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EFFECT OF URBAN EXPANSION ON THE AGRICULTURE LANDS OF MIQDADIYA CITY, DIYALA, IRAQ (URBAN GEOMORPHOLOGY)

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Abstract

This research highlights the problem of Urban expansion of Miqdadiya city and the resulting problems of deformity the landscape and shrinking it furthermore environmental degradation that accompanies it, follow-up the temporal spatial changes of this expansion requires the use of space images of different temporal dimension, so will use satellite images of Landsat 7ETM+, 8OLI for the period 1999-2018 to compare, using arc-Gis10_2 program to extract the most important spectral indices of space image data including NDVI NDBI, BUI, NDWI, DBSI, in addition to derive land units, slope, land use land cover (LULC) to analyze the extent and direction of change and for sustainable environmental geomorphic assessment for district achieves the balance of Urban expansion and maintains the landscape from degradation.

Key words: Urban expansion, agriculture lands, urban geomorphology

Introduction

Main landform units divided to sub units which have its special unique system of landforms and process, cities when extend sure will occupied many landforms units this will Perturb its own local process reflecting problems on city itself, and distorting landscape (Chunyang *et al.,* 2010). Studying relationship between cities expansion with land units and LULC according to specific spatial and temporal case reveal axis of city expansion and with which direction, what will result for this part of city when extended for this direction, for example floods, and prediction for future which best direction for city expansion so this an important thing when concern with planning for sustainable cities (El-Askary *et al.,* 2019).

Therefore, the current study aims to know the effect of urban expansion on the agricultural lands of Al-Muqdadiya City, Diyala, Iraq (a study in urban geomorphology).

Material and method

Study area

Diyala governorate, located in East of Iraq, study area lies in mid of it, from east bordered by Baladruz district, from south Baqubah district, while Hamren mountains bordered Miqdadiya from north side Khanaqin district and from west Alodiam in the south Khalis district, its astronomical position (N 34° 37 × 00 – N 33° 65 × 03) and (E 44° 65 × 08-E 45° 25 × 08) Fig. 1. The analytical and quantities approach, was used.

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Data acquisition

US satellite data Landsat 8 for the years 2013-2018 with a spatial resolution (30 meters) https://libra.developmentseed.org and Landsat 7 for the year 1999 with a spatial resolution (30 meters) https://earthexplorer.usgs.gov table 1.

Digital elevation data DEM 30 meters http://dwtkns.com/srtm30m/ to derive heights above sea level.

Use ARC Map 10.2 to achieve research applications and derivatives and build a geographic information base with the use of the spatial analysis Tools.

Data entry in Excel (v.2010)

Data analysis Many indices were selected to detect changing in area as shown in table 2.

