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Understanding people and forest interrelations along an intensification gradient in Arsi-Negele, Ethiopia

Jean-Yves Duriaux and Frédéric Baudron

Summary

This chapter presents the results of a scoping study conducted along an agricultural intensification and forest cover gradient from Arsi-Negele town to Munessa Forest in southern Ethiopia. It summarizes preliminary research in the study area led by the International Maize and Wheat Improvement Center (Centro Internacional de Mejoramiento de Maíz y Trigo, CIMMYT) as part of the Agrarian Change Project, a multi-country comparative research project led by CIFOR. The objective was to gather information that will guide further research in the area including: characterization of the intensification gradient (context), access to resources, livelihood strategies, market access and value chains, institutional support, and perceptions of change (land-cover change and historical trends).

2.1 Introduction

In Ethiopia, 82.22% of the population is rural and relies mainly on agriculture for its living (FAO 2014). Ethiopian (and most sub-Saharan African) farmers often experience low productivity due to low input access and use, lack of market access, and government or institutional failures, among other reasons (Ehui and Pender 2005). Although Ethiopia

is very diverse agro-ecologically and socioeconomically, mixed crop-livestock systems dominate. Livestock generate a number of benefits (nutritional animal products, income, manure, traction, saving, insurance, display of status, etc) but generally require more feed and fodder than available on-farm. Similarly, rural households are generally not self-sufficient in household fuel material (fuelwood, crop residue, dung and other materials). Therefore, farming households rely on communal resources, including pastures and natural areas, for their provision of fodder, fuel, construction materials and wild food.

In 2005 it was estimated that 11.9% of the Ethiopian territory was covered by forest (0.13 million km^2) and that these forest areas had been declining at a rate of 1.1% annually between 2000 and 2005 (FAO 2005 as cited by Garedew 2010). It is assumed that the rate of forest loss was similar for the period 2005–10 (FAO 2010). Although there is a lack of reliable data about forest cover before the 1980s, it is believed that in the late 1960s forest covered around 40% of the country (personal communication from Kedir Nino, head of Oromia Forest and Wildlife Enterprise – OFWE – Arsi-Negele Branch, September 2014). Various drivers have been identified in different regions, but changes in property and use rights, and the role of the State have been recognized as the most important (Bekele 2003). In addition to lack of governance during repeated periods of violent political, social and economic changes, uncertainty in the land tenure system and the introduction of new profitable crops have contributed to the decline in forest cover in the south Central Rift Valley of Ethiopia (Dessie and Christansson 2007). Sassen et al. (2012) demonstrated in Kenya that the context (e.g. law enforcement, collaborative management, political interference) is more important than the drivers (population, wealth, market access, prices) that operate under this context in explaining deforestation. Conservation and development policies and interventions need to address local factors within the context and conditions generated by larger-scale external influences (Sassen et al. 2012).

Most farmers in Ethiopia and sub-Saharan Africa have to achieve production with scarce resources (Rufino et al. 2009). Forest and other communal resources help farmers who are facing a shortage of resources at times of low agricultural productivity. Although communal resources provide fuel, food, feed and income, their buffering effect is decreasing fast as areas shrink or degrade (Tittonel 2013). It is thus urgent to understand what drives forest loss and its impact on rural livelihoods, and be able to identify compromises – in terms of landscape composition and configuration – that provide the best outcomes for rural households and the environment. Such analysis, however, should be context-specific.

This chapter provides a first overview of the selected study area, local value chains of important products and local perceptions of livelihoods, historical trends, land-use change and access to resources.

2.2 Methodology

2.2.1 Site selection

Suitable sites for the Agrarian Change Project – characterized by changing land-use practices, the presence of an intensification gradient/chronosequence and similar altitude, soil type and weather – were prospected. Interviews with Ethiopian forestry

experts Dr. Habtemariam Kassa (CIFOR; 19 September 2014) and Dr. Menfese Tadesse (Wondo Genet Forestry College; 23 September 2014) were held to obtain recommendations of possible study areas. Following their suggestions, exploratory visits took place until an adequate intensification gradient was found. Three settlements along the intensification gradient were selected. Each settlement was chosen as representative of distinct zones along the intensification gradient. Settlement leaders and local administration offices were invited to collaborate.

2.2.2 Selected landscape: Munessa Forest area

The selected landscape is located in the Oromia region, Arsi-Negele *woreda* (district) and includes three *kebeles* (subdistricts): Gambelto, Bombaso Regi and Ashooka. Munessa Forest is a protected forest that is owned by the State and controlled by OFWE. It has an estimated area of 23,000 ha and is subdivided into three management blocks: Degaga, Sole and Gambo (Figure 2.1; Halle-Wittenberg University 2002). Only the latter block is part of the selected landscape.

According to the Ethiopian classification of climatic zones, Munessa Forest and its surroundings can be classified as Woyna Dega (1500–2300 masl) and Dega (2300–3200 masl) zones (Teshome 1996). The selected landscape is found in the Woyna Dega zone since the elevation ranges from 1970 to 2200 masl. According to Lemenih (2004) the forest can be classified as tropical dry evergreen montane forest. Soils are mainly andosols (Lemenih 2004). The Halle-Wittenberg University website (2002) describes the area as presenting bimodal rainfall pattern with a short rainy season from March to May and a long rainy season from July to September. In Degaga station (~20 km north of the selected landscape) the mean annual rainfall is 1075 mm (18 year average) and the mean annual temperature is 15°C (16 year average) (Figure 2.2).

2.2.3 Understanding the context

A first set of interviews was conducted with the settlement leaders and administration officers in order to obtain general information about history, economic activities, agricultural seasons and presence of infrastructure in the area. In addition, two interviews were conducted with the head of OFWE to obtain background information about the forest history and the current situation.

A participatory rural appraisal (PRA) was held in each settlement with a subgroup of 50–60 community members that was representative in terms of gender, age and wealth. To obtain an initial but complete understanding of the settlement situation and its history, six participatory activities were carried out leading to the six following outputs: a timeline of historical events, a settlement map (displaying major resources and land uses), a representation of the modalities of access to major resources (forest products, land, water and grazing lands), a Venn diagram (representation of the institutional and organizational support in the area), value-chain representations for the main commodities, and a household typology based on self-categorization (Geilfus 2008).

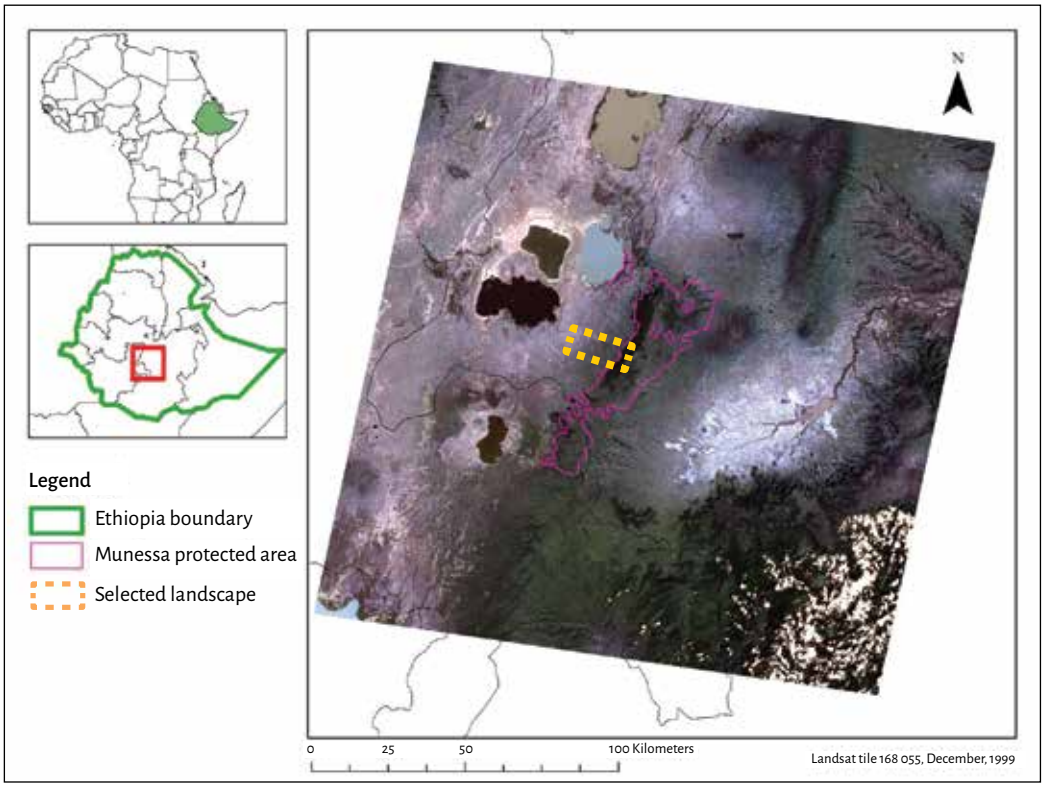

Figure 2.1 Location of Munessa Forest and the study area, which can be described as an intensification gradient.

Source: John Arnet and Ian Eddy (2015), Remote Sensing Department, University of British Columbia

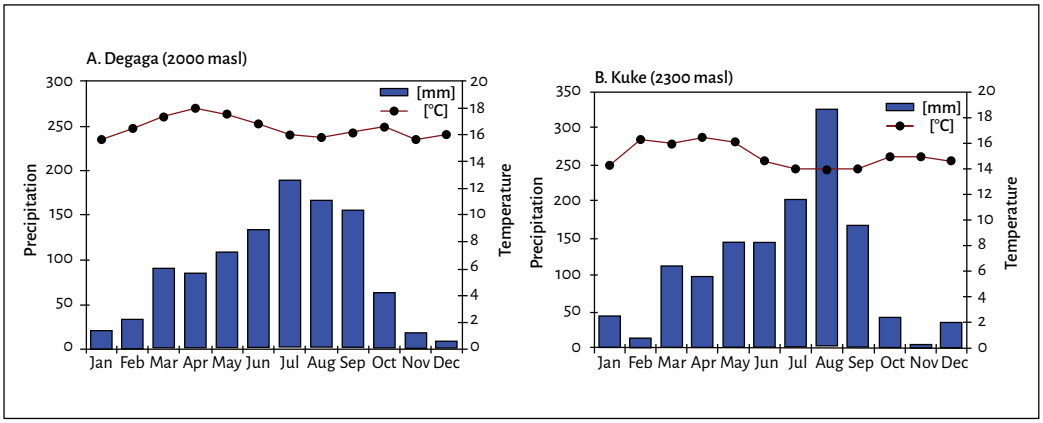

Figure 2.2 Mean annual rainfall and mean temperature (A) in Degaga (18 year average and 16 year average, respectively) and (B) Kuke (rainfall and temperature data for 2002). The two sites are about 20 km north from the studied landscape.

Source: Halle-Wittenberg University (2002)

2.2.4 Focus group discussions

An FGD was held in each settlement (n = 3) to analyze land-use/land-cover changes as well as trends of historical changes (Geilfus 2008). A group of 14 elders and settlement leaders were invited to participate. First, trend lines were drawn and discussed by participants, describing changes over the last 40 years in population, forest cover, crop productivity, food security, farm size and livestock number. The second part of the activity consisted of creating historical diagrams of land-use/land-cover change for five points in time during the last 40 years. Participants selected four land-use types: forest, cropland, grazing land and *eucalyptus* woodlots (most important land uses in the area), and their change over time was analyzed.

An FGD with elders and settlement leaders in one of the selected settlements. (Jean-Yves Duriaux/CIMMYT)

2.2.5 Key informant interviews

Based on preliminary information obtained through the PRA, actors of the following value chains were interviewed: fuelwood, maize, wheat, potato, milk and livestock. The urban market of Arsi-Negele and rural market of Lephis were visited several times to conduct interviews. A total of 23 interviews were held in order to complete the value-chain diagram for the different commodities. A list of interviews can be found in Appendix 2A.

