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Responding to Land Degradation in the Highlands of Tigray, Northern Ethiopia

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ABSTRACT

Improving the long-term sustainability and resilience of smallholder agriculture in Africa is highly dependent on conserving or improving the quality of the natural resource. Conservation agriculture is conceived around more integrated and effective management strategies for provisioning both food and other ecosystem services. If unattended to, land degradation would reduce agricultural productivity and increase pressure on marginal environments in the Tigray highlands of Ethiopia, adversely affecting food security and livelihoods of smallholder farmers. This paper answers some pertinent questions about mass mobilization of free compulsory labor for ecological restoration in Tigray. It details perception of changes in climate; the process of collective decisionmaking; resistance, documentation, and enforcement of rules; methods of conflict resolution; knowledge and information networks; arrangements for benefit sharing of communal resources; and the role of gender in mass mobilization for communal work. We analyzed data collected from 20 villages in 3 districts in the Tigray region through a household survey using a structured questionnaire, focus group discussions, and personal observations. The results reveal that the people are motivated to provide their free labor to restore the ecology to increase agricultural productivity and production to avoid food insecurity and improve their general livelihood. Availability of institutions in terms of grassroots organizations and rules and regulations was a major factor in the positive response to the call for action. The commitment of the government at both the national and local levels (through sensitization and mobilization for group formation and provision of tools and construction materials); the ethnic homogeneity of the population; and the existence of the Orthodox Church, where most of the people were members, were major factors for the success of the community mobilization for collective action in Tigray. Social networking with neighbors, the clergy, and leaders of grassroots organizations provided the knowledge and information on climate variability and solutions required to conserve the ecology and improve human livelihood. We also observed that there were no differences in gender division of labor except that women worked half the workload of men in a day; the women also did the cooking and cleaned up the surroundings after eating at the site. Both men and women played active roles in leadership with regard to mobilization of people, communal work planning and scheduling, conflict resolution, and sharing of community products. An impact assessment of the ecological conservation in Tigray on agricultural productivity and production and food security would be useful. It will be interesting to replicate the study in other areas in Ethiopia and other countries where the societies may not be homogenous to find out the level of commitment of the people to communal work.

Keywords: land degradation, ecological restoration, free labor, collective action

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ABBREVIATIONS AND ACRONYMS

ADLI	Agricultural Development Led Industrialization
AUC	Africa Union Commission
CFW	cash for work
CSA	Central Statistical Agency
EPRDF	Ethiopian People's Revolutionary Democratic Front
FFW	food for work
FGD	focus group discussion
GDP	gross domestic product
IBAR	Inter-African Bureau for Animal Resources
MASL	meters above sea level
NGOs	nongovernmental organizations
NIE	New Institutional Economics
OFSP	other food security program
PSNP	Productive Safety Net Program
SPSS	Statistical Package for Social Sciences
STD	standard deviation
SWC	soil and water conservation
TPLF	Tigray People's Liberation Front
TWA	Tigray's Women Association
UNESCO	United Nations Educational, Scientific and Cultural Organization

1. INTRODUCTION

Land degradation remains an important global priority issue for the 21st century requiring renewed attention by individuals, communities, and governments because of its adverse impact on agricultural productivity and the environment, and its effect on food security and quality of life (Stringer 2008; Eswaran, Lal, and Reich 2001). The phenomenon is a multifaceted and dynamic process that depends on biophysical, socioeconomic, cultural, and institutional factors, with strong negative effects on food security and quality of life. The land degradation process appears particularly severe in developing countries, which has significant implications for climate change mitigation and adaptation. This is because the loss of biomass and soil organic matter releases carbon into the atmosphere and affects the quality of soil and its ability to hold water and nutrients. The evidence that the climate is changing and that these changes can be attributed to human activities has become stronger in recent years. Climate change can be exacerbated by human-induced actions such as: the extensive use of land, deforestation, major technological and socioeconomic shifts, and the accelerated uptake of fossil fuels (Millennium Ecosystem Assessment 2005).

Rainfall and temperature are important determinants of crop harvests, and unfavorable realizations of either the amount or the temporal distribution of rainfall trigger food shortages and famine. For many developing countries, the most important impacts of climate change arise from higher temperatures, increased water stress, and extreme weather events that most strongly affect agriculture. Africa is particularly vulnerable to climate change because of its overdependence on rainfed agriculture, compounded by factors such as widespread poverty and weak capacity. In these countries the agricultural sector is more vulnerable to climate change. The risk of climate change thus has devastating effects on crop farmers; pastoralists and agropastoralists; poor people with low economic power, low level of education, low technological know-how; women; and children (Ishaya and Abaje 2008; Barber et al. 2003).

The current food crisis in the Horn of Africa is largely attributed to the adverse impacts of climate change. Recognition of the urgency of the current crisis in the Horn of Africa has raised awareness and renewed commitment from African leaders to find sustainable solutions for climate-induced vulnerability in the arid and semiarid lands (ASALs) and prevent food crisis. Interventions considered key in advancing long-term development of ASALS by the African Union Commission (AUC) and Inter-African Bureau of Animal Resources (IBAR) include the integration of local knowledge through participatory action research and enhanced use of natural resources (such as soil and water management initiatives and improved land-use planning; see AUC-IBAR 2011).

Ethiopia has recently been reported as one of the countries with the least capability for resilience and is therefore most vulnerable to climate change. In fact, Ethiopia has experienced no less than five major national droughts since 1980 and several local droughts. Food shortage and famine associated with rainfall variability has cascaded in high dependency on international food aid. Ethiopia is one of the biggest food aid recipient countries in Africa, accounting for 20–30 percent of all food aid to Sub-Saharan Africa (Yesuf et al. 2008; Bezu and Holden 2008). In recognition of the persistent problem of food insecurity in rural Ethiopia and the need to move away from the previous system of annual emergency appeals, the Government of Ethiopia and multinational donors in 2005 implemented the Productive Safety Net Program (PSNP), a social protection program. It is viewed as a food security enhancement program with the ultimate aim of providing transfers to the chronically food insecure *woredas*[1] population in a way that prevents asset depletion at the household level and creates assets at the community level (Gilligan, Hoddinott, and Taffesse 2008; Government of Ethiopia 2004). The program allows households to build assets and increase income through two components: community works and direct support.

Consequently communities build assets when they participate in public works through Cash for Work (CFW) or Food for Work (FFW) programs. Direct support is a minor component in the form of

[1] An administrative division of Ethiopia (managed by a local government), equivalent to a district.

cash or food transfers and targets assistance to members of the community who cannot participate in public works but need help. PSNP beneficiaries are expected to remain in the program for three years and subsequently exit from it. PSNP is complemented by a series of food security activities, collectively referred to as the Other Food Security Program (OFSP). OFSP includes a wide range of activities that differ by region, but the main element is a package of loans for agricultural and nonagricultural activities. Beneficiaries of the OFSP receive at least one of several productivity-enhancing transfers or services, including access to credit, agricultural extension services, technology transfer,[2] and irrigation and water harvesting schemes. Whereas the PSNP is designed to protect existing assets and ensure a minimum level of food consumption, the OFSP is designed to encourage households to increase incomes generated from agricultural activities and to build up assets (Andersson, Mekonnen, and Stage 2009; Gilligan, Hoddinott, and Taffesse 2008).

Ethiopia has a population of more than 80 million and an outsize number of rural people living in the highlands vulnerable to land degradation. The highlands of Ethiopia have an area of 1.13 million kilometer^2, representing 50 percent of the total area of the country and 90 percent of the economy; it produces 95 percent of regularly cropped land (Dejene et al. 2004). Agriculture contributes nearly 45 percent of Ethiopia's gross domestic product (GDP) of slightly more than US$10 billion. More than 85 percent of the population is dependent on the sector. Although the country is highly reliant on the agricultural sector for income, foreign currency, and food security, the sector is dominated by small-scale peasant farmers who depend exclusively on rainfed and traditional practices. The most devastating adverse impacts of climate change in this region are threatening the achievement of major developmental goals and food security of the people. Land degradation and droughts have caused declining and highly variable land productivity in Ethiopia (World Bank Report 2008; Yesuf et al. 2008; Holden, Shiferaw, and Pender 2003).

The highlands of Tigray are well known for the devastating land degradation problem that has resulted in a decline in agricultural productivity in the region. Land degradation is manifested in the form of soil erosion, deforestation, declining biodiversity resources, and soil moisture stress. This severe land degradation is attributed to the heavy concentration of the population in the highlands, coupled with unchanged agricultural technology, thus putting tremendous stress on the natural resources, particularly soil fertility. Average estimates of productivity loss due to soil degradation is estimated to be 2–3 percent annually, which explains most of the failure to realize the potential yield gains expected from agriculture intensification (World Bank Report 2008). Currently about 1.4 million people in 31 *woredas* in Tigray are vulnerable to chronic food insecurity due to natural and social-economic factors in the region (Amede et al. 2007; Nyssen et al. 2004).

Resolute efforts to remedy the degradation of natural resources have been under way, particularly since 1991, by the regional government and the people at large to restore and conserve natural resources in the region. Major strategies for environmental rehabilitation in the Tigray highlands—including construction of stone terraces, soil bunds, and microdams; establishment and development of area enclosures and community woodlots; enforcement of use rules; regulations for grazing lands; reduced burning; and application of manure and compost have increased crop production substantially (Gebremedhin et al. 2003; Taffere 2003).

The livelihoods of the indigenous people of the Tigray highlands depend on the natural resources that are directly affected by land degradation, and they inhabit economically and politically marginal areas in diverse but fragile ecosystems. They are vital and active parts of the ecosystems and help to enhance the resilience of these ecosystems (Kronik and Verner 2010; Ishaya and Abaje 2008; Jan and Anja 2007). Farmers possess valuable indigenous adaptation strategies that include early warning systems (Ajibade and Shokemi 2003) that enable them to recognize and respond to changes in climatic parameters (Thomas et al. 2007). In addition, they interpret and become accustomed to changes in climate in ingenious ways, drawing on traditional knowledge as well as new technologies to find solutions, which

[2] Such as advice on food crop production, cash cropping, livestock production, and soil and water conservation (SWC) projects.

help the society at large to cope with the impending changes. Consequently, development of planned adaptation strategies to deal with these risks is regarded as a necessary complement to climate change mitigation actions (Burton 1996; Smith et al. 1999; Parry 1986).

A unique indigenous adaptation strategy to land degradation in the Tigray region is the mobilization of free labor at the community level, invested in soil and water conservation (SWC) to restore the ecology of the community. This adaptation intervention may also be seen as a Pigouvian tax to address the environmental problems in the region. Mobilizing collective action labor for investment in public goods may therefore be a cheap and cost-effective way to enhance welfare and sustainable land management. Collective action is required to regulate rights and responsibilities to common-property resources and public goods to manage biophysical processes, negotiate joint investments and technological innovations for enhanced productivity, and to regulate benefits capture (German et al. 2006; Gebremedhin, Pender, and Tesfay 2002; Scott and Silva-Ochoa 2001; Meinzen-Dick et al. 2002; Gaspart et al. 1998; Munk Ravnborg and Ashby 1996; Ostrom 1990). The concept of collective action is rooted in the premise by Olson (1971): Individuals in any group attempting collective action will have incentives to *free ride* on the efforts of others if the group is working to provide public goods. However individuals will not "free ride" in groups that provide benefits only to active participants. Collective action in an attempt to eliminate the free rider problem in communities is challenged by the size of groups. Thus large groups would face relatively high costs when attempting to organize for collective action whereas small groups would face relatively low costs. Individuals in large groups would gain less per capita of successful collective action whilst whereas individuals in small groups would gain more per capita through successful collective action. Apart from the contribution of *voluntary* uncompensated labor in Tigray, vulnerable persons in some communities benefit from PSNP and OFSP by providing labor for community projects in exchange for cash and food.

Rural communities in Tigray have a far-reaching tradition of developing and enforcing regulations on the use of woodlots and grazing areas. Collective action for SWC and woodlot and grazing land management generally functions well in the highlands of Tigray. Community woodlots are common, with nearly 9 out of 10 communities having at least one community woodlot. Most of these woodlots were established after the downfall of the military government in 1991, and presently the regional Bureau of Agriculture has been instrumental in facilitating the establishment of the woodlots by providing technical and material assistance. The most common benefit from woodlots is the cutting and collection of grass for animal feed and as roofing materials. Thus, community natural resource management can be an effective means of redressing natural resource degradation and decreasing community poverty levels. Most woodlots are managed at the village level, although some are managed at the *tabia*[3] level. Conversely, unlike woodlots, all restricted grazing areas are managed at the village level (Badstue et al. 2005; Gebremedhin, Pender, and Tesfay 2003). Local communities employ regulations to contribute to a significant regeneration of grazing lands and to support community resource management in the restoration of the ecology.

Communities that depend on a common-property resource tend to self-organize to manage the resource collectively so that they can benefit from it for a long time (Gebremedhin, Pender, and Tesfay 2004; Varughese and Ostrom 2001; Wade 1987). In the process the communities mobilize the people, bring them together, and empower them to raise awareness so that collective action can be achieved for a common goal. This facilitates change and development, while taking into account the needs of the community, and leads to efficient community organization.

[3] The lowest unit in the administrative hierarchy also referred to as a community or a peasant association.

Objectives of Study

The study assesses collective mobilization of the rural people in the Tigray highlands to soil and water projects and woodlot and grazing land management as a focal point for conservation and agricultural development. The study details the operation, structure, and process of the collective decisionmaking and documentation of methods of persuasion (if any); methods of conflict resolution; arrangements for benefit sharing; and the role of gender in community mobilization. We also study the role and characteristics of how social networks function among farmers as catalysts for information diffusion on climate change and innovation in community mobilization for ecological restoration in the Tigray region. Specifically, the research intends to undertake the following:

1. Establish the command structure and modus operandi of community mobilization in the different communities for collective action.
2. Determine the role and responsibilities of females and males in the community mobilization for ecological restoration.

Research Questions

The research is structured around the following questions:

1. Who organizes the community for collective action and how is it done, and what is the response of the people?
2. What motivates the people to participate in compulsory free labor to restore the ecology?
3. How is knowledge shared and learned in the community mobilization?
4. How are conflicts, (if any) managed and resolved in programs to mobilize the people in the community for collective action?
5. How are the proceeds from the community mobilization shared?
6. What is the role of gender in the community mobilization?

