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An economic valuation of ecosystem services based on perceptions of rural Ethiopian communities

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ABSTRACT

Ethiopia is facing severe land degradation resulting in a growing need to better understand ecosystem services (ES) and their importance for rural communities. We conducted focus group discussions in six rural communities in Ethiopia's Oromia region to gather data on land use and livelihood trends over a timespan of three decades. We assessed the perception of local communities regarding the relevance of ES and economically quantified the perceived ES values that community members derive from forests, grasslands and croplands.

Results show that between 2000 and 2013 the area under cropland increased by 12%, whereas forests and grasslands decreased by 8% and 7%, respectively. Between 1982 and 2013 the perceived loss of ES values summed up to 280 US$/ha/y for forests, 79 US$/ha/y for cropland, and 12 US$/ha/y for grasslands.

We assessed the total economic value (TEV) of each land-use type, with forests ranking the highest, followed by croplands and grasslands respectively. While community members value forests the highest with respect to intangible ES, forests also experienced the strongest decline in the perceived contribution to livelihood. High population growth rates are a strong indirect cause of deforestation driving the need for more farmland.

We conclude that efforts for trans-sectoral policy development have to be made to harmonise land use policies, leading to long term sustainability.

1. Introduction

Land degradation is a threat to sustainable development, especially in developing countries, which strongly depend on their natural resources (The Economics of land Degradation [ELD] Initiative & UNEP, 2015; Nkonya et al., 2016). Ethiopia is facing severe land degradation caused by both human activities and natural factors, leading to a reduction in the economic value of ecosystem services (Gebreselassie et al., 2016; Thomas et al., 2013). Soil erosion stands out as specifically problematic, with its subsequent impacts on agricultural productivity and food security (Tamene and Vlek, 2008). A recent study identified anthropogenic land degradation on 23% of Ethiopia's total land surface (Le et al., 2014), which has significant economic implications: Annual costs of degrading ecosystem services (ES) were calculated to be as high as 4.3 billion USD for Ethiopia (Gebreselassie et al., 2016).

The intensifying shortage of fertile land, combined with an escalating population growth, and a strong economic dependency on agriculture drives the application of harmful land use practices, such as overgrazing, over-fertilization, steep-slope farming, and agricultural expansion at the cost of natural vegetation.

Ethiopia has approximately 11.5 million ha of forests, covering about 10% of the countries areal surface (FAO, 2010). Forest loss in particularly has been a problem for the country since a long time and Ethiopia has been losing its forests at a rate of 1.25% since 2010 (FAO, 2015), with other sources stating even higher numbers: Moges et al. (2010) assume a deforestation rate of 2% annually (Moges et al., 2010), and Nkonya et al. (2016) calculated rates as high as 25.9% between 2001 and 2009 (Nkonya et al., 2013).

Multiple factors lead to these high deforestation rates: Ethiopia's economy is strongly reliant on agriculture, which contributes up to 49% of the GDP and forms the basis for products accounting to up 80% of the country's exports (World Bank,

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2012). Approximately 85% of the population is involved in agricultural activities, causing extensive farmland expansion (Gebremariam et al., 2010). As Ethiopia also ranks amongst the top 10 countries regarding population growth worldwide, deforestation is likely to continue and even increase (United Nations, 2015). At the same time, Ethiopia is also one of the poorest countries in the world (Oxford Poverty and Human Development Initiative, 2014), and the rural population highly depends on forest products. Sustainable land management is further undermined by intense cattle farming. With an estimated 49 million pieces of cattle, 25 million sheep, and 22 million goats, Ethiopia has the highest numbers in livestock amongst all African countries (Gebremariam et al., 2010). Even though the government promotes a reduction of livestock numbers, past and present overgrazing has had considerable negative impacts on forested lands.

When forests are lost, numerous ES are lost as well, including provisioning, regulating and supporting ES, all of which are fundamental to human well-being. Examples include erosion control, climate regulation, provision of water (Bongers and Tennigkeit, 2010; Sunderland and Pottinger, 2011; TEEB, 2014). Recent efforts to support a sustainable and green economy underscore the growing need for a better understanding of ES and how communities perceive them. However, knowledge around the matter is very limited, specifically for developing countries (Zhang et al., 2015).