NDVI

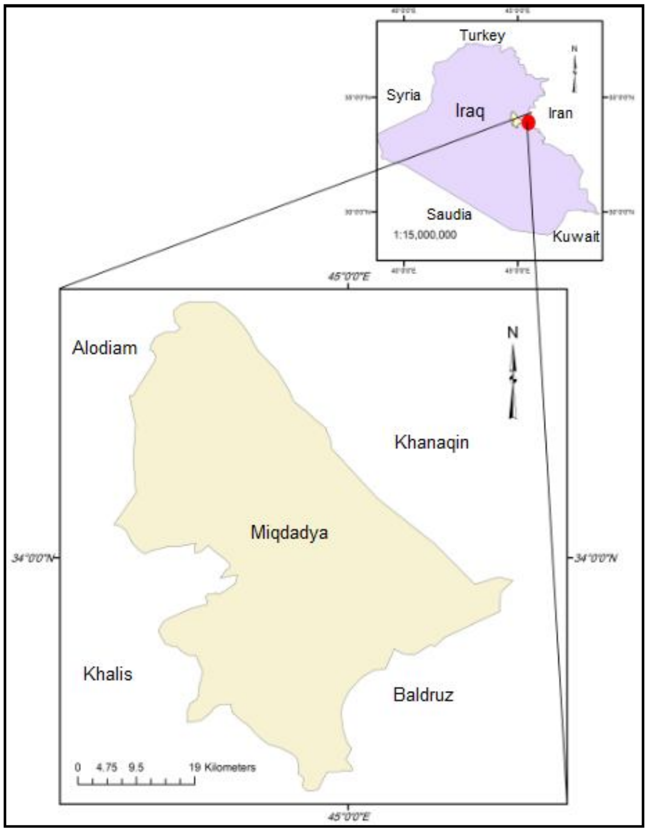

Fig. 1: Study area location.

Table 1: Satellite data outputs used.

Number	Satellite	Sensor	Path	Row	Year	Date
1	Landsat 7	ETM+	168	36	1999	12-07-1999
2	LANDSAT 8	OLI	168	37	1999	12-07-1999
3	LANDSAT 8	OLI	168	36	2013	10-07-2013
4	LANDSAT 8	OLI	168	37	2013	10-07-2013
5	LANDSAT 8	OLI	168	36	2018	08-07-2018
6	LANDSAT 8	OLI	168	37	2018	08-07-2018

This index was selected. Since, the urbanization replaces most of the vegetation (high NDVI) with building materials (low NDVI), the sudden decrease in NDVI should indicate urban development. This method was selected because the generation of a new composite image and the numerical differences between the two images of the same sensor at different time facilitates information about change detections (Rasul *et al.,* 2018).

NDBI

Normalized difference built-up index (NDBI). It proposed to determine the urban area, For Landsat OLI data, its value lies between -1 to +1. A negative value of NDBI represents water bodies whereas higher value represents build-up areas. NDBI value for vegetation is low (Ramadan, E. 2003).

Built-up Index (BUI)

Build-up Index (BUI) is the index for analysis of urban pattern using NDBI and NDVI. BUI is the binary image with only higher positive value indicates built-up and barren thus, allows BUI to map the built-up area automatically (Prasomsup *et al.,* 2020).

NDWI

This index is used at it maximizes the water reflectance by the green wavelength ,minimizes the NIR smutty reflectance by the water characteristics and takes the benefit of NIR high reflectance by the soil features ,conclusion of this process have positive results on water features and this enhanced the soil which usually has negative values or zero values (Singh *et al.,* 2018).

DBSI

The DBSI values can be between 2 to +2 and higher numbers represent more bare soil. An appropriate threshold for the bare soil class can be used for mapping bare soil and non-bare soil areas. Based on a test carried out with a sample of bare soil pixels, a DBSI value 0.26 and higher was delineated as bare soil for the study area, and areas with lower values were delineated as other classes (Rasul *et al.,* 2018). table 2.

Table 2: Selected spectral indices.

Selected Indices	Equation	References
NDVI	(NIR-R)/(NIR+R)	(Pettorelli, 2013)
NDBI	(B5-B4)/(B5+B4)	(Gervasi *et al.,* 2017)
BUI	NDBI-NDVI	(Chunyang *et al.,* 2010)
NDWI	(G-NIR)/(G+NIR)	(El-Askary *et al.,* 20190
DBSI	(SWIR1-G)/(SWIR 1+G)-NDVI	(Rasul *et al.,* 2018)

Table 2: Selected spectral indices.

Selected Indices	Equation	References
NDVI	(NIR-R)/(NIR+R)	(1)
NDBI	(B5-B4)/(B5+B4)	(2)
BUI	NDBI-NDVI	(3)
NDWI	(G-NIR)/(G+NIR)	(4)
DBSI	(SWIR1-G)/(SWIR1+G)-NDVI	(5)

Slope: An important selected parameter which affecting on urban extension, its range in area as shown in table 3.

Table 3: Slope classes.

Slope class	Percentage%
Min	0
Mean	20.7
Max	81.13

Land Units Area extended on many different land units

As known each unit has its unique specific form and process discriminating from others, unstudied with ignoring geomorphic processes and poor planning of cities will reflected problems on these cities it selves. The area consisting from (10) land units as shown in Fig. 2.