An interview with the community-based organization (CBO) managing the forest around Ashooka kebele was conducted with three members of the managing committee in order to understand the functioning of the organization as well as the actual situation concerning the forest access and use in the area (method based on personal

communication from Annemiek Pas, 29 September 2014). The head of the local office of OFWE working in the area was interviewed to examine the institution's position and the legal situation related to access and use of the forest. Representatives from Lephis Ecotourism Cooperative were interviewed (locally based) to examine its functioning and importance in the area. Finally, two meetings were held with health officers working in the area (one health extensionist and one health service provider) to get an understanding of the general health situation, the biggest problems and the most susceptible groups in the area.

2.2.6 Remote sensing

A preliminary analysis of land-cover change in the study area was performed by John Arnet, Ian Eddy and Sarah Gergel from the Remote Sensing Department of the University of British Columbia. The remote sensing study explored possible vegetation loss from 1987 to 2011.

2.2.7 Gray literature and literature review

Different literature sources were consulted, chiefly MSc and PhD theses from Wondo Genet Forestry and Agriculture College library.

2.3 General information of the study area

2.3.1 Selected zones and settlements

The study area is represented in Figure 2.3. It can be divided into three zones along an intensification gradient from Arsi-Negele to Munessa Forest (Gambo block) near Lephis village. The zone closest to the forest (Zone 1) has access to the forest, has a high tree density on its farmland and has species-diverse home gardens. In the intermediate zone (Zone 2), residents have no access to the forest but the density of indigenous trees is high both in the farmland and the home gardens. In Zone 3 (furthest from the forest) annual crops dominate, native tree species are almost absent from the farmland and home gardens are almost absent (only few *eucalyptus* trees can be found around the homestead).

As seen in Table 2.1, the tree density decreases with increasing distance from the forest. Indigenous trees are almost absent from Zone 3. Elevation varies less than 200 m and

Intensification gradient starting from a settlement next to Munessa Forest (left), to a high tree density zone (center) and ending in a low tree density zone (right). (Jean-Yves Duriaux/CIMMYT)

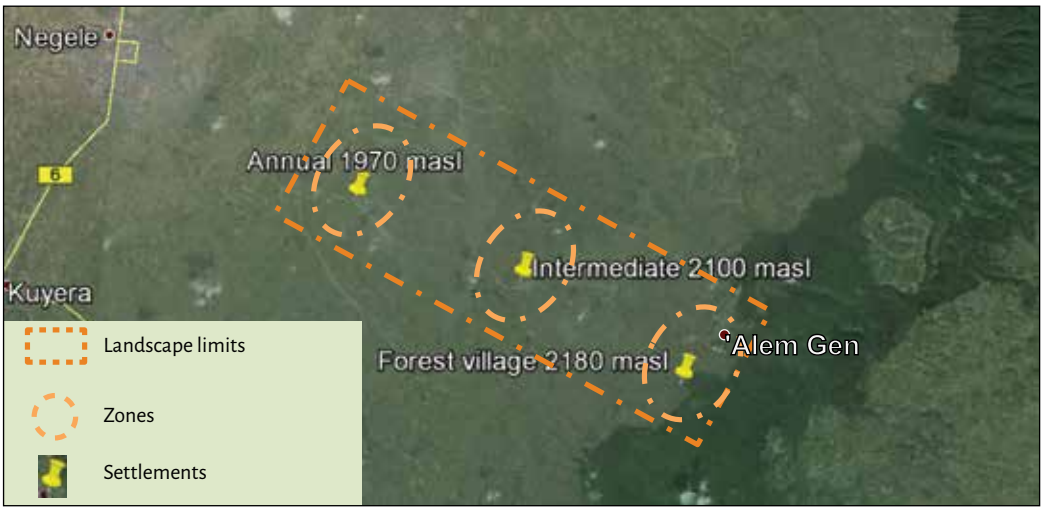

Figure 2.3 Map displaying the study area, and the three zones along an intensification gradient from Munessa Forest to Arsi-Negele.

Source: Modified by the author from Google Earth: Images ©2015 CNES/Astrium, Landsat, Digital Globe; Map data ©2015 Google

soil type does not change significantly (andosols) along the gradient. The most important market of the area (Arsi-Negele) is found at the extreme of the intensification gradient (away from Zone 1 and close to Zone 3), where farms are more market oriented and dedicate a significant area to vegetables (cabbages, carrots, onions and leaf beets). Zone 1 has access to a rural market (Lephis village) were traders buy products from the farmers and resell them in the Arsi-Negele market.

Common lands are of high importance for the residents of the study area, particularly as a source of feed for livestock. The settlement in Zone 1 is the only one with recognized access to the forest, but lacks common grazing land. Zone 2 and Zone 3 have access to communal grazing areas. The settlements near the forest have a smaller area of farmland than the ones in the other zones, therefore forest is used as an extension of the settlement and plays a vital role in providing a diversity of products: fuelwood, feed, construction materials and fruits.

Although men are usually considered the head of the household in Ethiopia, the proportion of female-headed households is very high in the region, ranging from 26% to 39%. This might be explained by the fact that in the 1970s, men generally married several wives, some of whom became the head of their household. Men with several wives usually have a main home, and their other wives and houses are considered separate households. Each household typically has its own agricultural land and animals. The man seems to have the strongest decision power in all households related to him. Almost all of the population is of Islamic faith.

Table 2.1 General characteristics of the three zones characterizing the study area, which form an intensification gradient from Munessa Forest to Arsi-Negele.

	Zones			
	Forest	Intermediate	Annual	Source
Settlement (*kebele*)	Sida Malkatuka (Ashooka)	Gurgure Lako 1 (Ashooka)	Shona (Gambelto)	–
Tree density	High	High	Low	Observation
Number of households	42	46	31	Settlement leaders
Percentage female-headed households	36%	39%	26%	
Elevation (masl)	2,180	2,110	1,970	GPS measurements
Area (ha)	38.8	89.5	61.5	
Distance to forest	0	5–6 km	10–12 km	
Distance to Arsi-Negele market	17 km	9 km	6 km	
Soil type	Andosols			Lemenih (2004)
Access to forest	Yes	No	No	Group interview with settlement leaders
Common grazing land	No	Yes	Yes	

2.3.2 Major agricultural enterprises and other economic activities

Agricultural production is the most important economic activity in the area. Most farms are mixed crop–livestock systems; therefore, livestock rearing is also common though it comes after crop production in perceived socioeconomic importance (note that this conclusion is drawn based on the great decline of grazing areas and livestock numbers due to cropping area expansion, and the perception of higher food security due to crop production as mentioned during the PRA and FGDs). Trading and transport services for agricultural products are other agriculture-related activities in the study area. Fuelwood extraction/production is also common in the area, being most important close to the forest where illegal trading remains common.

The four major crops (by planted area and perceived importance) are: maize (*Zea mays*), wheat (*Triticum aestivum*), potato (*Solanum tuberosum*) and teff (*Eragrostis tef*). Other crops vary in importance across the zones and include: barley (*Hordeum vulgaris*), vegetables and enset (*Ensete ventricosum*). Enset is mostly found in Zone 1 and Zone 2, usually planted in home gardens. It is sometimes planted with or next to a small number of coffee (*Coffea arabica*), avocado (*Persea americana*) or banana (*Musa* spp.) plants.

Wheat and maize with scattered trees (remnants of the original forest) in Zone 2. (Jean-Yves Duriaux/CIMMYT)

Maize is considered the most important crop in terms of food self-sufficiency. Part of the maize is consumed as green cobs (3 months before harvesting), while the dry grain is stored for consumption over the year. Potato and teff are considered cash crops in the area. Potato has a low selling price (ETB 100–200/100 kg or USD 5–10/100 kg) compared to all the other crops, but is characterized by high productivity (up to 20 tons/ha). On the other hand, teff has very low productivity (~1 ton/ha) but fetches high market prices (> ETB 1200/ha or USD 60/ha). Vegetables, if planted across large areas (i.e. not solely for household consumption), can also be a cash crop. Vegetable market prices are very volatile and vegetable production can be highly profitable at times, while one can hardly find a buyer at other times. Finally, wheat was one of the last crops introduced in the area and is characterized by high productivity compared to other regions in the country (3 tons/ha) and a price that is considered adequate even when the market is saturated. This is due to the constant demand from the milling industry year round.

Eucalyptus trees have become the most common tree species in the landscape, especially in Zone 3 where native trees have almost disappeared. *Eucalyptus* is present in all zones but can be found as woodlot in Zone 2 and especially in Zone 3. *Eucalyptus* is used as construction material and fuelwood, and is sold on the market. A study in Arsi-Negele area showed that 90% of the farmers interviewed planted *eucalyptus* trees and 52% had planted them since 1990 (Jenbere et al. 2012).

2.3.3 Agricultural seasons

Agricultural cycles and management in the area are mostly dependent on the rainfall pattern. Two cropping seasons are possible in the area starting with a short-cycle crop (potato, beans or vegetables) followed by long-cycle crop (wheat, maize) or another short-cycle crop. Although two cropping seasons are possible, not all land is

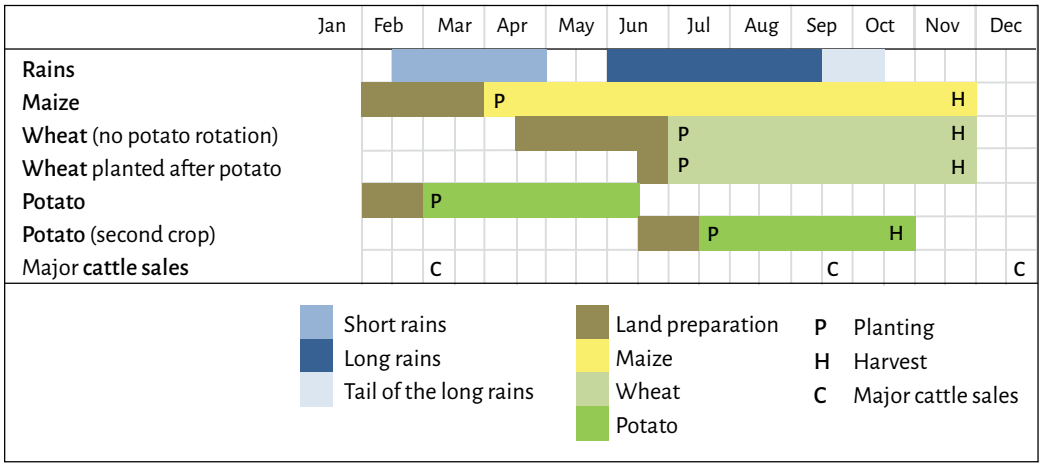

Figure 2.4 Rainfall and agricultural calendar in the study area.

planted during the short rains (Figure 2.4) since potato and vegetables require a large investment and most farmers do not have the resources available to plant the entire area they have available. Figure 2.4 represents schematically the different agricultural seasons, with a focus on the three most important crops. Land preparation starts with the first rains (February) and is mostly done using animal traction (oxen and plow). Potato can be planted twice in a year, but maize and wheat only once. Wheat can be planted after potato or in a field fallowed during the short rains, whereas maize (which requires a longer period of time) is planted in a field were no previous crop had been grown in that year. The major cattle sales are during March, September and December. The first major sale arises from farmers' need to obtain cash for the purchase of seeds and fertilizers. The other two major sales coincide with festivities during which the demand for (and thus the market price of) meat is high.

2.3.4 Munessa Forest

Ownership and management

Munessa Forest is a state-owned forest managed by OFWE. It is degraded due to constant grazing and extraction of fuelwood. In Zone 1 there is a forest plantation surrounding the natural forest, which demarcates the state land and is used for timber production. There is one local office for each of the blocks: Degaga, Sole and Gambo. Next to each office is a timber processing facility. OFWE employs guards (from the nearby communities) that patrol the forest and plantations to ensure that no illegal activities take place. Guards are empowered to detain illegal users if found in the plantations but not if found in the forest. In the latter situation, guards identify the illegal user and inform the CBO managing the forest.

