اتجاهات التغير للغطاء واستعمالات الأراضي والتنبؤ بها في منطقة المسيب بابل باستخدام الجيوماتكس

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Change trends and prediction for Lcluc in the Musayib area of Babylon Governorate using geomatics

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المستخلص

ركزت الدراسة على تحديد اتجاهات او محاور تغيرات الغطاء الأرضي واستعمال الأراضي في قضاء المسيب – شمال محافظة بابل للمدة بين ٢٠٠٠-٢٠٢٠ باعتماد صور القمر الصناعي Landsat-7 وLandsat-8 ، وبعد اجراء المعالجات الرقمية اللازمة لتلك الصور وتصنيفها باستخدام التصنيف الهجين في برمجية ARC GIS 10.7,ERDAS 2014واعتماد نظام تصنيف هيئة المساحة الجيولوجية الامريكية . USGS والهدف من هذا البحث هو معرفة التغير المساحي الحاصل في الغطاء الأرضي واستعمالات الأراضي وتحديد الاتجاه او المحور الأكثر تغيرا في أصناف الغطاء الأرضي واستعمال الأرض والاتجاه العام للتغير في منطقة الدراسة، ولتخمين التغيرات المستقبلية وما هي النطاقات التي سوف تتعرض للتغير، اذ تم تقطيع المرئيات الفضائية المصنفة او تقسيمها الى ثمانية أجزاء منفصلة يشير كل قسم منها الى اتجاه معين، لقياس مساحة ونسبة كل صنف من أصناف الغطاء الأرضي في كل جزء من تلك الأجزاء. على ضوء مخرجات العمليات السابقة المتمثلة بالمرئيات التي تم معالجتها وتصنيفها ومعرفة مساحات ونسب التغير في أصناف الغطاء الأرضي تم استخدام برنامج الادريسي لمحاكاة التغير المستقبلي للغطاء الأرضي واستخدام الأرض في منطقة الدراسة. اذ يتيح البرنامج إمكانية تطبيق نموذج CA-MARKOV الذي يجمع بين السلوك الذاتي الخليوي وتحليل سلسلة ماركوف، وتحليل تقييم متعدد المعايير (Multi-Criteria Evolution (MCE ، وتخصيص الأرض متعدد الأغراض Multi-Objective Land (Allocation (MOLA، وإجراءات تنبؤ الغطاء التي تضيف عنصرا من التواصل المكاني ، ومعرفة التوزيع المكاني المحتمل للتحولات الى تحليل .

الكلمات الدالة : التصنيف الهجين ، اتجاه التغير ، محاكاة التغير المستقبلي ، نموذج CA-MARKOV

Abstract

Determine the axes of trends of Lcluc changes in Musayib district – north of Babylon Governorate for the period between 2000-2020 for the satellite Landsat-8,7, after making the necessary digital processors for those images and classifying them using hybrid classification in the software ARC GIS 10.7, ERDAS 2014 and the adoption of the classification system of the US Geological Survey USGS. Therefore, the goal here is to know the areal change in Lcluc and determine the axes of the most changing trend of Lcluc, the general trend of Lcluc, and the general direction of change in the region, and to predict what will become of future changes and what are the most vulnerable uses to change, through the trend rose that shows the proportions of the areas of change and direction in the light of the results of digital processors of images and their classification, so the Idrisi program was used to simulate the future change of Lcluc for the region, and this software enables the possibility of applying the CA-MARKOV model that combines cellular self-behavior and Markov series analysis, Multi-Criteria Evolution evaluation analysis (MCE), Multi-Objective Land Allocation (MOLA), cover prediction procedures that add an element of spatial communication, and know of the potential spatial distribution of transformations that provide ideas for future planning.

Keywords: hybrid classification, direction of change, simulation of future change, model of ca-markov

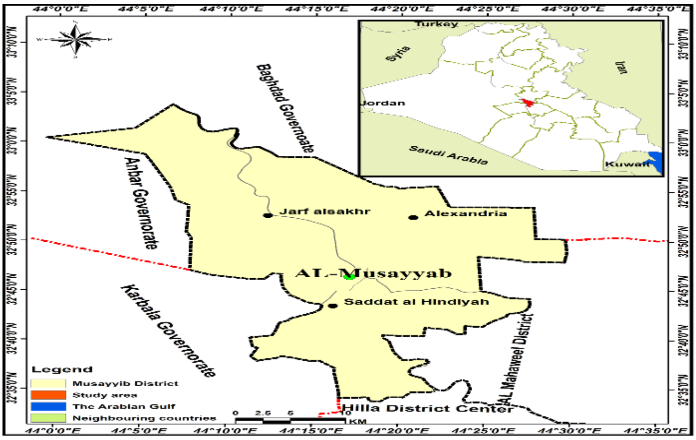
Introduction:

