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Ecosystem Services and Disservices in an Agriculture–Forest Mosaic

A Study of Forest and Tree Management and Landscape Transformation in Southwestern Ethiopia

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To my parents (Gemechu &
Tsige) and family (Konjit,
Obsinan & Firomse)

***

Namoota saamicha lafaaf
eenyummaa diduun ajj-
eefaman ykn qaamaa
hir'ataniif reebaman maraaf
na haa ta'u.

Abstract

The intertwined challenges of food insecurity, deforestation, and biodiversity loss remain perennial challenges in Ethiopia, despite increasing policy interventions. This thesis investigates smallholding farmers' tree- and forest-based livelihoods and management practices, in the context of national development and conservation policies, and examines how these local management practices and policies transform the agriculture–forest mosaic landscapes of southwestern Ethiopia.

The thesis is guided by a political ecology perspective, and focuses on an analytical framework of ecosystem services (ESs) and disservices (EDs). It uses a mixed research design with data from participatory field mapping, a tree 'inventory', interviews, focus group discussions, population censuses, and analysis of satellite images and aerial photos.

The thesis presents four papers. Paper I investigates how smallholding farmers in an agriculture–forest mosaic landscape manage trees and forests in relation to a few selected ESs and EDs that they consider particularly beneficial or problematic. The farmers' management practices were geared towards mitigating tree- and forest-related EDs such as wild mammal crop raiders, while at the same time augmenting ESs such as shaded coffee production, resulting in a restructuring of the agriculture–forest mosaic. Paper II builds further on the EDs introduced in paper I, to assess the effects of crop raids by forest-dwelling wild mammals on farmers' livelihoods. The EDs of wild mammals and human–wildlife conflict are shown to constitute a problem that goes well beyond a narrow focus on yield loss. The paper illustrates the broader impacts of crop-raiding wild mammals on local agricultural and livelihood development (e.g. the effects on food security and children's schooling), and how state forest and wildlife control and related conservation policy undermined farmers' coping strategies. Paper III examines local forest-based livelihood sources and how smallholders' access to forests is reduced by state transfer of forestland to private companies for coffee investment. This paper highlights how relatively small land areas appropriated for investment in relatively densely inhabited areas can harm the livelihoods of many farmers, and also negatively affect forest conservation. Paper IV investigates the patterns and drivers of forest cover change from 1958 to 2010. Between 1973 and 2010, 25% of the total forest was lost, and forest cover changes varied both spatially and temporally. State development and conservation policies spanning various political economies (feudal, socialist, and

‘free market-oriented’) directly or indirectly affected local ecosystem use, ecosystem management practices, and migration processes. These factors (policies, local practices, and migration) have thus together shaped the spatial patterns of forest cover change in the last 50 years.

The thesis concludes that national development and conservation policies and the associated power relations and inequality have often undermined local livelihood security and forest conservation efforts. It also highlights how a conceptualization of a local ecosystem as a provider of both ESs and EDs can generate an understanding of local practices and decisions that shape development and conservation trajectories in mosaic landscapes. The thesis draws attention to the need to make development and conservation policies relevant and adaptable to local conditions as a means to promote local livelihood and food security, forest and biodiversity conservation, and ESs generated by agricultural mosaic landscapes.

Keywords: conservation, deforestation, ecosystem disservices, ecosystem services, forest, Ethiopia, land grabbing, livelihood, Oromia, policies, political ecology, trees, tropical landscape mosaic

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List of Papers

Paper I

Ango, T.G., Börjeson, L., Senbeta, F., & Hylander, K. (2014). Balancing ecosystem services and disservices: smallholder farmers' use and management of forest and trees in an agricultural landscape in southwestern Ethiopia. *Ecology and Society*, 19, 30; 16 pages. http://dx.doi.org/10.5751/ES-06279-190130.

Paper II

Ango, T.G., Börjeson, L., & Senbeta, F. (*In press*). Crop raiding by wild mammals in Ethiopia: impacts on the livelihoods of smallholders in an agriculture–forest mosaic landscape. 22 pages. *Oryx– The International Journal of Conservation*; (http://dx.doi.org/10.1017/S0030605316000028).

Paper III

Ango, T.G. (2016). Impacts of medium-scale forestland 'grabbing' on local livelihoods and forest conservation in the southwestern highlands of Ethiopia. Submitted manuscript, 26 pages.

Paper IV

Ango, T.G., Hylander, K., & Börjeson, L. (2016). Drivers and patterns of forest cover change since the late 1950s in southwest Ethiopia: deforestation, agricultural expansion and coffee production. Manuscript, 39 pages.

My contributions to papers I, II and IV: I made substantial contributions to the conception and design of all three papers. For each paper, I have collected all the field data and performed the data analysis (except for the multivariate statistical analysis of tree species in paper I). In paper IV, although we used a previously published land cover dataset, to complement this dataset I analysed additional satellite images and aerial photographs. I drafted and led the writing process for all the papers, as well as the preparation of figures, maps, and tables.

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Abbreviations

ADLI	Agricultural Development-Led Industrialization
CSA	Central Statistical Authority
CSAg	Central Statistical Agency
EDs	Ecosystem Disservices
ESs	Ecosystem Services
FAO	Food and Agriculture Organization of the United Nations
FDRE	Federal Democratic Republic of Ethiopia
GPS	Global Positioning System
IFAD	International Fund for Agricultural Development
MA	Millennium Ecosystem Assessment
masl	meters above sea level
mm	millimeters
NTFPs	Non-Timber Forest Products
OBFED	Oromia Burea of Finance and Economic Development
OFWE-JBO	Oromia Forest and Wildlife Enterprise Jimma Branch Office
PDRE	People's Democratic Republic of Ethiopia
PFM	Participatory Forest Management
PGCR	Plant Genetic Resources Center
PMAC	Provisional Military Administration Council
PSNP	Productive Safety Net Program
REDD+	Reducing Emissions from Deforestation and Forest Degradation Plus
UNDP	United Nations Development Programme
WFP	World Food Programme

Introduction

This thesis examines two intertwined perennial challenges facing Ethiopia: attaining local food and livelihood security, and sustainable management of trees and forest. The focus is on smallholding dominated mosaic landscapes of the southwestern highlands, which shelter most of the remaining forest in the country. This forest supports a unique biodiversity as well as the production of shade coffee, *Coffea arabica* (Meyer, 1965; Senbeta, 2006). Coffee produced from this forest ecosystem is a main source of cash income to smallholders, and an important part of Ethiopia's coffee export (Gole, et al., 2002; FDRE, 2012).

Previous studies of the southwestern Ethiopian highlands have improved our understanding about the condition, biodiversity, and economic importance of this area, as well as several management challenges and drivers of deforestation (e.g. McCann, 1995; Zewdie, 2002; Gole, 2003; Stellmacher, 2007; Wakjira and Gole, 2007; Gobeze et al., 2009; Chilalo and Wiersum, 2011; Takahashi and Todo, 2012 and 2014; Aerts et al., 2013 and 2015; Belay et al., 2013; Hylander et al., 2013). However, there is a gap in our knowledge about how local farmers balance the management of forest ecosystem services (ESs) against the mitigation of ecosystem disservices (EDs) (e.g. wild mammal crop raiders), and how these local practices together with national development and conservation policies[1] shape smallholders' livelihoods and forest cover change in mosaic agriculture–forest landscapes. There is also a need for more precise knowledge about the trajectories and functions of trees in Ethiopian agricultural landscapes, for example as a possible trigger of 'forest transition' processes (cf. Sloan and Sayer, 2015).

This thesis examines the use and management of forest and trees in an agricultural landscape in relation to local livelihoods and agricultural production. It investigates how local practices along with policies for national development (e.g. 'land to the tillers', resettlement, and forestland leasing to investors—hereafter forestland grabbing or appropriation) and conservation (e.g. state forest and wildlife control, and banning hunting wildlife) have

[1] In this thesis, state policies refer to all development and conservation proclamations, legislation, strategies, and programs from the central or federal government referred to and discussed. In Ethiopia, policies have often been formulated at the central or federal government level, while regional governments approve and implement these same policies. I use the phrase 'national development and conservation policies' to refer to these policies.

shaped local livelihoods, as well as, tree and forest cover dynamics in southwestern Ethiopia since the late 1950s. The thesis draws on political ecology, and uses a framework that articulates both ESs and EDs. The thesis uses a mixed methods approach to generate and analyse data from various sources including participatory field mapping, interviews, a 'tree inventory', satellite images, aerial photographs and population censuses.

The thesis consists of a comprehensive summary and four papers. The comprehensive summary provides an account of the background, relevance and aim of the thesis; an overview of the current literature; details of the conceptual framework and methodological approach used; and a synthesis of the findings of the four papers. Paper I investigates how smallholding farmers in an agriculture–forest mosaic landscape manage trees and forest in relation to a few selected ESs and EDs that they consider particularly beneficial or problematic. Paper II builds on the EDs introduced in paper I to assess the effects of crop raids by forest-dwelling wild mammals on smallholders' livelihoods, and the broader implications for agriculture development and wildlife conservation in agriculture–forest mosaic landscapes. Paper III examines local forest-based livelihood sources, how these are undermined by state forestland transfer to private companies for coffee investment, and the effects of such appropriation on forest management efforts. Finally, paper IV investigates how local ecosystem use and management practices, along with national development and conservation policies, have together shaped forest cover change since the late 1950s. The papers address themes apparently related to each other, but interrogate different processes shaping tree and forest management in the same landscape and the associated local livelihoods.

Food security and environmental conservation challenges in Ethiopia

Ethiopia faces multitude of critical challenges, prominent among which are the issues of food and broader livelihood insecurity, and environmental problems. Although the country, has recently received praise for its fast-growing economy, and for achieving the Millennium Development Goal of halving the proportion of people in chronic hunger by 2015 (Fosu, 2014; FAO, IFAD and WFP, 2015), still 32% of its total population remains malnourished. The proportion of malnourished people in Ethiopia is substantially higher than the 23.2 % in Sub-Saharan Africa (FAO, IFAD and WFP, 2015). About 25 million Ethiopian people are trapped in poverty and vulnerability (UNDP, 2015), and about 8 million are reliant on the productive safety net program

(PSNP)[2] due to transitory (hungry season) and chronic food insecurity (Sabates-Wheeler and Devereux, 2010; World Bank, 2016). In addition, currently about 10.2 million Ethiopians need emergency food assistance due to the effects on agriculture production of insufficient rain during two rain seasons in 2015 (WFP, 2016). The hunger and malnutrition in Ethiopia illustrate how economic growth, although 'a necessary condition' is not alone sufficient to alleviate poverty (Hyden, 2007; Akanbi, 2015).

On the other hand, the country faces some serious environmental challenges including climate change and aspects of ecosystem degradation such as deforestation, loss of biodiversity, and soil fertility decline (Taddese, 2001; Comenetz and Caviedes, 2002; Gole, 2003; Senbeta, 2006; Boko et al., 2007; Hurni, 2007; Meshesha et al., 2012). According to a recent study (Gebreselassie et al., 2016), degradation related to land use and cover change costs Ethiopia about $ 4.3 billion per year. From 1990 to 2015, forest cover declined by about 0.8 % per year (FAO, 2015), and deforestation is the main cause of biodiversity loss (FDRE, 2005a). These environmental challenges coupled with other problems including 'misguided' policies such as land grabs (e.g. see Rahmato, 2014), bad governance (undemocratic, inefficient, and corrupt systems) (Bach, 2011; Lefort, 2012; Transparency International Corruption Perception, 2015), and a fast-growing human population (World Population Review, 2015) have contributed to the persistent food insecurity and malnourishment.

As of 2015, over 80% of the 90 million Ethiopians live in rural areas (CSAg, 2013) and are dependent on small-scale agriculture for their subsistence. The productivity of this type of agriculture is low, which is attributed to a number of factors including poor soil fertility and land management, tree and land tenure insecurity, insufficient access to agricultural technologies (e.g. chemical fertilizers), insufficient irrigation, and weather variability (Admassie, 2000; Rahmato, 2001; Sonneveld, 2002; Lemenih et al., 2005; Amsalu, 2015; Gebreselassie et al., 2016). Overall, food insecurity and environmental challenges are complex intertwined problems. Interventions to improve livelihood and food security often create or aggravate environmental challenges. For example, farmers use various coping strategies to mitigate low agricultural productivity and food insecurity, including expansion of farmlands into forest, elimination or reduction of fallow periods, and increased dependency on forest and tree resources. While such coping strategies can be of critical importance for sustaining livelihoods in the short run, they rarely bring lasting food security to farmers, but rather contribute to undermining ecosystem processes and services (Teklu et al., 2003; Amsalu, 2006). The task of achieving food security and mitigating environmental

[2] Introduced in 2005, PSNP provides cash and/or food to food-insecurity people for up to five years, at which point these beneficiaries are expected to graduate as food-secure (For more on PSNP see Devereux et al., 2008; and World Bank, 2011).

problems is a challenging one, particularly in areas where there has been severe soil nutrient depletion from continuous cultivation, deforestation and overgrazing (Bewket and Sterk, 2003; Lemenih et al., 2005; Gebreselassie et al., 2016).

State development and conservation policies – an overview

Since the 1950s, several major policies for national development and environmental conservation have been implemented in Ethiopia (Arado, 1996; Bekele, 2003; Lefort, 2012). This subsection presents an overview of the national development and conservation policies with a particular focus on food security, land use, and forest and wildlife management since the late 1950s. In the last half century, Ethiopia has seen three governments with varying political economic orientations: the feudal or imperial regime (pre–1974), the socialist military regime commonly known as the *Derg* (1974–1991), and free market-oriented federal regime (post–1991)[3].