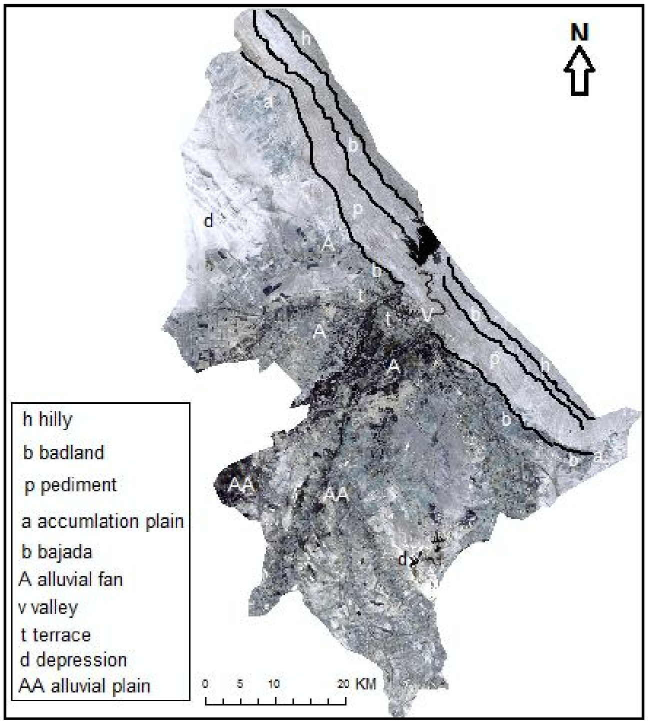

Fig. 2: Land units.

Land use land cover (LULC) area included (7) classes : (water, vegetation, fields, sabkha, urban, sand and barren). It's important proceedings changes in (Lulc) with spatial and temporal scopes to know trend, size and assessment that changes.

Results and Discussion

Tracking changes

To notice differences and changes in area with urban expansion and the others parameters that's achieved by:

Tracking changes with spectral indices: As showing in table 4, appear the following :

NDVI lowest value along study years was (-0.5321), while highest value was (0.5670) in same year (1999), NDBI lowest value (-0.6666) in (1999), while highest value (0.6112) in (2013), BUI lowest value (-0.0364) in (2013), while highest value (0.784) for same year too, NDWI lowest value (-0.0601) in (1999), while highest value (0.6153) for same year too, DBSI lowest value (-0.4766) in (2013), while highest value (1.2655) in (2018).

From tables 5, 6 and 7 as an example in (1999) the correlation between NDVI and NDBI with value (0.96404) a (strong positive correlation between tow indices), in (2013) the correlation between NDVI and NDBI with value (0.991827) a (strong positive correlation between tow indices), in (2018) the correlation between NDVI and NDBI with value (0.998995) a (strong positive correlation between tow indices), so these mean that applying these indices on area achieved the scientific purpose.

There are a strong positive relations for indices between years (2013-2018) with value (0.838124), while being moderate relations between (1999-2018) with value (0.501764) and strong relations between (1999-2013) with value (0.763049) table 8.

Table 4: Classes of selected spectral indices.

Year/2018 class	NDVI	NDBI	BUI	NDWI	DBSI
Min	-0.3000	-0.4735	-0.423	-0.9958	0.4259
Mean	0.1225	-0.002	0.0619	-0.9821	0.8561
Max	0.5570	0.5674	0.5618	-0.9205	1.2655
Year/2013 class					
Min	-0.4728	-0.4292	-0.0364	-0.4279	-0.4766
Mean	-0.1285	-0.0057	0.121	-0.1860	0.3056
Max	0.1916	0.6112	0.784	0.2664	0.8809
Year/1999 class					
Min	-0.5321	-0.6666	-0.931	-0.5080	-1.1319
Mean	-0.0656	0.0602	0.123	-0.0601	0.0607
Max	0.5670	0.4358	0.513	0.6153	0.5122

Table 5: Correlation relationship between spectral indices for (2018).