2. CONCEPTUAL FRAMEWORK

The conceptual framework of this study is premised on the theory of New Institutional Economics (NIE), which focuses on the social and legal norms and rules underlying economic activity, and rooted in the broad schools of thought proposed by Coase (1937, 1960) and Williamson (1975, 1985) on transaction costs; North (1971, 1990) on institutional analysis; and Olson (1971) and Ostrom (1990) on collective action. NIE brings into play theoretical and empirical tools of neoclassical economics in analyses of both the development of institutions and their effects on economic behavior and outcomes in different circumstances in society. Its specific contribution arises from its acknowledgment that economic actors face a particular setback as a consequence of imperfect information about the behavior of other actors in transactions and that institutions play an important role in addressing these problems (Kirsten, Karaan, and Dorward 2009; Dorward 2001; North 1994, 1995). This recognition demands explicit attention to the ways that actors and societies address problems arising from imperfect information in transactions.

Thus institutions are a means to reduce information and transaction costs, and were formed to reduce uncertainty in human exchange. They are viewed as formal or informal rules that govern people's behavior by providing a framework of incentives that shape economic, political, and social organization (Dorward and Omamo 2009). Formal economic institutions and rules, culture, values, conventions, and social networks are vital evolving structures in an institutional environment. Institutional structures perform two vital functions in social and economic interactions between actors. One is to coordinate the actions of different agents who all benefit from such coordination, but do not initially have a plan regarding the specific actions they must take in order to be aligned with each other, such as natural resource management. The other is to mediate and enforce in situations where there is some conflict between the goals of the different agents who interact but where an overall superior outcome can be attained if some of these conflicts can be considered (Dorward et al. 2009; Bose 2000). Institutions are supposed to constrain actors. Above all, nested within these structures they provide low-cost exchange and incentives for resource management, creating profitable opportunities for investment and exchange.

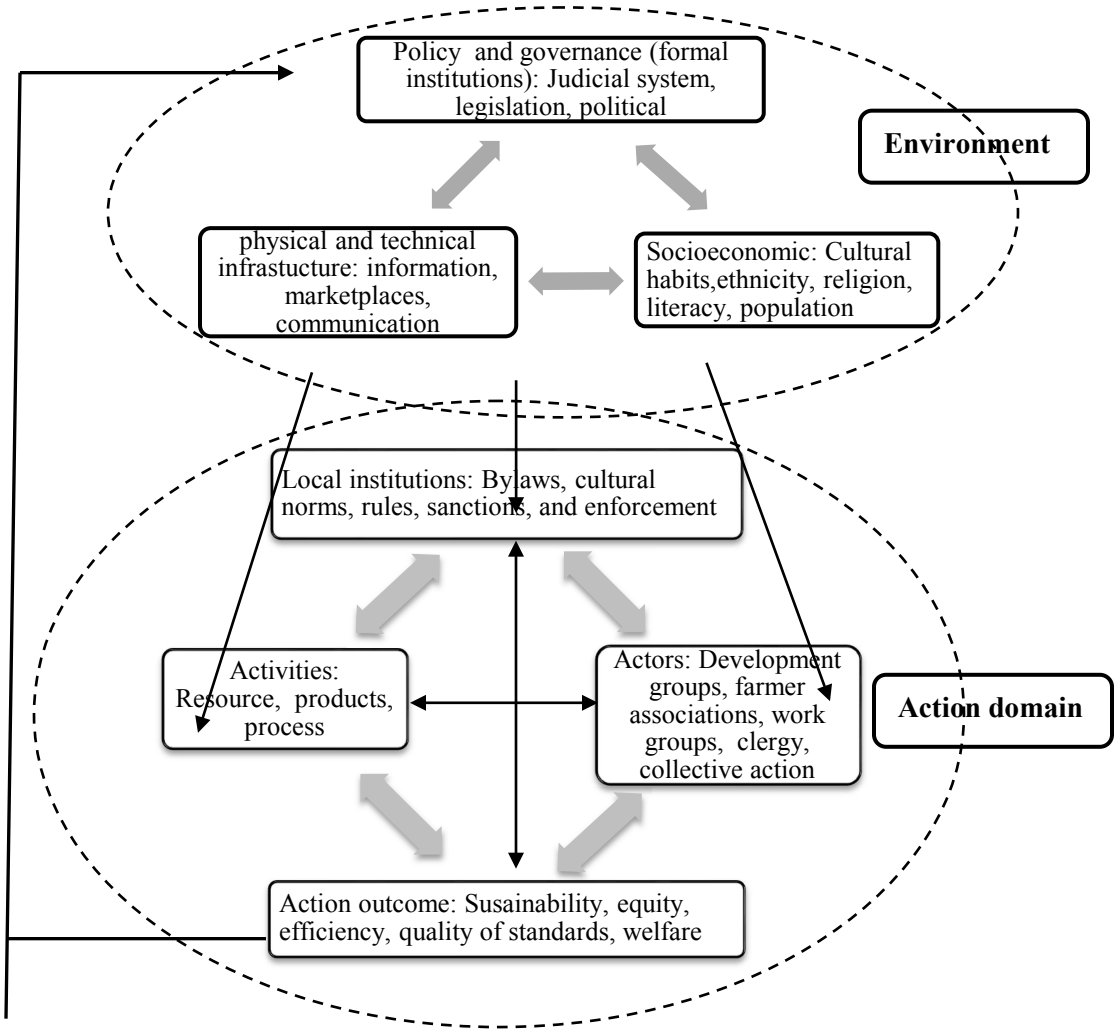
Natural resource is a dimension that influences the institutional arrangements governing relations among actors who are stakeholders in the same activities for two reasons. First, externalities associated with multiple-use rights are particularly important and complex for many, particularly renewable, natural resources. This factor leads to the general importance of collective and state action in natural resource management. Second, the general pattern of private-market contracts giving way to collective contractual forms of activity coordination can take on a particular form in natural resources management activities, as these resources generally exist without any investment. In communal management systems the income and use rights typically rest with individual households, whereas transfer rights are restricted and rest with the community. The latter right is generally less important to local communities than the income and use rights. The institutional settings in general strongly affect the resource use incentives, that is, the costs and benefits of different resource use options (Dorward and Omamo 2009; Angelsen 1997).

Ostrom (1990, 1992) documented resource characteristics of great relevance to natural resource management to include the ease of resource use by multiple users; the ease of exclusion of potential users; the importance of interactions and interdependence in use, management, and benefits across natural resources; the degree to which benefits can be divided among users; the degree to which benefits can be transferred between users; the size and dispersion of benefits; the temporal distribution of the resource and predictability across time and space; the mobility of resources; and the extent to which different resources can be distinguished from one another or recognized (Dorward and Omamo 2009). These attributes play a critical role in natural resource management.

To examine the nexus of community reaction to compulsory free labor for ecological restoration in the Tigray region and the institutions that are brought into play, we adapt the conceptual framework developed by Dorward and Omamo (2009) to assess institutional analysis linking the physical-infrastructure, socioeconomic, and policy-governance environments with the elements of the action domain (institutions, actors, and activities; see Figure 2.1). Three types of factors describe the

environment in which action domains are entrenched: physical and technical, socioeconomic, and policy and governance factors. The interactive impacts of these three categories of environmental factors determine how institutions and attributes of actors and activities combine to shape outcomes. Identifying and analyzing these interrelationships is therefore crucial for natural resource management. Institutions, actors, and activities influence one another. What is more, activities and their attributes also interact with different actors' attributes to shape institutions governing access to natural resources or opportunities. On the other hand, institutions, activities, and actors are affected by their wider environment. The interactions among institutions, actors, and activities involve actions that lead to outcomes such as equality in the sharing of communal products, good organization of the actors in restoring the ecology, and the general well-being of the actors realized.

Figure 2.1—Conceptual framework for analyzing community participation in compulsory free labor for ecological restoration in the Tigray region

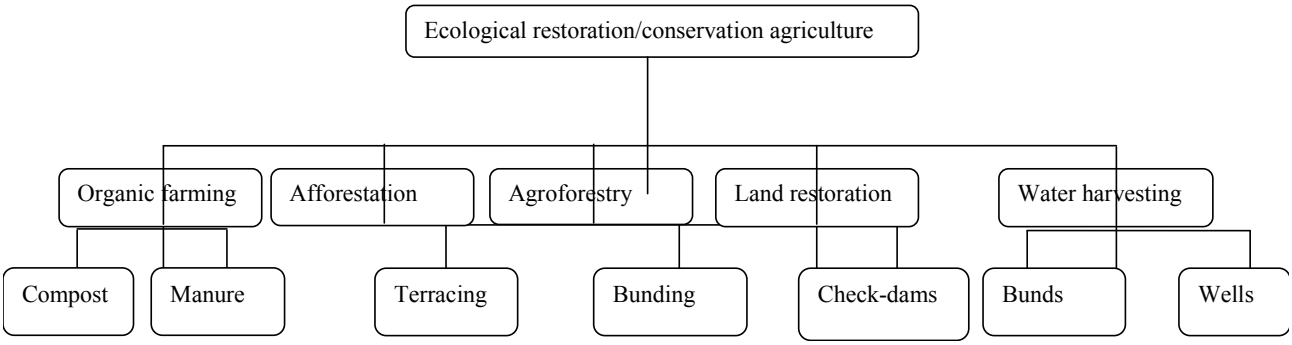


Source: Adapted from Dorward and Omamo 2009.

The action outcomes can strengthen or change the environment, institutions, activities, and actors as a result of direct or indirect impacts. Changes in the environment as a result of action outcomes can cascade into the aspirations and wealth of actors, and into the attributes of actors' too. These occurrences lead to institutional change.

In Tigray, the actors are involved in biological and physical soil and water conservation measures, which include organic farming, afforestation, agroforestry, land restoration, and water harvesting activities in their quest to restore the ecology, provide wood and nontimber forest products, and maximize productivity (Figure 2.2). This study did not investigate organic farming activity in the region. The term *afforestation* is used for the active establishment of enclosures, forest, or woodland in areas where there was no forest in recent years and the restriction of human activities for the short term, long term, or even permanently. Farmers plant woody perennials (economic trees) in association with herbaceous plants (crops, pastures) and livestock in a spatial arrangement, a rotation, or both, in which there are both biological and economic interaction between the tree and nontree components of the system (Negassi et al. 2002; Young 1989). Agroforestry production functions include fuelwood, fodder, fruit, and a range of other useful minor forest products such as medicinal plants and thatching materials. Service functions include shade, fencing, and SWC. Terracing, bunding, and check-dams are used to reduce erosion, enhance infiltration, and control runoff. Rainwater is harvested in wells and bunds and transported through canals for irrigation and livestock.

Figure 2.2—Activities of community actors in the Tigray region



Source: Authors' creation.

Overall, what appears instrumental to resource management is that institutions consist of a set of rights and duties or obligations. Even though legal rights are never unlimited, the kind of uses permitted by the law is often restricted (for example, not cutting trees in a protected woodlot). Restrictions of the rights that seek to minimize the set of permissible uses contribute to the economic value of the woodlot or the land resource. Furthermore, social norms such as customary law can in some cases be superior to administrative or judicial dispute resolution among people with close social ties. Local disputes are often resolved by appealing to generally accepted social rules, not by bargaining over legal rights. Through repeated interaction, agents tend to converge on strategies of cooperation that improve joint well-being. These strategies replace traditional legal remedies, and in some cases relationships prevail over law (Kirsten, Karaan, and Dorwad 2009; Ostrom 2005; Angelsen 1997).

Collective action is an area of considerable interest to NIE literature. The theory of collective action is a valuable tool when exploring how to overcome free rider problems and fashion cooperative solutions for the management of common resources or the provision of public goods (Olson 1971). Additionally, Schmid (2000) asserts that the main agenda of institutional economics is collective action. Collective action arises when people collaborate on joint action and decisions to accomplish an outcome that involves their interests or well-being. Olson (1971) emphasizes significant determinants of success in collective action to include the size, homogeneity, and purpose of the group. Building on this observation,

Gaspart and Platteau (2002) argue that the success of collective action depends on two sets of factors: characteristics of the people concerned (size, homogeneity, and social capital in the group) and characteristics of the environment that bear on the enforcement costs of a collective scheme (technical, economic, political characteristics, and the role played by state institutions; see Kirsten, Karaan, and Dorwad 2009; Sandler 1992).

Although collective action opportunities are high and information about actors' behavior is also available, contract enforcement can depend largely on a higher order set of norms and moral authority. This situation is also the arena in which laws and formal rules governing economic exchange are likely to be meaningful. This type of enforcement may prevail in formal commodity exchanges where many buyers and sellers collectively agree to abide by rules and laws established by the market and when information on behavior is readily available in a transparent way (Gabre-Madhin 2009). On the other hand, in the absence of other incentives, ethnicity is the basis for existing collective action.

An important field of investigation in the theory and application of collective action concerns the use of common-pool resources, such as land, forests, and water. Recent work by Ostrom (2005) and others has shown that local institutional arrangements, including customs and social conventions designed to induce cooperative solutions, can overcome the difficulties of collective action and help achieve efficiency in the use of such resources (Nabli and Nugent 1989). The key distinction here is between commons or common-property resources and open-access resources. Common-property and open-access regimes are generally thought to be inclined to overexploitation of resources; thus, the incentives for the individual users for conservation are small when the resource is shared by many (Kirsten, Karaan, and Dorwad 2009; Angelsen 1997). Some admonition to this general proposition is necessary when applied to the issue of land degradation.

Collective action is required to regulate rights and responsibilities to common-property resources to reduce transaction costs and externalities. This paper takes the approach that communal resource management can be a successful instrument for ecological restoration under local institutional arrangements intended to stimulate mutual resolutions, in line with an existing number of examples of successful management of resources held in common (Kirsten, Karaan, and Dorwad 2009; Fox 2007; Ostrom 1990; Coase 1960; Pigou 1920). In particular we take the stand that the primary functions of well-defined institutions are to allow agents to coordinate their actions and to induce cooperation between them, ultimately trading off among meaningful arrangements.