A CBO was created in 2012 with the support of OFWE, following the assumption that forest conservation would only succeed if local communities were involved in its management (based on previous experience). The CBO consists of ~150 members, all residents of settlements that border the forest in Ashooka *kebele*. Its objectives are: (1) to conserve

A representation of the biodiversity found in Munessa Forest: colobus monkey (*Colobus guereza*, top left), *Podocarpus falcatus* tree in the border of the forest (top right), silvery-cheeked hornbills (*Bycanistes brevis*, bottom left) and olive baboon (*Papio anubis*, bottom right). (Frédéric Baudron/CIMMYT)

the forest and wildlife; (2) to share the benefits with the CBO members; (3) to protect the springs that provide water to the communities; and (4) to restore the forest back to its original state. A committee of 30 members including a leader, a vice-leader, a secretary, a cashier and managers makes decisions. Leaders are in charge of activity planning, and managers execute these activities and supervise the work of other members. If any member of this CBO encounters financial problems, the cashier can provide credit and will guarantee repayment. The cashier is also responsible for fund-raising. Membership is not open to all: "only the ones that show potential and interest in conserving the forest can join." The leaders of each settlement make a pre-selection and the committee makes the final decision. Details about forest access rights are discussed in Section 2.5.

A local ecotourism cooperative provides guided tours and promotes sustainable use of the forest. They return 10% of their income to the communities through support for development projects promoted by the settlement leaders.

Biodiversity (trees, birds)

According to the bird list created by the Lephis Ecotourism Cooperative, there are more than 270 bird species in the area. Some key species found in the forest include: silvery-cheeked hornbill (*Bycanistes brevis*), Hemprich's hornbill (*Tockus hemprichii*), Abyssinian oriole (*Oriolus monacha*), white-cheeked turaco (*Tauraco leucotis*), black-winged lovebird (*Agapornis taranta*) and banded barbet (*Lybius undatus*).

According to the head of the Gambo office of OFWE there are four key tree species in the forest. These are protected by Ethiopian law due to their importance and endangered status, and include: *Hagenia abyssinica*, *Podocarpus falcatus*, *Cordia africana* and *Juniperus procera*.

2.4 Diversity of livelihood strategies

2.4.1 Household types as perceived by community members

The types of households delineated and described by the community members for the settlements of Zone 1 and Zone 2 were similar. The following types were common to both: (1) cereal producers, (2) livestock producers and (3) diversified farmers. An additional category was identified in Zone 1: landless households. The types identified in Zone 3 were: (1) renters, (2) model farmers, (3) traders and (4) vegetable producers (see Figure 2.5).

Although the self-categorization led to similar types in Zone 1 and Zone 2, the proportion of the total settlement population that each type represents was significantly different (Figure 2.5). *Diversified farmers* were the most common in Zone 1 while in Zone 2 *cereal producers* were the most common. *Livestock producers* represented a fifth of the households in Zone 1 but a small minority (2%) in Zone 2. In Zone 2, *cereal producer* was the most important type of household.

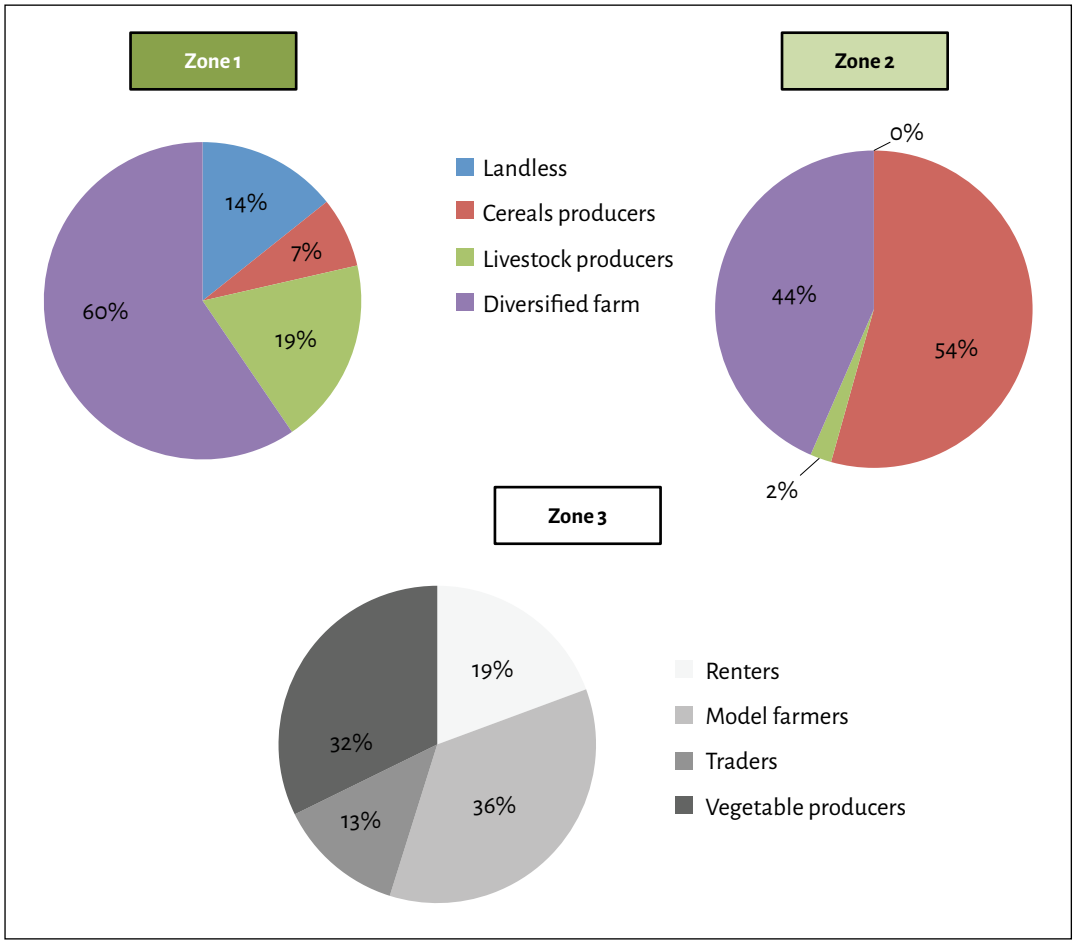

Figure 2.5 Household types and their proportions in the three settlements of the study area.

Weeding wheat fields in Zone 3 before mechanical harvest and transporting fuelwood to Arsi-Negele market. (Frédéric Baudron/CIMMYT)

In Zone 3, households were classified as *renters* (who cannot produce for lack of resources), *model farmers* (similar to *diversified farmers* but with an emphasis on being able to plant on time and having high productivity), *traders* (which besides farming also buy/sell agricultural products on the closest urban market) and *vegetable producers* (whose main income is generated by the sale of vegetables on the urban market).

The different household types identified during the self-categorization activity relate to different livelihood strategies. Farming is obviously the main activity in the study area, though different strategies exist. All farmers produce some maize and wheat, but some also produce other crops (*diversified farmers* and *vegetable producers*) and engage in other activities (e.g. trading). Livestock rearing, although decreasing for a number of reasons (e.g. decrease in communal and private grazing area due to the expansion of cropland and smaller farm sizes), is still recognized as an important strategy. Finally, the two household types that struggle the most to make a living include households that do not own land and those that are forced to rent their land due to lack of resources (labor or money to purchase agricultural inputs).

A problem that was identified as common for some household types was the difficulty of sourcing input on time (due to cash constraints), resulting in late planting and poor crop nutrition and protection. This in turn leads to a severe yield penalty, locking these households in a 'poverty trap'.

2.4.2 Criteria for self-categorization

Although the household types identified in Zone 3 were different from the ones identified in Zone 1 and Zone 2, there were similarities in the criteria used for the delineation of the types and the characteristics of the different types. The main criteria used were:

- the activity which generated most of the income (farming, trading, renting land, employment)
- the diversity of farming enterprises (livestock, cereal, vegetables, diversified)

- land and livestock ownership
- hiring or selling labor.

Two other characteristics of lower importance were also used when describing the household types:

- wealth (wealthy being described as being "better off" or always having cash available to buy agricultural inputs on time)
- the performance of the farms ("model," "good," "facing difficulties," etc.).

By using the criteria considered as important by the community, a statistical typology can be generated that would be representative of the situation in the study area. Tables with the typology and group characteristics for each settlement can be found in Appendix 2B.

2.5 Access to resources

2.5.1 Land

As most households are dependent on farming in the study area, land is a fundamental resource for local livelihoods. During Haile Selassie's era from 1930 to 1974, land was owned by landlords who did not live in the area (i.e. feudalism). Local communities used the land (mostly forest and grassland) to rear cattle, and a small portion of land was cultivated for subsistence agriculture. The communities had to pay a tribute to the landlords. With the fall of Haile Selassie and the beginning of the socialist regime in 1974, landlords were expropriated and land was redistributed among the community members under the famous slogan "land to the tillers." Land rights were transferred to land users. Adult males received land rights from the government according to their number of wives (indicator of household size). The area that adult males received at the time ranged from 3 to 8 ha. Farmers did not own their land but received use rights for a period of 100 years.

Nowadays, land can only be accessed through four modalities: (1) inheritance, (2) sale, (3) shared cropping and (4) renting. Traditionally, men inherit land from their fathers at the time of their marriage, or by arranging an early inheritance from their father. Although the government was said to promote women empowerment, most (if not all) inherited land is passed from father to sons. There were a large number of female-headed households in the study area (26%–39%) who probably inherited land at the death of their husband (more interviews are needed to confirm this supposition). Figure 2.6 represents the different modalities for accessing land.

Land rights can be sold legally. More frequently than selling, two short-term arrangements are made: shared cropping and renting. Shared cropping refers to the arrangement where two parties pool resources together to produce a crop and share the harvest equally. Usually in the area, one party contributes land and seeds, while the other party contributes labor and fertilizer; harvest is a joint responsibility. Farmers can also rent their land out and earn an income from it. This generally takes place when a household does not have enough cash to purchase seeds and fertilizers, or does not have adequate labor to work their land.

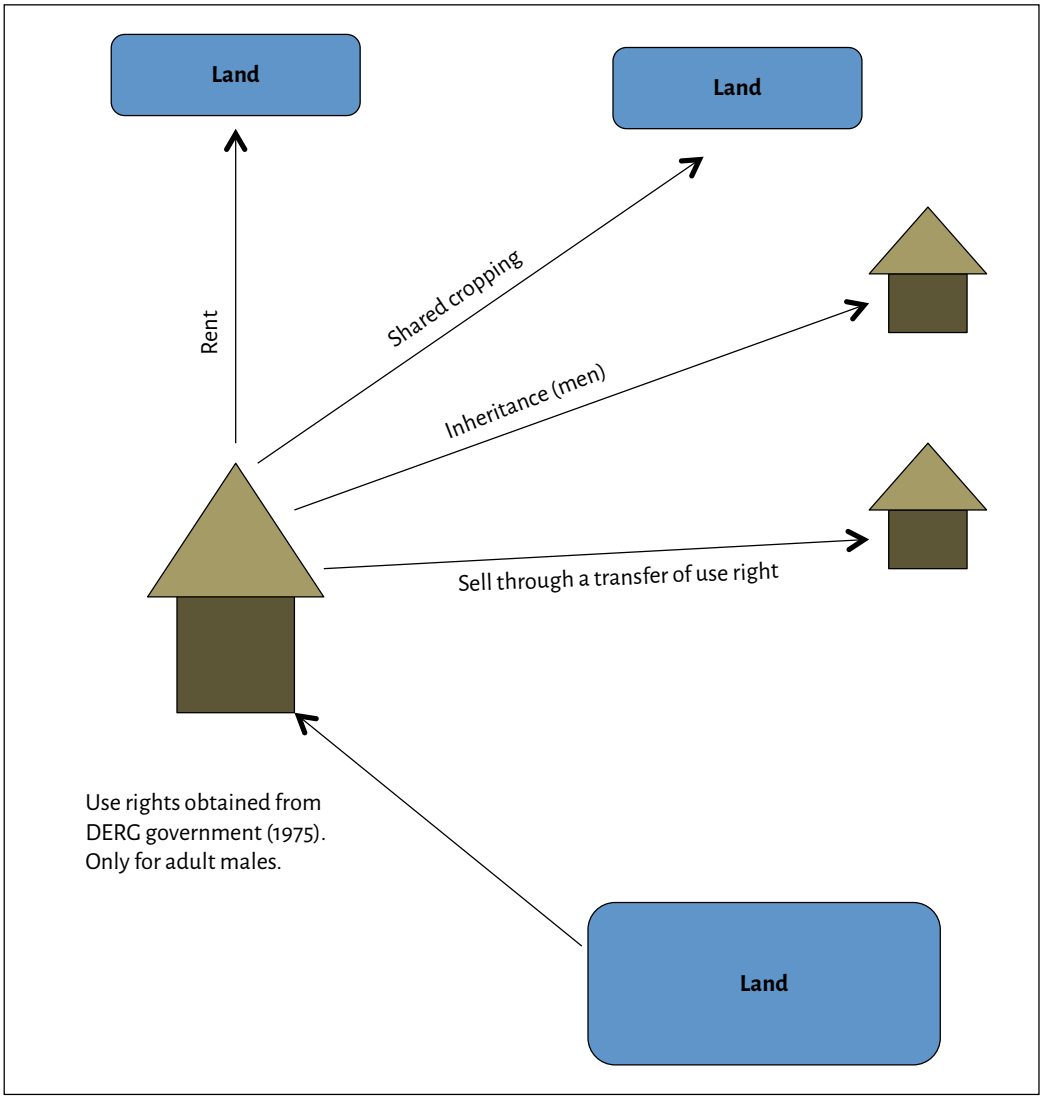

Figure 2.6 Modalities of land-use access in the study area.