Imperial regime (pre–1974)

The development strategy of the feudal regime[4] during the 1950s and 1960s was oriented towards modernizing or structurally transforming the Ethiopian economy (Arado, 1996). This strategy was influenced by the then-dominant theories of economic growth and modernization, and by donors (Arado, 1996). During this period, priority was given to expansion of large-scale commercial farms and coffee production (Arado, 1996; Alemu et al., 2002). However, in response to a food crisis that faced the country in the late 1960s, the imperial government began to promote smallholding settlement and agricultural production in new areas through conversion of land (mainly woodland and forest) to farmland (Alemu et al., 2002; Bekele, 2003). Despite this, livelihood and food insecurity persisted as serious problems for several reasons, a major one of which was inequitable land ownership (Arado, 1996; Alemu et al., 2002). Unlike in northern Ethiopia, where land was a communal resource, the Abyssinia occupation of the south in the 1880s resulted in

[3] The transition from one government to the next has never been smooth in Ethiopia, and major policy changes were often inevitable (Bekele, 2003; Markakis, 2011; Lefort, 2012). The socialist military overthrew Emperor Haile Selassie in 1974, and the Derg rule ended in 1991 when it was also overthrown by the Ethiopian People's Revolutionary Democratic Front led by the Tigray People's Liberation Front. The latter of these still rules the country today.

[4] Present-day Ethiopia was formed during the second half of the 19th century. From then until 1974 Ethiopia was ruled by feudal monarchies. The last king was Emperor Haile Selassie, who ruled the country from 1930 to 1974 except for the five years he spent in exile in the UK during the Italian occupation of Ethiopia from 1936 to 1941.

land and forest being dispossessed from local communities and coming under the ownership of emperors, absentee landlords (nobilities, military and other ruling class ancillaries), and churches; this situation persisted until 1974 (Zewdie, 2002; Bekele, 2003; Bulcha, 2011).

On the other hand, influenced largely by protection-oriented expatriate foresters and the 'deforestation narrative'[5], the imperial government launched forestry proclamations and regulations in 1965 and 1968, respectively, to promote forest conservation (Bekele, 2003). However, these policies had little effect on forest conservation, due to class interest, and conflicts between the imperial regime's development and conservation aspirations (Bekele, 2003). In this regard, Ayana et al. (2013) argue that conservationists of the imperial time had weaker political power compared to those in support of modernization and development. As members of the ruling feudal class, the proponents of modernization and development had the necessary means to advance a view of forestland as a frontier for commercial agriculture expansion.

In relation to wildlife conservation, after the mid-1960s the imperial regime began to the establish protected areas including national parks, wildlife sanctuaries and reserves, and controlled hunting areas for wildlife conservation (Tessema et al., 2010; Seifu and Beyene, 2014). This approach to conservation restricted settlement and use of resources (e.g. water and livestock grazing) in the protected areas, which had negative effects on the local communities relying which relied on these resources for subsistence (Tessema et al., 2010; Seifu and Beyene, 2014).

Socialist military regime (1974–1991)

During 1974–1991, under Marxist ideology, the military regime undertook several national development and conservation polices (Admassie, 2000; Alemu et al., 2002; Bekele, 2003; Ayana et al., 2013). Of these policies, the 'land to the tillers' proclamation of 1975 denotes a radical shift in development strategy compared to pre-1974 (PMAC, 1975). This land policy removed the inequitable and exploitative land rights of the imperial regime through land nationalization and redistribution. The policy entitled farmers to up to 10 ha of agricultural land for their own use, and it was hoped that this land reform would promote agricultural and national development (PMAC, 1975). In addition to 'land to the tillers', the regime launched a 'ten-year-perspective' plan (1984–1994) (Arado, 1996), which targeted surplus extraction through producers' cooperatives and the achievement of food self-sufficiency (Alemu et al., 2002). Nonetheless, the agricultural production was often stagnated, with no surplus for extraction (Belete et al., 1991).

[5] The deforestation narrative claims a near total loss of forest in Ethiopia in less than a century; however, McCann (1997) has demonstrated that such a narrative is untenable.

In 1987, the government modified the 'ten-year-perspective' plan to a three-year plan, which emphasized the production of staple cereal crops (Alemu et al., 2002).

In 1980, the socialist regime enacted a forest and wildlife resource conservation and development proclamation (PMAC, 1980). The regime maintained the pre-1974 state forest ownership arrangement, and also confiscated private forests (including plantations) held by absentee landlords and churches (PMAC, 1980; PDRE, 1987). For conservation purposes, most of this forest was designated as National Forest Priority Areas, and managed by the government (Bekele, 2003; Teketay et al., 2010). The 1980 legislation also gave kebeles (lower administrative units) the responsibility to managing the forest within their boundaries as community forest. However, these kebeles could use the forest they managed only after requesting and gaining permission from the government. The same proclamation also prohibited timber production, hunting, and settlement in the forest. These restrictions were also applied to protected areas established during the imperial and the Derg periods (PMAC, 1980; Seifu and Beyene, 2014; EWCA, undated).

To address land degradation and the 1984–85 drought, the regime undertook resettlement programs whereby people from drought-stricken areas, mostly in the north, were relocated to southwestern and western Ethiopia (Kloos and Aynalem, 1989; Rahmato, 2003). In addition to the resettlement program, a food-for-work program was implemented in the late 1970s and 1980s, supported by external donors and involving the construction of bunds and terraces as well as tree planting in return for grain (e.g. Wøien, 1995). Nonetheless, the top-down policies of the Derg failed to establish a secure sense of land and tree ownership (Admassie, 2000). Overall, polices of the Derg regime were unable to produce food security and sustainable environmental recovery (Wøien, 1995; Admassie, 2000; Bekele, 2003).

'Free market-oriented' federal regime (post-1991)

The post-1991 government has formulated and implemented several new developments and conservation policies, to a greater extent than its predecessors. One of these policies[6], Agricultural Development-Led Industrialisation (ADLI), was launched as a pillar development strategy with the development of smallholder agriculture as a priority (FDRE, 2003). ADLI has been promoted as an inclusive development strategy, owing to its emphasis

[6] Since the 1990s, and throughout the 2000s, the federal regime has also implemented the following development plans that were proposed or strongly supported by donors and lenders: a Structural Adjustment Program that involved devaluation of currency, derestricting food grain movement, deregulation of prices, subsidy removal, and privatization); and a Poverty Reduction Strategy Program (Government of Ethiopia, 1998; Ministry of Finance and Economic Development, 2002).

on the smallholder agriculture that employs 80% of the labour force (FDRE, 2003). The strategy has targeted the use of this huge agricultural labour force as well as land and provision of agricultural technologies (chemical fertilizers, improved seeds, and irrigation) to make agriculture an engine for industrialization and national development. Official statistics have shown an increase in agricultural production since 1991, largely due to an increase in cultivated areas (UNDP, 2014). However, local and national food security is still in a precarious situation. Since 2005, the government has used PSNP to support its failing ADLI strategy (Lavers, 2013). In a sense, PSNP has evolved from the food-for-work program of the Derg era and similar initiatives under the federal regime in the 1990s and early 2000s. Despite the PSNP target of making its beneficiaries food-secure in about five years (Devereux et al., 2008), the amount of cash transferred to poor and food-insecure families through PSNP has been shown to be insufficient to buy enough food, due to growing inflation (Sabates-Wheeler and Devereux, 2010). Furthermore, PSNP has not been able to protect the participating households from relying on their livestock during shocks, although it was found to increase the number of trees planted by farmers (Andersson et al., 2011).

On the other hand, over 3 million ha of degraded lands, including forest areas, have been enclosed for rehabilitation under the current regime (Lemenih and Kassa, 2014). Some studies have suggested success in the outcome of such enclosures, for example an increase in bush land in northern Ethiopia (see Teka et al., 2013; Lanckriet et al., 2015). Northern Ethiopia is the part of the country where area enclosures have been most widely implemented (Lemenih and Kassa, 2014). As PSNP is also widely used in northern Ethiopia (e.g. see Lavers, 2013), the observed environmental recovery has not yet brought local food security.

Furthermore, as a strategy to achieve long-term food security, technology transfer, and enhanced foreign currency earning, over the past decade the current regime has swiftly shifted its focus and transferred more than 3 million ha of land, mainly to foreign investors, for plantation agriculture (Oakland Institute, 2011; Rahmato, 2014). However, the possibility that this strategy will bring food security to the nation is small, because the commercial farmers (investors) have more incentives to export the food production, and mechanisms to realize the transfer of technology to small-scale farmers have rarely been in place (Oakland Institute, 2011). More certain outcomes of this strategy are that the transfer of land to investors has accelerated deforestation, negatively affected local livelihoods (Rahmato, 2014; Shete and Rutten, 2015), and further marginalized and exploited ethnic minorities by taking over their lands (Abbink, 2011; Oakland Institute, 2011; Lavers, 2012).

On the other hand, as during the socialist era, land was constitutionally declared as the property of the state and the peoples of Ethiopia (Constitution of the Federal Democratic Republic of Ethiopia 1994), and the right to

expropriate private and communal land was reserved for the government (FDRE, 1997 and 2005a). The state has also continued to own forest and wildlife, and regional states are given the mandate to administer and conserve most of these forest and wildlife areas (FDRE, 2007a and 2007b). This decentralization created difficulties in the management of several forests and protected areas on regional boundaries, because of inter-regional controversies over control (e.g. Kelboro and Stellmacher, 2012). The forest and wildlife development, conservation, and utilization polices of 2007 (FDRE, 2007a and 2007b) call for participatory forest and wildlife management. Like the policies of earlier governments, these policies prohibit settlement and hunting of wild animals, as well as the use of forest and forest-related environmental resources by communities without permission from the government. In stipulating such restrictions, these policies are similar to earlier forest and wildlife proclamations (e.g. PMAC, 1980).

Since the late 1990s, in line with a shift in favour of decentralized governance, a participatory forest management (PFM) approach has been introduced whereby management responsibilities and forest benefits are shared with local people (Ameha et al., 2014a). Afterwards, PFM projects mushroomed in Ethiopia, and successes of these projects in terms of improved forest condition and local livelihoods have been reported under external support from donors (Gobeze et al., 2009; Takahashi and Todo, 2012 and 2014; Todo and Takahashi, 2013; Ameha et al., 2014a). However, the sustainability of PFM projects has been questioned in relation to the lack of enough institutional support after donors exit, and in terms of the extent to which benefits to local communities such as access to non-timber forest products (NTFPs), can actually improve local livelihoods (Kassa et al., 2009; Ameha et al., 2014 a and b).

Despite the sustainability challenges facing PFM and forest management in general, the government's 2011 climate-resilient green economy strategy considered forest conservation and rehabilitation as one of its key pillars to ensure development and sustainability (FDRE, 2011). The regime is also in the process of finalizing preparations to implement a recent global initiative of Reducing Emissions from Deforestation and Forest Degradation Plus program (REDD+) in the country (Bekele et al., 2015). REDD+ would clearly add another dimension to a forestry sector already challenged by unfulfilled promises such as those of the PFM approach.

In summary, despite the implementation of diverse policies that have increasingly embraced dominant global development and conservation narratives since the late 1950s, the country is still far from the goal of mitigating the food and broader livelihood insecurity and environmental problems discussed above.

A 'new' green revolution: a way to achieve food security and better environmental conservation?

Both Ethiopia and the rest of Africa have seen competing strategies for overcoming food insecurity and environmental problems. For instance, Holmén (2003:22) has proposed a 'green revolution' which would consider and benefit smallholders who:

> are dispersed over an agro-ecological landscape that is much more heterogeneous than those areas where the original GR [green revolution] had its strongest impact, for example in Asia's river plains.

Similarly, Otsuka and Yamano (2005: 248) have suggested an 'organic green revolution' for Africa that would largely depend on 'manure and composts' unlike the Asian green revolution, which relied on chemical fertilizers. Foley et al. (2011:341) have stated that food security can be achieved with a combination of various strategies including those aiming to increase agricultural resource efficiency and close the yield gap through precision agriculture[7] and other mechanisms such as agroforestry and payments to farmers for environmental services.

The existence of competing strategies for achieving food security has an important impact on smallholders, and the importance of this factor may increase in the future. It thus needs to be considered from the perspective of long-term food security, environmental stability, and conservation perspective (Bommarco et al., 2013). These strategies propose the use of various local resources, including trees (Otsuka and Yamano, 2005; Foley et al., 2011), and they should be flexible and adaptable in relation to the existing diversity of environmental conditions (Holmén, 2003).

One example is the promotion of farmers' tree planting and forest management practices, as these provide important ESs that help smallholding farmers to meet their needs for income, food security, and wood, and reduce their vulnerability (Arnold and Bird, 1999, Kaimowitz, 2003, Sunderlin et al., 2008, Kamanga et al., 2009; Tesfaye et al., 2010, Hogarth et al., 2013). Tree planting and forest management also offer other important ESs including soil fertility and water regulation (Zhang et al., 2007; Power, 2010; Smukler et al., 2012). Moreover, the wood produced can be used as an energy source in place of crop residues and cow dung, thus allowing these to be used as compost ingredients to improve soil fertility and productivity. The use and promotion of such strategies, however, require prior understanding of local uses and management practices with regard to trees and forest in agricultural landscapes (Sunderlin et al., 2005).

[7] 'Precision agriculture refers to a series of technologies that allow the application of water, nutrients, and pesticides only to the places and at the times they are required, thereby optimizing the use of inputs' (Godfray *et al*. 2010:813).

On the other hand, mosaic landscapes in general, and trees and forests in particular, are also the providers of many EDs in the form of ecosystem processes that negatively affect farmers' livelihoods; for example, they shelter wild mammals that raid cultivated crops (Zhang et al., 2007). When designing strategies to achieve food security and/or environmental management, it is crucial to pay careful attention to such EDs in order to understand their trade-offs and synergies.

Aim and research questions

The overall aim of this thesis is to study smallholding farmers' tree- and forest-based livelihoods and management practices, in the context of national development and conservation, and to examine how these local management practices and policies transform the agriculture–forest mosaic landscapes of southwestern Ethiopia.

