Impact Factor:	ISRA (India) = 1.344	SIS (USA) = 0.912	ICV (Poland) = 6.630
	ISI (Dubai, UAE) = 0.829	РИНЦ (Russia) = 0.179	PIF (India) = 1.940
	GIF (Australia) = 0.564	ESJI (KZ) = 1.042	
	JIF = 1.500	SJIF (Morocco) = 2.031	

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SECTION 13. Geography. History. Oceanology. Meteorology.

LAND USE / COVER CHANGE DETECTION OF KUFA CITY, CENTRAL PART OF IRAQ USING REMOTE SENSING AND GIS TECHNIQUES

Abstract: *The large population growth of the province of Najaf, the latest great pressure on the city of Kufa, and the lack of adequate housing areas within the administrative boundaries has resulted in an increase of slums to a crawl towards agricultural areas and bypassed outside the administrative design of the city. Remote Sensing and Geographic Information Systems (GIS) have the potential to provide accurate information regarding land use and land cover changes. This paper testifies the appropriate techniques utilized to detect land use and land cover changes and the effect of irregular expansion on the urban planning.*

Key words: *Geographic Information Systems, city of Kufa, land use, urban planning.*

Language: *English*

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1. Introduction

Change detection has been defined as a "process of identifying differences in the state of an object or phenomenon by observing it in different times" (Singh 1989). This is considered an important process in monitoring land use/land cover changes, because it provides quantitative analysis of the spatial distribution of the population of interest and this makes land use/land cover study a topic of interest in remote sensing applications (Song et al. 2001, Gallego 2004). Land use/land cover changes are most important and typical applications of remote sensing data due to several factors such as urbanization and climate conditions. The process of urbanization has been characterized not only by population growth, but also by industrial expansion, increasing economic and social activities and intensified use of land resources (Pham et al. 2011). Furthermore, decision-makers are in constant need of current geospatial information on patterns and trends in land cover changes. Therefore, regular and up-to-date information on urban change is required for urban planning, land use management and appropriate allocation of services and infrastructure within the urban areas (Baransley and Barr 1996).

Urban sprawl refers to excessive unusual growth near the periphery of the city boundary or in the places where there is the absence of planning and availability of basic amenities, these locations represented in Iraq by random housing or slummism. Cities need to grow in a planned and phased manner, and ensure a balance between proportion of growth and available resources. However rapid unplanned growth exerts pressure on the natural resources.

Satellite remote-sensing techniques have been widely used in detecting and monitoring land cover change at various scales with useful results [. Reis 2008, Diallo, et al 2009, and Muzein 2006]. This is due to their potential of providing accurate and timely geospatial information describing changes in urban land cover [Xiao, et al 2006]. The integration of remote sensing (RS) and Geographic Information Systems (GIS) has also been widely applied and recognized as an effective tools in detecting urban land-use/land-cover changes . Satellite remote sensing has the ability to collect multitemporal data and turns it into valuable information for monitoring urban land processes. GIS on the other hand provides a more flexible environment for entering, analysing and displaying digital data from various sources necessary for urban feature identification. These make remote sensing and GIS more useful tools for urban growth detection projects (Weng, 2001).

2. The Objective

This study aims to use remotely sensed data and GIS together to monitor and characterize the urban sprawl in Al-Kufa City in terms of urban areas, availability of vegetation, soil and water bodies. The used approach is the comparative analysis using classification operation enables us to detect trend of land use/cover changes in different times.

3. Study Area

Al-Kufa City is subject to geographical location, as it is located on the Euphrates River, and 12 kilometers from An-Najaf City, 156 kilometers from Baghdad, 60 kilometers south of Karbala, and a few miles to the north-east of Al-Hira City. Its plain land, are high-elevated, and it rises 22 meters above sea level. The eastern bank is higher than the western one by almost six meters, which makes it safe from floods. Whenever we walked to the west, the surface rises gradually to reach 60.5 meters, and then descends steeper strongly toward the south-west to shallow salt lake that defined Bahr An-Najaf (Figure 1).

Ibn-Najim Marsh is located in the northeastern portion of the study area. The area of the water body influences by the seasonal changes in the Euphrates and the rate of rainfall.

