Integration Approach of Remote Sensing and GIS to Detect Land Use / Land Cover Change Dynamics in Himreen Lake and Surrounding Area

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Abstract :

In this research the poem of Anne Finch, Countess of Winchelsea, "A Nocturnal Reverie" will be analyzed from an ecological perspective. Ann Finch's contribution to understanding nature will be examined within ecocritical viewpoint and how her vision of nature is reflected in the poem. This study attempts to prove that Anne Finch was highly aware of the importance of nature in humans' life and believed that humans are responsible for both nature and humans' welfare. With her poem Anne Finch tried to convince man that nature is a beautiful and living community that should be respected in order to reach inner harmony and to make the world a better, freer and kinder place. In the poem Finch represents nature as a united society, every part and aspect of which has its feelings, wishes and goals. Finch finds in natural society freedom and equality, but this is possible only at night. The day is the time of the "tyrant-man", that belongs to a superior world and man suppresses the call of nature in himself. Still the tyranny of human cannot suppress nature completely because of the following reasons: a) man is not an authority, b) man feels the need in nature, and thus nature is superior to him. The study area is located north of the central part of Iraq. Some small cities lay within the area and Diyala River runs across it. It includes Himreen Lake in its middle part. The aims of this study was to develop and use applied approach for monitoring, detecting, analyzing and producing land use/cover change maps in Himreen and surrounding area during the period from 1984-2016, using remote sensing and geographic information system (GIS) techniques, as valuable contribution with high accuracy to planning and management in many fields of developments in the study area.

Remote sensing techniques are used to produce Land Use/Cover (LULC) map for the study area using Landsat-8 satellite (ETM) images acquired in 2013. These images have the best compatibility properties for this purpose than other images attained in different dates, using USGS classification developed procedure. (LULC) map is produced depending on the maximum Likelihood supervised classification (ML) of (ETM) images with assessment accuracy of (97.44%) and (0.9707) kappa coefficient. In other hand, the change detection of water class in Himreen Lake has depended on the vector map of Normalized Difference Water Index (NDWI) of six scenes Landsat satellite series (ETM) images for the periods (1984, 1992, 2002, 2006, 2013, and 2016). The (LULC) raster and water index image are converted to vector structure, using ArcGIS v.10 software in order to create a digital (LULC) map.

Three main classes of (LULC) are recognized in the mapped area. Those are Barren Land class (Code 7), the Barren Land Class is divided into four subclasses, which are Sandstone, Claystone, Mixed Exposed Land, and Bare soil. Agricultural Land class (Code 2), the Agricultural Land class is divided into two subclasses, which are Harvested Land and Idle Land. and Water class (Code 5), the Water class is represented by Himreen Lake. The mapped area revealed that the Barren Land Class covers the largest area, the Agricultural Land class and the Water class cover the smaller and smallest areas respectively. The Agricultural Land is represented in the eastern part of the mapped area in which the flood plain extends.

Change detection of water in Himreen Lake is represented by increase and decrease periods. Three increase periods during years (1984-1992, 2002-2006, and 2013-2016) and two decrease periods during years (1992-2002, and 2006-2013) are detected. It is noticed that the decrease of water is referred to many reasons such as, shortage in rainfall, decrease in Diyala River flow release from upstream country, as well as the random irrigation acts in the study area.

KEYWORDS: ***Land use/cover (LULC), Land use/cover change (LUCC), Normalized Difference Water Index (NDWI), Remote Sensing, GIS, Himreen Lake.***

1. Introduction:

Land cover/Land use can be considered as an interface between natural conditions and anthropogenic influences. The information in a pixel of satellite data is for a mixture of different land use/ cover (LULC) components and can be estimated using classification techniques. Remote sensing has emerged as the most useful data source for quantitatively measured land use/cover changes at the landscape scale. Land cover refers to the lands physical attributes such as; forest, grassland, ..etc.; whereas land use expresses the purpose to which those attributes are put or how they are transformed by human action such as cropping, ranching …etc., which means that land use relates to the human activity or economic function associated with a specific piece of land (Moran, *et al*., 2004 & Lillesand, *et al*., 2004).

Land use represents the link between human action and the landscape. Land cover is closely associated with land use. Over the years, Land Use Land Cover Change (LUCC) has been found to be a major contributing factor to local and global environmental change . (LUCC) is the collective result of both biophysical and socioeconomic driving forces. It is a highly dynamic and complex process, which involves interactions and feedback at multiple spatial and temporal scales, and thus requires a sophisticated multi-faceted analytical framework. Spatial analysis of historical land-cover change with the help of spatial statistics and landscape metrics has been employed to explore the nature of (LUCC) dynamics (Sun, 2006).

There are many potential benefits of acquiring land cover/use information. It is important in assisting local and regional decision-makers to monitor current conditions and model the impact of future growth. It is also important in urban land-use pattern rapid change in response to economic, social and environmental forces. In addition, agricultural resources, natural ecosystems, as well air and water quality, can all be affected by changing land use patterns. Information on changing land cover/use patterns is also valuable information for economic development, as investors can gain insights regarding new areas of growth. The remote sensing data can be particularly important in visualization of those trends. The large existing archive of imagery with a short repeat interval and consistent image quality has been particularly important in this trend (Almutairi, 2000).

Remote sensing and (GIS) are now providing new tools for advanced ecosystem management. The collection of remotely sensed data facilities the synoptic analysis of earth system function, patterns and changes at local, regional and global scales over time. Such data also provide an important link between intensive, localized ecological research and regional, national and international conservation and management of biological diversity (Lillesand, *et al*., 2004).

On the other hand, integration of remote sensing data and geographical information system (GIS) analysis has become a trend for environmental assessment and management, for its capabilities of managing and manipulating large amounts of spatial data to satisfy planner and policymakers growing needs of accurate (LULCC) information (YUAN, 2008).

2. Aims of the study

This study has three objectives:-

1- Produce, recognize and analyze vector maps of land use /cover (LULC) map of study area and calculate their areas depending on supervised classification of Landsat-8 satellite (ETM) images.

2- Produce, examine and analyze vector Maps of Normalized Difference Water Index (NDWI) of (ETM) images for Himreen Lake for years (1984 to 2016) using integration of remotely sensed data and GIS techniques in order to detect the changes dynamics that have been occurred.

3- Develop a framework of mapping and change dynamics detection techniques of land use/cover (LULC) in Iraq by integrating remote sensing and GIS techniques. Furthermore, to explore the potential of these techniques approach within the planning and management, such as urban planning, sustainable development planning, monitoring and management of natural resources and environment development, management of biological diversity, agricultural resources, etc….

