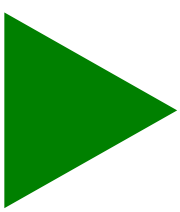
PUBLIC AND PRIVATE LABOUR INVESTMENT AND INSTITUTIONS FOR SOIL AND WATER CONSERVATION IN TIGRAY, NORTHERN ETHIOPIA

Kinfe Abraha Weldemichael

Working Paper 2002-02



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

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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 02

Public and private labour investments and institutions for soil and water conservation in Tigray, Northern Ethiopia

Kinfe Abraha Weldemichael

Wageningen, June 2002

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Summary

This case study discusses the role of local institutions, and how they could affect the decision making of households on private labour investments for soil and water conservation in the highlands of Tigray, Ethiopia, where soil degradation problem is a major threat to the agricultural sector and household food security. Soil and water conservation practices have been taken place widely either privately or by the public. Local institutions play greater role in mobilising resource, mainly labour, from their members and invest it on SWC practices as well as on other activities.

Farmers invest labour in soil and water conservation on own land privately and contribute labour to the institutions. They also are entitled to receive labour from the institutions. The institutions are found to influence private SWC investment decision in three major ways; through their investment on privately owned land, labour contribution from the household, and through their income effect. Other than institutional factors, factors like, level of erosion problem, resource endowment, and sex of the household head are found to affect level of private investment. Because of the level of degradation problem or due to unperceived soil erosion problems some households invest privately less, while the initial investment from the institutions encourages private SWC investment. Public investment in SWC includes the investments both on privately owned land and open land that are practised either through labour mobilised from the community or food-for-work. The level of private investment and land character (slope) mainly determines the level of community investment on private land, while labour contribution to the institutions is affected by the number of households enrolled in the institutions, food-for-work, number of female members in the household, and area. Thus the consideration of local institutions would be important in formulating policies for improved land management.

preface

writing this thesis paper is one of the major challenges I encountered during my study here in Wageningen. Due to lack of abundant literatures that have direct relation to my topic, I had some difficulties in choosing methods that could be appropriate for my research, to relate and compare its outcomes with other works. However, due to close supervision and frequent discussions with my supervisors, I am able to overcome the problem and complete it, though it took me longer than I expected. However, it is one of the best things that happened to me which gave me the opportunity to read and consult a wide range of literatures and learned a lot and now I am confident enough to make research with little supervision.

On this occasion I want to acknowledge my supervisors, Dr. Ruerd Ruben and Dr.Ir. Gideon Kruseman who devoted much of their time in supervising, consulting and editing my work. If it was not for you, this paper would not be as interesting as it is now.

I also want to acknowledge my class mates especially, Mehret Mesfin, Ximena Chavez, Marcus Hery, Moti Jeleta and others who were there for me when I needed them.

I also want to acknowledge the RESPONSE Project that covered larger part of my travelling expense for my field work.

1 Introduction

1.1 General introduction

Soil erosion is a major problem facing the agricultural sector in the highlands of Ethiopia. It is estimated that an average loss of 42 tons of soil per hectare per year occurs at national level from a cropland (Hurni, 1993). The problem has been aggravated by the pressure on land due to increasing population density (138 persons/sq.km of arable land) (Hagos *et. al.*, 1999), overgrazing, reduced fallow periods, cropping in marginal lands and deforestation. Recently, soil erosion problems have received greater attention and soil and water conservation (SWC) has therefore, become an area for public intervention (Shiferaw & Holden, 2000).

Productivity of the soil is highly reduced due to the soil erosion problem coupled with abnormal rainfall distribution, pest incidence, and crop disease problems. The production of many farmers is not even enough to feed and sustain the whole family until the next production season and thus food insecurity at household levels has become common.

To assure food security, the government has been designing and executing policies and programs that encourage and boost up agricultural production. One of the major agricultural programs is the extension program, which focuses on the use of modern inputs. Also soil and water conservation measures are taken seriously and are widely applied over the region. The activities of Soil and Water Conservation have been undertaken by either private action or by the community through mass mobilisation or food-for-work programs. A large majority of the farmer (87%) practice soil and water conservation on their own farms (Hagos *et. al.*, 1999). Public participation in soil conservation was focussed on the mountains, hillsides and open lands that are considered to be public property. Conservation on private farms was not a primary concern of the 'society'.

The highlands of Tigray are one of the most densely populated areas in Ethiopia with a fast growing population. More than 80% of the population is dependent on subsistence rain-fed agriculture. A baseline survey conducted in 1994 for Central Zone of Tigray Region showed the average land holding to be 1.3 ha. with a range from 0.22ha. in the highlands to 2.6 ha. in the lowlands. This survey also showed the poor fertility maintenance practices, like scarce chemical fertilisation and reduction or disappearance of fallow periods. The increasing population and the decreasing productivity made households to be unable to fulfil their food needs. The average soil erosion rate for the central highlands of the region is estimated as 17 metric tones per ha. (Hunting, 1975) as cited by Hagos *et. al.,*(1999), while studies by others (REST, 1989a, 1989b, Tekeste & Smith, 1989) estimated the loss above 80 tones per ha. per year. However, Tigray is also one of the regions where a concerted effort to address the problem of soil degradation is taking place through physical soil and water conservation programs, area closure, and reforestation.
Land should be managed in such a way that it could maintain its productivity in a sustainable manner. The physical soil and water conservation program is a widely practised sustainable land management activity in Tigray. Though many institutions and organisations have a direct contribution in the implementation of this program, -either through funding, co-ordination, or information dissemination, the community and its 'institutions' are the main ones responsible, both as investor (mainly labour)

and as a beneficiary. These institutions that form the community social capital, play important roles in the investment of soil and water conservation practices, both on private-owned and community-owned land. Social capital is defined as the relationship and norms that shape the quality and the quantity of human social interaction (Ruben and Strien, 1999). Local organisations (considered as social capital) can play a critical role in natural resource management, even where legal property right on the resource itself are individualised, or are controlled by the state (Scherr *et. al.*, 1995).

In Tigray, almost every member of a rural household is a member of at least one local institution, which is defined as any organisation that is primarily accountable to local people (Scherr *et. al.*, 1995), such as youth association, women association, or farmers association, farmers co-operatives, etc. Some of these institutions are active participants in the soil and water conservation practices. In sustainable land management these institutions can play different roles, like information dissemination, delivery of inputs like fertiliser, labour supply for soil and water conservation, organise training on improved land management, etc.

Every member of the voluntary institutions is expected to participate in soil and water conservation activities through their organisation and contribute a minimum of 20 days of labour. For the ease of monitoring and efficiency, new soil and water conservation units called *Gujile* are formed. Each *Gujile* consists of ten members: two from the Farmers' Association, three from the Youth Association, and five from the Women Association. Usually members of one Gujile are from one surrounding area or locality. After each working day of the *Gujile* in the SWC, the unit leader will report what was done and which problems were encountered (if any), after evaluating their daily accomplishments together with the *Gujile* members.

The labour supplied to institutions[1] by the members is invested into soil conservation practices on community/open land, mountains/hills, and for other activities, like construction of access roads. However, recently these works have also been applied on the privately-owned land that suffer from erosion problems, but using more stable and long-lasting techniques, like the construction of stone terraces.
In this paper, the investment of the local institutions on private land is called community investment. Community investment is defined as the labour invested by the community on private-owned land. These investments by the community could stimulate households to invest more on their own land. But institutions could also deter private investments (defined as labour supplied on conservation by the household on its own land) due to competition for family labour and congestion (competition for space in the conservation works).

As stated by Hagos *et. al.* (1999) most of the research conducted in Tigray, with few exceptions, focuses on biophysical aspects of the problem… particularly in soil erosion without much emphasis on the economic, social, or institutional factors that affect how farmers manage their land. Krishna and Uphoff (2001) have also showed that little attention have been given to institutions though it is recognised that social and institutional factors matters, in addition to technological and financial aspects.

[1] Here institutions refers to the organisations defined as the structure of recognised and accepted role

Hence, analysing how local institutions can influence the decisions of the household regarding labour investment in soil conservation and their contribution of labour to conservation on degraded lands is important. Moreover, identification of the factors which condition the local organisations, and the types of organisations which facilitate sustainable natural resources management, are important for policies to assist local organisations (Rasmussen and Meinzen-Dick, 1995). This can have implications for the potential role of institutions for sustainable land management, mainly on areas where there was no such kind of arrangement before.

The thesis is arranged in the following way. After this introduction, the description of the study area (chapter 2) followed by a review of theoretical literature (Chapter 3) are provided respectively. In Chapter 4 materials and methods are presented and in Chapter 5 the empirical results are discussed. Finally in Chapter 6 the conclusion and policy implications will be presented.

1.2 Research questions

In this thesis paper, I have analysed the effects of the institutions on the decision-making process of the households in soil conservation investment and the participation of households in community soil conservation activity. The following hypothesis are discussed and subsequently tested:

A- Private labour investment in soil conservation could be affected by the number of household members enrolled in institutions

When household members are enrolled in institutions they contribute labour to these institutions. When increasing the number of household members enrolled in the institutions, the contribution to the institutions increases. Households with more labour contributions than households who have less number of members enrolled in institutions thus face an additional cost. This competition for the same resource (labour) might result in the decrease of available labour to be invested privately on their own land. Hence, a negative relationship between the number of household members enrolled in institutions and private labour investment in soil and water conservation is expected.

B- Private Labour investment can be deterred/initiated by investment from institutions

When both the household and the community invest on private-owned land at the same time (year), there might be an oversupply of labour that can lead into the competition for space. When this occurs, the household will decrease its labour supply and reallocate time to other activities that could be performed privately, leaving the soil conservation to the community. Hence, community investment can lead to the substitution of family labour by community labour, resulting in decreased private labour investment by the household.

However, a positive relationship could also occur when investments by institutions play a role as social capital. In this case, conservation practices that are too difficult to be accomplished privately, for example because of the size of the degradation problem, could be addressed by mobilising labour from the community through the institutions. This can result in increasing the household labour supply in maintaining

the conservation structures and building new ones. In another case, the community could initiate private investment if the household gained significant returns (for example, through an increase in production of crop yield, feed for animals, etc.) from the investment of previous conservation works done by the community. This could encourage the household to additional investments. This is particularly true when the owner did not observe the erosion problem. Hence, private investment could be initiated by the investment from institutions and thus a positive relationship is expected.

C- Investment by institutions can deter private investment on degraded areas and can lead to free-ridding[2]

To test this hypothesis, it is important to know what factors determine the level of investment by institutions in soil conservation on private farms, and to identify who are most benefited from the institutions. The labour supplied to the institutions by their member is allocated into soil conservation practices on community/open land, mountains/hills, and on private farms, as well as in other activities, like construction of access roads. Thus, looking at what factors influence the investment by the

institutions on privately owned land, we need to assess which households are benefited by the institutions.
The expectation is that, farmers whose farms have higher erosion problem will benefit most while those with less erosion problems will benefit less from the institutions. This is because the supplied labour by the community in soil conservation focuses on areas where erosion problems are severed and usually on farms with steep slope. The hypothesis that community investment can result in free-ridding problem and decreased private labour investment on degraded lands is considering that households will try to abandon private conservation in the highly degraded areas leaving this to the community, and conserve the less degraded areas, which could irradiate the degradation into land with moderate slope and erosion problem. Hence, community investment could result in free riding problem, as well as facilitate the degradation of less-degraded areas because of its redistribution effect. This is because households that invest privately are less likely to gain contribution from the institutions compared to those that did not do so. Thus, the distributional effects of the community labour can affect households' private investment, resulting in decreased private investment.