The following key sets of questions are addressed in this research and in the four papers:

1) How and to what extent do farmers actively and strategically manage trees and forest, and related ESs and EDs, in order to enhance their agriculture production and improve their livelihood? (Mainly papers I–III, but also paper IV to some extent.)
2) Relatedly do farmers living at forest frontiers versus away from forest edges, and in coffee forest versus highland forest areas, show differences in their management of trees and forest in relation to ESs and EDs? If so, why? (All papers to varying degrees.)
3) In what ways and to what extent is farmers' management of trees and forest with regard to ESs and EDs related to forest cover change? How have these local decisions and practices, development and conservation policies, and other actors (government, forest enterprises, investors) together shaped the tree and forest cover across the agriculture-forest landscape? (Mainly papers III and IV, but also papers I and II to some extent.)

This study was carried out in a specific part of the southwestern highlands: the agriculture–forest mosaic landscape of Gera. Paper I introduces the conceptual framework of ESs and EDs. Paper II builds and expands on the empirical findings and conceptual understanding of paper I in relation to the effects and management of EDs from and related to trees and forest. Paper III focuses on the local forest-based livelihood sources and how these forest ESs are undermined by state transfer of forestland to private companies for coffee investment. Paper IV investigates how local ecosystem use and management practices and national development and conservation policies have together shaped forest cover change from 1958 to 2010.

Literature review

This section provides an overview of current literature in relation to the societal–ecological significance of tropical forests and their management, as well as that of trees in the agricultural landscapes.

Tropical forests

Tropical forests[8] cover about 1,770 million ha of land or 44% of the total forest area on the planet (Keenan et al., 2015:11). Of this total, the area of natural forests is about 1,731 million ha, while the rest is planted (Keenan et al., 2015:13). The natural tropical forests vary greatly in many aspects including their composition and productivity, due to variations in soil and climatic conditions. These forests are broadly classified as rain forests, moist deciduous forests, dry and very dry forests, and hill and montane forests (FAO, 1995). Rain, moist deciduous, and dry and very dry forests are found in areas with annual total rainfall of > 2500mm, between 1000–2000 mm and 500–1000 mm, respectively. Hill and montane forests are found in areas with an elevation of > 800 meters above sea level (masl) (FAO, 1995).

A broad range of different types of tropical forests are found in Ethiopia due to the variations in elevation (ranging from 155 meters below sea level in the lowlands to over 4000 masl in the highlands), soil and climate. The forests of the country include 'transitional' rain forest and dry and moist evergreen Afromontane (Friis et al., 2010: 261). This thesis is concerned with the moist evergreen Afromontane forest that covers the southwestern highlands.

The societal–ecological significance of tropical forests

Tropical forests provide several critically important ecological and socioeconomic benefits. These forests shelter more than half of the total species present on the planet (Lewis et al., 2015), and play important role in regulating the climate (Goodman and Herold, 2014; Lawrence and Vandecar,

[8] Here 'forest' refers to land area of 'more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10%, or trees able to reach these thresholds *in situ.'* (FAO, 2012:3).

2015). For example, during the 2000s tropical forests have stored an estimated 22–26% of all carbon emitted from anthropogenic sources per year, and thus could be essential component of the strategies to mitigate climate change (Goodman and Herold, 2014:2).

More importantly, from a local livelihood perspective, tropical forests are sources of provisioning ESs or resources for food, energy, and shelter, to several millions of people mainly living in rural areas (CIFOR, 2005; Chao, 2012). In addition, most people in developing countries use medicinal substances from plants in tropical forests (FAO, 2014). According to studies from various countries in the tropics, including Ethiopia, overall forest incomes from timber and NTFPs contribute substantially to household total incomes, in some cases up to more than half (e.g. Mamo et al., 2007; Vedeld et al., 2007; Kamanga et al., 2009; Belay et al., 2013; Angelsen et al., 2014; Abdullah et al., 2016). Forest resources are also essential component of rural livelihood diversification, and can provide safety nets during income crises for many households (Tesfaye et al., 2011; Kar and Jacobson, 2012; Rayamajhi et al., 2012; Kabubo-Mariara, 2013; Belcher et al. 2015) as well as supporting poverty alleviation (Arnold and Bird, 1999; Sunderlin et al., 2008; Tesfaye et al., 2010).

Despite the importance of forest-based livelihoods to rural communities in the tropics, this dependency on forest relies not only on proximity to forests (Belcher et al 2015), but also, and more importantly, on state control and policies that limit overall access and the types of resources to be collected (Anderson et al., 2006; Pouliot and Treue, 2013). Most forests in the tropics, including those in Ethiopia are owned by the state (FAO, 2008; Whiteman et al., 2015; Bekele et al., 2015)[9], which restricts local people's forest access to the harvesting NTFPs only (Pouliot and Treue, 2013; Ameha et al., 2014b).

Deforestation and forest management

Deforestation[10] remains a threat to tropical forests (Gibbs et al., 2010; Morales-Hidalgo et al., 2015). Over the period from 1990 to 2015, natural forests area reduced by 10% in the tropics, which is substantially higher than the global decline of 2.5% (Morales-Hidalgo et al., 2015:68; see paper IV for more discussion on tropical deforestation patterns and drivers).

As part of strategies to mitigate tropical deforestation, the area of forests designated as protected forest increased from 12% in 1990 to 26.6 % in 2015 (Morales-Hidalgo et al., 2015:71), and the area of planted forest nearly doubled (Payn et al., 2015). Tropical deforestation rates have also slowed in

[9] For example, in Africa, about 83% of the total 330 million ha of forests is state-owned (FAO, 2008:4).

[10] Deforestation refers to the 'conversion of forest to other land use or the permanent reduction of the tree canopy cover below the minimum 10% threshold' (FAO, 2012:5).

recent years (Keenan et al., 2015). Nonetheless, some projections predict a continuation of deforestation over the next 15 years (d'Annunzio et al., 2015). The continuation of deforestation of natural forests, even at lower rates, remains a critical global environmental problem from the perspective of biodiversity conservation, due to the endemic species these forests shelter (Morales-Hidalgo et al., 2015). In addition, most of the net carbon emissions from forestry and other land use in the tropics, which amount to about 1.1–1.4 Gt carbon per year, are from tropical deforestation (Goodman and Herold, 2014:2).

Until the mid-1980s, most tropical forests were managed by the state through a top-down approach (Bekele, 2003; Ribot et al., 2006). Parts of the state-owned forests are expropriated communal property. Expropriations of communal forests and state forest ownership were generally based on ideas regarding inevitability of overexploitation and degradation of common owned resources (Hardin, 1968).

Nonetheless, as the top-down forest management approach failed to improve forest conservation, forest governance decentralization initiated in the 1980s and 1990s (Ribot et al., 2006). Forest governance decentralization is aimed at transferring both forest management responsibilities and forest benefits, in the hope of creating improved local livelihoods and better conservation (Agrawal and Ostrom, 2008). Over the past three decades forest management in many countries has been undertaken in various forms including community-based co-management and collaborative management, which in this thesis is referred to as PFM. So far, the PFM approach has produced mixed results in relation to improving forest management and local livelihoods (Ribot et al., 2010; Ameha et al., 2014a; Bekele and Ango, 2015; Siraj et al., 2016). The major reason for the mixed effects of decentralized forest governance is the focus on devolving rule enforcement, and forest protection with limited rights to use and develop forest resources (Ribot et al., 2006 & 2010; Katila, 2008; Mustalahti and Lund, 2009; Ameha et al., 2014b).

Overall, then, forests in the tropics have faced serious management challenges (Nasi and Frost, 2009). Further, most tropical forests, particularly in low income countries like Ethiopia, are yet not inventoried (Sloan and Sayer, 2015), and it is difficult to see this happening in the near future (see e.g. the challenges described by Lund, 2015). Forests are also being transferred to international investors in the current land grabs for commercial agriculture (Wily, 2011; Rahmato, 2014). In addition, global interest in tropical forests not only for biodiversity conservation but also for climate change mitigation is increasing. In this regard, REDD+ with its monetary incentives, is a telling example. REDD+ aims to contribute to climate change mitigation, biodiversity conservation and poverty alleviation through emissions reduction from deforestation and forest degradation, and sustainable forest management (The REDD Desk, 2016). However, REDD+ seems to incentivize governments in developing countries to recentralize forest governance (Phelps et

al., 2010) and further marginalize the poor forest-dependent communities (Poudyal et al., 2016).

Trees in smallholding-dominated landscapes

Several tropical agricultural landscapes consist of of forest patches and other land uses including home gardens and other types of agroforestry practices such as grazing land with trees, tree crops with shade (e.g. coffee or cocoa with shade tree), and trees above annual crops (i.e., alley cropping). Trees in these types of agricultural landscapes are clearly managed; that is they are planted and/or retained from previous natural forest and coppices to provide various benefits including wood fuels and wood products, shade for other crop production (e.g. coffee), and fencing (Dewees, 1995; León and Harvey, 2006; Tolera et al., 2008; Pulido-Santacruz and Renjifo, 2011; Borkhataria et al., 2012).

As well as supporting local livelihoods, forest patches and trees provide other ESs including water and soil regulation and biodiversity conservation (Harvey and Haber, 1999; Perfecto and Vandermeer, 2008; Power, 2010; Smukler et al., 2012; Molla and Asfaw, 2014; Le Roux et al., 2015). The forest patches and trees on agricultural land may connect existing forest fragments and thus enhance migration of wild animals between the forest patches (Bhagwat et al., 2008; Perfecto and Vandermeer, 2010; Pulido-Santacruz and Renjifo, 2011). In addition to trees and tree-dwelling biodiversity (e.g. birds), the mosaic less intensively used tropical agricultural landscapes (DeFries et al., 2004) shelter several other types of associated biodiversity that may indirectly support the agricultural ecosystem and production (e.g. pollinators, predators of agricultural pests) as well as various micro-organisms that use the agricultural habitats for food or shelter and that may cause disease or damage to crops (CBD, 2001:107).

Overall, the biodiversity of forest patches and tree-rich agricultural mosaic landscapes is often essential for the health and function of not only the local agricultural ecosystem, but also the ecosystem processes at a regional scale. Hence, to improve local livelihoods and food security and contribute to biodiversity conservation (i.e., 'land sharing'), it is essential to understand the policy contexts and practices of tree management in mosaic agricultural landscapes (Fischer et al., 2008 and 2013; Gardner et al., 2009; Perfecto and Vandermeer, 2010; Vaast and Somarriba, 2014).

Conceptual framework

In this section, I present the concepts of ESs and EDs, and the political ecology perspective, and explain how these have informed my research.

Ecosystem services and disservices

Ecosystems provide societies with food, fodder and shelter in addition to many other important services including pollination, natural pest control, soil formation, and erosion control (Millennium Ecosystem Assessment, MA, 2005)[11]. These benefits are obtained from various ecosystem components and processes that are directly or indirectly beneficial to humans (MA, 2005)[12]. The Millennium Ecosystem Assessment classified ESs into four groups: provisioning (food, shelter, fiber, water, and genetic resources), regulating (pollination, natural pest control, erosion control, water purification, climate regulation), supporting (nutrient cycling, soil formation), and cultural (aesthetic, spiritual) services (MA, 2005). The supporting ESs relate to the primary production through photosynthesis, production of oxygen, soil formation, and nutrient cycling, and are necessary for the production of all other ESs (MA, 2005). This thesis deals with several provisioning (coffee, honey, timber, and NTFPs) and regulating (mainly shade and fencing) ESs from and related to trees and forest.

The ES approach was developed to increase public awareness about the importance of well-functioning ecosystems and how their degradation affects human well-being, and to promote sustainable management of ecosys-

[11] 'An ecosystem is a dynamic complex of plant, animal, and microorganism communities and the nonliving environment interacting as a functional unit.' (MA, 2005:V).

[12]As can be seen from this definition of ESs (MA, 2005), these services could be obtained from natural and/or human-modified ecosystems. This thesis and the papers use the broader conceptualization of ESs as derived from natural and/or human-modified ecosystems. In addition, following Wallace (2007), ecosystem functions and processes considered synonymous and are referred to as ecosystem processes in the thesis. Ecosystem processes 'are complex interactions among biotic and abiotic elements of ecosystems that lead to a definite result....involve the transfer of energy and materials…. Key processes include energy, nutrient, oxygen and water cycles and fluxes. It is important to note that these processes occur both within and outside organisms, and involve geochemical (e.g. volcanism) and cosmic (sunlight) processes that occur at least partly outside the biosphere as well as the socio-cultural processes' (Wallace, 2007:244).

tems (Daily, 1997; MA, 2005). Over the past decade, the concept of ESs has been successfully mobilized as a 'pedagogic tool' or 'communication metaphor' which supports ecosystem and biodiversity conservation (Liu et al., 2008; Gomez-Baggethun et al., 2010). The approach is also widely used as a framework to understand and analyse the relationships between society and nature.

However, the approach has also received important and unsettling critique, targeting for example its anthropocentric framing, the commodification of nature, and the implications of this (e.g. Kosoy and Corbera, 2010; Norgaard, 2010; Peterson et al., 2010; Chan et al., 2012; Ernstson and Sörlin 2013; Lele et al., 2013). The ESs approach stipulates human economic interests, rather than ethics, as the logic for ecosystem conservation (Redford and Adams, 2009; Gomez-Baggethun, et al. 2010; Kosoy and Corbera, 2010; Chan et al., 2012). Nonetheless, sustaining conservation by importing a market logic to places where such logic for conservation is 'culturally discouraged' or did not exist in the first place, is difficult (Gomez-Baggethun et al., 2010; Turnhout et al., 2013). On the other hand, a commodification of nature[13] by the use of the ES approach also obscures the ecosystem components and processes that produce ESs, which are valued as a few services or as a single monetary value, and this further distances the public from appreciating ecosystem processes and biodiversity (e.g. Peterson et al., 2010). Technically, it is also challenging to express the values of complex ESs as a single monetary value (Kosoy and Corbera, 2010). Cultural ESs in particular are thus mostly excluded from economic valuation (Chan et al., 2012). Furthermore, ESs valuation, exchange, and consumption involve power asymmetries that may create access inequalities, or deepen existing ones; this in turn may aggravate biodiversity degradation (Kosoy and Corbera, 2010; Kull et al., 2015).