3. Study area:-

3.1. Location

The study area is situated in the Foothill Zone of the Unstable Shelf of Nubio-Arabian Platform and Mesopotamian Zone (Buday, 1987). It is located within coordinates: Longitudes (44º 45´and 45º 15´), Latitudes (33º 55´ and 34º 25´), Fig. (1):

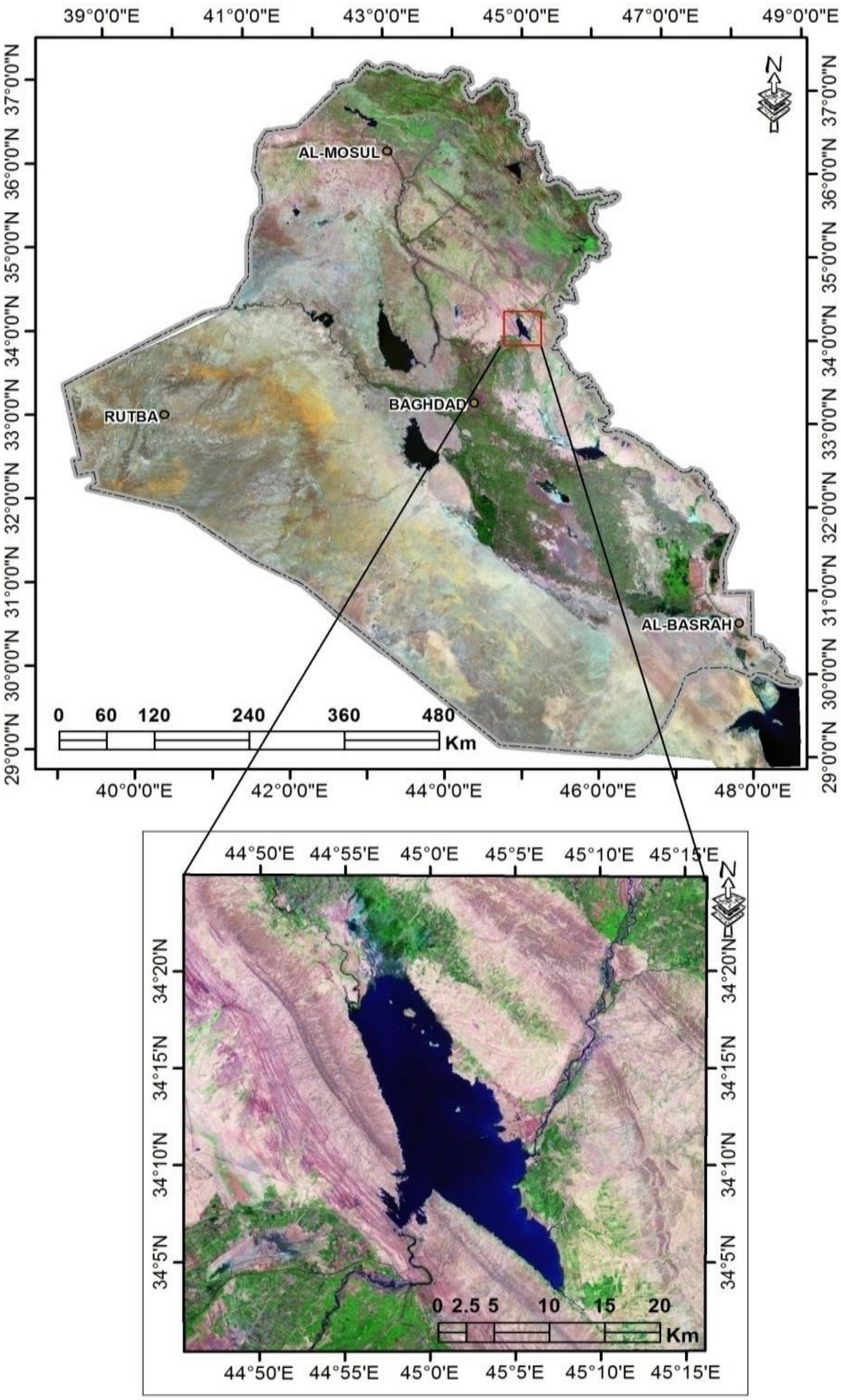

Fig. 1: Location map of the study area.

3.2. Geological Setting

3.2.1. Structural Geology

Structurally, the mapped area is situated in the foothill zone of the unstable shelf of Nubio-Arabian platform and Mesopotamian zone. Tectonically, it is partly belongs to Tigris and Himreen-Makhul subzone (Buday, 1987). Six anticlines take place in this area: Himreen, Gilabat, Pulkhana, Qumar, Kalar and Barda anticlines. Himreen, Gilabat and Pulkhana anticlines are the main structural elements. They are asymmetrical and thrusted anticlines, separated by broad and asymmetrical synclines filled by quaternary deposits (Barwary, 1991).