3. METHODOLOGY

Study Area

Tigray is positioned in the drier northern part of the country and belongs to the African drylands in the Sudano-Sahelian region. It is located between latitude 14° 1' north and longitude 38° 18' east. The region shares common borders with Eritrea in the north, the State of Afar in the east, the State of Amhara in the south, and the Republic of Sudan in the west. Tigray covers an area of 53,000 kilometers^2 and has a total population of approximately 4.3 million, with an almost one to one male to female ratio; 76.2 percent live in rural areas. The annual population growth rate is 2.5 percent per year, and the population density is 63 persons per kilometer^2. *Woreda* densities vary from 31.9 persons per kilometer^2 in Kafta Humera to over 250 persons per kilometer^2 in Adwa, Laelay Maichew, and Alamata (CSA 2008). The region has six administration zones: western, northwestern, central, eastern, southeastern, and Mekelle special zone. The eastern and central zones are densely populated as compared to a sparsely populated western zone. Administratively, the Tigray region has 35 *woredas*, 12 town *woredas*, and 665 *tabias*. Each *woreda* is subdivided into *tabias* and each *tabia* is divided into *kushets*.[4]

The landform is complex, composed of highlands in the range of 2,300–3,200 meters above sea level (MASL), lowland plains with an altitude range of less than 500–1,500 MASL, mountain peaks as high as 3,935 MASL, and high to moderate relief hills (1,600–2,200 MASL). By virtue of the complexities in topography, Tigray has diversified agroecological zones and niches, each with distinct soil, geology, vegetation cover, and other natural resources (Taffere 2003). Tigray is characterized by high temperatures and erratic rainfall. The overall temperature ranges from $5℃$ to 40 degrees Celsius. The climate is generally subtropical with an extended dry period of 9 to 10 months and a maximum effective rainy season of 50 to 60 days. Total amount of rainfall for the region varies from 400 millimeters to 800 millimeters, which makes the region usually moisture deficit resulting in recurrent droughts. The rainfall pattern is predominantly unimodal (June to early September). Exceptions to the rainfall pattern are areas in the southern zone and the highlands of the eastern zone, where there is a little shower during the months of March to mid-May (Nyssen et al. 2004). Taking into account rainfall, atmospheric temperature, and evapotranspiration, more than 90 percent of the region is categorized as semiarid. The remaining areas in the region can be categorized as dry submoist near the central south highlands and the Wolkite highlands and arid areas of Erob and Hintalo Wajerat *woredas* (Taffere 2003).

Study Woredas

Adwa

Adwa is one of the 35 *woredas* in the central zone of the region (Figure 3.1). It is bordered on the south by Werie Lehe, on the west by Laelay Maichew, on the north by Mereb Lehe, and on the east by Enticho. Adwa lies between latitude 14° 15′ north and longitude 38° 55' east. It has a total population of 99,711, of whom 49,546 are men and 50,165 women. Adwa occupies a total area of 1,888.60 kilometers^2 and a population density of 52.80. There are 20,141 households in Adwa with an average of 4.95 persons to a household (CSA 2008). Adwa *woreda* has a total of 18 *tabias*. Gendebta and Mariam Shewito *tabias* were selected for this study.

Gendebta is 21 kilometers east of Adwa and has a total population of 7,948 with 3,950 males and 3,998 females. There are 1,573 households, composed of 1,994 male-headed households and 380 female-headed households. Gendebta has a total land area of 3,634 hectares out of which 783 hectares have been cultivated, 865 hectares enclosed, 1,142 hectares earmarked to be enclosed, and 844 hectares under agroforestry use. In Gendebta *tabia* the entire four *kushets* (Bruh Tesfa, Wazga, Kmro, and Raeyo) were also selected for the survey.

4 *Kushet* refers to a village.

Mariam Shewito is 15 kilometers east of Adwa and has a population of 6,908 with 3,433 males and 3,475 females. There are 1,416 households, composed of 936 male-headed households and 380 female-headed households. The *tabia* occupies a total land area of 3,502 hectares, 618 hectares under cultivation, 616 hectares communal land, 998 hectares enclosed, 700 hectares under agroforestry, and 570 hectares earmarked to be enclosed. In Mariam Shewito all four *kushets*—Ketema, Daerowini, Genya, and Erar—were selected for the study.

Endamehoni

Endamehoni is situated in the southern zone of Tigray region (Figure 3.1) and is bordered on the south by Ofla, on the west by the Amhara region, on the north by Alaje, and to the east by Raya Azebo. Endamehoni lies between latitude 12° 45′north and longitude 39° 30' east. Maychew is the administrative center of Endamehoni. The *woreda* has a total population of 84,739, composed of 42,052 men and 42,687 women. The total land area is 2,287.71 kilometers^2, and the population density is 37.04 persons per square kilometer, which is less than the zonal average of 53.91. There are a total of 18,816 households, resulting in an average of 4.50 persons to a household (CSA 2008). Embahasti and Meswaeti *tabias* were selected from a total of 18 *tabias* in Endamehoni *woreda* for the study.

Meswaeti *tabia* has three *kushets*: Piasa, Maekel, and Edaga, with a total population of 4,255. There is a high population of females (2,561) in comparison to males (1,692). Furthermore, this *tabia* is characterized by soaring female-headed households, which account for almost 60 percent of the household heads. Meswaeti has a total of 431 hectares of cultivated land, 75 hectares watershed area, 125 hectares of forest, and 25 hectares enclosed area.

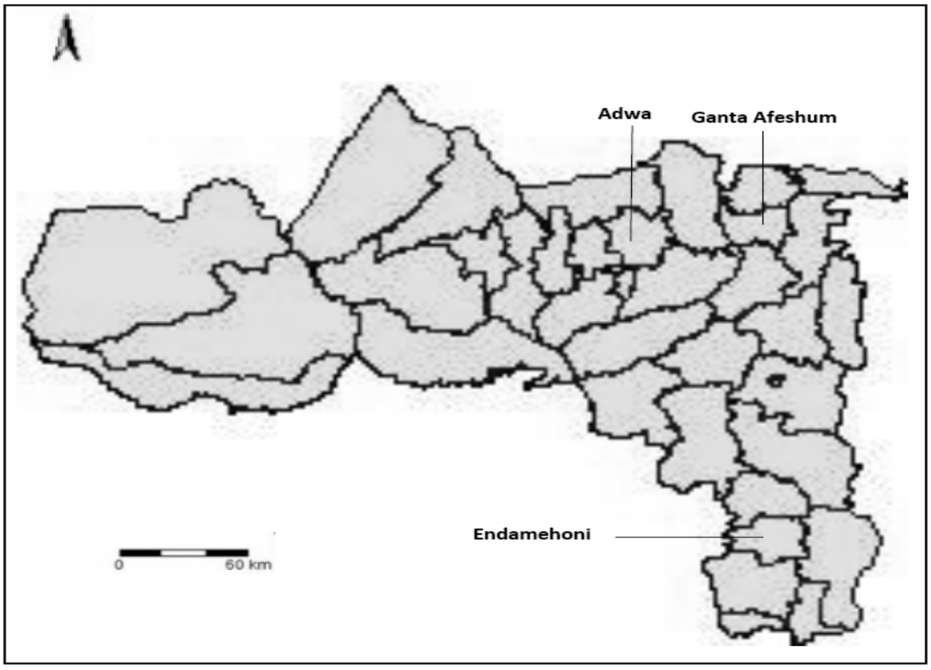
Tabia Embahasti has four *kushets*, namely, Adi Atsgeba, Bolenta, Degua, and Kola. It is characterized by a high female population of 2,121 compared to the male population of 1,884. Despite the domination of females in Embahasti, there are more male-headed households (533) than female-headed households (317). Embahasti has a total land area of 1,918 hectares, with 835 hectares cultivated, 447 hectares watershed area, 524 hectares forest, and 112 hectares enclosed area.

Ganta Afeshum

Ganta Afeshum is positioned in the eastern part of Tigray region (Figure 3.1), sharing boundaries with Hawzen in the south, Enticho to the west, Gulomahda in the north, and Saesi Tsaedaemba in the east. The administrative center is Adigrat. Ganta Afeshum lies between latitude 14° 20′ north and longitude 39° 15′ east with a total area of 1,636.36 kilometers^2. It has a total population of 88,644, with men and women consisting of 42,096 and 46,548, respectively. Population density in Ganta Afeshum is 54.17 persons per kilometer^2, with an average of 4.59 persons to a household (CSA 2008).

According to the Agriculture and Natural Resources annual report (2007), about 35 percent, 11 percent, 8 percent, and 49 percent of the *woreda*'s land is utilized for agriculture, forestry, grazing, and other purposes, respectively. The *woreda* has a total of 19 *tabias*. Hagere Selam and Sasun were selected for the study. Hagere Selam has an estimated population of 8,491, with 4,176 males, 4,315 females, and 1,294 households. Elevation in Hagere Selam ranges from 2,759 to 2,829 MASL. Hagere Selam has four communities; Dendera, Keshehat, Mitsnah Wegebet, and Nitsnah. The study was conducted in Dendera, Keshehat, and Mitsnah Wegebet. In Sasun *tabia* Bet Hawariat and Heli communities were selected from three communities. Sasun has an estimated total population of 4,625, dominated by females (2,437), and a total of 1,077 households (CSA 2008).

Figure 3.1—Map of the Tigray region showing the selected *woredas*



Source: Adapted from mapsof.net.

Sampling Method and Data Collection

The sampling method for data collection was explicitly designed to ensure adequate and relevant respondents. Primary data were collected from April to June 2011. A reconnaissance survey was first conducted to get familiar with the region and arrange for field collaborators. The main survey consisted of a household structured survey and focus group discussions (FGD) with selected farmers. Key informant interviews were also conducted and there were direct field observations of the extent of land degradation and fieldwork by the people.

Data Collection

Sampling Method

The central, eastern, and southern zones in Tigray were purposively selected for this research. The northwest and western parts were not selected because they are sparely populated and for security reasons. Also Mekelle special zone and southeastern zone are urban and not likely to suit the research focus. Three *woredas* were randomly drawn from the selected zones to include Adwa, Endamehoni, and Ganta Afeshum, situated in the central, southern, and eastern zones, respectively. *Woredas* were selected randomly to minimize bias and variance in the outcome. A total of six *tabias* were selected randomly from the *woredas* with each division being the source of two *tabias*. This was to ensure a complete representation of the total population and reduce prejudice as much as possible. Three to four *kushets* were then purposively selected from each of the six *tabias*. Criteria for selecting *kushet* included accessibility, compacted nature of group settlement, water management practices, and institutional arrangement by a church or mosque. This was to guarantee accuracy in the choice of study *tabias* and in this manner select exactly *tabias* involved in mass mobilization of compulsory free labor for the restoration of the ecosystem. The respective samples were selected from 20 *kushets* in the 6 *tabias*.

The sample administered questionnaire in each *kushet* varied from 20 to 27 farmers (Table 3.1). Randomized stratification was employed to select the number of farmers in each *kushet* for questionnaire interviews and FGD. Caution was taken to ensure that different smallholder farmers were selected for FGD and questionnaire interviews. Households in each *kushet* were stratified into male-headed and female-headed to ensure gender representativeness in the sample. Household heads were also regarded as the primary household decisionmaker with regard to agriculture and mass mobilization of labor for community work.

Table 3.1—Number of respondents interviewed in each *tabia* and *kushet* in the Tigray region

Woreda	*Tabia*	Number interviewed	*Kushet*	Number interviewed
Adwa	Gendebta	80	Bruh Tesfa	20
			Kmro	20
			Raeyo	20
			Wazga	20
	Mariam Shewito	80	Erar	20
			Daerowini	20
			Genya	20
			Ketema	20
Endamehoni	Embahasti	80	Adi Atsgeba	20
			Bolenta,	20
			Degua	20
			Kola	20
	Meswaeti	81	Edaga	27
			Maekel	27
			Piasa	27
Ganta Afeshum	Hagere Selam	81	Dendera	27
			Keshehat	27
			Mitsnah Wegebet	27
	Sasun	80	Bet Hawariat	40
			Heli	40
Total		482		482

Source: Author's creation.

Field Survey

For data collection a structured questionnaire was prepared to cover demographic characteristics, information on farmers' perception of climate change, their adaptation measures, the process and operation of *voluntary* uncompensated labor for collective action, and how knowledge is shared among farmers. Both open- and close-ended questions were included in the questionnaire. The questionnaire was pretested in Debretsehay and Dibla *kushets* in Adwa and Ganta Afeshum *woredas*, respectively, to ensure relevance (questions are pertinent to the objective of the research), validity (questions can be answered correctly by the respondents), and reliability (questions are stated clearly and specifically).

Detailed data were collected on information flows in each of the selected *kushets* using hypothetical, actual, and self-reported data sets. Hypothetical information flows explored questions such as: "With whom do you discuss important information on changes in the climate and ecological restoration?" "To whom do you give information?" "From whom do you receive information?" "What is the age of each person?" "What is the education level?" "Where does this person live?" "Approximately how far?" "Is this person a relative?" "Is this person from the same ethnic group?" "How often do you talk about new weather coping strategies with this person?" Actual information diffusion focused on farmers' sources of information in the *kushets* and self-reported learning networks based on who in farmer A's opinion farmer B would discuss and share important information on climate change and ecological restoration with. The snowball technique in which any actor mentioned became a potential candidate for interview was used in social network data collection. However, the randomized

stratification of selected farmers limited us in interviewing farmers outside our selected framework, although these were very few and thus the self-reported were used to fill omitted data.

The questionnaire was administered on head of households. Face-to-face interviews using the questionnaire were conducted by trained enumerators in the Tigre language. To avoid disruption in farm work, the survey was conducted during the dry season when farmers were less busy with farming activities. On the average, one interview took about 45 minutes.

Focus Group Discussion

To complement the data and help contextualize the results from the structured interviews, one FGD was conducted in each *tabia* that was selected for the study. The discussants were opinion leaders in the *tabias* comprising heads of peasant associations, *tabia* managers, religious leaders, and other key informants. The FGDs generated information on farmers' perceptions and experiences of climate change, their indigenous knowledge systems about the ecology, changes observed over the years, the different adaptation measures they have adopted, the procedure for sharing community proceeds, and the role of gender in community mobilization. Further discussions were held about division of labor between men and women during communal work; how resistance, if any, was dealt with; and general problems they encountered in mobilizing the people for ecological restoration.

Data Analysis

The data management and analysis was done using Statistical Package for Social Sciences (SPSS) 18 for Windows. Pearson's Chi-square (X^2) tests (non- parametric) were also used to compare categorical variables and test the null hypothesis, which states that there is no significant difference between the expected and observed result. Responses on projects that compulsory free labor is usually mobilized for, motivation for participation, role and benefits derived from the establishment of a community woodlot and a village grazing area, conflict resolution mechanisms in community mobilization, responsibilities of females and males in community work, and how knowledge and information on climate change and ecological restoration is shared among men and women were tested using the Chi-square (X^2)model:$X^2 = \sum[(Q_i - E_i)^2 \div E_i]$, where $Q_i =$ observed frequencies and $E_i =$ expected frequencies. Descriptive statistics were computed and pairwise cross tabulations were done to ascertain *bivariate* relationships.