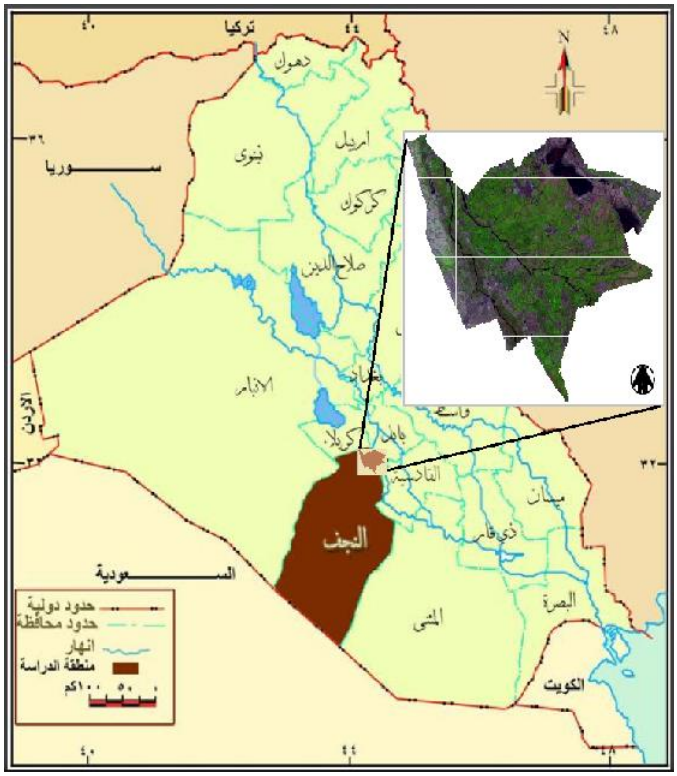

Figure 1 - Location of the study area.

4. Materials and Methods

4.1. Data Preparation

The following Landsat Images were used in the study in different sensors and dates; (A)(MSS in Oct 3,1976), (B)(TM in Aug 28,1990), (C)(ETM $^{+}$ in March 27, 2001), (D)(ETM $^{+}$ in March 28, 2006), (E)(ETM $^{+}$ in July 27, 2013), (F)(ETM $^{+}$ in Apr 7, 2013), (G)(ETM $^{+}$ in March 23, 2014) , and (H)(ETM $^{+}$ in Febr 06, 2015), (Figure 2).These images were processed using Erdas Imagine 2013 and ArcGIS 10.2. Besides the topographic maps of the study area with the scales of 1:100000 and 1:50000 are available.

4.2. Land Use / Cover Change Detection and Analysis

The two types of classification (i.e. unsupervised and supervised) has achieved on Landsat images to monitor vegetation cover and urbanization change detection of Al-Kufa City depending on the identification of all visible landmarks in the images. Image classification is perhaps the most important part of digital image analysis. With supervised classification, the information classes of interest like land cover type image. These are called “training sites". The image processing

