Chapter 67
Multi-Temporal Landsat Remote Sensing for Forest Landscape Fragmentation Analysis in the Yoko Forest, Kisangani, DRC

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ABSTRACT

This study assessed the impact of human activities on deforestation and sustainability of water resources and livelihoods in the Congo Basin. It mainly aimed to assess forest degradation in the Yoko reserve from 1976 to 2015 and investigate the compatibility of Landsat imagery for forest monitoring. Digital Image processing for unsupervised classification was done using ENVI software while supervised classification was done by means of ArcGIS 10. Results show that forest landscape faced large scale human induced fragmentation over the last 40 years. If these trends continue, they will affect the sustainability of water resources and livelihoods in the Congo Basin of the Democratic Republic of Congo. Hence, policy makers need to look at key drivers and address impacts that may threaten the future of Hydrological Ecosystems Services, including water and land resources in the Congo Basin. Authorities have to apply an Integrated Management of Water, Land and Ecosystems.

DOI: 10.4018/978-1-5225-7033-2.ch067

INTRODUCTION

Land cover fragmentation is now recognized as an indicator and a prominent interface between human activities and global environmental change. Human and environment interactions involve conversion of natural landscapes into anthropogenic land use or by changing management practices in human dominated landscapes (Foley et al., 2005). Understanding the role of land use in global environmental change and the long term human environment interaction requires historical reconstruction of past land cover conversions. Sequential information on land cover in most developing countries is quite often missing, outdated or inconsistent (Gregorio and Jansen, 1998; Brink and Eva, 2009). The launch of the Landsat imagery platform in 1972, followed by others such as SPOT and ASTER, has provided satellite remote sensing (RS) capacity to detect LUC change over the past 40 years at most. As suggested by Wasige et al. (2013), "land cover" refers to the biophysical state of the earth surface and immediate subsurface (Turner et al., 2005), and, "land fragmentation" brings out the aspect of human utilization of land (Turner and Meyer, 2004). The combined application of land cover and fragmentation data allows detection of type of change, as well as the way land is changing (Ickowitz et al, 2015).

This study provides fragmentation quantification in land cover. A few environmental studies have been undertaken in the Tshopo District of the Eastern Province of the Democratic Republic of Congo (DRC). This study targets the Yoko forest reserve located in the north-eastern part of the country, in the skirts of the City of Kisangani. The study specifically aimed to establish a detailed assessment of forest degradation over time and space to provide an accounting of environmental changes experienced in this region and the Congo Basin at large. Landsat MSS, TM, ETM and OLI images were used to detect the extent of land degradation in terms of both spatial and temporal patterns as well as magnitude and intensity over the period1976-2015. The following sections present the study area(Section 2), the type of data and methods used (Section 3)and the results of land cover fragmentation(Section 4), followed by a discussion (Section 5) and conclusion and recommendations (Section 6).

STUDY AREA

Yoko Forest Reserve covers a total area of 6,975 ha divided into two blocks, the northern Yoko (3,370 ha) and the southern Yoko (3,605 ha). It is a private property of the Institut Congolais pour la Conservation de la Nature (ICCN) pursuant to Order - Law No. 75-023 of July 1975 establishing a state owned company responsible for managing certain environmental public institutions as amended and supplemented by Ordinance - Act No. 78-190 of 5 May 1988 (Lomba, 2007). The Reserve is located in the administrative sector of Bakumu - Mangongo, to the south of Kisangani. It is geographically bound by the village Banango (kilometer 21; 00 ° 21.439 'N, 025 ° 13.979' E) and village Bagão (Kilometer 57; 00 ° 06.653 'N, 025 ° 17.622 'E) on the Kisangani-Ubundu road, to the left bank of the Congo River (Figure 1). Yoko Forest Reserve is bordered to the east and south by the River Yoko, which is a subsidiary of River Biaro Yoko (Mikwa, 2012).