Despite the pitfalls discussed above, which largely emerged from the inherent market logic and related payment schemes[14] of the ES approach, and its shortcomings in terms of biodiversity conservation (Peterson et al., 2010), the ES approach remains a widely-used conceptual and practical framework, in addition to the political will and interest it has generated in relation to

[13] Commodification is a process by which goods and services, natural entities and ecosystem processes, which are not produced for sale, are converted into an exchangeable form (Castree, 2003). Such conversion involves a number of elements that consists of abstraction, valuation, privatization, and alienation (Kosoy and Corber, 2010).

[14] Payment for Environmental (Ecosystem) Services is an economic instrument, in use since the 1990s and designed to provide incentives to land users or farmers. 'The core idea of [payments for environmental services]… is that external ES beneficiaries make direct, contractual and conditional payments to local landholders and users in return for adopting practices that secure ecosystem conservation and restoration' (Wunder, 2005:1).

biodiversity conservation[15]. To capitalize on the positive contributions of the ES framework, there are also efforts to further develop and modify it (e.g. Wallace, 2007; Lele et al., 2013; Shackleton et al., 2015). Wallace (2007) has, for example, offered an 'improved ESs' classification approach for decisions in natural resource management. Lele et al. (2013: 354) suggest among other things the incorporation of EDs into the ESs approach, in order to make the framework complete and consistent and hence a useful 'framework for scientific enquiry' about the society–nature relationship.

Engagement with the notion of EDs, which 'are the ecosystem generated functions, processes and attributes that result in perceived or actual negative impacts on human wellbeing'[16] (Shackleton et al., 2015: 4), is also a point of departure for this thesis. EDs manifest themselves in three ways:

> The first is through the impact of an ecosystem process or attribute on human wellbeing directly, such as a pollen allergens or a snake bite. The second may be the diminished flow of an ES [ecosystem service] caused by an EDS [ecosystem disservice], such as crop pests. The third is the loss or impairment of a supporting or regulating service caused by an EDS, such as primary production loss following a wildfire. (Shackleton et al., 2015: 4-5).

Hence, the conceptualization of ecosystems solely as providers of services is problematic when it comes to analysing local ecosystem use and management by smallholding farmers 'who are already aware of and fully experience a range of both' the positives and negatives of the local landscape (see paper I). Overall, smallholder farmers face diverse EDs. While they may not have conceptualized these impacts as EDs, many studies have described the negative impacts that local landscapes may bring to agriculture and local livelihoods. McNeely and Scherr (2003), for example, have estimated that pests, diseases, and weeds, damage between 20% and 25% of global cereal yield pre-harvest. Crop loss and other livelihood impacts from wildlife life crop raiders and predations are commonly reported in studies from many

[15] As Norgaard (2010: 1220 and 1226) suggests basic institutional transformation and subsequent economic change are required to deal with 'what are perceived to be very serious environmental problems generated by the economy we have,' and the 'project-by-project' payments for environmental services practice under the ES framework could only be 'a part' of this 'larger solution.' However, in my view, it is difficult to anticipate the emergence of a basic change in the global political economy and institutions that could ultimately mitigate global ecosystem degradation in more desirable ways, at least in the short term. Hence, it is important to make the best out of the positive contributions of the ES concept and framework, and deliberate on how to refine and guide its application in a way that promotes clearer understanding of how different societies relate to nature. In this regard, Dempsey and Robertson (2012) have also highlighted that there is diversity in the views, actors, and environmental policies in relation to the ES concept that can be used as ways to start critical and fruitful engagements, and possibly create change.

[16] The phrase 'ecosystem disservices' is variously conceptualized and used. For a recent review, see Shackleton et al. (2015).

landscapes including those in Ethiopia (Weladji and Tchamba, 2003; Wang et al., 2006; Warren et al., 2007; Lemessa et al., 2013; Seifu and Beyene, 2014). A few studies related to agro-ecosystems (e.g. Zhang et al., 2007) have conceptualized such negative impacts or damages as EDs. Other studies that used the EDs concept in research on tree and forest management in urban areas, have suggested that EDs from and related to urban forest and trees have shaped the perceptions and values of the urban residents (Lyytimäki et al., 2008; Lyytimäki and Sipilä, 2009; Escobedo et al., 2011).

Overlooking the real challenges that EDs pose to farmers can, for example, undermine the successes of environmental conservation programs (e.g. forest, biodiversity), as well as human wellbeing (see paper II; Shackleton et al., 2015). As a combined approach, the conceptualization of ecosystem services and disservices opens up the opportunity to explicitly investigate and understand the benefits and challenges that biodiversity and ecosystem processes in local landscapes offer to, for example, smallholding farmers, and how these farmers manage these landscapes based on their perception of services and disservices. I argue that this understanding is an important addition to the ES framework if it is to become more useful for research and practice (management, development) in smallholder dominated landscapes (cf. Lele et al., 2013).

This thesis outlines several EDs from and related to forest and trees, including wild mammal crop raiders and competition between trees and agricultural crops for nutrients and light. But its main focus is on wild mammal crop raiders.

Political ecology

The growing field of political ecology deals with society–environment relations, focusing particularly on the role of power relations and inequality at various spatial and temporal scales in shaping vulnerabilities, and environmental resource control, access, conservation, management, and degradation (Bryant and Bailey, 1997; Stott and Sullivan, 2000; Peet and Watts, 2004; Hornborg et al., 2012; Robbins, 2012). It is not a single theory, but rather a research tradition that comprising various approaches to understanding society–environment interactions with a focus on power asymmetries (Turner and Robbins, 2008). This interdisciplinary field 'combines the concerns of ecology and…political economy' to increase understanding of 'the constantly shifting dialectic between society and land-based resources, and also within classes and groups within society itself" (Blaikie and Brookfield, 1987:17).

Political ecology started as a reaction to the dominant 'apolitical' environmental degradation narratives or orthodoxies in developing countries, and since the 1980s has been increasingly deployed to deconstruct these narra-

tives (Bryant and Bailey, 1997; Peet and Watts, 2004). Political ecologists have unpacked the orthodoxies and demonstrated how various power asymmetries have shaped the control, vulnerabilities, and degradation of land resources, and also deployed unsettling questions of 'whose environments' and 'whose knowledge matters' in relation to development and conservation (Leach and Mearns, 1996; Kinlund, 1996; Bryant, 1998; Peet and Watts, 2004). Political ecology analyses have shown that social and environmental problems are conditioned by power asymmetries in the social and political spheres (Neumann, 2009; Robbins, 2012). Political economy and circumstances tend to undermine societies' stability and adaptation (Walker, 2005) and thereby put local communities into destitute situations that force them to rely more on, for example, forest resources for subsistence, which then may lead to degradation (Bryant and Bailey, 1997). Hence, political ecology is concerned with political forces and related power asymmetries in the struggle for control of and access to land-based resources, at various scales ranging from the individual, household, and community to the national and global levels (Robbins, 2012).

The political ecology perspective has nevertheless received various criticisms, as have the studies which use this perspective (Vayda and Walters, 1999; Ingalls and Stedman, 2016). One critical view is that political ecology approaches make a prior assumption about the link between local environmental changes and supra-local economic and political economic systems (Vayda and Walters, 1999). Nonetheless, expecting a researcher to 'begin research free from antecedent bias is to conceive this person as *tabula rasa'* (Penna-Firme, 2013:201). Similarly, as Peet and Watts (2004:16) have pointed out, a 'toolkit' is needed 'to explain the world', and 'In this sense, all theory makes prior assumptions and judgments'.

Another line of critique argues that political ecology studies have fallen short on developing and communicating alternatives to the orthodoxies they criticize (Walker, 2006; Ingalls and Stedman, 2016). Yet another is concerned with the lack of balance in focus between the realms of politics and ecology. According to this critique, ecological and environmental processes are only indirectly dealt with in many political ecology studies (Vayda and Walters, 1999; Walker, 2005). Although I agree with the argument that attention needs to be paid to a deeper understanding of ecological processes, I also concur with the conclusion that this 'does not alter the need for a basic focus on politics as part of the attempt to understand… environmental problems' (Bryant and Bailey, 1997:6).

The ES framework and the political ecology perspective both deal with society-environment relations, but with differing analytical views and focus,

as discussed above. Integrating them may yield better policy-relevant outcomes (cf. Peterson et al. 2000; Ingalls and Stedman, 2016)[17].

Through a focus on trees and forest using the ES and ED framework, I have sought to carefully balance the focus on ecology and politics in my research by being attentive to both local social–ecological dynamics and the political dimensions of these dynamics. The result, I believe, is a political ecology study that moves from ecology (ESs and EDs) to politics (policy and power relations), as opposed to many other PE studies that center more plainly on the politics of environmental change.

In this thesis, I use the political ecology perspective as an important critical analytical lens to discuss power relations and inequalities at various spatial and temporal scales, and how these affect local livelihoods, vulnerability, and management of the ESs and EDs from and related to trees and forest. In paper I, political ecology is implicitly used to interrogate the framing of an ecosystem as a provider of only ESs in relation to 'whose experience and knowledge matter'. This interrogation yields an understanding that local farmers have always lived with an ecosystem that provides both ESs and EDs. Such a conceptualization is highlighted as a useful analytical and pragmatic approach to better understand the way local ecosystem processes are perceived and managed by local farmers. Political ecology is more explicitly deployed in papers II–IV, where it is used to understand the effects of state forest and wildlife control, appropriations, top-down conservation and development policies, and associated power relations affecting local livelihood and food security, forest conservation, and land cover change.

[17] To produce policy- relevant counter narrative outcomes, resilience scientists (see for example Peterson et al., 2000; Ingalls and Stedman, 2016) suggest a serious engagement with ecology in political ecology studies. On the other hand, it is also argued that integrating the political ecology perspective into resilience thinking is important to better understand and improve the resilience of social–ecological systems (see for e.g. Hornborg, 2013).

Methodological Considerations

The study area

Location, history, and topography

Located in the Horn of Africa, Ethiopia has a total land area of 1.1 million km^2 and is the second most populous country in Africa, after Nigeria (Figure 1). This study was conducted in Ethiopia's largest region, Oromia, which contains over half of the country's total forest (FAO, 2010). Specifically, the study was carried out in Gera district, which lies in Oromia's Jimma zone in southwestern Ethiopia about 430 km from Addis Ababa.

Gera was a state ruled by kings until 1886, when its king was defeated by the southward-expanding Abyssinian Empire (Hassen, 1990). The occupation of Gera resulted in depopulation due to casualties, hunger, the slave trade, disease, and emigration, and this in turn led to regrowth and expansion of forest cover during the early decades of the 20^{th} century (oral histories; see also McCann, 1995). Gera has retained its name and existed as a district since at least the mid-1970s.

The district has a total area of 1454 km^2 (paper IV) and consists of a highland landscape with a mixture of hills, valleys and plains (Figure 2). Areas with an altitude over 1500 masl comprise 96% of the district area. Administratively, Gera district is divided into 29 rural kebeles and a town, Chira (Figure 1). The kebeles can be further classified as being located in coffee forest (16) and highland forest (13) areas (see paper IV). The coffee forest area kebeles are located within the coffee growing zone at around1500–2100 masl, whereas those in highland forest area are situated approximately above 2100 masl. Most of the data for this thesis were collected from villages located in four kebeles in the coffee forest zone (Gara Naso, Ganji Challa, Sadi Loya and Wanja Kersa), and two kebeles located in the highland forest zone (Dusta and Muje) (Figure 1; Table 1).

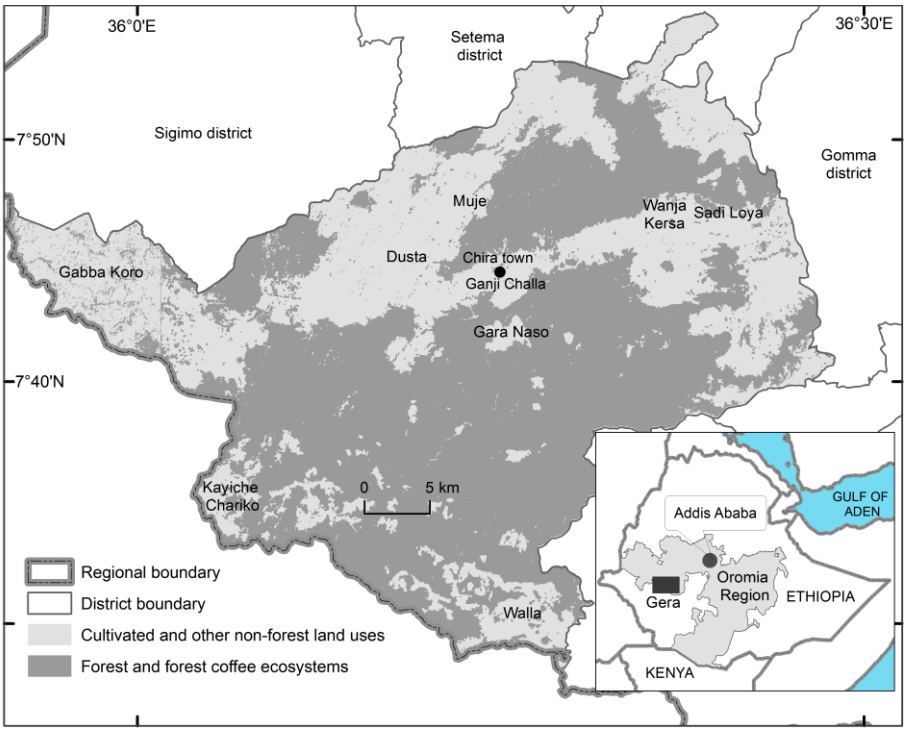


Figure 1. Location and land cover of the study area. The Gera map was produced from a free Landsat image taken in 2010 and 2011 (http://glovis.sugs.gov).

Climate, soil, and forest

Gera is located in the wettest part of Ethiopia. It receives a mean annual rainfall of 880–2080 mm and has a warm moist climate with a mean monthly temperature of 19°C. The Naso and Gojeb rivers and many other perennial streams drain the district. Soil types are dominated by orthic acrisol and dystric nitosols (OBFED, undated).

