LAND DEGRADATION & DEVELOPMENT
Land Degrad. Develop. **28**: 431–449 (2017)
Published online 3 August 2016 in Wiley Online Library (wileyonlinelibrary.com) **DOI**: 10.1002/ldr.2575

TRANSITION FROM FOREST-BASED TO CEREAL-BASED AGRICULTURAL SYSTEMS: A REVIEW OF THE DRIVERS OF LAND USE CHANGE AND DEGRADATION IN SOUTHWEST ETHIOPIA

Henok Kassa[1,2], Stefaan Dondeyne[3], Jean Poesen[3], Amaury Frankl[2], Jan Nyssen[2]*

[1]*Department of Natural Resources Management, Mizan-Tepi University, PO Box 391, Mizan Teferi, Ethiopia*
[2]*Department of Geography, Ghent University, Krijgslaan 281 S8, B-9000 Gent, Belgium*
[3]*Department of Earth and Environmental Sciences, KU Leuven, Celestijnenlaan 200E, B-3001 Heverlee, Belgium*

Received 17 July 2015; Revised 23 June 2016; Accepted 23 June 2016

ABSTRACT

The southwestern Ethiopian montane forests are one of the most species-rich ecosystems and are recognised globally as a priority area for the conservation of biodiversity. Particularly, in contrast to the drier central and northern Ethiopian highlands, they have received little attention by researchers. Here, we review changes to agricultural systems in and around these forests that are known as the genetic home of coffee (*Coffea arabica* L.) and that are important to the livelihoods of many rural people who have developed traditional management practices based on agro-ecological knowledge, religious taboos and customary tenure rights. We explored the impacts of conversions to agroforestry and cereal-based cropping systems on biodiversity, soil fertility, soil loss and the socio-economic conditions and culture. The increasing trend of cereal cropping, resettlement and commercial agriculture causes the deterioration of natural forest cover in the region and threatens biodiversity, land quality, sustainable, traditional farming practices and the livelihood of the local community. Large-scale plantations of tea, coffee, soapberry locally known as *endod* (*Phytolacca dodecandra* L'Hér.) and cereals have resulted in biodiversity loss. Following the conversion of forests, cultivated fields exhibit a significant decline in soil fertility and an increase in soil loss as compared with the traditional agroforestry system. The establishment of a sustainable agricultural system will require a change in paradigm, whereby the intrinsic values of the traditional forest-based agricultural system are recognised, rather than the ongoing mimicking of agricultural policies that were developed for the open fields of central Ethiopia. Copyright © 2016 John Wiley & Sons, Ltd.

KEY WORDS: montane rainforest; *Coffea arabica* L; traditional management practice; land degradation; southwestern Ethiopia

INTRODUCTION

Land degradation in Ethiopia stems from the historical development of agriculture and human settlement in highland regions (Hurni, 1988; Nyssen *et al.*, 2015). The human impact on the change in forest cover dates back 2,000 to 3,000 years in northern Ethiopia, which is a much longer period than in any other East African country (Nyssen *et al.*, 2004; Lanckriet *et al.,* 2016). The presence of this long-standing agricultural civilization that used the plough (Ehret, 1979; McCann, 1995) has led to the presence of extensive open fields, where good yields are sustained through fertiliser inputs (Kraaijvanger & Veldkamp, 2015) as cow dung and crop remnants have partially substituted wood as a source of energy (Haregeweyn *et al.,* 2008; Mekuria & Aynekulu, 2013); there, efforts are carried out since a few decades to bring back trees in the landscape (de Mûelenaere *et al.*, 2014; Belay *et al.*, 2015).

In contrast, the southwestern Ethiopian montane rainforest (Figure 1) where the local people have developed traditional management practices based on customary tenure rights and religious beliefs (Zewdie, 2007) has been much less studied, similarly to other agricultural systems on the margins of the Ethiopian highlands (Kuls, 1962; Tilahun *et al.*, 2015). Semi-permanent cultivation systems (Ruthenberg, 1983) in and at the margin of tropical forests are under threat worldwide (e.g. De Jong *et al.*, 2001; Fleskens & Jorritsma, 2010) and such is also the case in southwest Ethiopia (Engdawork & Bork, 2016). There, current land management dynamics that have resulted in deforestation are related to cropland expansion under the form of open farmlands, settlement and investment in commercial agriculture (Mekuria, 2005; Dereje, 2007; Bedru, 2007; Belay, 2010).

The objective of this paper is to review the literature on the environmental history of the forested parts of southwest Ethiopia to gain insights into the drivers of land use change in relation to land degradation. For this purpose, we used Wiley Online Library and Scholar Google to retrieve relevant literature sources and further networked with colleagues who are knowledgeable about the study area. Key informants were also interviewed by the first author, who was born and lives in the study area. We focussed on Keffa, Sheka and Bench Maji, the three westernmost administrative zones of the Southern Nations, Nationalities and Peoples region, the latter being one of the nine regional states of the Federal Democratic Republic of Ethiopia (Figure 2).

*Correspondence to: J. Nyssen, Department of Geography, Ghent University, Krijgslaan 281 S8, B-9000 Gent, Belgium.
E-mail: Jan.Nyssen@Ugent.be

Figure 1. The Dembi river in Sheko forest (6·9782°N, 35·4970°E) illustrates the original natural environmental conditions of southwest Ethiopia. This figure is available in colour online at wileyonlinelibrary.com/journal/ldr.

Here, local people have developed intricate agroforestry systems, but which are currently under pressure. Special attention is also given to local peoples' knowledge and traditional practices and the ongoing and potential threats to the sustainability of future land management. Furthermore, the impacts of these dynamics on land degradation are also discussed.

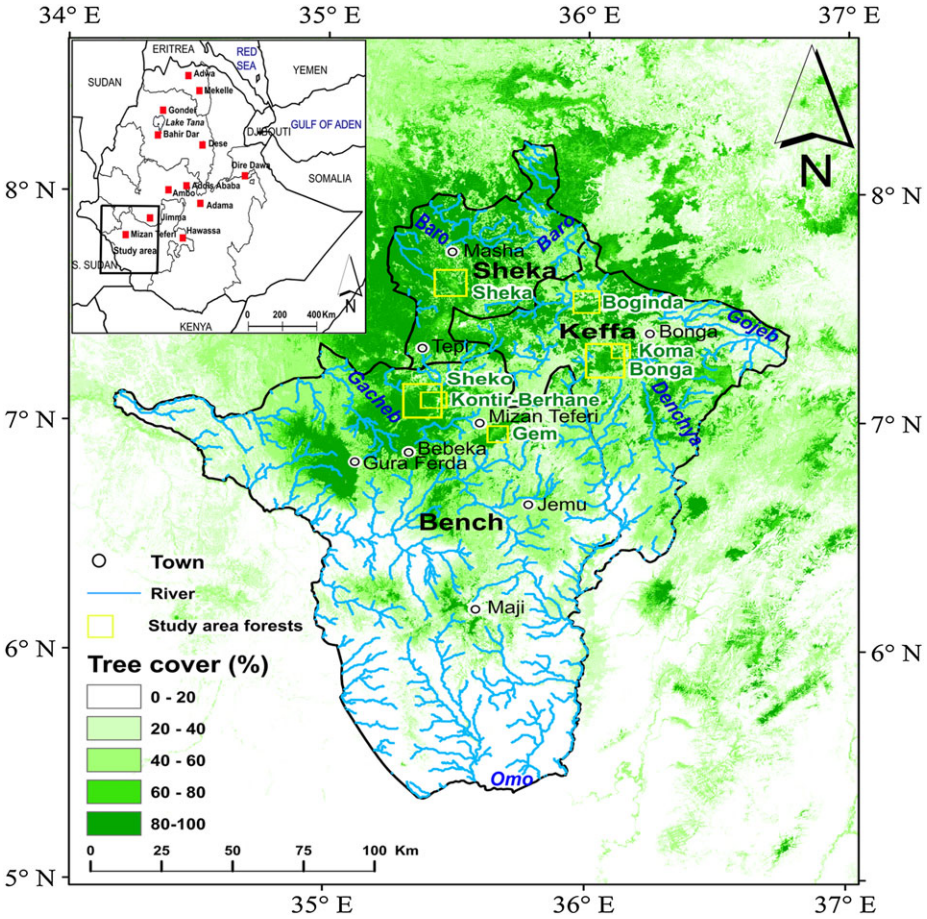

Figure 2. The study area in southwest Ethiopia with tree cover in 2000 (after Hansen *et al.*, 2013). This figure is available in colour online at wileyonlinelibrary.com/journal/ldr.

BIOPHYSICAL ENVIRONMENT

Climate of Southwest Ethiopia

Seasonal rainfall in Ethiopia is driven by the north–south movement of the Inter-Tropical Convergence Zone (ITCZ). After shifting northward, the ITCZ brings intense rainfall to southwest Ethiopia (Messerli & Rognon, 1980; Goebel & Odenyo, 1984). The annual rainfall pattern can be classified into two seasons: the dry season (December–February) and the rainy season (March–November) with particularly strong rains in summer. The commonly used bimodal rainfall distribution of the central and northern Ethiopian highlands with spring rains (*belg*) and the summer main rainy season *kiremt* (Fazzini *et al.,* 2015) is not applicable in southwest Ethiopia, neither when observing annual rain distribution (Figure 3) nor in the terminology that is used in the local languages of southwest Ethiopia (Table I). The average yearly rainfall in Aman near Mizan Teferi, the main town of Bench Maji zone (Figure 2) is 2296 (±244) mm y^{-1}, 1707 (±216) mm y^{-1} in Bonga (Keffa zone) and 1603 (±404) mm y^{-1} in Tepi (Sheka zone) (NMA, 2013) (Figure 3). The average air temperature ranges from 13 °C to 27 °C and varies according to elevation (IFPRI & CSA, 2006). Combined high rainfall, long growing season and temperature variation with elevation lead to a wide range of cropping possibilities.

Lithology and Soils

The southwestern Ethiopian highlands developed along the western margin of the Rift Valley as a result of uplifting over the past 18 million years (Beccaluva *et al.*, 2011). The underlying basement rock is of Precambrian origin. These intensely folded and faulted basement rocks are mostly directly overlain by Tertiary volcanic rocks that dominate the geology of the area (Kazmin, 1972). Although undifferentiated on the maps, the Precambrian rocks comprise a variety of metasediments, metavolcanic and intrusive rocks (Westphal, 1975). Following the uplift, the region has been dissected by rivers, resulting in elevations ranging from 900 to 3,500 m asl. Southwest Ethiopia drains partly to the White Nile through the Akobo-Baro river system and partly to the Omo-Turkana basin.

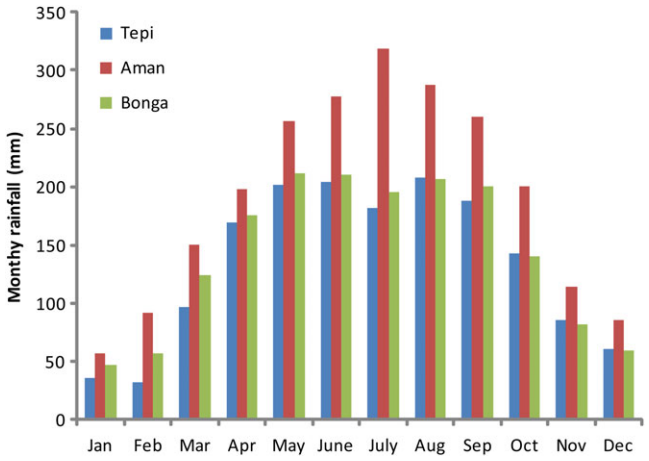

Figure 3. Average monthly rainfall at Tepi (1980–2012), Bonga (1960–2012) and Aman near Mizan Teferi (1954–2010) (Source: National Meteorological Agency). This figure is available in colour online at wileyonlinelibrary.com/journal/ldr.

Table I. Terminology to designate the seasons in the languages of the main ethnic groups living around southwest Ethiopia's forests

Language[a]	Rainy season[b] (March–November)	Dry season (December–February)
Bench	Wole/Dane enet	Ober enet
Keffa	Yoyo	Kawa
Sheka	Yoyo	Belo
Sheko	Ero benji	Siyatu benji

[a]All languages belong to the North Omotic language group; particularly, Keffa and Sheka languages are closely related (Aklilu, 2003; Theil, 2012).
[b]While agreeing that the second part of the rainy season is generally heavier, all key informants stressed that the terminology used designates the rainy season as a whole.

According to the harmonised soil map of Africa (Dewitte *et al.*, 2013), the major reference soil groups of the southwestern highland plateaus are Nitisols, Vertisols, Leptosols, Regosols, Cambisols and Acrisols. Nitisols are the dominant reference soil group in coffee-growing areas of southwest Ethiopia. Nitisols have a depth of more than 1·5 m, are clayey and red in colour. They primarily occupy slopes steeper than 5%. These soils are well-drained with good physical properties; they have high water-storage capacity, a deep rooting depth and stable soil aggregate structure. Nevertheless, rates of decomposition of organic matter and leaching of nutrients are extremely fast. Acidity ranges from medium to strong, and pH is generally less than 6 (Feyissa & Mebrate, 1994; Schmitt, 2006). On steep slopes, such as escarpments and on undulating topography, Cambisols and Regosols are most common. Vertisols are dark and heavy clay soils and are found in waterlogged plains and seasonal swamp areas in Keffa (Figure 2). Acrisols are dark red to reddish brown soils, with a texture of clay to sandy clay. They are found in few areas of the Keffa zone (Tafesse, 1996).