2.5.2 Water

There is free access to rivers for different uses: watering livestock, obtaining water for household consumption, washing and irrigation (to a lesser extent). Some of the rivers and streams dry out during the dry season, in which case communities can use rivers and streams in other settlements without any restriction. The term 'free access' means that not only people from communities bordering the rivers and streams, but any traveler and members of other communities can use the water without limitation related to quantity or use (this was clearly stated during the PRA). For example, when the stream next to Zone 3 dries out during the dry season, community members will take their animals to the river in Zone 2.

Livestock drinking water in the river next to Gogorri settlement in Zone 2. (Frédéric Baudron/CIMMYT)

Drinking water is considered a highly important resource. It was made available by the government after installation of infrastructure (pipelines, filters, pumps and distribution points). Distribution points are the only available sources of drinking water and are located at a walking distance of 0–2 km (in Zone 2 and Zone 3) depending on the settlement. A cashier controls the water point and collects payment for the water taken. The cost of the drinking water is ETB 1 (USD 0.05) for 100 L of drinking water. Infrastructure for drinking water is present in Zones 2 and Zone 3, but not in the zone next to the forest (Zone 1). Therefore, settlements next to forest have no access to 'clean' water (mentioned as a critical problem) and use the river as a source of drinking water (which has been reported by the health officers to cause diarrhea, a common problem in the area).

2.5.3 Communal grazing lands

Communal grazing lands are important sources of feed for livestock. The use of some communal grazing land is restricted to one settlement (when the communal grazing land is within the settlement borders); others are shared between different settlements (all the settlements that share a border with the communal grazing land). Members of a settlement with rights to use the communal grazing land have unrestricted use and may graze as many animals as they wish for as long as desired.

Travelers with cattle from other settlements are allowed to graze in the communal grazing land and stay overnight there. Then they will continue their journey. Apparently, this is a traditional practice.

2.5.4 Munessa Forest

Munessa Forest is said to be used exclusively by the settlements bordering it (Figure 2.7). The CBO managing the forest has an exclusive right to extract wood for sale.

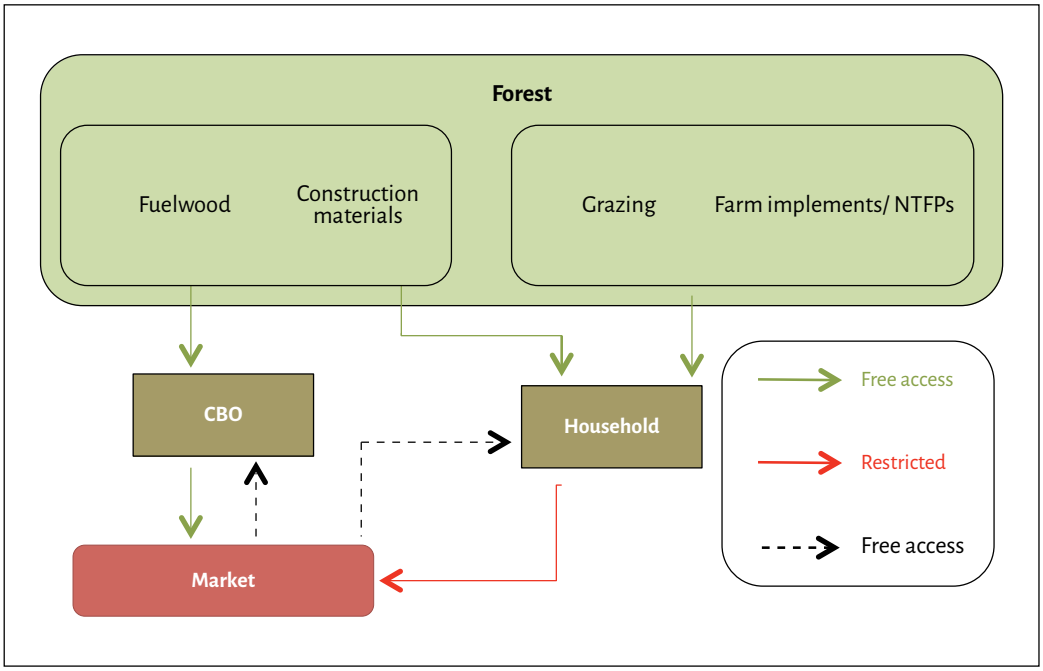

Figure 2.7 Diagram representing access to forest products in the study area.

The proceedings of the sale are distributed among the CBO members. Any community member (including non-CBO members) has the right to extract fuelwood and other forest products for household consumption, but only dead wood can be harvested.

There is no limit to the amount of products that can be extracted. All members of the CBO are responsible for monitoring the use of the forest. If rules are broken (illegal extraction for sale occurs), the CBO will first gather the community in a council that will make a decision. The decision is usually to exert public pressure on the culprit's settlement and give a warning. If the culprit repeats the illegal action, the committee will inform OFWE and the police, and the culprit will face legal prosecution and up to 5 years of imprisonment if found guilty.

2.6 Institutional support

2.6.1 Governmental institutions

The institution responsible for all administrative affairs is the Arsi-Negele *woreda* bureau. This institution has little direct contact with the population but provides any legal documents or permits. Under the supervision of this bureau is the *kebele* administration bureau. *Kebeles* are the smallest administrative subdivision in the country. Each *kebele* is composed of ~30 settlements. The study area covers parts of three different *kebeles*, each with a bureau: Gambelto, Bombaso Regi and Ashooka. The *kebele* administration bureaus are the direct link between the government and

the communities. They are in charge of resolving any administrative issues, keeping registers of population and land, organizing any project/activity planned by the government or other organizations and holding regular meetings with settlement leaders and local organizations.

The agricultural bureau of Arsi-Negele *woreda* is responsible for technical assistance in three domains: crop, livestock and environment. This office supplies assistance to all *kebeles* of the *woreda*. Each *kebele* has three development agents providing technical assistance to all farmers (one for each topic). According to community members, development agents are the most important government support they receive. There are supervisors that will visit the areas occasionally to control the quality of the development agents' work, and a veterinarian that will occasionally visit the area. The agricultural bureau also supervises one farmer-training center in each *kebele*, and one animal health center shared between 3–5 *kebeles*. The farmer-training centers host meetings with farmers and exhibit best practices in demonstration plots. The animal health centers are used to provide veterinary assistance to farmers. Both are run by development agents. Development agents interact closely with the *kebele* administration bureau.

A health center provides service to four *kebeles*: Gambelto, Ashooka, Bombaso Regi and Aga. They monitor target groups every 3 months including children under 5 years old, and pregnant and breast-feeding women. They also have a health extension agent in each *kebele* who teaches community members about hygiene, nutrition and health issues. The officers of the health center provide health care to all people in need. It was clearly stated that children, pregnant and breast-feeding woman do not pay for any received health service and that health extension has no cost. Based on the interviews, we cannot clearly define if other services to other groups require payment.

The OFWE is responsible for the forest plantations and indirectly for Munessa Forest. It has a central office in Arsi-Negele responsible for Munessa Forest and a sub-center near Zone 1 responsible for the Gambo sub-zone of Munessa Forest. Guards are hired to patrol the forest and control movement of fuelwood from the forest.

2.6.2 Religious institutions

Most (practically all) residents are Islamic. Therefore, the mosques are of great importance in the community. They provide spiritual guidance, but also promote union between the community members.

A Catholic mission is established close to Zone 1. It runs different development projects in the area. Its main achievement is the creation of a hospital that provides intervention for difficult medical cases in the area.

2.6.3 Local institutions

Settlement leaders' councils are the oldest institutions (except possibly for religious institutions) in the area and aim to maintain the peace in the community, promote its well-being and deal with other settlements. They comprise two leaders, one secretary, one cashier and two or three council members. They are in direct contact

with the *kebele* administration bureau. They help to solve conflict within the settlement and may gather the community to make a joint decision. They are also the ones that give permission for development or research activity (governmental or otherwise) in the settlement.

A general council of all settlements' leaders' councils in the area (> 50 settlements) is held occasionally to build a joint vision of development and social cohesion for the communities. It prevents conflict between bordering settlements or *kebeles*.

The decisions made by the local institutions will always prevail over the government's decisions on conflicts. Community meetings are held in order to solve conflicts regarding, for example, land, trade, illegal use of the forest and theft. If the conflict cannot be solved by the council or if the mediation proposed is not followed, the problem will be communicated to the *kebele* administration office or the police for legal action. There is an ancient tradition of solving conflicts through community meetings, the settlement leaders or the council.

Other local institutions have been created in recent times (< 15 years). A youth group (at *kebele* level) tries to create activities to reunite all young members as well as to find opportunities for them (university admission processes, scholarships and jobs). A women's group (at *kebele* level) controls a credit scheme and provide loans to its members.

There is a CBO managing the forest. It was created 2 years ago with the help of OFWE. It includes about 150 members from different settlements next to the forest from Ashooka *kebele* (Zone 1). They are responsible for the supervision of the use of the forest products (making sure, in particular, that they are used for household purposes and not sold, and that only dead wood is being extracted).

The Lephis Ecotourism Cooperative has worked in the area since 2011. It is composed of nearly 20 members from four different *kebeles* bordering the forest near Zone 1. Its objective is to promote the sustainable use of the forest and development of the community. It has received support from Ethiopian NGOs for its establishment. Ten percent of the Cooperative's income is saved in a bank account and used to support local development projects (e.g. water systems).

2.6.4 Non-profit/nongovernmental organizations

The Ethiopian Sustainable Tourism Association promoted the creation of the Ecotourism Cooperative by raising funds from USAID and building the capacity of the cooperative.

2.7 Market and value chains

2.7.1 Market places

The most important market in the area is the urban market of Arsi-Negele, where products from the rural surroundings (including the study area) are traded. Most agricultural products and livestock are transported to other areas of the country, while fuelwood and maize are mainly used within the city. The market is located at 16, 11 and 6 km from the center of Zone 1, Zone 2 and Zone 3, respectively. The highest selling prices

Livestock market in Arsi-Negele. (Jean-Yves Duriaux/CIMMYT)

in the area are fetched at this market. Market days are three times per week, on Mondays, Wednesdays and Fridays. The livestock market only takes place on Fridays. There are different market places in Arsi-Negele that specialize in different products. There is one livestock marketplace, one potatoes marketplace, three fuelwood marketplaces and one central market where many types of products are traded, including cereal and pulses.