Many studies of cover change Lcluc show that subject to determining the trends of change for Lcluc varieties, and future forecasting is not addressed because it is a topic of great importance in geographical studies at the moment through its role in drawing future policies for planning and development processes (Al-Mawla, Ali, 2018:405), so a spatial model was made within the environment of the Idrisi program by applying (Markov's algorithm) to show the varieties of land cover that will change in the Musayib area, and from those studies (Al-Ani, (2004) changes Land cover for Balad area using digital processing methods and automatic classification of remote sensing data, Digital processing methods and the automatic classification of remote sensing data and the emergence of a new scientific field called integration between remote sensing data and geographic information systems were used to study changes in the region of Balad, (Al-Ghazi, 2010), studied the changes of the land cover of the Alhamar marsh for the period 1973-2008 using remote sensing techniques, and adopted the formula of integration between remote sensing techniques and geographic information systems in the study of changes in Lcluc of the Alhamar marsh area for the period (1973-2008), and there are studies that dealt with The subject of the current study, (Sudani, 2019) Land cover in the eastern part of Wasit Governorate using modern technologies, a study in physical geography, the adoption of space images analysis to calculate the areas for each of the varieties of land cover and the calculation of the change in the areas classified in the eastern part of Wasit Governorate, (Hassan Rajab, 2020), spatial modeling of urban sprawl in the city of Duhok using the Markov algorithm (CA-Markov), (Ayasra, 2018), simulation of urban growth based on modeling cellular behavior and modeling of land changing The study showed that the class that has undergone the largest change and for all axes in the Musayib area is agricultural land, as its area has declined significantly and it is expected that this decline will continue in favor of other classes.

- Location of the study area:

The study area is part of the alluvial plain, located in the northwestern part of Babylon Governorate, specifically represented by the Musayib district, and includes three administrative aspects, namely Alexandria district, Jurf al-Sakhr district, and Sada al-Hindi district, in addition to the district center. Baghdad Governorate represents its northern border, and its southern border is represented by both the district of Al-Muhaweel and the center of the province of Babylon (Hilla), while on the east it is also bordered by the district of Al-Mahweel and from the west by the provinces of Anbar and Karbala. thus its takes a longitudinal shape extending from northwest to southeast, while the astronomical position of the study area is between latitudes (35' 32° -5' 33°) north and longitudes (0' 44° -30' 44°) east. With these features, it has occupied an area of (991.83) km^2, constituting (18%) of the total area of Babylon Governorate of (5315) km^2.

Figure (1) Location of the study area



Iraq republic. Ministry of Water Resources, General Authority for Surveying, Map Production Section, scale of 1/10000000, Baghdad, 2021.

Tools and means used:

1- Satellite images from the global site: (Https://qlovis.usgs.qov)

Table (1) Space images which adopted in this study

Num.	Image date	path	Raw	Satellite	Sensor
1	9/4/2000	168	37	Landsat-7	ETM+
2	31/8/2000	168	37	Landsat-7	ETM+
3	21/3/2020	168	37	Landsat-8	OLI
4	15/9/2020	168	37	Landsat-8	OLI

http://Erathexplorer.usgs.gov

2. Deriving Landsat 7.8 Digital Image Processing Using ARC MAP 10.7.1, Spatial Analysis Tools and Map Algebra Application for Digital Image Production

3- Maps used in the study:

Table (2) Types and specifications of maps used in the study

Map Name	type	Scale	Number	Production year	Product of
Musayib	Topography	1/100000	1-38-U-2D/1	1998	Public Survey Authority
Karbala	Geological	1/250000	-	2013	Geological survey organization
Iraq	Administrative	1/1000000	-	2021	Public Survey Authority

4- Software:

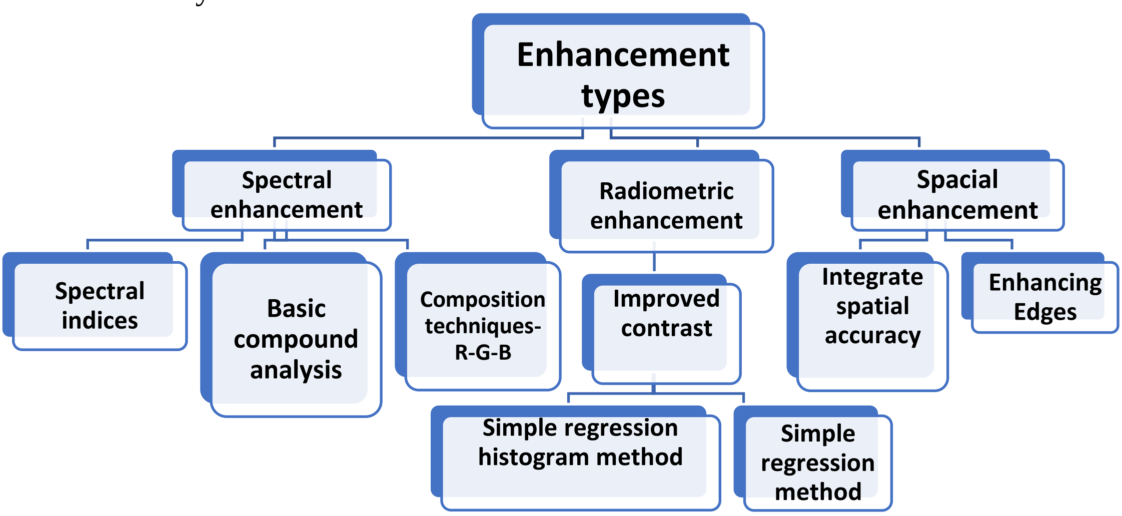
Table (3) Software used in the study

Software	**Usage**
ERDAS 2014	It is a program that deals with space images in terms of their processing, analysis and classification. The software was used to process and improve the space images used in the study.
Arc GIS 10.7	It is an integrated geographic information system, consisting of a large set of Effective tools that performs calculations, logical operations and builds a Geographic database. The software has been used to carry out the process of detecting the change of the land cover. Extracting indicators of environmental degradation in land cover patterns and presenting Digital map data, final output of maps and multiple other functions.
IDRISI 17.02	It is an integrated geospatial software system, developed by Clark Laboratories at the University of Clark to analyze and display digital geospatial information
Google Earth	Used as a reference to assess the accuracy of classification by taking readings of known areas.
Excel 2016	Used to process data statistically and draw shapes and charts.

Practical Procedures:

First: Space Data Processing: It means the actions that take place on the image and that deal significantly with the spatial frequency (Spatial Frequency to obtain improved and clearer image) (Al-Ghazi, 2010:36). The improvement of space images aims to facilitate image interpretation and make them more suitable for recognizing terrestrial objects and features from the original scene by increasing the distinction between space image features (John, Richards, 2006:83). There are many improvements and the study has been limited to some of them, figure (2):

Figure (2) Types of Enhancement operations performed on satellite images of the study area



1- Spatial Enhancement: is intended to reduce variations in cell values.

2- Radiometric Enhancement to remove space image distortion caused by multiple factors through its impact on the amount of energy that reaches the sensor device, including the effect of the atmosphere and the change of lighting due to the change in the location of the sun or the effect of noise.

3- Spectral Enhancement: is a process aimed to reducing variations in cell values

Second: Spectral Indicators: Spectral
Indicators are a measure of the classification of land cover, and are also called the term Band Combination, one of the most important improvements applied to space images, by performing some calculations between the different ranges of the space image, and is also one of the indicators to detect unobservable differences on color images (R, G, B), and there are more than 30 indicators to measure physical phenomena and detect changes in landscapes (Sudanese, 2019:56). Equations for these indices can be obtained from the https://www.indexdatabase.de/ website. Table 4 shows the work of the spectral indices used in the study to detect land cover change using ARC GIS 10.7 and using spatial analysis tools and Map Algebra.

Table (4) Land cover indices used in the study

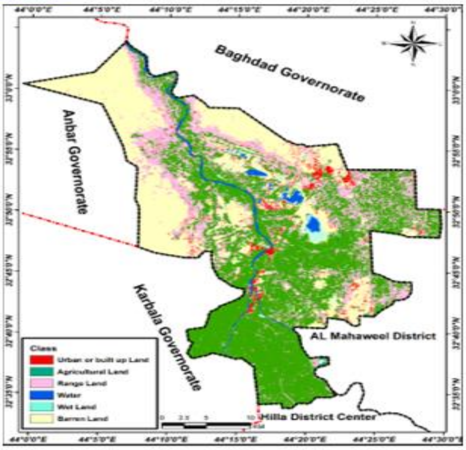
Indices	**Extension**	**Formula**	**Resources**
NDVI	Vegetation	NDVI $=\frac{(Nir-Red)}{(Nir+Red)}$	Rouse ,1973
IPVI	Vegetation for IR	IPVI = 0.5(NDVI) + 1	Sudani,2019
BSI	Bare lands	$\frac{(SWIR1+RED)-(NIR+BLUE)}{(SWIR1+RED)+(NIR+BLUE)}$ BSI=	Fadhil,2011
WI	Water	WI = $\frac{Nir+Swir1}{2}$	Alsaedi,2013
NDBI	Built up area	NDBI= $\frac{(SwiR1-NIR)}{(SwiR1+NIR)}$	Zha,Gao,2003
TCW	Humidity	TCW=0.1509*(Blue)+0.1973*(Green)+0.3279*(Red)+0.3406*(NIR)- 0.7112*(SwiR1)-0.4572*(Swir2)	Alhamadani, 2013

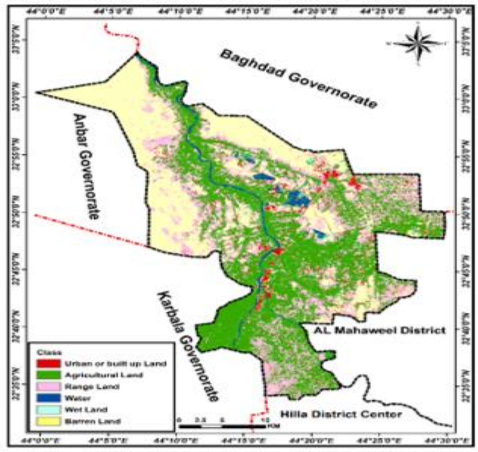
Table (5) Values obtained from indices for the study area for the period 2000-2020

Values of spectral indices used in the study												
NDVI			IPVI		BSI		WI		NDBI		TCW	
Year	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**
٢٠٠٠spring	0.47	-0.13	1.06	0.76	769.3	283.9	164.5	45.5	0.43	-0.34	75.85	122.8
٢٠٠٠fall	0.13	-0.46	1.26	0.76	666.2	129.4	164.5	15.5	0.45	-0.36	60.7	-110.5
٢٠٢٠spring	0.6	-0.25	1.3	0.87	1079.1	254.8	29555	5110	0.32	-0.46	695.5	-128.2
٢٠٢٠fall	0.53	-0.19	1.27	0.9	10933	69524	42074	6284	0.57	-0.37	8461	-6025