D- Labour contribution to institutions is influenced by sex composition of the family, and number of members of household enrolled in institutions

Every member of the associations is expected to contribute certain amount of labour and money (membership fee). The contribution of a household to the institution depends on the number of household members enrolled in the institutions, the capacity of the institutions to mobilise their members, and the objectives of the institutions. Expectations from market-oriented institution (for example farmers' co-operatives) to have a direct role in mobilising labour for soil conservation are low. This is because the objectives of these kinds of institutions are more focused on creating market outlet and input delivery, but not soil conservation. Hence, the labour contributions of households for soil conservation are irrespective of these institutions. However, the other voluntary organisations, like women's association, youth

[2] Free-ridding in this case is the desire of individuals to excessively exploit the community labour and/or is the reluctance to do/perform what could be done/ is required.

association, and farmers' association influence the supply of labour for soil conservation by the households, either on others' farms or on community owned/open land.

We also expect that family composition by sex could affect the contributions of the household. Families composed of more females might contribute more to the institutions than families with more males. This is because men are usually the ones that are sent for off-farm income generation and hence there is more male migration and a decreased labour supply from the male members. Besides, divorced women usually go back to their parents, which results in an increase in the number of female household members that could supply labour to their respective institution.

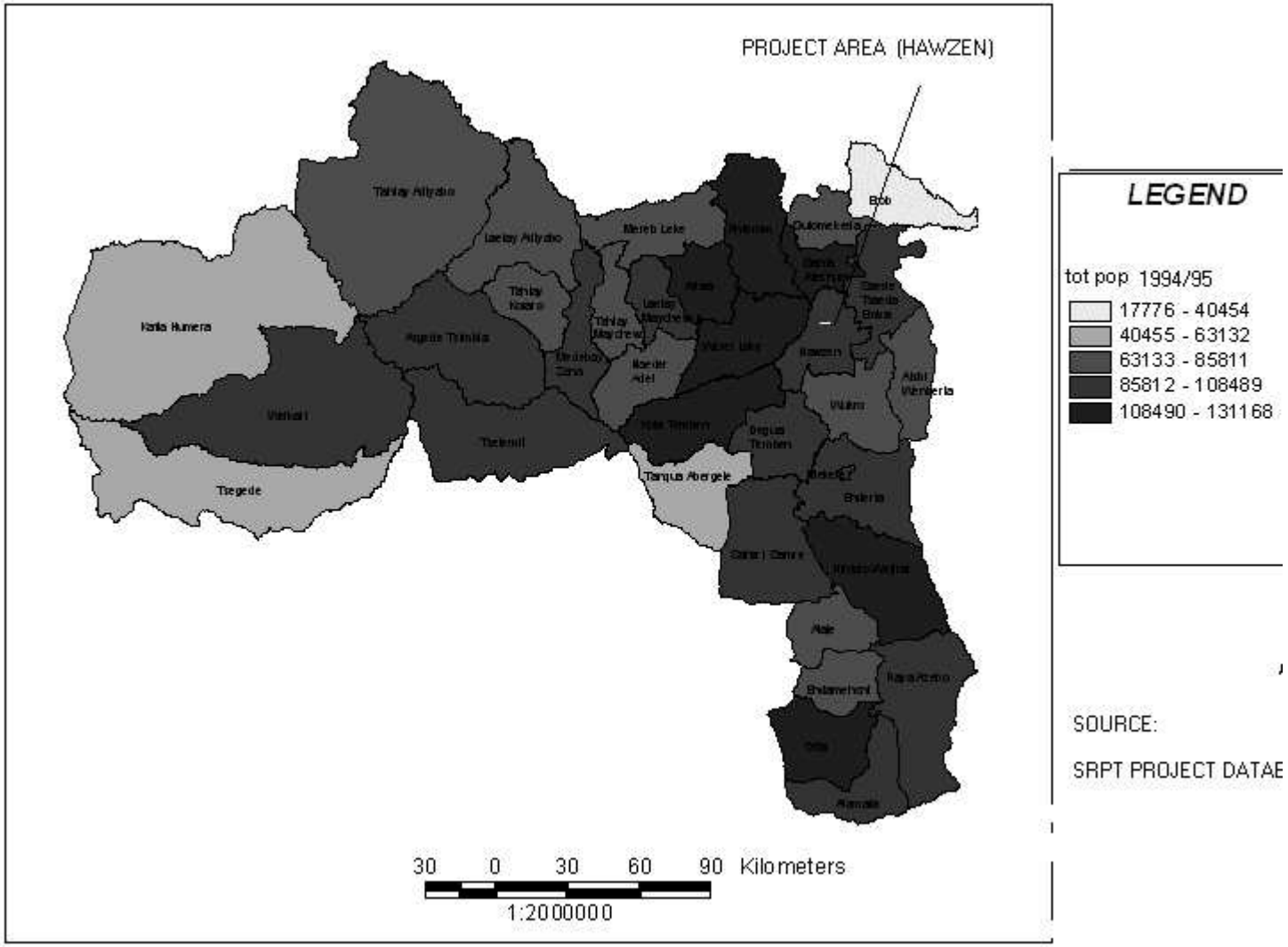
2 Description of the study area

The study area is located in eastern part of the Regional State of Tigray, Ethiopia. The region is divided into five administrative zones, which are further divided into districts called *Woredas*. The site of the study area is located in one of the seven *Woredas* of the Eastern Tigray Zone administration, called W*oreda Hawzen*. The central town of the woreda is located about 90 KM north of the regional capital *Mekelle.*

The Eastern zone is one of the densely populated areas of the region with a population size of 584,946 estimated for 1994 (Planning office). Like other parts of the country, most of the people living in the woreda are highly engaged in agriculture, mainly in crop production and animal rearing. However, there are few households around the town who are also engaged in other activities. The studied woreda is divided into 21 administrative localities, called *Tabia*s. Each *Tabia* has its own administration unit, called *Baito*. The people living in the *Tabia* select the *Baito* members. Each *Tabia* in the woreda has the so-called voluntary institutions, which comprises the Women's Association, the Youth Association and the Farmers Association. There are also other institutions like *Mahber* and *Tsebel* (which are religious in nature), market oriented like Farmers Co-operatives and other labour-sharing and mutual arrangements as well as saving groups like *Equib*. Market institutions may not be equally developed in all *Tabia*s.

The topography of the woreda is characterised by hills and valleys with Pick Mountains and gorges and high variation in slope. The altitude varies from around 1829 meter to 2353 meter in the highlands for *Tabia* Debre-bizen (one of the two studied *Tabia*s). The annual average rainfall is between 450 and 500mm. However, the distribution of the rain is limited to three months (June, July and August) and gets more unreliable in June.

Figure 1 Map of Tigray Region total population in 1994/95



2.1 Characteristics of the two Tabias

The study is conducted in 2 of the 21 *Tabia*s of the woreda. The first *Tabia* called *Debre-hiwot*, which is, located about 5 km from the woreda central town with a relatively better access to transportation, school, market and others services. The other *Tabia* called *Debre-bizen* is about 24km from the town. The second *Tabia* is the most remote one in terms of access to roads, bigger markets and schools**.** The information that was gathered by the woreda agricultural office shows that the number of households that lived in *Tabai Debre-hiwo*t was 726, and 962 for *Tabia Debre-bizen* for the year 1999. From the socio-economic survey made by the planning and economic development office of Eastern Zone (1997), it was found that the average family size for *Woreda Hawzen* was 4.9 for the year 1997. Of the 433 interviewed households, 24.4% were female-headed. The average dependency ratio for the zone was estimated to be 103%. When we consider the association or organisational participation, an average of 2.34 persons per household are being registered as members of the institutions, with a minimum of one and maximum of 5 household members. Concerning the enrolment in the Farmers Co-operatives, of the 77 households, only 5 households are not enrolled while the other 72 (93.51 %) of the households are members of the marketing institution.

Resource endowments vary from household to household. Resource endowment includes the land holdings, animal holdings other than oxen, oxen, and labour (family members above 15 years of age) of the households. The land holding of the households varies from 0.5 *Tsemdi* (local measurement which is equal to a quarter of a hector of land) to seven *Tsemdi* or about 1.75 ha., with an average landholding of 2.75 *Tsemdi* (0.69 ha.) per household. Many members of the households who are illegible for land have not received any land and in some cases the family has no land at all. Data collected by IFPRI-ILRI community level survey (1999) shows that the number of land-less households in *Tabai Debre-bizen* was 81 (8.36%) and 155 (10.94%) for years 1991 and 1998 respectively. The soil type of these *Tabia*s is predominantly sandy with a shallow soil profile, low water holding capacity and higher sensitivity to erosion.

Oxen are the main agricultural resource; ownership of oxen is the major criterion that is used in the classification of farmers into different wealth status. In the *woreda* the households are divided into three groups based on their wealth status: poor, medium, and rich. The poor are these how do not own any oxen and usually have small land, while the rich once have three and more oxen. The average number of oxen owned by a household is 1.3, with minimum zero and maximum three. Of the total 77 households interviewed 17% (13) have no ox at all, while 6%(5) have three oxen and the rest 43%(33) and 34%(26) households own 1 and 2 oxen, respectively. The animal holding index[3] (excluding oxen) for the household is zero at the minimum which means there are households that do not own any animal, while the maximum is 14 and an average of 4.

Like any other parts of Tigray, in the two *Tabia*s soil and water conservation works have been underway for years. The conservation is practised both on the private and community owned lands. On the privately-owned land household members invest their labour in building soil bands, stone terraces, planting trees, chuck dams and

[3] The procedure used for calculating the animal holding index is explained in the data analysis section.

others, especially when the household considers erosion as a major problem and sees the need for conservation. Of the 77 households that owned land, eight households (10.4%) did not make any soil conservation investment privately while the others spent an average of 20.89 man-days of labour investment in SWC. Four of the seven households which did not invest in soil conservation privately, did not consider soil erosion to be a problem while the remaining three household expressed soil erosion as a problem but the solution is beyond their capacity, either due to the gully formation or degradation being on steep slope.

Community soil conservation on private land is something that should not be undermined. As discussed in the earlier section, the labour supplied to the institutions by their members is invested both on the private and community land. The community conservation on private land in these two *Tabia*s is large, comprising about 73.7% of the total investment on privately-owned lands. The average community investment was estimated to be 58.53 man-days, with a minimum of zero for only one household. 76 households have received a contribution from the community ranging from one to 230 days. The household's contribution of labour to the institutions ranges between 23 and 133 days, with an average of 64 days. From the labour supplied to the institutions, on average 53.67 days (84%) is spent on soil conservation, of which 72.4% and 27.6% is on private and open/community owned land respectively.

Food-for-work is one of the major incentive system not only in the rehabilitation of the natural resource but also to assist the poor by creating off-farm employment. All the other households, except three have benefited from its implementation. From this work households have gained an average of 218,85kg. of grain(wheat) working for 72.95days at a wage rate of 3kg per day during the year 2001. This was the major source of income for households, mainly to the poor, next to the agricultural production. For some households who do not own land this was their 'only' means of living. The environmental rehabilitation works were undertaken through food-for-work and were only on the community/open land in the area of reforestation, gully treatment, and water shade management.

