AL-HAWIZEH MARSH MONITORING METHOD USING REMOTELY SENSED IMAGES

Israa J. Muhsin
Remote Sensing Unit, College of Science, University of Baghdad. Baghdad-Iraq.

Abstract

The main objectives of the present research are of two goals; first, to define and locale the main cover types (components) of AL-Hawizeh Marshes, and second, to track and detect the changes encountered in these cover types (components) during the last three decades time episodes To fulfill these goals, LANDSAT and MODIS images were applied. The LANDSAT images (MSS-1973, TM-1990 and ETM+ 2002) were used to determine the Marshlands cover types before, during and after the Marsh destruction (marshes dehydrations). One MODIS image was selected to cover the main changes that have been happened in 2010. Programming; Supervised classifications (minimum distance classification) were applied for monitoring the mean changes that have been happened on the objectives of Al-Hawizeh Marsh.

Keywords: Al-Hawizeh Marsh, supervised classification, minimum distance classification.

مراقبة هور الحويزة بطريقة استخدام الصور الفضائية

اسراء جميل محسن

وحدة الاستشعار عن بعد، كلية العلوم، جامعة بغداد. بغداد– العراق.

الخلاصة

تكمن الاهداف الاساسية في البحث المقدم في نقطتين: الاولى هي تعريف وتحديد موقع المركبات الاساسية التي تغطي منطقة هور الحويزة، والثانية تتمثل بتتبع اثر وكشف التغيرات المهمة التي طرأت على الهور خلال العقود الثلاثة الماضية. حيث استخدمت لتنفيذ هذه الاهداف صور لاندسات الفضائية (MSS-1973, TM-1990 and ETM+ 2002) لحساب المكونات الاساسية قبل واثناء وبعد عملية تدمير او تجفيف الاهوار وصورة فضائية واحدة للقمر مودس تم اختيارها لمعرفة اهم التغييرات التي طرأت على هور الحويزة لعام ٢٠١٠ . برمجيا تم تطبيق طريقة التصنيف الموجة والمتمثلة بحساب المسافة الصغرى لمراقبة التغيرات الحاصلة على العناصر الاساسية لهور الحويزة.

1. Introduction

Iraqi Marshes are important for economic, social, biodiversity values characterized by frequency of water flows, accumulation of nutrients and organic matter and the production of commercially important vegetation, terrestrial animals, birds and fish. The biogeochemical cycling of this extensive wetland region, when in its natural state, plays an important role in improving degraded water quality in the lower Tigris and Euphrates basin, traps sediments and pollutants and facilitates desalinization of salty water. These marshes act as a natural sponge storing water during high river flow and releasing water during low flow. As for Al-Hawizeh marsh, the quality of water is highly affected by the share of water that flows annually into it from Iran. The three rivers that

originate in Iran and contribute to AL-Hawizeh marsh are the Karkha, Teeb, and Dewaireg. The last two are seasonal rivers, while a new dam in Iran controls the flow of the first. Within Iraq, the main contributors to the Al-Hawizeh marsh are the rivers of Al-Kahla, Al-Mesharah, and sometimes the Crown-of-Battles Canal. They are all branches of the Tigris in Misan governorate. The quality of these rivers changes between summer and winter and depends upon the levels of release in the Tigris River [1, 2].

In general, AL-Hawizeh marsh is in accelerating high rate of changing state. These dramatic changes imply land, water and vegetation cover types. Vegetation cover types are expected to undergo significant changes in its types and distribution before and after the restoration stages. Detailed analysis of these vegetation changes will be specifically considered. To properly manage such dynamically active processes, a sustainable remote sensing data collection program is required The facilities which are presented by the Remote Sensing, such as cost, time, effort and inclusive vision that means spreading the features of a certain area on the other areas reveal the ability of using the Remote Sensing Technique for water and other objects(vegetation, dried marsh, etc.) monitoring in this marsh.