UCINET 6 for Windows, a social network analysis software package, was employed to analyze social relationships through numerical and visual representations as in Borgatti, Everett, and Freeman (2002) and Borgatti (2006). Data on interpersonal social networks were entered into 108-by-108 matrices in UCINET 6. Every farmer name that was mentioned in the interviews was entered into the matrix in order to fully display relationships and communication between individuals. Graphic networks were generated for three levels of behavior-relevance: (1) discussion networks displaying who talks to whom on climate change and community mobilization (receiving and giving advice), (2) the frequency of discussions, and (3) how useful the advice received was.

4. RESULTS

General Information of the Respondents

Males dominated the sample (60.6 percent), and the majority (38.2 percent) of the respondents were above 45 years of age. The rate of literacy[5] among respondents was high at about 60 percent of the sample (Table 4.1). However, most of those who could read and write had only attended primary school, constituting 43.6 percent of the sample. There was some homogeneity in the sample with all respondents being Tigre and also orthodox Christians. Many of the respondents had lived in their *kushets* for over 30 years (71.0 percent) with only 6.0 percent residing for a period of 1–10 years (Table 4.1).

Table 4.1—Demographic characteristics of respondents in the sample area, Tigray region

Characteristic	Frequency (Percent)	Characteristic	Frequency (Percent)
Sex		***Literacy***	
Male	292 (60.6)	Yes	287 (59.6)
Female	190 (39.4)	No	195 (40.5)
Age		**Length of stay in the *kushet***	
18–25	39 (8.1)	1–10 years	29 (6.0)
26–35	97 (20.1)	1–20 years	35 (7.3)
36–45	162 (33.6)	21–30 years	76 (15.8)
Above 45	184 (38.2)	Over 30 years	342 (71.0)
Level of education attained		**Religion**	
Primary	210 (43.6)	Orthodox Christian	482 (100)
Secondary	50 (10.4)	STD	.000
Tertiary	6 (1.2)		
Adult Education	21 (4.4)	**Ethnicity**	
Illiterate	195 (40.5)	Tigre	482 (100)

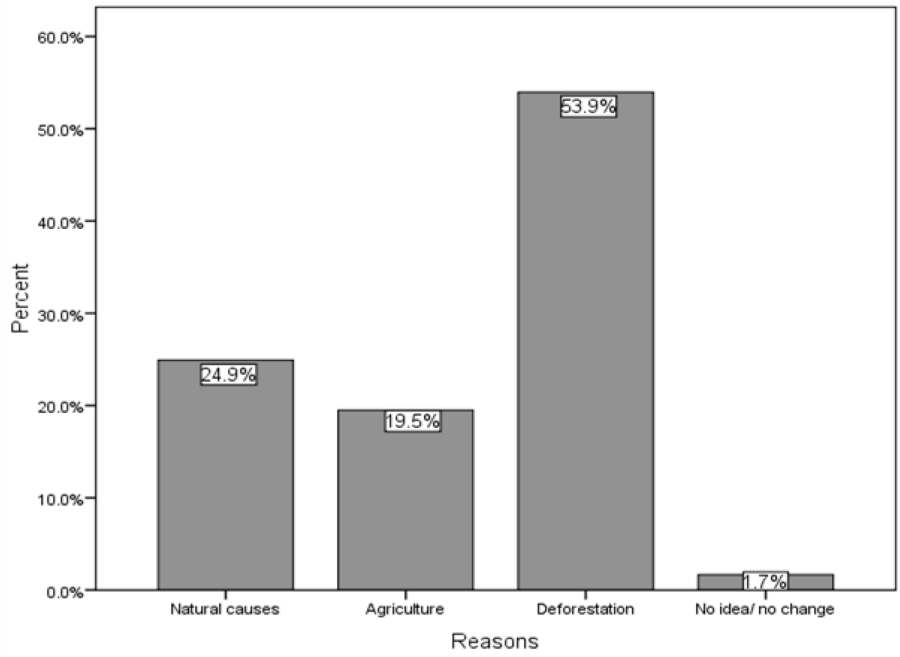
Source: Household survey 2011.

Changes in the Climate

Respondents (98.3 percent of the sample) had observed changes in the climate during their lifetime and they attributed them to deforestation (53.9 percent), natural causes (24.9 percent), and agriculture (19.5 percent; see Figure 4.1). During the FGD, many of the participants said they had observed a stable ecology with vegetative cover during their infancy, characterized by very cold temperatures, and abundant water resources available all year-round for irrigating vegetables and maize crops. They asserted that their lands were fertile and they did not have to depend on chemical fertilizers to maintain soil fertility. A farmer from Gendebta *tabia* asserted: "I have lived in this locality all my life, at the moment I am 61 years old. When I was a child this place was all covered with vegetation; it was green, forested, and fascinating. The forests were closed with rivers and lakes all year-round, with large hectares of uncultivated land and wild animals. However, in the course of time I have witnessed a decrease and a subsequent disappearance of the natural resources. There were no gullies; however, later many gullies surfaced and separated communities from one another."

[5] *Literacy* in this context refers to respondents who can read and write.

Figure 4.1—Reasons attributed to the changes in climate



Source: Household survey 2011.

The respondents admitted observing changes in the climate, including increased incidence of drought (62.2 percent of respondents) and a rise in the temperature (90 percent of respondents) in their lifetime. Flooding seemed not to be widespread in the study *tabias*, as about 67.8 percent of the respondents had not observed increased occurrences of seasonal floods in the last 10 years. They agreed that over time, as the community cut trees indiscriminately, the forests and water bodies also disappeared. The rate of soil erosion increased and the amount of available water for irrigating foodcrops also diminished. Consequently, land degradation and soil erosion were severe and drought also set in.

About 86 percent of the respondents had observed increased variety in the crops grown in the area. For instance, in Embahasti *tabia* only indigenous trees common to Ethiopia had been planted in the past, but at the moment exotic tree species and fruit trees have been planted as part of efforts to improve and restore the ecology. New plants include eucalyptus (*Eucalyptus globules* and *Eucalyptus camaldulensis*) trees, which tend to absorb water and affect the ability of groundwater to recharge, thus reducing the water available for other plants. The communities complained about the widespread cultivation of eucalyptus on communal lands; they named it as the main cause of the devastation of their ecology, which has made them resort to intensive agriculture. About 46 percent of the respondents reported having experienced crop failure due to the worsening situation of the ecology.

Despite the observance of drought in the area, 60.2 percent of the respondents in the structured survey said that the amount of rainfall was increasing during the main rain season, although focus group discussants intimated that the increase in rainfall is a recent occurrence (during the last two years).

According to the farmers, the major reason for human-induced causes of the change in the ecology was lack of education of farmers about the importance of conservation; as a consequence, they indiscriminately cut down trees to put more land under cultivation instead of increasing their productivity. "The government at that time did not make an effort to educate and alert us," one focus group discussant surmised.

Another cause of continued degradation of the ecology was the conflict caused by a war to dislodge the military government that was in power from 1974 to 1991 and the subsequent war between Ethiopia and Eritrea. These conflicts led to complete disregard for ecological restoration in Ethiopia, especially the Tigray region. According to the farmers in Ganta Afeshum, the people of Ethiopia during

the Derg regime (military government) had little means of making a living and so in the absence of forest guards they cut down trees indiscriminately and took the timber to Adigrat[6] to sell to make a living. Apparently soldiers also contributed to the depletion of the forests when soldiers of the Tigray People's Liberation Front (TPLF), which was fighting the military government and had a military camp in Ganta Afeshum *woreda*, cut down trees in the area for fuelwood without any replanting. These actions resulted in severe degradation of the ecology and led to shortage of rainfall. Population pressure is another major cause of the changes in the ecology. Farmers now have less than 1 hectare of land (as compared to about 2 hectares they had before) and so they cannot practice crop rotation on a large scale to rejuvenate the soil.

Table 4.2 presents respondents' perception of possible threats to their livelihoods by the changes in the climate. About 92 percent of them considered that changes in climate would likely affect their livelihood. However, farmers admitted that although in the past resources were relatively abundant, they did not know how to use them efficiently to enhance their livelihood, and poverty also made them act in some ways that were detrimental to ecological stabilization. Currently, due to technical and material support from the government, the people are able to restore the ecology and adopt improved agricultural practices, which have resulted in improvements in their livelihoods.

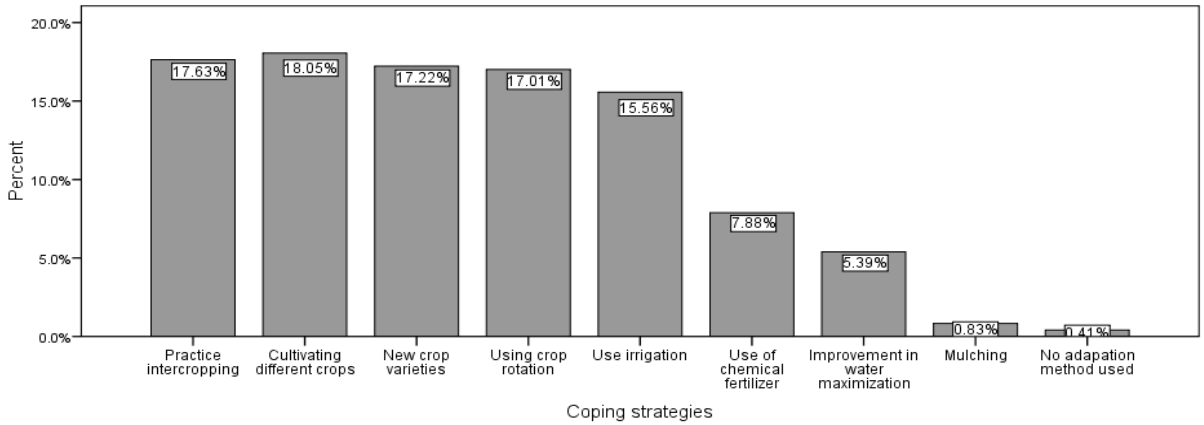
Table 4.2—Perceived threats to livelihoods by changes in the climate

Response	Frequency	Percent
Threats likely	443	91.9
Threats not likely	36	7.5
No idea	3	.6
Total	482	100.0
STD = 0.304		

Source: Household survey 2011.
Note: STD = standard deviation.

Coping strategies that have been adopted by farmers to combat the effects of changing climate include intercropping (17.6 percent of respondents), cultivation of different crops (18.1 percent), introduction of new crop varieties (17.2 percent), and irrigation (15.6 percent; see Figure 4.2). The adoption of the various strategies has been possible through the education imparted to the farmers by officers of the Bureau of Agriculture (48.5 percent), generational transfer of knowledge (25.3 percent), and through trial and error (26.2 percent).

Figure 4.2—Climate change adaptation strategies used by the farmers in the Tigray region



Source: Household survey 2011.

[6] The administrative center of *woreda* Ganta Afeshum.

Compulsory Free Labor for Community Work

Generally, almost all the farmers (99.6 percent) interviewed had participated in compulsory free labor for community work with only two who had never contributed labor because of health reasons. The community contributed free labor for various activities covering soil and water conservation (SWC; 61.0 percent), irrigation projects (18.9 percent), and construction of public infrastructure (13.1 percent; see Table 4.3). Mobilization of the people for communal work was done according to work groups (46.9 percent), development groups (27.0 percent), peasant associations (9.5 percent), and general mobilization at the *tabia* level (16.6 percent). During the commencement of community work, the developmental group leaders (30.9 percent), *tabia* heads (40.7 percent), and officials of the Bureau of Agriculture (28.4 percent) combined to take charge of overseeing that the work was carried out (Table 4.3).

Table 4.3—Projects that compulsory free labor is usually mobilized for and persons who mobilized the community for community work

	Community project	Who mobilized the community for compulsory free labor for community work?			
		Developmental group leaders	*Tabia* head	Officials of Bureau of Agriculture	Total
	Soil and water conservation	72(14.9)	117(24.3)	105(21.8)	294(61.0)
	Irrigation	37(7.7)	47(9.8)	7(1.5)	91(18.9)
	Public infrastructure	19(3.9)	30(6.2)	14(2.9)	63(13.1)
	Tree planting investment	21(4.4)	2(.4)	11 (2.3)	34(7.0)
Total		149(30.9)	196(40.7)	137(28.4)	482(100.0)
$\chi^2 = 51.115$					
df = 6					
P value = 0.000					

Source: Household survey 2011.

Notes: X^2 = Pearson chi-square value. Figures in parenthesis are the percentages and those without parentheses are the frequencies.

Respondents (99.6 percent) who contributed labor for communal work did so for a period of 20 days per year during the dry season so that it did not conflict with farm work. Approximately all the respondents (97.3 percent) considered the restoration of the ecology as a benefit they derived from compulsory free labor for community work. Approximately all (99 percent) of the farmers interviewed from the study *tabias* felt inspired to offer their free labor for community work. The motivation for the work included improvement in their livelihood (43.2 percent), increase in foodcrop production (36.3 percent), and possible increase in groundwater availability (19.5 percent; see Table 4.4).

Table 4.4—Motivation to participate in compulsory free labor for community work

		Reasons for feeling motivated					
		Contribution to enhancing livelihood	Increases the production of foodcrops	Increases water availability	Not applicable	I wish to work on my private land	Total
Motivation for participating in compulsory free labor for community work	Yes	208(43.2)	175(36.3)	94(19.5)	0(.0)	0(.0)	477(99.0)
	No	0(.0)	0(.0)	0(.0)	0(.0)	3(.6)	3(.6)
	N/A	0(.0)	0(.0)	0(.0)	2(.4)	0(.0)	2(.4)
Total		208(43.2)	175(36.3)	94(19.5)	2(.4)	3(.6)	482(100.0)
$\chi^2 = 9.640$							
df = 8							
P value = 0.000							

Source: Household survey 2011.
Notes: X^2 = Pearson chi-square value. Figures in parenthesis are the percentages and those without parentheses are the frequencies. N/A = not applicable.

