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Complex contexts and dynamic drivers: Understanding four decades of forest loss and recovery in an East African protected area

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ABSTRACT

Protected forests are sometimes encroached by surrounding communities. But patterns of cover change can vary even within one given setting – understanding these complexities can offer insights into the effective maintenance of forest cover. Using satellite image analyses together with historical information, population census data and interviews with local informants, we analysed the drivers of forest cover change in three periods between 1973 and 2009 on Mt Elgon, Uganda. More than 25% of the forest cover of the Mt Elgon Forest Reserve/National Park was lost in 35 years. In periods when law enforcement was weaker, forest clearing was greatest in areas combining a dense population and people who had become relatively wealthy from coffee production. Once stronger law enforcement was re-established forest recovered in most places. Collaborative management agreements between communities and the park authorities were associated with better forest recovery, but deforestation continued in other areas with persistent conflicts about park boundaries. These conflicts were associated with profitability of annual crops and political interference. The interplay of factors originating at larger scales (government policy, market demand, political agendas and community engagement) resulted in a "back-and-forth" of clearing and regrowth. Our study reveals that the *context* (e.g. law enforcement, collaborative management, political interference) under which *drivers* such as population, wealth, market access and commodity prices operate, rather than the drivers *per se*, determines impacts on forest cover. Conservation and development interventions need to recognize and address local factors within the context and conditionalities generated by larger scale external influences.

1. Introduction

Even though protected areas in the tropics have generally reduced deforestation within their boundaries (Bruner et al., 2001; Naughton-Treves et al., 2005), forest loss still continues in many (DeFries et al., 2005; Nagendra, 2008). This deforestation threatens the provision of forest-derived services and products. These services and products range from climate regulation and biodiversity conservation, to water-catchment protection, to providing local populations with food and timber (Millennium Ecosystem Assessment, 2005). Protected forests in East Africa, for example, often serve as important water catchments supporting high densities of people. They also attract substantial tourism and host rich biodiversity. One of these forests, on Mt Elgon (Kenya, Uganda), provides water for more than 2 million people in the surrounding districts (Fig. 1) and has a rich and remarkable history of both forest loss and forest recovery (KWS et al., 2001; van Heist, 1994).

Across the tropics the underlying drivers and proximate causes of deforestation have been the subject of numerous studies (Geist and Lambin, 2002). Population pressure and rural poverty, leading to agricultural expansion, dominate the global discussion on the causes of forest loss in the tropics (e.g. Allen and Barnes, 1985; Lung and Schaab, 2010; Uusivuori et al., 2002). By contrast, reviews show that these factors are seldom the principal determinants of when and where forest cover is lost (e.g. Angelsen and Kaimowitz, 1999; Rudel and Roper, 1996). Multiple political, institutional, economic and social forces operating at the local, national and global level interact to determine the patterns of tropical deforestation (Angelsen and Kaimowitz, 1999; Carr et al., 2005; Geist and Lambin, 2002; Lambin et al., 2001). The significance of different management arrangements, including the degree of community involvement, remains debated (Hayes, 2006; Southworth et al.,

