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ABSTRACT

Traditional classification methods are all pixel-based and do not utilize the spatial and context information of an image object and its surroundings, which has potential to further enhance digital image classification. In this study, this traditional method was compared with Object based image classification. This involved the development of a pixel-based classification model using the spectral characteristics of the image pixels, and the development of an object-based classification model using the spectral, spatial as well as the contextual information of the image pixels. The same set of ground data was used for accuracy assessment in both classifications for consistency. In the Pixel-based classification, a supervised *Euclidean distance* algorithm was utilized; in Object-oriented classification, the *Bhattacharya* algorithm was used. Using the Object-based classification, an accuracy of 93.71% was achieved while 57.34% accuracy was achieved for pixel-based classification. This showed that the object-based classification result was higher than that of the Pixel-based classification by 36.37%. The greenery results (maps) from image classification was compared with the detailed map of Uwani urban in terms of spatial overlap and size in order to determine to what extent they agree. The Object-based classification method showed a 94.20% area agreement with the vector map, while the Pixel-based classification method showed 86.24% area agreement with the vector map of Uwani Enugu. Based on the greenery distribution of Uwani obtained from the classified map, a greenery program is therefore recommended for the residents of Uwani Enugu to improve the environmental condition and aesthetics in the area.

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INTRODUCTION

Man has played an increasingly large role in the modification of the global environment. With increasing population and developing technologies, he has emerged as the major most powerful and universal instrument of environmental change in the biosphere today. However, in urban design, this lost natural environment is simulated by the introduction of open spaces and green area to regain that natural, and aesthetic environment which we had lost during uncontrolled urban development. Urban greenery is thus a key natural resource for a city; besides, vegetation has vast health and aesthetic significance for people. These modifications touch individual physiological and morphological parameters, longevity, growth, and evolution, and increase the tolerance of urban plants to different pressures such as drought, cold or vermin. It is obvious that developing a system of monitoring urban greenery is an essential task for any city. This system is able to give information related to the current state of urban vegetation and forecast various situations. To derive land-cover information from remote sensing imagery, however, can be a difficult task depending on the complexity of the landscape and the spatial and spectral resolution of the imagery being used. This work focuses on two Image Classification techniques (the pixel based image classification and the object oriented image classification), comparing them for mapping urban greenery, while exposing and comparing the accuracies derived from the two analysis results.

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STUDY AREA

The study area lies in the heart of Enugu urban area of Enugu state Nigeria between longitudes 7º28'38.4"Eand 7º30'35.8"E, and between latitudes 6º23'40.2"N and 6º25'46.3"N, or 331,594mE to 335,213mE, and 707,064mN to 710,927mN, about 13.98 Sq. Km. Stretching from Uwani through University of Nigeria Enugu Campus, Maryland layout, and Achara layout part of Enugu Urban. The study area being a well-developed urban area was chosen for this research because it possesses all the characteristics of a typical urban area as can be seen anywhere in the world which is dynamic in spectral characteristics.

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DATA

Two datasets were used in this study, they are;

- Remotely Sensed data (QuickBird image 2008).
- Field survey data (this data was obtained using a hand-held GPS-Garmin 78Sc).

DATA PREPARATION

- Preparation/Refinement of the remotely sensed data; The QuickBird Imagery was obtained in the .ecw (compressed) format, it was then converted to Tagged Image File Format (TIFF/.tif) which we used for this research. The QuickBird image of the area was reprojected to WGS84 UTM Zone 32N in ArcCatalogue, the pixel size was set, and then georeferenced in Erdas Imagine.
- Preparation/Refinement of the field survey data.

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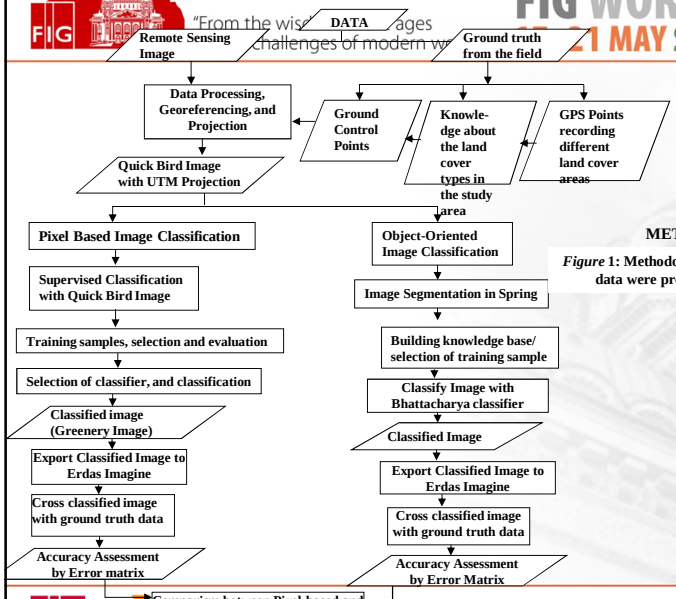

METHODOLOGY

Figure **1: Methodology flow chart showing how the two sets of data were processed and compared for this research**

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DATA PROCESSING

Data processing Was Done in Two phases; Pixel Based and Object Based.

