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Policy and demographic factors shape deforestation patterns and socio-ecological processes in southwest Ethiopian coffee agroecosystems

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A B S T R A C T

Land-use change, a major driver of biodiversity loss and ecosystem service degradation, is caused by intertwined local and regional forces that shape human-environment interactions. In order to understand the interacting effects of local processes and national policies on landscape changes, we studied two districts of contrasting demographic and land-management histories in southwest Ethiopia. Our main objectives were to understand the extent of forest cover changes through time, and to explore how deforestation rates correlate with (a) local changes in settlement, demographic conditions, and livelihood practices, and (b) broader changes in land-tenure and agricultural development policies in Ethiopia. We found that: (a) over 36% of the forests were lost since 1973, (b) deforestation rates varied through time due to changes in land-tenure and agricultural development policies, and (c) rates also varied between the two districts with higher rates in Yeki that correlated with demographic pressure from resettlement and agricultural expansion, and lower rates in Decha associated with lower population pressure and in response to forest conservation practices and higher non-timber forest benefits to local communities. The interactions in agricultural policy, land-tenure, demographic dynamics, and conservation policies with forest stability or decline suggested by this study shows the importance of carefully considering the undesirable effects of resettlement and agricultural development policies and the need to support community forest conservation that also benefits local people.

Introduction

Land-use change is a major threat to biodiversity, ecosystem services, and human well-being in tropical ecosystems (Millennium Assessment, MA 2005). In parts of sub-Saharan Africa where small-scale agriculture remains the major source of rural livelihoods, deforestation remains a primary environmental concern. This is more typical to Ethiopia with over 83% of the total population living on small-scale agriculture (Central Statistics Agency, CSA 2012). Ethiopia has a long history of intensive agriculture and high population pressure, thus lacking historic data on forest cover and there is no good baseline data about the extent of deforestation rates or forest cover in the past. About 40% of Ethiopian landmass was arguably covered by forests by the beginning of the 20th C. The forest cover has been variably estimated to be decreased from 16% in 1950s, to 2.7% by 1989, and to less than 2.2% recently (Bishaw, 2001; Crummey, 2009; Pankhurst, 1995; Woien, 1995).

Investigations from some parts of Ethiopia suggest that forest cover has increased in the highlands of Tigray, Northern Ethiopia, since 1961 (Meire et al., 2013) including the southern and eastern parts of Tigray region (Teka et al., 2014; Woien, 1995), in Wello in North Ethiopia since the 1930s (Crummey, 1998), and in Chimoga watershed in Northwest Ethiopia (Bewket, 2002). However, most researchers now agree on declining forests in many parts of Ethiopia, and Millennium Assessment (MA, 2005) considered Ethiopia as one of the 29 countries which lost > 90% of its original forest cover.

The majority high forests in Ethiopia are now limited to the southeastern and southwestern parts of the country. Southwest Ethiopian forests are home to diverse species and ecosystem services including wild coffee, spices, forest honey, and a variety other timber and non-timber forest products on which millions of small-scale farmers depend (Gole, 2003; Senbeta & Denich, 2006; Tadesse, Zavaleta, Shennan, FitzSimmons, 2014). However, these forests are also under continuous degradation and conversion to

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other agricultural landscapes (Dessie & Kleman, 2007; Getahun, Rompaeya, Turnhouta, & Poesen, 2013; Reusing, 2000; Wiersum, 2010).

In many parts of Ethiopia, various drivers of deforestation and land-use changes have been reported such as agricultural expansion (Reid et al., 2000; Tekle & Hedlund, 2000), logging for construction and fuel (Assefa & Bork, 2014; Dessie & Kleman, 2007), increased access to market and major urban centers (Getahun et al., 2013; see also Rudel, 2013), commercial logging and commercial farming (Dessie & Kleman, 2007), changes in land-tenure and land-use policy, cattle diseases, drought, and resettlement (Reid et al., 2000), and population growth (Bewket, 2002).

It has been shown from other areas that deforestation results from increased local demands (e.g. pressure for more forest products and agricultural land from population growth) that interact with external socioeconomic and policy changes (Lambin, Geist, & Lepers, 2003). For instance, agricultural expansion by smallholders in tropical regions particularly in sub-Saharan Africa is exacerbated by rural population growth and national polices that promote intensive cereal-based agriculture (Lambin et al., 2003; MA, 2005). In Cameroon, economic recession and subsequent de-urbanization (Mertens, Sunderlin, Ndoye, & Lambin, 2000; Sunderlin et al., 2000), emerging global markets such as the oil boom, and export prices from coffee and cacoa (Gbetnkom, 2005) have increased deforestation and agricultural expansion. Landscape changes in coffee agroecosystems in Central America have also been reported as being caused by complex and divergent drivers (Schmitt-Harsh, 2013).