Biodiversity in the Genetic Home of Coffee

Ethiopia is one of the top 25 biodiversity-rich countries in the world (World Conservation Monitoring Centre, 1994). The majority of the species are found in the highland forests and particularly in the southwestern highlands. The forests of the southwestern highlands fall within the eastern montane hotspot of Ethiopia and are the genetic home of coffee (*Coffea arabica* L.) (Labouisse *et al.*, 2008; Meyer, 1965; Vavilov, 1935). Among the seven major vegetation types in Ethiopia, four vegetation types occur in southwest Ethiopia, namely, montane rainforest, transitional rainforest, dry peripheral semi-deciduous Guineo-Congolian forest and riverine forest (Friis, 1992).

The Bonga forest (Table II) is one of the most species-rich forests in Ethiopia (Friis *et al.,* 1982; Schmitt, 2006; Matheos, 2011; Sisay, 2008; Ensermu & Teshome, 2004; Kochito, 2008; Feyera, 2006). In addition to plant diversity

Table II. Forests studied in southwest Ethiopia, listed from South to North

Forest name	Coordinates of forest centre	Administrative zone	Area of the forest (km^2) [a]	Nearby towns	Main ethnic groups in and around the forest	Elevation (m asl)	References
Gem	6·96°N, 35·65°E	Bench Maji	80–200	Mizan Teferi	Bench	1400–2800	Getachew (2010)
Kontir-Berhane (part of Sheko forest)	7·08°N, 35·40°E	Bench Maji	250	Sheko, Mizan Teferi, Gezmeret	Sheko, Bench, Keffa, Majangir, Me'en Settlers: Amhara	950–1800	Feyera (2006)
Sheko	7·09°N, 35·37°E	Bench Maji	2200–3940	Tepi, Mizan Teferi, Gezmeret	Sheko, Majangir, Keffa, Bench, Me'en Settlers: Amhara	700–2800	Dereje *et al.* (2015); WCC-PFM (2011); Feyera (2006)
Bonga	7·27°N, 36·07°E	Keffa	1600–2500	Sheshinda, Wushwush, Gimbo	Keffa, Bench, Kulo, Charra, Manjo[b], Oromo, Nao Settlers: Amhara, Oromo, Gawata	1000–3500	Tezera (2008); Schmitt (2006); Sisay (2008); Bender-Kaphengst (2011)
Koma (part of Bonga forest)	7·30°N, 36·09°E	Keffa	12	Wushwush, Agama, Komba	Keffa, Manjo[b] Settlers: Kambata	1850–2250	Stellmacher (2005); Stellmacher & Mollinga (2009); Vandenabeele (2012); Ayana *et al.* (2015)
Boginda	7·50°N, 36·02°E	Keffa	600–1000	Bonga, Wushwush, Gewata	Keffa, Bench, Kulo, Charra, Manjo[b], Nao Settlers: Amhara, Oromo	1500–3500	Mekuria (2005); Philippe (2003); Sisay (2008)
Sheka	7·60°N, 35·48°E	Sheka	1000–2400	Masha, Tepi, Gecha	Sheka, Keffa, Sheko, Bench, Majangir, Manjo[b] Settlers: Amhara, Oromo, Sidama	900–2700	Tadesse (2007); Zewdie (2007); Tadesse & Fite (2011)

[a]Reported areas vary among authors; lower value indicates natural forest, and higher values include also villages, grazing land and cropland in clearings.
[b]Manjo is a lower social-ethnic caste within the main ethnic groups.

richness, at least 17 endemic plant species were identified in these forests (Sisay, 2008; Schmitt, 2006). Similarly, the Maji, Sheka and Sheko forests (Figure 2) are rich in plant species composition (Tadesse, 2007; Feyera, 2006; Gemedo & Simon, 2007).

According to Leykun (2008), three forests in Bonga hold 61 mammalian species, 210 bird species, 10 reptiles, 7 amphibian species and 6 fish species. The forests comprise 21% of all mammals and 23% of all bird species in Ethiopia, of which five species are endemic.

THE TRADITIONAL AGROFORESTRY SYSTEMS OF SOUTHWEST ETHIOPIA

Forest Tenure

Before integrating under the Ethiopian crown in the late 19th Century, societies in southwest Ethiopia were organised according to a clan system (*sensu* Huntingford, 1955) that comprised, for instance in Keffa, clans of 'great people', 'common people' (serfs), 'bad people' (craft workers) and slaves (Gezahegn, 2003; Yonas, 2005). Descendants of the latter two casts are still nowadays part of the socially discriminated Manjo socio-ethnic groups (Lange, 1984; Van Halteren, 1996; Pankhurst, 1999; Yihenew, 2002; Gezahegn, 2003; Yoshida, 2008). An overview of all mentioned forests, their location and ethnic groups who live in and around these forests is given in Table I.

During the reign of emperor Menelik II (1889–1913), a landlord–tenant land tenure system was introduced in Sheka and is still known as the *kobbo* holding system. The landlords, who originated from northern and central Ethiopia, assigned traditional clan leaders to manage the land and collect taxes from tenants within their territory. Under the *kobbo* system, a peasant who used a block of forest (*kobbo*) for producing honey had to pay taxes to the clan leader, often in kind. Disputes over the *kobbo* forestland use rights were mediated and resolved by the clan leaders and elders. Regardless of ownership of land, individuals who hung beehives outside *kobbo* land had exclusive recognised use as well as heritable right over the tree (Dereje & Tadesse, 2007). This customary forest tenure system, which has been functioning for more than a century, is still recognised by the local communities.

Although both the military Derg government (1974–1987) and the Ethiopian People's Revolutionary Democratic Front (EPRDF) government (post-1991) nationalised all natural forests, including *kobbo* forestland, local communities continued the customary *kobbo* forest use right informally. Even though the practice is not recognised by any statutory law, *kobbo* landowners have the right to inherit, rent, share, donate and divide their *kobbo* land. Such transactions are overseen and enforced by elders and clan leaders, whereby only men have the right to inherit *kobbo* land. Women have access rights through their husband, and widows keep indirect user's right of the *kobbo* land until a son reaches maturity (Dereje & Tadesse, 2007). Members of the Manjo communities have their own forest block, *kobbo*, or are engaged in shared beekeeping on other's *kobbo* land (Dereje & Tadesse, 2007).

The forest management in Sheka is based on the communities' traditional ecological knowledge and is highly influenced by their social organisation (king '*shekitato*', councillor '*mikiracho*' and clan leader '*gepitato*') and religious concepts (Mengistu, 1995). Until the end of the imperial period (1974), clan leaders controlled all aspects of people's life, administered natural resources, allocated land to newcomers and 'purified' the land and its people from misfortunes (Mengistu, 1995). The forests are divided into cultural forest and large forest areas that are administered through the *kobbo* holding system. Access to cultural forests, which also includes wetlands, riverine forests and waterfalls as traditional religious sites, is restricted through resource and habitat taboos (Figure 4) through the *guudo* (a cultural forest used as a worship place) and *deddo* (a large tree under which prayers or religious ceremonies are conducted). The indigenous community has customary right for their traditional activities like worshipping inside cultural forests. It is prohibited to cut cultural forest area for any use (Zewdie, 2007). The Sheka people believe that a person who violates these taboos will die or face evil things.

The management of large *kobbo* forests is based on the rights and obligations of the individual who inherited the forestland from his ancestors. The management of the *kobbo* is based on customary rules that identify the rights and obligations of the individuals who have their own forestland (*kobbo*). Hence, *kobbo* is a fraction of one's own inherited 'forestland' primarily used for harvesting honey and other non-timber forest products (NTFP; *sensu* FAO Forestry, 1999). Only the owner has the customary right to hang beehives for honey production, to use timber for making traditional beehives and house furniture, to extract wild coffee, climbers, spices and agricultural tools (Zewdie, 2007). Further, the owner is responsible for different management activities like weeding, protection of the forest from any encroachment, livestock disturbance or hunting (Zewdie, 2007; Dereje & Tadesse, 2007). These rules promote sustainable management of the forest and sustenance of the *kobbo* owners' livelihood. Further, the strict follow-up by clan leaders and elders of already inherited *kobbo* forest strengthens the efficient management of the *kobbo* forest. In this customary system, only the heir *kobbo* owner has forest use rights, which are clearly defined (Dereje & Tadesse, 2007; Zewdie, 2007).

In Keffa, besides protected and forested ceremonial sites (*deejjo*) such as graveyards and large springs (Yonas, 2005), the local community applies two traditional informal mechanisms to govern forest access rights; the *wejoo* and the *gogoo* mechanism. The principal accessing mechanism is mediated by local rules: (i) geographic proximity to the resource, (ii) proven track and demarcation of plots and (iii) ancestral claim of ownership. The remaining forest is attributed on a 'first come, first served' base (Yihenew, 2003; Stellmacher, 2005; Stellmacher & Mollinga, 2009). In the

Figure 4. The upper part of this catchment in Daken (7°2′35″N, 35°38′55″E) is occupied by a cultural forest and henceforth protected from encroachment, what leads to the sharp boundary between cropland and forest. This figure is available in colour online at wileyonlinelibrary.com/journal/ldr.

wejoo mechanism, aged parents transfer the responsibility of forest product management and collection to their younger son, hence primarily by patrilineal heritage (Zewdie, 2007). *Gogoo* is a sharecropping arrangement for forest goods, which benefits to women, poor and aged farmers (Yihenew, 2002). The implementation of *wejoo* and *gogoo* has strongly increased in recent years in the absence of statutory forest access mechanisms (Yihenew, 2002; Yihenew, 2003; Dereje, 2007; Stellmacher & Eguavoen, 2011).

In contrast to the *kobbo* system, where the *kobbo* owner had restricted use rights over the forest, such as hanging beehives, hunting and collection of climbers (Dereje & Tadesse, 2007; Zewdie, 2007), the forest owner in Keffa has the right to cultivate and collect coffee and harvest plants and wood from the forest (Stellmacher & Eguavoen, 2011).

Traditional Agroforestry and Livelihood

Sale of NTFP is the major source of cash income for rural households in southwest Ethiopia (Mohammed & Wiersum, 2011). The most common NTFPs are coffee, honey, spices, fruit and bamboo (van Beijnen *et al.,* 2004; Jacomijn, 2006; Assefa, 2007; Anteneh, 2006). The contribution of NTFPs to the total household cash income is slightly higher than the contribution of farm products (Mohammed & Wiersum, 2011). Moreover, the combination of agriculture and the production of high-value NTFPs provide higher incomes than agricultural production only. Collection of diversified products from agroforestry leads to less exposure of the household to resource constraints throughout the year (Anteneh, 2006). With regard to the collection and sale of different NTFPs, forest coffee is the major commercial NTFP in southwest Ethiopia (Mohammed & Wiersum, 2011; Stellmacher & Mollinga, 2009). Assefa (2007) also indicated that NTFP from natural forests yielded twice the net benefits than that of tea plantations, besides an estimated value of €85 per hectare per annum for the carbon sequestration of those forests.

Traditional Farming and Agricultural Policy Package Programme

In the past, shifting cultivation, cattle rearing, hunting and wild honey collection were the major livelihood means for the communities in southwest Ethiopia. The sedentary lifestyle and agriculture that now dominates began with the imposition of the Menelik II regime in the 1890s (Akalu, 1982; Legesse, 2000). Traditionally, farmers use sticks and hoes for tilling their farmland (FARM Africa & SOS Sahel-PFM, 2004; Fujimoto, 2009). The local people use intensive, integrated home garden crop production to produce food for their family and livestock. In this regard, agricultural practices in the region are mainly smallholder subsistence farming, based on a low-input, rain-fed and traditional practice farming system (Rojahn, 2006). The food crops are perennial crops dominated by root and tuber crops such as ensete (*Ensete ventricosum* Welw.), yam *(Dioscorea rotundata* Poir*.)*, taro (*Colocasia esculenta* L.) and cassava (*Manihot esculenta* L.) (FARM Africa & SOS Sahel-PFM, 2004). The agro-ecological conditions are also suitable for growing different types of crops: cereals, such as maize (*Zea mays* L.), sorghum (*Sorghum bicolor* L.), barley *(Hordeum vulgare* L.*),* wheat (*Triticum aestivum* L.), rice (*Oryza sativa* L.) and 'teff' (*Eragrostis tef* Zucc.); pulses, including field pea (*Pisum sativum* L.) and haricot bean (*Phaseolus vulgaris* L.); and the oil crop sesam (*Sesamum indicum* L.). Extensively grown horticultural plants include fruits, for example, banana (*Musa* × *paradisiaca* L.) and mango *(Mangifera indica* L.); spices, such as Ethiopian cardamom (*Aframomum corrorima* (Braun) P.C.M. Jansen),

black pepper (*Piper nigrum* L.) and ginger (*Zingiber officinale* Roscoe) and other cash crops such as coffee (*Coffea arabica* L.), chat (*Catha edulis* (Vahl) Forssk. ex Endl.) and tea (*Camellia sinensis* (L.) Kuntze) (Tezera, 2008; van Beijnen *et al.,* 2004; Belay, 2010).

