RURAL CREDIT AND SOIL AND WATER CONSERVATION:
A case study in Tigray, Northern Ethiopia

S. Boetekees

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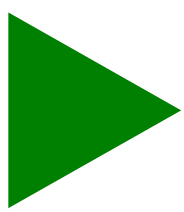

Policies for Sustainable Land Management in the Ethiopian Highlands

IFPRI-WUR project *Policies for Sustainable Land management in the Ethiopian Highlands*

Land degradation problems--including soil nutrient depletion, soil erosion, deforestation and other concerns--are severe in the Ethiopian highlands. These problems are contributing to low and declining agricultural productivity, poverty and food insecurity. The proximate causes of these problems are relatively well known. Underlying these proximate causes are many more fundamental causes. These more fundamental causes are affected by many aspects of government policy. Assessing the impact of different causal factors and identifying effective policy strategies to improve land management is a critical research challenge that has not yet been solved. In part, this is due to the complexity of factors influencing the problem. "One-size-fits-all" policy or program approaches are unlikely to be broadly successful. There is thus a general need and desire for more effective targeting of policy strategies towards specific regions and groups, although this depends on improved information about the potential impacts of alternative strategies.

The long-term goal, immediate purpose and specific objectives of the project are as follows:

Long-Term Goal:
To contribute to improved land management in the Ethiopian highlands, in order to increase agricultural productivity, reduce poverty and ensure sustainable use of natural resources.

Immediate Purpose:
To help policy makers in Ethiopia identify and assess strategies, including technology development policies, to achieve that goal.

Specific Objectives:

- To identify the key factors influencing land management in the Ethiopian highlands and their implications for agricultural productivity, sustainability and poverty;
- To identify and assess policy, institutional and technological strategies to promote more productive, sustainable, and poverty reducing land management;
- To strengthen the capacity of collaborators in the Ethiopian highlands to develop and implement such strategies, based upon policy research; and
- To increase awareness of the underlying causes of land degradation problems in the Ethiopian highlands and promising strategies for solving the problems.

The research takes place in Tigray, Northern Ethiopia. The project started in January 2001 and will continue until December 2003.

The WUR component of the project is funded by the Dutch Ministry of Foreign Affairs, Cultural Cooperation, Education and Research Department, Research and Communication Division (WW132171), Wageningen University (RESPONSE programme) and the Netherlands Ministry of Agriculture, Nature Management and Fisheries (North-South Programme). Their support is gratefully acknowledged.

More information can be found at the project web site:
www.sls.wau.nl/oe/pimea

The Participants

The WUR component of the project is co-ordinated by the **Development Economics Group** of **Wageningen University**. Next to overall project management, the DEG is responsible for bio-economic modelling and backstopping of research activities.

For more information and ordering of working papers contact:
Dr. G. Kruseman
Tel : +31 (0) 317 484668
Fax: +31 (0) 317 484037
Gideon.Kruseman@wur.nl

The **Trade and Development Group** of the **Agricultural Economics Research Institute** (LEI) is responsible analysis of current and alternative agricultural activities, using the NUTMON methodology.

For more information:
G. Meijerink
Tel : +31 (0)70 3358243
Fax: +31 (0)70 3615624
G.M.Meijerink@wur.nl

Plant Research International (PRI) is responsible for analysis of potential activities, using TCGs, and the analysis of the dynamics of natural resources.

For more information:
Dr. H.Hengsdijk
Tel : +31 (0) 317 475913
Fax: +31 (0) 317 418094
h.hengsdijk@wur.nl

ALTERRA is responsible for the spatial aspects of sustainable land management and the scaling-up of biophysical processes, using the LISEM model.

For more information:
Dr. M.E. Mosugu
Tel : +31 (0)317 474648
Fax: +31 (0)317 419000
m.e.mosugu@wur.nl

In Ethiopia the local partner is **Mekelle University**. MU is responsible for facilitation of PhD and other research conducted within the framework of the project.

For more information:
Dereje Aberra
Derejeaa@yahoo.com

The other project partner is the **International Food Policy Research Institute**. IFPRI is primarily responsible for the marketing analysis.

For more information:
Dr. J.Pender
j.pender@CGIAR.ORG

S. Boetekees

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List of *Policies for Sustainable Land Management in the Ethiopian Highlands* working papers:

2002-01	Kruseman, G., J.Pender, G.Tesfay and B.Gebremedhin *Village stratification for policy analysis: multiple development domains in the Ethiopian Highlands.*
2002-02	Kinfe Abraha Weldemichael *Public and private labour investments and institutions for soil and water conservation in Tigray, Northern Ethiopia.*
2002-03	Boetkees, S. *Rural credit and soil and water conservation: a case study in tigray, Northern Ethiopia.*
2002-04	Kruseman, G., R.Ruben, G. Tesfay *Diversity and Development Domains in the Ethiopian Highlands*

PIMEA WORKING PAPER 03

RURAL CREDIT AND SOIL AND WATER CONSERVATION: A case study in Tigray, Northern Ethiopia

S. Boetekees

Wageningen, June 2002

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Preface

This survey among farmers in the northern province of Ethiopia was carried out as part of a larger study entitled “Policies for Sustainable Land Management in the Highlands of Tigray, North Ethiopia”. This larger study is carried out by Wageningen University and Research Center (WURC), in collaboration with the International Livestock Research Institute (ILRI), the International Food Policy Research Institute (IFPRI) and Mekelle University College (MUC).

Abstract

The biggest concern of the Ethiopian agricultural sector is the widespread degradation of land contributing to declining agricultural productivity. Investments in soil and water conservation measures could contribute to improved land management. However, peasants' investments in land have been limited. Assessment of both the ability and the willingness of farmers to invest in soil and water conservation is therefore an important research issue since both aspects can represent serious constraints for improved, sustainable land management.

The willingness and ability of Tigray farmers to invest in soil and water conservation measures are constrained by many factors, among which their cash-flow is an important one. Farmers may need cash for their conservation activities, i.e. for purchasing fertiliser and other agricultural inputs, for constructing terraces etc. In Tigray, formal credit for long-term investments is not available to small farmers, as repayment requirements do not exceed periods of one year. Moreover, the use of credit for long-term investments is difficult for farmers, as they are faced with problems such as the requirement for collateral, poor infrastructure, asymmetric information, imperfect credit markets and high interest rates.

This thesis examines the relationship between access to credit and soil and water conservation measures undertaken by small farmers in selected areas in Tigray, Northern Ethiopia. An assessment is made on credit institutions available to rural households both from institutional and from household perspective. Issues like client selection, collateral requirements and loan duration are discussed. Activities concerning soil and water conservation present in Tigray in general and the research area in particular are discussed. Binary logistic regression is used to determine the factors influencing farmer's credit use and conservation decisions and probit analysis was used to determine the factors influencing their choice for available credit institutions. Analytical results indicate that: i) soil and water conservation structures like terraces, soil bunds etc. and chemical fertilisers are technically complementary in the sense that they raise yields substantially when used in combination, ii) households in the survey are not constrained in their access to credit institutions. They are rather demand-constraint due to risk aversion, iii) peasants' conservation decisions are hardly influenced by credit accessibility, as credit is not used for long-term SWC investments.

Keywords: land degradation, soil and water conservation (SWC), credit, chemical fertilisers, rural households

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A large part of the material used for this thesis has been collected during fieldwork in Atsbi/Wemberta woreda in the Eastern Zone of Tigray, Ethiopia. This internship was partly enabled by financial contribution of Wageningen University through the FOS (Financiele Ondersteuning Studenten) and WUF (Wageningen Universiteits Fonds).

Doing fieldwork under primitive circumstances has been a great challenge and a really educational experience. First of all, I would like to thank all the farmers living in Golgol Na'ele and Mikael Emba, for their time and their patience, and most of all for their tremendous hospitality during my stay in the field. I also want to express my gratitude to those people who helped me make my work easier: my translators Alem Tsehay Tsegay and Dawit Kahsay; my supervisors on Mekelle University campus, Girmay Tesfay and Dereje Assefa; the development agent of tabia Golgol Na'ele, Haftom and Alemayo Atsbaha, leader of tabia Mikael Emba.

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Raf Aerts and Eva November: thank you for your warm friendship. I always felt very much welcome in your home in Mekelle, and I hope to see you soon, wherever!

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Abbreviations and acronyms

BoANR	-	Bureau of Agriculture and Natural Resources
DECSI	-	Dedebit Credit and Savings Institution
EC	-	Ethiopian Calendar
ETB	-	Ethiopian Birr (1 ETB = 0.12 US$)
FAO	-	Food and Agriculture Organisation
GC	-	Gregorian Calendar
IFPRI	-	International Food Policy Research Institute
ILRI	-	International Livestock Research Intitute
MUC	-	Mekelle University College
NGO	-	Non Governmental Organisation
REST	-	Relief Society of Tigray
SSA	-	Sub-Saharan Africa
SWC	-	Soil and Water Conservation
UNCCD	-	United Nations Convention to Combat Desertification
UNEP	-	United Nations Environment Programme
WURC	-	Wageningen University and Research Center

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1 Introduction

Land degradation is a common phenomenon throughout the world. One of its forms, soil erosion, occurs in many of the world' s agricultural regions. Land degradation is one of the main causes of declining agricultural productivity and is partly determined by biophysical aspects such as soil, topography, vegetation and climate. However, economic and social factors, such as land management practices, tenure regimes and economic systems, together with population growth, determine its severity. There is an urge to manage, control and conserve the agricultural resource base properly, as it is the foundation for survival and development of people in many developing countries.

As in most developing countries, agriculture is the predominant sector within the Ethiopian economy, primarily depending on smallholder farming. Ethiopia is currently one of the most environmentally troubled countries in Northeast Africa. The main environmental problem in Ethiopia is land degradation, in the form of soil erosion, gully formation, soil fertility loss and severe soil moisture stress (Hagos *et al.*, 1999). The highlands of Tigray contain many of the areas of greatest land degradation concern in Ethiopia. To compensate for the falling yields farmers in the highlands have cleared forests on steeper slopes, accelerating land degradation in the process (www.fao.org/docrep/X5318E/x5318e02.htm#The). Declining soil fertility is severe in the semi-arid highlands of Ethiopia that constitute 95 percent of the cultivated lands (Shiferaw and Holden, 2000), and represents a major constraint for crop production, production potential and thus, on income- and food security.

One of the main triggers of land degradation problems in Ethiopia is the rapid population growth. The growing population of Ethiopia places an increasing pressure on the agricultural sector and consequently land becomes relatively scarce. This increasing population pressure is forcing farmers to cultivate marginal land resulting in increasing soil erosion as more marginal land is brought into production. In addition, Ethiopian smallholders practice rather traditional methods of farming; irrigation, improved seeds and pesticides are scarcely applied. The pressure on land makes the traditional agricultural systems for generating soil fertility (e.g. utilisation of fallow and manure, terracing, and using crop residues) difficult to sustain.

Soil conservation measures can be defined by “any set of measures intended to control or prevent soil erosion, or to maintain fertility” (Stocking *et al.*, 1989). Morgan (1995) defines the aim of soil management as “maintenance of the organic content of the soil, to maintain fertility and retain the soil structure”. The biggest concern of the Ethiopian agricultural sector is the widespread degradation of land contributing to declining agricultural productivity. Soil however is only one of the determining factors of agricultural production. Nonetheless, it is not the most important land degradation problem to farmers in many places, nor one that they are likely to take action to for prevention. In a semi-arid area, such as much of Tigray, farmers may be more concerned about conserving water than soil. When dealing with soil degradation and erosion one should also consider climate and water resources as important factors. In this context it is more appropriate to refer to soil and water conservation (SWC) than to soil conservation alone.

Investments in soil and water conservation measures (construction of terraces, soil bunds, gully treatment, irrigation, drainage, use of inorganic fertilisers, etc.) contribute to improved land management. Most farmers are aware of the seriousness

of soil erosion on their land, nonetheless peasants' investments have been limited. On the one hand these limited investments stem from the inability to do so. This inability is caused by factors internal to the rural poor, such as absence of skill and low education, income and capacity to respond to income-generating opportunities. Likewise, the inability to invest in SWC can be caused by external factors. Examples are insecure land tenure, limited access to minerals or other natural resources, limited access to credits or other financial resources and no access to markets, technology and productive infrastructure like irrigated water, electricity, transportation etc. On the other hand, part of this decision is often determined by farmers' low willingness to invest. There are several reasons for this ' non-adoption' of conservation practices by Ethiopian peasants, with a technical, institutional, environmental and/or socio-economic nature.

Assessment of both aspects (inability and unwillingness of farmers to invest in soil and water conservation) is an important research issue as both aspects can form serious constraints for improved, sustainable land management. The willingness and ability of Tigray farmers to invest in soil and water conservation measures are constrained by many factors, among which their cash-flow is an important one. Farmers may need cash for their conservation activities, i.e. for purchasing fertiliser and other agricultural inputs, for constructing terraces etc. In Tigray, formal credit for long-term investments is not available to small farmers, as repayment requirements do not exceed periods of one year. Moreover, the use of credit for long-term investments is difficult for farmers, as they are faced with problems such as the request for collateral, poor infrastructure, asymmetric information, imperfect credit markets and high interest rates (Shiferaw and Holden, 1999). Farmers' poverty reduces their ability of making investments, and even more when coupled with their inaccessibility to credit. Besides, farmers' poverty might reduce their willingness of making investments as the return to investments is often low on a short-term basis.

1.1 Objectives of the study

In general, the objective of this research is to gain insight into the relationship between access to (formal and informal) credit and soil and water conservation measures undertaken by small farmers in selected areas in Tigray, Northern Ethiopia.

In this context it is important to identify both formal and informal rural credit systems in selected areas of the Tigray region of Northern Ethiopia, and to try and answer the following questions:

- Which credit services are present in the area and which of those services are available for peasant farmers?
  This question is to be answered from both the supply-side and demand-side dimension, i.e. from institutional and household perspective. From the institutional viewpoint questions are put forward concerning target groups, client selection, credit requirements and collateral issues, loan duration, loan purposes, interest rates charged etceteras. The household perspective deals with the assessment of institutions or systems available to the rural poor, the terms and conditions of these systems according to households and purposes one is able to receive credit for.

- To what degree is the use of credit affected by the socio-economic environment of rural households and by their specific characteristics?

In answering this question it is tried to determine the strength of influence household characteristics have upon the choice of (not) using the available credit sources. Besides, an assessment is made of the extent to which farmers concentrate their demand on the earlier assessed supply side of credit institutions.

- What individual, communal and/or governmental activities concerning soil and water conservation are present in Tigray and in the research area in particular?

- Does credit accessibility influence peasants' conservation decisions, directly or indirectly? That is, is the credit used for agricultural inputs (short-term investments), soil and water conservation (long-term investments) or for other purposes than simply consumption? In other words, is there a linkage, direct or indirect, between soil and water conservation and (agricultural) credit?

1.2 Problem statement and Hypothesis

We address the problem of land degradation in Tigray and its possible linkages to credit systems, taking into consideration a complexity of factors, which are linked to the concept of credit and the conservation behaviour of the households. One of these factors is the fungible nature of money. Because of the fungible nature of money, the linkage between household conservation behaviour and credit is presumably an indirect linkage. Production and land conservation decisions are likely to be influenced by factors related to their dual nature as units of consumption and production (conservation investments are competing for resources needed for current production or consumption, and are therefore non-separable from production and consumption decisions). Therefore, use of available credit for conservation purposes is not guaranteed, as farmers can use the money for other purposes, like education for children, hiring in labour, or simply for smoothing their consumption. Savings, investments, insurance are often not clearly distinguishable, as saved and borrowed resources are exchangeable and substitutable between agriculture and for example housing, health or education.

Government policies and programmes also play a crucial role in affecting farmers' decisions with regard to land management. Therefore, a more detailed discussion will be presented in following chapters on agricultural extension, agricultural input supply (improved seeds and fertilisers), credit supply and land policy in Tigray.

Land ownership, or better yet, secure property rights have a profound influence on the decisions farmers make regarding their investments. Land tenure is of particular interest in Ethiopia since farmers do not own the land (land is owned by the state and cannot be sold nor mortgaged). A land tenure system that is insecure is a major obstacle to conservation today and in the future. If land is not individual property, it is not likely that farmers will benefit from their investments made in conservation. Therefore it is not presumable that these farmers will make these kinds of investments. Moreover, farmers are living with the risk of losing "their" land because of possible future redistribution. Hence, incentives for soil and water conservation are presumably low (unwillingness to invest).

The most important hypotheses forwarded here are the following:

- There is no direct relationship between credit and long-term soil and water conservation investments at an individual level, as farmers do not take credit to protect their land from land degradation by investing in structures like soil bunds

or terraces. Credit is rather used for consumption goods or short-term investments in agricultural inputs like fertilisers or improved seeds.

- Prosperous farmers (welfare measured by livestock and durable assets owned) may have more access to credit considering the collateral aspect and will invest more in agricultural inputs than less wealthy farmers.

- The use of chemical fertilisers in Ethiopia was subsidised by the government until a few years ago. Still, Ethiopia's fertiliser use is under the average of Sub-Saharan Africa. The Ethiopian government (at least partly) regulates soil and water conservation programmes. The use of chemical fertilisers and application of soil and water conservation structures are assumed to be technically complementary. It is expected that artificial fertiliser use in combination with soil and water conservation structures will raise the yield substantially.

1.3 Thesis outline

The remainder of this thesis is organised as follows. Chapter two presents a review of the literature on credit and soil and water conservation activities among rural households in developing countries. In chapter three the methodology of the research is stated. Chapter four provides a general description of the study area. In chapter five the credit systems in the area are assessed and credit use from the farmers' point of view is discussed. Also the main policies of the government concerning soil and water conservation are described. Chapter six contains the empirical research on credit use and soil and water conservation activities, and their relations. Descriptive analysis and results are also presented in this chapter. Finally, chapter seven provides a discussion on these results and some conclusions and policy implications are given.

2 Theoretical background

As said in the introduction of this thesis, land degradation is a common phenomenon throughout the world. However, during the last forty years, Sub-Saharan Africa's (SSA) agricultural development contrasts markedly with that of Asia and Latin America. Sub-Saharan Africa is the only region in the world where almost no progress has been made in raising average per capita food consumption or reducing the incidence of undernourishment (Sanchez, 2001). The extensive margin of new arable land available to bring into cultivation, so as to satisfy population-driven increases in food-demand, is rapidly being exhausted across most of the continent. There are thus intense pressures for agricultural intensification so as to improve factor productivity without expanding the area under cultivation (Barrett *et al.*, 2002).

Many SSA countries are among the poorest in the world and the farming populations constitute both the majority and the poorest segments of these societies. It is frequently claimed that poverty may inhibit investment in land conservation and induce myopic survival strategies that prove detrimental to the natural resource base (Holden and Shiferaw, 2002). Poor farmers living under stress with severe material or cash needs have very short time horizons and are thus less able to plan or invest for the future in general. In this chapter an attempt is made to assess the interaction between soil and water conservation investments by rural households in developing countries and factors influencing households' decisions to make such investments based on a review of available literature. The emphasis lies on the interaction between credit and SWC investments. Major causes of soil erosion are presented first. Second, soil and water conservation measures and implications for policy will be discussed. Third, factors influencing farmers' decision to invest in soil and water conservation measures are summarised. Specifically, the role that credit can play in such investments will be discussed. Later on, in chapter five, some of the factors influencing farmers' decisions to invest in SWC will be discussed when applying to farmers living in Tigray, Northern Ethiopia.

2.1 Land degradation, its causes and its consequences

Declining Sub-Saharan Africa's agricultural productivity is both a cause and a consequence of deterioration in the natural resource base on which agriculture depends (Barrett *et al.*, 2002). Several definitions of land degradation have been suggested by different authorities to express the degree of impairment of land utilisation, or of land potential. According to the UNCCD (United Nations Convention to Combat Desertification), degradation of land involves the reduction of the renewable resource potential by one or a combination of processes acting upon the land (www.unccd.int/knowledge/INCDinfoSeg/partii.php). In general, land degradation implies temporary or permanent regression from a higher to a lower status of productivity through deterioration of physical, chemical and biological aspects (Ponniah, 1998).

Direct causes of land degradation are apparent and generally agreed, including production on steep slopes and fragile soils with inadequate investments in soil conservation or vegetative cover, erratic and erosive rainfall patterns and declining use of fallow. Furthermore, limited recycling of dung and crop residues to the soil, limited application of external sources of plant nutrients, deforestation and overgrazing play a significant role in land degradation. There are many underlying causes of land degradation, including population pressure, poverty, high costs and limited access to agricultural inputs and credit, low profitability of agricultural

production and many conservation practices, high risks facing farmers and insecure land tenure. Also the short time horizon of rural households, and farmers' lack of information about appropriate alternative technologies are important aspects concerning land degradation (Hagos *et al.,* 1999). Broadly speaking, causes of land degradation can be grouped into two categories: natural and man-made causes. The basic man-made factors that ultimately trigger the processes contributing to land degradation are increasing pressures from removal of vegetation cover, poor land use, insecure land tenure, inappropriate land management practices and poverty (FAO, http://www.fao.org/docrep/V9909E/v9909e02.htm). Various authors have thereby linked increasing population growth with the quality of the natural resource base The increasing pressure on land resulting from this growth is perhaps the most important factor causing land degradation (Elshout *et al.*, 2001). Extensive farming systems, which were traditionally in harmony with the environment since only low production was demanded, become inappropriate. Moreover, increasing numbers of the rural population are being forced to farm marginal and unsuitable land, which shell quickly becomes degraded. For example, cultivating hillsides without adequate preventive measures leads to water erosion and leaving soils exposed during fallow periods often leads to wind erosion.

Land degradation has numerous economic, social and ecological consequences, onsite and offsite alike (Ponniah, 1998). Examples are decline in land productivity leading to reduced agricultural production, decline in income of agricultural populations resulting in the further worsening of a poverty situation, increased rural-urban migration, increased frequency of natural disasters such as floods, the concomitant loss of life and poverty and loss of biodiversity. Land degradation is a major factor in constraining food production in Africa to only a two percent average annual increase. As this is much lower than the average population growth rate, per capita food production has been falling and household and national food security is at risk in many countries (UNEP, http://www.unep.org/geo2000/english/0053.htm). Moreover, land degradation is also altering hydrological conditions. Where vegetative cover is removed, soil surface is exposed to the impact of raindrops, which causes a sealing of the soil, surface. Less rain then infiltrates the soil, runoff increases, encouraging erosion.

In the next section some soil and water conservation measures are presented and policy implications to combat land degradation are discussed. Thereafter, factors influencing the adoption of such investments will be highlighted.

2.2 Soil and water conservation measures and policy implications

Conservation of agriculture refers to a range of soil management practices that minimise effects on composition, structure and natural biodiversity and reduce erosion and degradation. Investments in soil and water conservation measures contribute to improved land management, or improved management of natural resources. Soil conservation basically means a way of keeping everything in place, literally as well as in a more abstract sense of maintaining the functions of the soil in sustaining plant growth. Soil conservation practices involve managing soil erosion and its counterpart process of sedimentation, reducing its negative impacts and exploiting the new opportunities it creates (Noordwijk and Verbist, 2000). Young (1998) defines soil conservation as a combination of controlling erosion and maintaining soil fertility. Morgan (1995) defines the aim of soil management as "maintenance of the organic content of the soil, to maintain fertility and retain the soil structure".