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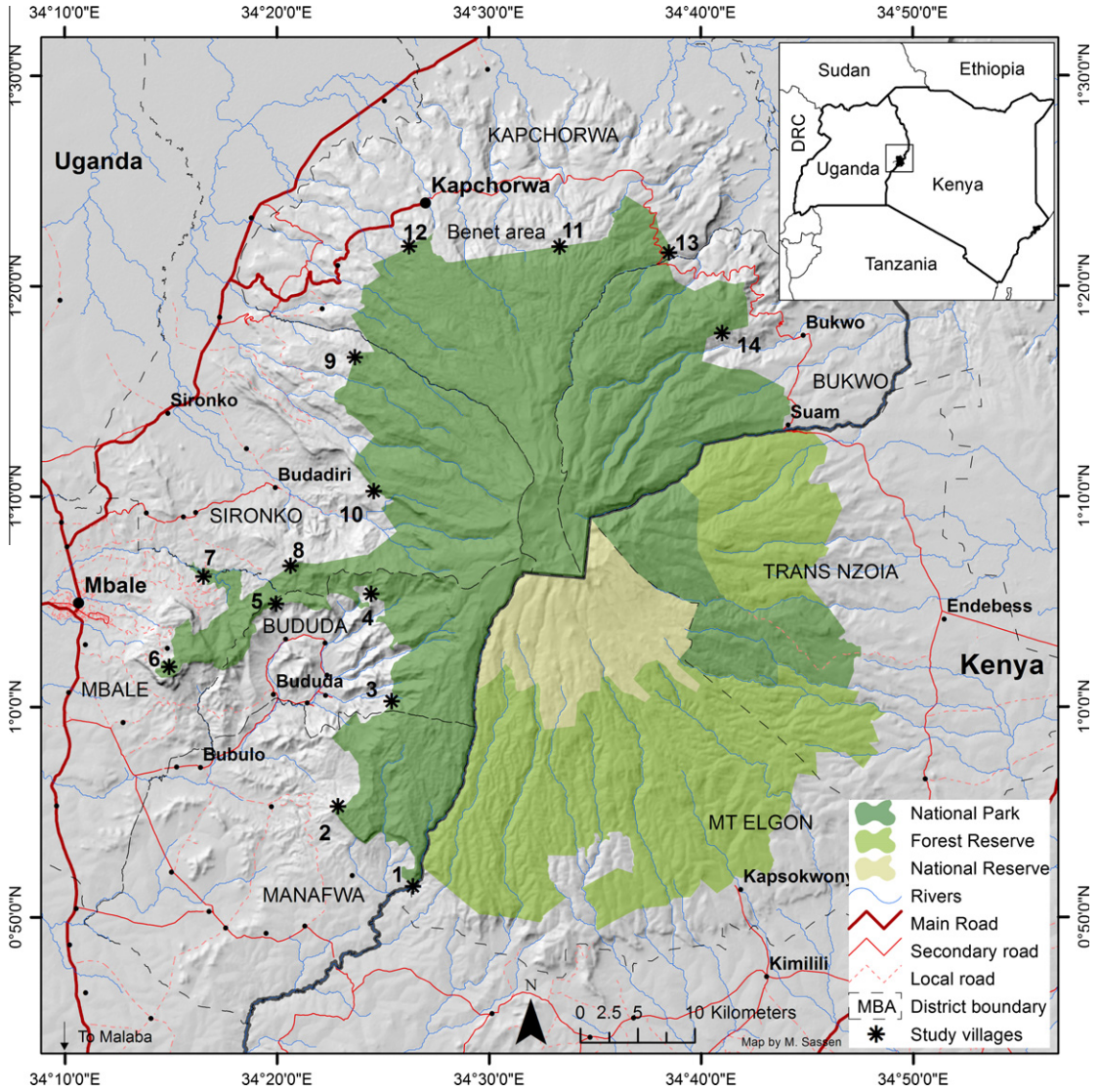

Fig. 1. Map of Mt Elgon, Uganda and Kenya, with the location of the 14 study villages.

2006). Deforestation by small scale farmers reflects marginal choices about whether and where to clear (Sheil and Wunder, 2002). Such choices depend on the availability of the resources needed for agricultural production, infrastructure, markets, perceived costs and benefits and alternative options outside agriculture (Angelsen et al., 1999; Kaimowitz and Angelsen, 1998; Maeda et al., 2010). These factors are often time and location specific, but local studies using longitudinal data and linking people and place can clarify their role (see e.g. Fox et al., 2003).

We assess how changing contexts in combination with more local drivers can influence forest cover within one protected area (see also Gaveau et al., 2009; Nagendra et al., 2010). We examine cover in Mt Elgon National Park, Uganda between 1973 and 2009. Previous studies emphasized the deforestation during the civil unrest of the 1970s and 1980s (Otte, 1991; van Heist, 1994). Some forest recovered subsequently though clearance has remained a local concern (UWA, 2000). We use a combination of data and methods to investigate the diversity of factors that affected forest clearance and recovery within a single national park (as in Ostrom and Nagendra, 2006). We examine three periods broadly corresponding to weak enforcement, strong enforcement and community engagement periods, and investigated the effects of changing political, economic and social factors.

2. Study area

2.1. Mt Elgon

Mt Elgon is an extinct 4321 m high Miocene volcano, shared between Kenya and Uganda. Its slopes are generally gentle (averaging less than 4°), with characteristic natural terraces cut by sheer cliffs in the north, and steep slopes in the south and south-west. A parasitic vent formed the 20 km long ridge that extends towards the west. The protected area covers approximately 1120 km^2 in Uganda and 1400 km^2 in Kenya (Fig. 1). Dry north-easterly and moist south-westerly winds determine the climate. July–August and December–February are relatively dry, although rain falls in all months (Fig. 2). Annual precipitation in the protected area is between 1500 and 2000 mm. More rain falls on the western and south-western slopes and most falls mid-slope at between 2000 and 3000 m altitude (m.a.s.l.) (Dale, 1940; IUCN, 2005). The mountain is an important water catchment area for the Turkwell and Lake Turkana systems, the Lake Victoria Basin, Lake Kyoga and the Nile Basin (IUCN, 2005). The vegetation is composed of an afromontane forest belt (*Podocarpus* spp., *Cornus volkensii*, *Schefflera* spp., *Hagenia abyssinica*, *Olea* spp., *Prunus africana*) with large areas of bamboo (*Arundinaria alpina*) on average between 2000 and