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Incentives for Conservation in Tigray, Ethiopia: Findings from a Household Survey

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Incentives for Conservation in Tigray, Ethiopia: Findings from a Household Survey[1]

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Summary

Understanding the problem of land degradation in a given spatial and temporal context, requires looking at the community baseline conditions such as the natural resource base, human resources, existing institutions and infrastructure base, and how these conditions interact with policies and institutions to influence human responses and thereby affect productivity, livelihood security and the natural resource base. This study provides a description of the land users' priorities, attitudes and perceptions, household characteristics and socio-economic status, access to credit, and farm inputs, tenurial arrangements and variations in land quality and technology characteristics and their effects on the households' interest in and ability to invest in conservation technologies based on a preliminary statistical analysis from a survey of 400 households in 16 communities carried out in 1998. Furthermore, it poses important questions that could serve as basis for further rigorous econometric analysis and future research endeavor.

I. Introduction

The Ethiopian highland is one of the areas on the African continent with highest agricultural potential. War, policy failures, technology stagnation, high population pressure, land degradation, and drought have contributed, however, to Ethiopia being one of the poorest countries in the world (World Bank, 1997). Continued rapid population growth has also contributed to a fall in food production per capita in the country as a whole over the last 30 years (Shiferaw and Holden, 1997).

Land degradation, taking the form of severe soil erosion and nutrient depletion, is the most serious environmental problem calling for combative action if sustainable agricultural development and environmental rehabilitation is to take place. A study of soil conditions in 38 SSA countries estimated the average net nutrient loss per hectare to be 20 kg N, 10 kg

[1] The Norwegian Research Council is gratefully appreciated for providing the funds to cover the field activities under the research project "Incentives for Land Conservation in the Highlands of Tigray", a collaborative work between the Agricultural University of Norway (NLH) and Mekelle University (MU). None of these institutions takes responsibility for the contents in this report.

P_2O_5, and 20 kg K_2O (Stoorvogel and Smaling, 1990). The study reported considerable differences between SSA countries. Burundi, Ethiopia, Kenya, Lesotho, Malawi and Rwanda were rated among those with highest nutrient depletion rates. The largest amounts of nutrients disappear through soil loss (erosion) and yields, while removal through residues, leaching, and gaseous emissions are less important. The supply of nutrients comes from fertilizer, manure, depositions, soil formation and N-fixation. Average fertilizer (nutrient) use rates are low in SSA countries, estimated at 9 kg/ha cultivated area compared to 47 kg in Latin America, 69 kg in South Asia, 190 kg in East Asia and 142 kg in Europe in 1989/90 (World Bank, 1992). In contrast, Ethiopia's average fertilizer consumption is only about 7 kg per hectare (FAO, 1998). Thus, only a meager proportion of the plant nutrients lost are replaced in SSA since withdrawal by far exceeds the supply of nutrients by fertilization.

Poverty in combination with market imperfections may lead to inability to invest in land conservation and lead myopic survival strategies may be detrimental to the natural resource base (Hagos and Holden, 2002; Holden et al., 1998). The combination of low economic growth, rapid population growth and environmental degradation imposes a self-reinforcing vicious circle, which worsens poverty and environmental deterioration unless a concerted effort is made to deal effectively with the problem of land degradation. The vicious circle may also lead to social instability and conflicts.

Ethiopia is the largest, both in terms of population and in terms of area, of the above mentioned countries of SSA with severe land degradation problems. With a per capita GDP of US$ 120 in 1992, Ethiopia is also among the poorest countries in the world (World Bank, 1992). As much as 94 % of the agricultural production in the country has been estimated to take place in the peasant sector (FAO, 1986). Smallholder peasant agriculture contributes 45% of GDP, 85% of export income, and 80 % of employment in the country (World Bank, 1992). The "income" of these peasants is mainly their subsistence production as they sell only small surpluses and as they are only partially integrated into markets.

The Ethiopian highlands (more than 1500 m.a.s.l) constitute 43% of the country but supports about 88% of the population (MNRDEP, 1994), and accounts for 95% of the regularly cropped land and 70% of the livestock (FAO, 1986). The population density is close to ten times that of the lowlands. FAO (1986) estimated that 50% of the highlands were significantly eroded, 25% were seriously eroded and 4% had reached the point of no return.

The average net soil loss from cropland in the highlands has been estimated to be 100 t/ha/year but may vary from 50 to 170 t/ha/year for the various agro-ecological zones and

altitude zones. The highest rates are found in the High Potential Cereal Zone in the 2000-2500 m.a.s.l altitude zone (FAO, 1986). For the entire country, on cultivated land average soil loss rates of 42 t/ha/year have been estimated, while soil loss on single fields may reach up to 300 t/ha/year (Hurni, 1993).

In response to the massive and accelerating degradation of productive agricultural land in the country, a large scale soil conservation program was initiated following the 1973/74 famine. The extensive rehabilitation scheme was implemented via the food-for-work program (FFW) provided by the World Food Program (WFP). Although considerable areas of agricultural land were treated with conservation structures through this program, emphasis on uniform physical structures, the exclusion of the land users, and lack of sufficient scientific data to design effective soil and water conservation techniques (SWCT), have had severe drawbacks on the effectiveness of the FFW. The Soil Conservation Research Project (SCRP) was, therefore, established in 1981 to provide, among other things, data on erosion processes and test new conservation techniques appropriate for different agro-ecological zones. As a result, the SCRP organized under the Ministry of Agriculture has carried out extensive research in soil and water conservation since 1981[2]. None of this research was carried out in Tigray, however.

Most of the research efforts in Ethiopia have until recently concentrated on measuring changes in the physical environment and testing various conservation technologies in physical terms. Socio-economic research in relation to land degradation and conservation has largely been missing up to 1994 although the need for such has been highly appreciated. Economic analysis on the tested conservation technologies is still at its early stage. It is now widely recognized that economic and institutional factors have a significant role to play in deterring or promoting the successful implementation of technically effective conservation technologies. Soil and water conservation programs in the past which emphasized technical solutions to the complex land degradation problem of the developing countries without due consideration to economic and institutional interventions have provided several examples of failures (e.g. see Bojö, 1991). Several recent studies on technology adoption have also demonstrated the crucial role of institutional and economic incentives for adoption of

[2] The project has received basic funding from Swiss Development Cooperation (SDC), and inputs from the Ethiopian Government for personnel costs.

innovations intended to improve sustainability of smallholder farming (e.g. see Fujisaka, 1994; Orji, 1991; Ervin and Ervin, 1982).

Economic and institutional analysis of tested soil and water conservation technologies, as stated above, is of vital importance for creating the necessary policies and institutional structures, and thus incentives to promote sustainable land use in the highlands of Ethiopia. Past soil conservation programs were carried out based on a top-down planning approach with standardized conservation technologies that were not adapted to local conditions. These programs largely overlooked the role of the land users' perceptions, attitudes and priorities in relation to land conservation. These are frequently cited reasons, which led to the rejection of innovations, intended to promote sustainability of smallholder farming.

It is on these areas of socio-economic and policy-relevant research regarding farmers' perceptions, and factors influencing acceptance of innovations for land conservation, that this research will focus.

The research project "Incentives for Land Conservation in Smallholder Agriculture in Ethiopia: - Policies for Sustainable Development", financed by the Research Council of Norway, has focused its research activities in the Amhara and Tigray Regions of Ethiopia. The project included a baseline survey in the northern predominantly dry land Tigray Region. This is a particularly interesting area since a lot of effort has gone into land conservation during the last five years. Drought and food insecurity represent serious problems in this region in particular due to the relatively low and erratic rainfall pattern. A consequence of this variable rainfall is that food production is highly variable and this causes food insecurity to be a major problem in the area. According to a survey by REST and NORAGRIC (1995), only 17 per cent of the households were self-sufficient in food. There is thus both a transitory and chronic food insecurity problem.

This report will focus on the research findings from the baseline survey in the Tigray Region. This research was carried out in close collaboration with Mekelle University College, Ethiopia. The research has also been integrated with a larger and more long-term research program initiated by International Food Policy Research Institute (IFPRI) and International Livestock Research Institute (ILRI). The survey reported here therefore represents a sub sample of the larger sample from which IFPRI and ILRI plan to run a community survey.

The objectives of this smaller project are to:

1. Carry out economic analysis of tested soil and water conservation technologies from the land users' and society's perspective.

2. Assess the land users' priorities, attitudes and perceptions, household characteristics and socio-economic status, access to credit, input and output prices, tenurial arrangements and variations in land quality and technology characteristics and their effects on the households' interest in and ability to invest in conservation technologies.
3. Investigate the importance of population pressure and poverty on the incentives for conservation of land.
4. Explore alternative institutional arrangements to create incentives for land conservation at the farm and community levels and facilitate more widespread adoption of proven and cost-effective techniques.
5. Undertake economic analysis on alternative policies that internalize the land degradation externality and investigate their impacts on household welfare and production decisions.

The objective of this report is primarily to respond to the second of the above stated objectives:

> **Assess the land users' priorities, attitudes and perceptions, household characteristics and socio-economic status, access to credit, input and output prices, tenurial arrangements and variations in land quality and technology characteristics and their effects on the households' interest in and ability to invest in conservation technologies**.

In Tigray, it is of particular importance to study the links between land degradation, land conservation and food security. This report therefore also presents findings related to these links.

The report summarizes the basic findings in a community and household survey, covering 16 communities and 400 households sampled in the highlands of the Tigray Region of Ethiopia representing a broad range of variations in agro-climate, population density, market access, and presence or absence of irrigation projects.

1.2. Study site

The population of the region was 3.136 million in 1994, 85% of which lived in rural areas (CSA, 1995). The annual population growth rate is estimated to be at least 3% (CSA, 1995). About 45 % of the population is below the age of 15, indicating a high dependency ratio and the likelihood of continued rapid population growth as the children reach childbearing age. The average population density of the region is 39 persons/ km² (CSA, 1995). The average

arable land holding in the region is 1.2 ha per household (SAERT, 1994), varying from 0.5 ha in the highlands[3] to 2.0 hectares in the lowlands (Tsegay, 1996).

Tigray Region belongs to the African Dry lands, which is often called the Sudano-Sahelian region (Warren and Khogali, 1992). It is characterized by sparse and highly uneven distribution of seasonal rainfall, and by frequent drought. The amount of rainfall increases with altitude and from east to west, and decreases from south to north. Average rainfall varies from about 200 mm in the northeast lowlands to over 1000 mm in the south Western highlands. The coefficient of variation in annual rainfall for the region is about 28 %, compared to the national variation of 8 percent (Belay, 1996). Generally, the rainfall distribution is mono-modal in character, with few exceptions in the Southern and Eastern zones, where it is bimodal. Most of the rainfall falls during the "*meher*" season from June to September.

Average temperature in the region is estimated to be 18^0C, but varies greatly with altitude. In the highlands of the region, during the months of November, December and January, the temperature drops to 5^0C. In the lowlands of Western Tigray, especially in areas around Humera, the average temperature increases from 28^0C to 40^0C during the summer.

According to the Regional Conservation Strategy of Tigray (RCST, 1996), the major soil types identified so far are Cambisols, Rendzinas, Lithosols, Acrisols, Fluvisols, Regosols, Nitosols, Aerosols, Vertisols, Xerosols, Solonchacks, and Andosols. Generally, the soil of the region is highly eroded and with low fertility (RCST, 1996).

The highland plateau of Tigray, which is claimed to have been covered by rich forest of junipers, olea, and cordia, alternating with montanae Acacia, is converted into the almost barren plateau (Hunting, 1974). Currently, only about 1.6 % of the total land area[4] of Tigray is forestland (Land Use Planning Team, 1996).

As far as water resources are concerned, about 90 billion meter cubic units of water are drained from the region via the Tekezze basin. Studies indicate that about 300 thousand hectares of land are suitable for irrigation from surface water sources (SAERT, 1994a).

[3] Highland here refers to areas above 1500 m.a.s.l.

[4]The commonly cited figure is less than 0.3 percent.

Preliminary studies[5] also show that there is ample of ground water potential (BoPED, 1995). Nonetheless, currently, less than one % of the land is irrigated.

There are three main farming systems in Tigray; namely, the pastoral system, the mixed pastoral and cereal production system, the food crop production system, and the mixed crop-livestock farming system (Belay, 1996). Mixed crop-livestock farming is the dominant system in the highlands while pastoral systems are common in the lowlands. Of the estimated 616 thousand farmland holders in Tigray in 1996/97, more than three-quarters were mixed crop-livestock producers (CSA, 1997).