The government's agricultural policy package programme encourages cereal crop production by distributing improved seeds (mostly cereals) and chemical fertilisers (Mekuria, 2005; Belay, 2010; Dereje, 2007). Natives are experienced with low-cost traditional soil fertility management practices like manure, compost, crop rotation, intercropping and agroforestry systems in a suitable environment where large volumes of organic materials are available (Anteneh, 2006; Berhanu, 2011). Yet the government is promoting the use of mineral fertilisers, and these are mostly used by settlers (Berhanu, 2011). However, concerns about the sustainability of these cereal-based cultivation practices have been raised, as they resulted in a reduction in fallow periods, a decrease in soil organic matter content and a deterioration of the soil structure, as well as the cultivation of crops on steep slopes (up to 50%) (Mekuria, 2005; Belay, 2010).

Keeping livestock is considered as a source of livelihood and an employment opportunity for the local communities in southwest Ethiopia (Tezera, 2008; Belay, 2010). Cattle, sheep and goat rearing are widely practiced on communal and agricultural land (Tezera, 2008; Belay, 2010). Livestock is a source of milk, meat, power for agricultural operations and income (van Beijnen *et al.,* 2004; Tezera, 2008; Belay, 2010). Some grazing areas in forests around the villages are open access to all people (Zewdie, 2007). There is a strong increase in grazing under degraded communal forest in relation to increased population densities. Further, livestock production is under immense pressure from the prevailing trypanosomiasis transmitted by tsetse flies (*Glossina* spp.) (Belay, 2010; Pingali *et al.,* 1987). Because the vector lives under the cover of forests and bush, animal production is limited in moist forests of southwest Ethiopia. Still, the local Sheko cattle breed has a high tolerance to trypanosomiasis and also has good production and reproduction potential as stressed by Takele *et al.* (2011) and Stein *et al.* (2011).

DRIVERS OF LAND USE CHANGE

Resettlement

The arrival of settlers from drought-prone areas of central or northern Ethiopia and from other parts of southern Ethiopia to the densely forested region of southwest Ethiopia influenced the local forest management, agroforestry practices and forest cover (Belay, 2010; Mekuria, 2005; Stellmacher, 2005). There are, however, no official statistics on how many people have resettled in southwest Ethiopia over the past decades. During the reign of Emperor Haile Selassie (1930–1974), many peasants were relocated from northern Ethiopia to the southern and southwestern regions (Belay, 2004; Wood, 1977). It is estimated that 20,000 families were resettled in Keffa through 1974 (Clarke, 1986). The Derg regime (1974–1987) officially supported the resettlement of several thousands of people from the central highlands to southwest Ethiopia because of an epidemic disease outbreak that caused a massive decimation of domestic animals (Alemneh, 1990). Approximately 250,000 people were resettled in Keffa between 1985 and 1988 (Alemneh, 1990). Similarly, the current government has relocated several thousands of people from northern and other southern regions to southwest Ethiopia (Belay, 2010).

Since imperial and Derg times, resettlement of people is governed by the central government, involving the lower administrations (Pankhurst, 1992; Dessalegn, 2003; Keller, 1991; Stellmacher & Eguavoen, 2011). In recent years, the village administrators are the key players in the distribution of land because they know the area very well (Dereje, 2007; Moti *et al.*, 2011).

Settlers originate from food-insecure and famine-struck areas of the country. The new settlers were and are still selected based on the severity of the problem, free consent and willingness of resettlers to move from drought-prone densely populated areas of central and northern Ethiopia (Wood, 1985; Pankhurst, 1988; Kloos & Aynalem, 1989). During the Derg regime, large numbers of people were forcefully resettled in a disorganised way (Pankhurst & Piguet, 2004; Mulat *et al.*, 2006).

Land allocated to new settlers, for farmland and for residence, had been forests that local people used for harvesting NTFPs (Mekuria, 2005; Belay, 2010; Moti *et al.*, 2011; Bedru, 2007). The settlers were also provided with permanent communal grazing lands in the area (Belay, 2010).

Although most of the resettlement in southwest Ethiopia was undertaken without consultation of the local people, except for the recent EPRDF regime planned resettlement, the host communities generally do not oppose resettlement if there is unoccupied land available (Moti *et al.*, 2011). The installation of infrastructure and distribution of agricultural inputs related to resettlement programmes also benefits host communities. Pankhurst & Piguet (2004) indicate that the opposition of the host community on the new settler starts not on their arrival, but the crux of the matter lies in the relations between hosts and migrants and their resource use, given the tendency for migration to exacerbate resource conflict.

Reusing (2000) indicated that the settlers have introduced a new farming system, which is not adapted to the area. For settlers from northern, central and other parts of the southern region, resettlement entailed a shift from an intensive agro-based livelihood to a forest-based system of which they had no experience and were not prepared to manage. Rather, an extensive cereal-based farming system was established at the expense of large tracks of forest in the region (Alemneh, 1990; Baah *et al.,* 2000; Mekuria, 2005). Forests are burnt, trees are felled and even the largest of them are killed by debarking and, in case of protected trees, illegal underground cutting of their roots. This led to the rapid expansion of cropland. Further, indigenous people are dynamically changing their agricultural system mimicking the resettlers'

cultures (Belay, 2010). The increase in population as a result of resettlement in the region increased the demand for land, fuel wood and construction wood, which further aggravated deforestation (Mekuria, 2005; Reusing, 2000; Belay, 2010). Furthermore, the 2 ha of land given to new settlers upon arrival are frequently expanded through different mechanisms, that is, by illegal clearing of the forestland, by bribing local administrators or through the purchase of land from the local community. Furthermore, the intensive coffee management needs more labour and, as a result, a type of social coalition has formed between the labourers and the local coffee growers to maintain labour support during coffee management periods. Hence, most coffee growers assign a plot of land to labourers for sharecropping, to keep the workforce in the area. These casual labourers put their maximum effort to utilise the land productively as terms of the agreement are for short periods. A sharecropper who works in such a manner after a certain period of time may purchase this land or other agricultural land and become registered as a landowner. This manner of settlers gaining ownership of land further causes land shortages in local communities, which consequently results in the logging of forestland for new cultivation (Dereje, 2007; Belay, 2010). According to Reusing (2000), settler demand for the expansion of grazing land to support intense livestock production has also aggravated forest degradation.

Commercial Agriculture

Commercial agricultural projects have expanded rapidly in forested areas of southwest Ethiopia. Large areas of forestland have been set aside for tea, coffee, soapberry, rubber tree, black pepper and cereal crop production investment in the region, which has resulted in a rapid decrease of forested areas in the region (Tadesse, 2007; Tezera, 2008; Dereje, 2007). For example, tea and soapberry plantations require the complete clearance of forest, while for coffee plantations, some forest trees are left for their shade. The 6,000 ha Bebeka coffee plantation is the largest and oldest in the country. Large forest land (3,000 ha) managed under the *kobbo* customary system has, for instance, been converted to a commercial tea plantation (Tadesse *et al.*, 2002). A coverage of 100 km^2 of commercial farms was reported for Sheka zone (Tadesse, 2007) and 220 km^2 for Keffa zone (Tezera, 2008). Given the increasing number of international land deals in Ethiopia (Dereje *et al.*, 2015), it is anticipated that larger areas of forest land has been allocated to commercial agriculture in recent years. Many plantations in forests were started without any environmental impact assessment (EIA). Currently, project EIAs prepared by investors are accepted by authorities (including the Environmental Protection Agency) based on trust and without verification (Tadesse, 2007). Moreover, as the government's interest now in Ethiopia is rapid development, EIAs are frequently seen as hurdles introduced to act against development activities. Such conception leads to an exploitative type of relation between investment and nature (Leykun, 2008; Tadesse, 2007).

Land clearing for commercial farming has also contributed to changing the local people's perception and respect of taboos, cultural forests and sacred sites. Furthermore, investor expansion of coffee and tea inside the farmers' land through the approach of an out-grower scheme has facilitated forest degradation in the region. To encourage such expansion, investors have provided training and thousands of tea seedlings to farmers (Tadesse, 2007; Sisay, 2008).

Land Tenure and Its Socio-Economic Impacts

Emperor Menelik II (1889–1913) confiscated land from the Keffa nobility and distributed fertile land and forests to northern landlords and loyal servants of the emperor (Wood, 1985). These feudal landlords had the right to impose taxes and to require the labour of the local peasants. In return, the landlords had the obligation of paying coffee as a tribute to the emperor. This obligation, coupled with the emerging coffee trade business and free labour, resulted in the expansion of semi-forested coffee and the transplantation of coffee seedlings in the forest and home gardens in the region (Schmitt, 2006). Tewoldeberhan (1990) states that much of the existing forest at the beginning of the 20th century was secondary growth that had developed since the late 19th century as a result of the forest being cleared for agriculture.

During the reign of Emperor Haile Selassie (1930–1974), land in southwest Ethiopia was owned either by the state or the church, and particularly, the fertile land was in the hands of northern landlords, political elites and appointed local chiefs. Additionally, landlords who gave use rights to the peasants ruled most of the forest. Because less revenue could be obtained from the degraded North, the central government had given much attention to the expansion of exportable products such as coffee in southwest Ethiopia. The increase in demand of coffee by the Arab world and Europe encouraged the northern landlords, as well as foreign merchants and investors, to cultivate coffee plantations in southwest Ethiopia in 1933 (Schmitt, 2006). Keffa began to contribute large amounts of coffee in the late 1950s and became Ethiopia's largest contributor (27%) of exportable coffee in the 1960s (Fee, 1961; Krug & De Poerck, 1968). Country-wide, the increases in exportation and in domestic consumption of coffee have led to a strong increase of the coffee production, from about 3 million bags (in 1990) to nearly 8 million bags in 2012 (Mitiku *et al.*, 2015). This increase in coffee demand encouraged the expansion of coffee farms through the clearing of virgin forests, which, coupled with peasant insecurity in land use rights, led to the degradation of the region's forests (Tewoldeberhan, 1990).

After the overthrow of the Imperial regime in 1974, the Derg regime announced a land reform programme abolishing the feudal system and nationalising all lands. Coffee plantation areas owned by foreigners and feudal landlords were confiscated by the government or redistributed amongst local peasants (Schmitt, 2006). Peasant associations distributed land to landless tenant farmers. This trend resulted in the expansion of cultivated land at the expense of forestland (Mekuria, 2005). In addition to

land distribution, peasant associations encouraged coffee and cereal production by distributing improved coffee and cereal varieties, fertiliser, agrochemicals and by disseminating modern management and marketing practices among the farmers. This encouraged the rapid expansion of cereal crops, coffee plantations and semi-forest coffee in southwest Ethiopia (Philippe, 2003; Schmitt, 2006; Mekuria, 2005). Disrupting the customary forest tenure system, weakening the local belief system and implementing development programmes, such as villagisation without the consent and willingness of the community, contributed to forest degradation in southwest Ethiopia (Stellmacher, 2005; Wood, 1993). Farmers in southwest Ethiopia live in scattered manner partly because their most vital land resources are scattered in space (Lorgen, 1999). Enforced villagisation (Yihenew, 2002) started in 1985 and had two objectives: removing people from the natural forest edges so as to reduce the pressure on the forests and providing basic social services to farmers at a centralised location (Baah *et al.*, 2000). This contributed to land use change dynamics: villagisation caused land abandonment around forest edges and initiated reversal transitions. However, this was short-lived, and later, farmers returned to their original locations exerting further pressure on the natural forest (Mekuria, 2005).

After the overthrow of the Derg regime in 1991, the EPRDF confirmed that the right to ownership of rural and urban land, as well as natural resources, is exclusive to the state and that it cannot be subjected to sale or other means of exchange (Philippe, 2003; Stellmacher, 2005; Stellmacher & Mollinga, 2009). The governmental forest policy in Ethiopia primarily focused on 'rigid conservation', hence on the exclusion of human interference, rather than on the management of forest resources. This affects the practicability of the ancestral customary forest management system in the area. For example, the lack of legal recognition of the customary institution by the government created a perception of forest resources not being a common resource, therefore every member of the community would be utilising the forest resources illegally (Zewdie, 2007).

Additionally, after 1991, the distribution of large forest areas for commercial agriculture, resettlement and the exclusion of local customary forest management in the region intensified large clearings of forests for their resources (Belay, 2010; Zewdie, 2007). The distribution of improved varieties of cereal and coffee, fertilisers, chemicals and credit services from the government facilitated the conversion to cultivated land (Mekuria, 2005). According to Dereje (2007), the increase in the price of coffee and market incentives further encouraged farmers to expand coffee cultivation both in the forest and in their garden.

