in the classified image and much spread around the areas of the lake water (Fig. 9).

c. Turbid water

This class gives higher mean values in green (band 1) then gradually decrease in red (band2) and NIR bands (band3, 4) (Fig. 9), this class appear due to the higher shallowness of water in this area. Fig. 8 shows these areas in light blue at the southern east of the study area.

d. **Lake water**

This class gives lowest mean values in green, red and near infrared bands other than class of turbid water, it appears in the classified image (Fig. 8) as dark blue color.

e. Islands/land

This class gives higher mean values in red then decrease in both bands 3 and 4 (Fig. 9). This class appears as blue patches as it distributed in each side of the study area. Some of these islands are connected to ground so it could be named islands\land in the classified image.

f. Submerged land

This class gives a similar trend of wetland class at green (band 1), red (band 2) but give higher mean values in near infrared (Fung and Lo, 1980) (Fig. 9). The distribution areas of this class in the classified image are close to the distribution areas of wetland class (Fig. 8). So it is expected that both submerged land and wetland classes will give lower classification accuracy.

Figures (10 and 11) show the TM classified image and the spectral signatures. Seven land cover types have been identified. Two of them are different types of water bodies, while the other four land cover are different species of vegetation. The last one was the islands/build up land. Each class will be illustrated separately in the next sections:

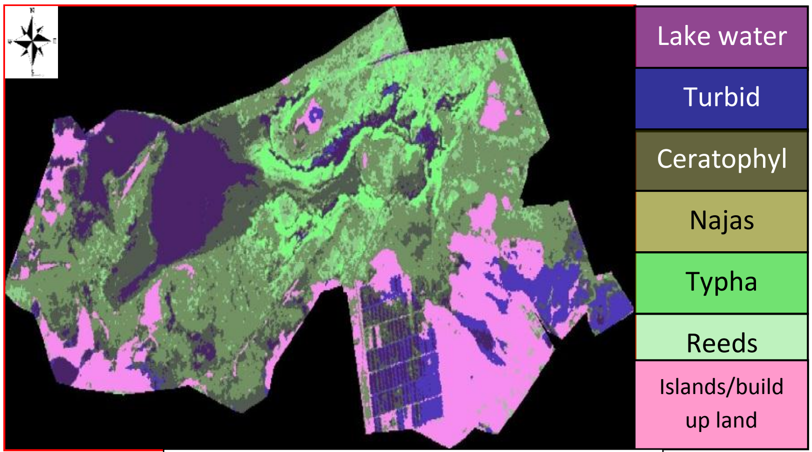

Figure (10).Classified image of TM 1988

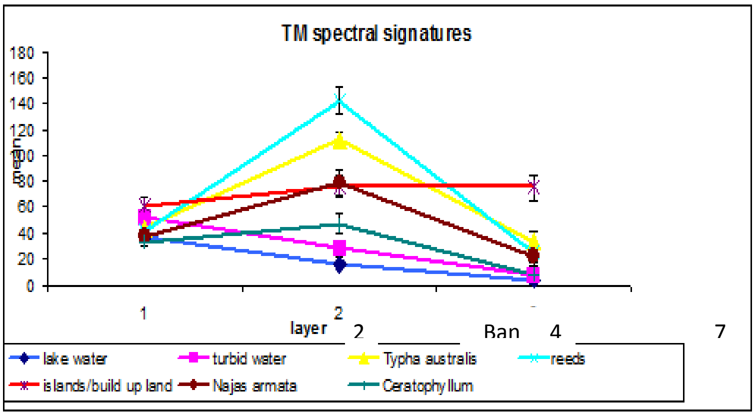

Figure (11). Spectral signatures of TM 1988

a- Lake water

Lake water class is representing open lake water area as it appears in a violet color in the classified image (Fig 10). As it recorded lower mean values in the green (band2) (Fig.11) then decreased gradually in both near and mid infrared (band4, 7) (Salem *et al*.,1996).

b. Turbid water

This class gives the similar pattern of lake water but with higher mean values in green and near infrared bands (Fig.10) (Saha *et al*., 1990). This class distributed at the southern areas of the lake water as it is represented by light blue color (Fig.11).

c. Vegetation

This class comprised from four types of the vegetation species, which are gradually distributed from lower spectral pattern (Ceratophullum spp.), which is distributed on lake water edges and appeared as dark green (Fig.10) to higher spectral one (Typha australis) represented by light green color in the eastern side of lake water (Fig.11). These classes give higher mean values in near infrared band (Cavalli et al. 2007 and Salem et al.1996).

d. Islands/build up land

This class is widely distributed at separated areas of the lake with pink color in the classified image (Fig.10) and gives highest mean values in mid infrared band (Saha et al.1990). Through this time, many parts of islands are prepared for building new urban areas or for other land use, so this class could be named as Islands/ built up land.