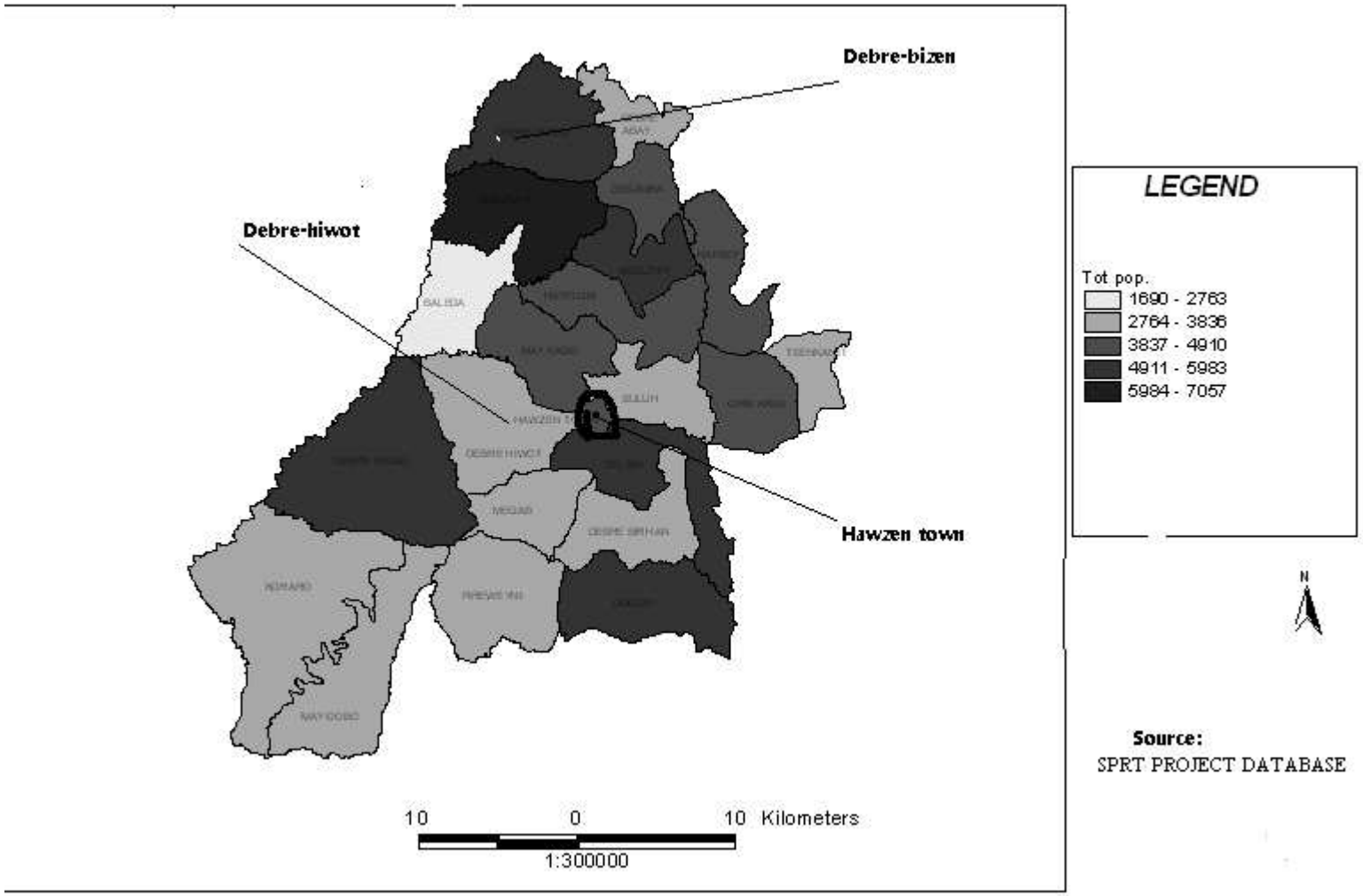
The institutions in these two *Tabia*s are common to the area. In both *Tabia*s, all 'voluntary organisation' are operational; both have Farmers co-operatives, *Baito* (the administration unit), other religious institutions, and mutual co-operation arrangements, like labour sharing. Both have elementary school, but the nearest junior secondary school for Tabai Debre-hiwot (1-hour walk from *Hawzen* town). The same *Tabia* has better access to a road, which crosses it on its way to a bigger town called Wukro. When we consider the markets for the product and labour, *Tabai Debre-hiwot* has a better access because of its proximity to the town where there is the biggest market in the woreda. *Tabia Debre-bize*, which is located 24km far from the town and has no transportation system, has less access to the markets. However, there is a very small 'market' about 1.5 hour walk, which opens once a week for few hours. If we consider the topography of this *Tabia* it is more undulated than Tabai Debre-hiwot is.

Based on the study conducted by the SRPT (Strengthening Regional Planning in Tigray) population density indicator is higher in *Debre-bizen* than for Debre-hiwot, but the potential production is higher in Debre-hiwot. The environmental fragility index, (based on erosion risk distribution, and distribution of areas having slope >30%) is higher for Debre-bizen than for Debre-hiwot. When we compare the rural

technology application index[4] between these *Tabias, Debre-bizen* has a very low technology level while Debre-hiwot has relatively higher rural technology application index. Thus, in many ways *Tabia* Debre-hiwot seems to be a relatively better place than *Tabia Debre-bizen*.

[4] This refers to the use of kerosene stoves, tie-rigger, improved plough

Figure 2 Map of Hawzen Woreda showing total population in the *Tabias*



3 Theory and Review literature

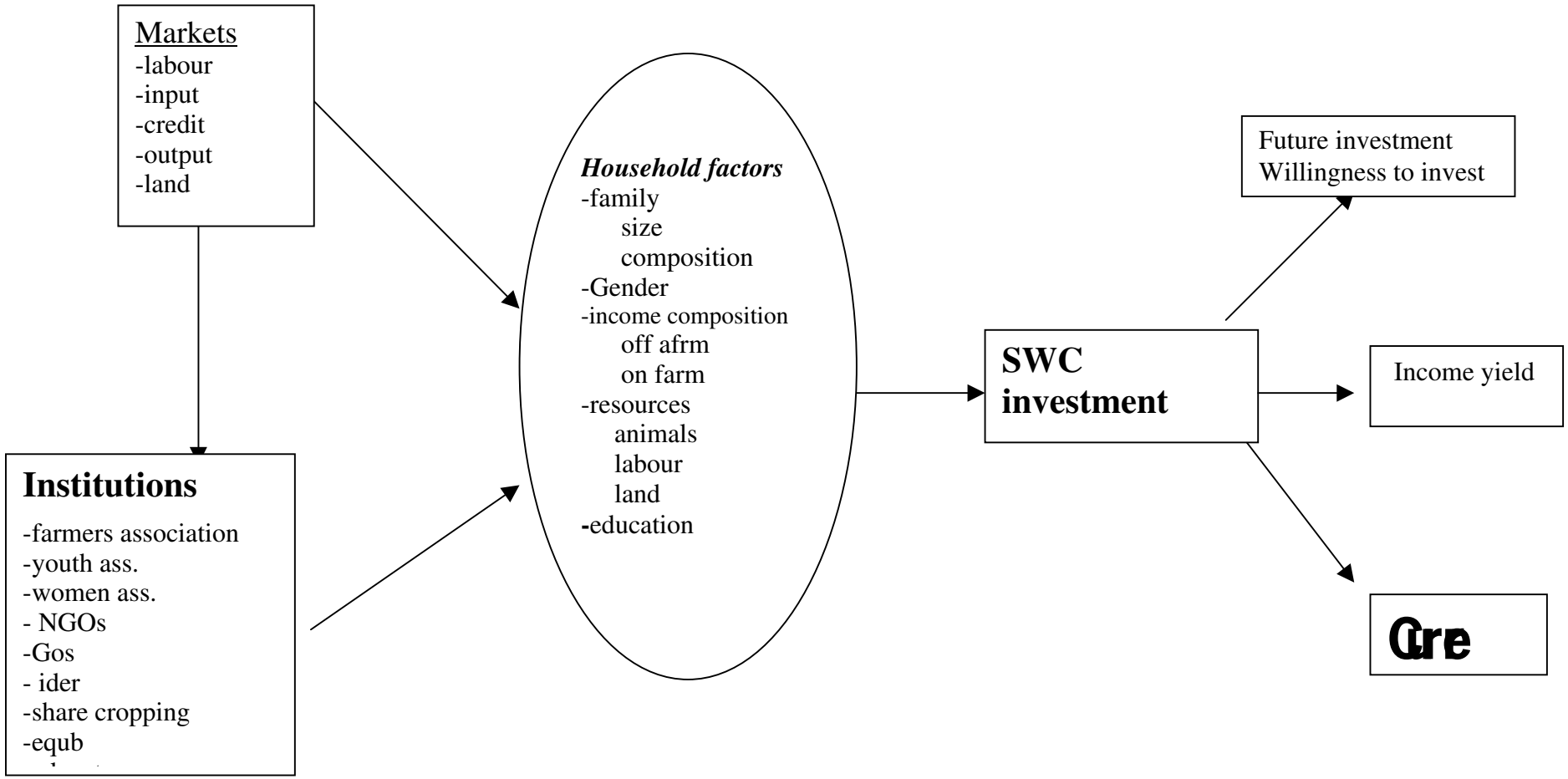
3.1 Private Soil conservation Investment and Institutions

Adoption of private Soil investment of a household on private land depends on: -
household factors (such as family composition and size, education, attitude towards erosion, and experience, resource endowment, income)
biophysical factors (like susceptibility to erosion, slope, and soil type),
socio-economic factors (population pressure, institutional setting, participation in institutions, and markets, of the household (on farm and off-farm income)) and
Institutional factors such as land tenure systems, investment policies etc.
These factors are also naturally related.

Population pressure aggravated soil degradation due to overexploitation of the natural resource base. It also contributes to the socio-economic problems, which themselves reinforced land degradation, like increased poverty as a result of resource constraints and decreasing returns to capital and labour in agriculture. On the other hand, by increasing the value of land relative to labour, population growth may induce farmers to make labour-intensive investment in land improvement and soil management (Pender, 1998). Insecure land tenure can affect farmers' decision with regard to management of the land by limiting the ability to mortgage transfer or sale. This can limit the investment in soil management, even if its potential return in the future is high. But it also affects access to credit that could intern affect their ability to make land-improving investments (Feder *et. al.* (1988) as quoted in Hagos *et. al.* (1999)).

Household members could work in soil and water conservation on their own land or on community land through institutions. These institutions with active members invest more on the community land or on others' farm. When household members are enrolled in institutions they contribute labour to these institutions that will be supplied to either soil conservation practices or other activities. Participation in institutions can be one factor that determines the level of household private investment

Figure 3 Showing the relation ships among factors and the household and SWC



3.2 optimisation decision

For any production cycle, the household is assumed to maximise a utility function

$$U=u(C, L_e),$$

which is the utility derived from consumption of manufactured goods(C) and leisure (L_e). The utility of the household is constrained by its net income Y. The income of the household is derived from on-farm income (Y_i) gained from the sale of portion of the total Q agricultural production and off-farm income (Y_j) derived from off-farm labour (L_m) and labour supply to food-for-work (L_{ffw}). The output (Q) which is determined by Soil factors/soil quality (S), input (X_i) and on-farm labour (L_f), given land size (A) and other farm characteristic (OTH) like education (edu).