The uncertainty in land and forest ownership results from the feeling among farmers that land or forest could be given or redistributed to others because all land, including the natural resources, belongs to the state. This feeling of insecurity causes further exploitation of the forests (Belay, 2010). Zewdie (2007) indicated that after the shift of ownership of forestland to the state, deforestation of the cultural forests and other forests around settlements was aggravated by the expansion of large-scale commercial farms and illegal timber extraction in the Sheka zone. This, in turn, created less responsibility for forests on the part of the local community and developed a perception of forest resources being common resources. The social, economic and cultural marginalisation of the *Manjo* community has had an immense effect on forest degradation. The marginalisation by the Keffa and Sheka people, which began during the imperial regime, forced them to live and hunt in the forest. However, the Derg regime tried to integrate these people with the rest of the society through the villagisation programme. They were assigned a plot of land. However, because of a lack of access to disease-resistant seeds or seedlings or to fertile land and lack of livestock and agricultural experience, they were forced to frequently change settlements. This, coupled with a weak position in land tenure, resulted in a shift to subsistence living, such as frequently changing agricultural locations by clearing forestland and selling wood and charcoal to villages (Zewdie, 2007; Hartmann, 2004; Gore, 1994).

Assefa (2007) and Zewdie (2007) further state that the increased demand for charcoal and wood in towns and large villages for construction and household consumption, coupled with the economic problems of densely populated rural communities, has caused immense forest degradation in the region. Nevertheless, no research was conducted on rural and urban consumption of wood fuel (Assefa, 2007; Belay, 2010).

LAND USE CHANGES

The southwestern part of the Ethiopian Highlands was completely covered by montane rainforests at the beginning of 19th century (Chaffey, 1979; Reusing, 1998, 2000). In this regard, 38·4% of the southwestern region remained covered by closed forests between 1971 and 1975 (Chaffey, 1979). In a similar study, Mekuria (2005) showed that the Bonga catchment (Figure 2) has undergone significant alteration and transformation in recent decades. The portion of large natural forest (35%) and wooded grassland (30%) in 1967 dropped to 7% natural forest and 6% wooded grassland in 2001, whereas 19% of the cultivated and settlement land in 1967 increased to 75% in 2001. Similarly, Behailu (2010) and Belay (2010) reported on the conversion of natural forests, shrubs, marshes and woodland to cultivated, grazing and settlement land in the Bench Maji and Keffa zones.

According to Dereje (2007), the 4,000 km^2 Sheko forest (Figure 2, Table II) has also undergone significant changes to the portion of forestland (71% in 1973, dropping to 48% in 2005), whereas agriculture and settlement lands increased to 15%, state coffee plantations to 5%, bare land to 10% and agroforestry to 22%. Another change was the traditional forest fallow land management that was replaced by agroforestry (Figure 5).

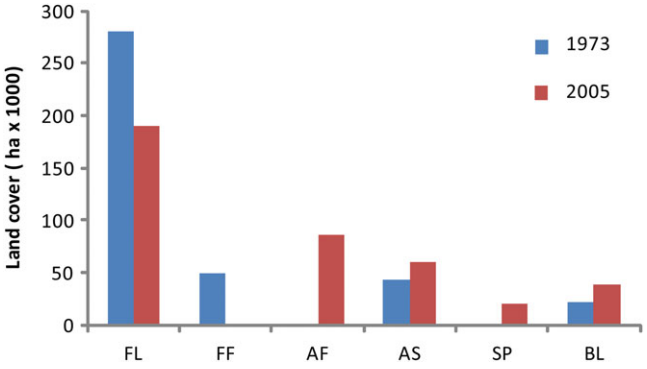

Figure 5. Land cover changes of Sheko forest between 1973 and 2005 (after Dereje, 2007). FL, forest land; FF, forest fallow land; AF, agroforestry; AS, agriculture and resettlement; BL, bare land; SP, state coffee plantation. This figure is available in colour online at wileyonlinelibrary.com/journal/ldr.

According to NTFP-participatory forest management (PFM) (2009), large clearings of coffee forestland were recorded between 1973 and 2009, with the forest coverage dropping from 74% to 59%, whereas agricultural land increased from 22% in 1973 to 36% in 2009 (Figure 6). The portion of coffee and tea estates increased from 0% in 1973 to 1·6% coffee and 0·15% tea estates in 2009. Similarly, the portion of Sheka's dense closed forests (39%) and open forests (33%) in 1987 decreased to 31% and 25%, respectively, in 2001 (Bedru, 2007). However, the portion of agriculture (6%) and tea plantations (0%) in 1987 increased to 10% and 0·5%, respectively, in 2001 (Bedru, 2007).

CONSEQUENCES OF FOREST DEGRADATION

Impacts on Biodiversity

In southwest Ethiopia, the conversion of natural forest to monoculture resulted in significant impacts on biodiversity richness (Tadesse, 2007). Monocultural tea and eucalyptus plantations instead of natural forest result in large losses of plant biodiversity, forest ecosystems and their services and the many animal species that are dependent on forest ecosystems. Tea plantations and black pepper cultivation can cope with some exotic trees; however, the soapberry *endod* (*Phytolacca dodecandra* L'Hér.) requires full land clearance for best results. Exotic tree plantations for coffee shade and as energy source for the tea processing industry have resulted in the destruction of forest ecosystems in the Sheka region. This has led to the loss of many species of birds, insects, mammals, bee colonies and microorganisms that depend on the forest ecosystem (Tadesse, 2007). Similarly, wetlands for which indigenous cultivation systems had been developed (Dixon, 2002) are excessively drained, which has led to strong decreases in species diversity (Kassahune *et al.,* 2014).

Impacts on Soil Loss and Fertility

The soils in cereal-based farming show a change in properties compared with soils in a perennial-based farming system, which are generally higher in silt, clay, available P, available K, organic carbon, total nitrogen and cation exchange capacity (CEC). Furthermore, most of the soil property values decline with increasing years of cultivation in the cereal-based farming system (Mekuria, 2005). In studies near Mizan Teferi (Getachew, 2010) and Bonga (Berhanu, 2011) (Figure 2), it was also shown that soil organic matter, total nitrogen, available phosphorus and CEC were higher in forestland than cultivated land.

Very few studies on soil erosion rates have been conducted in southwest Ethiopia. Getachew (2010) reported higher rates of soil loss (184 Mg ha^{-1} y^{-1}) in cropland compared with fallow land and forestland on the slopes of Gem mountain (Figure 7). The soil loss rate increased over time as cultivation continued after forest clearing (Figure 8). Moreover, the cultivated lands show a net soil loss with high sediment deposition on the lower and middle slopes in the early years after the start of cultivation, as well as increased

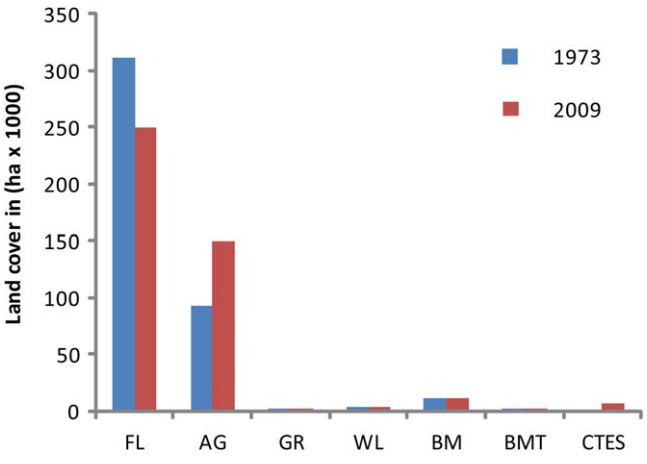

Figure 6. Land cover changes in and around the forests of Bench Maji, Sheka and Keffa zones in southwest Ethiopia between 1973 and 2009 (after NTFP-PFM, 2009). FL, forest land; AG, agriculture land; BM, bamboo; BMT, bamboo and trees; CTES, coffee and tea estate; GR, grassland; WL, wetland. This figure is available in colour online at wileyonlinelibrary.com/journal/ldr.

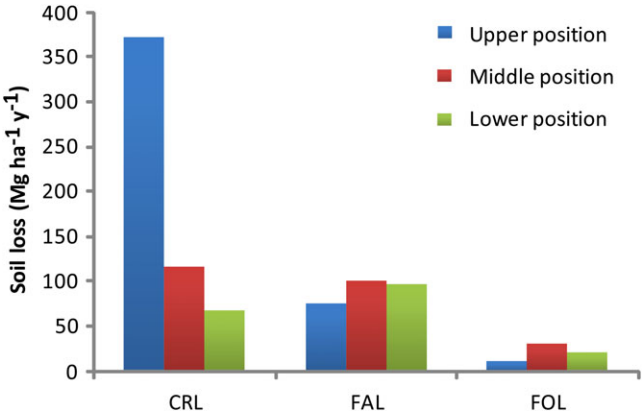

Figure 7. Rates of soil loss by water in cropped (CRL), fallow (FAL) and forest land (FOL) on upper, middle and lower slope positions in Bench Maji zone (modified from Getachew, 2010). This figure is available in colour online at wileyonlinelibrary.com/journal/ldr.

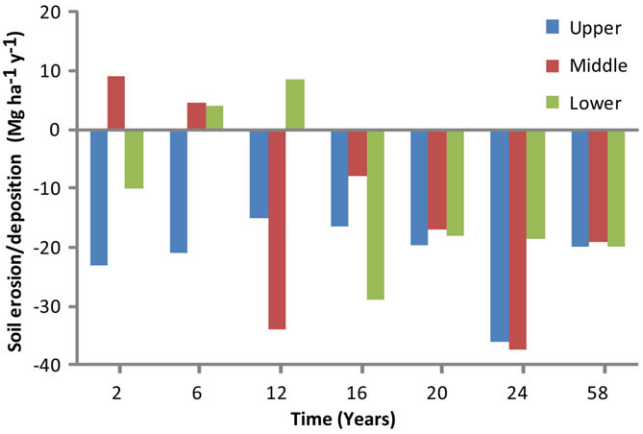

Figure 8. Soil erosion and deposition rates along the slope over time (in years since forest clearing) in a sub-catchment of Gimbo Wereda (Keffa zone); positive values indicate deposition, negative values soil loss (after Mekuria *et al.*, 2012). This figure is available in colour online at wileyonlinelibrary.com/journal/ldr.

sediment delivery to the rivers (Figure 9). Rill and gully erosion is probably the dominant process that leads to the delivery of rock fragments from the hillslopes to the drainage network (Poesen, 1987). Mekuria *et al.* (2012) found a mean annual soil loss from cultivated fields of $15 \pm 3\,\mathrm{Mg\,ha^{-1}\,y^{-1}}$, whereas Berhanu (2011) measured a soil loss of $14{\cdot}7\,\mathrm{Mg\,ha^{-1}\,y^{-1}}$ in the upper part of a catchment cultivated by settlers in the Bonga area, $11\,\mathrm{Mg\,ha^{-1}\,y^{-1}}$ in the middle part and $7{\cdot}6\,\mathrm{Mg\,ha^{-1}\,y^{-1}}$ in the lower part, which are higher soil loss rates than in a nearby catchment cultivated by natives.

Field observations show the presence of ancient debris flows and recent landslide scars, but its extent has not been studied. Possible linkages to deforestation are through (1) decreased shearing resistance of soils after disappearance of root cohesion (Ammann *et al.,* 2009) and (2) river downcutting, which leads to increased sediment delivery to rivers, as observed in the study area by Broothaerts *et al.* (2012).

Impact on the Local Communities' Livelihood and Culture

The livelihood of southwest Ethiopia's farmers largely relies on production of NTFPs such as honey, spices, medicinal plants, fodder, fuelwood and construction materials. Wetlands provided thatching materials, fodder, year-round water and medicinal plants (Kassahune *et al.,* 2014). Problems related to the conversion of forests (and wetlands) to other land uses in line with agricultural investment and resettlement has resulted in altered livelihood strategies by the local community, which further exacerbates rural poverty and migration (Zewdie, 2007; Moti *et al.,* 2011). Cereal crop production requires improved varieties and high inputs, which is less affordable for most farmers. This is a challenge compared with the forest NTFPS, which do not require much input (Mekuria, 2005). Finally, the large-scale clearing of cultural forests without the consent of the local community affects the cultural practices of the local community who consider the forests as sacred places (Zewdie, 2007).

CONSERVATION EFFORTS

Biodiversity Conservation

The issue of *in situ* wild coffee conservation has received attention since 1998 when the coffee improvement project of Ethiopia proposed the establishment of three *in situ* conservation reserves in the southwestern forests (Demel, 1996). The Kontir-Berhane forest and the Buginda forest

Figure 9. Gravel bars in the Eseni river near Aman (6·9481°N, 35·5495°E). Local residents claim that the occurrence of gravel and sand in river beds is a new phenomenon that occurred after deforestation. The coarse material is commonly related to increased rill and gully erosion and peak flow discharges, but part of this material could also have been delivered by landslides entering the river. This figure is available in colour online at wileyonlinelibrary.com/journal/ldr.