Third: Digital Classification. IS defined as the series of operations carried out for the purpose of classifying the millions of units (pixels) that make up space image into groups or classes so that each group or class represents a specific terrestrial feature (Ali, Al-Mawla, 2018:528). Each class is given its own color or symbol on the images, which represents a particular type of land cover or one of the ground features, and this process gives a comprehensive idea of the studied area and the most important features in it (Al-Ghazi, 2010:60). The space images of the study area were classified using hybrid classification in ARC GIS and ERDAS 2014, adopting the U.S. Survey Classification System.

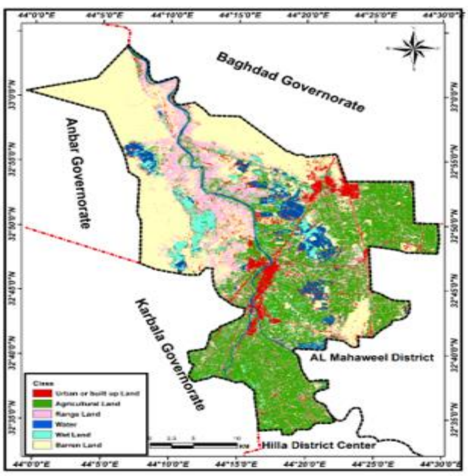
Map(1)Hybrid Classification for 2000Spring Season Map(2) Hybrid Classification for 2000Fall





Season Map(3) Hybrid Classification for 2020S

Map(4) Hybrid Classification for 2020Fall



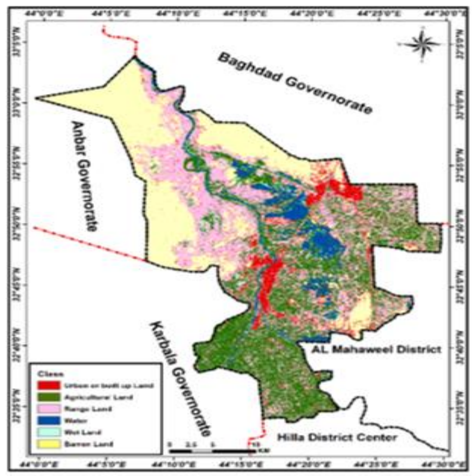


Table (6) Areas and rates of change of Lulc for the period 2000-2020

Num.	Class	Year 2000		Year 2020		Change km²	Change percentage%
		AREA km²	Percentage%	AREAkm²	Percentage%		
1	Pasture lands	225.449	22.732	193.508	19.511	- 31.941	- 14.17
2	Barren lands	296.026	29.848	342.846	34.569	46.821	13.66
3	Wetlands	15.171	1.529	53.836	5.428	38.665	71.82
4	Urban or built land	26.539	2.676	70.726	7.131	44.187	62.48
5	waters	21.509	2.169	53.959	5.441	32.45	60.14
6	Agricultural land	407.092	41.046	276.914	27.921	- 130.178	- 31.98
Total		991.783	100	991.783	100	324.24	

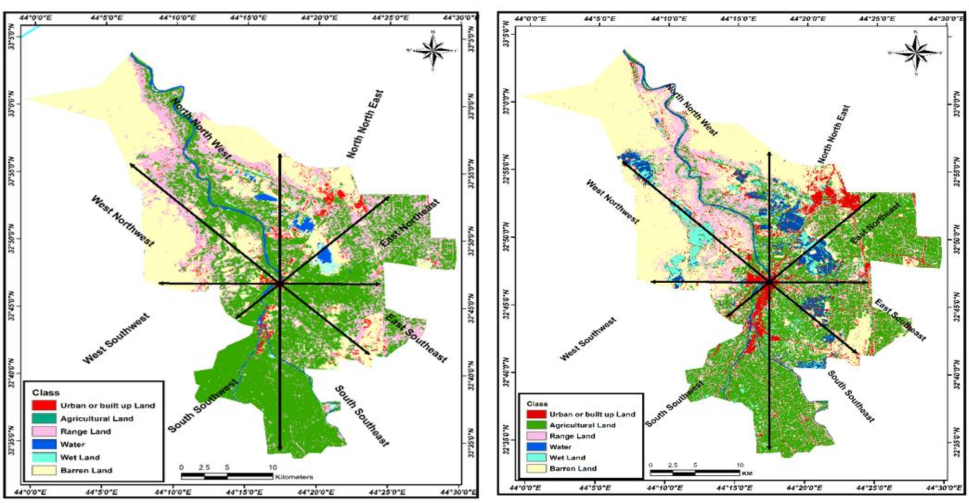
Trends change for LCLU:

After identifying the change in lclu in the study area during the period (2000-2020), it is necessary to identify the directions or axes of these changes to know the most changing direction in the classes of LCLU.

