



Climate Change and Rural Livelihoods in Northern Ethiopia

**Impacts, Local Adaptation Strategies
and Implications for Institutional Interventions**

Alebachew Adem

Edited by

Meheret Ayenew

FSS Monograph No.7



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Abbreviations and Acronyms

CSA	Central Statistical Authority
CSOs	Civil Society Organizations
DECSI	Dedebit Credit and Savings Institution
DFID	Department for International Development (UK)
Eba	Ecosystem-based Adaptation
EGS	Employment Generation Schemes
ENSO	El Nino Southern Oscillation
EPACC	Ethiopia's Program of Adaptation to Climate Change
EWS	Early Warning System
FAO	Food and Agricultural Organization (UN)
FGDs	Focus Group Discussions
GHGs	Green House Gases
GTP	Growth and Transformation Plan
HARITA	Horn of Africa Risk Transfer for Adaptation
ICPAC	Climate Prediction and Applications Centre (IGAD)
IGAD	Inter-governmental Authority on Development
IPCC	Inter-governmental Panel on Climate Change
KP	Kyoto Protocol
LULUCF	Land Use, Land Use Change and Forestry
MDG	Millennium Development Goal
MoA	Ministry of Agriculture
MoFED	Ministry of Finance and Economic Development
NAMA	Nationally Appropriate Mitigation Action
NAPA	National Adaptation Program of Action
NGOs	Non Governmental Organizations

NMA	National Meteorology Agency
NORAGRIC	Center for International Environment and Development Studies (Norway)
PSNP	Productive Safety Net Program
REDD	Reduced Emissions from Deforestation and Forest Degradation
REST	Relief Society of Tigray
SLA	Sustainable Livelihood Assessment
SCUK	Save the Children UK
SLF	Sustainable Livelihood Framework
SNNPRS	Southern Nations, Nationalities and Peoples' Regional State
TLUs	Tropical Livestock Units
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention for Combating Desertification
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
UN-ISDR	United Nations International Strategy for Disaster Reduction
USAID	US Agency for International Development
WASH	Water Sanitation and Hygiene
WRI	World Resources Institute

About the Author

Alebachew Adem is an environmental researcher at the Forum for Social Studies (FSS). He holds an MA degree in Geography and Environmental Studies from Addis Ababa University and an M.Phil in Development Studies from the Norwegian University of Science and Technology. He has taught Geography and Environmental Studies at Debu and Addis Ababa Universities. His research interests include rural livelihoods and climate change adaptation; gender and migration; pastoralism; environmental conflict; and biofuels.

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Executive Summary

Climate change is a key emerging threat to the lives and livelihoods of the rural poor in Ethiopia. Many studies point to the increased frequency of meteorological drought, unseasoned floods and outbreak of human and livestock diseases in many parts of rural Ethiopia. Recent drought episodes, flash floods and disease outbreaks in the northern parts of Ethiopia are stark reminders of how food and water security and rural livelihood strategies are still largely dependent on the climate system and vulnerable to its seasonal variability and long term changes. Ethiopia's response to climate change today will bear directly on the development prospects of a large part of the country's rural areas and populations.

The study was conducted in selected rural kebeles in Meket, North Wello Zone, Amhara and Raya Azebo districts, Debubawi Zone in Tigray. The study employed both qualitative and quantitative methodologies and triangulation of data. The central tenet of the study was that rural communities' vulnerability in the northern highlands of Ethiopia has been increasing primarily due to the impacts of changing climatic circumstances, local ecological degradation and mounting resource-use pressures and land-use conflicts. More specifically, the study: i) assessed the vulnerability of rural households to climate change-induced hazards and identified the determinants of their vulnerability; (ii) identified household and community coping and adaptation strategies; and (iii) examined their implications for future institutional interventions.

Analysis of the historical climate data in Meket and the Raya Valley revealed that there has been an increasing trend of rainfall variability both in space and time and a general tendency of increase in temperature over the last three decades. Coupled with the erratic and variable rains, rising temperatures exacerbate existing problems of soil moisture and fertility losses leading to further land degradation, destruction of the patchy vegetations and expansion of localized deserts.

Historically, droughts, famines and epidemics are very common occurrences in Meket and Raya Azebo. Some of these have been associated with climatic variability and change. In the last three decades, there has been an increased frequency of meteorological drought episodes, famines and outbreaks of diseases in both districts. These meteorological droughts have claimed the lives of thousands of people, destroyed crops and contributed to the death of many animals. Because of changes in the patterns of the local climate, the people in the districts are exposed to chronic food shortages, degradation of natural resources mainly soil, water, and vegetation covers, limited livelihood options and distress migration.

Adaptation at individual and household level depends on personal and household characteristics, such as wealth status, education, skills, social networks, access to resources, technologies and opportunities, and management capacities. The study shows that female-headed households, the landless and those with limited access to productive assets are among those who suffer disproportionately from the impacts of climate change because of their excessive reliance on natural resources. At the same time they have limited options to diversify into less climate-sensitive activities. Despite their vulnerability to climate change, rural women are also the unsung heroines. In Meket and Raya Azebo, women are observed struggling and strategizing to prevail amid deteriorating environmental conditions. In this regard, involving both women and men and their respective views in the climate adaptation process of planning and implementation is critical to ensure that the final solutions will actually benefit all members of the community.

In the last two decades, the Federal Government and the regional governments in Amhara and Tigray have provided emergency assistance and implemented various development interventions in the form of livelihood diversification, soil and water conservation, environmental rehabilitation and capacity building. NGOs operating in the study areas have also provided emergency support and implemented various projects aimed at raising awareness, building local capacity, reducing and mitigating disaster risks, enhancing rural livelihoods and rehabilitating the environment. Despite the limitations of financial resources, logistics and questions of sustainability, such institutional interventions have saved many lives, protected assets, rehabilitated degraded environments and enhanced local resilience. However, most institutional responses have in the main been grossly inadequate, fragmented, short lived and uncoordinated.

However, the main challenge for external interventions in rural Meket and Raya Azebo districts has so far been in the use of local and indigenous adaptation mechanisms in the planning, implementation and evaluation of such development interventions. In this regard, much remains to be done by institutional actors, both governmental and non-governmental, to harness the value of indigenous ecological knowledge, to empower and genuinely allow full participation of poor households (including female headed households) and consider environmental sustainability, technological adaptability and socio-cultural acceptability factors when designing and implementing development and adaptation programs and plans.

1. Introduction

1.1. Background

The world is faced with the triple crises of accelerating climate change, financial disorder and food and oil price instability. All these crises punish the worse-off and most vulnerable, those who did little to cause the problems. In particular, climate change poses a serious threat to development and the attainment of the Millennium Development Goals (MDGs) in the poorest countries and some of the worst effects on food and water security and health will be in poor sub-Saharan Africa, particularly in vulnerable regions. Scholes and Biggs (2004) refer to sub-Saharan Africa as the food crisis epicenter of the world, and projected that climate change during the first half of the 21st century will make this situation worse. At the same time, agriculture in sub-Saharan Africa will play a crucial role through its direct and indirect impacts on poverty and social inequality, as well as in providing an indispensable platform for wider economic growth that reduces poverty far beyond the urban industrial sector (Christiaensen et al., 2006; DFID, 2005).

The political and popular consensus on the reality of climate change, its human causes, and the severity of its impacts may not be very old, but most scholarly and policy literature holds that poor, natural resource-dependent rural households will bear a disproportionate burden of adverse impacts (Smith et al., 2003). Certainly, in many parts of Africa, these effects are already in play with potentially disastrous consequences for the poor (Adger et al., 2005; Adger et al., 2007). But the rural poor have also successfully faced threats linked to climate variability in the past, even if climate change likely increases the expected frequency and intensity of such threats (Mortimore & Adams, 2001; Scoones, 2001).

In this regard, some of the most important impacts of global climate change will be felt among the populations predominantly in rural Africa often referred to as subsistence or smallholder farmers. Their vulnerability to climate change comes both from their geo-physical locations and from various socioeconomic, demographic, and policy trends limiting their capacity to adapt to change (Davidson et al., 2003). It is widely recognized that failure to respond to the challenges posed by climate change on rural livelihoods and particularly on small-scale subsistence farmers would impede national and global efforts aimed at reducing poverty, inequality and insecurity.

In Ethiopia, the potential for natural environmental hazards and climate change to undermine development is great and growing (World Bank, 2009a; Aklilu & Alebachew, 2009). Climate change adds a new and largely uncertain dimension to the development problem of the country by compounding the risks of natural

hazards. It will add to the burden of those who are already poor and vulnerable by affecting their livelihood pattern and strategies and triggering food, feed and water insecurity (Aklilu & Alebachew, 2009). Particularly, global climate change poses particular risks to small farmers who have an immediate daily dependence on climate sensitive livelihoods and natural resources with limited economic and technological capacity to mitigate and adapt to climate change impacts. This is evident already in many parts of the country, and poverty-stricken and disaster-prone rural areas will be worst hit.

It is, therefore, essential for all development actors to better understand the localized impacts of climate change and explore promising responses, notably household, community and institutional adaptation responses. Keeping this in focus, the study is conducted to assess the experience of rural people in climate change adaptations and explore ways in which resource-poor farmers can better cope with and adapt effectively to the multiple stresses and impacts of climate change. The study also assessed locally appropriate mitigation options and responses that could benefit poor rural communities, including cases where adaptation strategies simultaneously deliver mitigation outcomes. The work fits well with current interest and engagement of the Ethiopian government, the civil society and donor agencies on the local manifestations and impacts of climate change and the search for effective and affordable adaptation options.

1.2. The research problem

Climate change is a key emerging threat to the lives and livelihoods of the rural poor in Ethiopia. The country has historically been affected by climate variability and associated droughts and the social, economic and environmental costs of extreme climate events have always been immense. Similarly, the potential for current climate change to undermine the country's economic and social development is huge (World Bank, 2009a; NMA, 2007; Aklilu & Alebachew, 2009). Many studies point to the increased frequency of meteorological drought, unseasoned floods and outbreak of human and livestock diseases in many parts of rural Ethiopia. Recent drought episodes, flush floods and disease outbreaks in the northern parts of Ethiopia are stark reminders of how food and water security and rural livelihood strategies are still largely dependent on the climate system and vulnerable to its seasonal variability and long term changes.

A high dependence on natural resources and climate sensitive livelihoods coupled with the existence of rampant poverty and naturally variable weather patterns put Ethiopia in an extremely vulnerable position. It is predicted that the country will face impacts of climate change in the form of droughts, floods, strong winds and heat waves, frosts, pests and diseases affecting livelihoods and health of the people and the natural ecological systems (NMA, 2007; EPA,

2010). The country's major economic sectors (agriculture, forestry and energy) and natural resources (water and range resources, biodiversity) are vulnerable to current climate variability, and will be affected even more by future climate change. The impacts range from recurrent drought and loss of biodiversity, dwindling water and range resources and soil nutrients, to catastrophic floods and declining animal and food production (NMA, 2007).

Most of the regions and the people throughout the country are living through a period of rapid and dramatic changes in ecological and land use patterns. The pace of change in the pattern of climate and different forms of environmental hazards in the country often exceeds the capacity of local institutions to adapt to or mitigate the effects of such changes. On the other hand, the negative impacts associated with climate variability and change are also compounded by non-climatic stressors, such as depleting natural resources, poverty, limited technological, logistical and institutional capacities, which drive vulnerability further. Ethiopia's response to climate change today will bear directly on the development prospects of a large part of the country's rural areas and populations.

The history of North Wello and Southern Tigray is intimately linked to drought, resource degradation and famine. The majority of the rural people in the two areas depend heavily on rain-fed subsistence agriculture and the daily exploitation of natural resources. Especially in the hazard-prone districts of Meket and Raya Azebo, meteorological drought episodes and disease outbreaks have claimed the lives of thousands of people, destroyed crops, and contributed to the death of many animals (Dessalegn, 1991; Ege & Yigremew, 2000; Tassew, 1998; Haile, 2002). Outbreak of climate-sensitive human and livestock diseases and crop pests at various times in the past have also undermined the productivity and food security of the rural populations. In short, because of changes in the patterns of the local climate, the people in these areas are exposed to chronic food shortages, degradation of natural resources, unstable livelihoods, and distress migration (Markos, 1997; Alebachew, 2000).

While climate change is not the only threat to natural resources and rural livelihoods, climate-induced changes to resource flows will affect the viability of rural livelihoods unless effective measures are taken to protect and diversify them through adaptation and locally appropriate mitigation and development strategies. For the poorest and most vulnerable, these strategies should be based on research-generated, locally responsive and community-based strategies integrating traditional adaptation measures and scientific knowledge. Knowledge-based and locally-rooted activities can deliver "win-win" approaches to climate change adaptation, as they serve immediate needs and bring immediate benefits to local communities while also contributing to longer-term

capacity development that will create a basis for reducing future vulnerabilities. For the poor and vulnerable, the actions that they take will be constrained by their limited assets and capabilities, but they will also be the most appropriate given the specific local manifestations of climate change impacts. These actions should be supported by external agencies to build up the resilience and adaptive capabilities of the rural poor.

In the absence of empirical research generated knowledge and the development of research inspired policies, strategies and programs, however, attempts to improve the quality of life of poor households and bring about economic expansion and rural transformation would be unrealistic especially in the hazard-prone areas of the country. Taking Meket and Raya Azebo districts as case studies, the present research seeks to fill-in such gaps through examining the localized impacts of climate change on rural livelihoods and assessing both key aspects of vulnerability and promising examples of adaptation.

1.3. Objectives of the study

1.3.1. General objective

The central tenet of the study was that rural communities' vulnerability has been increasing primarily due to the impacts of changing climatic circumstances, local ecological degradation and mounting resource-use pressures. Hence, the research was conducted with the main aim of (i) assessing the vulnerability of rural households to climate change-induced hazards and identifying the determinants of their vulnerability; (ii) identifying household and community coping and adaptation strategies and the implications for future adaptation investments; and (iii) generating information and knowledge that will provide policy makers and other stakeholders with tools to better understand, analyze and form informed policy decisions.

1.3.2. Specific objectives

The specific objectives of the study include, but are not limited to, assessing:

- ***Indicators of vulnerability and adaptive capacity:***
 - Identify the main indicators and determinants of vulnerability to climate change;
 - Assess the adaptive capacity of vulnerable households and the implications for future adaptation interventions.

- ***Threats and costs:***
 - Assess climate change threats to key rural priorities such as food security, household income, access to water, energy, health, and disaster preparedness with particular attention to gender effects.
- ***Local adaptation responses and implications for future investments:***
 - Identify indigenous strategies for coping with climate change and variability which could inform initiatives to build local adaptive capacity and strengthen rural livelihood systems;
 - Identify successful adaptation and resilience response measures via project interventions (if any);
 - Assess the role of gender in adaptation responses, i.e., ways in which women's participation in planning or implementing responses affects adaptation and resilience outcomes.
 - Identify major entry points for future adaptation projects or investments.
- ***Co-benefits and key messages for policy decisions:***
 - Identify co-benefits of adaptation response measures to other rural challenges, for example, food and feed security, access to water, energy, health, market outlets and disaster preparedness;
 - Generate knowledge that will inform discussions on possible future climate change research in the country.

1.4. Justification and significance of the study

Ethiopia is vulnerable to extremes of normal climatic variability, and climate change is likely to increase the frequency and magnitude of some disasters and extreme weather events. Climate change may worsen existing social and economic challenges in Ethiopia, particularly for those regions and communities dependent on resources that are sensitive to climate change. It is already clear that weather variability is affecting rural livelihoods in Ethiopia. It is also a threat to the effective implementation of the country's growth and transformation plan (GTP) and its ambition of achieving the Millennium Development Goals, which call for eradicating hunger and poverty, achieving universal primary education, promoting gender equality, reducing child mortality, improving maternal health, combating diseases and ensuring environmental sustainability. The negative impact of global warming on the viability of these goals cannot be understated in Ethiopia.

Past and current investments and disaster interventions in the country are more focused on recovery from a disaster than on the creation of adaptive capacity. Increased capacity to manage future climate change and weather extremes can reduce the magnitude of economic, social and human damage and eventually, investments, in terms of improved adaptation and nationally appropriate mitigation strategies and infrastructural provisions. Thus, vulnerability to climate change, disaster management and adaptation must be part of long-term sustainable development planning in Ethiopia. There is need to reform the disaster intervention and investment policies in Ethiopia to focus more on reducing vulnerabilities and strengthening the adaptive capacity of communities than just focusing and investing more in emergency and recovery operations.

Thus, a study which generate empirical data that signal the climate change trend at local level, identify local community level indicators, evidences or practices, explore government pertinent rural development, disaster preparedness and mitigation policy and strategy documents in view of the climate change induced risks and map out the local community adaptation practices in relation to the climate change, will contribute to existing knowledge and the development of suitable adaptation and mitigation strategies and practical measures.

More specifically, such climate change adaptation and vulnerability study is necessary to raise visibility of the actual and potential impacts of climate variability and change on vulnerable groups and regions in Ethiopia. It is necessary to build capacity and resilience to enable resource-poor rural women and men to cope with the negative impacts of climate change, and to mainstream gender into climate change discussion and adaptation planning. In this case, it is hoped that the study will provide relevant information for informed policy decision making, local development planning and institutional interventions aimed at building a climate-resilient green economy in the country.

1.5. Research methodology

1.5.1. Study sites

Depending on agro-ecological conditions, asset bases and livelihood activities, the vulnerabilities and resilience of communities and regions to climate variability and change vary among households or community groups and across space in Ethiopia. For the purpose of this study, four rural kebeles in Meket wereda¹ (North Wello Zone in Amhara Regional State) and Raya Azebo wereda (Debubawi Zone in Tigray Regional state) were selected based on vulnerability

¹ Wereda refers to district, which is the middle-level administrative unit lying between those of the Regional State and the Kebele (the lowest administrative unit), and often placed under the Zone which fulfills coordination purposes.

profiling and livelihood zoning, recurrence interval of climate extremes, consideration of non-climatic factors exacerbating the impacts of climate change, and a focus on regional economies dominated by dependence on small-scale rain-fed agriculture. Based on these criteria, two rural kebeles from Meket (kebele 024 and 026) and Raya Azebo (Hawelti and Ade-Halga) were selected. The study sites together with the sample size taken from each rural kebele are indicated in Table 1.

Table 1. Sample kebeles and households

Region	Zone	Wereda	Sample kebeles	Sample size (households)
Amhara	North Wello	Meket	Mesfina (024)	60
			Dibeko (026)	60
Tigray	Debubawi Zone	Raya Azebo	Ade-Halga	60
			Hawelti	60
Total	2 zones	2 weredas	4 kebeles	240

1.5.2. Data sources and sampling

Relevant data for the study have been collected from primary and secondary sources. The primary sources include: structured household questionnaire surveys, in-depth focus group discussions (FGDs) with community representatives, key informant interviews, personal narratives (case summaries) and direct observation. Moreover, relevant federal and regional government policies, strategy documents, proclamations, and reports were critically assessed. Secondary data has been collected from the National Meteorological Agency (meteorological data from nearby weather stations) and from published and unpublished documents of theoretical nature, and other empirical studies on relevant topics.

The selection of sample kebeles was basically based on vulnerability profiling, livelihood zoning and the presence of non-climate stressors in the area. A total of 240 households were drawn by employing systematic random (using kebele registration lists and in consultation with kebele officials) and purposeful (to include female headed households) sampling procedures from the selected kebeles for the household questionnaire survey². The sample households were

² Of the total 240 questionnaires collected, only 223 of the questionnaires were used in the analysis and writing of this report. Eight of the questionnaire were incomplete, 7 were inappropriately filled and the remaining 2 were never returned.

interviewed using a structured survey questionnaire. The questionnaire items contained various questions on the demographic and socio-economic profile of respondent households, their asset bases and livelihood activities, bio-physical setting of the pilot areas, land-use/cover change, the condition of range, animal, water and soil resources, climate and weather patterns, the occurrence and history of environmental hazards and adaptation strategies adopted by communities, governmental and non-governmental actors, etc.

A total of 8 FGDs were conducted with selected members of the community in the study kebeles. Four of the FGDs were gender separate (conducted with females only) and the rest mixed groups. Further, for the purpose of case studies, in-depth assessment and substantiating the argument advanced throughout the study, 8 household heads (one male and one female farmer from each study kebele) were thoroughly interviewed using a checklist of guiding questions. Although limited in scope, the narratives provide some glimpses into the lives and lived experiences of individual women and men, who often are subsumed as aggregated data under the umbrella of farmers or under the guises of the household concept.

Also, key informant interviews with resourceful persons were conducted. The key-informants interviewed included experienced people and community elders, including men and women. Zonal and wereda experts and kebele officials were interviewed in order to gain enhanced explanations about the local manifestations and impacts of climate change and the response measures in place. Discussions and informal conversations with wereda and zonal administrators, officials and experts from the sector offices and NGOs operating in the study area were conducted. Pre-arranged but unstructured list of items were employed to guide the discussions and interviews with the officials and other resource persons. This was supplemented by other qualitative information collected through field observation, photography and audio recordings.

On the other hand, secondary data were procured from available meteorological records, IPCC and UNFCCC reports, academic and research publications, and various activity reports of governmental and non-governmental organizations. Although not complete, long-term rainfall and temperature records for selected stations spanning for over 3 decades were obtained from the National Meteorological Agency. Further, relevant federal and regional government policies, strategy documents and proclamations were reviewed.



Plate 1. Partial view of FGDs and interviews conducted in the field

1.5.3. Data analysis and presentation

The data gathered from both primary and secondary sources has been analyzed using qualitative and quantitative methods. Qualitative analysis usually relies on inductive reasoning processes to interpret and structure the meanings that can be derived from gathered information (Merriam, 2002). The qualitative information gathered using interviews, discussions, observations and narrative stories has been first translated, affixed codes and categorized into various themes identifying preliminary patterns, themes and relationships. Following such identification and categorization, a more focused investigation of observed commonalities and differences was conducted. Analysis of the narrative stories of individual cases helped capture the insights about the lived experiences of the research subjects and to present the important details of their insights and experiences in a vivid and visually descriptive manner. The quantitative data collected from the questionnaire survey, meteorological data and other secondary sources was analysed using SPSS (Statistical Package for Social Sciences) and Microsoft Office EXCEL software. The programs were extensively used to produce different kinds of illustrations, statistical tables (more frequently), graphs and charts (whenever deemed necessary) and cross-sectional analysis.

1.6. Scope and limitations of the study

Selection of research topic, study subjects and study site are important aspects for doing research. The challenging nature of this task of selection is clear when the study area is characterized by diversity in major features of interest for the

research. The present research should have been comprehensive and much interesting had it been possible to include more districts and sub-districts in Amhara and Tigray Regional States and beyond. However, for practical reasons such as administrative and resource considerations, the research report relied on assessment and documentation of the vulnerabilities, adaptive capacities and coping strategies of 223 households selected using purposive and systematic random sampling procedures from Meket and Raya Azebo weredas in Amhara and Tigray Regional States.

However, this does not limit the relevance and generalizability of the findings of the study to other neighboring districts under comparable settings. In this regard, attempts were made to make a much more comprehensive review of the relevant literature and available federal and regional policy documents that can be applicable to other areas. On the other hand, in addition to the widely scattered geographical location of the research sites and the dispersed nature of settlements, the absence of statistical information and other documentary sources were common problems.

Despite all these challenges, attempts were made to gather as much reliable information as possible through the use of diverse information sources and triangulation of data.

2. Profile of the Study Area

2.1. North Wello and Southern Tigray

The name North Wello is intimately linked to drought, resource degradation and famine. The 1966 famine, also known in other parts of the country, is often referred to as the Wag-Lasta famine (Mesfin, 1986). Lasta corresponds more or less to the current districts of Meket, Bugna and Gedan. The 1973/74 famine was concentrated to eastern Wello (Hussien, 1976; Mesfin, 1986). Also the 1984/85 famine was worse in Wello, especially the eastern lowlands (Dessaiegn, 1991). Since 1995, the frequency of drought occurrence and the number of famine victim populations in the region has increased dramatically (Ege & Yigremew, 2000). Relief and temporary migration to find work are common parts of the coping strategy. The population in the zone has become dependent on relief to survive. Even in the best production years, about 12% of the population need external assistance (Ege & Yigremew, 2000).

While North Wello has a long history of settled agriculture dominated by cereal-based farming systems, the people in the zone still depend for their livelihoods on traditional, low-input, subsistence agriculture. Rainfall and temperature anomalies, depleting natural resources and declining soil fertility are among the most important technical constraints on crop production in the zone. Livestock production is probably the most significant component of local agriculture but traditional grazing is under threat from population pressure and expanding crop cultivation. There is little investment in commercial agriculture, very limited secondary processing of agricultural products and therefore few opportunities for other sources of income outside rain-fed subsistence farming. As a result, policy makers and development actors in the zone are faced with the challenge of managing limited natural, financial and human resources in a way that supports sustainable rural livelihoods.