(Figure 2) were among the first priority areas for the *in situ* conservation of wild coffee's genetic resources, but for a variety of reasons, the project ceased in 2008. However, a new approach to forest management with the dual purpose of conservation and development through participatory management of the *in situ* conservation of wild coffee was started in the Bench Maji and Keffa zones (WCC-PFM, 2011; FARM Africa & SOS Sahel-PFM, 2004). The introduction of PFM was designed to shift the management of the forest from the government to the community. The forest areas were placed under the PFM programme to reduce environmental degradation, increase sustainable forest conservation, conserve the ecosystem and improve the welfare of the local community (Gobeze *et al.,* 2009; Stellmacher & Mollinga, 2009).

However, through an in-depth ethnographic case study in the Agama forest (part of the Koma forest), Vandenabeele (2012) showed that the NGOs initiating the PFM face challenges because of missing to incorporate the local community's historical background and the socio-political context in the conceptual framework of the PFM. For instance, the community-based institutions (forest cooperatives) developed by the NGOs failed to achieve the desired goal of PFM because local power relations were insufficiently considered. To be more precise, although government representatives signed an agreement to share resources and responsibilities with communities, 'the long-standing uneven relationships between the government and local people hardly changed' (Ayana *et al.,* 2015).

The Keffa and Sheka forests were registered as UNESCO biosphere reserves in 2010 and 2012. The biosphere reserve approach aims to conserve biodiversity and improve the livelihoods of the local community through innovative marketing of their products, environmentally friendly agriculture and ecotourism (Figure 10). It also promotes education and research as well as interaction with global networks (Berghöfer *et al.*, 2013; Tadesse & Fite, 2011). For example, ca. 10,000 tourists visited Keffa in 2008 of which 200 were foreigners (Tezera, 2008; Berghöfer *et al.*, 2013). The Bebeka coffee plantation also organises touristic activities on its estate.

Farmer cooperatives (ca. 10,000 ha in Keffa) are supplying NTFPs such as high quality organic coffee, spice and honey for export to the international market (Berghöfer *et al.,* 2013). Mitiku *et al.* (2015) showed that especially Rainforest Alliance certification (followed by Fairtrade) improved the incomes of coffee producers.

Soil Conservation

Soil conservation is essential because soil is the medium of plant growth; it provides essential nutrients, water and physical support. For instance, soil organic matter and carbon are essential to maintain soil structure and its water holding capacity to supply nutrients and to sustain biological. Soil macronutrients like nitrogen, available phosphorus and potassium are the three most important soil nutrients required for plant growth. The CEC determines the soil ability to retain positively charged nutrients like Ca^{2+}, Mg^{2+}, NH_4^+, K^+ and Na^+. Maintaining those physical and chemical characteristics of the soil has an important role for sustainable plant growth.

The majority of the cereal-based farming in the southwestern Ethiopian highlands is, however, accomplished without soil conservation measures (FARM Africa & SOS Sahel-PFM, 2004), and a nationwide map shows that in the study area, conservation structures are installed on less than 1% of the cropland, in contrast to 20–75% in central and northern Ethiopia (Hurni *et al.,* 2015). Major reasons

Figure 10. Promotion of ecotourism in Keffa. This figure is available in colour online at wileyonlinelibrary.com/journal/ldr.

for absence of soil conservation on cropland in the study area (i) a perceived absence of urgent need for conservation, given the recent deforestation and hence availability of still relatively deep soils (Yesuf *et al.,* 2005) and (ii) absence of 'food-for-work' programmes or other financial or policy incentives for conservation activities (*sensu* Shiferaw & Holden, 1997), because overall, the area is not considered as food insecure. However, Baye & Terefe (2009) indicated that introduced vetiver grass (*Vetiveria zizanioides* L) plays a crucial role in controlling runoff, soil erosion and in stabilising steep slopes inside coffee, rubber, fruit and cereal fields. Accordingly, the office of agriculture and other governmental institutions in the Bench Maji, Keffa and Sheka zones are reproducing and distributing vetiver grass, indigenous and nitrogen-fixing trees to agricultural land on steep slopes (pers. comm. Nardose Takele, 2013; own observations). Nevertheless, vetiver grass is not really taken up by the communities because of its space occupied, non-palatable nature and decreased need for thatching given the wide introduction of metal sheets for roofing (based on interviews in villages of Bench Maji zone).

DISCUSSION

Drivers of Land use Changes in Southwest Ethiopia

From the perspective of forest cover change, Reusing (2000); Mekuria (2005); Bedru (2007); Dereje (2007) and Belay (2010) are in agreement with the identified causes of Geist & Lambin (2002); Lambin *et al.* (2003) and Kabanza *et al.* (2013), who showed that forest cover changes are driven by a complex of underlying causes rather than by single factors such as 'shifting cultivation' or 'increasing population' pressure.

The forest degradation related to resettlement has been driven by the increase in population, government policy and economic factors. The introduction of a new unsustainable farming system, the increased demand for land, fuel wood and construction wood for a growing population, the illegal expansion of agriculture and grazing land and the policy choice to have settlers achieve food security at the expense of available natural resources provokes the degradation of dense natural forests in the settlement areas (Mekuria, 2005; Reusing, 2000; Behailu, 2010; Belay, 2010). Similarly, Geist & Lambin (2002) indicate that the immigration of settlers in less populated regions increased the deforestation in Africa and Latin America (Geist & Lambin, 2002). In contrast, Kabanza *et al.* (2013) showed that where population density was the highest in southeastern Tanzania, large areas of cropland and bushland were converted to cashew tree cultivation, which represents a case of 'more people, more trees'.

In a country like Ethiopia, where agriculture is a mainstay for the livelihoods of the majority of the population, a natural or man-made failure in agriculture could have a tremendous effect on the food security of a population. Thus, resettlement is considered to be the easiest solution to curb the problem temporarily or permanently. However, as shown here, such resettlement programmes have a profound impact on the environment. In addition, population increase, market access and government land policy enforceability further exacerbated the extent and degree of forest degradation.

Forest degradation related to the expansion of large-scale commercial agriculture has been driven by national and international market demand and government tenure policy. The rapid expansion of large-scale private cash crops (coffee, tea, *endod*, rubber tree, pepper and cereals), the expansion of the out-grower scheme approach, a large demand for tea and illegal logging for the expansion of commercial farmland have resulted in the large-scale destruction of ecologically important forest resources. Furthermore, weak law enforcement by the government, which is in need of foreign currency, has resulted in the large-scale degradation of forestland (Tadesse, 2007; Bedru, 2007; Tezera, 2008; Dereje, 2007). Similarly, Lambin *et al.* (2003) indicated that commercialisation and the increase in growth of the national and international market as well as market failure have driven deforestation in Indonesia, where the presence of ill-defined policy and weak institutional enforcement has resulted in an increase in extensive illegal logging. Furthermore, Barbier (1997) showed that economic factors and policies have a direct impact on the decision-making of land managers. Forest degradation related to the expansion of large-scale commercial farms stems from crop selection, national and international markets, investors' perceptions about ecology and technological factors. Market-oriented and profit-oriented agricultural investments always have short-term or long-term impacts on the environment because of a higher priority assigned to profit maximisation than to ecological issues. Furthermore, poor environmental impact assessments and policy enforcement on investment projects have led to uncontrolled and unbalanced decisions concerning the environment. The government tenure policy has a significant impact on the sustainability of natural resources. Provision of ownership rights is of great importance on the behaviour of individuals towards resource utilisation and care. A feeling of insecurity about resources results in suspicion, less motivation to conserve and, consequently, leads to fear-motivated decision-making over resource utilisation, as also demonstrated by Kalema *et al.* (2015) in other parts of Equatorial Africa. In contrast, Liscow (2013) indicated that strong protection of property rights in Nicaragua encouraged agricultural investment and consequently led to accelerated deforestation. Yet, in their meta-analysis of the relationship between land tenure and tropical deforestation, Robinson *et al.* (2014) showed that, overall, greater land tenure security is associated with a slow rate of deforestation.

The unconsented villagisation programme caused local communities, which were dependent on forests for their livelihoods, to feel insecure, which further caused a shift in livelihoods, such as logging timber for sale to the village and further forest degradation when returning to their original

location (Zewdie, 2007; Mekuria, 2005). Similarly, Kikula (1997) indicated that the villagisation programme in Tanzania has had long-term negative environmental impacts such as forest cover decrease and land degradation. Kabanza *et al.* (2013) also showed that villagisation resulted in a decline in forest cover in the Makonde plateau in southeastern Tanzania, even though the villagisation policy was enacted with the intention to reduce the impact on the forests and to provide collective social services. However, villagisation works only when the people consent to the programme; otherwise, it has a strong impact on the environment by alternating the utilisation of resources in the new and in the previous place. Villagisation was perceived as temporary, which consequently led to the rapid and less sustainable utilisation of natural resources.

Governmental policy's direction towards promoting the large-scale and small-scale expansion of cash crops for national and international markets has resulted in forest degradation. The distribution of inorganic fertilisers, improved varieties of coffee and cereals, pesticides, credit services for farmers and market facilities have resulted in the rapid expansion of crop and coffee land at the expense of forests (Mekuria, 2005; Belay, 2010). Similarly, Turner (1999) indicated that the provision of better access to credit, improved crop varieties and markets can potentially encourage more deforestation rather than relieving pressure on the forest (Turner, 1999). Geist & Lambin (2002) also showed that economic factors are prominent underlying forces of tropical deforestation. High demand in national and international markets for commercialisation hastened deforestation. Land tenure and agricultural policy have been organised to promote cash crop expansion. The policy direction towards securing food demand at the local, regional and national level and a need to increase foreign income has resulted in forest degradation. A policy direction that promotes market-oriented production at the expense of forests could be catastrophic in the long run.

Although the intent of nationalising forest resources has been to better protect them, ignoring the cultural and socio-economic tie of local people with the forest exacerbated forest degradation. According to Zewdie (2007), the customary land tenure system played a pivotal role in the sustainable management of forests in the region. Typically, traditional leaders claim authority over land and natural resources by referring to their pivotal role in the relationship they maintain between local people and place by mediating between the material and the spiritual world (Dondeyne *et al.,* 2012; Virtanen, 2005; Convery, 2006). The customary tenure system and culturally oriented ecological tie are important for the conservation of forest ecosystems as sites, such as springs, pools, rivers, forests, rocks and mountains are valued and respected because of their ancestral spiritual tie with the local community. So, despite the government attempts – indeed under the various political regimes – to undo the traditional customary tenure rules of access to land, these still *de facto* function to some extent. Formal recognition of these institutions could be beneficial to the conservation and sustainable management of the forest resources.

Impacts of Land use Changes on Natural Resources

Tadesse (2007) and Moti *et al.* (2011) showed that the conversion of forests to monocultures has significantly contributed to a loss of biodiversity in the region. This finding is in agreement with the findings of Thiollay (1997, 1999); Onderdonk & Chapman (1999); Hamer *et al.* (1996) and Vasconcelos (1999). Changes in forest cover, structure and composition have detrimental effects on the disturbance and survival of plant and animal diversity. Thiollay (1997, 1999); Schulze *et al.* (2000); Vasconcelos (1999); Hamer *et al.* (1996) and Onderdonk & Chapman (1999) found that changes in forest structure negatively affect the composition and diversity of microorganisms, insects, birds and primates. Habitat conversion or modification by humans to produce goods and services is the most substantial human alteration of ecosystems threatening biodiversity (Chapin *et al.,* 2000). The conversion of forestland to monocultures has irreversible effects on biodiversity loss. Forests play an important role in creating positive ecological conditions for understory plants, animals, microorganisms, insects and birds. The disturbance and removal of the forest result in the disturbance of habitats, food and water sources of other organisms, which result in the migration and death of living organisms that depend on the forest. Worldwide, Runyan *et al.* (2012) showed that deforestation leads to a rapid decline of mycorrhizal fungi, Rhizobium sp. and soil microbial population.

Also in line with Runyan *et al.* (2012), the conversion of forests to other land uses leads to a significant decrease of soil fertility in the study area (Getachew, 2010; Berhanu, 2011; Mekuria, 2005; Mulugeta *et al.,* 2005a, 2005b). Furthermore, in the study area, Getachew (2010); Alemneh (1990) and Solomon (1994) showed that soil loss from cultivated land is higher than from forestland, which is in agreement with Lal (1996) who found that the conversion of forests into an annual cropping system results in high runoff and accelerated soil erosion, which may result in the loss of soil nutrients through the removal of fine earth. Berhanu (2011) and Getachew (2010) showed that soil loss from the upper section of the cultivated land is higher than the middle and lower sections, which is in agreement with Lal (1990) and Woldeamlak & Sterk (2003). Soil loss from cultivated land in southwest Ethiopia is higher than (Getachew, 2010) or equal to (Mekuria *et al.,* 2012; Berhanu, 2011) the soil formation rates for warm humid agroecologies in Ethiopia, modelled at $18\,\mathrm{Mg\,ha^{-1}\,y^{-1}}$ (Hurni, 1983). In addition, with time, soil loss rates increase in line with declining soil structure and organic matter content (Getachew, 2010), what will lead to irreversible degradation, in line with findings by Runyan *et al.* (2012) worldwide.

