



Forest cover loss and recovery in an East African remnant forest area: Understanding its context and drivers for conservation and sustainable ecosystem service provision



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ABSTRACT

Understanding of the often complex forest cover change drivers, and the perceived and observed forest cover changes substantially contributes to the sustainable management of tropical forests. This paper aims at developing an integrated view on tropical forest cover change and its drivers by combining the perception of the stakeholders (farmers, forest guards, and forest managers) and five decades forest cover mapping, based on interview and remote sensing respectively, through a case study in the central highlands of Ethiopia. Afforestation and deforestation occurred when law enforcement was stronger and weaker respectively, depending on political regimes. Since 1937 i.e., the early Imperial period, the position of the forest edge has not changed much over time, it rather became sharper. In the late Imperial era (1972–1975), the forest cover declined only by 1.6%. In the subsequent two governments, the socialist and the current federal rule (1975–2014), the forest cover increased by 17%. There was a 3.9% forest cover decline during the transition between the two governments. This pattern of overall net forest cover increase observed by remote sensing data has been correctly perceived by stakeholders. Stakeholders acknowledged the observed forest cover increase, however, they argued that the forest is declining in terms of its quality for several ecosystem services (ES). The ES decline is believed to have resulted from the gradual shift of pure dense indigenous forest to an increasing share of exotic plantations. In the three political regimes, land policy, illegal encroachments, population pressure and social unrest have been the leading drivers of forest cover change. Communities' involvement in forest management activities and sharing benefits were regarded as positive perception of forest management strategies during the federal administration (1993–2007) of the current government by farmers. Among the factors that determine forest management strategies proposed by stakeholders are gender, landholding size, education level and age. Future conservation and development interventions need to consider stakeholders' concerns. Their involvement in forest management is also necessary for improved biodiversity conservation, ecosystem service provision, and social wellbeing.

1. Introduction

Tropical forests contain at least two-thirds of the Earth's terrestrial biodiversity (Gardner et al., 2009), they also store about 40% of global terrestrial carbon (Beer, 2010), maintain indigenous cultures, and support the livelihoods of millions (Lowman, Burgess, & Burgess, 2006,

p. 291). Increased rates of deforestation as well as forest degradation in and around these forests, however, are constantly eroding the biodiversity and thereby threatening the functioning of ecosystem services that are essential for human wellbeing. Finding a sustainable and balanced way between the tropical forest ecosystems and human activities is, therefore, a high priority on the agenda of environmental policy

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makers (Balmford, Beresford, Green, Naidoo, & Walpole, 2009). In this context, the installation of protected forest areas has played a crucial role in slowing down deforestation. Nevertheless, even within the protected East African forest reserves, the total forest cover area has been decreasing over the past decades (Green et al., 2013; Sassen, Sheil, Giller, & ter Braak, 2013) as a result of increasing demand for new land resources. This results in several recent estimates of local and national forest cover changes (Getahun, Van Rompaey, Van Turnhout, & Poesen, 2013) that seem to reveal that tropical deforestation rate remains unchanged regardless of several forest management interventions (Acharid et al., 2002; Beer, 2010).

National forest policies are widely mentioned as a driver of forest cover change that plays a central role in both forest cover increase and decline in many tropical countries (Eliasch, 2008), but its exact role and impact on local forest governance remain debated (Southworth, Nagendra, & Munroe, 2006). For instance, forest policy implementations often aim at increasing forest biomass stocks, without distinguishing between natural and planted forests or reforests (Chazdon et al., 2016). Moreover, the need of stakeholders is not taken into consideration, while they are highly dependent on forests (Duguma, Hager, & Gruber, 2009). In this sense, forest quality in terms of its long term biodiversity conservation and related ES maintenance may become critical even though the forest standing stock is still adequate. In this respect, analyzing the roles of national forest policies in local forest governance could reveal important insights. Distinct forest policies have been implemented in the last five decades in Ethiopia by three different political regimes. During the Emperors' time, i.e. before 1974, land property rights were complex because land ownership could belong to private owners, communities the state, or the church (Young, 2006, p. 290). During the socialist military regime (1975–1989), all land use rights were awarded to peasants until the subsequent land reform of 1975, which nationalized all landholdings under the direct possession of the state (Stellmacher, 2007). Despite the differences in approach (the former used 'divine right' to legitimize its system of rule and the latter was guided by Marxist-Leninist ideology) both regimes governed through highly centralized power structure (Young, 1997). In 1995, the current rule i.e. "Ethiopian People's Revolutionary Democratic Front" (EPRDF) adopted a more decentralized federal policy (Young, 1997) and proclaimed agricultural intensification. The forest sector is believed to supplement the agricultural production for accelerated economic growth (Stellmacher, 2013). These land policy transitions have had significant implication for the development of forest policy, but not many studies looked into the effects of these policies and policy changes on forest cover and forest cover change. Therefore, more studies are needed to better understand the influence of national forest policies on local forest governance and forest cover change dynamics in East African countries.