To prevent soil and water erosion and reclaim already damaged lands a long range of conservation techniques exists. Mentioning them all goes beyond the scope of this thesis. Examples of soil and water conservation measures are: construction of terraces, soil bunding (contour bunding, graded bunding), bench terracing, contour trenching, stone walls, gully control measures, construction of farm ponds, check dams, construction of water ways, disposal drains, silt application, integrated measures etc. As such, the soil is protected from rainfall erosion and water runoff; the soil aggregates organic matter, the fertility level naturally increases and soil compaction is reduced. The use of artificial fertilisers is also perceived as SWC measure as they are considered by many to be critical inputs for restoring soil fertility and increasing crop yields in SSA (Kelly *et al.*, 2002). The use of organic matter is often low in developing countries as most land use practices destroy the crop residues and animal manure application is not common (manure is also used as source of fuel in most rural households). Soil degradation partly reflects the extraordinarily low use of mineral fertilisers in the SSA (Barrett *et al.*, 2002) and, consequently, crop yields are low. Use of fertilisers (in combination with organic inputs) may be recommended in such cases to restore or improve the nutrient balance of the soil. Moreover, when fertiliser is used in conjunction with SWC measures like soil bunds or terraces, responses in output are many times greater than when both measures are applied separately (as results from a case study in Australia on fertiliser use in farm forestry: http://www.nre.vic.gov.au). More evidence for this technical complementarity between SWC measures and fertilisers can be found in the literature. Clay *et al.* (2002) emphasise in their article on input use and conservation investments that positive effects of fertiliser applications are enhanced by improvements in farming practices, particularly soil conservation and by the use of manure, compost and other organic matter. Kelly *et al*. (2002) also discuss the synergy between natural resource management practices like anti-erosion measures and fertiliser technologies. They argue that neither input strategy, on its own, is capable of achieving production goals and food security. A problem in promoting the combination of inorganic fertilisers and natural resource management practices is the financial sustainability over time, as both strategies are costly. One solution could be that adoption of both natural resource management practices and external inputs is facilitated by the presence of a cash crop in the cropping system (Kelley *et al.*, 2002).

According to Barrett et al (2002) several priorities emerge concerning policies on improving smallholder natural resource management practices like soil and water conservation measures. Top-down approaches should be replaced with farmer-centred approaches in order to spur rapid and widespread adoption. Such actor-oriented approaches take into account the broader livelihood objectives of rural Africans, which are primarily geared towards coping with a high degree of uncertainty, minimising risk and meeting subsistence needs, rather than maximising production and profits (Boyd *et al.*, 2000). Furthermore, learning processes have to become central to the cycle of developing, disseminating and evaluating new methods. Hence, information flows and access to and quality of education in rural Africa have to be improved. Finally, it is understood that the adoption of improved natural resource management techniques occurs as a result of decisions made by a wide range of people, each influenced by the incentives and the constraints they face. Necessary public investments and policy reforms must therefore be undertaken to reduce the structural impediments that discourage investment in improved natural resource management. Factors influencing farmers' decision to invest in new technologies will be discussed in the next section.

2.3 What determines whether farmers adopt or reject innovations?

A crucial aspect of raising productivity in agriculture concerns the spread of agricultural innovations, new products (crops) or new techniques (http://www.feweb.vu.nl/oae/CurrentResearch/ current.htm). An important policy concern is that existing innovations are often adopted very slowly, even in the face of continued land degradation. The decision to adopt new technology (in this thesis adoption of technology for resources management and conservation, such as soil conservation and use of conventional inputs like agricultural fertilisers and chemicals) is analogous to an investment decision. The decision may involve substantial initial fixed costs, while the benefits accrue over time. Initial costs may include the purchase of new equipment and of learning the best techniques for managing the technology on the farm (Caswell *et al.,* 2001). There is an extensive body of literature on the economic theory of adoption of, or investment in, technology. Factors affecting decisions of households to invest in SWC will vary considerably among different household according to their access to different types of assets and according to the needs and priorities of individual households (Boyd *et al.*, 2000). Hence, the adoption of agricultural innovations, in general, and in soil conservation in particular, is a complex process. In this section the key issues related to adoption of SWC practices are highlighted.

In general there are two major types of barriers to adoption: farmers who are unable to adopt and farmers who are unwilling to adopt innovations. As discussed in the introduction of this thesis, inability to adopt new technologies, hence to make investments, stems among others from scarce or lacking information, limited availability and accessibility of supporting resources and inadequate skill. Few farmers are able to adopt even simple technologies, let alone packages of conservation measures without adjusting their traditional practices and their livelihood strategies (http://www.taa.org.uk/TAAScotland/Saunders.htm). Unwillingness to adopt or invest is often caused by farmers' belief in traditional practices, increased risk of negative outcomes or by high costs of the new technology (Caswell *et al.,* 2001). In places where environmental degradation is severe it is important to investigate farm households' interest, their willingness and their ability to pay to sustain the land productivity of their own land (Holden and Shiferaw, 2002). Thus, different factors may affect smallholders' adoption decisions (and the extent of the use of conservation practices once adoption occurs) both directly and indirectly (through their effects on the perception of the problem of soil erosion and its economic impacts). Some of these factors will be briefly discussed below.

2.3.1 Farmers' perception of the problem

Farmers' perception and recognition of the problem of land degradation is perhaps the most important factor influencing farmers' land management. Perception of the degree of the erosion problem and its impact on short-term returns and land values are highly correlated with the farmer's willingness to invest in conservation measures (Ervin and Ervin, 1982). In other words, adoption of conservation technologies is likely to increase with recognition of the erosion problem. Once the erosion problem is perceived, the farmer decides whether to adopt conservation practices or not. Moreover, once erosion is perceived as a problem, farmers also perceive benefits from using conservation practices. According to Ervin and Ervin (1982) farmers are often aware of the condition of their land, but they may not be fully aware of land degradation, its causes and its consequences. Some problems of land degradation like waterlogging are readily observable and well understood by SSA smallholders, but

others are not so immediately obvious (Boyd *et al.*, 2000). Soil erosion is often a very slow process and may almost be invisible. Farmers may therefore not observe ongoing erosion or nutrient depletion problems, or perceive them as immediate problems (Hagos *et al.*, 1999). Yet farmers need to perceive the severity of soil erosion and the associated yield loss before they can consider investing in its prevention (Gebremedhin and Swinton, 2002). Farmers need to learn about new methods in order to adopt them. The individual decision to invest in improved technology depends fundamentally on the farmer's awareness of the need for improvement and his or her beliefs about the potential of the new practice (Barrett *et al.*, 2002). Pretty and Buck (2002) argue that by promoting improved information flows, farmers can improve their agro-ecological understanding of the complexities of their farms and related ecosystems and better access to information can lead to improved agricultural outcomes.

2.3.2 Secure ownership

Investments in soil and water conservation practices pay dividends over an extended period, and farmers are more inclined to undertake such investments when they are more likely to reap the full stream of benefits over time and where that future stream of net returns is more predictably favourable. So, incentives to adopt innovations depend on security of usufruct rights in land, animals and other durable, productive assets (Barrett *et al.*, 2002). Insecure land ownership is often regarded as a constraint in the adoption of SWC practices (Boyd *et al.*, 2000; Gebremedhin and Swinton, 2002) as it is yet another reason for farm households to adopt short planning horizons and to have low willingness to invest in conservation practices (Holden and Shiferaw, 2002; Tarawali *et al.*, 2002). Tenure security determines the extent to which farmers may benefit from investments made to improve the land. In extreme cases in which farmers hold land for only the current season, they will have no incentive to invest; rather, their incentive is to get the maximum that they can from the land, even it that means undermining its future productive capacity. More generally, farmers may expect to use land for an undetermined period of time, but consider that there is some risk of losing the right in the future. The greater the risk of losing the right, the less likely they are to invest, or to conserve the productive capacity of the land (Feder *et al.,* 1988). Continued ownership of the land by the government, for example, and all the rules and regulations by which it seeks to control the use of this land has placed it in opposition to people. People than, understandably, develop an irresponsible attitude toward this land, one of getting as much out of it as they can with no feeling of responsibility for its maintenance. At the same time they are not unaware that their activities are causing the evident deterioration. But they feel helpless in a situation in which they do not have effective control of the land that sustains them. The lesson to be learned from this situation is that people must own the land that sustains them if they are to use it responsibly and if their sense of self-confidence is to be maintained (www.unu.edu/unupress/unupbooks/80a02e/80A02E0j.htm).

2.3.3 Population pressure and poverty

The complex interlinkage between poverty, population growth (or population pressure) and environmental degradation provides a further dimension to the problem of degradation of the resource base in the poorest areas that rely on exploitation of land resources. Land degradation is about people. People cause and suffer from it. Unsustainable land management practices caused by increasing population pressure will enhance degradation of land especially in susceptible dryland (http://www.unep.org/Documents/Default.asp?DocumentID=186%ArticleID=2710). Due to population pressure, traditional systems of land use often break down or are no

longer appropriate (www.fao.org/WAICENT/OIS/PRESS_NE/PRESSENG/2000/pren0027.htm). Population growth increases demand for land and therefore contributes to farming on marginal lands (steep lands, fragile soils) leading to soil erosion (Adesina and Chianu, 2002). Thereby, it increases the demand for biomass as a source of fuel, leading to deforestation and increased burning of dung and crop residues, thus increasing the problems of erosion and nutrient depletion. Population growth also increases the demand for livestock products and therefore leads to increased livestock numbers, causing overgrazing and consumption for crop residues by animals (Hagos *et al.,* 1999). Land degradation is thereby closely linked to poverty in developing countries. Poverty is a consequence of land degradation (http://www.fao.org/WAICENT/OIS/PRESS_NE/PRESSENG/2000/pren 0027.htm) and at the same time one of the causes. Poor people, with no resources to fall back on, are forced to put immediate needs before the long-term quality of the land. Concluding, poverty and cash-liquidity constraints reduce a household willingness and ability to invest in conservation. Poverty also increases the probability that farm households will adopt short planning horizons and thereby neglect benefits accruing further in the future (Holden and Shiferaw, 2002).

2.3.4 Risk and uncertainty

Adoption theory in agriculture essentially sees the decision whether to adopt or reject innovations as a 'risky choice' problem (Marsh, 1998), i.e. risk plays an important role in the process of adopting new technologies. Farmers' attitudes to risk will influence their willingness to invest in SWC, and an important question is how farmers cope with living in marginal, risk-prone environments such as semi-arid areas. The decision of whether to invest in SWC is mediated by the extent to which this increases or reduces the overall risks of a particular livelihood strategy (in this case agricultural production) relative to not doing so. The adoption of SWC practices can be regarded as a risk reduction strategy, whereby the overall resilience of the farming system may be enhanced and the impact of any stress (such as erratic rainfall) are less dramatic. However any investment in SWC may be more risky that other options open to households such as migration, as returns to any investments in land cannot be relied upon in semi-arid environments (Boyd *et al.*, 2000).

2.3.5 Ability to borrow funds

Even if smallholders are willing to invest, they often have limited capacity to mobilise labour, land or cash for investment in even effective and profitable conservation practices. Because cash can alleviate household constraints on labour, land, equipment and the like so long as markets exist for these inputs, financing may be the most widespread limitation on smallholder capacity to invest in conservation practices. Rural SSA financial markets are plagued by structural problems of covariate risk and information asymmetries that induce credit rationing. The consequence can be limited smallholder cash savings and credit access because informal finance tends to be too short of duration to match the multi-year payoff on conservation investments as well (Barrett *et al.*, 2002). In other words, one of the main potential constraints to farmers' adoption of modern technologies and inputs is their shortage of capital. The ability to borrow funds can be an important economic factor in soil and water conservation investments, enhancing or constraining farmer's dispositions towards erosion control (Ervin and Ervin, 1982). The cash available to a given household may not suffice to make a conservation investment and the household may need to borrow. This is especially true for construction of bunds and terraces. Hence, the degree of development of credit markets can be important. It is

difficult to increase productivity of the agricultural sector in the absence of an efficient credit facility, given the fact that the majority of farmers in developing countries are resource-poor. Often, credit markets in environmentally fragile areas are quite underdeveloped. There are high interest rates and limited access for smallholders. However, even where the formal or informal credit market is developed in general, there might be special constraints for getting credit for conservation investments. Loan sizes to construct large items such as bunds or terraces might exceed the capacity of local creditors or even village credit groups, especially if many households require loans at once. Secondly, the externalities in many conservation investments and the associated problem of free riding can undermine a farmer's ability to get credit for such investments. Thirdly, creditors may not perceive (and indeed there may not be) a clear short-term effect of conservation investments that generate cash, hence the risk of default may appear greater. Finally, production investments often require, but also create loan collateral. This is generally not so with conservation investments.
(www.rimisp.cl/publicaciones/electronicas/encuentro/pub32/). Lack of access to credit, and hence the inability to borrow funds may be a critical barrier to adoption of SWC measures. Specific credit programmes targeted to small farmers are often needed to permit farmers to purchase seeds, fertilisers and other inputs necessary to restore and maintain soil fertility. Credit needs to be accessible and needs to remain affordable to small farmers. Credit by itself may not be sufficient to increase investment in soil conservation, since funds can be used for other activities. However, targeting credit towards farmers with fewer resources may increase the capacity of those producers most likely to make investments in conservation (Wyatt, 2002).

3 Methodology

3.1 Site selection

For the socio-economic survey a research area in Tigray was selected. As this research was done within the RESPONSE-project[1], selection of this research area was done by the project based on a number of criteria. The idea was to find two sites for this collaborative project that are contrasting in opportunities for development (for bio-economic modelling), but that are comparable with respect to soil type and geomorphologic characteristics (for bio-physical modelling). A weather station should be close in order to have access to rainfall data etceteras and preferably there should be already some basic information on the site (such as activities of NGOs or research institutes). Because ultimately the RESPONSE-research should lead to policy recommendations, the sites should be fairly representative for the Highlands of Tigray. Therefore, soil type and geomorphologic characteristics should be fairly general, and the sites should also represent fairly common *kushets* (villages), i.e. they shouldn't have a specific characteristic that will set them apart from all other sites (source: Mission Report Ethiopia).

The *woreda* (district) Atsbi/Wemberta in the Eastern Zone of Tigray includes two *tabias* (communities) that meet the requirements and represent two contrasting sites: Golgol Na'ele and Mikael Emba. These tabias and their exact location will be discussed more detailed in chapter four.

3.2 Description of the data set

3.2.1 Data

A large set of data used in this study for empirical analysis was collected from different sources to gain a thorough understanding of both the supply- and the demand-side of credit systems and soil and water conservation programmes and activities.

The first data set for this study comes from a socio-economic household survey holding much information related to households' demographic features, farmland characteristics, crop- and livestock production systems, labour use, input use, assets, income and expenditures, saving and borrowing behaviour and conservation behaviour of peasant households. The data were collected in the two selected communities (tabias) in Tigray in August-November 2001. In this same period a second data set was obtained from institutions involved in credit provision to the rural poor, collecting detailed information on their terms and conditions regarding loan disbursements.

3.2.2 Sample selection

A total of eighty households were surveyed in two *tabias* (the lowest administrative unit in Tigray) Golgol Na'ele and Mikael Emba, some fifty kilometres from Mekelle, the main town of eastern Tigray. The two selected tabias each consist of four *kushets*, or villages. Households were stratified based on the 'ownership' of land. All landowners in both tabias were given a four-digits number. Subsequently, a fixed

[1] A project of Wageningen University in collaboration with ILRI, IFPRI and MUC on 'Policies for Sustainable Land Management in the Highlands of Tigray, Northern Ethiopia'.

number of ten households per kushet were systematically selected, using a lottery system. The total number of households with land and the total cultivated area per kushet are shown in table 3.1 and 3.2 for tabia Golgol Na'ele and tabia Mikael Emba respectively. A note should be made that one tsmad is equal to approximately one fourth of a hectare.

Table 3.1. Number of households with land and total cultivated area per kushet in tabia Golgol Na'ele

Kushet	Number of households with land		Cultivated land size per kushet	
	Male headed	Female headed	Tsmad	Hectare
Seryen	42	312	1395	349
Baeti Ero	34	254	925	231
Maeregat	25	229	666	167
Tegahne	398	32	690	173
Total	1407	1097	3676	919

Source: BoANR Atsbi/Wemberta woreda, 2001

Table 3.2. Number of households with land and total cultivated area per kushet in tabia Mikael Emba

Kushet	Number of households with land		Cultivated land size per kushet	
	Male headed	Female headed	Tsmad	Hectare
Arwa	283	205	624	156
Gedam	240	155	622	156
Lae'Lay Adi Armo	169	152	486	122
Gundafru	290	175	596	149
Total	982	687	2328	582

Source: BoANR Atsbi/Wemberta woreda, 2001

3.2.3 Questionnaires

Relevant information for the study was thus collected from two types of questionnaires: a socio-economic household questionnaire and a smaller institutional questionnaire used to assess the credit institutions and their terms and conditions in the study area.

For the household questionnaire eighty farmers were selected randomly. Person-to-person interviews were held using a semi-structured questionnaire (annex 1). The questionnaire consisted of both closed pre-coded and open questions. The questionnaire was tested and revised in July-August 2001, the actual data collection took place in August-November 2001. The household questionnaire was divided into ten parts. Part A collected information on household composition, age, education, religion, occupation and participation in local organisations. Part B covered an assessment of farm equipment and durable goods owned, their durability time and unit prices. Part C concerned households' saving possibilities and their actual saving activities. Part D collected information on credit related issues, like availability, credit use and problems encountered in using this credit. This was done for both the formal and the informal sector. Part E covered the households' agricultural activities related to livestock production, i.e. livestock owned, livestock by-products sold and perceived constraints in livestock production. Part F dealt with the assessment of land 'owned' in terms of number of plots and total area and information on the type of land use was collected. Part G covered the households' agricultural activities related to crop production, including inputs used (labour, fertiliser, seeds, manure etceteras) during last cropping season, the consumption of home produce, price tables for crops sold

and perceived constraints in crop production. Part H collected information on degradation and conservation issues, including soil and water conservation structures per plot of the household and households' participation in SWC activities on communal land. Finally, the parts I and J collected information on respectively other sources of household income and their weekly, monthly and yearly expenditures.

The institutional questionnaire (annex 2) was used to collect information on the (semi) formal credit systems present in the research area. The two major credit-providing institutions were visited, both head offices and sub-branches. The questionnaire consisted of only open questions. To each institution some general questions were posed in order to determine the general objectives and the structure of the institution concerned. Regarding credit data were collected from each institution with regard to the clients of that institution and the process of client selection, types of credit offered, strategies of loan distribution, interest rates charged, repayment enforcement etceteras. Likewise, questions were raised about the treatment of the fungible nature of money, the extent to which rural savings in the study area are encouraged and provision of information to the clients. In order to get a thorough understanding on the involvement of the credit institutions in soil and water conservation activities, the extent to which the provided credits are linked with agricultural input provision and/or with SWC was examined. Finally, to get an idea of the performance of each institution, information was collected on the achievements obtained so far and the output of the credit activities in the research area during the last year, i.e. 1993 EC[2]. These questions referred to the number of loans distributed, the total amount of loans disbursed, the total amount of loans repaid, the total amount of loans outstanding, the total amount of loans in arrears, the total amount of savings and the average default rate in the area.

More data related to credit activities and data concerning soil and water conservation activities were collected from the Bureau of Agriculture and Natural Resources (BoANR) and the woreda administration bureau in Atsbi. As this information was very limited, secondary, additional data on this subject were collected from several sources in Ethiopia: the Regional Planning Bureau in Mekelle, the library of Mekelle University and the library of the International Livestock Research Institute (ILRI) in Addis Ababa.

3.2.4 Field work

The survey was spread over a three-month period (starting from the 3rd of August to the 10th of November 2001) including the pre-testing and revising of the household questionnaire. Each selected household was visited only once with each household questionnaire taking up approximately three hours. Due to remoteness, up to three households could be visited per day. The interviewing was done with the help of interpreters.

3.2.5 Data processing

Initially, the data collected from the questionnaire were entered in excel. Later on SPSS (Statistical Package for the Social Science) and Eviews (Econometric Views)

[2] Ethiopia uses the Julian calendar which is divided into 12 months of 30 days each and a 13th month of five or six days at the end of the year. The Ethiopian calendar (EC) differs seven years and eight months from the Gregorian calendar (GC), which is mostly used in European countries, i.e. 1993 EC = 2001 GC.

were used to process and analyse the data in the analytical models used. The actual analysis and its results are presented in chapter six.

3.3 Analytical approach

The households in the survey were initially divided into three groups, depending on certain activities related to soil and water conservation and credit utilisation. This was done in order to estimate the level of influence of household characteristics upon the use of credit and to explore the relationship between credit use and SWC measures. Binary logistic regression was used for analysing the significant differences between these groups. Furthermore, probit analysis was used to analyse the strength of influence household characteristics have upon the use of a specific credit source and to explore the significant differences between the use of credit from different credit providers. Finally, an attempt was made to examine the possible linkage between credit use and soil and water conservation measures, i.e. to investigate the possible role of credit systems in soil and water conservation decisions of smallholders. Due to collinearity in the data set this part of the analysis could however not be executed. Chapter six provides more detailed information on the analytical approach.

3.4 Reliability of the data and limitations of the survey

Data obtained by administering questionnaires is only as good as the appropriateness and comprehensibility of the questions, the willingness of respondents to respond truthfully, and the integrity of the translators and the supervisions made. There are sufficient reasons to have confidence in the quality of the collected and analysed data for the following reasons:

- The household questionnaire was designed and pre-tested by the author herself. The pre-test was done on eleven farmers to make sure that all questions were clearly formulated and to ascertain the fact that the respondent perceived the questions the same way as the interviewer did in order to avoid any biased answers. After the pre-test the questionnaire was redesigned.
- The designer was present at all eighty household interviews, having a controlling hand in the questions posed and the clarity of answers given.
- Interpreters were carefully trained and instructed, so that they understood each and every question as it was meant and so that they knew how to raise the questions to the respondent and how to translate them for the author.

In spite of that, the following points can admittedly be stated as limitations that might had an influence on the data:

- The first forty households were interviewed with the help of a different interpreter than the last forty households. In spite of the careful training given, this may have resulted in differences in perception of the interpreters.
- During the analysis it appeared that there was collinearity in the data set. Due to this fact analysis (especially linking credit to SWC in a two stage procedure) could not be completed. This collinearity will be discussed in more detail in chapter six.

4 The Research Area

4.1 Natural features of Tigray

Tigray is the most northern region of Ethiopia, located in the semi-arid Sudano-Sahelian zone. The region is bounded to the north by Eritrea, to the west by the Sudan, to the south by the Amhara region, and to the east by the Afar region. Altitude varies from 500 metres to 4000 metres above sea level. The region covers an approximate area of 80.000 square kilometres, with a population of more than 3.46 million and an estimated annual population growth rate of 3% (Gebremedhin, 2001).

Agriculture is the mainstay of the economy of Tigray. As a source of income 80-85% of the population depends on mixed crop-livestock subsistence agriculture, with oxen power supplying the only draft power for ploughing. Most of the region either produces just enough for subsistence during good rainfall years or face chronic deficits (Gebremedhin, 2001).

Tigray has been quoted as 'one of the regions with the highest rate of soil erosion in the world' (http://137.224.135.82/cgi/projects/other/Tigray/ethiopie.html). The long history of sedentary agriculture coupled with the recurrent deficiency in moisture and the rugged terrain appear to be the major causes of this vicious circle of environmental degradation and the deterioration of the socio-economic conditions of the people.

Tigray is characterised by sparse and highly uneven distribution of seasonal rainfall, and by frequent occurrence of severe drought. The amount of rainfall increases with altitude from east to west and decreases from south to north. Average annual rainfall varies from about 200 mm in the north-east lowlands to over 1000 mm in the south-west highlands (Hagos *et al.*, 1999). In the Highlands, close to the eastern escarpment (where the study site is located) the average rainfall is 450 mm.

