CGIAR Challenge Program on
WATER & FOOD
Nile

Uptake of integrated termite management for the rehabilitation of degraded land in East Africa:
A research into use baseline study in Diga, Ethiopia

Nile BDC Technical Report – 6

Uptake of integrated termite management for the rehabilitation of degraded land in East Africa:

A research into use baseline study in Diga, Ethiopia

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This Research Into Use (RIU) project is a collaboration between the International Livestock Research Institute (ILRI), Makerere University, Wollega University, and the International Water Management Institute (IWMI). The RIU program of the CGIAR Challenge Program on Water and Food (CPWF) is financially supported by the CGIAR Research Program on Water, Land and Ecosystems.

ISBN: 92–9146–324–8

Cover picture: Wollega University/A maize cob eaten by termites at Lelisa Dimtu *kebele*, Diga, Ethiopia

Editing, design and layout—ILRI Editorial and Publishing Services, Addis Ababa, Ethiopia.

Citation: Taye, H., Swaans, K., Legesse, H., Fekadu, D., Geleta, N. and Peden, D. 2013. *Uptake of integrated termite management for the rehabilitation of degraded land in East Africa: A research into use baseline study in Diga, Ethiopia.* Nile BDC Technical Report 6. Nairobi, Kenya: ILRI.

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Acronyms

CBO Community-based organization

CSA Central Statistics Authority

DA Development agent

FGD Focus Group Discussion

FHH Female-headed household

HS Household Survey

ILRI International Livestock Research Institute

ITM Integrated Termite Management

KII Key Informant Interview

MHH Male-headed household

NBDC Nile Basin Development Challenge

NGO Non-governmental organization

NR natural resources

RIU Research Into Use

SPSS Statistical Package for Social Science

SWC soil and water conservation

WOA *Woreda* Office of Agriculture

WU Wollega University

1 Introduction

In degraded areas in East Africa, termites pose a major threat to agricultural crops, forestry seedlings, rangelands and wooden structures. In Ethiopia, the problem is most severe in the western parts of the country including Wollega area (Abdulahi et al. 2010). In the past, several attempts were made to reduce damage caused by termites, including extensive termite mound poisoning campaigns. But as termite species also have beneficial effects in sustaining functionality and provision of ecosystem services (Mugerwa 2011), attempts to control termite species should therefore be conducted with care.

Termites are usually symptom of human induced degradation of land and biomass resources. Land rehabilitation is necessary for securing increasingly threatened feed and water resources for livestock. Based on a research project in Nakasongola, Uganda, severe land degradation of rangelands linked to overgrazing and termite damage to pastures can be reduced through night corralling[1] of cattle followed by reseeding of degraded pastures (Mugerwa 2007; Mugerwa et al. 2011; Peden et al. 2011).

Cognizant of this finding, a Research Into Use (RIU) project was designed to identify appropriate combinations of technical and institutional options for Integrated Termite Management (ITM)[2] through a process of shared learning and innovation. The project is being implemented in Nakasongola, Uganda, and in Diga, Ethiopia. Strategies to engage development, extension and private sector partners through action-research will facilitate longer term solutions, even beyond the project lifetime and taking results to scale.

In addition to a literature review on the relation between termites and land degradation, the project also envisaged a baseline study to collect relevant information on the problem in the focal sites and potential termite and land management options that can help to rehabilitate land productivity. Special attention was paid to farmers' ethno-ecological knowledge, a rich resource of information which is often neglected (Altieri 1993; Morse and Buhler 1997).

This report refers to the study in Ethiopia. The second section gives an overview of the research design and the action sites in Diga, Ethiopia. The third section presents and discusses the major findings of the study and their implications. The last section summarizes the major conclusions of the study and provides recommendation for future action.

1. Night corralling refers here to the practice of confining cattle at night to relatively small areas for about two weeks during which animals deposit manure that help replenish soil fertility.
2. ITM can be seen as a specific strategy of integrated pest management (IPM) that explicitly involves appropriate biomass, pasture, water, and livestock management (technical, financial, policy, and governance) practices for improving water productivity and sustainable and resilient livelihoods.

2 Research framework

2.1 Objectives and questions

The overall objective of this study is to understand the termite problem along with the prevailing socio-economic, biophysical and ecological contexts that can buttress the effort to develop integrated termite management strategies in the study area. Specifically, it attempts to explore and understand termite related knowledge, attitudes and practices of key actors (farmers, extension officers, local researchers etc.) in the action-research sites, and to understand the degree to which termite damage is a constraint to farmland productivity and peoples' livelihoods, and potential mechanisms (policies, investment strategies, and extension) to foster uptake of ITM.

The following research questions are addressed by the baseline study.

- How severe is the termite problem in the project areas and what are the implications?
- What is the state of land degradation in the project areas and how is it related to termite damage?
- To what extent is termite damage a constraint to improving farmland productivity and peoples' livelihoods?
- What is the level of knowledge, attitude and practice of key actors related to termites and their management?
- What are the coping and controlling strategies employed by farmers and other actors of the termite problem?
- What are the existing and potential institutional structures and mechanisms to foster uptake of ITM?

2.2 Research design

For the baseline study, both primary and secondary data were collected. For the primary data, participatory, rapid, and mixed-method tools were employed to capture the data required. A Household Survey (HS), Focus Group Discussions (FGDs), and Key Informant Interviews (KII) were used at *woreda* and *kebele* level (see respectively Annex I, II, and III). The study was conducted in two project *kebeles*. These are Bikila and Lelisa Dimtu.

Table 1 presents the tools used to address each research question along with the type of data collected.

Table 1. Key issues addressed and the tools employed

Issue category	Data collected	Tools employed	Research questions addressed
General and basic information	Village characteristics, termites infestation level, trends and seasonal calendar of termites and related activities	KII, secondary data	What are the general characteristics of the study area in relation to termites?
Crop and livestock production	Major crops grown and annual yield, major livestock species, livestock density, area under crops, grazing practices, types of pasture (private, communal, seasonal), management practices of pasture etc. and their linkage with the termite problem, crop productivity	FGD, HS, secondary data	What is the degree to which termite damage is a constraint to improving productivity and livelihoods?
Land and soil degradation and management	Soil management practices, type of soil and water conservation practices (indigenous and introduced); relationship between SWC measures and termites, causes of degradation, farmers' classification of degradation and types of damage linked to termites, types and causes of land degradation in priority order, gender differences in land and soil management practices etc.	FGD, KII, HS	What is the state of land degradation in the project areas and how is it related to termite damage?
Termite problem and consequences	Type of species, farmers criteria for termite classifications, types of damages (farms, forest, infrastructures etc.), when termite started to become a problem, indicators, ecological, economic and social consequences etc.	FGD, KII, HS, termite species identification	What is the extent and consequence of the termite problem in the project areas?
Coping and control strategies of the termite problem	Coping strategies such as how they adjust/change farming practices minimize damage etc. Innovations and strategies to address the problem, actors involved, level of effectiveness, reasons for not becoming effective, gender differences in coping and controlling strategies of termite problem	FGD, KII, HS	What are the coping and controlling strategies employed by farmers/actors to the termite problem?
Knowledge, attitude and practice	Actors knowledge, attitude, practice on land degradation and termite problem, its causes, consequences, controlling mechanisms, copping strategies, gender differences in KAP etc.	FGD, KII, HS	What is the level of knowledge, attitude and practice of key actors related to termite problem and management?
Institutions and polices	Type of local institutions and bylaws, type of collective actions, degree of enforcement of bylaws etc. Polices, strategies, interventions, institutional structures related to land management, ITM etc.	FGD, KII, review of secondary information	What are the institutional structures and mechanisms such as enabling policy, investment strategies, and extension to foster uptake of ITM?

2.3 The study area

The study *woreda*, Diga, is located in East Wollega Zone of Oromia Regional State to the west of Addis Ababa (Figure 1). Elevation varies from 1380 to 2300 masl. The total population of the *woreda* is about 68 906 with an average household size of seven persons. On average each household holds two ha; 68.2% of the *woreda* is arable land, 12.2% grazing land and 16.9% forest land. In terms of agro-ecology, lowland covers 60% of the *woreda* and the other 40% falls under mid-highland areas. In case of rainfall pattern, the *woreda* is predominantly mono modal and it receives rain from mid-March through November. The dry season extends from January to mid-March.[3] According to *woreda* experts, termites are a problem in 13 of the 21 *kebeles* in the *woreda* including the research sites.

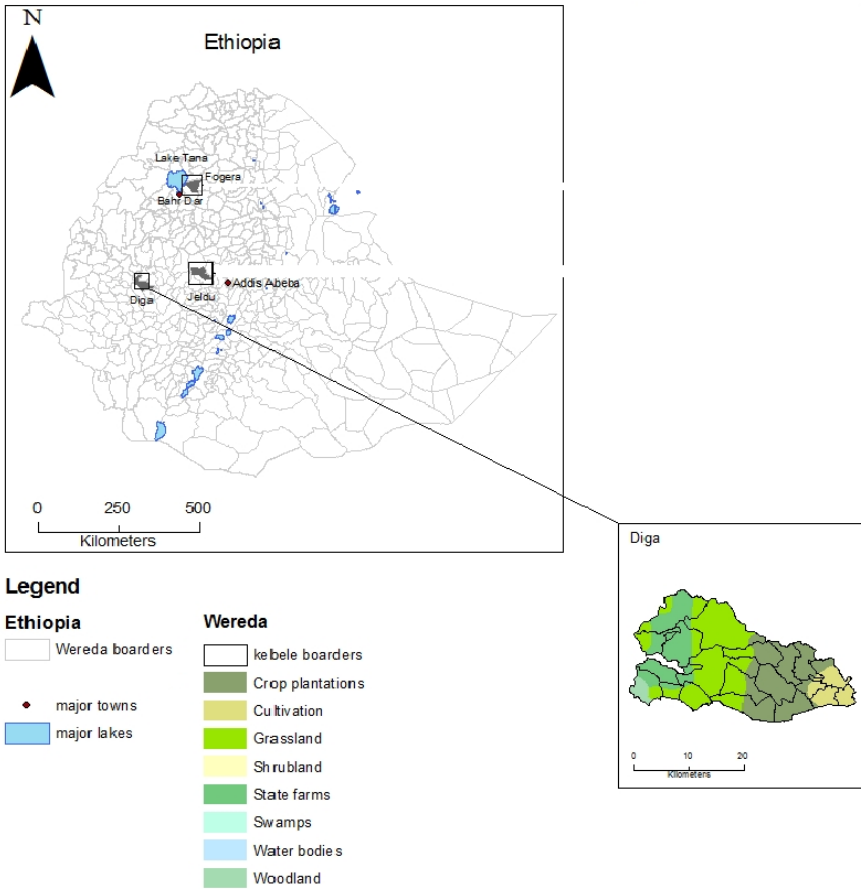


Figure 1. Map of Ethiopia and Diga *woreda*

This study was conducted in two *kebeles* of the *woreda*, i.e. Bikila representing the mid-highland and upper stream of Didesa watershed, and Lelisa Dimtu representing the lowland and downstream of the watershed. These *kebeles* are selected for the project due to termite infestation and the difference in agro-ecologies and landscapes. The assumption is that such diversity will give an opportunity to develop solutions applicable to varied agro-ecologies and landscapes.

3. http://nilebdc.wikispaces.com/Baseline+survey+narrative+of+project+sites+%28Jeldu,+Fogera+and+Diga+Woredas%29 (last consulted on 26/11/2012)

2.4 Data collection tools

a) **Review of secondary information:** Secondary data were collected from NBDC reports, *woreda* sector office documents etc. Besides, polices, strategies, interventions, institutional structures related to land/termite management etc., were reviewed from *woreda*, regional and national government policy documents and plans.

b) **Key Informant Interview (KII):** For this purpose, explorative interviews using a semi-structured checklist were conducted with key informants from *woreda* and *kebele* level (Annex III). Key informants are knowledgeable individuals who know the area and the problem well. At *woreda* level, experts working in the area of soil and water, crop production and protection and livestock production were interviewed. At *kebele* level, the DA, *kebele* chairman and elders were interviewed on trends and seasonal aspects of the termite problem, social, political, economic and biophysical dynamics and history of village/*kebele* etc. For the KIIs, purposive sampling was used to select the informants who are knowledgeable about the issues and the area. Hence, *woreda* agricultural office experts, concerned Wollega University staff, *kebele* chairman, development agent and elders were interviewed.

c) **Focus Group Discussions (FGDs):** FGDs were conducted with 8–12 farmers in a group and the farmers were selected based on their vulnerability to termite infestation and land degradation problems. The major data collected included information about the termite problem, its consequences, coping strategies, control mechanisms used to date etc. In each *kebele*, one FGD (men and women mixed) was conducted using a semi-structured checklist (Annex II). Purposive sampling was used to select women and men farmers' representatives who had experience and knowledge about termites and soil degradation problems and related issues.

d) **Household Survey (HS):** A structured questionnaire with close-ended questions was designed to collect household level quantitative data such as the number of livestock and their kinds, type of crops produced, size of land, level of use of agricultural inputs, damages from termites, type of coping and controlling strategies applied, food security situation and involvement in local institutions etc. (Annex I). The questionnaire was pretested for consistency, clarity and timing as well as revised on the basis of feedbacks from enumerators.

For the household survey, cluster sampling[4] was used to randomly select respondent households. First, villages were clustered according to level of termite infestation (high, medium and low) by the DA and *kebele* administration. Then villages were randomly selected from clusters of villages representing different termite infestation levels. Hence, four villages from Lelisa Dimtu and three from Bikila were selected. Households were selected randomly from each village in proportion to the number of households in each village. From each *kebele*, 28 households, i.e. 56 households from the two *kebeles*, were selected for the household survey.

No wealth classification was conducted in the project sites previously. Hence, wealth status classification was done post survey using asset data collected in the household survey. Major asset used by the community for classifying households into various wealth groups is number of livestock. Hence, after taking the number of livestock for each wealth group

4. It is a sampling technique used when 'natural' but relatively homogeneous groupings are evident in a statistical population. The population is subdivided into groups called clusters so that there is small variability within clusters and large variability between clusters.

(poor <2, medium >2 and < = 8 and better off >8) from the community, wealth status classification was done for each sample household using household survey data.

For an overview of data collection methods and participants, see Table 2.