2. Studied Region

Al-Hawizeh Marsh lies to the east of the Tigris River, straddling the Iran-Iraq border. The Iranian section of the marshes is known as Hawr Al-Azim, where primarily the Karkha River feeds it. In Iraq, this marsh is largely feed by two main distributaries departing from the Tigris River near Amara, known as al-Musharah and Al-Zahla. During spring flooding the Tigris may directly overflow into the marshes. Extending for about 80 km from north to south, and 30 km from east to west, the marshes cover an approximate area of 3,000 square kilometres.
The northern and central parts of the marshes are permanent, but towards the southern sections they become increasingly seasonal in nature. The permanent marshes have moderately dense vegetation, alternating with open stretches of water. Large permanent lakes up to 6 m deep are found in the northern parts of the marshes. The Hawizeh Marshes have survived best in the Mesopotamian Marshes and are often used to help reproduce flora, fauna and species in other marshes, [3]. (Figure 1) shows the studied region.

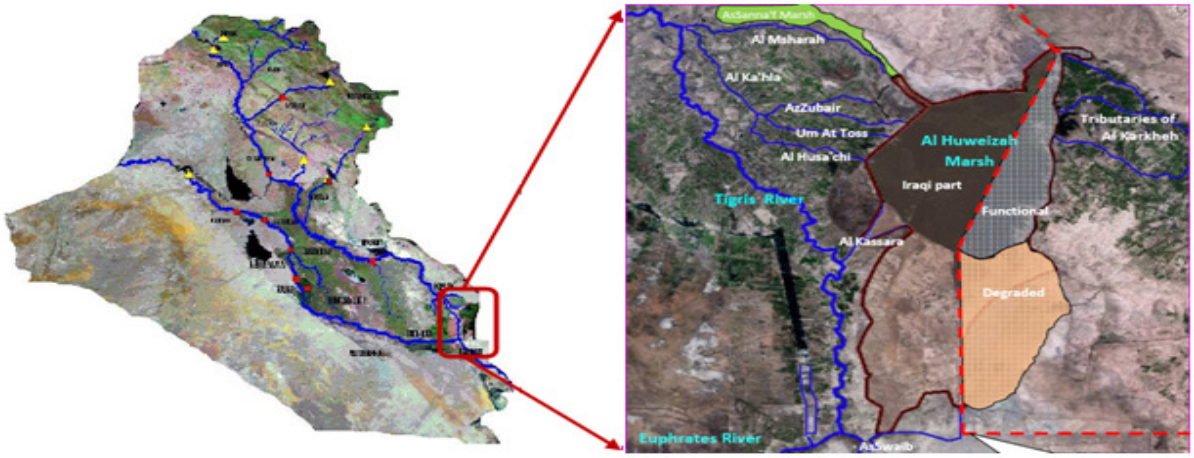


Figure 1: Show the studied region (AL-Hawizeh marsh)

3. Image Analysis

The analyst attempts to locate specific sites in the remotely sensed data that represent homogenous examples of these known land-cover types. The spectral characteristics of these known areas are used to "train" the classification algorithm for eventual the image [4]. Every pixel both within and outside these training site is then evaluated and assigned to the class of which it has the highest likelihood of being member. Supervised classification involve a considerable amount of input from the image analyst and knowledge of the type of source that have been found in the study area, [5]. It's more accurate for mapping classes than unsupervised classification, and it could be performed by varies types of classifier algorithms. In our present research the supervised classification is performed by adopting the minimum distance classifier, it's used to classify unknown image data to classes

which minimize the distance between the image data and the class in multi-feature space. The distance is defined as an index of similarity so that the minimum distance is identical to the maximum similarity. In this method the mean vectors for each class in each band (μ_{ck}) are calculated. To perform a classification first calculate the distance between each mean vector (μ_{ck}) and unknown Pixel ($P_{i,j,k}$) So, for two points the distance between them is given by the equation (1), ,[6]:

$$Dis = \sqrt{(p_{i,j,k} - \mu_{ck})^2 + (p_{i,j,k} - \mu_{cl})^2} \quad \ldots\ldots(1)$$

Where:
P=unknown pixel, μ =mean vector.

Where (μ_{ck}) and; (μ_{cl}) represent the mean vectors for class c measured in band *k* and *l*. After computing the distances, the unknown pixel is assigned to the "closest" class and if the pixel is farther than the analyst defined distance from and category mean, it would be classified "unknown", for example see (Figure 2), [6].

