

Accuracy Assessment of Image Classification Algorithms

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Abstract

Iso-cluster unsupervised classification was performed using the multivariate toolset of ArcMap 10.1 to identify the spectral clusters or natural statistical groupings present in Kwali Area Council of the Federal Capital Territory Abuja using 2011 Landsat-7 ETM+ and adopting supervised classification that involves ground truthing, the previous knowledge of the study area and creating training site. The maximum likelihood classification (supervised classification), default colour was changed to multiple colour that can easily be interpreted. The new colour assignment was based on information obtained from prior knowledge of the study area. The supervised classified image was further processed to remove all the noises - unwanted or non-relevant information that made it appear speckled. Using the generalization toolset of ArcMap 10.1 spatial analyst tool, the classified output was filtered to remove the noise; this was done using eight nearest neighbours kernel majority filter. Also, the ragged boundaries of the classified output were smoothed as well as clumping the classes together using boundary clean toolset.

Introduction

An adequate number of training samples and their representativeness are vital for image classifications (Chen and Stow, 2002; Landgrebe, 2003; Mather, 2004). Using ArcMap 10.0; polygon collection method, training samples (Figure 5.4a and b) were collected from areas that appear relatively alike on the Landsat 7 ETM+ and Landsat1 MSS images. Groundtruth data, previous knowledge of the study area and the result of the unsupervised classification aid the training set samples.

3.0 Methods

(c) Entity ID: L72189056_05620110121, Acquisition Date: 21st January, 2011, Path: 189 Row: 56, Band Combination: 123456.16.278

4.0 Results

4.1 Unsupervised Classification

Figure 2 shows that the study areas contain seven major colours based on colour classes identified on the Landsat-7 ETM+ image using band combinations in VNIR and TIR. The Figure 2 also identified that class -5 of the colour layer dominates the scene, particularly toward the north, north central and south of the image, while other colour class layers are partially distributed of which class-2 colour layer shows the lowest.

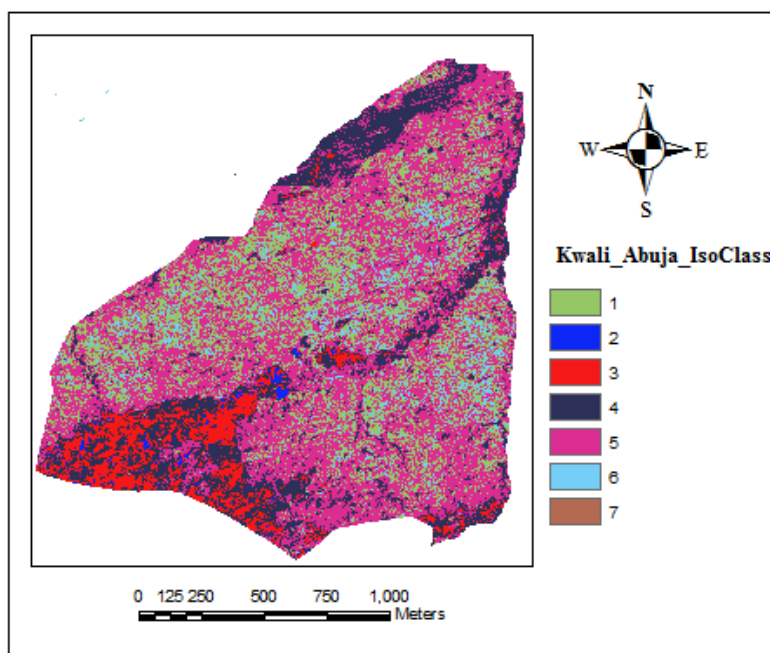


Figure 2. Iso-unsupervised Classification of the study area

Figure 3 shows that the study areas contain seven colour classes potentially identified using band combination in the VNIR. The Figure 3 precisely shows that class -5 colour layers dominates the scene, particularly at the central and south of the image. Other classes of colour were also identified of which the colour with class-7 layer shows the lowest.