Table 2. Organizations and community representatives contacted for the baseline survey

	Woreda	Bikila	Lelisa Dimtu
KII	Livestock production expert; soil and water management expert; crop protection expert; WU outreach and research director	Development agent; *Kebele* chairman; *Kebele* manager; 2 elders	Development agent; *Kebele* chairman; *Kebele* manager; 2 elders
FGD		Women: 3 participants from 3 villages; 67, 38 and 30 years old; only one is literate (grade 2); one is FHH while others are married. Men: 4 participants from 3 villages; all are literate except one (grades 5, 6 and 7); 39, 35, 34 and 31 years old; all married	Women: 3 participants from 3 villages, 2 are with no schooling; one is grade 11; all married; they are 33, 40 and 55 years old. Men: 9 participants from 3 villages; 3 are with no schooling; 3 are primary school level (grades 2, 5, 6), and 3 at high school level (grade 8, 9, 10); 36 to 65 years old; all married
HH survey		28 randomly selected household heads from three villages (Zone 1, Zone 2 and Zone 3)	28 randomly selected household heads from 4 villages (Dimtu, Addis Gebo, Bissilo, and Nebar Gebo)

2.5 Data analysis and validity

In the baseline study, both qualitative and quantitative data were collected. The qualitative data were analysed through categorization, summarization and interpretation in line with the research questions while the quantitative data was analysed using SPSS. Simple descriptive statistics, using percentages and means, were employed to summarize the quantitative data.

To ensure the quality and validity of data, triangulation was conducted by collecting data using various data collection tools and data sources. The data collection tools were designed through extensive discussions and consultations with local stakeholders after which it was pilot tested. Moreover, the findings were extensively discussed by the project team and presented to local stakeholders to improve validity.

2.6 The study team

The study team comprised of staff from ILRI, Wollega University (WU) and *Woreda* Office of Agriculture (WOA). WU staff included a soil and water management specialist, crop production expert, crop protection expert and socio-economist. Besides, two experts from WOA were part of the team to support community mobilization and data collection.

3 Results and discussion

This section presents the main findings of the research. First, a brief overview is provided of the two *kebeles* and people's livelihoods where the baseline study was conducted. Subsequently, people's land use practices are discussed by focusing on livestock and crop production, soil fertility and land management, and agricultural water management. Finally, findings are presented on termite related knowledge, attitudes and practices among key actors, and the potential and scope of existing institutions and mechanisms in terms of termite management.

3.1 General overview of the *kebeles* and peoples' livelihoods

Data are collected based on the discussion with development agents and information obtained from *woreda* office of agriculture. Accordingly, Bikila is a *kebele* with mid-highland agro-ecology characterized by rugged and undulated topographies, having high soil erosion problems. There is relatively high vegetation and forest cover. There is shortage of grazing land in the area, but potential for irrigation is relatively good. It is reported that 83 hectare (out of the potential irrigable 140 ha) is already under cultivation. Crop and livestock production are the main sources of livelihoods for people in the *kebele*. In terms of population, currently (2012) there are 2161 people living the *kebele* vs. 1940[5] in the year 2000. Farmers and elders also reported that the population is increasing.

Also in Lelisa Dimtu, the main livelihoods of the *kebele* are crop and livestock farming. From the total area of the *kebele*, 1750 ha are already cultivated. The *kebele* is dominated by lowland area where significant portion of the arable land was cultivated under state farm. It is reported that there is high population growth over the last decades and that the land holdings are becoming smaller and smaller. Unlike Bikila, there are lands in Lelisa Dimtu that have been abandoned for the last 20 years due to severe soil degradation. This is mainly because of mechanized farming and blanket application of chemical fertilizers, herbicides and pesticides when the area was under state farm. Thus, there is poor vegetation and forest cover in the area. Use of modern soil and water conservation structures such as bunds, cut of drains, terraces etc. have started recently. Irrigation is limited. For instance, there is a potential irrigable land of 50 ha of which 36 ha is already irrigated. Based on data obtained from the Development Agents, the population has slightly increased over the last ten years from 4381[6] in the year 2000 to 4473 in 2012.

It seems that intensification is high in Lelisa Dimtu in terms of area under cultivation (both using rainfall and irrigated) and historical use of inputs for long time. Percentages of cultivated land from the total area were respectively 58 and 67% for Bikila and Lelisa Dimtu. In Bikila, 5% of the cultivated land is irrigated while this figure is 2% for Lelisa Dimtu.

5. http://www.oromiyaa.com/english/images/Diga%20Leka%20Woreda.pdf
6. http://www.oromiyaa.com/english/images/Diga%20Leka%20Woreda.pdf

Similarly, forest cover is higher in Bikila as 7% of the total area is covered by forest while that of Lelisa Dimtu is only less than 1%.

See Table 3 for the main characteristics of the Bikila and Lelisa Dimtu *kebeles*.

Table 3. Land and population characteristics of Bikila and Lelisa Dimtu *kebeles*

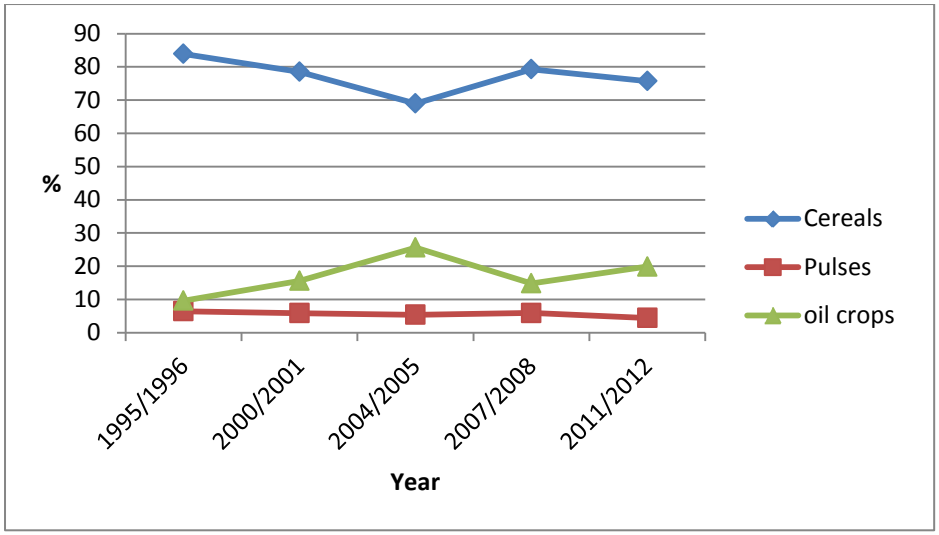
Indicators	Bikila	Lelisa Dimtu
Total area (ha)	2765	2600
Cultivated land (ha)	1613	1750
Grazing land (ha)	20.5	210
Forest land (ha)	193	10
Irrigated land (ha)	83	36
Total population (number)	2161	4473
Total household (number)	395	717
Female household heads (number)	48	81
Cultivated land as percentage of total area (%)	58	67
Forest land as percentage of total area (%)	7	0.4
Irrigated land as percentage of cultivated land (%)	5	2

Source: *Kebele* development agent office and own calculations.

3.2 Livestock and crop production

Crop production is the main source of food and income for farmers in the study area. In the lowlands (Lelisa Dimtu) annual crops such as maize, sorghum, finger millet, sesame, groundnut and common bean are cultivated. In the mid-highland areas (Bikila), maize, sorghum, finger millet, common bean, teff, faba beans and barely, sesame, and common bean are produced. Perennial crops such as coffee, sugarcane, mango, avocado, and banana are also cultivated in both *kebeles*. Similarly, farmers in both *kebeles* cultivate vegetables such as tomato, onion, shallot, hot pepper, local cabbage, root and tuber crops yam, taro, sweet potato and potato. Crop production and productivity is low due to various reasons.

FGD participants in both *kebeles* mentioned that productivity has decreased over time along with a decrease in rainfall intensity and soil fertility. They also mentioned that termite infestation and land degradation have increased in the last decade. Still, farmers in FGDs and KIIs reported that farmland in Bikila has increased over the years, along with increased level of deforestation. In Lelisa Dimtu, however, farmland seems to have decreased over the last decades as more land has come out of production. Farmers also indicated that use of inorganic fertilizer has increased. Although it was reported that farmers are increasingly diversifying crops as a coping strategy to various risks such as drought and low soil fertility, the total area under cultivation in East Wollega Zone is still largely dominated by cereals (Figure 2).



Source: CSA (2012).
Figure 2. Crop production trend in East Wollega Zone (1995 to 2012)

According to *woreda* experts, use of improved crop technologies and practices is at infant stage in the area. This is mainly due to poor credit and input services, lack of appropriate and relevant technologies and limited awareness. Compared to other crops, farmers used more chemical fertilizers and improved seed for maize plantation in the 2011/12 cropping season (see Table 4). But, even for this crop only 23% and 25% of farmers that cultivated maize reported that they used chemical fertilizer and improved variety, respectively. Organic fertilizer use was relatively high and 60% of farmers that cultivated maize reported that they applied organic fertilizer on their maize farm in 2011/12 cropping season. In general, relatively more farmers in Bikila used improved seeds and chemical fertilizer as compared to farmers in Lelisa Dimtu. This could be due to the proximity and accessibility of Bikila *kebele* to the main asphalt road and the *woreda* capital, Diga. On the other hand, from sample households interviewed more farmers in Lelisa Dimtu used organic fertilizer than in Bikila. This could be due to the larger livestock population in Lelisa Dimtu (Table 5).

Table 4. Improved variety and fertilizer use in 2011/12 cropping season in the study area (No. = 56)

Crop type	No. of farmers planted crops*		Improved seed		Chemical fertilizer		Organic fertilizer	
	Bikila	Lelisa Dimtu	Bikila	Lelisa Dimtu	Bikila	Lelisa Dimtu	Bikila	Lelisa Dimtu
Sorghum	21	27	0%	0%	0%	0%	19%	37%
Maize	28	24	29%	21%	29%	17%	50%	71%
Millet	19	17	32%	0%	0%	6%	11%	12%
Teff	13	0	0%		23%		8%	
Sesame	2	17	0%	0%	0%	0%	0%	12%

* The number of respondents in each *kebele* was 28.

There is significant difference in use of agricultural inputs by wealth status (Figure 3).The poor did not use improved seed and chemical fertilizer for maize in 2011/12. The very high

price of chemical fertilizer and improved seed seemed to hamper poor farmers from using these inputs (Figures 4 and 5). The trend is different for organic fertilizer use.

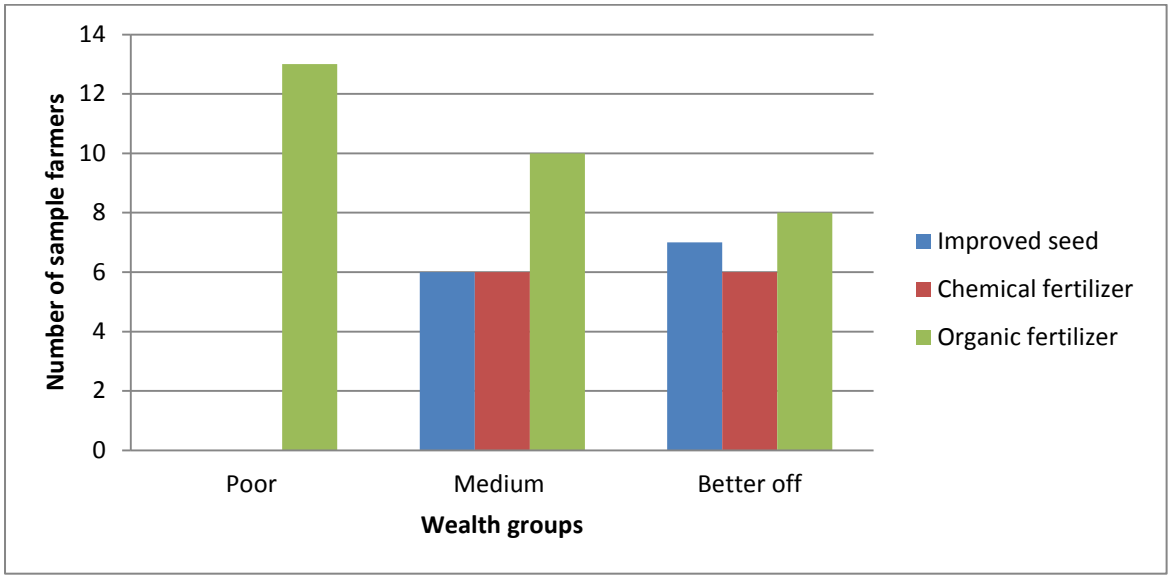
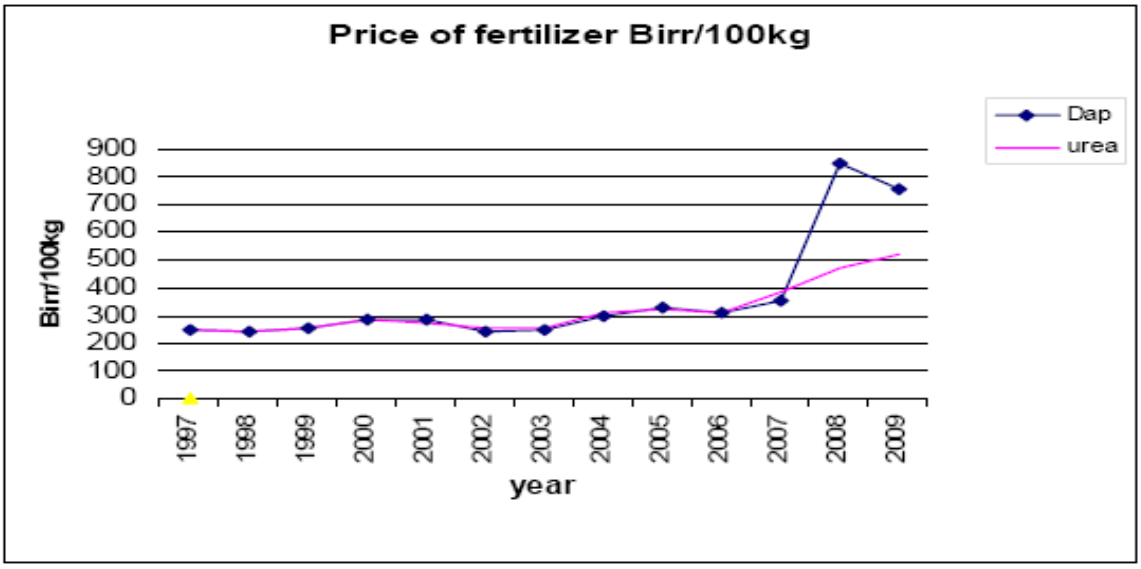
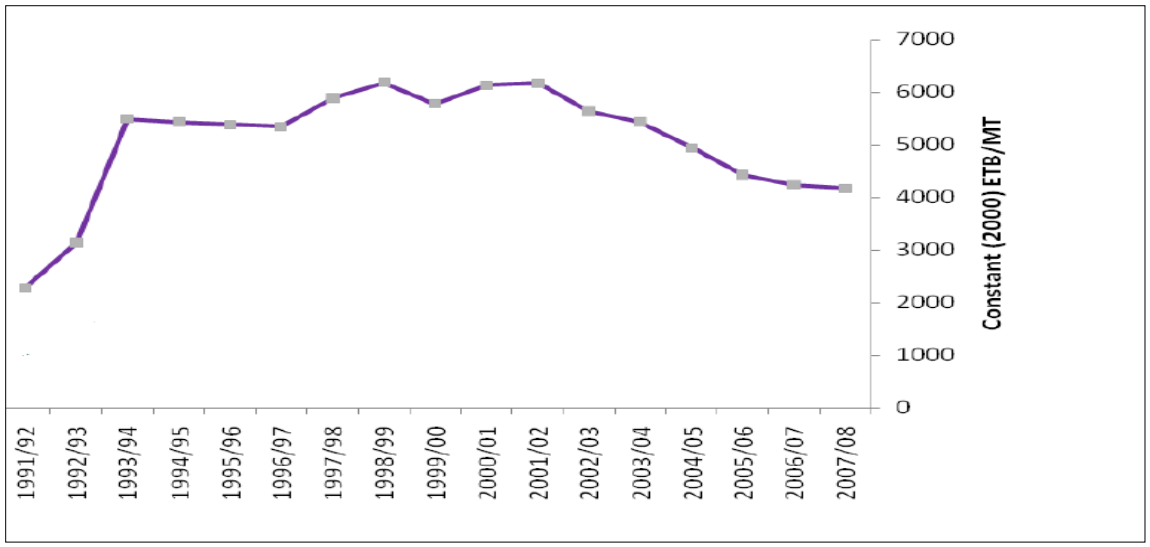


Figure 3. Improved seed, organic and inorganic fertilizer use by wealth groups



Source: Ayele and Lema (2011).
Figure 4. Trend of fertilizer price in Ethiopia (from 1997–2009)



Source: Spielman et al. (2011).
Figure 5. Real price of cleaned hybrid maize seed from 1992–2008 (based on ESE price)

All the 13 farmers that reported using maize improved seed and the 12 farmers that used chemical fertilizer were from medium and better-off categories. Besides their incapacity to buy inorganic fertilizers, applying organic fertilizer is cumbersome and requires labour.