The study at hand contributes to narrowing the knowledge gap in the area of ES valuation in a developing country by economically quantifying the costs associated with land degradation. We understand 'land degradation' according to the ELD Initiative, which defines it as "*reduction in the economic value of ecosystem services and goods derived from land as a result of anthropogenic activities or natural biophysical evolution*" (ELD Initiative, 2013). Land degradation is a human concept, which as such has to be evaluated from the perspective of local people and the values they assign to their land. Hence, this paper presents an economic valuation of ES based on perceptions of rural Ethiopian communities, using participatory approaches. According to the ELD definition, declining economic benefits, which people obtain from their land over time, are considered to be the 'costs of land degradation'.

2. Material and methods

2.1. Study site and community selection

The study focuses on Oromia, the largest region of Ethiopia in East Africa (Fig. 1). In order to analyse the various contexts in which land degradation may occur, we were aiming for participating communities to have different main vegetation cover types (e.g. forest, cropland). To determine these characteristics we used a map by Le et al. (2014). The map was developed based on the long-term trend of Normalized Difference Vegetation Index (NDVI) over the period 1982–2006 using remotely sensed images. NDVI essentially measures the 'greenness' of the earth's surface, indicating biomass production. Through comparing NDVI values over time, it is possible to identify significant biomass production changes on the ground. Le et al. (2014) employed the GIMMS (Global Inventory Modeling and Mapping Studies) NDVI data archive, which was the only dataset for a global land degradation assessment available at the time and therefore provided the best basis for community selection, despite a number of shortcomings the method still has. These for example include problems with the interpretation of the effect of soil moisture in sparsely vegetated areas. However, Le et al. (2014) were able to correct biases caused by rainfall variability, atmospheric fertilization and chemical fertilizer in order to show human-induced biomass production decline or improvement.

Fig. 2 displays land degradation hotspots and land cover types, as well as areas with positive or no significant NDVI change for the Oromia region.

Accessibility was the second factor relevant for the identification of suitable partner communities. We assessed accessibility using based on availability of infrastructural elements such as roads, as well as potential threats in the area leading to safety concerns with respect to site visits. Additionally, conducting fieldwork in Ethiopia is not possible without the official endorsement and support from regional and local governments. Accordingly, the opinion of local partners was taken into account for the final selection of our 6 partnering communities displayed in. All field work was carried out in 2014.

2.2. Focus group discussions

We conducted Focus Group Discussions (FGDs) in a total of six communities. The FGD format allows an interactive participation of community members (interviewees), supporting each other in understanding questions and concepts, while providing researchers with valuable insights into opinions and perceptions. Participants were asked to come to consensus regarding all questions, best representing their community as a whole, as opposed to providing individual information. This allowed researchers to derive resilient estimates for each community (e.g. regarding crop production, land use etc.).

The researchers conducting the FGDs consisted of a group of international experts and a local expert from the Natural Resource Management Department of the Oromia Regional Agricultural Bureau. The latter acted as the main facilitator and interpreter during the discussions, which were held in the local language *Afan Oromo*. Each FGD was attended by 6–13 participants per session. FGDs were additionally attended by local Development Agents,

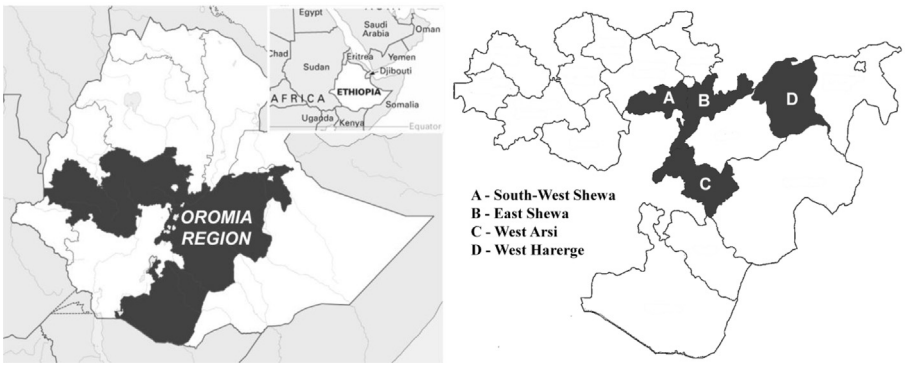

Fig. 1. Maps of Oromia Region and zones in which data was collected.