Generally, the studies by Getachew (2010); Berhanu (2011) and Mekuria (2005) are in agreement with Warren (2002): land degradation cannot be judged independently of its spatial, temporal, economic,

environmental and cultural context. That is to say, while analysing land degradation in space and time, not only does the limitation of natural conditions have to be considered but also the roles of the socio-economic and cultural driving forces (Warren, 2002).

The forest has a large role in buffering runoff response and reducing soil loss (Assefa, 2007), as well as in the enhancement of soil fertility, which allows the production of high quality NTFPs (Tezera, 2008). However, conversion of the forest to other land uses has short-term and long-term effects on soil fertility and soil loss. Subsistence farmers in Ethiopia who are less likely to use inorganic fertiliser cultivate crops continuously in the same field without any amendments or fallow periods. This results in less productive and degraded land.

Conservation and Conservation Policies

The presence of high species diversity and the increased and continual threat on the forest has encouraged conservation to reduce the risk of biodiversity loss, land degradation and socio-economic impacts. According to Baye & Terefe (2009), biological soil and water conservation techniques play an important role in controlling runoff and sediment transport. *In situ* conservation of wild coffee in the forest with the intention to shift the management of the forest from the government to the community through PFM contributed to the conservation of wild coffee and forests and generated income for the local community. Other conservation efforts, such as registration with UNESCO's biosphere reserves, have played an important role by strengthening biodiversity conservation, improving the local community's livelihood and promoting environmentally friendly agriculture and ecotourism. Because the cause for land use and land cover changes are diverse and are the result of different interacting factors, diverse strategies are needed to tackle the forest degradation problem other than simply giving more priority to strict conservation rules.

CONCLUSIONS

The southwestern Ethiopian highland forests, one of the most biodiverse forests in Ethiopia, have been traditionally managed as agroforestry systems. The major drivers of deforestation and land cover change in the region are expansion of commercial agriculture, resettlement, shifts in tenure arrangements and related socio-economic and cultural changes, which cause the expansion of cereal cropping, settlements, grazing land and coffee and tea farms at the expense of closed and dense forests. This review aimed at contributing to design strategies to prevent a catastrophic shift from reversible to irreversible land degradation. The conversion of natural forests and forest-based cropping to cereal monocultures resulted in a great loss of species of birds, insects, mammals, bee colonies and microorganisms. Additionally, following the conversion, the extent of soil degradation increased rapidly as a result of agricultural expansion and settlement, and the degradation might be irreversible in many of these places. The soil fertility of cultivated land declined with an increasing number of years of cultivation. The few soil erosion measurements available show that soil loss is particularly high at the upper position of the cultivated land and generally equal or larger than the estimated rates of soil formation. The conversion also has socio-economic impacts; traditional production of honey, spices, medicine, fodder, fuelwood and construction materials, which are used for consumption and for sale, have been affected. The clearing of forests has also affected the cultural practices of the local communities who consider them to be sacred. Conservation of forests and rehabilitation of degraded lands have received minimal priority, though, because of the continuous threat on it, the southwestern forests are demarcated as a National Forest Priority Area and have also been registered as a UNESCO biosphere reserve. The establishment of a sustainable agricultural system in southwest Ethiopia will especially require a change in paradigm, whereby the intrinsic values of the traditional forest-based agricultural system are recognised, rather than the ongoing mimicking of agricultural policies that were developed for the open fields of central Ethiopia.

ACKNOWLEDGEMENTS

This study was conducted in the framework of the STRONGBOW project, a cooperation between five Ethiopian Universities (including Mizan-Tepi University), the Horn of Africa Regional Environmental Centre, VU University Amsterdam (Netherlands), University of Leuven and Ghent University (Belgium), funded by NUFFIC (Netherlands). The project managers and staff are sincerely thanked for their cooperation. The Bench Maji, Semen Bench district and Debub Bench district agricultural offices and NTFPS provided valuable information and materials for this study, as well as Mekuria Argaw, Ashiber Berhie, Sisay Tomas, Abebe Abay, Girma Wolda, Getachew Mekuria and Yassin Nurahmed. Many inhabitants of the study area are thanked for giving information and other support. Last but not least, Paolo D'Odorico and Artemi Cerdà are thanked for the constructive comments on an earlier version of this work.

REFERENCES

Akalu A. 1982. The process of land nationalization in Ethiopia: land nationalization and the peasants. Bloms Boktryckeri: Lund, Sweden.

Aklilu Y. 2003. Comparative phonology of the Maji languages. *Journal of Ethiopian Studies* **36**: 59–88.

Alemneh D. 1990. Environment, famine and politics in Ethiopia: a view from the village. Lynne Rienner Publishers Inc: USA.

Ammann M, Böll A, Rickli C, Speck T, Holdenrieder O. 2009. Significance of tree root decomposition for shallow landslides. *Forest Snow and Landscape Research* **82**: 79–94.

Anteneh A. 2006. The role of coffee based agroforestry on food security for smallholder in Bench Woreda, Kite; Southwestern Ethiopia. MSc. Thesis in Tropical Land Resource Management, Mekelle University, Ethiopia.

Assefa S. 2007. Economic value of afromontane natural forest in Sheka zone, southwestern Ethiopia: a clue for advocacy and informed decision

making. In Forests of Sheka: multidisciplinary case studies on impact of land use/land cover change, southwest Ethiopia, Fetene M (ed). MELCA Mahiber: Addis Ababa; 183–218.

Ayana AN, Vandenabeele N, Arts B. 2015. Performance of participatory forest management in Ethiopia: institutional arrangement versus local practices. *Critical Policy Studies* **15**: 1–20. DOI:10.1080/19460171.2015.1024703.

Baah F, Taye K, Kumar S, Okwadi J, Pozo EA, Africa Z. 2000. Natural resources under threat: an analysis of the farming systems of Gimbo Woreda, Kefa-Sheka zone. Working Document Series 84, Ethiopia-2000. International Center for Development Oriented Research in Agriculture (ICRA), Wageningen, The Netherlands.

Barbier EB. 1997. The economic determinants of land degradation in developing countries. *Philosophical Transactions of the Royal Society of London B: Biological Sciences* **352**: 891–899. DOI:10.1098/rstb.1997.0068.

Baye M, Terefe B. 2009. The experience of coffee plantation development enterprise in Ethiopia. Ethiopia workshop paper. Addis Ababa.

Beccaluva L, Beccaluva G, Wilson BM. 2011. Volcanism and evolution of the African lithosphere. *Geological Society of America, Special Paper* **478**: 1–333.

Bedru S. 2007. Land use/land cover changes in Andracha and Masha *Woreda*s of Sheka Zone, SNNP Regional State. A clue for advocacy and informed decision making. In Forests of Sheka: multidisciplinary case studies on impact of land use/land cover change, southwest Ethiopia, Fetene M (ed). MELCA Mahiber: Addis Ababa; 21–56.

Behailu A. 2010. Land use and land cover analysis and modeling in south western Ethiopia: the case of selected resettlement kebeles in Gimbo Woreda. MSc. Thesis in Environmental Science, Addis Ababa University. Ethiopia.

Belay H. 2010. Resettlement induced land use changes and their impact on non-timber forest products production activities in Guraferda resettlement sites, Bench-Maji Zone, SNNPR. MSc. Thesis, Addis Ababa University, Ethiopia.

Belay K. 2004. Resettlement of peasants in Ethiopia. *Journal of Rural Development* **27**: 223–253.

Belay KT, Van Rompaey A, Poesen J, Van Bruyssel S, Deckers J, Amare K. 2015. Spatial analysis of land cover changes in eastern Tigray (Ethiopia) from 1965 to 2007: are there signs of a forest transition? *Land Degradation & Development* **26**: 680–689. DOI:10.1002/ldr.2275.

Bender-Kaphengst S. 2011. Saving the wild coffee forests. Joint forces for Kafa Biosphere Reserve in Ethiopia. In Biosphere reserves in the mountains of the world. Excellence in the clouds? Austrian MAB Committee (ed). Austrian MAB Committee: Vienna; 89–92.

Berghöfer A, Stadler C, Langdale G. 2013. Sustaining life: the cloud forests of Kafa: marketing concept for the Kafa Biosphere Reserve, Ethiopia. Report to NABU–The Nature and Biodiversity Conservation Union. Berlin, Germany.

Berhanu A. 2011. Impact of resettlement on soil quality and management practices: the case of Gimbo Woreda, Keffa Zone, SNNPR, Ethiopia. MSc. Thesis in Environmental science, Addis Ababa University, Ethiopia.

Broothaerts N, Kissi E, Poesen J, Van Rompaey A, Getahun K, Van Ranst E, Diels J. 2012. Spatial patterns, causes and consequences of landslides in the Gilgel Gibe catchment, SW Ethiopia. *Catena* **97**: 127–136. DOI:10.1016/j.catena.2012.05.011.

Chaffey DR. 1979. South-west Ethiopia forest inventory project: a reconnaissance inventory of forest in south-west Ethiopia. Ministry of Overseas Development, Land Resources Development Centre: Surrey (UK).

Chapin FS, Zavaleta ES, Eviner VT, Naylor RL, Vitousek PM, Reynolds HL, Hooper DU, Lavorel S, Sala OE, Hobbie SE, Mack MC, Díaz S. 2000. Consequences of changing biodiversity. *Nature* **405**: 234–242. DOI:10.1038/35012241.

Clarke J. 1986. Resettlement and rehabilitation: Ethiopia's campaign against famine. Harney & Jones Ltd: London.

Convery I. 2006. Lifescapes and governance: the régulo system in central Mozambique. *Review of African Political Economy* **109**: 449–66. DOI:10.1080/03056240601000846.

De Jong W, Chokkalingam U, Perera GA. 2001. The evolution of swidden fallow secondary forests in Asia. *Journal of Tropical Forest Science* **13**: 800–815.

Demel T. 1996. Seed ecology and regeneration in dry Afromontane forests of Ethiopia. Doctoral Thesis. Swedish University of Agriculture Sciences, Umeå, Sweden.

de Mûelenaere S, Frankl A, Haile M, Poesen J, Deckers J, Munro N, Veraverbeke S, Nyssen J. 2014. Historical landscape photographs for calibration of landsat land use/cover in the northern Ethiopian highlands. *Land Degradation & Development* **25**: 319–335. DOI:10.1002/ldr.2142.

Dereje T. 2007. Forest cover change and socioeconomic drivers in southwest Ethiopia. MSc. Thesis, University of Munchen, Germany.

Dereje T, Tadesse W. 2007. Customary forest tenure in southwest Ethiopia. *Forests, Trees and Livelihoods* **17**: 325–338. DOI:10.1080/14728028.2007.9752607.

Dereje T, Azadi H, Nyssen J, Mitiku H, Witlox F. 2015. Transnational land deals: towards an inclusive land governance framework. *Land Use Policy* **42**: 781–789. DOI:10.1016/j.landusepol.2014.09.021.

Dessalegn R. 2003. Resettlement in Ethiopia. The tragedy of population relocation in the 1980s. Forum of Social Studies: Addis Ababa.

Dewitte O, Jones A, Spaargaren O, Breuning-Madsen H, Brossard M, Dampha A, Deckers J, Gallali T, Hallett S, Jones R, Kilasara M. 2013. Harmonisation of the soil map of Africa at the continental scale. *Geoderma* **211**: 138–153. DOI:10.1016/j.geoderma.2013.07.007.

Dixon AB. 2002. The hydrological impacts and sustainability of wetland drainage cultivation in Illubabor, Ethiopia. *Land Degradation & Development* **13**: 17–31. DOI:10.1002/ldr.479.

Dondeyne S, Kaarhus R, Allison G. 2012. Natural conservation, rural development and ecotourism in central Mozambique: which space do local communities get? In Making sense of place: multidisciplinary perspectives, Convery I, Corsane G, Davis P (eds). The Boydell Press: Woodbridge; 291–301.

Ehret C. 1979. On the antiquity of agriculture in Ethiopia. *Journal of African History* **20**: 161–177. DOI:10.1017/S002185370001700X.

Engdawork A, Bork H. 2016. Farmers' perception of land degradation and traditional knowledge in southern Ethiopia – resilience and stability. *Land Degradation & Development* Article in Press. DOI:10.1002/ldr.2364.

Ensermu K, Teshome S. 2004. Biodiversity, ecological and regeneration studies in Bonga, Borena and Chilimo forests, Technical Report Prepared for FARM-Africa, SOS-Sahel, Addis Ababa.

FAO Forestry. 1999. Towards a harmonised definition of non-wood forest products. *Unasylva* **50**: 63–64.

FARM Africa, SOS Sahel-PFM. 2004. "Transforming lives and landscapes": linking agroforestry and NTFPs farmers to the market (project profile). UK Participatory Forest Management Programme (PFMP).

Fazzini M, Bisci C, Billi P. 2015. The climate of Ethiopia. In Landscapes and landforms of Ethiopia, Billi P (ed). Springer: Netherlands; 65–87 DOI: 10.1007/978-94-017-8026-1_3.

Fee C. 1961. Coffee. In Agriculture in Ethiopia, Huffnagel HP (ed). FAO: Rome; 204–227.

