CASE STUDY

Detailed Land Use/Land Cover Detection in Settlement Growth in Kenya

DigitalGlobe FOUNDATION

Using Satellite Images of Kapsoya Sub-County, Eldoret, Kenya to Determine Settlement Growth

Land use and land cover (LULC) change has become a central component in current strategies for managing and monitoring urban growth. This research examines the urban LULC changes that have been taken place in Eldoret, Kenya for the past five years due to the rapid urbanization using IKONOS images. Supervised classification object-oriented techniques have been utilized for delineating eight different classes: trees, cultivation, grass, bare soil, red clay roof, grey mabati roof, painted mabati roof and greenhouse. Urban land use change for the year 2042 was modeled using a Markov chain based approach. For the projection of 2042, transitional probability matrix table from the land use land cover map of 2008 and 2012. Projected land cover changes show a growing built up area, which threaten the areas air, water and soil quality.

Urbanization is an inevitable process due to economic development and rapid population growth. Urban growth, particularly the movement of residential and commercial land use to rural areas at the periphery of metropolitan areas, has long been considered a sign of regional economic vitality. But its benefits are increasingly balanced against ecosystem impacts, including degradation of air and water quality and loss of farmland and forests, and socioeconomic effects of economic disparities, social fragmentation and infrastructure costs (Sahoo, 2013). The process of urbanization has been influenced mainly by the combination of driving forces: geographical location, population growth, public service accessibility, economic opportunity, government plans and policies, land market, globalization, tourism activities and political activities.

Remote sensing and GIS have proved to be effective means for extracting and processing varied resolutions of spatial information for monitoring urban growth (Eastman, 2012). To better understand the complexity of urban systems and its spatial and temporal dimensions, urban growth models need to be linked with land use change model (Bhagawat R. 2011). The imagery data of very high resolution as well as the innovative modeling methods of their proceeding have contributed to integrated urban studies. Many researchers recently have engaged in the innovative concept of object- oriented analysis dealt with meaningful objects rather than pixels (Eastman, 2012). The main advantage of object-oriented image processing is that it groups neighboring pixels into meaningful areas according to their spatial and spectral homogeneity. The formed meaningful objects are closer to the human perception of landscape than single pixels. What is more interesting is that the object oriented approach takes into account not only the spectral information but also the form, the texture, the shape and an additional great variety of features based on image objects (Spring, 2013).