Previous studies on land-use changes and deforestation in southwest Ethiopia mostly focused on local drivers of deforestation without examining the broader political and socio-economic processes. In pre-1974 Ethiopia, land-tenure was complex and diverse (Rahmato, 2009) which might have promoted land-tenure security while maintaining customary forest ownership regimes that used to conserve forests. After the national 1974 land-to-the-tiller proclamation, the Derg regime nationalized land and homogenized the pre-existing diverse ownership regimes throughout Ethiopia and allowed local farmers to farm their own plot using usufruct rights (Rahmato, 1994, 2009). This disrupted the pre-existing ownership regimes, created land-tenure insecurity, and changed customary forest ownership to state ownership which in turn alienated indigenous people from their forests while causing competition and rivalry for forest resources (Bekele, 2003; Stellmacher, 2007; Wood, 1993). Insecure land-tenure can impact forest cover by reducing tree cover through agricultural expansion and by disrupting customary forest ownership (see Place & Otsuka, 2001).

The other factor possibly associated with increased deforestation is Ethiopia's agricultural development policy after the 1990s. This policy has promoted intensive farming practices and cropland expansion by providing extension and credit programs to small-scale farmers. In addition to agricultural extension, agricultural investment policies promoted agricultural expansion which may also have encouraged further deforestation and intensification in the region (see Gebreselassie, 2006) as has been reported in many tropical regions (Geist & Lambin, 2002).

Studies that identify the extent and drivers of deforestation as well as the interaction among drivers will help avoid unintended consequences of policy interventions on the sustainable management of forest resources. The national agricultural development and land-use policies interacting with resettlement programs in southwest Ethiopia could shape demographic and livelihood practices that modify spatial and temporal patterns of deforestation. The degree of resettlement in the region varied from place to place with Yeki district heavily settled with people who came from other parts of Ethiopia than Decha region. Decha region have more indigenous people who more depend on forest products than the people in Yeki (Tadesse, Zavaleta, Shennan, et al., 2014). The contrasting histories of two political districts in the Ethiopian Southwest, Yeki and Decha regions, give us the opportunity to explore how deforestation rates vary in adjacent regions facing comparable political and economic conditions but with key differences in local cultural and livelihood characteristics. We examined how deforestation rates vary between the two districts with contrasting demographic and socio-economic conditions, and how rates correlate with different time periods marked with broader policy and socio-economic changes in Ethiopia and beyond.

Methods

The study areas

We studied two major regions of contrasting demographic and land-use histories in southwest Ethiopia: (1) Yeki found at 7.2° N, 35.3° E covering 618 km^2 area, and (2) Decha districts (including adjacent forested villages of Gimbo district) found at 36.1° E, 7.1° N with a total area of 1392 km^2 (Fig. 1A). Rainfall in the region is unimodal with annual precipitation of >1200 mm and mean monthly temperature that ranges from 18 °C to 23 °C (Ethiopian National Meteorological Services Agency, 2010). Vegetation in the region is predominantly classified as moist Afromontane forests with the surrounding lowland transitional rainforests (Friis, 1992). About 10 of the 58 national forest conservation priority areas of Ethiopia are found in and around these regions.

The major resettlement program in 1984–85 occurred as a national response to the Ethiopian famine crisis (Clay & Holcomb, 1985; Rahmato, 2003). During this period, the majority of the 600,000 people who came from northern and central parts of Ethiopia were relocated to southwest Ethiopia. Of these about 64,660 people were settled to Kaffa region, including Decha and Gimbo areas; and about 150,939 people to Illubabor region, including Yeki district (Rahmato, 2003). Consequently, indigenous people in Yeki district became less dominant (58.9%) than they are in Decha and its surrounds (84%) (CSA, 2011).

Yeki has high population density (~223 persons/km^2) that has doubled since the 1990s (CSA, 2012). Settlers, composed of various socio-cultural groups, practice intensive cultivation than indigenous people. Yeki was dominated by indigenous Majangir and Shako peoples who predominantly practiced shifting cultivation and hunting-gathering before the 1960s (Stauder, 1971). There has been rapid land-use transition from shifting cultivation and hunting-gathering practices to intensive cultivation due to demographic changes, and promotion of cereal cultivation. Resettlement and villagization programs have promoted sedentary agriculture while discouraging hunting-gathering and shifting cultivation practices.

The people of Decha are predominantly indigenous Kaffichos (81%) who practice subsistence cereal cultivation mixed with forest coffee and various non-timber forest products. Settler population in this district and its surrounds is <11% (CSA, 2012). Average population density of Decha and surrounding region is ~86 persons/km^2 with an increase from 54 to 86 persons/km^2 between 1990s and 2010 (CSA, 2012; Center for International Earth Science Network, CISEN 2012). Minority Manjos belong to the Kafficho ethnic groups who used to practice hunting and gathering before 1980s and who are now practicing intensive cereal cultivation (Yosinda, 2009). Indigenous peoples in Decha district have a long history of sedentary cultivation practices with high use of non-timber forest products. The predominant coffee production in Yeki district is