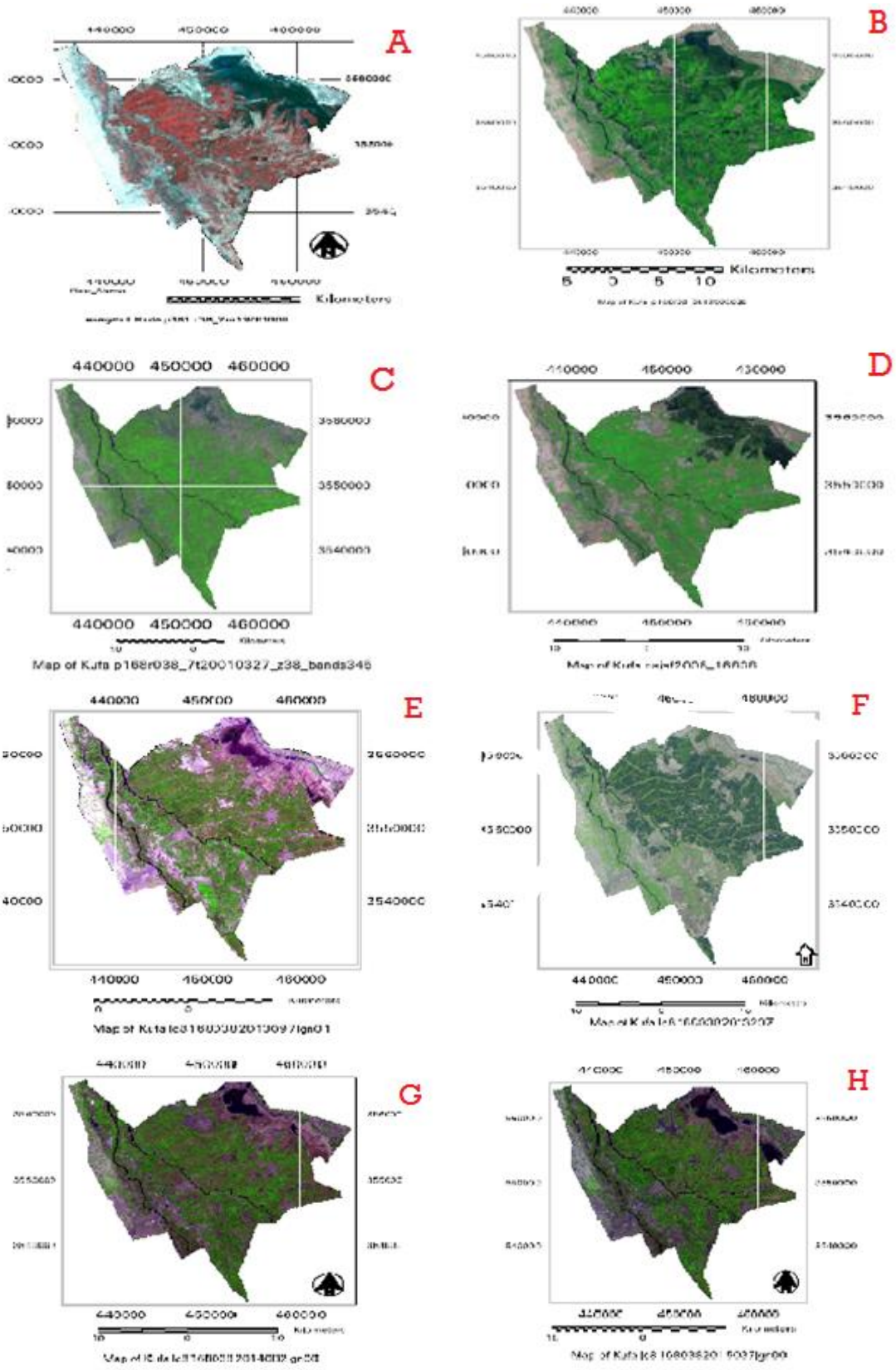

Figure 2 - The multi-temporal Landsat images used in the study.

Software system is then used to develop a statistical characterization of the reflectance for each information class. This stage is often called "Signature analysis ".The error matrix and Kappa Khat methods were used to assess the mapping accuracy. Five land use / cover types are identified in

the study area viz., (1) vegetation and agricultural land (2) barren land (3) built-up land (4) water body (Figure 3).

Classified image pairs of the different decade's data were compared using cross-tabulation in order to determine qualitative and quantitative aspects of the changes for the periods from 1976 to 2015.

5. Results and Discussion

The results obtained through the analysis of multi-temporal satellite imageries were illustrated and data are registered in Table 1 which illustrates magnitude of change in different land categories. Tables (2-8) depict the accuracy assessment of the land use/cover analysis. A brief account of these results is discussed in the following paragraphs.

In 1976, the farmland was sparse as well as an excessive incoming waters to The Euphrates due to good monsoon rains during that period, and lack of population proliferation, which was stationed only in the centers of the cities without expansion, followed by 1999, which was marked by a period of heavy rain, it was clear that the water bodies were extended at the expense of the agricultural areas. As for 2001, it turned into those bodies to barren tracts of land in addition to note a slight population growth. In 2006, it had reduced the cultivated areas owing to the circumstances of the country, as well as the expanding urban at the expense of agricultural land, this breadth encompassed the peripherals of the city and its environs, as well as the widening the areas that have been reclaimed for agriculture in the period before 2003, which is located to the east of Al-Kufa City where exploited random expansion of population.

