# Areal Quantification Changes Assessment in Ibn Najm Marsh(southern Iraq) Using Multitemporal, Multisptial and Multispectral Satellite Images

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**Abstract**

Iraq has had more than 10000 km$^2$ of geographical low land areas called marshes. Enriched with great diversity of natural vegetation and wild life. With increasing climatic changes and passive man interference phenomena, vast areas of these marshes have deteriorated through drying out processes at an alarming rate. According to recent survey achieved by several Iraqi ministries marshes areas have decreased to about quarter of theS original area. The statistical data and geospatial information are weak. We monitored, assessed the environmental processes and detect changes using digitally processed landsat MSS (Multispectral Scanner) and Spot (System Pour Observation) satellite images that transform haur Ibn Najm (marsh) into agricultural land as result of desiccation processes. Seasonal and long-term changes are detected. Hydrological and terrain changes are studied .The methodology of using multitemporal , multispatial and multispectral images is currently being evaluated in this marsh ,by using land sat MSS data with (79x79m) spatial resolution and spot data with (10x10m) spatial resolution , acquired between 1985 and 2002 respectively. The area of haur Ibn Najm has been calculated in both images before and after drying out processes according to GIS (Geographic information System) .Ground truth points have been plotted in the previous marsh or present cultivated land by GPS (Global Positioning System) to support the indisputable facts reached.

**Keyword:** Remotsinsing, Satelliest, space images, drought, wetlands.

# تقدير التغيرات الكمية في مساحة هور ابن نجم(جنوب العراق) باستخدام صور فضائية متعددة الازمنة والتميز والاطياف

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**الخلاصة**

العراق كان يمتلك اكثرمن 10000km$^2$ من مساحات جغرافية منخفضة تدعى الاهوار.غنية بانواع كثيرة من النباتات الطبيعية والحياة البرية. بازدياد ظاهرة التغيرات المناخية والتدخل السلبي للانسان، فان مساحات واسعة من تلك الاهوار تدهورت من خلال عمليات التجفيف وبمعدل خطر.طبقا للمسوحات الاخيرة

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التي انجزت من قبل عدد من الوزارات العراقية فان مساحات تلك الاهوار قد تناقصت الى حوالي الربع من مساحتها الاصلية. ان المعلوما ت الاحصائية والارضية لتلك المناطق قليلة.العمليات البيئية المسؤولة عن تلك التغيرات( التجفيف) روقبت وحوسست بستخدام الصور الفضائية المصححة رقميا للماسح متعدد الاطياف (MSS) و ( SPOT) ,التي حولت هور ابن نجم الى ارض زراعية. روقبت التغيرات ا لموسمية والطويلة المدى للمنطقة. دورست التغيرات المائية والارضية للهور. قيمت الطريقة التي اتستخدم فيها الصور الفضائية المتعددة الازمنة والتميز والاطياف في دراسة ذلك المنخفض المائي باستخدام بيانات(MSS) وبدقة تميزية (٧٩ X ٧٩ m) بيانات ( SPOT) وبدقة تميزية( ١٠ X ١٠m) اخذت مابين ١٩٨٥و٢٠٠٢ بالتسلسل.حسبت المساحة لهور ابن نجم لكلا الصورتين الفضائيتين قبل وبعد عمليات التجفيف طبقا لانظمة المعلومات الجغرافية( GIS ).نقاط الحقائق الارضية هي ثبتت على الهورسابقا والاراضي الزراعية حاليا بواسطة نظام الموقع العالمي ( GPS ) لتساعد الحقائق التي وصل اليها.

## 1-Introduction

The most speedily and accurate means of classifying and delineating inland wetland is through the interpretation of remote sensing data. Interpretations may take place at a number of levels of complexity, from the easily recognizable objects. such as water, vegetation, roads and canals, to the derivation of detailed information like the separation between natural and cultivated vegetation , dry or wet soils , bare salted deserted soils or fallow soils and irrigation or drain canals.

The distinction and mapping of picture element (pixel) depend on the classification purpose and the scale of the image hold. Iraq is one of few countries, who has such a unique large depressions filled with water in the south locally called Haurs or marshes.

Briefly they are formed by the Tigris and Euphrates, but in our region only the Euphrates. As the Twin Rivers flow towards the south the slope and the velocity of the Twin Rivers are decreasing.