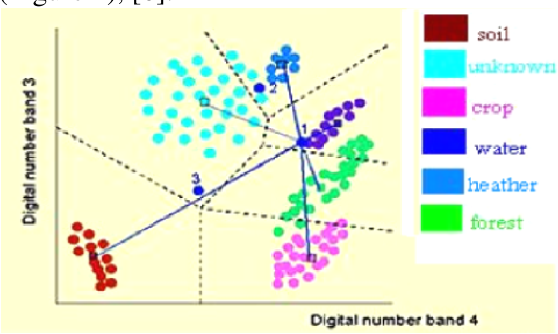
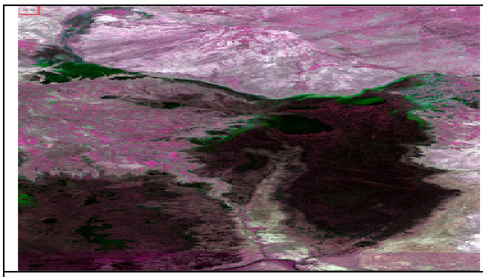


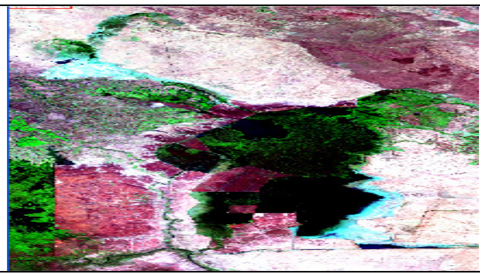
Figure 2: how the minimum distance classification

4. Methodology

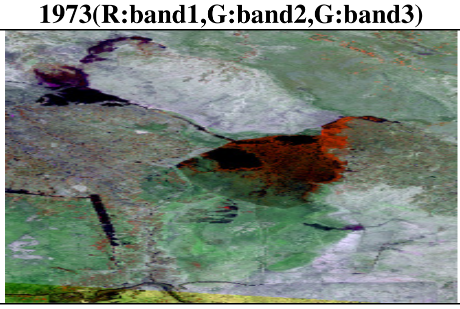
Al-Hawizeh Marsh is considered as the largest marsh at the southern part of Iraq. It's play an important role for improve the economic, social, biodiversity status in the country, so this marsh region was deserved to be investigated. The investigation has been achieved using many satellite images captured by LANDSAT (MSS-1973 with spatial resolution 79 m, TM-1990 with spatial resolution 28.5m, ETM+ 2002 with spatial resolution 14.25m) and MODS-2010 with spatial resolution 250 m as shown in (figure 3), all these images were geo-referenced to the (Universal Transverse Mercator (UTM) / World Geodetic System-84 (WGS-84) coordinate system zone 38. The objects (water, vegetation, etc.) of the studied area have been witnessed large changes since 1973. These changes were monitored using remote sensing techniques. Supervised classification (minimum distance classification) was appropriated technique for studying these changes, Regions of interest for each object of the studied area have been selected to provide the classes of each image, equation (1) has been used to compute the distance between the pixel of the image and the mean of the specified classes, where the studied area assign to be 6 classes (bare land, vegetation(reed &papyrus), water, salt crust, turbid water, and crop) in (MSS-1973, TM-1990, ETM+ 2002, MODS-2010), The result of the classification can be shown in (figure 4). the statistical properties of the classified image can be show in the table (1), as well as the classes distribution can be seen in the (figure 5).



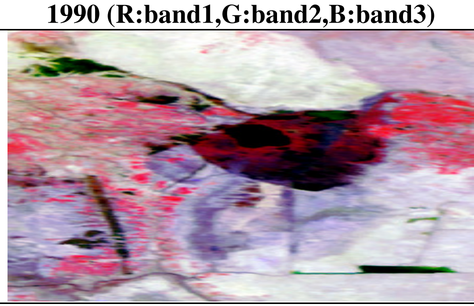
1973(R:band1,G:band2,G:band3)



1990 (R:band1,G:band2,B:band3)



2002(R:band1,G:band2,G:band3)



2010(R:band1,G:band2,G:band3)

Figure 3: Show the original images of studied region.