The southwestern highlands, including Gera, shelter most of the remaining forest of the country. This Afromontane forest is an important biodiversity hotspot (Lemenih and Woldemariam, 2010), characterized by endemism (PGRC, 1996) and home to the gene pools of many important crops including coffee (Meyer, 1965) and false cardamom *Aframomum corrorima* (Senbeta, 2006). A small portion of the forest in Gera is plantation forest that was established during the Derg period. The Gera forest and associated ecosystems (e.g. wetland and grassland) shelter a diversity of wildlife including lions and buffaloes, and a variety of monkeys and bush pigs. However, the forests in the southwestern highlands declined during the late 20th century and continue to decline today, mainly due to conversion of forestland to

agricultural land (see paper IV; Reusing, 1998; Gole, 2003; Hylander et al., 2013; Tadesse et al., 2014).

Most of the forest in Gera is owned and managed by the Oromia Forest and Wildlife Enterprise Jimma Branch Office (OFWE-JBO) and a PFM was introduced in 2003 (paper III; see also Takahashi and Todo 2012). Smallholding farmers and investors are formal users of most of the semi-managed forest coffee land, but smallholders also informally access the state forest for wild coffee collection and honey production (papers I and III).

Demographic characteristics

In 2015, Gera had over 138,000 inhabitants, with a crude population density of 95 persons per km^2 (CSAg, 2013). A majority of the inhabitants (95%) live in rural environments and are smallholder farmers (CSAg, 2013), and a majority of the total population belong to the Oromo ethnic group (CSA, 1996). About 85% of the inhabitants are Muslims. Only 30% of the total population aged five or over have attended school (CSAg, 2007).

Socioeconomic characteristics

The district has a long history of agriculture and forest-related livelihood practices (Hassen, 1990), and is characterized by an agriculture–forest mosaic landscape (Figure 2).

Farmers grow various types of annual and perennial crops, and many also engage in livestock (cattle, sheep, poultry, equines) production and practice bee keeping. The major annual crops grown in the district are maize, barley, wheat, *tef* (*Eragrostis tef*), beans, and peas. Farmers also produce tubers such as enset (*Ensete ventricosum*), which is an important staple crop for many families. Crop productivity is low in the district, for several reasons including very low usage of agricultural technologies such as chemical fertilizers and improved seeds. Food insecurity is one of the major challenges facing the district (OBFED, undated).

Major market centres in the district are located in Chira town, and in Kayiche Cheriko and Dusta *kebeles* (Figure 1). At these markets, coffee, cereals, honey, animals, and *khat* (*Catha edulis*) are widely traded. Larger market centers are also located in the nearby towns of Jimma and Agaro, though the poor condition of the road that connects Gera to these centres implies high transport costs, especially during the wet season.

Figure 2. Photos showing part of the Gera agriculture–forest mosaic landscape.

Areas above coffee-growing altitudes during wet (a) and dry (b) seasons; areas within coffee-growing altitudes during wet (c) and dry (d) seasons.

Research design and data

Deebin gaarii dha, deddeebii keessa funyoonni dhagaa murt.

It's good to come back, because even a rope can cut a stone if you keep rubbing it. (An elderly man used this proverb to reply when I informed him of my plan to visit him again during my next fieldwork period. Muje, 30 May 2011)

This research combines qualitative and quantitative analyses in a mixed methods design, a type of research design generally used for new data generation, complementarity, and triangulation or validation (Creswell, 2003; Elwood, 2010; Bryman, 2012). This section presents an overview of the methods, sampling strategy, fieldwork periods, issues studied, and data analysis performed. Reflections on the methods, fieldwork, and ethical challenges are also offered.

Sampling strategy

Before going to the field, I used Google Earth to strategically select a number of study areas, identified as transects, within the Gera district. Seven 1-km transects and two 3-km transects, were plotted and their coordinates were exported to a hand-held GPS. As I began the fieldwork, these transects were used to identify villages (located along the transects) from which farmers were selected for interviews (Table 1; papers I and II). Farm households along the transects were selected strategically to provide farmers of different ages and genders (to capture diverse perceptions and practices) during all the fieldwork periods, except the second and third periods when a stratified random sampling strategy was used (Table 2; papers I–IV). Initially, three 1-km transects were selected near forest margins and four 1-km transects at a distance from forest margins (paper I). To increase the diversity of respondents, two additional 3-km transects were then laid out, one near and one at a distance from forest margins (paper II). The reason for choosing transects near versus far from forest was to compare how farmers living relatively near or far from the forest areas manages trees, and forest resources, and benefits from forest ESs, and how they coped with forest EDs. The transects away from forests were 2−3 km from the forest edges, because most wild mammals travel less than 2 km from forests (Lemessa et al., 2013). Five of the transects, three near and two at a distance from forest margins, were located in kebeles in coffee forest areas. The remaining four transects, one near and three at a distance from forest edges were located in kebeles in highland forest areas (Table 1).

Table 1. List of kebeles, and the number of locations (transects), farmers and fields studied through participatory field mapping, interviews and focus group discussions.

	Location	Fieldwork phase [†]				
		Exploratory: 7–17 Sep 2010	First: 3 May to 10 July 2011	Second: 19 Feb to 23 Mar 2012	Third: 2–14 Oct 2012	Fourth: 4 Oct to 4 Nov 2013
Kebele names (and the number of corresponding locations or transects studied through participatory field mapping, interviews, and focus group discussions)	Near forests	• Sadi Loya (1)	• Muje (1) • Sadi Loya (1)	• Gara Naso (1) • Muje (1) • Sadi Loya (1)	• Gara Naso (1) • Muje (1) • Sadi Loya (1)	• Wanja Kersa (1)
	Away from forests	• Ganji Challa (1)	• Muje (1) • Wanja Kersa (1)	• Dusta (1) • Muje (1) • Wanja Kersa (1)	• Dusta (1) • Muje (1) • Wanja Kersa (1)	• Dusta (1)
	Total	• 2	• 4	• 6	• 6	• 2
Number of farm households covered in the participatory field mapping and interviews	Near forests	• 3 (all male-headed)	• 10 ➢ 8 male-headed ➢ 2 female-headed	• 27 ➢ 26 male-headed ➢ 1 female-headed	• 14 (all male-headed)	-
	Away from forests	• 4 (all male-headed)	• 11 ➢ 9 male-headed ➢ 2 female-headed	• 27 ➢ 24 male-headed ➢ 3 female-headed	• 9 (all male-headed)	-
	Total	• 7 (all male-headed)	• 21 ➢ 17 male-headed ➢ 4 female-headed	• 54 ➢ 50 male-headed ➢ 4 female-headed	• 23 (all male-headed)	-
Number of fields covered in the participatory field mapping and interviews	Near forests	• 23	• 113	• 172	-	-
	Away from forests	• 50	• 100	• 177	-	-
	Total	• 73	• 213	• 349	-	-

Table 1.Continued…

	Location	Fieldwork phase[†]				
		Exploratory:7–17 Sep 2010	First: 3 May to 10 Jul 2011	Second: 19 Feb to 23 Mar 2012	Third:2–14 Oct 2012	Fourth: 4 Oct to 4 Nov 2013
Number of general interviews or interviews without specific field focus conducted	Near forests	-	-	-	-	• 14 ➢ 12 male- headed ➢ 2 female-headed
	Away from forests	-	-	-	-	• 16 ➢ 14 male-headed ➢ 2 female-headed
	Total	-	-	-	-	• 30 ➢ 26 male-headed ➢ 4 female-headed
Number of key informant interviews conducted		-	• 9 (all men)	-	-	• 11 (all men)
Number of other interviews conducted [‡]		-	-	-	-	• 15 (all men)
Number of focus group discussions conducted [§]	Near forests	• 2 ➢ 1 all-male group ➢ 1 all-female group	• 4 ➢ 2 all-male groups ➢ 2 all-female groups	• 5 ➢ 2 all-male groups ➢ 2 all-female groups ➢ 1 mixed group	-	• 2 ➢ 1 all-male group ➢ 1 all-female group
	Away from forests	-	• 4 ➢ 2 all-male groups ➢ 2 all-female groups	• 3 ➢ 2 all-male groups ➢ 1 all-female group	-	• 2 ➢ 1 all-male group ➢ 1 all-female group
	Total	• 2 ➢ 1 all-male group ➢ 1 all-female group	• 8 ➢ 4 all-male groups ➢ 4 all-female groups	• 8 ➢ 4 all-male groups ➢ 3 all-female groups ➢ 1 mixed group	-	• 4 ➢ 2 all-male group ➢ 2 all-female group

†: All three households and 23 fields studied during the exploratory phase in Sadi Loya were studied again during the first fieldwork period. However, these farm households and their fields along with others studied during the first fieldwork were excluded from the second fieldwork period. Similarly, the households and fields studied during the first fieldwork period in Wanja Kersa and Muje were excluded from the second fieldwork period. The third fieldwork was a follow-up in which some of the farmers and fields studied during the second fieldwork period were selected and studied again (see paper II for details). ‡: Includes interviews with school directors (n=6), staff of district and regional offices including OFWE-JBO (n=5), and representatives of private coffee investors (n=4) in Gera (see papers II and III for details). §: Excludes six focus group discussions (one in each village) conducted at the onset of the second fieldwork period to set local wealth status criteria (see paper I).

Fieldwork phases, methods, and data sources

From 2010 to 2015, I visited the study area six times to collect data and report my results back to the informants mainly (Table 2). The total length of the fieldwork for this thesis was about 22 weeks. The fieldwork periods took place in different seasons of the year, in order to allow me to observe the various production and livelihood activities with a focus on activities related to forest and trees (Table 2; Figure 2). Papers I–IV draw on the data and the different fieldwork periods to varying extents, but each paper is based on data collected from at least two fieldwork periods (Table 2).

The methods used for data collection included participatory field mapping, interviews, focus group discussions, observations (Table 2), a review of published (e.g. censuses) and unpublished documents (e.g. official letters), and analysis of remotely-sensed images (papers III and IV).

Participatory field mapping and interviews

Participatory field mapping and interviews were the most important methods used in this research (Tables 1 and 2). These data collection methods were chosen to better understand the landscape processes by engaging with the farmers and their landscapes. The participatory field mapping involved visiting most of the fields used by 79 selected farmers (Table 1), living in the villages along the transects near and at a distance from forest margins. The mapping was made by taking GPS coordinates and/or identifying and outlining the boundaries of fields on printed sheets of a high resolution satellite image (World View 2 from 27 October to 2 November 2011, or Google Earth images; see Figure 3). Interviews were conducted together with the mapping. During the mapping and interviews the selected farmers showed me the fields they used, including their boundaries, while I asked them about various aspects of their management and cultivation practices and the tree species present at the specific locations (Tables 1 and 2).

Of the total number of fields (land use types) used by the selected farmers during the exploratory (n=73), first (n=213), and second (n=349) fieldwork periods, I mapped 100%, 99% and 76%, respectively (Table 1; papers I and II). Only the exploratory and first fieldwork phases included mapping by outlining the boundaries of fields on high-resolution satellite image printout and by taking their coordinates using a hand held GPS. During the second fieldwork period, I did not record the coordinates of the fields, which was a time-consuming activity. Data on the fields that were not mapped were generated only through interviews; that is, without visiting or locating the fields on the satellite image. Nearly all of the fields I did not map were located in other landscapes away from where the selected farmers were living. During

the second fieldwork period I recorded all trees and shrubs in the mapped fields except semi-managed forest coffee and forest (Table 2; paper I).

Table 2. Fieldwork phases, methods used, type of data generated, and paper(s) produced.

Fieldwork phase†	Data collection methods‡	Issues studied	Paper (s) produced
Exploratory: 7–17 Sep 2010	- Participatory field mapping - Interviews - Focus group discussion - Observation	Scoping of current and historical land use practices; ESs and EDs from and related to forest and trees in the agricultural landscape.	I
First: 3 May–10 Jul 2011	- Participatory field mapping - Interviews - Focus group discussion - Observation	Historical and current land use practices; use and management of ESs from and related to trees and forest; documentation of EDs, mainly wild mammal crop raiding species, crop raiding events, level of damage, mitigation strategies, and the impact of pests on livelihoods; forestland grabbing and its effects.	I–IV
Second: 19 Feb–23 Mar 2012	- Participatory field mapping - Interviews - Observation	The same issues as the first fieldwork phase (except forestland grabbing), but from a randomly selected larger sample of informants to allow for quantitative analysis; and a tree species inventory.	I, II
Third: 2–14 Oct 2012	- Interviews - Observation	Yields obtained and losses to wild mammals (maize and enset production)	II
Fourth: 4 Oct–4 Nov 2013	- Interviews - Focus group discussion - Observation	ESs from and related to forest; changes in the amount or character of these ESs, and reasons for such changes; forest access dynamics; forest management; forestland grabbing; coffee investors' relations with local farmers; effects of forest land appropriation; pests' crop raids, effects, and mitigation strategies.	II–IV
Last: 6–17 Jan 2015	- Informal conversations - Observation	Additional data on current and historical forest cover change to corroborate data from earlier fieldwork, although that main task was reporting back.	IV

†: Preliminary findings were reported back to the informants in the form of pamphlets during the second, fourth, and last fieldwork phases. ‡: Interviews were based on checklists during the exploratory, first, third, and fourth fieldwork periods. The checklist interviews were conducted with the selected farmers or with key informants. The interviews conducted during the second fieldwork period were based on a semi-structured questionnaire.

Figure 3. Part of a high-resolution satellite image printout used in the participatory field mapping and interviews, and examples of landscape features discussed with farmers during fieldwork.

Image (a) is a sample of the fields mapped (identified and outlined) on a high- resolution satellite image of Dusta in 2012. The codes were unique and used to identify the owner and the field (e.g. WH04 indicates the fourth field owned by the farmer with code WH) to easily connect interview data with specific fields. Lower photos show a dead tree (b) and current location of trees in an agricultural landscape (c); both photos are from villages situated above coffee growing altitudes.