Rainfall is highly variable temporally as well as spatially. Most of the rainfall falls during the "Meher" season from June to September and is most intense during July and August. In some parts of Tigray, there is a short rainy season called "Belg" which falls during the months of March, April and May.

Average temperature in the region is estimated to be 18 °C, but varies greatly with altitude. In the highlands of the region during the months of November, December and January, the temperature drops to 5 °C. In the lowlands of western Tigray, the average temperature increases from 28 °C to 40 °C during the summer.

4.2 Characteristics of the research area

The Regional State of Tigray is divided into four administrative zones: Eastern, Western, Southern and Central Tigray. These zones are further divided into 36 *woredas*, or districts. Each woreda is again sub-divided into *tabias* (communities). Finally, each tabia consists of several *kushets* (villages) which constitute the basic administrative unit in the region.

As a survey site for this research two tabias were chosen by the RESPONSE project. Both tabias, Golgol Na'ele and Mikael Emba are located in the Eastern zone of Tigray in Atsbi/Wemberta woreda (figure 4.1). The zone has an estimated total population of 639.186 people as of 1990 EC,

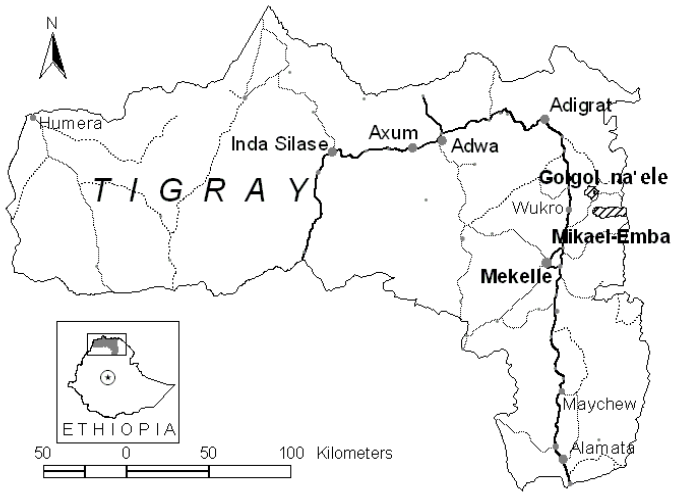

Figure 4-1. Location of study sites Golgol Na'ele and Mikael Emba

out of which more than 85% is rural. The estimated average household size in rural areas is 4.5. The zone is divided into 7 woredas and 116 tabias. It is agro-ecologically categorised into three major climatic zones as *Degua* (highland), *Weinadog'ua* (mid-highland) and *Kolla* (lowland) and although the largest part of the zone is ecologically treated as mid-highland, which is optimum suitable for crop production, the agricultural performance so far remained poor (Tigray planning and economic development bureau, 1997).

Both tabias Golgol Na'ele and Mikael Emba consist of four kushets. The soil characteristics of the two tabias are comparable and quite common for the whole Tigray area. The tabia Golgol Na'ele has comparatively more advantage and potential than the tabia Mikael Emba. It has an irrigation dam (built in 1997), with a capacity of 70 ha. It has good market access – it is located at 2.5 km from Atsbi, with 1.3 km all weather road, 0.7 km seasonal road and 0.5 km passable road. It takes about 25 minutes to get to Atsbi by foot. There are conservation measures (stone terracing) being implemented in the catchment area., although there is no area closure (grazing lands with restrictions). There are several local organisations active. The kushets have communal grazing lands and community woodlots. All four kushets are included in the survey.

The remote tabia Mikael Emba is more limited in its possibilities. It has a river diversion which irrigates only 0.25 ha (since 1982), although its capacity is 5 ha. Irrigation can be considered to be negligible. The tabia is located 18 kilometres from Atsbi, with rough roads (there is only one seasonal road). There are conservation measures (stone bunds) and area closure. There are also community woodlots available. All four kushets are included in the survey (source: Mission Report Ethiopia).

Average annual temperatures and rainfall for the woreda Atsbi/Wemberta are presented in figure 4.2.

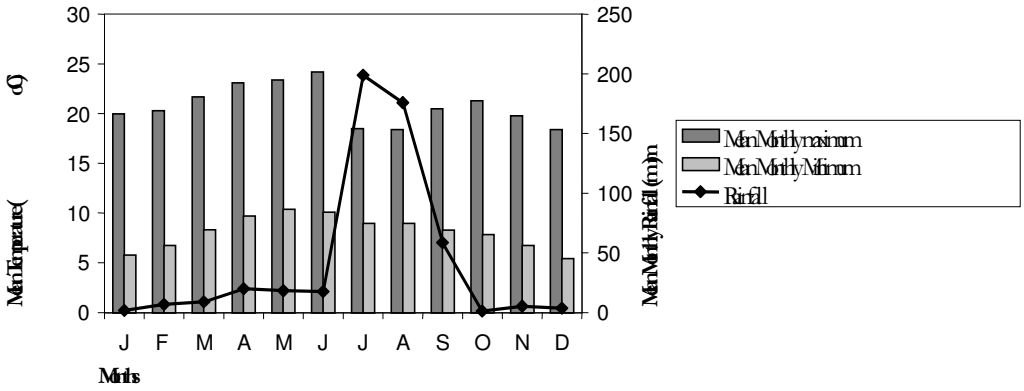

Figure 4-2. Climate data for Atsbi/Wemberta woreda (SAERT, 2001)

Table 4.1 presents some of the major characteristics of the households in the survey concerning their production system. Average land holdings are bigger in Golgol Na'ele than in Mikael Emba. However, average household size is also bigger in this tabia and if we compute the average area owned per member of the family, the number is the same, i.e. 0.32 tsmad for both tabias.

Table 4.1. Features of surveyed households in tabia Golgol Na'ele and Mikael Emba

Tabia	Average land holding (tsamd)	Average household size	Major consumption crops	Major cash crops	Livestock owned (in TLU)
Golgol Na'ele	2.6	6.08	Barley fababean	Barley Wheat	2.54
Mikael Emba	1.84	5.18	Wheat Barley Teff	Barley Chickpea	2.13

5 Credit and Soil and Water Conservation in the study area

In this chapter an assessment is made of the rural credit systems available to the farmers in the survey and the extent to which farmers use these systems is discussed. Programmes in the study area concerning soil and water conservation are discussed as well.

5.1 Rural credit systems in Tigray

Most of the rural households in Atsbi/Wemberta woreda are low-income farmers depending on rain-fed and very small-scale agriculture to sustain their livelihoods. The declining soil fertility is severe and forms a major constraint on crop production, production potential and hence, on income- and food security. Moreover, the pressure on land due to a rapid increase in population makes the traditional agricultural systems for generating soil fertility (e.g. utilisation of fallow and manure, terracing, and using crop residues) difficult to sustain.

Agricultural credit is often seen as one of the requirements for accelerating the pace of agricultural and rural development. According to Gebremedhin *et al.*, credit provision to rural households is one of the prerequisites to start agriculture moving in Tigray. Credit provision is believed to enable the farmers to adopt technologies extended by the BoANR and possible other agents (Gebremedhin *et al.*., 1996).

Sources of agricultural credit can be diverse including relatives and friends, saving groups, private moneylenders, banks, input suppliers, marketing agencies, farmer co-operatives, and specialised agricultural banks. In other words, sources of agricultural credit range from informal to formal finance. In order to make a clear distinction between the two, a definition of informal finance is in order here. The 'safest' definition of informal finance is a broad one: informal finance is perceived as all modes of financial transactions that do not take place within formal finance. According to Moll (1998) 'the term 'informal' refers to the provision of services which is generally not, or only partly regulated by law, but which relies on self regulating mechanisms'. The formal financial sector is protected by legislation, controlled by the central bank and supported by the state and the national and international banking community (Bouman, 1994).

The objective of this section is to make an assessment of the main institutions providing credit in the study area. There are many (semi) formal credit institutions active in the region of Tigray as a whole, including branch offices of the Development Bank of Ethiopia (DBE), the Commercial Bank of Ethiopia (CBE), the Bureau of Agriculture and Natural Resources (BoANR), Relief Society of Tigray (REST) and various other NGO's. Nonetheless, only BoANR and REST are included in this section as formal credit institutions, as they are the only institutions present in the study area, and thus available to the farmers in the survey.

Complementary to the formal sector several informal financial institutions have been active for decades in Ethiopia. The Equb for example is of the ROSCA-type (ROtating Savings and Credit Association), a traditional savings association where each member agrees to pay periodically a small sum into a common pool. Each time when savings are pooled, they are immediately redistributed among the members in rotation, until each has had its turn and the ROSCA comes to an end (Bouman, 1994). Another informal social and financial institution is the Idir, resembling the ASCRA (Accumulating Savings and CRedit Association). This is an association made up by a

group of persons united by ties of family and friendship, by living in the same district, by jobs, or by ethnicity, and has an objective of providing mutual aid and financial assistance in certain circumstances. The pooled savings are kept in custody and accumulated for a specified time, at the end of which the savings are redistributed (Bouman, 1994). Although it is said by many that these forms of informal finance are frequently used, almost every farmer in this study responded not to use Equb nor Idir, due to lack of money ('everyone is poor, so these sources of credit are not available in this area'). As Aredo (1993) stated: "The Equb takes place in rural and urban areas, though it seems to work more in urban areas". Due to this fact informal finance is left out of consideration in this paper.

5.1.1 The Relief Society of Tigray - REST

The Relief Society of Tigray is an institution involved in many developmental programmes in the field of environmental rehabilitation, agricultural development, relief and social development, and credit and saving activities aiming at contributing to the socio-economic development of the region. This last branch of REST, engaged in credit and saving activities is called DECSI (Dedebit Credit and Saving Institution), formerly RCST (Rural Credit Scheme Tigray), and is one of the largest MFIs in Ethiopia. REST initiated and established the Rural Credit Scheme in 1994, based on the results of an extensive base line survey conducted in 17 woredas in Tigray. This socio-economic survey was meant to identify the accessibility and constraints of rural finance. Of the respondents 60 percent said to have one ox or less; of these, 60 percent were female headed households. Households were using the traditional methods of agriculture, and not modern technologies like fertilisers and improved seeds, so production was very low. Approximately 89 percent of the respondents replied to depend on food aid from different governmental and non-governmental sources. Additionally, no formal institutions existed to serve the poor. A ten-year-profile-survey was done on different banking systems and it appeared that around ten billion Ethiopian Birr was distributed for different activities, but of which only 4 percent had been distributed to the agricultural sector and even only to specific (coffee-producing) areas. The only option for the poor was to seek other financiers like local moneylenders, being at the mercy of a 120-150 percent interest rate (REST head office-Mekelle, 2001).

Operation of the RCST was started in May 1994 in eight branch offices (two in each zone). Within one year four branches were added. Branches of RCST, were established in the woreda Atsbi/Wemberta in 1995 in Atsbi and in Haike Massal. DECSI is now operating in all woredas of Tigray National Regional State through 12 branches and 109 sub branches. It provides credit and savings services to the poor adapting the Grameen Bank innovations.

Institutional environment and organisational structure

DECSI is operationally an autonomous department of REST. It is structurally different from the other departments in that it has its own finance, administration, planning and research units. The other departments are served by similar REST level services. Since September 2001 DECSI has a new organisational structure. A board of directors nominated by a shareholders' general meeting governs the institution. The shareholders are the owners of the company and have the authority to decide on any matter that concerns the institution. The Board of Directors administers the company, and currently it is composed of people from the owner organisations and other distinguished individual persons. The General Manager directs and administers the day-to-day operation of the company. At the head office level there are departments

which are under direct supervision of the general manager. These departments include the department of Planning and Business, Operations, Finance and HRD (Human Resource Development). All departments have distinct purposes and responsibilities.

Objectives of DECSI

The prime objective of DECSI is to provide effective and efficient financial services to meet the credit demand of rural and urban poor, engaged in small-scale agriculture and small income generating activities. It is aimed at improving the productivity and income of the poor as well as to generate employment opportunities in the region. The specific objectives of DECSI are the following:

- Increasing and improving agricultural production through the provision of credit for agricultural inputs.
- Creation of job opportunities;
- Since there is not enough land to produce sufficient income to cover the households' expenditures, and since there is no land redistribution at this moment leaving many young people without income, people should be able to generate and diversify their own income.
- Reduce the interest rate at least to market level, in order to reduce the exploitation of the local community by the local moneylenders.
- Stimulation of the local economy by promoting saving and credit, i.e. 'show the people that credit and saving will break their vicious circle of poverty'.
- Promote sales of agricultural production.

Strategies

To achieve these objectives, DECSI operates according to four strategies. First of all, all activities of the institution are based on a community participatory approach; the selection of beneficiaries, group formation and program implementation are done with full participation of the local community. The second strategy is related to priority. DECSI gives special emphasis to women by giving them priority and by making the loan delivery system gender-based so as to encourage women to engage in some economic activities and earn an income without being discouraged by their male counterparts. The third strategy deals with cost and sustainability. The institution should cover all cost from income, so there is a massive mobilisation of savings to meet the increased loan demands in rural Tigray (reduction of all costs in order to reach a self-sustainable level). Finally DECSI works with an integrating strategy by linking its operation with other development programmes of the region. In this way costs will be reduced (e.g. BOANR provides extension services, a 'package program'. DECSI has agreed to provide credit service to the people who are participating in this program).

DECSI's mode of operation

The Dedebit Credit and Saving Institution offers two financial products, i.e. credit (regular and agricultural input loans) and savings (on individual, group and centre level).

Credit

DECSI provides two types of loans; regular loans and agricultural input loans. Regular loans are given to regular clients who are selected by the credit and saving committee and remain permanent clients. The target group or beneficiaries of the institution are the rural poor. For considering an individual to be poor, the number of oxen a households owns, or equivalent wealth, is considered as a criterion. In principle therefore DECSI serves those who have two or less oxen, or its equivalent.

However, those who are extremely poor, with no means to work with are first served (the proportion of households in the study area belonging to this group is unknown).

Another criterion for households to be eligible for the regular loans is that they are required to be active and motivated to work. Regular loans are extended for any kind of activities as long as the activities are supposed to generate income and enable the borrowers to repay the loan. No loan is thus provided for consumption purposes. Examples of income-generating activities include service (grinding mills, transport, etc.), agricultural related activities (oxen, beekeeping, agricultural inputs, etc.), trade (livestock trading, grain trading, shop keeping, etc.) and handicrafts (preparing and selling local beer or food, basket making, etc.).

A third criterion that should be fulfilled in order to qualify for a regular loan is that the person who is given the loan should be a permanent resident of a specific place. This makes it easier for the institution to determine the eligibility of that person.

Agricultural input loans are provided for the purchase of agricultural inputs such as fertilisers and improved seeds. These loans are provided to clients for a maximum period of six months. These clients are farmers who are the beneficiaries of the extension package program of the Bureau of Agriculture and Natural Resources. Extension agents who are responsible for technical assistance select the farmers (see also BoANR in the next section). Farmers are supposed to settle their loans immediately after harvest.

As most households in the area do not possess any fixed assets, for both type of loans the collateral issue is solved following a group based lending mechanism. Joint liability and group pressure is used as an insurance mechanism against defaults by extending loans only to those individuals within a binding group context. Potential beneficiaries have to form groups of five to seven persons and seven to ten groups are federated into a larger group called the centre. These groups have to satisfy a few requirements:

- group members are required to be like minded and to have a similar socio-economic status;
- group members have to be from the same kushet, if possible;
- groups and centres are formed on a gender basis;
- the centres and groups have their own names and code numbers so as to be identified easily from each other;
- each group and centre has chair persons and secretaries;
- each member has to fill a group application form and signs to confirm that he/she will abide with the rules and regulations of the institution.

No new loans are issued to the individuals in a group while an existing loan of one of the members in that group is in arrears.

Currently the size of the loan DECSI is disbursing has a minimum of 50 and a maximum of 5000 ETB, with a yearly interest rate of 12.5 percent. Initially the group to which the client belongs requests a loan for a certain activity, then the centre to which the group belongs. Finally the credit and savings committee is responsible to fix the loan size. The committee takes into consideration the capacity of the borrowers to repay the loan and the level of the cost for which the activity demands.

Savings

Saving is an important component of the DECSI program, as it provides the main source of fund for the credit disbursed. The institution provides three types of saving deposits. *Individual* saving is a voluntary saving deposit of any individual or organisation. *Group* saving constitutes a tax of five per cent of all regular loans disbursed and a group members' monthly contribution of one Birr. Group saving serves as collateral for the loans taken by the group members. Half of the group fund can be lend to its contributors for any purpose they want it to use, including consumption. Finally, *centre* saving constitutes each members' monthly contribution of one Birr. Both the group and the centre savings are compulsory.

The amount of savings accumulated thus serves as a security against default, loan fund and capital base for the beneficiaries. It is one of the strategic approaches of DECSI so as to be self-reliant in the future.

Economic performance of DECSI

The economic performance of DECSI during its lifetime and its past year in the woreda Atsbi-Wemberta and especially in the tabias Golgol Na'ele and Mikael Emba is presented in annex 3. Some central issues, like the percentage of female and male borrowers, the percentage of outstanding loans, the percentage of repaid loans etc. are provided in tables 5.1 and 5.2.

Table 5.1. Output of DECSI on woreda and tabia level as of the year of establishment of each branch

	% of loan portfolio disbursed in Atsbi/Wemberta woreda	male borrowers (%)	female borrowers (%)	Savings as % of loan portfolio	Repayment rate
Woreda Atsbi/Wemberta	-	69.9	30.1	17.9	79.1
Golgol Na'ele	4.1	67.8	32.2	2.2	83.8
Mikael Emba	7.3	80.7	19.3	0.8	79.4

Source: REST/DECSI, 2001 GC

Table 5.2. Output of DECSI on woreda and tabia level in 1993 EC.

	% of loan portfolio disbursed in Atsbi/Wemberta woreda	male borrowers (%)	female borrowers (%)	savings as % of loan portfolio	Repayment rate
Woreda Atsbi/Wemberta	-	77.6	22.4	25.6	-
Golgol Na'ele	5.9	63.4	36.6	3.7	91.3
Mikael Emba	8.1	72.4	27.6	2.8	95.0

Source: REST/DECSI, 2001 GC

5.1.2 The Bureau of Agriculture and Natural Resources - BoANR

The Bureau of Agriculture an Natural Resources was founded in 1983 EC. In 1986 EC almost all woredas of Tigray had their own branch. The Atsbi/Wemberta branch was established in 1984 EC. The Bureau of Agriculture has credit components in its rehabilitation and extension activities. As the bureau's main objective is to extend modern technology to farmers, the credit activities are directly or indirectly linked with extension work. Apart from the rehabilitation programmes, BoANR works with

different NGOs for the provision of agricultural and rural development credits by the latter.

Institutional environment and organisational structure

The BoANR is a governmental organisation. It has three main structures, i.e. on regional, zonal and woreda level. The structure of the regional Bureau of Agriculture extends from regional office at the top to development agents at the tabia level. All operational departments are represented from the regional to the woreda level. BoANR has three departments: the extension, regulation and administration department. The extension and regulation departments provide technical service through extension development agents (DA's) of different disciplines. These development agents are responsible for the contact with the farmers. BoANR focuses on rural farmers engaged in agricultural production and supply credit in kind (and before 1988 EC in cash).

Objectives of BoANR

The general objectives of the BoANR are the following:

- Providing regulatory and extension activities for the farmer in the field of agriculture and natural resources. To establish this extension service is provided on different disciplines (agronomy, irrigation, animal husbandry, forage development, environmental rehabilitation etc.).
- Rehabilitation of the degraded environment by undertaking programmes for soil and water conservation, grazing enrichment, area closures etc.
- Increasing the productivity of agriculture by undertaking practices like agronomy, crop protection, irrigation, moisture harvesting etc. to ensure food self-sufficiency.

The activities of BoANR with credit components have the following objectives:

- Rehabilitation of war and draught affected persons by provision of inputs on credit.
- Supply of agricultural inputs on credit to new technology adapters on demonstration plots.
- Facilitation of the development of farmers' cooperatives.
- To serve as a linkage between farmers and NGOs

Beneficiary selection and target groups

As the main objective of the BoANR is to extend modern technology to farmers, the credit activities of BoANR are directly or indirectly linked with extension work. Farmers who are believed to be the early adapters of new technologies are selected by the development agents to use the input at their land and serve as a demonstration for others. Improved and selected local seeds along with fertilisers are the main purpose of the loan. When these farmers are however in lack of cash to purchase the new technology, the bureau provides them on credit. Yet, the farmers have to pay a down payment of 25 percent. Repayment of the loan is made immediately after harvest. In addition to the early adapters of the new technology, producers of farm implements and irrigation systems are also provided credit. Water pumps and vegetable seeds have been given to irrigation users on credit. This type of loan charges an interest rate of 12.5 percent. The main objective of this loan is new technology adoption, not as such the credit component.

To rehabilitate draught and war affected persons until 1988 EC credit in cash was given by the Bureau, by the women's association and the like against an interest rate of 2 percent. Because of defaulting problems, the unwillingness or the inability of

farmers to repay (e.g. due to failures in productivity) it was decided that credit should come from one accountable sector, being DECSI. Now fertilisers, improved seeds etc. are provided by BoANR, but with credit from REST. BoANR only provides the materials, takes coupons from the farmers (who get these coupons from REST) and takes the money from REST.

Mode of operation

The following types of credit in kind are provided to the beneficiaries:
- Seed and fertilisers, for poor farmers involved in agronomy packages.
- Modern beehives.
- Heifers (improved milking cows), oxen, goats for by-products or fattening.
- Motor pumps, for irrigation.

Until 1993 EC taking fertiliser from the BoANR was mandatory. This obligation came from the ambition of development. The head office of BoANR was giving targets to the grass root level branches, which they had to fulfil. Farmers were given the possibility of taking this on credit, but after five years there were so many complaints from the farmers side that BoANR decided to change its policy. Nonetheless, compulsory fertiliser loans still exist. People at the grass root level are sometimes still working according to this former policy and since good results are established it is often left this way. This could be the explanation why farmers in Golgol Na'ele replied to have compulsory fertiliser loans and farmers in Mikael Emba stated that they were allowed to use only their own manure.

The source of fund for the credit activities of BoANR include different NGOs, like World Vision Ethiopia, Relief Society of Tigray, the Tigray Rural Development Programme and the Government. The responsibility for follow-up and loan repayment rests on the local administrative bodies, BoANR staff, and tabia development agents. Beneficiaries are required to be within the target group of the program and capable of using the loan effectively. To secure against default, group collateral is required.

Although it is not a savings institution itself, BoANR encourages rural savings by increasing income-generating capacities working closely with REST where it concerns credit activities. REST is increasing the saving culture of people by lending them money and teaching them how and why to save.

Financial performance BoANR

The financial performance and actual products disbursed on credit are presented in table 5.3 and 5.4.

Table 5.3. Financial performance of BoANR in woreda Atsbi/Wemberta from 1984-1993 EC

Total amount of loans disbursed (ETB)	5.978.282,60
Total amount of loans repaid (ETB)	1.894.058,90
Total amount of loans outstanding (ETB)	4.048.265,70

Source: BoANR 2001 GC

Table 5.4. In kind credit products distributed in woreda Atsbi/Wemberta from 1998-1993 EC

Heifer	37
Milking cows	18
Poultry	420
Modern beehive	305
Motor pump	10

Source: BoANR 2001 GC

5.1.3 Credit from the farmers' point of view

Above we described the formal institutions available to the farmers in the survey. In this section we will describe the credit use farmers point of view. To what extent do farmers know about this availability? And, if they know, to what extent are they using credit from these sources, for what purposes do they need credit, and what are the major problems with these institutions according to the households? These are some of the questions we will try to answer in this section.