On the whole about 80.5 percent and 68.9 percent had given their free labor for the establishment of a community woodlot and a village grazing area, respectively (Table 4.5). Farmers were content to give free labor and materials for the establishment of a grazing area because 45.9 percent of them felt they had spare time to contribute labor, 30.4 percent considered it a source of feed for their livestock, and 23.7 percent wanted to restore the ecology. For community woodlots, the motivation for participating in their establishment included availability of spare labor (40.9 percent), source of fuelwood (35.3 percent), and ecological restoration (23.9 percent).

Table 4.5—Role played in the establishment of a community woodlot and a village grazing area

		Role played			
		Labor	Material	Not applicable	Total
Involvement in the establishment of a community woodlot	Yes	388(80.5)	76(15.8)	0(.0)	464(96.3)
	No	6(1.2)	10(2.1)	0(.0)	16(3.3)
	N/A	0(.0)	0(.0)	2(.4)	2(.4)
Total		394(81.7)	86(17.8)	2(.4)	482(100.0)
$\chi^2 = 5.045$					
df = 4					
P value = 0.000					
Involvement in the establishment of a village grazing area	Yes	332(68.9)	61(12.7)	0(.0)	393(81.5)
	No	2(.4)	4(.8)	0(.0)	6(1.2)
	N/A	60(12.4)	21(4.4)	2(.4)	83(17.2)
Total		394(81.7)	86(17.9)	2(.4)	482(100.0)
$\chi^2 = 24.392$					
df = 4					
P value = 0.000					

Source: Household survey 2011.
Notes: X^2 = Pearson chi-square value. Figures in parenthesis are the percentages and those without parentheses are the frequencies. N/A = not applicable.

Ecological restoration was important to the communities because of the realization that without doing so their soils would continue to be poor and land productivity would be low. For most of the respondents the major assets they possessed were their land and labor and so it was important to safeguard them to enhance their livelihood. Rainfall was considered vital for crop, livestock, and milk production, but most of the respondents were aware that adequate rainfall would not be obtained without significant tree cover. This notion motivated them to reclaim land that had been engulfed with gullies and cultivate plant species that provided vegetative cover and feed for their animals and helped to maintain soil fertility, thereby reducing the dependence on chemical fertilizers.

According to the farmers, although they received food or cash under the PSNP when they worked to conserve their lands, they were not discouraged to give free labor for the same purpose under the communal work scheme because their ultimate aim was to restore their ecology, increase water availability, and maximize farm production. They believed in the essence of conservation and were of the opinion that without it they would perish. One focus group discussant summarized, "We consider conservation as our life and we cannot live without it." Another said, "We either survive or we are eliminated from this environment. It is therefore important to restore our ecology"; and from yet another discussant, "It is also imperative to leave the next generation a legacy of sound sustainable ecology to enhance continuous productivity and survival." With the support of the nongovernmental organizations (NGOs) and the Government of Ethiopia they had resolved to work unrelentingly to prevent environmental degradation.

Farmers derived various benefits from community woodlots and village grazing areas. The benefits obtained from woodlots included cutting trees for building houses (40.5 percent), cutting trees for constructing locally made ox plough (22.2 percent), and collecting tree debris for fuel wood (22.2 percent). Many of them had the benefit of a grazing area for their livestock (40.9 percent) and subsequently harvested hay for their livestock (15.8 percent; see Table 4.6).

Table 4.6—Benefits derived from the establishment of a community woodlot and a village grazing area

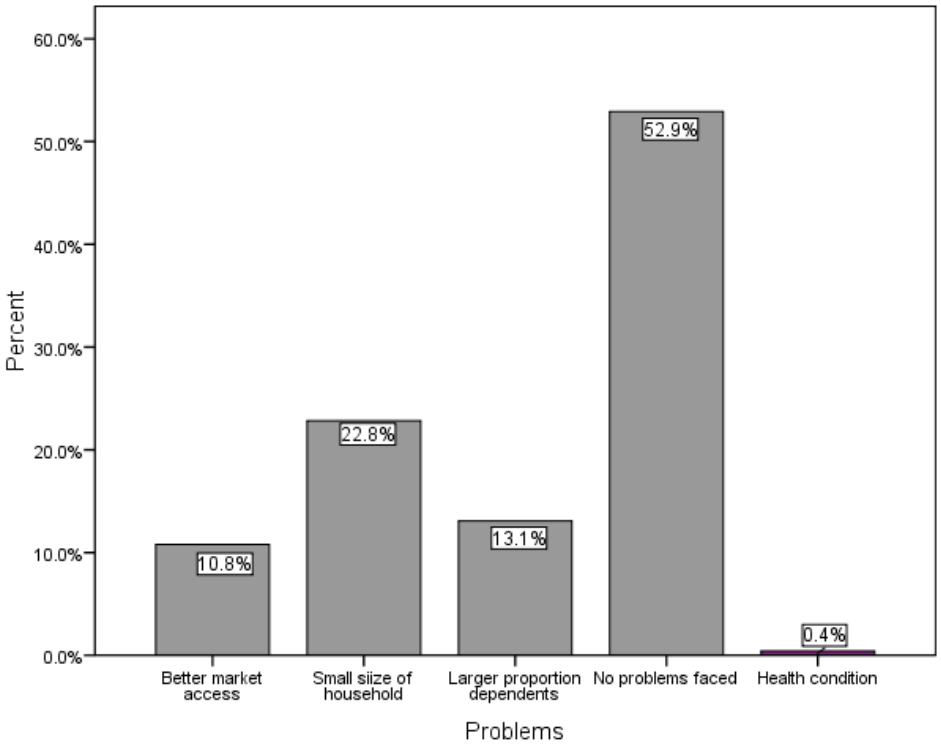
Woodlot/Grazing area		Benefits of a woodlot/grazing area					
		Cutting trees for construction of house	Cutting trees for ox plough construction	Fuelwood collection from dead trees	Revenue from the sale of trees	Beekeeping	Total
	Yes	195(40.5)	107(22.2)	107(22.2)	8(1.6)	47(9.8)	464(96.3)
Woodlot	No	5(1.0)	9(1.9)	0(.0)	2(.4)	0(.0)	16(3.3)
	N/A	0(.0)	1(.2)	1(.2)	0(.0)	0(.0)	2(.4)
Total		200(41.5)	117(24.3)	108(22.4)	10(2.0)	47(9.8)	482(100.0)
$\chi^2 = 23.707$							
df = 8							
p-value = 0.003							
Grazing area		Grazing area for livestock	Cutting grass for feed	Cutting grass for thatching	Dung collection	Beekeeping	Total
	Yes	197(40.9)	76(15.8)	72(14.9)	5(1.0)	43(8.9)	393(81.5)
	No	3(.6)	3(.6)	0(.0)	0(.0)	0(.0)	6(1.2)
	N/A	0(.0)	38(7.9)	36(7.5)	5(1.0)	4(.8)	83(17.2)
Total		200(41.5)	117(24.3)	108(22.4)	10(2.0)	47(9.8)	482(100.0)
$\chi^2 = 94.371$							
df = 8							
p-value = 0.000							

Source: Household survey 2011.

Notes: X^2 = Pearson chi-square value. Figures in parenthesis are the percentages and those without parentheses are the frequencies. N/A = not applicable.

About half of the respondents (52.9 percent) felt that problems were not encountered in getting people for community work. Those who thought problems were encountered attributed them to small size of households (22.8 percent), larger proportion of dependents (13.1 percent), and better market opportunities in their communities (10.8 percent; see Figure 4.3).

Figure 4.3—Problems encountered in getting people for community work



Source: Household survey 2011.

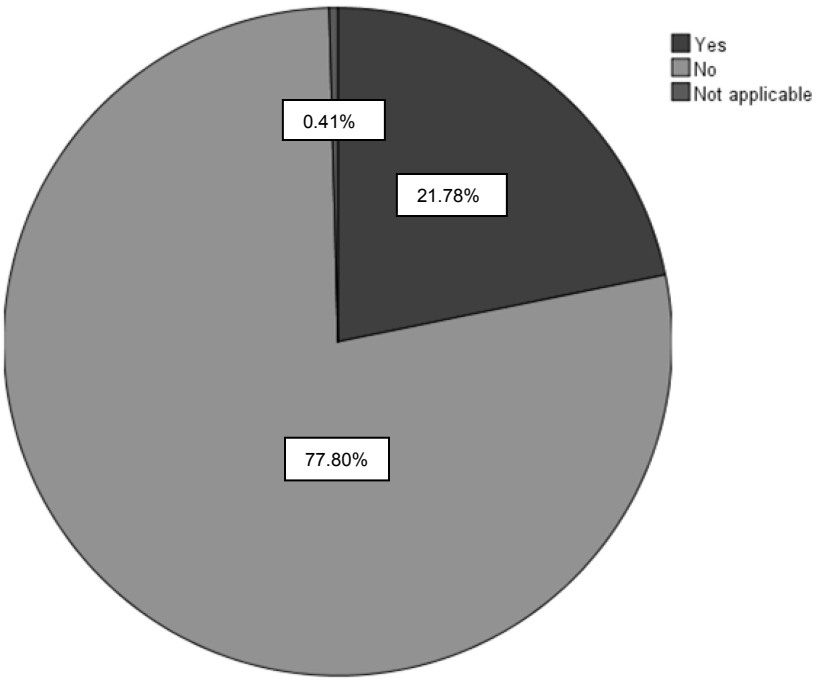
About 45 percent of the respondents did not think they faced any challenges in participating in compulsory free labor for community work. However more than half of the respondents made mention of various activities that conflict with communal work, including domestic work (21.8 percent), taking care of livestock (19.3 percent), and other business activities (13.1 percent). There were reports of shortages of tools and materials for undertaking communal work such as hammers, nails, wire mesh, pickaxes, hoes, and shovels. The females were the most affected by the shortage of tools for communal work. Many of the males were able to buy tools by themselves but the females tended to be constrained.

The communities were confronted with a mountainous topography, and climbing the mountains was complex and precarious. The people were also vulnerable to scorpion stings and snakebites and sliding or falling rocks from the hillsides as they worked on the watersheds. This was further compounded by the deplorable road network—when there was an accident during communal work in the catchment area in the mountains, it was difficult to transport the injured person to a clinic or health center in a timely fashion. The inaccessibility of the road network also hindered the transport of cement and other materials to the catchment area for community work.

Most respondents (77.8 percent) had not observed any form of resistance to compulsory free labor for community work because they considered the land as their own (Figure 4.4). “There is no resistance in communal work,” one focal group discussant asserted. “We can say confidently and boldly that there is no resistance even in this entire *woreda* [Endamehoni] and the whole Tigray region in mobilizing people for community work. We are in high spirits to participate in the compulsory free labor for community work; amidst the challenges we have, we work diligently.” They acknowledge that they

have soil moisture and water conservation problems; it was therefore important to contribute their free labor. They believe that this generation must restore the ecology and ensure the maximization of production, thus "we give maximum labor and achieve maximum productivity," another focal group discussant said. According to the farmers, they have been fully involved in the compulsory free labor initiative and also supported the idea. Twenty years ago the mountains were bare, but through committed and enthusiastic contribution of free labor for SWC these mountains have been conserved.

Figure 4.4—Resistance to community work



Source: Household survey 2011.

However, there were instances when very poor farmers who did not have anything to eat went to their private farms to work. Nevertheless, these farmers believed that the area must be conserved and thus saw the need for free labor mobilization for community work. Most of the people were happy to work and there was also a local bylaw that stipulated that anyone who absented himself/herself from community work due to travel to another *tabia* would be punished with a heavier workload than is usually accomplished in a day. Absenteeism due to sickness, pregnancy, or traveling to another *tabia* for a funeral was not considered a form of resistance to community work. The sick were required to provide evidence from a doctor, otherwise they were penalized.

During conflict resolutions with reference to any form of resistances, the community employed mediation through discussions with the entire community (38.8 percent), through the use of group elders in a conflict resolution committee (30.3 percent), through the use of the bylaw as a point of reference in a local court (16.4 percent), and through the involvement of the peasant association (14.5 percent; see Table 4.7).

Table 4.7—Conflict resolution mechanisms in community mobilization

		Conflict resolution				
		Conflict resolution committees	Through discussions	Local courts	Peasant association	Total
Resistance in compulsory free labor for community work	Yes	35(7.3)	62(12.9)	3(.6)	5(1.0)	105(21.8)
	No	111(23.0)	124(25.7)	75(15.6)	65(13.5)	375(77.8)
	N/A	0(.0)	1(.2)	1(.2)	0(.0)	2(.4)
Total		146(30.3)	187(38.8)	79(16.4)	70(14.5)	482(100.0)
$\chi^2 = 40.634$						
df = 6						
p -value = 0.000						

Source: Household survey 2011.
Notes: X^2 = Pearson chi-square value. Figures in parenthesis are the percentages and those without parentheses are the frequencies. N/A = not applicable.

The Role of Gender in Community Mobilization

In compulsory free labor for community work the males were solely responsible for providing labor (66.0 percent) and materials (34.0 percent). Some of the females took charge of cooking (warming food and making tea and coffee during recess—6.6 percent) and cleaning up the environment after work (2.9 percent). However, many of the females also contributed labor (55.6 percent) and materials (34.9 percent), just like the males (Table 4.8). The only difference is that females did half the workload of males.

Table 4.8—Responsibilities of females and males in free labor for community work

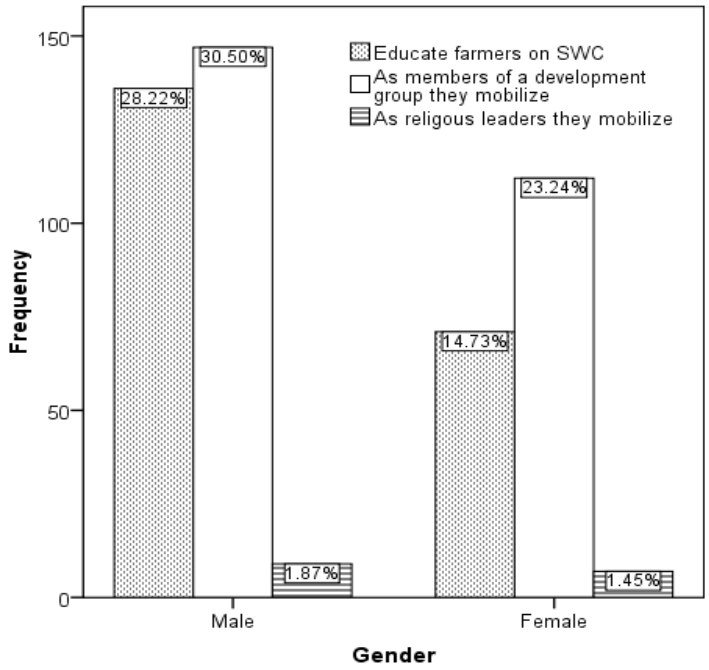
		Role of Females				Total
		Cooking	Cleaning the environment	Labor	Materials	
Role of Males	Labor	31(6.4)	13(2.7)	191(39.6)	83(17.3)	318(66.0)
	Materials	1(.2)	1(.2)	77(16.0)	85(17.6)	164(34.0)
Total		32(6.6)	14(2.9)	268(55.6)	168(34.9)	482(100.0)
$\chi^2 = 42.012$						
df = 3						
p-value = 0.000						

Source: Household survey 2011.
Notes: X^2 = Pearson chi-square value. Figures in parenthesis are the percentages and those without parentheses are the frequencies.