We are, however, in the year 2013 and the subsequent expansion we have noted large population and all the random and systematic has been to the detriment of the agricultural area, especially the Al-Kufa City was surrounded by orchards, for its three parts, which had led to reduced agricultural land and the emergence of large areas of slum area such as Al-Barakiyah, south of Kufa, in addition to the areas of Abbasiya, Al-Hurriyah, and Al-Zarga that are extended to Al-Kufa by Missan Quarter.

Two images have been taking in the year of 2013 on April and July that it represents a peculiar attribute due to the large and distinguished change in spatial phenomena, including the expansion of population aggregates into towns and large towns such as Abbasiya, Al-Hira, and Al-Barakiyah due to the close location close to the centers of the cities as a result to the living conditions and the previous and current lack of support for housing, these phenomena came in the slums at the expense of agricultural land.

The agricultural land, which turned into residential areas, are in particular from the orchards, old Bay on the palm trees, and fruits, while the seasonal and cultivated areas that produce seasonal crops such as rice and corn (wheat) has not affected largely in this transformation. .

There is a difference in the expansion of agricultural area because of a lack of support and possibilities for irrigation and the adoption of farmers on the old methods in addition to the weakness of the reclamation of affected land, as evidenced by the appearance of the water in the rainy season, causing a phenomenon of salinity that was not processed and reclamated. This impact we can see clear in visual imagery in 1990 and 2001.