The majority (83%) of the population of Tigray depend on subsistence agriculture. The climate is generally sub-tropical with an average annual rainfall between 450mm-980mm, extended dry period of nine to ten months, and a maximum effective rainy season of 50 to 60 days (Belete, 2002). The rainfall pattern is predominantly mono-modal (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. Considering rainfall, atmospheric temperature and evapo-transpiration, more than 90 percent of the region is categorized as semi-arid (Belete, 2002). The remaining areas in the region can be categorized as dry sub-moist (near the central south highlands) and arid (the lower areas of Erob and Hintalo Wajerat weredas) (Belete, 2002). The major crops grown include sorghum, teff, maize,

finger millet, wheat, barley, pulses, sesame, various vegetables and horticultural crops. Livestock with the exception of plough oxen play an important but secondary role. The livestock component increases in the lowland areas, especially in the southern and western zones (REST/NORAGRIC, 1995).

Tigray faces major environmental challenges including variable climate, soil erosion, gully formation, and pressure to cultivate slopping land, and vicious circle of over-use of land in order to meet basic food security causing decreased fertility (Tassew, 1998; Haile, 2002). 70% of farm households own less than 1 ha (Tassew, 1998). In the southern and central zones unreliable rainfall is seen by farm households to be the most significant problem, followed by crop pests and lack of oxen (REST/NORAGRIC, 1995). Lack of pasture and fodder are the main constraints to animal production.

Despite such pressing challenges, there are promising ongoing efforts to remedy these problems. This include massive soil and water conservation measures supported by NGOs as well as the regional government, promotion of area closures to allow environmental regeneration, communal (*tabia*) resource management including state managed forest enclosures, improved regional transportation access, increased institutional support for agricultural research and extension services as well as “land registration aimed at improving farmer’s land tenure security” (Berhanu, 2002; Haile, 2002).

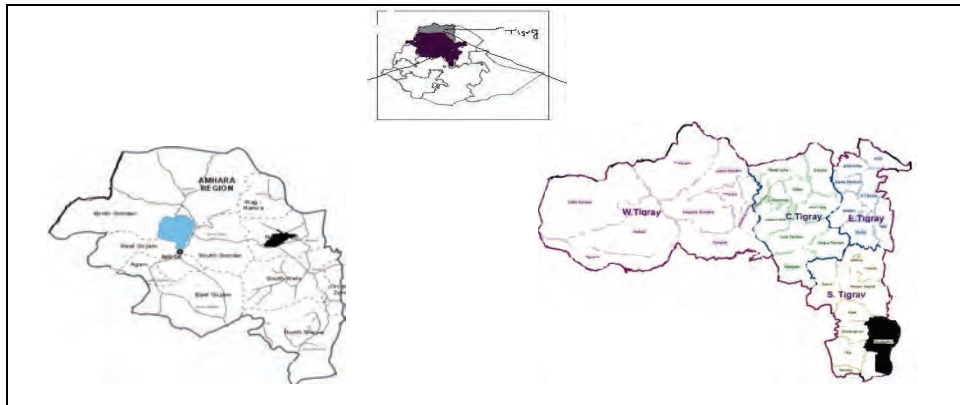


Figure 1. Location of the study area (Meket in Amhara, shaded left), Raya Azebo in Tigray (shaded Right)

2.2. Profile of Meket Wereda

Meket wereda is located about 660 km north of Addis Ababa, in the North Wollo zone of the Amhara Regional State. It is one of the most rugged, degraded and

food insecure weredas in North Wollo. In the 2007 census, the population of the wereda was estimated at about 227,338 people (49.5 % females) (Table 2). While the district has a long history of settled agriculture dominated by cereal-based subsistence farming systems, this drought prone, low-potential area is now subject to severe environmental degradation, which has provoked chronic food insecurity and occasional famines (FAO, 1986; Dessalegn, 1991). Frequent drought and soil erosion are the most important technical constraints on crop production in the district. The landscape of the district is spectacular, stony and very rugged. The terrain is composed of high mountains surrounded by steep gorges and broad valley escarpments, and high plateau dissected by deep valleys created by rivers and streams.

Table 2. Population size of Meket wereda and North Wollo zone in Amhara Region

Population	North Wollo Zone		Meket Wereda	
	No.	%	No.	%
Total population	1,503,283	100.0	227,338	100.0
Males	754,354	50.2	114,731	50.5
Females	748,929	49.8	112,607	49.5
Rural population	1,347,624	10.4	215,590	94.8
Urban population	155,659	89.6	11,748	5.2

SOURCE: Computed from CSA (2007)

The wereda extends from the divide between the Tekeze and Bashilo watersheds northwards with elevations ranging from about 1200 m.a.s.l. at the northwestern most point to over 3200 m.a.s.l. along the eastern part of its southern border. The wereda baseline data prepared by SOS Sahel (in 1997) divide the wereda into four main agro-climatic zones. These are the lowland or semi-arid lowlands (below 2,300 m.a.s.l), the woina-dega or sub-humid midlands (at 2,300 to 2,800 m.a.s.l), the cold dry humid highlands (2,800 to 3,200 m.a.s.l,) and the dega or the very dry cold humid high altitude plateau, which, at over 3,200 m.a.s.l, is often battered by frost and hail³. The majority of the population (80%) lives in

³ These classifications are particular to Meket, and differ from standards generally applied in Ethiopia, as an area classified as lowland in Meket would be regarded as part of the highlands elsewhere (See SOS Sahel, 1997; Eyasu and Daniel, 2000).

the midlands (woina dega) and kola (lowland) agro-ecological zones, and the minorities are highlanders (Adams & Emebet, 2005). The very-humid *wirch* zone is characterized by cool, wet weather conditions, and as frost makes the area unsuitable for cultivating crops, farmers specialize in rearing livestock, particularly sheep.

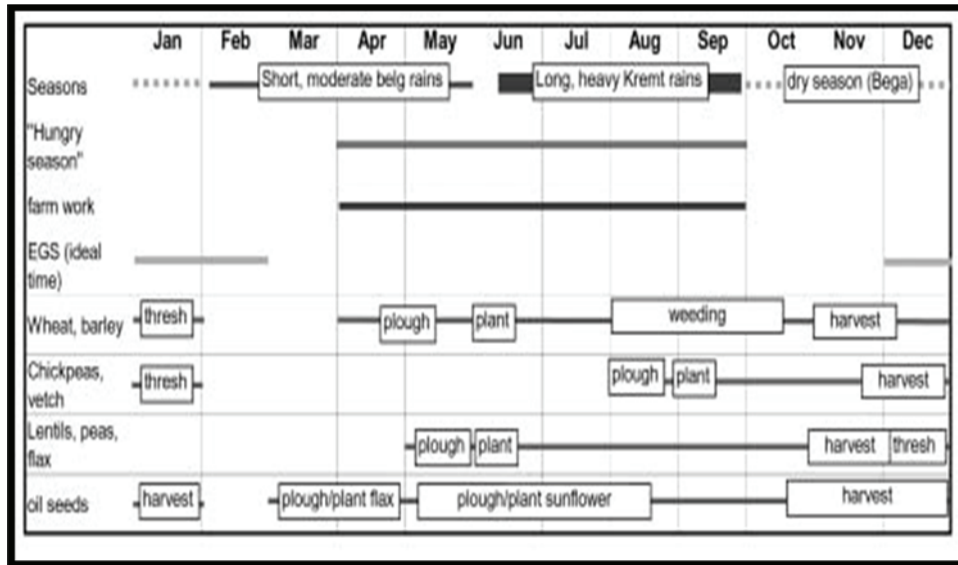


Figure 2. Seasonal cropping calendar in Meket (SOURCE: SCUK, 2001)

According to the meteorological data obtained from the NMA, the mean annual rainfall in Meket ranges from 600 mm in the lowlands to well above 1000 mm in the highlands. Although the district used to enjoy two distinct rainy seasons: the *belg* or short rains between February and May, and the main *meher* rains from June to August; the majority of the rural communities are predominantly meher-reliant, although some rely on the belg season as the main or secondary growing season. Rainfall is extremely uneven and erratic, and in recent years particularly the *belg* rains have become increasingly unpredictable, often failing completely. This has resulted in a growing tendency to cultivate crops only in the *meher* season, which has significant implications for annual production levels, as the *belg* crop used to account for up to 40% of the total harvest (Dessaegn, 1991). The seasonal calendar (described in figure 2) shows the timing of agricultural activities in a *meher*-dependent area. It is important to note the timing of the main periods of agricultural activities- ploughing, planting, weeding and harvesting (March to July for cereals). This is the period of time when farmers

will be extremely busy on farm activities as compared to the slack period after harvest, i.e., December to March.

With widespread soil erosion and low, erratic rainfall, Meket district is classified as a low potential cereal zone (FAO, 1986). The major crops include barley, wheat, teff, beans, peas and chickpeas. In the kola or lowland areas sorghum is increasingly being grown as a dominant crop. In terms of topography, most of Meket is rugged with rocky hills and farmlands frequently dissected by deep gullies. In terms of vegetation the district has lost the original vegetation, although some *Juniperus procera* (tid), *Podocarpus gracilior* (zigba) and *Olea africana* (woira) can still be found in church compounds and deep, inaccessible gorges. There is widespread deforestation and erosion; and areas of bare rocks are now common in the district and several farms are covered with stone mantles. Farm borders and riversides are severely overgrazed, and in the eroded wastelands only a few shrubs and scattered small trees rise above stands of annual grasses. Firewood is now so scarce that dung cakes are used as fuel. A growing number of farmers plant eucalyptus around their homesteads carefully protecting it with stone walls.

2.3. Profile of Raya Azebo Wereda

Raya Azebo is one of the 11 weredas in the Debubawi zone of the Tigray Regional State. With a total population of 136,039 (about 88.2% are rural) (Table 3) and an estimated area of 1,440.63 square kilometers, Raya Azebo has a crude population density of 94 persons/km², which is less than the zonal average of 133 persons/km². The administrative center of this wereda is Mehoni.

Table 3: Population size of Raya Azebo and Debubawi Zone in Tigray

Population	Debubawi Zone		Raya Azebo Wereda	
	No.	%	No.	%
Total population	1,004,558	100.0	136,039	100.0
Males	496,444	49.4	67,774	49.8
Females	508,114	50.1	68,265	51.2
Rural population	879,745	87.6	119,984	88.2
Urban population	124,813	12.4	16,055	11.8

SOURCE: Computed from CSA (2007)

Raya-Azebo is characterized by kola agro-ecology (arid and semi-arid climate) with relatively hot temperature and high evapo-transpiration that results in high levels of moisture stress. In terms of land use patterns, cultivated land accounts for 23.8% of the total area, forest land covers 0.7%, 22% is under area closure,

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i.e., controlled grazing area, 29.3% bush land, 2.7% homestead area, and 21.7% miscellaneous land. Average land holding size is 1.84 ha/household (REST Coordination Office in Raya Azebo 2010). Topographically, the district is dominated by plain landscapes mostly covered with alluvial clay loam soil which is relatively fertile and offers good potential for agricultural production. Rainfall of the wereda ranges from 300 to 700 mm and is erratic in distribution. Its temperature ranges from 16 to 27° C. Farming activities of the wereda depends on the February to May ‘belg’ rains and July to August ‘Meher’ rains (see Figure 3). Hence, crop production in the area is mainly rain-fed, supplemented by traditional flood water diversion. The main crops cultivated are sorghum, teff, and maize. The main livestock reared are cattle, shoats and camels. The seasonal calendar, the rainfall pattern and the detail farm and off-farm activities of rural people in the Raya Valley area is shown in Figure 3.

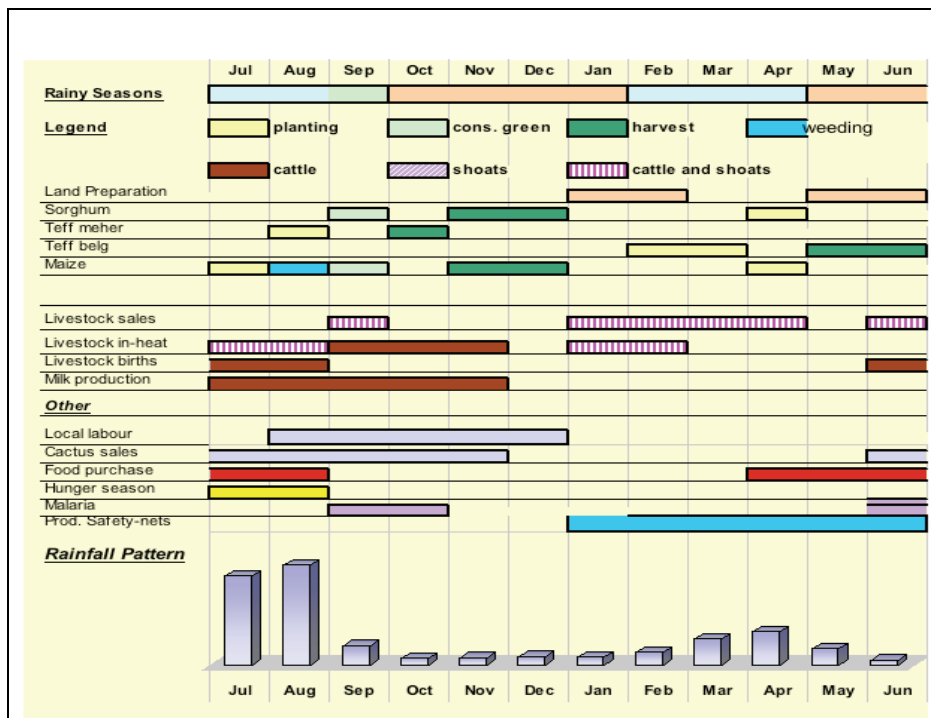


Figure 3. Seasonal calendar of farmers in Raya Azebo

SOURCE: Livelihood profile of Tigray Region (2007).

Raya Azebo wereda, which is characterized by recurrent drought, is also vulnerable to the negative impacts of climate change in comparison with the other areas in the region. The rural populations in some of the rural kebeles, for example, in Hawelti, Ade-Halga, and Mechare are living with climatic conditions which are generally dry, with short rainy seasons, unpredictable rains and long dry spells (personal communication with Wereda and Zonal experts). Severe, long lasting droughts have occurred, and also some events of flooding in relation to intense rainfall. The direct impacts of drought in combination with local environmental degradation have lead to reduced or totally lost crop yields and serious losses of livestock and soil fertility. A comparison of the general profile of Meket and Raya Azebo is given in Table 4.

Table 4. Profile of Meket and Raya Azebo

Profile	Wereda	
	Meket	Raya Azebo
Population density ^a	119p/ km ²	94 p/km ²
Soil characteristics	Reddish-brown (<i>keyate</i>)	Alluvial plain soils
	Degraded, shallow, infertile	Fertile and productive
Land holding per household	0.63/ha ^b	1.84/ha ^c
Mean annual rainfall	761mm ^d	420.3 mm ^d
Mean annual temperature	22.3 ^b	23.5°C ^e
Main crops cultivated	Wheat, barley and teff (highlands)	Sorghum, Teff and maize
	Sorghum and maize (lowlands)	

SOURCE: ^a CSA (2007)

^b Wereda Agriculture Office, Flakit

^c REST Coordination Office, Mehoni

^d NMA (2010)

3. Literature Review

The review of the literature in this chapter is organized along two main lines. The first part of the literature provides a general survey of the literature on climate variability and change in Ethiopia and on the impact of climate change on key socio-economic sectors and natural resources of the country, with focus on rural livelihoods. The second part provides a review of the conceptual or theoretical literature in climate change adaptation studies. In this part, the concepts of climate change adaptation, vulnerability, adaptive capacity and related terms are reviewed and the most important theoretical and conceptual models for the analysis of climate change vulnerability and adaptive capacity are briefly discussed.

3. 1. Climate variability and change in Ethiopia

In Ethiopia, climate variability is nothing new. The country has always suffered from great climatic variability, both yearly and over decades. Rain failures have contributed to crop failure, death of livestock, hunger and even famine in the past. Even relatively small events during the growing season, like too much or too little rain at the wrong times, can spell disaster. Small farmers and cattle herders, who are already struggling to cope effectively with the impacts of current climatic variability and poverty, face daunting task in coping with weather variability and adapting to future climate change.

Droughts and floods are very common occurrences in Ethiopia with significant events every 3–5 years (World Bank, 2006). Since the 1980s, the country has experienced at least five major national droughts, along with literally dozens of local droughts (World Bank, 2009). Over the last two decades, the frequency of droughts and floods has increased in many areas resulting in loss of lives and livelihoods (Mesfin, 1986; Dessalegn, 1991; Campbell, 1999). In particular, reports point to the increased incidence of meteorological drought episodes, famines and climate-sensitive human and crop diseases in the northern highland and southern lowland regions of the country (World Bank, 2009; Oxfam International, 2010; Aklilu & Alebachew, 2009; UN-ISDR, 2010; Table 5). These droughts are major causes of food insecurity and transient poverty destroying watersheds, farmlands, and pastures, contributing to land degradation and causing crops to fail and livestock to perish. The 972/73 ENSO related drought, for example, led to the Wello famine during which about 200,000 people died (Nicholls, 1993; Webb & Braun, 1994). During the 1984/5 drought, national GDP growth declined by 9.7%, agriculture output declined by 21%, and gross domestic savings fell by about 59% (World Bank, 2006). Had it not been for the drought shock in 2002 and 2003, the poverty in 2004 would have been at least 14% lower a figure that translates into 11 million fewer people below the

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poverty line (UNDP, 2007/08). Flooding meanwhile causes significant damage to settlements and infrastructure, and the inundation and water-logging of productive land undermines agriculture by delaying planting, reducing yields, and compromising the quality of crops (NMA, 2006; Aklilu & Alebachew, 2009). Outbreak of climate-sensitive human and livestock diseases and crop pests in various times in the past have also undermined the productivity and food security of the rural population, especially in drought and flood prone areas of the country (Tulu, 1996; McMichael, 2006; MoFED, 2006).

Table 5. A chronology of Ethiopian drought and famines since the 1950s

Year	Affected region	Triggers and severity
1957/8	Wello and Tigray	-Rain failure in 1957; -Locust infestation in 1958
1964-66	Wello and Tigray	Very severe -Rain failure; 250,000 dead
1971-75	Whole of Ethiopia	-50% livestock lost in Wello and Tigray
1978/9	Southern Ethiopia	Failure of the short rains
1982	Northern Ethiopia	Unseasoned rains
1984/5	Whole of Ethiopia	Rain failure; 1 million people died
1987/8	Whole of Ethiopia	Drought in lowland areas
1990-92	Most of Ethiopia	Rain failure, regional conflicts
1995/6	Afar, South Oromiya	Livestock death
1999/2000	Amhara, Tigray, Afar, Somali, South Oromiya	Drought, severe water shortage, livestock death
2002/3	Whole of Ethiopia	11.3 million required emergency food assistance
2008	Wello, Tigray, Eastern Ethiopia	Rain failure/drought

SOURCE: Webb and Braun (1994), Nicholls (1993), NMA (2007), UN-ISDR (2010)

3.1.1. Observed trends and projections

Behavior of the current climate

Ethiopia is located in a geologically active zone and geographically sensitive area. Consequently, natural hazards, for example, tectonic activities, and human-induced climate change and variability on different spatial and temporal scales have affected its geology and natural and socio-cultural environment.

Superimposed on this, increasing human impact continues to modify and negatively change the country's land cover, land surface and hydrology (Mohammed, 2005).

Both instrumental and proxy records have shown significant variations in the spatial and temporal patterns of climate in Ethiopia. Figure 4 shows the annual time series of minimum and maximum temperatures for 40 stations averaged over Ethiopia. The figure reveals a warming trend in temperature. It is also evident from the figure that the average annual minimum temperature is increasing much faster than the average annual maximum temperature. Some examples of the recent trends of Ethiopian rainfall are shown in Figure 5. The figure indicates the behavior of Ethiopian rainfall which is highly variable in space and time. It also shows a decreasing tendency in the annual rainfall in some areas. The same trend has also been noted in seasonal rainfall. Easterling et al. (2000) observed historically a significant decrease in the number of days with precipitation exceeding 25.4mm over Ethiopia during the main rainfall season, i.e. June to September. The degree of rainfall variability is highest in the arid and semi-arid areas where climate and natural disasters related emergency relief appeared to be an integral part of the livelihood systems of the dry-land communities.

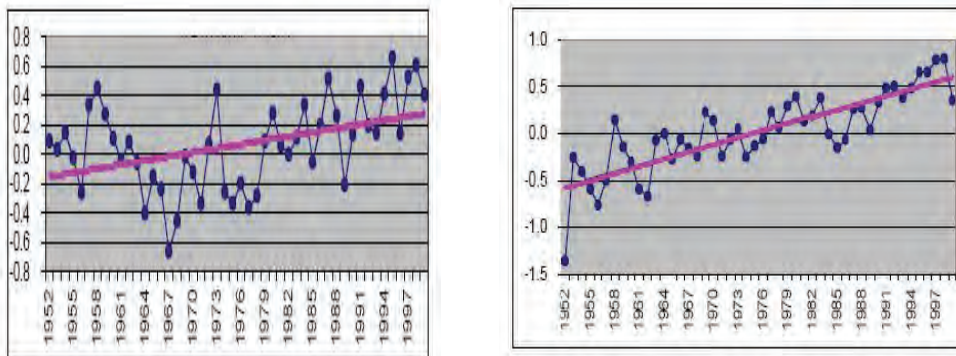


Figure 4. Maximum (left) and minimum (right) temperatures over Ethiopia.

SOURCE: NMA (2001)

Climate change and rural livelihoods in northern Ethiopia

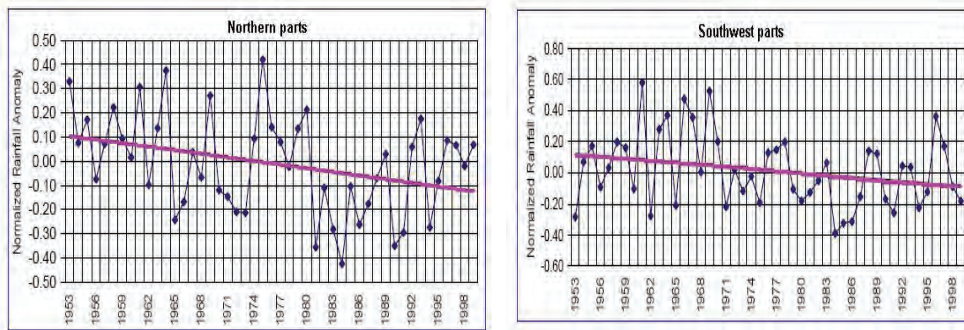


Figure. 5. Rainfall over Northern (left) and Southern (right) parts of Ethiopia.

SOURCE: NMA (2001)

According to NMA (2007) Ethiopia experienced 10 wet years and 11 dry years over the last 55 years, demonstrating the strong inter-annual variability⁴. Between 1951 and 2006 the annual minimum temperatures in Ethiopia increased by about 0.37°C every decade. The UNDP Climate Change Profile for Ethiopia (UNDP, 2007/08) also shows that the mean annual temperature has increased by 1.3°C between 1960 and 2006 at an average rate of 0.28°C per decade. The temperature increase has been most rapid from July to September (0.32°C per decade). It is reported that the average number of hot days⁵ per year has increased by 73 (an additional 20% of days) and the number of hot nights has increased by 137 (an additional 37.5% of nights) between 1960 and 2006. The rate of increase is seen most strongly in June, July and August. Over the same period, the average number of cold days and nights⁶ decreased by 21 (5.8% of days) and 41 (11.2% of nights), respectively. These reductions have mainly occurred in the months of September to November (McSweeney et al., 2008).

⁴ The wet years included 1958, 1961, 1964, 1967, 1968, 1977, 1993, 1996, 1998 and 2006. Dry years were 1952, 1959, 1965, 1972, 1973, 1978, 1984, 1991, 1994, 1999, and 2000 (NMA, 2007). The increase in the number of dry years coupled with the decline in growing season rainfall is linked to anthropogenic warming in the Indian Ocean.

⁴ Hot day/night is defined by the temperature exceeded on 10% of days/nights in the current climate of that region and season.

⁵ Cold day/night is defined as the temperature below which 10% of days/nights are recorded in the current climate of that region and season.