In order to contribute to a better understanding of forest cover change and the role of policies on forest management systems, a study area, Menagesha Suba forest at 45 km west of Addis Ababa, Ethiopia was selected as a case study (Fig. 1). This study area was selected because: (1) this forest is one of the oldest conservation areas in Eastern Africa, (2) the area was subject to different forest management intervention policies during the last five decades that resulted in forest increase, degradation (reduction in quantity and/or quality of the forest's structure and function) and deforestation (the conversion of either indigenous or exotic forest into other land use such as pasture and croplands), and (3) the study area is under pressure of an increasing population and the expanding capital city.

The study addressed the following specific objectives:

- 1) To map forest cover change over the last five decades and to compare it with stakeholder perceptions on the change and its drivers. We relied on remote sensing data (high resolution satellite and aerial imagery) from the period 1972–2014 to quantify the observed forest cover change. We used questionnaires to capture stakeholders'

(farmers, forest guards and forest managers) perceptions of indigenous forest (land predominantly covered by a relatively continuous cover of native tree species) cover change into other land use types such as exotic plantation (land covered by continuous cover of non-native tree species), pasture land, or farmland within the Menagesha Suba protected area, as well as its drivers. Stakeholders' perception on forest cover change are believed to complement the result of the observed forest cover change.

- 2) To understand the perception of farmers on forest management strategies implemented during three subsequent political regimes in the study area. Furthermore, to investigate forest management options proposed by farmers and social factors affecting the proposed management options. Age, gender, landholding size, household size, and education are considered to determine the proposed management strategies.

2. Materials and methods

2.1. Study area

The study area extends between 8° 53' - 9° 03' N and 38° 28' - 38° 40' E in the central highland of Ethiopia lying in an altitudinal range between 2200 and 3320 m a.s.l. (Fig. 1). Menagesha Suba forested land covers 35 km² within its former legal boundary (96 km²) delineated in 1984. It is characterized by cereal dominated farmland with sparsely scattered woodlands. Menagesha Suba forest is the oldest preserved park in Africa, protected since the 16th century (MoA, 2002). Breitenbach and Koukol (1962) observed trees as old as 360 years. The forest is composed of two forest blocks: Menagesha (380 ha), a smaller block in the northeast, and Suba (3120 ha), a larger block in the southwest. Suba lies on the western slopes of the large extinct Wochecha volcano while Menagesha occupies a smaller volcanic cone. The Menagesha Suba forest is classified as upland dry evergreen forest (Friis, 1992). The vegetation distribution follows altitudinal variation ranging from high forest on the lower altitudes to afro-alpine vegetation at higher altitudes. The Juniperus-Olea forest belt with presence of Afrocarpus reaches 3000 m a.s.l. The plantation part of the forest consists of Eucalypt, Pine, and Cypress trees. The area enjoys the presence of various larger mammal species such as Menelik bush-buck, colobus monkey, baboon, duiker, leopard, and serval (MoA, 2002).

The forest is surrounded by small towns and the rapidly expanding city Addis Ababa, where a considerable number of the population depends on biomass for fuelwood energy. This has led to lucrative markets, in most cases for illegally harvested wood from the forest (Bekele, 2003). In the 1991 count, there were 4216 households with a total population of over 23,500 in the seven peasant associations. Out of these, about 1426 households with a population of over 8000 resided within the demarcated area of the forest (MoA, 2002). There have been long-term social-ecological interactions between the forest and the local communities, which in the last three decades have been characterized by conflicts and illegal encroachments (Duguma et al., 2009). The communities in the area are agrarian and practice subsistence agriculture as well as small-scale woodlot and shrub planting (Duguma & Hager, 2010). Agricultural land productivity is low and the only source of forest products in the area is Menagesha Suba forest. Therefore, the communities are highly dependent on the forest for forest ecosystem services. For example, a study conducted by MoA (2002) shows that about 31% of the households that are located inside the forest boundary strongly rely on the forest for fuel wood, charcoal, and timber.

2.2. Mapping forest cover changes

Remote sensing imagery, aerial photographs, and field observations were the main data sources used for this research. Semi-structured interviews were used to complement the findings. To make an appropriate temporal selection of the imagery, major political, policy, and

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