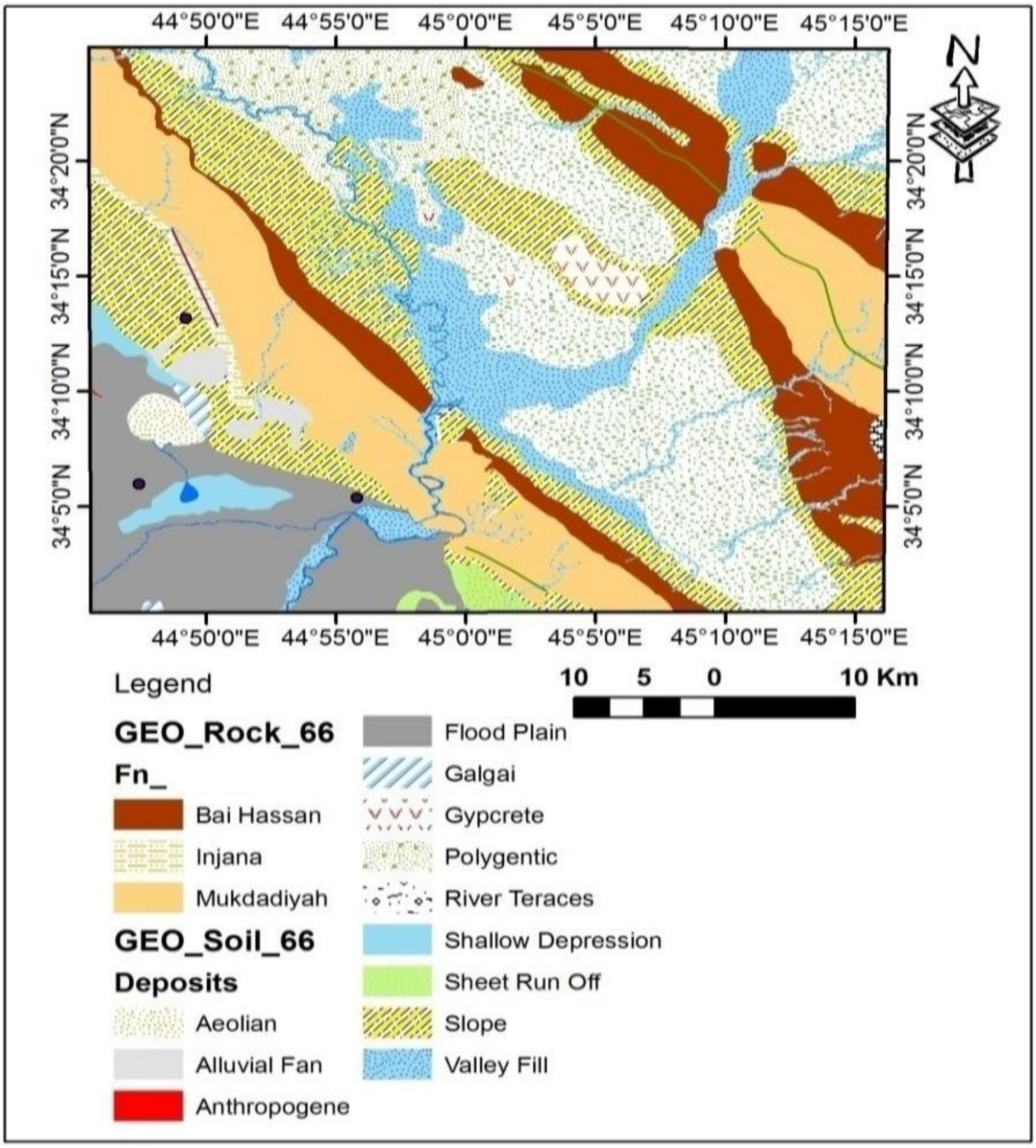

Fig. 2. Geological map of the mapped area
(modified from Brwary and Selwa, 1993).

3.2.2. Stratigraphy

- Pre-Quaternary deposits

The geology of the mapped area is reviewed hereinafter, and special attention is paid to its relation with (LULC). The reviewed data is quoted from (Barwary, 1991 and Barwary & Selwa, 1993), figure (2). These deposits are represented by (Upper Miocenc – Pleistocene) deposits: Injana Formation (Upper Miocene), Mukdadiya Formation (Pliocene), Bai Hassan Formation (Pliocene) and Bammu Conglomerate (Pleistocene) .

- Quaternary deposits

Quaternary deposits cover more than (75%) of the mapped area. These are represented by (Pleistocene-Holocene) deposits: Alluvial fan deposits (Pleistocene) , Slope deposits , Polygenetic deposits , Gypcrete , Sheet run off deposits, Floodplain deposits, Sabkha deposits, Depression fill deposits, Aeolian deposits and Valley fill deposits.

3.2.3. Geomorphology

- **Units of Structural origin:** The most important structural elements are Himreen, Gilabat and Pulkhana anticlines which give rise to different slopes controlled by lithology as well. The main features are: Cuestas and Hogbacks, Ridges, Slopes.
- **Units of Denudation origin:** Those units include the Pediment which is the gently sloping polygenetic deposits land surface bordering the foot of mountains; and the Badlands which is developed within soft rocks, especially Bai Hassan Formation, forming erosion area dissected by deep valleys.
- **Units of Alluvial origin:** Which include the Flood plains originated by lateral erosion of rivers such as Tigris, Adhaim and Diyala, and along main valleys. In addition to the Alluvial Fans which form when the eroded load is forced to pass through a narrow passage. There is one huge fan at Tikrit, a Bajada at the south western flank of Himreen anticline, and Depressions that are represented in the western part of Himreen anticline.
- **Units of Aeolian origin:** Those are well developed between Adhaim River and Shari Lake.
- **Units of Evaporation origin:** Those units include the Gypcrete which is well developed in the mapped area east and west of the Tigris

river covering vast area. Due to their high dissolving ability it forms geological hazard. The Sabkha is well developed around Shari Lake.

- **Units of Solution origin:** Those include the Sinkholes. The small holes are well developed within areas covered by Gypcrete. They are (1-2 m.) in depth and (1-10 m.) in diameter. They are formed due to dissolving of the Gypcrete.

3.3. Climate

The current climate in the study area, especially during the period from (1990-2007), is under the influence of arid climate. The following climatic data are gathered from the Iraqi Meteological Organization (Adhim Metrological Station). The data of different climatic elements is show in Table (1) and plotted in the morphogenetic diagram (Peltier, 1950 in Fookes *et al*., 1971) (Fig. 3).

Table.1: Climate data of the mapped area

Period (1990-2007)	Climatic element \ Months	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	Average
	Monthly Average													
	Relative Humidity (%)	78	68.1	59.4	49.3	36.7	28	26.5	28.5	33.7	44.8	60.7	75.3	49.1
	Normal Air Temperature (C°)	9.0	11.3	15.8	21.5	28.1	32.7	35.7	35.0	30.9	24.9	16.9	11.1	22.7
	Monthly Total													
	Rainfall (mm)	36.1	31.9	28.3	18.7	11.7	0.7	0.0	0.0	1.3	7.3	26.8	30.3	377.1
* Total annual rainfall														

