Using Landsat Imagery to Analyse Land Cover Change in the Njoro Watershed, Kenya

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Introduction In developing nations where resources are scarce and increased population pressures create stress on available resources, methods are needed to examine effects of human migration and resultant changes in land cover. Widespread availability and low cost of remotely sensed imagery and Geographic Information Systems (GIS) are making such methods a reality to develop quantitative resource mapping and land cover change detection in developing nations (Sheng *et al*., 1997). However, difficulties arise in tropical regions when trying to analyse traditional vegetation bands (Bands 3 and 4), or indices such as NDVI because saturated pixels limit spectral distinction.

Materials and methods Band separability for 9 informational classes was measured for a Landsat 7 image acquired in Kenya's Rift Valley (Path 169, Row 60) on 4 February 2003. Baldyga et al. (2004) showed that vegetation diversity and temporal variability resulted in large classification errors using bands 2, 3 and 4 in an unsupervised classification in 4 scenes captured for this region. Band separability analysis indicates that in this region the nine identified spectral classes are best distinguished using a four-dimensional image consisting of bands 4, 5 and 6 and the tasselled cap transformation for brightness (TC1). Nine informational classes were identified for this project and a combination of unsupervised and supervised classification methods were used to classify the 4-dimensional image.

Results Baldyga *et al*. (2004) achieved only 41% accuracy with unsupervised classification; errors were most frequent in distinguishing agricultural lands from grasslands. This has serious implications, as response to land cover change is not linear (Baldyga *et al*., 2004). The current classification (Table 1) was only 75% accurate; the greatest error was in classifying Barren areas. Barren areas in the region change seasonally and annually, so the error is not surprising given that ground truth data collection was impossible on the acquisition date of the Landsat image. Shrublands and Riparian area were classified as Agriculture and Forest respectively. In all cases of misclassification, at least one adjacent cell was classified as the accuracy assessment point. Several points were collected using a range finder and calculating the location, rather than collecting an actual GPS coordinate at the point due to inaccessibility. All misclassified Grasslands cells were classified as Agriculture or Forest and located near transitional areas.

Table 1 Error matrix resulting from accuracy assessment

Land Cover Class	Map Total	Number Correct	Producer's Accuracy	User's Accuracy
Open Water	5	5	100%	100%
Urban	3	2	67.00%	67.00%
Agriculture	33	21	64.00%	81.00%
Barren	10	1	10.00%	10.00%
Forest	25	15	60.00%	79.00%
Grasslands	95	86	91.00%	78.00%
Wetlands	—	—	—	—
Riparian	1	0	0.00%	0.00%
Shrublands	1	0	0.00%	0.00%
Total:	**173**	**130**		
Overall Accuracy:		**75.14%**		

Conclusions We believe the classification accuracy, using the bands and enhancements indicated above, was much higher than indicated. Refining the classification process by incorporating ancillary data will improve results in Riparian and Agricultural areas. Classified land cover scenes are input to GIS-based models as part of a systems approach to understanding watershed dynamics. Therefore, developing accurate classification methods in rapidly changing tropical landscapes is critical, as migration into these fertile areas puts pressure on scarce resources.

References

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