Feyera S 2006. Biodiversity and ecology of Afromontane rainforests with wild *Coffea arabica* L. populations in Ethiopia. Doctoral Thesis. ZEF-Ecology and Development Series No. 38, ISBN-3-86537-807-2. University of Bonn, Germany.

Feyissa A, Mebrate M. 1994. Provenance trial of *Cordia africana*. In Provenance trials of some exotic and indigenous tree species. Research Note No. 3, Forestry Research Centre: Addis Abeba; 81–96.

Fleskens L, Jorritsma F. 2010. A behavioral change perspective of maroon soil fertility management in traditional shifting cultivation in Suriname. *Human Ecology* **38**: 217–236. DOI:10.1007/s10745-010-9307-5.

Friis I. 1992. Forests and forest trees of northeast tropical Africa: their natural habitats and distribution patterns in Ethiopia, Djibouti and Somalia, *Kew Bulletin Additional Series* **15**. Royal Botanical Gardens: London.

Friis I, Rasmussen FN, Vollesen K. 1982. Studies in the flora and vegetation of SW Ethiopia. *Opera Botanica* **63**: 1–70.

Fujimoto T. 2009. Taro (*Colocasia esculenta* [L.] Schott) cultivation in vertical wet-dry environments: farmers' techniques and cultivar diversity in southwestern Ethiopia. *Economic Botany* **63**: 152–66. DOI:10.1007/s12231-009-9074-7.

Gemedo D, Simon S. 2007. Species richness and conservation status of some ecologically and economically important species in Sheko forest. Paper presented at Tropentag 2007, Witzenhausen, Germany.

Geist HJ, Lambin EF. 2002. Proximate causes and underlying driving forces of tropical deforestation. *Bioscience* **52**: 143–150. DOI:10.1641/0006-3568(2002)052[0143:PCAUDF]2.0.CO;2.

Getachew M. 2010. Significance of traditional land use practices and landscape positions on soil degradation in Gem Mountain at Mizan Teferi. MSc. Thesis, Mekelle University, Ethiopia.

Gezahegn P. 2003. Differentiation and integration: craft-workers and Manjo in the social stratification of Kafa, southern Ethiopia. MSc. Thesis, University of Bergen, Norway.

Gobeze T, Bekele M, Lemenih M, Kassa H. 2009. Participatory forest management and its impacts on livelihoods and forest status: the case of Bonga forest in Ethiopia. *International Forestry Review* **11**: 346–358. DOI:10.1505/ifor.11.3.346.

Goebel W, Odenyo, V. 1984. Ethiopia. Agroclimatic resources inventory for land-use planning. Ministry of Agriculture, Land Use Planning and Regulatory Department, UNDP, FAO. Technical report DP/ETH/78/003, vol. I. 208 pp; vol. II. 95 pp.

Gore C 1994. Social exclusion and Africa south of the Sahara: a review of the literature. Geneva: International Institute for Labour Studies, Discussion Paper **62**.

Hamer KC, Hill JK, Lace LA, Langan AM. 1996. Ecological and biogeographical effects of forest disturbance on tropical butterflies of Sumba, Indonesia. *Journal of Biogeography* **24**: 67–75. DOI:10.1111/j.1365-2699.1997.tb00051.x.

Hansen MC, Potapov PV, Moore R, Hancher M, Turubanova SA, Tyukavina A, Thau D, Stehman SV, Goetz SJ, Loveland TR, Kommareddy A, Egorov A, Chini L, Justice CO, Townshend JRG. 2013. High-resolution global maps of 21st-century forest cover change. *Science* **342**: 850–853. DOI:10.1126/science.1244693.

Haregeweyn N, Poesen J, Deckers J, Nyssen J, Haile M, Govers G, Verstraeten G, Moeyersons J. 2008. Sediment-bound nutrient export from micro-dam catchments in northern Ethiopia. *Land Degradation & Development* **19**: 136–152. DOI:10.1002/ldr.830.

Hartmann I. 2004. "No tree, no bee – no honey, no money": the management of resources and marginalization in beekeeping societies of southwest Ethiopia. Millennium Ecosystem Assessment conference, "Bridging Scales and Epistemologies: Linking Local Knowledge and Global Science in Multi-Scale Assessments", Alexandria, Egypt.

Huntingford G. 1955. The Galla of Ethiopia: the kingdoms of Kafa and Janjero, Vol. **6**. International African Institute: London.

Hurni H. 1983. Soil formation rates in Ethiopia (with scale 1: 1,000,000). Ethiopian Highlands Reclamation Study, UTF/ETH/O37/ETH. Roma: FAO, working paper 2.

Hurni H. 1988. Degradation and conservation of the resources in the Ethiopian highlands. *Mountain Research and Development* **8**: 123–130. DOI:10.2307/3673438.

Hurni K, Zeleke G, Kassie M, Tegegne B, Kassawmar T, Teferi E, Moges A, Tadesse D, Ahmed M, Degu Y, Kebebew Z, Hodel E, Amdihun A, Mekuriaw A, Debele B, Deichert G, Hurni H. 2015. Economics of land degradation (ELD) Ethiopia case study. Soil degradation and sustainable land management in the rainfed agricultural areas of Ethiopia: an assessment of the economic implications. Report for the Economics of Land Degradation Initiative.

IFPRI, CSA. 2006. Atlas of the Ethiopian rural economy. International Food Policy Research Institute, Washington, DC, USA and the Central Statistical Agency: Addis Ababa, Ethiopia.

Jacomijn S. 2006. Local valuation of forests in south west Ethiopia. Non Timber Forest Products Research and Development Project in S-W Ethiopia. Wageningen University, Student Research Series No. 6. Wageningen, The Netherlands.

Kabanza AK, Dondeyne S, Tenga JJ, Kimaro DN, Poesen J, Kafiriti E, Deckers J. 2013. More people, more trees in south eastern Tanzania: local and global drivers of land-use change. *African Geographical Review* **32**: 44–58. DOI:10.1080/19376812.2012.746093.

Kalema VN, Witkowski ETF, Erasmus BFN, Mwavu EN. 2015. The impacts of changes in land use on woodlands in an equatorial African savanna. *Land Degradation & Development* **26**: 632–641. DOI:10.1002/ldr.2279.

Kassahune M, Debela H, Endalkachew K. 2014. Impacts of wetland cultivation on plant diversity and soil fertility in South-Bench district, Southwest Ethiopia. *African Journal of Agricultural Research* **9**: 2936–2947. DOI:10.5897/AJAR2013.7986.

Kazmin V. 1972. Geological map of Ethiopia 1:2,000,000. Geological Survey of Ethiopia, Ministry of Mines, Energy and Water Resources: Addis Ababa.

Keller EJ. 1991. The politics of resettlement; The politics of villagization. In Ethiopia: a country study, Ofcansky TP, Berry LB (eds). Federal Research Division, Library of Congress: Washington DC; 232–234.

Kikula IS. 1997. Policy implications on environment: the case of villagisation in Tanzania. Dar es Salaam University Press (DUP): Dar es Salaam; 327.

Kloos H, Aynalem A. 1989. Settler migration: causes, patterns of movement and some demographic impacts. Proceedings of the Workshop on Famine Experience and Resettlement in Ethiopia. 29–30 December 1988, Institute of Development Research, Addis Ababa University.

Kochito M. 2008. Assessment of the traditional medicinal plants, their management and conservation status in Gimbo Woreda, Kafa Zone. MSc. Thesis, Addis Ababa University, Ethiopia.

Kraaijvanger R, Veldkamp T. 2015. Grain productivity, fertilizer response and nutrient balance of farming systems in Tigray, Ethiopia: a multi-perspective view in relation to soil fertility degradation. *Land Degradation & Development* **26**: 701–710. DOI:10.1002/ldr.2330.

Krug CA, De Poerck RA. 1968. World coffee survey, Vol. **76**. FAO: Rome.

Kuls W. 1962. Land, Wirtschaft und Siedlung der Gumuz im Westen von Godjam (Äthiopien). *Paideuma* **8**: 45–61.

Labouisse JP, Bellachew B, Kotecha S, Bertrand B. 2008. Current status of coffee (*Coffea arabica* L.) genetic resources in Ethiopia: implications for conservation. *Genetic Resources and Crop Evolution* **55**: 1079–1093. DOI:10.1007/s10722-008-9361-7.

Lal R. 1990. Soil erosion in the tropics: principles and management. McGraw-Hill. Inc.: USA.

Lal R. 1996. Deforestation and land use effects on soil degradation and rehabilitation in western Nigeria. II. Soil chemical properties. *Land Degradation & Development* **7**: 87–98. DOI:10.1002/(SICI)1099-145X(199606)7:2<87::AID-LDR219>3.0.CO;2-X.

Lambin EF, Geist HJ, Lepers E. 2003. Dynamics of land-use land cover change in tropical regions. *Annual Review Environment Resources* **28**: 205–241. DOI:10.1146/annurev.energy.28.050302.105459.

Lanckriet S, Rangan H, Nyssen J, Frankl A. 2016. When the cattle came home: the influences of Holocene climatic shifts and agro-biotic exchanges on land cover and land use in the Ethiopian highlands. *PLoS One* submitted.

Lange WJ. 1984. History of the southern Gonga (southwestern Ethiopia). Studien zur Kulturkunde, Band 61. Franz Steiner Verlag GmbH: Wiesbaden.

Legesse A. 2000. Oromo democracy: an indigenous African political system. The Red Sea Press: Asmara, Eritrea.

Leykun A. 2008. Status and distribution of faunal diversity in Kafa afromontane coffee forest. Submitted to PPP (Public-Private Partnership) project. Addis Ababa, Ethiopia. PRSP. Poverty Reduction Strategy Paper. Green Coffee Forest ecosystems in Ethiopia.

Liscow ZD. 2013. Do property rights promote investment but cause deforestation? Quasi-experimental evidence from Nicaragua. *Journal of Environmental Economics and Management* **65**: 241–261. DOI:10.1016/j.jeem.2012.07.001.

Lorgen CC. 1999. The experience of villagisation: lessons from Ethiopia, Mozambique and Tanzania, report. OXFAM: Oxford.

Matheos E. 2011. Inventory of woody species in Bonga forest. Institute of Biodiversity Conservation and Research. Technical Report No. 1. Addis Ababa, Ethiopia.

Mekuria A. 2005. Forest conversion-soil degradation-farmers' perception nexus: implications for sustainable land use in the southwest of Ethiopia. Doctoral Thesis. ZEF-Ecology and Development Series No. 26, ISBN-3-86537-444-1. University of Bonn, Germany.

McCann JC. 1995. People of the plow: an agricultural history of Ethiopia, 1800–1990. Univ. of Wisconsin Press: Madison, USA.

Mekuria A, Vlek PLG, Denich M. 2012. Application of the Caesium-137 technique to soil degradation studies in the southwestern highlands of Ethiopia. *Land Degradation & Development* **23**: 456–464. DOI:10.1002/ldr.1088.

Mekuria W, Aynekulu E. 2013. Exclosure land management for restoration of the soils in degraded communal grazing lands in northern Ethiopia. *Land Degradation & Development* **24**: 528–538. DOI:10.1002/ldr.1146.

Mengistu S 1995. Social organization of production among the shekacco of southwestern Ethiopia. MA. Thesis, Addis Ababa University, Addis Ababa.

Messerli B, Rognon P. 1980. The Saharan and east African uplands during the quaternary. In The Sahara and the Nile, Williams M, Faure H (eds). AA Balkema: Rotterdam; 87–132.

Meyer FG. 1965. Notes on wild *Coffea arabica* from southwestern Ethiopia, with some historical considerations. *Economic Botany* **19**: 136–151. DOI:10.1007/BF02862825.

Mitiku F, de Mey Y, Nyssen J, Maertens M. 2015. Do Private Sustainability Standards Contribute to Poverty Alleviation? A Comparison of Different Coffee Certification Schemes in Ethiopia. Bioeconomics Working Paper Series: WP 2015/03.

Mohammed C, Wiersum KF. 2011. The role of non-timber forest products for livelihood diversification in southwest Ethiopia. *Ethiopian e-Journal for Research and Innovation Foresight* **3**: 44–59.

