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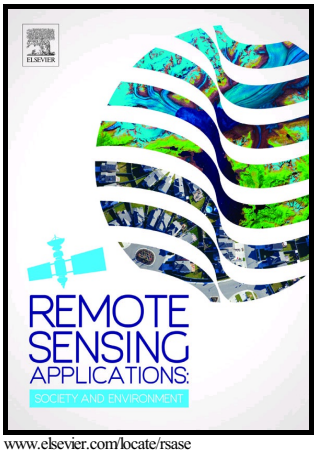

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Land use and Land cover (LULC) changes in semi-arid sub-watersheds of Laikipia and Athi River basins, Kenya, as influenced by expanding intensive commercial horticulture

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Abstract
Agriculturally productive watersheds in Kenya are experiencing important land transformations with consequences on environmental resources. Previous work identified spatial pockets of vegetation decline across sub-watersheds with intensive farming. While this is crucial information in delineating impacted regions, it is important to understand the type of occurring changes, spatial patterns and the rate of change. The study focused in the Athi River and Laikipia regions which have intensified commercial horticulture, yet marginalized semi-arid to arid environments. The study quantified land use and land cover changes between 1984 and 2009/2010, identifying areas of change and the average annual rate of change. Landsat (5 TM, MSS and 7 ETM+) multitemporal data were used in classification and change detection analysis. From the results, both regions experienced intense land transformation at varying magnitudes during the 25 years period. Woody grasslands covered vast areas. In Laikipia, the averaged percentage annual rate of land change to settlements/urban use was highest (20.2%). There was a decline in barren area, forest and wooded grasslands (–1.4 %, -0.7% and -0.3% respectively). In the Athi River region, the averaged percentage annual rate of changes was in the order of agriculture, water, settlement, bare soils, woody grasslands (37.7%, 17.2%, 8.4%, 3.9, 2.9% respectively) while dark bare soils, and forest cover declined (-3.4% and -3.3% respectively). Observed LULC transformations were largely attributed to socio-economic drivers including increased human migration into agriculturally productive sub-watersheds fueling growth of settlement, increased irrigation farming and therefore increased area under water, and growth of cities and industrial areas.

Keywords: Land transformation, deforestation, horticulture, population

1. Introduction

Land use and land cover (LULC) transformation is an important research item due to the increasing impacts on ecosystems and link to global, regional and local climate change and variability (Bajocco et al., 2012; Liu et al., 2014; Mahmood et al., 2006; Turner II et al., 2007; West et al., Foley, 2010). The common drivers of LULC include agricultural encroachment, deforestation, road construction, dams and irrigation, wetland modification, mining, expansion of urban environments (Liu et al., 2014), and coastal zone degradation (Patz, 2008). At the watershed scale, land cover changes pose risks of water pollution due to loss of vegetative cover, which acts as a barrier to the movement of materials into water systems, reducing runoff (Notter et al., 2007; Schneider and Pontius Jr, 2001). This significantly increases possible impacts on terrestrial and aquatic systems, and social-economics of communities (Adger et al., 2005).

In Kenya, the proliferation of intensive commercial horticulture in Kenya in the recent past has influenced LULC changes in central districts that are agriculturally productive (Becht et al., 2005; Francis, 2014). The uneven clustering of large scale farms, over-extraction of surface water for irrigation, clearing of marginal lands and continuous tilling to increase year round production of fresh produce are some activities impacting the use and management of environmental resources (Aeschbacher et al., 2005; Owiti and Oswe, 2007). The horticulture sector is labor intensive, attracting population into sub-watersheds, leading to high population density and growth of unplanned settlement (Muriuki et al., 2011). Unrestrained growth within sub-watersheds exerts pressure on