Almost all of the cropland is planted to annual food crops, including cereals (teff, wheat, barley, maize, sorghum, and millet), pulses (beans, chick peas, and lentils), and oilseeds (sesame, flax, and noug). A very small fraction of farmers (less than 1%) produces vegetables, fruits, or spices (SAERP, 1997). Manure and/or crop residues are used to maintain soil fertility by about 60% of farmers. Chemical fertilizers are used by only about 12% of farmers; high costs and lack of knowledge are the main reasons cited by those not using them. Livestock are also very important to agriculture in Tigray. Two thirds of households in Tigray own at least one ox, and about half own at least one cow (SAERP, 1997). About one third of households own any goats and one-quarter own sheep; these households average about seven goats or sheep each. Donkeys are the most common pack animal; owned by about one-third of households. About three-quarters of households raise some chickens, on average about seven per household. Bee keeping is an activity among 10% of households (SAERP, 1997).

The availability of feed and water are serious constraints to livestock production in Tigray. Communal grazing areas, private pastures and crop residues are the principal sources of feed. Three-quarters of farmers in the SAERP's survey reported lack of feed, particularly crop residues, to be a serious constraint to livestock production (SAERP, 1997). More than a third of farmers reported spending more than 1 hour per day taking their animals to a water source (SAERP, 1997). Various diseases are also important constraints, particularly trypanosomiasis in lowland areas. A substantial proportion (more than 10%) of sheep and goats are afflicted by pasteurellosis (SAERP, 1997).

[5] According to sources in the Regional Bureau of Agriculture and Natural Resources Development (BANRD) only minor exploration studies have been undertaken to identify ground water potential in the region.

Social services are also limited, particularly in rural areas. In 1994, only about 14% of rural adults were literate compared to 57% of urban adults (CSA, 1995). Only 11% of rural households had access to potable water (through piped water or protected wells) compared with 74% of urban households. Less than 3 % of households in rural areas had a toilet, compared with 29% in urban areas. Almost half of the urban households had access to electricity[6], compared with virtually none in rural areas. Health services are very poor. The infant mortality rate is 123 per 1000 live births and average life expectancy is only 49 years (CSA, 1995).

The transport infrastructure is poor and underdeveloped. In the region, there are 976 km. of gravel all-weather roads and 1,400 km. of rural roads. This amounts to only 0.31 km. of all-weather road per 1,000 people, less than half the average for Africa as a whole (BoPED, 1995). Much of the road network is in poor condition: 80-85% percent of the gravel roads are in need of intensive maintenance, and the rural roads are mostly unfit for motor vehicle transport services (BoPED, 1995). As a result, walking and pack animals still remain the dominant modes of transportation in rural areas.

Not surprisingly, poverty and food insecurity are very severe in the region. Several hundred thousand people died because of famine during the mid-1980s, and many are affected by food shortages on a regular basis. In 1996, nearly three-quarters of respondents in the SAERP's survey reported being affected at least twice by famine since 1985 (SAERP, 1997). A survey in Central Tigray, found that over 80 % of households were food deficit in 1992/93 (REST and NORAGRIC, 1995).

1.3. Land Degradation in Tigray

Soil erosion, gully formation and loss in soil fertility are considered the three major land degradation problems facing the region. Though soil erosion is prevalent throughout Ethiopia, this problem is particularly severe in Tigray. The early human settlement and expansion of agriculture, together with the steep terrain and the erratic and intense nature of the rainfall have resulted in erosion to being a major problem. Hurni (1988) estimated that more than half of the area of the highlands of Tigray was severely degraded, with soils less than 35 cm deep. Hurni and Perich (1992), also argued soils in Tigray are believed to have lost 30-50 % of their

[6] In rural areas, the population's energy demand is met 66% from firewood, 12% from dung and 9% from crop residues. In urban areas, the source of energy are 50% charcoal, 40% fuel wood and 2% dung (BoPED, 1995)

productive capacities compared with their original state some 500 years ago. REST's recent studies in seven *weredas* of the Central zone of Tigray indicate that about 46 % of the currently cultivable land is exposed to severe soil erosion. Although two decades ago, about 30 % of the cultivated land is said to have required soil and water conservation measures (Hunting, 1975); now almost all the cultivable land needs treatment. Some authors indicated that at the present rate of conservation work, 20-25 years would be necessary to cover the whole Tigray (Tekeste and Smith, 1989).

Estimates of soil erosion rates vary substantially. According to the Hunting report (1975), the average rate of erosion in the Central highlands of Tigray, the most densely populated area, was measured to be above 17 t/ha/year. Other studies in the 1980s reported estimates of erosion rates of more than 80 t/ha per year (REST, 1989a; 1989b; Tekeste and Smith 1989). A recent study of erosion in part of Central Tigray near Adwa, estimated, using the universal soil loss equation (USLE), that 18% of the area studied was eroding at rates exceeding 10 t/ha per year (Eweg et al., 1997). Though estimates of the economic impact of soil erosion are not available, it is estimated that those impacts will be probably greater in Tigray, where soil erosion is more severe than in much of the highlands[7].

Soil nutrient depletion poses a related and at least as critical a problem for agricultural production in Tigray. No estimates are available on the extent of the problem in Tigray specifically. The main nutrient outflow in Stoorvogel's and Smaling's estimates, for the country as a whole, is soil erosion (about 60 kg per ha), followed by removal of harvested products and crop residues; while inflows from manure and chemical fertilizer are very low (averaging less than 10 kg per ha).

A major cause of the high removal of nutrients in crop residues and low addition of manure is burning of dung and crop residues to satisfy household energy needs. Sutcliffe (1993) estimated the impact of nutrient depletion due to burning of dung and crop residue in the Ethiopian highlands to be 465 thousand tones of grain and 1 million tropical livestock units (TLU) of livestock production in 1990, valued at EB[8] 580 million. Bojø and Cassells estimate the gross discounted cumulative loss due to this to be about EB 8 billion (compared with their estimate of EB 3 billion for cumulative losses due to erosion). Thus, the costs of

[7]For soil erosion estimates and their economic impact for the highlands of Ethiopia see Ethiopian Highlands Reclamation Study (EHRS), 1985; Hurni, 1988, Sutcliffe, 1993, and Bojø and Cassells, 1995.

[8] One US Dollar ≈ 8.5 Ethiopian Birr (EB).

nutrient depletion due to burning of dung and crop residues may be larger than (though of the same order of magnitude as) the costs of soil erosion. Although these estimates are clearly subject to substantial uncertainties, and most are not specific to Tigray, they suggest that both soil nutrient depletion and soil erosion are major problems in Tigray.

Soil erosion and nutrient depletion are exacerbated by, and, in turn, exacerbate, the problem of moisture stress inherent in the semi-arid environment of Tigray. The amount of rainfall, even in a normal year, is not sufficient to sustain normal crop growth in most parts of Tigray, unless water harvesting mechanisms or supplementary irrigation is introduced. Under average conditions and presuming the moisture deficit is uniformly distributed over the growing season, yields will be 45% below potential (SAERT, 1994a). The result is a viscous cycle of erosion, low soil moisture, and poor soil and plant nutrition, contributing to worsening land degradation, low productivity and poverty.

1.4. Past and Present Conservation Efforts in Tigray

To reverse the land degradation process, concerted efforts have been going on in terms of soil and water conservation activities. Terracing and reforestation programs started in 1970 under a USAID sponsored FFW program. In the four years following this program about 1500 ha were terraced and planted at 11 sites (Hunting, 1975). This was later complemented by the UN/FAO food-for-work (FFW) programs. The initial stage of implementation was plagued by a series of problems of technical and institutional character. For instance, the reforestation program had technical failures in the alignment of terraces, poorly organized nurseries, incorrect spacing and wrong choice of species (BANRD, 1996). The planning and implementation process was not based on the active and voluntary involvement of the land users. Conservation was considered a subsidiary of food aid.

Since the 1980s, the emphasis and focus of soil and water conservation efforts has gradually changed: these strategies were considered as programs for strategic food shortage alleviation. Soil and water conservation activities have become one of the major preoccupations of the people and the authorities. Initially, every dry season, for four months, the farmers in Tigray build stone terraces over whole catchments starting with higher level fields. This implies a work rates equivalent to 2.5 to 5 months of part-time work per hectare of terracing work for a farmer and his family if tools are supplied. Each family was able to give 90-180 man days per year spread over 90-120 days of the year when extra activities like soil conservation are possible (Tekeste and Smith, 1989). This had a serious cost implication to the household**.**

Conservation strategies focused mainly on the construction of technologies of physical structures depending on the land use pattern; namely, for a steep uncultivated land contour stone bunds, cut-off ditches and contour furrows; for cultivated land contour stone/soil bunds, grass strips, complemented by gully control were used. Measures were also introduced to reverse the biological degradation of the environment. These included closure of uncultivated and overgrazed hillsides for natural regeneration and reforestation, on both community and private lands, by the community in collaboration with governmental and non-governmental institutions. According to the BNREP, the total number of seedlings produced and planted in the years 1991/92 and 1992/93 were 15.8 million and 41.4 million respectively. Assessment results indicate, however, the survival rates, especially on community plantations, were very low (MUC and REST, 1996).

Since 1995, a major shift was made in the number of days allocated for 'voluntary' public work in soil and water conservation activities. From the previous four months, now farmers, involving all physically able bodies, undertake twenty days of fieldwork. Emphasis is now put on integrating soil and water conservation activities as part of the land management practices by each farming household.

The planning and implementation process of soil and water conservation is done with the active interaction of the people and the local *Baitos*[9]. Mass mobilization and the involvement of grass-root institutions is the main strategy for implementing the process, which will depend very much on farmers' motivation and approaches of implementation and the types of incentive mechanisms we have in play.

The conservation strategy was accompanied by a long-term strategy of improving the moisture status of the region by promoting small-scale irrigation development. In 1995, the regional government of Tigray initiated an ambitious plan to construct 500 micro dams within ten years with a capacity of irrigating 50,000 ha in the moisture stressed and drought prone areas. By the end of 1997, 25 dams and 3 river diversion structures with a nominal capacity of irrigating about 2,500 ha of land were completed. However, most of the completed dams are

[9] *Baitos* are the village council elected by the people and are responsible for administrative and socio-economic functions in their respective *Tabias*. A *Tabia is*, in turn, the lowest administrative unit in the regional structure.

operating much below their capacity mainly due to a shortage of water[10]. Only about 300 ha were actually being irrigated in 1998.

2. Survey methodology

The survey was planned and designed at Mekelle University College during visits by Stein Holden from NLH in November/December 1997 and January 1997. The survey was initiated during the second visit when survey assistants were trained.

2.1. Stratification and sampling

Stratification and sampling was done in collaboration with John Pender from IFPRI. Sixteen communities (*tabias*) were selected as a sub sample of the sample of 100 communities where IFPRI and ILRI/MUC plan to carry out a community survey in 1998/99. The following criteria were used in the sampling:

- The lowland pastoral areas (< 1,500 m.a.s.l.) were excluded
- Geographical zone (Eastern, Southern, Central and Western). These zones reflect significant variation in rainfall, agricultural potential and development pathways.
- Distance to market: Far from market (> 10 km) vs. close to market (< 10 km)
- Population density: High population density relative to low population density
- Irrigation projects: Communities with and without irrigation projects.

Four communities were selected from each of the four zones in Tigray, as this would include a systematic variation in agro-climatic conditions, agricultural potential, population density and market access conditions.

IFPRI and ILRI have stratified the highlands of Tigray in three strata:

1. Communities without irrigation projects, located far from markets (> 10 km)
2. Communities without irrigation projects, located close to markets (< 10 km)
3. Communities with irrigation projects

We selected three communities out of the sample with irrigation projects. Among communities far from markets, we strategically selected one with low population density and one with high population density from each zone. In the Eastern and Western zones, we also

[10] Technical problems such water seepage (due to poor design), increased salinity of soils, and limited water storage and, hence, limit capacity to irrigate more land are important problems being faced during implementation. There are other institutional and health related problems as well (see, Ghebreyesus et al,. 1999; Bedini, et al., 1996;).

selected one with high population density and one with low population density among villages close to markets. In the Southern zone, we had only one distant from market and with irrigation project. The two other communities with irrigation projects were located in the Central zone, one with short distance to markets, the other far from markets.

The names and basic information on the 16 selected communities can be found in Appendix 1. Within these communities, lists of all households were obtained and simple random sampling was used to select 25 households from each community.

The strategic sampling was used to increase the variation in rainfall, market access and population density and to ensure the inclusion of communities with irrigation projects. It is hoped that this variation can improve the analysis on the importance of these variables.

2.2. Design of household and village questionnaires

During the visit in December 97, visits were made to a number of projects and communities and informal discussions were held with farmers, local leaders and project staff. Questionnaires developed for use in other parts of Ethiopia also formed part of the basis for developing a prototype household questionnaire. The questionnaire was further developed during the training of enumerators for the survey in January 98. A copy of the household questionnaire can be found in Appendix 2.