At the work site, the people worked in groups of about 10–15, with both men and women carrying out the same activities. Each group had a leader that was either a male or a female. The leader was responsible for planning, sequencing of various activities, scheduling, and organizing the people in the group for the work. However, the development agent was in charge of giving out the workload to the group leaders and undertook overall supervision of the work.

In mobilizing people for community work, gender played an important role in sensitizing farmers on the importance of SWC. A total of about 30.5 percent males and 23.24 percent females participated in mobilizing the community for work in their respective developmental groups (Figure 4.5).

Figure 4.5—The role of gender in mobilizing people for compulsory free labor for community work



Source: Household survey 2011.

Community associations consisted of 20–30 members for men, women, and the youth (18–29 years of age) separately. Although organized separately, they also belonged to developmental groups with both men and women as members. Groups were used as machinery for organizing the people for community work. The leaders of the developmental groups and associations played the role of mobilizing their members for community work. They also educated members on the importance of community work.

If conflicts rose from community work the males as well as the females played active roles in resolving them. However, males further provided security and restored the community to calm when there was any type of disturbance or misunderstanding.

About 54.4 percent of the respondents perceived that benefits accrued from community work were shared equally among men and women, guided by the appropriate bylaws and with the active participation of all the people who took part in the communal work. However, when the product was scanty, balloting[7] was used to share it with the active participation of both males and females. In Mariam Shewito *tabia*, when the product was not enough, they would first conduct a meeting involving the entire community. During the meeting the community would decide what to use the product for. They may decide to share the resource by balloting or donate it to a school or health center to sell and use the proceeds for maintaining these public facilities.

In Gendebta, when the communal product was not enough to be shared among all the men and women in the community, they would share according to the poverty–wealth status of farmers. Priority would be given to the very poor farmers in the community before others would be considered. A similar procedure was used in Hagere Selam and Sasun. In Meswaeti the women were given 60 percent of the product; however, when it was not enough then it would be shared equally among the households in the community. In Embahasti *tabia* despite the fact that there were no differences in sharing the products according to the bylaws, there was nothing to share. This was because they did not have control over the eucalyptus trees they had planted on their communal lands. It was alleged that the entire plantation on the

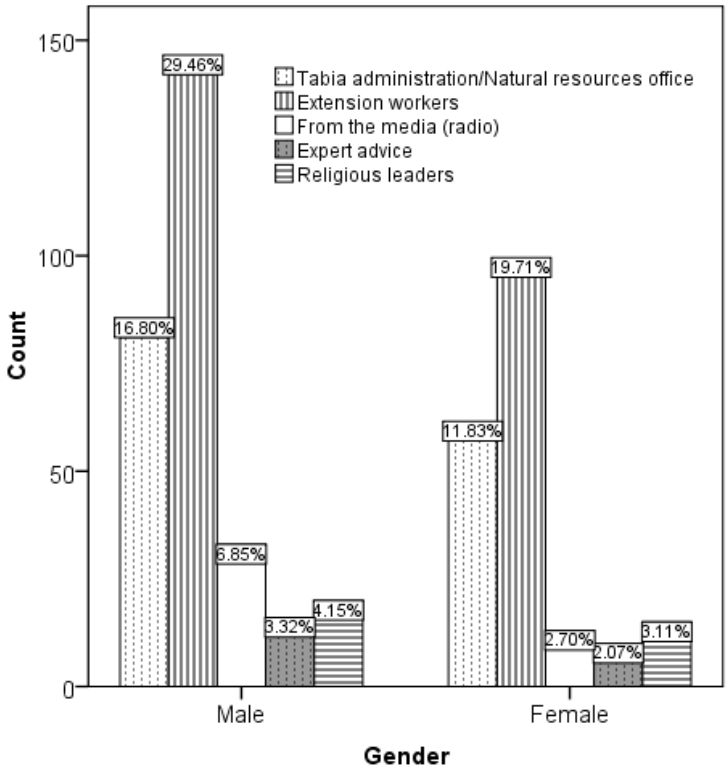
[7] Community recipients are drawn at random and the process of sharing is governed by chance.

communal lands had been sold to the Maichew factory for half a million birr.[8] Inhabitants were disappointed they did not receive any money from the sale of the communal product. They apparently blamed the *tabia*, zonal, and *woreda* officers whom they alleged had not been transparent with the community.

Social Learning through Networks among Farmers in Tigray

Respondents in Tigray had many external sources of information on changes in the climate and ecological restoration. Most females (19.7 percent) and males (29.5 percent) received their information from extension workers (Figure 4.6). It is worthy of note that in the community, 22.2 percent of males shared this information and knowledge with both men and women compared to about 17.2 percent females. Females (21.8 percent) were more enthusiastic to share information with their fellow women than with their male counterparts (Table 4.9).

Figure 4.6—Sources of information and knowledge on climate change and ecological restoration by males and females



Source: Household survey 2011.

[8] One US dollar is equivalent to 17 Ethiopian birr in August 2011.

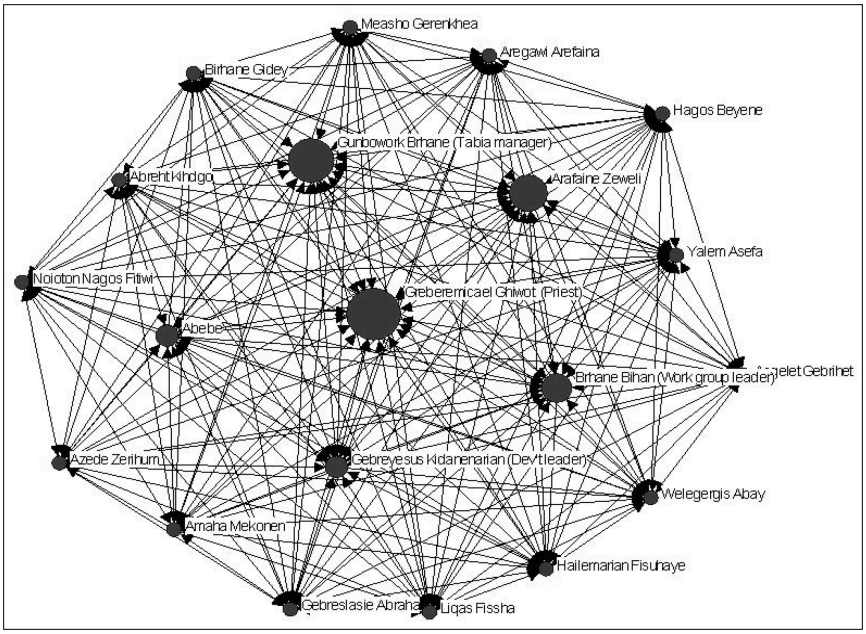
Table 4.9—How knowledge and information on climate change and ecological restoration is shared among men and women

Gender	Knowledge and information sharing among men and women							
	Women share with women	Women share with both men and women	Men share with only men	Men share with men and women	Information is shared among us at meetings by the development agent	By the local elders and leaders	Religious leaders	Total
Male	55(11.4)	50(10.4)	56(11.7)	77(16.0)	14(2.9)	20(4.1)	20(4.1)	292(60.6)
Female	50(10.4)	33(6.8)	33(6.8)	30(6.2)	13(2.7)	20(4.2)	11(2.3)	190(39.4)
Total	105(21.8)	83(17.2)	89(18.5)	107(22.2)	27(5.6)	40(8.3)	31(6.4)	482(100.0)
$\chi^2 = 2.831$								
df = 4								
p-value = .587								

Source: Household survey 2011.
Notes: X^2 = Pearson chi-square value. Figures in parenthesis are the percentages and those without parentheses are the frequencies.

Figure 4.7 presents the exchange of information on climate change and compulsory free labor among farmers in Ketema. It depicts 20 farmers (actors) involved in information exchange. Almost all the farmers in this *kushet* were connected directly or indirectly. The direct lines depict ties or connections between members in the network. The size of the nodes represent the degree of influence (or engagement) of members in the network in the exchange of information. Bigger nodes represent key actors and the opposite is true for smaller nodes. Thicker lines depict higher frequency of communication. Four major information brokers in Ketema included the priest, *tabia* manager, development group, and work group leaders.

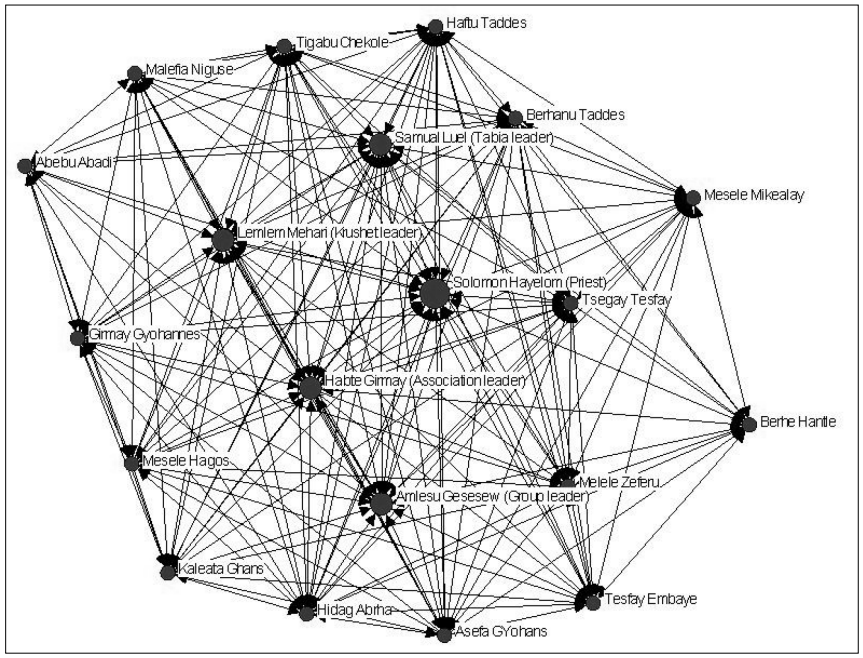
Figure 4.7—Key actors in the diffusion of information and knowledge in Ketema *kushet* in Adwa *woreda*



Source: Household survey 2011.

In Bolenta *kushet* in Endamehoni *woreda* the nature of the relationships that existed among the different actors found dominance in the flow of knowledge and information among four farmers (Samuel Luel, Habte Gimay, Lemlem Mehari, and Amlesu Gesesew), who were leaders of associations, and the *kushet* priest (Solomon Hayelom; see Figure 4.8).

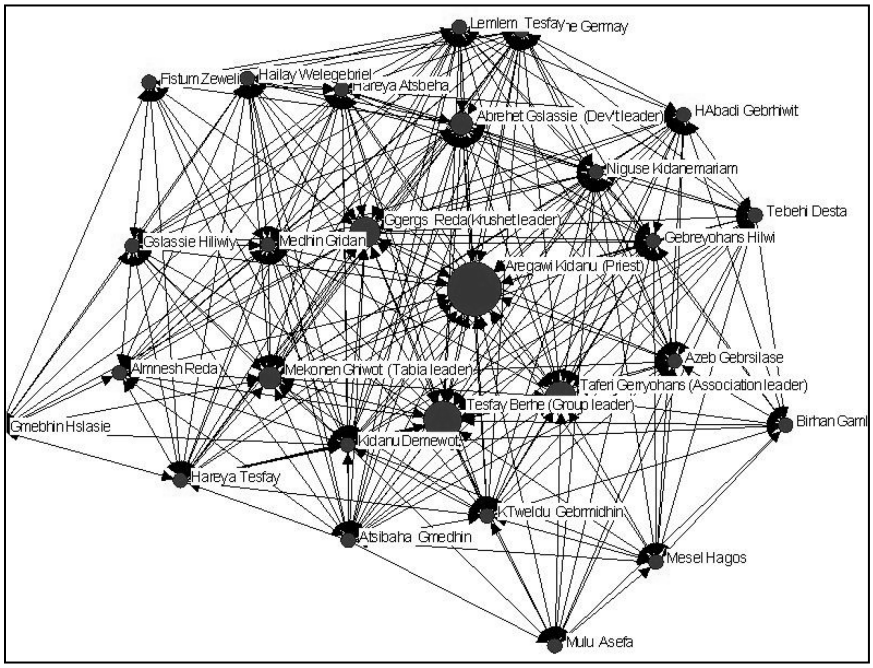
Figure 4.8—Key actors in the diffusion of information and knowledge in Bolenta *kushet* in Endamehoni *woreda*



Source: Household survey 2011.

The exchange of information among farmers in Mitsnah illustrates 27 actors in the *kushet* (Figure 4.9). A key information broker in this *kushet* included the village priest and a few other farmers. Central to the diffusion of knowledge was priest Aregawi Kidanu, Ggergs Reda, Tesfay Berhe, Taferi Grryohans, Mekonen Ghiwot, and Abrehet Gslassie. One important finding is the role played by group leaders and the local priest in knowledge and information dissemination. Farmers relied on neighbors (intra- and inter-village) and kinship for their social network information on climate change and community mobilization for ecological restoration. Information was also shared among people in the same community and also among people in neighboring communities. Most of the exchange of information and knowledge in the *kushets* occurred in households within 0.1–0.2 kilometers and 0.9–1.0 kilometers distance.

Figure 4.9—Key actors in the diffusion of information and knowledge in Mitsnah Wegebet *kushet* in Ganta Afeshum *woreda*



Source: Household survey 2011.