Two rural markets are found in Zone 1 and Zone 2. Lephis market in Zone 1 is an important node in the value chains of fuelwood and potatoes, since farmers sell products to rural traders who then resell the products in Arsi-Negele's market. In Zone 2, Gogorri market is small and most buyers are local residents. In these rural markets, community members buy foodstuffs for the household and sell small quantities of agricultural products. Women are the most common sellers in rural markets. According to community members of Zone 3, there is little interest in a rural market in their settlements since Arsi-Negele market is relatively close and fetches better prices. Rural markets are always 1 day earlier than Arsi-Negele market so that traders can transport products the next day (from rural to urban markets).

2.7.2 Fuelwood

Most actors in the fuelwood chain are women, who take on the role of harvesters, traders and sellers in the market (Figure 2.8). Although it is illegal to sell fuelwood from the forest, most fuelwood marketed from Zone 1 originates from there. Zone 2 and Zone 3 do not have access to the forest for fuelwood. Farmers are allowed to sell fuelwood from non-protected species found on their farm (woodlots or scattered trees). The most common planted species on farms are *eucalyptus* species.

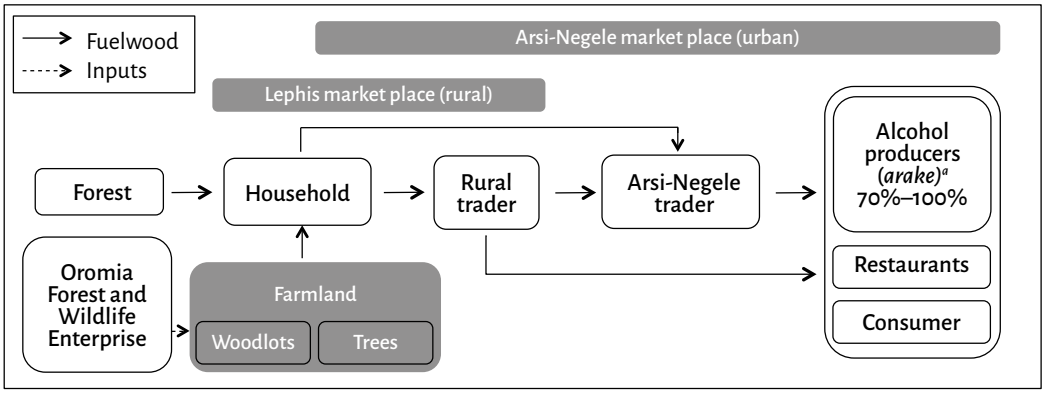

Figure 2.8 Fuelwood value chain in the study area.

Note: The main transportation methods are donkeys and donkey carts. These are also the measurements to pay the farmers.

Arake (traditional alcohol) production in Arsi-Negele. (Addis, 2008)

The only input used for *eucalyptus* was reported to be the seedlings sold at a low price by OFWE (or for free if received from a project). The forest is the most important source of fuelwood traded at Arsi-Negele and Zone 1 the most important production area in the study landscape (as reported by fuelwood traders in Arsi-Negele). This means that most fuelwood traded in the study area has an illegal origin.

Fuelwood is transported by backload for short distances, by donkey cart for longer distances, and by donkey for both short and long distances. Rural traders tend to buy fuelwood from the rural areas (where established exchange places exist) a day before Arsi-Negele's market. Farmers can also bring their fuelwood directly to Arsi-Negele. In Arsi-Negele, traders buy fuelwood from rural traders and farmers,

Table 2.2 Price range for fuelwood in Arsi-Negele market.

Fuelwood	Time of the year	Price per donkey (ETB)	Price per cart (ETB)
Highest price	Dry season	60–80	500–800
Lowest price	Rainy season	35–40	350–450

Note: USD 1 = ~ETB 20. No estimation of the weight of fuelwood that a donkey or cart represents at this stage of the study; measurements will be done in the next phase.

and resell to buyers. This step is sometimes avoided when consumers come and buy directly, or when a periodical arrangement exists. The largest buyers of fuelwood in the study area and in all area surrounding Arsi-Negele are the local producers of *arake*. *Arake* is a strong alcohol that requires several distillations (low combustion efficiency). All sellers interviewed in Arsi-Negele stated that they sell between 70% and 100% of their fuelwood to *arake* producers. The rest is sold to restaurants and a small proportion to households.

Highest prices are attained during the dry season as fewer people sell (Table 2.2). Most farmers have alternative income from their recent harvest. Conversely, farmers have little alternative sources of income to fuelwood during the months before harvest time (wet season) and often face food shortages. Fuelwood supply therefore increases during the wet season, and prices reach their lowest levels as farmers look for this alternative source of income. Prices are ~ETB 20 higher per donkey load in Arsi-Negele compared with prices in the rural areas. Selling fuelwood is a coping strategy for vulnerable households that face shortages of cash, land or food.

2.7.3 Maize and wheat

Maize and wheat are the most common crops in the study area. Maize is harvested both as green cobs and dry grain. Wheat is generally harvested by combine harvesters through hire services. For both crops, part of the harvest is stored for self-consumption and another part is sold in Arsi-Negele's market (Figures 2.9 and 2.10). If they do not need the cash immediately and have room for storage, farmers will store the grain and only sell when prices are high. Little maize and wheat is sold on rural markets.

In Arsi-Negele market, grain traders first buy maize, later beans and finally wheat. Farmers bring their grain by donkey carts and sell to traders. Traders will subsequently sell maize and beans to Arsi-Negele retailers and consumers but also to traders from other regions of the country. In the case of wheat, traders sell mostly to milling factories located in other regions of the country. If grain is sold for use outside Arsi-Negele, it is transported by trucks provided by the buyers.

Maize and wheat prices vary with the season (Tables 2.3 and 2.4). For both crops, prices are the lowest at harvest time and the highest a month before harvest time.

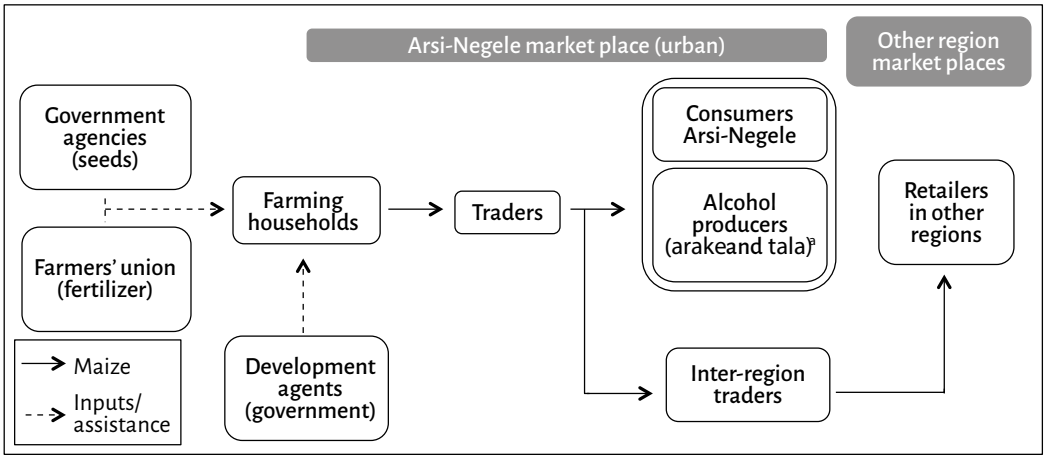

Figure 2.9 Maize value chain in the study area.

a Tala is a locally brewed beer.

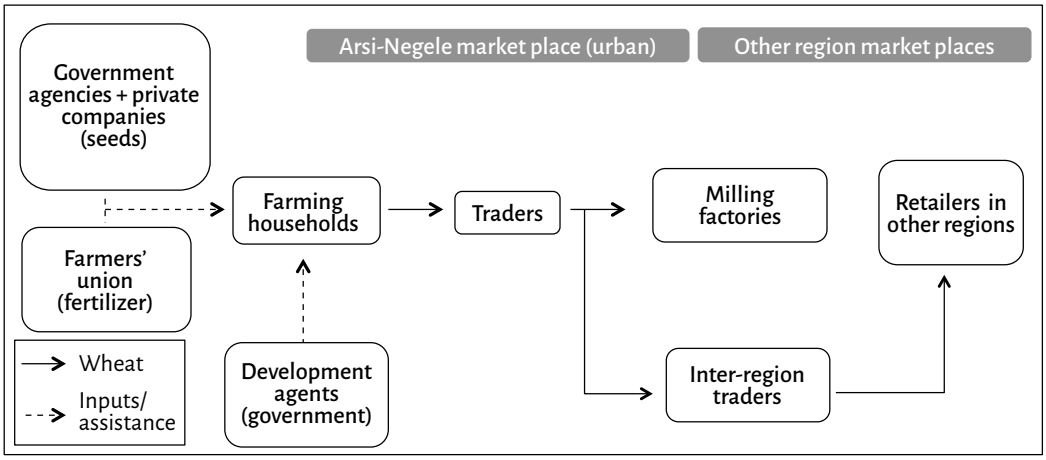

Figure 2.10 Wheat value chain in the study area.

Table 2.3 Price range for maize in Arsi-Negele market.

Maize	Time of the year	Price per 100 kg (ETB)
Highest price	April–October	600
Lowest price	November–December	400

Note: USD 1 = ~ETB 20.

Table 2.4 Price range for wheat in Arsi-Negele market.

Wheat	Time of the year	Price per 100 kg (ETB)
Highest price	April–November	900
Lowest price	November–January	750

Note: USD 1 = ~ETB 20.

2.7.4 Potatoes

Potatoes are an important cash crop, characterized by a short growing period. They can be planted before wheat or maize. Farmers cannot plant all their land with potatoes at this time because potato seed is expensive and potatoes are a high-input demanding crop.

Most commonly, potatoes are sold at harvest time through intermediaries (Figure 2.11). Intermediaries are contacted by farmers using cellphones and link up with the regional traders who arrange for transport and for cash to pay for the harvest. Intermediaries receive a prearranged payment for each bag of 100 kg. Sometimes farmers can also store a part (or more rarely the totality) of their harvest to wait for higher prices in the market. In this case, they bring their potato harvest by donkey cart to Arsi-Negele's market.

In Arsi-Negele's market, there are intermediaries year round that buy potato from farmers until they collect enough potato to fill a truck. A trader will then come and buy the potato from them and bring it to other regions of the country.

Farmers can also sell directly in the market to other buyers such as retailers that will resell in the city, restaurants and consumers.

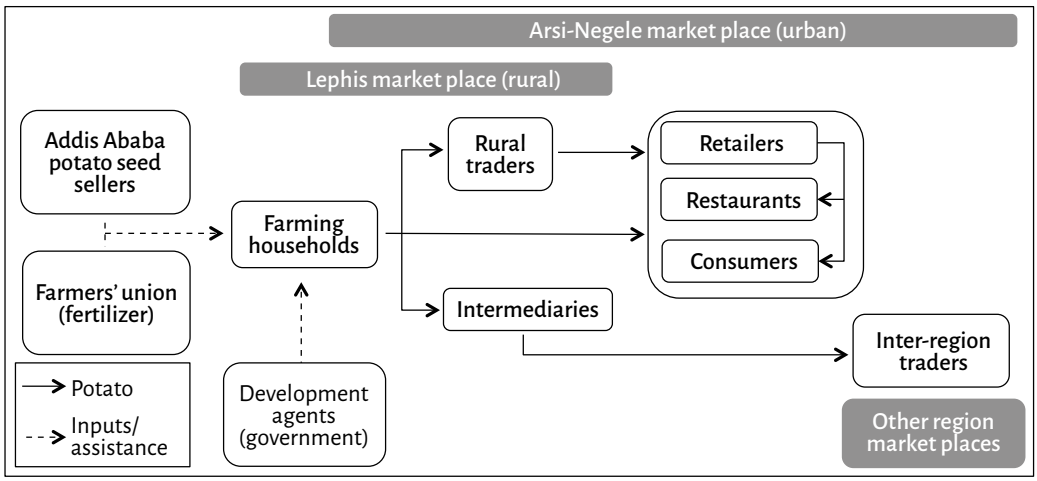

Figure 2.11 Potato value chain in the study area.