Accordingly dropping down their silt content, forming many ridges in the marshes as they change their flow courses and leaving the marshes. Those ridges are very essential for marsh inhabitants in various life practices. Two drastic events have taken place in the last twenty years of the last century.

The first is the building of many dykes and dams by Turkey and Iran resulting in a dramatic discharge decrease of both rivers (427 $m^3$/sec) [1]. The second is the drying out processes of water contained by these marshes.

This brings the marsh environment and its ecosystem into nearly calamity state. However in 2003 reflooding took place in the dried marshes resulting in a partial submerging of the dried lowland but still far from the optimal marsh environment we pursue.

## 2- Atmospheric Climate

The following table summarizes the climatic data in the area under study. These data were drawn from Karbala climatological station, nearest to the area.

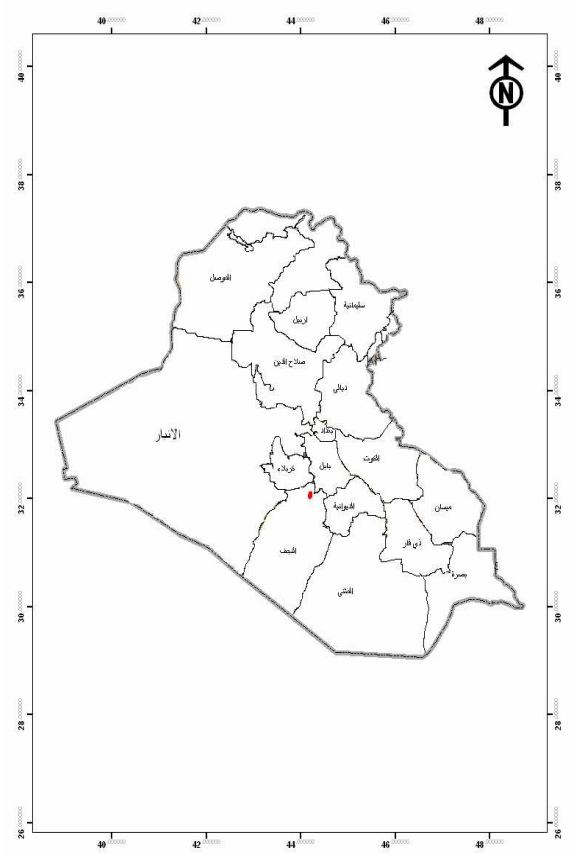
The climatologically classification has been classified according to köppen is BSh desert climate [2].

**Table 1-** Climatic factors dominate the area 2 for the period (1960-1990) after Abdullah1990**.**

| Station | Mean annual rainfall (mm) | | | Mean annual temp.(°c) | Max (°c) | Min .(°c) |
|---|---|---|---|---|---|---|
| Karbala | 130 | | | 23 | 30 | 16 |
| Mean annual days of | | | | Wind | | Mean annual dryness index |
| fog | frost | thunders torm | Dust storm | Speed (m/sec) | Direc -tion | 30 |
| 4 | ‹0.5 | 12 | 8 | 3.2 | NW | |
| Mean annual Relative humidity% | | | | Mean annual evaporation (mm) | | |
| 42 | | | | 3400 | | |

**3- Environmental setting of the marsh**

The marsh under study is called haur Ibn Najm. It has been intensively studied using satellite imagery. It is situated between 32$^o$ and 33$^o$ latitudes, 44$^o$ and 45$^o$ longitudes north and north- east of Bahr An-Najaf vast depression near the holy city of An-Najaf (figure 1). Administratively, three governates share the marsh. The majority of the marsh (75%) however belongs to An-Najaf governate , the rest is shared by Babil and Al-Qadisiya governates




**Figur 1-** Location of Haur Ibn- Najm marsh

**4- Desiccation mechanism of the marsh**

This marsh has been dried out through blocking the water tributaries, branches and canals which transfer water from Euphrates to the marsh. On the other hand drain canals has been constructed in the lowest point of the marsh in order to pull out the remaining shallow water and drain it into main drain canals namely Al-Sharqy Euphrates and 1.3 MD. Afterthe completion of this operation, a reclamation process of the marshland has begun to convert it into gricultural land.