The household has total available time (T) that is spent on L_e, L_m, L_f, L_{ffw}, L_{tcc} (labour supplied to community), and L_{pcc} (labour supplied for soil conservation privately on own land). The household also receives labour from the community for SWC (L_{fcc}) and can hire in L_h labour. Thus, the time equilibrium of the household will be:

$$T + L_h + L_{fcc} = L_e + L_m + L_f + L_{ffw} + L_{pcc} + L_{tcc}$$

[The Lf includes both the hired labour and family labour (L_{ff}) devoted on-farm production ($L_f = L_h + L_{ff}$)]

Incorporating the soil conservation decision in the utility maximisation decision is important as it could affect directly the leisure time and indirectly the output. If we approximate soil quality as the soil depth (S) then this depth is determined by the soil regeneration function of labour spent on SWC ($Z(L_{swc})$), the initial soil depth (So) and rate of soil loss (Rs).

$$S = So + Z(L_{swc}) - R_s$$

Hence, the change in soil depth over time (S_d) can be found as:

$$S_d = S - So = Z(L_{swc}) - Rs$$

Thus $S_d = Z(L_{swc}) - R_s$ can be expressed as the soil quality dynamics. This should be incorporated in the optimisation decision of the household in its production decision. So we can reinstate the production technology constraint as:

$$Q(S, L_f, R, X_i)$$

Where R_s, the rate of soil extraction due to the production activities, affects future productions.

The utility maximisation problem can be given as: -

$$\text{Max } U(i) = u(C, L_e) \quad (1)$$

Subject to:

Cash constraint: $CP_p = P_a * Q(S, L_f, R_s, X_i) + W_m L_m + W_{ffw} L_{ffw} - W_h L_h$ (2)

Time/labour constraint: $T + L_h + L_{fcsc} = L_f + L_e + L_{fc} + L_{ffw} + L_m + L_{tcsc}$ (3)

Technology constraint: $Q(S, L_f, R, X_i \backslash A, oth) = 0$ (5)

Soil quality constraint: $Sd = Z(L_{swc}) - R_s$ (6)

where W_h, W_m, W_{ffw} refer to wage of hired labour, wage off-farm labour, wage of labour in food-for-work respectively. The non-negativity constraint applies to: $L_h>0, L_{fcc}>0, L_f>0, L_e>0, L_{pcc}>0, L_{ffw}>0, L_m>0, L_{tcsc}>0, Q>0, C>0$, and $S>0$.

From the cash constraint we can see that the first derivative of C with respect to Q is Pm (equation 7)

$$\frac{\partial C}{\partial Q(.)} = \frac{P_a}{P_p} = P_m \tag{7}$$

The present value of Hamiltonian expression of the maximisation problem is given by

$$H = U\{[P_m Q(X_i, S, R_s, L_f) + W_m L_m + W_{ffw} L_{ffw} - W_h L_h], T + L_{fcc} + L_h - L_m - L_f\} + \lambda(Z(L_{swc}) - R_s) \tag{8}$$

Points that optimise H will also optimise the utility. Hence the utility is maximised when the following first order conditions are meet.

$$\frac{\partial H}{\partial S} = \frac{\partial U}{\partial C} P_m \frac{\partial Q(.)}{\partial S} = 0 \tag{9}$$

$$\frac{\partial H}{\partial L_f} = \frac{\partial U}{\partial C} \frac{\partial Q(.)}{\partial L_f} P_m - \frac{\partial U}{\partial L} = 0 \tag{10}$$

$$\frac{\partial H}{\partial R_s} = \frac{\partial U}{\partial C} \frac{\partial Q(.)}{\partial R_s} P_m - \lambda = 0 \tag{11}$$

$$\frac{\partial H}{\partial L_{psc}} = \frac{\partial U}{\partial C} \frac{\partial Q(.)}{\partial L_{pwc}} P_m - \frac{\partial U}{\partial L} + \lambda = 0 \tag{12}$$

$$\frac{\partial H}{\partial L_{csc}} = \frac{\partial U}{\partial C} \frac{\partial Q(.)}{\partial L_{csc}} P_m + \frac{\partial U}{\partial L} + \lambda = 0 \tag{13}$$

$$\frac{\partial H}{\partial L_{ffw}} = \frac{\partial U}{\partial L_{ffw}} W_{ffw} - \frac{\partial U}{\partial L} = 0 \tag{14}$$

$$\frac{\partial H}{\partial L_h} = \frac{\partial U}{\partial C} \frac{\partial Q(.)}{\partial L_h} P_m - W_h + \frac{\partial U}{\partial L} = 0 \tag{15}$$

$$\frac{\partial H}{\partial L_m} = \frac{\partial U}{\partial L_m} W_m - \frac{\partial U}{\partial L} = 0 \tag{16}$$

$$\frac{\partial H}{\partial \lambda} = Z(L_{psc} + L_{csc}) - R_s = 0 \tag{17}$$

According to the order conditions for optimality stated above, at the margin the marginal return to soil quality should be zero. If the marginal return is positive then that point is not the point of optimisation. Hence, farmers continue exploiting the resource until the return and cost of exploitation are equal. Though I can not make a full empirical estimation using the above models, equation 12,13, & 14 are useful in identifying the level of labour supply for soil conservation for optimum use of the available labour.

3.2.1 Labour allocation and investment decision

The decision of a household to invest labour in soil and water conservation (SWC) or not is determined by the marginal soil depth regeneration capacity of labour, plus the

value of the increase in product due to the increase in soil depth because of the additional unit of labour spent on SWC. In this case the labour supplied for soil conservation is not directly reflected in the production as it is not directly involved in the production, but by affecting the change in soil depth, it indirectly affects the future production. Hence, the return from investing extra labour in soil conservation should not be lower than the shadow wage rate, or the decrease in value of the production due to soil quality loss should be higher than the wage. If the value of the increased production is less than the wage of the labour, then the household may not invest in SWC. We can also see that whether to hire in or sell labour is determined by their respective wage and marginal productivity. A household can decide to hire in labour not only when the value of the marginal product from extra hired labour is higher than its wage, but also when the family could not satisfy its labour needs. If both hired and family labours are close substitutes (having equal marginal productivity), the household can hire in labour when there is higher market wage for the family labour.

The decision on the allocation of available time/labour for different use is then based on their relative marginal return, for example, utility gains from the extra allocation of labour to that activity, and the availability of a labour market (for example, in food-for-work or other off-farm activity). Thus, it is not only the wage but also the availability of market for all forms of labour that determines the allocation of labour. If there is no market, for example, for female labour in the off-farm sector, then they will be forced to work in food-for-work as long as its return is higher than in other alternatives.

In a rain-fed peasant economy where the agricultural activities are seasonal the labour market is seasonal as well. At these times, the wage is higher than in other periods because of increased demand but short supply. Hence, at these times of the season households try to become self-sufficient (even those who were net sellers in the other periods) because of demand fluctuations. de Janvry *et. al.* (1991) refers to this experience while saying: "…the greater the price elasticity of demand of a household that tend to be a net seller, the more likely it is to stay self-sufficient as supply fluctuates. Conversely, the greater the elasticity of supply of the household that tends to be a net buyer, the more likely it is to stay self sufficient as demand fluctuates." (p.1402)

Where some markets are poorly developed or missing, farmers production decision can not be separated from their consumption preference and constraint, and, as a result, farmers' response may depend greatly upon their preference and endowments (Singh *et. al.*, 1986, de Janvry *et. al.* 1991). Hence, subsistence farmers of developing countries make decision whether to invest in soil conservation or not depends on labour endowment, since most of the investments are labour-intensive investments.

When there is no market for (extra) labour of a household, income is derived only from the agricultural output and the time available for leisure will increase, even though there may be a decrease in income and hence there will be a decrease in the marginal utility of leisure. Where there is not enough income to sustain the families livelihood (for example in case of subsistence poor farmers), the marginal utility a household can derived could be higher from increased income (output) than the decrease in marginal utility of leisure from extra supply of labour. Hence, the marginal utility of income is higher than leisure. Households accept measures that can improve their production as long as they consider the measure can address their

problems and increase production without incurring 'additional cost'. For example, when the problem is soil erosion, and the farmer believes that soil and water conservation can increase production, soil conservation measures could be taken by the household if it is possible to address the problem using family labour without additional cost to hire in labour and/or if it does not lead to the reduction of income. The reason here is that, since the household is using the unemployed family labour for the construction of the SWC structures, there will be no reduction in the utility of income (as the shadow price for unemployed labour is zero), rather an increase in future utility because of increase in future income is expected. As stated by Hagos *et. al.*,(1999) the opportunity costs of poor farmers' labour time may be so low at certain times of the year, encouraging them to make labour intensive investment in land improvement and soil management. Pender (1999) also considers the declining value of labour relative to land as an incentive for performing labour-intensive land improvement structures like terraces.

Soil and water conservation structures can reduce the cultivable land, harbour rodents, and create difficulties in ploughing and thus could result in lower production and income (at least in the short run). When conservation is unproductive, the level of conservation that will be achieved even by a peasant with a perfect oversight is likely to be limited (Shiferaw and Holden, 1998). When the increase in productivity due to SWC is lower than the decrease in land due to the SWC structures, there will be no incentive for the household to undertake SWC measures. This is true unless the household gives more weight to future income than immediate income. For a subsistence farmer it is difficult to imagine giving more weight to future income than sustain its short-run livelihood. Thus, poverty tends to increase farmers' short-term perspective (shortening time horizon) and limits their interest in investing in soil and water conservation measures that yield benefits only in the longer term (Holden *et. al.*, 1998). On the other hand, poorer farmers may be more likely to invest in labour-intensive land improvement because they have less profitable investment alternatives (Ibid.). Hence, SWC practices are less likely to be undertaken privately unless there is something from behind that pushes to do so, like food-for-work to enhance voluntarily participate in soil conservation program (Hagos *et. al.*, 1999).

Conservation activities that are too large to be accomplished using the family labour need to hire in extra labour. This will leads to additional cost or the household has to suspend the work until enough labour can be mobilised, which will lead to further reduction in productivity due to soil degradation. To meet the labour needed for conservation, the household can make arrangements, like hiring in labourers (which might be impossible due to the low income or fundamental financial constraint), labour sharing, sharecropping, or enrolment in institutions that are organised with such objectives. If individuals are enrolled in institutions they are expected to supply labour (Ls) to other member individuals or to common land, and are also entitled to receives labour (Lr) from other members through their institutions to accomplish the work.

Hence, the total labour supplied for soil conservation (L_{swc}) onto any private land is:

$$L_{swc} = L_{csc} + L_{psc} \quad (18)$$

And the available family labour for soil conservation (L_{psc}) on own land will be

$$L_{psc} = T - (L_e + L_m + L_{ff} + L_{ffw} + L_{tcsc}) \quad (19)$$

Thus the enrolment in institutions will directly affect the labour supply both to and from the household.

Most investments in conservation activities by subsistence farmers in the highlands of Ethiopia are done in the form of labour-investment, but locally available materials like stone is also used. Hence, these are labour-intensive investments. A farmer can undertake soil conservation measures on his land if he observes soil erosion problem and if he is able to relate the loss in production with the erosion problem. However, in an area where there are no clearly defined land ownership rights, private investors or individuals have little incentive to invest in the land, unless there is a short-run positive profit from the investment. Thus, individuals tend to over-exploit the resources with little or no investment for its maintenance/ conservation. Hence, social cost is higher than the benefit in the sense that there is a negative externality from the production or consumption behaviour of the individuals. In this case, the externality can be expressed in terms of soil degradation.