Reasonable numbers of poor farmers used organic fertilizer for maize plantation in 2011/12. Poor farmers opt for organic fertilizer as inorganic fertilizer is expensive and crop residues and animal dung can be accessed freely from their agricultural practices.

There are different cropping systems in the study area among which row planting (maize), mixed cropping (maize with common bean, finger millet with sesame, and local cabbages with finger millet) and crop rotation are the major ones. Almost all farmers in the area practise crop rotation every year. But, crop rotation is not common for maize (mono-cropping) as it is planted on backyard plot with better fertility management. Besides, maize should be planted around the homestead to protect the crop from wild animal damage, while shortage of land around the homestead hinders use of crop rotation.

Major constraints of crop production identified by farmers in Lelisa Dimtu include termite infestation, poor soil fertility, weed, vertebrate pests, and lack of irrigated land. Based on farmers' perceptions, termite infestation and poor soil fertility are the two most important factors affecting farmers' livelihoods. On the other hand, the major crop production constraints in Bikila as perceived by farmers include termite infestation, poor soil fertility, poor input supply, weed, vertebrate pests, shortage of irrigated land, unseasonal rainfall and lack of oxen. Termite infestation, poor soil fertility and vertebrate pests (especially monkey and baboons) are termed as the most important constraints by farmers.

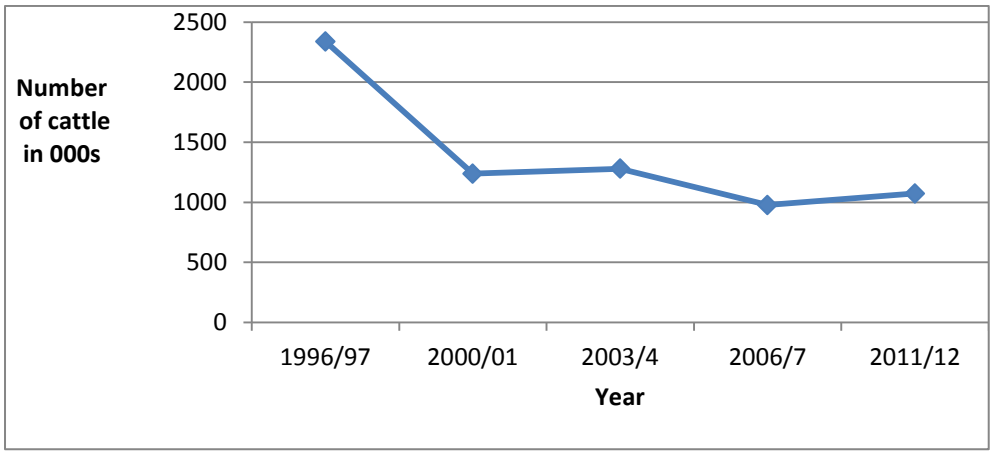
The major livestock species in the area include cattle, goat, sheep, donkey and poultry. On average, each household had four cattle in Bikila and four to five in Lelisa Dimtu (Table 5). In FGDs, grazing land and livestock population are reportedly decreasing in both *kebeles* over the last decades. Supporting evidence was provided from annual sample surveys conducted in East Wollega Zone where the study *woreda* is located. The number of cattle has shown a

decreasing trend over the last 15 years in the zone (Figure 6). Permanent Rivers and temporary rivers (during rainy season) are the main water sources for the animals. The major feed sources for animals in the study area are grasses on grazing lands, crop residues (maize, sorghum and finger millet) and fodder trees during the dry season.

Table 5. Number of livestock by species and number of households by *kebele* based on records kept by the DA

	Bikila	Lelisa Dimtu
Cattle	1580	3258
Sheep	896	300
Goat	146	205
Donkey	85	145
Mule	0	8
Chicken	1943	3210

The main feed sources in the *kebeles* are grazing land (both individual and communal) and crop residues. Farmers reported that there is feed shortage in both *kebeles* and their animals do not get enough feed especially in the dry seasons. For instance, 82% of households said that they faced feed shortage. Even though 57% of households interviewed which reported having individual grazing land, it covered only four months of their feed demand on average. They have to rely on crop residues as feed for the rest of the year. Various reasons were given but termites (35%) and shortage or lack of grazing land (30%) were the most frequently mentioned by farmers for not having enough feed for their animals. Only 10% reported that they get enough feed for their animals and about 8% reported that they do not have any livestock. They need to ration the available feed to cover the feed demand of their livestock. Specially, they had to conserve some of the crop residues for the dry season.



Source: CSA (2012).
Figure 6. Number of cattle in East Wollega Zone (1996–2011)

In general, farmers use cattle dung for improving soil fertility for producing crops. Cereals are predominantly cultivated in the area. There is limited cultivation of legumes, which could

improve soil fertility. Moreover, crop residues are used for livestock feed. Despite this, there is feed shortage for livestock, which limits their productivity and number. With smaller numbers of livestock, the amount of animal manure integrated into the soil will also be smaller which in turn affects soil fertility.

3.3 Soil fertility and land management

During the Haile Selassie regime before 1974, land was owned by landlords (Ambaye 2012). During that period, natural forest cover in the area and the amount and distribution of rainfall were relatively good (NBDC 2011). The soil was fertile and farmers were able to produce crops without using fertilizer inputs. In the Derg era, starting from 1974, land was distributed to peasants (Ambaye 2012). Furthermore, there were state farms in different parts of the country including Wollega. For instance, a cooperative association was formed in Lelisa Dimtu in 1979/80 (NBDC 2011). Under the state farm system, there were no private land holdings. All farmers were expected to work for the farm. This kind of state ownership hindered farmers from carrying out land management and tree planting. Attempts to introduce mechanized farming led to destruction of dense forests (ibid).

In the current regime farmers can transfer the land use rights to their children, except selling the land (Ambaye 2012).There are communally owned lands which are mostly grazing lands. There are also abandoned lands (especially in Lelisa Dimtu *kebele*) which are not productive due to poor soil and land management practices over the years. These lands are now *de jure* holdings owned individually but are de facto communal grazing lands.

In upstream Bikila, FGD participants reported high soil and land degradation. The main causes of land degradation included undulated topography, lack of soil conservation practices, termite infestation, leaching of basic cations due to high rainfall, deforestation, and shortage of organic manure. In Lelisa Dimtu, farmers in the FGD also mentioned high soil and land degradation. They estimated that more than half of the *kebele* land has been out of production for more than 20 years due to soil degradation. Inappropriate cultivation practices, termite infestation, leaching of basic cations due to high rainfall and deforestation were reported to be the main causes of land degradation in the *kebele*. Besides, high application of inorganic fertilizers and other chemicals by the state farm during the Derg Regime contributed negatively. Farmers reported that termites aggravate land degradation especially during the dry season by eating what is left on the rangelands.

Households were also asked to rate the fertility status of their lands. Most farmers (73%) rated their farmland medium in soil fertility status, as it is productive without fertilizer but with lower yield (Table 6). About 25% said that their land was either infertile or very infertile. Percentage of households with medium and fertile land increased with increase in wealth status. For instance, respectively 70%, 75% and 83% of the poor, medium and better off households reported that fertility of their land was medium and above (Table 6). As discussed later, use of soil fertility inputs also increases when famers have better wealth status. Hence, better soil fertility of medium and better-off farmers could be due to their capacity to apply various soil fertility management practices. They can also access relatively better fertile land through various land sharing arrangements such as sharing and contacting.

Table 6. Soil fertility status of farmlands as reported by farmers in the baseline survey (No. = 56)

Fertility status (No. + %)		*Kebele*			Wealth status			
		Bikila	Lelisa Dimtu	Total	Poor	Medium	Better off	Total
Infertile+ very infertile	Number	7	7	14	6	6	2	14
	Percentage	25%	25%	25%	30%	25%	17%	25%
Medium and fertile	Number	21	21	42	14	18	10	42
	Percentage	75%	75%	75%	70%	75%	83%	75%
Total	Number	28	28	56	20	24	12	56
	Percentage	100%	100%	100%	100%	100%	100%	100%

*Very infertile: abandoned land infertile: non-productive without fertilizer; medium: productive without fertilizer, but low yield; fertile: highly productive with minimum fertilizer.

As far as reasons for poor soil fertility is concerned, more than half of respondents (51%) believe that it is a combination of factors rather than a single factor which is responsible, showing the importance of an eco-system approach to address land degradation. About 26% of the interviewed households reported that soil erosion and termites combined are the main reason for the poor soil fertility of their farm land. Respectively 21%, 16%, and 12% of the farmers mentioned respectively soil erosion, mono-cropping, and termites as the main (single) reason for poor soil fertility (Table 7).

Table 7. Farmers' perception on reasons of poor soil fertility

Reasons	Number of HH	Percentage
Soil erosion	9	21%
Termites	5	12%
Mono-cropping	7	16%
Soil erosion and termites	11	26%
Soil erosion, termite and mono-cropping	4	9%
All* except drought	5	12%
All*	2	5%

*all includes soil erosion, termite, drought, over grazing, mono cropping.

There is observable difference in terms of application of soil improvement mechanisms showing that wealth status has some impact on households' ability to improve soil fertility. About 70, 87 and 92% of the poor, medium and better-off sample farmers used various mechanisms to improve the soil fertility status of their farmland. Coping strategies employed for addressing the challenges of poor agricultural productivity varies by wealth status. Off-farm work is employed as coping strategy by 25% and 8% of the poor and medium wealth groups, respectively. Besides, out migration for seasonal labour work is used as copping strategy by 5% of the poor sample households. Both strategies were not used by the better-off farmers. Sharing[7] in fertile land has been used as a strategy by significant number of farmers from all wealth groups.

Currently, there are a number of soil fertility and land management practices in the area. Organic and inorganic fertilizer application, crop rotation, intercropping and fallowing (in the lowlands) are practised by farmers to improve soil fertility on individual farmlands. Terraces, planting grasses in strip, tree plantation and area closure are practised on degraded communal lands by the community. It was reported by farmers that inorganic and organic fertilizers application and crop rotation are the most effective in terms of improving soil fertility. Terraces, plantation of grass and trees on communal lands were reported to be effective by farmers to prevent land degradation. In both *kebeles*, it is reported by FGD participants that soil and water conservation activities have increased in recent years due to high government attention.

In the household survey, 80% of the total households interviewed tried to improve the soil fertility of their farmland using various soil fertility improvement mechanisms. The most frequently used mechanisms include the use of manure, fallowing (in the lowlands), crop rotation, and application of inorganic fertilizers in ranking order. Farmers in the FGDs reported that corralling, application of compost and manure are the most effective practices that improve the fertility of the soil and decrease termites' infestation. Farmers observed that the higher the fertility of the soil, the lower the termite problem. They added that the intensity of termite is lower on crop lands with high cattle manure and compost than soils with low organic manure and compost. They explained that termites will eat the manure and the compost which will divert their attention from the crops. They believe that improving the fertility of the soil decreases the infestation of termite damage on the crop.

Following the downfall of the Derg regime, more soil fertility management practices were used by farmers as the state farmland was redistributed to individual farmers. Corralling is being practised in Bikila *kebele*, where the animals stay three to four days in one place. There is limited practice of corralling in Lelisa Dimtu as manure is mainly used from a permanent livestock shed. Corralling is mainly practised for the purpose of soil fertility improvement. The practice is mostly used around homesteads for maize cultivation. Farmers reported that corralling also helps to reduce the problem of termites.

In the study areas, crop residues are used for various purposes. The available crop residue in the study area includes maize, sorghum and sesame in the lowland areas and additionally teff, finger millet, and faba beans in the mid highlands. Some farmers leave the crop residue on the field for soil fertility improvement. Some farmers practice burning left over crop residue during land preparation for the next season. There are general preferences in use of

7. It is an arrangement where farmers with better resources such as oxen, labour, fertilizer, and seed agree with farmers who lack these resources but land. The one who shares in the land cultivate it by applying the inputs and share the product with the land owner using a pre-agreed sharing quota.

crop residues. For instance, maize and sorghum are preferred for fuel, beans and sesame for soil fertility and millets and teff for livestock feed. The household survey also depicted that farmers use crop residues for feed, soil fertility, cooking, lightening and house construction purposes. From 2011/12 cropping season harvest, based on sample farmers' estimation, an average of more than half of millet crop residue was used for feed. Similarly, more than 60% of sesame crop residue used for soil fertility (62%) while sorghum was used mainly for cooking (49%).Maize is being used both for feed (32%) and cooking (37%). More than half of the teff straw was used for animal feed (53%) and it was also used for soil fertility (37%) and house construction mixed with mud (Figure 7).