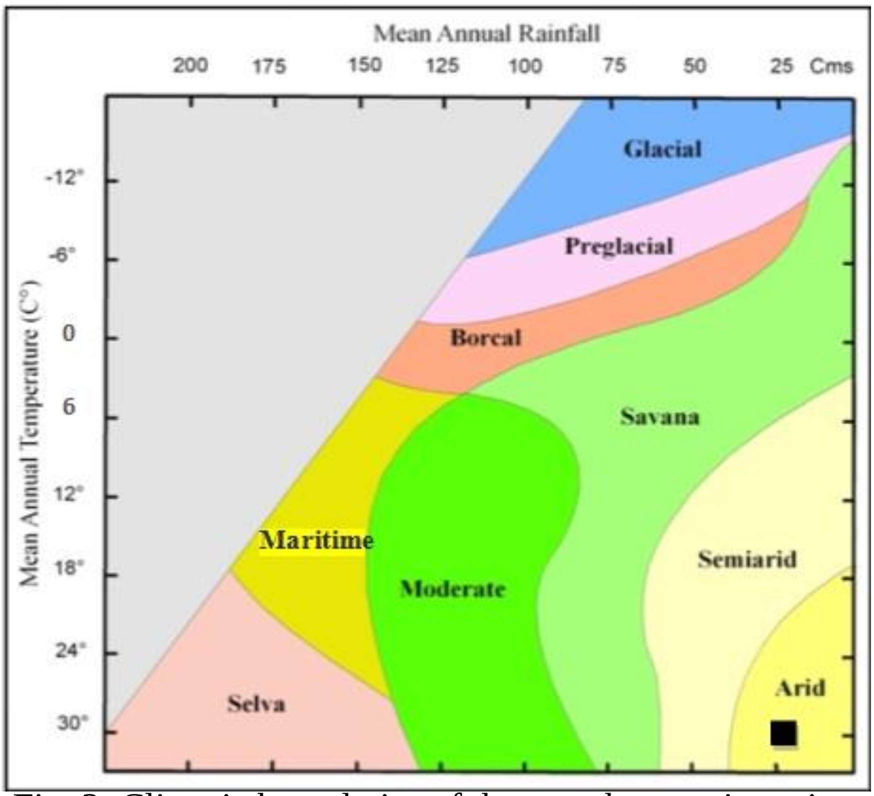

Fig. 3: Climatic boundaries of the morphogenetic regions (After Peltier, 1950 in Fookes *et al*., 1971).

4. Methodology:-

4.1. Data and Software

ERDAS Imagine v.11 and ArcGIS v.10 softwares are used to present the data and analyze six scenes of (168/36) Landsat 8 from different periods (1984, 1992, 2002, 2005, 2013 and 2016) having (30 m) spatial resolution, Table (1). In addition to that, (40) scenes of Quick Bird satellite very high resolution (0.6 m.) images which totally cover the study area, are used. These images and the previous work are used to monitor the study area. One scene is used for delineating the different types of classes to produce the (LULC) map of the area, as well as to monitor the dynamic change of water in Himreen lake for (1984-2016) periods.

4.2. Pre-processing

A data subset is prepared using area of interest file (AOI) option. The images are corrected according to (WGS84) datum and (UTM) projection for (Zone 38N) using nearest neighbor resembling method. All bands, except band 6 (Thermal band), are used in supervised classification.

4.3. Office checking

Unfortunately, field checking is not carried out due to accessibility restriction to the mapped area, therefore the accuracy assessment of the supervised classification of (LULC) classes of the mapped area is depending on Quick Bird scenes, the previous studies such as the geological map, and the topographic map. Most of the photos added to this project are taken from Google Earth website.

5. Land Use – Land Cover Classification:-

5.1. Land Use – Land Cover Standards

Land Use / Land Cover codes of USGS land categories are developed by Anderson *et al*., (1976) for use with remotely sensed images. The codes are organized into four hierarchical levels. At the top of the hierarchy, **level I** include:

1. Urban and Built-Up Land
2. Agricultural Land
3. Brush or Transitional Between Open and Forest
4. Forest
5. Water
6. Wetlands
7. Barren Land

8. Tundra
9. Permanent Snow and Ice

Each sub-level contains maximally nine categories (1 - 9). **Level I** has the lowest resolution, or detail of the Landscape, while **level IV** the highest resolution.

5.2. Creating Land Use/ Land Cover Map

The produced (LULC) map depends on digital interpretation of (ETM) data acquired in (2013) using supervised classification maximum likelihood method. Different classes are recognized in the mapped area by selecting related spectral signatures from different image places. Seed properties method is used which is provided in ERDAS Imagine v.11 software. The used spectral range limit is (10 – 20) % reflectance of pixel, which is taken from the image of the mapped area. The space of seed properties is (300) pixels that cover all area around the chosen pixel.

Post classification with filter (3*3) Kernel has used to refine the image views and remove unwanted isolated pixels. The classified map shows the derived (LULC) map of the mapped area. It present three main different classes and many of these classes are divided into more than one subclass when possibly enclosed.

5.3. Produced Land Use / Land Cover Map

The Land Use – Land Cover map is produced depending on the digital interpretation of Landsat (TM) data using Maximum Likelihood classification (ML). Anderson *et al.*, (1976) classification (USGS classification) is used to classify the Land classes. Maps of Land Use – Land Cover are fundamental tools for natural resource management and planning. The Land Use / Land Cover codes provide a standard system by mean of which units of land can be categorized.

The classified image, figure (4), shows the derived Land Use / Land Cover map of the mapped area. The area is classified into three classes; **(level I)** are Barren Land (**Code 7)** , Agricultural Land (**Code 2)**, Water (**Code 5)**,.the Barren Land and Agricultural Land classes are classified into subclass (**Level II)**, the Barren Land classes are classified into subclass (**Level II)**, sandstone, claystone, mixed barren land, and bare soil. The Agricultural Land classified into subclass (**Level II)** are vegetated, harvested and idle lands.