The use of satellite image printouts as interview material enhanced the interaction and discussions with the respondents by serving as common ground for discussion, particularly when high-resolution images were used (cf. Årlin et al., 2015). By performing interviews in the physical presence of the object of the interviews (e.g. cultivated fields), the participatory field mapping and interviews helped farmers to remember their experiences and histories related to ESs and EDs from the trees and forest in each field. Hence, this approach to fieldwork approach is a key to understanding the embodied experiences of farmers (Börjeson 2004; Neumann 2011). Participatory field mapping and interviews can unlock land use histories through observations and discussion with informants in relation to forms in the landscape. In my case, examples included conversations about tree stumps, old trees, and walking trails which offered important clues about past experiences and histories of the forest ecosystem or specific tree management (Figure 3 b; cf. Widgren, 2004; Årlin et al., 2015). Ingold (2000:189) summarizes this point well:

> landscape is constituted as an enduring record of – and testimony to – the lives and works of past generations who have dwelt within it, and in so doing, have left there something of themselves.

In addition to the participatory field mapping and interviews discussed above, I conducted other types of interviews during the fourth fieldwork period. First, I interviewed 30 strategically-selected farmers living in two areas (groups of villages), one near forest in a coffee forest area and one away from forest in a highland forest area, respectively (Table 1). The interviews during this fieldwork period did not focus on specific fields like the previous interviews, but rather on the interviewees' overall perceptions and experiences of aspects including ESs and EDs from and related to trees and forest, access, forestland grabbing and its effects, forest history, and forest management (Table 2).

Second, I interviewed staff and representatives at Gera district agriculture and administration offices, Oromia regional investment bureau, and OFWE-JBO about diverse issues related to forestland grabbing, PFM, and wild mammal pests and mitigations (Table 1; paper III). Finally, I interviewed six school directors in Gera about the impact on school attendance of children's participation in guarding crops from wild mammal crop raiders (paper II); and four representatives of private coffee investors in Gera about their coffee management and their relations with local people (paper III).

Key informant interviews

A total of 20 interviews were performed with key informants (Table 1). The informants were identified through snowballing, and were mostly elderly farmers along with some staff at Gera district agriculture office and OFWE-JBO. All of them were recognized as knowledgeable about specific issues I

was enquiring about, including land use and forest cover history, migration, state-led resettlement programs and forestland grabbing and its effects (Table 2). These interviews generated valuable data on such issues.

Observation and informal or spontaneous discussions

Personal observation was not used as a stand-alone method to gather data on a pre-defined research problem. However, it served as an important complementary data collection method, especially to the participatory field mapping and interviews. Participatory field mapping involved extensive walking across the landscape between fields and villages, which gave the opportunity for observation and spontaneous discussion with both selected farmers and local residents. Important issues included internal migration from coffee forest areas to highland forest areas and the impacts of logging quotas on forest cover (discussed in paper IV). These issues were first brought to my attention through observation of enset transported from Muje to Gara Naso and a large trail for transporting goods by foot or on horses in Muje, and ensuing discussions with local residents (Figure 1; see paper IV). Observation and ensuing discussion also brought my attention to the state forestland transfer to private companies engaged in coffee production and the conflicts between the companies and local residents (see paper III). Moreover, these spontaneous conversations initiated through observation resulted in the identification of some of the key informants I have on for the study.

Focus group discussions

Focus group discussion was another important method that generated valuable data for this study. Taking the various fieldwork periods together, a total of 22 focus group discussions were conducted with women (n=10) and men (n=11) in separate groups, and one mixed group, on various issues that mainly emerged earlier in the interviews (Table 1). Thirteen discussions were conducted in villages near forests, and nine in the villages away from forests (Table 1). The major issues covered were forest cover history and changes, migration to and within Gera, and ranking of ESs and EDs from and related to forest and trees (Table 2; see papers I, II and IV).

In all cases, the women's focus group discussions had fewer participants than the groups with men. One major reason was that in most cases the women needed to get permission from male heads of the household to participate in the discussions. Getting such permission was not easy, especially from the heads of households with little prior information about my research. These separate discussions were important not only to evaluate the differences between the respective views of women and men, but also to get women involved, which was observed to be difficult during a trial with a mixed-gender focus group discussion aimed at ranking households based on wealth category in Muje.

Satellite images and aerial photos

Satellite images and aerial photos were used to establish the pattern and trends of forest cover change in Gera from 1958 to 2010 (see paper IV). Part of the data came from the forest and non-forest datasets generated by Hylander et al. (2013) who used multispectral Landsat images from 1973, 1985, 1995, 2001, and 2010 (http://www.usgs.gov/) to examine impacts of shade coffee production on forest cover change in southwestern Ethiopia including most (93.4%) of Gera. To produce a complete analysis of forest cover change for the whole of Gera district, I analysed Landsat images using a similar method (an ISODATA unsupervised classification) for the part of Gera that was not included in the study by Hylander et al. (see paper IV for details). Version 10.2 of ArcMap was used for this analysis. From the satellite image analysis, forest and non-forest areas were computed at kebele level. The *kebeles* were classified as either coffee forest area or highland forest area. Forest area changes in Gera district were computed for the periods: 1973–1985, 1985–1995, 1995–2001 and 2001–2010 as well as the full period of 1973–2010 (paper IV).

Aerial photographs taken on January15, 1958 were interpreted for two separate areas: parts of Sadi Loya–Wanja Kersa, and Muje kebeles (Figure 1; paper IV). These two areas represent coffee forest and highland forest areas, respectively, that making them good representatives of the district. Forest and non-forest land use types were visually identified and digitized manually in ArcMap (see paper IV for details).

Population censuses and unpublished documents

Kebele population data for 1984, 1994, and 2007 were obtained from published population censuses (paper IV). A major challenge in using these population data was the merging of the kebeles from the1984 and 1994 censuses into 29 larger kebeles when the 2007 census was conducted. Key informants were used to identify the merged kebeles, in order to aggregate the 1984 and 1994 data and thus make them comparable with the corresponding population numbers in 2007 (see paper IV for details).

Population numbers were also interpolated for 1985, 1995, and 2001, and extrapolated for 2010 proportionally; that is linearly from the 1984, 1994 and 2007 population censuses (see paper IV for details). Crude population densities were calculated for 1985, 1995, 2001, and 2010 and used as proxy population densities for the periods for which forest changes were computed: 1973–1985, 1985–1995, 1995–2001 and 2001–2010.

Real-time data collection on crop raiding by wild mammals: challenges

Two techniques were attempted to capture real-time data on wild mammals' visits to crop fields and crop damage during two different cropping seasons. The first technique was to instruct ten selected households, each with at least

one literate member, to follow and record wild mammal visits and damage to their maize fields and enset during the 2011 cropping season. Despite the demonstrations given to the selected farmers on how to record the data in a notebook handed, this diary keeping did not work well. This was because daily monitoring and estimation of the damage demanded too much work of the farmers. The second attempted technique was to hire field staff known as development agents from the district agriculture office, including one local resident. Based on the lessons from instructing farmers to keep diaries, only one maize field and one stand of enset (one of the staple crops usually cultivated in home gardens) were chosen per farm/household, and these assistants were asked to record wild mammal pest visits and the level of damage for a total of 36 selected households in six villages for the 2012 cropping season (see paper II). Three development agents and one local resident were hired and trained to perform the data collection. However, due to problems of incompleteness and questions of reliability, the data gathered by the hired assistants were not used in this thesis. One problem was that, especially during cropping season, the development agents lacked sufficient time to monitor the selected fields, which undermined the quality of the data collected. In addition, the maize sown by 13 farmers living in high-altitude parts of the district, where maize is sown at the onset of the short rainy season, completely failed due to late arrival of the short rains that year.

Field notes, field assistants, and interview strategies

I did not routinely record interviews; only a few of the interviews with those key informants. I observed that informants were more willing to openly discuss issues perceived as 'sensitive' when interviews were not recorded. Instead of voice recording, I took short notes during the interviews and wrote detailed field notes every day after fieldwork. This note writing also created an opportunity to reflect on the data collected and to plan subsequent fieldwork and daily activities.

All interviews were conducted without involving a translator. Although the main targets of the interviews were heads of household, in many cases other adult family members were present and participated in these interviews. Throughout the fieldwork I used local residents as field assistants (except in two villages, where on some occasions I used development agents); these assistants followed me during my walks from one household to the next, crisscrossing the different village landscapes. The use of local residents was an important part of the process of familiarizing myself with the Gera mosaic landscape. However, the field assistants were not allowed to be present during the interviews on issues considered as sensitive. Interviewing and mapping of some fields, for example those held only on the basis of informal rights, was difficult to achieve and required repeated visits to build

trust, as illustrated by the quotation at the beginning of this section (Research design and data).

Qualitative data analysis and statistical tests

In all the papers, qualitative data (text) from various fieldwork periods and collection methods (individual interviews, focus group discussions, conversations with farmers, and observations) were combined, sorted, and manually coded to identify emerging patterns or categories (Bryman, 2012). I performed qualitative data analysis in two major steps. In the first step, I identified and separated the data to be used in the four papers, examining the data from the different fieldwork periods separately. Once I had identified the qualitative data to be used in the papers, I moved on to the second step, in which for each paper I sorted and coded the data to identify emerging patterns or categories. These categories were used as analytical themes in the papers.

In addition to qualitative data analysis, some statistical tests were performed in all papers except paper III. Paper I used a multivariate statistical analysis of tree species based on survey (tree species inventory) of annual crop fields, grazing land, and home gardens. The objective of this statistical test was to show if there were any differences in the number of trees species managed (i.e. planted or retained) inside fields and along field boundaries, and in villages close to and far from forest, using data from the selected six villages. Another statistical test used was to evaluate whether the species composition of trees differed between those managed inside fields and those managed along field boundaries (see paper I for details). Paper IV used two non-parametric statistical tests. The Wilcoxon rank-sum test was used to evaluate whether there were differences in the extent of forest cover changes and population densities between coffee forest and highland forest kebeles. The Spearman's rank correlation test was performed to evaluate whether the extent of forest cover changes were correlated with population densities in coffee forest and highland forest kebeles (see paper IV for details). Papers I and II used chi-squared tests to analyse the responses from the participatory field mapping and interviews during the second fieldwork period. All statistical tests were performed using the free software package R (https://www.r-project.org/) (papers I, II and IV).

Ethical considerations and reflexivity

I encountered one major ethical challenge and one other problem while undertaking this research. In this subsection, I briefly discuss these challenges and describe how I attempted to handle them.

A major ethical issue I faced was the farmers' requests for advice in relation to forestland expropriation, for example. I find research a very painful

task, in this regard, as it may involve listening to emotionally-moving lived experiences but at the same time being unable to offer any immediate help or advice (based on either academic or political grounds). What I found even more depressing was the realization that there is little likelihood of any immediate desirable change resulting from the reports of the findings of this research, whether in the form of popularized pamphlets or papers published in academic journals. It has, however, been a privilege to engage in this research and learn about complex real world problems, and to generate knowledge that contributes even marginally to solving these problems in the future.

During the initial fieldwork periods, my mapping of the fields used by the interviewed farmers generated a rumour that I had been sent by the government to measure the land that the farmers owned and the proportions of their land they usually cultivated. According to this rumour, I was to report back the information to the government so that it would (i) confiscate the land that farmers did not use frequently and reallocate it to investors and other farmers, and (ii) increase the land tax for farmers who owned large areas of land. This rumour persisted for some time, but eventually dissipated fully, and as discussed earlier the participatory field mapping remained a useful methodology. A number of reasons contributed to the dissipation of the rumour. One factor was farmers' realization that if the supposed hidden agenda were real, the lands of all farmers would have been mapped, not just the fields of a few selected farmers. Secondly, the field mapping performed during the first fieldwork period did not result in any land confiscations or increase in land tax. Another reason was the efforts I made to regularly explain the aim of my fieldwork to both the interviewed farmers and other local residents, especially when I got a sense that my presence and work were misunderstood. The use of local residents as field assistants also helped me to be aware of local worries and questions and thus to address them as early as possible.

Both of the challenges encountered in my research, the request for advice and the rumour, were related to the divide and 'power asymmetry' between me as a researcher and the informants and local residents as the researched. The use of research equipment including large-scale satellite image printouts and GPS, coupled with the perception of me as coming from an urban area, underlay this divide and power asymmetry. This perception of me became obvious as it tended to surface during interviews, especially in the first couple of meetings with a household or individual. Clearly, it is difficult to:

> fully understand how particular aspects of our perceived identity shape the research process, since these are subjective responses experienced by research participants…perhaps never voiced. (Nayak and Jeffrey, 2011:142).

However, as a person born and brought up in a rural area in Ethiopia, with similar norms and values to the residents in Gera, and being able to speak the

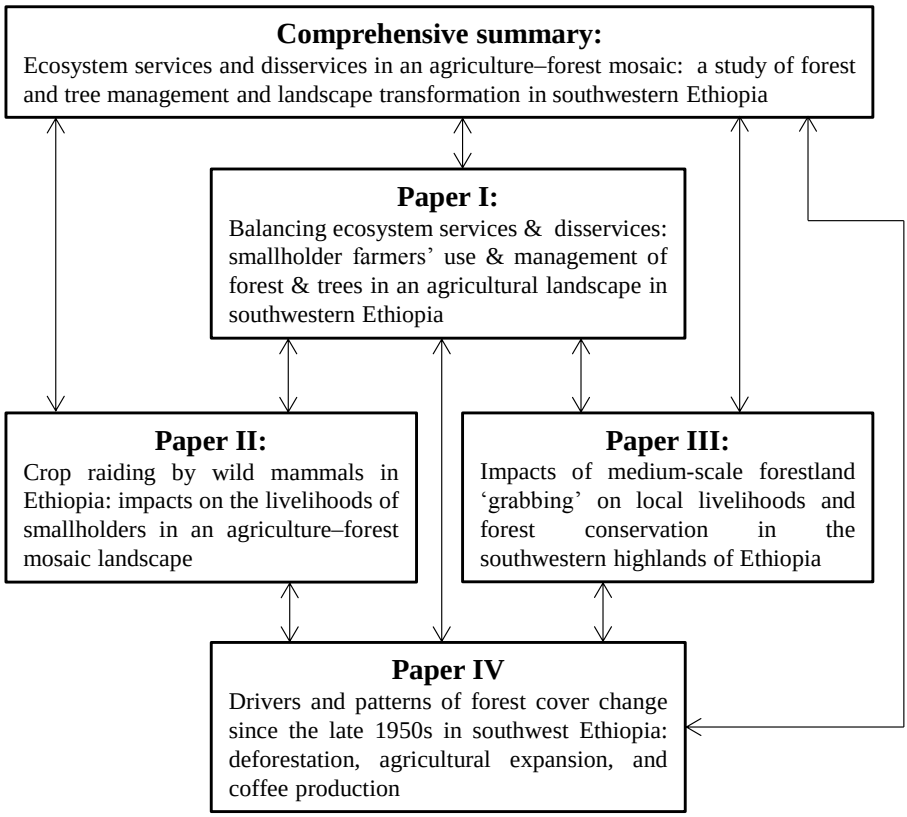
same languages as the informants, I believe I have managed to understand and mitigate much of the asymmetries and divide related to this research. I was therefore able to relate to most of the households I interviewed in a way that helped me to win their trust and encourage them to share their stories with me, while at the same time being open about my role and position as a researcher.

