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Modelling Land Use Change in Northern Ghana

Ademola Braimoh, Paul L. G. Vlek

University of Bonn, Department of Ecology and Resource Management, Germany

Abstract

The Volta Basin in West Africa drains about 400,000 km^2 area of land, including 70 % of mainland Ghana. Low rainfall reliability and water insecurity, high population growth rate and macroeconomic transformation in the last few decades have had a profound influence on livelihood strategies of the largely rural populace. Therefore, many parts of the basin are "hotspots" of land use / land cover change (LUCC). The determinants of LUCC in an area within the Volta Basin of Ghana were identified using multiscale, spatial statistical analyses. Land cover change trajectories were defined using multitemporal Landsat TM images acquired over a 15-year period. Training signatures for land cover classification using maximum likelihood algorithm were developed based on PCA, tassel cap and NDVI transforms, while ground truth data were obtained from aerial photo interpretation, field visits and topographic maps. Change detection was based on synergy between image-differencing and post classification. Statistical relationships between land cover and selected biophysical and socio-economic variables were determined at different cell resolutions ranging from 30 m to 1050 m using generalized linear mixed model technique, which also allows incorporation of spatial correlation in the analysis. The results indicated the scale-dependency of LUCC patterns in the study area. There was a drastic conversion of woodland to agricultural land and a general transition to less vegetation cover. Spatial statistical model also revealed that driving factors of land use change could be related to well-established land use paradigms. Thus, the model could be used to support land use planning and other environmental management decision-making in the study area.

Keywords: Land use change, spatial model, environmental management

Contact Address: Ademola Braimoh, University of Bonn, Department of Ecology and Resource Management, Walter-Flex-Straße 3, 53113 Bonn Bonn, Germany, e-mail: abraimoh@uni-bonn.de