National average rainfall figures do not capture the large spatial variations in rainfall across different parts of the country. Not only do arid and semiarid or drought-prone areas like North Wello and South Tigray have lower average annual rainfall, but they also exhibit significantly larger inter-annual rainfall variability. Table 6 shows mean and coefficients of variation of average annual rainfall levels for drought-prone Wello and Tigray and moist zones in Arsi and Jima in Oromiya region and in Gojam Amhara reguib from 1980–2001. Both the mean annual amount of rainfall registered and the values of the coefficient of variations are extremely unfavorable in drought prone Wello and Tigray relative to non-drought-prone parts of the country. In fact, rainfall variability may actually be worsening in Ethiopia. Table 6 contains meteorological data that suggest rainfall was more variable in the 1980s and 1990s than in the 1970s; although the overall mean in the 1970s was lower (Figure 6).

Table 6. Rainfall amount and distribution in drought-prone and non-drought prone areas

Regions/zones	Average annual rainfall (mm)	Coefficient of variation (%)
<i>Drought prone</i>		
Tigray	710	23.2
Amhara/North Wello	832	27.3
Amhara/South Wello	901	21.3
<i>Non-drought prone</i>		
Oromiya/Arsi	878	11.2
Oromiya/Jima	1505	10.0
Amhara/Gojam	1180	15.4

SOURCE: Mulat (2004)

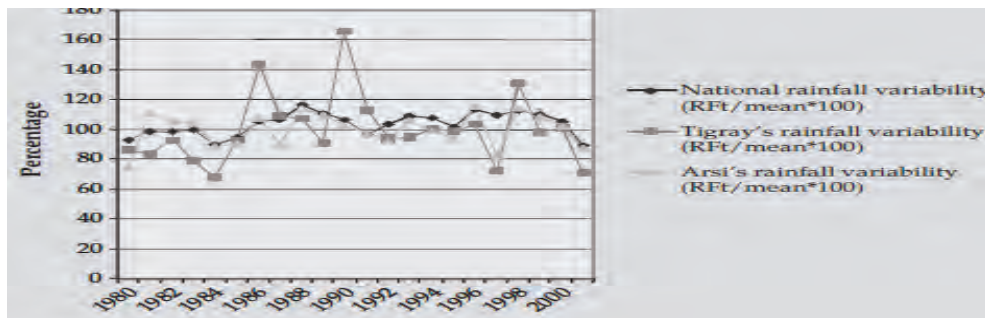


Figure. 6. Rainfall variability: National, Tigray, and Arsi compared

SOURCE: Mulat (2004)

Future climate change over Ethiopia

The results of the IPCC mid-range emission scenario show that compared to the 1961-1990 average, the mean annual temperature across the country will increase by between 0.9 and 1.1 °C by the year 2030 and from 1.7 to 2.1 °C by the year 2050 (Figure 7). According to NMA (2001), temperature across the country could rise by between 0.5 and 3.6 °C by 2080, whereas precipitation is expected to show some increase (Table 7).

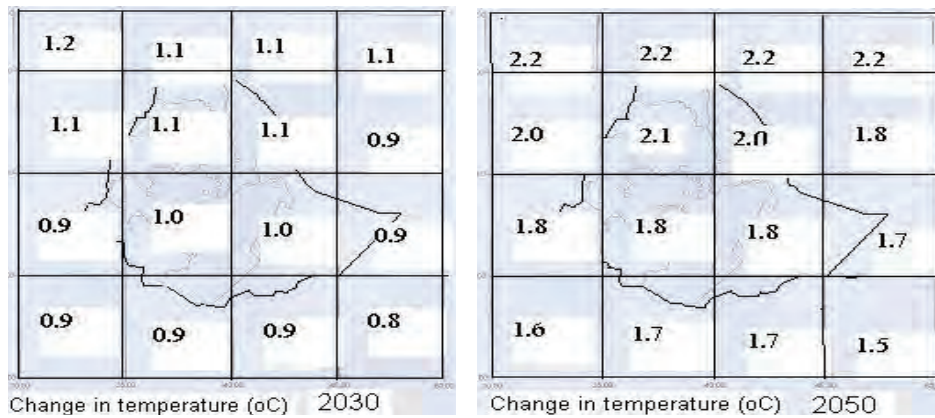


Figure. 7. Projected change in temperature (°C) relative to the 1961-1990 level

SOURCE: NMA (2001)

Unlike the temperature trends, it is very difficult to detect long-term rainfall trends in Ethiopia due to the high inter-annual and inter-decadal rainfall variability. According to NMA (2007), between 1951 and 2006, no statistically significant trend in mean rainfall was observed in any season. The results of the IPCC mid-range emission scenario (Table 7) show that compared to the 1961-1990, annual precipitation show a change of between 0.6 and 4.9 % and 1.1 to 18.2% for 2030 and 2050 respectively. The percentage change in seasonal rainfall is expected to be up to about 12% over most parts of the country. The largest change of about 22.1% was observed in 2050 winter (December, January and February) season, while decreases were observed over parts of north Ethiopia.

Table 7. Rainfall projections over Ethiopia in comparison to Kenya and Malawi

Country	Region	Projections		
		Seasons ⁷	2030	2050
Ethiopia	Central & South	MAM	1 - 7% increase	2 - 13% increase
	North	MAM	1 - 3% decrease	2 - 6% decrease
	Whole of Ethiopia	JJA	4 - 6% increase	7 - 12% increase
		SON	3 - 6% increase	6 - 11% increase
	Central/West/South	DJF	4 - 11% increase	2 - 22 % increase
	Northeast	DJF	2% decrease	4% decrease
	Whole of Kenya	MAM	2 - 12 % increase	4 - 22 % increase
Kenya	North/West	JJA	5 % increase	9 % increase
	Eastern/South	JJA	4 - 11 % decrease	8- 21 % decrease
	Whole of Kenya	SON	1 - 6% increase	0.5-11 % increase
	Whole of Kenya	DJF	6 - 21 % increase	11- 40 % increase
	North	MAM	1 % increase	2 % increase
Malawi	South	MAM	1 % decrease	2 % decrease
	Whole of Malawi	JJA	5 - 9 % decrease	9 - 17% increase
	Whole of Malawi	SON	2 - 6 % decrease	4 - 10 % decrease
	Whole of Malawi	DJF	0 - 2 % increase	0 - 5 % increase

SOURCE: IGAD Climate Prediction and Applications Centre (ICPAC, 2007)

3.1.2. Sectoral impacts of climate change in Ethiopia

Climate change is fundamentally a sustainable development issue. Key natural resources and ecological systems, for example, land resources, water, wetlands and natural habitats, all of which are vital to sustainable development, are sensitive to changes in climate, including both the magnitude and rate of climate

⁷ MAM (March April, May), JJA (June, July, August), SON (September, October, November), DJF (December, January, February).

change as well as to changes in climate variability. Economic activities, such as crop farming, livestock herding, energy production and water supply, that depend on these natural resources are, therefore, also sensitive to climate variations. Thus, climate change represents an important additional stress on the natural resource base of the country, which is already affected by increasing resource demands, unsustainable management practices and environmental degradation. These stresses will interact in different ways across the different regions but can be expected to reduce the ability of some environmental systems to provide, on a sustained basis, key goods and services needed for successful economic and social development. These will include adequate food and feed, good health, water and energy supplies, employment opportunities and social advancement. The geographical distributions of the major climate change-induced hazards, including droughts, floods and crop pests, in Ethiopia are shown in Figure 8.

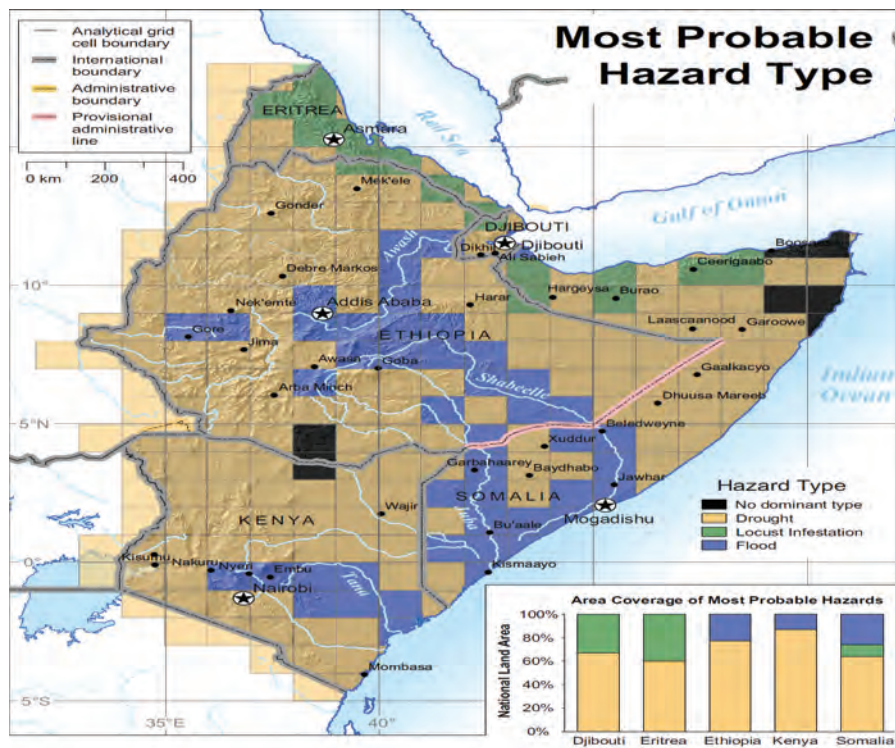


Figure.8. The geographical distribution of hazard types in Ethiopia and the Horn Region.

SOURCE: UN-ISDR (2010)

Impacts on human health

Climate change will have a wide range of impacts on human health in Ethiopia, especially via its effects on vector- and water-borne diseases and reduced availability of food and feed resources. A variety of tropical diseases common in Ethiopia are sensitive to changes in meteorological parameters such as rainfall, temperature, and humidity. These include malaria, cholera, yellow fever and meningitis among others. In recent times, significant variations in climate extremes have been observed over parts of the country that may have effects on these diseases. It has, for example, been observed that some areas that were once classified as cold and malaria free zones are now becoming warmer and good breeding sites for mosquitoes and hence experiencing frequent malaria epidemics (Daniel, 2007).

In central Ethiopia, for instance, an association has been documented between increasing malaria prevalence and incidence with concomitant warming trends from 1968 to 1993 (Tulu, 1996). Case study reports from East Shewa zone in Oromiya (Daniel, 2005) and from Borena, Guji in Oromiya and South Omo in the SNNPR (Aklilu & Alebachew, 2009) found that the relatively less known disease of malaria which used to be insignificant and cause very mild sickness in the lowland areas has become a major health issue in the zones. Serious disease outbreaks have been associated with very wet periods with, for example, cholera and Rift Valley fever epidemics occurring after heavy rainfall and flooding (NMA, 2007). In fact, malaria and diarrhea are among the most prevalent causes of illness in Ethiopia (MoFED, 2006; McMichael et al., 2004).

Impacts on water resources

Water has been recognized as an entry point to sustainable development. Unfortunately, water resources are expected to be highly vulnerable to future climate change. The most significant and immediate consequences will be related to changes in rainfall regimes, soil moisture budgets and short-term variations in spatial and temporal distribution and patterns of regional and local rainfalls.

In Ethiopia, climate change is predicted to have serious implications for the hydrology of the major river basins, lakes and other water sources. These affect the magnitude and seasonality of surface flows and increase the frequency of extreme events, such as drought and floods. Although there are no much detailed quantitative studies on the major water systems in the country, the limited studies that assessed the impact of climate change on the water resources of Ethiopia confirmed that the country's rivers are highly sensitive to climate change (Zeray, et al. 2006; Tenalem & Dagnachew, 2007; Tarekegn, 2000; Kinfe, 1999). In the dry lands, a decrease in river flow might cause small streams to dry up completely, and the magnitude of flow of the medium to large rivers

will decrease significantly (Zeray et al., 2006). On the other hand, predicted increase in the amount of rainfall in central Ethiopia will trigger the occurrence of floods, landslides, soil erosion and water contamination as has been the case in the 2006 flood that hit parts of South Omo, Dire Dawa and other parts of central Ethiopia. There are already serious conflicts over limited water and grazing resources in the southern and eastern lowlands during periods of droughts (Riche et al., 2009; Aklilu & Alebachew, 2009).

Impacts on energy resources

Energy is the major driving force for a modern economy. As clearly stated in the 1994 energy policy of Ethiopia the importance of energy security in the achievement of food security, economic growth and transformation in the country cannot be exaggerated. With the increasing price of oil and scarcity of foreign exchange, energy security has also become one of the major national development agendas of Ethiopia. The country's environment provides natural resources and energy services from diverse sources, such as water, plants, geothermal and solar energy. Ethiopia is endowed with such diverse energy resources. However, the current energy consumption is mainly biomass that accounts for 91%, imported petroleum for 7.4% and hydro for 1.1% (Yohannis & Helawi, 2008). Dependence on biomass has led to massive deforestation. On the other hand, the major source of energy for industrial and urban uses is hydropower, where reservoir storage has shown marked sensitivity to variations in runoff and periods of drought (World Bank, 2006). During drought years, for example 2007/08, electric power and water rationing have been repeatedly imposed on Addis Ababa and other major urban centers when water in supply reservoirs had fallen to unsustainable levels. While the hydropower generation is highly vulnerability to climate variability, deforestation will interfere with the catchment areas of the hydropower generation plants thereby creating an energy crisis.

Environment and biodiversity

Climate change affects the biodiversity of Ethiopia by affecting the productivity of forest and bush communities, which will have the effect of eliminating some species and introducing new species in their place. According to NMA (2001), climate change will lead to change of forest types, shift of forest to new species and fragmentation or disappearance of some indigenous species. Under the assumption of temperature rise of 2.4 to 3°C and a 5% decline of rainfall, subtropical dry forests show a decline in spatial coverage (21-24%), subtropical moist zone will decrease by 4% while tropical thorny woodland, very dry, and dry tropical forests will increase by 4%, 7% and 8% respectively. The models also predicted an expanded coverage of semi-arid and arid forests replacing subtropical high forests. On the other hand, there is fear that intensified change in climate may force some animal species to migrate (Nkomo et al., 2006).

Impacts on rural livelihoods, economic growth and transformation

In Ethiopia, there is a strong link between climate change, food security and rural livelihoods. For many decades, agricultural production in the country has not kept pace with population increases. Especially in the densely populated regions, food insecurity with high malnutrition has long remained a major problem where millions can quickly become dependent on relief aid during major droughts and at times of widespread crop infestations and unseasoned floods (Campbell, 1999). In Northeastern Ethiopia, for example, drought induced losses in crop and livestock between 1998 and 2000 were estimated at \$266 per household- greater than the annual average cash income of more than 75% of households in the region (Carter et al., 2004). On the other hand, during prolonged drought years, increasing distances between water and pasture cause problems to the health of cattle and create local conflicts over resources in pastoral areas (USAID, 2002). In such instances, weakening of the market for livestock, scarcity of currency and the depletion of local food stores force a large proportion of the population to rely heavily on food assistance (USAID, 2002).

Table 8. Major disasters, people affected and economic losses incurred (1983-2008)

Year	Major Disaster	Number of people		Economic loss US\$ X 1,000)
		Affected	Killed	
1983	Drought	7,750,000	300,000	-
1987	Drought	7,000,000	367	-
1988	Epidemic	-	7385	-
1989	Drought	6,500,000	-	-
1994	Flood	-	-	3500
1995	Flood	-	-	500
1997	Drought	986,200	-	-
1998	Drought	-	-	15,600
1999	Flood	-	-	2700
2000	Epidemic	-	311	-
2003	Drought	4,900,000	-	-
2005	Drought	12,600,000	-	-
2006	Flood	361,600	364	3200
2008	Drought	6,400,000	-	-
<i>Number of disasters from 1980-2008</i>				
No. of events	8	Average affected per year		1,591,727
No. of people killed	313,285	Economic Damage (US\$ X 1,000)		31,700
Average killed/year	10,803	Economic Damage per year (US\$X 1,000)		1,093

SOURCE: UN-ISDR (2010)

Despite the expansion of the national economy, the number of food insecure and relief-assisted population in Ethiopia has been extremely high in recent years, especially in 2000 following the drought of 1999/2000; in 2003 following the drought of 2002/3; in 2007 after the 2006 flood episode; and in 2008/9 following the drought in 2007/08 (Table 8). From 1994-2005 the population classified as needing assistance has been around 10% of the national population (Adams & Emebet, 2005).

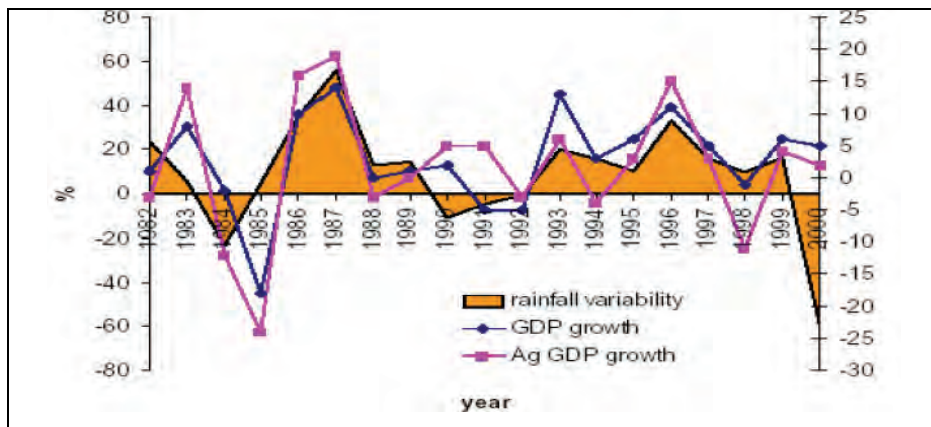


Figure 9. Relationship between annual rainfall and GDP growth over Ethiopia
SOURCE: de Jong, cited in World Bank (2006).

The occurrence of a single climate disaster, such as drought or flood, is capable of stagnating or even reversing national economic growth achieved over a decade or so (Table 8). This is especially so when the mainstays of the economy and pillars of economic growth and transformation are climate-related, such as rain-fed agriculture. Figure 9 shows the relationship that exists between annual rainfall, country gross domestic products (GDP) and the gross domestic products from the agriculture sector in Ethiopia. This figure clearly indicates that Ethiopia's GDP faithfully follow its annual rainfall. In this regard, it can be argued that one of the most widespread and potentially devastating impacts of climate change in Ethiopia will be changes in the frequency, intensity, and predictability of precipitation. Changes in precipitation will ultimately affect water availability and may lead to decreased agricultural, industrial and energy production and potentially widespread food and energy insecurity. Table 9 provides a summary of the impacts of climate change on key economic sectors and natural resources in Ethiopia.

Table 9. Sectoral impacts of climate change in Ethiopia

Sector	Potential impacts
Agriculture	Shortening of maturity period Expanding crop diseases Crop failure
Livestock	Change in livestock feed availability and quality Effects on animal health, growth and reproduction Impacts on forage crops quality and quantity Change in distribution of diseases Change in income and prices Contracting pastoral zones in many parts of the country
Forests	Expansion of tropical dry forests Loss of indigenous species/expansion of toxic weeds Desertification
Water Resources	Decrease in river run-off Decrease in energy production Flood and drought impacts
Health	Expansion of malaria to highland areas Threat from expanding endemic diseases and newly emerging varieties of human, plant, and livestock diseases Shift in species distribution
Wild life	Shift in biomes over decades/centuries Shifts in genetic makeup of population Loss of key wetland stopover and breeding sites for threatened bird species
Environment	Out-migration of endemic and threatened species Reduced productive capacity from degradation of forest, range, and water resources

SOURCE: Adapted from NMA (2001)

3.2. Theoretical and conceptual framework

3.2.1. Indicators of vulnerability and adaptive capacity

The concept of vulnerability appears frequently in both scientific reports and policy documents. It has important communicative value: it captures notions of possible loss, damage and impact; of threat, risk and stress; of uncertainty and insecurity; of a lack of power and control; and of a number of other factors that contribute to a feeling or state of being vulnerable. According to Vogel (2005), vulnerability can be seen in terms of the characteristics of individuals or groups in terms of their capacity to anticipate, cope with, resist and recover from the impacts of climate change or other environmental disasters.

IPCC (2001) provides a comprehensive conceptualization of vulnerability as “the degree, to which a system is susceptible to or unable to cope with adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity”. This definition explicitly includes external, i.e. exposure, and internal factors, i.e. sensitivity and adaptive capacity, and allows consideration of both socio-economic and biophysical factors. According to the IPCC definition, vulnerability to climate change depends upon three key elements: exposure to physical effects of climate change; the degree of intrinsic sensitivity of the natural resource system or dependence of the national economy upon social and economic returns from that sector; and the extent to which adaptive capacity enables these potential impacts to be offset (IPCC, 2001). This definition is useful for vulnerability assessment and has been applied widely.

Rural communities can become vulnerable for various reasons, such as changes in the climate system that induce floods, droughts, and diseases, changes in the management and control of natural resources, such as overgrazing, pollution, depletion, etc.; and changes in environmental and social policy. The impacts of these changes are felt unequally throughout a community or region (Galvin et al., 2001; Adger, 2000). The severity of impacts experienced will depend on which resources are available to a given group or individual. Although various communities may face similar risks, they may not be equally vulnerable. Resource poor areas and marginalized communities are the ones who will be affected first and most by changing climatic circumstances.

The main aim in vulnerability assessment is the identification of who and what is exposed and sensitive to change. A vulnerability assessment starts by considering the factors that make people or the environment susceptible to harm, i.e. access to natural and financial resources; ability to self-protect; support networks and so on (Tompkins et al., 2005). In this kind of assessment exercise,

researchers distinguish between social vulnerability and bio-physical or natural vulnerability. Basically, social vulnerability factors are those that relate to economic resources, the distribution of power, social institutions, cultural practices, and other characteristics of social groups typically investigated by the social sciences and the humanities. Biophysical vulnerability factors, in contrast, are related to system properties investigated by the physical sciences. These two categories can overlap, for instance, in the case of built infrastructure.

Vulnerability is highly dependent on context and scale. Thus, caution must be exercised to avoid interpreting indicators of vulnerability in an overly rigid fashion. In this regard, several authors have stressed the importance of defining vulnerability for a particular situation, i.e., the vulnerability of specified variables of a specified system to specified hazards within a specified time horizon; instead of assessing the vulnerability of a place to climate change in general (Brooks, 2003; Füssel, 2007). For example, an assessment can deal with the vulnerability of crop land and forest-based livelihoods in northern Ethiopia to drought over the next 30 years. In particular, specifying a hazard is important, as a system may be able to adapt to some hazards, for example, drought, and not to others, such as flooding. While some broad boundaries for terms and concepts associated with vulnerability can be identified, in practical attempts to apply vulnerability in the pursuit of adaptation, some flexibility must be retained due to inherent differences among different stakeholders, institutions, spatial scales and adaptation problems (Lynch et al., 2008).

Adaptive capacity is the ability of a system to adjust to climate change, moderate potential damage, take advantage of opportunities, or cope with consequences (IPCC, 2001). In general, the methods and frameworks for assessing vulnerability must also address the determinants of adaptive capacity in order to examine the potential responses of a system to climate variability and change. In the literature, the determinants of adaptive capacity have been widely debated and usually include the stock of human and social capital, the range of available technological options for adaptation, the availability of resources and their distribution across the population, the structure of critical institutions, and the derivative allocation of decision-making authority, and the decision criteria that would be employed (IPCC, 2007; Adger & Vincent, 2005). In general, indicators of vulnerability and adaptive capacity should include measures of insecurity and marginalization, distribution of wealth and assets, geographical and environmental dimensions, demographic and health status characteristics and social capital (Adger & Vincent, 2005; Stern, 2008). In short, adaptation policies must ultimately aim to move human, economic and ecological systems along the path from climate vulnerability towards climate resilience. Good adaptation policies will do so in an effective, efficient, equitable, flexible and sustainable manner.

3.2.2. *Adaptation, social protection and disaster management*

While their scope and specific interests may differ, adaptation, social protection and disaster risk reduction focus on protecting livelihoods and reducing people's vulnerability to hazards by improving methods, strategies and actions, to anticipate, resist, cope with and recover from their impact (Devereux & Wheeler, 2004; Davies et al., 2008). The social safety policy agenda in many poor countries target the poorest and most vulnerable in society and the transfer of resources (especially cash and food) to households to smooth consumption or support income. A comprehensive social protection that aims to prevent impoverishment and protect, promote and transform livelihoods and social relations provides significant opportunities to help people adapt to climate change (Devereux & Wheeler, 2004). According to Davies et al. (2008) and Devereux (2006), social protection has much to offer in helping the poorest reduce their exposure to current and future climate shocks (Table 10).