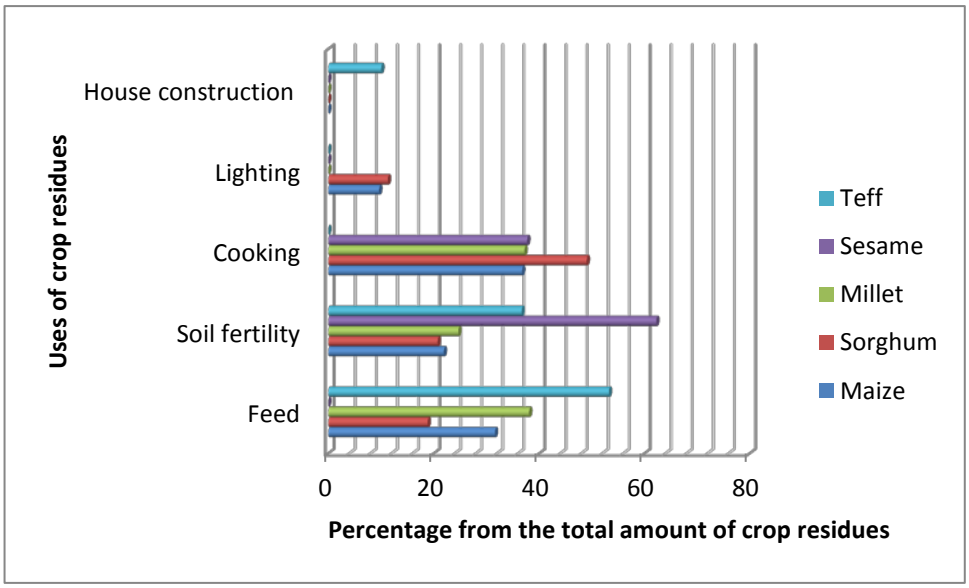


Figure 7. Use of crop residues by farmers in the study area (from 2011/12 harvest)

3.4 Agricultural water management

Generally, in both study *kebeles*, there are limited agricultural water management activities (NBDC 2011). For instance, in terms of water management, farmers in the area are practising traditional irrigation at small-scale level by traditionally diverting some rivers and using water pump in some cases. Farmers mainly cultivate maize and some vegetables using traditional irrigation. There is no modern irrigation in the *kebeles* although there is some potential for it. Similarly, there is limited effort to conserve rain water using ponds or any other structures. Recently, interventions have been initiated by the government to conserve soil and water using various physical and biological conservation systems.

In Bikila, development agents reported that except irrigation, there are few practices for collection and use of rain and ground water. Construction of ponds, water wells and other water conservation and management practices are at early stage. In this *kebele*, there are two rivers. Farmers use traditional irrigation and water pump to divert the water and use it for irrigation. It is reported that about 83 ha is currently irrigated. Consequently, about 45% of the households interviewed reported that they have irrigated land. However, almost all of them reported that there is termite infestation on the irrigated land in the harvesting season. There are also about nine farmers who have wet land (Bone land) and most of them (7) reported that there is termite infestation on the wet land (Table 8).

Table 8. Termite attacks on irrigated and wet lands in Bikila and Lelisa Dimtu *kebeles*

S. No.		No. of farmers owning		No. of farmers reporting termite attack	
		Bikila	Lelisa Dimtu	Bikila	Lelisa Dimtu
1	Irrigated land	13	8	12	5
2	Wetland (*Bone land*)	9	14	7	5

Similarly, in Lelisa Dimtu there are limited water management practices. There are five rivers used by farmers for traditional irrigation. It is reported that only 33 ha of land is being irrigated in this *kebele*. From the household heads interviewed, only a quarter reported that they have irrigated land, while half of them own some wet lands. In terms of termite infestation, both the irrigated and wet lands were reported to be infested by termites specially when the lands are dry and the crops are matured.

3.5 Termites: Problem, perceptions and control

The problem and its causes

Termite is a major problem in the study area on crop land, rangelands and around homesteads threatening the livelihood of farmers. Irrespective of their wealth status, almost all (93%) of the households interviewed in the baseline survey reported that there is termite attack on their farmlands. Farmers reported that the problem of termite was there since long time ago, but its severity has been increasing in the last 15–20 years in the area. About 20 years ago, some control measures were conducted by the government especially in the state farms. Every year, chemicals were applied by the government on the state farms to control the termites. But, after the state farms were closed and transferred to individual farmers, there was limited use of chemicals for termite control because farmers have no access and capacity to buy and apply chemicals. Currently, chemicals are available at Nekemte Market but it is expensive.

Farmers gave different reasons for increased termite infestation in the area (Table 9). From the 56 household heads interviewed, seven out of ten (71%) believed that they knew the reasons for increased termite infestation. The remaining third (29%) reported that they did not know. The most frequently mentioned reasons as perceived by interviewed farmers in the mid-highland Bikila *kebele* include deforestation (26%), soil degradation (24%), and overgrazing (16%) while in the low land *kebele* of Lelisa Dimtu, soil degradation (33%), overgrazing (25%) and deforestation (22%) were listed. There is no significant difference among the different wealth groups in terms of perception on the reasons for termite infestation.

Table 9. Farmers' perception on causes of termite infestation based on the baseline survey

	Kebeles		Total
	Bikila	Lelisa Dimtu	
Drought	6 (11.8%)	2 (4.1 %)	8 (8.0%)
Excess rainfall	3 (5.9%)	0	3 (3.0%)
Forest	0	1 (2.0%)	1(1.0%)
Deforestation	13 (25.5%)	11(22.4%)	24 (24.0%)
Soil degradation	12 (23.5%)	16 (32.7%)	28 (28.0%)
Over grazing	8 (15.7%)	12 (24.5%)	20 (20.0%)
God	3 (5.9%)	1 (2.0%)	4 (4.0%)
Population pressure	6 (11.8%)	6 (12.2%)	12 (12.0%)

Farmers reported that termite infestation has increased with deforestation because some termite eating rodents have migrated to other areas. Similarly, ants living under the grasses that eat termites have decreased due to overgrazing. Soil degradation does not only affect the crop cover, but it also leads to less decaying materials on which termites can feed.

Farmers' classification of termite species

There are two types of termite species in the study area. Farmers differentiate the two types of termites based on body size, head colour, feeding habit and mound formation. The local names given to the two types of termites are *Werrartu (*meaning *'invaders' in* Afan Oromo*)* and *Marimartu* (meaning '*common to the area'* in Afan Oromo*)*. The *Marimartu* have mounds and stay in some places whereas, the *Werrartu* are non-mound forming and migratory type. Table 10 indicates the detail characteristics of the two types of termites as described by farmers. These classifications need to be scientifically verified.

Table 10. Farmers' classification of termites based on different characteristics

Characteristics	Marimartu (common to area)	Werrartu (invaders)
Body size	Big body size	Small body size
Mound structure	Upper ground mounds	Underground mounds
Head colour	Red head colour	White head colour
Feeding habit	Construction material (home) and cause a serious damage on crops	Feed on decay material and inside the plant
Queen	Have queen	No queen

Most of the household heads interviewed did not know that there are various types of termites (Table 11). Only about a third (29%) of them knew that there are different types of termites. Major criteria used by farmers to identify the termites include body size (27%) type of mound (20%) and colour (20%). Farmers' perception on the benefit of termite varies. About 39% of interviewed household heads believe that termites have benefits. About 32%of farmers believe that termites improve soil fertility as the mounds help decompose crop residues. Some farmers also reported that the queen can be used for livestock fattening purposes.

Table 11. Farmers' knowledge on termites' classification and benefits based on household survey (No. = 56)

	Kebeles		Total
	Bikila	Lelisa Dimtu	
Identify termite species Yes	6 (21%)	10 (36%)	16 (29%)
No	22 (79%)	18 (64%)	40 (71%)
Characteristics used to identify termites			
Body size	5 (18%)	10 (36%)	15 (27%)
Type of mound	3(11%)	8(29%)	11 (20%)
Colour	3 (11%)	8 (29%)	11 (20%)
Head and mouth structure	0	5 (18%)	5 (18%)
Feeding habit	1 (4 %)	2 (7%)	3 (5%)
Effect on plants	0	3 (11%)	3 (11%)
Do termites benefit?			
Yes	6 (21%)	16 (57%)	22 (39%)
No	20 (71%)	10 (36%)	30 (54%)
I do not know	2 (7%)	2 (7%)	4 (7%)
What are their benefits?			
Soil fertility	5 (18%)	13 (46%)	18 (32%)
Feed/fattening	3 (11%)	4 (14%)	7(12%)

In general, there was clear difference between the two *kebeles* in terms of knowledge and perception on termites' species and benefits. This could be related to the knowledge and information diffused in Lelisa Dimtu *kebele* during the Derg time as the area was a state farm.

Damages caused by termites

Farmers reported that termites cause damages on crops, trees, grazing lands and houses. According to FGD participants, termites attack almost all crops and trees. But, the level of

damage and tolerance of the crops and trees varies. The most susceptible crops to termite attack include maize, sugarcane, teff and sorghum in the mid highlands. Tuber crops and vegetables have higher tolerance to termite attack. On the other hand, it was reported that sorghum, finger millet, sesame, groundnut and common bean, are more tolerant to termite attack, while maize was the most susceptible crop in the lowlands. Improved maize varieties were reported to be more affected than local ones.

To assess the rate of termite damage, households were asked in the household survey to rate the severity of termite damage on their houses, grazing lands, trees, fruits and annual crops using a rating scale of five. These are: no termite (no visible termite), not severe (termites are observed but there was no serious damage), seasonal severity (damage happens in some seasons), severe (termite damage was visible), and very severe (termite damage was visible and very high). This scaling was also used for the annual crops farmers cultivated in the previous cropping season (2011/12). Based on the analysis, maize, teff, wheat and barley are the most susceptible even if all crops are attacked by termite. It seems that sorghum and sesame are relatively tolerant (Table 12).

Table 12. Farmers' assessment of termite damage on annual crops

Crop	No. of farmers	Reported severe termite attack	Percentage
Wheat	2	2	100%
Teff	13	13	100%
Maize	52	52	100%
Barely	1	1	100%
Groundnut	6	5	83%
Haricot bean	4	3	75%
Millet	36	22	61%
Sorghum	47	20	43%
Sesame	19	5	26%

Based on farmers' response, it seems that almost all trees are attacked by termites. Eucalyptus (96.3%) and *Acacia abyssinica* (53.8%) seem to be more susceptible trees to termite attack. Likewise, coffee (75%) and sugarcane (100%) were rated as most susceptible to termites (Table 13).

From the total households interviewed, 85% reported that termites were damaging their houses and 87% of them believe that the damages caused by termites were severe and highly severe. The remaining farmers rated the damage as seasonally severe. Similarly, about 80% of interviewed households have reported termite infestation on their back yard of which 67% believe that the level of damage was severe and highly severe. From 41 households that have reported to have individual grazing land, 36 (88%) reported termite infestation on their grazing land. In terms of severity, 31 (86%) reported that it was severe or highly severe.

Table 13. Farmers' assessment of termite damage on trees, fruits and other perennial crops

Trees, fruits and other perennials	No. of farmers having fruits and trees	No. of farmers reporting at least seasonal severity	Percentage of farmers reporting at least seasonal severity
Trees			
Haginea abisinica	4	0	0.0
Ekebergia capesil	12	3	25.0
Ficas species	36	12	33.3
Cordia africana	45	19	42.2
Syzygium guineense	28	7	25.0
Vernonia amagdailina	37	15	40.5
Albili agumifera	11	3	27.3
Ficus vasta	10	1	10.0
Eucalyptus	27	26	96.3
Broad-leaved croton *(Croton macrostachyus)*	39	18	46.2
Acacia abyssinica	13	7	53.8
Fruits			
Mango (*Mangifera indica*)	48	17	35.4
Banana (*Musa* spp**)**	24	8	33.3
Orange (*Citrus sinensis*)	1	0	0.0
Avocado (*Persea americana*)	5	1	20.0
Other perennials			
Coffee (*Coffee arabica*)	36	27	75.0
Sugarcane (*Saccharium* spp)	3	3	100.0

Control strategies

According to farmers in FGDs, there were different strategies used to reduce the infestation of termites. Cultural practices such as queen removal, smoking and flooding were largely practised on farmlands. Mostly, these cultural practices were effective when done in combination. In addition to these cultural control measures, chemicals were used by the agricultural office of the *woreda* where the severity was very high. But farmers have limited

access and capacity to use chemical to reduce the problem of termites. In Lelisa Dimtu, there was blanket and wide application of chemicals when the land was owned by state farms 20 years ago. The household survey also confirmed the findings of the FGDs. From the total household heads that reported their farm was infested by termites, 93% have tried to control termites using various mechanisms. The major mechanisms employed include chemical, fumigation, digging mound and removal of the queen and flooding. Use of chemicals, and digging mound and queen removal were mentioned as the most effective mechanisms, but even in those cases almost half of the people classified their effectiveness as moderate (Figure 8).

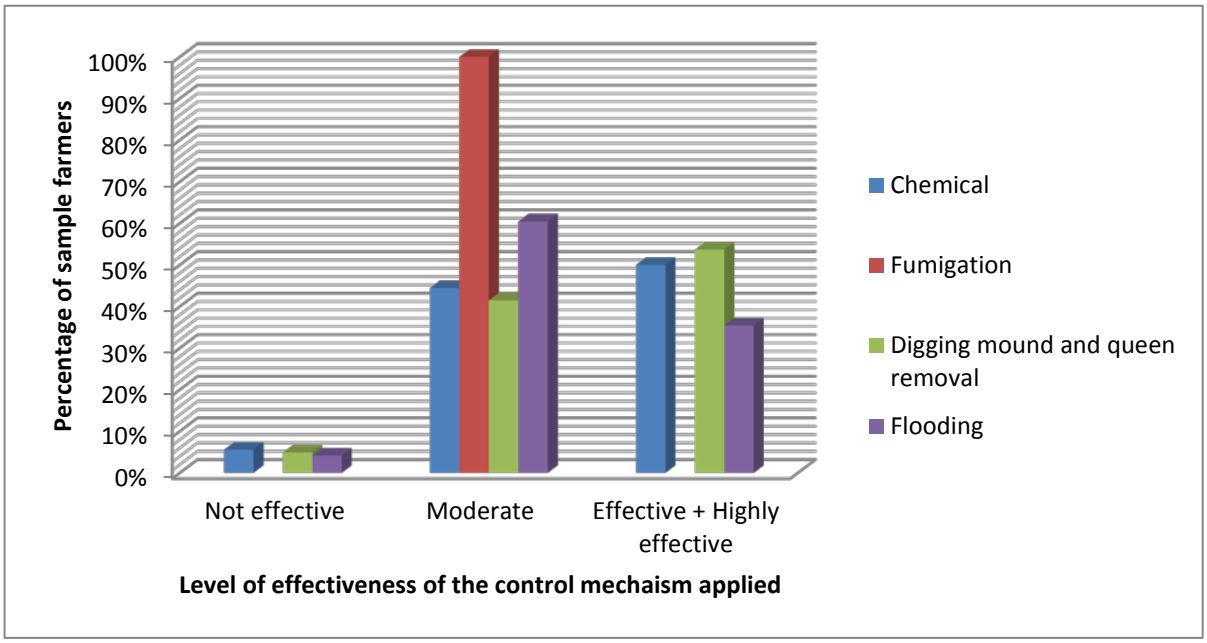


Figure 8. Farmers' assessment of control mechanisms employed

Similarly, 90% of farmers with termite infestation on their trees and fruits have employed control mechanisms. The mechanisms tried on trees and fruits include salt, animal dung and boiled water in addition to the mechanisms used for farms.