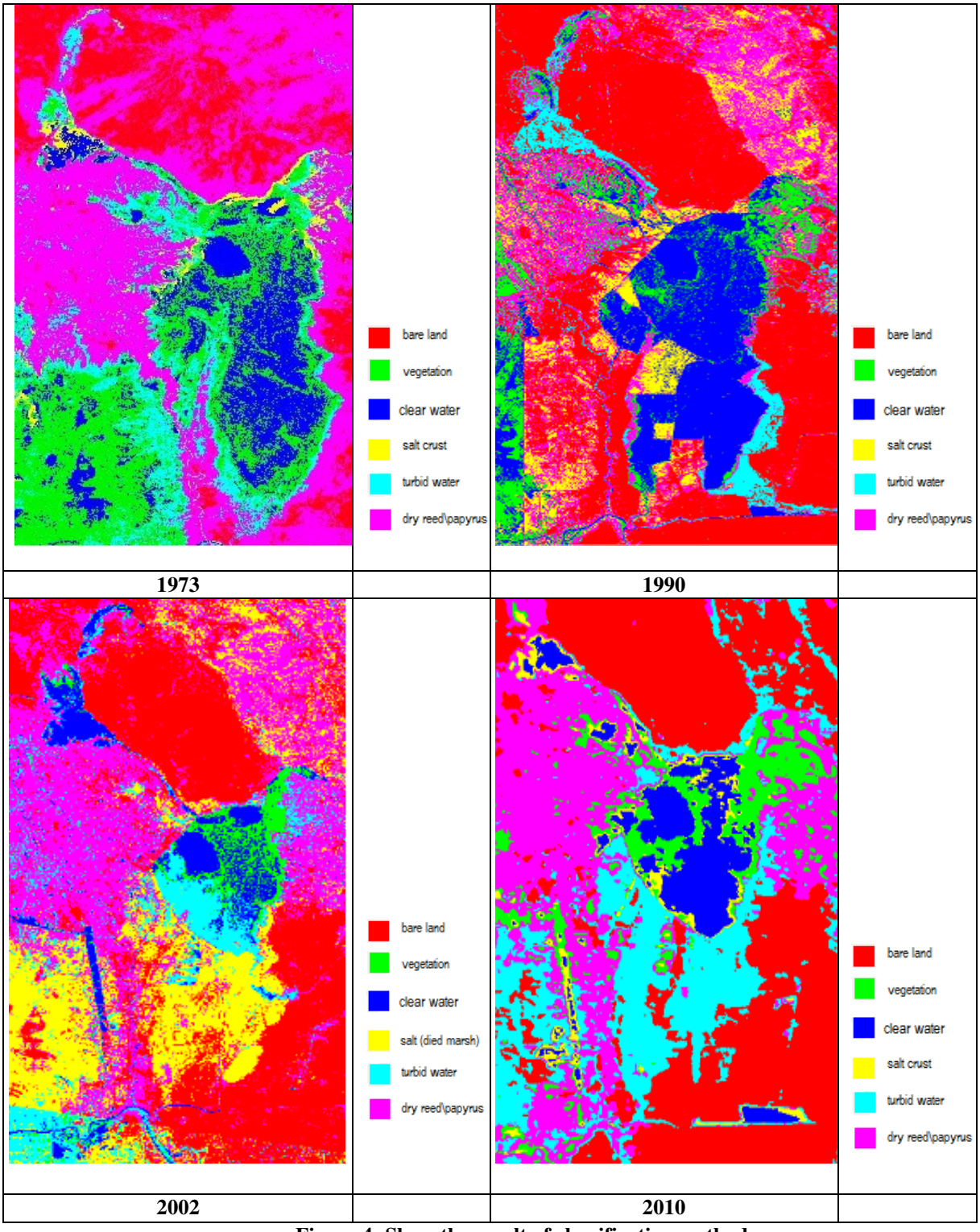
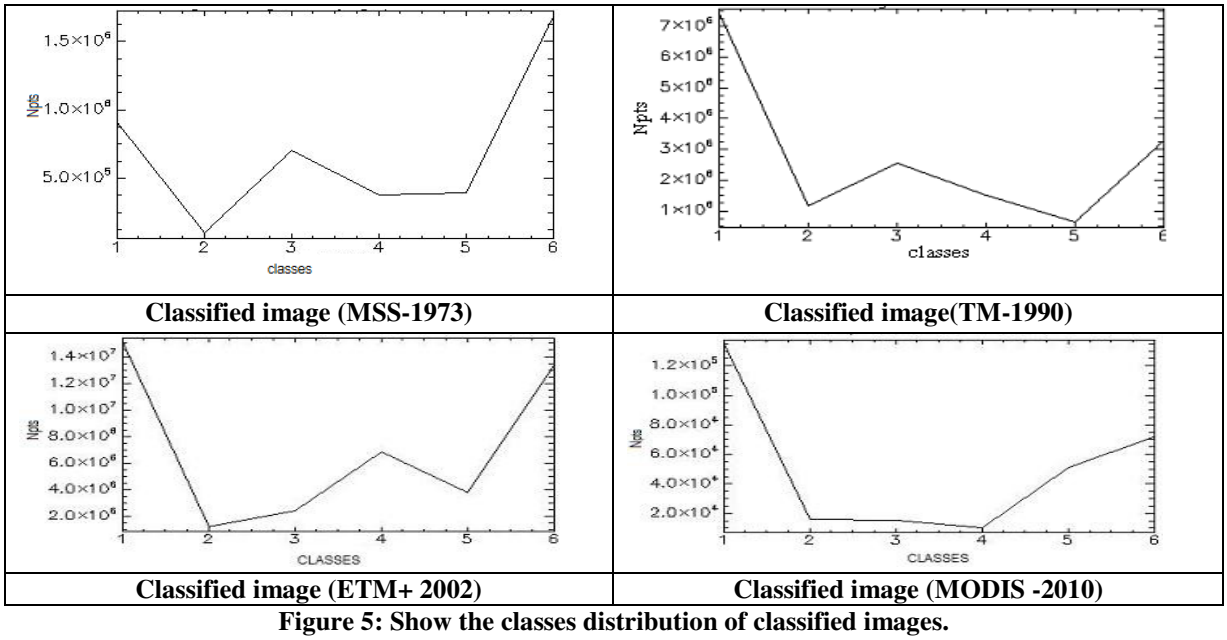