3.2.2 Collective action

The return from soil conservation investment in the highlands of Ethiopia is not profitable enough according to Shiferaw & Holden (2001). Hence, there is lack of economic incentive to undertake soil and water conservation measures by private investors. This is true for farmers whose objective is profit maximisation. However, subsistence farmers could prioritise other objectives, like risk minimisation and food self-sufficiency. In areas where there is no market for labour, the major resource of most households needed for soil conservation (labour) is available during certain periods of the year. To these farmers, unless it is beyond their capacity (either because the problem is too large pausing difficulty to address privately or the problem is not observed, and is not perceived as a problem by the landowner), soil conservation measures will somehow be undertaken. Thus, farmers may be encouraged to make investment in soil and water conservation that yield relatively low returns even when there is limited development of labour and credit markets (Hagos *et. al.*, 1999).

The necessary condition for the social efficiency of private land use requires that markets are perfectly competitive and the price of all resources relevant for the wellbeing of all individuals reflect their social scarcity values (Shiferaw and Holden, 2000). The mere existence of the land degradation externality does not justify policy intervention (Kirby and Blyth, 1987). Intervention in soil conservation is, therefore, justified when the net social benefit of intervention is shown to be positive (Shiferaw & Holden, 2000). To achieve positive net social benefits of such investments may require collective action at the village level (or higher), to assure that externalities are taken into account (Pender, 1999). It is important to bear in mind that the impacts of labour-intensive land improvements on resource condition are likely positive (Ibid.)

In addition to the direct effects on the participation of households in soil and water conservation, institutions also indirectly influence the investment in soil and water conservation through affecting the income of farm households. The income effect could be, for example, in the form of improving access to credit and off-farm job opportunity or, to market for outputs, inputs, labour, and credit which all determines the income level of households and hence investment in soil and water conservation. Therefore, we should bear in mind that investment in soil and water conservation requires whole farm analysis. It should be clear that whether farmers consider erosion as a serious problem and know what they could do about it before they can decide whether or not to engage in to conservation measures (Graaff, 1996,). The farm

household decision-making with regard to the adoption of soil and water conservation measures thus starts with the identification of the erosion problem and continues until the future readiness to undertake conservation measures. By examining the response of farmers related to these incentives, one can see what role local institutions could play in the facilitation of undertaking these measures.

Organisations are not, in general, an end in themselves, but a means for improving the management of the resources (Rasmussen and Meinzen-Dick, 1995). Institutions can play different roles starting from as a welfare-increasing device to an enforcement mechanism (Ruben and van Strien, 1999). As welfare-increasing device, institutions can serve the community as an informal insurance, facilitate and ease access to credit services, provide agricultural inputs like fertiliser, and offer market outlets for their production. These roles are important mainly when the state and the market could not fulfil the needs of the community. They can facilitate information flows to the community concerning for example market conditions. As an enforcement device, institutions play roles in organising the community to control default in obligations, for example when the legal systems are not operating efficiently (Ibid.).

As stated earlier, in developing countries –due to the absence of market incentive for private investors to invest in soil and water conservation –institution and the state are the main responsible units. Local institutions play a pivotal role in this conservation practice mainly as mobilising body, and for monitoring and controlling the activities. Their roles as input delivery, in the credit service provision, and information dissemination have implication for the overall improved land management. However, if these institutions are to play an effective complementary role to the state and the market, these organisations must posses the ability to define rules and to enforce them. Rules can be defined and enforced either through voluntary co-operative behaviour or through authoritarianism *(de Janvry et. al., 1995).*

Many local and international NGOs are working in co-operation with the government and the population in the field of soil and water conservation for rehabilitating natural resources and their sustainable use. These NGOs work through the provision of materials, helping in manpower development and technical assistance and most of all providing funds, which are usually channelled towards the execution of soil and water conservation though food-for-work (FFW). The projects of food-for-work usually focus on conservation on the hillsides and in the area of gully treatment.

As discussed earlier, soil erosion problems received greater attention and soil and water conservation became an area for public intervention (Shiferaw & Holden, 2000). The mere existence of land degradation externality does not involve policy interventions (Kirby and Blyth,1987). Intervention in soil conservation is, therefore, only justified when the net social benefit of intervention is shown to be positive (Shiferaw & Holden, 2000).

In developing countries, the divergence between private and social functions of soil use may be attributed to imperfect information, high transaction costs, imperfect insurance and capital markets, incomplete property rights, and misguided government incentives (Shiferaw & Holden, 2000). Where information is imperfect and information asymmetry prevails amongst agents, market prices cannot reflect all the dimensions of transaction and therefore the price mechanism is not always an adequate co-ordination mechanism. This calls for mechanism of co-ordination, either

state hierarchy or community participation (Douma and Schreuder, 1998). When the state fails to deliver public goods, insurance, management of externalities, and minimum basic needs and democratic rights, civil organisations may develop to fill the vacuum. Otherwise, market failure may lead to the emergency of institutions (de Janvry, *et. al.* 1995). Institutions could be formed either through voluntary co-operation of individuals or could be induced from external agencies (Ostrom, 1990). Transaction costs matters enormously in explaining the likelihood of co-operation, the competitiveness of alternate forms of organisation, the effectiveness of collective action and the role of developmental state.
In countries where the market is not working and there are no clearly defined property rights, investment in soil and water conservation in order to insure sustainability of the resources could taken place through public investment and collective action. Hence, policy instruments for its implementation are needed. The choice of policy instruments for resources conservation may depend on environmental effectiveness, cost of contracting, monitoring and enforcement, distribution effects, and conformity with other policies and political preferences (Shiferaw & Holden, 2000). The suitability of policy instruments may, therefore, be examined in related to the ecological, economical and institutional setting**.**

For the execution of programs for soil and water conservation and other activities, that need the mobilisation of public, local institutions which are more accepted by the people living in the area, have to be involved from the very beginning in order to insure its sustainability. Local institutions as discussed by Uphoff (1995) provide a better basis for collective action because most people within a locality, community or group maintain face-to-face relationship with each other and are likely to have multi-lateral connections. Working with and through collective action organisation at a local level could produce improvements in productivity.

4. Materials and Method

4.1 Data collection and analysis

Primary data for the analysis is collected from the two *Tabia*s, one with better market access and the other from a remote area. A Semi-structured household questionnaire has been prepared to interview household heads, which are randomly chosen from the two *Tabia*s. Accordingly, 80 households (45 from *Tabia* Debre-hiwot and 35 from Debre-bizen) were selected and interviewed.

The questionnaire includes[5]: the household members, grouped by age, sex, education, and institutional enrolment, land and animal holdings, labour supplied by the household members for conservation of their own land, on other farmers land and on community/open land, labour supplied by other to their land, days spent on food-for-work, and other activities through the institutions. However, some household Indicators like, income of the households, the type and size of each conservation measures, productivity of the land under the different conservation structures, are not available which inhibited the economic interpretations of the efficiency measures.

To answer the research questions raised above, quantitative analysis of the data was important. Hence, for each research question, statistical analyses of the collected data are conducted using the Eviews statistical package, which I found it appropriate and easier. First, some rearrangement of the data was done to make it 'appropriate' for the analysis.

Index formation

In the analyses, animal holding and participation in institutions are used in their index forms. The index formation for the animal holding is done by giving different weights to each kind of animals and multiplying by their respective number and then summing up to get the total animal holding index. The weight is given based on the weight the farmers gave depending on their market value. Hence, the weight given for cows is 3, for donkey, calf, and ship & goat are 2, 1, and 0.5 respectively. For a household who own 1 cow, 1donkey, 1 calf, and 1 sheep the animal holding index will be

1*3+1*2+1*1+1*0.5= 7.5

Since ownership of oxen is one major wealth indicator, I prefer to treat it independently and hence it is not included in the animal holding index. Rather, it will be expressed in terms of number of oxen the household owns.

Another variable used in its index form is the institutional participation index. This is an approximation of the number of household members enrolled in institutions and gives different weight to the members based on their level of participation and their role in soil conservation. All the three voluntary institutions (except the farmers' co-operatives that have no direct role in soil conservation) are given the same weight by the farmers and thus the index and the number of household members enrolled in institutions is the same or is a simple additive. However, for the farmers' co-operatives a dummy variable is used to show whether the household is enrolled or not.

4.1.1 Dummy variables

Many of the data I used for the analysis are dummy variables. The dummy variables include *Tabia* identification (i.e. 0 for *Tabia* debre-bizen and 1 for *Tabia* Debre-hiwot), enrolment in the co-operatives (if the household is enrolled dummy=1, if not dummy=0, sex (whether the household head is male (dummy=1) or female (dummy=0)).

The total land of household holdings was categorised into three slope categories (flat, medium, and steep slopes) and three erosion problem groups (low, medium and high erosion problem). Due to multicollinearity problem it was not possible to include two or all the three biophysical variables together (land size, the slope, and erosion problems) in the models for the analyses. The deletion of one of the variables from a model may not give good estimation as both the land factors and the land size could affect the investment decision. Even though, the problem of multicollinearity is apparent when using two of the above three variables, I have tried to use the one, which could have more effect than the other does. However, there was no significant difference between the last two variables. Hence, an alternative procedure was used to classify the land by combining both the slope and the erosion problem forming land group matrix (table 1) and include the land size in the model as one independent variable. Taking erosion problem and slope variables as a column and row elements of the matrix respectively, nine land groups (Ers) were identified. Since there is no way to identify the actual land size in each of the nine group, the use of dummy variables to identify if there is any land in a particular group was necessary. The dummy ers (.)=1 is used if there is a land in that group and Ers (.)=0 otherwise.

Table 1- Land classification matrix

	Erosion problem			
Slope category		low	Medium	high
	Flat	Ers1	Ers2	Ers3
	Medium	Ers4	Ers5	Ers6
	steep	Ers7	Ers8	Ers9

Other variable included by using dummies is the attitude towards land tenure rights. This attitude towards land tenure rights is taken based on whether the respondent considers that the present land use right has effect on the decisions in soil conservation investments or not. If the land tenure right has an effect on the SWC decision the dummy will be 0, but if the respondent thinks it has no effect, the dummy will be 1.

The value for the other variables is given by the actual values collected during the interview. These variables include private investment in this year (2001) and the cumulative investment, investment by the community in this year and the years

[5] The questioner is attached as annex 1 at the end.

before, labour supply in the year 2001, food-for-work in the year 2001, and other variables which are indicated in the following table (table 2).

Table 2- variables used in the analysis (symbol, unit of measurement) and their descriptive statistics

No	Variable	Symbol	unit	Estimated results for the sample			
				mean	minimum	maximum	St.dev
1	Household head age	Age	years	50.51	28	69	10.88
2	Household head Sex	Sex	Dummy	0.87	0	1	0.34
3	Association	Ass	Number	2.34	1	5	0.79
4	Co-operative	Cop	Dummy	0.94	0	1	0.25
5	Female household members	Female	Number	3.56	1	7	1.5
6	Male household members	Male	>>	3.64	0	7	1.56
7	HH members above 15 years old	Ageabove15		3.55	1	7	1.2
8	Oxen	Oxen	number	1.3	0	3	0.83
9	Other animals	An2	Index	4.08	0	14	3.2
10	Land size	tlnd	Tsemdi[6]	2.74	0.5	7	1.19
11	Private investment	privateSWC	Man-days	20.89	0	150	30.37
12	Community investment	communitySWC	>>	58.5	0	230	65.1
13	Contribution to the institutions(total)	contributiontota	>>	64.01	23	133	20.83
14	In soil conservation	contributionswc	>>	53.68	20	100	16.49
15	Erosion/slope group (9 groups)	Ers (.)	dummy				
16	Food-for-work	ffw	Man-days	72.95	0	160	36.12
17	Attitude towards land tenure rights	tenure	dummy	0.94	0	1	0.25
18	education	edu	years	1.65	0	8	4.66

[6] Tsemdi is a local measurment for land size, which is 'equivalent' to a quarter of a hectare of land.