Table 5.5 presents an overview of credit institutions available and the actual credit use from the farmers' point of view (in percentages). In the table a distinction is made between the two tabias in the survey.

Table 5.5. Credit institutions known by farmers and actual credit use in 1993 EC in tabias Golgol Na'ele and Mikael Emba (percentages)

Tabia	**Number of farmers**	**Available formal credit sources**		**Actual use of formal sources**	
		REST	**BoANR**	**REST**	**BoANR**
Golgol Na'ele	40	100	100	22.5	72.5
Mikael Emba	40	100	100	22.5	2.5

It is clear that all farmers in the survey are aware of the availability of formal credit in the area. However, not all households actually make use of this formal credit. Especially the use of fertiliser loans is low in tabia Mikael Emba. The reason for this lies in the fact that BoANR obliged the fertiliser loan for most farmers in Golgol Na'ele, but not for farmers in Mikael Emba. As explained above (paragraph 5.1.2) taking fertiliser from BoANR was obligatory until 1993 EC for all farmers in Tigray. Now it is no longer obligatory according to the head office of BoANR in Mekelle, though branches at the grass root level are sometimes still working according to this policy. As Golgol Na'ele and Mikael Emba have to do with different branches (respectively the branches in Atsbi and Haike Massal) a difference in policy exists between these tabias. Farmers in Mikael Emba are allowed to use only the manure from their own livestock.

Concerning the Relief Society of Rest there is no difference between both tabias. Of the forty farmers in each tabia, nine farmers are borrowing credit from REST. Main purposes for which credit from REST was obtained were in Golgol Na'ele to purchase livestock (78%), for trading activities (11%) and to purchase seeds (11%). Credit in Mikael Emba was mainly used to purchase livestock (56%), to purchase seeds (22%), for trading activities (11%) and for beekeeping (11%). On average households in Mikael Emba received higher amounts from REST (1037 ETB) than households in Golgol Na'ele (678 ETB). The amounts borrowed varied between 400 ETB and 1000 ETB in Golgol Na'ele and between 285 and 1900 ETB in Mikael Emba. Higher amounts received were used mainly for purchasing livestock or investments in trading activities.

All eighteen households using credit from REST responded that peer group lending was the most important collateral required. Farmers have to form groups with four to six other farmers in order to become eligible for a loan. In addition, 33 percent of the farmers in Mikael Emba replied to also have to be required to personally sign for their received loans.

According to the farmers, interest rates of the loans received from REST vary between 10 and 15 percent. The repayment period of the loans is maximum one year, but a first instalment has to be paid after six months.

To be eligible for loans from both BoANR and REST, farmers have to meet some requirements, like working in mass mobilisation for at least twenty days a year. In order to explore the knowledge of farmers on these requirements, farmers were asked to list obligations they had to fulfil in order to get credit from one of the institutions. Table 5.6 lists the answers given in percentages per tabia.

Table 5.6. Obligations to be eligible for loans listed by percentages of farmers from Golgol Na'ele and Mikael Emba

Obligations	Golgol Na'ele	Mikael Emba
Unknown	10	13
Peer group establishment	30	55
Participation in SWC/developmental activities	25	10
Be resident of the tabia	10	75
Involvement in tabia meetings	8	5
Participation in a local association, like peasant or women's association	18	13
Fertiliser loan form BoANR is obligation itself	73	0

Finally, all farmers in the survey (whether they were users from credit of REST and BoANR or not) were asked to list the main problems they had with the use of formal credit. For farmers in Golgol Na'ele the main problem related to formal credit use was their fear of repayment. Approximately 60 percent of the households responded to be afraid of failing in productivity and not being able to repay the loan received. In case of default interest rates will increase, increasing their burden even more. For many farmers in Golgol Na'ele this is a reason not to use credit at all. Approximately 35 percent of the households has problems with the mandatory fertiliser loan of BoANR. These problems are in the first place related to the risk that they will fail in productivity and as a result in repayment. The problem is that these households will be excluded from free-food-aid or food-for-work activities if they refuse to take the obligatory loan. Moreover, farmers in Golgol Na'ele claim that the use of chemical fertilisers does not increase production, as most of the time it is washed away by rain. Rather they prefer to use there own livestock's manure. The third problem concerning the use of formal credit relates to peer group establishment. An estimated 18 percent of the households claim to have difficulties in finding a peer group. One has to have collateral like assets in order to be allowed to join a group. Households are quite critical in establishing such groups as everyone is responsible for the members in the own peer group. If one of them defaults, the rest of the group has to repay the loan (15 percent of the households responded to have problems with this shared responsibility as they are having a hard time surviving themselves).

Farmers in Mikael Emba face the same problems concerning peer group establishment. An estimation of 48 percent of the households claim to have problems

finding such peer groups. Of the respondents, 40 percent replied to have problems with the shared responsibility of such groups, as this increases their risk to borrow money substantially. Furthermore, 25 percent of the households replied to be risk averse. They rather not borrow money from formal sources at all, as they fear the chance of failing in productivity (e.g. due to crop failure) and hence in repayment.

It seems that in the study area access to credit is not the bottleneck of development. It is rather the return to investments that discourage farmers to borrow money from formal credit sources to invest in soil and water conservation or chemical fertiliser use. Chemical fertilisers and soil and water conservation measures do not have major returns on a short-term basis. Of all households in the survey 26 percent applied for a loan from REST. An approximate 23 percent actually received a loan from this institution (only a few farmers were refused because they were not members of a required peer group). Of the farmers not applying for such loans, 48 percent responded not to do so because of fear of repayment as a result of failing in productivity. An approximate 25 percent of those households responded not to need credit sources. Moreover, 85 percent of the households in the survey replied to take more credit from formal sources if their capacity in terms of income and wealth was higher. An estimated 50 percent of those households responded to use the extra credit for trading activities and approximately 28 percent responded to use the credit for purchasing livestock.

5.2 Soil and Water Conservation in Tigray

Soil and water conservation is of major importance in Ethiopia and especially Tigray, as the region is faced by major land degradation problems, like soil erosion, soil nutrient depletion and soil moisture stress. The early settlement and expansion of agriculture, together with the steep terrain and the erratic and intense nature of the rainfall has caused erosion to be a major problem. The persistent deterioration of the quality of the cultivated land, the expanding gullies, and the poor yield, partially explained by the poor water holding capacity of the soil, suggest that soil erosion is a critical problem. Hagos *et al.* (1999) give an oversight of available estimates to sketch the magnitude of the problem. It was estimated that more than half of the area of the highlands of Tigray was severely degraded, with soils less than 35 cm deep. Tigray's soils are believed to have lost 30-50 percent of their productive capacities compared to their original state some 500 years ago. About 46 percent of the currently cultivable land is exposed to severe soil erosion, while two decades ago the cultivated land requiring soil and water conservation was estimated at 30 percent (Hagos *et al.*, 1999).

Besides soil erosion, soil nutrient depletion poses a related (and likely at least as critical) problem for agricultural disaster for agricultural production. For the extent of this problem, no estimates are available. Major causes of the high removal of nutrients are soil erosion, followed by a removal of harvested products and crop residues, the burning of dung and crop residues to satisfy household energy needs and the low addition of manure and chemical fertilisers (Stoorvogel and Smaling, 1990).

Soil erosion and nutrient depletion are exacerbated by, and also exacerbate, the problem of moisture stress inherent in the semi-arid environment of Tigray. The amount of rainfall, even in a normal year, is not sufficient to sustain normal crop growth in most parts of Tigray, unless water harvesting mechanisms or supplementary irrigation is introduced (Hagos *et al.*, 1999).

Especially the Eastern zone of Tigray, being a drought prone area, is characterised by the above situations with the prevailing recurrent critical food deficits.

Implications of these related natural resource problems include lower and less reliable crop yields, reduced grazing areas for livestock, decrease in soil water holding capacity and decrease in availability of fuelwood due to the degree of deforestation in the region. These are presumably the main reasons why crop production in most areas of Tigray does not reach the subsistence level.

As stated in the introduction of this paper assessment of both the ability and the willingness of farmers to invest in soil and water conservation is an important issue as both aspects can form serious constraints for improved, sustainable land management. Farmers' poverty reduces their ability of making investments, and even more when coupled with constrained accessibility to credit. Poor farmers living under severe material or cash needs have very short time horizons and thus are less able to plan or invest for the future (Shiferaw *et al*., 1998).

In the next sub-sections the socio-economic factors influencing farmers' decision to invest in soil and water conservation are discussed as well as government policies and programmes concerning land management, since these too might play a crucial role in farmers' decision-making regarding soil and water conservation.

5.2.1 Socio-economic factors influencing farmers' decision to invest in SWC

There are many indigenous soil and water conservation measures practised by farmers both on their cultivated and uncultivated lands. The practices are largely meant to mitigate the soil degradation problems and are highly integrated into the farming practices and have both production and protection objectives. Some of the traditional soil management and other farming practises performed by farmers in the region are manuring, crop rotating, intercropping, fallowing, terracing across farm lands, tree plantations and others.

There are several socio-economic factors influencing land degradation through their impacts on farmers' decisions regarding land use and land management practices, including practices of fallow, utilisation of manure, chemical fertiliser use, and adoption of soil and water conservation measures. These socio-economic constraints include the pressure of an increasing population, poverty, land tenure status, presence of existing land investments and, as discussed earlier, the ability to borrow funds. Each of these are considered below.

Population pressure

As stated before, rapid population growth is one of the main causes of land degradation problems in Ethiopia as this growing population places an increasing pressure on the agricultural resource base. Due to this fact land becomes relatively scarce and the process of agricultural intensification needs to take place more quickly than in other cases (Boserup, 1965). Agricultural intensification is traditionally associated with changes in land use and fallow periods. As the population density increases, changes occur in cropping techniques such as first expanding the area under cultivation, and when that is no longer possible, shortening fallow periods and increasing the labour input to satisfy the higher demand for food (Lele and Stone, 1989). In Tigray the increasing population pressure is forcing farmers to cultivate increasingly marginal land, including farming on steep and fragile soils, exacerbating erosion problems. The pressure on land makes the traditional agricultural systems for

generating soil fertility (e.g. utilisation of fallow and manure, terracing, and using crop residues) difficult to sustain. Moreover, population pressure may add to other problems, which in turn contribute to land degradation. It might worsen poverty, for example, as a result of resource constraints and decreasing returns to capital and labour in agriculture. Land tenure might become more insecure and farms might become more fragmented, as a result of new redistributions of land (Hagos *et al.*, 1999).

Poverty

Poverty is extreme in Tigray. Still many farmers are below the level of self-sufficiency and are dependent on free-food-aid or food-for-work programmes to sustain their lives. Poverty is one of many factors that has often been thought likely to affect investments. Poorer households are likely to have a higher rate of time preference suggesting that they will place relatively less weight on the future benefits of intensification (Lee and Barrett, 2001). Hence, poverty tends to increase farmers' short-term perspective. However, since conservation practices often require short-run expenditures for long-run productivity benefits, longer planning periods make conservation investments more attractive (Ervin and Ervin, 1982). Poverty thereby limits farmers' ability to purchase feed or livestock products and chemical fertilisers, contributing to overgrazing and soil nutrient depletion respectively. As stated in the subsection above, the combination of poverty and population growth worsens land degradation even more due to the limited access to resource constraints. People in such situations are trying to find alternative sources of livelihood, resulting in for example deforestation and burning of dung and crop residues as fuel source (Hagos *et al.*, 1999).

Land tenure status

Land is the most basic element in Tigray's peasant subsistence economy on which the livelihood of most of the rural population is determined by his relation to the land. Ethiopia, and Tigray in particular, has known several land tenure arrangements during the past decades. Some of these will be discussed below in relation to tenure security, a major aspect of tenure arrangements influencing farmers' decisions regarding land management.

Prior to Italian occupation, particularly during the time of emperor Menelik at the end of the 19th century, there where three major traditional tenure systems in Ethiopia. These were the *Risti* system, the *Gulti* system and the village ownership tenure system. The Risti system was prevalent in most parts of Tigray. It was a system with family ownership with individual inheritance of land rights. In areas where this system predominated, the rural community was composed of an extended family whose individual members had a specific right to a share of a given area of land by virtue of their descent from the original settler or head of the family (Tigray planning and economic development bureau, 1997). Among the major problems that associated the system were the frequent and continual pressure to obtain land by the extended family that reinforced fragmentation of land. Moreover the system led to deterioration in the quality of land, as land distributions were periodically undertaken to ensure that every member of the family was granted access. The principle of equal division governed land distribution, with land divided into sections according to quality and than allocated by lottery (Hagos *et al.*, 1999).

During the post-Italian period a relaxed extension of the previous tenure system was prevailed. The Gulti system of tenure emerged with the strengthening of the central

imperial power. The original occupants of the land became tenants, and worked as sharecropping tenants of the Gulti-holding landlords. Prevalence of such tenancy arrangements was much lower in the North. Nonetheless, holders of Risti-rights were required to pay tribute to local church and secular authorities that administered communities under Gulti rights (Hagos *et al.*, 1999).

In the village owner tenure system land was periodically redistributed, usually in the admission of new comers into the community and when individual farmers called a redistribution to ensure fairer distribution. In general this system avoided absenteeism and concentration of land in the hands of few. In this tenure system land was being distributed by the village head. Individual usufructs were limited to periods between the redistribution. Besides, during the system the rights to use church land was also more relaxed and those who provided the required service to the church had unlimited right to the land (Tigray planning and economic development bureau, 1997).

The *Derg* (the name given to the military government) proclaimed the land reform legislation of March 1975. With the aim of transforming the nature of agrarian relations and agricultural production in the country. Land was proclaimed to be the collective property of the Ethiopian people and redistributed to the tillers (Hagos *et al.*, 1999) to avoid exploitation of farmers by landlords. Any person willing to cultivate land was to be allocated land sufficient for his needs. Ten hectares was fixed as the maximum land holding. Farmers themselves did participate actively in the decision making process through the peasant association, responsible for land redistribution and management of common pool resources. However, the absence of clearly defined rights to natural resources led to a situation of insecurity and hence less efforts in land management. The reallocation of land and the increasing population growth reduced individual land holdings to uneconomical levels (Tigray planning and economic development bureau, 1997).

The last big land redistribution was in the period between 1991 and 1993 GC (i.e. around 1985 EC). The government decided this land redistribution because of unequal distribution and due to the increasing population. Criteria for this redistribution were family size and animal resource owned. The bigger the family, the larger the received plots but the larger the livestock, the smaller the plot as one was expected to have an income source from the animals (Bureau of Agriculture and Natural Resources, 2001). In most communities, land was redistributed until 1983 EC to accommodate young families and returnees from settlement areas, resulting in more fragmentation of holdings.

Since 1983 EC, land redistribution has stopped in Tigray, and the current land policy in Tigray formally prohibits further land redistribution, except where public irrigation or other major investments in infrastructure are being made. However, due to the major land redistributions made in the past, farmers feel insecure about their rights and property. They may expect to use land for an undetermined period of time, but feel that there is some risk that they will lose this right in the future. This makes the possibility for them to invest in their land less likely than in cases where farmers feel secure about the tenure as their incentives for investments are much lower.

Ability to borrow funds

Shortage of capital can be one of the constraints to farmers' adoption of modern technologies and inputs. Borrowed funds (like off-farm income) can indicate supplemental income for financing conservation expenditures. Alternatively, it could

reflect the need for supplemental income for family living expenses or essential farm production expenses other than conservation (Ervin and Ervin, 1982). In Tigray, rural credit is provided by REST and (in the form of inputs) by BoANR. An assessment was made on the linkage between such an institution and soil and water conservation investments. It seems that farmers are restricted from the services from REST as long as they do not participate in the governmental mass mobilisation program, a soil and water conservation program in which each farmer is obliged to participate at least 20 days a year. In the survey done, no farmer borrowing from REST borrowed with the purpose of erosion control. Maybe this is the case in Tigray as most conservation investments are done by the government and are almost never private. In the next section 'presence of existing land investments' we will step into more detail about this. Most farmers in the survey used credit from BoANR in the form of fertilisers or improved seeds. However, most farmers responded that this fertiliser loan was a mandatory loan. According to Holden and Shiferaw (2001) unlimited availability of credit for fertiliser use to replenish soil nutrient loss due to erosion discourages farmers to undertake physical soil conservation structures.

Presence of existing land investments

The Ethiopian government, in co-operation with several non-government organisations (NGOs), has focused on participatory programmes and projects regarding land management in which farmers participate by contributing labour. This too plays a crucial role in affecting farmers' decisions with regard to land management. Of all eighty farmers in the survey only six farmers had no soil and water conservation measures on its plots. All households with SWC measures responded to have acquired the measures through government action and not through private investments. Government extension programmes like mass mobilisation and food-for-work (see for more detail next section) might reduce the incentive of farmers to take action themselves.

5.2.2 Government programmes of soil and water conservation

Despite the increasing land degradation in the highlands of Tigray, soil and water conservation was neglected for a long time. Only since the 1970s large efforts to promote soil and water conservation have been undertaken in Tigray to reverse the land degradation process. Terracing and afforestation programmes started in 1970 under a USAID-sponsored food-for-work programme. The effort was further expanded with the involvement of the UN/FAO World Food Programme (Holden and Shiferaw, 1999). The initial stage of implementation had technical failures in the alignment of terraces, poorly organised nurseries, incorrect spacing and inappropriate choice of species (Hagos *et al.*, 1999). Moreover, the top-down planning, lack of participation and proper planning, have contributed to the inefficiency of past conservation programs.

Since the early 1980s soil and water conservation activities have become one of the major preoccupations of the people and the authorities. This has involved mass mobilisation of labour as well as food-for-work programmes (Hagos *et al.*, 1999).

Conservation technologies on arable land are dominated by physical structures, commonly the stone and/or soil bunds, diversion ditches and check dams. Both the physical and biological conservation measures on uncultivated lands are mainly the area closures (natural vegetation), tree and stripe grass, trench bunds, hill side terraces, check dams, cut off drains, waterways and gully plantations.

On arable land the physical structures have multiple functions such as water harvesting, soil trapping and slope modification (bench terrace development), while biological conservation measures have functions like water storage (infiltration), management of run-off, protection of soil surface and production of multifunctional species of trees and fodder grass (Tigray planning and economic development bureau, 1997).

There are clearly defined tenures of performing the communal conservation works in the rural communities of the zone. Development committees are established in each tabia responsible for scheduling work, developing norms and mobilisation of labour and necessary tools in co-operation with development agents. Moreover, at the general meeting of the community evaluations are conducted on previous SWC work and on responsible persons like group leaders, agricultural cadres and level men.

During the mass mobilisation in SWC works, the following guidelines are applied:

- Due to the seriousness of the erosion problem every capable member of the community above the age of 14 (regardless of gender, wealth status and possession of land) is obliged to contribute labour to the programme. The screening age level of 14 might decrease with availability of adults.
- During the slack period (mostly November and December) there are 20 days of SWC works where an individual should accomplish at least a length of 140 meters of soil or stone bunds. Hence, in general each worker should establish 7 meters a day. However, this also depends on the type of structure one has to build, the condition of the area (flat/hilly) and the availability of resources (e.g. stones/sand). For females the amount is set on 3.5 meters per working day.
- The work is performed in groups, *Gugille*, consisting of eight to ten people.
- Every day supervision and evaluation (on the quality of the work) is done by the group leaders and agricultural cadres.
- Individuals failing to participate in the SWC works will be penalised in cash or are excluded from any benefits coming to the community (food-for-work, free-food-aid, credit from REST and others).
- Twenty days per year are unpaid, but indirectly farmers benefit from the development and further benefits coming to the community as described above (Tigray planning and economic development bureau, 1997; BoANR, 2001).

Besides mass mobilisation for soil and water conservation, food-for-work activities are organised in the tabias. In Golgol Na'ele this food-for-work programme is called the model site programme. The activities are the same, only the way of payment slightly differs from the food-for-work programme in tabia Mikael Emba:

- Activities in food-for-work programmes include mainly soil and water conservation activities. However, rural road maintenance, construction work (of schools/clinics etceteras) is possible.
- Model site workers in Golgol Na'ele receive 3 kg of grains per working day. Food-for-work participants in Mikael Emba receive 12.5 kg of grains per four working days per month.
- The amount of work to be done is quantified by the woreda expert on a contractual base depending on the type of work, the condition of the area etceteras.
- Participant selection is done in the following way: first a food aid quota for each woreda is set by zonal and regional authorities, based on crop assessment and food stock information. The *baito* (woreda district council) then allocates quota to the tabias. Each tabia has a relief and rehabilitation committee of three to five people,

which drafts a list of beneficiaries. The general assembly of the tabia then discusses the list for approval and may vote of who should be included or excluded, based on off-farm income, the ownership of oxen or other livestock and remittances received (priority is given to the poorest people) and on the participation in the mass mobilisation programme (BoANR, 2001; Gebremedhin and Swinton, 2000).

These soil and water conservation programmes are initiated by the government through the Bureau of Agriculture and Natural Resources. BoANR is collaborating with the following organisations: IFAD (International Fund for Agricultural Development), WFP (World Food Programme), EGS (Employment Generating Scheme), WVE (World Vision Ethiopia), and TRDP (Tigray Regional Development Program). Basically World Vision Ethiopia (a non-governmental organisation) is the resource provider. WVE gets its resources from (non)secular donors from abroad among which USAID, both in cash and in kind (grains, oil, vitamins etceteras). All SWC in the woreda Atsbi/Wemberta is done with this money and these grains. The Employment Generating Scheme is an organisation used as a kind of guideline in regulating the food-for-work programmes. The IFAD is mainly occupied with SWC activity interventions, providing BoANR with computers, vehicles and alike in the form of nominal credit on a long term basis. The BoANR itself provides resources (materials, but also mobilisation of people), staff and technical supervision for all activities. Also REST (the Relief Society of Tigray) is working together with BoANR in the implementation of SWC projects in all zones of Tigray. They especially have a collaboration in the so-called packages. Fertilisers, improved seeds (and sometimes pesticides) and other materials like beehives are given either on cash or on credit basis by BoANR., the latter in collaboration with DECSI/REST. Farmers borrow money from DECSI, and are not actually given cash, but coupons. With these coupons they can go to the BoANR for the materials needed.

In the light of this research it is important to explore the relation of soil and water conservation and the provided credit by the above mentioned credit institutions. It is evident that both BoANR and REST are, besides credit provision, involved in SWC programmes, the activities of which described above.

Concerning REST, provided credits are not directly linked with soil and water conservation in the research area. The in kind loans of BoANR, especially the ones of fertilisers and improved seeds, are more directly linked with soil and water conservation in the fact that chemical fertilisers and soil and water conservation structures are presumed to be technically complementary. Nonetheless, to some extent both loans are indirectly linked to soil and water conservation: one of the criteria to be eligible for a loan is to be resident of a specific area and to involve in all developmental activities in that area, including soil and water conservation activities.

6 Relations between formal credit and soil and water conservation

This chapter presents the analysis of this research and its results. To explore the specific household characteristics influencing credit use and behaviour towards soil and water conservation measures, we made use of descriptive analysis and binary logistic regression. Opposed to what was thought at the time of writing the proposal for this research, investments in soil and water conservation are not individual decisions in the two study sites, due to provided programmes like mass mobilisation and food for work. As a starting point for analysis, therefore, the choice had been made to subdivide the households in the data set according to their activities related to soil and water conservation and credit. Three groups of households could be distinguished, which will be discussed in more detail below. Logistic regression is a linear probability regression technique that could be a useful tool in analysing dichotomous-choice problems, like in this case the problem of belonging or not belonging to a certain group. There are two commonly used Qualitative Response (QR) models: probit and logit regression models. The probit model uses the cumulative standard normal distribution of the continuous probabilities. The logit-model uses the logistic cumulative distribution function. To determine the strength of influence household characteristics have upon the household's combination of activities related to soil and water conservation and credit binary logistic regression (BLR) is used. The dependent variable of the function estimated with the binary logistic method is either zero (no) or one (yes) as answer on the question if the household concerned belongs to a certain group or not. This means that the dependent variable is a binary variable. Binary choice models are suited to deal with these types of dependent variables. They assume that individuals, in this case households, are faced with two alternatives and that the choice depends on identifiable characteristics (Pindyck and Rubinfeld, 1998).