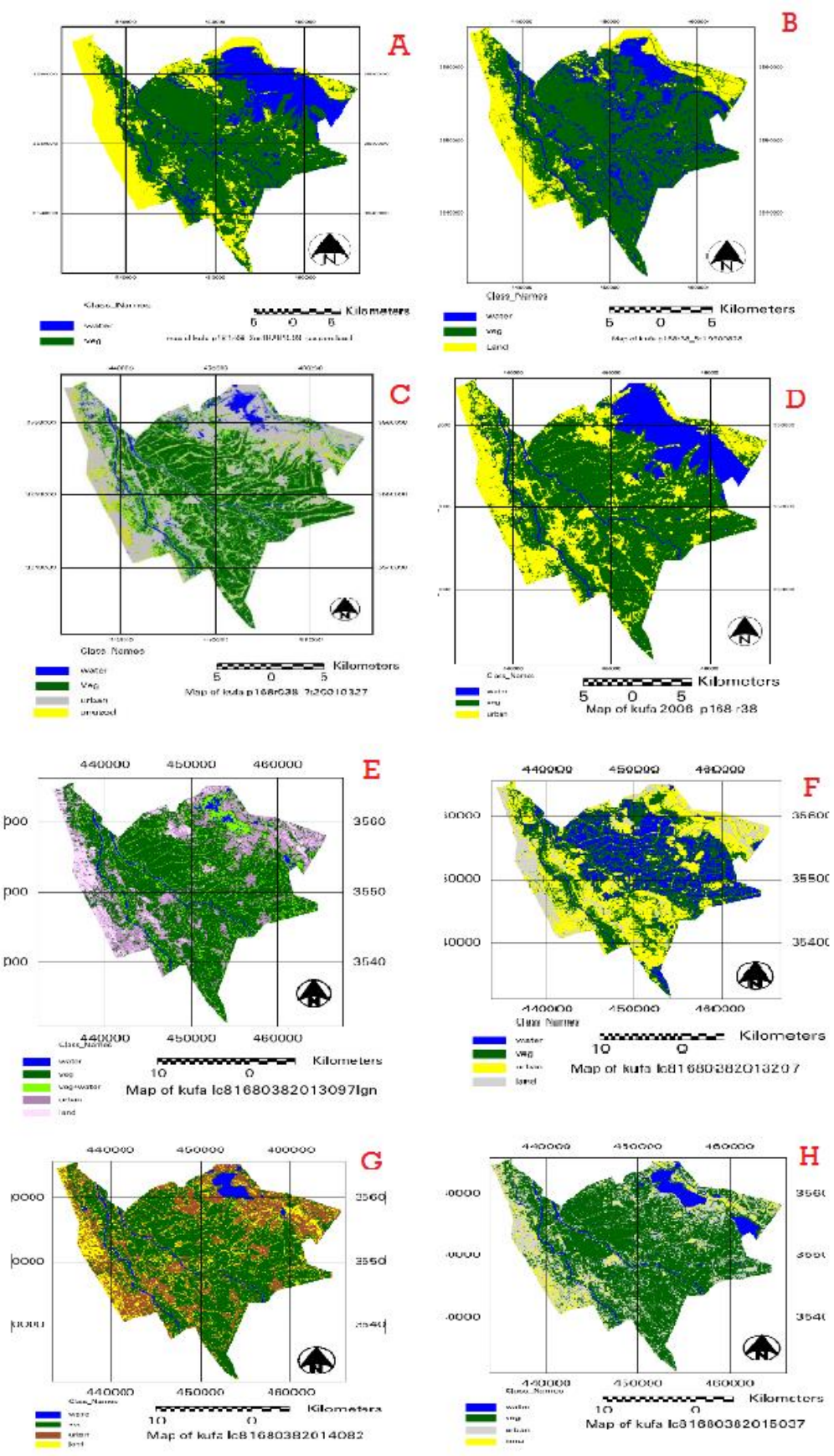

Figure 3 - Land use/cover change in different land use categories.

Table 1

The calculations of the areas of the land use/cover categories (A) MSS in Oct 3,1976,(B) TM in Aug 28,1990, (C) ETM + in March 27, 2001, (D) ETM + in March 28, 2006,(E) ETM + in July 27, 2013, (F) ETM + in Apr 7, 2013, (G) ETM + in March 23, 2014 , and (H) ETM + in Feb 06, 2015

p181r38_2m19761003_usuperclassif.img

A

HISTOGRAM	COLOR	Class Names	Area(Hectares)	sum of area	NO Color
16884		water	5485.6116	9480.582	65535
12296		water1	3994.9704		65535
24763		veg	8045.4987		6553855
22500		veg1	7310.25		6553855
16294		veg2	5293.9206	31485.4092	6553855
18562		veg3	6030.7938		6553855
14789		veg4	4804.9461		6553855
14840		land	4821.516		-65281
11730		land1	3811.077	13695.5097	-65281
15583		land2	5062.9167		-65281

p168r38_5t19900828_kufa_calorclassify_unsuper.img

B

HISTOGRAM	COLOR	Class Names	Area(Hectares)	sum of area	NO Color
68701		water	5580.238725		65535
47322		water1	3843.72945	9423.968175	65535
136963		veg	11124.81968		6553855
110096		veg1	8942.5476		6553855
44962		veg2	3652.03845		6553855
42235		veg3	3430.537875	35271.55013	6553855
45162		veg4	3668.28345		6553855
54827		veg5	4453.323075		6553855
69219		unused	5622.313275		-65281
51065		unused1	4147.754625	9770.0679	-65281

unsuper_classif_kufa_p168r038_7t20010327.img

C

HISTOGRAM	COLOR	Class Names	Area(Hectares)	sum of area	NO Color
47165		water	957.7466395	2805.883921	65535
91013		water1	1848.137282		65535
304716		veg	6187.654511		6553855
264415		veg1	5369.290315		6553855
206230		veg2	4187.768249		6553855
193486		old veg	3928.984762	33887.72202	6553855
195443		old veg1	3968.724191		6553855
178134		old veg2	3617.242444		6553855
194528		veg3	3950.143926		6553855
131876		new veg	2677.913619		6553855
100547		urban3	2041.737546		-1061109505
153286		urban2	3112.671502	13360.04273	-1061109505
195691		urban1	3973.760153		-1061109505
208402		urban	4231.873533		-1061109505
92744		unused	1883.287487		-65281
120141		unused1	2439.619188	4322.906676	-65281