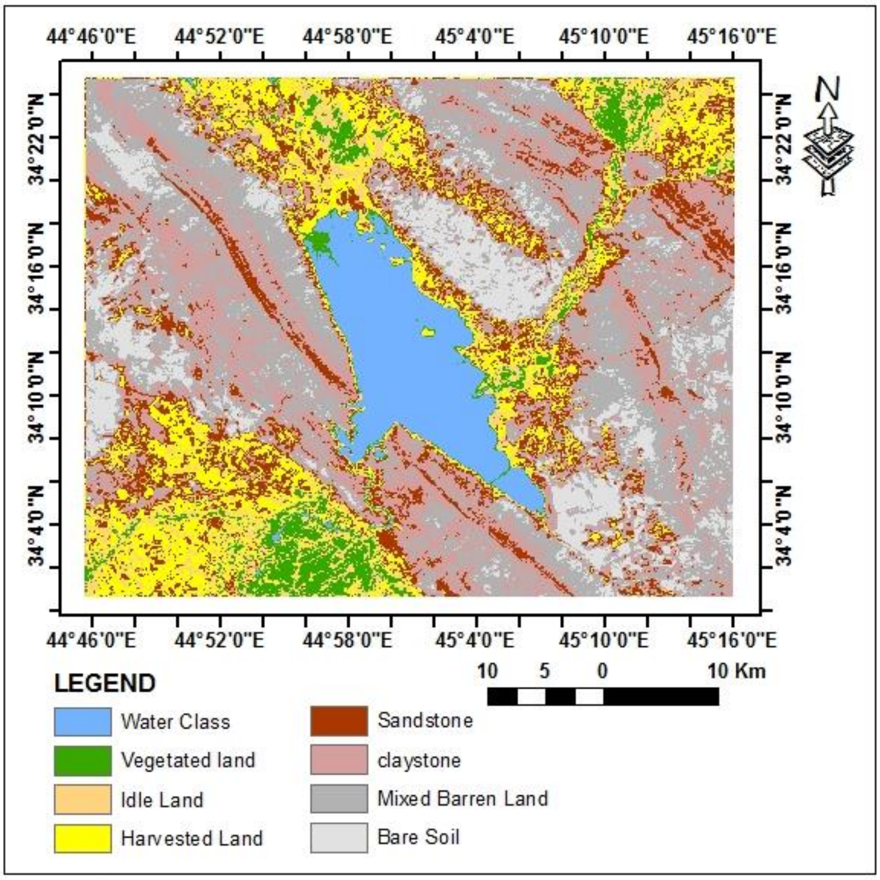

Fig. 4: Classified image of mapped area at 2013

5.3.1. Barren Land Class (Code 7)

Barren Land is a land of limited ability to support life and in which less than one-third of the area has vegetation or other cover. Generally, it is an area of thin soil, sand, or exposed rocks. This class within the map area is divided into three subclasses as follows:

5.3.1.1. Exposed Rocks (Code 74)

The Bare Exposed Rock category includes areas of bedrock exposure, desert pavement, scarps, talus, slides, volcanic material, rock glaciers, and other accumulations of rock without vegetative cover, with the exception of such rock exposures occurring in tundra regions (Anderson *et al*., 1976). In the map area, the bare rocks exposed are divided into two types: **Claystone with Siltstone and Sandstone:**This class display in violet to light violet color with (432 RGB). It is represented by Bai Hassan, Mukdadiya, Injana, and Fatha formations, which consist of Claystone, Siltstone and Sandstone.

5.3.1.2.Mixed Barren Land Subclass (Code77):

The mixed barren land category is used when a mixture of barren land features occur and the dominant land use occupies less than two-thirds of the area. Such a situation arises, for example, in a

desert region, where combinations of salt flats, sandy areas, bare rocks, surface extraction, and transitional activities could occur in close proximity and in areal extent too small for each to be included at the same pixel. Where more than one-third intermixture of another use or uses occurs in a specific area, it is classified as Mixed Barren Land (Anderson *et al*., 1976).This class displays in brown color with (453 RGB). It consists mainly of slope sediments and Bai Hassan Formation, with mixture of terraces and soil distributed on the slopes surface, (Fig.5).

Fig.5: Mixed Barren Land.

5.3.1.3. Bare soil (Loamy Soil) (Code 78)

The soil has various textures and compositions. It is found as, powdery, granular or fibrous form and composed from sand, silt, clay, gravels and rock fragments. The soil appears gray to light gray color with (432 RGB). These sediments form the surface of great polygenetic, valley fill sediments and the slope sediments in narrow gentle slopes on the foot of the main ridges.

5.3.2.Agricultural Land Class (Code 2)

Agricultural Lands may be defined broadly as a land used primarily for production of food and fiber. They represent the main class in the eastern part of the mapped area, in which the flood plain extends. The Agricultural Land includes two types, the first vegetated land like cropland and pasture (Code 21) orchards, groves and another Agricultural Land (Code 22), confined feeding operations (Code 23) (Fig. 6); with red color in (RGB 432 and 453) in Landsat TM image. The second type is like idle, and harvested land .

The areas around Himreen Lake and along Diyala River within the mapped area have high distribution of vegetation, with some scattered agricultural fields in the mountainous area. The mapped area has a high density of date palms and fruit groves, barley, wheat, and different vegetation.

Figure .6: Agricultural Land class in Bajalan plain

5.3.3. Water Class (Code 5)

The water bodies have distinguished spectral reflection and appear in black color in (432 and 453 RGB) (TM) images. The water is classified into two main sub-classes; the shallow water (rivers, canals, turbid water and margins of Himreen Lake) as they appear in dark green color in Landsat image with (453 RGB) color composite; and deep water (refers to deep part of Himreen Lake) as it appears in dark color in Landsat image with (453 RGB) color composite.

Himreen Lake is the only lake in the mapped area and the Diayla River appears as a linear water body surrounded by date palms and groves.

5.4. Classification Accuracy Assessment Results

Accuracy may be defined, in a working sense, as the degree (often as a percentage) of correspondence between observation and reality. Accuracy is usually judged against existing maps, large scale aerial photos, satellite images or field checks**.**

The Overall Accuracy (OA) of the classification results was calculated by dividing the total correct sum of main diagonal cells by the total number of pixels checked in the error matrix. The User Accuracy (UA) is "the probability that a pixel classified on the map, actually represents that class on the field (ground)" and it was calculated by dividing the diagonal value for each class by its row total . Whereas, the Producer Accuracy (PA) indicates the percentage of a reference pixel being correctly classified, and it was calculated by dividing diagonal value for each class by its column total, (Lillesand *et al*., 2004).

Tables (2) shows the Accuracy Assessment of the thirteen subclasses, which resulted from the supervised classification of the Landsat (ETM) satellite image. Validity of this classification results was performed based on the (256) check points, which been used for

validation of the classification used in the image. The achieved Overall Accuracy is (97.44%) and a Kappa coefficient is (0.9707).

Table .2: Accuracy assessment of data in error matrix

Class name	**Reference Total**	**Classified Totals**	**Number Correct**	**Producers Accuracy**	**User Accuracy**	**Kappa**
Water Class	6	5	5	83.33%	100%	1
Vegetated Land	5	5	5	100%	100%	1
Idle Land	5	5	5	100%	100%	1
Harvesred Land	4	4	4	100%	100%	1
Sandsone	5	5	5	100%	100%	1
Claystone	5	5	5	100%	100%	1
Mixed barren Lane	5	5	5	100%	100%	1
bare Soil	4	5	4	100%	80%	0.7771
Total	39	39	38	97.92%	97.5%	

Overall Classification Accuracy = 97.44% Overall Kappa (K^) Statistics = 0.9707

5.5. Statistics analysis of Landuse/Land cover classes:

The identified eight classes/subclasses from the supervised classification for the (LULC) types in the mapped area have various distributions. The thematic classification image is converted from raster structure to vector structure, using ArcGIS software and the area of each class is tabulated in Table (3). Figure (7) shows the coverage area (in km²) and percentage for each class in the mapped area. The data reveals that the Barren Land Class, including (Bare Exposed rocks, Mixed Barren Land, Bare Soil), has the largest coverage in the mapped area, Vegetated Land and sand sheet class represents the second largest class, and the Agricultural Land, including (Idle Land, Harvested Land), represents the third largest class; while the other classes covered small area.