4.2 Model specification and estimation methodology

For testing the theories discussed in the first chapter, quantitative analysis of the data is necessary. As it requires more than the qualitative insight given by pure theory, policy analysis needs the quantification of the various mechanisms analysed in theory (Sadulate E. & de Janvry A. 1995). Hence, we should build a model that can be used in the quantitative analysis of the theories.

To analyse the effects of the institutions on the decision of the households in SWC it would be important to test the treatment effect which is defined as the effect of a program in place on participants compared to no program at all or some alternative programs (Heckman, 2001). In this case, the treatment variables are the local institutions. We compare the effect of institutions between households that are enrolled in the institutions and households that are not. Since we do not have any households that are not enrolled in the institutions, it is not wise to make the treatment effect test. However, as shown by Heckman (Ibid.), it is possible to test the likely effect of a new program or an old program applied to a new environment by use of structural estimation. Additional benefits of using the structural model are that they can be used to test economic theories and make quantitative statements about the relative importance of causes. They can also be used to compare across empirical studies.

Since there is no predetermined model that can be used in the quantitative estimation, regression analysis of the structural model to identify which variables have significant roles/effect on the respected theories will be applied.
The structural model for the first hypothesis is:

privateSWC=f(Age, sex, ass, cop, communitySWC, cont1, cont2, oxen,

tlnd, an2, ers(.), ffw, female, male, tabia, edu, tenure)

Here we examine the variables that are determinants of private investment in soil conservation and particularly institutions, both the number of household members enrolled in institutions (ass) and the investment made by the institution.

The second structural model refers to the community investment on private land. In this model we analyse what household factors, land factors and/or socio-economic factors influence (determine) the decision of the institutions/community for supplying labour to the private owned land. The structural model for this analysis is given as:

communitySWC= f (Age, sex, ass, cop, privateSWC, cont1, cont2, oxen, tlnd,

an2, ers (.), ffw, female, male, tabia, edu, tenure)

The third model is used to express the relationship between contribution to institutions (contributiontot.) and the other household, socio-economic and institutional factors. We examine the factors that are determinants of the contribution to institutions/community: does being enrolled in institutions imply an increase in contribution, or there are other factors. The model for the regression analysis in this case is:

Contributiontot =f (Age, sex, ass, cop, communitySWC, privateSWC, oxen, tlnd, an2, ers (.), ffw, female, male, tabia, edu, tenure)

However, first some tests for cross correlation between the different variables have been conducted. Very high correlations between 'this year investment' and 'last years investments' were found, which violated the rule of absence of correlation among explanatory variables. Hence, the use of alternative variable, like total investment (which is the sum of 'this year investment' plus 'last years investments' was applied. Then a suitable method of analysis has been chosen to make the complete statistical analysis.

Investment in conservation, either by the community or by private owner, and the labour contribution of households to associations is not expected to be negative. Hence, censoring the models at zero on the left side seems to be necessary which lead us to the use of the Censored Tobit model. However, due to the problem of simultaneity, the use of the above method will result in inconsistent and biased estimates. Hence, looking for an alternative appropriate method was important. Accordingly, the two stage least square method is chosen to estimate the first two equations simultaneously, and ordinary least square method was used for the last model (because no simultaneity problem was found during the preliminary tests).

5. Estimation result

The tests for the hypotheses discussed before and using the models developed yields the following results from the regression analysis using the two stages least square method for the first two models and least square method for the last model (contribution to institutions).

5.1 Private labour investment

In this model two major research question have been tested. The first question was to test if the number of household members enrolled in institutions could affect private labour investment in soil conservation (the first hypothesis). The second question addressed here was, if the labour contributed by institutions on privately owned land could affect private labour investment for soil conservation on own land (the second hypothesis). The following results are obtained:

Private investment in soil conservation is affected by the sex of the family household head. Here female-headed households invest less in soil and water conservation than male-headed households do. In reality, women headed households are usually poor and do not own oxen. If there is any mature male member of the household, he is sent for off-farm job, and they give-out the land for sharecropper. They are not much 'concerned' on the condition of the land as they may lack the capacity to deal with the problem, while they do not expect full benefit from their investment. Female house heads are usually occupied with managing the household matters inside the house and spent less time in soil conservation and hence less investment. On the other hand the heads of male headed households spent more time on supervising and follow-up of the land condition by taking some measures when there is a need to do so. Hence, land that is owned by male headed household is managed better than that of owned by female headed.

Another variable that determines the private investment is the animal holdings of the households. Private investment is negatively related with animal holding. This is when the number of animals increases (excluding oxen), the need for more time to watch after and take care of these animals increase. Because of the increase in area closure and the decrease in accessible land in the last few years, the effort needed to attend after animals increased with increasing the number of animals owned which intern decreased the time available for soil and water conservation. Hence, the competition for time/labour between managing the animals and conservation can result in decreased investment in soil conservation.

Table 3 results of the regression analysis for the first model

Dependent Variable: private investment
Method: Two-Stage Least Squares
Included observations: 77
Instrument list: ASS SEX AN2 ERS2 ERS3 ERS4 ERS6 COMMUNITYSWC CONTRIBUTIONSWC OXEN ERS8 ERS9

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-13.40992	13.73775	-0.976137	0.3325

Household head sex	16.62301	9.770826	1.701291	**0.0935***
Animal index	-1.774217	0.816933	-2.171803	**0.0334**
Land group 2	11.33703	6.699455	1.692231	**0.0952**
Land group 3	16.45867	8.774371	1.875767	**0.0650**
Community SWC	0.208033	0.046909	4.434784	**0.0000**
Contribution to SWC	0.404202	0.213884	1.889818	**0.0630**
OXEN	6.579832	4.629935	1.421150	0.1598
Number of HH members enrolled in Institutions	-7.493955	4.653500	-1.610391	0.1119
R-squared	0.367622	Mean dependent var		20.88961
Adjusted R-squared	0.293224	S.D. dependent var		30.36690
S.E. of regression	25.52944	Sum squared resid		44319.15
F-statistic	4.941325	Durbin-Watson stat		1.940334
Prob(F-statistic)	0.000077			

The private investment in soil conservation can increase when the land a household owns is in the second and third land groups[7]. These groups are characterised having flat slope but medium and high erosion problem respectively. Here the household considers there is a soil erosion problem and since this land group is not with in the categories where the slope is steep, it is less likely that the community can invest labour there. This is because of the focus of the community conservation to steep slope lands. Hence, the household has to address the problem using family labour giving a positive relationship between private investment in SWC and these land groups that have flat slopes.

One of our major research questions was to test if being a membership of institution could affect the private investment in soil conservation. Estimated result described the effects of the institutions in three different ways. In the first case, institutions can positively affect the private investment through mobilising labour and investing on private land. The second condition is the effect of institutions on private investment through the contribution of labour by the household to institutions while the third situation is the negative relationship between private investment and enrolment in institutions, which is not significantly different from zero.

The positive relation between the community and the private investment may be accounted due to the fact that households could invest more if they gained benefit from the already existing investment. The existing investment could be first done by the institutions, mainly when the household owns land that has higher erosion problems and a steep slope category. If this investment resulted in an increase in production then the household will increase its effort to keep the conservation structures in good condition through investing more labour on its maintenance and start investing more on the other lands where the community is not much interested in investing. Shiferaw & Holden (1999) have come across with such events were farmers maintain erosion control methods once installed through food-for-work incentives.

* The variables written in **bold** are significantly different from zero at 90% confidence interval

[7] The land groups are formed based on their relative slope and erosion problem

Hence, the positive effect of the institutions may be is accounted due to the increase in production because of the increased community investment in soil conservation. One of the unexpected results is the relationship between labour contribution by the households to institutions and private labour supply on oneself land. From the empirical test it is found that labour contributions to institutions are related to private investment positively. However, because of the competition of the households' labour that otherwise could have been invested in own land, negative relation was expected, unlike to the positive result obtained. If more contribution can result in rise in income of the household (for example, if increasing in contribution can lead to more work on food-for-work), thereby reducing migration looking for off-farm employment, then this could lead to a positive relation. However, the third way that the institutions could affect the households decision in soil and water conservation, because of the number of household members enrolled in the institutions, turned out to be untrue. Hence, the first hypothesis that enrolment in institutions could affect private investment negatively is not justifiable.

Though it was not possible to include land tenure/rights to the model to see if this could affect private labour investment in soil conservation, however, an alternative solution was to use the attitude of farmers towards the present land use rights and the following is observed. Unlike to what have been said, such as, clearly undefined land tenure rights affects private investments negatively by shortening the time horizon (Holden *et. al.*, 1998) and the reduction of incentives to invest (Pender, 1998), 94% of the respondents denied its negative effect. The empirical test also confirmed the absence of any significance relationship between private soil conservation investment and attitude towards tenure rights. The reasons could be first because they are subsistence farmers and give more weight to short term incentives. Hence it is not the land tenure system that shortens the time horizon but it is the poverty. Second, the investment they make is labour investment, and households invest in soil conservation usually when it does not compete for labour and time with other activities. Third, they have the right to transfer it to their household members or rent it for certain years. Besides, they think there will be no more land redistribution as they got promise from the regional government. Hence, land tenure rights have little effect on the decision of households in soil and water conservation labour investment.

5.2 Community investment

From the result of the regression analysis of the second model, the third major research question that investment by institutions could affect private labour investment on degraded areas and can lead to free-ridding problem is addressed. To answer the above research question, identifying the factors that determine the level of community investment, is important. This model examines which factors determine the investment of labour by the community on private land. This could also be used to show whether free ridding problem exists. The existence of free-ridding problem can be speculated based on the results of the first and the second model.

The following results are obtained from the analysis of this second model. The major determinants of the community investment on private land, which are significant, include Land group 3, private investment, and Land group 9, while the variable oxen is not significantly different from zero.

Unlike to chapter 5.1, where private investment was related with Land group 3 positively, here in this model Land group 3 is negatively related to community investment. Since the focus of the community conservation work was onto community lands, the hillsides and adjacent areas, the community less treated private owned lands that were far from the hillsides or with flat slopes. Land group 3 is from the land categories with flat slope but high erosion problem. Even if it has high erosion problem, may be because of down stream runoff, usually it is left untreated because of the distance from the hillsides. In this case, it is not the erosion problem that is taken into account but the slope category plays greater role in the decision making.

Table 4 results of the regression analysis for the second model (community investment)

Dependent Variable: COMMUNITY INVESTMENT
Method: Two-Stage Least Squares
Included observations: 77
Instrument list: PRIVATESWC ASS SEX AN2 ERS2 ERS3 ERS6 CONTRIBUTIONTOTA OXEN ERS8 ERS9

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.515772	12.36491	0.769579	0.4441
LAND GROUP 3	**-34.31228**	**19.16832**	**-1.790052**	**0.0777**
PRIVATE INVESTMENT	**0.894616**	**0.208378**	**4.293242**	**0.0001**
OXEN	11.85327	7.516941	1.576874	0.1193
LAND GROUP 9	**50.27829**	**14.73515**	**3.412133**	**0.0011**
LAND GROUP 8	16.13055	13.76923	1.171493	0.2453
R-squared	0.383893	Mean dependent var		58.53247
Adjusted R-squared	0.340506	S.D. dependent var		65.09923
S.E. of regression	52.86661	Sum squared resid		198436.4
F-statistic	8.847956	Durbin-Watson stat		1.866278
Prob(F-statistic)	0.000001			

The other land groups that are usually ‘legitimate’ for the community conservation are these that are characterised by having steep slope. Hence, Land group 7, 8, and 9 were expected to have positive relationship with community conservation. The result showed that Land group 8 is not significantly different from zero while Land group 9 is positively related to community labour supply as expected. This land group, which has steep slope and high erosion problem, showed to have a significant and large positive relation with the community conservation.