Table 10. Promoting adaptation through social protection

Approaches to social protection	Benefits for disaster management and adaptation
Provision	Protection of those most vulnerable to disasters and climate risks who have low levels of adaptive capacity
Prevention	Preventing damaging coping strategies as a result of risks to climate sensitive and weather dependent livelihoods
Promotion	Promotes resilience through livelihood diversification and security in order to withstand natural and climate-related shocks Promotes opportunities arising from climate change
Transformation	Transforms social relations to help address underlying causes and drivers of vulnerability

SOURCE: Adapted from Devereux and Wheeler (2004)

In disaster risk reduction, relief and recovery efforts are designed to smooth the social impact of shocks with far less emphasis on preventative approaches that tackle disasters from a holistic perspective. In adaptation, attention to building on existing coping practices is also focused on smoothing shocks as a first step. However, disaster risk reduction expands beyond the remit of climate change adaptation (Davies et al., 2008). The full range of hazards that disaster risk reduction can encompass includes natural causes, such as geological, hydro-meteorological and biological, or those induced by human processes, for

example, environmental degradation and technological hazards. Similarly, climate change adaptation moves outside the realm of most disaster risk reduction experience to address longer term impacts of climatic change, such as loss of biodiversity, changes in ecosystem services and spread of climate-sensitive diseases.

Climate change adaptation clearly focuses on climate-related hazards, such as floods, droughts and storms. The disaster risk management community has a long history of dealing with such events, and therefore a wealth of experience relevant to adaptation. Importantly, both adaptation and disaster risk reduction seek to build resilience to hazards in the context of sustainable development. Climate change adaptation requires the re-shaping and re-designing of development, social and economic practices to respond effectively to current climate variability new or anticipated environmental changes (Sperling & Szekely, 2005).

The World Resources Institute (WRI, 2007) presents a model of adaptation which helps to illustrate how closely disaster risk reduction is linked with adaptation. The WRI frames adaptation as a 'continuum of responses to climate change' divided into four types of adaptation efforts ranging from 'pure' development activities at one end of the continuum to very explicit adaptation measures at the other. These are: addressing the drivers of vulnerability; building response capacity; managing climate risk; and confronting climate change with highly specialized activities, such as relocating communities in response to sea level rise. While disaster risk reduction measures typically fall under the middle two categories of building response capacity and managing climate risk, they can fit into every category of the adaptation continuum addressing drivers of vulnerability, including diversifying livelihood strategies in flood-prone areas as well as confronting climate change, for example, by reducing the risk of river outburst floods.

3.2.3. The gender approach

IPCC (2001) underlines how the ability to adapt to climate-induced changes is a function of several strategic factors, including wealth, technology, information, skills, infrastructure, institutions, equity, empowerment and the ability to spread risk. At the household level, this translates into control over land, money, credit and tools; good health and personal mobility; household entitlements and food security; secure housing in safe locations; and freedom from violence (Enarson, 2000).

Vulnerability and poverty are strictly connected to gender inequality (IPCC, 2001). Poor communities are not homogenous, however, and it is important to understand the differentiated social impacts of climate change based on gender,

age, disability, ethnicity, geographical location, livelihood, and migration status (Tanner & Mitchell, 2008). As women constitute the largest percentage of the world's poorest people, they are most affected by these changes (Cornwell, 1997). Children and the youth, especially girls and elderly women, are often the most vulnerable. For example, one obvious consequence of climate change is reduction in the availability of water. Men and women have distinct roles in water collection, use and management leading to different needs and priorities. Climate change will increase the time taken to collect water in rural areas, a task mainly done by women and girls due to traveling greater distances to find water. In urban areas, water collection is also an issue as women and girls may spend hours queuing for intermittent water supplies (Brody et al., 2008).

A synthesis of research conducted in the past few years with regard to the gender dimension of climate change has documented five major adverse impacts (Enarsen, 2000):

- Relative increase in the economic insecurity of women: The process involves the loss of economic resources and deterioration of economic status. In fact, women lose productive assets and become sole earners. Moreover, they are also exposed to the loss of entitlements. It should be noted that households could no longer be considered as unitary associations characterized by an equal distribution of resources among its members;
- The participation of women on relief and reconstruction work as well as in capacity building activities may be negatively influenced by gender barriers;
- Sustained increase in women's workload;
- Progressive deterioration in the working conditions of women as compared to men;
- Women recover more slowly from economic losses than men because their socio-economic status is more vulnerable. Factors, such as reduced income, loss of employment, expanded workloads and critical working conditions make the recovery from natural disaster problematic for both men and women. However, gender inequality plays a relevant role; it emphasizes the adverse affects on women's lives and limiting their long-term recovery.

It follows that the responses to climate change should be gender sensitive. And a gender-sensitive response requires more than a set of disaggregated data showing that climate change has differential impacts on women and men. It requires an understanding of existing inequalities between women and men, and

of the ways in which climate change can exacerbate these inequalities (Masika, 2002). Conversely, it also requires an understanding of the ways in which these inequalities can intensify the impacts of climate change for all individuals and communities. It is also important to note that a gendered approach to climate change should not simply be about women. Men and boys are also vulnerable to the impacts of climate change but often in different ways, and these need to be identified and taken care of. Furthermore, women and girls are involved in relationships with men and boys and it is important to capture the interaction between the sexes (Cornwell, 1997).

However, focusing solely on vulnerability may be misleading since women often have untapped skills, coping strategies and knowledge that could be used to minimize the impacts of crisis, environmental change and disasters (Alebachew, 2010). In reality, women have a key role in development, and any potential environmental policy should take cognizance of women as key players; particularly given their role as natural resource managers (Fordham, 2001). Studies underline the existence of potentials linked to women's active involvement in agriculture and their dependence on biomass energy that make them the "key stakeholders" in effective environmental management (Fade, 1995).

3.2.4. Sustainable livelihood approach (SLA) to climate change adaptation

Designing climate change adaptation requires a reliable comprehension of the vulnerability context and the local socio-economic and political realities. Given that the poor are most vulnerable to disruptive shocks and trends, protecting their livelihoods and building their resilience require an understanding of how their livelihoods are comprised, conducted and how they can be made resilient and sustainable in the face of changing climatic circumstances. Hence, reducing peoples' vulnerability to shocks, such as climate-related disasters, require a thorough understanding of the livelihood-climate change interactions. By understanding peoples' livelihoods, we can begin to understand why they are vulnerable; how they cope; how they will be affected by climate change impacts; how they might respond with the resources they have; and how these conditions can be reflected and built upon for successful adaptation strategies. This knowledge can be developed through a four step participatory process (Ashley & Carney, 1999): (i) identifying how livelihoods are conducted; (ii) identifying the main climate-induced vulnerabilities that affect livelihoods; (iii) identifying existing coping strategies; and (iv) identifying the needs and priorities of stakeholders in the face of climate-induced vulnerabilities.

The fundamental goal of adaptation strategies is the reduction of the vulnerabilities to climate-induced change in order to protect and enhance the livelihoods of poor people. These, in turn, are strictly correlated to the concept of livelihood assets. This expression comprises "the means of production available to a given individual, household or group that can be used in their livelihood activities" (Ellis, 2000). As a consequence, as some authors underline with particular emphasis, "the greater and more varied the asset base the higher and more durable the level of sustainability and security on their livelihoods" (Enarsen, 2000).

Although using the SLA with its diverse components, for example, livelihood assets, strategies, mediating factors and outcomes, and focus on multiple levels may seem like an overwhelmingly exhausting task, the idea of the framework is not to tackle all issues at once. The approach rather attempts to identify the strengths of people at risk and to build on them in order to achieve positive outcomes. The approach has been selected and used in the present study with this view in mind and its application greatly assisted in the identification of key issues related to the multifaceted impacts of climate change on rural livelihoods and the scale of the adaptation responses. These are needed to reduce peoples' vulnerability to climate hazards. This is often done through protecting their assets and the environmental resources in which their survival and livelihoods depend as well as by finding strategically important intervention areas for future adaptation investments by external actors.

3.2.5. Ecosystem-based approach to adaptation

Biodiversity is inextricably linked to climate. In other words, changes in climate affect biodiversity, and changes to natural ecosystems also affect climate (Reid & Swiderska, 2008). Climate change has already had observed impacts on natural ecosystems and species. Natural systems, such as forests, wetlands, grasslands and dry land ecosystems, are especially vulnerable to climate-induced disturbances. However, enhanced protection and management of biological resources can mitigate the impacts and contribute to solutions as nations and communities strive to adapt to climate change (Millennium Ecosystem Assessment, 2005).

Biodiversity is the foundation and mainstay of rural livelihoods: agriculture, forests, pastures, wildlife and fisheries. Poor people generally depend more on ecosystem services and products for their livelihoods than do wealthy people (Hazlewood & Moc, 2001). As a result of this dependency, any impact that climate change has on natural systems threatens the livelihoods, food intake and health of poor people (Ziervogel et al., 2008). The rural poor, who often live in ecologically fragile areas, are particularly vulnerable. Because of their reliance on ecosystem services, the combined effects of ecosystem decline and climate

change will fall hardest on the poor (Figure 10). The lack of assets and opportunities that define poverty increase the vulnerability of the poor to a shrinking and less reliable natural resource base. Unlike more affluent families, the poor often cannot replace lost ecosystem services by changing jobs or falling back on savings. Particularly hard hit will be the poor who rely for income on the “commons”- those areas where natural resources are accessed by many users simultaneously and pressures on the resources are already high. Strengthening the resilience of people and ecosystems and their ability to adapt to climate change will be a major development challenge in the coming decades.

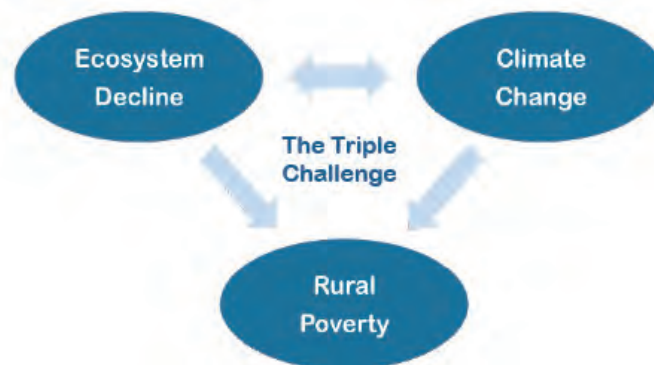


Figure 10. The triple challenge for rural livelihoods in developing countries

SOURCE: Hazlewood & Moc (2001)

Given the reliance of the poor on environmental services for their livelihoods, a central element of this adaptation approach should be ecosystem management and restoration activities, such as watershed rehabilitation, agro-ecology, and forest landscape restoration (Thompson et al., 2009). Ecosystem-based adaptation represents an overall strategy which uses biodiversity and ecosystem services to help poor rural people to adapt to the adverse effects of climate change (World Bank, 2009b). As one of the possible elements of an overall adaptation strategy, ecosystem-based adaptation (EBA) uses the sustainable management, conservation and restoration of ecosystems to provide services that enable people to adapt to the impacts of climate change. It aims to maintain and increase the resilience and reduce the vulnerability of ecosystems and people in the face of the adverse effects of climate change. EBA can generate significant social, economic and cultural co-benefits, contribute to the conservation of biodiversity and build on the traditional knowledge and practices of indigenous peoples and local communities, including the important role of women as custodians of local knowledge (Marsh, 2003). In addition, healthy and well

managed ecosystems have climate change mitigation potential, for example, through the sequestration and storage of carbon in healthy forests, wetlands, and coastal ecosystems.

3.2.6. *Climate change adaptation planning*

Adaptation is a continuous stream of activities, actions, decisions and attitudes that inform decisions about all aspects of life, and that reflects existing social norms and processes (Adger et al., 2005). As a process, it needs careful planning. However, there is no universal recipe for designing and implementing adaptation (Füssel, 2007), because adaptation concerns a wide array of sectors with distinct objectives and vulnerabilities to different climatic threats, for instance, agriculture, human and animal health, pest control, water management, ecosystem management, including forestry, disaster prevention, human settlements, industry and energy. Moreover, a large diversity of adaptation options is available, with different timings, actors, functions and forms (Table 11). These options must be tailored to the local economic, environmental, political and cultural conditions of the area, and institutional arena relevant for the sector.

Table 11. Common types of adaptation

<i>Base of categorization</i>	<i>Types of adaptation</i>
Timing	Anticipatory (or proactive) and Responsive (or reactive)
Temporal scale	Short-term (tactical) and Long term (strategic)
Spatial scope	Localized and Widespread
Actors	Private and Public
Function or effects	Retreat. Accommodate. Protect. Prevent. Tolerate. Spread. Change. Restore
Form	Structural. Legal. Institutional. Regulatory. Financial. Technological

SOURCE: Smith et al. (1999); IPCC (2001)

In some cases, an individual adaptation can be sufficient to reduce individual vulnerability; however, collective interventions are often required (Adger et al., 2005). Collective adaptation decisions are taken by a wide array of actors at different scales, for example, individuals, firms, civil society, and local, regional, national and international public institutions. The different scales of decision making are interrelated. For instance, individual decisions are constrained by

local and national institutions, and national adaptation policies are influenced by international processes such as the UNFCCC.

An essential step in adaptation planning is to understand the scales that are relevant for the actors concerned by adaptation and the cross-scale interactions (Adger et al., 2005). In particular, understanding local institutions is a key component of local adaptation planning as these institutions mediate impacts and vulnerability, and determine the possible individual and collective adaptation responses as well as their outcomes (Agrawal, 2008).

According to IPCC (2004), adaptation measures may be legal, financial, economic, technological, public education, and/ or research and training. The same source classifies climate change adaptation strategies into six categories:

- *Prevention of loss*: involving anticipatory actions to reduce the susceptibility of an exposure unit to the impacts of climate.
- *Tolerating loss*: where adverse impacts are accepted in the short term because they can be absorbed by the exposure unit without long-term damage.
- *Spreading or sharing loss*: where actions distribute the burden of impact over a larger region or population beyond those directly affected by the climatic event.
- *Changing use or activity*: involving a switch of activity or resource use to adjust to the adverse as well as the positive consequences of climate change.
- *Changing location*: where preservation of an activity is considered more important than its location, migration occurs to areas that are more suitable under the changed climate.
- *Restoration*: this aims to restore a system to its original condition following damage or modification due to climate.

Because climate change will impact all aspects of sustainable development and because vulnerability depends strongly on development, policy makers must strive to mainstream adaptation to climate change into national and sectoral development (Huq et al., 2003; Lemos et al., 2007; UNFCCC, 2002). Development interventions that do not address adaptation to climate change may worsen the existing environmental and socio-economic situation (Agrawal, 2008). Policy makers should also identify and remove maladaptive practices, i.e., existing policies that increase vulnerability, for instance, incentives that encourage natural resource overexploitation or adaptation measures that fail to achieve their objectives (UNFCCC, 2002). Another argument for mainstreaming

adaptation into development policies is that climate change threats and the need for adaptation can be a catalyst for achieving sustainable development (UNFCCC, 2002).

Adaptation to climate change is a dynamic and multi-dimensional process integrating various components, such as sound planning, research, technologies, funding, training, capacity building, public awareness, and education. However, for proper implementation of various programs, policies, strategies and actions on adaptation, there is need for a good enabling environment, which includes legislations and institutions that can support mainstreaming of adaptation concerns in development planning. Effective implementation of adaptation actions, therefore, requires more than the mere output of climate data (Adger et al., 2005).

The evaluation of adaptation options must not be limited to their effectiveness, i.e., their capacity to achieve the expressed objectives of vulnerability reduction (Adger et al., 2005). But other criteria must also be considered, especially equity, economic efficiency, legitimacy, flexibility, feasibility and environmental sustainability (Smit et al., 1999). As short-term or local successes may cause failures in the longer term or in other places, the outcomes of an evaluation of adaptation options depend on the temporal and spatial scale of analysis (Adger et al., 2005). What is needed is an analysis that goes beyond scales to evaluate adaptation options more comprehensively.

4. Results and Discussions

Introduction

Historically, Meket and Raya Azebo lie within the most intensively cultivated, degraded drought-prone areas of Ethiopia where tackling rainfall variability, drought and local resource degradation are an integral part of peoples' lives and livelihoods. In districts, access to and the conditions of natural resources provide opportunities as well as challenges. But, what precisely is the impact of climate variability/change on the patterns of the local climate, on land degradation and rural livelihoods in the districts? What survival and coping strategies are employed by rural people? What options and strategies are available to enhance local resilience and capacity to effectively adapt to the multi-faceted impacts of climate change? The chapter argues for a deeper understanding of the complexity of the links between rural poverty, land degradation and climate change in future development interventions and policy formulation.

The first section of the chapter presents the demographic and socio-economic background of the respondent households and discusses local evidences of climate change and variability. The second section assesses the impact of climate change-induced hazards on key socio-economic sectors and natural resources. The final section presents the local adaptation strategies employed by households and external actors, such as institutions. The discussion is based on results obtained from the household questionnaire survey, the in-depth discussions and interviews, field observations and data from meteorological and documentary sources.

4.1. Respondents and households characteristics

Age and sex

As shown in Table 12, quantitative data have been collected from a total of 223 households in all the four sample rural kebeles in Meket and Raya Azebo districts. Specifically, 106 of the respondent household heads constituting 47% were from Meket district and 117 or 53% were from Raya Azebo. Of the total sampled respondents, 69 constituting 31% were female headed households. The age distribution shows that the age of respondents range from 20-78 years with more than one-third (36%) of the respondents falling in the age percentiles of below 25 years, about 43% in the age ranges between 25-50 years and the rest are above 50 years of age.

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Table 12. Distribution of respondents by age and sex

Zone	Wereda	Kebele	Sample household size					
			Male		Female		Total	
			No	%	No	%	No	%
North Wello	Meket	024 (Mesfina)	37	24	15	22	52	23
		026 (Dibeko)	40	26	14	20	54	24
Debubawi Tigray	Raya	Ade-Halga	35	23	25	36	60	27
	Azebo	Hawelti	42	27	15	22	57	26
Total	2 weredas	4 kebeles	154	00	69	100	223	100

SOURCE: Field data (July-August 2010)

Family size and education

The family size and educational background of the sample household heads are given in Table 13. As the table shows, a substantial proportion of the respondents have large family sizes, which is typical of rural Ethiopia. Specifically, about 57% of the households have a family size of 4 to 6 members and nearly 30% have a large family size of more than 7 persons per family. With regard to the educational status of the respondent household heads, nearly half or about 46% of the study household heads were illiterate with no formal education of any kind and thus are unable to read and write whatsoever. Nearly 18% of the respondents stated that they can read and write while a little over one-third or nearly 37% have some form of formal schooling, i.e. primary education and above. The data for the two districts were revealing of the low level educational achievement of most rural Ethiopians.

Table 13. Educational and occupational characteristics of respondents

Family size	Study weredas					
	Meket		Raya azebo		Total	
	No	%	No	%	No	%
1-3	16	15.1	13	11.1	29	13.0
4-6	61	57.5	67	57.3	128	57.4
7-9	25	23.6	34	29.0	59	26.5
10-15	4	3.8	3	2.6	7	3.1
Total	106	100.0	117	100.0	223	100.0

Educational status	Meket		Raya Azebo		Total	
	No.	%	No.	%	No.	%
Illiterate	53	50.0	49	41.9	102	45.7
Read & write	22	20.8	17	14.5	39	17.5
Primary (Grades 1-6)	24	22.6	40	34.2	64	28.7
Post-primary	7	6.6	11	9.4	18	8.1
Total	106	100.0	117	100.0	223	100.0

SOURCE: Field data (July-August 2010)

Livelihood activities

In rural Ethiopia, agriculture may be viewed as a land use system, an economic mode of production and a way of life for many people who derive their main livelihood incomes or subsistence from crop farming and livestock herding largely dependent on feeds grown naturally. However, with the increasing challenge of natural hazards and human-induced climate risks, more and more farmers are trying to combine their earlier mode of production with on-farm and off-farm or non-agricultural livelihood sources, such as animal fattening, bee-keeping, small scale rural trading; mining and collection and sell of natural resources, such as non-timber products, wood and wild fruits; and seasonal out-migration. In Meket and Raya Azebo, like in many other rural parts of Ethiopia, food and livelihood security are inextricably linked with the exploitation of the natural resource base, including land, water and forest resources.

A list of agricultural and non-agricultural livelihood activities of respondent household heads in the pilot areas is given in Table 14. The table shows that for the overwhelming majority of households, i.e. 97% in Meket and 95% in Raya Azebo, cereal crop cultivation still forms the main livelihood activity followed by seasonal labor migration and petty trade. In fact, in both districts, households engage in a diverse portfolio of livelihood activities, including livestock fattening and selling, fruit and vegetable production and selling, livestock and salt trade, bee-keeping and the production and sell of forest products, such as firewood, charcoal, incense and natural gums, animal fodder and cattle dung.

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Table 14. Main livelihood activities of respondent households

Income sources	Study wereda					
	Meket		Raya Azebo		Total	
	No	%	No	%	No	%
Crop cultivation	103	97.2	111	94.8	214	96.0
Livestock selling/fattening	21	19.8	31	26.5	52	23.3
Selling livestock products	39	36.8	18	15.4	57	25.6
Bee keeping	16	15.1	34	29.1	50	22.4
Production/selling of vegetables and fruits	14	13.2	44	37.6	58	26.0
Making and selling of charcoal	13	12.3	11	9.4	24	10.8
Selling firewood/cattle dung /fodder	39	36.8	30	25.6	69	30.9
Selling water	16	15.1	15	12.8	31	13.9
Incense and natural gum	7	6.6	7	6.0	14	6.3
Collection and sell of wild leaves and fruits	11	10.4	17	14.5	29	24.8
Extraction/selling minerals	2	1.9	9	7.7	11	4.9
Petty rural trade	67	63.2	33	28.2	100	44.8
Seasonal labor migration/casual urban jobs	79	74.5	58	49.6	137	61.4
Total	427	402.8	418	357.3	845	378.9⁸

SOURCE: Field data (July-August 2010)

The tabulated data clearly show the immediate daily dependence of the rural people on cereal crop cultivation, livestock, natural resources and biodiversity. There are encouraging signs that rural households are trying to avoid the risk of overdependence on only one source of income, i.e. cereal crop cultivation, which itself is very sensitive to climate variability and change. However, in their attempt to diversify their sources of income and subsistence, some of the off-farm and non-agricultural income generating activities, such as collection and sell of firewood and charcoal making, are unsustainable sources, which

⁸ Percentages do not add up to 100% due to multiple responses.

aggravate the problem of local ecological destructions and reduce ecosystem resilience.

Although there has been a great deal of effort to address land degradation in the districts, these have failed to reverse the downward spiral in much of the worst affected areas. Part of the reason for this has been the promotion of practices and technologies that were not well suited to the conditions facing farmers in their particular location, and hence not feasible, profitable or excessively risky (Berhanu, Pender & Ehui 2002; USAID, 2000).

Recent trends in demographics, settlement and farm expansion and increased reliance on chemical fertilizers inhibited adoption of sustainable soil conservation and land management practices in many of the kebeles. However, the social, economic and environmental costs, both at micro and macro levels, of climate change and land degradation in the districts, in particular the costs of erosion of household assets and soil, are too many and dangerous to set the issue aside. In both Meket and Raya Azebo, overcoming the challenge of climate change and land degradation requires that farmers adopt profitable and sustainable soil conservation and land management practices. The alternative is to pursue alternative livelihood strategies that are less demanding of the land resource and hence less sensitive to changes in the local climate.

Land holdings and ownership

Land, particularly farm land, is the most valuable resource and household asset in North Wello and South Tigray. However, farm lands in many areas are fragmented and too small to cover the farming households' annual consumption and expenditure patterns and hence ensure their food security. According to data obtained from North Wello Zonal Agriculture Office and REST Coordination Office in Raya Azebo, average farm holding per household in Meket is 0.63 hectare and in Raya Azebo is 1.84 hectare respectively. In both districts, most of the small farmers have miniscule or to use Dessalegn's term "starvation plots" (Dessalegn, 2008) only enough to sustain and survive. As the data in Table 15 clearly show, a substantial proportion of the sample households, i.e. about 80% in Meket and 56% in Raya Azebo, have no sufficient land to farm and support their households. In lean years when the rains fail, most households became food insecure for most of the months and mostly rely on external aid, such as safety net and other forms of external assistance. Even in good years, annual production from small household plots fails to support them for the year; and for three to four months, such families rely on the safety-net program of the government.

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Table 15. Land ownership and average size of holdings of sample households.