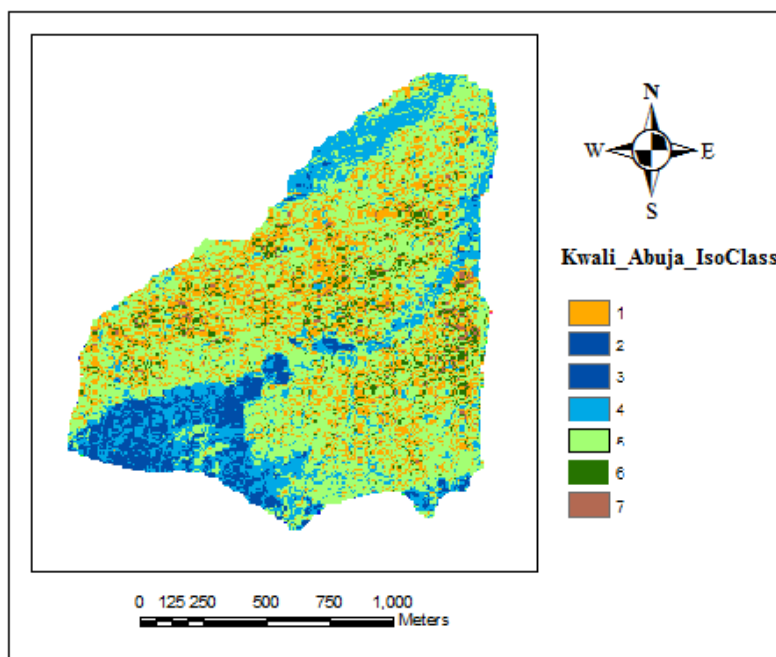


Figure 3. Iso-unsupervised Classification of the study area

4.2 Training sites classification

Figure 4 shows training samples collected for the supervised classification with number of training samples cells and histogram of training samples. The Figure 4 classify different properties of the training sites that includes Identity (ID), Class name, Value, Color and Count. Therefore, the class name (water body) of the ID-2 and Value (2) and Count (5383) has the highest scene on the image, based on the classified histogram result. Other class-name are partially distributed across the study areas.

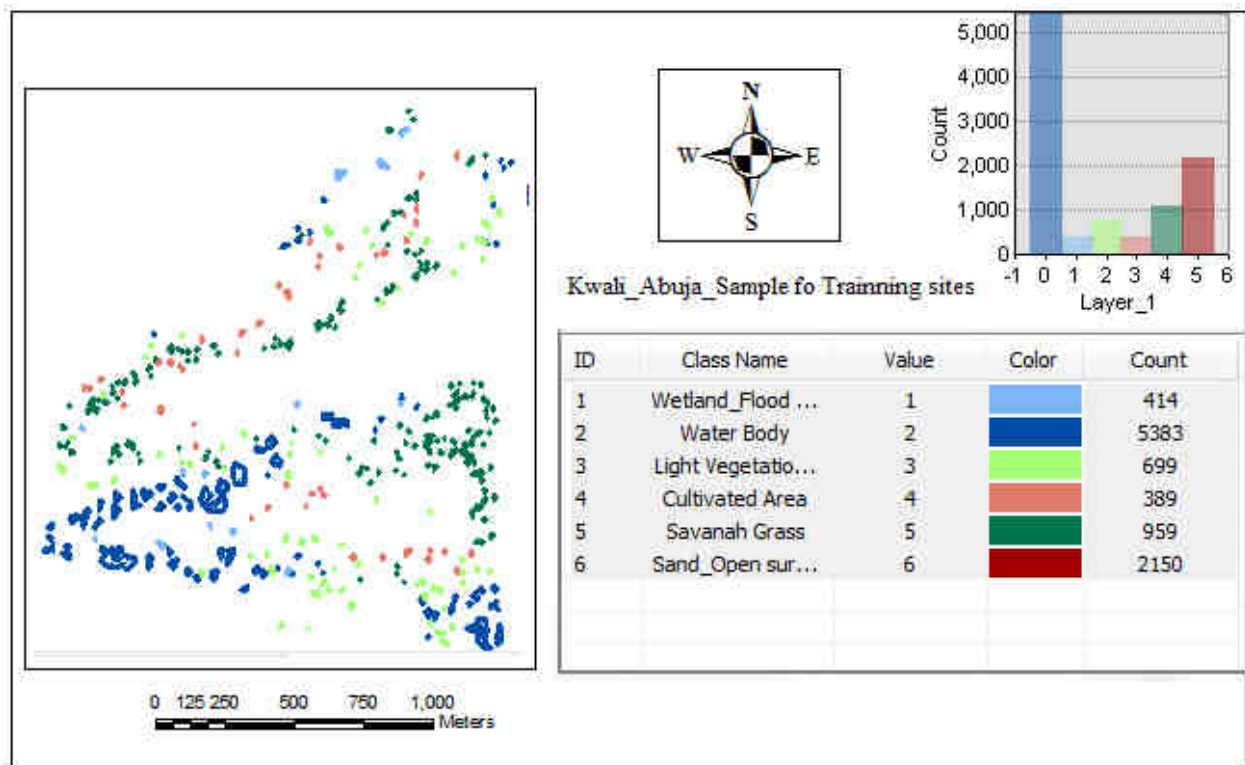


Figure 4. Training sites, samples cells and histogram of training ready for the Supervised Classification
 4.3 Supervised Classification