Table .3: Area and percentage of classes in the mapped area

GRIDCODE	Class Name	Area km²
1	Water Class	175
2	Vegetated Land	154
3	Idle Land	122
4	Harvesred Land	206
5	Sandsone	257
6	Claystone	425
7	Mixed barren Lane	501
8	bare Soil	241

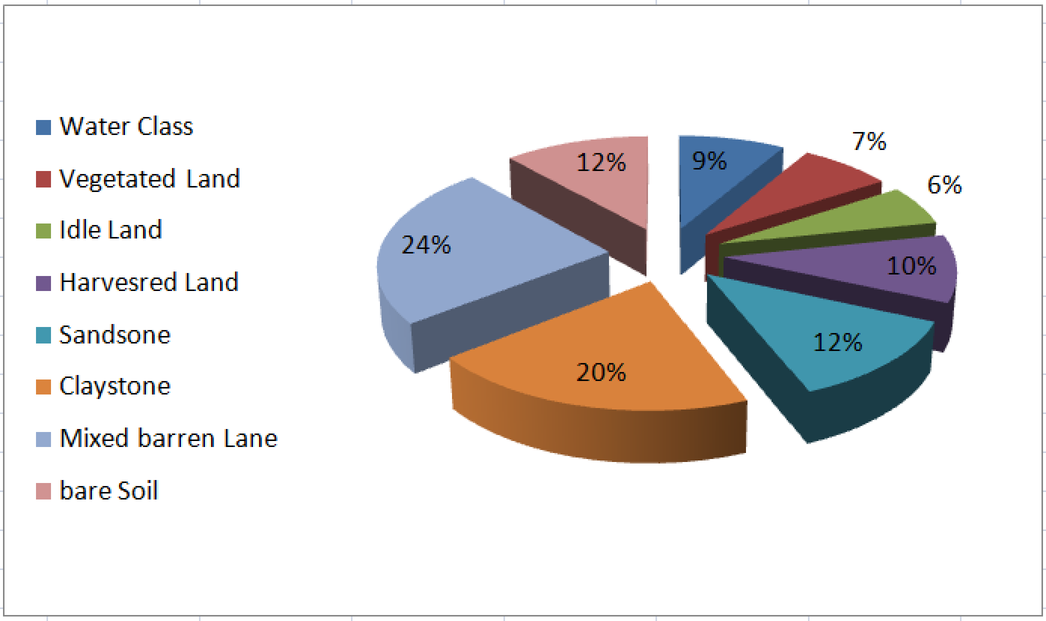

Fig.7: Plot diagram showing area and percentage of classes in the mapped area

6. Normalized Difference Water Index (NDWI)

Remote sensing techniques provide important capabilities to map surface water features and monitor the change dynamics of surface water and water resources by the measurements of the electromagnetic spectrum in the visible and Near-Infrared bands.

The Normalized Difference Water Index (NDWI) was used to oversee the situation of water in the study area. The lowest digital number (less than 50) for the mean of near infra-red (NIR) and short wave infra-red (SWIR) (Equation 1) spectral region was thresholded to clearly enhanced water bodies. This equation used with the (ETM), (TM), and Landsat 8 images depending on bands (4 and 5) and with (MSS) sensor depending on bands (6 and 7).

$$WI = \frac{NIR + SWIR}{2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

The result data interval between (0 –255) has thresholded the water which represent data less than (45) digital number for landsat 8, (ETM), (TM), and (MSS) sensors, resistivity. This index is better than equation (2) (CMP, 2003 and Jackson, *et al.*, 2004) to determine the water bodies

$$NDWI = \frac{Red - SWIR}{Red - SWIR} - 1 \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

6.1. Integration of Remote Sensing and GIS Data

From satellite images all threshold images (NDWI) that have (0.1) structure are converted to vector by using ArcGIS program to calculate the change in three periods. To neutralize the difference in spatial resolution, the vector structure exchange is used from the raster structure, and the Boolean Operation logic (intersect and eras) is used to determine the change in three periods (1984,1992 ,2002, 2006, 2013, and 2016).

The outcomes of the change detection steps were performed on the Landsat images that cover the study area in six different times (1984 to 2016). As pointed out previously, steps and results are summarized below (figure 8, 9, 10, 11):