2.3. Data collection, punching, and polishing

Enumerators were hired in January 98 and trained for two weeks parallel with the selection of communities and refinement of the questionnaire. The questionnaire was divided in three parts and specialized training was given to enumerators taking responsibilities for different parts of the questionnaire. Each household would then be visited at least three times to complete the whole interview and each interview took less time. The households were paid a compensation (coffee) for the time they had to spend on being interviewed.

Fitsum Hagos was responsible for managing the survey, which was carried out during February to mid April 98.

The data were punched using the software Roasoft allowing of easy entry by relatively unskilled punchers. Crosschecking and polishing of the data has partly been made in Mekelle University College and partly at NLH, Norway.

2.4. Preliminary analysis

Summary statistics were derived directly from Roasoft. Data were also transferred to spreadsheet for further data checking and conversion to more useful form for basic and more complex analysis. This document presents the results of the preliminary analysis.

3. Summary of basic survey findings

3.1. Household characteristics

Some of the basic characteristics are summarized in Table 3.1. The average household size for the sample of 398 households in the highlands of Tigray was 4.68, varying from 4.38 in the zone to 4.96 in the Central zone.

12 % of the households in Southern Tigray had absent household members, followed by Tigray with 7% of the households having absent members. This type of migration is much less common in the Central and Western zones.

58 % of the households in Southern Tigray, 41% in Central, 34% in Eastern, and only 5% of the households in Western Tigray have had to migrate in the past due to drought or to non-farm employment. Most of the migration has been within Tigray but also a significant share of the migration has gone to other parts of Ethiopia, Eritrea and other countries, especially Saudi-Arabia and Sudan.

We see that there are very few households which report to have members with specific skills. It proportion of households having members with specific skills is somewhat higher in the Southern zone, which also has the highest share of migrant household members.

In the community survey, we documented the history of people's settlement and migration in each of the respective *tabias*. From the discussion, it came out that settlement in communities of the Eastern, Central and Southern zones are ancient in contrast to communities in the Western zone, which were found to be of relatively recent origin. Migration history of people showed that there was an east to west movement at different juncture of history. The major reasons for such population movements were growing population pressure in the earlier settled areas, religious expansion and conquest.

Table 3.1 Household composition and migration pattern among surveyed households

Characteristic	Zone				Total
	Central	Eastern	Southern	Western	
Household size	4.96	4.38	4.93	4.44	4.68
Share of households with absent household members	0.01	0.07	0.12	0	0.05
Number of children below 5 years per household	1.38	1.01	1.05	1.23	1.14
Children, 5-17 years, per household	2.18	1.77	1.82	2.32	2.01
Adults, 18-65 years, per household	2.41	2.02	2.23	2.23	2.22
Adults above 65 years, per household	0.47	0.58	0.34	1.0	0.49
Share of households which have had to migrate in the past	0.41	0.34	0.58	0.05	0.34
Share of households which have migrated within Tigray	0.23	0.09	0.22	0.01	0.14
Share of households which have migrated to other parts of Ethiopia	0.04	0.10	0.14	0.03	0.08
Share of households which have migrated to Eritrea	0.02	0.05	0.01	0	0.02
Share of households which have had members migrating to other	0.04	0.04	0.03	0.01	0.03
Share of households reporting that the head of household has specific skills	0.03	0.04	0.06	0.01	0.04
Share of households reporting females with skills	0.02	0.03	0.07	0	0.03

Migration as means of overcoming periodic shocks has also been quite common in Tigray as far as people can remember (see Appendix 5). All the communities seem to have their traditional destination in case of severe stress. The communities in the Southern zone used to migrate to places in Southern Tigray (the Raya Azebo area) and southwestern Ethiopia (especially Jimma). People in Samre, because of their proximity prefer to migrate to Belessa and Semien, in Wello and Gondar respectively. The communities in Eastern and Central

zones migrate mostly to Western Tigray, Eritrea or Sudan. In the communities of the Western zone, migration is quite rare. Drought, locust (pest) attack, severe taxation and civil unrest were the major reasons leading to such strong population movements. The locust attack in 1951/52 and drought in 1985 seem to have strong and widespread displacement effects in almost all the communities in Tigray.

Currently, such strong population movement, especially out of Tigray, seems to have declined in almost all the communities. Availability of food aid in case of stress, access to food-for-work (FFW) and other income opportunities, peace and trust on the government are said to be accountable for such change. In almost all the discussions, migration is not now seen as a major means of coping with stress such as drought.

Household composition in 1991 (at the time of change in Government) was also asked for the same households. Household sizes were significantly smaller at that time and particularly the number of children was smaller in the Eastern and Southern zones.

The level of education among household members was low. Household heads had on average less than two years of education in all zones. The same was the case for adult female household members. There were very few with more education. We, therefore, do not expect the number of years of education to be a useful explanatory variable in econometric analysis.

3.2. Farm characteristics

We will present some of the basic characteristics of the farms of the surveyed households by zone. We look in particular at the variation in farm size and oxen holding sizes in each zone. We also look at how farm sizes vary between high population density areas vs. low population density areas, and for communities close to markets vs. communities far from markets.

3.2.1 Farm size and cropping pattern

Average farm size and standard errors on mean farm size are presented in Table 3.2.1. The areas are measured in *tsimdi* (1 *tsimdi* $\approx$ 0.25 ha). We see that the average farm size is smallest in the Central zone and largest in the Southern zone. The variation in farm size is also smallest in the Central zone. This is evident from the standard errors as well as Gini-coefficients for land distribution. The distribution is most egalitarian in the zone with highest population density (smallest average farm size). The distribution is most skewed in the zone with largest average farm size. The fact that we purposively selected communities with high

and low population densities within each zone may have biased the Gini-coefficients for each zone upwards. Still, we found the Ginis for land distribution to be fairly low. The data on average number of plots per farm for the different zones indicate that the degree of land fragmentation is largest in the Central zone where land is most scarce and lowest in the Western zone.

Average areas per farm under different crops are also presented in Table 3.2.1. We see that teff is the crop with largest average area for all four zones. In the Eastern zone, the average areas of barley and wheat are higher than the average area of teff, however. The barley area is also large in the Southern zone while maize is an important crop in the Western zone. We see that grain crops dominate as the areas of legumes or perennials are very small.

As part of documenting the communities' perceptions about changes in land management over time we asked farmers to respond to questions related to changes in land use pattern, cropping pattern and cropping mixes and the reasons leading to those changes.

Table 3.2.1 Farm size, Gini-coefficients for land distribution and cropping pattern

Variable	**Zone**				**All**
	Central	**Eastern**	**Southern**	**Western**	
Average farm size	2.63	3.72	5.30	4.11	3.95
Standard error	0.12	0.28	0.37	0.26	0.13
Gini-coefficient for land	0.29	0.36	0.41	0.35	
Number of plots per farm	3.16	2.99	3.11	2.42	2.92
Teff area	**0.77**	0.73	**1.55**	**1.27**	**1.08**
Wheat area	0.40	0.79	0.86	0	0.51
Barley area	0.34	**0.96**	1.26	0.02	0.64
Sorghum area	0.40	0.40	0.71	0.36	0.47
Maize area	0.05	0.26	0.2	1.18	0.42
Millet area	0.18	0.09	0.08	0.82	0.29
Oats area	0.05	0.04	0.05	0.08	0.05
Faba beans area	0.22	0.12	0.19	0.16	0.17
Vegetables	0.03	0.02	0.21	0.05	0.08
Cowpea area	0.03	0.09	0.07	0.03	0.05

In almost all the communities, there was changes in land use pattern mainly characterized by conversion of forest land into arable land, conversion of pasture into arable land, arable land in to grazing land (waste land!) and forest land into barren waste land. The major forces behind these changes were the growing need for additional cultivable and grazing land, firewood, construction material, deterioration in land quality and the recurrence of drought.

Table 3.2.2 Importance of crop varieties with changing environment

Crop Types	Varieties[11] disappearing/decreasing importance	Reasons for extinction/decrease in	Varieties being introduced	Reasons for introduction/increased
Teff	kezeze,sergenay, Taf hagy, gondere, dalga bie'ray, monora, goyayto,	late drought, moisture stress, long maturing, pest, lack of	DZ-X-37, digla*, taf tsdia*, mixed teff*, taff dessie, taff mission	early maturing, high yielding, moisture stress tolerant,
Wheat	gerey, kinkina, shehane, are wejarat, dessalegn, felasito, guande,	moisture stress, low yield, vulnerable to rust, long	Enkoy, Canada, Shehan, Paven, Lackech, Tselim* senday,	high yielding, drought and rust tolerant
Barley	gndibo, demhay, tselim segem, ares, geyiho, genbo, berguda,	land shortage, long maturing, moisture stress, fertility loss, change in crop	Saesea, Hanfets	early maturing, moisture stress tolerant, economical....
Maize	berihu, Anji,	long maturing,	Catomani, wedi 40	high yielding,
Sorghum	marte, minaba, kuchbiye, hagla, akoma,,tigrewana, abaldhet, gimbilu,	nutrient depletion, moisture stress and weed,	Shulkit, wedi 40, kuchbiye,amal, gimbilo, wedi mihret	early maturing, high yielding, bird resistant

*Local varieties

Recently there have been numerous of changes from grazing land or community wasteland to forestland due to enclosures and reforestation programs**.**

Through the years, farmers have also developed various land and crop management practices. Fallowing and crop rotation used to be the dominant land management practices in the past. Nowadays, use of external inputs (mostly manure), inter- (mixed) cropping and crop rotation, have a very significant role to play. The major reason for the decreased role of fallowing as a

[11] Note that the same varieties could have different names in different localities. It will be an interesting research area for specialists to document the evolution of this change and what that implies in terms of biodiversity erosion.

feasible land management practice has to do with the series of land redistributions triggered by the land reform of 1975. Land shortages made also fallowing infeasible.

In all communities, farmers witnessed major changes with respect to crop combinations. Some crops have lost their economic importance in the face of land degradation, moisture stress and land shortages. These processes might have led to serious erosion in to the bio-diversity basis of the region. From the group discussions, we were able to document that many local varieties have lost economic importance over time and new varieties, local or improved, are being introduced (see table 3.2.2.). The main reasons for variety extinction or fall in importance include moisture stress, long maturity, decline in productivity, poor soil and change in taste while the reasons for introducing new varieties are demand for short maturing varieties, moisture stress tolerance and high yield.

3.2.2 Plot characteristics

Distance of plots from homestead

The walking distance for all the plots from the household's dwelling place was asked and here is the average distance for all the zones. The average distance for all zones as a whole is 31.075 minutes. Accordingly, the Southern and Central zones had relatively more distant plots.

Table 3.2.3 Average distance of plots (in minutes walk)

Zones	Central	Eastern	Southern	Western	All
Avg. distance	34.3	33.2	37.5	19.3	31.075

Soil type, soil depth, slope access to irrigation water

We tried to characterize farms on the basis of their soil type, soil depth, and slope. Moreover, we classified plots on whether they are irrigated or not. Here below are given the average values for all the variables.

Mekeyih and *walka, hutsa, and mekeyih* and *baekel* are dominant soil types in the Central, Eastern and the Southern and Western zones respectively. Mitiku (1996) identified *walka* as Vertisol, *baekel* as Cambisols and *mekeyih* as luvisols. *Hutsa* stands for sandy soil. *Walka* soils are relatively fertile; *Baekel* soils are extremely low in organic matter, phosphorus and

cation exchange capacity (CEC) while *Mekih* soils are red soils, which are well drained but low in CEC. *Hutsa* soils are poor sandy soils.

Table 3.2.4 Plots categorized according to soil type and irrigation access (in %)

Soil Type	Central	Eastern	Southern	Western	All
Walka	32	26	20	17	24
Mekeyih	39	17	34	44	33
Baekel	20	23	26	20	22
Hutsa	9	34	21	19	21
% of irrigated	0.13	0	0	0	0.13

About 45 % of the plots in all zones are of medium (50-100 cm) soil depth. As far as soil depth is concerned, there seems to exits small differences among the zones except the Southern zone, which has relatively more plots with deep soils.

Likewise, more than half of the plots have 0-5 % slope gradient. More plots in the Southern zone seem to have a slope gradient between 5 - 10 %.

Table 3.2.4 Plots categorized according to soil depth

Soil Depth	Central		Southern	Western	All
Shallow (<50 cm)	41	40	28	43	38
Medium (50-100 cm)	45	43	52	42	46
Deep (>100 cm)	14	17	20	14	33

Table 3.2.5 Slope gradient of plots

Slope	Central		Souther	Western	All
0-5 %	68	77	64	67	69
5-10%	26	21	34	19	26
10-30%	6	2	3	14	6
> 30%	-	-	-	-	-

Irrigation seems to play an insignificant role in agriculture as only 0.13 % of the plots have access to irrigation water.