Table 2.5 Price range for potato in Arsi-Negele market.

Potato	Time of the year	Price per 100 kg (ETB)
Highest price	December–May	220
Lowest price	June–August	100

Note: USD 1 = ~ETB 20.

Potato price varies during the year and is lowest during harvest time (Table 2.5). There are two potato harvest times in the area. The first is the most important and is in June/July. During the second period, much less area is planted. The second harvest is around October/November.

2.7.5 Livestock

Cattle are an important asset for farmers in the study area. They provide draft, milk and income through the sale of live animals. Cattle are also an inflation-proof asset used for banking and sold during times of hardship. Traditionally, milk and butter are women's property, while live animals are men's property.

Milk and butter are mostly consumed at home but can also be sold in Arsi-Negele's market or locally within the community.

Live animals (including cattle, sheep and goats) are only sold on Arsi-Negele's market, where traders buy animals, mostly transport them to other regions of the country and also sell them to restaurants in town (Figure 2.12). Restaurants are most often also butcheries that sell raw meat to urban households. Sometimes a fattener will buy lean or cheap animals on Arsi-Negele's market, fatten them near the city over 3 months and sell the finished animals back on the market. Oxen (castrated males used specifically for traction) are sold during the 3 months preceding the start of the planting season to other farmers.

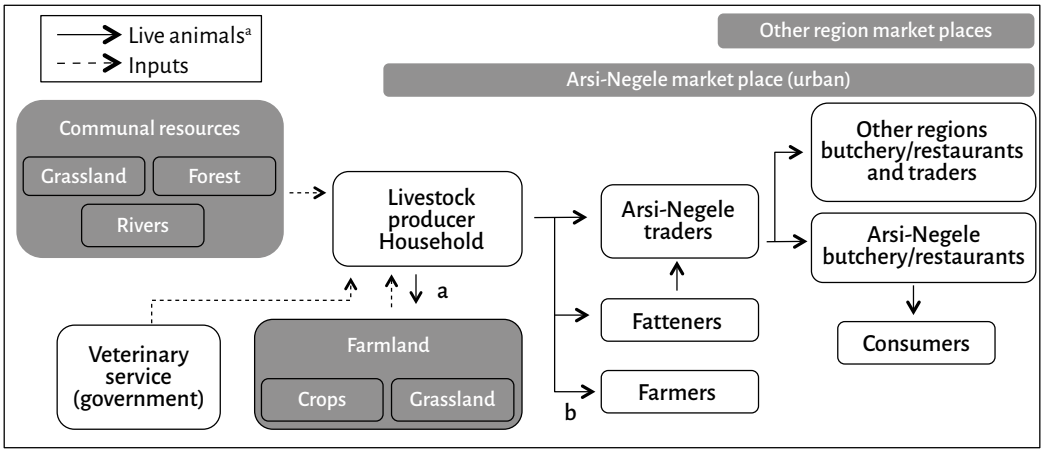

Figure 2.12 Livestock (live animals) value chain in the study area.

a All dark arrows represent live animals to be used for meat, except for 'a' which represents oxen and donkeys, and 'b' which represents animals to be used for work.

Table 2.6 Price range for male adult cattle for meat in Arsi-Negele market.

Cattle for meat	Time of the year	Price per animal (ETB)
Highest price	April/September/December	25,000
Lowest price	January–March	12,000

Note: USD 1 = ~ETB 20.

Donkeys are of extreme importance for transport. Young donkeys can be sold to other farmers in the same livestock market in Arsi-Negele.

The market price of cattle sold for meat is marked by three peaks during the year (Table 2.6) related to religious or national celebrations: Easter (after 2 months of fasting), Ethiopian new year (September) and Christmas time (Orthodox tradition). The lowest prices occur during the dry season when there is little feed for the animals and farmers need cash for the preparation of the planting season. At this time, supply is high, demand low and this is a buyer's market (farmers are in need of cash). The price for a working ox is around ETB 12,000 and their sale occurs from January to March (before planting, since they are needed for land preparation).

2.7.6 Highest possible income from a hectare of cropland

Based on the information gathered during interviews (highest market price) and FGD (highest yield), we estimated the maximum income that 1 ha can generate for the most important crops (see Table 2.7). These calculated incomes are theoretical and presented only for comparison between crops as farmers are unlikely to obtain both the highest yield and the highest market price.

Potato produces much higher income than cereals but also requires a much greater investment in input and cannot be stored as long. Wheat produces much lower income than potato but almost twice as much as maize.

Table 2.7 Maximum attainable income from the three main crops in the study area.

	Zone 1	Zone 2	Zone 3
Maize	–	ETB 12,000	ETB 15,000
Potato	–	–	ETB 40,000
Wheat	–	ETB 25,600	–

Note: Max income = max yields x highest price at Arsi-Negele's Market. USD 1 = ~ETB 20.

2.8 Food security, nutrition and health

2.8.1 Interviews with health officers

The groups most susceptible to nutritional deficiencies are children younger than 5 years old, pregnant women and breast-feeding women (not an extensive list). The cereal-based diet of the area results in deficiencies in vitamin A among other micronutrients. Every 3 months, regular checkups (with special focus on children) take place in the settlements. For each *kebele* (~30 settlements) there is one health officer who is responsible for medical checkups of the community members, providing vitamin A and deworming for children, and advising sick patients to visit the health center. There is one health center for the four *kebeles*. All settlements in the study area share the same health center. The health center is located between Zone 2 and Zone 3.

Vitamin A is provided to children from 6 months to 5 years old. For children from 2 to 5 years it is provided together with deworming tablets. In cases of acute malnutrition, every 3 months, children are provided with ready-to-use therapeutic food (*Plumpy Nut*), which has a high caloric content and contains different vitamins.

Pregnant women are at risk of anemia and are provided with folic acid by the health center. Breast-feeding women should attend the health center regularly to get vitamins and other nutritional supplements.

Ready to use therapeutic food provided to children under 5 years of age presenting with malnutrition symptoms. (Frédéric Baudron/CIMMYT)

Residents from Zone 1 were reported to be commonly affected by diarrhea as a result of lack of clean water. During the PRA residents of Zone 1 identified the lack of clean water as one of their most important problems.

A hospital is located in Zone 1, built and managed by a Catholic mission (*Consolata*). Community members only go to this hospital in the case of extreme illness or serious accident. A small private clinic is located in Zone 2, which provides a faster service for community members who have the resources to access it. Any important matter has to be treated in the Catholic hospital.

2.8.2 Food security

From the information collected during FGDs, community members in the three zones appear to be food secure. A food secure household was defined as one that does not struggle to feed the family. Community members indicated that food security was achieved between the years 1980 to 1990 because of the following:

- access to fertilizer, improved seeds and agricultural technical assistance leading to improved yields
- education resulting in better planning of the food production and consumption throughout the year
- introduction of potato into cropping cycle.

The change in food security over the past 50 years is discussed in Section 2.10.

2.9 Land-cover change: remote sensing

A preliminary analysis of land-use change around Munessa Forest area was conducted (Figure 2.13). The study spanned the period 1988–2011 and covered a much larger area than the study area discussed in this chapter. It yielded interesting insights regarding land-cover change around Munessa Forest.

During the period analyzed, the greatest vegetation changes in Munessa Forest occurred between 1987 and 1995. It can be hypothesized that this was the result of farmers returning to the forest border and clearing it, after they had been displaced from it in the late 1970s by the Derg regime. Bekele (2003) mentions an official government report presented to the vice minister of Agriculture by the Ethiopian Wildlife Conservation and Development Organization, listing extensive damage to the national parks by farmers and stating that the destruction was an expression of resentment toward the former government (i.e. the Derg regime).

Between 1995 and 2011, vegetation was lost mainly from scattered forest patches on the eastern side of the forest, where agricultural expansion was still possible through forest clearance. On the west side of the forest (where the study area is located), most forest was cleared before 1987 and such vegetation loss was thus not captured by the remote-sensing analysis.

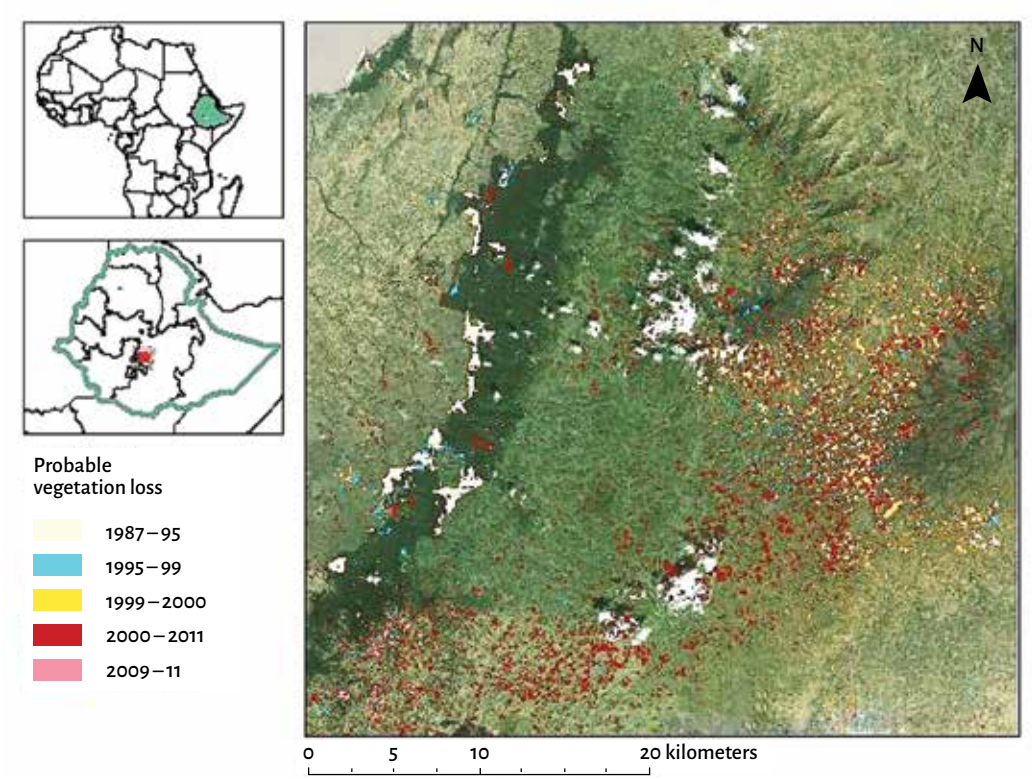

Figure 2.13 Probable vegetation loss between 1987 and 2011.

Source: John Arnet and Ian Eddy (2015), Remote Sensing Department, University of British Columbia

2.10 Perceptions of changes during the past 40 years

2.10.1 Historical diagrams of land-use change

Figure 2.14 represents diagrammatically the perception of land-use change over time in Zone 2 (settlement Gogorri Lako Toko). Perceptions were very similar in all zones (see Appendix 2C). Four major land uses were identified during the first FGD (Zone 1) and then used for the next two zones: forest, cropland, grazing land and woodlots. Woodlots are plots planted with *eucalyptus* for the production of construction materials and fuelwood.

The general trends observed were a sharp decrease in forest cover as it was converted to agricultural land resulting in the total disappearance of the forest. Grazing land has decreased constantly since 1975, and can only be found today in smaller area. Grazing land was mainly converted to cropping land, with some converted to *eucalyptus* woodlots. (Note: 'grazing land' includes all private grazing land and all communal grazing land within the settlement boundaries and excludes communal grazing land that is shared with other settlements and therefore not considered part of the settlement.)