Phase 1: Pixel Based Image Classification

During the training exercise, we created four themes; Buildings, Greenery, Paved Area, and Shadows.

Samples of these themes were randomly picked across the image so as to get a reliable classification.

In the training, we got the following set of values for each theme; Buildings: 313,372pixels, Greenery: 75,671pixels, Paved Area (Open space): 611,807pixels, Shadows: 23,610.

During classification the *Euclidean Length* algorithm was used. The classification method by Euclidian Length is a supervised classification procedure which uses the Euclidian distance to associate a pixel to a class.

The classifier compared the pixel Euclidian Length to the grouping average andthe "pixel" was incorporated to the grouping presenting the smallest Euclidian Length. This procedure was repeated until the whole image was classified. After specifying this classifier, the acceptance threshold was set at 99.9%, output image (data model) was set to *image*, and the sample analysis was carried out, then the image was classified.

After classification, Class Mapping was done to associate the grouped classes to their respective themes which established the connection between them.This action makes the classified image very useful for further analysis unlike ordinary coloured raster which it was before it was mapped.

The Accuracy Assessment of The Pixel Based Image Classification Method was done in Erdas Imagine 9.2. The result of the accuracy assessment showed that the Pixel-based classification had up to 57.34% accuracy.

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Phase 2 : Object-Based Image Classification method

In this classification technique, we took the following steps; Image Segmentation, Sample Training, Classification , Class Mapping, Reprojection in ArcCatalogue, Georeferencing, Accuracy Assessment in Erdas Imagine.

We carried out training, this helped to defined sample objects for each theme to guide the software in grouping the image pixels accordingly .During the training exercise, four themes were created; Buildings, Greenery, Paved Area, and Shadows.

Samples of these themes were randomly picked across the image so as to get a reliable classification. Classification was done using the training data and the Bhattacharya algorithm in the object-based method. The Battacharya distance measure was used in this classifier by regions, to measure the statistical separability between a pair of spectral classes.

The spring software, while classifying, took note of segment size, shape, context, tone, and texture. After specifying this classifier, threshold was set at 99.9%, output image (data model) was set to *image*, sample analysis was carried out, and the image was classified.

During the process of exporting the image, the raster dataset lost its projection and therefore needed to be restored. This we achieved by reassigning the same projection (UTM Zone 32N) to it in ArcCatalogue.

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RESULTS AND ANALYSIS

Many comparative analyses were made in order to show the difference between the two methods of classification. They are shown below..

Table 1: Comparison of the resultant areas from Both methods

	PIXEL-BASED CLASSIFICATION			OBJECT-BASED CLASSIFICATION		
	AREA IN HECTARES (ha) PIX	AREA IN SQUARE METRE (m^2) PIX	PERCENTAGE OF AREA PIX	AREA IN HECTARES (ha) OBJ	AREA IN SQUARE METRES (m^2) OBJ	PERCENTAGE OF AREA OBJ
GREENERY	107.779857	1077798.57	22.85%	98.724119	987241.19	20.92%
BUILDINGS	133.276614	1332766.14	28.25%	179.932306	1799323.06	38.14%
PAVED AREA	159.666103	1596661.03	33.84%	142.875469	1428754.69	30.29%
SHADOW	71.039904	710399.04	15.05%	35.981483	359814.83	7.63%
TOTAL	471.762478	4717624.78	100%	471.762478	4717624.78	100%

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Figure 2: Histogram showing Comparison of Area Calculated by Pixel-based and Object-based Methods.