Table 1 - continue

najaf2006_16838_kufa.img

D

HISTOGRAM	COLOR	Class Names	Area(Hectares)	sum of area	NO Color
218636		water	4919.31		65535
132958		water1	2991.555	7910.865	65535
350729		veg	7891.4025		6553855
371156		veg1	8351.01		6553855
267658		veg2	6022.305	31799.5425	6553855
220392		veg3	4958.82		6553855
203378		veg4	4576.005		6553855
238527		urban	5366.8575		-65281
276850		urban1	6229.125	14663.9025	-65281
136352		urban2	3067.92		-65281

lc81680382013097lgn01_kufa_classif_unsuper.img

E

HISTOGRAM	COLOR	Class Names	Area(Hectares)	sum of area	NO Color
60090		water	1352.025	1352.025	65535
238041		veg+water	5355.9225	5355.9225	2147418367
398528		veg	8966.88		6553855
425910		veg1	9582.975		6553855
273814		veg2	6160.815	31429.1025	6553855
251515		veg3	5659.0875		6553855
47082		veg4	1059.345		6553855
271451		urban	6107.6475		-1350323713
290636		urban1	6539.31	12646.9575	-811477249
159692		land	3593.07	3593.07	-35586049

lc81680382013207_kufa_classif_unsuper.img

F

HISTOGRAM	COLOR	Class Names	Area(Hectares)	sum of area	NO Color
472211		water	10624.7475	10624.7475	65535
330602		veg	7438.545		6553855
173114		veg1	3895.065		6553855
23678		veg2	532.755	19853.2125	6553855
147904		veg3	3327.84		6553855
207067		veg4	4659.0075		6553855
202862		urban2	4564.395		-65281
247998		urban1	5579.955	17936.7075	-65281
346327		urban	7792.3575		-65281
264873		land	5959.6425	5959.6425	-741092353

calssif_unsuperlc81680382014082.img

G

HISTOGRAM	COLOR	Class Names	Area(Hectares)	sum of area	NO Color
84520		watre	1901.7	1901.7	65535
296598		veg1	6673.455		6553855
397727		veg2	8948.8575		6553855
365362		veg3	8220.645	29135.97	6553855
235245		veg	5293.0125		6553855
157575		land	3545.4375		-65281
247177		land1	5561.4825	9106.92	-65281
230025		urban	5175.5625		-1605292801
114507		urban2	2576.4075	14229.72	-1605292801
287900		urban1	6477.75		-1605292801

Table 1 - continue

classif_unsuper2_lc81680382015037.img

H

HISTOGRAM	COLOR	Class Names	Area(Hectares)	sum of area	NO Color
139924		water	3148.29	3148.29	65535
258880		veg	5824.8		6553855
425853		veg1	9581.6925		6553855
486164		veg2	10938.69	34202.7675	6553855
349226		veg3	7857.585		6553855
140847		land	3169.0575	3169.0575	-65281
298246		urban	6710.535		-741092353
56740		urban2	1276.65		-741092353
26227		urban3	590.1075	13854.195	-741092353
234529		urban4	5276.9025		-741092353

Table 2

Classification accuracy assessment report for MSS image in Oct 3,1976.

ACCURACY TOTALS

Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
Unclassified	0	0	0	---	---
water	4	4	4	100.00%	100.00%
water1	3	3	3	100.00%	100.00%
veg	3	3	3	100.00%	100.00%
veg1	8	7	7	87.50%	100.00%
veg2	3	4	3	100.00%	75.00%
veg3	2	2	2	100.00%	100.00%
veg4	1	1	1	100.00%	100.00%
land	1	1	1	100.00%	100.00%
land1	1	1	1	100.00%	100.00%
land2	4	4	4	100.00%	100.00%
Totals	30	30	29		

Overall Classification Accuracy = 96.67%

KAPPA (K^) STATISTICS

Overall Kappa Statistics = 0.9613

Table 3

Classification accuracy assessment report for TM image in Aug. 28, 1990.

ACCURACY TOTALS

Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
Unclassified	0	0	0	---	---
Class 1	3	2	2	66.67%	100.00%
Class 2	6	6	6	100.00%	100.00%
Class 3	1	1	1	100.00%	100.00%
Class 4	1	0	0	---	---
Class 5	3	3	2	66.67%	66.67%
Class 6	0	1	0	---	---
Class 7	2	3	2	100.00%	66.67%
Class 8	1	1	1	100.00%	100.00%
Class 9	4	4	4	100.00%	100.00%
Class 10	2	2	2	100.00%	100.00%
Totals	23	23	20		

Overall Classification Accuracy = 86.96%

KAPPA (K^) STATISTICS

Overall Kappa Statistics = 0.8467

Table 4

Classification accuracy assessment report for ETM$^+$ image in March 27,2001.