Structure of thesis and summary of papers

Structure of thesis

The numbering of the four papers used in this thesis indicates not only the chronology in relation to the writing process, but also an attempt to develop issues introduced and touched upon (or discovered as important) in earlier papers. Paper I investigates how smallholding farmers in an agriculture–forest mosaic landscape manage trees and forest in relation to a few selected ESs and EDs that they consider particularly beneficial or problematic.

Figure 4. Development of the papers and structure of the thesis.



Paper II builds further on the EDs introduced in paper I to assess the impacts of forest-dwelling wild mammals on smallholders livelihoods, and exposes how EDs of wild mammals have caused not only yield loss but also indirect costs that contribute to the severity of the problem. Paper III examines the local forest-based livelihood sources and how these ESs have been undermined by state transfer of forestland to private companies for coffee investment. Paper IV analyses how local management of ESs and EDs along with development and conservation policies have together shaped the forest cover in the area. Taken together, the separate but partly overlapping themes of the papers contribute to the overall aim of the thesis (Figure 4).

Summary of papers

Paper I: Balancing ecosystem services and disservices: smallholder farmers' use and management of forest and trees in an agricultural landscape in southwestern Ethiopia

Agriculture–forest mosaic landscapes support local livelihoods by providing services and benefits including food, fodder, fibre and regulation of water quality and soil fertility. Such landscapes also support biodiversity, some of which poses challenges to farmers' livelihoods that invite management intervention, which in turn has implications for biodiversity conservation. This paper examines how smallholding farmers in an agriculture–forest mosaic landscape in Gera district, southwestern Ethiopia, manage trees and forest in relation to a few selected ESs and EDs that they highlight as beneficial or problematic. Shade coffee and honey production, and establishment of live fences were studied as examples of ESs, and wild mammal crop pests and their management as an example of EDs. The study was based on data collected from farmers living in six villages, three near and three far from forests, using mixed methods including participatory field mapping, interviews, and a tree species inventory. The paper reveals several management practices that result in a restructuring of the agriculture–forest mosaic: (i) planting of trees on field boundaries and removal of trees standing inside arable fields, (ii) preservation of trees on semi-managed forest coffee land, (iii) maintenance of patches of shade coffee fields in the agricultural landscape, and (iv) establishment of woodlots with exotic trees. The strategies farmers employed to mitigate crop damage by wild mammals such as baboons and bush pigs, including migration and the clearing of new land for agriculture, and allocation of migrants to lands along forests, had contributed to a reduction in forest and tree cover in the agricultural landscape. The study concludes that farmers' management practices were overall geared towards mit-

igating the negative impact of disservices and augmenting positive services. The paper also highlights that the operationalization of ecosystem processes as both services and disservices is a pragmatic tool for studies related to local perceptions and management of agricultural landscapes.

Paper II: Crop raiding by wild mammals in Ethiopia: impacts on the livelihoods of smallholders in an agriculture–forest mosaic landscape

This paper analyses the effects of wild mammal crop raiders, discussed in paper I as an example of EDs related to trees and forest. Raiding by wild mammals poses a serious challenge not only to the livelihood and food security of many smallholder communities in tropical agriculture–forest mosaic landscapes, but also to wildlife conservation. However, relatively little is understood about the broader livelihood implications of human–wildlife conflicts and how this problem impacts on, for example, local agricultural development. Accordingly, this study assessed, the impact of the direct and indirect costs of wild mammal crop raiders on smallholder farmers' livelihoods in southwestern Ethiopia, using data from participatory field mapping, interviews and focus group discussions with smallholding farmers. The study shows that wild mammals, mainly olive baboons and bush pigs, were severely raiding most cultivated crops in villages close to forests. In addition to yield loss due to such raids, pest mitigation practices: (i) brought substantial indirect costs to the farmers in terms of additional labour for guarding and cultivation, (ii) competed with children's schooling, and (iii) undermined farmers' interest in investing in agricultural inputs that seemed to affect both agricultural production and household food security. The study also reveals that farmers' mobilization of different mitigation strategies was not sufficient to reduce the negative impacts of these pests on household economies to tolerable levels. Government policies and institutions were generally found to have undermined farmers' coping strategies and thus aggravated the problem of mammal pests. The paper concludes by discussing the importance of interventions aimed at easing the direct and indirect costs of this ED and its negative impact on local agricultural development and livelihood security in a way that also integrates concerns for wildlife conservation in agriculture–forest mosaic landscapes.

Paper III: Impacts of medium-scale forestland 'grabbing' on local livelihoods and forest conservation in the southwestern highlands of Ethiopia

This paper aimed to further develop the analysis of the tree and forest ESs introduced in paper I, but with a focus on forestland transfer to private com-

panies for coffee production, and to examine how this strategy has affected local forest-based livelihoods and forest management in the southwestern highlands of Ethiopia. Based on data mainly from interviews and documents (e.g. letters from government agencies), this paper shows that there have been ongoing transfers of parts of forestland in Gera to private investors since the late 1990s; that is before the onset of the recent large-scale land grabbing in other parts of the country. By 2010, over 1700 ha of forestland had been transferred to six private companies engaged in coffee production. The study shows that subsistence farmers living in and around the forest rely substantially on the forest for shade coffee and honey production, wood for construction, raw material to make farm implements, wood fuel, and grazing for livestock; and that the transfer of part of the forest to private companies has disrupted the forest-based livelihoods of the affected farmers. The forestland transfer has generated conflicts between the farmers and the companies, with the result that several farmers have been imprisoned. New livelihood opportunities created by the companies, including low-paying jobs, were considered by the farmers as insufficient to justify the appropriation. Likewise, other benefits envisioned as results of the investments in coffee production, such as technological transfer from the companies to farmers, and companies' contribution to foreign currency earnings to the country through coffee export, had not yet materialized at the time of the study. The paper demonstrates that the transfer of forestland to private companies has affected forest conservation efforts through conversions of forestland to coffee plantations and that some smallholders have responded by intensifying their use of the forestland that they still have access to, hoping to secure their rights to these lands. This paper shows how a relatively small area of land grabbed by the state in areas with relatively high population density can have substantial impacts on local livelihoods and forest management. Hence, forestland grabbing has been counterproductive in terms of its effects on livelihood and forest conservation.

Paper IV: Drivers and patterns of forest cover change since the late 1950s in southwest Ethiopia: deforestation, agricultural expansion, and coffee production

This paper investigates the patterns and drivers of forest cover change in the Gera landscape over the past 50 years, drawing on several data sources: Landsat images, aerial photos, participatory field mapping, interviews, focus group discussions, and population census data at local or *kebele* level. The results show that the forest cover in Gera declined from 78.9% in 1973 to 59.5% in 2010, corresponding to a loss of 24.5% of forest cover in 37 years: however, forest cover changes also varied both spatially and temporally. From 1973 to 2010, deforestation rates were significantly lower in coffee

forest areas than in highland forest areas ($p < 0.001$ for relative rate forest cover change). A comparison of the forest and non-forest cover classes between the 1958 aerial photos and 1973 Landsat images for two selected areas also revealed a forest cover decline in both coffee forest and highland forest areas. The paper shows how migration from coffee forest to highland forest kebeles displaced deforestation from coffee forest to highland forest area. Population density in highland forest areas was higher than coffee forest areas. There was negative correlation between population densities and area of forest cover change in highland forest areas, which shows that people have moved to low population density areas and converted forestland to farmland. The first and second major periods of forest cover decline occurred during 1973–1985 and 2001–2010 respectively. These periods overlap with the implementations of major land and forest use policies or programs, including the 1975 radical 'land to the tillers' proclamation, the forestland transfer to companies for coffee production since the late 1990s, and the introduction of participatory forest management in 2003. The findings demonstrate that state development and conservation policies spanning various political economies (feudal, socialist, 'free market-oriented'), and the associated power asymmetries in relation to forest land control, have directly or indirectly affected local ecosystem use and management practices, as well as migration processes; and that these factors—policies, local management practices and migration—have together shaped spatial patterns of forest cover change at the sub-district level. The findings of this study highlight the importance of gaining a detailed understanding of how various local ecosystem use and management practices and policies are spatially and temporally interlinked and how this shapes deforestation patterns at the sub-district level, in order to generate viable strategies to improve forest management in the southwestern highlands.

Concluding discussion

Mootiif abbaan lafaa laftiif bosonni keenya jedhan; nuy immoo kan Waaqaati jenne.
'The imperial government and the landlords said the land and forest belonged to them, but we said both belong to God.' (An elderly man interviewed in Gera in 2011).

This thesis concerns the intertwined issues of local livelihood and environmental management in the context of national development and conservation policies in the Ethiopian highlands, with a focus on trees and forest management in relation to their ESs and EDs. In this section, I present a synthesis of the various findings discussed in the four papers, and situate them within a broader scientific and policy discussion about ES and ED management and transformation of tropical mosaic landscapes.

Managing ecosystem services and disservices in an agriculture–forest mosaic landscape

The examination of how smallholding farmers in an agriculture–forest mosaic landscape manage trees and forest in relation to selected ESs and EDs, reported in paper I, has demonstrates that these farmers' management practices were overall geared towards mitigating the negative impact of disservices and augmenting the positive services, and that this restructured the agriculture–forest mosaic landscape. The smallholders in Gera relied to varying degrees on forest, trees, and related ESs for shade coffee and honey production (papers I and III), wood for construction, raw material to make farm implements, fuel wood and grazing for livestock (paper III). The investigation of this illustrates the various ESs and the substantial role they play in local livelihoods and food security. On the other hand, forest-dwelling wild mammal crop raiders were found to be a serious challenge to agricultural production and local livelihoods in villages at forest margins (papers I and II). Paper II further showed that at forest edges, wild mammals have not only brought direct costs by raiding most cultivated crops, but also caused substantial indirect costs including additional labor for guarding and negative effects on children's schooling. Moreover, these raids were a disincentive for farmers' investment in agricultural technologies (chemical fertilizers and improved seeds), which affected agricultural production and local food secu-

rity. The use of such technologies in Ethiopia (FDRE, 2003) and generally in Africa (Morris et al., 2007) is seen as a key strategy to enhance smallholder agricultural production and to promote rural development. In this sense, as shown by the case of forest-dwelling crop raiding wild mammals in Gera, EDs pose a challenge to rural development initiatives in mosaic agricultural landscapes.

Farmers' management practices and work processes in relation to trees and forest mainly involve planting and/or retaining of trees inside fields (e.g. shaded coffee and grazing land) and/or along field boundaries on different land uses (e.g. annual cropland), establishing woodlots, and removing trees and clearing forest land to expand agriculture (paper I). To cope with pests, several farmers migrated to highland forest areas where the forest does not shelter coffee, in order to convert forestland to farmland (papers I and IV). Another strategy has been to welcome migrants to settle on forest edges (paper I). Other major ED mitigation strategies that are not related to tree and forest management include guarding and the use and adaptation of local socio-economic institutional arrangements (didaro or crop cooperation; and yekuto or crop sharing). These were shown to be of critical importance in ensuring that yields were not totally lost to wild mammals (paper II). On the other hand, the management of a variety of tree species on arable land (49 species; see paper I) indicates the role that this mosaic agriculture–forest landscape can play in biodiversity conservation (Pimentel et al., 1992; Manning et al., 2006; Hylander and Nemomissa, 2008 and 2009; Perfecto and Vandermeer, 2008 and 2010; Smukler et al., 2012; Molla and Asfaw, 2014; Le Roux et al., 2015). Moreover, a recent study (Vanderhaegen et al., 2015) has shown that non-forest land uses including semi-managed forest coffee patches, woodlots, grazing, and annual crop fields store 80% of the total carbon stock in Gera and neighbouring areas, which illustrates the importance of trees outside of forest in climate change mitigation.

In this thesis, the concepts of ESs and EDs were found to align well with how farmers conceive of and engage with nature; for example, how they articulate the choices they face, their perceptions of problems and benefits associated with cultivation in the vicinity of forests, and their resulting management practices (papers I and IV). This conceptualization remained a useful way to operationalize the 'trade-offs' of ecosystem services (Rodríguez et al., 2006) in an endeavour to understand these from the perspective of local farmers. Understanding local agro-ecosystem relations from the perspectives of local farmers can also help mitigate the power asymmetry that implies a superiority of 'scientific' over local knowledge by overlooking the relevance and role of local knowledge and experience as part of solutions to food insecurity and global environmental problems such as biodiversity loss. This thesis demonstrates how a conceptualization of the local ecosystem as a provider of both ESs and EDs generates an understanding of local

practices and decisions, which are key processes shaping development and conservation trajectories in mosaic landscapes.

