Research Application Summary

Effect of land use and cover change on carbon stock and water quality of River Atari in Kapchorwa-Uganda

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Abstract

The objective of this study was to examine the trend in land-use/cover change around Atari micro-catchment and determine the effect of these changes on carbon stock and Atari river water quality. An Earth Resources Data Analysis System (ERDAS) Imagine image processor was used for the digital analysis of Landsat image series (1973, 1996 and 2005) for deriving the land use/cover characteristics of the catchment. Preliminary results showed that subsistence farming has increased over time while grassland and forest have declined. Total suspended solids and total N in total organic carbon followed the same trend.

Key words: ERDAS, farming, forest, water quality

Résumé

L'objectif de cette étude était d'examiner la tendance dans le changement d'utilisation de terre /couverture végétale autour du micro-basin d'Atari et de déterminer l'effet de ces changements sur le stock de carbone et la qualité d'eau de la rivière Atari. Un système d'analyse des données de ressources terrestres (ERDAS) a été employé pour l'analyse numérique de la série d'images de Landsat (1973, 1996 et 2005) pour conclure sur les caractéristiques d'utilisation de terre/couverture végétale du micro-basin. Les résultats préliminaires ont prouvé que l'agriculture de subsistance a augmenté au cours du temps tandis que les espaces de prairie et de forêt ont diminué. Les solides totaux suspendus et l'azote total dans le carbone organique total ont suivi la même tendance.

Mots clés: ERDAS, élevage, forêt, qualité de l'eau

Background

Land and water quality degradation by erosion is still widespread and reported to be increasing globally causing *inter-alia* declining crop yield and increasing water rehabilitation costs (Sanders, 1992; Magunda and Tenywa, 2001). Studies have shown that water quality is also linked to land use and cover in a catchment (Ahearn *et al*., 2005). These studies have focused on their relationships with water quality variables such as dissolved salts, suspended solids, and nutrients (Allan *et al*., 1997; Johnson *et al*., 1997; Smart *et al*., 1998; Sliva and Williams, 2001; Turner and Rabalais, 2003; Ahearn *et al*., 2005).

In Uganda, Lake Kyoga is one of the important lakes vital to the livelihoods of people and is a major regional fishery. A recent study on livelihoods around the lake (conducted at 26 landing sites within 4 districts) found that 80% of households dependent on its fisheries (ILM, 2004). Reports from Atari, one of the micro-catchments of Lake Kyoga, show that the river and its tributaries are already showing signs of water pollution. For the last two decades, as more land got converted into agriculture, an increase in sediment levels became evident (http://www.undp.or.ug/projects/16). This increase in sediment level is threatening the biodiversity and stability of the Lake Kyoga ecosystem and thus the livelihood of many communities around the Lake.

Study Description

River Atari is located in Kaptanya sub-county Kapchorwa district in the eastern part of Uganda. It flows from Mt Elgon and is located approximately 1.5km from Kapchorwa Town. Geographically it is located between Latitude 1° 7´ N and 1° 36´ N, and Longitude 34° 18´ E and 34° 48´ E. The main soils in the area are nitisols, vertisols, luvisols, gleysols and acric-ferralsols. The dominant land use around the micro-catchment is small scale farming. This area has experienced large-scale land clearing for cultivation with most of the cleared land being converted into agricultural land and pastureland. One of the activities carried around the catchment is maize growing which exposes the soil erosion especially when grown on steep slopes. Land use changes in the micro-catchment and sediment and nutrient loading into the river were assorted.

Results

Preliminary results show that agricultural land-use has increased exponentially (R^2=0.91) with time at the expense of grassland (R^2=0.86) and forest (R^2=0.73) which have gradually declined at a rate of 0.32% and 0.53% every year; respectively (see Fig. 1 and Table 1).

Figure 2 shows sediment load and river flow. The peak sediment load coincides with the start of the rainy season when ground cover of cropped fields is minimum. The peak total Nitrogen (TN) load coincides with the peak of flow when the contribution of sub-surface flow is maximum. As expected, total phosphorus