**5- Change detection procedure**

Change detection is defined as temporal information for a given area that can be extracted from images acquired at different times by multitemporal or multidate processing [3].change or alteration detection procedures involve either multidate or a post classification comparison approach. A multidate approach combines or compares the two images to produce one output or two output data respectively.

A post classification comparison approach involves an initial supervised or unsupervised classification of the two images [4]. The alteration assessment study involves the two images ensured pixels correspond to the same ground truth point in both images. The ground truth points chosen were permanent features in the terrain such as intersection between permanent canals and fields near settlements.

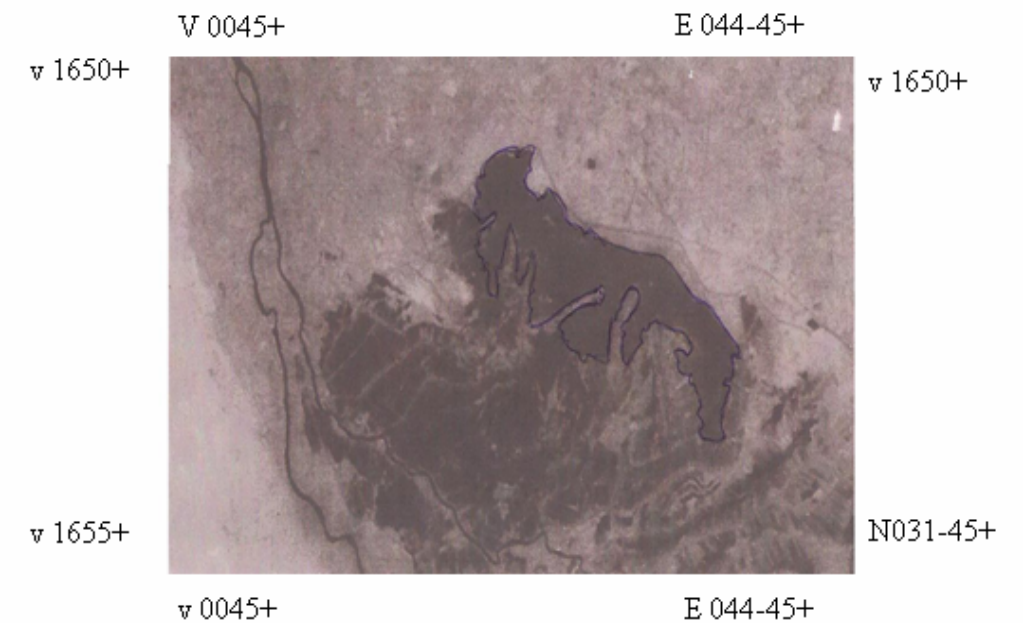
In the analysis MSS image band 4 (0.8-1.1μm) and panchromatic (0.51-0.73 μm) spot image were used. MSS image or principal component 1 was used for detecting and delineating water bodies of the haur Ibn-Najm. Spot image or principal component 2 was used to sense the dried out cultivated marshland.

**5- 1Image interpretation processes:**

**5-1-1 MSS image interpretation**

The original 1/1000000 landsat image of MSS band 4 enlarged by us to 1/250000 scale,figure.2.The methodology followed is the process of density slicing that converts the continuous grey tone of MSS image into a series of density slices ,each corresponding to a specified digital range [5]. The marsh bounded by contour line, since water bodies have a low reflectance in this band because their pixels values have a range of 0-6 (nearly black).

The wet land area occupied by haur Ibn Najm in this date was measured according to Erdas 8.4 , indicated 68km$^2$ [6] .




**Figur 2-** Landsat MSS, band 4. The delineation of wetland Haur Ibn- Najm marsh

**5-1-2-Spot image interpretation**

This image represents the dried out cultivated marshland scale (1/250000) was received by Google earth, figure.3. Looking at this image various objects of different sizes and shapes appeared. Some of these objects may be easily identifiable while others may not. Two main drains are discerned, namely Al-sharqy Euphrates drain in the upper part, 1.3 MD drain in the lower part. So they are making the upper and lower boundary of the dried land and were used actively in drying out mechanism. The image shows extensive agricultural field which is cultivated by rice and vegetables during summer and wheat and barley during winter.

Uncountable numbers of irrigation and drainage canals through these cultivated fields were observed. The area of the former haur has been measured according to (Erdas 8.4) and indicated 64 $km^2$ [7].