Figure 4: Show the result of classification methods.

Table 1: Represents the statistical properties of studied area classes.

Classified Image		*Statistical properties*				
	Class No.	*Class name*	*Npts (number of points)*	*Total*	*Percent%*	*Acc Pct (accumulative percent)*
LANDSAT-MSS (1973)	1	Bare land	906650	906650	21.7435	21.7435
	2	vegetation(reed\papyru)	96908	1003558	2.3241	24.0676
	3	clear water	705275	1708833	16.9141	40.9817
	4	salt crust	379633	2088466	9.1045	50.0861
	5	turbid water	394212	2482678	9.4541	59.5402
	6	crop	1687072	4169750	40.4598	100.00
LANDSAT-TM (1990)	1	Bare land	7415922	7415922	44.7236	44.7236
	2	vegetation(reed\papyru)	1169266	8585188	7.0516	51.7752
	3	clear water	2544871	11130059	15.3475	67.1227
	4	salt crust	1498879	12628938	9.0394	76.1621
	5	turbid water	623377	13252315	3.7594	79.9215
	6	crop	3329349	16581664	20.0785	100.00
LANDSAT-ETM+(2002)	1	Bare land	15071054	15071054	35.2527	35.2527
	2	vegetation(reed\papyru)	1202821	16273875	2.81335	38.0663
	3	clear water	2427440	18701315	5.6780	43.7433
	4	salt (died marsh)	6849857	25551172	16.0225	59.7668
	5	turbid water	3766372	29317544	8.8099	68.5768
	6	crop	13433884	42751428	31.4232	100.000
MODIS (2010)	1	Bare land	134566	134566	45.0341	45.0341
	2	vegetation(reed\papyru)	15740	150306	5.2676	50.3017
	3	clear water	15028	165334	5.0293	55.3310
	4	salt crust	10015	175349	3.3516	58.6826
	5	turbid water	51155	226504	17.1196	75.8023
	6	crop	72305	298809	24.1977	100.000



Classified image (MSS-1973) | **Classified image(TM-1990)**

Classified image (ETM+ 2002) | **Classified image (MODIS -2010)**

Figure 5: Show the classes distribution of classified images.

5. Discussion

The results obtained in this study deals with monitoring the main changes of the important objects of the Al –Hawizeh marshland. Minimum distance classification is used to classify the LANDSAT and MODIS images

acquired in 1973, 1990, and 2002. For the year 2010, MODIS images were used. The classified image, statistical results and classes distribution can be shown in (figure 4), table (1) and (figure 5) respectively.

the LANDSAT and MODIS images were classified into (6) Marshlands cover classes namely (Clear Water, Turbid Water, Reed, Papyrus, Crops, Dried Marshland, Bare land, Salts Crust) using supervised classification methods.