1- Measuring the trends of change for the period between (2000-2020) spring season:

The map (4-1), table (4-3) and figure (4-1) show the areas and proportions of changes for each of the eight parts into which the maps of the study area were divided for the period (2000-2020) for the spring season, and it turns out that the part (north-northeast), (northwest) and (west northwest) were the most changed parts in the area and percentage of LCLU, as the area of change was about (45.42), (104.34), (43.63) km^2, and the percentage of change has reached (41.64), (33.52) and (36.61)% respectively either The most classes that have undergone a negative change In those parts were agricultural lands, as their areas decreased by (3.38), (15.67), (10.17) % of the total area of each part, and that change is due to the human factor represented by the security events experienced by the region and the subsequent waves of displacement of the inhabitants of villages and countryside and the loss of large areas of fertile agricultural land and the transformation of a large part of it into barren land, which also increased in those parts with an area of (5.63), (23.64), (4.51) km2, and a change rate of (5.16), (7.63), (3.79)% The area of wetlands increased by (7.59), (3.97) and (12.44)% for each of these parts. This increase is the result of the negligence of irrigation and puncture systems, which led to the rise of the groundwater level and the filling of depressions with water, map (4-1).

Referring to Table (4-3) and the map, it can be noted that the part (east of the southeast) was the least vulnerable parts to change during the study period, as the total area of change was about (25.43 km^2) and a percentage of change amounted to (30.98%), if the area of most classes increased except for agricultural land and pastures their area decreased, the percentage of change was about (-5.51%) and (9.54-%) respectively, to move towards the conversion of areas of agricultural land into ponds of fish breeding and production, in addition to increasing the area of The barren lands that have reached a rate of change amounted to about (3.59%).



Map (5) Trends of change of lulc for duration (2000-2020).

Source: Depending on the hybrid classification maps (1) and (2) for the spring season.

Table (7) Area and percentage of change for each of the directions of change in the study area for the period (2000-2020) for the spring season

Classes	NE North		NE North		SE EAST		S SE		SW S		SW S		NW W		NW N		Total	
	Ch. A.K M2	Ch. p%	**Ch. A.K M2**	Ch .p %	**Ch. A.K M2**	Ch .p %	**Ch. A.K M2**	Ch .p %	**Ch. A.K M2**	Ch .p %	**Ch. A.K M2**	Ch .p %	**Ch. A.K M2**	Ch .p %	**Ch. A.K M2**	Ch .p %	**Ch. A.K M2**	Ch .p %
Pastures	-١٠,٦	-٩.٧١	-١١,٦	-٩.٢	-٧.٨٢	-٩.٥٤	0.68	0.54	6.92	6.74	-٠.٧٤	-٣.١	-٧.٩٧	-٦.٦٩	-٧.٥٣	-٢.٤	53.7	29.1
Barren	-٥.٦٣	-٥.١٦	2.58	2.04	2.95	3.59	3.88	3.13	2.56	2.49	2.2	9.23	4.51	3.79	23.64	7.6	47.9	15.1
Wet	8.28	7.59	0.67	0.53	1.1	1.34	5.53	4.46	3.85	3.75	1.48	6.21	14.8	12.4	12.3	4	48	73.3
Urban	9.65	8.84	7.69	6.1	4.31	5.25	5.94	4.79	8.13	7.92	2.05	8.6	2	1.68	6.51	2.1	46.5	62.4
Agricultural	-٣.٦٩	3.38	5.07	4.02	-٤.٥٢	-٥.٥١	-١٩,٨٨	-١٦,١	-١٦,٥٩	-١٦,٢	-٥.٨٢	-٢٤	-١٢,١	-١٠,٢	-٤٨,٥١	-١٦	116	27.5
Water	7.58	6.95	5.58	4.43	4.73	5.77	3.86	3.11	0.12	0.11	0.68	2.84	2.23	1.87	5.86	1.9	30.6	58.7
Total	45.4	** 41.64	33.2	31.2	25.4	31	39.8	32.1	38.2	37.2	12.9	54.7	43.6	36.6	104	34	343	34.6

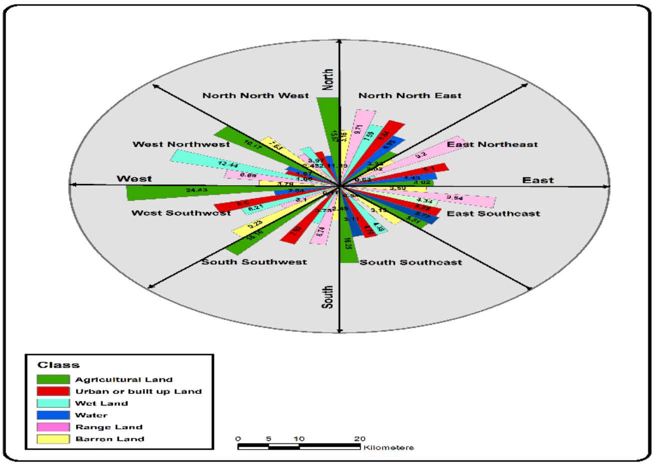
Change area km^2 change percentage %

Source: satellite images Landsat-7 and Landsat-8 for the period (2000-2020) spring season

*Percentage change per class = Change area for class/total area of the part$_x$100

** Total percentage change of part = total change area of part / total area of part $_x$100

Figure (2) Percentage of the area of change for land cover classes for the duration (2000-2020) for the spring season



Source: chart (7)

The map (4-1) and Figure (4-1) show that the direction of urban growth of the study area for the period (2000-2020) from the center of the judiciary towards (north-northeast) and (south southwest) and with a change area of (9.65 km2) and (8.13 km2) respectively, and there are many factors that contributed to the urban growth in these two directions in the study area, including the extension of the Euphrates River and its branches as well as the extension of the main transport routes represented by the Hilla - Baghdad road, which branches into two branches, one towards the district of Al-Mahaweel and the other towards the district of Al-Musayib and Karbala Governorate, in addition to the migration factor and the natural increase of the population.