Figures (11 and 12) show the ETM classified image and the spectral signatures, seven classes were identified in this date. Three of them representing different types of water (farms water, drainage water and lake water), while the other two classes are representing two graduated signatures of the same type of land cover and are called dredged land. The last two classes which are urban and vegetation could be represented by two different types of land use. The following sections will illustrate each class separately.

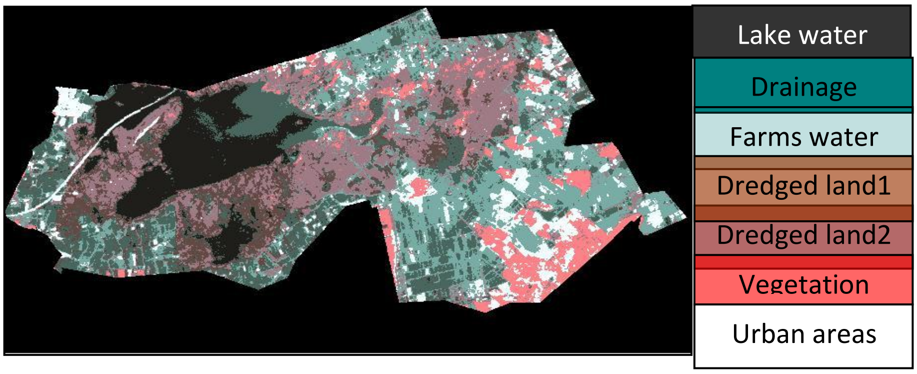

Figure (11) .**Classified image of ETM 2005.**

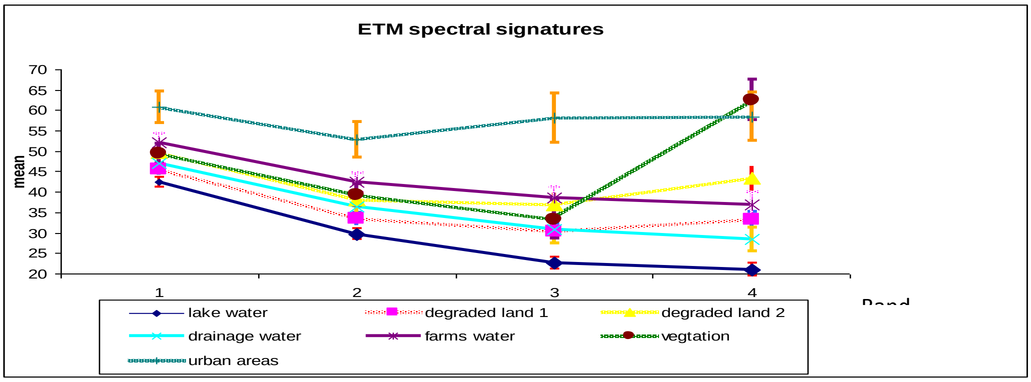

Figure (12). Spectral signatures of ETM 2005.

a. Lake water

This class represents lake water with heavy grey color in the classified image (Fig.11). It gives higher mean values in blue (band 1) and green (band2) while lower in red (band3) and NIR (band 4). This class gives lower spectral trend than other two water types (drainage and farms water).

b. Drainage water

This class represents other type of water with higher mean values (Fig.12) appearance of this class is due to the spread ness of surrounding activities which like agriculture and fish farming.

c. Farms water

This class gives the highest mean values in all bands (Fig.12), so it may be highly polluted water with mixed fish farms and agriculture wastes.

d. Dredged land

In classified image (Fig. 11) named as dredged land which may be dredged for different land uses. This class gave two graduated signatures which give higher mean values in blue and NIR bands (Fig. 12). This graduation in the same land cover type may be due to the difference in the water content (Narayan *et al.*,1989).

e. **Vegetation areas**

This class gives higher mean values in NIR band. It appears as bright red color at the southern east area of the classified image (fig. 11).

f. Urban areas

This class gave higher mean values in all bands. It includes the new established urban areas and new roads in this time. It appears as white color in the classified image (Fig.11).