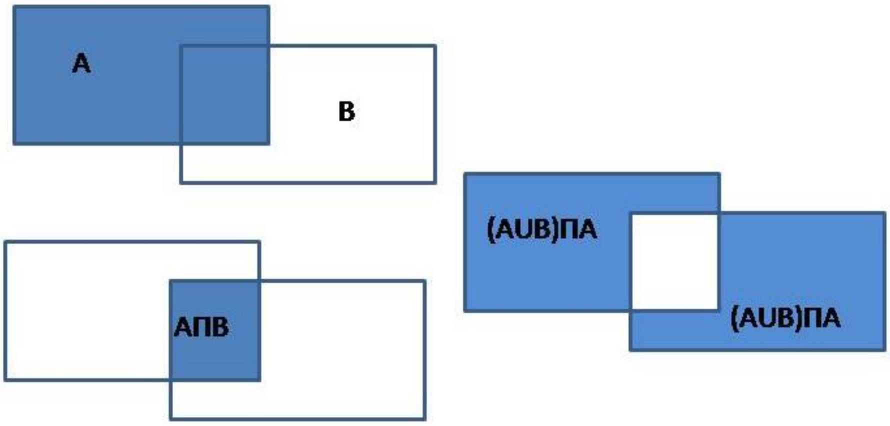

Fig.8: Boolean Operation logic (intersect and eras) that used in this study

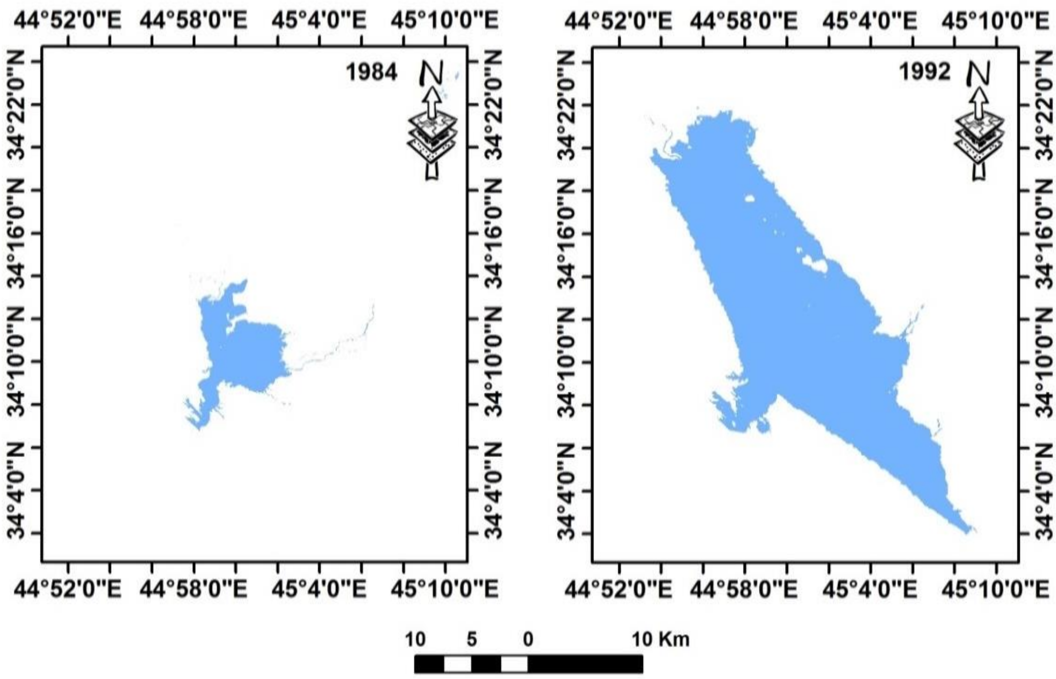

Fig.9: Vector of NDWI in (1984 and 1992)

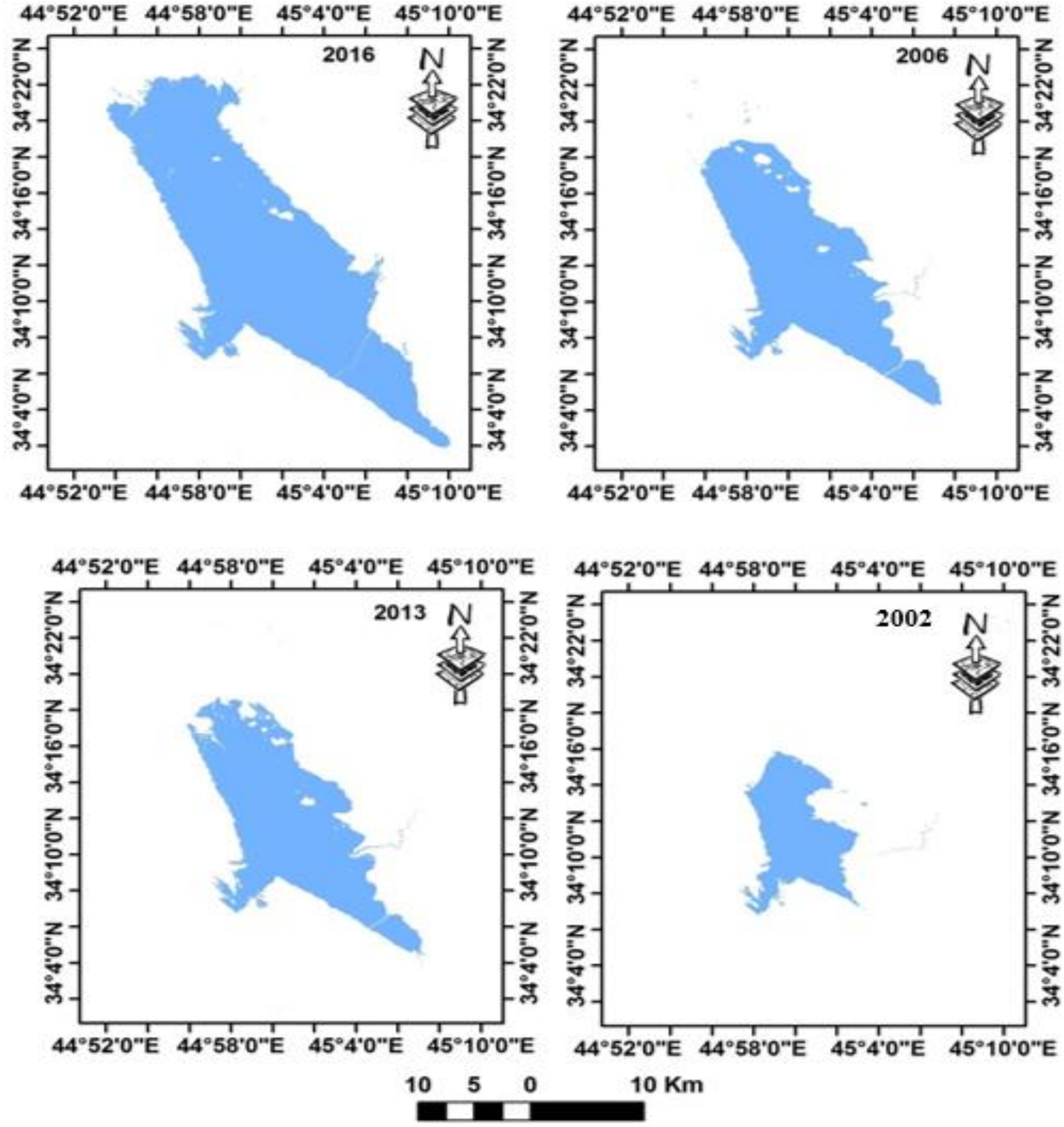

Fig. 10: Vector of NDWI in (2002, 2006, 2013 and 2016).

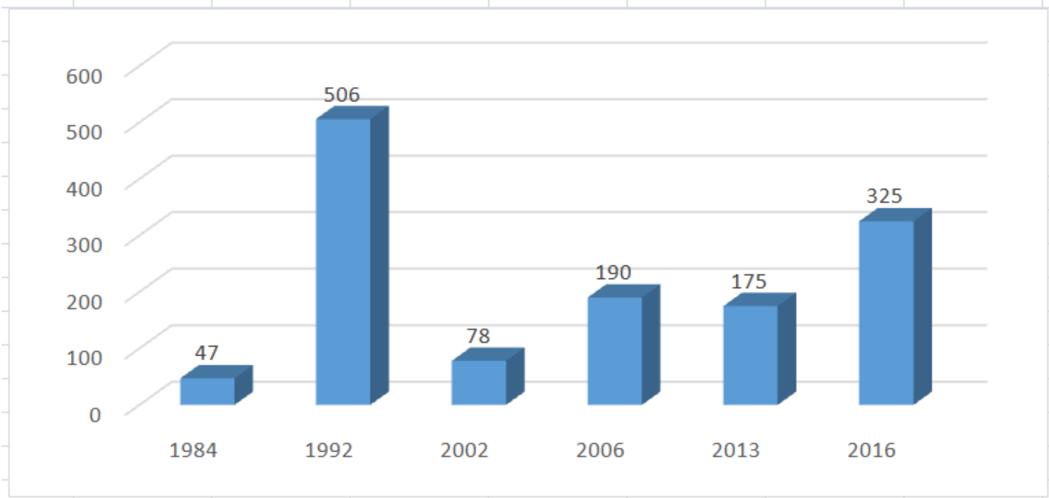

Fig. 11: Histogram of water body in mapped area for the six periods.