BUI	*DBASI*	*NDWI*	*NDBI*	*NDVI*	
				1	NDVI
			1	0.998995	NDBI
		1	0.956007	0.941897	NDWI
	1	0.933668	0.997651	0.999719	DBASI
1	0.999733	0.94169	0.998967	1	BUI

Table 6: Correlation relationship between spectral indices for (2013).

BUI	*DBASI*	*NDWI*	*NDBI*	*NDVI*	
				1	NDVI
			1	0.991827	NDBI
		1	0.997798	0.98118	NDWI
	1	0.966118	0.981109	0.997774	DBASI
1	0.909127	0.985828	0.972531	0.934882	BUI

Table 7: Correlation relationship between spectral indices for (1999).

BUI	*DBASI*	*NDWI*	*NDBI*	*NDVI*	
				1	NDVI
			1	0.96404	NDBI
		1	0.95582	0.999569	NDWI
	1	0.931965	0.997363	0.942209	DBASI
1	0.999988	0.930178	0.996995	0.940557	BUI

Table 8: Correlation relationship for spectral indices within study years.

year 1999	*year 2013*	*year 2018*	
		1	year 2018
	1	0.838124	year 2013
1	0.763049	0.501764	year 1999

Its clear that spatiotemporal changes happened in area can appoint by spectral indices changing within years of study. A strong changes between NDVI and DBSI with positive value (0.853302), strong change too between NDWI and BUI with positive value (0.995257), while being moderate value (0.564565) between NDBI and NDWI and a negative relations for rest values indicating weak changes in area table 9.

Table 9: Changing relationship between indices.

BUI	*DBASI*	*NDWI*	*NDBI*	*NDVI*	
				1	NDVI
			1	-0.22842	NDBI
		1	0.564565	-0.93253	NDWI
	1	-0.98401	-0.70255	0.853302	DBASI
1	-0.96202	0.995257	0.481592	-0.96323	BUI

There are no obvious change with tow indices NDBI and BUI, that's belong to land uses planning in 1999 (long planning extent) the lands was allocated for building and accommodation been negligent along study years till 2013 occupied by vegetation biomass, this being clear with NDVI, Fig. 3.

Tracking changes by (LULC) The feature of degradation of landscape in area being clear after stopping implementing construction projects and stop execution of planning, a randomly urban extension increasing accompanies with barren lands increasing too Fig. 4.

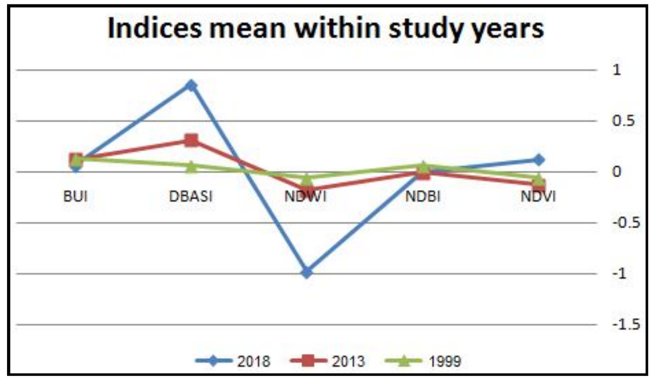

Fig. 3: Indices mean within studdy years.

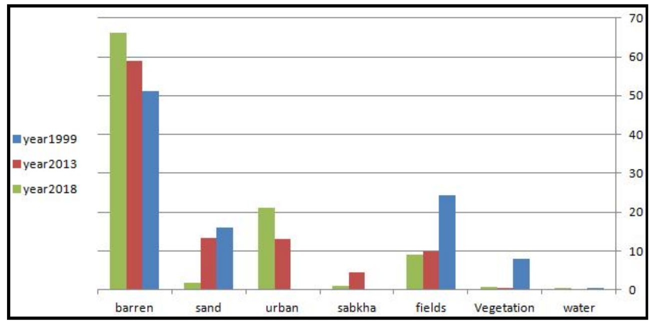

Fig. 4: LULC.