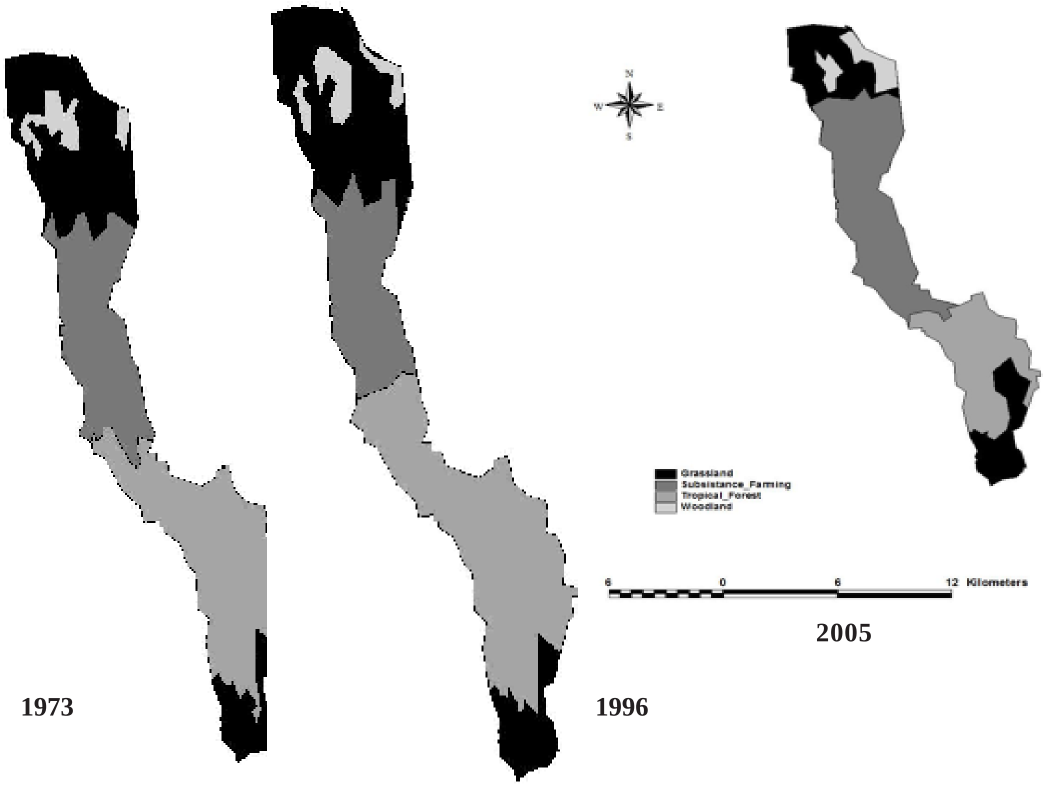

Figure 1. Land use/cover change in Atari micro-catchment.

Table 1. Change in land-use/cover in Atari micro-catchment.

Land use/cover	1973	1996	2005
Grassland	36.6	32.2	25.2
Subsistence farming	11.7	20.9	42.6
Forest	46.2	41.6	26.5
Woodland	5.5	5.2	5.7

(TP) followed the trend of total suspended solids (TSS). The peaks of TOC followed the trends of TN and TP.

Assessments were carried out by analysing Landsat images (1973, 1996 and 2005) using an Earth Resources Data Analysis System (ERDAS).

Research Application

This information can be used design appropriate Integrated Watershed Management (IWM) strategies to enhance the stability and resilience of the micro-catchment in particular and the Lake Kyoga catchment in general.

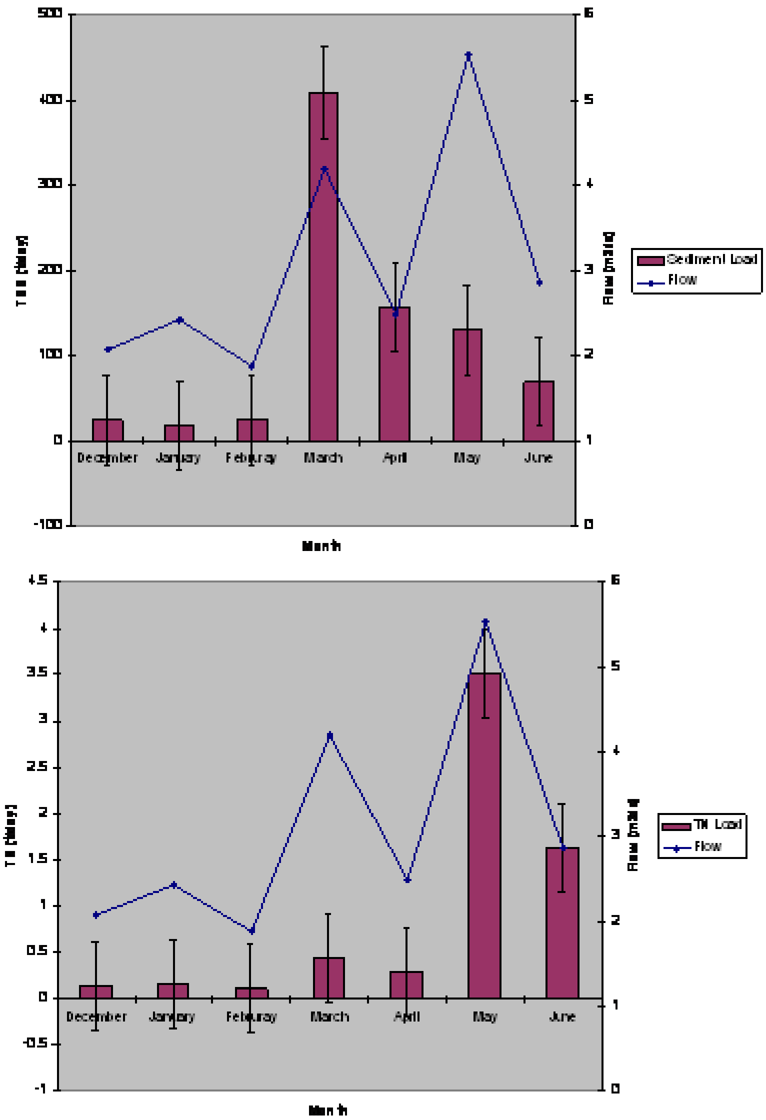

Figure 2. Sediment and nitrogen loading into River Atari.

Recommendation

- There is need to identify best IWM strategies to enhance the stability and resilience of the micro-catchment
- There is need to identify the best soil and water management practices around the catchment to avoid further environmental degradation.

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