As far as grazing land controlling mechanisms are concerned, about half (47%) of the farmers that reported termite infestation on their individual grazing land, said they tried at least one control mechanism. The main control mechanisms used were chemicals, digging mound and removing the queen and flooding. The remaining farmers have not employed any controlling mechanisms whatsoever. The main reasons mentioned for not applying control mechanisms on grazing lands include lack of effective control mechanisms, shortage of labour for applying the mechanisms and inaccessibility of chemicals.

From the interviewed sample households, only one out of seven (15%) of the poor have applied chemicals. On the other hand, half (46%) and a third (33%) of the middle and better-off wealth groups used chemicals, respectively. However, it is important to note that even if there are farmers that use chemicals from markets, the government has also distributed chemicals freely. Hence, this is not only related to purchasing power but also the ability to seek government services. In terms of applying digging mound and flooding for termite control, there is no remarkable difference (Table 14).

Table 14. Application of control mechanism by wealth status

	Poor	Medium	Better off
Chemical	15%	46%	33%
Digging mound and flooding	75%	71%	75%

Farmers underlined that the control mechanisms work only for those termite species that are sedentary. There was no control measure practice for those termites which did not have mound or queen in one place except chemicals. The main coping strategies employed by farmers to reduce the damage caused by termites are use of tolerant crops such as sorghum and finger millet. In addition, farmers cultivate local maize variety instead of the improved ones due to its relatively better tolerance to lodging and termite attack. Farmers harvest trees attacked by termites for home consumption before they are totally damaged.

Consequences and impacts

Farmers reported that termites have affected their livelihoods directly by damaging the crops and their houses and indirectly by decreasing the soil fertility of farmlands. Termites cause poor soil fertility due to land degradation and decrease the size of cultivated land by making the land non-productive. These have decreased crop production and productivity thereby constraining the livelihood of the community. Farmers reported that due to these effects of termites, the land was becoming less productive over the years and cost of production was also increasing due to increased demand for inorganic fertilizers to improve the soil fertility caused by the termites. Decreases in crop production and productivity due to land degradation added up with the direct damages caused by termites on crops to decrease farm income and household food security. For instance, from the households interviewed, almost all (96%) believed that termites have decreased their farm income, two-third (66%) thought that their household food security was threatened because of termites and a quarter (28%) indicated that it made them vulnerable to poverty.

It is also reported by farmers that there is increasing outmigration due to poor soil fertility, shortage of land and poor agricultural productivity for which termites have contributed a lot. FGD participants said that in the last decade or so, there has been increasing termite infestation and decrease in crop productivity and livestock population; hence household food security has been increasingly under threat over those years.

From the total households interviewed, 75% reported that they faced food shortages, mostly in the rainy season in the months of June, July and August. Households in all wealth categories faced food shortages (respectively 85%, 79% and 50% for poor, medium and better-off households).

The frequently mentioned reasons for facing food shortage in ranking order were poor soil fertility (22%), termite damage (21%), land shortage (12%), oxen shortage (10%) and wild animal damage on crops (7%). Farmers have employed various coping strategies to cope the food shortage including reduced quantity of food per day and per meal, selling of animals and productive assets (Figure 9).

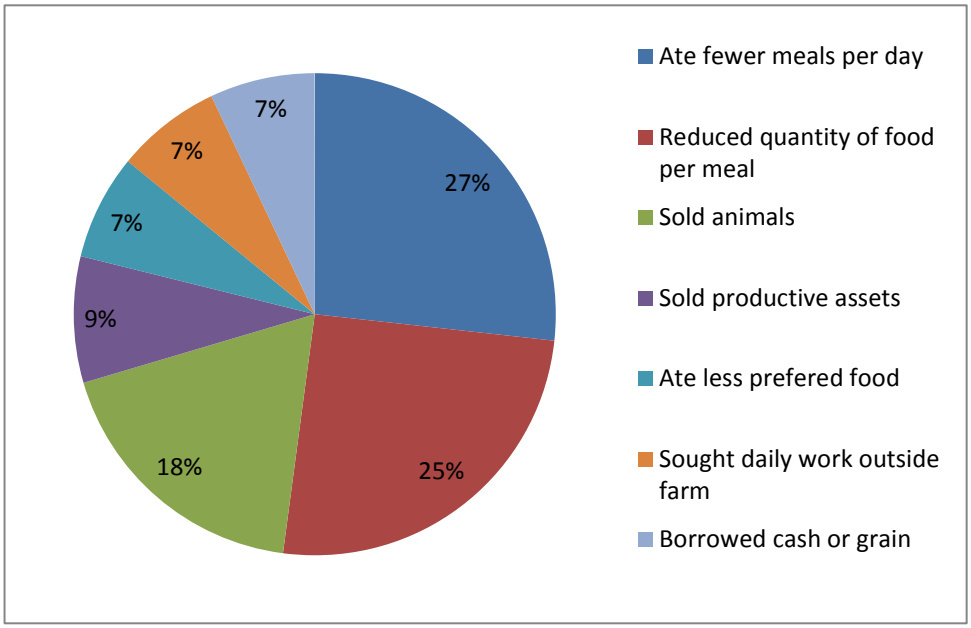


Figure 9. Coping strategies employed by households at time of food shortage (percentage of sample households)

3.6 Formal organizations, institutions and collective action

At *woreda* level, there are government organizations involved in land, soil and termite management activities directly or indirectly. These are *woreda* office of agriculture, office of land administration, office of cooperatives and livestock agency which are under *woreda* administration (Figure 10). The office of agriculture has natural resource and extension teams. The natural resources (NR) team is responsible for coordinating activities related to soils fertility improvement and soil and water conservation and directly works with the NR DA at *kebele* level. The extension team is also responsible for carrying out activities in the area of crop production and protection which includes termite management. At *kebele* level, this team works with the crop DA.

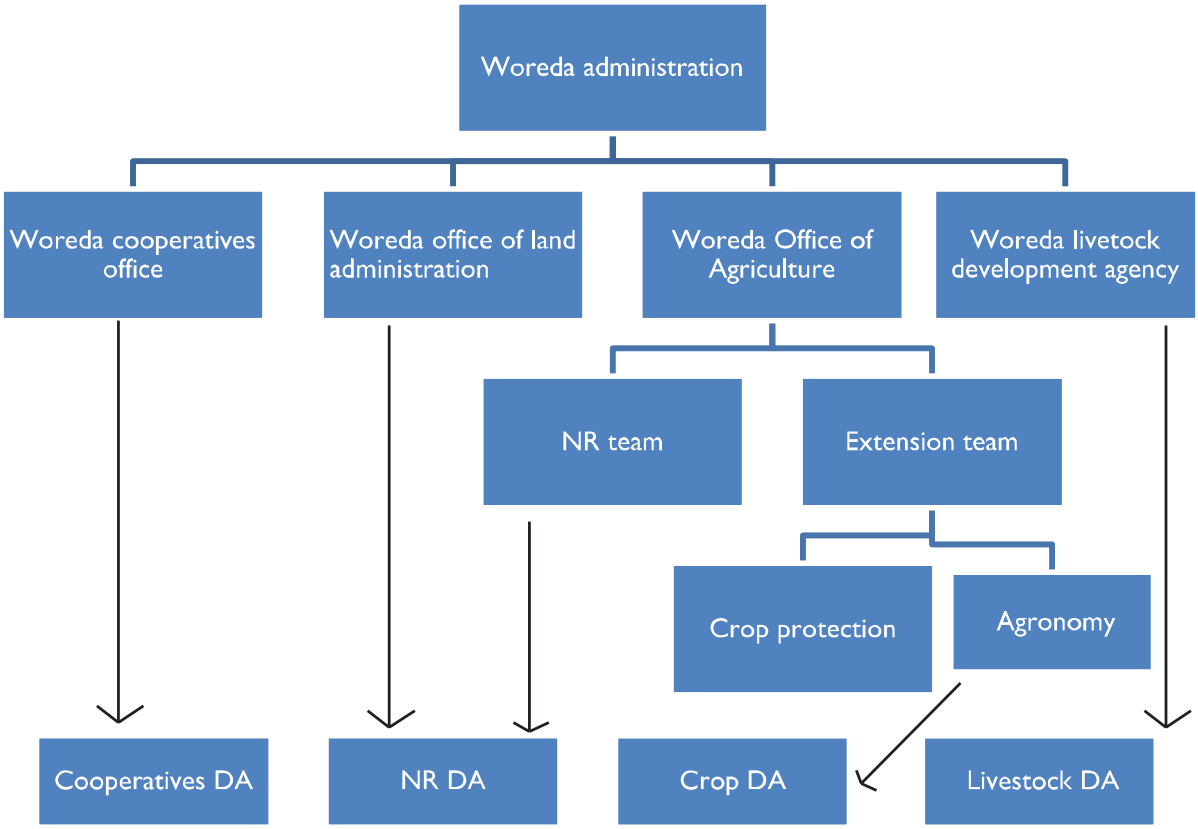


Figure 10. *Woreda* and *kebele* level government structures with a role in soil, land and termite management

The *woreda* office of land administration is responsible for land management in the *woreda* and work closely with the natural resource (NR) team in the agricultural office and the NR DA at *kebele* level. The *woreda* livestock development agency is responsible for coordinating livestock development activity and works directly with the livestock. The cooperatives office provides technical support in organizing farmers in cooperatives and get various credit and input provision services including that of soil fertility and weed and pest management inputs. At *kebele* level there are agents that support farmers to be organized into groups and cooperatives.

At community level, various formal and informal local institutions have a direct and indirect role in land, soil and termite management (Table 15). The *kebele* is the biggest formal government structure for managing development and administration activities at the local level. There are zones under the *kebele* followed by gares. The final formal structure is shene which comprises five households. Among others, these formal structures are being used to mobilize the community for development activities. There are also other formal institutions such as cooperatives, and farmer and women associations which are not part of government formal structure. Informal institutions include 'edir', 'equb', 'debo', 'wonfel' etc. These support various collective actions and resource sharing and provision arrangements such as finance, labour and information.

Table 15. Local institutions, their purpose and role in collective action and termite management

Institution	What is it and its purpose	Role in collective action	Role in termite management
Edir	Funeral institution where members contribute cash, labour and other kinds of resources for conducting funeral ceremony of members or relatives at time of death	General social support and information sharing	Can be used to disseminate information related to termite management
Equb	Financial institution where members collect a given amount of money weekly/ fortnightly/monthly and provide money for one of the members in turn until every member has received	Resources mobilization (mainly cash)	Cash could be used to buy chemical inputs
Shene	Formal group of farmers in the *kebele* structure where five farmers are members and one of them was coordinator; used for local development initiated by the government	Resources mobilization (mainly labour) and information sharing	Can be used to control termite on the farms of the members by mobilizing labour and other resources also for land preparation
Gare	Formal group of farmers in the *kebele* structure. 5–6 shenes form one gare and there is one coordinator under which 20–30 farmers are members; used for local development initiated by the government	Resources mobilization (mainly labour) and information sharing	Can be used to control termite on farms of the members by mobilizing labour and other resources
Saving and credit groups	Formal group established by credit providers as group collateral	Resources mobilization (mainly cash)	Cash could be used to buy chemicals
Cooperatives	Formal service cooperatives legally registered/established by farmers for providing services	Mainly input provision	Can provide chemicals for termite control
Debo	Labour mobilizing institution where a farmer prepares food and drinks and call for labour support from neighbours and relatives	Resources mobilization (mainly labour)	Can be used to apply queen removal and flooding also for land preparation
Wonfel	Labour mobilizing institution where a group of farmers work in each farms in turn	Resources mobilization (mainly labour)	Can be used to apply queen removal and flooding and also for land preparation

There is one NGO in the *woreda*, Mekaneyesus, working on termite and land management and livelihoods improvement. Ghibe Didesa union provides agriculture inputs to cooperatives. There is no strong private sector in the *woreda*. Wollega University and Bako Agricultural Research Center conduct research on agricultural problems in the *woreda*.

In the household survey, households were asked for their involvement and frequency of participation in these institutions. From the interviewed households respectively 80%, 61% and 52% reported that they have participated in edir, debo and farmer groups. Their frequency of involvement also varies by type of local institution (Figure11). In general, however, farmers perceive these institutions are important for collective action including soil and water conservation, soil fertility and termite management.

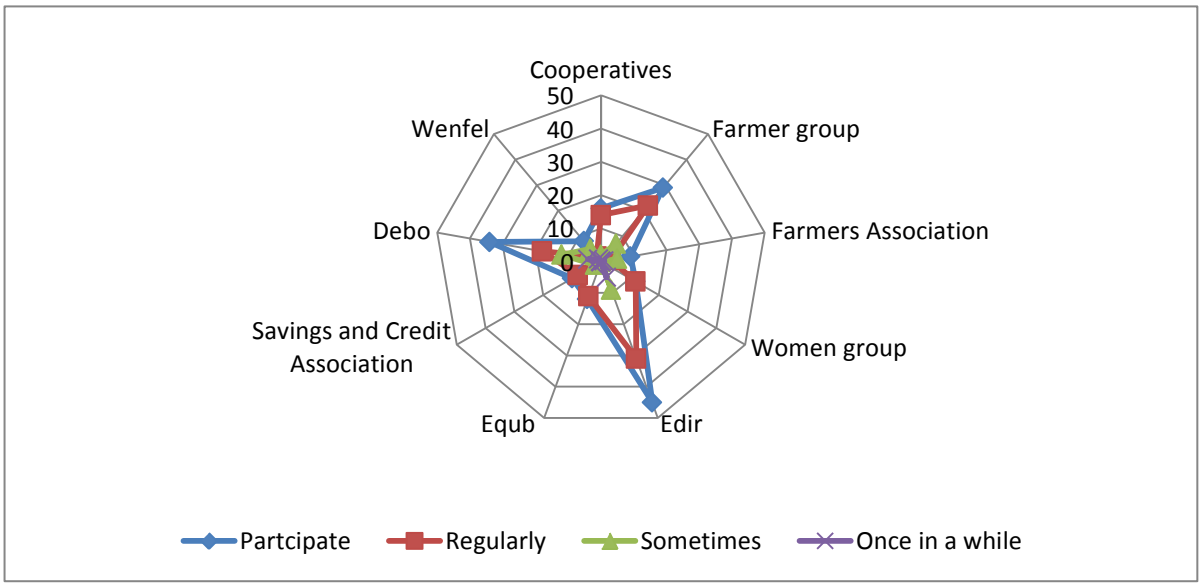


Figure 11. Frequency of participation in local institutions (percentage of sample households)

Some institutions have indirect roles in improving soil fertility through mobilizing cash resources for buying or coordinating provision of inputs such as inorganic fertilizers. Others have direct role in soil fertility through labour contribution to cultivation practices or constructing soil and water conservation activities. Some local institutions have a role to play in termite management by mobilizing labour for digging mounds while others could have role in mobilizing cash or provision of chemicals for termite control.