The previous classification revealed that classified image at 1973 is characterized by widely distribution of submerged and wetland areas but limited distribution of vegetation cover. While the classified image at 1988 is characterized by expansion and spreading of vegetation cover especially at the areas were submerged and wetland at 1973. Also many islands connected to ground prepared for building new projects may be urban areas, fish farms or agriculture lands. The classified image at 2005 is characterized by continuous expansion of different activities like agriculture, fish farming, urban areas and roads, this lead to appearance of new water types like drainage and farms water. In addition vast areas of vegetation are dredged for establishing new projects like fish farming.

B.CHANGE DETECTION RESULTS

The results of the used change detection methods have been obtained also during this study. The type of method implemented can affect the qualitative and quantitative estimates of the phenomenon (Colwell & Weber, 1981). In this study, both principal components and post classification comparison methods have been used. The results of both principal components and post classification comparison that are used to identify the study area's changes during (1973, 1988 and 2005) have been discussed in the next sections.

i. Principal component analysis

The principal component analysis was performed on the raw data of the three satellite images at different dates, band 4 from each image has been chosen because it has good capability for distinguishing between land and water. Eigen values and Eigen vector are two matrices that resulting after performing the principal components on the raw data. The eigen-vectors loadings of the decreasing variances for each principal components and eigen-values that are expressed as percentage of original bands are listed in table (1).

Highest reflectance are expressed by brightest pixels (positive eigenvector loadings) and lowest reflectance are expressed by darkest pixels (negative eigenvector loadings), while the resulting Eigen values of these pcs show that almost 73% of the statistical variation is represented by the first PC. Figures (12, 13, and 14) show the three Pc_s images.

Table (1) Eigen-values and vectors matrics of PC's (1973, 1988 and 2005).

Pcs	Eigen value	percentage
Pc1	1487	73%
Pc2	328	16%
Pc3	214	10%

No. of Pcs	Pc_1	Pc2	Pc3
1973	0.24	-0.34	-0.9
1988	0.94	0.28	0.14
2005	0.20	-0.89	0.39

From Table (1) and (Fig.12, 13 and 14), it could be observed that:

a. **Pc_3 record high negatively eigen vector in 1973 image, these areas appeared as darkest tones in eastern and south eastern part of the study area (Fig. 12), these areas could**

represent vegetation cover. In the same time, pc_3 record high positively Eigen vectors in 2005 image which appears as brightest tones in the image. These areas are distributed at different parts of the study area which represented submerged land in 1973 and became dredged land within 2005 date. The other brightest zones represented urban areas and roads in 2005. While the grey tones in pc_3 image are the unchanged areas in 1988.

b. **Pc_2 records high negatively Eigen vectors in 2005 image with dark tones (Fig.13). These areas appear as darkest tones and represent vegetation cover, while during (1988, 1973) they were islands. In the same time, the pc_2 record positively eigen vectors in 1988 image, these areas appear as brightest tones (Fig.13) as it located at different places of the study area, and represent most of the urban areas.**

c. **Eigen vector in Pc_1 is positively loaded at all dates; the highest value at 1988, these areas appear as brightest tones (Fig.14) at the eastern side of the lake, these areas represent the vegetation cover. While the lowest vector values at 1973 and 2005 appear as grey and black tones (Fig.14) representing submerged land and water bodies. The first principal component gives general view about the majority of information at the three histories.**

From these results, it was observed that the highest vegetation cover in 1988 responsible for appearance of brightest tones in pc_2 image, but in 1973 and 2005 dates the vegetation growth responsible for the highly appearance of darkness areas in Pc_3 and Pc_2 image respectively. While the roads, urban areas and dredged lands in 2005 date are mainly responsible for the appearance of brightest tones in pc_3 image. This means that study area at 1988 characterized by abundance of heavy vegetation growth, while at 2005 it characterized by expansion of new activities like roads and urban areas.