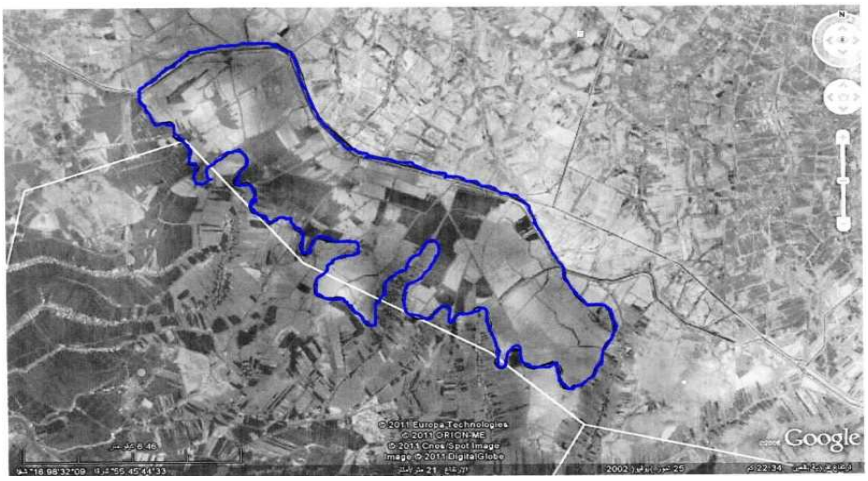



**Figure 3-** Spot image, the delineation of wetland Haur Ibn- Najm marsh

**5-2- MSS and Spot images sub-set**

This operation enable us to concentrate and extract part of the original MSS and spot imaged.To excute this process (Erdas imagine) was used [6].The image of figure.4 is gained out of this process.

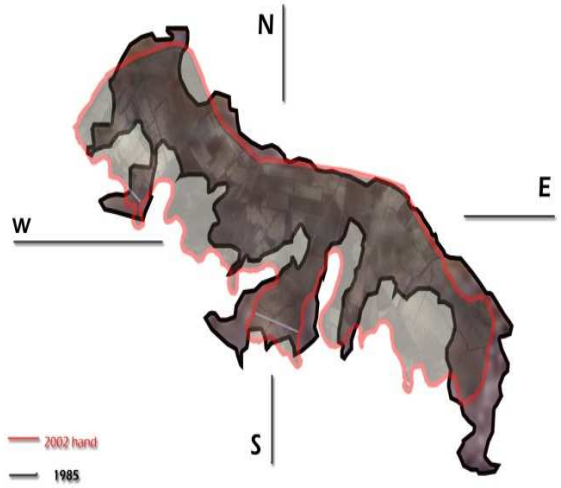



**Figure 4-** Panchromatic subset and merging of MSS and Spot images extracted from the surrounding area

**5-3- Data –set Merging :**

The digital merging of different spectral sets (spot and MSS) , figure 4 and figure 5 is important components of digital image processing because it allows for visual or computer analysis at once, for the same area. Merging is the spatial superposition of digital images taken at different wavelength different resolution, different times or at different sensors. Data set merging can be benefit to both computer based analysis and change detection, plus visual interpretation including multisensory image analysis [8].

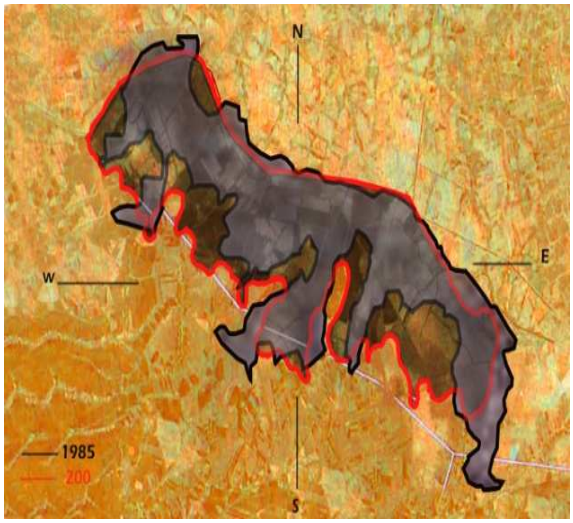



**Figure 5-** False colour composite subset and merging of MSS and SPOT images, within the surrounding area

Shows the ground truth location upon the area figure 6.Any image showing the spatial attributes of spectral classes would have to be compared to ground reference data to determine their true identity value [9]. Global positioning system (GPS) has been used for locating ground truth points upon the area.