The major research question that should be addressed here is the relationship between private investment and community investment in soil conservation. The expectation was that, because of the competition for space, negative relationship would hold. This is mainly true when both the private and community labour investments were taken place at the same time. However, unlike to the expectation the relation became

positive. There may be two reasons for this. First, since the data analysed were a cross sectional data using the cumulative labour investments, it is difficult to see whether both private and the community conservation activities were done at the same time/year. The second reason for this could be due to the response of the institutions to requests from individuals. Households ask for community assistance when the problems are beyond their capacity. Therefore, individual farmers have to try to address the problem first by themselves by investing more labour. If the problem persist, then the community can be mobilised to work there. Hence, positive relationship between community and private investments could occur when the problem is beyond the individual capacity. Hence, it can be said that private investment and community investment are complementary. However, this could result in free ridding problem. For example, individuals could want to spend more of their time and labour on other private works, leaving conservation activities on the degraded lands for the community. It can also aggravate degradation of the less degraded area for example; leaving the less degraded lands untreated and waits until it becomes beyond the individual capacity so as to get the community help. Thus, the distribution effects of the community labour can affect households' private investment resulting in decreased private investment in highly degraded areas and may facilitate the degradation of less degraded areas.

5.3 Labour Contribution to institutions

In this model the last research question, labour contribution to institutions by households is affected by sex composition of the family and the number of members of household enrolled in institutions is addressed. Unlike to the first two models, this model is estimated using the ordinary least square method as there is no simultaneity problem. It was also possible to use the Censored Tobit model. In both cases, identical results are obtained. The empirical result of the estimated model showed us the number of household members enrolled in institutions positively affect the contribution of the household to the institutions. This is in line with my expectation that associations can affect the households' decision on labour allocation.

In addition to the number of households enrolled in institutions, other factors have been tested with respect to level of labour contribution to institutions. These that are found to be positively affecting the labour contribution are *food-for-work*, *number of female household members*, and *location of the tabia*. More than 95% of the interviewed farmers gain a part (may be the larger part) of their income from food-for-work activities. Any decision by any body to suspend the household from food-for-work will directly affect their livelihood. The local institutions have this power directly or indirectly to suspend the household from any aid or food-for-work activities if they. Hence, food-for-work is used as one of the monitoring and controlling mechanism for the households to enhance the fulfilment of their obligation**, though there are other controlling mechanisms like sanction.**

Table 5 results of the regression analysis for the third model (contribution total[8])

Dependent Variable: CONTRIBUTION TOTAL
Method: Least Squares
Sample: 1 77

Variable	Coefficient	Std. Error	t-Statistic	Prob.

[8] Contribution total is the sum of the labour contributed to institutions for soil conservation and labour contributed to other activities like construction of access roads.

C	**18.34599**	**6.744183**	**2.720269**	**0.0082**
ASS	**10.00882**	**2.313242**	**4.326750**	**0.0000**
LAND GROUP 5	**-10.86315**	**3.517863**	**-3.087997**	**0.0029**
FFW	**0.181220**	**0.052249**	**3.468394**	**0.0009**
FEMALE	**2.630105**	**1.239730**	**2.121515**	**0.0374**
***TABIA*CODE**	**8.855591**	**3.538972**	**2.502306**	**0.0146**
R-squared	0.530279	Mean dependent var		64.05195
Adjusted R-squared	0.497200	S.D. dependent var		20.83450
S.E. of regression	14.77340	Akaike info criterion		8.298253
Sum squared resid	15496.00	Schwarz criterion		8.480887

Female members of households are usually confined to work around the house/family while male members are more geared towards income generating activities. Such labour distribution within the household forces the male household members to migrate to areas were off-farm income can be generated. Because of this, the female household members are usually there and supply labour to their institution. Besides, when a married female is divorced, usually she returns back to her parent's place while the husband stays in 'his' house. The return of the females to their parents increases the number of female member of households who will stay at home. This increases the number of household members that could contribute to the institution. Hence, the contribution of labour by the household to the institutions is positively related to the number of female members in the household.

Another factor that is found to affect the households' labour contributions is ownership of Land group 5. This is a land where both slope and erosion problem are medium. This variable affected the contribution of labour by households negatively. Though I do not have any reason to explain this, it could be true only if the institutions are so flexible to allow their members to work on this land group instead of working through the institutions, however, to my knowledge there is no such type of arrangements. Or may be these households received limited returns from institutions thereby reducing their contribution.

Before I start discussing about other issue, it is necessary to look at the relation ship between these three models and see whether the issue of simultaneity is true. The structures of the models are[9]:

Private Investment = f (sex, animal index, land group2, landgroup3,

Community Investment, contribution to SWC)

Community Investment = f (land group3, private Investment, land group9)

Contribution Total = f (ass., land group5, food-for-work, female, *Tabia*code)

The first two dependent variables, namely private Investment and Community Investment, and land group3 have confirmed the existence of simultaneity, while contribution total does not have any variable in common with the other models. We can see that community contribution decreases on particular land groups where there are high levels of private investments, for example land group3, while we can not see

[9] The models include only variables that are significantly different from zero

any private or community investments on like land groups4, 5, 6 and 7. Usually these land groups have medium slope and receive little attention from the institutions, but could be fairly difficult to conserve them using family labour. Hence, the households turn to leave them untreated because they focus to the problems that they could tackle easily, and wait for assistance. This could then aggravate the erosion problem of such areas (medium slope lands) as well as increase the level of labour assistance needed by the household resulting overexploitation of community labour (free-ridding).

Finally, it is found that the contribution of labour to the institutions is positive for more remote *Tabia*. This may be due to the fact that these farmers have less access to labour markets and therefore less probability for engaging frequently to the off-farm employment. This can limit the labour time that the members could contribute to their institutions. Moreover, since their *Tabia* is nearer to the town and to the nearby road, there may not be much pressure on constructing access road and hence reduce the need of labour by the institutions from the members.

6. Conclusion and policy implication

The wide spread of local voluntary institutional arrangements in Tigray has made this region in Ethiopia known for its concerted effort to address soil erosion problems. These institutions are almost autonomous, but backed up by the government in every decision they make. Every household has a family member enrolled in at least one of these local institutions. Institutions could be initiated by individuals or by government agencies. The so called voluntary institutions in Tigray, though they were formed for administrative and security reason, they have been expanding their role and almost interfere with the daily activities of the households. Every decision by these institutions, directly or indirectly, affects the livelihood of the households. The role-played by these institutions in soil and water conservation is immense so that it could affect every household's decisions in soil and water conservation.

Labour investments in soil and water conservation are taken into account in the analysis of household's decision making. First, the labour invested in soil conservation directly affects the leisure time and the satisfaction derived from it. Secondly, its (labour investment in SWC) effects on present and future income due to the increase in production or decrease in off-farm employment and the change in soil quality due to the investment. For a utility maximising household, in equilibrium the marginal increase in income due to conservation is equal to the loss in income due to the decrease in off-farm employment. This is particularly true if there is market for the family labour. The decision on the allocation of labour is then based on the relative marginal returns. Hence, price incentives for non-erosive crops or crops that need conserved lands could lead to increased labour investment in soil conservation.

In the highlands of Ethiopia, where the benefits from investing in soil conservation are not promising, private investors have little incentives for investing in soil and water conservation. But, where there is limited development of labour and credit markets, farmers may be encouraged to make investment in soil and water conservation that yield relatively low returns. Public investment in soil and water conservation are essential, provided that the total social returns from the conservation are higher than the social cost of conservation. Social benefits from labour-intensive investments are usually positive. Thus, the public investment in soil conservation like, conservation through community mobilisation and food-for-work that are labour intensive, are justified and have positive social effects.

Institutions can play different roles from a welfare-increasing device to an enforcement mechanism. Local institutions play a pivotal role in this conservation practice mainly as mobilising bodies, monitoring and controlling the activities. If these institutions are to play an effective complementary role to the state and the market, these organisations must have the ability to define rules and mechanisms to enforce them, such as sanctions and control over the economic and social benefits that the household could achieve from any participation through the institutions.

Private soil and water conservation decisions of households are affected not only by household factors but also others, such as public investments. Local institutions have influenced households' decision-making in soil conservation in three major ways. First, they affect the private labour investment through their initial labour supply to privately owned land, which induce the households to devote more time and labour to new conservation structures and maintenance. Second, institutions also affect the households' decision by competing for the households' labour, which is then supplied for soil conservation on private and/or community-owned land, as well as for other activities. The third way the institutions affect the households' decisions is through their effect on the income of the households, for example through food-for-work. However, an additional expected effect of institutions was that the number of household members enrolled in institutions could affect the households' private labour investments in soil conservation, which is not empirically confirmed.

Household factors affect private soil and water conservation investments decisions, for example, female headed households invest less on their own lands. Levels of private investments also affect the overall conservation investments on own land. Individuals who invest more privately have a better chance to enjoy labour supplied from the institutions while those who do not made conservation works privately receive less assistance from the institutions, leaving the female-headed households with less conserved land. Thus, taking household head gender into consideration during the decision of institutions in addressing distribution issue or supplying targeted labour assistance to these individuals would be important. In addition to gender, considering the level of contribution to institutions would be important for controlling free riding.

Relating the level of contribution to institutions and benefits that the households' could receive from institutions could encourage participation as long as return from institutions is proportional to the level of contribution. This could reduce the free-riding problem because the free-riders would no longer receive community assistance if they do not contribute to the community. Thus the second hypothesis that

community conservation could affect (deter/encourage) private soil and water conservation investment is confirmed and its effect is rather positive and did not deter private investment.

There are other factors that determine the level of community investment on privately owned lands. Factors such as level of private investment and land quality played a role. The hypothesis that investment by institutions can deter private soil conservation investment on degraded lands has proven to be true. The joint use of the results obtained from first two models, it is possible to speculate that soil degradation could be aggravated on medium slope lands because of the absence of any significant level of conservation from both the private and the community.

Land quality factors, mainly land slope and erosion problems are found to affect both the private and community investments in soil conservation. An increase in private investment but a decrease in community investment is observed with land groups that have flat slope and high erosion problem. In general, increase in private investment resulted in increased community investment and vice versa, which shows the complementarity nature and/or the push and pull effects of the two investments.

Unlike to the usual concern that clearly undefined tenure rights and ownership affects the private soil and water conservation investment negatively, no effect has been observed in this particular case study. On the contrary, besides labour, poverty is the major problem that limited other conservation investments. Hence absence of tenure rights should not be an excuse for a subsistence farmer for not conserving the land, but immediate/short term returns from investments matters. However, the effect of clearly undefined land rights on population growth (leading to increased poverty), which in turn affecting soil degradation problem, can not be undermined.

The number of household members enrolled in institutions and participation in food-for-work activities are the main determinants of labour contributions by households to institutions. The public investment in food-for-work plays important role, not only directly through the rehabilitation of the degraded areas owned by the community and through its income generation effect, but also indirectly due to its impact in the private labour investment. Participation in the food-for-work project increased households' labour contribution to institutions, which could be used in soil conservation on private land, which in turn improved private soil conservation investment on own land due to the increased labour supply privately to maintain the conservation structures built by the community. Hence, the role of local institutions should be appreciated and taken into account whenever there is a public investment, since this could lead to the fulfilment of multiple objectives for sustainable development through increased community participation.