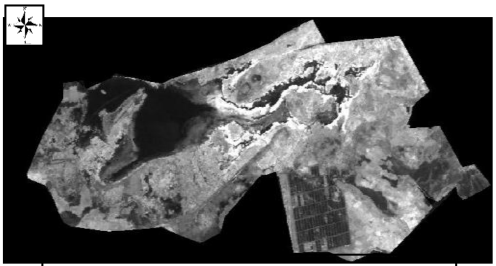

Figure (12) First principal

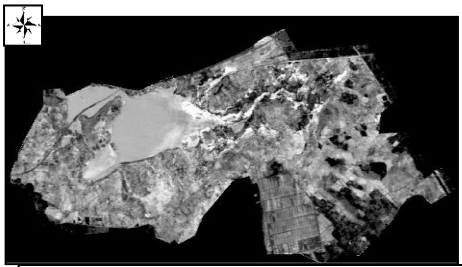

Figure (13). Second principal

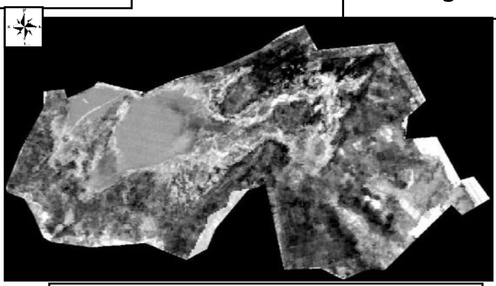

Figure (14). Third principal

ii. Post classification comparison

Post-classification change detection technique was carried out by overlaying the final classified images of 1973, 1988 & 2005 then cross-tabulation analysis was used in order to determine which land-use of the earlier date has been replaced by a new one. This helps to determine and explain the spatial patterns of the land use changes in the study area from 1973 to 1988 as shown in table (2) and from 1988 to 2005 as shown in table (3).

Table (2) study area's changes from 1973 to 1988

		1973														
		Water	**%**	**Km^2**	**Vegetation**		**Km^2**	**Island/land**		**km^2**	**Submerged land**		**km^2**	**Total**		**km^2**
1988	**water**	70409	12.8	18	1394	0.25%	0.36	32067	5.8%	8.2	11154	2%	2.8	115024	21%	29.5
	vegetation	90626	16.5	23	98294	17.8%	25	23005	4.2%	5.88	129665	23.6%	33.2	341590	62%	88
	Island/built up land	19519	3.55	4.9	4182	0.76%	1.07	53678	9.7%	13.7	15336	2.79%	3.9	92715	17%	23.7
	Total	180554	33%	46.2	103870	19%	26.6	108750	20%	27.8	156155	28.5%	40	549329	140.6 km^2	

- **Island/Built up land: parts of islands connected to ground and prepared for building or crops cultivation or other land use.**
- **Island \land: parts of islands filled to connect to land.**
- **Submerged land: lands lying below the high tide line or high water mark.**

From table (2) it could be observed that:

a. **Low pattern change in water areas as about 18 km2 weren't change (1973-1988), while only 8km^2 of islands\land and 3km2 of submerged land converted to water, also 0.36 km^2 of vegetation become water areas. So the total changed area to water is about 10 km^2 which is used in the operation of the new established bersek fish farm.**

b. **The decreasing in water areas from about 46 km^2 to 30 km^2 is due to the conversion of about 23 km^2 of water to vegetation zones.**

c. **High pattern change in vegetation cover as vegetation areas in 1973 were about 26.6 km^2 and highly increasing to 88 km^2 this increasing occur by rate +4.06 km^2/y. This high rate of change is due to the conversion of vast zones of submerged land with about 33km2 and water areas with about 23 km2 to vegetation areas , in addition 6km^2 of island /land covered by vegetation, this indicate that the study area at this time suffering from heavily vegetation growth.**

d. **At this period (1973-1988) high dredging operations begun to expand as 20 km2 of vegetation, island/land and submerged land have been dredged for establishment of new activities these activities are fish farms, urban areas and roads.**

Table (3): Study area's changes from 1988 to 2005

	1988												
	Water		%	Km^2	vegetation		Km^2	Island/built up land		km^2	Total		km^2
2005	water	68400	12	17.5	182700	31%	46.7	65700	11.3%	16.8	316800	54.6%	81
	vegetation	4500	0.7	1.15	7200	1.24%	1.8	18900	3.2%	4.8	30600	5.3%	7.8
	Dredged land	18900	3.2	4.8	170100	29.3%	43.5	14400	2.5%	3.6	٢٠٣٤٠٠	35%	52
	Urban areas	3600	0.6	0.9	9000	1.6%	2.3	17100	2.9%	4.4	29700	5%	7.6
	Total	95400	16.4	24.4	369000	63%	94	116100	20%	29	580500	147.5 km^2	