In terms of role in termite management, farmers reported that local institutions such as debo, wonfel, gare and shene can be used to mobilize labour and are helpful for applying labour based control mechanisms such as queen removal and flooding. Likewise, institutions that help to mobilize cash or facilitate credit services such as equb and saving credit organizations can help farmers to get money for buying chemicals. On the other hand, institutions such as cooperatives can facilitate provision of various inputs. Other local institutions such as edir can be helpful in disseminating information and technologies on various issues including land, soil and termite management. But, currently, the role of these institutions is limited despite their potential.

Involvement of households in local institutions has some variation by wealth groups (Figure 12). For instance, a higher number of better-off farmers were members of a cooperative, followed by medium wealth group farmers. This may be due to involvement in the work of cooperatives that requires money and capacity to buy and use inputs. On the other hand, a higher number of poor farmers has engaged in Debo which requires only contribution of labour. There is no significant difference in involvement in edir by wealth group as it is culturally important institution for all segments of the society.

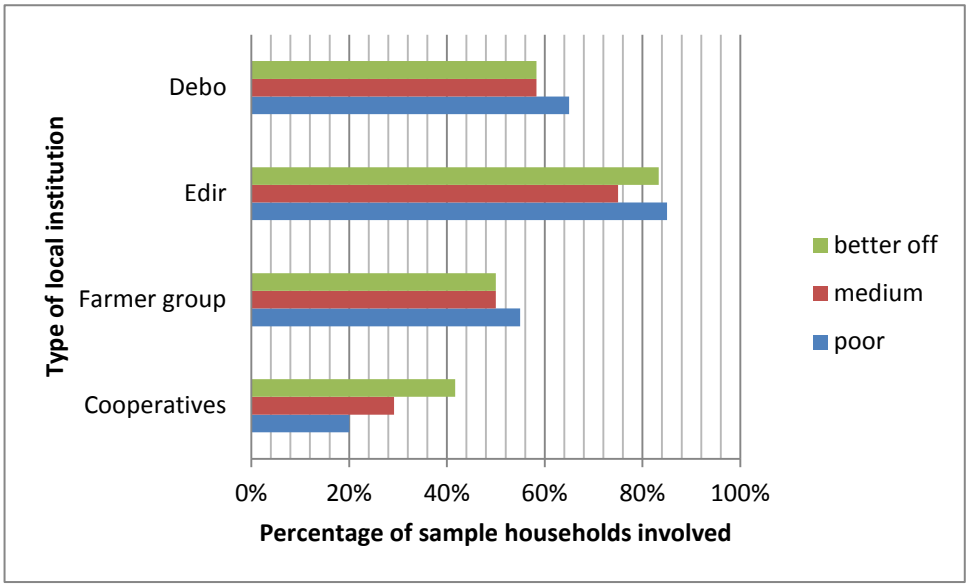


Figure 12. Farmers' involvement in local institutions by wealth status (percentage of farmers)

3.7 Gender issues in land and termite management

It was reported that women have a substantial role in soil fertility and land management activities, despite their limited decision-making power in application of soil, land, and termite management techniques.

Women have a major role to play in managing manure and crop residues. They are mostly responsible for collecting and storing animal dung for the purpose of firewood and soil fertility. Besides, as the manure is mostly used around homestead, women are responsible for applying it on the backyard. Women also collect the crop residues from the field for animal feed and firewood. It is a common practice for farmers to leave the crop residue on the farm and allow the cattle to feed. Some farmers collect and conserve it for seasons when there is feed shortage. In terms of decision-making, women can decide by themselves on use of crop residues whether it should be used for animal feed or fuel. However, in terms of manure, the decision is made jointly by the husband and wife. In the use of organic fertilizer, both males and females have roles. But the decision on how much and when to use is decided by the man.

In terms of termite management, women have a limited role in selecting and applying control mechanisms in farm and grazing lands. Similarly, the decision on what type of mechanisms to be used is made solely by men. However, at homesteads especially when termite is attacking the house women apply various control mechanisms such as boiled water, gasoline, salt, fumigations and various spices. It is reported that in these cases, women do not need to consult their husbands. In soil and land management, women have roles in applying various mechanisms. It is reported that they contribute labour or prepare food and drinks for mobilizing labour. The men play pivotal role both in terms of deciding and applying the type of land and soil management practices (Table 16).

Table 16. Gender roles and decision-making in soil, land and termite management

Issues	Who have roles		Who decides	
	Male	Female	Male	Female
A. Soil fertility				
Use of crop residues	✓	✓		✓
Manure use	✓	✓	✓	✓
Inorganic fertilizer	✓	✓	✓	
B. Termite management				
Queen removal	✓		✓	
Flooding	✓		✓	
Smoking	✓		✓	
Chemical	✓		✓	
Botanicals	–	–	–	
C. Soil and land management				
Soil bunds	✓	✓	✓	
Terraces	✓	✓	✓	
Tree planting	✓	✓	✓	
Grass strip	✓	✓	✓	
Check dams	✓	✓	✓	
D. Others				
Using manure for fire wood	–	–		–
Using crop residue for fire wood	✓	✓		✓

In summary, women have access to the use of crop residues and manure for animal feed and fuel. However, they need to discuss this with their husbands especially in terms of the manure which has major role in soil fertility management. Similarly, women play a role in the application of inorganic fertilizer, but the decision for using it belongs to men. In terms of termite management, women's access and control seems to be limited for farmland and grazing land, but they have better access and control over termite management around the homestead (mainly related to women who stay around homestead and manage household chores). Women also have a role to play in soil and land management practices even if they do not have decision-making-power on the type of practices for the household to adopt.

4 Conclusions and recommendations

4.1 Conclusions

The study areas are predominantly mixed crop–livestock farming systems where crop production is the main source of livelihood followed by livestock production. Cereals, especially maize and sorghum, are largely cultivated. There are limited leguminous crops mainly common beans followed by groundnut and sesame in the lowland areas. Perennial crops such as coffee, sugarcane, and fruit trees such as mango, avocado, and banana are also cultivated. In general, use of improved agricultural technologies and practices is limited, but has shown an increasing trend in recent years. Agricultural input use is highly affected by wealth status of farmers due to the skyrocketing prices. In terms of application of agricultural inputs such as improved seed and inorganic fertilizer, farmers give priority to maize. Likewise, use of organic fertilizer is widely practised though it is mainly applied for maize crop around the homestead. Farmers in the study areas practice various cropping systems such as row planting, mixed cropping and crop rotation. Major constraints of crop production identified by farmers include termite infestation, poor soil fertility, weed, vertebrate pests, and lack of irrigated land.

Livestock production is the second most important source of livelihood in the study area. Farmers mostly reared cattle, goat, sheep, donkey and poultry. Crop residues and grazing land are the main source of animal feed. But farmers reported that there is feed shortage in dry seasons due to termites and shortage of grazing land. Over the years, there has been decrease in the size of the grazing land and livestock population. In general, farmers use cattle manure for improving soil fertility. However, due to decrease in the number of livestock population, the amount of manure incorporated into the soil is decreasing thereby affecting the soil fertility in the area.

There is high soil and land degradation in the study area due to undulated topography and lack of appropriate soil and water conservation practices. Furthermore, termite infestation, deforestation, and limited use of organic manure and blanket application of inorganic fertilizers and other chemicals have exacerbated the land and soil degradation problems. Farmers in the study area have tried to apply a number of soil fertility management practices. Organic and inorganic fertilizer application, crop rotation, intercropping and fallowing were practised by farmers to improve soil fertility on individual farmlands. Farmers reported that corralling, compost, and manure were the most effective soil fertility management practices not only for improving soil fertility but also for reducing termite infestation.

Crop residues are used for various purposes such as feed, soil fertility, cooking, lighting and house construction. In the study area, farmers are using crop residues of maize, sorghum and sesame in the lowland areas and teff, finger millet, and beans in the mid highlands. There are general preferences in the use of crop residues. For instance, maize and sorghum are preferred for firewood for cooking, beans and sesame for soil fertility and millets and teff residues for livestock feed. However, in practice there are no such demarcations and farmers are using the crop residues in multiple ways.

Agricultural water management activities are mostly restricted to using rivers for irrigation through traditional ways. There are few farmers using underground and above ground water for agricultural development by other mechanisms except river water. Similarly, there have been limited efforts to conserve water for agricultural purposes despite current initiation to start soil and water conservation activities.

Termites are a major problem affecting crop lands, rangelands and homestead. The problem of termite was there for long time; but it has been especially severe in the area for the last 15–20 years. According to farmers' perceptions, the reason termite becomes a serious problem is mainly soil degradation, overgrazing and deforestation. Based on farmers' classification of using body size, head colour, feeding habit and mound formation, there are two types of termite's species in the study area. Termites damage almost all crops and trees. However, there is difference in terms of tolerance to termite attack. For instance, maize, teff, coffee, sugarcane and eucalyptus are reported to be most susceptible. On the other hand, sorghum, finger millet, sesame, and common bean, are relatively more tolerant. It is reported that tuber and vegetables have higher tolerance to termite attack and improved crop varieties are more susceptible than the local ones.

The most frequently used termite control mechanisms in the study areas are cultural practices such as queen removal, smoking and flooding. Mostly, these cultural practices were reported to be more effective when done in combination specifically for sedentary termites. In addition to these control measures, chemicals were used by the agricultural office of the *woreda* in areas where the severity was very high. But farmers reported that they have limited access and capacity to use chemicals.

Termites have affected farmers' livelihoods directly through damaging the crops and their houses and indirectly by decreasing the soil fertility of farmlands. In terms of the latter, termites have led to poor soil fertility due to land degradation and decreased the size of cultivable land by making the land non-productive. These have decreased crop production and productivity thereby affecting the livelihood of the community. Farmers reported that due to these effects of termites, the land was becoming less productive over the years and cost of production was also increasing due to more demand for inorganic fertilizers to improve the poor soil fertility. The decrease in crop production and productivity due to land degradation added up with the direct damages caused by termites on crops has affected farm income and household food security.

Both formal and informal institutions play a role in soil, land and termite management. The formal structure of *woreda* government has various departments dealing with soil and water conservation, land administration and pest management. There are also development agents at *kebele* level who are part of this formal structure and organize the implementation of these activities. At community level, there are formal institutions such as cooperatives and local institutions such as edir, equb, debo, wonfel etc. These institutions support various collective actions and resource sharing and provision arrangements such as finance, labour and information etc.

Although termite management is mainly seen as a male activity, in general women have a substantial role in termite related activities, such as soil fertility and land management activities. Especially, in terms of the use of manure and crop residues, it is often women who play a key role in decision making. Moreover, many of these practices are applied directly near the homestead, which is often the domain of the woman; hence it is important to keep these gender aspects into account when designing interventions.

4.2 Recommendations

1. Termites are symptoms of land degradation and poor soil fertility caused by a variety of factors (overgrazing, deforestation, soil erosion). To address this, we need to address the underlying factors.

2. The issue of cause and effect is not clear to people and extension agents; this requires capacity building in terms of the underlying factors and how they are related.

3. Single bullet solutions are not effective (for reasons mentioned above); we need an integrated approach that takes into account the system aspects of the problem. In general, this may mean a combination of cultural methods, soil and water conservation, soil fertility measures, protection etc.

4. People need incentives to work on land degradation/termite infestation; we need to make clear what the costs are and what they can gain by working on these issues (and we need to measure this).Increased income resulting from higher production for feed or markets/food can work as a 'pull' factor that makes other things happen.

5. In case of communal grazing area, the added value of 'feed' to cattle through better management of grazing areas may be an incentive, which lead to more cattle, manure, which in turn can be applied to crop field etc.; for crop farming, improved production can lead to higher income/food (e.g. maize), more residues etc.

6. Adding organic/synthetic manure improved soil fertility and may reduce termite infestation; but in general the role of inputs needs further exploration; for instance, to what extent does it lead to improved production, how accessible are they and what are the trade-offs?

7. The role of men/women farmers and other actors needs further exploration; what are the needs? How can actors jointly engage in an activity which makes sense to them and which has added value in terms of income/food? This issue requires joint action around identified promising activities and addressing bottlenecks.

8. Finally, as many of the mentioned issues have implications for others in the community, results and findings need to be shared and discussed in terms of their effectiveness and implications for the community and system as a whole.

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Annex I. Household questionnaire

MODULE 0. HOUSEHOLD IDENTIFICATION AND INTERVIEW SUMMARY

Diga *woreda*—RIU Project Baseline Survey

Household Questionnaire

Kebele (name): _____ CODE: |____|____|

Village (gare) (name) _____

Household Number |____|____||____|____|

D D M M Y YYY

Date of interview |____|____||____|____||____|____|____|____|

Sex of respondent: Female [ ] Male [ ]

Enumerator (Name) _____

…….. To be completed after interview has been done ……

Name of supervisor_____

Checked:_____ D D M M Y YYY

|____|____||____|____||____|____|____|____|

Date of data entry _____

➡ **IMPORTANT NOTE TO ENUMERATOR:** Please get consent BEFORE you start filling in the questionnaire

Hello, my name is _____I am working with _____ (ILRI/IWMI/WU/WA). Your household has been randomly chosen to participate in this study. We are trying to learn more about the size of households and communities that are affected by termite problem and what control and coping mechanisms they have employed. This information is highly important for conducting research to solve the problem of termites in the *kebele*/village. The study is a confidential exercise and your name will not be disclosed anywhere. Please feel free to answer these questions as they will help in understanding and addressing the termite problem in the community. Would you be willing to have a discussion with me for about an hour?

If **NO**, circle here ☐ and end interview.

If **YES**, circle here ☐ to acknowledge that consent from the respondent is granted.