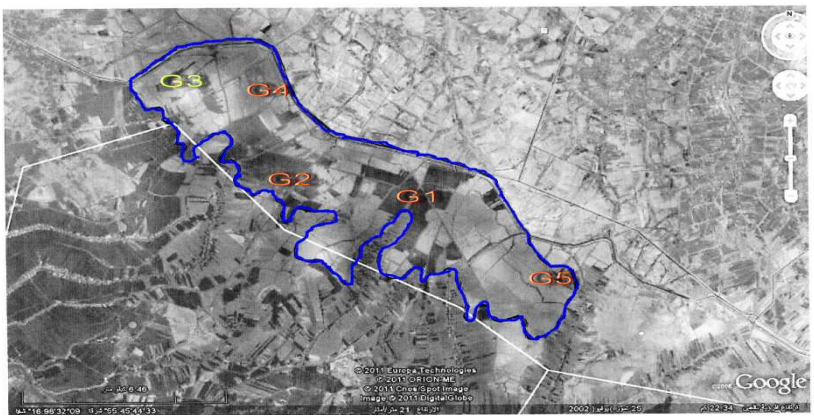



**Figure 6-** Panchromatic SPOT image of Haur Ibn-Najm with ground truth locations**.**

**6. The representative ground truth points**

1- G1.38R o45°92´29″ E , 355 ° 83´15″N
This point is located in the intersection between two drain canals. It occupied by 70% natural vegetation mostly reed, surrounded by many irrigation canals.
2- G2.38R o45°84´31″ E , 355 ° 79´94″ N
This point is located in the middle of natural vegetation with density of 80%.the natural vegetation constitute of rush and reed surrounded by rice fields.
3- G3.38R o45°16´30″ E , 356 ° 17´08″ N
It is located at the end of small tributary canal charging the marsh with water. This area is submerged with water after the refloodingn processes. Rush and read is growing with 90%, water depth 0.5m.
4- G4.38R o45°54´78″ E , 356 ° 14´98″ N
This point is located in the eastern side of the marsh in the eastern Euphrates drain, which will be main supplier of water in the future. It has 75% of natural vegetation (rush, reed and tamarix).
5- G5.38R o46°38´83″ E , 355 ° 40´72″ N
It is located in a village south of the marsh, fishing and Buffalo breeding is their occupation with some cultivation.

**7. Assessment of boundaries association in MSS and Spot images**

To assess the boundaries coincidence in both images. A simple visual comparison can made by deep look at figure 4 In order to interpret this visual interpretation, a numerical comparison can be constructed to detect the association percentage both boundaries using statistical equation of coefficient of areal correspondence [10].
X=[(joint surface covered by two boundaries)/ (total surface covered by two boundaries)] *100 [10].

Using (Erdas 8.4) the measured surface area included in one boundary and excluded by the other one or vis, versa is equal to 17km² .
X=(132-17)/132=87 % boundaries association
The 13% difference is due to terrain changes of some areas of the marsh consequently pixel values of these areas (cultivated land ) have the same pixel vales to that the surrounding areas.
In essence constructing a sharp boundary line around the marsh in 1985 MSS image is possible but rather impossible in 2002 spot image.

**8. Conclusions**
1- The value of the marshes wetland had gained increased recognition because they contribute to a healthy environment and support species diversity.
2- The demography of the region has changed from hunting, grazing and sheep buffalos breeding into peasant profession.
3- Evidence from southern Iraq has shown that long term changes in the marsh can be detected using remote sensing data.
4- Seasonal long term changes can be calculated on both scenes MSS and spot images however the spectral resolving power and high resolution provided by spot imagery made it more easy to detect such changes.
5- Reflooding operations of the marshes are extremely difficult process owing to the sharp decrease in water discharge of the twin rivers and climatic changes.
6- Sensing data and geographic information systems is the most accurate and rapid way in detecting any short or long term changes in the terrain especially with advances of satellite sensors like for example IKONO (spatial resolution 1m).
7- Agricultural products of rice through summer and wheat and barley in winter were not economically successful due to lack in soil fertility of the former marsh land.
8- The marsh should be treated as a controlled natural habitat.
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