As discussed in chapter five, there are two formal credit institutions available to the farmers in the study area, REST and BoANR. A more detailed exploration of credit use was done using probit analysis in order to analyse what factors determine whether farmers take credit from REST, from BoANR, from both or not at all? A probit specification is designed to analyse data reflecting a choice between two alternatives, in this case, the choice to borrow credit from a specific formal source or not. The dependent variable in the probit model, y_t, always takes the value of zero or one. Typically, y_t is assigned the value of one when the event in question, for example borrowing money from REST, occurs. The probit specification then provides a model of the probability of observing $y_t = 1$ (Eviews user's guide, 1994).

The intention was also to estimate the link between credit and SWC in a two-stage procedure. The idea was to determine the influence of certain household characteristics on the use of a formal loan, under the condition that households had soil and water conservation structures on at least one of their plots. Due to multicollinearity in the data set this was not possible. Collinearity is the expression of the relationship between two (collinearity) or more (multicollinearity) independent variables. Multicollinearity occurs when any single independent variable is highly correlated with a set of other independent variables (Hair *et al.*, 1998). As stated before, there was hardly any variability between the values of the variables in the data set. The two-stage procedure predicted a perfect model, as it appeared that all farmers having SWC (74 out of 80), also had a formal loan. An extreme case of (multi)collinearity is singularity. Singularity occurred in the probit analysis and will be discussed below.

6.1 Factors influencing farmers' credit use and conservation decisions

To explore the specific household characteristics influencing credit use and behaviour towards soil and water conservation measures, we divided the households in the survey according to their activities related to soil and water conservation and credit. The following activities were selected to examine possible differences among all eighty households:

- Every household should have soil bunds, stone faced trench bunds or suchlike on at least one of its plots. This means that households having no soil and water conservation structures on any of its plots are excluded from this part of the analysis. This was decided because it appeared that having these structures is not an individual decision of the household. SWC structures are mainly implemented by the government through mass mobilisation and food-for-work programmes (see also chapter 5.2.2). Moreover, all farmers not having SWC in the survey responded to be on the list of getting these structures on their plots in the near future. A total of six farmers were excluded for this reason.
- Since the use of artificial fertilisers is one form of investments in soil and water conservation, albeit a short-term one, it is important to examine which farmers use fertilisers and to what extend it is used.
- To explore the possible role of credit in this all, a third activity examined is the use of formal loans. All farmers borrowing credit from REST, BoANR or both are included as formal credit-users. Informal loans were excluded from the analysis, as there was a lot of missing information on this subject.

All these activities were entered in the data set as binomial variables (zero for not taking part in the activity and one for taking part in the activity). Subsequently, individual households could be clustered based on a certain combination of the above-mentioned activities. The following groups could be distinguished:

- A group in which all households have soil and water conservation structures on at least one of their plots, make use of fertilisers, and in which all households are borrowers of a formal credit source, either BoANR or REST or both.
- A group in which all households have soil and water conservation structures on at least one of their plots and all households make use of fertilisers, but in no use is made of a formal credit source.
- A group in which the households all have soil and water conservation structures on their plots but none of the households make use of fertilisers. Only a few of these households make use of a formal credit source (BoANR or REST, not both).

The three groups that could be distinguished and their activities are specified in table 6.1.

Table 6.1. Activities of households in the sample

Groups	Number of households	SWC (%)	Fertiliser use (%)	Average fertiliser use (kg/tsmad)	Formal credit (%)			
					Total (%)	Only BoANR (%)	Only REST (%)	Both (%)
1	36	100	100	16	100	58	22	19
2	20	100	100	22	0	0	0	0
3	18	100	0	0	28	11	17	0
Total	**74**	**100**	**76**	**14**	**55**	**31**	**15**	**9**

6.1.1 Hypothesis and selection of variables

One of the basic assumptions regarding the distinction of the groups is that soil and water conservation structures and fertiliser use are technically complementary in the sense that a combination of the two would increase the yield (crop production per land unit, i.e. per tsmad) substantially. Groups 1 and 2 are therefore expected to gain higher yields than the third group.

Another assumption concerns the income of the three groups. Group 3 is expected to be the poorest group of all, since households in this group are not using chemical fertilisers at all. The reason for this lies presumably in the fact that they cannot afford to purchase these chemical fertilisers and are reliant on their own livestock's manure for keeping up the nutrient balance in their land. As the households in the other groups do use chemical fertilisers it is also expected that manure use (in kg/tsmad) is highest in group 3. Group 2 is expected to be the richest group, as they seem to be able to purchase and use the chemical fertilisers from their own income resources. This use is not associated with additional (borrowed) money as no one uses any form of formal credit.

These hypotheses are first analysed using independent-sample t-tests for various variables. Average values and standard deviations of variables are presented for each group in annex 4.

The variables used for binary logistic regression can be divided into three main groups, i.e. household characteristics, production or economic features and institutional features (see annex 5 for definition and coding of the included variables). Variables used, and reasons for their utilisation are presented below.

Household characteristics

Education is expected to have a positive effect on both soil and water conservation (including fertiliser use) and credit utilisation. Higher educated farmers are presumed to have a better knowledge about the role of innovations with respect to land degradation and improved production capacity. It is also expected that farmers' knowledge on the procedures of getting formal credit increases with the level of education (Kashuliza and Kydd, 1996). Lower educated farmers are likely to be ignorant of the formal credit sources and sceptical on its use or role in e.g. investing in innovations. The level of education of the head of the household is included in the analysis as well as the highest level of education within the household.

Gender is expected to be an important discriminant variable for the groups studied. Rural institutions in general may be male-biased (Moll, 2001). These rural institutions include credit-providing institutions and institutions involved in agricultural extension. It is often suspected that female heads of households have a more restrained access to at least formal credit institutions than males because of their generally lesser education and social and cultural constraints (Kashuliza and Kydd, 1996). However, in this thesis gender is expected to have a positive relation to credit use as REST claims to give priority to females in its credit provision.

Age is also expected to play an important role in the groups distinction as age is presumed to be linked with experience in farming. Experienced farmers are more likely to be favoured by credit channels in comparison to beginning (mostly young) farmers who would be perceived as high-risk clients (Kashuliza and Kydd, 1996).

Young farmers are therefore likely to have restricted access to formal credit. Another assumption is that experienced farmers are more likely to see a positive role for soil and water conservation investments, like chemical fertiliser use (or application of SWC structures).

For the same reason the household size (measured as the total number of members within the household) is included in the analysis. Larger households usually have more adults engaged in farming and hence an increased possibility of experience.

The main occupation of the head of the household is an important variable to include in the analysis. This variable indicates whether the occupation of the household head is in the first place related to agriculture or not. It is expected that households mainly working in agriculture are more involved in agriculture-related activities than households whose main occupation is in another sector.

Production /economic features

The total farm size can be seen as a criterion for provision of credit to farmers, as land is often used as collateral. In this context, it is expected that farmers with relatively larger farms often receive and use more credit than farmers with smaller farms. Moreover the total available land is assumed to relate to the amount of yield, and therefore income. This is expected to have a positive relation with investments in SWC applications and/or fertilisers. To make up for differences in household sizes, area per member of the household is also included.

In order to incorporate a farmer's possibility of attaining extra land, the percentage of sharecropped in land (percentage of total area) is entered into the model. Sharecropping in is the only way for farmers in Tigray to get an extra unit of land. The amount available for farming is expected to relate positively with surpluses and the possibility of farmers sharecropping in land increases their total available land. Farmers sharecropping in land are expected to have more relations with credit institutions as they have to pay rent (usufruct) to the owner of the land and need more inputs (oxen-power, seeds, fertilisers etc.).

The percentage of irrigated land (related to the total area) is also expected to play a role in the groups distinction, as farmers having (some) irrigated land are expected to have more knowledge on the use of fertilisers and soil and water conservation. Farmers in Tigray having irrigated land are carefully trained in order to cultivate their land properly. Irrigation substantially increases the production capacity of land an, similarly as total land availability, is expected to raise the likelihood of SWC application and investments in fertilisers.

Asset ownership, i.e. the average value of durable goods owned, value of in kind savings and the value of the total livestock during last year (1993 EC) is incorporated in the model as total wealth. These variables offer an indication of credit demand, and of repayment capacity. In cash savings are not included as it can be seen as a resultant of having credit. As explained in chapter four, the Relief Society of Tigray is encouraging rural savings to their client by, among others, forcing them to save to secure default.

The average use of manure, instead of or next to fertilisers, is also an important discriminant variable for the groups studied. It is expected that the availability (and hence the use) of manure decreases the willingness of farmers to invest in fertilisers.

The income retrieved from off-farm labour is expected to relate positively with investments in soil and water conservation and negatively to credit demand.

Institutional features

Household participation in food markets is also included as an independent variable. A household is considered to participate in food markets if it had sold part of its yield in 1993 EC. The variable included to measure this is the value of crops sold.

The households' membership of local village organisations is expected to increase access to credit and investments in soil and water conservation as it is presumed that farmers are informed through these organisations about the role of innovations and credit use. From these local organisations the following are included in the analysis: participation of the household in the peasant or woman's association, and the participation of the household in soil and water conservation programmes like food for work and model site. The latter two are included as one variable, as the type of work and payment is quite the same and farmers are working voluntarily in one of these organisations. The difference is only the location of the programmes. Mass mobilisation is not included as separate independent variable as farmers are obliged to spend at least 20 days per year in this programme (unpaid) and all farmers participate in it.

6.1.2 Results

Figure 6.1 shows the average value of crop production per tsmad per household for each group in 1993 EC (this value is measured by the market price of each crop, where the price of consumed crops can be seen as opportunity costs of not selling). Average output value of the crops is taken as basis and not the total amount in kilograms harvested, as no conversion factor was known to measure each crop to its relative output. Groups 1 and 2 clearly have higher values than group 3, as was expected (see annex 4 for t-tests and means per group). It seems that the combination of chemical fertiliser and SWC structures is technically complementary indeed, as it clearly results in a higher yield value for those groups using this combination. However, we should look at possible other reasons for these differences before we state that SWC and fertiliser use are technically complementary. One explanation for these differences in average yield value could be found in the degree of land degradation. Land degradation is difficult to measure, however degradation is expected to be worse on hilly or steep plots. Between the groups a significant difference in steepness of the cultivated area could not be found.

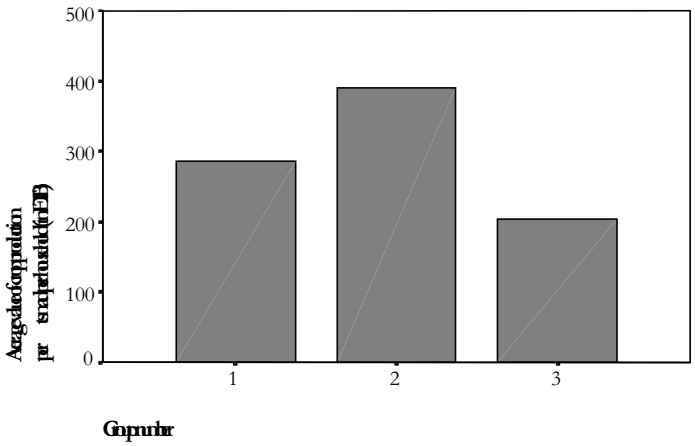

Figure 6-1. Average value of crop production per tsmad per household for each group

Another explanation for the difference in crop yield between the groups could concern the type of crops harvested. Table 6.2 presents the percentages of crops harvested by each group in 1993 EC (measured by percentage of total cultivated area).

Table 6.2. Crops harvested by group 1, 2 and 3 and average of all groups in 1993 EC (% of cultivated area)

Crops	Group 1	Group 2	Group 3	Average
Barley	42	34	37	38
Wheat	28	23	39	31
Teff	3	16	4	6
Chickpea	11	13	10	11
Fababean	16	8	7	12
Linseed	-	3	-	1
Lentil	-	3	3	1

For each group the two main crops are barley and wheat. As these crops are for each groups measured against the same values, the difference cannot be explained by this. However, for the second group teff also forms a major crop next to barley and wheat with an estimated 16% per tsmad (on average). Since teff is one of the most expensive crops, this cropping pattern presumably clarifies part the difference in value of yield between all groups, but in any case the difference in output between group 1 and group 2. Another possible reason for the difference in value between group 1 and 2 is the amount of fertilisers used by the groups. Households in the second group use significantly higher amounts of chemical fertilisers (16, 22 and 0 kg/tsmad for group 1, 2 and 3 respectively).

When comparing the income of the three groups we don't take the total average income of the groups as a measure, as this is partly a resultant from soil and water conservation programmes and credit use. In order to avoid a bias we rather look at income derived from off-farm work, crop and livestock production and remittances. Figure 6.2 presents the total average income per capita per group (total value of all mentioned income-components), showing that group 2 is on average the richest group, as was expected. Group 3 appears to be the poorest group, which is also according to

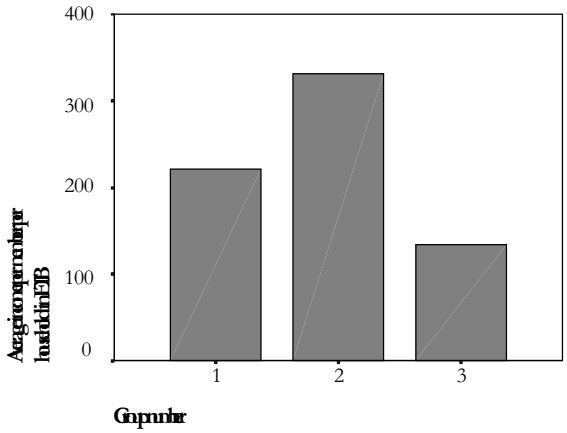

Figure 6-2. Average income per capita for each group in 1993 EC (in ETB)

the expectation. Group 3 seems not to be able to purchase chemical fertilisers from own resources. Some of the households in this group (11%) might therefore use the fertiliser loan of BoANR, others use only the manure from their own livestock. Manure use might be significantly highest in this group for this reason (manure use is 264, 222 and 401 kg/tsmad for group 1, 2 and 3 respectively). As explained above (table 6.2), their cropping pattern does not really differ from that of households in other groups, so differences in manure use per tsmad cannot be explained by that. Households in group 2 however, seem to be able to purchase fertilisers from own resources as no utilisation is made of fertiliser loans in this group.

In order to clearly understand the differences in income between the groups, the income-components are presented separately in figure 6.4. Now we see significant differences between group 1 and 2 in crop and livestock production, and between group 2 and 3 in crop production. Households in group 2 also have a significant higher income per capita from off-farm labour and remittances.

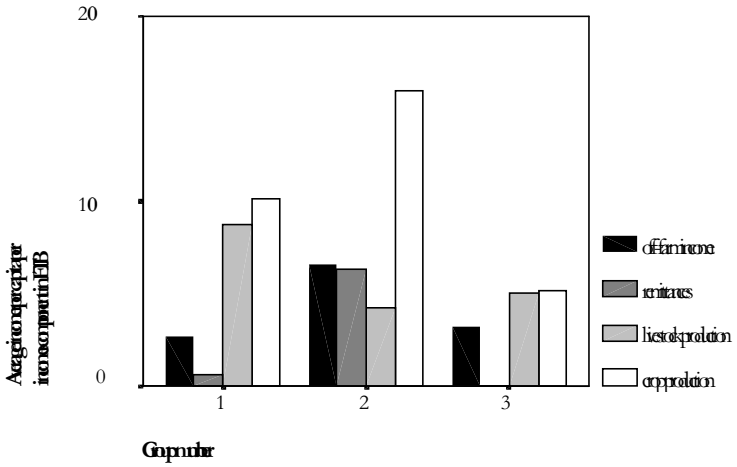

Figure 6-3. Average of income components per capita for each group in 1993 EC (in ETB)

Besides income we also take into account the average wealth of the groups. Wealth is determined here by adding the total value of assets owned, the value of livestock and the value of the in kind savings (savings in cash are not taken into consideration as these are most often a resultant from borrowing money from REST). Figure 6.5 presents the level of wealth for each group in 1993 EC (per capita). The level of income per capita is also shown in order to make a comparison with households' wealth.

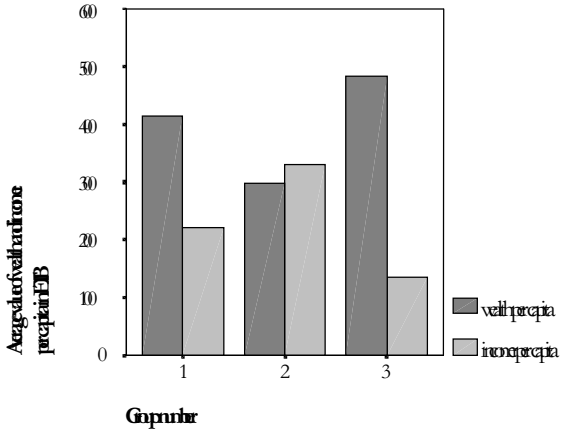

Figure 6-4. Income and wealth per capita for each group in 1993 EC (in ETB)

The average wealth per capita of households in group 2 is lower than that of the other groups. The fact that none of the households in group 2 are formal credit users can be explained by this lower wealth as wealth, or assets are often used as collateral. It seems that group 2 is constrained in their access to credit due to shortage of assets. They are dependent on income sources like off-farm labour for the purchase of chemical fertilisers. On the other hand, these farmers seem to be able to purchase chemical fertilisers from own resources and may therefore be demand-constrained regarding credit. They might not be willing to borrow credit from formal institutions, as they do not need this credit. Whether these farmers are demand- or supply-constrained when it concerns credit is not clear. In binary logistic regression we will go into more detail regarding this issue. The wealth of households in group 3 is significantly higher than their income. Households in group 3 are clearly not able to purchase chemical fertilisers from own income-resources. Approximately 30 percent of these households therefore use formal credit. Surprisingly, the level of wealth is higher in group 3 than in group 1. One would expect the opposite as all farmers in group 1 are credit users (hence none of these households are constrained in access to credit). It seems that farmers in group 3 are therefore not supply-constrained but demand-constrained where it concerns credit use.

So far, we discussed some major differences between the three groups based on differences in mean values (see for these values annex 4). Binary logistic regression was used to determine which characters predict whether a household belongs to group 1, 2 or 3. Binary logistic regression was executed three times, one time for each group (see annex 6, annex-tables 6.1.1, 6.2.1 and 6.3.1 for the complete output of the regression for each group). Each group is compared to the total of households belonging to other groups. In this way it is examined which variables in the data set more or less account for the fact that farmers have a certain conservation and/or borrowing behaviour.

Group 1

The characteristics of the households belonging to group 1 (those farmers using SWC, fertiliser and formal credit) are compared with the characteristics of all other households (annex-table 6.1.2, annex 6). Logistic regression resulted in four significant characteristics. Wealth of the household is positively related to the classification in group 1. The total days per year the household worked in other SWC programmes than mass mobilisation, the income received from off-farm labour

activities and the average amount of manure used per tsmad are negatively related to the classification in group 1. The households in this group are thus on average wealthier than other households, strengthening the assumption that wealth is an indicator for repayment capacity. Group 1 spends less days per year in organised voluntary soil and water conservation programmes and receives less income from off-farm activities (hence participate less in off-farm work) than the other households. Also households in group 1 use on average less kilograms of manure per tsmad, which might be a resultant from their use of chemical fertilisers. Spending fewer days in organised (voluntary) SWC programmes does not result in less conservation structures on the farmers' plots. The percentage of land conserved with SWC structures was calculated for each group, resulting in 91, 80 and 94 percent of total area owned for group 1, 2 and 3 respectively. However, the fact that farmers in this group work on average fewer days per year in these programmes means that they receive less food-for-work than other households. Together with the fact that they also generate a lower income from off-farm activities, one might say that households in group 1 are constrained in income (in cash and in kind) received. These constraints in income generating activities seem to urge them to borrow money from formal sources for consumption/fertilisers and other.

Group 2

The characteristics of the households belonging to group 2 are compared with those of all other households in annex-table 6.2.2, annex 6. For group 2, logistic analysis resulted in nine significant characteristics (significance level between 0,01 and 0,1): the area per member of the household, the percentage of sharecropped in land, and the income from off-farm labour are positively related to the classification in group 2. Also positively related to this classification are the age of the household head, the main occupation of the household head and the total days per year the household works in SWC programmes other than mass mobilisation. The number of people in the households, the average wealth of the households and gender of the household head are negatively related to the classification in group 2. Household heads in group 2 are thus on average older, more engaged in agriculture and with fewer household members than other households. There are more female heads than in other households. They are less wealthy, but earn more income from off-farm labour. They have a higher percentage of sharecropped in land, have on average more land per household member (presumably due to the fact that they are with less members and sharecrop in a significant number of tsmad) and spend more days a year working in voluntary SWC programmes. Households in group 2 receive significantly more income from off-farm activities and for example SWC programmes (as they are spending more days per year on average than other households). It was already observed that farmers in group 2 have per capita a higher income from crop production, off-farm labour and remittances per capita. Now it appears that they also receive a significant higher amount of grains through SWC programmes. Though these farmers are less wealthy (in assets) than others, they seem to have more liquid means and are therefore able to purchase inputs and consumption goods from resources other than credit institutions.

Group 3

In annex-table 6.3.2 of annex 6 the characteristics of the households belonging to group 3 are compared with the households of other groups. Logistic regression resulted in four significant characteristics: the education of the head of the household and his/her age are negatively related to the classification of households in group 3 as well as income from off-farm labour activities. Average wealth is positively related to

the classification in group 3. Hence, household heads in group 3 are less educated than all other household heads and they are on average younger. The fact that these households are not using chemical fertilisers and most of them are not using formal credit is in line with the expectation concerning education and age. Lower educated farmers were expected to be ignorant of the formal credit sources and sceptical on its use or role in e.g. investing in innovations. Moreover, young farmers were expected to have restricted access to formal credit. They are not that experienced and are therefore perceived as high-risk clients. Households in group 3 are on average more wealthy than all other households together and earn less money from off-farm labour than others. If we compare the average values of wealth per household, group 3 is less wealthy than group 1 but wealthier than group 2. This means that these farmers might be less constrained in access to formal credit than farmers in group 2 (30 per cent of the households in group 3 are formal credit users). On the other hand, since their income from off-farm labour is significantly lower than that of other groups, these farmers might be demand-constraint regarding credit use from formal institutions, as their repayment capacity in case of a bad production year is quite low.

The characteristics of the households in the three groups are summarised in table 6.3 with the average values and significant characteristics indicated per group.