Module 1. Household demography

Member ID	Name of HH member (write names)	Age	Sex M = 1 F = 2	Relation to HH [see code]	Current Residence **see code]**	Marital status Ask for those >10 years [see code]	Labour capacity **see code]**	Literate Ask for those >6yrs 0 = No; 1 = Yes	If age >6 years is the person attending school? 0 = No 1 = Yes	Education level (highest achieved) [see code]	Occupation for persons age > 6 **see code]**	
											Primary	Secondary
101	102	103	104	105	106	107	108	109	110	111	112	113
01												
02												
03												
04												
05												
06												
07												
08												
09												
10												

Relationship to respondent HH (105)			Residence (106)	Marital status (107)	Education (111)	Occupation (112/113)	Codes: Labour capacity (118)
01= HH Head **02** = 1st spouse **03** = 2nd spouse **04** = 3rd spouse	**06**. Son or daughter **07**. Son/daughter in law **08.** Grandson/daughter **09**. Mother or father	**12**. Other relatives **13**. Adopted child, custody **14.** Step daughter/son **15**. Niece/Nephew	1. Here and present 2. Here but temporarily absent 3. Lives elsewhere 96. Others	1. Married 2. Single 3. Divorced, separated 4. Widowed 96. Others	1 = 1–4 grade 2 = 5–8 grade 3 = 9–10 grade 4 =Above 10th grade 5 = Adult education	1. Cultivates own land or family land 2. Herding 3. Other paid work 4. Other non-paid work 5. Unpaid domestic help 6. Student 7. No occupation	1 = Young child (too young to work) 2 = Working child (herding livestock; domestic chores; childcare; may be hired or fostered out) 3 = Adult (able to do full adult workload) 4 = Working elderly (not able to do full adult workload) 5 = Partially disabled (able to do light work only) 6 = Permanently unable to work (physically or

05 = Inherited wife	**10**. Father/mother in law **11**. Brother or sister	**16**. No relationship **98** = do not know	(specify)	(specify)	6 = Religious education 96 = Others (specify)	8. Ill/disabled 98. Do not know	mentally disabled, or non-working elderly) 7 = Chronically ill (unable to work for the past 3 months or more)

Module 2. Household socio-economy

Line No.	Asset	Currently owned	Line No.	Asset	Currently owned	Line No.	Trees and fruits	Currently owned	Severity of termite attack (use code*)
211	212	213	211	212	213	211	212	213	214
	Livestock		20	Water pump (hand/foot)		29	Haginea abisinica (Koso)		
1	Oxen		21	Water pump (diesel		30	Ekebergia capesil (Sombo)		
2	Bulls			Household goods		31	*Ficas* species (Oda)		
3	Cows		22	Charcoal/wood stove		32	Cordia africana (Waddessa)		
4	Heifers		23	Kerosene stove		33	Syzygium guineense (Baddessa)		
5	Calves		24	Wheelbarrow		34	Vernoniaama gdailina (Ebicha)		
6	Sheep		25	Animal cart		35	Albilia gumifera (Muka Arba)		
7	Goats		26	Consumer durables		36	Ficus vasta (Kiltu)		
8	Donkeys		27	Mobile telephone		37	Eucalyptus		
9	Mules		28	Radio		38	Bisana/bakanisa		
10	Poultry			Bicycle		39	Acacia abisinica/girar/lafto		
	Productive assets					40	Mango		
11	Plough					41	Banana		
12	Sickle (machid)					42	Orange		
13	Pick axe (doma)					43	Avocado		
14	Gejera/gejemo					44	Coffee		

Line No.	Asset	Currently owned	Line No.	Asset	Currently owned	Line No.	Trees and fruits	Currently owned	Severity of termite attack (use code*)
15	Axe (metrebia)					45	Sugarcane		
16	Hoe (mekotkocha)								
17	Spade (akafa)								
18	Traditional beehive								
19	Modern beehive								

*Code: 4 = very severe (termite damage is visible and is very high); 3 = severe (termite damage is visible) 2 = seasonal severe (damage happen in some season) 1 = not severe (termite are observed but there is no serious damage) 0 = no termite activity (no visible termite activity)

215	How many ha of land do the household have to cultivate?	____Ha	
216	Since when have the household occupied your farmland?		
217	Rented in_____(ha) Rented out_____(ha) Shared in_____(ha) Shared out_____(ha)		
218	How many ha of land did you cultivate (use) this season?	____Ha	
219	Is your land affected by termite damage?	0 = No 1 = Yes	
220	If yes, which land?	1. Grazing land 2. Farmland 3. Homestead 4. Bone/Wet land 5. Irrigated land	
221	Lighting method in home?	1. Dung 2. Firewood 3. Candle 4. Lantern (kuraz) 5. Fanos 6. Masho 7. Electricity 8. crop residue 96. Others specify _____	
222	Household cooking method?	1. Dung 2. Firewood 3. Charcoal 4. Kerosene gas 5. Crop residue 96. Others specify _____	
223	Main materials for walls of the home?	1. Mud/Clay 2. Cane/Stalks 3. Stalks with Mud/dung 4. Wood 5. crop residue 6. Bamboo with mud 96. Other_____ (Specify)	
224	Main materials for roof?	1. Iron sheet 2. Thatch/straw 3. Stalks with mud/dung 4. Wood 5. Bamboo with grass 96. Other_____ (Specify)	
225	Number of rooms in the main house?	Number of rooms _____	

226	Do animals stay in the same room with family members?	No Yes	
227	Are there termites at your homestead?	No Yes	
228	If yes, where and how do you rate the severity (use code* for rating?)	Main house wall---------- Main house roof---------- Main house ground---------- Kitchen---------- Cattle house wall---------- Cattle house ground---------- Polls---------- Garden----------	

*Code: 4 = very severe (termite damage is visible and is very high); 3 = severe (termite damage is visible) 2 = seasonal severe (damage happen in some season) 1 = not severe (termite are observed but there is no serious damage) 0 = no termite activity (no visible termite activity).

Module 3. Crop and livestock

Module 3.1 Agricultural technologies known and used in last three years

Line #	Type of technique known by respondent (or other HH member) (see code)	Where did you get the information? (see code)	Are you still practicing the technique? 0 = No 1 = Yes	If not practicing the technique, why? (multiple responses are possible) (see code]	If not practicing the technique, why? (305) 01. Access to credit is a problem 02. Access to oxen is a problem 03. Access to labour is a problem 04. Access to land is a problem 05. Lack of time 06. Not interested 07. There are better alternatives 08. Against our tradition 09. Not locally appropriate 10. Too complicated 11. Lack of technical support 12. Do not know enough about it 13. Too risky 14. Lack of cattle 15. Expensive 16. Shortage of land 96. Other _____ (Specify)
301	302	303	304	305	
1					
2					
3					
4					
5					
6					
7					
8					
6					
10					

Code technique (302) A) Agriculture 01. Row planting 02. Inter/mixed cropping 03. Crop rotation/pruning 04. Seed preparation/ selection 05. Fertilizer applications 06. Green manuring 07. Fallowing 08. Vegetable production	B) Livestock 09. Improved sheep/goat breeds 10. Improved poultry breeds 11. Improved beehives/beekeeping 12. Forage production 96. Others (specify)		Source of information (303) 00. From nobody 01. Government 02. NGO 03. Radio 04. Individual 05. DAs 06. Teachers 07. Health workers 09. research 96. Others _____ (Specify)

Module 3.2 Crop production and termite damage

This part of the questionnaire is filled by interviewing the HH head in relation to the production period of the year 2011/12 (2003/4 E.C).

Note: Please convert the local weight units to the kg

Line #	Crop name	Area planted in ha.	Did you use improved seed? 0 = no 1 = yes	Weed control methods used (see code)	Cultivation method used (see code)	Source of improved seed (see code)		Watering method 0. Rainfed 1. Irrigation 2. Both	Did you use chemical fertilizer 0 = no 1 = yes	If you used chemical fertilizer (in kg)	Did you used natural fertilizers 0 = No 1 = Yes		What is the type of natural fertilizers used? (see code)	Product in kg	Cropping stage the crop is affected by termite (see code)	Extent of the termite damage (see code)	Expected product if without termite damage (kg)	Estimated loss due to termites (kg)
306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324
						A	B			DAP	Urea							
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

11																		
12																		
13																		
14																		

Source of improved seeds (312/313) 1 = Extension/ office of Agriculture 2 = From cooperative office 3 = From local market 4 = From own product reserved for seed 5 = Received from other farmer 6 = NGO 7 = From neighbouring regions 96 = Others (specify)	Natural fertilizers used (319) 1 = Compost 2 = Dung 3 = Crop residues 4 = Green manure 96. Others (specify)	Extent of termite attack (322) 4 = Very severe (termite damage is visible and is very high); 3 = Severe (termite damage is visible) 2 = Seasonal severe (damage happen in some season) 1 = Not severe (termite are observed but there is no serious damage) 0 = No termite activity (no visible termite activity	Cropping stage when the crop is attacked by termite (321) 1 = Germination 2 = Vegetative 3 = Maturity 4 = Harvesting 5 = At all stages 96 = Others (specify)	Cultivation method used (311) 1 = Zero tillage 2 = Hand dug 3 = Oxen ploughing 4 = Tractor 5 = Repeated ploughing by oxen 96 = Others (specify)	Weed control methods used (310) 1 = No weeding 2 = Hand weeding 3 = Herbicide 4 = Cultivation 96 = Others (specify)

325	How do you estimate the loss due to termite damage on your trees and fruits last year? (in one year)	In birr_____	Ask this question only if the interview reported on Module 1 that the trees are attacked by termite
326	What coping strategies have you used to withstand the damage? (Write the strategies used by farmers)		
327	Have you tried any control mechanisms?	0 = No 1 = Yes	
328	If yes, what are they? And how you rate their effectiveness?	Type of control mechanisms 1 = Chemical---------- 2 = Botanical ---------- 3 = Chilli---------- 4 = Animal dung---------- 5 = Salt ---------- 6 = Boiled water ---------- 7 = Fumigation ---------- 8 = Digging the mound------ 9 = Flooding---------- Combination (write no)---------- 96 = Others (specify)	Code for effectiveness 1 = Highly effective 2 = Effective 3 = Moderate 4 = Not effective For effectiveness Put the code in front of the control measure. If combinations used put the numbers on no. 9.
329	If not, why not?	1. Termites on grazing land cannot be controlled 2.available controlling mechanisms are not effective 3. Lack of labour to apply control mechanisms 4. Lack of money to buy chemicals 5. Lack of knowledge and skill to apply the control mechanisms 6. Chemical not available 96. Others (specify)_____	
330	Does the household have irrigated land?	0 = No 1 = Yes	
331	If the response is yes, how many hectares of land have been irrigated?	----------hectares	
332	If yes, did the household use irrigated land in the last 12 months?	0 = No 1 = Yes	
333	Is the irrigation land affected by termite?	0 = No 1 = Yes	
334	Do you have bone land (wet land)?	0 = No 1 = Yes	
335	If yes, how many ha?	----------hectares	
336	Is your bone/wet land affected by termite?	0 = No 1 = Yes	

Module 3.3 Livestock feed and water

337	Do you get enough feed for your animals from your farm?	0 = No 1 = Yes
338	If not why not?	Termite infestation No feed technology Do not have the skill to produce feed Shortage of grazing land Drought 96) Others (specify)
339	What are the main sources of feeding for your animals?	1. Individual enclosure_____(ha) 2. Open grazing_____(ha) 3. Cut and carry_____(kg/day) 96) Other (specify)
340	If you use individual enclosure, for how many months it is sufficient for you?	_____(months)
341	Is your individual enclosure (grazing land) affected by termites?	0 = No 1 = Yes
342	If yes, what is its extent?	Code: 4 = very severe (termite damage is visible and is very high); 3 = severe (termite damage is visible); 2 = seasonal severe (damage happen in some season); 1 = not severe (termite are observed but there is no serious damage); 0 = no termite activity (no visible termite activity
343	If termite severely affected your feed sources, how do you cope with it?	
344	Have you tried any control method on your grazing land?	0 = No 1 = Yes
345	If, yes, what are the mechanism used and how do you rate their effectiveness? Type of control mechanisms tried 1 = Chemical---------- 2 = Botanical ---------- 3 = Chilli---------- 4 = Animal dung---------- 5 = Salt ---------- 6 = Boiled water ---------- 7 = Fumigation ---------- 8 = Digging the mound------ 9 = Combination (write no)---------- 96 = Others (specify)	Code for effectiveness 1 = Highly effective 2 = Effective 3 = Moderate 4 = Not effective For effectiveness Put the code in front of the control measure. If combinations used put the numbers on no. 9.
346	Do you conserve feed for seasons where there are feed shortages?	0 = No 1 = Yes
347	If yes, what methods have you employed?	1 = Hay making 2 = Rotational grazing 96 = Others (specify)

348	How do you assess the effectiveness of these methods in terms of protecting termite attacks? 1 = Hay making---------- 2 = Rotational grazing ---------- 96 = Others (specify----------	Code for effectiveness 1 = Highly effective 2 = Effective 3 = Moderate 4 = Not effective
349	If not applied any control method why not? 1. Termites on grazing land cannot be controlled 2. The available controlling mechanisms are not effective 3.Llack of labour to apply control mechanisms 4. Lack of money to buy chemicals 5. Lack of knowledge and skill to apply the control mechanisms 6. Chemical not available 96. Others (specify)_____	

Module 4. Soil and land management

401	How do you assess the fertility of your land?	1) Very infertile (abandoned land 2) infertile (non-productive without fertilizer) 3) medium (productive but with low yield) 4) fertile (minimum fertilizer) 5) very fertile (productive without fertilizer)	
402	If infertile what do you think are the reasons?	1) Soil erosion 2) termite 3) drought 4) over grazing 5) mono cropping 96) other (specify)	
403	Have you tried mechanisms to improve soil fertility?	0 = No 1 = Yes	
404	If yes, what are they? And how do you rate their effectiveness?	1 = fallowing---------- 2 = termite control mechanisms---------- 3 = enclosure ---------- 4 = using crop residue ---------- 5 = Use of inorganic fertilizer---------- 6 = use of manure 7 = combination ---------- 8 = crop rotation ---------- 9 = mixed cropping---------- 96 = other (specify)	Code for effectiveness 1 = highly effective 2 = effective 3 = moderate 4 = not effective
405	What coping strategies have you used to withstand the damage?	1 = off farm work 2 = abandoning the land 3 = family members out migration for seasonal labour 4 = renting/sharing in fertile land 96 = other (specify)	
406	For what purpose do you use animal manure? Estimate the use by per cent per year.	Animal manure management 0 = no animal manure 1 = feed ----------% 2 = soil fertility----------% 3 = cooking----------% 4 = lighting ----------% 96 = Others (specify) ----------%	
407. For what purpose have you used crop residue from last year (2003/2004 E.C cropping season)? Estimate the use by per cent by crop type/year. Use the following table.			