Though no significant role have been played by the farmers' co-operatives either in improving the income or access to services for the members, their potential for improved land management is high. They can serve as delivery channel for inputs and arranging fertiliser credit to their members. Besides, they can offer a market outlet for the products, thereby encouraging any production increasing investments, including soil and water conservation. If their role in improving the income is credited by their

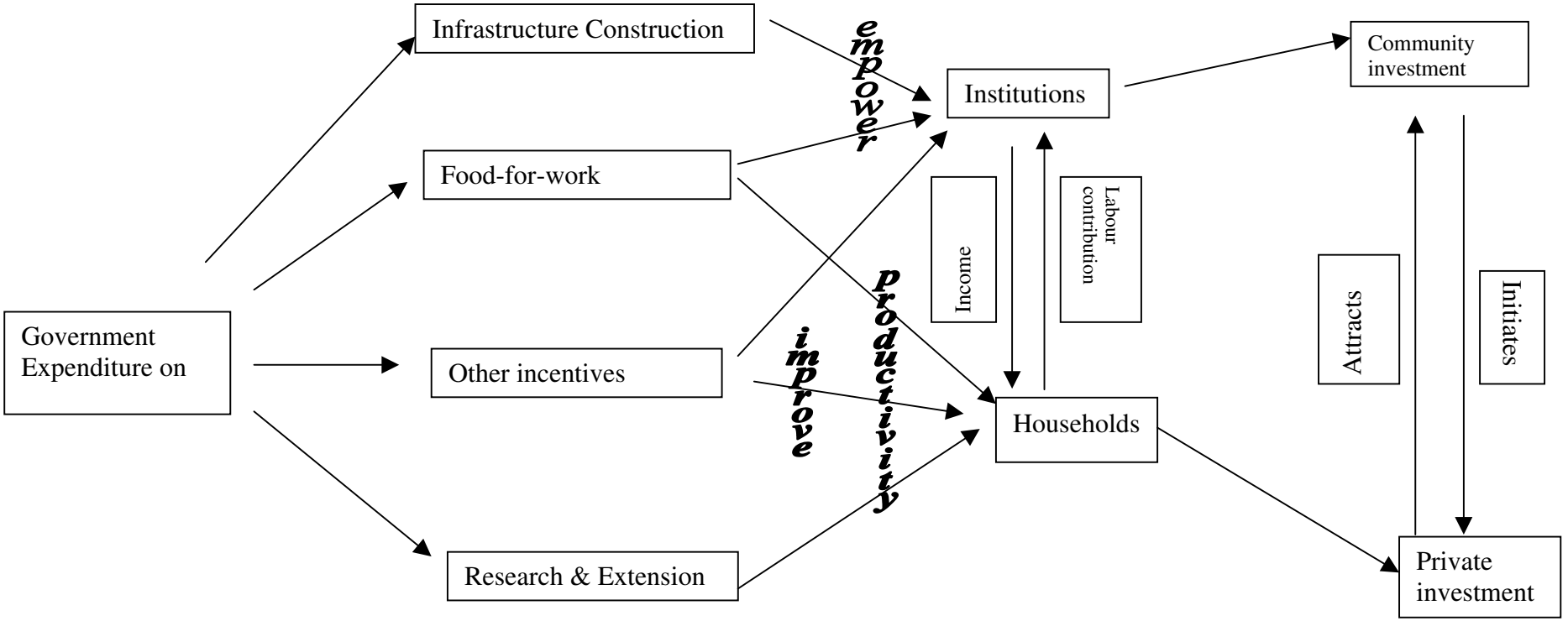
members, then these institutions could play greater role in soil and water conservation too. Thus strengthening their managerial and/or financial capacity, formulation of appropriate policies, and public investments in infrastructure (mainly road) would be important.

The land degradation problem is aggravated due to rapid population growth, which resulted in deforestation, fragmentation of farmland and cultivation of marginal land. Although, the health service coverage increased to a large extent, due to cultural and religion causes, family planing is not widely in effect. These local institutions can help in breaking the cultural and religion barriers through gradual changes. Hence, targeting these institutions in the family planning policy could help not only in combating the rapid population growth but also minimises indirectly soil degradation and related problems. We should also bear in mind that the food aid programs and policies affect negatively not only the family planning policies, but also the environmental policies because they some how encourage population growth.

Finally, the strengthening of the local institutions through capacity building and giving more power in making decision can facilitate the overall development endeavours. For instance food security can be improved through increased production by use of improved land management techniques, including soil and water conservation, fertiliser provision etc. In areas where these institutions are less functional (in many other regions of the country they do not even exist), identifying their role and acceptance by the community in their local areas (modifying to suit to the areas) could be very important. This can indicate their future potentials for soil and water conservation.

Though this case study focuses particularly on the labour investment in soil and water conservation and how the local institutions could affect households' decision making, it is possible to imagine the roles the institutions could play in the overall improved land management. The positive impacts of local institutions in initiating private soil investment as well as increased investments of households on the community owned land, among others, can be expressed as one important outcome of this study paper which confirms that consideration of local institutions in formulating policies for improved land management is important.

Figure 4 showing the role of public expenditure in SWC investment



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Annex I- Questionnaire used in the field interview

Farm Household Survey Questionnaire
used for research on:
The role of institutions in SWC and its policy implication for improved land management

by Kinfe Abraha

Identification

Questionnaire number:

Date of interview: Day: _____ Month: _____ Year: _____

Interviewed by:
Date entered: Day:__ Month: _____Year: _____

Zone:

Woreda:

Tabia:

Kushet:

Name of the household head _____ sex ____ age ____

A1-household composition by sex, age, education, organisation…

Id 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	5. association/organization 1-general service ass. 2-womens' ass. 3-youth ass. 4-farmers ass. 5-bito 6-Edir 7-Equb		6. Religion 1= orthodox 2= catholic 3= Islam 4= other		7. Education and training 0= no education 1=literacy cham.(meserete timhert) 2=1-6 grade 3=7-8 grade 4=9-12 grade other training includes 5=extension education 6=health (human) 7=animal health 8=SWC				Occupation 1 = student (in school) 2 = watch after animals 3 = housewife 4 = farming 5 = hired laborer 6 = off-farm activity 7 = other, specify	
			Code		Code		name	Code		Code	level	code	Other training	Code	occupation	code

A2- Membership in organisation

Id. no.	association/organization	Characteristics of the association						5.services acquired from the organization 1-credit 2-input delivery 3-output market 4-religious --- 5-administration 6-other ---		***Membership***				
		Origin of the Organizations 1-local (free ins. from tabia) 2-Gov[t] 3-regional NGO 4-International NGO		Size	Types of Activities 1-credit 2-input delivery 3-output market 4-religious --- 5-administration 6-other		Role in SWC 1-high 2-med. 3-low 4-none			Your contribution 0-no 1-little 2- medium 3-high 4-very high		Form of your contribution 1-labour 2-money 3-other (specify)		How much
			Code			Code			code		code		Code	

PART B. HOUSEHOLD RESOURCE ENDOWMENT

B1. Land use -plots used (cultivated, grazed…) by household

Plotnr.	2. Name of plot (or description)	3. area of plot 1 = square meters 2 = hectares 3 = local unit		4. slope category of each plot 1 = flat 2 = moderately steep 3 = steep 4 = very steep		5. What kind of land is it? (used for what purpose?) 1 = homestead 2 = cropland 3 = grazing 4 = wasteland 5 = other, specify…		6. How did the household acquire the plot? 1 = purchased 2 = inherited 3 = rented for a fixed price 4 = borrowed in return for portion of crop / share cropping 5 = common land 6 = given by government 7-other, specify…		7. Erosion problem 0=No If yes Severity of the problem 1-low 2-mild 3-medium 4-high 5-very high		8. If yes is the answer in 7 do you practice SWC measures ? 0-no 1-yes if no what is the reason? 2-lack of knowledge 3- not own land 4-lack of money, credit… 5- expect no benefit 6-time constraint	
		Amount	Unit code		Code		Code		code		code		Code

If the answer for column 8 is yes (year 2001), and second copy for years before 2001

Ser.no	Plot name	Type of SWC measure 1-stone terrace 2-soil band 3-drainage ditch 4-check dam 5-other (planting trees, grass strip…)		Who (organizations) participated in the SWC 1-local 2-Gos 3-NGOs 4-No		Cost of the practice (privately)			Cost of the practice through the organization		
						labor	material	other	labor	material	other
			code		code						

B2. Livestock owned

1.Does your household own any animals			2. How did you acquire these […] 1 = bought 2 = borrowed 3 = hired out 4 = born 5 = exchanged 6 = other, specify…			1. Does your household own any […]			2. How did you acquire these […] 1 = bought 2 = borrowed 3 = hired out 4 = born 5 = exchanged 6 = other, specify…	
Livestock type	1 = yes 2 = no	How many		Code		Livestock type	1 = yes 2 = no	How many		Code

PART C. PRODUCTION CHARACTERISTICS OF THE HOUSEHOLD

C1. Crop production

1. Have you harvested any […] during the past 12 months?			2. On which plot have you harvested this […] (see for code, part B1 page 5)	3. Which inputs have you used? 0= none 1 = fertilizer 2 = compost 3 = cow dang 4= other				4.What labour did you use? 1 = family labour 2 = hired labour 3 = exchange labour 4 = other, specify…		5.Cost of labour 1=during planting 2=weeding 3=irrigation 4=harvesting							
										family				hired			
Major Crop type	1 = yes 2 = no	Size (in tsemdi)			code	amount	cost	labour	code	1	2	3	4	1	2	3	4

D1-Conservation practice on community land and the organization working with

Seri. No	Family member name	Labor supply on community (through mobilization)								Through food/ cash for work		other		
		Forest land/mountain		crop land		grazing land		other		Man days	payment (money equivalent			
		man days	organization	man days	organization	man days	organization	man days	organization			man days	Payment.	Type of activity

E1-If you have the money/ credit for SWC would you like to invest on SWC

Yes-----

No------- if no is you response why? ----------

If yes is you response how much interest rate would you be willing to pay?

How much would you invest?

state	Interest rate(%)	Amount you would invest	Type of investment	

E-2 If some one tells you he/she wants to invest on SWC on your land so that you can pay him part of your production would you accept the offer? Yes_____ No_____

If your answer is yes how much are you willing to give up in return to his investment on your land?(by type of investment and duration)

Willing to pay							
Type of SWC measure		Percentage of the product you are willing to pay for this duration (year)					
		1year	2year	5 year	10 year		
stone terrace							
soil band							
drainage ditch							
check dam							
other (planting trees, grass strip…)							

E3-How much would you be willing to pay to use someone's conserved land? If the conservation is

Type of SWC measure		Percentage of the product you are willing to pay for this duration (year)					
		1year	2year	5 year	10 year		
stone terrace							
soil band							
drainage ditch							
check dam							
other (planting trees, grass strip…)							

F1-what do you think your benefit from investing in SWC? ____improved productivity

-soil and moisture retention
- leveling of the farm
-feed and grass for livestock

F2-what do you fear or risk do you think from investing in SWC?____

G1- is there any member of your family who has got any plot recently? Yes__ ____ No_____

If yes what kind _____

Why does he/she got land now? _____

G2- do you have any plot of land taken from you and given to some one recently?

Yes _____No_____If yes why from you?_____

G3- Does the present land user right has any effect /negative/ on your decision in investing for SWC?

Yes_____ No_____

G3- do you think you would invest more in SWC if there were clearly defined land ownership? Yes_____ No_____