Table 6.3. Average values of variables per household per group and indicated significant characteristics

Characteristics	Group 1	Sig.	Group 2	Sig.	Group 3	Sig.
Number	36		20		18	
Education of head[3]	0.69		0.55		0.39	**
Highest education within household[3]	2.03		1.55		1.44	
Sex of household head						
Female (%)	5.60		20.00	*	22.20	
Male (%)	94.40		80.00		77.80	
Age of household head (years)	46		50	***	35	***
Number of members	6.33		5.40	**	4.61	
Farming as main occupation (% yes)	91.70		85.00	*	66.70	
Total area owned by the household (in tsmad)	2.35		2.03		1.33	
Total area owned by the household per member (in tsmad)	0.39		0.42	**	0.31	
Percentage of sharecropped in land	5.86		10.33	***	7.41	
Percentage of irrigated land	1.58		1.86		0.00	
Value of wealth of the household (in ETB)	2644.39	**	1550.51	***	1987.14	*
Average manure used (in kg)	264.24	*	221.80		401.18	
Income from off farm labour (in ETB)	151.67	**	333.75	***	116.67	**
Value of crops sold (in ETB)	28.06		30.80		8.72	
Member of peasant association (% yes)	75.00		65.00		33.30	
Member of women association (% yes)	80.60		80.00		88.90%	
Participation in other SWC programmes (days/year)	55.92	**	93.85	**	111.78	

(*) indicates that the value of the characteristic is significantly different at 0.10
(**) indicates that the value of the characteristic is significantly different at 0.05
(***) indicates that the value of the characteristic is significantly different at 0.01

From this table it appears that the characteristics wealth and income from off-farm labour form the main distinctions among the households in the three groups. The

[3] Education was included in the model as an ordinal variable (coding 1-4), but is treated here as a nominal variable.

average wealth per household was positively related to classification in groups were formal credit was used. Hence, wealth goes together with formal credit related activities. Wealth was initially incorporated into the model as an indicator of credit demand and repayment capacity. It appears that more wealthy farmers have relations with credit institutions, presumably due to the fact that this wealth ensures repayment (assets and livestock are often used as collateral by credit institutions). Income received from off-farm labour was negatively related to classification in groups were formal credit was used and hence, goes together with a decrease in formal credit related activities. This implies that farmers not using formal credit sources rely more on off-farm activities than farmers who do use credit from formal institutions. Before, the question was raised if those farmers not using formal credit are constrained in their access to institutions providing credit or if they are rather demand-constrained. If we look at the results presented in chapter five, we see that only 26 percent of the household in the survey applied for a loan from REST. Approximately 3 percent were refused by the institution due to the fact that those farmers were not able to establish peer groups. Of the farmers not applying for a formal loan, 48 percent responded not to do so because of fear of repayment as a result of failing in productivity. An approximate 25 percent of those households responded not to need credit sources. Moreover, 85 percent of the households in the survey replied to take more credit from formal sources if their capacity in terms of income and wealth was higher. It seems that households' level of wealth and income do not determine the access of farmers to credit institutions. It rather determines the capacity of farmers using those loans. Farmers are therefore perceived to be demand-constrained regarding formal credit use. Income from off-farm labour is highest in the first two groups, possibly explaining the fact that those farmers are fertiliser users and farmers in group 3 aren't.

Besides off-farm income and wealth, age of the household head and participation in other SWC programmes than the compelled mass mobilisation are important discriminant variables. Household heads in group 3 are significantly younger than households in group 1 and 2. As expected, age of the household head relates to experience and hence, relates positively with the use of chemical fertilisers. Farmers in group 3 are no fertiliser users. However, 30 percent of those farmers make use of credit while it was expected that participation in credit institutions would decrease with age. Participation in SWC programmes other than mass mobilisation was expected to raise the knowledge of farmers about the role of innovations (e.g. fertiliser use) and credit use, as farmers would get informed and trained by working in these programmes. It appears that farmers in groups 1 and 2 spend significantly less days per year working in these voluntary programmes than farmers in group 3, while the latter are using no fertilisers and 70 percent of those households do not use formal credit. The fact that these farmers are working more days in these programmes might be rather explained by the income (in kind) they receive from working in these programmes. As they are constrained in credit use and since their income from sources like off-farm labour is very low (significantly lower than in other groups), these households spend more days in working in SWC programmes as they receive a certain amount of kilograms grain for it.

Household membership of local village organisations like peasant and women's organisation shows no significant relationship with the use of fertilisers and credit. There is thus no indication that information through these organisations on the role of innovations and credit use plays a significant role in the distinction between the groups. The average level of education within the household also shows no relationship with the combination of the activities related to SWC and credit. The

education level of the household head, on the other hand, is significantly lower in group 3. As expected, these households have less knowledge about the role of innovations with respect to land degradation and improved production capacity. Lower educated farmers were presumed to be ignorant of the formal credit sources and sceptical on its use or role in e.g. investing in innovations. Investments in SWC and use of credit show little relationship with the sex of the head of the household. Groups 2 (significantly) and 3 have a higher percentage of female household heads. The variable gender was not significant for group 3, but this is a result from the fact that group 3 was compared to the average of groups 1 and 2. If it had been compared to group 1 alone, it would probably have been significant. Hence, there has been found some indication of male-biased credit institutions, which is contradictory to the expectation. The total area owned by the household per member was found significantly highest for farmers in group 2. These differences between the averages in area owned result from farmers having the possibility to share crop in land (raising the land owned per household member significantly for group 2). Farmers having sharecropped in land were expected to have more relations with credit institutions, but this is apparently not the case. It seems that farmers in group 2 gain higher yields because of this extra land, resulting in a higher income from crop production. The remaining variables in the analysis (household size, main occupation, average manure used and value of crops sold) show no clear relationship to the combination of the activities. Average manure use is highest in group 3, as was expected, though not significant.

6.2 Factors determining farmers' choice for available credit institutions

Two groups of households are users of formal credit (all farmers of group 1 and 30% of the farmers in group 3), hence a more detailed exploration of credit use was felt needed. In the study area there are two main formal credit providers, REST and BoANR. The latter provides credit in the form of fertiliser-loans with a repayment period of six to eight months. In one of the tabias however (Golgol Na'ele), this fertiliser loan is compulsory to most of the farmers. Whether households take a fertiliser loan from BoANR is thus not explicable by household characteristics. Nevertheless, it was decided to make a probit analysis on formal credit from BoANR as well, as it might explain which farmers BoANR selects for the obliged loan. In total, probit analysis was done four times on all eighty farmers in the survey: a probit analysis on households using credit from REST, from BoANR, from both and a probit analysis on farmers using no credit at all (in this case, y_t is assigned the value of one when the event in question occurs, i.e. when the household is *not* borrowing funds from a formal credit source).

As independent variables for the probit analysis, almost the same variables were used as in the binary logistic regressions (paragraph 6.1.1): education, sex and age of the household head, family size (total number of members within the household), main occupation of the household, farm size (area owned), farm size per household member, percentage of sharecropped in and irrigated land, wealth, average manure use, income from off-farm labour, and participation in peasant and/or women's association. The value of crops sold is excluded from the probit analysis, as it might be a resultant from borrowing funds (e.g. to repay a loan). The average manure use per tsmad is also excluded from probit analysis as it might be a resultant from the chemical fertilisers already used. No data are available on how much manure a household would use, when chemical fertilisers are not available.

6.2.1 Results

The results of the probit analysis for the probability of borrowing from REST, BoANR, REST and BoANR or from no source at all respectively, are shown in table 6.4 below (for the complete output, see annex 7).

As was explained in the beginning of this chapter, the data set used showed hardly any variability between values of variables. A two-stage procedure could not be performed due to collinearity. This collinearity caused problems in the probit analysis as well. In the case of the probits 'REST' and 'both' (the latter estimating the probability of farmers using REST and BoANR) singularities occurred. A singularity is the extreme case of collinearity or multicollinearity in which an independent variable is perfectly predicted (a correlation of +/- 1.00) by one or more independent variables (Hair, J.F., *et al,* 1998). Regression models can not be estimated when a singularity exists, therefore independent variables were omitted from these analyses in order to remove the singularity (these omitted variables are indicated with (a) in table 6.4).

As for the probability of farmers using credit from REST and farmers using credit from both REST and BoANR, singularities occurred due to the fact that all households using credit from these institutions were male headed households. It also appeared that all these households had agriculture as their main occupation. The variables 'sex' and 'farming' were therefore omitted from these analyses. Besides, in estimating the probit of both sources collinearity was found between the variables measuring the total days a year a household works in mass mobilisation and other soil and water conservation programmes. This singularity was removed by combining the two variables (in table 6.4 variables massmob and SWCprog) into one variable measuring the total days per year a household worked in a conservation programme (in table 6.4 the variable SWCtot).

Table 6.4. Model results from probit analysis, determining the probability a household uses credit from REST, BoANR, both REST and BoANR or does not use a formal loan at all

	Using credit from REST	**Sign.**	**Using credit from BoANR**	**Sign.**	**Using credit from both**	**Sign.**	**Using no formal loan at all**	**Sign.**
C	-0.0003		0.1586		3.3268		0.7126	
Eduhead	-0.4243		1.0617	***	0.1199		-0.2999	
Age	-0.0335		-0.0505	**	-0.1623	**	0.0273	
Sex	(a)		-0.6804		(a)		-0.3858	
Members	0.1466		0.0467		0.7223		-0.0654	
Farming	(a)		1.0402		(a)		-1.1699	*
Area	-0.0748		0.9345	*	-0.2360		-0.3941	
Areahead	0.0660		-2.2941		4.2315		2.2043	
Share	0.0027		-0.0394	*	-0.0396		0.0165	
Irrig	-0.1228		0.0446		-0.0835		0.0347	
Peas_ass	0.5618		-0.2322		2.5199	*	0.0638	
Wom_ass	-1.4831	**	-1.0146		-3.1951	***	0.6890	
Wealth	0.0002		0.0001		-0.0004		-0.0002	
Inclabor	-0.0007		-0.0027	***	-0.0031		0.0014	**
Swcprog	-0.0016		-0.0123	***	(a)		0.0078	***
Massmob	0.0228	*	0.0453	***	(a)		-0.0383	***
Swctot	(b)		(b)		-0.0176	*	(b)	
Mc Fadden R^2	0.1965		0.4565		0.5371		0.3636	

% predicted correctly	85.00	80.00	95.00	80.00
Observation with dep = 0	62	50	73	41
Observation with dep = 1	18	30	7	39
Total observations	80	80	80	80

(*) indicates that the value of the characteristic is significantly different at 0.10
(**) indicates that the value of the characteristic is significantly different at 0.05
(***) indicates that the value of the characteristic is significantly different at 0.01
(a) this variable was not included in the probit analysis, due to singularity
(b) this variable was not included in the probit analysis as it is the total of the variables 'mass mob' and 'swc prog'. Because in one probit this variable led to singularity it was decided to take the total of both, in order not to exclude one of the variable.

The results for probit analysis for REST imply that participation of the household in the women's association has a negative effect on borrowing from REST. This seems to be unlikely, but might be explained by the fact that all households using REST as a formal credit source are male headed households (the variable sex was excluded for this reason, causing singularity). It seems that in the study area REST is male-biased, restraining female heads of households in their access to formal credit institutions. However, REST claims to give special emphasis to women (see chapter 5.1.1 on DECSI's strategies) by giving them priority and by making the loan delivery system gender-based. From the tables in chapter 5.1.1 (table 5.1 and 5.2) it appears that on average 30 percent of the borrowers in the woreda Atsbi/Wemberta is female. For tabia Golgol Na'ele this was 37 percent during 1993 EC, and for tabia Mikael Emba approximately 28percent. A possible explanation for the results obtained is that the database does not give a proper indication as the data-set consists for 87.50 percent of male headed households.

Involvement in mass mobilisation on the other hand has a positive effect on using credit from REST. This is in line with the fourth strategy of REST/DECSI (chapter 5.1.1), linking its operation with other development programmes of the region by providing credit to those people working in the obliged mass mobilisation programme for at least 20 days (see also 5.2.2, guidelines for mass mobilisation).

The probability of households using credit from BoANR is positively related to the level of education of the household head, the area owned (in tsmad) and to the total days a year the household participated in mass mobilisation. The probability of using BoANR as a credit source is negatively related to the age of the household head, the percentage of sharecropped in land, the income received from off-farm labour and the total of days a year the household worked in SWC programmes other than mass mobilisation. As explained above the probability of households taking a fertiliser loan from BoANR is not explicable by household characteristics as these loans are mostly obliged. The probit analysis on borrowing from BoANR was included to determine selection criteria used by BoANR for the obliged loan. Young farmers with a higher level of education, but lower levels of income from off-farm labour are taking the fertiliser loans from BoANR . Besides, the target group of the Bureau of Agriculture and Natural Resources owns on average more land. This does not include share cropped in land, as this is negatively related to the probability of using credit from BoANR. It seems that BoANR is giving chemical fertilisers on loan to those farmers with an income restriction (households who are share cropping in land can be considered as not having restrictions in income, as one has to pay usufruct to the owner, and one needs to have additional inputs like labour, seed etceteras). Working in other SWC programmes than mass mobilisation is negatively related, implying that

each day a household works less in these programmes will increase the chance of getting credit from BoANR. As explained earlier in this thesis these working days can be viewed as income as well, as households receive on average three kilograms of grain per day. Hence, this negative relation contributes to the assumption that BoANR selects those farmers with an income restriction. Given the positive relation between the probit and the number of days a year a household works in mass mobilisation, households seem to profit from BoANR as long as they participate in this programme for at least (the mandatory) twenty days. In chapter 5.1.2 the main objective of BoANR was described as extending modern technology to farmers. Therefore the credit activities of BoANR are directly or indirectly linked with extension work. The main purpose of loans BoANR is providing are chemical fertilisers and improved and selected local seeds. Farmers who are believed to be the early adapters of new technologies are selected by the development agents as beneficiaries of its service. Farmers can purchase these inputs on cash, however, when they are in lack of cash to purchase the new technology, the bureau provides them on credit. In addition, producers of farm implements and irrigation systems are also provided credit. One could expect the variable indicating the percentage of irrigated land to be positively related with the probability of using fertiliser loans from BoANR, however this is not the case. An estimated 12.5 percent of the farmers in the survey have irrigated land. Of these households 60 percent is using the fertiliser loan from BoANR. This does not mean however that the remaining 40 percent does not use chemical fertilisers at all. All households having irrigated land make use of chemical fertilisers. Hence, 40 percent of the households are not using credit to purchase those fertilisers, they seems to be able to purchase such inputs from own resources.

The results for the probit on credit users from both BoANR and REST imply that a higher age of the household head reduces his/her probability in using credit from both REST and BoANR. This also counts for the total days a year a household works in SWC programmes (in this case all programmes, hence mass mobilisation and other, as singularities occurred in the probit when trying to enter both variables separately). A household working more days in these programmes is less likely to use credit from both institutions than households working less days in SWC programmes. This negative relationship of all programmes might be explained by an overruling negative relationship between this probit and SWC programmes other than mass mobilisation, as mass mobilisation (entered as a single variable) proved to relate positively to both the probit of REST and the probit of BoANR separately. These two negative relationships in the probit discussed here seem to relate to the above discussed target group of BoANR., giving chemical fertilisers on loan to younger income-restrained farmers. Participating in the women's association is negatively related to the probability of households using both REST and BoANR as a formal credit source. This is clearly a resultant from the fact that in the data set used all households borrowing from REST are male headed. Furthermore, a positive relation exists between probability that households borrow credit from both institutions and participation of the household in the peasant association. Households' membership of peasant association was expected to increase farmers' knowledge on the role of innovations and credit use. Participation of the household in the peasant association thus increases their access to credit and investments in soil and water conservation and increase the probability that farmers are using both credit from REST and chemical fertilisers on loan from BoANR.

The probability of households not having a formal loan at all was estimated by assigning the dependent variable (no loan) a value of 1, when the household is *not*

borrowing funds from a formal credit source. The results obtained imply that the probability of not using credit from any formal source increases if a household's main occupation is not farming (there is a negative relationship between farming and the probit (no loan)). This corresponds to the expectation that households mainly working in agriculture are more involved in agriculture-related activities than households working primarily in other sectors. A household who is not involved in agriculture would of course not borrow fertilisers from BoANR, as it is not needed. However, households mainly working in other sectors apparently also use less credit from REST. Agriculture is a very risky business in which income derived from e.g. crop production varies between seasons. This might be a reason for the negative relationship with the variable farming. Income from off-farm-labour and the number of days a year a household worked in other programmes than mass mobilisation are positively related to the probability of not borrowing. This is quite likely as households who generate income from other sources besides agriculture do not need credit as much as households having no such income sources. Finally, working in mass mobilisation is negatively related, implying that the probability of not having any formal loan is increased as the number of days a year worked in mass mobilisation decreases. As explained before, households are required to work at least twenty days a year in this organisation. If farmers do not participate in mass mobilisation for at least twenty days they will be penalised in cash or are excluded from any benefits coming to the community like food-for-work and free-food-aid. They will also be restrained in their access to credit from REST and others.

7 Conclusions and Implications

This thesis had the aim of getting insight in the relation between both formal and informal rural credit systems and soil and water conservation measures undertaken by small farmers in selected areas in Tigray, Northern Ethiopia. In the introduction four research objectives were presented. In the first part of this chapter the corresponding conclusions will be presented. In the second part some policy implications concerning credit and soil and water conservation are put forward.

7.1 Conclusions

The main providers of credit are the Relief Society of Tigray (REST) and the Bureau of Agriculture and Natural Resources (BoANR). Both institutions are formal institutions. Informal finance was found to be hardly used in the study area. It occurs that farmers borrow money from neighbours, friends or relatives, but these loans consist of very small amounts (five to ten ETB) and have a maximum repayment period of one week. In other words, farmers in the study area do not use informal finance on a large scale, and informal finance was therefore left out of consideration. REST is one of the largest non-governmental micro finance institutions in Ethiopia. Their strategy corresponds with that of the Grameen Bank, extending in cash loans to jointly liable poor group members for their self-employment and income generation. These loans are extended for a maximum period of one year with an interest rate of 12.5 percent, but farmers have to make a first instalment after six months. Only 22.50 percent of all farmers in the survey made use of this credit source in 1993 EC. Main purposes of the loans were to purchase livestock, seeds and to participate in trading activities. The major problems households face with credit from REST is the requirement of establishing a peer group. Within such groups, farmers have a joint responsibility for the repayment of all loans. In case of default of one of the group members, other members have to pay. The Bureau of Agriculture and Natural Resources, a governmental organisation, provides chemical fertilisers, improved seeds and other agricultural products on loan to farmers lacking cash to purchase these products. Until 1993 EC taking fertiliser from BoANR was mandatory. This obligation stemmed from the ambition of development. Since many farmers were complaining BoANR decided to change its policy. Loans are provided with an interest rate of 12.50 percent and a repayment period of six to eight months. An estimated 38 percent of the farmers in the survey borrow fertilisers from BoANR, of which only 1.25 percent were farmers living in Mikael Emba. The difference between these tabias stems from the fact that grassroots level branches of BoANR sometimes still work according to the policy of compelling fertiliser loans. This is the case for the branch in Atsbi (responsible for farmers in Golgol Na'ele), but the branch in Haike Massal allows the farmers (including those of Mikael Emba) to use own livestock's manure.

The main reason for farmers not to borrow credit from these formal institutions is presumably risk aversion (42.50 percent of the households in the survey responded to be afraid to fail in productivity and hence in repayment). Of the farmers in the survey not applying for formal loans (74 percent), 48 percent responded not to do so because of fear of repayment as a result of failing in productivity. An approximate 25 percent of those households responded not to need credit sources. Households' capacity (in terms of wealth and income) to repay a loan is too low when these households fail in productivity. Due to this risk-aversion, farmers are perceived to be demand-constrained regarding credit with a main reason of risk-aversion.

The client selection of both REST and BoANR seems to work efficiently, as only a small percentage of farmers in the survey replied not to be able to borrow credit from each of the institutions. The reason for this constrained access was mostly that they faced problems regarding the required peer-group formation of REST. Farmers who failed to repay a loan in previous years were not able to find such groups as other farmers didn't allow them to join their groups.

Soil and water conservation programmes in the study area were found to be mainly governmental. In mass mobilisation every capable member of a community is obliged to contribute at least twenty days of unpaid labour per year. Individuals failing to participate in this programme are penalised in cash and excluded from any benefits coming to the community, including free-food-aid, access to REST and working in food-for-work programmes. Activities in such food-for-work programmes mainly include soil and water conservation activities. Participation in these programmes is voluntarily and participants are paid on average three kilograms of grain per day.

Soil and water conservation structures like the application of terraces and soil bunds are technically complementary in the sense that when they are used in combination, yield (measured in average value of crop production per household in ETB) is raised substantially. When fertilisers are used on steep, not conserved plots, it was expected that the absorption of these fertilisers by the soil was lower, due to run-off by heavy rainfall.

Furthermore, no relationship was found between credit and soil and water conservation investments at individual level, i.e. the choice whether or not to take measures concerning soil and water conservation on own plots seems to be no individual decision made by the farmer. Farmers do not use credit to protect their land from degradation. Credit was rather used for livestock production, trading activities and short-term investments like seeds and chemical fertilisers. The latter, however, has been the result of the compelled fertiliser use from BoANR in tabia Golgol Na'ele. When households are left the choice to use chemical fertilisers or manure, like farmers in tabia Mikael Emba were, we see that 55 percent of the households choose to use only manure from their own livestock (in tabia Golgol Na'ele the percentage of farmers using chemical fertilisers is approximately 88 percent). It seems that governmental actions in SWC (via mass mobilisation etc.), its land tenure policies (land in Tigray is owned by the state) and its extension programmes, take away the incentive of farmers to undertake action themselves. Credit does not seem to be the bottleneck of development in the area, but it's rather the low return to investments on short-term that discourage households to make those investments.

7.2 Policy implications

It seems that in the study area the unwillingness to invest in soil and water conservation is high. Households showed to be risk-averse, being afraid of failing in productivity and consequently not being able to repay possible loans. Soil and water conservation programmes like mass mobilisation and the so-called food-for-work should therefore perhaps offer soil and water conservation applications and chemical fertilisers in packages. To promote conservation efforts or to increase farmers' incentives for investment, policies should take into account the constraints and limitations of farmers. Conservation should therefore be linked to subsidies and credit facilities. So far, the activities in SWC programmes include soil and water conservation activities like building terraces, stone bunds etc. As land degradation is

severe in the highlands of Ethiopia, these applications of soil and water conservation structures are a must. However, as SWC structures and chemical fertilisers prove to be technically complementary, the application of artificial fertilisers in combination with these SWC structures is highly important to recover or improve the nutrient balance of the soil. It appears that if farmers are left the choice to use chemical fertilisers or manure, the majority of farmers rather use only manure as it will not increase their costs (manure is something they already have, while chemical fertilisers need to be purchased).

Further research should therefore be done on possibilities for provision of agricultural implements like inorganic fertilisers. Household are not always able to purchase such fertilisers from own resources, simply because they are lacking financial means. Moreover, households are not always willing to purchase chemical fertilisers from own resources, as return of those investments in combination with SWC applications is too small on short-term basis. It might be a result from these reasons that Ethiopia's fertiliser use is still under the average of Sub-Saharan Africa. If it is decided to provide fertilisers and agricultural inputs on credit, this combination of micro-finance with extension services should go together with careful training of rural smallholders. Knowledge on the role of fertilisers and suchlike would increase farmers' willingness to adopt such innovations. As discussed, BoANR was obliging fertiliser loans until 1993 EC, but got a lot of resistance from the farmers. It seemed that farmers did not really grasp the positive effect the use of chemical fertilisers had on their plots in combination with SWC applications and therefore on their crop production. Rather, they used their own livestock's manure as no risk was involved concerning repayment and alike.