3.2.3 Fertilizer use

The principal organization involved in the provision of agricultural inputs to farmers in Tigray is the Bureau of Agriculture and Natural Resources Development (BANRD). REST and Disaster Prevention and Preparedness Bureau, the later through its rehabilitation scheme, are involved in the same effort, particularly in the supply of oxen. The BANRD provides farmers with inputs such as fertilizer, improved seeds, herbicides, and insecticides, either on credit basis or for cash, in collaboration with Dedebit Credit and Saving Company and the Agricultural Inputs Supply Corporation (AISCO), a state-owned enterprise.

Based on the information from individual households, it was found out that about half (48.75%) of the households use fertilizer. The average fertilizer use per ha[12] is about 29 kg with an average expenditure of Birr 68.25. The most serious constraint faced by farmers for not using fertilizer is high fertilizer prices. Most farmers feel that the fertilizer prices are so high and they fear that this will contribute to their indebtedness.

Table 3.2.6 Fertilizer use

	Central	Eastern	**Southern**	**Western**	**All**
% using	61	23	37	74	49
Average use of fertilizer per average plot size in all the zones					
DAP (in kg)	23	18	36	42	30
Urea (in kg	24	19	35	37	29
Average use	26	17	24	47	29
Average	68	17	64	124	68

3.2.4 Classification by oxen holding

Oxen are the main source of traction power. Far from being a very important input in the production system, oxen are also an important wealth indicator in the Ethiopian highlands. For this reason we have classified households according to oxen ownership. The variation in oxen holding by zone is presented Table 3.2.7.

[12]The average farm size in Tigray is 3.95 *Tsimdis* (see table 3.2.1).

Table 3.2.7 Average number of oxen per household and percentage distribution of households by oxen category and zone

Variable	Zone				All
	Central	Eastern	Southern	Western	
Average number of oxen per household, 1996/97	0.87	1.09	1.15	1.27	1.10
No oxen	39	41	43	26	37
One ox	39	26	21	33	30
Two oxen	18	20	24	32	24
More than two oxen	4	13	12	9	10
Gini-coefficient for livestock distribution	0.53	0.53	0.55	0.41	

We see from Table 3.2.7 that the average oxen holding size was largest in the Western zone and lowest in the Central zone. Two oxen are required for plowing and it is only 22 to 41 % of the households in the various zones that have two or more oxen. This indicates that the large majority of households is not self-sufficient in traction power and depend on hiring in or exchanging oxen, or they are forced to rent out their land to people with oxen. The Gini-coefficients for distribution of oxen holdings are fairly high, except in the Western zone. The size of the oxen holding may be a better indicator of wealth than the farm size.

We also asked about the current (1998) oxen holding and the purchase and sale of oxen over the last year. The average oxen holding was reduced from 1.10 oxen per household to 0.93 oxen per household and this reduction was found in all zones although it was largest in the Southern zone. It was also mainly those with more than two oxen who have reduced their holdings.

3.2.5 Classification by population density

We selected communities with high and low population densities in each zone. To get a rough picture of the relationship between population density, farm size and size of oxen holdings we calculated average values for high and low population density areas (Table 3.2.8.).

Table 3.2.8 Household size, oxen holding size and farm size in low vs. high population density areas

Variable	Low population density	High population density
Household size 1998	4.86	4.44
Oxen holding 1996/97	1.26	0.89
Farm size	4.67	3.02

As can be seen from the table above, average farm and oxen holdings are lower in densely populated communities.

To get a better idea of the determinants of farm size, we run a simple regression with farm size as the dependent variable, keeping in mind that the direction of causality may be in opposite direction and there may be important variables missing. Egalitarian motives have been important in the land distribution policy in Ethiopia. In 1975, there was a major land reform where land was redistributed from land-rich to land-poor households based on their family size and food needs, considering the land quality as well. Land has been redistributed several times later to adjust for changes in family sizes and provide land to new families. Recently there have been few redistributions, however. It is of interest to see how efficient this past policy has been in providing lasting effects in terms of providing land according to the needs of people. We collected data on household size in 1991 and expect, if the policy has been efficient, that this household size would be an important determinant of farm size also in 1998 as there have been no redistributions of land after 1991. It is also possible that the size of oxen holding (wealth of households) would influence their access to land. Wealthy households may have been more influential and able to obtain relatively larger land shares. There may also be a reverse causality as farm size may determine how large oxen holdings and even family sizes a farm can support if there is limited communal grazing land or off-farm income opportunities. We tried to get data on oxen holdings in the 1980s and 1991 but the quality of these data seemed not to be very good. We are therefore resorting to using oxen holding in 1996/97 in the regression analysis. This variable may be a good proxy variable for oxen holding in the past (assuming wealthy households manage to stay wealthy over time). We also included three dummy variables to distinguish the four zones, one dummy variable for market access (1=good market access, 0=poor market access), and one dummy variable for population density (1=high population density, 0=low population density). The results from the analysis are given in Table 3.2.4.

Table 3.2.9 Determinants of farm size in the survey communities

Variable	Parameter estimate	Standard error	t-value
Intercept	3.59		
Household size 91	0.207	0.0646	3.20***
Oxenholding 96/97	0.385	0.1207	3.19***
Central zone dummy	-1.186	0.372	-3.19***
Eastern zone dummy	0.036	0.362	0.10
Southern zone dummy	1.419	0.367	3.87***
Market access dummy	-0.534	0.272	-1.96*
Population density	-1.526	0.266	-5.73***
R-squared			0.25

Perhaps surprisingly, these variables could explain only 25% of the variation in the farm size. Population pressure is obviously causing a significant intercommunity variation in farm sizes. There is also a significant variation between zones with smaller farm sizes in the Central zone and larger farm sizes in the Southern zone compared to the Western and Eastern zones. There was also a highly significant impact of household size in 1991, showing the effect of land reforms but one would perhaps have expected a larger explanatory power of this variable on the variation of farm sizes. The size of oxen holdings was significant at approximately the same level as household size. If there is close correlation between recent and past oxen holdings, this shows that past wealth mattered for actual land redistribution and this may perhaps explain why household size did not have stronger influence. We cannot rule out the reverse causality that small farms are forced to have smaller oxen holdings, however. Still, there is a lot of unexplained variation in farm sizes. Variation in land quality may be one of the reasons for this. However, the egalitarian principles in relation to distribution of land of different qualities within communities should have reduced this variation within communities.

3.2.6 Profitability and riskyness of crops

We asked farmers to rank the crops they sold according to their profitability and riskyness. The responses therefore give an indication both about which crops are important for sale and the risk in relation to the production of these crops in the different zones in Tigray.

Table 3.2.10 important crops grown for sale and their relative profitability ranking by zone (rank=1 is the most profitable)

Crop	Zone				All
	Central	Eastern	Southern	Western	
Teff, No. of responses	78	68	82	80	308
Teff, Average score	1.85	2.18	1.79	1.18	1.73
Wheat, No. of responses	45	52	46	1	144
Wheat, Average score	3.02	2.37	2.02	1	2.45
Barley, No. of responses	40	87	69	1	197
Barley, Average score	2.98	2.57	2.51	4	2.64
Maize, No. of responses	9	44	9	78	140
Maize, Average score	3.56	2.43	2.22	2.38	2.46
Sorghum, No. of resp.	39	23	41	25	128
Sorghum, Average score	3.13	3.22	2.22	2.60	2.75
Millet, No. of responses	18	11	3	34	66
Millet, Average score	1.94	2.64	2.33	1.79	2.00
Oats, No. of responses	13	5	1	21	40
Oats, Average score	3.38	1.80	3.00	3.38	3.18
Faba beans, No. of resp.	34	15	7	11	67
Faba beans, Average score	2.47	3.13	1.57	2.55	2.54
Vegetables, No. of resp.	11	3	1	6	21
Vegetables, Average score	2.00	3.00	5.00	1.17	2.05

The number of responses is an indicator of how frequently the crop is grown for sale in the different zones while the average score indicates how profitable the crop is considered to be (as a cash crop). There are some clear differences between the zones. If we look at the total number of responses and scores, it is clear that teff is the most common and most profitable cash crop followed by wheat, maize and barley. Millet is considered as a good cash crop in the Western zone. Crops grown for cash are predominantly grain crops. Only a few grow legumes or vegetables for sale.

In Table 3.2.11 the crops grown for sale are ranked according to riskyness with average scores by zone. Overall, for all areas, teff is also the least risky crop, while those growing them consider vegetables, oats and maize the most risky crops.

Table 3.2.11. Ranking of cash crops according to riskyness (rank=1 is the most risky).

Crop	Zone				All
	Central	Eastern	Southern	Western	
Teff	2.97	2.57	2.17	2.87	2.64
Wheat	2.49	2.54	2.04	2.00	2.36
Barley	2.28	2.20	1.75	1.00	2.05
Maize	1.67	2.32	1.88	1.76	1.94
Sorghum	2.14	2.96	2.07	1.60	2.16
Millet	2.50	3.09	2.33	1.94	2.30
Oats	1.69	3.40	4.00	1.19	1.70
Faba Beans	1.88	1.87	3.86	1.82	2.08
Vegetables	1.82	1.00	3.00	1.00	1.52

3.3. Village characteristics

As indicated, we tried also to complement the household survey with a community survey using a semi-structured questionnaire addressed to key informants (*Baito* members, elders, farmers' leaders, BANRD experts and *wereda* administrators and NGO workers). The objective of the study was to capture qualitative information on historical perspectives of the problems and changes in infrastructure, settlement and migration history, changes in land use and cropping patterns, tenure pattern and institutional aspects of the on-going soil and water conservation practices.

3.3.1. Altitude

The altitude of the study areas ranges from 1750 to 2750 m.a.s.l. Areas between 1500 and 2500 m.a.s.l are categorized as intermediate highland and those above 2500 m.a.s.l are highland. Fourteen communities of the study areas belong to moderate highland while the remaining two belong to highland (See Appendix IV). This variation in altitude does have an impact in terms of rainfall distribution and the type of crops grown.

3.3.2. Distance to the nearest market and wereda town

The average distance to the nearest market for all communities is 73.13. The distance ranges from 15 minutes in the nearest to 150 minutes in the most distant, with a standard deviation of 44.1. The distance to the *wereda* town (district) is 113.4 minutes (SD 92.14). It ranges from 15 minutes in the nearest to 300 minutes in the most distant. Most of the communities do not have access to transport facilities. Hence, pack animals and human power remain the most important means of transport from villages to market and *wereda* centers.

Table 3.3.1 Distance to the nearest market and wereda town

Zone	Tabia Name	Distance to nearest market	Distance to *wereda* town
Southern	Hintalo	30	60
Southern	Samre	15	15
Southern	Mai Alem	45	120
Southern	Mahbere Genet	60	150
Eastern	Hagere Selam	150	300
Eastern	Kihen	120	120
Eastern	Genfel	30	30
Eastern	Emba Asmena	90	90
Central	Seret	30	30
Central	Debdebo	30	30
Central	Mai Keyahti	120	120
Central	Adi Selam	120	300
Western	Hadegti	90	90
Western	Tseada Ambera	120	120
Western	Mai Adrasha	30	30
Western	Adi Menabir	90	90
Average		**73.13**	**113.4**

3.3.3. Infrastructure

In the sixteen communities of the study site, there are 15 schools, 9 dirt roads, 6 clinics, 10 grinding mills, 12 water points, 5 nursery sites, 1 power generator and one kindergarten. Most of the facilities are established after 1990. However, almost half of the schools were established in the 1970s and before. The main roads passing through some of these communities were established in the early 1940s**.**

Though there is slight improvement in the availability of such public services, they are far from adequate. This is especially true with regard to water sources and clinics. With in the *tabias* there are *kushets*, which do not have access to potable water.