Do you own land?	Study wereda					
	<i>Meket</i>		<i>Raya Azebo</i>		<i>Total</i>	
	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>
Yes	103	97.2	111	94.9	214	96.0
No	3	2.8	6	5.1	9	4.0
Total	106	100.0	117	100.0	223	100.0
Average size of cultivated land	<i>Mean</i>	<i>S.D</i>	<i>Mean</i>	<i>S.D.</i>	<i>Mean</i>	<i>S.D.</i>
	0.76	0.704	1.48	0.501	1.15	0.603
Do you have enough land for cultivation?	<i>Meket</i>		<i>Raya Azebo</i>		<i>Total</i>	
Yes	21	20.4	50	45.0	71	33.2
No	82	79.6	61	55.0	143	66.8
Total	103	100.0	111	100.0	214	100.0
Use irrigation for growing crops?	<i>Meket</i>		<i>Raya Azebo</i>		<i>Total</i>	
Yes	13	12.6	27	24.3	40	18.7
No	90	87.4	84	75.7	174	81.3
Total	103	100.0	111	100.0	214	100.0

SOURCE: Field data (July-August 2010)

Since the majority of land holdings are so small, the income patterns of households owning them are highly vulnerable to the vagaries of weather and economic shocks. Any exogenous shock, unfavorable weather conditions, a bad crop or an adverse economic policy proves their undoing and they slip below the poverty line. As Table 15 shows, the majority of farm households, i.e. about 87% in Meket and 76% in Raya Azebo, rely on rain-fed agriculture and only few households, i.e. less than 13% in Meket and 24% in Raya Azebo, practice irrigation agriculture. This clearly shows how climate sensitive the agricultural sector is and how any small deviation in the patterns of the local climate, particularly the rains in the main rain season, could be seriously devastating for most subsistence farmers. In this regard, policies with a pronounced bias in favor of expanding irrigation, water harvesting and management as well as facilitating non-farm income, such as improving human capital or labor skills by providing information, training, technical and technological backups, would help reduce their vulnerabilities to climatic and non-climatic risks.

Livestock holding

For small farmers in Meket and Raya Azebo, livestock not only provide draught power and manure but also a measure of social status and economic security since they can be sold to raise cash at times of most need. Cattle are generally the preferred species because they are the main source of draught power and also provide fuel in the form of dung cakes. In the high attitude zones in Meket, sheep are more important while goats are better adjusted to the climatic conditions in the lowlands. In Raya Azebo, cattle and camel are most important household assets. In particular, camels are important since they are better adapted to the lowland ecosystem with scrubby bush and the cactus leaves, which dominate much of the uncultivated area in the district. In fact, cactus growing has become a popular adaptation activity to help secure emergency food rations for households and their livestock while the wood is also being used to make fences.

In Meket, communal areas are freely grazed, although the predominantly scrubby bush provides only limited forage. Livestock are given teff straw and other crop residues as supplementary feed with draught oxen receiving preferential treatment. As population pressure in the highlands has increased, the area under cultivation has expanded, and most of the land previously used as communal grazing is now taken up by crops or in some areas by eucalyptus trees⁹. In Raya Azebo, previously common grazing areas are under community enclosures with households participating in the management of such areas allowed to cut and carry the grasses for controlled feeding of their livestock.¹⁰ However, most livestock in the study kebeles graze freely on the common grazing areas, which are mostly dominated by cactus, acacia and other thorny bush species. In both Meket and Raya Azebo, forage has become such a scarce resource that some farmers in Meket have even started watering their grass plot during the dry season. In Raya Azebo, some farmers have started growing cactus leaves for fodder and livestock feeding.

⁹ Interview with Ato Moges Alem, agriculture expert at Mesfina kebele, Meket

¹⁰ According to REST Coordination Office, Mehoni, Raya Azebo district, such practices are referred to as 'zero grazing, areas.

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Table. 16. Average livestock possession of sample households

Wereda	Wealth category	Livestock wealth						TLU
		Oxen	Cows	Calves	Shoats	Donkeys & Horses	Camels	
Meket	Poor	0.2	0.5	1.1	1.6	0.0	0.0	0.93
	Middle	1.4	1.3	1.0	1.3	0.7	0.0	3.0
	Better-off	2.0	1.7	2.0	3.8	0.7	0.0	4.90
Raya Azebo	Poor	0.4	0.7	1.1	1.6	0.0	0.0	1.37
	Middle	2.8	2.1	2.1	4.5	0.3	0.0	4.30
	Better-off	2.6	3.2	2.8	5.1	0.7	2.0	6.39

SOURCE: Field data (July-August 2010)

The average farmer in the middle income category in Meket owns 3 TLUs¹¹ as compared to 4.3 TLUs in Raya Azebo (Table 16). During drought or lean seasons, many farmers in both districts have to sell animals to meet their daily needs, but then lack the means to restock their herds. In view of the fact that wealth ranking was mainly based on the ownership of livestock, it was not surprising to find that the better-off groups own the most animals in each wereda. It was found that 37% of the sample households in Meket, for example kebele 024 and 026, and about 21% in Raya Azebo, for example Ade-Halga and Hawelti, had no livestock. Because all of these households belong to the least endowed group, one can assume that they have limited or no access to draught power, manure or cash from the sale of animals.

Data from the survey also revealed that 30% of the sample households in Meket, for example 29% of households in kebele 024 and 31% in kebele 026, and 33 % in Raya Azebo for example, 35% in Ade-Halga and 31% in Hawelti, had only one ox. Those who own a single ox make arrangements with kin, friends, or co-villagers in the same situation, for taking turns to use the pair. Farmers without oxen can rent or borrow them although they have to wait until the owners have finished ploughing. As the going rate is two to three days of human labor to use a pair of oxen for one day, poorer farmers have less time to invest in their own farms and little chance of improving their economic situation.¹²

¹¹ Tropical Livestock Unit. TLU is calculated on the basis of the following standard values for Africa given by Jahnke (1982): 1 adult cattle or equine = 0.7 TLU, 1 goat or sheep = 0.1 TLU, 1 calf = 0.4 TLU.

¹² Interview with Ato Getahun Abate, chairperson of Mesfina (kebele 024), Meket

4.2. Patterns of the local climate

Temperature variability and trends

The average annual temperature in Meket is 22.3 °C and in Raya Azebo 23.1 °C. The pattern of temperature distribution in Raya Azebo shows a general increase and certain inter-annual variability¹³. A similar pattern in temperature distribution has been observed in the highlands of Ethiopia (Muna, 2006), parts of southern Ethiopia (Aklilu & Alebachew, 2009), Oromiya and southern Tigray (Oxfam International, 2010). Hence, the pattern observed in the study follows the general observation and trend of atmospheric warming in Ethiopia (NMA, 2007). As can be seen from Figure 11, Raya Azebo has experienced rising trends of temperature over the past three decades. It is well recognized that small increases in temperature could exacerbate problems of water, human and livestock health problems, and scarcity of food and feed production.

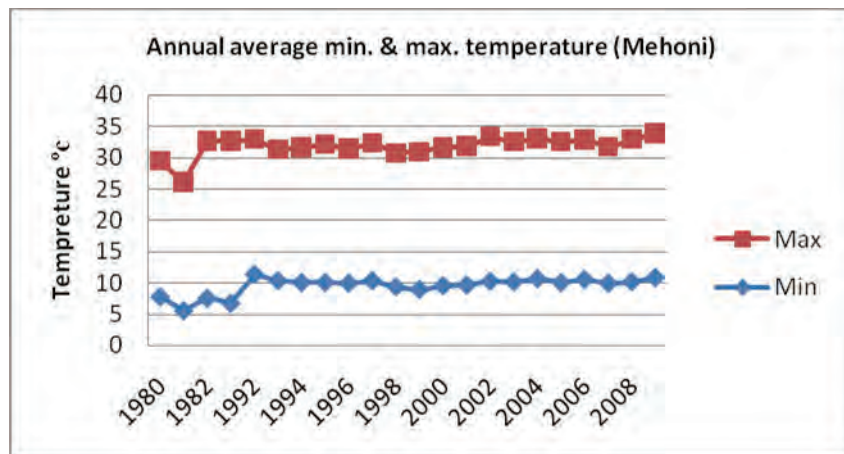


Figure 11. Patterns of temperature in the study area

Rainfall variability and trends

An analysis of the average annual rainfall trends in the past five decades in Ethiopia shows a more or less constant trend (NMA, 2007). However, a trend of increasing rainfall was observed in central Ethiopia while an overall declining trend was recorded in the water stressed northern, north-eastern and southern lowland regions. The pattern of rainfall distribution in the past two to three decades in the study areas is shown in Figure 12. The average annual rainfall in the study area ranges from 400-800mm with wide temporal and spatial

¹³ No temperature data is available for Meket or Geregera/Flakit (the wereda capital)

variations. Also, the rainfall pattern is extremely unpredictable and erratic both in space and time.

In Raya Azebo and Meket, it is common sense that rainfall patterns are perceived to have changed over the past decades, particularly in terms of timing and duration. The frequency of drought is viewed as increasing particularly over the past two decades. Some people from the two localities observed that the changes have become more noticeable since the major famine in 1984; and years of ‘good rainfall’ are seen as a distant memory. Except in more dry years, changes in the seasonality, distribution and regularity of rainfall were more of a concern than the overall amount of rainfall. The main rainy season is also seen as becoming progressively shorter- it now starts much more late and finishes earlier than it used to; and the rains in general are becoming more unpredictable. As water shortage is already a major development challenge in the study area, the uneven and erratic nature of the rains will exacerbate the existing problems of drought and land degradation.

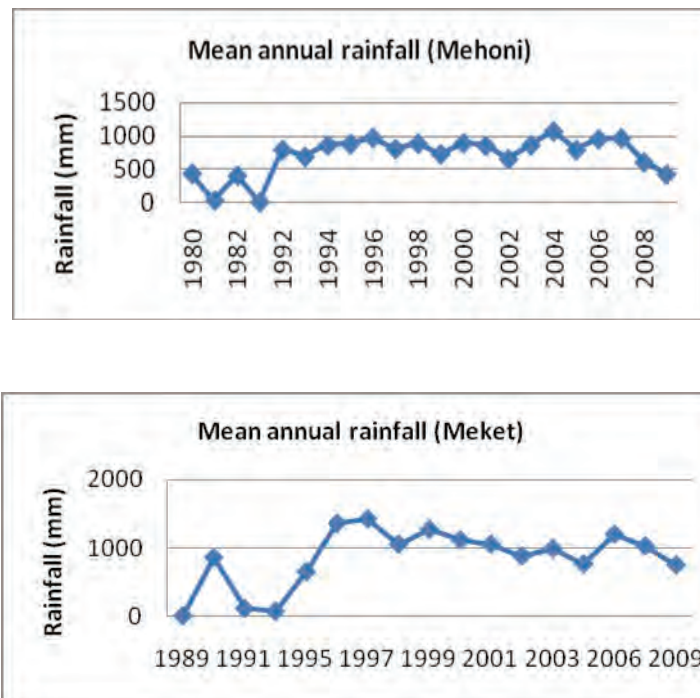


Figure 12. Patterns of rainfall distribution in the study area

4.3. Perceptions of climate variability and change

Local cultural perceptions and perspectives about the causes and local evidences of climate variability and change are vital for understanding the qualitative perceptions of people at the frontline. These can assist in climate risk assessments, public awareness campaigns and future adaptation and intervention options, all of which can benefit from the knowledge and historical experience of those affected by the varying weather and changing climatic conditions. This factor is very important in the perspective of future climate change adaptation strategies, the more so if we consider the fact that rural people constitute 84% of the 74 million people in the country (CSA, 2007).

Box- 1

“Praying for rains”

Mersha, aged 43, is in no doubt that the climate is changing. When asked to tell about what he knows concerning climate change, Mersha simply gives a pragmatic definition “It is an environmental and economic challenge which kills our crops and our animals.” Because of climate change, “we are experiencing rising temperature and very little rainfall. As the land continues to get barren and dry, production is falling and livestock emaciating... I wonder what is happening to the climate and our land. As a desperate attempt to get out of the deadlock, we were all praying in the local St. George church. People were fasting, praying day and night for the rain to come...Milking cows were separated from their calves and small children were not allowed to stay with their mothers and suck milk. “We are desperate farmers. Prayers and seeking for external support seems the only thing we can do now. Mersha believes that without the safety-net program from the government the community would be unable to survive. He thinks adult men will probably be forced to go elsewhere in search of casual work, which he deeply regrets because he believes that the head of the family should be there "to manage their lives on a daily basis". Separation will be painful, but, he says, "If the drought continues like this, what can I do here. I may need to leave...”

Discussions and interviews held with selected community members, including youth leaders, elders, women farmers, and kebele officials, in the study area revealed that in the past few years the temperature has shown an increasing trend while the rainfall pattern has shown a decreasing trend in amount and irregularities in its spatial and temporal distribution (Box 1 and 2). According to informants in Meket and Raya Azebo, there has been a general tendency of atmospheric warming and elders have explained this in terms of burning sun light, powerful sunrays, very dry and windy days and extended dry spells. Respondents in kebele 024 in Meket district, Mesfina and Ade-Halga,

Raya Azebo, also bitterly complained about the long dry and hot days they are experiencing in recent times. They reported that while ploughing or grazing their herds, they spend much time looking for tree shades; only to discover that their land is simply barren.

Box- 2.

“Water torture”

Kahssay, 41, was a member of the TPLF army. He retired from military service some 6 years ago and he is now a farmer in the small village of Ade-Halga in Raya Azebo. He says “I am enduring poverty and hardship due to drought. Although I do all I can to satisfy my family needs, it is not enough... I plant sorghum, maize and all sorts of beans, but there are no results because it is too dry... There was a lack of rain in the past, but at the moment, it is worse...Last season, we tried to plant sorghum but it didn't grow except in those fields that have a little bit of irrigation...All the other land that is waiting for the rains was not able to produce anything. Most of the farm plots could not be sown and those planted with seedlings dried up because the soil was too dry... Eventually, we let our cattle graze these fields since the plants did not mature. If the rain does not come, we will start again at zero and replant our fields... We are under God's will and we can do nothing to change the situation. The lack of rain is a real torture.” Despite these problems, Kahssay hung on to the cattle he had bought with the support he received from the safety-net program, which he says "saved my life". He sold one to buy food and let his wife start a small business, which now "looks promising".

On the other hand, rainfall patterns are perceived to have changed over the past decades (Figure 13), particularly in terms of timing and duration. FGD participants in Ade-Halga and Hawelti particularly complained about the erraticity and irregularity of the rains and the failure of the main rainy seasons in the past three years (2007- 2009). Community representatives and local officials in Meket also complained about the irregular rains and decline in the number of rainy days. In both districts, the frequency of drought is viewed as increasing, particularly over the past three decades. Elders and some FGD participants indicated that the changes have become more noticeable since the major famine in 1984; and years of ‘good rainfall’ and favorable harvest are seen as a distant memory.

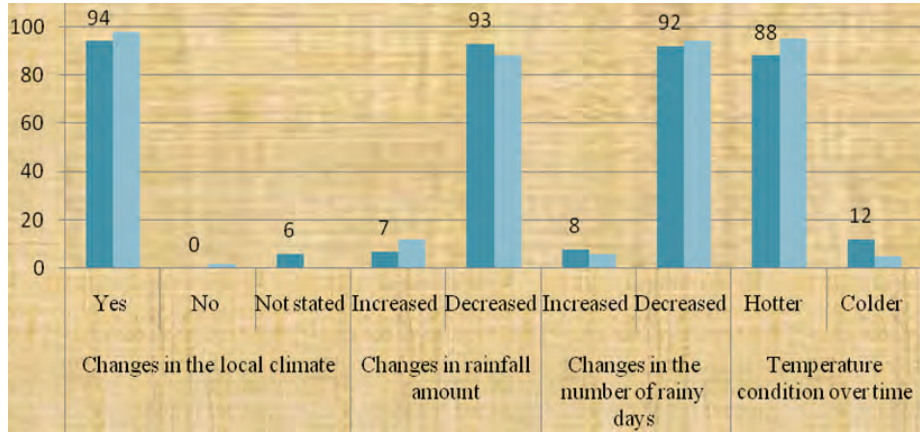


Figure 13. Community perceptions of changes in the local climate (% of households)

■ Meket ■ Raya Azebo

Individual responses captured in the household survey on the patterns of climate change also reflect the views aired in the discussions. More than 90% of the households confirmed that they had experienced changes in the patterns of the local climate in the form of increased temperatures, declining rainfall amounts, and reduced rainy days (Figure 13). This is in agreement with the rainfall data obtained from meteorological records. In the discussions, the participants in Meket described the irregularities and vagaries of rainfall in terms of late onset and early cessation of the main rains. It was indicated that rains which normally should start in mid-June shifted to July and ceased much earlier in the same month than was normally the case which stretched from the end of August to mid-September. In Hawelti and Ade-Halga, Raya Azebo, informants reported failure of rains for three consecutive years, i.e. 2007-2009. More recently, these areas received heavy rains in mid-August 2010.

Farmers are increasingly unsure of receiving enough rain to justify planting staple food crops. As one FGD participant in Ade-Halga commented:

“Over the past three to four years, we have lost the rains. This year, i.e. 2010, we have relatively good rains. But for the past three years, there was serious drought. The rains fail and even when they do come come, it did not happen at the right time: it is starting later and finishing before long. We prepare the land for planting when the short rain starts but then it stops and no more rain comes so we have wasted our time. For three consecutive years, our crops failed.” (Meresa, 38).

Amdebirhan Mebre Birle, a 51 year old priest and a farmer from kebele 026 (Dibeko) in Meket district, expressed a similar concern over the change and uncertainty:

“...Gone are the good old days with ‘good’ rains and relatively stable conditions. These days, nature has changed its face against us, our land and our crops....For God’s sake, I don’t know what tomorrow will bring but all I know is that the sun is burning, the land is exposed and full of stone, and the rains are changing- it is becoming less and it is falling at the wrong time...Whose fault, whose sins are causing all these changes.”

Some informants in Meket acknowledged that whatever they might wish there was unlikely to be a return to the old ways of life in the near future. And there are real fears about what will happen when the situation of the rain and the rising temperature with characteristics of escorting sun with violent windy conditions continue to hit their places (Box 3). In the focus group discussions and interviews held with farmers, kebele officials and wereda agriculture office employees in the study districts, participants mentioned the following as local level evidences and indicators of change in climate patterns:

- Shifts in the onset and cessation period of the rains;
- Shorter rainy days;
- Warmer and fewer cold days and nights;
- Frequently short but heavy precipitation events;
- Hailstorm and frost, particularly in Meket;
- Instability of winds, for example in Raya Azebo;
- Increased landslides and soil erosion, for example, in Meket;
- Increased health risks, such as malaria, diarrhea, and malnutrition problems.

Box- 3

“As hot as hell”

Lemlem Tesfahu, 39, is a female household head supporting her large family of 7 members on her own. Two years ago, her husband started salt and honey trade. But he failed to show up since he left home some 8 months ago. She now manages the farm, the family herds and participates in some public activities. She is also a known hair dresser and a traditional weaver. For her, rising temperature and “the escorting sun” are the major concerns. “Since women spent most of their time travelling far to fetch water, firewood, or graze the herds, they suffer from the intimidating temperature, which affect their health...Everyday early in the morning, I start each day dressing women’s hair and weaving traditional clothes. I do not have time to rest. In the afternoon, I fetch water and visit my farm. When I return, I collect and carry firewood for cooking. Later in the evening, I start weaving again”.

“I hear people talking about the old days when everything was plenty and people generous. Things are not like that. Things are changing ...Admittedly, there are good government initiatives to support women... to plant trees and harvest rain and river water. But there is nothing we poor people can do to reduce the temperature...If rainwater is available, we can plant seedlings...But there is none. As a result, the temperature is getting high; the days hot, as hot as hell...People are desperate to leave. But God knows, if the government continues to support us, we may be able to make the best use of our environment.”

4.4. Impacts of climate change-induced hazards

4.4.1. Impacts on rural livelihoods

“In the past few years we have no rains, but prolonged droughts, dust and rocks. Our cattle and horses are in a terrible state and people are farming dust and stones. People are just barely surviving. We are faced with difficult choices--- .either to abandon our land and migrate to far places as our youth do, or seek for assistance” (Memrie Yitbarek Adugna, 68, Mesfina kebele, Meket)

“For the last three consecutive years, we have very bad weather with no rains at all. The drought killed all our crops and there was a lot of hunger around here. Many households barely survived thanks to the wheat they received from the safety-net program. Our young men actually migrated to other areas leaving us behind” (Hiwot Hadush, 26, Hawelti, Raya Azebo).

Increased vulnerability to poverty and food insecurity

Rural households in Meket and Raya Azebo rely heavily on climate-sensitive resources, such as local water supplies and agricultural land; climate-sensitive activities, such as crop farming and livestock husbandry; and natural resources,

such as fuel wood and wild herbs. Climate variability and change put pressure and reduce the availability of these local natural resources by limiting the options for resource poor households that depend on these for subsistence and daily survival. Plate 2, for example, shows the impact of drought on crop production in Raya Azebo wereda.



Plate 2. Crop damages from rain failure

Table 17. Number of food insecure households (1997-2001 E.C.)

Number of food insecure households		
Year	Meket	Raya Azebo
2001	52,293	59,733
2000	57,535	67,733
1999	57,535	59,733
1998	57,535	62,000
1997	49,582	82,000

SOURCE: Wereda Agriculture Offices in Meket and Raya Azebo (Unpublished document)

While Meket and Raya Azebo districts are no stranger to climatic variability having suffered droughts that have contributed to hunger and even famine in the past, the perception of households and individuals at the forefront details how climate change is set to make the lives of the poorest even harder. The number of food insecure households in the districts is shown in Table 17. As data obtained from CSA (2007) show, the loss of crops from flooding, crop pests, weeds, frost, hailstorms and weeds is also a major challenge affecting crop production in the zones (Table 18).

Table 18. Crop damage in hectare (in North Wello and South Tigray (Meher season, 2006/07)

Cause of damage	Damaged crop area by crop type			
	Households	Cereals	Pulses	All crops
North Wello				
All damages	222,205	19,725	6984	38,604
Frost/floods	61,604	2127	1353	5227
Hailstone	86,678	4929	1005	10,700
Weeds and pests	91,431	4074	1815	7936
South Tigray				
All damages	149,983	20,291	2291	40,448
Frost/floods	47,832	3706	443	7843
Hailstone	52,139	6800	-	11,357
Weeds and pests	43696	2286	-	4802

SOURCE: CSA (2007)

Table 19. Local perceptions on climate change-induced drought, labor availability and food security

Labor availability at times of drought and major food insecurity	Sample Weredas	
	Meket (N=106)	Raya Azebo (N=117)
Increases	-	12
Decreases	100.0	86.3
Remains same	-	1.7
Total	100.0	100.0
The occurrence and duration of drought and food and water insecurity over time	Meket (N=106)	Raya Azebo (N=117)
Intensified (got worse)	84.9	79.5
Declined (got better)	9.4	19.6
Remained same	5.7	0.9
Total	100.0	100.0

SOURCE: Field data (July-August 2010)

In both Meket and Raya Azebo, crop and livestock production is constrained and hardly meets basic household requirements. As the data in Table 19 clearly show, the majority of the households, i.e. 85% in Meket and 80% in Raya Azebo, reported that they were increasingly feeling the pressure from climate

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change-induced hazards mainly in the form of recurrent drought and food and water insecurity. The food insecurity problem becomes more serious when the most productive and energetic young men (and sometimes women) migrate from food insecure rural areas (also Table 19 and Box 4) in search of ‘greener pasture’ elsewhere. This complicates the poverty and dependency situation at the source areas. This information and perception of the rural households are substantiated by the data collected from the local administration of Mesfina (kebele 024) in Meket district. The official kebele data show that in the 8 years period from 2003 until 2010 (1995- 2002 E.C.) 300 households¹⁴ have been on average resettled in Humera/Metema each year on a ‘voluntary basis.’ The total number of households affected by climate change-induced hazards in Meket in the main growing season (*Meher*) of 2009/10 is shown in Table 20.

Table 20. Households affected by climate-change-induced hazards in Meket (Meher 2002 E.C.)

Hazard type	Number of Affected households
Drought	22,810
Pest infestation	8,622
Hailstorms/frost	6,415
Snow	3161
Total affected	41,008

SOURCE: Meket Wereda Food Security Office (Unpublished documents)

¹⁴ Total household size of kebele 024 (Mesfina) as of May 2010 was 8900. According to the discussion held with the kebele cabinet members, the continued resettlement program in the area (though a “necessary” and “well planned” venture undertaken on a “voluntary basis”) is a clear indication that the area is increasingly under stress from climate risks and local resource degradation.

Box- 4

“No man remains...”