Figure 5 indicates the presence of six colours using 2007 Landsat-7 ETM+ band ratio in the VNIR and TIR. The Figure 5 identified the land-use and land-cover type namely; cultivated area (35.2%), light vegetation shrubs (32.4%), sand open surface (16.5%), savannah grass (14.2%), water body (12.0%) and wetland flood plain (9.1%) of which cultivated areas and light vegetation shrubs shows sign of dominance.

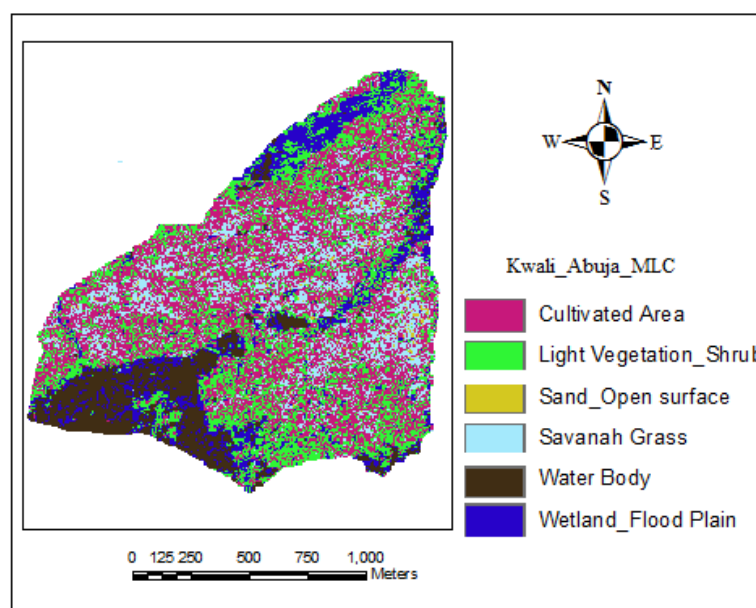


Figure 5. Supervised Classification of the study area

4.4 Filtered Image classification

Figures 6 and 7 shows the capability of using the generalized toolset of ArcMap 10.1 Spatial Analyst tool, the classified output was filtered as shown in Figure 6 to remove the noise; this was done using eight nearest neighbours kernel majority filter. The Figure 6 further shows that cultivated area (35.2%), light vegetation

shrubs (32.4%), sand open surface (16.5%), savannah grass (14.2%), water body (12.0%) and wetland flood plain (9.1%), and that cultivated areas shows higher sign of dominance.

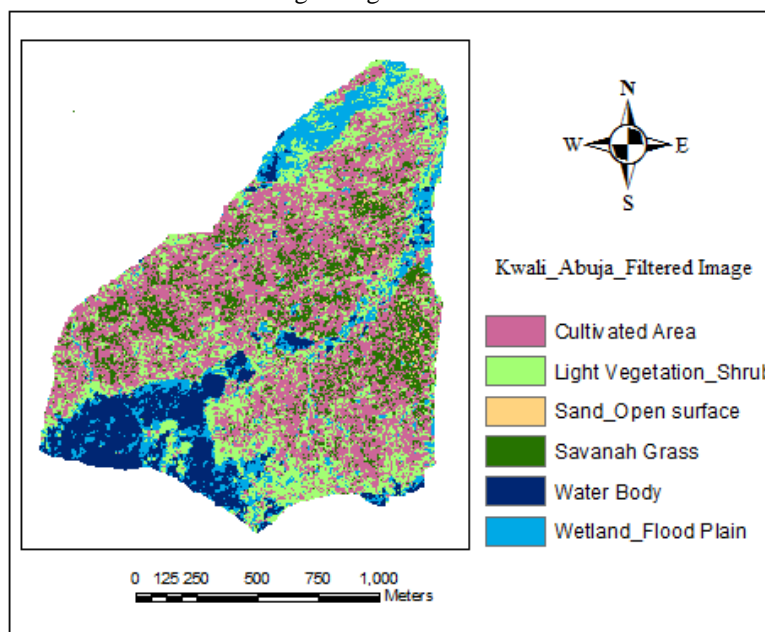


Figure 6. The Filtered and generalized classified image of the study area

4.5 Smoothen Image classification

Figure 7 also shows that, the ragged boundaries of the classified output were smooth as well as clumping the classes together using boundary clean toolset. The Figure 7 further illustrates that the smooth images shows that cultivated area (35.2%), light vegetation shrubs (32.4%), sand open surface (16.5%), savannah grass (14.2%), water body (12.0%) and wetland flood plain (9.1%). However, cultivated areas dominate a larger part of the study areas.

