

Land-use and land-cover changes in the Central Rift Valley of Ethiopia: Assessment of perception and adaptation of stakeholders



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ABSTRACT

Understanding the perception of land-use and land-cover (LULC) change and the adaptation strategies of different stakeholders is very important for the development and implementation of appropriate LULC policies. This study explores the perception and the adaptation strategies followed in response to undesired LULC changes in two districts of the Central Rift Valley of Ethiopia, Adami Tulu Jido Kombolcha and Arsi Negele by comparing perceived LULC changes with observed LULC changes according to the interpretation of remote sensing data. Between 1973 and 2014, cropland expanded at the expense of all other land-cover types. The area covered with forest, woodlands, grasslands and water have declined from 10.0%, 33.0%, 30.0% and 16.0% to 4.4%, 18.3%, 17.2% and 13.4% of the total study area, respectively, while the area cover for cropland increased from 11.0% to 46.7%. Population growth, drought, social unrest, government change, and land tenure policy were perceived as the major drivers underlying these changes. Drought, decline in productivity, loss of wildlife and birds, and land degradation are the most widely perceived impacts of these LULC changes. Older farmers and farmers with a higher education have taken more measures to adapt to LULC changes. Stakeholders have a comprehensive understanding of the LULC change in the study area but very low adaptive capacity due to lack of financial resources, lack of information on best practices and lack of technical knowledge.

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1. Introduction

The population in Ethiopia increases by approximately 2.2 million people per year, and is predicted to be more than doubled by the year 2050 (United Nations Population Division, 2009). This population growth causes an increased pressure on land resources, mainly resulting from a demand for agricultural products (Kebede, Haile, & Dadi, 2012; Meshesha, Tsunekawa, & Tsubo, 2012a, and Molla, 2014). Moreover, large families lead to land fragmentation upon succession, and thus a reduced acreage per family. As a consequence, Ethiopia is experiencing widespread conversion of natural vegetation into cropland, in the absence of agricultural intensification (Kindu, Schneider, Teketay, & Knoke, 2013). These land-use and land-cover (LULC) changes, in combination with unsustainable land management, seriously affects Ethiopia's rich biodiversity, crop productivity and livestock grazing lands (Hamza & Iyela, 2012), and thus economic productivity.

A number of studies have assessed LULC changes in Ethiopia, indicating that cropland has expanded considerably at the expense of other LULC types. Cropland expansion has been reported not only in the Central Rift Valley (Garedew, Sandewall, Söderberg, & Campbell, 2009; Meshesha et al., 2012a), but also in many other regions in Ethiopia (Alemu, Garedew, Eshetu, & Kassa, 2015; Assefa & Bork, 2014; Assen, 2011; Dessie & Kleman, 2007; and Tefera, 2011). Cropland expansion to compensate for the decline in crop productivity and to satisfy the demand for croplands from new households has mostly come at the cost of forests, woodlands, grasslands and water (Garedew, Sandewall, Söderberg, & Campbell, 2012; Kindu et al. 2013; Meshesha et al., 2012a; Mengistu, Waktola, & Woldetsadiq, 2012 and Molla, 2014). This research has also revealed that the observed cropland expansion caused land degradation (Assen, 2011; Meshesha et al., 2012a; Molla, 2014), reduced farm output and reduced productivity (Hamza & Iyela, 2012; Meshesha et al., 2012a; Molla, 2014), lack of fodder and scarcity of wood (Garedew et al., 2009), and a loss of wildlife (Hamza & Iyela, 2012; Molla, 2014). In addition, LULC changes were related to changes in the local climate, including increased droughts, and changes in rainfall patterns, causing floods and reducing the sizes

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of lakes (Garedew et al., 2012; Hamza & Iyela, 2012; Meshesha et al., 2012a; Molla, 2014; Tsegaye, Moe, Vedeld, & Aynekulu, 2010).

Most studies in the Central Rift Valley, and elsewhere in Ethiopia, focused on LULC changes, their drivers and their societal and biophysical impacts. However, in order to design and implement measures to mitigate LULC changes or adapt to their negative impacts, it is important to understand how stakeholders perceive them (Meyfroidt, 2012). After all, stakeholders base their decisions on their perception of the drivers and impacts of LULC change. Currently, there is very little information about these perceptions. In addition, farmers were the only sources of information in available studies on LULC dynamics (Adimassu, Kessler, & Hengsdijk, 2012; Garedew et al., 2009; Mengistu et al., 2012; Meshesha et al., 2012a and Molla, 2014), while other stakeholders, such as institutions and businesses have not been considered. This study explores the stakeholders' awareness of LULC change in the Central Rift Valley, by comparing their perception with observed LULC changes. We first assessed LULC change that took place in three periods between 1973 and 2014, based on remote sensing imagery. Subsequently, we used questionnaires to investigate the stakeholder perception of LULC changes, their drivers and their impacts. Finally, we compared both results to analyze to what extent the stakeholder perceptions correspond to the observed changes.