Referring to the map (4-1), it can be noted the significant change in the water area in the parts (northeast) and (east northeast), where they increased by a change rate of (6.95%) and (4.43%) of the total area of each part, this change resulted from the increase in the number of ponds for the breeding and production of fish, which are important economic activities because of their impact on providing job opportunities for the population as well as their contribution to the optimal investment of land.

It is clear from the above that human factors had the greatest impact on the change in the classes of lulc in the eight parts into which the study area was divided, and that the class that has changed negatively in all directions or axes is the category of agricultural land, where agricultural land decreased by an area of about (136.83 km^2) from the year 2000, and by (-34.44%), due to the degradation of soil and vegetation cover as a result of wrong agricultural methods and neglect of irrigation and Agricultural land abandonment which led to an increase in the area of deserted land where the area of barren land increased by an area of about (31.62 km^2) and by about (10.83%).The area of pasture land has increased significantly from what it was in the year 2000, the map looks (4-2), and that its area increases in the fall season more than it is in the spring season in the study area to turn abandoned agricultural land or fallow in the summer into lands for grazing animals for vegetation growth in it .The increase in the area of water The wetlands have been concentrated in three parts of the parts into which the study area has been divided, its (NW, NE) and (NE) and (NW), where the changing area of water in these parts amounted to about (25.02) km^2, which is 70.51% of the total area of change of water.

Simulation of prediction of changes for LCLU:

In light of the outputs of the previous processes represented by the images that were processed and classified and the knowledge of the areas and percentages of change in the classes of land cover, the Idrisi program was used to simulate the future change of Lulc in the study area. The program enables the application of the CA-MARKOV model that combines cellular self-behavior with

Markov chain analysis, Multi-Criteria Evolution (MCE) analysis, Multi-Objective Land Allocation (MOLA), cover prediction procedures that add an element of spatial communication, and knowledge of the potential spatial distribution of transformations to Markov series analysis (Ayasra, 2018:3).

Markov series Analysis (MCA) is applied based on the analysis of two maps of the Raster cell land cover together over two periods of time to calculate the Transition Probability Matrix and the Transition Areas Matrix, where the Transition Areas Matrix appears as a text file (Ayasra, 2018:4), Table 4-5 contains the probability that each type of land cover will change to another layer, as well as the matrix of transition zones is also a text file that records number of pixels that are expected to change for each class of land cover to each other on a specific number of units of time (years or decades), and in both files the rows represent the old land cover classes while the columns represent the new classes.

Using the Markov technique, two images classified as LULC (2000 and 2020) of Musayib district were analyzed and produced:

1- The Variability possibility Matrix: It is a text file that records the probability that each class of LULC will change to other classes.

2- Matrix of transition areas: It is a text file that also records the number of pixels for each type of land cover expected to change to the other class and according to the time period.

3- Conditional probability images: indicate the probability of each type of land cover appearing in each pixel after the specified number of time units. These images are calculated as projections from the two input images of LULC, and a Raster group file can be created that includes images of conditional probabilities and Table (7) indicates the probabilities of change for the specified classes and through it can be observed the following:

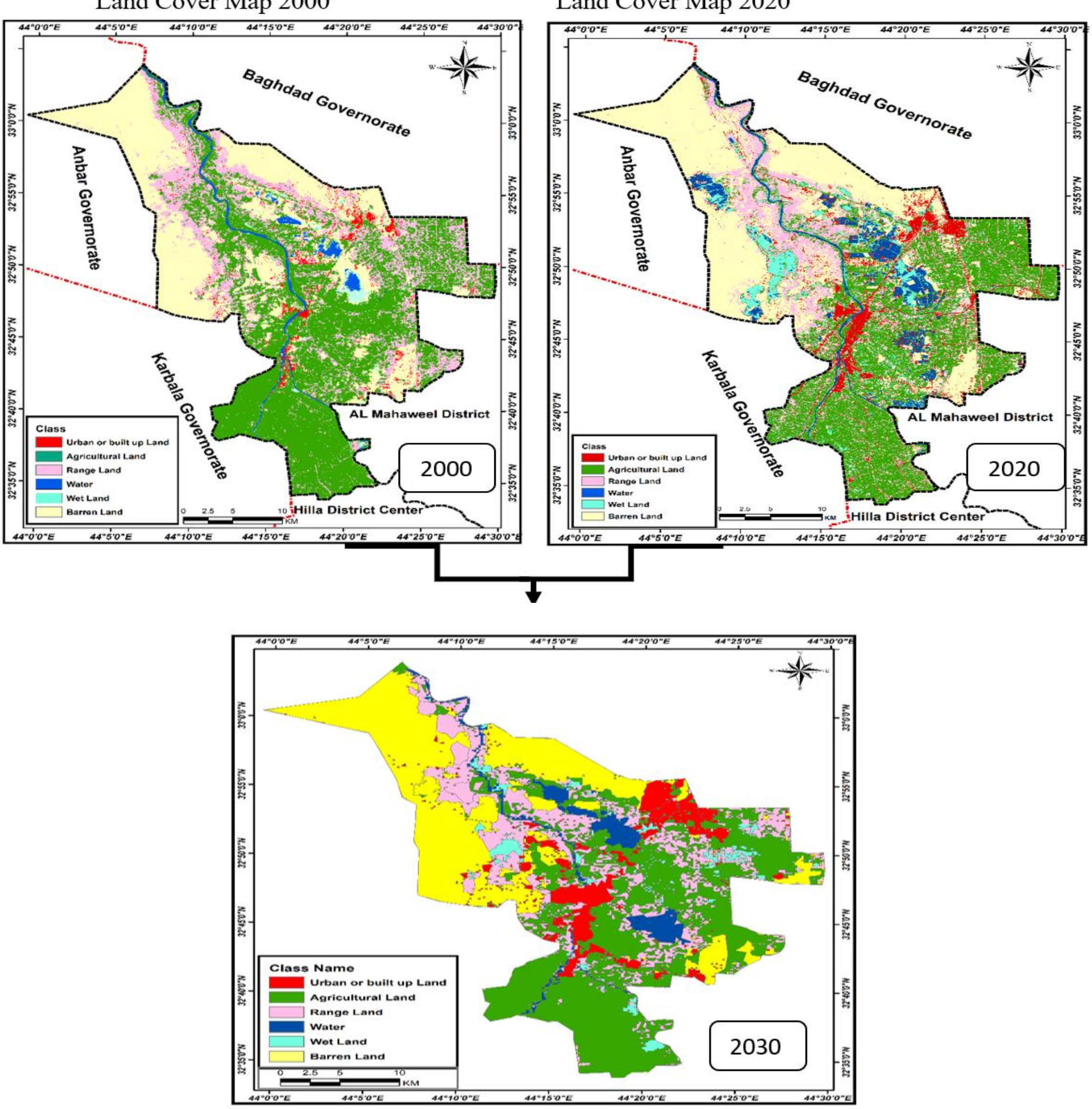
Table (7) Simulation of the probability of change at the level of (pixel) values for the classes of land cover for the district of Musayib 2000-2020

		2020					
	Classes	pastures	Bare	Wet	Urban	Agricultural	Water
2000	pastures	0.3841	0.2524	0.0125	0.1113	0.2125	0.0271
	Bare	0.1163	0.6298	0.0177	0.0921	0.0726	0.0714
	Wet	0.1667	0.1667	0.3600	0.0667	0.1067	0.1667
	urban	0.0250	0.0813	0.0125	0.8043	0.0528	0.0012
	Agricultural	0.1055	0.1849	0.0592	0.2455	0.3344	0.3705
	waters	0.0050	0.0050	0.0949	0.0067	0.0972	0.7912

Source: Adopted by the Markov* MARCOV Chain model

- 80% Urban land continues to extend during the above period, and there is a 24% probability of agricultural land becoming urban land. Of course, urban land loses nothing of its area to other varieties.
- The transformation of 25%, 16%, 18% of pasture lands, wetlands and agricultural lands into barren lands.

Map (6) Simulate the future change of land cover in Musayib district for the period (2000-2030)



Source: Using the Idrisi program and relying on the two images classified for the years (2000-20٢٠)

Discussion of the results: through the available data, the mechanism of action and the use of the ca-markov technique, the results related to the future change of the areas of land cover varieties and land uses, map (6) and joul (8), as follows:

Table 8 Significant change in LULC for Musayib district and its expectations for the duration (2000-2030)

Classes	٢٠٠٠		٢٠٢٠		٢٠٣٠	
	Area km^2	Percentage%	Area km^2	Percentage%	Area km^2	Percentage%
	٢٢٥,٤٥	22.73	193.51	19.51	164.73	16.61
Pastures	296.03	29.85	342.85	34.57	403.35	40.67
Bare	15.17	1.53	53.84	5.43	51.26	5.17
Wetlands	26.54	2.68	70.73	7.13	87.64	8.84
Urban or built land	21.51	2.17	53.96	5.44	41.34	4.17
waters	407.04	41.05	276.91	27.92	243.47	24.54
Agricultural	991.78	100	991.78	100	991.78	100

1- Due to the continuous increase in the demand for urban or built land as a result of the increasing population size, this contributed to the extension of built up areas from (26.54 km^2) in 2000 to (70.73 km^2) in 2020, and it is expected that the area of urban land will reach (87.64 km^2) by 2030, and this extension will be at the expense of agricultural land.