Table 3.3.2 Infrastructure

Types of infrastructure and year of establishment								
Tabia Name	**School**	**Clinic**	**G. Mill**	**Road**	**Drinking water**	**Nursery**	**Power supply**	**others**
Hintalo	1958	1958	1997	-	1997	-	-	-
Samre	1946 1971	1970, 1982	1960, 1993	1975	1995	-	1996	-
Mai Alem	1997	-	1994	-	1990	-	-	-
Mahbere Genet	1993	-	1990	-	1995	-	-	-
Hagere Selam	1976	old, 1993	1996	1995	-	1,993**	-	-
Kihen	1997	-	-	1943*	1983	1993	-	-
Genfel	1989	-	-	1995	n.a.	-	-	-
Emba Asmena	1977	-	1996	1993	n.a.	1993**	-	-
Seret	1972, 1996	1995	1993	old, 1995	1994	1993	-	1995***
Debdebo	1965	1993	n.a	old, 1995	1994	1992	-	-
Mai Keyahti	1968	1997	1996	-	1995	-	-	-
Adi Selam	1995	-	-	-	1996	1994***	-	-
Hadegti	1994	-	1995	-	-	-	-	-
Tseada Ambera	-	1980	-	-	1994	-	-	-
Mai Adrasha	1996	-	n.a	1951	-	1968, new	-	-
Adi Menabir	1990	-	-	-	-	1993	-	-

* main road ** co-operative nursery *** Kindergarten **** Community nursery n.a. not available

3.4. Market characteristics and property rights

We characterize the market institutions in the surveyed communities based on farm household participation and perceptions of these markets. We expect there to be significant market imperfections. These imperfections may include missing markets, rationed markets, seasonal markets, thin markets, interlinked markets, etc. due to high transaction costs, imperfect information and material conditions (Biswanger and McIntire 1987). The actual and potential functioning of markets has important implications for household food security and decision-making, including natural resource management, and therefore also for policy.

3.4.1 Credit markets

In Tigray, the Dedebit Rural Credit and Savings Scheme have provided rural credit since 1994. Dedebit extends short-term credit for agricultural input purchases as well as credit for petty trading to enable creation of self-employment, especially among unemployed young people and women. Loan sizes range between EB 50 and 5000 and the loan period is a maximum of one year. Dedebit follows the eligibility criterion of "the household being able to pay back". In principle, all productive loans that enable the borrower to generate income so that he/she can repay the loan are eligible (Gebremedhin, et. al., 1996). This is usually measured by whether the household is male-headed, or at least has adult male members; whether the household has land and its willingness and capacity to cultivate the land. Though women and the poor are expected to benefit from the service, the eligibility criteria seem to favour male-headed households and the relatively less poor. There are no material collateral requirements to credit; security is in the form of peer group monitoring. Borrowers form groups of seven people and bear collective responsibility and will have to repay collectively in case one of them defaults. Lending activities, including loan eligibility assessment, loan approval, collection, etc. involve the community and *tabia baitos*, the local administrative bodies. This has by far supported Dedebit in significantly reducing loan defaults.

Dedebit has 120,000 regular clients and in 1997 it extended agricultural input loans to 220,000 farmers. Credit in-kind, in collaboration with the Bureau of Agriculture, is the dominant form of activity.

We asked people whether they have had access to credit over the last five years, the source and the purpose of this credit. The information is summarized in Table 3.4.1.

We see that 172 out of 398 households have not obtained credit for any purpose over the period 1993-98. The major sources of credit have been the Bureau of Agriculture and REST. Informal credit from relatives and neighbors is rare as only 4% of the households stated to have obtained this type of credit over the period. The major purpose of credit has been to buy farm inputs in the form of fertilizer and seeds. Twenty five households had obtained credit for purchase of oxen. Most of these households were located in the Eastern zone. It appears to be very difficult to obtain credit for business/trading or consumption. Use of credit for farm inputs was more common in the Western and Central zones, which also have the highest agricultural potential (highest rainfall) and lowest risk in farming.

Table 3.4.1 Access to credit by zone, source and purpose during 1993-98

Source of credit	Zone				All
	Central	Eastern	Southern	Western	
Bureau of Agriculture	45	14	28	51	138
REST	27	33	18	16	94
Private	3	2	10	0	15
No Access	35	52	51	34	172
Fertilizer/seed	56	23	34	66	179
Seed	1	5	4	0	10
Oxen	3	18	3	1	25
Other animals	2	0	3	1	6
Trading	1	3	1	0	5
Consumption	2	3	3	0	8

We also asked the current access to credit for various purposes, also allowing for comments on why access was denied and concerns of those with access to credit. The information is summarized in Tables 3.4.2 and 3.4.3

Table 3.4.2 Current access to credit for various purposes by zone

Purpose of	Access	Zone				All (%)
		Central	Easter	Southern	Wester	
Farm inputs	No	57	66	68	54	245(62)
	Yes	41	34	32	46	153
Oxen	No	77	69	79	86	311(78)
	Yes	21	31	21	14	87
Business	No	72	74	69	88	303(76)
	Yes	26	26	31	12	95
Consumption	No	74	75	75	87	311(78)
	Yes	24	25	25	13	87
Family events	No	77	82	81	87	327(82)
	Yes	21	18	19	13	71

We see from Table 3.4.2 that 62% of the households considered themselves to not to have access to credit for purchase of farm inputs and 78% considered themselves to not have access to credit for purchase of oxen. The share of the households with access to credit for business, consumption or family events was also very low, 18-24%. The large majority of households are therefore rationed out of credit markets. Some of the respondents gave reasons

for being rationed out or not being interested in credit (while having access). These responses are summarized in Table 3.4.3.

A considerable share of those with access to credit (about half) stated that they were not interested in obtaining credit. Forty five of the households that stated not to have access to credit said it were because they still have unsettled debits. Poor rainfall and poor yields last season may be the reason for that. We may conclude that credit is not an important means of consumption smoothing in Tigray.

Table 3.4.3 Reasons for no access to or no interest in having credit for households having access to credit

Reasons for no access	Zone				All
	Central	Eastern	Southern	Western	
Has unpaid credit	13	10	9	13	45
No capacity to pay back	12	9	6	11	38
Poor/Old/Sick	9	21	7	12	49
No credit service	0	2	1	6	9
Other	5	6	4	6	21
No need/no interest	8	14	8	5	35
Fear of credit	3	11	3	0	17
High interest rate	8	0	2	6	16
Other	1	1	3	1	6

3.4.2 Land tenure and land markets

The land tenure issue has been one of the most contentious issues in Tigray in particular and Ethiopia in general. Since 1975, land is the property of the state, and it may not be sold or mortgaged. Farmers are granted only usufruct rights. The regional land policy, which was promulgated in 1997, guarantees, in principle, the right of individuals to improvements they make to land, including the right to bequeath, transfer, remove, or claim compensation for such improvements if the right of use expires. Moreover, it prohibits further redistribution of land. However, the current policy does not address some important issues. Given the scarcity of land, and that further redistribution is prohibited, it is not clear how peasants' right of free access to land can be assured in practice given the increasing problem of landlessness. To reveal some of the perceptions in relation to this issue we included some questions in the survey:

- Whether they fear that they will lose land due to land distribution in the future (even if land redistribution is ruled out)
- Whether this fear affects their land management/investment strategies
- Whether land conflicts are solved in a good way in the community
- Whether violations of land use restrictions are common in the community.

The responses are summarized in Table 3.4.4.

Table 3.4.4 Perceptions on land tenure security and land conflicts

Question	Response	Zone				All
		Central	Eastern	Southern	Western	
Fear of loss of land	Yes	56	45	42	61	204
	No	43	54	58	38	193
Does the fear affect land management?	Yes	3	8	20	13	44
Land conflicts solved in a good way?	No	0	1	10	25	36
Violations of land use restrictions common?	Yes	0	0	4	0	4

We see from Table 3.4.4 that more than half of the surveyed households fear future land redistributions but only 11% indicate that this fear affects their land management and among these again only two stated clearly that it affected negatively their investment in land. There appeared to be no serious land use conflicts or violations of land use restrictions in the Central and Eastern zones. In the Western zone, however, 25% of the households were critical to the way such conflicts were resolved. Only in the Southern zone were there few households, which reported violations of land use restrictions. It may generally be concluded, therefore, that the tenure system functions quite well and that the tenure insecurity that many still may feel seems not to affect land management in a negative way. Reasons in relation to the fear or lack of fear for land redistribution were also recorded for some households. These are summarized in Table 3.4.5 below.

Increasing landlessness is apparently both a cause of fear of future land redistributions as well as an important reason why many do not fear but rather hope for more land redistributions because they or their children have little or no land. Some even stated their willingness to share their land with others. Some express that they accept the government decisions on this

while very few think that there will be no more land redistributions although that is the current official policy.

Table 3.4.5 Reasons for fear or no fear of future land redistribution

Response by those fearing/not fearing	**Zone**			
	Central	**Eastern**	**Southern**	**Western**
Increasing landlessness	0	4	7	0
Increasing population pressure	1	0	6	0
Fear of loosing land	3	5	7	3
Loss of income, become poorer	3	2	1	0
Land shortage	3	3	5	1
Those not fearing:				
More equitable distribution	0	0	2	3
All should have a share	4	0	0	0
Landless can get land	13	13	5	3
I can share with others	0	0	1	7
It will go to my children	4	10	9	0
I will have a share/ I have a small area/ I will not loose land	8	9	7	2
I am too old	0	3	2	0
I accept government decision	9	2	10	5
Land will no more be redistributed	0	4	2	0

The variation in size of oxen holdings within communities creates incentives for exchange of oxen as well as land through rental contracts, usually of short duration. The extent and forms of rental contracts for land are summarized in Table 3.4.5.

Table 3.4.6 Rental contracts for land, interlinkage arrangements, and sharing rules

Contract arrangement	**Respo**	**Zone**				**All**
		Central	**Eastern**	**Southern**	**Western**	
Share contract	Yes	24	31	60	38	153
Fixed rent	Yes	1	0	9	0	10
Input sharing	Yes	8	1	5	2	16
Credit linkage	Yes	0	1	1	0	2
Share of output to owner	0.25	0	15	24	19	58
	0.3	2	0	0	5	7
	0.35	0	0	1	1	2
	0.5	20	16	36	13	85
	0.6	1	0	0	0	1
Land conservation	Owner	16	7	6	6	35
	Renter	25	33	62	33	153

We see from Table 3.4.6 that share tenancy contracts are common. Typically, poor households without oxen are forced to rent out their land to richer households with oxen. One could perhaps expect that the poor owners are more risk averse than the renters are and that this would pull in direction of fixed rent contracts in a risky production environment but this appears not to be the case. Sharing of output and risk appears to be the dominant solution. There is some variation in the share going to the owner (0.25-0.6), but 0.5 is most common. Shares as low as 0.25 are quite common in the Southern, Western and Central zones. A higher share on average goes to the owner in the Central zone where land is most scarce. Renting of land is most common in the Southern zone where both oxen and land distributions are most skewed. The quality of land may also affect the share going to the owner. We also see that there was some variation in who was responsible for conservation of the rented land, but in most cases, it was the responsibility of the renter.

The number of plots rented in or out is summarized in Table 3.4.7.

Table 3.4.7 Number of plots rented out or in by households

	Zone				All
	Central	**Eastern**	**Southern**	**Western**	
Rented in	3	10	27	3	43
Rented out	33	44	85	40	202

There was a large discrepancy between the number of plots reported to have been rented out and reported to have been rented in. This may be due to underreporting of rented in plots. We found that 18% of the owned plots were rented out on average. We see that renting out was most common in the Southern zone where land and oxen distribution was most skewed.

From the informal discussions, it was reported that the value of land has increased during recent years. Shares are mostly between one third-half in contrast to a quarter, which was common before the land redistribution of 1975. Moreover, cash advance payment is becoming a common practice, although we did not try to explicitly capture this on our household survey. Lastly, crop residue, an important source of animal feed, which used to be taken by the sharecropper, is now likely to be shared between the landowner and the sharecropper. There are webs of well-developed informal contractual arrangements that regulate such sharecropping arrangements. Sharecropping rates differ according to land quality, lowland vs. highland land, irrigated or non-irrigated land and the contribution of the shareholder in terms of additional input and better management. We also found that the one

having the responsibility to conserve land also has the right to use the straw and in many cases has grazing right on this land, a right which may not be strictly exclusive.

3.4.3 Other interlinkage (exchange) arrangements

In Table 3.4.8, we present the extent of other forms of exchange among households. Such forms of exchange include exchange of oxen and labor, more specifically, oxen for labor, oxen for fodder, grazing for plowing, labor for food and labor exchange.

Accordingly, sharing of oxen is even more common than share tenancy for land and it is most common in the Western zone and least common in the Southern zone where share tenancy for land was most common. Predominantly it is households with one ox, which share their ox with other households also having one ox in order to plough with a pair of oxen**.** Exchange of oxen for fodder or grazing for plowing was also very common ways of resource redistribution. Human labor was less frequently a part of these forms of interlinkage arrangements.

Table 3.4.8 Other forms of market interlinkages

Type of exchange	Zone				All
	Central	Eastern	Southern	Western	
Sharing of oxen	45	35	23	58	161
Oxen for labor	3	1	4	0	8
Oxen for fodder	19	19	17	2	57
Grazing for	23	9	17	20	69
Labor for food	2	1	1	1	5
Labor exchange	6	1	0	8	15

3.5 Perceptions of the problem of land degradation

We asked the households to indicate which types (if any) of land degradation they experienced and to rank these problems according to severity (most severe has rank 1). The overall responses are summarized in Table 3.5.1.