5. DISCUSSION

Demographic Characteristics

The study shows that literacy levels among the respondents in the Tigray region are high (59.6 percent) and thus households with better education are more likely to have enhanced understanding of new technologies and so may be more likely to adopt new technologies (Yesuf and Pender 2005). Also, high literacy rates among farmers increase understanding of conservation for productivity and thus result in increased investments in land improvements and management (Tessema and Holden 2005; Pender and Gebremedhin 2004; Gebremedhin et al. 2003) and the readiness to contribute *voluntary* uncompensated labor.

All interviewees were Tigrayan and also orthodox Christians, reflecting a homogenous social structure with shared norms and beliefs. This perhaps supports the hypothesis on why these communities are well structured and also demonstrate unwavering commitment for compulsory free labor for community work. The theory of a community as having mutual norms and common interests is strongly dependent on the views of its members. This concept of community subsisting among individuals with shared interest is rooted in the premise by Ascher (1995, 83): "common interests and common identification growing out of shared characteristics." Common and shared, rather than individual and egocentric, is the recipe for successful community resource management. For this reason, in a community, individuals relinquish some of their individuality instincts and work as a single entity to achieve communal goals (Agrawal and Gibson 1999Kiss 1990). These individuality instincts apparently promote the nexus among community members that uphold profitable collective decisions.

The majority of the indigenes (71 percent) had lived in their *kushets* for over 30 years and had in-depth knowledge of the ecology and any changes that have taken place over the years. This might have contributed to the willingness of the people to respond to the call to come together to restore the degraded ecology. More to the point, Ishaya and Abaje (2008) and Nyong, Adesina, and Elasha (2007) assert there is an increasing realization of valuable sources of ecological information from indigenes.

Changes in the Climate

Results show that farmers undoubtedly acknowledge a change in the climate during their lifetime, including rising temperature and recurring drought. Low and variable rainfall and a short rainy season in the northern highlands have been reported in the literature (Yesuf and Pender 2005; Esser et al. 2002; Hagos, Pender, and Gebreselassie 2002) and have led to pervasive risk of drought. Smallholder households in Tigray are highly reliant on agriculture and other natural resources for their livelihoods. For these activities, the timing and quantity of rainfall are very important. Fluctuations in rainfall have the potential of exposing farmers to environmental shocks such as drought and flooding, which can undermine household livelihood. Although droughts are frequent in Sub-Saharan Africa, especially Ethiopia, their effects are exacerbated by profound rural poverty; inadequate government capacity; and exposure to other political, economic, and health shocks. The Tigray highland is of particular interest given its widespread poverty, high population pressure on land resources, and exposure to recurrent droughts (Gray and Mueller 2011; Kazianga and Udry 2006; Dercon, Hoddinott, and Woldehanna 2005; World Bank 2005).

Drought in the Tigray highlands can be seen to generate both direct and indirect effects. It has a direct effect on diminished crop production and an indirect effect on livestock prices as they decline when the drought is severe. Additionally, drought has been shown to be a major production constraint that reduces crop yields in low rainfall areas (Abera 2009; Ceccarelli, Acevedo, and Grando 1991), contributes to land degradation, and threatens the food security (Holden, Shiferaw, and Pender 2003) of smallholder farmers.

Deforestation was perceived and ranked as the most important cause of the changes in the climate in Tigray, followed by natural causes and agriculture, in that order. This is in agreement with other findings in the literature that cite deforestation in the highlands and Ethiopia as a major problem impeding the capacity of forests and land to contribute to food security and to provide other benefits such as fuelwood and fodder (Holden, Shiferaw, and Pender 2005; Gebremedhin et al. 2003; Hagos, Pender, and Gebreselassie 2002; Bishaw 2001). Farmers perceived the cause of the severe land degradation in Tigray to be intensified social conflict and substantial resource allocation to the conflict instead of environmental protection. Land degradation became severe as land and forest resources were literally left without appropriate management. These perceptions are in line with findings from other studies (Hagos, Pender, and Gebreselassie 2002; Gebremedhin 1998; Lanz 1996; Dejene 1990; Semait 1989).

Rapid population growth in Ethiopia (2.9 percent) and Tigray (2.5 percent) also contributed to the widespread forest clearing for fuelwood, fodder, and construction materials, resulting in substantial environmental degradation. Tigray highland is characterized by relatively high population density (33 persons per kilometer^2) and a much higher population density per unit of arable land (138 persons per kilometer^2). This has decreased the size of holdings and resulted in small units of land intensively cultivated by subsistence farmers, leading to the conversion of forested and marginal areas into agricultural lands (UNESCO 2010; CSA 2008; Gebremedhin et al. 2003; Esser et al. 2002; Hagos, Pender, and Gebreselassie 2002; Bishaw 1993; Hoekstra, Torquebiau, and Bishaw1990). As the population increased, the demand for more agricultural land was inevitable and thus degradation of the environment ensued. For example, in Ethiopia, from 1990 to 2005, 14 percent of forest cover or 2.1 million hectares of forest was lost. Then again between 1990 and 2010, an average of 140,900 hectares or 0.93 percent of forest was lost per year. Deforestation rates have increased by 10.4 percent since the end of the 1990s. In total, between 1990 and 2010, Ethiopia lost 18.6 percent of its forest cover or around 2,818,000 hectares (Butler 2011; Bishaw 2001). These staggering statistics perhaps explain why farmers identified deforestation as a major driver of change in the environment/climate in the Tigray highlands.

Respondents admitted having observed land degradation in the form of soil erosion and nutrient depletion coupled with changes in rainfall and temperature. Consequently, farmers in the northern highlands have adopted a variety of coping strategies apart from SWC activities. We observed that most farmers practiced intercropping of different traditional crops, and new crop varieties, crop rotation, and irrigation in an attempt to increase food production. These practices were adopted as coping strategies to minimize risk and conserve soil fertility (Esser et al. 2002; Bishaw 2001).

Although some farmers attributed the changes in climate to natural or divine causes, they did not envisage the solution to be beyond their control. Even though they admitted that they had low economic capacity, they were of the conviction that with their strength they would be able to implement the necessary conservation measures. It is important to note that if these mind-sets are successfully encouraged and used (Hagos, Pender, and Gebreselassie 2002; Lynne, Shonkwiler, and Rola 1988), they could be far more effective than the use of subsidies to promote community conservation projects activities in the Tigray highlands.

Community Mobilization for Collective Action

Ethiopia has suffered extreme economic and political turmoil since the early 1970s with the overthrow of the imperial regime and the transition from the overthrow of Mengistu Hailemariam and his Derg regime in 1991 to the current Ethiopian People's Revolutionary Democratic Front (EPRDF) government. The EPRDF commenced its rule with key priorities in the decentralization of natural resources management with the full involvement of local communities and poverty reduction strategies. The Agricultural Development Led Industrialization (ADLI) policy introduced required that farmers adopt profitable and sustainable land management practices, or pursue alternative livelihood strategies that are less demanding of the land resource. This policy initiative was viewed to be in sharp contrast to the heavily centralized, socialist Derg regime and that of the imperial regime, which also neglected environmental issues. There was also a general lack of commitment and awareness among farmers concerning SWC efforts (Segers et

al. 2008; Yesuf and Pender 2005; Jagger, Pender, and Gebremedhin 2003; Yohannes 2003; Esser et al. 2002; Ezra 2001).

Initiatives to promote SWC have been undertaken in the Tigray region since the 1970s. As early as 1980s smallholder households in Tigray were required to contribute uncompensated labor with emphasis on SWC structures. This was considered an important intervention aimed at restoring the productive capacity of the land as water was conserved and soil loss was kept minimal. SWC interventions introduced by the Derg regime during 1970–1990 were largely unsuccessful as they were characterized by negative attitudes of farmers (Chisholm 1998). Thus compulsory free labor was amended and reinforced by the current government with the full involvement of the local people. Government also provided farmers with technical and material support. Specifically, the Bureau of Agriculture and Rural Development is tasked with equipping farmers with technical skills to undertake SWC activities (Wolde-Aregay 1996). It involved mass mobilization of labor during the dry season. Initially all able-bodied persons in Tigray were obliged to provide labor for four months in a year during the dry season and were mobilized to conserve the catchments. Every household was expected to provide 90–180 persons per year spread over 90–120 days of the year depending on the size of the household. This, however, had serious cost implications for the household and interfered with other activities. In 1992 the government, after a critical assessment, substantially reduced the number of days allocated for compulsory free labor in SWC activities to 20 days in a year and only in the dry season when there are no agricultural activities (Jagger, Pender, and Gebremedhin 2003; Teshome 2003; Esser et al. 2002; Hagos, Pender, and Gebreselassie 2002; Tekeste and Paul 1989).

Religion plays a major role in the behavior of the people. For instance, in Tigray, the religious composition is almost exclusively orthodox Christian, constituting 96.7 percent of the populace (CSA 2008), and as a result the people are subject to the norms and rules of the Orthodox Church. In particular, religious leaders are able to define *appropriate* social behavior and conduct. In the highland areas of Tigray, priests of the Orthodox Church in the villages tend to be influential and assume the position of small-scale power brokers. They ensure that the norms and rules of the church are followed, including a set of principles that, among other things, puts restrictions on when farmers can work in their fields in order not to conflict with observance of saints' days (Teshome 2003; Vaughan and Tronvoll 2003; Hagos, Pender, and Gebreselassie 2002; Mequanent 1998). These local rules also have a very important bearing on the contribution of *voluntary* uncompensated labor for the management of natural resources in Tigray.

Additionally, a number of studies (Segers et al. 2008; Vaughan and Tronvoll 2003; Lanz 1996) have emphasized that farmers' overwhelming and undeniable commitment to compulsory free labor for the restoration of the ecology in Tigray originated from the 1975– 1991 revolution against the military Derg government. The defunct Tigray People's Liberation Front (TPLF) and Tigray's rural population effectively coalesced. The TPLF used effective mobilization techniques that integrated cultural symbols, propaganda, and coercion to rally vast numbers of the rural poor, with whom it established a creative and stable relationship. The TPLF's control over the rural population also maintained social order (Lanz 1996). What is more, the TPLF's revolutionary democracy was based on communal collective participation, premised on consensus forged through discussion led by the frontline organization. Nevertheless, the strategy of allegiance to the TPLF's activist doctrines and institution may actually influence people's decisions to contribute labor explicitly in community developmental programs. Simply put, party members were made the target group and in general they were more receptive than other farmers to the labor mobilization efforts. Through decentralized decisionmaking and administrative power to local communities and the objective of enhancing farmers' livelihoods in areas under its control, the TPLF inspired rural people's confidence and support for its political project (Segers et al. 2008; Duffield and Prendergast 1994; Hendrie 1999).

In contemporary mobilization of people for community work, community leaders take advantage of this historical legitimacy to stimulate farmers' collective memory of this alliance and reinvent the activist grassroots institutions through which resistance against the Derg regime was realized. In what followed farmers were constantly motivated during meetings to participate in developmental programs as a social duty, and a great deal of emphasis was put on collectivity. As with victory during the

revolutionary days, poverty was presented to the farmers as the enemy and a fight they must defeat through dedicated labor for community development programs. Furthermore, literature supports the premise that the effects of mobilization on participation in development are most evident among farmers who are members of the TPLF (Segers et al. 2008; Vaughan and Tronvoll 2003). This also explicates why the tradition of committed mass mobilization in Tigray has prevailed with very limited resistance to devoting 20–40 days of uncompensated labor annually to various land reclamation and tree planting initiatives since 1991.

The study exemplifies community mobilization on the basis of developmental groups and associations for community work. Associations exclusively for women, men, and the youth were established long ago during the TPLF resistance to raise consciousness about the TPLF's ideology and policies. As a result there was mobilization through the farmer's (peasant association), women's, and youth associations. In the rural highlands of Ethiopia, several local associations, established and run by the people themselves, have been instruments to organize socioeconomic collaboration and mutual assistance among villagers. Although these associations are now, at least formally, disassociated from the TPLF, membership is voluntary (Segers et al. 2008; Poluha 2003; Vaughan and Tronvoll 2003). Local leaders capitalize upon these established institutions to continue to mobilize farmers for restoring the ecology of Tigray.

Decisionmaking in Tigray is considered by some to be more participatory than in other regions as a legacy of the early TPLF's commitment to grassroots democratic control (Segers et al. 2008; Keeley and Scoones 2003; Milas and Latif 2000). This was implemented during planning and organizing community work, sharing community resources, and resolving conflicts arising from community work. The planning and implementation process of SWC projects was done with the active interaction of the people and the local *baitos*.[9] Mass mobilization and the involvement of grassroots institutions are perhaps the main strategies for implementing the process, which depends very much on the motivation of the farmers to participate (Hagos, Pender, and Gebreselassie 2002; Tekeste and Paul 1989).

A possible explanation is the institutional innovation in the development of the *baito* system, which is essentially a system of local democracy, developed by the TPLF during the civil war, based on direct election of representatives at the *kushet* and *tabia* levels. *Tabia* representatives then make up the *woreda* council, which has major responsibilities for the planning and implementation of local development. At the *tabia* level, social courts have been established that, among other tasks, deal with conflicts over the sharing of natural resources. The *baito* system facilitated detailed discourse at the local level of developmental problems, including those of a common-property nature. It is also used to mobilize communities to directly deal with specific problems, both through labor mobilization and through rule-making and resolution of conflicts over resource sharing (Segers et al. 2008; Chisholm 1998). Intrinsically the *baito* system, to some extent, building on traditional community-based institutions, has facilitated the region to mobilize considerable free labor to resolve natural resource problems, in a way that was unattainable during the Derg regime.

Contrary to the findings of others (Hurni 1990; Gamachu 1988; Bishaw 2001), our study found that currently farmers in the Tigray highlands were committed and enthusiastic about providing some time for uncompensated communal work for SWC and afforestation projects. Although such time has an opportunity cost, the people were not perturbed to shift their personal labor from private use to communal need to restore the ecology. It is furthermore remarkable that the perception of land degradation and awareness of the problem have also played an enormous role in their willingness to contribute labor for ecological conservation.

[9] Similar to village councils.

Compulsory Free Labor for Community Work in Tigray: Success or Failure?