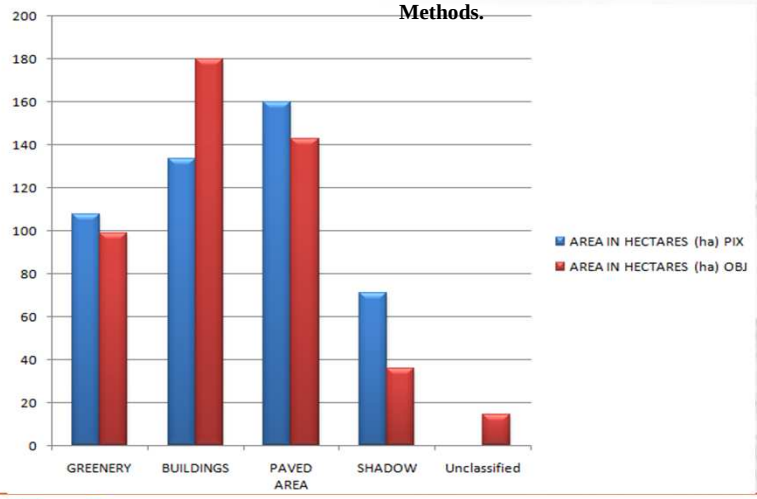

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Table 2: Comparism of Classification Accuracy

	PIXEL-BASED CLASSIFICATION					OBJECT-BASED CLASSIFICATION				
Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
GREENERY	32	31	17	53.13%	54.84%	32	33	30	93.75%	90.91%
BUILDINGS	40	38	22	55.00%	57.89%	40	39	37	92.50%	94.87%
PAVED AREA	34	35	17	50.00%	48.57%	34	36	33	97.06%	91.67%
SHADOW	37	39	26	70.27%	66.67%	37	34	34	91.89%	100.00%
Overall Classification Accuracy	57.34%					93.71%				

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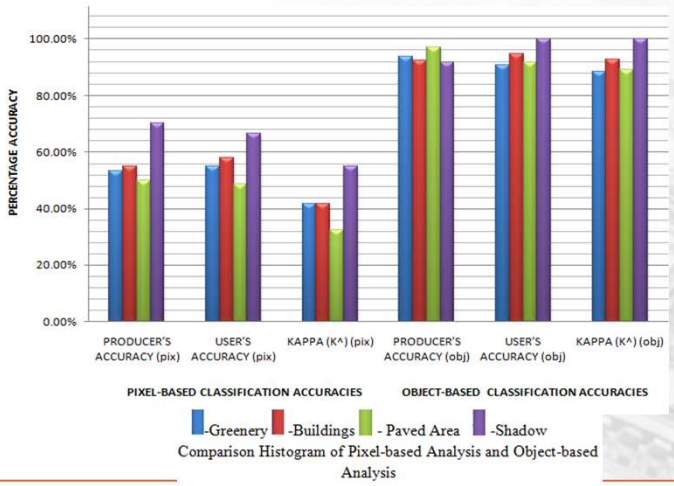
Figure 3: Comparison Histogram of Pixel based Analysis and Object Based Analysis



Comparison Histogram of Pixel-based Analysis and Object-based Analysis

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TABLE 3: Classification and KAPPA Accuracy

	PIXEL-BASED CLASSIFICATION			OBJECT-BASED CLASSIFICATION		
Class Name	Producer's Accuracy	User's Accuracy	Kappa (K^)	Producer's Accuracy	User's Accuracy	Kappa (K^)
GREENERY	53.13%	54.84%	0.4182	93.75%	90.91%	0.8829
BUILDINGS	55.00%	57.89%	0.4154	92.50%	94.87%	0.9288
PAVED AREA	50.00%	48.57%	0.3253	97.06%	91.67%	0.8907
SHADOW	70.27%	66.67%	0.5503	91.89%	100.00%	1.0000
Overall Classification Accuracy	57.34%		0.4300	93.71%		0.9162

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CONCLUSIONS

Urban greenery is a key natural resource for a city; besides, vegetation has vast health and aesthetic significance for people. It is obvious that developing a system of monitoring urban greenery is an essential task for any city. This system is able to give information related to the current state of urban vegetation and forecast various situations. The Greenery results from our classification shows that while University of Nigeria, Enugu campus has abundant greenery around the staff quarters, most part of the Enugu urban have little or no greenery except for places very close to a river or stream. The object based classification gives a vector-like, accurate and aesthetic map than the pixel based method which mix up pixels belonging to different land uses.

In conclusion, the Object based classification presents an easier, faster, and cheaper way of producing Land-use and Land-cover maps for quick decision making. Though not as accurate as ground survey method, but it gives results that are very close to reality as edges are clearly defined unlike the Pixel based classification where the edges of the map objects are very hazy.

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THANKS FOR LISTENING!!!
ANY QUESTIONS ??
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