Table 3.5.1 Ranking of land degradation problems according to importance (number of responses in rank category)

Type of Problem	Rank 1=most important	Rank 2	Rank 3
Soil erosion	293	35	10
Gully Formation	36	255	14
Nutrient Depletion	34	40	47
Deforestation	3	11	43
Overgrazing	0	7	26
Moisture stress	17	0	0
Loss of biodiversity	0	0	1
No problem	2	41	59
Other	9	0	0

It is clear from the table that soil erosion is perceived as the most serious land degradation problem, followed by gully formation, nutrient depletion and deforestation. It is perhaps surprising that overgrazing was considered less of a problem in this type of semi-arid area where livestock has such a significant role. It is possible that farm households underestimate the significance of less visible problems like nutrient depletion and overgrazing. In addition, loss of biodiversity was not a concern among farm households in contrast to the society's view that points that out as one of the most serious problems

We also asked whether households had experienced yields changes (increase or decrease) over time, and in each option, what they thought were the reasons for increase or decrease in yields. The responses are summarized in Table 3.5.2.

The responses indicate that over half of the respondent households have experienced yield declines. Many seemed to have a rather short time perspective in mind when they responded and indicated yield variation to be induced by variation in rainfall, perhaps also indicating their difficulty in separating the effects of rainfall variability from other effects. Only 22 responded that yields had clearly declined due to land degradation or lack of use of fertilizer (nutrient depletion). Those who experienced yield increase believe conservation investments, fertilizer use, extension advice and irrigation as important reasons.

The community survey seems to strengthen these observations. We asked about how farmers view changes in yield in the1980s and 1990s and what reasons led to such changes. In general, from the group discussions it came out that yield per hectare for the major crops have decreased over time. This is explained by shortage of land, recurrence of drought and

constraints related to land degradation and loss of bio diversity. Interestingly enough, however, it was also pointed out that yield increases have been made possible, especially in the adequate moisture areas, through improved management and use of external inputs, particularly fertilizer. Their major concerns are fertilizer prices and recurrence of drought.

Table 3.5.2 Perceptions of yield changes and their causes

Yield Change	Reasons for Change	Number of responses
Yield decline	All	223
	Inadequate rainfall	188
	Land degradation	19
	Did not use fertilizer	3
	Hailstorm	6
	Excess rainfall	2
Yield increase	All	173
	Conserved land	58
	Use of fertilizer	29
	Improved extension support	29
	Irrigation	9
	Use of improved seed	1
	Adequate rainfall	45

We also asked households to indicate and rank what they thought were the most important causes of the most important land degradation problems that they experienced. We have chosen to categorize causes in relation to the main resources (labor, cash, land, and knowledge) of farm households. The causes related to land management are of the local spatial externality type. We have summarized this information in Table 3.5.3. We have only included the most and second most important causes in the table.

Table 3.5.3 The most important causes of the most important environmental problems as perceived by the farm households

The most important causes for each of the environmental problems (number of households ranking the causes as most important (=1) and second most important (=2)	**Environmental Problems**									
	Soil erosion		**Gully formation**		**Nutrient depletion**		**Deforestation**		**Over-grazing**	
	1	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
Shortage of labor	152	54	140	74	39	25	23	8	5	7
The cost of reducing the problem is larger than the benefit	85	112	67	97	32	30	17	18	4	6
Lack of cash	33	45	30	14	17	7	2	1	5	3
The source of the problem is in the communal land	14	61	14	57	10	9	6	10	12	3
The source of the problem is in the land of other farmers	3	18	9	28	7	5	2	1	2	5
Lack of knowledge about how to tackle the problem	48	2	36	5	6	1	1	1	4	0

We can see from Table 3.5.3 that shortage of labor was ranked as the most important cause of soil erosion, gully formation and nutrient depletion. However, many farmers also ranked high costs relative to benefits of tackling the problems as an important reason for the persistence of these problems. Many households also ranked lack of knowledge to solve these problems as an important cause. The causes of the two most important problems, soil erosion and gully formation, were also indicated to be due to local spatial externalities as they were perceived to originate in communal land or the land of other farmers. Overgrazing, although not perceived to be very important, may be more related to the management of communal lands.

3.6. Responses to the problem of land degradation

The farm households were asked what they considered the most important solutions to the environmental degradation problems that they faced. These were solutions that farmers could do themselves. They were asked to rank these solutions according to their importance. The solutions were defined in seven categories and the most important solution was given a score of seven, the second most important a score of six, etc., while unranked solutions were given zero score. The average scores for the different solutions are presented in Table 3.6.1.

Table 3.6.1 Ranking of the most important solutions to the environmental problems

Solutions	**Zone**				**Average**
	Central	**Eastern**	**Souther**	**Western**	
To maintain conservation structures	5.0	5.2	5.5	4.5	5.0
Cooperate with neighbors	4.5	5.5	2.9	3.9	4.2
Plant trees	4.0	3.4	3.5	3.4	3.6
Build new conservation	1.3	1.1	3.9	1.0	1.8
Buy fertilizer	2.0	0.3	1.9	2.3	1.6
Control animals	0.5	0.1	0.4	0.3	0.3

We see that maintenance of existing conservation structures was perceived as the most important thing that farm households could do themselves, while building of new structures had a considerably lower rank. This is because there has been a lot of building of new conservation structures in Tigray over the last five to ten years. Cooperation with neighbors was considered the second most important solutions. This may indicate both that cooperation is seen as essential to solve the problems and that farm households have a cooperative attitude that is one of the preconditions necessary for collective action to work. Planting of trees also received a relatively high average score as something farm households could do themselves. Purchase of fertilizer received a lower score.

There are some differences between the responses in the four zones. Building of new conservation structures was considered much more important in the Southern zone than in the other zones while cooperation with neighbors was considered less important in this zone than in other zones. Purchase of fertilizer as a solution was considered much less important in the Eastern zone than in the other zones, probably due to the drier climate making fertilizer use less profitable and more risky.

3.7 Perceptions of the Benefits of Conservation

The households were asked to rank the most important effects of conservation efforts on their farm and on their community. The average ranks of the different effects are presented in Table 3.7.1 for the farm and community by zone.

Table 3.7.1 Ranking of the most important effects of conservation efforts on the farms and in the communities by zone

The Ranked Problems (maximum= score=6) **On Farm**	**Zone**				**Avg. ran**
	Central	**Eastern**	**Southern**	**Western**	
Soil formation leading to higher yields	5.9	5.9	5.7	5.6	5.8
Reduced flood problem, reduced gully formation and risk	3.3	3.6	3.1	3.2	3.3
Less moisture stress and more stable yields	2.8	1.7	3.6	1.7	2.4
More vegetative cover and better access to fuel wood	1.1	1.2	0.4	1.9	1.2
Less migration to other areas	0.3	0	0.3	0.1	0.2
Better food security in the village	0.1	0	0.1	0	0.1
In the Community					
Soil formation leading to higher yields	5.4	5.8	5.1	5.4	5.4
Reduced flood problem, reduced gully formation and risk	2.2	2.6	2.6	2.5	2.5
Less moisture stress and more stable yields	1.7	1.3	2.6	1.2	1.7
More vegetative cover and better access to fuel wood	1.3	0.8	1.2	1.5	1.2
Less migration to other areas	1.4	1.4	0.3	1.6	1.2
Better food security in the village	0	0	0.2	0	0.1

We see from Table 3.7.1 that soil formation leading to higher yields is seen as the most important effect of conservation investments. It may appear surprising that this seems to have very little impact on food security on the farm and in the communities as these effects have received very low scores. This may be because the effect on yields is not sufficient to fill the

large food deficit gap and the growing gap due to population growth. Reduced flood problem and reduced risk of gully formation was ranked as the second most important effect of conservation investments while reduced moisture stress and more stable yields was ranked as the third most important effect. Improved vegetative cover and better access to fuel wood was ranked as the forth most important effect. At the community level, reduction in migration to other areas was ranked as equally important as the improvement of vegetative cover and access to fuel wood while less migration had a very low rank at the farm level. There were fairly small differences across zones.

3.8 The importance of private incentives and community cooperation to conserve land

We asked where in the village the problem of land degradation was perceived to be largest, in the private land or in the communal land. Perhaps surprisingly, as many as 308 (81%) of them responded that the problem was largest in the private land while only 108 (28%) stated it was largest in the communal land. This implies that 34 (9%) of the respondents indicated that the problem was equally important in private and communal land as 382 responded to the question. These responses may indicate that common property management functions well in Tigray. Community efforts on conservation gave first priority to rehabilitation of communal lands while rehabilitation of private lands have come later but is still incomplete. These responses may indicate also that private incentives are perceived to be insufficient to conserve private land. At least they indicate the households in Tigray have a preference for solving the problems by working together (by habit). Mass mobilization of labor for various purposes has been going on for quite some time. We return to this below.

We asked whether the households expected the community to solve the problem on their private land. As many as 366 responded that they expected the community to solve the land degradation problem in their private land while only 30 responded that they did not expect the community to do so. We may wonder why community action is considered so crucial. We asked what the households needed assistance for from the community leadership (*baito* and *kushet*). The types of assistance were divided in technical assistance, conflict resolution, labor mobilization and other reasons (to be specified). The responses are summarized in Table 3.8.1.

Table 3.8.1 Types of assistance needed from the *baito/kushet* to reduce the land degradation problem

Type of Assistance	Zone				Average (%)
	Central	Eastern	Southern	Western	
Technical assistance and labor mobilization	60	58	45	59	56
Technical assistance	23	28	46	8	26
Technical assistance and conflict resolution	14	10	4	31	15
Technical assistance and other assistance	0	1	1	0	1
Conflict resolution and labor mobilization	1	0	0	1	1
Conflict resolution and other assistance	1	0	0	0	0
Labor mobilization	1	1	2	1	1
Other assistance	0	0	1	0	0
No assistance	0	2	1	0	1

We can see that 56% of all the respondents demanded both technical assistance and assistance with labor mobilization. Twenty six percent demanded technical assistance only, while 15% demanded a combination of technical assistance and conflict resolution. All the other combinations of assistance gave very low responses. It clearly illustrates that technical assistance is in highest demand but the large majority indicate that technical assistance alone is insufficient. It should be combined with assistance in labor mobilization or conflict resolution according to 71% of the respondents. There was some variation among zones. The combination of technical assistance and conflict resolution was stated to be more important in the Western zone (31% of the respondents) while only 4% stated this combination to be important in the Southern zone. In the Southern zone they also placed less emphasis on the need for labor mobilization in combination with technical assistance as many as 45% in this zone indicated that only technical assistance was needed.

We asked how much labor the households have contributed in the mass mobilization during the last year. Adult persons, males and females, (18-60 years old) are supposed to contribute one-man month each per year, equivalent to 20 working days per person per year. This may be seen as a tax on the labor force of the households. It implies that labor is taxed at a flat rate and that labor-rich households pay more tax than labor-poor households do. If all households

benefit equally from the work done through this mass mobilization scheme, it has an equalizing effect of reallocation of resources from (labor) rich to (labor) poor households. The other possible effect is that the time could have been allocated for other purposes if the individual households were to decide themselves. It is possible that the program forces up the level of investment in these communities even at the private land, at least in the land of labor-poor households. We asked a few questions to investigate further, on what types of work mass mobilization has been used for during the last year, the motivation for participation in mass mobilization activities, the size of the contribution, and problems faced in relation to the mass mobilization.

The type of activities households were involved in during mass mobilization last year is presented in Table 3.8.2.

Table 3.8.2 Types of mass mobilization activities during last year (EC 1989)

Types of Activities	**Zone**				**Average (%)**
	Central	**Eastern**	**Southern**	**Western**	
Conservation on communal land	62	51	48	27	47
Conservation on private	28	17	41	14	25
Road construction	0	0	4	1	1
Other work	3	19	14	2	10
All activities	93	87	107	44	83

We see from Table 3.8.2 that 83% of all households stated to have participated in one or more conservation activities. Participation in conservation of communal land was most common (47%), followed by conservation of private land (25%), and other work (10%), while only 1% were involved in road construction. Overall, participation was largest in the Southern zone where obviously some participated in more than one type of activity. The participation in mass mobilization activities was much lower in the Western zone than in any of the other zones. Mass mobilization for conservation of private land was most common in the Southern zone.

We asked about the level of motivation in relation to participation in the mass mobilization activities. The responses are summarized in Table 3.8.3.

Table 3.8.3 Level of motivation

Level of motivation	Zone				Average
	Central	Eastern	Southern	Western	
Very high	32	27	27	15	25
High	47	45	38	51	45
Medium	2	1	11	0	4
Low	6	4	11	3	6
No response	13	23	13	31	20

We see that the large majority of households are (very) highly motivated for participation in the mass mobilization activities. It is possible that some of those who did not respond feared to give their honest (critical) response, but still as much as 70% stated to be highly motivated. The larger share, which did not respond in the Western zone, may not have participated in mass mobilization as a larger share in this zone appeared not to participate in such activities (Table 3.8.2). This indicates that these activities really have a strong bottom-up support.