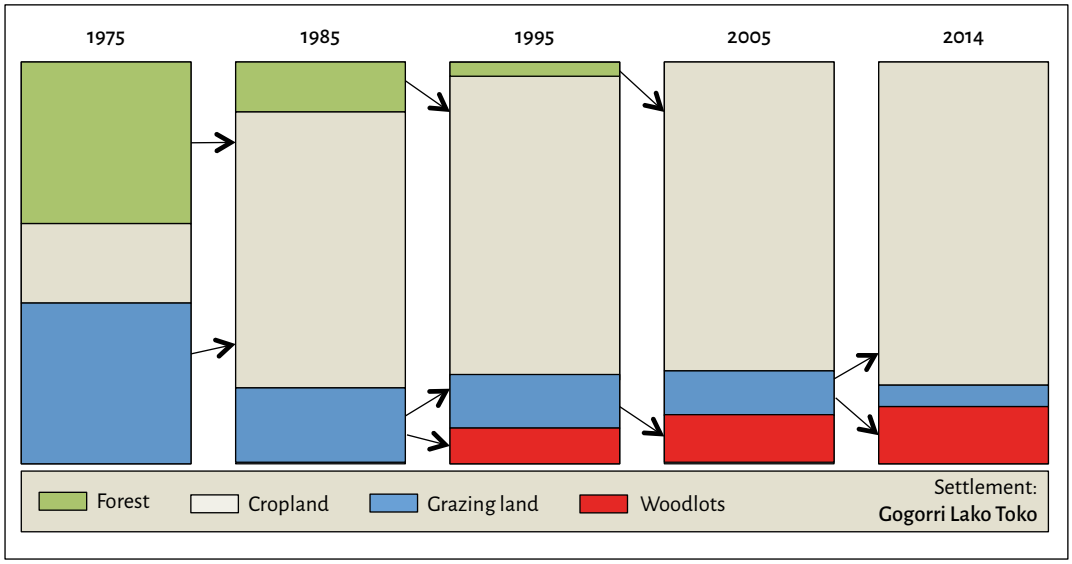

Figure 2.14 Historical diagram of land-use change in the landscape as perceived by elders of Zone 2.

The area dedicated to *eucalyptus* woodlots increased as a result of the growing scarcity of fuelwood and construction materials (resulting from deforestation). *Eucalyptus* was introduced to the area by the government in the 1970s. It grows fast and requires little management. Today, it is the dominant tree on-farm (as in many other rural areas of Ethiopia).

The conversion of grazing land to cropland was said to have led to an increase in food security, but also had important consequences for gender dynamics. Indeed, women traditionally control milk and butter, while men control crop harvest. Such a drastic decrease in grazing land has reduced cattle numbers and the associated dairy production per household and has disempowered women.

Similar trends were found in a land-use/land-cover change study using remote-sensing techniques and conducted in a landscape bordering the study area (Mekonen 1998). The study focused on changes between 1965 and 1994. Cropland increased sharply between 1965 and 1988 at the expense of grassland and forest. The extent of the different land uses differed from that perceived by the farmers, but this could be a result of the fact that Mekonen's study included the protected forest owned by the government, whereas the perceived changes were limited to the settlements boundaries. In Mekonen's study, cropland increased from 24.1% in 1965 to 54.2% in 1994, whereas grassland declined from 14.3% to 2.1%.

2.10.2 Historical trend lines

Population has grown constantly since 1970. At that time, the total population in each settlement was said to be between 20 and 30 people, compared to 200–600 today. These numbers are estimations made by settlement elders and leaders, and not official figures. Although people were said to have died during the 1984–85 famine and during conflict that punctuated the 40 years of study, these events were not visible on the trend line drawn by the participants of the FGDs.

Forest was the most important land-cover class before 1970. The trend line presented in Figure 2.15 does not take into account the state-owned forest (Munessa Forest). According to the elders of Zone 1 and Zone 3, most (if not all) of the forest was cleared by 1982. In Zone 2, the last remaining forest patches were cleared by 1995. During the regime of Haile Selassie, all land was owned by a few landlords (nobles).

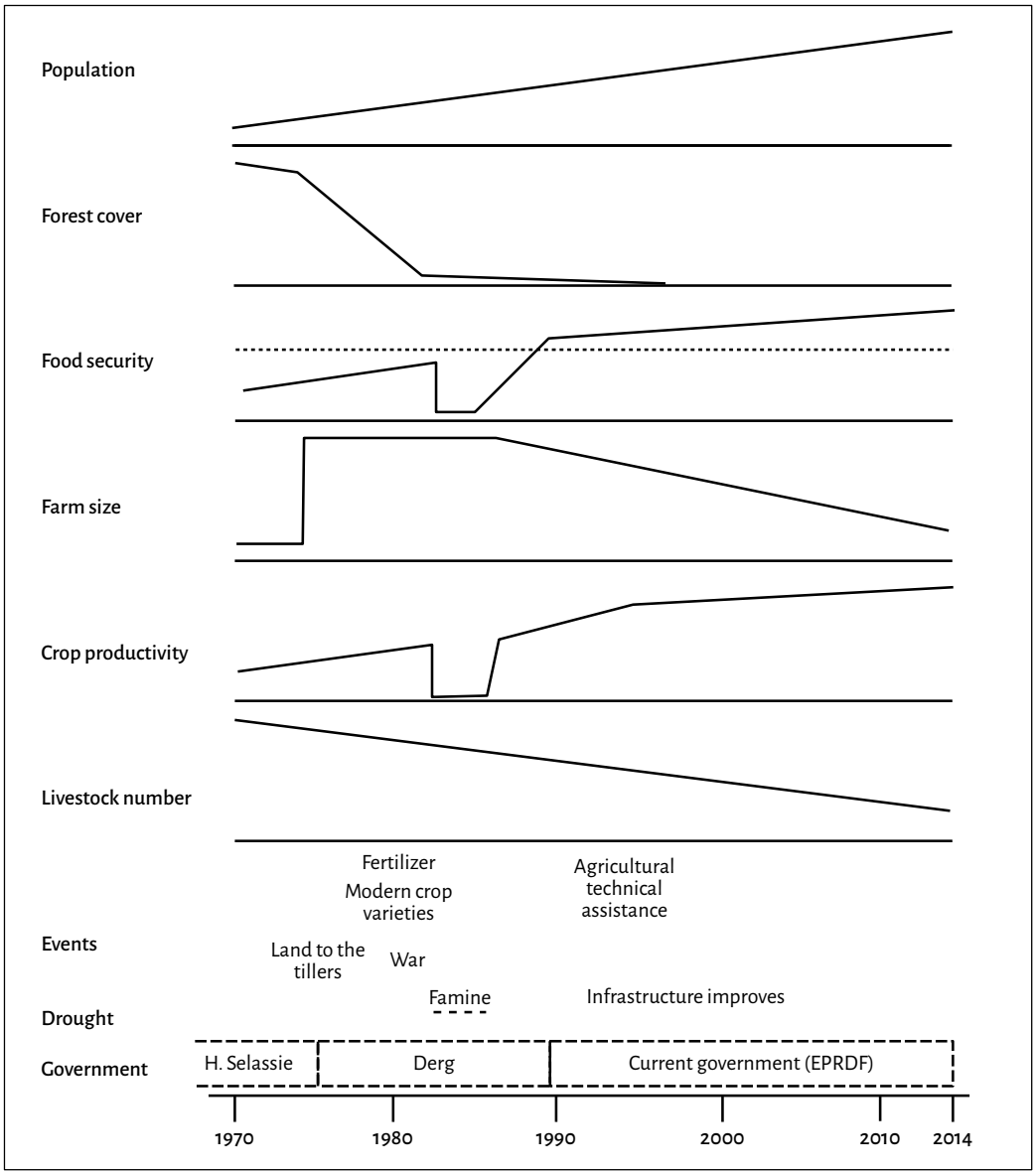

Figure 2.15 Historical trend lines and important events between 1970 and 2014 in the study area.

Note: The lines represent an average for the three zones where information was collected.

People of the Oromo ethnic group (all the population on the studied landscape) were discriminated against and considered servants of the landlords, and were unable to access land. Landlords initiated deforestation and forest degradation by extracting wood for timber. The sharp decline in the forest cover during the Derg regime was a result of the agrarian land reform that gave "land to the tillers." Forest clearance was the dominant strategy to access farmland during that time. The forest remained state land and access was forbidden. Anyone who entered the forest and/or used its products risked imprisonment (Bekele 2003).

Food security (defined as having enough food – or cash to purchase food – to feed the family) has increased from 1970, when most households struggled to produce or purchase enough food, to today, when most household produce enough for self-consumption and market surpluses. At the time of Haile Selassie, farmers had very limited cropland (around 0.5 ha for 20 people) and were mainly allowed to use the land for grazing. The diet was based on milk and honey (from the forest). With the land reform, farmers could use land for cropping, increasing agricultural yield. Food security was achieved at the end of the 1980s. The years 1984–85 were marked by a major famine resulting from two consecutive years of drought. Access to fertilizer and improved seeds, together with better planning of food production and consumption, were the main reasons given for the improvement in food security.

The average farm size was negligible before 1975, since all land was owned by landlords. With the land reform, farmers gained rights to use the land they cultivated. The area of land received from the government depended on the total area available and the household size (or in the case of the study area, the number of wives in the polygamous households). Land was accessed by men only. At this time (1977), the average farm size was the highest in the period considered. Farm size plateaued after this, and started to decline as farms were subdivided through inheritance.

Crop yield (kg/ha) has increased since the 1970s. Crop yield was very low, since there was little knowledge about crop management and no external input was used. Crop yield increased with access to fertilizers and improved seeds (during the Derg regime), and to agricultural technical assistance (with the current government). During the drought of 1984–85, most crops failed. After that, the productivity kept increasing. Comparing the trend line for the yield of different crops (see Appendix 2D) reveals that maize yield peaked in 1995 and declined until 2008 because of weather conditions (too wet). From 2008 to today, maize yield increased until it reached maximum yields (achieved in the study area). Wheat productivity also reached its peak around the same time as maize but since then has decreased due to the increased occurrence of fungal diseases. Maximum yields mentioned by farmers are 3 tons per ha for maize, 3.2 tons per ha for wheat and 20 tons per ha for potato.

Both total livestock number and livestock number per household have decreased steadily since 1970. The reason for this is the reduction of grasslands and forest, which used to be the major sources of feed. Today, most feed comes from crop residues, but the feed quantity produced by crops is lower than that produced by grazing land.

Acknowledgments

Jean-Yves Duriaux and Frédéric Baudron based this chapter on data collected from September to December 2014. Support was received from CIFOR personnel: Liz Deakin, Mrigesh Kshatriya, Habtemariam Kassa and Terry Sunderland. The remote-sensing preliminary analysis was undertaken by John Arnet, Ian Eddy and Sarah Gergel from the University of British Columbia. Advice was also received from Dr. Menfese Tadesse from Wondo Genet College of Forestry and Agriculture.

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Appendices

Appendix 2A Interviews with value chain actors

Table 2A.1 Number of interviews with value chain actors.

Value chain	No. of interviews
Fuelwood	8
Maize and wheat	5
Potato	5
Livestock	5

Appendix 2B Typologies based on self-categorization for three settlements

Table 2B.1 Typologies for Zone 1, Sida Malkatuka settlement, based on self-categorization activities.

Category	Criteria	Proportion of the households
Landless	• No farming land • Employed (agriculture or forest guard) • Can rent land or do sharecropping sometimes	14% 16 out of 42
Cereals producers	• Most land is covered with maize and wheat • Livestock (4 oxen for cultivation and 1–3 cows)	7% 3 out of 42
Livestock producers	• More than 5 animals, but normally 8–10 • Grazing land in the farm • Cropland, mostly maize followed by wheat and barley • Enset is important as a feed during dry season	19% 8 out of 42
Diversified farm	• Enset and coffee • Vegetables • Grazing land • Maize and wheat • Livestock (less than five)	60% 25 out of 42

Table 2B.2 Typologies for Zone 2, Gogorri Lako Toko settlement, based on self-categorization.

Category	Criteria	Proportion of households
Cereals producers	• Most land is covered with maize and wheat and some with barley • Livestock (2 oxen for cultivation and 2–3 other animals) • Very little false banana in home garden	54% 25 out of 46
Livestock producers	• Donkeys, sheep and 8–10 cattle • Grazing land in the farm • Cropland, mostly maize followed by wheat and barley • Very little sorgum and sometimes potato	2% 1 out of 46
Diversified farm	• Maize and wheat, barley, sorgum, cabbage, potato, teff • Enset and coffee; some farms have avocado trees • *Eucalyptus* planted in woodlots • Grazing land (little) • Livestock (2 cows – 2 oxen)	44% 20 out of 46

Table 2B.3 Typologies for Zone 3, Shona, based on self-categorization.

