Using Landsat Imagery to Analyze 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 land cover changes. Widespread availability and low cost of remotely sensed imagery and Geographic Information Systems (GIS) are making such methods a reality for developing quantitative resource mapping and land cover change detection in developing nations (Sheng et al. 1997). Difficulties arise, however, in tropical regions when trying to analyze traditional vegetation bands (Bands 3 and 4) or indices such as NDVI because the pixels are saturated making spectral distinction limited.

Materials and methods Band separability for nine 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 four 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 tasseled 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 four-dimensional image.

Results Baldyga et al. (2004) were able to achieve only 41% accuracy with an unsupervised classification. Classification errors have been most abundant in distinguishing agricultural lands from grasslands. From a curve number based hydrologic modeling approach this has serious implications, as response to land cover change is not linear (Baldyga et al. 2004). While results from the current classification (Table 1) yielded only an overall 75.14% accuracy, the greatest error was found in classifying Barren areas. Barren areas change both seasonally and annually in the region, so the error is not surprising given that ground truth data collection was not possible on the Landsat image acquisition date. 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 overall classification accuracy using the bands and enhancements indicated above to be much higher than indicated. Refining the classification process by incorporating ancillary data sets will yield improved 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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