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Annex 1: Household Survey Questionnaire

Farm Household Survey Questionnaire
for research on Rural Credit Systems and Conservation Measures of Small Farmers, *a graduate thesis within the project on "Policies for Sustainable Land Management in the Highlands of Tigray, Northern Ethiopia"*

Identification
Questionnaire number: _____
Date of interview: Day: _____ Month: _____ Year: _____
Interviewed by:
_____
Date entered: Day: _____ Month: _____ Year: _____
Entered by: _____
Zone: _____Code: _____
Woreda: _____Code: _____
Tabia: _____Code: _____
Kushet: _____Code: _____
Household: _____Code: _____

PART A. HOUSEHOLD CHARACTERISTICS

A1. Household composition ***(household being defined as a group of individuals living together, sharing income together, pooling productive resources together and sharing consumption and other items during the previous year). ONLY INCLUDE AS MEMBER IF LIVED IN HOUSEHOLD FOR 6 MONTHS OR LONGER!***

No.	**1. Name**	**2. Sex** 1 = m 2 = f		3. **Relation to head** 1 = head 2 = wife / husband 3 = child 4 = grandchild 5 = niece / nephew 6 = father / mother 7 = sister / brother 8 = grandfather / mother 9 = hired labor 10 = other specify…		**4. Age** (in completed years)	**5. Ethnic group** 1 = Tigray 2 = Erob 3 = Saho 4 = other, specify…		**6. Religion** 1 = Orthodox 2 = Protestant 3 = Catholic 4 = Muslim 5 = other, specify…		**7. hh member since (year)**	**8. Registered as tabia resident** 1 = yes 2 = no		**9. Education: highest level accomplished?** -2 = illiterate -1 = literacy campaign certificate 0 = religious school 1 = grade 1 completed 2 = grade 2 completed . . 12 = grade 12 completed 13 = other, specify…	
			Code		**Code**			**Code**		**Code**	**Eth. Cal ……**		**Code**		**Code**
1															
…															

A2. Household occupation ranked

Name of household member	**Primary occupation**	**Specify period**	**Secondary occupation**	**Specify period**	**Third occupation**	**Specify period**

A3. Household participation in local organizations / associations

Name of household member	**Organization/association** 1 = peasant association 2 = women's association 3 = youth association 4 = equb 5 = other, specify…		**Role in association**	**Form of contribution** 1 = money 2 = labour 3 = money and labour specify amount		**Services acquired from the organisation / institution** 1 = credit 2 = input delivery 3 = output market 4 = communal benefit 5 = other, specify…	
		Code		**Amount**	**Code**		**Code**

PART B. HOUSEHOLD ASSETS

B1. Farm equipment and durable goods owned

1. Does your household own any […]			2. How many in number?	3. Is any […] jointly owned with another household?		4. If yes, what proportion belongs to your household? (%)	5. Durability time? (in years)	6. Unit price of […] (in Eth. Birr)
Item	1 = yes 2 = no							
		Code		1 = yes 2 = no	Code			
Horse / mule cart								
Donkey cart								
Maresha								
Nowit								
Megafia								
Arut								
Miran								
Karfas								
Hoe								
Radio								
Bed								
Kerosene stove								
Other durable goods or farm implements, specify…								

PART C. SAVINGS

C1. Are there any formal institutions or associations offering a possibility to save in the tabia? ***(e.g. REST, banks or GOs)***
Yes..1 / no..2

If yes, fill in table

Source	
1	
…	

C2. Are there any informal institutions or associations offering a possibility to save in the tabia? ***(e.g. EQUB)***
Yes..1 / no..2

If yes, fill in table

	Source
1	

C3. Does your household have any kind of savings what so ever? ***(e.g. cash, gold/jewellery/land/livestock/stores of grain etc.)***
Yes..1 / no..2

If yes, what is the main way of saving in your household?
<FIRST LIST, THAN RANK>

WAY OF SAVING	1st	3rd
	2nd	4th

C4. What is the main purpose / objective for saving for the household?

……
……
……

PART D. CREDIT

D1. Informal credit: is there any informal source of credit available in the tabia?
Yes..1 / no..2

If yes, please list all informal sources available.

D2. Did you apply for one of these sources during the past year?
Yes..1 / no..2

If no, what is the reason for not applying to these informal credit sources
……
……

If yes, fill in table

1. Source 1 = money lenders 2 = trader / intermediary 3 = equb group 4 = friends or relatives 5 = church 6 = other, specify…		**2. When borrowed credit? (month and year)** Include all loans, even if already repaid	**3. Purpose of credit** 1 = to purchase livestock 2 = to purchase inputs 3 = for household expenditures 4 = for trading 5 = SWC 6 = other, specify…		**4. Amount desired** 1 = in cash 2 = in kind		**5. Amount received** 1 = in cash 2 = in kind		**6. Reason for lesser amount of loan received than desired**
	Code			**Code**		**Code**		**Code**	

Source 1 = money lenders 2 = trader / intermediary 3 = equb group 4 = friends or relatives 5 = church 6 = other, specify…	**7. Type of collateral required** 0 = no collateral 1 = land 2 = house 3 = savings 4 = signature, personal guarantee 5 = group lending 6 = other, specify…		**8. Interest exists on loan?** 1 = yes 2 = no		**9. If yes, what rate of interest?** Unit code: 1 = per week 2 = per month 3 = per year 4 = other, specify… (in Eth. Birr)		**10. Maximum repayment period of loan** 1 = 1 month 2 = 6 months 3 = 1 year 4 = other, specify…		**11. Loan already repaid?** 1 = yes 2 = no		**12. If no, why not?** 1 = deadline of repayment period not reached 2 = reduction in income 3 = unwilling to repay 4 = other, specify…	
		Code		**Code**		**Code**		**Code**		**Code**		**Code**

D3. Formal credit: Is there any formal source of credit available in the tabia?
Yes..1 / no..2

If yes, please list all formal sources available.

D4. Did you apply for one of these sources during the past year?
Yes..1 / no..2

If no, what is the reason for not applying to these formal credit sources
……

If yes, fill in table

1. Source 1 = REST/ Dedebit 2 = Bureau of Agriculture 3 = World Vision 4 = ..association 5 = other, specify…		**2. When borrowed credit? (month and year)** Include all loans, even if already repaid	**3. Purpose of credit** 1 = to purchase livestock 2 = to purchase inputs 3 = for household expenditures 4 = for trading 5 = SWC 6 = other, specify…		**4. Amount desired** 1 = in cash 2 = in kind		**5. Amount received?** 1 = in cash 2 = in kind		**6. Reason for lesser amount of loan received than desired**
	Code			**Code**		**Code**		**Code**	

Source 1 = REST/ Dedebit 2 = Bureau of Agriculture 3 = World Vision 4 = ..association 5 = other, specify…		**7. Type of collateral required** 0 = no collateral 1 = land 2 = house 3 = savings 4 = signature, personal guarantee 5 = group lending 6 = other, specify…		**8. Interest exists on loan?** 1 = yes 2 = no		**9. If yes, what rate of interest?** Unit code: 1 = per week 2 = per month 3 = per year 4 = other, specify… (in Eth. Birr)		**10. Maximum repayment period of loan** 1 = 1 month 2 = 6 months 3 = 1 year 4 = other, specify…		**11. Loan already repaid?** 1 = yes 2 = no		**12. If no, why not?** 1 = deadline of repayment period not reached 2 = reduction in income 3 = unwilling to repay 4 = other, specify…	
	Code		**Code**		**Code**		**Code**		**Code**		**Code**		**Code**

D5. Are there specific obligations to have access to formal credit?
Yes..1 / no..2

If yes, what are these obligations (by source of credit)?

Credit source 1 = REST/ Dedebit 2 = Bureau of Agriculture 3 = World Vision 4 = ..association 5 = other, specify…	**Obligations** 1 = involvement in SWC 2 = involvement in tabia-meeting 3 = be resident of tabia 4 = involvement in any kind of developmental activity 5 = other, specify…	
		code

D6. What does your household prefer as a means of getting credit?
Informal sources..1 / Formal sources..2

Can you explain why?

……

……

D7. During the last 12 months, did you apply for a loan from any source (friend, family, or institution) and were refused?
Yes..1 / no..2

If yes, fill in table:

Event (when and for what purpose)		1. Reason for being turned down? 1 = lack of collateral 2 = shortage of credit budget 3 = not a resident 4 = investment activity not accepted 5 = bad credit history 6 = other, specify…		2. Who turned you down? 1 = REST / Dedebit 2 = BOANR 3 = friends / relatives 4 = other, specify…	
			Code		Code
1					
2					

D8. Would you take more credit if you were able to do so (if better credit access)?
Yes..1 / no..2

If yes, for what purpose(s) would you use the money (e.g. consumption, investment, savings etc.) <FIRST LIST, THAN RANK>

LIST OF CREDIT USE	
	1st
	2nd
	3rd

PART E. LIVESTOCK PRODUCTION

E1. Information of Livestock owned

1. Last year (1993 EC), did your household own any […]?					2. Type, number and reason of stock increase during past year [1993 EC]	3. If bought, specify source of finance	4. Type, number and reason of stock decrease during past year [1993 EC].	5. If sold, why?		6. If sold, where?	
Livestock type		1 = yes 2 = no		Number	1 = born 2 = bought 3 = other, specify… (put code in brackets: number [code])		1 = sold 2 = died 3 = other, specify… (if more than 1 answer put code in brackets)	1 = feed shortage 2 = getting old 3 = consumption 4 = credit repayment 5 = others, … (if more than 1 answer put code in brackets)		1 = within tabia 2 = in woreda town	
	Code		Code						Code		Code
Oxen											
Bulls											
Cows											
Calves											
Heifer											
Goats											
Sheep											
Chicken											
Donkeys											
Mules											
Horses											
Camel											
Other, specify											

E2. Age of livestock in years (currently owned)

CHECK FROM PREVIOUS TABLE - Specify real age in brackets!

Type of livestock		Age of livestock in years [enter numbers of animals owned in each age category]							
	Code	< 1 YR	Value in ETB	1-2 YR	Value in ETB	2-3 YR	Value in ETB	4+ YR	Value in ETB
Oxen									
Bulls									
Cows									
Calves									
Heifer									
Goats									
Sheep									
Donkeys									
Mules									
Horses									
Camel									
Chicken									
Others…									

E3. Price table livestock sold during past 12 months (1993 EC)

Type of livestock	Unit price of livestock if sold within tabia (in Eth. Birr)				Unit price of livestock if sold in woreda town (in Eth. Birr)			
	<1 YR	1-2 YR	2-3 YR	4+ YR	<1 YR	1-2 YR	2-3 YR	4+ YR
Oxen								
Bulls								
Cows								
Calves								
Heifer								
Goats								
Sheep								
Chicken								
Donkeys								
Mules								
Horses								
Camel								
Other, specify…								

E4. If livestock by-products have been sold in the last year (1993 EC) fill in the following table:

1. Type	2. Amount sold (unit code can be liters, kg, nr. etc.)		3. Sold where? 1 = within tabia 2 = in woreda town		4. Unit price if sold in tabia (in Eth. Birr)	5. Unit price if sold in woreda town (in Eth. Birr)
	Amount	Unit code		Code		

E5. What do you see as the most important constraints in your livestock production? <FIRST LIST, THAN RANK>

LIST OF CONSTRAINTS	1st	5th
	2nd	6th
	3rd	7th
	4th	8th

PART F. LAND USE TYPE

F1. Does your household (any of its members) currently use any cultivated land, woodlot, pasture or irrigated land?
Yes..1 / no..2

List of all plots used by household *(include homestead and communal grazing land)*

1. Plotnr.	2. Name of plot (or description)	3. Area of plot (in Tsmad (*))	4. Slope category of each plot 1 = flat (< 5%) 2 = moderately steep (5-15%) 3 = hilly (15-30%)	5. Land use type? 1 = homestead 2 = rainfed cultivated 3 = irrigable cultivated 4 = private pasture	6. How did the household acquire the plot? 1 = rented in 2 = land redistribution 3 = share cropped in

			4 = steep (> 30%)		5 = fallow 6 = common grazing land 7 = other, specify…		4 = borrowed in (no payment) 5 = inherited 6 = other, specify…	
				Code		**Code**		**Code**
1								
2								
3								
4								
5								
6								

Conversion factor Tsmad: _____(try to measure or ask respondent if known both in tsmad and square meters)

F2. If you or any of your household members would want to obtain additional (temporary) land, is this possible?

Yes..1 / no..2

If yes, specify in what way.

	Method	**Terms and conditions under each method**
1		
2		
3		
4		
5		
6		
7		

PART G. CROP PRODUCTION

G1. Crop production

1. Plotname	**2. Crop type per proportion of plot harvested during last season?** 1 = teff 2 = barley 3 = wheat 5 = sorghum 6 = potato 7 = pea 8 = bean 9 = other, specify…				**3. Type and amount of inputs used per tsmad and crop type.** 1 = fertiliser 2 = seeds 3 = manure 4 = pesticides 5 = insecticides 6 = improved seed 7 = other, specify…				**4. Output of each crop harvested**	
	Proportion of plot	**Type of crop**	**Code**	**Variety of crop**	**Type of input**	**Code**	**Amount**	**Unit code**	**Amount**	**Unit code**

G2. Labour use per plot and crop type

Crop type	**Amount of labour used for ploughing** (ask hrs per day)	**Labour source** 1 = family 2 = hired 3 = exchange 4 = animal		**Amount of labour used for weeding** (ask hrs per day)	**Labour source** 1 = family 2 = hired 3 = exchange 4 = animal		**Amount of labour used for harvesting** (ask hrs per day)	**Labour source** 1 = family 2 = hired 3 = exchange 4 = animal		**Total labour used in hours**
			Code			**Code**			**Code**	

G3. Price data table for crops sold

1. Crop type sold		2. Amount of crops sold (unit code can be litres, kg etc)		3. Sold where? 1 = in tabia 2 = in woreda town		4. Unit price if sold in tabia (in Eth. Birr)		5. Unit price if sold in woreda town (in Eth. Birr)	
	Variety		Unit code		code	Nov-Jan 1993	Apr-June 1993	Nov-Jan 1993	Apr-June 1993

G4. Are there any changes in your cropping pattern?
Yes..1 / no..2

If yes, fill in the table for each plot:

1. Change in cropping pattern	2. Reason for change
Introduction new varieties	
Varieties withdrawn from system	
Decrease in input use	
Increase in input use	
Fallow	
Rotation	
Intercropping	
Composting	

G5. Please list the three most important crops in terms of the following <RANK>:

Rank in terms of income source (cash crops)	Rank in terms of domestic use [contribution to self sufficiency]
1st	1st
2nd	2nd
3rd	3rd

G6. What do you see as the most important constraints in your crop production? <FIRST LIST, THAN RANK>

LIST OF CONSTRAINTS	1st	5th
	2nd	6th
	3rd	7th
	4th	8th

PART H. DEGRADATION AND CONSERVATION ISSUES

H1. Has the size of your land changed over the last 15 years?
Yes..1 / no..2

If yes, 1 = increased
2 = decreased

What do you think is the reason of this change?

Reason	1 = yes 2 = no	Code
Land taken from farmer during land redistribution		
Land degradation		

H2. Has the yield on your plots changed over time, since acquirement of your plots?
Yes..1 / no..2

If yes, **1 = increased**
2 = decreased

What do you think is the reason of this change?
.....

H3. What are the most important degradation problems on your farm and in your community?
< FIRST LIST, THAN RANK >
(e.g. erosion, nutrient depletion, overgrazing etc.)

LIST OF DEGRADATION PROBLEMS

1st	
2nd	
3rd	
4th	
5th	
6th	
7th	
8th	

H4. Does any kind of soil and water investment occur on one or more of your plots you are currently cultivating?
Yes..1 / no..2

If yes, fill in table for every plot:

1. Name plot	2. What type of measure applied? (+proportion on which applied) 1 = stone terraces 2 = soil bunds 3 = stone faced trench bound 4 = check dams 5 = other, specify…			3. Applied when? (Year EC)	4. Applied by whom? 1 = privately 2 = organisation specify…		5. When done privately, cost of establishment, in terms of…		6. How frequently maintained since establishment? 1 = monthly 2 = half yearly 3 = yearly 4 = other, specify		7. Maintenance done by who? 1 = privately 2 = oganisation specify…		8. When done privately, cost of maintenance in terms of…		9. Did you borrow money to establish and / or maintain the application? 1 = yes 2 = no	
	Proportion of plot		Code			Code	Labour	Money		Code		Code	Labour	Money		Code

H5. Does your household or any of its members participate in SWC on communal/public land?
Yes..1 / no..2

If yes, fill in the following table:

1. Name of household member	2. Description of activity	3. Activity in which organisation	4. Participation of household in terms of money (Eth. birr)	5. Participation of member in terms of labour

H6 Has any member of your household received any benefit from the communal SWC activities?

1. Type of program	2. Any benefit?		3. Value of benefit in cash (in Eth. Birr)	4. Value of benefit in kind	
	1 = yes 2 = no	Code			Unit amount

PART I. HOUSEHOLD INCOME FROM OTHER SOURCES

I1. During the last year [1993 EC], did your household receive income from any of the following sources? *[other than already mentioned]*

1. Source			2. If paid in cash, how much did you receive? (in Eth. Birr)	3. If paid in kind, how much received (specify days and unit code)
	1 = yes 2 = no	Code		
Hiring out livestock				
Hiring out labour				
Non-farm employment				
Food for work				
Food for aid				
Remittance income from family members				
Renting / share cropping out land				
Others,…				

PART J. HOUSEHOLD EXPENDITURES

J1. How much does the household spend for the following items? [per given period]

1. Weekly expenses		2. Monthly expenses		3. Yearly expenses	
Item	**Expenses in Eth. Birr**	**Item**	**Expenses in Eth. Birr**	**Item**	**Expenses in Eth. Birr**
Sugar		**Labor**		**Land tax**	
Salt		**Travel expenses**		**House maintenance**	
Coffee		**Health / medicine**		**Clothing**	
Tea		**Veterinary service**		**Improved seeds**	
Edible oil				**Fertilizers**	
Spices				**Insecticides**	
Vegetables				**Pesticides**	
Graining				**Farm implements**	
Soap /washing products				**Education (fee + books)**	
Fuel wood				**Church contribution**	
Lamp oil				**Association**	
				Ceremonies	

Annex 2: Institutional Questionnaire

General information about the institution:

- When was the institution founded, and since when is there a branch of the institution present in the study area?
- What are the general objectives of the institution?
- What is the structure of the institution?
- To what extent is the institution involved in Soil and Water Conservation (in general, and explicitly in the research area)?

General information about credit activities:

- Who are the clients of the institution and how is the selection of these clients executed?
- What types of credit is the institution providing?
- What are the strategies of the institution to distribute the credit in the research area?
- What type/which types of collateral is/are required?
- What interest rate is charged by the institution?
- How is repayment enforced by the institution?
- How is dealt with the fungability condition of money use?
- To what extent are rural savings encouraged?
- Are the provided credits linked with agricultural input provision and/or with soil and water conservation, and if yes, to what extent?
- In what way is information of the institution provided to the clients?

Specific information about the credit activities of the institutions:

- What are the achievements obtained so far, and what problems have been encountered?
- What is the output of the institutions' credit activities in the research area last year?
  This question refers to:
  - the number of loans distributed
  - the total amount of loans disbursed
  - the total amount of loans repaid
  - the total amount of loans outstanding
  - the total amount of loans in arrears
  - the total amount of savings
  - What is the average default rate in the area?

Annex 3: DECSI's financial performance

Woreda level

Annex-table 3.1. Output of DECSI in Atsbi Wemberta woreda as of the year of establishment of the branch

	Male	Female	Total
Number of loanees	6457	2778	9235
Amount of loans disbursed (ETB)	13.382.334,66	4.228.291,00	17.610.625,66
Amount of loans repaid (ETB)	10.402.290,47	3.528.406,28	13.930.696,75
Amount of loans outstanding (ETB)	2.980.044,19	699.884,72	3.679.928,91
Amount of loans in arrears (ETB)	569.884,25	35.773,30	605.657,55
Amount of savings (ETB)	2.575.901,62	578.451.89	3.154.353,51

Annex-table 3.2. Output of DECSI in Atsbi Wemberta woreda in 1993 EC.

	Male	Female	Total
Number of loanees	941	272	1213
Amount of loans disbursed (ETB)	1.371.520,00	634.280,00	2.005.800,00
Amount of savings (ETB)	406.503,36	103.112,24	512.615,60

Tabia level - Mikael Emba

Annex-table 3.3. Output of DECSI in tabia Mikael Emba as of the year of establishment of the branch

	Male	Female	Total
Number of loanees	502	120	622
Amount of loans disbursed (ETB)	946.415,00	341.630,00	1.288.045,00
Number of loans repaid	417	85	502
Amount of loans repaid (ETB)	791.510,00	287.630,00	1.079.140,00
Amount of loans outstanding (ETB)	154.905,00	54.000,00	208.905,00
Amount of loans in arrears (ETB)	55.876,00	3.450,00	59.326,00
Amount of savings (ETB)	6.472,85	2.841,35	9.314,20

Annex-table 3.4. Output of DECSI in tabia Mikael Emba in 1993 EC.

	Male	Female	Total
Number of loanees	105	40	145
Amount of loans disbursed (ETB)	131.250,00	32.000,00	163.250,00
Total amount of loans repaid	125.610,00	29.400,00	155.010,00
Amount of loans in arrears	5.640,00	2.600,00	8.240,00
Amount of savings (ETB)	3.475,00	1.130,00	4.605,00

Tabia level - Golgol Na'ele

Annex-table 3.5. Output of DECSI in tabia Golgol Na'ele as of the year of establishment of the branch

	Male	Female	Total
Number of loanees	331	157	488
Amount of loans disbursed (ETB)	531.100,00	190.625,00	721.725,00
Number of loans repaid	228	150	378
Amount of loans repaid (ETB)	414.250,00	158.775,00	573.025,00
Amount of loans outstanding (ETB)	116.850,00	31.850,00	148.700,00
Amount of loans in arrears (ETB)	33.370,00	2.500,00	35.870,00
Amount of savings (ETB)	9.826,17	6302,00	16.128,17

Annex-table 3.6. Output of DECSI in tabia Golgol Na' ele in 1993 EC.

	Male	Female	Total
Number of loanees	177	102	279
Amount of loans disbursed (ETB)	86.300,00	32.100,00	118.400,00
Total amount of loans repaid	75.950,00	32.100,00	108.050,00
Amount of loans in arrears	11.250,00	0.00	11.250,00
Amount of savings (ETB)	3.015,59	1.321,22	4.336,81

Annex 4: Independent-samples t-tests for variables for each group

In the table below, average values for each group are given together with their standard deviations (the latter one is given in brackets).