7. RESULTS AND CONCLUSIONS

The results and conclusions of this study can be divided in two categories as follow;

1-For the Land use/Land cover classified mapped area:

Eight classes/sub classes of Land Use/Land Cover (LULC) types having various distributions were identified in the mapped area figure (4). They are determined from the supervised classification. The thematic classification images acquired in (2013) are converted from raster data structure to vector data structure using ArcGIS (10.3) software, and the area calculations of each class is listed in table (3). In qualitative term figure (7) shows the coverage area in (km^2) and percentage for each class and sub class in the mapped area. The data reveals that the barren land class (includes bare exposed rocks such as sand stones and clays stones, mixed barren land and bare soil) has the largest coverage area (1124 km^2) ,while agricultural land class included(vegetated land, idle land, harvested land) represented the second largest class (482km^2), and the water class covered the smallest area (325km^2).

Figure (4) shows the general distribution of the agricultural land class represented in the eastern part of the mapped area in which the flood plain extends. The vegetation is highly distributed around Himreen lake and along Diyala River; while the barren land class is highly distributed in the mountain areas surrounding Himreen lake.

2- For the Normalized Difference Water Index (NDWI) of Himreen lake from (1984-2016):

The method of the post-classification comparison change defection approach is employed in the study. Raster data of NDWI are converted to vector data to monitor the change detection of Himreen lake for six periods from (1984-2016) (Fiure. 9 and 10). From reviewing the enclosed maps the following could be concluded;

- Increasing in the water area in periods (1984-1992 , 2002-2006 ,2013-2016)
- Decreasing in the water areas in periods (1992-2002, 2006-2013).

In quantitative terms Figure (9) shows decreasing in the water area at Himreen lake in (1984) and increasing in (1992). It cover (47 km^2) in (1984) and (506 km^2) in (1992) .While figure (11) shows the remarked difference between positive and negative water area between (1992-2002), the water cover area (78 km^2) in (2002), (190 km^2) in (2006),

(175 km²) int (2013), and (325 km²) in (2016). Generally, the best period for water quantity increments of Himreen lake was in 1992 and 2016. It is noticed that the decline of water area in Himreen Lake for many time periods from (1984-2016) refers to many reasons as follow;

- The change in climatic conditions such as the increments of the draught and the decline of rain fall.
- The decreasing in the flow of Diyala River from the upstream countries.
- The bad management for the water resources in the study area such as using the water of Diyala River and Himreen Lake for random irrigation.

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"تكامل تقنيات الاستشعار عن بعد ونظم المعلومات الجغرافية لكشف التغيرات في الغطاء الارضي واستعمالات الارض و في بحيرة حمرين والمناطق المحيطة بها "

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المستخلص

هدفت هذه الدراسة الى استخدام منهج تطبيقي تحليلي لمراقبة وكشف التغيرات وتحليل وانتاج خرائط استعمالات الارض والغطاء الارضي لبحيرة حمرين والارضي المحيطة بها الواقعة الى الشمال من وسط العراق خلال الفترة من 1984 – 2016 باستخدام تقنيات الاستشعار عن بعد ونظم المعلومات الجغرافية كمساهمة تكفل الدقة العالية في التخطيط والادارة في مشاريع التنمية المختلفة .

تم استخدام تقنيات الاستشعار عن بعد لانتاج خريطة لاصناف استعمالات الارض- الغطاء الارضي بالاعتماد على البيانات الفضائية للقمر الصناعي لاندسات - 8 للمتحسس TM والملتقطة عام 2013 نظرا لافضليتها من حيث الخصائص النوعية لهذا الغرض في الدراسة مقارنة ببقية المرئيات الفضائية المتوفرة بتواريخ زمنية اخرى ، اذ تم استخدام تقنية التصنيف الموجه لانتاج خريطة استخدامات الارض – غطاءات الارض اعتمادا على نظرية الاحتمالية (العظمى) بأستخدام برنامج ERDAS V.2011 وبرنامج ARCGIS V.10 واظهرت نتائج التصنيف بأن دقة التصيف الموجه 97.44 % وان قيمة معامل كابا 0,9707 .وفي جانب اخر من الدراسة تم القيام باجراء كشف التغيير على بحيرة حمرين باستخدام دليل المياه (NDWI) لانتاج خرائط من المرئيات الفضائية نوع ETM للقمر لبصناعي لاندسات – 8 للسنوات 1984-1992، 2006, , 2002 ، 2O13 2016 باستخدام برنامج ERDAS V.2011 وبرنامج ARCGIS V.10 .

اظهرت خارطة استعمالات الرض والغطاء الارضي وجود ثلاثة اصناف رئيسية ضمن منطقة الدراسة وهي: الاراضي الجرداء ، الاراضي الزراعية والمياه ، واشتمل الصنفين الرئيسين الاوليين على ثلاثة أصناف ثانوية لكل منهما ، اذ غطت الاراضي الجرداء المساحة الاكبر تليها الاراضي الزراعية واخيرا المياه . كما بينت بان الاراضي الزراعية تتركز معظمها في الجزء الشرقي لمنطقة الدراسية بسبب وقوعها ضمن السهل الفيضي الفيضي لنهر ديالى ، اما الاراضي الجرداء فتتركز معظمها في جبال منطقة الدراسة . اما خرائط كشف التغيير لبحيرة حمرين للفترة الزمنية 1984-2016 فقد اظهرت زيادة في مساحة البحيرة ثلاث فترات زمنية من 1984-1992 ومن 2002-2006 ومن 2013-2016 ، فيما اظهرت نقصان في مساحة البحيرة لفترتين زمنيتين من 1992-2002 ومن 2006-2013 . وتعود اسباب فترات النقصان في مساحة وكمية المياه في البحيرة الى عدة اسباب منها قلة التساقط المطري في تلك الفترات قلة ونقصان كمية الجريان المائي لنهر ديالى من بلد المنبع ، اضافة الى سوء ادارة الموارد المائية وطرق الري العشوائية من مياه نهر ديالى ومياه البحيرة ضمن منطقة الدراسة .