Local practices and policies shape livelihood and landscape transformation

This thesis exposes how local ecosystem management practices and national development and conservation policies together shape local livelihood and landscape transformation. The centrally-drafted state conservation policy that bans wild animal hunting and particularly its implementation, for example, has overlooked local contexts, farmers' perceptions, and the challenges farmers face in attempting to balance ESs and EDs from and related to forest and trees (papers I and II). Government institutions were largely indifferent or unsupportive in the face of local challenges related to supporting secure forest access (paper III) and managing EDs (paper II) that negatively affected households' food and livelihood security. The same institutions have overseen the implementation of wildlife protection (e.g. OFWE-JBO, local and district level offices) and offered full support to the transfer of forestland by government to private companies for coffee investment (e.g. district and regional level offices) (papers II and III). The transfer of forestland to private companies has effectively alienated the affected farmers from land used on the basis of informal access or *de facto* rights to forest resources (paper III). The impacts of this forestland grabbing on local livelihoods and forest condition and management are comparable to those of recent large-scale land grabs in other parts of Ethiopia, and elsewhere in the global south (paper III; De Schutter 2011; Davis et al. 2014; Rahmato 2014; Balehegn 2015; Shete and Rutten, 2015).

The analysis of remote sensing data in paper IV showed that the Gera landscape lost 25% of its forest cover in about four decades. Rates of forest cover change varied significantly, both spatially and temporally. The decline in forest cover and the varied patterns of deforestation rates were shaped by diverse interwoven proximate causes and underlying drivers related to local ecosystem use and management, migration, and state development and conservation policies. Papers I and IV demonstrate that altitudinal migration from coffee forest areas to highland forest areas implied a deforestation 'displacement' or 'leakage', a phenomena reported in land change studies (see Aukland et al., 2003; Meyfroidt and Lambin, 2009). Shade coffee production significantly reduced forest cover decline in coffee forest areas (paper IV; Hylander et al., 2013). The state's view of forest as undeveloped land prior to the 1970s, development policies related to land and forest, the 'land to the tillers' proclamation, state logging quotas, the state-led resettlement program in the mid-1980s, and the forestland grabs starting from the late 1990s, all

contributed as underlying drivers of forest decline in the area. The pre-1974 view of forest as undeveloped land was a major underlying driver of deforestation during that period, as it contributed to the attraction of a large number of immigrants to Gera to purchase and convert forestland (paper IV). This view of the forest was largely shaped by the Imperial government's concern with producing food through arable land expansion (Bekele, 2003). The first (1973–1985) and second (2001–2010) major periods of forest cover decline overlap with the formulation and implementation of the Derg's 'land to the tillers' proclamation, and the current government's transfer of forestland to private investors (papers IV and III). Paper IV demonstrates that these and other policies from the mid-1970s to 2010 have impacted on forest cover decline via knock-on effects that created additional possibilities for migration to and within Gera. Such migration led to more forest conversions, for example the chain migration that followed 'the land for tillers' proclamation (paper IV).

On the other hand, despite ongoing deforestation in many areas, the forest cover gains in some areas and the expansion of tree-planting mainly eucalyptus trees, an exotic tree species, illustrate the nonlinearity of local livelihoods and landscape transformation (papers I, II and IV; cf. McCann, 1995). Such tree planting practice and tree cover gain could potentially trigger a 'forest transition' from forest loss to gain (cf. Sloan and Sayer, 2015). The forest transition theory, which is based on Europe's and North America's forest history, claims that as farmers migrate to cities, abandonment of land particularly in remote areas, brings about forest recovery (see Mather, 1993; Mather and Needle, 1997). In the tropics, however, some studies have suggested that forest transition takes a different route that involves reforestation and afforestation by local people as part of their livelihood strategies (see for example Rudel et al, 2002). The emerging pattern in Gera aligns well with the findings from other landscapes in Ethiopia (Ango, 2010; Jeneber et al., 2012; Desalegn et al., 2014), as smallholders' engagement in tree planting is shaped by local livelihoods (papers I and IV). In addition to the demand for shade for coffee, the market for eucalyptus, state forest ownership, and limited access (i.e. to NTFPs) have also contributed to the expansion of planted and retained trees (papers I, and IV). Most of these factors, coupled with the fast speed at which eucalyptus grows, are forces that motivate farmers to plant eucalyptus. Smallholders have been undertaking eucalyptus tree planting regardless of recent strong advice from the government to stop planting this tree, based on nationwide debate about its negative environmental consequences (papers I and IV; Chanie et al., 2013).

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Finally, this thesis demonstrates how farmers' forest and tree management practices were geared towards augmenting ESs while mitigating EDs within the constraints and opportunities they faced from the national policy con-

texts. The thesis concludes that the state development and conservation policies, and associated power relations and inequality, have overlooked local farmers' contexts and perspectives, and have often undermined local efforts towards livelihood security and forest conservation efforts. It also highlights how a conceptualization of a local ecosystem as a provider of both ESs and EDs can generate an understanding of the local practices and decisions that shape development and conservation trajectories in mosaic landscapes. The thesis draws attention to the need to make development and conservation policies relevant and adaptable to local conditions as a means to promote local livelihood and food security, biodiversity conservation, and ESs generated by agricultural mosaic landscapes.

Sammanfattning (summary in Swedish)

I de mosaiklandskap som karaktäriseras av småskaligt jordbruk utgör skog och träd inte bara ett viktigt bidrag till lokalbefolkningens försörjning, utan värdesätts nu mer och mer även för andra ekosystemtjänster såsom bevarande av biologisk mångfald och klimatreglering. Även om dessa egenskaper värdesätts, något som också reflekteras i politiska riktlinjer, så fortsätter osäker tillgång till mat, avskogning och utarmning av den biologiska mångfalden att utgöra sammanflätande och ihållande utmaningar i Etiopien.

Den här avhandlingen är en studie över småskaliga lantbrukares träd- och skogsbaserade försörjningssätt, och hanteringen av dessa, i relation till nationell utvecklings- och naturskyddspolitik. I avhandlingen, som fokuserar på Gera-distriktetet i sydvästra Etiopiens högland, undersöks också hur lokala försörjningssätt formas av politiska riktlinjer, lantbrukarnas jord- och skogsbruksmetoder och nyttjande av träd, liksom av andra aktörers verksamheter (såsom skogsföretag och företag som investerar i kaffeproduktion). Det är i de sydvästra högländerna som det mesta av den skog som återstår i landet finns kvar. Den här skogen innehåller en unik biologisk mångfald och i skuggan av träden odlas kaffe som är en av Etiopiens viktigaste exportprodukter.

Studien utgår från ett politiskt ekologiskt perspektiv och fokuserar på begreppen ekosystemtjänster (fördelar) och dess motsats–ekosystemotjänster– det vill säga ekosystemprocesser som har en negativ effekt på lantbrukares försörjning. I avhandlingen används en bred forskningsansats med både kvalitativa och kvantitativa data från främst deltagande kartering i fält, ”inventering” av träd, intervjuer, fokusgruppsdiskussioner, befolkningsstudier och analys av satellit- och flygbilder.

Denna avhandling består av en övergripande sammanfattning och fyra artiklar. Den första artikeln utforskar hur småskaliga lantbrukare i Gera-distriktet i sydvästra Etiopien brukar skog och träd i relation till de ekosystemtjänster och ekosystemotjänster som de upplever som ”fördelaktiga” eller ”problematiska”. Skuggodlat kaffe och honungsproduktion är exempel på ekosystemtjänster, medan angrepp från vilda däggdjur ses som en otjänst. I artikeln beskrivs fyra exempel på böndernas hantering av träd som leder till en förändring av landskapsmosaiken: (1) plantering av träd för att markera gränser mellan åkrar och borttagning av träd inne på åkermarken (2) bevarandet av träd för kaffeodling i skogslandskap, (3) bevarande och bruk av träd i områden med skuggodlat kaffe i jordbrukslandskapet, och (4) etable-

ring av lundar med snabbväxande exotiska trädslag i jordbrukslandskapet. Några av strategierna som lantbrukarna använde, som exempelvis migration och omvandling av skogsmark till jordbruksmark med syfte att minska skadorna från vilda djur såsom babianer och busksvin, ledde till att utbredningen av skog och träd minskade i landskapet. Jordbrukarnas strategier för att hantera träd och skog syftade främst till att minska negativa effekter (ekosystemotjänster) och förstärka fördelarna (ekosystemtjänsterna). Studien visar också att uppdelningen av ekosystemprocesser i tjänster och otjänster är ett pragmatiskt verktyg för att analysera lokala upplevelser och brukande av odlingslandskap.

Den andra artikeln fördjupar diskussionen om ekosystemotjänster och består av en uppskattning av effekterna av direkta och indirekta kostnader för vilda däggdjurs angrepp på grödor. Studien visar att vilda däggdjur, främst babianer och busksvin, i stor utsträckning angrep grödor i byar som gränsade till skogsområden. Utöver förlorad skörd till följd av dessa angrepp, så innebär arbetet för att minska angreppen (1) indirekta kostnader för lantbrukarna (i form av ytterligare arbete för vakthållning och odling), (2) inskränkning av barnens möjligheter att gå till skolan, (3) undergrävande av böndernas vilja att investera i insatsvaror i jordbruket med konsekvenser för både jordbruksproduktionen och hushållens tillgång till mat. De strategier som lantbrukarna satte upp för att minska skadorna var inte tillräckliga för att minska de negativa effekterna som dessa skadedjur hade på hushållens ekonomier. Statlig naturskyddspolitik och statliga institutioner visade sig generellt sett undergräva böndernas strategier för att handskas med problemet och bidrog istället till att förvärra problemet med däggdjursangrepp.

Den tredje artikeln syftar till att fördjupa analysen av ekosystemtjänster från och kopplade till träd och skogar som inleddes i den första artikeln, men här med ett fokus på skogsmark som överförts till privata företag för kaffeproduktion och hur den strategin har påverkat lokalbefolkningens skogsbaserade försörjning och skogsbruket i sydvästra Etiopiens högländer. Artikeln visar att en omfattande överföring av skogsmark till privata företag för kaffeproduktion har pågått i Gera sedan slutet på 1990-talet, dvs redan innan de storskaliga marköverföringarna i Etiopien och andra afrikanska länder satte fart på 2000-talet. Fram till 2010 hade över 1700 hektar skogsmark överförts till sex privata företag. Studien visar att självförsörjande bönder som lever i och i närheten av skog använder denna för skuggodling av kaffe och honungsproduktion, tillgång till trä för byggnation råmaterial till jordbruksverktyg, ved för bränsle, och som betesmark för boskap. Överföringen av delar av skogsmarken till privata företag har haft en begränsande effekt på lokalbefolkningens försörjning från skogen. Dessutom har överföringen av skogsmark lett till konflikter mellan bönderna och företagen. Som en följd av konflikterna fängslades flera lantbrukare. De nya försörjningsmöjligheter som skapats av företagen, såsom lågavlönade jobb, ansågs av lantbrukarna som otillräckliga för att kompensera för marköverföringen. På liknande sätt

hade andra förväntade fördelar förknippade med investeringar i kaffeplantager, såsom teknologisk överföring från företag till lokala lantbrukare och företagens bidrag till landets intäkter av utländsk valuta från kaffeexporten inte infunnit sig vid tiden för studien. Överföringen av skogsmark till privata företag har påverkat naturskyddsarbetet genom omvandling av skogsmark till kaffeplantager av några företag, liksom en intensifiering av användningen av skogsmark för skuggodling av kaffe av småskaliga lantbrukare i syfte att säkra markrättigheter och därmed undvika att blir fråntagna ytterligare mark. Den slutsats som dras är att överförande av skogsmark har varit en kontraproduktiv utvecklingsstrategi i och med att den skapat sämre förutsättningar för lokalbefolkningens försörjning och för främjande av naturskydd i området.

Den sista artikeln undersöker förhållandena och drivkrafterna bakom förändringarna i utbredningen av skogsmark i Gera distriktet mellan 1958 och 2010. Artikeln visar att den totala utbredningen av skog i Gera minskade med 25 % mellan 1973 och 2010. Avskogning skedde också mellan 1958 och 1974. Utbredningen av skog de senaste 50 åren har varierat både rumsligt och över tid. Från 1973 till 2010 var avskogningstakten anmärkningsvärt lägre i skog odlad med kaffe, det vill säga på höjdnivåer lämpliga för kaffeodling, jämfört med i mer höglänta skogsområden som inte är lämpliga för kaffeodling. De två mest betydande avskogningsperioderna pågick mellan 1973-1985 och sedan mellan 2001-2010. Dessa perioder sammanfaller med betydande reformer av markrättigheter och andra utvecklings- och naturskyddsåtgärder. Faktorer som påverkat omfattningen och de geografiska och tidsmässiga mönstren för hur utbredningen av skogsmark har förändrats är: småskaliga lantbrukares användande av lokala ekosystem för sitt uppehälle, såsom omvandling av skogsmark till jordbruksmark i höglänta skogsområden för produktion av årliga grödor och för att undvika angrepp från vilda däggdjur, och marknadsintressen (produktion av skuggodlat kaffe), i kombination med utvecklings- och naturskyddspolitik på statlig nivå och folkomflyttning inom och till Gera.

Denna avhandling visar hur bönders skogsbruk och bruk av träd i jordbrukslandskapet har syftat till att förstärka ekosystemtjänster och samtidigt minska ekosystemotjänster inom de begränsningar och möjligheter som skapats av statlig politik. I avhandlingen dras slutsatsen att utveckling- och naturskyddspolitiken på nationell nivå ofta har undergrävt både lokala möjligheter till tryggad försörjning och åtgärder för att bevara skog. Avhandlingen visar också hur en uppdelning av lokala ekosystem som tillhandahållare av både tjänster och otjänster kan underlätta förståelsen för lokala strategier och beslut som påverkar utveckling och bevarande av natur i mosaiklandskap. Avhandlingen belyser särskilt behovet av att utvecklings- och naturskyddspolitik görs relevant och anpassningsbar för lokala förhållanden, som ett sätt att främja lokalbefolkningars försörjning och tillgång till mat,

bevarandet av skog och biologisk mångfald, samt de ekosystemtjänster som genereras av mosaikslandskap.

Nyckelord: naturskydd, avskogning, ekosystemotjänster, ekosystemtjänster, skog, Etiopien, marköverföring, försörjning, Oromia, skadedjur, nationell politik, politisk ekologi, träd, tropiska mosaiklandskap

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