- **Dredged land: land which is dredged for using in digging for new canals and drains, or establishment of new farms.**

Table (3) shows that:

1. **High increase in water areas by rate +3.3km^2/y , although 17.5 km^2 record no change in this period , The increasing in area resulting from conversion of about 46.7 km^2 of vegetation to water, in addition 16.8 km^2 of island/built up land are covered by water . So the total changed areas to water about 63km^2, these areas are used for the operation of established fish farms up to 2005.**
2. **High decreasing of vegetation areas by rate -5km^2/y, this decreasing resulting from high dredging of about 43 km^2 of vegetation, in addition 46.6 km^2 of vegetation converted to water, and 2km^2 was dredged for establish new urban areas.**
3. **About 3.6km^2 of island/built up land is dredged for new activities, while 4km^2 is dredged for established new urban areas like zerzara and roads like international coastal road. In addition the total areas dredged for establishing new canals and drains or for new fish farms are about 47km^2 , while urban areas increased by area 7km^2 , this show the expansion of the dredging operations for building new fish farms, urban areas and roads.**

CONCLUSION

4. **The expansion of different activities in Lake Edku since last centuries up to present study produce several impacts on it's free area and quality: During 90's the areas that were vegetation began to dredge for the construction of roads, urban areas and fish farms..**
5. **The current conditions of lake water cause high decrease in fish production and the quality of fish fry, this forcing many fishermen to change their jobs. In addition most of fishermen suffering from diseases due to direct contact with the polluted lake water. Also many fish farms are threatened from the bad quality and high prices of fish fry that are collected from lake water.**
6. **Recommendations**
7. **Eliminate pollution of the lake by taking effective and urgent actions to stop dumping the sewage of neighboring villages in the lake and create units and sanitation systems for maadeya villages.**
8. **Raise the livelihood, health and environmental standards for small-scale fishermen, through the work of development projects in the field of fishing and marketing, and enhance the level of public services in surrounding villages to ensure civilized living, also the involvement of fishermen in making of decisions concerning with their profession is a must.**

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استخدام تقنية الاستشعار عن بعد وطرق الكشف عن المتغيرات لرصد مشاكل بحيرة ادكو

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الملخص :

تعد بحيرة إدكو واحدة من أهم البحيرات في شمال الدلتا ، حيث يبلغ إنتاج الأسماك سنوياً حوالي ١٠٩١٠ طن / عام ، وتدعم الظروف المعيشية لأكثر من ٤٠٠٠ صياد. تعرضت بحيرة ادكو باستمرار إلى العديد من التغييرات التي تسببت في تدهور إنتاجها ومساحتها ونوعيتها حيث تم اختفاء حوالي ٤٠٪ من مساحة البحيرة وأصبحت نوعية مياه البحيرة تزداد سوءا. الهدف من هذه الدراسه هو تحقيق الاستخدام المستدام لبحيرة ادكو ، ويمكن تحقيق ذلك من خلال جمع مجموعة موثوقة وشاملة من البيانات العلمية. أيضا لتحليل الاتجاهات وتقدير التغيرات الزمنية استخدمت تقنيات الكشف عن التغير. أوضحت النتائج أن النباتات المائية زادت خلال الفترة من عام ١٩٨٣ إلى عام ١٩٨٨ ، وتم ملء العديد من الجزر وتوصيلها بالأرض. وبينما تم توسيع المناطق الحضرية والطرق خلال الفترة ١٩٨٨-٢٠٠٥ ، لوحظ أن المناطق المائية قد ازدادت تدريجياً ، حيث كانت تستخدم في تشغيل المزارع السمكية. في نفس الوقت يتم تجريف العديد من المناطق لإنشاء قنوات ومصارف جديدة. لحماية مياه البحيرة من التدهور ، أوصي بالاتي ١) إزالة المزارع السمكية التي انتهكت القانون .٢) اتخاذ إجراءات فعالة وعاجلة لوقف إغراق مياه الصرف الصحي في القرى المجاورة في البحيرة. وإنشاء وحدات وأنظمة صرف صحي لقرى المعديه ، وزيادة ورفع إنتاجية البحيرة بما يتماشى مع مساحة المياه بمعدل ١ طن لكل فدان سنوياً ، وتوفير ما يلزم من الزريعة السمكية من إنتاج المفرخات كحل لصيانة ورفع الإنتاجية.