Annex-table 4.1. Average values and standard deviation of variables for each group

Variable	Type	Group 1	Group 2	Group 3
MEMBERS Number of members in household	Numerical	6.3333[a] (1.9567)	5.4000 (2.4366)	4.6111 (1.6852)
LABFACT Labour factor of the household	Numerical	3.2806[a] (1.1306)	2.8500 (1.3945)	2.2222 (0.7788)
AV_AGE Average age of all members in the household	Numerical	19.6111[b] (3.9877)	25.6000[a] (12.5421)	16.9444 (4.5822)
EDU_HH Highest level of education within household	Ordinal	2.0278[a] (1.1081)	1.5500 (0.9445)	1.4444 (0.7838)
SEX Gender of head of household	Binomial	0.9444 (0.2323)	0.8000 (0.4104)	0.7778 (0.4278)
AGE Age of household head	Numerical	49.9167[a] (9.8861)	50.0500[a] (12.0720)	34.6111 (9.0498)
EDUHEAD Level of education of household head	Ordinal	0.6944 (0.9202)	0.5500 (0.6863)	0.3889 (0.5016)
FARMING First occupation of head is farming	Binomial	0.9167[a] (0.2803)	0.8500 (0.3663)	0.6667 (0.4851)
PEAS_ASS Participation in peasant association	Binomial	0.7500[a] (0.4392)	0.6500[a] (0.4894)	0.3333 (0.4851)
WOM_ASS Participation in women association	Binomial	0.8056 (0.4014)	0.8000 (0.4104)	0.8889 (0.3234)
VAL_ASST Value of assets in ETB	Numerical	145.2708 (106.2386)	103.7375 (80.9579)	114.9861 (126.1518)
VAL_KIND Value of in kind savings in ETB	Numerical	109.2694[a] (104.1702)	95.2925[a] (89.5983)	36.8189 (58.5456)
VALUE93 Value of livestock owned in 1993 EC in ETB	Numerical	2389.8472[b] (1667.5147)	1351.4750 (1389.7133)	1835.3333 (1520.0102)
WEALTH Value of wealth per capita in ETB	Numerical	415.4860 (231.4018)	297.3314 (284.1317)	483.4870 (435.8701)
AREA Total area owned by household in tsmad	Numerical	2.3472[a] (0.9933)	0.2.0275[a] (1.2463)	1.3333 (0.5623)
AREAHEAD Total area owned per member in tsmad	Numerical	0.3900 (0.1685)	0.4222 (0.2697)	0.3081 (0.1377)
IRRIG Percentage of area which is irrigated	Numerical	1.5822 (4.0252)	1.8620 (0.50717)	0.0000 (0.0000)
SHARE Percentage of area which is share cropped in	Numerical	5.8639 (15.0796)	10.3330 (23.9367)	7.4072 (24.4026)
SWCPRC Percentage of area which is conserved	Numerical	91.2222[b] (15.1678)	80.2000[a] (23.9090)	94.4444 (17.1883)
MASSMOB Nr of days worked in mass mobilisation	Numerical	38.3611 (19.5801)	28.5000 (18.7153)	36.1111 (13.3456)
SWCPROG Nr of days worked in other SWC programmes	Numerical	55.9167[a] (111.7778)	93.8500 (83.8019)	111.7778 (91.5202)
INCLABOR Income received from off-farm labor per capita in ETB	Numerical	26.7275[a] (59.7308)	65.6548 (70.6228)	32.0370 (52.3861)
INCREMIT	Numerical	5.8333	62.9464	0.0000

Income from remittances per capita in ETB		(26.1998)	(181.5937)	(0.0000)
INCLIVST	Numerical	87.1257	42.4835	50.2340
Income from livestock production per capita in ETB		(142.4500)	(50.8154)	(88.5332)
CROPVAL	Numerical	636.5250[a]	765.0500[a]	250.2778
Income from crop production in ETB		(440.7834)	(621.2252)	(264.9221)
AV_FERT	Numerical	15.7053[b]	21.6625[a]	0.0000
Average kg of fertiliser used per tsmad		(7.6643)	(14.9878)	(0.0000)
AV_MAN	Numerical	264.2386	221.7970	401.1789
Average kg of manure used per tsmad		(422.9836)	(334.3013)	(551.4889)
CROPSLD	Numerical	28.0556	30.8000	8.7222
Value of crops sold inn 1993 EC in ETB		(58.0059)	(44.6526)	(25.6442)

(a) value of variable is significantly different from the value of that variable in group 3
(b) value of variable is significantly different from the value of that variable in group 2
Significance level at 0.05 and below

Annex 5: Description of variables used in binary logistic regression

Annex-table 5.1. Description of variables used in Binary Logistic Regression

Variables	Definition of variables	Codes & units
a) Household Characteristics		
Eduhead	Level of education of the head of the household	0 = illiterate, 1 = grade 1-3, 2 = grade 4-6, 3 = grade 7-9, 4 = grade 10-12 (*)
Edu_hh	Highest level of education within the household	0 = illiterate, 1 = grade 1-3, 2 = grade 4-6, 3 = grade 7-9, 4 = grade 10-12 (*)
Sex	Sex of the head of the household	0 = female, 1 = male
Age	Age of the household head	Number of years
Members	Total members of the household	Number of people
Farming	First occupation of household head	1 = farming, 0 = other
b) Production/economic Features		
Area	Area owned by the household	Total of tsmad (equal to 0.25 ha.)
Areahead	Average area per member	Total of tsmad (equal to 0.25 ha.)
Share	Percentage of sharecropped in land	Measured as a percentage of 'area'
Irrig	Percentage of irrigated land	Measured as a percentage of 'area'
Wealth	Total wealth of the household from assets, livestock and in kind savings	Ethiopian Birr
Av_man	Manure use of household	Kilograms/tsmad
Inclabor	Income from labour (off-farm)	Ethiopian Birr
c) Institutional Features		
Cropsld	Value of yield sold in 1993 EC	Ethiopian Birr
Peas_ass	Participation of household in peasant association	0 = no, 1 = yes
Wom_ass	Participation of household in women's association	0 = no, 1 = yes
Swcprog	Participation of household in soil and water programmes (food for work and modelsite)	Total days per year

(*) religious school and literacy certificate are equalised to grade 1-3

Annex 6: Results binary logistic regression

Annex-table 6.1.1. Results binary logistic regression for group 1

	B	S.E.	Wald	Df	Sig	Exp(B)
Eduhead	.769	.534	2.073	1	.150	2.157
Edu_hh	.413	.401	1.060	1	.303	1.511
Sex	.464	1.193	.151	1	.697	1.590
Age	-.025	.037	.449	1	.503	.975
Members	-.102	.331	.094	1	.759	.903
Farming	.133	.996	.018	1	.894	1.142
Area	.525	.888	.349	1	.555	1.690
Areahead	-4.048	4.040	1.004	1	.316	.017
Share	-.026	.021	1.471	1	.225	.975
Irrig	.072	.088	.677	1	.411	1.075
Wealth	.001	.000	4.139	1	.042	1.001
Av_man	-.001	.001	2.981	1	.084	.999
Inclabor	-.003	.001	5.151	1	.023	.997
Cropsld	.010	.008	1.567	1	.211	1.010
Peas_ass	.380	.925	.169	1	.681	1.463
Wom_ass	-.353	1.114	.100	1	.751	.703
Swcprog	-.011	.005	4.998	1	.025	.989
Constant	.609	3.033	.040	1	.841	1.839

Percentage predicted correct: 79.70%
Nagelkerke R square 46.80%

Annex-table 6.1.2. Comparison of characteristics from households in group 1 with all other households with indicated significant characteristics

Characteristics	Households in group 1	Sig.	All other households
Number	36		38
Education of head	0.69		0.47
Highest education within household	2.03		1.50
Sex of household head			
Female	5.60%		21.05%
Male	94.40%		78.95%
Age of household head (years)	46		42
Number of members	6.33		5.02
Farming as main occupation (yes)	91.70%		76.31%
Total area owned by the household (in tsmad)	2.35		1.70
Total area owned by the household per member (in tsmad)	0.39		0.3682
Percentage of sharecropped in land	5.86		8.95
Percentage of irrigated land	1.58		0.98
Value of the wealth of the household (in Eth. Birr)	2644.39	**	1757.33
Average manure used (in kg)	264.24	*	306.77
Income received from off farm activities (in Eth. Birr)	151.67	**	230.92
Value of crops sold (in Eth. Birr)	28.06		20.34
Member of peasant association (yes)	75.00%		50.00%
Member of women association (yes)	80.60%		84.21%
Participation in other SWC programmes (days/year)	102	**	87

(*) indicates that the value of the characteristic is significantly different at 0.10
(**) indicates that the value of the characteristic is significantly different at 0.05
(***) indicates that the value of the characteristic is significantly different at 0.01

Annex-table 6.2.1. Results binary logistic regression for group 2

	B	S.E.	Wald	Df	Sig	Exp(B)

Eduhead	1.118	1.134	.972	1	.324	3.059
Edu_hh	-1.881	1.237	2.311	1	.129	.153
Sex	-5.780	3.375	2.933	1	.087	.003
Age	.433	.167	6.736	1	.009	1.542
Members	-2.096	.966	4.710	1	.030	8.133
Farming	5.494	3.233	2.889	1	.089	243.326
Area	-3.457	2.155	2.574	1	.109	.032
Areahead	37.710	16.730	5.080	1	0.24	2.38E+16
Share	.107	.043	6.233	1	.013	1.113
Irrig	.027	.141	.038	1	.846	1.028
Wealth	-.003	.001	6.707	1	.010	.997
Av_man	-.001	.003	.200	1	.654	.999
Inclabor	.012	.004	7.654	1	.006	1.012
Cropsld	.009	.015	.354	1	.552	1.009
Peas_ass	-2.817	2.259	1.555	1	.212	.060
Wom_ass	5.193	4.768	1.186	1	.276	180.003
Swcprog	.035	.016	4.732	1	.030	1.036
Constant	-40.609	16.869	5.795	1	.016	.000

Percentage predicted correct: 93.20%
Nagelkerke R square: 80.30%

Annex-table 6.2.2. Comparison of characteristics from households in group 2 with all other households with indicated significant characteristics

Characteristics	**Households in group 2**	**Sig.**	**All other households**
Number	20		54
Education of head	0.55		0.59
Highest education within household	1.55		1.83
Sex of household head			
Female	20.00%	*	11.12%
Male	80.00%		88.88%
Age of household head (years)	50	***	43
Number of members	5.40	**	5.76
Farming as main occupation (yes)	85.00%	*	83.33%
Total area owned by the household (in tsmad)	2.03		2.01
Total area owned by the household per member (in tsmad)	0.42	**	0.36
Percentage of sharecropped in land	10.33	***	6.38
Percentage of irrigated land	1.86		1.05
Value of the wealth of the household (in Eth. Birr)	1550.51	***	2425.30
Average manure used (in kg)	221.80		309.89
Income received from off farm activities (in Eth. Birr)	333.75	***	140.00
Value of crops sold (in Eth. Birr)	30.80		21.61
Member of peasant association (yes)	65.00%		61.11%
Member of women association (yes)	80.00%		83.33%
Participation in other SWC programmes (days/year)	94	**	74

(*) indicates that the value of the characteristic is significantly different at 0.10
(**) indicates that the value of the characteristic is significantly different at 0.05
(***) indicates that the value of the characteristic is significantly different at 0.01

Annex-table 6.3.1. Results binary logistic regression for group 3

	B	S.E.	Wald	Df	Sig	Exp(B)
Eduhead	-4.633	2.330	3.954	1	.047	.010
Edu_hh	.436	.736	.351	1	.554	1.546
Sex	2.317	2.282	1.031	1	.310	10.149
Age	-.206	.081	6.459	1	.011	.814
Members	.011	.593	.000	1	.986	1.011
Farming	-2.862	1.812	2.495	1	.114	.057
Area	-5.219	3.256	2.569	1	.109	.005
Areahead	8.291	10.076	.677	1	.411	3987.158
Share	-.026	.046	.330	1	.556	.974
Irrig	-.740	3.790	.038	1	.845	.477
Wealth	.002	.001	3.385	1	.066	1.002
Av_man	.002	.001	1.693	1	.193	1.002
Inclabor	-.007	.003	4.530	1	.033	.993
Cropsld	-.018	.015	1.439	1	.230	.983
Peas_ass	.850	1.752	.236	1	.627	2.340
Wom_ass	3.908	3.452	1.282	1	.258	49.812
Swcprog	-.001	.009	.004	1	.950	.999
Constant	8.187	6.178	1.756	1	.185	3593.326

Percentage predicted correct: 91.90%
Nagelkerke R square: 74.00%

Annex-table 6.3.2. comparison of characteristics from households in group 3 with all other households with indicated significant characteristics

Characteristics	Households in group 3	Sig.	All other households
Number	18		56
Education of head	0.39	**	0.64
Highest education within household	1.44		1.86
Sex of household head			
Female	22.20%		11.71%
Male	77.80%		89.29%
Age of household head (years)	35	***	48
Number of members	4.61		6.00
Farming as main occupation (yes)	66.70%		89.29%
Total area owned by the household (in tsmad)	1.33		2.23
Total area owned by the household per member (in tsmad)	0.31		0.40
Percentage of sharecropped in land	7.41		7.46
Percentage of irrigated land	0.00		1.68
Value of the wealth of the household (in Eth. Birr)	1987.14	*	2253.72
Average manure used (in kg)	401.18		249.08
Income received from off farm activities (in Eth. Birr)	116.67	**	216.70
Value of crops sold (in Eth. Birr)	8.72		29.04
Member of peasant association (yes)	33.30%		71.43%
Member of women association (yes)	88.90%		80.36%
Participation in other SWC programmes (days/year)	111.78		69.46

(*) indicates that the value of the characteristic is significantly different at 0.10
(**) indicates that the value of the characteristic is significantly different at 0.05
(***) indicates that the value of the characteristic is significantly different at 0.01

Annex 7: Results probit analysis

(a) = the variable is not included in the analysis due to singularity (this is discussed in chapter 6)

Annex-table 7.1. Output Probit analysis of REST

Dependent Variable: REST_alg				
Variables	**Coefficient**	**Std. Error**	**z-statistic**	**Sig.**
Constant	-0.000319	1.760241	-0.000181	0.9999
Eduhead	-0.424260	0.276121	-1.536502	0.1244
Sex	(a)	(a)	(a)	(a)
Age	-0.033541	0.026092	-1.285494	0.1986
Members	0.146599	0.227328	0.644877	0.5190
Farming	(a)	(a)	(a)	(a)
Area	-0.074796	0.553340	-0.135173	0.8925
Areahead	0.065985	2.772663	0.023798	0.9810
Share	0.002700	0.009669	0.279290	0.7800
Irrig	-0.122848	0.095134	-1.291317	0.1966
Peas_ass	0.561825	0.520021	1.080388	0.2800
Wom_ass	-1.483116	0.609217	-2.434462	0.0149
Wealth	0.000225	0.000152	1.477208	0.1396
Inclabor	-0.000661	0.000679	-0.973718	0.3302
Swcprog	-0.001595	0.002333	-0.683733	0.4941
Massmob	0.022794	0.012897	1.767382	0.0772

S.E. of regression	0.404535	Mean dependent variable	0.225000
Sum of squares residuals	10.80079	S.D. Dependent variable	0.420217
Log likelihood	-34.27365	Akaike inf. Criterion	1.206841
Restricted log likelihood	-42.65311	Schwarz criterion	1.623696
Average log likelihood	-0.428421	Hannan-Quinn criterion	1.373970
LR statistic (13 df)	16.75892	Observation with Dep = 0	62
Probability (LR stat)	0.210561	Observations with Dep = 1	18
McFadden R^2	0.196456	Total observations	80

Annex-table 7.2. Prediction table for probit analysis REST

	Estimated Equation			**Constant Probability**		
	Dep = 0	**Dep = 1**	**Total**	**Dep = 0**	**Dep = 1**	**Total**
P(Dep=1)<=C	61	11	72	62	18	80
P(Dep=1)>=C	1	7	8	0	0	0
Total	62	18	80	62	18	80
Correct	61	7	68	62	0	62
% Correct	98.39	38.89	85.00	100.00	0.00	77.50
% Incorrect	1.61	61.11	15.00	0.00	100.00	22.50
Total Gain	-1.61	38.89	7.50			
Percent Gain	NA	38.89	3.33			

Annex-table 7.3. Residual test for probit analysis REST

Standardized residuals Probit estimation			
Mean	0.016945	**Skeweness**	2.609078
Median	-0.297887	**Kurtosis**	12.29886
Maximum	5.632852	**Jarque-Bera**	378.9933
Minimum	-1.118430	**Probability**	0.000000
Standard Deviation	1.043764		

Annex-table 7.4. Output Probit analysis of BoANR

Dependent Variable: BoANR_alg				
Variables	**Coefficient**	**Std. Error**	**z-statistic**	**Sig.**
Constant	0.158552	2.051135	0.077300	0.9384
Eduhead	1.061718	0.403922	2.628524	0.0086
Sex	-0.680388	0.857504	-0.793451	0.4275
Age	-0.050498	0.025090	-2.012678	0.0441
Members	0.046652	0.235250	0.198307	0.8428
Farming	1.040168	0.778356	1.336366	0.1814
Area	0.934529	0.534948	1.746954	0.0806
Areahead	-2.294084	2.747745	-0.834897	0.4038
Share	-0.039449	0.021772	-1.811936	0.0700
Irrig	0.044623	0.058068	0.768464	0.4422
Peas_ass	-0.232170	0.658133	-0.352770	0.7243
Wom_ass	-1.014642	0.677194	-1.498304	0.1341
Wealth	0.000118	0.000163	0.721910	0.4703
Inclabor	-0.002709	0.000910	-2.975361	0.0029
Swcprog	-0.012285	0.003606	-3.407047	0.0007
Massmob	0.045339	0.016309	2.780027	0.0054
S.E. of regression	0.390902	Mean dependent variable		0.375000
Sum of squares residuals	9.779463	S.D. Dependent variable		0.487177
Log likelihood	-28.76261	Akaike inf. Criterion		1.119065
Restricted log likelihood	-52.92506	Schwarz criterion		1.595471
Average log likelihood	-0.359533	Hannan-Quinn criterion		1.310070
LR statistic (15 df)	48.32490	Observation with Dep = 0		50
Probability (LR stat)	2.25E-05	Observations with Dep = 1		30
McFadden R^2	0.456541	Total observations		80

Annex-table 7.5. Prediction table for probit analysis BoANR

	Estimated Equation			**Constant Probability**		
	Dep = 0	**Dep = 1**	**Total**	**Dep = 0**	**Dep = 1**	**Total**
P(Dep=1)<=C	42	8	50	50	30	80
P(Dep=1)>=C	8	22	30	0	0	0
Total	50	30	80	50	30	80
Correct	42	22	64	50	30	80
% Correct	84.00	73.33	80.00	100.00	0.00	62.50
% Incorrect	16.00	26.67	20.00	0.00	100.00	37.50
Total Gain	-16.00	73.33	17.50			
Percent Gain	NA	73.33	46.67			

Annex-table 7.6. Residual test for probit analysis BoANR

Standardized residuals Probit estimation			
Mean	-0.018770	**Skeweness**	-0.323003
Median	-0.041298	**Kurtosis**	4.756944
Maximum	1.891015	**Jarque-Bera**	11.68059
Minimum	-3.026398	**Probability**	0.002908
Standard Deviation	0.824441		

Annex-table 7.7. Output Probit analysis of both BoANR and REST

Dependent Variable: Both				
Variables	**Coefficient**	**Std. Error**	**z-statistic**	**Sig.**
Constant	3.326838	2.898640	1.147724	0.2511
Eduhead	0.119902	0.489674	0.244860	0.8066
Sex	(a)	(a)	(a)	(a)
Age	-0.162301	0.076249	-2.128579	0.0333
Members	0.722270	0.452262	1.597015	0.1103
Farming	(a)	(a)	(a)	(a)
Area	-0.236013	0.876070	-0.269400	0.7876
Areahead	4.231535	3.970562	1.065727	0.2865
Share	-0.039565	0.044438	-0.890332	0.3733
Irrig	-0.083504	0.149815	-0.557382	0.5773
Peas_ass	2.519957	1.453105	1.734188	0.0829
Wom_ass	-3.195144	1.201766	-2.658706	0.0078
Wealth	-0.000403	0.000439	-0.917567	0.3588
Inclabor	-0.003138	0.002459	-1.276062	0.2019
Swcprog	(a)	(a)	(a)	(a)
Massmob	(a)	(a)	(a)	(a)
Swctot	-0.017604	0.010310	-1.707537	0.0877

S.E. of regression	0.218979	Mean dependent variable	0.087500
Sum of squares residuals	3.212781	S.D. Dependent variable	0.284349
Log likelihood	-10.98869	Akaike inf. Criterion	0.599717
Restricted log likelihood	-23.73722	Schwarz criterion	0.986797
Average log likelihood	-0.137359	Hannan-Quinn criterion	0.754908
LR statistic (12 df)	25.49706	Observation with Dep = 0	73
Probability (LR stat)	0.012635	Observations with Dep = 1	7
McFadden R^2	0.537069	Total observations	80

Annex-table 7.8. Prediction table for probit analysis both BoANR and REST

	Estimated Equation			**Constant Probability**		
	Dep = 0	**Dep = 1**	**Total**	**Dep = 0**	**Dep = 1**	**Total**
P(Dep=1)<=C	72	3	75	73	7	80
P(Dep=1)>=C	1	4	5	0	0	0
Total	73	7	80	73	7	80
Correct	72	4	76	73	0	73
% Correct	98.63	57.14	95.00	100.00	0.00	91.25
% Incorrect	1.37	42.86	5.00	0.00	100.00	8.75
Total Gain	-1.37	57.14	3.75			
Percent Gain	NA	57.14	42.86			

Annex-table 7.9. Residual test for probit analysis both BoANR and REST

Standardized residuals Probit estimation			
Mean	0.003701	**Skeweness**	3.869171
Median	-0.011920	**Kurtosis**	21.19080
Maximum	3.435064	**Jarque-Bera**	1204.927
Minimum	-1.292094	**Probability**	0.000000
Standard Deviation	0.655677		

Annex-table 7.10. Output Probit analysis of not using credit

Dependent Variable: No loan				
Variables	**Coefficient**	**Std. Error**	**z-statistic**	**Sig.**
Constant	0.712634	2.066925	0.344780	0.7303
Eduhead	-0.299996	0.277785	-1.079955	0.2802
Sex	-0.385799	0.797560	-0.483724	0.6286
Age	0.027318	0.023032	1.186063	0.2356
Members	-0.065368	0.238758	-0.273782	0.7843
Farming	-1.169968	0.645219	-1.813286	0.0698
Area	-0.394127	0.586815	-0.671638	0.5018
Areahead	2.204312	3.214714	0.685695	0.4929
Share	0.016461	0.010352	1.590043	0.1118
Irrig	0.034660	0.053936	0.642617	0.5205
Peas_ass	0.063825	0.561924	0.113583	0.9096
Wom_ass	0.689029	0.663229	1.038901	0.2989
Wealth	-0.000200	0.000152	-1.316750	0.1879
Inclabor	0.001409	0.000596	2.363640	0.0181
Swcprog	0.007819	0.002464	3.172938	0.0015
Massmob	-0.038273	0.013237	-2.891258	0.0038
S.E. of regression	0.417390	Mean dependent variable		0.487500
Sum of squares residuals	11.14972	S.D. Dependent variable		0.502997
Log likelihood	-35.27133	Akaike inf. Criterion		1.281783
Restricted log likelihood	-55.42677	Schwarz criterion		1.758189
Average log likelihood	-0.440892	Hannan-Quinn criterion		1.472788
LR statistic (15 df)	40.31088	Observation with Dep = 0		41
Probability (LR stat)	0.000407	Observations with Dep = 1		39
McFadden R^2	0.363641	Total observations		80

Annex-table 7.11. Prediction table for probit analysis not using credit

	Estimated Equation			**Constant Probability**		
	Dep = 0	**Dep = 1**	**Total**	**Dep = 0**	**Dep = 1**	**Total**
P(Dep=1)<=C	33	8	41	41	39	80
P(Dep=1)>=C	8	31	39	0	0	0
Total	41	39	80	41	39	80
Correct	33	31	64	41	0	41
% Correct	80.49	79.49	80.00	100.00	0.00	51.25
% Incorrect	19.51	20.51	20.00	0.00	100.00	48.75
Total Gain	-19.51	79.49	28.75			
Percent Gain	NA	79.49	58.97			

Annex-table 7.12. Residual test for probit analysis not using credit

Standardized residuals Probit estimation			
Mean	-0.019611	**Skeweness**	-0.745747
Median	-0.123348	**Kurtosis**	10.79123
Maximum	4.061614	**Jarque-Bera**	209.7595
Minimum	-5.188215	**Probability**	0.000000
Standard Deviation	1.061266		

Annex 8: Photographs