We also asked about the attitudes towards the current level of mass mobilization. The responses are presented in Table 3.8.4.

Table 3.8.4 Attitudes towards the current level of mass mobilization (20 days/person)

Attitude	Zone				Average (%)
	Central	Eastern	Southern	Western	
Too little	4	16	18	0	10
Suitable amount	75	53	54	65	62
Too much	7	8	12	4	8
Depends on need	0	0	4	0	1
No response	14	23	12	31	20

We see from Table 3.8.4 that 62% of the households think that the current level of mass mobilization is suitable. Only 8% think it is too high, while 10% think it is too low. Twenty percent did not respond. There were more respondents thinking that this was a too low level in the Southern and Eastern zones. The responses strengthen the impression that the program has good bottom-up support and the level of labor tax is appropriate. It illustrates that households feel they benefit from the program.

To get a better idea about how they felt they had benefited from the mass mobilization program on their own farm, we asked about the types of activities that have taken part, and how they ranked these according to their importance. There were seven categories and the highest rank was seven (most important activity). The responses are summarized in Table 3.8.5.

We see from Table 3.8.5 that building of stone terraces is seen as the most important effect of mass mobilization on the private land, followed by gully control and building of soil bunds. Protection against floods, tree seedlings and building of terraces were also ranked but as less important than the other activities. Gully control was considered to be particularly important in the Western zone. Building of soil bunds was given a particularly high rank in the Southern zone.

Table 3.8.5 Ranking of benefits on private land from mass mobilization activities

Mass Mobilization	Zone				Average
	Central	Eastern	Southern	Western	
Building of stone terraces	6.5	4.5	5.5	4.9	5.4
Building of soil bunds	2.5	3.9	5.1	2.6	3.5
Building of terraces	1.0	1.1	2.2	1.2	1.4
Protection against floods	1.9	1.5	1.5	1.9	1.7
Gully control	4.1	3.0	2.7	5.0	3.7
Tree seedlings/planting	1.8	1.6	1.3	1.7	1.6

The households were asked about what they considered the most important problems they faced in relation to participation in the mass mobilization program. This participation was regarded to be in conflict with other uses of their time, which were considered important for them. The responses are summarized in Table 3.8.6.

Table 3.8.6 Activities in conflict with participation in mass mobilization

Frequency of	Zone				Average
	Central	Eastern	Southern	Western	
Looking after animals	0.42	0.39	0.42	0.24	0.37
Domestic work	0.54	0.43	0.33	0.46	0.44
Business activities	0.09	0.05	0.31	0.11	0.14
Other	0	0.01	0.01	0	0.01

We see from Table 3.8.6 that a considerable share of the households considered the mass mobilization to cause problems for them in terms of diverting their labor away from important activities like looking after animals and domestic tasks. In the Southern zone, it appeared also to be in conflict with various types of business activities, which more than 30% of the households indicated to be involved in.

3.9. Food Security and the Role of Food-For-Work Activities

The households were asked about how they try to prevent negative effects of drought, i.e. what types of insurance systems they were using. They were asked to rank a number of alternatives according to their relative importance. We have summarized the responses in Table 3.9.1 for the four highest ranked insurance methods as stated by the households in each of the four zones. The responses in the table indicate the percentage of the households in the zone ranking the insurance method at the stated level.

Table 3.9.1 Ranking of insurance systems used by households by zone

Strategies	RANK 1				RANK 2				RANK 3				RANK 4			
	C	E	S	W	C	E	S	W	C	E	S	W	C	E	S	W
Drought resistant crops	53	51	48	58	20	25	28	23	15	6	0	9	5	4	3	1
Drought resistant varieties	10	16	3	13	54	41	32	51	15	14	24	10	4	3	8	2
Short duration	34	30	39	28	11	20	20	18	50	38	24	47	0	1	3	0
Diversify crop production	1	1	2	1	2	1	0	0	1	11	3	1	11	8	2	4
Avoid use of risky inputs	0	0	0	0	0	2	0	1	2	2	1	0	9	8	5	10
Avoid use of expensive inputs	0	0	0	0	0	0	0	0	0	0	3	0	0	1	1	2
Use stone mulch	0	0	0	0	0	0	0	0	2	3	6	0	0	1	5	0
Stone	0	0	0	0	4	0	0	1	5	11	1	10	9	12	5	11
Water harvesting/ irrigation	0	0	3	0	5	4	13	0	3	0	6	3	8	8	20	8
Other land	1	0	2	0	0	1	0	0	2	1	5	0	8	6	3	2
Animals as	0	0	0	0	0	2	0	0	0	4	1	1	2	3	1	3
Exchange of animals	0	1	0	0	1	0	2	0	0	0	0	0	0	3	2	0
Planting of trees	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0
Cash/Bank	0	0	0	0	2	1	1	3	3	5	4	9	12	11	1	16
Off-farm activities	0	0	2	0	0	0	0	1	0	1	0	1	16	14	9	4
Rely on food aid	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2

*C=Central zone, E= zone, S=Southern zone, W=Western zone.

We see from Table 3.9.1 that the choice of drought resistant crops and short duration crops and varieties were considered the most important risk reduction strategies, followed by water harvesting and investment in irrigation. Other strategies include investing in soil

conservation, while using savings of cash and animals only appeared as third and forth rank for some of the households. Very few also ranked off-farm income higher than forth rank. This may also be because some of these activities are primarily chosen for other reasons than as an insurance system, which thus may be just a by-product.

We also asked households about their ex post coping (risk coping strategies) activities in the cases of moderate and severe droughts. They were asked to rank these coping activities according to priority (Rank 1= Priority 1). The responses for the case of a moderate drought are presented in Table 3.9.2 and the responses to a severe drought are presented in Table 3.9.3.

Table 3.9.2 Stated coping responses to moderate drought by rank and zone

Strategies	RANK 1				RANK 2				RANK 3				RANK 4			
	C	**E**	**S**	**W**	**C**	**E**	**S**	**W**	**C**	**E**	**S**	**W**	**C**	**E**	**S**	**W**
Sell animals	46	39	45	51	6	6	5	3	3	3	2	6	3	1	3	2
Sell trees	9	7	7	3	10	1	11	15	5	2	0	0	0	0	2	2
Food-for-Work	23	35	38	14	38	11	35	11	11	4	6	1	5	0	0	1
Cash-for-Work	1	2	1	4	20	27	12	15	19	16	13	5	6	2	8	1
Employment inside *woreda*	2	2	0	0	4	4	12	3	7	18	13	13	11	8	5	1
Employment elsewhere in Ethiopia	3	2	2	4	5	5	7	7	16	10	21	4	11	18	17	10
Employment in Eritrea or Saudi-Arabia	1	1	0	0	0	2	1	0	2	3	3	0	6	5	2	0
Off-farm income	1	1	1	5	0	3	2	8	10	5	7	5	1	4	3	4
Borrow from relatives	4	6	2	15	11	16	7	21	17	14	18	23	27	22	22	13
Borrow from others	5	0	0	2	1	3	4	4	1	11	3	12	6	4	6	19
Use Cash/Bank savings	0	1	1	0	0	0	0	0	0	0	1	0	1	1	1	1
Reduce expenditure	3	2	2	1	0	2	3	3	0	1	2	0	4	6	0	4
Beg for help from relatives	0	1	0	0	0	0	0	0	0	0	2	0	0	0	4	4

We see from Table 3.9.2 that sale of animals is the first priority coping strategy followed by FFW in the case of modest drought. Other commonly stated coping responses in decreasing order of importance include borrowing from relatives, cash for work (CFW) and other employment locally or elsewhere in Ethiopia, and borrowing from others than relatives. Some

stated that selling of trees was an important response. Very few stated that they would use cash or bank savings, beg for help from relatives or reduce expenditure. We see that FFW was relatively less important in the Western zone where borrowing from relatives was relatively more important. This is the zone with highest and most reliable rainfall indicating less need for FFW assistance from the outside. Otherwise, there were small differences between the zones.

Table 3.9.3 Stated coping responses to severe drought by rank and zone

Strategies	RANK 1				RANK 2				RANK 3				RANK 4			
	C	**E**	**S**	**W**	**C**	**E**	**S**	**W**	**C**	**E**	**S**	**W**	**C**	**E**	**S**	**W**
Sell animals	44	41	36	35	3	10	3	2	11	7	5	30	6	5	4	16
Sell trees	0	4	4	0	10	3	1	6	1	1	0	9	7	4	5	10
Food-for-Work	5	13	16	7	27	24	25	15	21	11	3	11	12	1	3	2
Cash-for-Work	1	2	3	9	6	6	12	4	25	22	20	12	7	5	3	9
Employment inside *woreda*	4	7	1	3	7	2	7	8	3	4	9	3	2	5	2	12
Employment elsewhere in Ethiopia	6	3	3	7	1	7	6	4	8	3	15	10	12	19	19	11
Employment in Eritrea or Saudi-Arabia	1	1	0	0	1	4	1	0	7	7	3	0	3	4	1	0
Off-farm income	1	2	0	1	6	2	2	20	1	3	2	1	6	5	0	7
Borrow from relatives	14	6	5	18	20	6	8	24	11	23	6	12	16	10	8	12
Borrow from others	15	2	5	11	10	20	6	7	1	3	5	3	3	2	2	4
Use Cash/Bank savings	2	1	0	1	2	1	0	0	0	0	1	0	0	0	0	0
Reduce expenditure	2	3	7	0	0	0	1	0	1	0	2	1	3	70	4	3
Beg for help from relatives	4	15	2	6	0	4	0	0	0	4	1	0	0	2	5	2

The responses to severe drought summarized in Table 3.9.3 indicate that sale of animals is the most important response also in this case. FFW and CFW appear relatively less important than in the case of moderate drought while borrowing from relatives and others are stated to be relatively more important in case of severe drought. Selling of trees was relatively less important while begging for help from relatives became more important in the case of severe drought.

The farm households were also asked whether there had been any changes in their strategies to cope with risk now as compared to five years ago. The responses are summarized in Table 3.9.4 below.

Table 5.9.4 Changes in risk coping strategies during the last five years

Change in coping	ZONE			
	Central	**Eastern**	**Southern**	**Western**
% stating that there has been a change	61	54	57	39
Types of change recorded	**% of respondents reporting the change**			
Use of irrigation	18	15	17	7
Soil conservation	37	29	19	32
Food-for-Work	11	18	10	10
Cash-for-Work	6	11	1	8
Off-farm income	5	9	9	2
Use of fertilizer	3	0	1	3

We see from Table 3.9.4 that more than half of the respondents in the Central, Eastern and Southern zones reported a change in the risk coping strategies over the last five years. Almost 40% also reported such a change in the Western zone. We see that the most widespread change is investment in soil and water conservation and investment in irrigation. It also appears that FFW and CFW has become more important. These are often used for establishment of conservation and irrigation structures as well. It is possible that these activities have resulted in less out-migration. A few in the Western and Central zones stated that use of fertilizer was a way of coping with risk. These are the zones with highest rainfall and where fertilizer use is least risky.

FFW activities have been very common in Tigray as a way of improving food security at household level. We asked whether households had participated in FFW during the last five years and how many times they had participated, how many persons in the household had participated, the number of days they had worked, and the quantity of food they had received. The responses are summarized in Table 5.9.5 by zone.

We see that the percentage of households which have participated, the average frequency of participation, the average number of persons who have participated per household, the average duration of the activity, as well as the average total quantity of food were highest in the Central and Southern zones and lowest in the Western zone where rainfall is more abundant, while the drought prone Eastern zone fell somewhere in between for all these indicators.

Table 3.9.5 Participation in food-for-work during the last five years

	Zone				All
	Central	**Eastern**	**Southern**	**Western**	
% participated in FFW during the last 5 years	85	64	80	46	69
Average frequency of participation*	2.19	1.80	1.86	1.65	1.91
Average number of persons participated*	3.41	2.33	2.88	2.57	2.86
Duration (total days)*	92	116	86	52	89
Quantity of food received (kg)*	290	227	326	149	262

* These quantities are averages for the households that were involved in FFW.

The households were asked about the effects of the participation in FFW on their farming activity. The effects are summarized in Table 3.9.6.

We see that the most important effect was that access to FFW reduced the pressure of being self-sufficient in food production. It also reduced their time available for looking after their own farm and animals.