Moti J, Mokonnen Y, Adugna T, Mitiku H, Ansha Y, Kindeya G, Kelemework T, Yemane G, Mekonnen T. 2011. Impact of resettlement

on the livelihood, food security and natural resource utilization in Ethiopia. Dryland Coordination Group (DCG) Report No. 65.
Mulat D, Fantu G, Ferede T. 2006. Agricultural development and food security in Sub-Saharan Africa: the case of Ethiopia. FAO Working paper 2, FAO Policy Assistance Unit of the FAO, Sub regional Office for Eastern and Southern Africa, Rome.
Mulugeta L, Karltun E, Olsson M. 2005a. Assessing soil chemical and physical property responses to deforestation and subsequent cultivation in smallholders farming system in Ethiopia. *Agriculture Ecosystems & Environment* **105**: 373–386. DOI:10.1016/j.agee.2004.01.046.
Mulugeta L, Karltun E, Olsson M. 2005b. Soil organic matter dynamics after deforestation along a farm field chronosequence in southern highlands of Ethiopia. *Agriculture Ecosystems & Environment* **109**: 9–19. DOI:10.1016/j.agee.2004.01.046.
NMA. 2013. Ethiopia meteorology station 30-year rainfall data. New merged 30-year climate time series. National Meteorology Agency: Addis Ababa.
NTFP-PFM. 2009. Forest landscape sustainability and improved livelihoods through non-timber forest product development and payment for environmental services. Non-Timber Forest Products Research and Development Project South-West Ethiopia. Year two annual report, Huddersfield (UK) and Mizan Teferi (Ethiopia).
Nyssen J, Poesen J, Moeyersons J, Deckers J, Mitiku H, Lang A. 2004. Human impact on the environment in the Ethiopian and Eritrean highlands – a state of the art. *Earth-Science Reviews* **64**: 273–320. DOI:10.1016/S0012-8252(03)00078-3.
Nyssen J, Frankl A, Zenebe A, Deckers J, Poesen J. 2015. Land management in the northern Ethiopian highlands: local and global perspectives; past, present and future. *Land Degradation & Development* **26**: 759–764. DOI:10.1002/ldr.2336.
Onderdonk DA, Chapman CA. 1999. Coping with forest fragmentation: the primates of Kibale National Park, Uganda. *International Journal of Primatology* **21**: 587–611. DOI:10.1023/A:1005509119693.
Pankhurst A. 1992. Resettlement and famine in Ethiopia: the villagers' experience. University Press: Manchester and New York.
Pankhurst A. 1999. 'Caste' in Africa: the evidence from south-western Ethiopia reconsidered. *Africa: Journal of the International African Institute* **69**: 485–509. DOI:10.2307/1160872.
Pankhurst A, Piguet F. 2004. Contextualizing migration, resettlement, and displacement in Ethiopia. In: Pankhurst A, Piguet F (Eds.): People, Space and the State: Migration, Resettlement and Displacement in Ethiopia. Proceedings of workshop held by the Ethiopian Society of Sociologists, Social workers and Anthropologists & the United Nations Emergencies Unit for Ethiopia. Department of Sociology and Social Anthropology, Addis Ababa University.
Pankhurst R. 1988. Resettlement in Ethiopia: a background paper. AAU. (Unpublished).
Philippe L. 2003. Dynamics of coffee production systems in Kaffa. A case study from two villages in Kaffa province of Ethiopia. MSc. Thesis, Wageningen University, Wageningen, The Netherlands, 75 p.
Pingali P, Bigot Y, Binswanger H. 1987. Agricultural mechanization and the evolution of farming system in Sub-Sahara Africa. The John Hopkins University Press: London, UK; 216.
Poesen J. 1987. Transport of rock fragments by rill flow-a field study. *Catena Supplement* **8**: 35–54.
Reusing M. 1998. Monitoring of natural high forests in Ethiopia. Government of the Federal Democratic Republic of Ethiopia, Ministry of Agriculture, Natural Resources Management and Regulatory Department; in cooperation with GTZ: Addis Ababa.
Reusing M. 2000. Change detection of natural high forests in Ethiopia using remote sensing and GIS techniques. *International Archives of Photogrammetry and Remote Sensing* **33**: 1253–1258.
Robinson BE, Holland M, Naughton-Treves L. 2014. Does secure land tenure save forests? A meta-analysis of the relationship between land tenure and tropical deforestation. *Global Environmental Change* **29**: 281–293. DOI:10.1016/j.gloenvcha.2013.05.012.
Rojahn A. 2006. Incentive mechanisms for a sustainable use system of the montane rain forest in Ethiopia. Doctoral Thesis, Department of Economic and Social Sciences. Universitaet Kiel.
Runyan CW, D'Odorico P, Lawrence D. 2012. Physical and biological feedbacks on deforestation. *Reviews of Geophysics* **50**: RG4006. DOI:10.1029/2012RG000394.
Ruthenberg H. 1983. Farming systems in the tropics. Clarendon Press: Oxford.
Schmitt CB. 2006. Montane rainforest with wild *Coffea arabica* in the Bonga region, south west Ethiopia: plant diversity, wild coffee management and implications for conservation. Doctoral Thesis. ZEF-Ecology and Development Series No. 47. University of Bonn, Germany.
Schulze MD, Seavy NE, Whitacre DF. 2000. A comparison of the phyllostomid bat assemblages in undisturbed neotropical forest and in forest fragments of a slash-and-burn farming mosaic in Peten, Guatemala. *Biotropica* **32**: 174–184. DOI:10.1111/j.1744-7429.2000.tb00459.x.
Shiferaw B, Holden ST. 1997. Peasant agriculture and land degradation in Ethiopia: reflections on constraints and incentives for soil conservation and food security. *Forum for Development Studies* **24**: 277–306. DOI:10.1080/08039410.1997.9666063.
Sisay N. 2008. Flora Biodiversity assessment in Bonga, Boginda and Mankira forest, Kafa. Submitted to PPP (public-private partnership) project. Ethiopia Wildlife and Natural History society (EWNHS) report, Addis Ababa, Ethiopia.
Solomon A. 1994. Land use dynamics, soil degradation and potential for sustainable use in Metu area, Illubabor region, Ethiopia. African studies series A13. Geographica Bernensia, University of Berne: Switzerland.
Stein J, Ayalew W, Rege ED, Mulatu W, Lemecha H, Tadesse Y, Tekle T, Philipsson J. 2011. Trypanosomosis and phenotypic features of four indigenous cattle breeds in an Ethiopian field study. *Veterinary Parasitology* **178**: 40–47. DOI:10.1016/j.vetpar.2010.12.025.
Stellmacher T. 2005. Institutional factors shaping coffee forest management in Ethiopia. The case of Bonga forest, Kaffa Zone. Paper presented at the conference on International Trade and the Protection of Natural Resources in Ethiopia. German Ethiopian Association, Berlin 5-6 March 2005.
Stellmacher T, Mollinga P. 2009. The institutional sphere of coffee forest management in Ethiopia: local level findings from Koma forest, Kaffa zone. *International Journal of Social Forestry* **2**: 43–66.
Stellmacher T, Eguavoen I. 2011. The rules of hosts and newcomers. Local forest management after resettlement in Ethiopia. Paper presented at the 4th European Conference On African Studies, 15–18 June 2011, Uppsala, Sweden.
Tadesse W. 2007. The impacts of land use/ land cover changes on biodiversity in Mash and Anderacha Woredas of Sheka Zone, SNNP Regional State. A clue for advocacy and informed decision making. In Forests of Sheka: multidisciplinary case studies on impact of land use/land cover change, Fetene M (ed). MELCA Mahiber: Southwest Ethiopia; 57–88.
Tadesse W, Fite G. 2011. Sheka Forest Biosphere Reserve nomination form. UNESCO-MAB National Committee. Federal Democratic Republic of Ethiopia: Addis Ababa.
Tadesse W, Denich M, Demel T, Vlek PLG. 2002. Human impacts on *Coffea arabica* genetic pool in Ethiopia and the need for its *in situ* conservation. In Managing plant genetic diversity, Engels J, Rao VR, Brown AHD, Jackson M (eds). Proceedings of an international conference: Kuala Lumpur, Malaysia, 12–16 June 2000; 237–247.
Tafesse A. 1996. Agroecological zones of southwest Ethiopia. Doctoral Thesis, University of Trier, Germany.
Takele T, Workneh A, Hegde BP. 2011. Breed and trait preferences of Sheko cattle keepers in southwestern Ethiopia. *Tropical Animal Health and Production* **43**: 851–856. DOI:10.1007/s11250-010-9772-2.
Tewoldeberhan G. 1990. Ethiopia's future conservation strategy must take cognizance of its past. Paper presented to the Conference on a National Conservation Strategy for Ethiopia, Addis Ababa.
Tezera C. 2008. Land resources and socio-economic report of Bonga, Boginda, Mankira and the surrounding areas in Kaffa zone, SNNPRS, Ethiopia. Public–Private Partnerships project.
Theil R. 2012. Omotic. In Semitic and afroasiatic: challenges and opportunities, Edzard L (ed). Otto Harrassowitz: Wiesbaden; 369–384.
Thiollay JM. 1997. Disturbance, selective logging and bird diversity: a neotropical forest study. *Biodiversity and Conservation* **6**: 1155–1173. DOI:10.1023/A:1018388202698.
Thiollay JM. 1999. Responses of an avian community to rain forest degradation. *Biodiversity and Conservation* **8**: 513–53. DOI:10.1023/A:1008912416587.
Tilahun M, Vranken L, Muys B, Deckers J, Gebregziabher K, Gebrehiwot K, Bauer H, Mathijs E. 2015. Rural households' demand for frankincense forest conservation in Tigray, Ethiopia: a contingent valuation analysis. *Land Degradation & Development* **26**: 642–653. DOI:10.1002/ldr.2207.
Turner MD. 1999. Labor process and the environment: the effects of labor availability and compensation on the quality of herding in the Sahel. *Human Ecology* **27**: 267–96. DOI:10.1023/A:1018725327873.

van Beijnen J, Mostertman I, Renkema G, van Vliet J. 2004. Baseline description of project area: summary of participatory appraisal data at Kebele and Got level. Non timber Forest Products Research and Development Project in SW Ethiopia. Wageningen University, Student Research Series No. 1. Wageningen, The Netherlands.

Vandenabeele N. 2012. A case study of local practices of a participatory forest management project in Kaffa, Ethiopia. Self-formation between Principle and Practice. Unpublished master's thesis, Ghent University and Wageningen University.

Van Halteren B 1996. The socio-cultural and socio-economic position of the Manjo of Kaffecho-Shekacho zone (identification report). Bonga, Ethiopia: Government of Kaffa Zone. Unpublished.

Vasconcelos HL. 1999. Effects of forest disturbance on the structure of ground-foraging ant communities in central Amazonia. *Biodiversity and Conservation* **8**: 407–418. DOI:10.1023/A:1008891710230.

Vavilov NI. 1935. The phyto-geographical basis for plant breeding [first published in Russian, translated by Love D (1992)]. In Origin and geography of cultivated plants (English edn), Dorofeyev VF (ed). University Press: Cambridge; 316–366.

Virtanen P. 2005. Land of the ancestors: semiotics, history and space in Chimanimani, Mozambique. *Social & Cultural Geography* **6**: 357–378. DOI:10.1080/14649360500111246.

Warren A. 2002. Land degradation is contextual. *Land Degradation & Development* **13**: 449–459. DOI:10.1002/ldr.532.

WCC-PFM. 2011. A new approach to the conservation of wild *Coffea arabica* in southwest Ethiopia: developing the potential of participatory forest management. Summary of annual report of year one. Wild Coffee Conservation – participatory forest management for *in-situ* conservation of wild coffee. Mizan Aman, Ethiopia, 17 p.

Westphal E. 1975. Agricultural systems in Ethiopia. Agricultural Research Reports 826, Center for Agricultural Publishing and Documentation. Wageningen.

Woldeamlak B, Sterk G. 2003. Assessment of soil erosion in cultivated fields using a survey methodology for rills in the Chemoga watershed, Ethiopia. *Agriculture Ecosystems and Environment* **97**: 81–93. DOI:10.1016/S0167-8809(03)00127-0.

Wood A 1977. Resettlement in Illubabor province. PhD dissertation, University of Liverpool, England.

Wood A. 1985. Settlement and circulation in a frontier region, Illubabor province, Ethiopia. In Circulation in third world countries, Prothero RM, Chapman M (eds). Routledge and Kegan Paul: London; 303–324.

Wood AP. 1993. Natural resource conflicts in south-west Ethiopia: state, communities, and the role of the national conservation strategy in the search for sustainable development. *Nordic Journal of African Studies* **2**: 83–99.

World Conservation Monitoring Centre. 1994. Biodiversity data sourcebook. World Conservation Press: Cambridge, U.K.

Yesuf M, Mekonnen A, Kassie M, Pender J. 2005. Cost of land degradation in Ethiopia: a critical review of past studies. Environmental Economics Policy Forum in Ethiopia: Addis Ababa, Ethiopia.

Yihenew Z. 2002. Access to forest resources and forest-based livelihoods in highland Kafa, Ethiopia: a resource management perspective. Doctoral Thesis, University of Huddersfield.

Yihenew Z. 2003. Forest access: policy and reality in Kafa, Ethiopia. *Leisa Magazine* **19**: 21–22.

Yonas A. 2005. Community values and natural resource management. The case of indigenous and settler communities in Kaffa. MSc thesis, Addis Ababa University.

Yoshida S. 2008. Searching for a way out of social discrimination: a case study of the Manjo through the 2002 incident in Kafa. *Nilo-Ethiopian Studies* **12**: 47–60.

Zewdie J. 2007. The impact of cultural changes on the people of Sheka and their traditional resource management practices: in the case of Masha *Woreda*, Sheka Zone. A clue for advocacy and informed decision making. In Forests of Sheka: multidisciplinary case studies on impact of land use/land cover change, southwest Ethiopia, Fetene M (ed). MELCA Mahiber: Addis Ababa; 58–89.