The LANDSAT -MSS / 1973 marshland image consider to be stable and environmental equilibrium status. Hence it represents a reference case in the Marshlands History. The classification results of this image reveal that image marsh classified into six classes each class show a specified object of the studies region, the description of these objects can be detailed as; bare land (free land from any water), vegetation (reed and the papyrus; where the reed is the main cover types of all the Mesopotamian Marshlands. They are growing in all parts of the Marshes except certain deep lakes and the shallow parts near the Marshes edges were Papyrus is more prevailing. Heights of the Reed plant ranging between (5 to 10 m), while the papyrus is the second main constituent of the Marsh vegetation cover types. It occupy a zone surrounding the Reed area along the shallow edges of the Marsh and decrease in its density to the inner inside of the Marsh, while the Reed oppositely increase in growing density towards the inside of the Marsh. Heights of the Papyrus plants are usually less than that of the Reed), Clear Water(refers to the water that occupied the deeper parts of Al- Hawizeh Marsh and constitutes permanent lakes inside the main Marsh. Two of these lakes are Al-Murays and Umm al-naaj lakes occupying the northern part of the Marsh. It appeared in dark color on the LANDSAT image, without any vegetation cover even the floating one), salt crust (the covered land by the salt),Turbid Water(Its light blue color on the Image indicates its turbidity by the silts and clays sediments), the final class represent the crop spread in large area of the image.

The classification result of the LANDSAT –TM 1990 marshland image reveal that Clear Water class has more extension in the al-Hawizeh marsh as a consequence of disappearing of the vegetation cover in the eastern part of the marsh. Decrease of vegetation cover in this part may be due to increase of the water level as a result of the water supply from the Iranian side. The Turbid Water class has also more distribution than in the 1973 image especially in the south-eastern part. The vegetation class, which is mainly Reeds and Papyrus, reveal noticeable decrease in its distribution in the south and south-eastern part, with some patches of vegetation cover in the south western part. Papyrus class appears in the northern parts of the marsh and even in its middle part.

The result of the LANDSAT –ETM+ 2002 show that The Water Class is usually occupying Al-Murays and Umm Al-Naaj lakes. Most of Umm Al-Naaj Lake was changed to white Salt Crust. The Turbid Water is still appears in limited localities along the outer edges of Al-Murays lake. The Reed is prevailing in the north-eastern part of the remaining Marsh, while the Papyrus is dominant within the shallow water to the east of the Reed. The Dried Land class has the most extension in this stage of draining activities. It appears almost in all the southern part of the marsh with its higher percentage than before.

Finally, LANDSAT –MSS 2010, It documented the restoration stage of the Marsh. The inundation or re-flooding of the Iraqi marshlands was still in a state of assessment and evolution, it is possible to see the removal of the barriers and opening the outlets that supply the water from Al Musharah and Al Kahlaa rivers into the western bank of the Marsh and that on the eastern bank from Tigris River as well. The Water Class is clearly displayed in its usual location within Umm Al-Naaj and Al-Murays lakes. Dramatic changes concerning this class are visible in middle part of the southern half of the marsh. The inundation water covers considerable area of the previously dried land.

6. References

1. Hossein G. and Mehran G. **2005**: "Marshlands of Mesopotamia and the rivers that feed them" Centre for Riverine Landscapes, Faculty of Environmental Sciences, Griffith University, Nathan, QLD 4111, Australia.
2. UNEP, **2001**. "The Mesopotamian Marshlands: Demise of an Ecosystem. Early Warning and Technical assessment Report". UNEP/DEWA/TR.01-3 Rev.1, Division of Early Warning and

Assessment, United Nations Environmental Program, Nairobi, Kenya.

3. Al_Amiri M, H. ,**2008** "Applications of Rs/Gis For Monitoring the Mesopotamian Restoration Al-Aweizeh Marsh", International Institute For Geo-Information Science And Earth Observation Enscheda, The Netherlands.
4. Jensen, J. R, **2000**, "Remote Sensing of Environment an Earth Resource Perspective" Prentice Hall Series in geographic information science.
5. Short, N.M, **2006**. "Remote Sensing Tutorial". NASA Official web site.
6. Thomas M. L., Ralph W. K., and Jonathan W. C. **2008**, "Remote Sensing and Image Interpretation", 6th Edition, New York: John Wiley & son.