Table 3.9.6 Effects of access to food-for-work on households' farming activity

Stated effects (% of households indicating	**Zone**				**All**
	Central	**Eastern**	**Southern**	**Western**	
Less time to look after the farm and animals	26	21	34	2	21
More time to look after the farm and animals	0	0	4	2	1
Less need to produce own food	57	45	39	29	43
More investment on own farm	2	2	7	3	4
Other	19	14	10	14	14

Access to FFW could theoretically have reduced the need for migration and thus increase the time available for farming but very few indicated that access to FFW lead to more time for farming or increased investment on own farm. The main investment effects of the FFW are therefore likely to be the direct effects of FFW. We also asked about what types of FFW activities the households had been involved in. We are therefore able to get a good perspective of the direct investments made through FFW. The types of activities are summarized in Table 3.9.7.

We see from Table 3.9.7 that most of the FFW activities were various types of soil and water conservation and irrigation dam investments. These activities may be said to improve future food security. The food distributed through these FFW activities was mainly obtained through outside assistance. Some households had also been involved in road construction. These investments may also be important for food security, as they are likely to contribute to improved market access, including food market access.

Table 3.9.7 Types of food-for-work activities that households have participated in

FFW activities that households have participate	**Zone**				**All**
	Centra	**Eastern**	**Southern**	**Western**	
Stone terrace construction	35	8	20	6	18
Soil bund construction	4	4	15	0	6
Bench terraces construction	1	0	0	7	2
Check dam construction	6	5	0	1	3
Dam construction	14	12	48	15	22
Gully control	6	4	0	0	3
River diversion	0	2	0	0	1
Tree planting	2	5	3	4	4
Soil and water conservation	18	8	3	7	9
Road construction	8	14	7	6	9
School construction	1	4	1	0	2
Other house construction	3	0	0	0	1

To find out whether the access to FFW was constrained during last year we asked households whether they would have liked to have access to more FFW than they had during last year (EC1989). The drought in 1997 was likely to affect the demand for FFW in 1998 (EC1990). We therefore asked how many man days of FFW (optimal number of days) they would

demand given the drought. We also asked whether they actually had access to FFW in EC 1990. The responses to these questions are summarized in Table 5.9.8.

We see from Table 3.9.8 that one third of the households would have liked to have access to more FFW during 1997 with the highest percentage of households being constrained in the Southern zone and the lowest in Western zone. We also see that the extra demand for FFW in terms of man days of work or food were highest in the Southern zone and lowest in the Western zone while the Central and Eastern zone fell in between. In 1998, the highest demand for FFW as percentage of households demanding it was in the Eastern zone (68%) while also more than 50% were demanding FFW in the Central and Southern zones. Only 18% demanded FFW in the Western zone. It appears that more households have access to FFW in 1998 than those demanding it in the Central and Western zones while the percentage

Table 3.9.8 Access to and demand for food-for-work in 1997 and 1998

	Zone				**All**
	Central	**Eastern**	**Southern**	**Western**	
% of households constrained in their access in 1997	38	37	45	13	33
Average extra demand for those constrained (man	46	48	59	31	49
Average extra food demand for constrained households	125	144	176	93	144
% of households demanding FFW in 1998	51	68	56	18	48
Average FFW demand in 1998 in man days/hh.					
% of households with access to FFW in 1998	83	66	54	36	60

with access was close to the percentage demanding in the Eastern and Southern zones. There was quite good match between supply and demand but we did not obtain information about how much FFW the households actually obtained in 1998. We may conclude, however, that FFW is extremely important for household food security in Tigray not only in drought years but also in normal years, as many households appear to be deficit producer of food and have limited access to other off-farm sources of income.

3.10 Attitudes towards having more children

Population growth is still high in Ethiopia and agricultural production per capita has decreased since 1970. Before 1970, it was above 250 kg/capita but fell below 150 kg/capita after 1982 (FAO, 1986). There is a fear that further population growth will increase the pressure on natural resources, and lead to worsening of poverty and food insecurity. One important question is whether family planning can lead to reduced population growth. Cultural norms and religion are among the factors, which may influence households' attitudes towards having more children. We asked the households whether they thought it was good to have more children and for the reasons for their response to this question. The answers are summarized in Table 3.10.1.

Table 3.10.1 Attitudes towards having more children

% of households giving the	**Zone**				**All**
	Central	**Eastern**	**Southern**	**Western**	
% Thinking it is good to have more children	53	63	51	54	55
Reasons why it is good to have more children:					
Children are gifts from God (good to have)	46	56	50	36	47
Children provide labor to the household	46	50	46	46	47
Children take care of me when I am old	36	47	35	34	38
They increase the chance of getting more land	21	23	24	18	22
Reasons why it is not good to have more children					
The household becomes poorer	44	37	48	47	44
There are no employment opportunities	39	36	34	38	37
There will be more mouths to feed	40	34	35	38	37
There is no land for the children	21	18	22	18	20

A small majority considered the benefits of having more children higher than the negative effects. The responses indicate that this is not only due to religious or cultural beliefs but also because children provide labor to the household and old-age security to parents. More than 20% of the households also thought that it was possible for the family to obtain more land when it had more children. On the other hand, those who thought it was not good to have more children feared that more children would lead to more poverty due to lack of employment opportunities and lack of land for the children. It would therefore become more difficult to feed the family.

IV. Discussion and Conclusions

Understanding the problem of land degradation in a given spatial and temporal context, requires looking at the community baseline conditions such as the natural resource base, human resources, existing institutions and infrastructure base, and how these conditions interact with policies and institutions to influence human responses and thereby affect productivity, livelihood security and the natural resource base. This study provides a description of the land users' priorities, attitudes and perceptions, household characteristics and socio-economic status, access to credit, and farm inputs, tenurial arrangements and variations in land quality and technology characteristics and their effects on the households' interest in and ability to invest in conservation technologies based on a preliminary and simple statistical analysis from a survey of 400 households in 16 communities in Tigray carried out in 1998. Furthermore, it poses important questions that could serve as basis for further rigorous econometric analysis and future research endeavor.

The Tigrayan economy and society is characterized by the dominance of smallholder agriculture, where smallholder producers cultivate an average landholding of less than one hectare in a risky environment and heavily depend on natural factors. On the other hand, there is high population growth and involving high dependency ratios. The human capital resources in the region are poor in quality with low level of education and learned skills that have implications on agricultural productivity, food security and resources management.

In such a rural setting, where land is the major source of livelihood, the question of access to cultivable land is quite important. Past and present policies have been mainly driven by egalitarian motives. Land has been redistributed several times to adjust for changes in family sizes and provide land to new families. This goal seems to have been relatively met as can been seen for the relatively low Gini-coefficients on land holding sizes of households ranging

between 0.29 and 0.41 in the different zones. On the other hand, besides having egalitarian land distribution, the question of ensuring efficient allocation of scarce land resources is crucial in achieving higher agricultural productivity and ultimately rural transformation.

Formal rural land markets are absent in Tigray as they are in the whole country. Informal land rental arrangements are common, however. There are other interlinkage markets as well involving oxen and labor exchanges. Through such informal arrangements, households seem to have managed to transfer resources (e.g. oxen and labor) from resource rich to resource poor households perhaps leading to gains in efficiency. It is of great interest to assess the efficiency and resource use impacts of such informal land markets and other interlinkages and examine whether there are rooms for Pareto improvements through changes in policy.

Another crucial element with regard to land policy and its implications on agricultural production and resource management is tenure security. It is interesting to note that, tenure insecurity seems to be pervasive in Tigray. The fact that more than fifty percent of the households fear further land redistribution (though the current land policy prohibits further land redistribution) underscores the problem. This may have important implications on the incentives of farmers for sustainable resource use. This issue is supported by the fact that about 81 percent of households identified the problem of land degradation to happen on private holding perhaps implying lack of private incentive for conservation. This may also be due to poverty and other resource constraints faced by households. This calls for a careful analysis of the differentiated impact of the role of tenure insecurity on households' decision to undertake short- and long-term investments on land.

The survey results also show that households' access to markets is constrained by distance (average distance to the nearest market and major market being 73 and 113minutes respectively) and lack of access to transport facilities implying high transaction costs and imperfect information. These render markets for output and factors of production to be poorly developed, missing, seasonal or rationed. Although, a formal credit market is emerging, the major type of credit is credit in-kind; mainly for agricultural inputs. Credit services for consumption or other business purposes are very poor. Hence, the role of credit in asset building and in consumption smoothing is still limited. Moreover, the credit market for farmers is typically rationed.

The impact of market imperfections and credit constraints on households' behavior implies their production and consumption decisions are inseparable. This, in turn, implies that household resource endowments (in livestock, labor, and land holdings) are crucial to the

households' decision-making process because the substitutability between the different resources is also limited due to imperfections in output or /and factor markets. In this context, faced with the same policy intervention, households are expected to respond differently. Consequently, incorrect or missing price signals may accrue from society's perspective and possibly result in inefficiencies. Possible outcomes could include too rapid extraction of and too low investment in natural resources.

Addressing land degradation problems in developing countries should start from the understanding of the households' perceptions about the severity of the problem and the constraints they face to deal with the problem by their own means. The survey results indicate that there is high degree of awareness that land degradation in form of soil erosion, gully formation and nutrient depletion is the main environmental problem, and it is realized to have serious implications on agricultural productivity (about 56% of the farmers have witnessed yield decrease partly as a result of deteriorating soil quality). However, awareness does not seem to have been translated into widespread adoption of conservation technologies by individual households.

Households identified shortage of labor, high cost of land improvement vs. benefits, and lack of cash as major constraints not to undertake conservation activities. This may point to the need for policy responses to address households' constraints through labor mobilization (for which there seems to exist high level of social capital), provision of low cost technologies and/or technologies that have better returns so that households could alleviate their cash constraints. The on-going conservation efforts should translate themselves into increased crop yield and, hence, lead to improved food and livelihood security for the people.

Labor mobilization for conservation work seems to work very well in Tigray. This is as system of taxing labor rich households in favor of labor poor households. This underlines the usefulness and perhaps relevance of Pigovian taxes in addressing environmental problems in developing countries. Labor is one of the most abundant resources in developing countries. Mechanisms need to be devised to exploit this resource for a common good (e.g. investments in public infrastructure such as roads, irrigation structures, etc.) or to undertake conservation investments on private lands. Policy makers need, however, to be careful in defining the investment focus by identifying investment areas that yield better and quick returns.

Furthermore, farmers indicated that the major responses to land degradation problem, among others, should be maintenance of established conservation structures. A good deal of the households' gained from the ongoing community conservation efforts in terms of the

construction of stone terraces, soil bunds and gully stabilization on their private holding. This experience has also generated expectations by households that society (e.g. the local communities) should help them in tackling the land degradation problems on their private holding. While, on the one hand, this demand points to the resource-intensive (mainly labor and technical knowledge) nature of these investments, given household constraints in these resources, it may also indicate the lack of an incentive to a widespread and spontaneous adoption of conservation technologies and maintenance thereof, in the absence of continued public support. Public intervention in conservation work could be justified due to households' lack of technical skills, need for coordination across farms and resources distribution from labor rich to labor poor household farms. Public intervention in conservation work is also broadly justified by market imperfections, and prevalence of poverty and food insecurity. While these arguments underline the need for community intervention and support of conservation work on private holdings, it also raises the question of the possible interaction of public action and private incentives to undertake such investments. Any policy response should take into account the impact of public action on private incentives and the possible costs and benefits of such actions given that there is room for individual action.

Land degradation problems were also associated with the existence of local spatial externalities as the source of the problem was identified in the communal land or land of other farmers. This underlines the need for collective action and coordination across private farms. It may also imply that communal lands are left untended perhaps because the property rights here are not clearly defined. The border between state and communal ownership (e.g. on forestry land) is very thin as far as such communal lands are concerned. It may be important for policy to ascertain that communal lands do not degenerate to 'free access regimes' which would lead not only to the classical problem of the 'tragedy of the commons' but also pose a negative externality on privately held plots. This calls for a two-pronged policy response in terms of reversing degradation problems on communal lands by mobilizing labor from the community and clearly defining the property regimes. This, of course, calls for a clear understanding of the mechanisms of how common property regimes are managed and how individual households and communities feel about communal lands be it forest or grazing lands.

Finally, the survey showed that farmers have developed various mechanisms of insurance and coping with stress. This may not be costless, however. The cost of these responses in relation to household resources and the frequency of risks affect the household's ability to cope with

risk. Sometimes adverse shocks lead to just temporary consumption declines but sometimes they can trigger longer-term difficulties by perpetuating poverty by stifling mobility, creating implicit taxes on saving, and generating other distortions. The important issue in this regard is the role of households' consideration of risk and risk coping on their crop choice, input use and land management behavior. These decisions could be constrained by households' immediate consumption requirements and precautionary savings. In this case, attention needs to be given to the understanding of the dynamics and linkages between poverty, risk and incentives for conservation.

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