“Now there is no rain, only hot sun, no harvest but dry and cracked soils. Before the 1984 drought, people's situations were good, there were sufficient rains and good harvest to feed the family... people took three to four meals daily... when they harvested their crops one might get 50 sacks... when we were young, our fathers slaughtered the sheep and distributed the meat to relatives free... Since then, the rains are gone. Harvest is poor and cattle are emaciated from underfeeding. There is no milk in the cows' udders. Even physically, the cattle are not looking healthy. They perish in the dry season. They are all getting barren... Desperately; our young men and even the girls are leaving their home areas in the search for work. Even when the rains are good, farm plots are so small and insufficient to produce what is needed to feed the family. Hence, after the season is over “no man remains in the village”. They are often away for six or seven months but young people, especially single men, may leave for years” (Berihun Demillie, 40, Meket)

Table 21. Comparison of crop harvest in different years (% of respondents)

	Meket (N=103)	Raya Azebo (N=111)
Good	5.8	13.5
Normal	10.7	14.4
Poor	63.2	56.8
Complete crop failure	18.4	8.1
Did not farm at the time	1.9	7.2
Total	100.0	100.0
2008/09 harvest compared to the harvest 5 years before (in 2004/05)	Meket	Raya Azebo
Good	6.8	8.0
Normal	12.6	15.9
Poor	51.5	53.0
Complete crop failure	18.4	8.1
Did not farm at the time	10.7	15.0
Total	100.0	100.0
2008/09 harvest compared to your harvest 10 years ago (1998/99)	Meket	Raya Azebo
Good	2.9	4.4

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Normal	6.8	7.1
Poor	58.3	62.7
Complete crop failure	18.4	8.1
Did not farm at the time	13.6	17.7
Total	100.0	100.0
2008/09 harvest compared to your harvest 20 years ago	Meket	Raya Azebo
Good	2.9	6.2
Normal	1.9	5.3
Poor	50.6	53.0
Complete crop failure	18.4	8.1
Did not farm at the time	26.2	27.4
Total	100.0	100.0

SOURCE: Field data (July-August 2010)

As can be seen from the household data in Table 21, informants in the study area tend to reinforce the common saying in rural Ethiopia that “gone are the good old days” with plenty of harvest and the blessings of God. As the data show, there is a general perception among rural households that crop production and land productivity has declined in the past 20 or so years. According to Ato Mulu Kassaye, the food security focal person at the agriculture office in Raya Azebo district, the rains in Raya Azebo failed for three consecutive years (2007-2009). As a result, crops failed; water and feed resources dried up; and most resource poor households in the district, especially in the drought prone kebeles of Hawelti, Ade-Halga and Mecharie, became food insecure and were surviving on the assistance they received from the safety-net program of the government.

An elderly man from Ade-Halga recited in a community discussion: “*We no longer can predict as to when the rain will come or stop with certainty. When we expect it to rain it doesn’t come. It may start to shower anytime and after we plant, it stops just as our crops start to grow. And it begins to rain after the crops have already been ruined*” (Tigaw Kahssay, 58). As a result, as a middle aged head of the local women association in the kebele reported, “*Poor farmers with extended families are no longer able to adequately feed their family and support the education of children. Some children are malnourished. Cattle are emaciated. The youth are getting tired of village life and our men are migrating to other areas leaving the women behind.*” (Amakelu Haftu, 37).

Such recitations were also common in the community discussions held at the two study sites in Meket. Suffice here is to cite the common saying among the youth which goes “*dingai kemaris tersedije barfis*” i.e. literally ‘rather than farming dust and stones, I better migrate to unknown destinations’. In both Mesfina and Dibeko, it was possible to see a few stunted crops; in the lowlands there was nothing growing at all. As a crop specialist extension agent stated during the discussion held with the local cabinet members in kebele 024, Meket “*people are just barely surviving. Women and children are suffering from extreme workload and malnutrition. Cattle and horses are in a terrible state...People are farming dust and stones and nobody can predict what the future will bring to our area.*” As a charming but impoverished young housewife said in a focus group discussion held at kebele 026 (Dibeko), “*being hit by repeated and unrelenting droughts is unfortunate;, farming sand and dust is bad; and losing our crops intolerable, and the fact that our family is being separated by drought and poverty is really devastating.*”

Box- 5

“Left empty-handed...”

“Life is hard. We are defeated people...The soil is exposed by the floodwater and there are large gullies everywhere. The land is dry, dusty and barren... Sometimes when the rains do come, it will be accompanied by hail storm which destroy the crops. Usually the rains fail or come at wrong times and in wrong quantities when our grains are almost ripe. This cause the ripe grains fell on to the earth...Now, if you go and see my *wassera* field, there are only empty shells. When we hope of good harvest, then there are pests such as *diri* (army worm), *fenttera* (grasshopper), *degeza* (bush cricket), *qoratch* destroying our crops...We work hard, plough and weed with the whole family but at the end we are left empty handed...Thanks God, my family has an eucalyptus farm where we sell one *awraji* or *qoami* 25-30 Birr and one *maager* 13-15 Birr...” (Fentaw Kebede, 26, Meket)

In both Raya Azebo and Meket, rural families, who are already poor and marginalized, are struggling to cope with the added burden of increasingly unpredictable weather (Box 5). Many have been forced to sell their assets, including livestock. Some have removed their children from school-coping mechanisms that only increase the cycle of vulnerability and insecurity¹⁵. The situation is exacerbated by poorly developed rural roads and market infrastructures that have weak links to facilitate the exchange of food crops,

¹⁵ Discussion with school directors in Meket (Mefina), and Raya Azebo (Hawelti).

livestock and other basic needs. Hence, households lose their assets and thus get exposed to hunger, malnutrition, food insecurity and ill health. This has forced a considerable number of household to depend on food aid. In Meket, for instance kebele 024, of the total households in need of emergency food aid, only 1000 households (12.5%) were receiving support from the government's safety-net program.

Impacts on animal health and productivity

The effects of climate change on food production are not limited to crops and agricultural production. Climate change will have far-reaching consequences for the livestock sector, mainly arising from its impact on grassland and rangeland productivity. Heat distress suffered by animals will reduce the rate of animal feed

intake and result in poor growth performance. Lack of water and increased frequency of drought will lead to a loss of resources. These impacts are likely to lead to changes in income and prices, and hence changes in livelihood and investment.

Table 22. Average livestock possession per household (1990- 2010)

Average livestock possession in each wereda	Livestock species					
	Oxen	Cows	Calves	Shoats	Camels	Equines
Meket						
Average livestock possession per household (as of August 2010)	0.3	0.5	1.1	1.8	-	0.3
Average livestock possession per household in 2005/06	0.5	0.7	2.4	3.1	-	0.7
Average livestock possession per household in 2000/01	2.3	1.3	1.2	2.4	-	1.2
Average livestock possession per household 20 years ago	2.4	2.8	2.3	7.1	-	1.6
Average livestock possession in Raya Azebo	Oxen	Cows	Calves	Shoats	Camels	Equines
Average livestock possession per household (as of August 2010)	0.5	0.7	0.4	3.7	0.2	0.2
Average livestock possession per household in 2005/06	1.1	1.6	2.2	3.7	0.1	0.2
Average livestock possession per household in 2000/01	2.4	2.1	1.5	3.7	0.1	0.2
Average livestock possession per household 20 years ago	2.7	2.8	2.2	9.6	-	0.4

SOURCE: Field data (July-August 2010)

In both Meket and Raya Azebo, livestock possession per household showed marked decline in the last twenty years covering the period 1990- 2010. As the data in Table 22 clearly show, livestock possession in Meket declined from 2.4 oxen, 2.8 cows and 7 shoats in the 1990s to 0.3 oxen, 0.5 cows and only 1.8 shoats in 2010. In the same way, livestock possession in Raya Azebo declined from about 2.7 oxen, 2.8 cows and nearly 10 shoats to about 0.5 oxen, 0.7 cows and 4 shoats during the period under review. The only exception in Raya Azebo is in the number of camels where relatively better off households are tending towards camel husbandry.

Informants in the study kebeles also reported sharp decline in the productivity of livestock and bitterly complained about the loss of livestock productivity in terms of the quantity and quality of milk and butter. Informants recited recurrent drought, shortage of water, pasture, and prevalence of endemic and unidentified animal diseases for poor condition of cattle and the loss of livestock productivity. Coupled with the problem of crop production, the loss of livestock due to mortality or morbidity from drought and other climatic-induced hazards means serious risk for the livelihood and socio-cultural fabrics of the farming communities.

Associated with drought and the stress from variable and changing climate, shortage of adequate fodder and underfeeding of cattle reduce their resilience to disease risks. As discussed in the previous section, the burden from crop failure or the lack of good harvest is already a serious threat and challenge for secure livelihood and household food self-sufficiency. In this regard, declines in livestock productivity and sometimes loss of a milking cow or goat means loss of important source of food or income as well as fallback option for resource poor farmers. According to Fentaye, health extension worker at kebele 024 in Meket, the decline in animal productivity and reproductive capacity is compounding the food insecurity situation and increasingly pushing poor households to the margin of life or survival. Fentaye affirmed that:

“The area is not receiving sufficient rain as it used to... Besides, the rain is erratic, uneven and unpredictable. Grasses are no longer sufficient or nutritious. Now the fields are barren. In the past, cows used to give birth to calves frequently. Now they stay long without giving birth to calves. The cows are underfed and weak physically. Even if they do give birth to calves, they can't feed them adequately let alone provide extra milk for families. That is why children are undernourished and unhealthy...they lack balanced food...”

According to informants in Meket's kebele 026, well-fed and healthy cows used to conceive at the age of three years. But now this is not possible. Because of prolonged drought, underfeeding and poor health, cows generally stay at least five years to conceive. This affects the number of livestock and milk availability

to a household. Not only the amount or supply of milk is reduced but also because of poor feeding and lack of nutritious grasses and crop residues, the amount of milk households get is reduced. Not only this but the aroma, taste and thickness of milk produced are also poor. Animal death from diseases, underfeeding and climate stress is another serious challenge to small farmers who raise cattle besides crop cultivation. In both Meket and Raya Azebo, community members, local administrators and experts reported that there is major downward shift in wealth class among many households in recent years due to bad harvest and increased livestock morbidity and mortality.

Impacts on human health and nutrition

Climate change and variability affect human health directly by affecting the occurrence and spread of diseases and indirectly by affecting diets, biodiversity and ecosystems. It is common among farmers and elders in the study area to hear them complain about “nature” (climate) and the health risks associated with the change in the local climate. In the FGDs, discussants told the same story: ‘previously we never experienced as much food and water borne diseases, as well as respiratory and infectious diseases as being experienced now. Malaria was occasional. Now it is common due to the drought and the high temperature. Previously it used to prevail only in isolated pockets in low-lying areas. Now it is rampant everywhere. The problem is that with increasing health risks you cannot find an effective cure either from the clinics or the traditional healers’.

Table 23. Malaria affected population

Year (E.C.)	Number of people affected by malaria (1997-2001 E.C.)		Common diseases affecting the population in the districts (2002 E.C.)	Disease type	
	Raya Azebo	Meket		Raya Azebo	Meket
2001	10,881	4005	Malaria	6620	5685
2000	23,583	-	Diarrhea	4192	2911
1999	62,764	-	Parasite	2932	4005
1998	113,609	5685	Respiratory	10,401	7285
1997	61,267	-	Skin diseases	4655	2831

SOURCE: Raya Azebo and Meket Wereda Health Offices (Unpublished reports)

Table 23 shows the number of people affected by malaria and other climate sensitive diseases. Climate change may worsen the prevalence and distribution of malaria, respiratory and other diseases in Meket and Raya Azebo through food shortages, scarce potable water and poor hygiene, which often result in malnutrition and increased morbidity and mortality (Box 6). Any extreme climate event or prolonged climate stress is likely to have an effect on the

incidence of infectious diseases, especially in those areas and villages with high prevalence of malaria, tuberculosis, HIV and AIDS and water and food-borne diseases.

Box-6

“Proud but hungry”

"The people of Meket are hard working, deeply religious and proud. They have prestige symbols such as guns and mules, which the owners show off on holidays. At home, though they are now getting poorer, their tradition and hospitality have a distinct quality of their own. Now the burden of poverty is weighing down on the people... Mothers have very little to feed their children and familial ties are loosening... One day I went to the health station and told the young doctor that I had a stomach ache and asked him to give me an injection. He stared at me intently and then burst into laughter. When I asked him why he was laughing at me, he replied that my sickness was hunger and nothing else. He was telling the truth." (Asnaku Mergia, 37, head of household)

Some informants say there are many more diseases nowadays and more deaths, but usually they attribute this to people's insecurity and meager diet: *"The major disease now is hunger. Old and young have all fallen to the bed. How can people cope with drought and the requirements of farming when they are underfed and suffer from ill-health"* (Hagos, 47, Ade-Halga). A local health worker at the village health station in Ade-Halga claimed that: *"The incidence of drought and crop failure has increased. It is disturbing to see people farming and getting nothing. Famine coupled with dysentery is killing lots of people. Most families are poor and they don't have money to get medical treatment. If someone visit each household in the village and makes a survey, he won't find a household in which there are no people who haven't become bedridden due to hunger and disease. In some households there is no one even to give water to the sick members of the family."*

According to Merigeta Mekonnen, a local priest in kebele 026 (Dibeko):

"In the old days there were no doctors. Church scholars and the traditional students rub leaves and give them to the sick person and the sick gets cured. There were also psychic cases, those who were possessed. Most ill people will be given the holy water in the local church and they will be cured and freed from their possession and sins... There were not many diseases then because people fed on teff injera, milk and butter. Now there is a clinic and the health workers treat people and cure some diseases. But there is a problem... Nowadays, there is no healthy person; even those who are walking are not well. Everyone is coughing or taking injections. We don't know the nature of today's diseases. They call it lung disease,

kidney disease, stomach disease, but there is no medicine. There are doctors, but they are not able to cure."

Box-7

“Health, Diet and beauty”

Lemlem Hagos, 37, was born and grown up in Hawelti. As a young girl, she looked after the cows, helped to grind the grain, fetched water and prepared injera. She says “When I was 15, I married and moved to the house of my husband. I used to support my husband in the preparation of our land and sowing, weeding and harvesting the crops. Today my two sons take care of the farm because my husband has a severe cough. Because of his illness, I have to work to bring in income for the family- just a year ago our two sons left us and now live in Maichew. Because of the drought, life is hard now. I cannot prepare good food for my husband. He is weak because he cannot get good and healthy food. We usually eat wheat bread and shiro wet. During summer time, I eat cactus fruits and give my husband all the bread and the injera. My husband used to be a good farmer and a hero. I was beautiful and he married me because my parents considered him a brave and hard working man with good prospect...but now he is ill and my beauty is lost because I can't eat well and dress well. After all, beauty is all about eating well and taking care of oneself...”

As the two excerpts in Boxes 6 and 7 attest, hunger and malnutrition are major health risks exacerbating the problem of poor health and reduced immunity from the burden of diseases that can be associated with climate change and poverty. On the other hand, due to drought and the resultant feed and food insecurity, people were forced to look for other non-palatable wild fruits, leaves and roots. As a result of these changes in diet, certain abnormalities have been observed during acute drought. A good example cited in Ade-Halga (Raya Azebo) and Mesfina (Meket) is stomach ache, serious abdominal pain, cholera, and bloody diarrhea.

The depletion of biodiversity and particularly the loss of indigenous medicinal plants weaken the traditional health systems of communities and poor households with little or no access to modern health services. This has been the case in Meket kebele 026, where there is poor road network and deficient transport service. In general, the climatic factors are superimposed upon existing weak infrastructure, land-use changes and drug resistance by pathogens. These cause cholera, diarrhea, malaria, and other diseases and reduce the immunity and working capacity of poor rural people and thereby increase the incidence of morbidity and mortality.



Plate 3. Taking a patient to a health station in Meket

Impact on access to social services

Despite recent improvements, social infrastructure is extremely weak in rural areas. In Mesfina kebele 024 and Dibeko kebele 026, the people have to travel some 25-40 km either to the town of Flakit to the north or Lalibella further south in order to get medical attention or other public services (Plate 3).

With increasing drought, resource degradations and insecurity, poor households find it really difficult to send their children to school. During the day, most of the young people are too busy herding cattle, fetching water, collecting firewood or making dung cakes. The situation is not much better in Raya Azebo. During summer extending from June to September, young people are forced to engage in the collection and sell of wild fruits, mainly cactus or *beles*, when families face food shortages. School attending children also engage in vending cactus and roasted beans in the street of Mehoni town.

There is also the difficulty of firewood and water; and the main chore for young girls is the collection of water for the household from the springs or wells. In Hawelti and Ade-Halga, there are public taps and water collection points where people can fetch or water their livestock. However, in some villages of Mesfina, such as kebele 024 in Meket, young girls and women may need to travel as much as two hours walking each way every day. So while families may appreciate the importance of education, it can be very difficult for such families to continue sending their children to school while facing drought-induced poverty and insecurity. According to a school principal in Dibeko “*during drought times when most families will be food insecure, children are malnourished ... Poorly fed and physically weak children come to school not to attend their education but to be relieved from herding and sleep in class.*”

4.4.2. Gendered impacts¹⁶

Women in the study area are more vulnerable to climate change impacts because of their household and farming responsibilities (Box 8). In order to cater for the needs of their families and effectively shoulder their farming responsibilities, including land preparation, sowing, weeding, etc., poor women heavily rely on the exploitation of climate-sensitive natural resources on a daily basis. Climate change-induced scarcities of natural resources compel such women to spend more time on their traditional roles and limit their opportunities to involve in other productive and empowering activities, such as education and non-farming activities. Declines in agricultural production and food security have more effect on women due to physical, social and economic issues that include pregnancy, lactation, child feeding, care giving and inequitable distribution within families. Because women are primary caregivers, times of disaster and environmental stress will magnify burdens of care giving.

Box- 8

“Drought happens every day”

I interviewed nine women under the shade of a tree in the vicinity of a rural town named Mesfina in kebele 024, Meket. In order to facilitate the discussion, sliced breads were distributed to the participants, and a bowl of boiled beans was placed in the middle of the circle, so the women could eat as they spoke.

The women vividly recited poems from the famous famine of 1984 and the occurrence of recurrent drought and crop damages since then. According to them, drought is now part of their day-to-day life experience. Whether it is summer or winter season, food insecurity is common and hunger knocks every ones door. In those days when the vegetation was good the climate was much more stable. “We knew that the rains will be good enough to support crop growth and encourage livestock productivity. The countryside looked beautiful and clouds floated through the sky. When the rains fell and people were in need of labor, the villagers were united. They contribute labor, farm the lands of the sick and weak, exchange gifts and support each other in times of need”.

¹⁶This section provides a general assessment of the gendered impact of climate variability/change. A detailed assessment of the effect of climate change and resource degradation on women (with a particular focus on female headed households) is given in section 4.6.

According to the women, drought happens every day in recent years. Although the area has been among the most drought prone and food insecure in the region, the drought situation has been worse since the mid 1980s. “Since that time, we couldn’t produce enough to feed our families.” The land got exposed and barren. Rocks and gullies have replaced the soils and the vegetation. The sun has become cruel, the water scarcer and firewood and dung almost rare. Since farming is no longer enough to feed families, people tended to engage in non-agricultural activities. Women without men in their families are especially finding it hard to rely on farm incomes. Women are increasingly feeling the pressure and experiencing the effect of the drought every day. It is common for women to eat less or skip meals.¹⁷

During periods of drought and food insecurity, adult men migrate from Meket and Raya Azebo to other areas in search of employment, usually to commercial farm areas or urban centers like Maichew, Shire, Mekele, Woldiya, Dessie, Kombolcha, Bahir Dar, Jima and Addis Ababa. This intensifies women’s workload and often times leads to psychosocial stress and insecurity. In community discussions held with women in Ade-Halga of Raya Azebo and Msfina in Meket, there were bitter complaints against men leaving their wives behind and migrating never to return again. According to these women, some men who left their villages and wives behind have betrayed their families by establishing new lives at the destinations.

Climate change is exacerbating existing shortages of water, firewood and cattle dung. Women and young girls, who are largely responsible for water collection and dung making, are more sensitive to the changes in seasons and climatic conditions that affect the amount and quality of water and its accessibility. This in turn makes collection even more time consuming and labor taking. On average, women in the study area work 14-17 hours each day, and during chronic drought and famine years and at times of want, the daily working schedule may extend from 16-18 hours and beyond. As shown in Table 24, with drought, more and more women are forced to venture far in order to fetch water and collect firewood or dung cakes.

During the past five years women in Meket were on average required to travel 10 kms to fetch water and about 16 kms to collect firewood and dung cakes. On the other hand, women in Raya Azebo cover about 6 kms to get access to water during dry seasons. On the whole, the situation has got worse during the past 5 years because water, firewood and pasture resources have been relatively less available in nearby areas than in the past. This means that with climate

¹⁷ At the time of the discussion, some women were not eating the sliced breads and boiled beans. They were rather putting the sliced breads into their pockets. Later, I came to learn that these women were saving the sliced breads for their children.

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variability and change as well as increasing pressure on natural resources, water and other natural resources are being depleted and becoming less available or scarce. In some cases, however, it is relatively easy to obtain water and pastures at nearby locations during rainy seasons thus reducing the need for women and herders to venture far to fetch water for domestic consumption or graze and water their herds.

Table 24. Average distance traveled (km) by women to fetch water and collect firewood

During drought season	Wereda			
	Meket		Raya Azebo	
	To fetch water	To collect firewood	To fetch water	To collect firewood
During the last 5 years	10.2	16.1	6.9	12.7
During the last 10 years	12.9	12.3	11.2	9.6
During the Derg period	16.3	8.2	13.1	8.7
During non-drought years	Wereda			
	Meket		Raya Azebo	
	To fetch water	To collect firewood	To fetch water	To collect firewood
During the last 5 years	6.1	8.7	4.7	9.4
During the last 10 years	7.3	9.3	7.1	7.9
During the Derg period	4.8	6.1	11.8	6.1

SOURCE: Field data (July-August 2010)

Climatic change-induced disasters and weather extremes, such as flooding and landslides causing death and injury, affect women and men differently. This largely depends on the means at the disposal of each to ensure their own safety and to re-establish their lives after the disaster. Since women are often the primary caregivers for children, the elderly and the ill, they have less mobility and limited access to early warning information and information about assistance during emergency (Yianna & Piana, 2005). As primary caregivers, women may see their responsibilities increase as a result of family members being more often sick. Furthermore, poor rural women often have less access to medical attention and care than men. In both Meket and Raya Azebo, the low position assigned to rural women in society also exacerbates their vulnerability.

Furthermore, climatic and non-climatic stresses affecting either access to or the conditions of natural resources affect particularly poor women in terms of livestock productivity as well as access to resources such as fuel wood, traditional wild foods and medicines. This produces overall harsh consequences upon rural households. The burden on women and young girls also doubles during times of drought and want. For example, children in remote villages in

Meket or some villages in Ade-Halga will be forced to drop out of school and look for wild foods, such as fruits and roots for the family and water and fodder for the cattle. In Ade-Halga, Raya Azebo, for example, an informant called Dembashu Gezu narrated how her daughters and sons assist the extended family by collecting and selling wild fruits. She said:

” I have 5 children-2 sons and 3 daughters. I have about 1 hectare of land but no livestock. We prepare the land manually by digging and sometimes borrowing oxen from relatives. I work traditional clothes and sell to the local merchants. During the summer, my daughter sells firewood while my sons collect and sell cactus fruits. My kids help in all these activities. But during times of intense drought and when there is no food for the family, the oldest daughter moves back and forth between Mehoni, Maichew and Alamata to work there while the others will be busy collecting and selling cactus fruits.”

4.4.3. Impacts on the local environment

The household data (Table 25) are clearly indicative of the problem of forest, water and soil resources degradation in the pilot areas. Respondent household heads confirmed the general observation that the forest cover and the availability of water resources have declined throughout the country with time. This is particularly a major problem in resource poor farming communities like Meket. However, in the case of Raya Azebo there are important environmental regeneration interventions by the Regional government, local administrations and NGOs. As compared to Meket, the low percentage responses from Raya Azebo (in relation to observed changes in the rates of soil erosion, deforestation and water availability) are indicative of some of the ongoing environmental rehabilitation activities in the area.