Furthermore, we explored the adaptation mechanisms that stakeholders have applied to cope with LULC changes and their associated impacts and we analyzed the factors affecting farmers' adaptation. Specifically, we evaluated the hypothesis that farmers with a higher education as well as older farmers are more likely to make adaptation measures, due to their increased access to information and their increased land management experience (Bryan, Deressa, Gbetibouo, & Ringler, 2009; Deressa, Hassan, Ringler, Alemu, & Yesuf, 2009; and Obayelu, Adepoju, & Idewu, 2014). We also hypothesized that farmers that own their land make more adaptation measures than farmers who rent land, because ownership is a long term investment which requires responsible land management (Bryan et al., 2009). We expected no relation between family size and making adaptation measures, as previous results have showed mixed findings (Deressa et al., 2009; Yirga, 2007), and we have no reason to assume either is correct

a priori. Finally, we also expected that adaptation is not affected by marital status, whether farmers are original from this region or others, and whether livelihood depends mainly on crop cultivation or livestock rearing, as we found no studies that suggest so, and we had no reasons to assume so either.

2. Materials and methods

2.1. Study area

The study area comprises two neighboring districts in the Central Rift Valley: Adami Tulu Jido Kombolcha and Arsi Negele (Fig. 1). The area extends from 7°8.736' to 8°4.701' N and 38°24.133' to 38°55.185' E, covering a total area of 271, 118 ha. The area encompasses two large connected lakes: Lake Abyata and Lake Langano. The elevation of the study area ranges from approximately 1572 m to over 2800 m above mean sea level. Annual rainfall ranges from about 650 mm near Lake Abyata in the valley up to 1250 mm in the higher elevations while average annual temperature varies from 19 °C in the valley to about 14 °C in the higher elevations (Hengsdijk, Driel, Haile, Argaw, & Jansen, 2010). The region is very vulnerable to climate change as it encompasses a dryland zone which has been hit hard in terms of drought (Legesse & Ayenew, 2006; Meshesha et al., 2012a and Meshesha, Tsunekawa, & Tsubo, 2012b). Crop production, primarily rain-fed, and livestock rearing are the major sources of livelihood, and cropland and grassland are the related dominant land cover types in the study area (Kindu et al., 2013).

2.2. Materials and methods

The main data sources for this research were semi-structures questionnaires (Fig. 2). These questionnaires were complemented with field observation, remote sensing imagery, black and white aerial photographs, topographic maps and secondary literature.

In 2014, a reconnaissance survey was conducted and the current LULC distribution in the study area was discussed with local Agricultural and Rural Development experts. Accordingly, the following classes were identified for the land-cover classification:

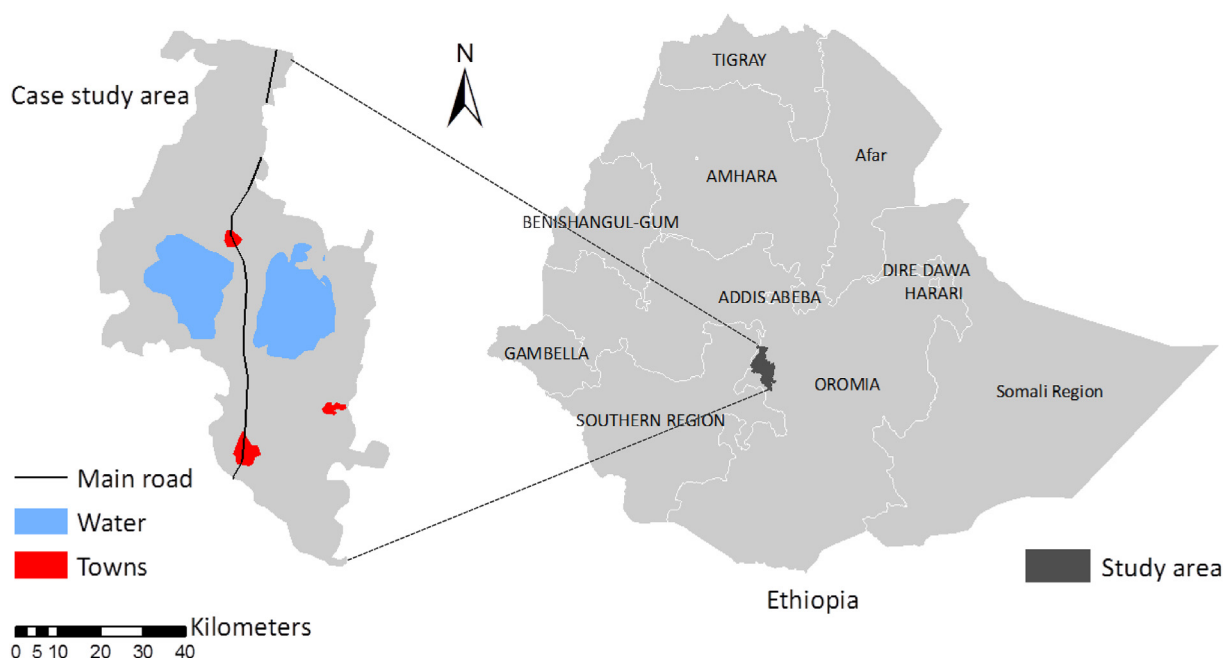


Fig. 1. Location of the case study area in Ethiopia.

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