

Dynamics of Usangu plains wetlands: Use of remote sensing and GIS as management decision tools

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Abstract

Wetlands are resources of paramount importance with many values and functions that need proper management for their continued functioning and the delivery of benefits to the community. Sustained functioning of wetlands requires proper use of land and management of water. It is commonly said that increased human activities have had negative impacts on the Usangu Plains wetlands and that these wetlands are on the verge of total collapse due to altered flows. Nevertheless, these beliefs are little supported by quantitative data. A study on the dynamics of Usangu Plains wetlands therefore investigated long-term and seasonal changes that have occurred as a result of human and developmental activities in the study area for the periods between 1973 and 1984, and between 1984 and 2000. Landsat-MSS and Landsat-TM images were used to locate and quantify the changes. The study revealed a 14% increase in area covered by vegetated swamp between 1973 and 1984, and a decline by 77% and 70% in area covered by closed and open woodlands respectively. Between 1984 and 2000, the vegetated swamp cover declined by 67%, while the closed woodland and open woodlands declined by 83% and 77% respectively. It has also been revealed that the differences in spatial resolution could impair the detection of change. The continued decline in wetland covers has the potential to cause irreversible changes in these wetlands. Remote sensing and GIS technologies have proved to be useful tools for assisting decision-makers to locate and quantify changes in land resources, and hence to identify appropriate solutions for sustainable management of wetlands.

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1. Introduction

Wetlands comprise about three to six percent of the earth's land surface area, but they provide a host of goods and services, including water quality maintenance, agricultural production, fisheries, and recreation (Acreman and Hollis, 1996). Other services include floodwater retention, provision of wildlife habitat, and control of soil erosion

(Sugumaran et al., 2004). Despite these proven advantages, conversion of wetlands to other land uses has been problematic. Due to the notion that wetlands are wastelands with no uses, wetlands have been destroyed by being drained, irrigated, and polluted. Wetlands are some of the most threatened habitats in the world (Papazoglou, 2000).

The pace, magnitude and spatial reach of human alterations of the land surface are unprecedented (Lambin and Geist, 2001). To understand recent changes and to generate scenarios predicting future modifications of the earth system, the scientific community needs quantitative, spatially explicit data on how land cover has been changed by human use over the years, and how it will be changed in

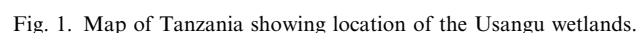
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With rapid changes in land cover occurring over large areas, remote sensing has become an essential tool for monitoring such changes. Traditionally, wetlands are delineated using ground surveys, although such surveys are difficult and time-consuming (Yasouka et al., 1995; Lyon, 1993). The remoteness and inaccessible nature of some of the wetlands limits the feasibility of ground-based inventory and monitoring. The type, aerial extent, land cover types, and use of wetlands can be determined through remote sensing and thus enable derivation of cost-effective solution for wetland management (Goldberg, 1998; Lyon and McCarthy, 1995).

the dynamics of wetlands on the Usungu Plains, and the links between factors causing change, by utilizing remote sensing and GIS. Using images from 1973, 1984 and 2000, this paper examines changes in land-use and cover in the Usungu Plains wetlands as a result of human activities.

The Usangu Plains are located in the south-western part of Tanzania (Fig. 1). They lie between longitudes of 33°E and 35°E, and latitudes of 8°S and 9°30'S, covering an area of approximately 15,560 km². The plains lie at an average elevation of 1100 m above mean sea level (amsl), while the surrounding hills are 3000 m amsl. The Usangu wetlands are located at the center of the Usangu Plains. They comprise the western and eastern wetlands—joined by a narrow band of land along the Great Ruaha River at Nyaluhanga. There are also some intermediate swamps



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