Table 25. Local perceptions on rate of natural resource degradation (% of respondents)

Change in forest woodland/grassland cover with time	Wereda	
	Meket (N=106)	RayaAzebo (N=117)
Decreased	89.6	51.3
Increased	8.5	41.9
No much change	1.9	6.8
Total	100.0	100.0
Compared to the past, problem of soil erosion	Meket (N=102)	Raya Azebo (N=114)
Decreased	39.2	67.3

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Increased	58.9	32.7
Remained same	1.9	-
Total	100.0	100.0
Compared to the past, availability and volume of water	Meket (N=103)	Raya Azebo (N=116)
Decreased	82.4	53.4
Increased	12.6	39.7
Remained same	4.9	6.9
Total	100.0	100.0

Source: Field data (July-August 2010)

In order to assess the link between deforestation, soil erosion and climate change, informants were asked to indicate whether they agree or disagree with the view that resource degradation and climate change are interlinked. The responses tabulated in Table 26 tell about the experiences and local environmental knowledge of respondents in relation to deforestation and its link with more flooding and erosion as well as climate variability and change. Accordingly, most respondents, i.e. about 86% in Meket and 58% in Raya Azebo, confirmed that accelerated deforestation and rangeland degradation have contributed to a change in the patterns of the local climate.

Table 26. Local perceptions on the link between deforestation, soil erosion and climate change

Deforestation/rangeland degradation aggravated current flooding and soil erosion problems?	Wereda	
	Meket (N=103)	Raya Azebo (N=113)
Yes, I agree	86.4	57.5
No, I disagree	13.6	42.5
Total	100.0	100.0
Deforestation aggravated climate change	Meket (N=104)	Raya Azebo (N=115)
	Yes, I agree	68.3
No, I disagree	31.7	39.1
Total	100.0	100.0

SOURCE: Field data (July-August 2010)

General water stress

Water stress is probably the main indicator that drought prone rural areas like Meket and Raya Azebo are facing to deal with the harmful effects of climate variability and change. Both districts historically suffer from general water stress. However, recent trends in the local climate indicate a general rise in temperature and a very erratic and uneven rainfall pattern. As a result, permanent water sources are now being overexploited except during a few months during the summer. For example, during the drought season in Meket (kebele 024), commonly used springs and ponds become dry and women and young girls spend more time searching for and excavating other springs.

4.4.4. Impacts on key livelihood resources



Plate 4. Flooding and soil erosion problems in Raya Azebo (above) and Meket (Below)

The impact of climate change on rural livelihoods largely depends not only on actual changes in the patterns of climate but also on the main livelihood activities of rural communities. The source of this dependence can be the extraction of natural resources and rain-fed agriculture, including the specific natural, physical, financial, human and social resources needed to carry out these activities as well as the impacts of climate change-induced hazards on these key livelihood resources. As discussed in the previous sections, climate variability coupled with local resource degradations pose serious threats to the viability of sustaining rural livelihoods in the study districts. This is particularly true where climate change will destroy or reduce the quality of the local natural resource base upon which current livelihoods depend (Plate 4). A summary of the impacts of climate variability and change on the main livelihood resources in the study area is given in Table 27.

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Table 27. Impacts of climate variability/change on key livelihood resources in the study kebeles

Key livelihood resources	Impacts
Natural capital	<ul style="list-style-type: none"> • Soil erosion • Gulley formation • Deforestation • Loss of indigenous tree and grass species • Formation of localized deserts • Drying up of springs and ponds
Physical capital	<ul style="list-style-type: none"> • Destruction of physical infrastructure • Decrease in river run-off • Decrease in energy production • Flood and drought impacts
Financial capital	<ul style="list-style-type: none"> • Loss of income from crops (crop damage/failure, reduced productivity) • Loss of income from livestock (decreased market price, decreased productivity, emaciation and death)
Human capital	<ul style="list-style-type: none"> • Expanding crop diseases • Out-migration of adults • Increased workload on women and young people • Impacts on education, health and well-being • Poor housing and sanitation • Expansion of malaria to highland areas
Social capital	<ul style="list-style-type: none"> • Displacement • Out-migration • Family dislocation, separation, divorce • Weakening social ties • Erosion of institutions

SOURCE: Field data (July-August 2010)

4.4.5. Non-climate related stressors

Other than climate change and climate variability, subsistence and smallholder livelihood systems in Meket and Raya Azebo currently experience a number of interlocking stressors (Table 28 and Plate 5). These include environmental degradation; poverty; population pressure and harmful socio-cultural factors; and lack of adequate access to socio-economic services, technology and early warning information.

Table 28. Non-climate stressors affecting rural livelihoods in Meket and Raya Azebo

- Poverty and food insecurity;
- Environmental degradation, including deforestation, rangeland degradation and soil erosion;
- Population pressure;
- Land hunger, such as scarcity, fragmentation, security issue;
- Poor health condition- lack of safe water and sanitation, endemic diseases, HIV and AIDS, TB, infectious diseases, etc and limited health facilities;
- Lack of viable alternative income generating activities;
- Limited social infrastructural services;
- Lack of access to relevant and up-to-date information and technology;
- Local power relations that marginalize some groups when it comes to access to credit, extension services and social networks;
- Gender and age discrimination;
- Out-migration of young and able-bodied men and to some extent young women;
- Disagreements over land rights and conflicts over land use.

SOURCE: Field data (July-August 2010)



Plate 5. Dung cakes and firewood selling add fuel to vulnerability

Land degradation and unsustainable resource use

Rural livelihood strategies and most adaptation strategies adopted by farmers are crucial in building resilience to the impacts of climate change. However, there are some unsustainable development practices and coping strategies which poor rural households have developed out of desperation and lack of options. Such unsustainable practices include fuel wood and charcoal making; mono-

cultivation, for example, eucalyptus tree planting in Meket; grazing competition and land use as in lowland areas of Raya Azebo. These disrupt traditional coping strategies and in some cases lead to soil infertility, overgrazing and loss of crop productivity and biodiversity. On the other hand, the loss of soil fertility has encouraged the use of chemical fertilizers, which further results in reduction in the fertility, stability and sustainable productivity of the land resources. Such land degradation reduces average agricultural productivity. It also increases farmers' vulnerability to drought by reducing soil depth and moisture-holding capacity (Box 9).

Box- 9.

“More people, less trees, more erosion”

“Since 1984 our land has become increasingly degraded and food production is no longer secure-even in years of good rainfall...Not long ago, there were a lot of trees in my village and the forests were preventing flooding... Over the years, the trees were cut down, the land was overgrazed and the population grew. The remaining vegetation dries up because of lack of water. When the forest was cleared the soil was washed away by the flood and the productivity of the land decreased. When the forest protected the land, it was thick and fertile. Now all this is gone...” (Asres, 44, Dibeko).

Demographic expansion

Land is a scarce resource in Meket and Raya Azebo. Average farm holding per household is extremely low, particularly in Meket, which is about 0.63 ha. Since land is a fixed asset, any rise in population or family size will mean further fragmentation and scarcity of land. A high population growth rate induces increased demand for resources and exacerbates the rate at which these resources are exploited (Box 9). With a rise in population, the demand for fuel and cultivation increased resulting in the practice of over-cultivation, cultivation of marginal lands and hillsides and clearing of bush. Under such circumstances, the resilience of the local ecosystem will be eroded further exposing the locale to climate change and poverty.

Overdependence on rain-fed agriculture

The vulnerability of Meket and Raya Azebo to climate variability and change can be partly explained by the overdependence of the subsistence farmers on rain-fed agriculture based on traditional technologies and practices, which in turn is dependent on the nature and behavior of the rainfall. Let alone complete failure, even small changes in the amount, distribution and timing of the rains could slash crop and livestock production and productivity. Traditionally, poor farmers prepare for the possibility of climate shocks and stresses by employing

reactive and conservative risk management strategies which buffer them against climate extremes in the short-term but at the expense of average productivity and profitability. Such strategies, such as sticking to traditional land preparation methods and familiar crops instead of trying new varieties and resorting to short-term, inefficient and exploitative resource use practices further expose the farmers to climatic and non-climatic shocks.

Lack of preparedness

A good early warning system helps to detect the problems of food and water scarcity and disease outbreaks at an early stage of drought and before the occurrence of flood disasters. Such a system requires research based knowledge and information on climatic events and a mechanism for information gathering, processing and analysis. It also requires appropriate policies, strategies and legislation in relation to climate change and other environmental events.

In Meket and Raya Azebo, there are early warning units and committees at kebele and district levels. However, the existing early warning system does not adequately capture the threat of climate change and hence fails to provide relevant and specific early warning information in terms of climate risks and their impacts on human health, crops, water resources, livestock diseases, etc. to subsistence farmers. This is particularly the case in remote villages like kebele 024 and 026 in Meket where the socio-economic infrastructure is limited and the settlements are scattered. The existing early warning units are poorly organized, less motivated and weak¹⁸. Even any information released by the early warning units and committees as a whole appears to contribute little or has no impact on the lives of poor farmers due mainly to inadequate institutional information flow and lack of confidence in the system.

Socio-cultural practices

In Meket and Raya Azebo, socio-culturally ascribed roles determine women's and men's responsibilities within the rural communities. Division of labor and roles between women and men at community level and within the household are well defined. For example, women take full responsibility for managing ruminants, dairy production, fetching water, collecting and making dung cakes and gathering fuelwood. They also share other tasks with men, such as working on the farmland. Usually, a household's property is under the control of the husband. Other traditional practices continue to diminish women's rights, for example, early marriage, widow inheritance and beating.¹⁹

¹⁸ Interview with Ato Getahun Abate, chairperson of kebele 024, Meket, and Ato Moges Alem, extension agent in the kebele.

¹⁹ Interview with experts at the respective Zonal and Wereda Women's Affairs' Offices

On the other hand, the multiple roles played by women have created conditions whereby they influence and are influenced by the environment. In both Meket and Raya Azebo, as elsewhere in rural Ethiopia, women's access to natural resources such as water, fuel wood, traditional medicines and other natural resources, is key for the survival of their families. As the environment degrades, the soils are eroded and the forests are depleted, this relationship becomes increasingly negative; and the scarcity of resources increases demanding more time and energy to secure them. Lack of education and limited awareness also perpetuate their plight. What is more, the experiences and knowledge which rural women have accumulated about water and land management and the environment is rarely acknowledged or utilized.

4.5. Vulnerability (livelihood) profiling

The ability of vulnerable communities to cope with climate variability is largely determined by the way in which such communities conduct and secure their livelihoods. By understanding peoples' livelihoods, we can begin to understand why they are vulnerable; how they cope; how they will be affected by climate change impacts; how they might respond with the resources they have; and how these conditions can be reflected and built upon for successful adaptation strategies. This knowledge can be developed through the application of the SLF. Since SLF is centered on the assets and capabilities that shape livelihoods while also considering the vulnerability context of the poor, it is recommended for answering the key questions in a comprehensive way. The profiling exercise of the livelihood groups in this section has been developed in the light of the SLF which was originally developed by DFID (DFID, 1999; Ashley & Carney, 1999) and later simplified and contextualized by others (Toufique & Turton, 2002).

During the fieldwork, attempts were made to profile the major livelihood groups in the study area. Among the livelihood groups, the landless and marginal farmers; handicraft workers and wage laborers; petty traders; and urban-based farmers and agri-businesses were identified as the major livelihood groups in the area (Table 29). The selection of livelihood groups was made through the use of the household questionnaire survey and in close consultation with resource persons in the sample districts. In the profiling exercise, splitting each livelihood group was found to be extremely challenging. Hence, after close consultation with the resource persons and local administrators in each study kebele, it was found convenient to group and discuss two or more specific livelihood activities with more or less similar degree of vulnerabilities into one broad livelihood category.

Table 29. Major vulnerable and non-vulnerable livelihood groups in the study area

Highly vulnerable livelihood groups	Viable /Less vulnerable livelihood groups
<ul style="list-style-type: none"> • Landless • Small and marginal farmers • Handicrafts • Petty traders • Agricultural wage laborers 	<ul style="list-style-type: none"> • Urban based farmers/traders • Rural livestock and commodity traders • ‘Rich’/large farmers • Households with diversified income sources

SOURCE: Field data (July-August 2010)

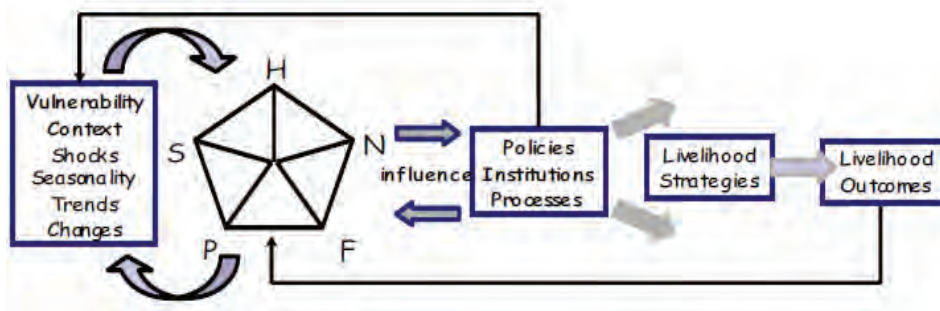


Figure 14. Simplified operational version of SLF
SOURCE: Adapted from Ashley and Carney 1999)

Five concepts are crucial for understanding the linkages within the SLF: the vulnerability context; livelihood assets; mediating factors/institutions/policies and processes; livelihood strategies; and livelihood outcomes (FAO, 2006; DFID, 1999). The *vulnerability context* refers to the external or unpredictable events that can undermine livelihoods and cause households to fall into poverty. Some of these factors are fast acting, such as landslides, pest infestations, flash floods, epidemics, earthquakes, and others are slow and gradual processes, such as land degradation and gully formation. Both can undermine rural livelihoods. It is important to distinguish between shocks originating from outside a community, which affect all people in the same locality, and idiosyncratic shocks that principally affect only individual households.

Livelihood assets refer to the resource base of the community and of different categories of households (i.e., human, natural, financial, physical and social). Although the asset bases are interlinked, the relative importance of each type of capital differs between communities and between wealthy and poor households

within the same community. For instance, for historical or political reasons, rich communities may control more and better land and natural resources than poor communities, and within any given community, rich households control more land, livestock and physical and financial capital than poor households.

The *mediating factors – policies and institutions* – are important sets of man-made external factors that influence the range of livelihood options open to different categories of people. They also influence access to assets and vulnerability to shocks. An enabling policy and institutional environment makes it easier for people - poor and less poor - to gain access to assets they need for their livelihoods. A disabling policy and institutional environment may discriminate against the poor thus making it difficult for them to get access to land, livestock, capital and information. In the main, these include policies; legislations; culture; institutions, such as markets; and power relations that have direct and indirect impacts on people's livelihoods and livelihood choices. They also determine how organizations and individuals within them operate and interact (DFID, 1999).

Livelihood strategies are the range and combination of activities and choices that people make in order to achieve their livelihood goals (DFID, 1999). On the basis of their personal goals, their resource base and their understanding of the options available, different categories of households - poor and less poor - develop and pursue different livelihood strategies. These strategies include short-term coping strategies, such as ways of earning a living, coping with shocks and managing risk and adaptive strategies that people develop as a response to long-term adverse events or trends (Ellis, 2000). However, people's livelihoods and livelihood strategies are dynamic and changing over time in response to constraints and opportunities.

Local institutions influence household livelihood strategies directly by determining which activities are legal or illegal and appropriate or inappropriate. In this instance, distinctions can be made, for example, among women and men, boys and girls, single, married, female headed and married, etc. Creating incentives to pursue certain activities and choices over others and influencing perceptions of the effectiveness of particular strategies for achieving desired outcomes are important considerations. Local institutions also affect household livelihood strategies indirectly through their influence on access and control of household assets.

On the other hand, *livelihood outcomes* are what household members achieve through their livelihood strategies, such as levels of food security, income security, health, well-being, asset accumulation and high status in the community. Unsuccessful outcomes include food and income insecurity, high

vulnerability to shocks, loss of assets, impoverishment and desperate out-migration.

Assessment of livelihood assets

The status of the livelihood assets or capitals for the major vulnerable livelihood groups in the study area has been assessed following the five types of livelihoods assets, viz. human, natural, financial, physical and social capitals, identified in the SLF. The present assessment of livelihood assets has been developed from some earlier uses of a ‘qualitative to quantitative’ livelihood asset scoring tools developed in previous studies by FAO (Bishop-Sambrook, 2004). Thus, livelihood assets for each livelihood groups were assessed using a scale starting from a value of “0” to a maximum of “5” for each type of assets and carried out for all five types of assets sequentially. These evaluations are based on the locally defined standard indicators where the access to particular type of asset scores is calculated through the scoring system as shown in Table 30.

Table 30. Level of access to specific type of asset

Level of access to specific type of asset	Score allotted
“Low ” access	“0” to “1”
“Medium” access	“2” to “3”
“High” access	4” to “5”

The scores assigned to each of the above access classes are employed to each of the five capital resources and for each of the main livelihood categories (Table 31). The results are roughly plotted in a pentagon diagram for developing a comparative overview of the asset composition of the respective livelihood groups. This allows easy comparison between asset categories and helps to get an overall understanding about the main asset portfolios of each broad livelihood groups.

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Table 31. Definition of local indicators used in the assessment of the assets by livelihood groups

Assets	Locally defined indicators (i.e., access to these asset components)
Natural	Farmland
	Grazing land
	Water for livelihood activities (i.e. irrigation)
	Potable water
	Firewood etc.
Human	Information (markets, climate, production)
	Social status
	Age, gender, experience
	Literacy/education
	Awareness (health, sanitation, production, climate)
	Status of personal/family health, etc.
Financial	Household size
	Cash money
	Savings
	Remittances
	Readily sellable valuable assets (e.g. fixed properties)
	Credit facilities
	Sellable livestock, poultry, grains, etc.
Social	Access to customary institutions, village associations
	Formal institutions that provide services (i.e. youth, women forums, kebele association)
	Benefits from kinship/friendship/neighborhood ties
	Local groups and political decisions, etc.
	Livestock (shoats, oxen, cows etc.)
Physical	Beehives
	Access to health services
	Occupational equipments (e.g. farm implements, handicrafts, water pumps)
	Homestead gardens
	Type/condition of the dwelling houses
	Water harvesting, storage facilities
	Soil conservation structures/trees
	Access road/transport access
	Market outlets

SOURCE: Field data (July-August 2010)

4.5.1. Livelihood profile of the landless and marginal farmers

Vulnerability context

It emerged from the field investigation that small and marginal farmers in the study area are vulnerable to a multiplicity of climatic and non-climatic vulnerability factors (Table 32). Their vulnerability context is defined by several thriving climatic factors, such as the low or erratic rainfall, high temperature, dryness, high evaporation rate and reduced crop yields and livestock productivity. However, beside these factors the non-climatic factors have the strongest impact and the most serious repercussions on the livelihood outcomes of the people in this category.

Table 32. Major vulnerability factors of landless households and small farmers

<i>Major vulnerability factors</i>	<i>Causal factor</i>
High temperature/heat waves	Climatic
Rainfall variability/failure	Climatic
Hailstorm/frost	Climatic
Landlessness	Non-climatic
Lack of livestock and productive assets	Non-climatic
Lack of skills, information and marketable skills	Non-climatic
Income poverty (lack of cash, no savings)	Climatic/ non-climatic
Food poverty (Poor diet, malnutrition...)	Climatic/non-climatic
Poor health/lack of access to healthcare facilities	Climatic/Non-climatic
Unavailability of work during dry season	Climatic/non-climatic
Famine, flood and epidemics	Climatic
Poor wage rate	Climatic/Non-climatic
No/low female employment	Non-climatic
Commuting to other locations for work	Climatic/non-climatic
Seasonal migration	Climatic/non-climatic

SOURCE: Field data (July-August 2010)

Hence, the vulnerability contexts of this category of people arise mainly from environmental factors, including drought, hailstorm, lack of water, soil erosion and their socio-economic vulnerabilities, such as lack of farmland, fragmented and miniscule plots, soil erosion, poverty, very low or no access to irrigation, agricultural inputs and services, large family size, lack awareness about the importance of education, and socio-economic opportunities. However, a cursory investigation of the information obtained from informants show that some natural factors, including farm size, its location, gradient and fertility of the soil, and institutional variables in terms of access to water sources, extension services and credit put the small and marginal farmers in Raya Azebo in a relatively

better position than the landless or the small and marginal farmers in the sample kebeles in Meket district.

Livelihood assets/capitals

Landless people do not have access to cropland or grazing land. In this group, there are people who own miniscule plots, especially female headed households, but whose farms are cultivated by other farmers through share cropping arrangements. By comparison, small and marginal farmers were found to have access to their own cultivable lands but the amount of land they own is so small that they cannot invest in soil and water conservation measures. These farmers have no or very limited access to water supplies and agricultural inputs or extension services. They do not own their own livestock (only an ox or one or two shoats), no trees, and no ponds. Their livelihood is totally dependent on rain-fed crop cultivation and the daily exploitation of natural resources, such as fuel wood, dung, fodder, charcoal, wild food, on community areas. They also engage in casual daily labor in neighbors' farmlands in exchange for grains, food or some badly needed cash. Most are also relying on the productive safety-net program of the government which transfers food (mainly wheat), cash and supplementary food to beneficiaries. Some also engage in public works activities, such as construction of sand terraces in Meket and environmental rehabilitation and water infrastructural development activities in Raya Azebo, under cash-for-work program arrangements.

The landless and the small and marginal farmers lack the necessary human capitals that include education, awareness, and health condition, to enable them improve their existing situations. Usually, a large number of them are illiterate. Their access to agricultural extension services, credit facilities and medical attention is extremely limited. The status of financial assets among the landless, small and marginal farmers is quite poor. In addition, people from this category have a low grip on savings and cash in their households, if any at all. In addition, their social status is quite low as participation of this group of farmers in village or kebele associations, local government decisions, formal cooperatives and government institutions is quite limited. The ownership of physical assets by this category of farmers is as well extremely low. Despite this grim reality, however, most of the small and marginal farming households have some useful agricultural equipments and tools that are essential for cultivation. Some of the marginal households own livestock and poultry too.

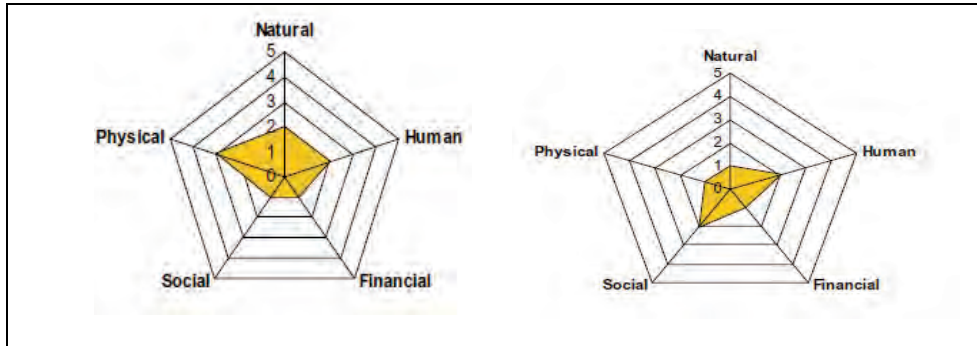


Figure 15. A comparison of the asset bases of landless households (left) and small farmers (right)

As Figure 15 shows, the size and shape of the asset pentagon, that is, the amount and relative importance of each type of capital, varies between the landless and the small farmers. It is clear from the figure that the status of financial, natural and the physical resources is very low for both the landless and small farmers. However, the small farming households usually have limited holding of physical and natural assets that are highly valuable for household consumption. Landless households, on the other hand, have no or very limited access to livestock holdings or other physical and natural resources.

Mediating factors (policies and institutions)

The participation of landless and marginal farmers in economic and social affairs is constrained by the lack of resource and access to social and political capital. Thus, people rely on informal safety-nets and local informal social institutions, such as kinship, *senbetie*, *mahiber*, *equib*, *kirie or edir*, for support in the critical times. Because of relatively flat topography and better social infrastructure, the situation seems a bit different in some of the rural kebeles in Raya Azebo, where rural people's participation in formal institutions, social affairs and organizational activities is encouraging. The social activities revolving around the public works program under the food-for-work package in Meket or the sources or environmental rehabilitation activities in Raya Azebo have remained major mediating factors for the landless and the small and marginal farmers. Linkages with the local elites, although crucial, are also very limited for this group of people.

Livelihood strategies

In order to cultivate their small farm plots, which are usually less than $\frac{1}{2}$ a hectare plot (or two *timad*), a plot rightly described by Dessalen (2008) as "starvation plot", small and marginal farmers rely on *yekul* and *yegulbet*. *Yekul* is a contractual agreement through which seed and oxen are provided by better-off

households renting land. The production is shared equally except the straw, which depends on who provided the labor. *Yegulbet* is a contractual arrangement involving hiring out one's labor for two or three days in exchange for the use of a pair of oxen for one day. The small farmers are responsible for all other inputs, and therefore retain the entire harvest. If the household has labor shortage, it will not be able to send a migrant away for seasonal employment during the busy seasons. Some households divide the land and farm half of it on the basis of *yekul* and the rest through *yegulbet*.