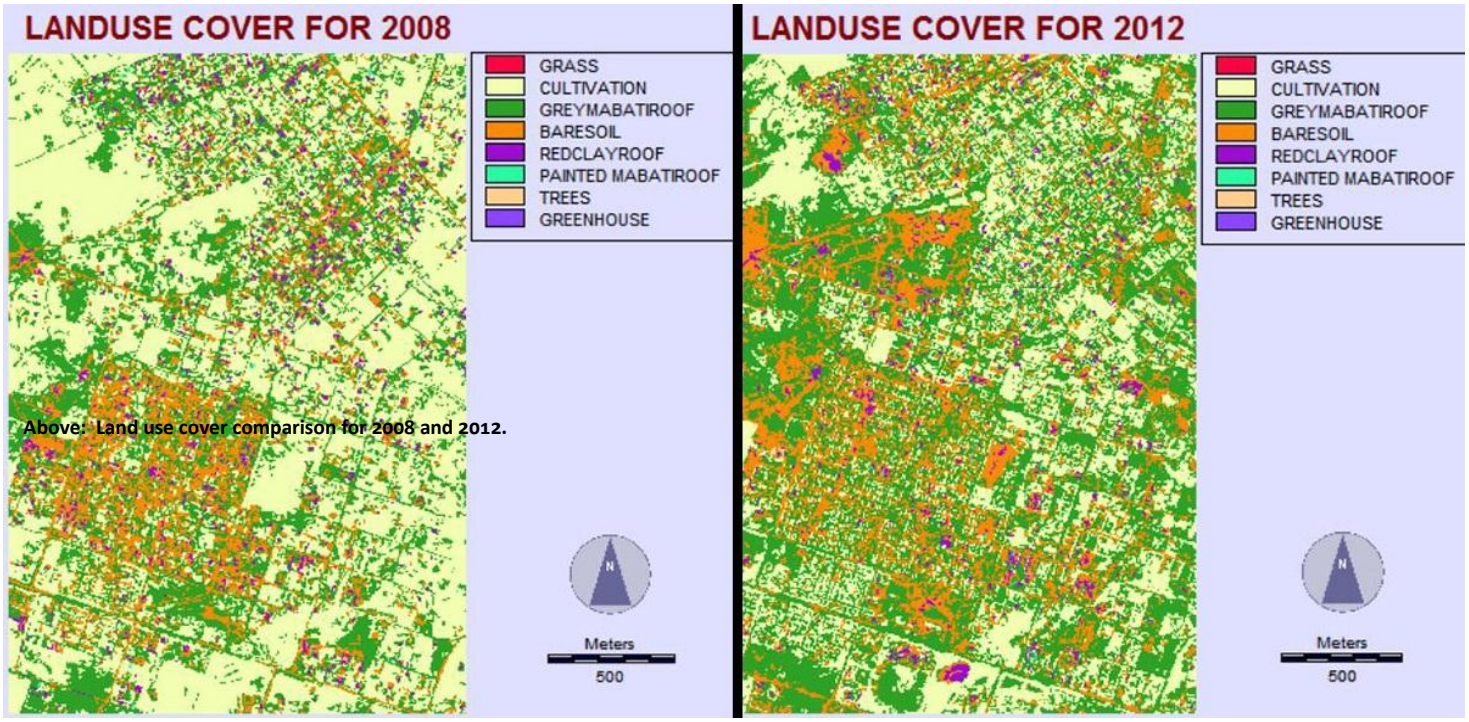
The change detection techniques are applied on images of different dates is divided in two general categories: pre-classification and post-classification methods. Pre- classification techniques are applied on rectified and normalized corrected images (e.g., image algebra, indices, transformations, etc.) and detect the possible position of change without providing any information for the type of land cover change. On the other hand post-classification techniques are based on the comparison of classified images and provide detailed information about the nature of change (e.g., from vegetation to urban) for every pixel or object. The results of the land use/land cover LULC change can be effectively used to understand the relationship between the spatial pattern and urban growth in Kapsoya sub-county, Eldoret.

High spatial resolution IKONOS satellite imagery from DigitalGlobe was used in this study. The satellite data consist of a pan-sharpened image, dated October 2008, with spatial resolution of 2m, and a pan-sharpened Ikonos image of August 2012, with spatial resolution of 2m. All the images have been ortho-rectified with sub-pixel accuracy, using the corresponding Rational Function model. This data is for Eldoret Town. The focal area of Kapsoya Sub County of roughly 499.55 hectares was extracted and analyzed.

LULC was quantified for the last five years in Kapsoya Sub-county, Eldoret using remote sensing. According to the classification the tree cover has reduced from 0.08% to 0.06%. It has also been noted that the area that was previously cultivated has reduced significantly from 52.61% to 30.69% which has been transformed to grass and bare soil. The red clay roof spectral class is close to that of the bare soil therefore there may have been an overlap. There has been a rapid rise in bare soil which could be attributed to the increased roads and footpaths. There has also been a rapid rise in the grey mabati roof especially around the Munyaka area which is indicative of overcrowding in that area. There is an increase in the number of greenhouses due to the adoption of intensive urban agriculture.

YEARS	2008		2012	
LAND USE CATEGORY	HECTARES	%	HECTARES	%
TREE	0.42	0.08	0.31	0.06
CULTIVATION	262.82	52.61	153.30	30.69
GRASS	151.30	30.29	226.53	45.35
BARESOIL	67.76	13.56	104.59	20.94
REDCLAYROOF	15.21	3.05	12.98	2.60
GREYMABATIROOF	0.85	0.17	1.48	0.30
PAINTEDMABATIROOF	1.06	0.21	0.20	0.04
GREENHOUSE	0.12	0.02	0.18	0.04
TOTAL	499.55	100.00	499.55	100.00

This study has assessed and modeled the trend of urban land cover changes in the area by using an integrated approach including GIS, RS, and modeling tools. The derived maps have provided new information on spatial-temporal distributions of built-up areas in the region. The LULC analysis indicates that there is an increase of built up area and decrease of cultivated land and trees. Thus the ecological effects of land cover conversion include changes in soil quality, soil erosion, water quality, and biodiversity loss and habitat availability is consistent with global concerns over the degradation of the environment due to increasing urban growth throughout the world.



Above: Land use cover comparison for 2008 and 2012.

Above: Land use cover comparisons from 2008/2012