2- The area of agricultural land in the study area has declined a lot and has become occupying an area estimated at (276.91 km^2) in 2020 after it was occupying an area estimated at (407.04 km^2) and it is expected that this area will decrease to reach (243.47 km^2) in 2030, because of the degradation, neglect and expansion of the phenomenon of desertification, and the expansion of urban land at the expense of 3- Referring to Table (4-6) it can be noted the expansion of the area of barren land in the study area, due to the influence of natural factors such as climate change, or because of the impact of wrong human activities such as wrong farming methods and other activities that led to the significant deterioration witnessed by the study area in the cultivated areas, after it occupied an area of (296.03 km^2) in 2000, its area increased to (342.85 km^2) in 2020 and it is expected that the area of barren land in the region will expand to reach 403.35 km^2 in 2030.

4- The area of wetlands, pastures and water is expected to decline in 2030 to reach 51.26 (164.73 and 41.34 km^2) respectively, as a result of the climate changes witnessed by Iraq and the world in general that began to show their effects clearly and rapidly from drought and water scarcity.

Conclusions:

1- The study proved that the hybrid classification method is more effective in distinguishing ground covers compared to other classification methods, for the possibility of adding external data and the possibility of modifying it, as well as it integrates with the method of image and digital classification (Supervised and unsupervised) and does not eliminate them.

2- The maps of the directions of change show that the change of LCLU in the region has been concentrated in three directions (axes) (NE, NW, west) where the variable area in these parts (195.68) km^2 with a change rate of (20%) of the total area of the region and also shows that the urban growth in the region has taken two directions, namely (NE - south-southwest) with the extension of the main roads and the Euphrates River and its branches.

3- The study concluded that the human factor had the greatest impact on changing LCLU in the region, whether negative or positive, as well as natural factors.

4- Through the application of simulation models using LCM modeling and CA-Markov modeling, it was possible to predict the future change of land cover and land use to spend Musayib until (2030) in terms of the amount and direction of the developed area, where the results of LCM modeling and CA-Markov modeling showed the continuation of the decrease in cultivated areas to reach (243.47) km^2 and the increase in the area of barren land to (403.35) km^2 As for the water, its areas are expected to decrease to (41.34) km^2 as well as wetlands, and urban growth continues until the area of the area reaches the area Urbanism in 2030 to (87.64) km^2.

References:

– Hassan, Mazkin Mohammed, and Samir Sabah Rajab, Spatial Modeling of Urban Encroachment in Dohuk City Using the Markov Algorithm (CA-Markov), University of Duhok Journal, Volume (23), Issue 2, Dohuk, Iraq, 2020.

- Al-Hamdani Abdul Amir Salman Daoud, Characterization, classification and prediction of the boundaries between the units of soil maps using remote sensing technologies and geographic information systems for the Najaf Sea region – Iraq, PhD thesis, Faculty of Agriculture, University of Basra, 2017.
- Al-Saadi, Ayat Abdul Khaliq Jabbar, Study of Land Cover Changes and Assessment of the State of Desertification in Southern Iraq Using Digital Technologies for Remote Sensing Information, Master's Thesis, GM, Faculty of Science, University of Basra, 2013.
- Al-Sudani, Nozhat Adel Kased, Land Cover in the Eastern Part of Wasit Governorate Using Modern Technologies, Master's Thesis, Faculty of Arts, University of Basra, 2019.
- Al-Ani, Rukia Ahmed Mohammed, Study of Land Cover Changes for a Country Region Using Digital Processing Methods and Automated Classification of Remote Sensing Data, Master Thesis,, Faculty of Education, University of Tikrit, 2004
- Ayasra, Thaer Mutlaq Mohammed, Simulation of Urban Growth Based on Modeling Cellular Self-Behavior and Modeling of Land Change, Applied Study on Sakib Area in Jordan, Journal of Architecture and Planning, Volume 30), Issue (1), Riyadh, 2018.
- Al-Ghazi, Hassan Sawadi Najiban, Land Cover Changes for the Alhamar Marsh Area for the Period 1973-2008 Using Remote Sensing Techniques, PhD thesis, Faculty of Education, University of Basra, 2010.
- Al-Mawla, Tariq Juma Ali, Cartographic Representation of Land Cover Changes in Basra Governorate Using Remote Sensing and Geographic Information Systems Techniques for the Period 1973-2013, PhD thesis, Faculty of Education, University of Basra, 2014.

-John. A. Richards, Xiuping Jia, Remote Sensing Digital Image Analysis An Introduction, 4th edition, Australian National Universty,2006.
-Fadhil, A, M, 2011.Drught mapping using Geoinformation technology for some sites in the Iraqi Kurdistan region. International Journal of Digital Earth, Vol. 4,.
-Majeed, H. M. S., Ahmed, R. K., Suhad, S. K., Amin, R. A. M., & Tanzeeh, M. H. Spectral indices analysis in detection of the thermal variability for Baquba city and its environmental effects with the support of GIS & RS technique. Journal of University of Shanghai for Science and Technology, 702-711.
- Zha, Y., Gao, J., WI, S.,2003, use of normalized difference built-up index in automatically mapping urban areas from TM imagery. Int. J. Remote sens.24.
- Rouse. J.W., R.H. Haas, J.A. Schell and D.W. Deering .1973. Monitoring vegetation systems in the great plains with ERTS, Third ERTS Symposium.
http://Erathexplorer.usgs.gov United States Geological Survey
https://www.indexdatabase.de database for remote sensing indices -