ACCURACY TOTALS

Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accurac
	0	0	0	---	---
water	1	1	1	100.00%	100.00%
veg	1	1	1	100.00%	100.00%
veg1	3	3	3	100.00%	100.00%
veg2	0	0	0	---	---
old veg	2	3	2	100.00%	66.67%
old veg1	0	0	0	---	---
old veg2	1	3	1	100.00%	33.33%
new veg	3	1	1	33.33%	100.00%
water1	1	1	1	100.00%	100.00%
urban3	1	1	1	100.00%	100.00%
veg3	0	0	0	---	---
urban2	2	1	1	50.00%	100.00%
unused1	0	0	0	---	---
urban1	3	3	3	100.00%	100.00%
urban	1	1	1	100.00%	100.00%
unused	1	1	1	100.00%	100.00%
Totals	20	20	17		

Overall Classification Accuracy = 85.00%

KAPPA (K^) STATISTICS

Overall Kappa Statistics = 0.8343

Table 5

Classification accuracy assessment report for ETM⁺ image in March 28, 2006.

ACCURACY TOTALS

Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
Unclassified	0	0	0	---	---
water	3	3	3	100.00%	100.00%
water1	2	2	2	100.00%	100.00%
veg	4	4	4	100.00%	100.00%
veg1	1	2	1	100.00%	50.00%
veg2	3	2	2	66.67%	100.00%
veg3	3	3	3	100.00%	100.00%
veg4	1	1	1	100.00%	100.00%
urban	5	4	4	80.00%	100.00%
urban1	1	2	1	100.00%	50.00%
urban2	3	3	3	100.00%	100.00%
Totals	26	26	24		

Overall Classification Accuracy = 92.31%

KAPPA (K^) STATISTICS

Overall Kappa Statistics = 0.9130

Table 6

Classification accuracy assessment report for ETM⁺ image in Apr. 07, 2013.

ACCURACY TOTALS

Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
Unclassified	0	0	0	---	---
Class 1	1	1	1	100.00%	100.00%
Class 2	5	5	5	100.00%	100.00%
Class 3	5	5	5	100.00%	100.00%
Class 4	2	2	2	100.00%	100.00%
Class 5	1	1	1	100.00%	100.00%
Class 6	4	3	3	75.00%	100.00%
Class 7	0	0	0	---	---
Class 8	3	5	3	100.00%	60.00%
Class 9	7	7	6	85.71%	85.71%
Class 10	6	5	5	83.33%	100.00%
Totals	34	34	31		

Overall Classification Accuracy = 91.18%

KAPPA (K^) STATISTICS

Overall Kappa Statistics = 0.8974

Table 7

Classification accuracy assessment report for ETM⁺ image in March 23, 2014.

ACCURACY TOTALS

Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
Unclassified	1	0	0	---	---
watre	1	1	1	100.00%	100.00%
veg1	5	5	5	100.00%	100.00%
veg2	6	6	6	100.00%	100.00%
veg3	4	4	3	75.00%	75.00%
veg	6	6	6	100.00%	100.00%
urban3	2	4	2	100.00%	50.00%
urban	2	1	1	50.00%	100.00%
urban2	0	0	0	---	---
urban1	0	1	0	---	---
unused	3	2	2	66.67%	100.00%
Totals	30	30	26		

Overall Classification Accuracy = 86.67%

KAPPA (K^) STATISTICS

Overall Kappa Statistics = 0.8442

Table 8

Classification accuracy assessment report for ETM⁺ image in Feb. 06, 2015.

ACCURACY TOTALS

Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
Unclassified	0	0	0	---	---
water	2	2	2	100.00%	100.00%
veg	1	1	1	100.00%	100.00%
veg1	5	5	5	100.00%	100.00%
veg2	4	5	4	100.00%	80.00%
field	3	3	2	66.67%	66.67%
urban	5	4	3	60.00%	75.00%
urban1	2	3	2	100.00%	66.67%
urban2	0	0	0	---	---
urban3	0	0	0	---	---
urban4	2	1	1	50.00%	100.00%
Totals	24	24	20		

Overall Classification Accuracy = 83.33%

KAPPA (K^) STATISTICS

Overall Kappa Statistics = 0.8037

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