Discussions with local communities have clearly indicated that their labor on SWC activities was yielding good results with particular reference to availability of water and achievement of high farm productivity. What is interesting in this context is that the people value the associated positive benefits of their labor and are willing to continue to mobilize the local community in the sustainable management of their ecology. These results have been noted in terms of soil conservation, water infiltration, crop yield, biomass production, groundwater recharge, and prevention of flood hazard by Gebremedhin et al. (2003); Taffere (2003); and Hagos, Pender, and Gebreselassie (2002).This observation is further substantiated by field investigation results from detailed in situ studies of analyses of 30–year-old photographs of landscape changes, which show that the status of natural resources has strongly improved since 1975. The rehabilitation was due both to improved vegetation cover and the implementation of physical conservation structures. The studies further demonstrate that in Tigray, sheet and rill erosion rates have decreased, infiltration and spring discharge have been enhanced, and vegetation cover and crop production have improved. Similarly, overall land management has improved in 85 percent of the analyzed landscapes (Nyssen et al. 2007). Integrated conservation, rehabilitation, and community-based management of natural resources are therefore vital, not only to maintain local biodiversity, but to increase food productivity and enhanced livelihoods in Tigray. Maintaining and enhancing farmers' participation is obviously a continuous challenge. Thus it implies that sustained motivation will determine the success or the failure of any future SWC program in Tigray (Reubens et al. 2011; Nyssen et al. 2009; Mitiku, Herweg, and Stillhardt 2006; Hagos, Pender, and Gebreselassie 2002; Tekeste and Paul 1989).

Impediments to the Contribution of Free Labor for Ecological Restoration

Our study found that farmers in Tigray encountered difficulties in getting adequate labor during mass mobilization for compulsory free labor. Better market access, small size of households, and larger proportion of dependents were found to impinge on the contribution of labor in Tigray toward community work. The impacts of market access on the contribution of labor for SWC activities is generally diverse in Tigray (Yesuf and Pender 2005; Hagos 2003). For instance, Gebremedhin et al. (2003) and Pender, Gebremedhin, and Haile (2003) observed that collective action for natural resource management is perhaps more effective in communities that are remote from markets. In particular, households remote from a major road in Tigray were more likely to invest labor in SWC programs. Overall, it appears that better access in terms of road and market can take some labor away from SWC activities.

Smallholder farmers were confronted with occupational health hazards associated with community work because of the mountainous and hilly topography in Tigray. This is further compounded by the lack of social services, such as health, and infrastructure, for example, roads that are not well developed in the rural highlands of Ethiopia. This is worrying and can affect the contribution of labor for community work. Better developed and networked roads help to ensure that during compulsory free labor materials and tools can easily be transported to the watershed or work site. Farmers who are injured during community work can also be easily conveyed to health centers for immediate treatment.

Eucalyptus has been established to provide a cost-effective way of increasing farmers' income and also providing them with timber for fuelwood and construction (Holden, Shiferaw, and Pender 2005; Jagger and Pender 2003). Exotic species, mostly *Eucalyptus camaldulensis* and *Eucalyptus globulus*, were promoted in Ethiopia extensively to principally cope with the ever-growing demand for fuel and timber, even if not without problems (Reubens et al. 2011; Gindaba, Rozanov, and Negash 2005; Wilson 1977). In Tigray a new land policy prohibited farmers from planting eucalyptus on cultivable land (Hagos, Pender, and Gebreselassie 2002). Conversely, eucalyptus planted on marginal lands can have grave repercussions for food productivity and water availability. Contrary to this observation, Holden, Shiferaw, and Pender (2005) reported that eucalyptus tree planting on marginal lands will not have severe negative effects on food production and land conservation. Although in Tigray eucalyptus is generally planted on communal lands, farmers in Embahasti protested about its allelopathic effects and its strong tendency of absorbing all groundwater (Khan, Hussain, and Khan 2008; German et al. 2006), eventually

lowering the water table and depriving foodcrops of adequate water. Eucalyptus species have the capacity to absorb excessive water, making them highly aggressive to the environment and transforming ecosystems by drying the soil where they are planted. Farmers might therefore have some legitimate reasons for objecting to the planting of eucalyptus on communal lands unsuitable for crop production.

The Role of Gender in Compulsory Free Labor for Community Work

Overall, it appears that both males and females provided labor and materials during community work, but females further provided labor to ensure that the working environment was tidy and food and beverages were served during recess. Strikingly, we found no differences in the pattern of gender division of labor. Activities undertaken by females and males were the same. However, women were usually given a lighter workload than men. This is perhaps because the community recognized the multiple roles of women in society, which has been reported to affect their ability to respond and also to participate in community conservation projects (Mehra 1993). It is therefore worth noting that despite the time limitations resulting from women's multiple roles and the possibility of multiple roles increasing women's workload, creating role conflicts, and inefficiencies (Lindsey 2011; Suda 2000; Mehra 1993), Tigrayan women combined SWC activities with their regular traditional household chores. Ecological development programs in the case of common-property resources can be sustainable if a developed consultative process with both men and women takes into account critical complex gender and social relations within and among communities (Shah and Shah 1995), such as the multiple roles of women in society.

There was also no difference in the specific tasks performed by men and women who participated in the mobilization of the people for the communal work. Both men and women tend to be equally involved in sensitization, community mobilization, planning and scheduling work, conflict resolution, and the sharing of communal products. Men were, however, reported to be more involved than women in providing security during conflicts. The active role played by women observed in Tigray is exceptional. Research has shown that strong local and community organizations can empower women and mobilize labor for community conservation projects (Dejene 2003). Furthermore, Tigrayan women are able to participate in developmental and conservation projects because of their access to membership in community associations. Teshome (2003) emphasized the role of the Tigray's Women Association (TWA) in mobilizing its members for developmental projects. The association is organizationally structured in a way that it reaches down to the *kushet* level. It also provides short-term training for women committees that coordinate women at the *tabia* and *kushet* levels around issues and women participation in community developmental projects. Consequently, women play a fundamental role in decisionmaking.

In addition, development literature has documented at length how the failure to integrate women into developmental projects can contribute to their lack of success (Mehra 1993), especially natural resource management projects. Taking into account that women are involved in all activities relevant to natural resources and livelihoods, women are considered to be primary users and managers of community resources. They are powerful agents of change and their leadership and decision-making in compulsory free labor is critical (Aguilar, Araujo, and Quesada-Aguilar 2007). This growing recognition of the importance of women's roles in the development process and natural resource management is perhaps a step forward to attaining gender equity.

Part of the reason for the active participation of women in the entire compulsory free labor process—sensitization, mobilization, decisionmaking, and leadership—had to do with the empowerment of women enshrined in their local bylaws, and also because women considered environmental conservation activities important. The strong involvement of women's groups in environmental conservation efforts tends to reinforce the view that women have a high interest. Furthermore, collective action has been seen as a potential means of achieving greater equity and a voice in natural resource management (German et al. 2006). These require collective action where strong community and grassroots organizations have been observed to be fundamental to mobilizing labor, facilitating training, and ensuring that these resources are appropriately used in attaining the community's objectives.

We observed that female-headed household were economically vulnerable and thus severely affected when there was a shortage of tools for compulsory free labor for community work. These households remain at an extreme disadvantage and are likely to be among the most food insecure. This possibly calls for programs to overcome structural constraints to development facing female-headed households.

In fact, there is growing evidence to show that women and men have quite different channels of communication and receive information from very different sources and in quite different ways (Mehra 1993; Collier 1990). We observed that both men and women had equal access to information regarding ecological restoration and climate change–related information. This information was usually disseminated during meetings by experts from the Bureau of Agriculture and Natural Resources. The role of information and knowledge- sharing on climate change and ecological restoration cannot be underrated (Roux et al. 2006) because the success of sustainable ecosystem management depends strongly on the acquisition and use of knowledge that is continuously updated and shared among farmers.

Building Sustainable Communities through Social Networking

The analysis in NetDraw showed that the Ketema *kushet* had stronger social interactions among the farmers, followed by Bolenta and Mitsnah Wegebet, in that order. Farmers diffused information among almost all the farmers in Ketema and also disseminated information more frequently. It is also interesting to note that although Ketema is not as remote as Bolenta and Mitsnah Wegebet, it demonstrated stronger social interaction. The small population size in Ketema and the easy accessibility of the *kushet* possibly explains this observation. Mitsnah Wegebet and Bolenta, although remote, are characterized by high population and sparse settlement. Also the remoteness of Bolenta and Mitsnah Wegebet can perhaps reduce the frequency of the farmers receiving knowledge from external sources to disseminate among them.

We found out that within the *kushets*, social network learning was from key farmers who acted as teachers or advisers to the other farmers. Most of these key information brokers were usually the religious leaders or leaders of an association in the community, thus directly supporting extension activities within the *kushets* and providing farmers with information from formal sources. Central to this idea is the concept of information intermediaries who receive information and redistribute it in locally contextualized formats, giving it validity and an appearance of trustworthiness. These brokers have the ability to control the flow of information and resources to other less well-connected actors (Clark 2006; Haythornthwaite 1996), particularly for people who are not in direct contact with the official extension system. Identifying these brokers in the *kushets* and building on these existing systems and networks can strengthen social networking and further improve information flows with respect to knowledge and information on climate change and community mobilization.

The results suggest that an overwhelming majority of respondents in our survey paid heed to the advice of farmers who had successfully adopted the knowledge or advice. This may explain why many actors rely on the brokers in the *kushets* who are perceived as technically competent to obtain information and advice. They work on the assumption that if one farmer adopts a technology successfully, other farmers may learn the innovation from him/her, and share with others, thereby developing a multiplier effect (Hoang, Castella, and Novosad 2006; Kiptot et al. 2006). The analyses found that minor actors (learners/listeners) did not find all the advice from the brokers to be useful information, possibly because even though they received diverse information they were cautious of putting the advice into use. A majority of the respondents had close kin relations with people whose advice they found relevant and followed. Hoang, Castella, and Novosad (2006) observed that the decision on whether or not to adopt advice depends very much on kinship networks.

Farmers in the Tigray region were found to rely on neighbors (intra- and inter-village) and kinship for their social network information on climate change and community mobilization for ecological restoration. Social relationships such as kinship ties and physical distances are relevant proxies that play a clear role in farmer information networks. Rogers (1983) highlighted the importance of

neighbor networks in the diffusion of innovations through their mechanism of information sharing. When individuals interact frequently in local networks and in the observance of local norms, they are more likely to exchange information (two-way information sharing) and to observe each other's behavior (one-way information sharing). Relationships with neighbors are highly regarded by poor households, especially by farmers with few kin ties in the *kushets*. Neighbor networks provide this group of farmers with a pathway to integrate into the local community and make up for the benefits that they do not get from kinship networks (Van den Broeck and Dercon 2011; Hoang, Castella, and Novosad 2006; Isham 2002). In the *kushets* in Tigray, neighbor networks appear to play a significant role in the adoption of technological innovations.

6. CONCLUSIONS AND POLICY IMPLICATIONS

This study has been motivated by the response of the people of the Tigray region in Ethiopia to degenerative climate conditions with the associated land degradation, which is predicted to become even worse in the years ahead. The study is premised on the notion that the long-term sustainability and resilience of smallholder agriculture is highly dependent on conserving or improving the quality of the natural resources. The study is aimed at finding out mechanisms that have been used to let the people of Tigray recognize the need for action to restore the ecology and participate in it without any direct compensation.

The study indicates that farmers have witnessed a change in the climate during their lifetime, including rising temperatures and recurring drought. Deforestation was perceived and ranked as the most important cause of the changes in the climate in Tigray, then natural causes and agriculture, in that order. The human-induced land degradation in Tigray has been attributed to intensified social conflict, population pressure, and the lack of education and awareness on the importance of conservation. The underlying reason for communities in Tigray to restore their ecology through community work was the restoration of soil fertility and the subsequent increase in agricultural productivity. Soil and water conservation (SWC) activities in Tigray result in multifunctionality of the land through enhanced irrigation, livestock production (pasture development), and crop diversification (introduction of new crops). All of these functions ultimately diversify livelihoods and improve resilience among vulnerable households in the Tigray region. Knowledge about the need for communal action and benefits that could accrue and how they would be shared were major motivating factors for responding to the call to act.

The existence of institutions in terms of grassroots organizations and rules and regulations with appropriate sanctions were major factors in the positive response to the call for community action in Tigray. The community was structured and organized into development groups and men, women, and youth associations. These community organizations played a vital role in mobilizing their respective members for compulsory free labor. During communal work, the developmental group leaders, *tabia* heads, work group leaders, and officials of the Bureau of Agriculture were in control of the organization of people and tasks, and ensured that the work was carried out. We also observed that the strong institutional and organizational developments were linked to the strong Tigray People's Liberation Front (TPLF) insurgency campaigns against the Derg regime and later the commitment of government at the national, regional, and local levels.

The homogeneity in the community in terms of ethnicity and religion played a major role in ensuring trust among the people and promoted successful group cohesion and cooperation. We observed a docile society that was enthusiastic to take on community activities to restore their degraded ecology, and this may be due to the connection of the people to the Orthodox Church of Ethiopia. All of these factors contributed to the near absence of resistance to the call to contribute 20 days of free labor per year to ecological restoration for SWC and the establishment of woodlots and grazing grounds.

We conclude that commitment of people to communal activities like ecological restoration can be sustained if there are appropriate local- and national-level institutions, support systems, and policies related to rural development. As it is done in Tigray, both men and women should be fully involved in the planning, mobilizing, organizing, providing leadership, resolving conflicts, and sharing communal products related to communal activities involving the whole citizenry. Such involvement of the whole community in all aspects of the community mobilization and the ensuing collective action promotes gender equity in the local communities and engenders positive responses to the call to act together to tackle community problems.

The case study in the Tigray region has illustrated how social networks and power relations are unique for each *kushet* and require appropriate methodological adaptations in research and development approaches. Social connectedness in the *kushets* is an important resource that should be taken into account by development agents, extension workers, and advisory services in the dissemination of knowledge and information on climate change and community mobilization.

We recommend similar research in an ethnically heterogeneous society in Ethiopia and other countries to find out how institutions are used in mass mobilization of the community for ecological restoration and maintenance of other common-property resources. Such a study would demonstrate any spillover effects of the innovations from the Tigray study for community mobilization. In particular, it will be interesting to study how the community responds to the call to act to conserve communal property and the role of institutions in encouraging participation and preventing deviant behavior. Because conservation agriculture is often conceived for provisioning both food and other ecosystem services, it will be insightful to conduct an evaluation to find out how SWC initiatives have affected the agricultural productivity, income, and livelihoods of smallholder farmers in the Tigray region.

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