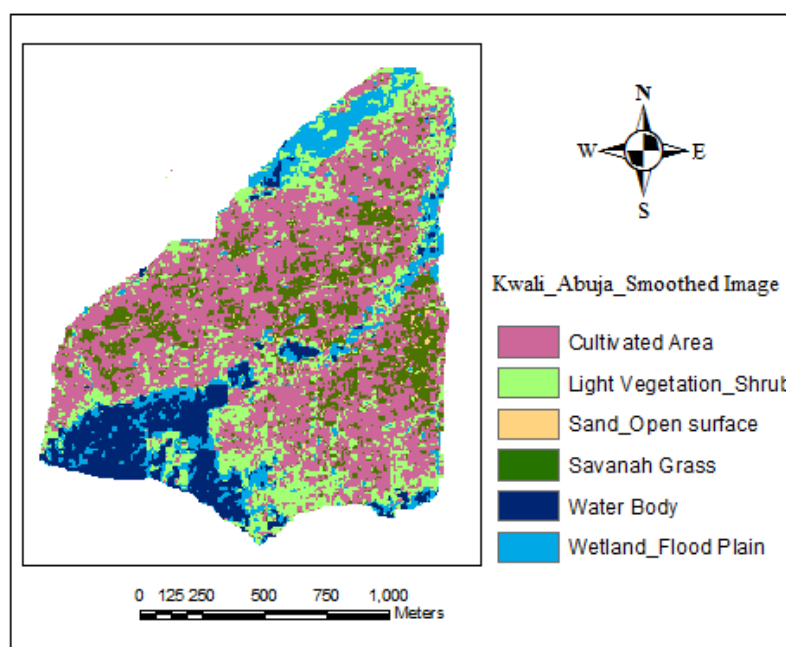


Figure 7. The smooth and generalized classified image of the study area

4.6 Discussion

The result has shown that the classified satellite images (Figures 2 -5) put Figure 5 (Supervised classification-MLC) as the most approximate representation in relation to feature and object identification ahead of unsupervised classification methods. But, when considering the availability of the quantities or number of feature or object on the images, Figures 2 and 3 (Inso-supervised classification) proved to be the best and

better way of assessing target areas ahead of MLC. For the MLC and Inso-unsupervised algorithms, class differences of 48.47% & 51.53% of cultivated areas, 50.68% & 46.32% light vegetation shrubs, 53.70% & 46.30% sand open surface, 46.76% & 53.24% savannah grass, 70.39% & 29.61% water body and 40.56% & 59.44% wetland flood plain respectively (Table 1). A classification accuracies of 20.12%, 27.54%, 11.01%, 23.04%, 4.52% and 13.78% were recorded for cultivated areas, light vegetation shrubs, sand open surface, savannah grasses, water body and wetland flood plain respectively (Table 1). The Filtering's method (Figure 6) produced 83% of cultivated areas, 12% light vegetation shrub, 23% sand open surface, 43% savannah grasses, 11% water body and 79% wetland flood plain agreement with the MLC, while the smoothen method (Figure 7) indicates 83% of cultivated areas, 12% light vegetation shrub, 23% sand open surface, 43% savannah grasses, 11% water body and 79% wetland flood plain agreement with MLC. This result shows 88% and 97% agreement with those two methods. The filtering and smoothening result implies that the two methods further buttress the capability of using MLC to identify and evaluate object accurately.

Table 1. Areas (Hectares) of LU/LC of Kwali Area Council, Abuja from Classification Algorithms

Class	LU/LC Types	Unsupervised classifications of LULC (hectares)	Supervised classifications (MLC) of LULC (hectares)	Classification accuracy		
				MLC (%)	Unsupervised (%)	Total Accuracy results
1	Cultivated Areas	2305.2	2450.5	48.47	51.53	20.12%
2	Light vegetation shrubs	3494.4	3014.8	50.68	46.32	27.54%
3	Sand open surfaces	1397.4	1204.9	53.70	46.30	11.01%
4	Savannah grass	2546.7	2900.2	46.76	53.24	23.04%
5	Water body	751.8	316.3	70.39	29.61	4.52%
6	Wetland flood plain	1321.1	1936.4	40.56	59.44	13.78%
Total		11816.6	11823.1	310.56	286.24	100.00%

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