Line no.	Purpose	Maize	Sorghum	Finger millet	Sesame	Other (specify)
408	409	410	411	412	413	414
1	Feed					
2	soil fertility					
3	cooking					
4	lighting					
5	Others (specify)					

Soil and water conservation method employed

Line no.	Technology type	Know how to do 0 = No 1 = Yes	If yes, are you practicing/ applying? 0 = No 1 = Yes	If yes are you getting benefits? 0 = No 1 = Yes	If not applying why?(see code)
415	416	417	418	419	420
1	Stone terrace				
2	Soil bund				
3	Check dam				
4	Drainage ditch				
5	Trenches (stone faced)				
6	Trees planted				
7	Grass strip				
8	Live fence				
9	Others (specify)				

Reasons for not applying (420)	
01. Tiresome 02. Lack of manpower 03. Lack of land 04. Takes a lot of land space	05. Creates crop pests 06. Financial problem 07. Lack of technical knowhow 08. Land does not belong to me 09. The land do not require 10 = It will not work 96. Others (specify)

Module 5. Termites

501	Is there termite infestation/problem on your farmland or home stead?	0. No 1. Yes	
502	If no, what about at your *kebele*?	0. No 1. Yes	
503	When did the termite problem start?	1. 1–3years 2. 3–6years 3. 6–10 years 4. >10 years 98. I do not know	
504	What are the consequences of termites on the household?	1.Reduced income 2. Food insecurity 3. Migration 4. Unable to send children to school 5. Poverty 96. Other (specify)	
505	What do you think are the major causes for termite infestation? (multiple responses are possible)	1. Drought 2.Excess rainfall 3. Forest 4. Deforestation 5. Soil degradation 4. Over grazing 6. God 7. Population pressure 96. Other (specify) 98. I do not know	
506	Have you tried to control termite infestation on your farm?	0. No 1. Yes 3. Do not remember	
507	If not, why not? (multiple responses are possible)	1. Termites cannot be controlled 2.Available controlling mechanisms are not effective 3. Lack of labour to apply control mechanisms 4. Lack of money to buy chemicals 5. Lack of knowledge and skill to apply control mechanisms 6. Chemical not available 96. Others (specify)_____	
508	If yes, what controlling strategies have you used?	1. Boiled water 2.Queen removal 3. Chemical 4. Wood ash 5. Red pepper/Chilli 6. Cow dung 7. Mix of strategies (specify)_____ 8. Flooding 9. Local alcohol residue 96. Others (specify)_____	

509	From these strategies, which ones were successful (put the number)	1) Highly successful ---------- 2) Moderately successful ----------	
510	What factors do you think exacerbate termite damage on farmland s? (multiple responses are possible)	1. Drought 2. Excess rainfall 3. Forest 4. Deforestation 5. Soil degradation 6. Over grazing 7. Use of fertilizer 8. Non-use of fertilizer 96. Other (specify) 98. I do not know	
511	Can you identify the termite species?	0. No 1. Yes	
512	If yes, what are the characteristics to identify them? (multiple responses are possible)	Body size 2)type of mounds 3) feeding habits 4) effects on plants/crops 5) colour 6) head and mouth parts 7) Others (specify)	
513	Is there species difference in terms of the damage they cause?	0. No 1. Yes 98. I do not know	
514	Do termites have any benefit?	0. No 1. Yes 98. I do not know	
515	If yes, what are the benefits?	1 = mound for soil fertility 2 = medicine 3 = feed for domestic animals 96 = other (specify)	
516	Are you willing to pay for ITM services?	0. No 1. Yes	
517	If not why not?	1 = no capacity 2 = do not believe ITM solve termite problem 96 = specify	

Module 6. Access to information and participation in CBOs

Information type	Do you get this information? 0 = No 1 = Yes	If yes, source of information [see code]			How often do you get this information? [see code]	Do you use the information for improving your agricultural practices? 0 = No 1 = Yes	If not why not? [see code]
601	602	603	604	605	606	607	608
		A	B	C			
1. Termite management							
2. Soil fertility management							
3. Livestock production							
4. Crop production							
5. Agricultural product price							
6. Soil and water conservation							
7. Weather early warning							
8. Others (Specify)							

Source code (603-606)		Frequency of accessing information (606)	Why not (608)
1. *Woreda* agricultural offices	*5.* DA	1. Weekly or more frequent	1 The source is not reliable
2. NGOs	*6.* Teachers	2. Every two to three weeks	2 The info is not enough
3. Radio	*7.* Others (specify) _____	3. Every month	3 There is no provision of necessary inputs
4. Neighbours/ friends		4. Every two to three months	4 Lack of resources such as labour, capital etc.
		5. Every four or more months	

609. Do your HH members have participation in one of the following CBOs?
0 = No
1 = Yes

Line #	HH member ID		Organization name	How often the HH members participate in these CBOs? (see code)		What is your role in these CBOs? (see code)		Roles the CBO has in supporting land/termite management? (multiple responses are possible)	
610	611		612	613		614		615	
	Men	Women		Men	Women	Men	Women	See code	Comment
1			Cooperatives						
2			Farmer group						
3			Farmers Association						
4			Irrigation users association						
5			Women group						
6			Edir						
7			Equb						
8			Sembete (mahiber)						
9			Savings and Credit Association						
10			Debo						
11			Wonfel						

Participation (613)	Support to land/termite management?(615)
1. Regularly 2. Sometimes 3. Once in a while	0. No support 1. Credit provision for farming including termite management 2. Extension support on termite/land management 3. Extension support in crop/livestock production

Role in CBO (614) 1. Ordinary member 2. Member of committee 3. Leader of committee 4. D/K 96. Others (specify)_____	4. Provision of termite control chemicals 5. Information sharing on termite/land management 6. Labour support for S&W conservation activities 7. Labour support for termite control activities 8. Others (Specify)

Module 7. Food security

Food availability, access and coping strategies over the last 12 months

701	Which one was the primary source of food for your household member in the last 12 months?	1. Own production 2. Purchase 3. Relief food aid 4. Fish	5. Gift from relatives or friends 6. Hunting and collecting wild roots 96. Others (specify) _____	
702	Which one was the secondary source of food for your household member in the last 12 months?	1. Own production 2. Purchase 3. Relief food aid 4. Fish	5. Gift from relatives or friends 6. Wild food 96. Others (specify) _____	
703	During which months of the last 12 months, (complete cycle of 2003/2004 E.C. growing season) did you have enough food?			
704	What were the reasons for household food shortage? Put the numbers in priority order below. 1st)_____ 2nd)_____ 3rd)_____ 4th) _____ 5th)_____ 6th)_____	1. Drought 2. Oxen shortage/absence 3. Crop damage due termites 4. Land shortage 5. Livestock water shortage 6. Excess rain 7. Poor soil fertility due to soil erosion 8. Lack of livestock production practice	9. Problem of livestock market 10. Weeds 11. Storage pests 12. Lack of livestock feed 13. Crop damage due to other pest and diseases 14. Crop damage due to wild animals (baboons, monkeys etc.) 96. Other specify _____	
705	Which of the following can you say was true for your household at any point in time during the last 12 months (these are things the HH wish it would not have had to do) to cope with food shortage	0) Nothing has been made 1) Ate fewer meals per day 2) Reduced quantity of food per meal 3) Ate food normally we do not eat (wild food such as leaves and roots) 4) Ate less preferred food 5) Sought daily work outside farm 6) Migrated to find work 7) Borrowed cash or grain 8) Sold productive assets 9) Consume seed stock	10) Sold cultural items 11) Sold animals 12) Sold household effects (utensils etc.) 13) Sold firewood 14) Made and sold charcoal 15) Rented out land 16) Withdrew children from school 96)Others (specify)	

Thank you for your time!

Annex II. FGD checklist

Identification

Date _____ Time: Start_____ End _____

Kebele _____ Village _____

Facilitator name _____ Note taker _____

Number of participants _____ (men) _____ (women)

Description of FGD participants' characteristics: Age, gender, marital status, educational level

General

- Number of villages in the *kebele*
- Total population (HHs, MHH and FHH)
- Major livelihood activities (agricultural, petty trade, labour work etc.)
- Average land holding
- Social services in the *kebele* (animal health, DA, human health services etc.)
- Major natural resources (river/other water sources, forest etc.)

Crop and livestock production

	What are the major crops and fruit trees grown in their order of importance?		
	Which crops are more susceptible/tolerant to termite attack and why?		
	What are the major constraints for crop production in the area (in ranking order)		
	Number (or ha) of grazing land availability in the village?		
	How much livestock feed on a specific grazing land? Name the grazing land and number of livestock		
	What are the major livestock species in the area?		
	How many livestock are there in the village by species?		
	What are the major livestock diseases in the villages?		
	What are the main sources of water for livestock? Name and distance from the village		
	What are the main feed sources for livestock in the area in order of importance?		
	What are the major constraints for livestock production in the area in order of importance?		
	What are the types of cropping systems practised in the *kebele*?		

Land/soil degradation and management

Describe nature of soil/land degradation in the *kebele*. What are the main causes?		
Classify state of degradation and what types of damage are linked to termites		
What is the impact of soil/land degradation in the community? (social, economic, environmental)		
What type of soil fertility management is practised in order of importance?		
Which ones are effective? Which are not and why?		
What is the effect of soil fertility management practices on termite damage? Are they reducing/increasing the problem? Is there difference by type of soil fertility management practice? If yes describe		
What type of soil and water conservation practices are implemented in the area in order of importance? Which ones are successful and which are not and why?		
What is the effect of SWC measures on termite damage? Are they reducing/increasing the problem? Is there difference by type of SWC measures? If yes describe		
What are the major causes of soil/land degradation in priority order?		
Describe crop residue and animal manure management practices in the community		
What are the major cultivation methods in the area and their effect on termite infestation?		

Local institutions and collective actions

What are the existing local CBOs, institutions and bylaws?		
What is their role in land and soil fertility management, termite control etc.?		
Type of collective action by the type of activity and season		
How is the degree of enforcement of bylaws in these CBOs and institutions?		
Is there any mechanism for financing termite control activities? For instance micro credit scheme etc.		

The termite problem

	Is termite a problem in the *kebele*?		
	If yes, in which specific villages is the problem severe? Mention the name of the villages and rank in terms of infestation (high, medium, low)		
	When has this problem started to be severe in the area? What do you think is its cause?		
	Are there different species of termites? If yes, how do you differentiate them? List their local names and describe their characteristics. Are they different in terms of damage? If yes, rank them in terms of their damage?		
	What strategies are used by the community to control the problem? (Local/indigenous solutions). Which are effective and which are not and why?		
	Do control strategies vary by termite species? If yes, which control strategies are effective for which species?		
	What strategies/interventions/controlling methods were tried by the government and NGOs? Which are effective and which are not and why?		
	What are the social, economic and environmental impacts of the termites?		
	What coping strategies have been used by the community?		

Gender roles

Issues		Who plays roles		Who decides?	
		Male	Female	Male	Female
Soil fertility					
Use of crop residues					
Manure use					
Inorganic fertilizer					
Termite management					
Queen removal					
Boil water					
Chilling					
Chemical					
Botanicals					
S&W conservation					
Soil bunds					
Terraces					
Tree planting					
Grass strip					
Check dams					
Others					
Using manure for fire wood					
Using crop residues for firewood					

Annex III. KII checklists

Checklist for KII at *woreda* Level

Identification

Date _____ Time: Start_____ End _____

Woreda _____ Office/department_____ _____ _____

Facilitator Name _____ Note taker _____

Name of KII _____

Description of respondent characteristics: Age, gender, educational level, field of study, work experience

General (could be from secondary sources)

- Size and population of the *woreda*
- Number of *kebeles*
- Agro ecology
- Food security status (safety net *kebeles*)
- ETCMajor crops grown
- Livestock population

Crop and livestock production

- Major crops grown and area under crops
- Major livestock species
- Livestock population in the *woreda*
- Major livestock diseases, feed and water availability
- Grazing land availability(private, communal)
- Livestock density (number of livestock/ha of grazing land)
- Management practices of pasture
- What are the major challenges in relation to crop and livestock development in the *woreda*?
- Major interventions over the last 10 years in the area of crop and livestock development (to solve the problems)
- Type of existing local institutions and bylaws and type of collective action by the type of activity
- Institutional structures related to crop and livestock development
- How do you see the problem of termite in the *woreda*? Which *kebeles* are affected? What solutions are tried and which ones are effective? Which are not and why?

Land/soil degradation and management

- What is the condition of soil/land degradation in the *woreda*? Which *kebeles* are severely affected? What are the main causes?
- Classification of degradation and what types of damage are linked to termites?
- What is the impact of soil/land degradation?
- Soil management practices (both indigenous and introduced by gov't or NGOs)
- Which ones are effective? Which are not and why?
- Type and amount/extent of physical and physical of soil and water control conducted in the *woreda*
- Relationship between SWC measures and termites
- What are the other causes of degradation? Rank them in their order of importance for the *woreda*
- Type of existing local institutions and bylaws and type of collective action for land/soil/NR management?
- Institutional structures related to land/soil/NR management?
- Polices and strategies related to land management?

The termite problem

- Is termite a problem in the in the *woreda*?
- If yes, in which specific *kebeles* is the problem severe?
- Are there different species of termites? If yes, how do you differentiate them? Are they different in terms of damage? If yes, rank them in terms of their damage?
- What are the social, economic and environmental impacts of the termites? (Outmigration, food insecurity etc.)
- When has this problem started in the area? What do you think is its cause?
- What strategies are used by the community to control the problem? (Local solutions) which are effective and which are not and why?
- Do control strategies vary by termite species? If yes, which control strategies are effective for which species?
- What strategies/interventions/controlling methods were tried by the government and NGOs? Which are effective and which are not and why?
- What copping strategies have been used by the community?
- Type of existing local institutions and bylaws and type of collective action for termite management?
- Institutional structures related to termite management
- Are there any mechanisms for financing termite control activities? For instance micro credit scheme etc.

Checklist for KII at *kebele* level

Identification

Date _____ Time: Start_____ End _____

Kebele _____ Village _____

Facilitator Name _____ Note taker _____

Name of KII _____

Description of respondent characteristics: Age, gender, marital status, educational level

General

- History of the *kebele*/village
- Major incidents (drought, flood, pestf.)
- Forest cover
- Livelihoods
- Seasons

Trends and history in land/soil degradation and management

- What is the trend of soil/land degradation in the *kebele*? What are the main causes?
- Classify status of degradation and what types of damage are linked to termites
- What is the impact of soil/land degradation?
- Soil management practices (both indigenous and introduced by government or NGOs)
- Which ones are effective? Which are not and why?
- Type and amount/extent of physical and physical of soil and water control conducted in the *kebele*;
- Relationship between SWC measures and termites
- What are the major causes of degradation? Which ones are severe in the area? Is there change overtime?

History and trends of local institutions and collective actions

- Are there changes in local institutions and organizations? If yes, what local institutions and bylaws existed before but not now?
- type of collective action by the type of activity and season
- Degree of enforcement of bylaws etc.
- Institutional structures related to land management, ITM etc.

History of termites

- When has the termite problem started to be severe?
- What are the major causes of the termite problem? Were there changes overtime?
- What control mechanisms were tried? Which ones were effective? Which were not? What are the reasons for non-effectiveness?
- Are there botanicals and predators which are effective for control?
- What are the major consequences of the termite problem to the community including outmigration? Is there change over time?

Table 1. Seasonal calendar

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Rainfall intensity												
Termite infestation												
Land degradation												
Feed availability												
Labour availability												
Organic manure availability												
Food availability												

0 = non 1 = very low 2 = low 3 = medium 4 = high 5 = very high

Table 2. Crop calendar

Major crop	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Maize												
Sorghum												
Haricot bean												
Finger millet												

Agricultural activity: ploughing, planting, weeding, harvesting, on farm storage, threshing

Table 3. Trend analysis for the last 10 years

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Human population										
Livestock population										
Crop diversity										
Crop productivity										
Soil fertility										
Outmigration										
Termite infestation										
Rainfall intensity										
Grazing land										
Farm land										
Household feed security										
Deforestation										
S&W conservation										
Use of inorganic fertilizer										
Land degradation										

0 = No change 1 = Increasing 2 = Decreasing

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Overseas Development Institute	http://odi.org.uk
Stockholm Environment Institute	http://sei-international.org
Wollega University	http://www.wuni.edu.et
World Agroforestry Centre	http://worldagroforestrycentre.org

ISBN: 92–9146–324–8