Conclusions

NDVI lowest value along study years was (-0.5321) (high to moderate vegetation density), while highest value was (0.5670) (scarceness in vegetation density). NDBI lowest value (-0.6666) in (1999), while highest value (0.6112) in (2013), BUI lowest value (-0.0364) in (2013), while highest value (0.784) for same year too. Positive values indicate built up area. NDWI lowest value (-0.0601) in (1999), while highest value (0.6153) for same year too, positive values represented Hamren reservoir and many irrigation channels. DBSI lowest value (-

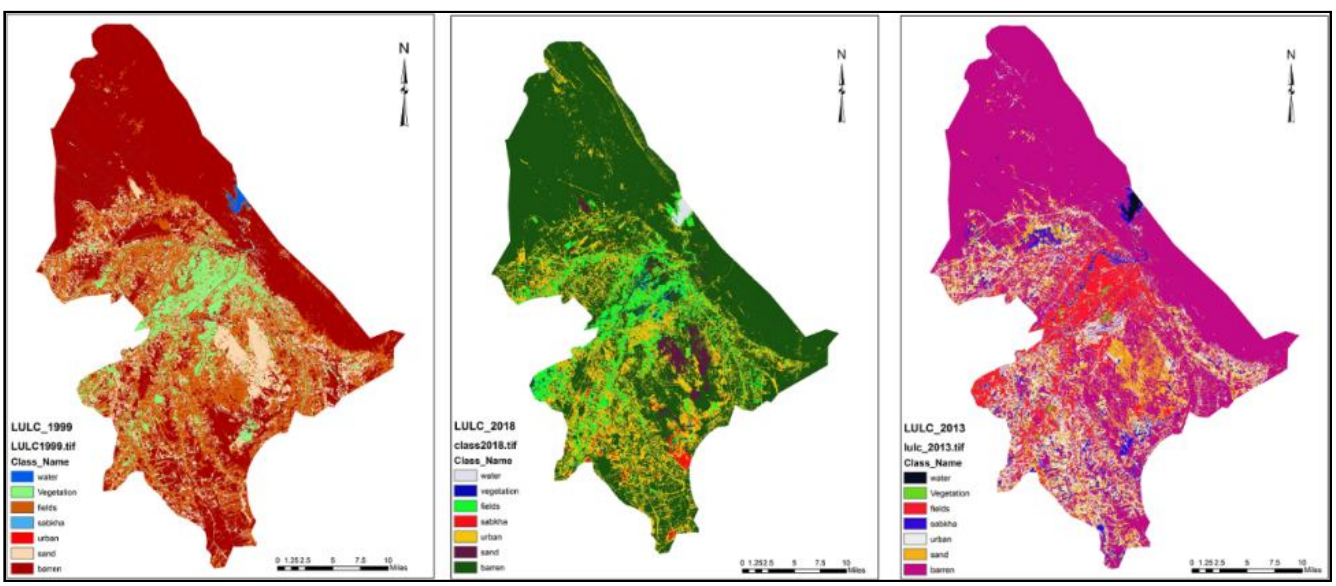

Fig. 5: LULC maps (1999_2013_2018).

0.4766) in (2013), while highest value (1.2655) in (2018) indicating bare soil. No purposely changes with NDBI and BUI, cause stopping of land uses planning in 1999. The correlation between NDVI and NDBI as an example was (0.96404) a (strong positive correlation between tow indices), mean these indices applying properly for area. The strongest positive relations for indices was between years (2013-2018). NDWI and BUI was the had the strongest correlation positive value (0.995257). Oblivious landscape degradation appeared when analysis LULC of area, barren lands occupied the higher proportion. Urban change was the second in LULC analysis indicating the unplanning and randomly extension of this class.

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