Category	Criteria	Proportion of the households
Renters	• Rent their land because they do not have enough money to obtain fertilizer or seeds, or because of illness • Lack oxen and have no animals	19% 6 out of 31
Model farmers	• Can produce two times per year (first vegetables and then cereals) • Can prepare all inputs before the rain so they can plant on time • Own 2–4 oxen and 2–3 cows • Own their own donkey cart to bring their product to the market • Hire labor • A model for other farmers • Own or are building a house in Arsi-Negele (closest town) • Plan all their activities • Have capital, so provide credit to poorer farmers • Are better-off economically (e.g. have house, chairs, etc.)	36% 11 out of 31
Traders	• Practice agriculture and trading • Own 2–3 animals (cattle) only because of lack of grazing land • Store their product and wait for higher prices to then sell to the market • Rent their cart services to people (10–15 people, ETB 2 to go and ETB 5 to come back) and for product (ETB 10/QQ[a] to go and ETB 20–30 to come back)	13% 4 out of 31
Vegetable producers	• Plant on time when the rain starts (and can get all the inputs on time) • Own 3–4 cattle • Do two plantings of vegetables per year • Start with cabbage nursery before the rain starts and irrigate with water from the river • If many people plant, the prices go down; prices are very variable	32% 10 out of 31

a QQ stands for quintal and represents 100 kg.

Appendix 2C Perception of land-use change in two settlements

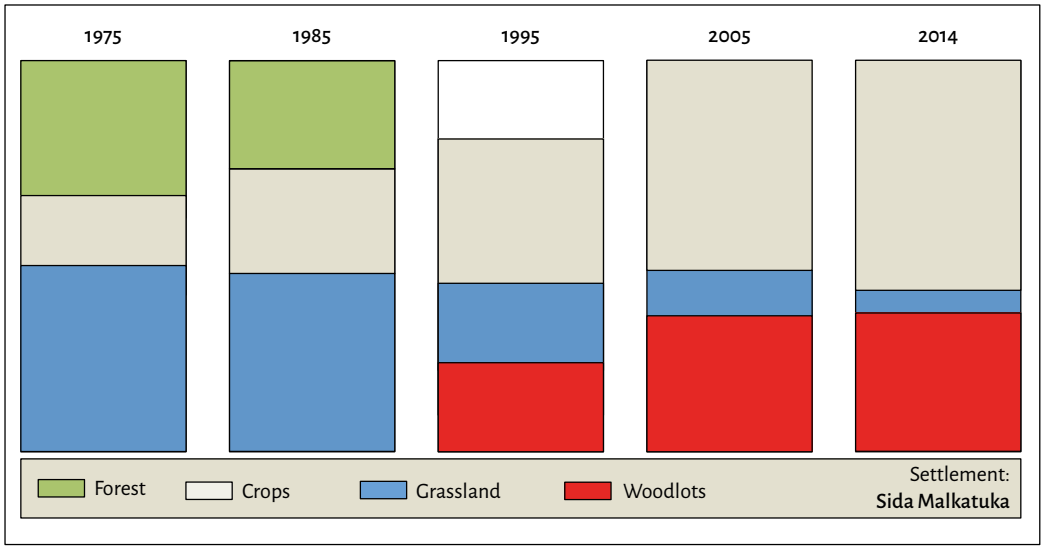

Figure 2C.1 Perceptions of land-use change in Zone 1, Sida Malkatuka.

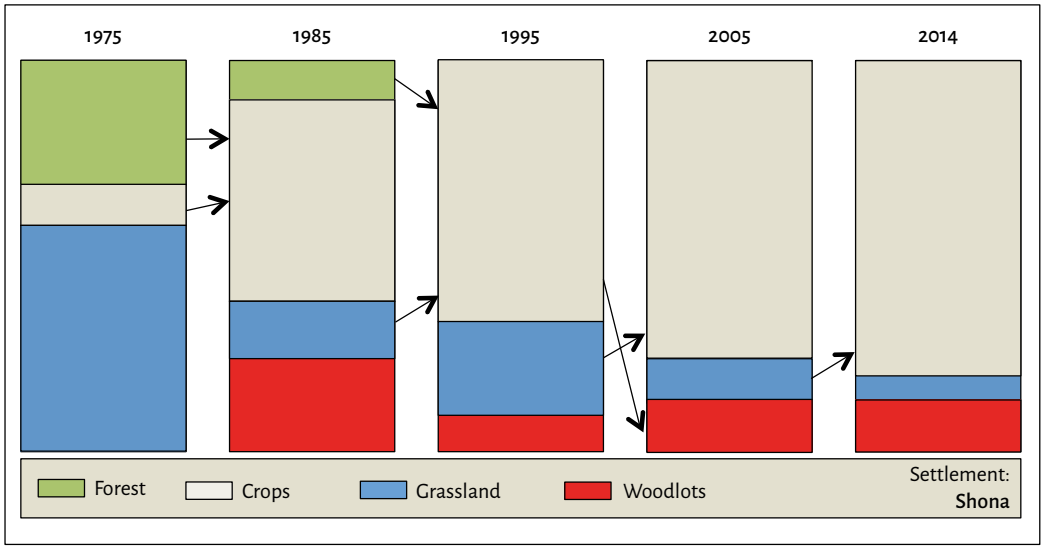

Figure 2C.2 Perceptions of land-use change in Zone 3, Shona.

Appendix 2D Trend lines of historical changes in three settlements

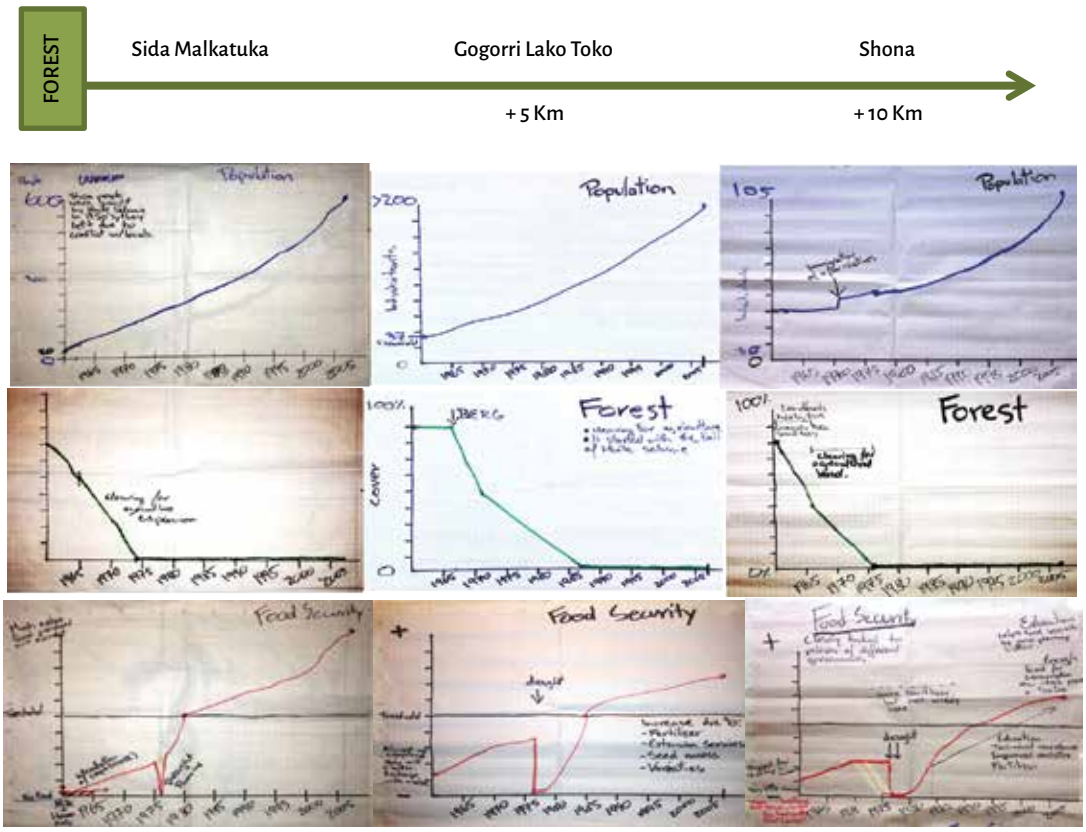

Figure 2D.1 Trend lines for population, forest cover and food security changes over time.

Note: Years on the graphs are on the Ethiopian calendar, which is 8 years behind the Gregorian calendar (e.g. 2007 in Ethiopian calendar is 2015 in Gregorian calendar).

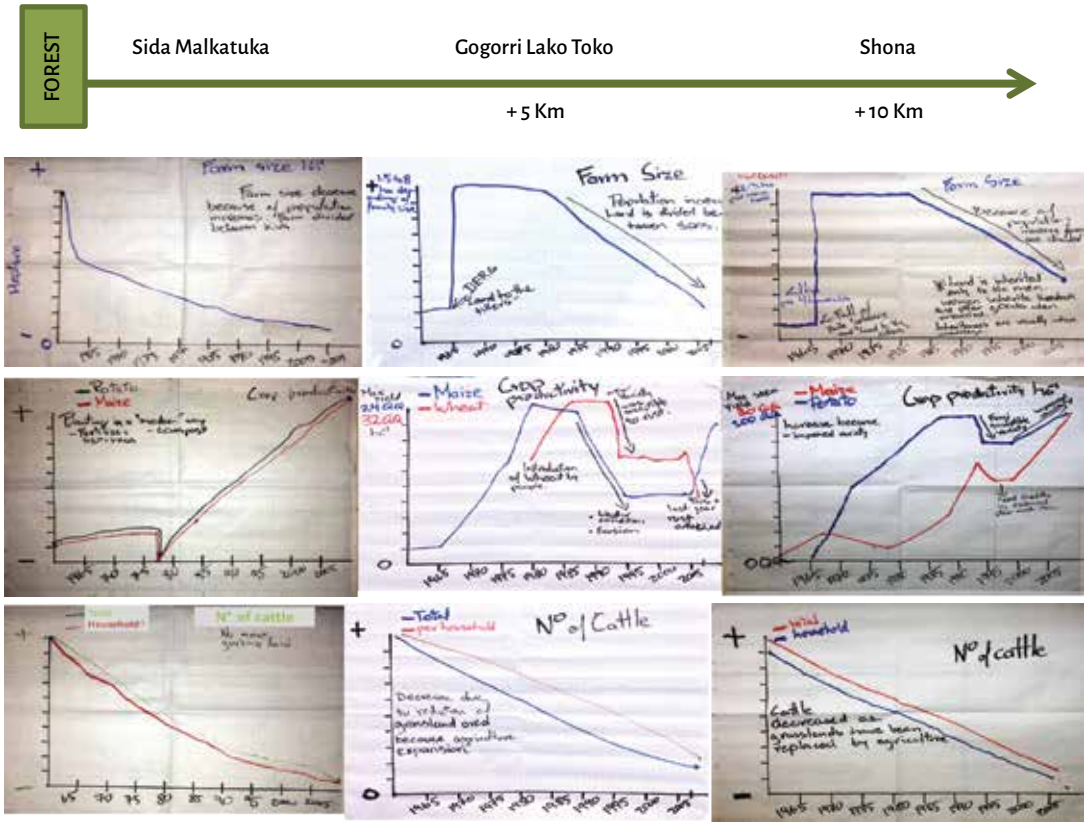

Figure 2D.2 Trend lines for farm size, crop productivity (the two crops considered the most important in the settlement) and livestock number (per settlement and per farm) changes over time.

Note: Years on the graphs are on the Ethiopian calendar, which is 8 years behind the Gregorian calendar (e.g. 2007 in Ethiopian calendar is 2015 in Gregorian calendar).