On the other hand, the major livelihood activities of the landless and female headed households is relief assistance, gifts from relatives, sell of water, grass, firewood, charcoal, dung cakes, and payments of labor contribution in private farms or in public works programs. The small and marginal farmers rely on crop cultivation, livestock rearing, and exploitation of natural resources, such as grass and firewood, casual labor and relief assistance. Small and marginal farmers cultivate crops, such as teff, maize, sorghum and some beans. Mostly small and marginal farmers are engaged in some rudimentary and casual on-farm and off-farm wage labor along with farming on their own land. Livestock rearing contributes little to their livelihoods.

Livelihood outcomes

The major livelihood outcome for the landless and small and marginal farmers is the relative access to public works and food crop production that determine their status as food and income insecure groups. The landless, female headed households and the marginal groups have limited assets to expand their incomes. Their primary response is to increase income from labor migration by sending off more household members to search for wage labor outside their villages. The sale of firewood, dung cakes and eucalyptus trees and cactus fruits can also be increased to earn more income for household use.

The last resort for the poor households is to seek credit from within the community. However, during bad years credit is scarce and where available higher interest rates are charged. Poor farmers with cropland are dependent over the limited cropping opportunity and gradually become exposed to climatic variability. Hence, the gradual uncertainties of livelihoods are increasing and the erosion of different types of assets has become a trend. The overall situation for this group of rural people is towards an increasing trend of poverty, livelihood insecurity and destitution.

4.5.2. Livelihood profile of farm and off-farm workers

Vulnerability context

The category includes rural people engaged in farming and agriculture based non-farm activities including petty rural trade, wood carving, pottery, crafts

making, weaving, basketry, traditional medicine, church services and other non-agricultural wage employment.

In the study area, people who depend on off-farm and non-agricultural activities are affected by the shortage of inputs, job opportunities and volatile market conditions. During drought seasons and flood episodes, the market and employment conditions deteriorate and these group of people shift to farming or harvesting natural resources. Among a number of non-climatic factors lack of employment opportunities, savings, ownership of cultivable land, healthcare facilities, poor wage rate, food storage, low female employment opportunities, commuting problems to other locations for work and distressed seasonal migration are among the prominent ones. A comparative overview of various types of the vulnerability factors that form the vulnerability context of the non-farm/wage laborers category in the study area are outlined in Table 33.

Table 33. Major vulnerability factors of on-farm and off-farm workers

Major vulnerability factors	Causal factor
High temperature/heat waves	Climatic
Rainfall variability/failure	Climatic
Poor health	Climatic/non-climatic
Lack of information and marketable skills	Non-climatic
Lack of market facilities and materials	Non-climatic
Lack of healthcare facilities	Non-climatic
Lack of cash/savings	Climatic/non-climatic
Lack of food storage	Climatic/Non-climatic
Lack (ownership) of cultivable land	Non-climatic
Unavailability of work during dry season	Climatic/ non-climatic
Famine, flood and epidemics	Climatic
Poor wage rate	Non-climatic
No/low female employment	Non-climatic
Commuting to other locations for work	Climatic/Non-climatic
Seasonal migration	Climatic/on-climatic

SOURCE: Field data (July-August 2010)

Livelihood assets/capitals

Those people involved in off-farm activities and other wage laborers still have a lower proportion of access to most of the livelihood assets or capitals. Access to natural, financial and physical assets is lower than access to their social or human resources. Rural wage laborers in the study villages were found to be holding only a very limited amount of land. The status of their financial

resources, though relatively better than the landless and the marginal farmers, is low and unstable. Incomes and work opportunities are generally limited and seasonal. Mostly in case of the agricultural wage laborers, usually the wages often received in terms of seasonal returns in kind and in cash, are limited. However, in case of the non-agricultural wage labor, the wages are paid in monetary terms but they are low and unstable. Households in the category may hold limited amount of financial savings and livestock assets. Usually, women engage in animal fattening, hairdressing and selling of alcoholic drinks. Despite the limited amount of savings that they own, they save primarily for the next round of the lean period where they would not find any labor employment.

In general, the situation of the asset portfolio of households combining on-farm and off-farm activities is relatively better than those in the landless or marginal farmers' category. This is particularly true in those villagers located near to or in the vicinity of rural markets, towns and along main transport or road lines. Opportunities for nonagricultural activities and wage employment are relatively better in such locations than those living and working in remote villages with poor road and market outlets.

Mediating factors (policies and institution)

Socio-cultural factors and external climatic and non-climatic factors influence the livelihood activities and outcomes of agricultural based craft workers and wage laborers. Among the intrinsic societal characteristics, the prominent factors are unfavorable and discriminatory socio-cultural attitude and practices toward handicraft workers and women engaged in pottery. Traditionally, throughout the history of northern Ethiopia, craft workers were excluded from mainstream society (Tassew, 1998). Despite playing an important role in agricultural innovations and rural livelihoods, yet they have such a low status and were for long culturally marginalized, socially segregated, such as in marriage, communal assemblies and residential areas, and had restricted access to physical and natural assets, including land and livestock. The socially ascribed roles for women coupled with restrictions on spatial and job mobility limit rural women's access to critical resources, including physical, natural and financial capital.

Livelihood strategies

The most common off-farm livelihood activities of people in this category include wood carving, pottery, sale of local beverages, crafts making, weaving, basketry, traditional medicine, and wage employment in agriculture or non-agricultural activities. Crop cultivation and livestock husbandry are also an integral part of their livelihood activities.

Livelihood outcomes

The livelihood situation of rural people in craft and pottery or weaving activities suffer from socio-cultural restrictions and other factors of climatic and non-climatic contexts. However, depending on the local economy, climate and institutional support, the livelihood outcomes of people combining agricultural and non-agricultural activities can be far better than those in the landless or marginal farmers' category. Nevertheless, compared to the landless and marginal farmers, this group of people remains relatively more vulnerable to their societal contexts and lack of opportunities, inputs and markets.

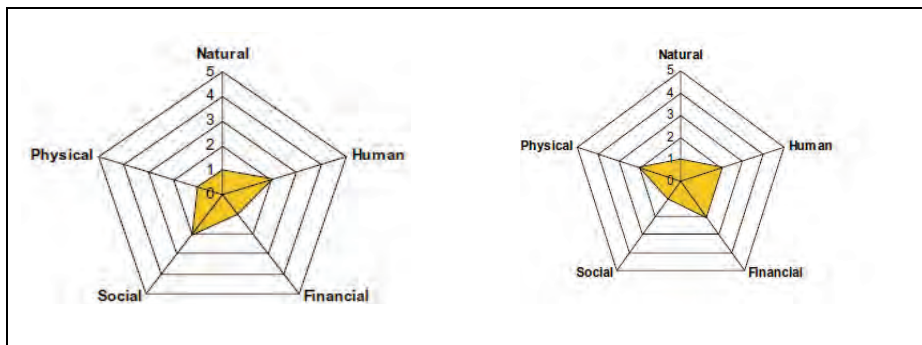


Figure 16. Asset bases of rural-based craft workers/petty traders (left) and urban-based farmers and traders (right)

4.5.3. Livelihood profile of viable groups

Vulnerability context

In addition to the climatic risks, such as low precipitation, high temperature, hailstorms/frost, pests that are affecting the overall agricultural sector, the major forms of vulnerability factors for the relatively better-off farmers and urban-based businesses are primarily non-climatic in nature. Obviously, the climatic conditions and the adversity of drought in agriculture in the study kebeles cause direct and indirect effects over the livelihoods of these people. During the advent of drought, famine or at times of crop failure and outbreak of livestock diseases, people engaged in urban-based businesses and trading activities also experience limited sale of their products and often are subjected to severe economic constraints (Table 34).

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Table 34. Socio-economic vulnerability factors and problems faced by small rural enterprises

Business type	Major risks
Cottage/handicraft enterprises	Lack of sufficient initial capital Lack of continuous supply of raw materials Lack of adequate skill Lack of working premises Absence of market demand
Small-scale enterprises	Lack of sufficient initial capital Lack of working capital Lack of continuous supply of raw materials Shortage of supply of raw materials Lack of working premises
Retail trade	Lack of sufficient own capital Lack of working premises Shortage of working capital Limited markets
Service trade	Lack of working premises Lack of sufficient own capital Access to raw materials Lack of workplace Shortage of working capital

SOURCE: Field data (July-August 2010)

Livelihood resources

Relatively better-off households in the study area were found to be relatively viable and resilient to climatic and non-climatic stressors. This is possible because this group of people have generally access to several forms of capitals and assets; and this includes both *endogenous and idiosyncratic factors*. Such influencing factors include better access to fertile land, irrigation facilities, and good access to extension services and credit facilities. They have more developed information and communication systems and networks that supply information about market and related conditions elsewhere.

Mediating factors (policies and institution)

Non-agricultural activities and urban-based businesses in the study area are influenced by several factors, including access to information and transport systems, loan facilities, high interest rates, access to credit, market facilities, relationship with the influential and urban based wholesale business people and so forth.

Historically, rural development policies in Ethiopia often tend to neglect the role of rural businesses and non-farm activities and their link with agriculture. There is an economic and social cost for the failure to recognize the importance of the rural non-agricultural or off-farm sector in expanding livelihood opportunities, decreasing vulnerabilities and its potential role in absorbing the growing rural labor force that contributes to the local/regional economy and societal transformation.

Livelihood strategies

Rural households in this category participate in a variety of farm, non-farm and business activities. They own relatively large farms of not less than 2 hectares. In addition, they may own backyard fruit, vegetable or eucalyptus farms. Some have access to relatively good land or irrigation and private grazing lands. They also fatten livestock and make good use of extension services and credit facilities. However, traditional farming technology, such as simple hand tools, horse or ox-driven implements and labor, is the dominant farm input and comes mainly from the family. Among the category, those involved in livestock trade, salt trading, butter trade, retail trade and cottage and handicraft industries are the better off. There are also individuals who combine self-employment and wage employment. Wage employment includes manual work in construction, masonry and carpentry. Self-employment includes retail trade, transporting goods by pack animals, handicrafts and stone mining. Some are also involved in activities, such as vegetable selling, grocery shops and roadside businesses, both in and out of the study areas.

People in this category appear better prepared to cope with or mitigate the harmful effects of climate variability and change. When confronted with climate change induced food insecurity or other disasters, these people employ the following strategies:

- *Livelihood diversification*: consideration of more than one livelihood activity at a time works as insurance of livelihoods for this group. Decreasing dependency over a single major livelihood activity reduces the extent of vulnerability to climate.
- *Limited dependency over the primary production systems*: this option is adopted by informants from urban-based businesses and traders. Better off rural families tend to limit their reliance on primary production. Some relocate to towns or in the vicinity area of towns and rent out land to small and marginal farmers on a share cropping base or other arrangements.
- *Setting up buffer savings and assets*: one major factor that makes this group less vulnerable is their buffer savings and their financial status.
- *Maintaining clients through credit and advance sale*

- *Building up liquid financial assets*: lending money to poor households or purchasing any asset in the critical moments from the vulnerable groups.
- *Maintaining exogenous market relations*: households try to maintain a larger network beyond their area.

Livelihood outcomes

Despite the vulnerability of incomes from rural and small town-based businesses and service activities on climatic and non-climatic factors, those engaged in urban-based business and wholesale trade activities have generally better resistance and adaptive capacity or options than poor farmers and petty traders. Rural towns act as a focal point in the development of rural business and non-farm incomes. It is essential to ensure adequate economic and social infrastructure to support emerging rural non-farm activities and to renovate and develop traditional ones. Physical infrastructure will undoubtedly play a significant part in strengthening farm/non-farm linkages. Road access to rural towns is essential to stimulate rural-urban linkages and provide necessary inputs and market access. Efficient and accessible rural credit is important to promote rural non-farm activities; and investment in human capital is essential to ensure that rural non-farm activities and small-scale enterprises are reliable and able to cope with climatic stresses and benefit from new technological developments.

4.5.4. Adaptive responses by livelihood groups

Various livelihood groups have different ways of managing climatic and non-climatic risks. Each livelihood group has its own set of vulnerabilities to the major climatic risks and employs different strategies to the extent that its livelihood resources allow doing so (Table 35).

Table 35. Adaptation practices of livelihood groups in Meket and Raya Azebo

The Landless and marginal farmers	Agriculture based off-farm workers	Better-off farmers and urban-based farmer-traders
<ul style="list-style-type: none"> • Smoothing/adjusting consumption • Eating wild/famine food • Seeking food aid/cash transfers • Begging/borrowing from relatives • Public works (cash/food-for-work) • Herding livestock of other families • Farming on 	<ul style="list-style-type: none"> • Modifying farming practices • Water harvesting/storage • Irrigation agriculture • Combining multiple occupations • Livestock husbandry and poultry • Migration (seasonal and cyclical) • Homestead gardening 	<ul style="list-style-type: none"> • Combining multiple occupations • Mortgaging properties • Retail trade • Investing in soil and water conservation • Homestead gardening • Sell of business/seed money • Cash crop production • Saving grains

sharecropping arrangements	• Bee-keeping	• Borrowing money to poor households (with high interest)
• Sell of charcoal/firewood	• Petty trade	
• Dung cake preparation and selling	• Crafts work	• Modifying livestock diversity (Switching from grazers to browsers)
• Sell of fodder and grasses	• Livestock fattening	
• Casual labor	• Early selling of weak and sick livestock	• Savings and credit
• Selling water	• Diversifying livelihood activities	• Investing in education
• Desperate out-migration	• Invest in the education of children	
	• Tree planting	

SOURCE: Field data (July-August 2010)

4.6. Climatic variations and gender specific vulnerabilities

In the analysis of the vulnerabilities, livelihood activities and coping strategies of the different livelihood groups, some observations on the gender specific vulnerabilities of the major livelihood groups emerged. Some of such findings on the gender specific vulnerabilities are outlined in Table 36. In general terms, women headed households with few adult working members, the landless and those women in the marginal farmers group were found to be among the most food insecure and most vulnerable with limited assets and strategies to cope with and adapt to climatic and non-climatic stresses and risks.

Table 36. Climatic variations and gender specific vulnerabilities

Gender specific vulnerabilities	Meket	Raya Azebo
Increased workload in the homestead (fetching water, collecting firewood, preparing dung cakes, transportation burdens, managing the home gardens)	Women face considerable physical burden fetching and carrying water to their households. Deterioration of water quality in the ponds/springs during dry seasons adds to it	Carrying loads and distances covered are lower in general but relatively higher where the distance of safe water sources are long

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	Women (especially divorced, separated widowed) face increasing workloads in land preparation, sowing, harvesting and transportation activities	Women of relatively poorer households participate in the various field activities such as land preparation, clearing weeds, harvesting
Increased work load outside the home	The burden is more worse for women headed households Collecting wild food , firewood, dung	Some women also commute to nearby towns or villages for casual work Collecting and selling firewood and cactus.
Lack of employment/low female wage rate	Women face unemployment If employed, women get a very poor wage rate (or share of crop in kind)	Wage rate is comparatively good in non-agricultural activities but still remains considerably lower than their male counterparts.
Increased consumption disparities (poor nutritional intake)	Women face malnutrition and feel stressed from feeding young and old/sick members	Women face malnutrition and feel stressed from feeding young and old/sick members
	In the cold season women face asthma and other respiratory diseases. In the dry season, health maladies such as skin disease, fever, gastric, diarrhea etc.	Incidence of some vector borne disease such as malaria, typhoid, diarrhea, fever, etc.
Poor health, sanitation and limited medical attention	Due to waster shortage women face difficulties in having sufficient water within the households for sanitation, hygiene and bathing purposes When sick, women rarely visit health stations or get necessary medical attention	Households with limited access to piped water facilities face relatively higher problems in sanitation, hygiene and bathing
Difficulties in maintaining homestead gardens	Homestead gardens as in most of the cases are managed by the women members; the women face considerable difficulties in managing water for their gardens.	Household those are distant from the improved water storage capacities (e.g. STW, DTW, Water tanks) face such problems.
Social insecurity in absence of adult male members due to migration	Some women feel unsecured, lonely and overburdened when their spouses stay long as migrants outside their villages	Some women feel unsecured and betrayed when their spouses stay long and detached from their village for long time

SOURCE: Field data (July-August 2010)

4.6.1. Vulnerability of female headed households²⁰

Rural women are particularly affected by climate change because they generally do not have secure and affordable access to and control over land, water, livestock and trees. Thus, they are forced to make do with limited resources and alternatives when their subsistence needs and livelihoods are threatened. Elderly women, disabled women, widowed women and women in female headship face the most acute challenges related to climate change whilst having fewer resources to compensate for and adjust to changing circumstances.

Women assume the position of family or household head when they are divorcees or become widows or when they are abandoned (Table 37). However, there are local disparities in the causes of divorce. For example, while male-outmigration is the main cause for female headship in Meket with 38%, divorce accounting for 39% is the dominant factor in Raya Azebo. In Meket, a household led by a woman is perceived as incomplete, and not able to perform socialization and economic functions adequately. Such women were socially ascribed lower status, disapproved, looked down and doomed to hardship. In Tigray, over 30 percent of the population are estimated to be de facto female headed households, mainly from death of spouse and traditional migration patterns (Meehan, 2004).

Table 37. Causes for female headship

Causes for female headship	Wereda				Total (N=69)	
	Meket (N=29)		Raya Azebo (N=40)		No	%
	No	%	No	%		
Divorce	6	20.7	21	52.5	27	39.1
Death of spouse	9	31.0	10	25.0	19	27.5
Migration of husband	11	37.9	7	17.5	18	26.1
Never married	1	3.5	1	2.5	2	2.9
Not stated	2	6.9	1	2.5	3	4.4
Total	29	100	40	100	69	100

SOURCE: Field data (July-August 2010)

²⁰ In order to identify women headed households and interview the head woman, kebele registration lists from the local administration offices have been used. In addition, Kebele administration cabinet members in each pilot area were consulted for the purpose.

4.6.2. The role of migration in female household headship

Desperate rural out-migration is an important coping strategy commonly employed by adult people in resource poor and environmentally degraded areas, including Meket and to some extent Raya Azebo. Almost all women who mentioned migration of spouse as a major cause for their status as head of a household emphasized the economic motives as the major cause for male outmigration. In particular, they narrated how life has increasingly become intolerable and uncomfortable due to climatic and non-climatic stresses, including famine, crop failure, poverty and insecurity. For the respondent women, leaving ones village and family in search of seasonal employment is common especially during drought or poor harvest seasons; and is a necessary household coping strategy. It is the only feasible and available option for poor households with adult members who can bear the challenge of separation and get accustomed to different social and economic environments “out there.”

Among women informants, some mentioned migration of spouses as a decision made in consultation with them and other kinfolks. That is why migration in the Ethiopian context can be considered as part of a family’s survival strategy undertaken to ensure the viability of the rural household (Alebachew, 2000). During drought or lean seasons, resource poor households and marginal farmers feel insecure and seasonal employment in the nearby areas dry up or get crowded. Informal safety-net mechanisms cannot be relied upon. Hence, such families prefer to send their adult members for seasonal employment (Box 10). The role of relatives, friends and co-villagers as suppliers of information about places where opportunities and constraints may exist and providers of initial support and assistance for potential migrants is important in the decision-making process about the place of destination. Previous visits, migration experience, education and exposure to other media sources are also important sources of information for potential migrants.

Box-10.

“The pain of separation”

“During famine and severe drought, our oxen and cows’ ribs stood out, the land cracked and people became hungry. Young and adult men leave the village and only women and children are left behind under the protection of God. Some women had one or two animals: a cow or sheep. Occasionally, they sold one to buy food. Those of us with no livestock had no security. Among us the young ones couldn’t stand life; so they also migrate... My husband left the village some five years ago and since then he has never returned. He sent us some money and few clothes during epiphany. The last time he visited us was in epiphany (in 2009). Since then he only sent words about his whereabouts and his health...When my husband was here, I used to attend the household chores and support him in the field preparing the land while he ploughs, and

in weeding and harvesting the crops. Now, things became worse. We lost our cow partly because of drought and partly lack of care. This year, I begged relatives to plough my land and despite complaining, they helped somehow... In order to feed the family, I have to get up very early every morning and prepare the morning and evening meals for my children. After that, I have to visit the field, one child on my back and one on my stomach. On my way back, I gather wood for cooking. Now the entire burden rests on my back. My only prayer is for my husband to come to us safe and share my burden”

(Guday Asmare, 27, Meket)

In Meket and Raya Azebo, there are particular constraints affecting female headed households in pursuing their livelihoods, especially in the rural areas. These constraints include smaller holdings, lack of draught animals, and shortage of household labour, especially during peak ploughing and harvesting seasons. Despite such constraints, informants confessed that they received intermittent remittances from their spouses although they do not want to mention the exact timing and amount of money they receive. Others only knew the whereabouts of their spouse.

Among some respondents, there was a feeling that if conditions at the village continue to deteriorate, their spouses may not return at all. This is a challenge as these women have to bear the burden of attending to all the domestic, field and community activities and feed all the household members by themselves. But, this should not mean that the outcome of male migration and female household headship is grimmer and bad for all such women. Definitely, when drought and land degradation, considered to be slow-onset disasters, make male outmigration in search of employment necessary, women’s domestic and care responsibilities increase (Box 10) making it difficult for them to engage in other in-come generating work. Nonetheless, the widely-held view that male out-migration makes woman more vulnerable may not be always the case because in some instances male migration can give women greater decision-making power and open up new livelihood possibilities for them (Box 11).

Box-11

“Spicy wet and injera”

“I first married when I was about 13. Since then I have been married three times but divorced due to disagreements. My last husband was forced by the police to go to a resettlement area. I no longer know his whereabouts or even whether he is alive or dead. Since that time, I have been renting out land because there was no one to look after the farm and two of our oxen and a cow died from the drought. Nearly 6 years ago, my family moved to Dibeko town where I learned and began to brew and sell *tella* and *arekie*... My son was hired in another family’s farm. My daughter helps me in the chores and in my business. My eldest son is a deacon and helps me in times of

need. Since 2008, I started running a small shop selling chewing gums, salt, sugar, soap, pens and other articles. In the past two years, my life has started to change for the better. I have brought my son back from where he was working and he is now attending school. I still make *spicy wet* from peas and lentils and eat with *teff injera*. I now have access to piped water... Overall, my life has improved” (Serkie Desie, 39, Meket)

Role of divorce and death of spouse

Divorce and the death of a husband are also important factors for women assuming female household headship in the study area. About one-fourth of the respondent women cited divorce and death of a husband as the main reasons for them assuming household headship role (Table 37). Although it is difficult to get the true opinion of the respondents as to the causes of divorce or death of a spouse, poverty, illness, conflict, family disagreements and adultery were mentioned as factors by some respondents.

4.6.3. Female headed households and rural assets

Land, water and forest resources are vital rural assets and access to and control over these resources determine ones’ socio-economic standing and level of vulnerability and adaptive capacity to the impacts of climate variability and change. Given that women in general and female headed households in particular are disadvantaged in terms of access to and control over basic assets and productive resources, it is quite relevant to assess the relative importance of each factor of production with respect to the sample female headed households in the study area.

Female headed households and access to land

As compared to male headed households, female headed households in Both Meket and Raya Azebo face shortage of productive land (Table 38). The majority of female headed households do not have access to sufficient land to be able to adequately feed their households. In fact, the over-whelming majority of female headed households in the sample kebeles in Meket (96%) and Raya Azebo (80%) own less than 1 hectare of land. Not only farm plots are miniscule, but less productive too: only 14% of female headed households in Meket and about one-third in Raya Azebo had access to fertile and productive land.

Table 38. A comparison of FHHs and MHHs in terms of access to land and livestock

Responses	Wereda				Total (N=223)	
	Meket (N=106)		Raya Azebo (N=117)		FHHs (N=69)	MHHs (N=154)
	FHHs (N=29)	MHHs (N=77)	FHHs (N=40)	MHHs (N=77)		
Landless	6.9	1.3	10.0	2.6	8.7	2.0
Land quality						
Good	13.8	28.6	35.0	46.7	26.0	37.7
Poor	31.0	46.8	37.5	26.0	34.9	36.3
Bad	44.8	19.5	12.5	20.8	26.1	20.1
No stated	3.5	3.8	5.0	3.9	4.3	3.9
Total	100	100	100	100	100	100
Land holding (Hectare)						
	FHHs (N=26)	MHHs (N=71)	FHHs (N=35)	MHHs (N=70)	FHHs (N=61)	MHHs (N=141)
Below 0.5	50.0	9.9	25.7	5.7	29.5	7.8
0.50-0.75	26.9	49.3	20.0	8.6	26.2	29.1
0.75-1.0	19.3	19.7	34.3	21.4	27.9	20.6
1.0-1.5	3.8	15.5	14.3	52.9	13.1	34.0
Above 1.5	-	5.6	5.7	11.4	3.3	8.5
Total	100	100	100	100	100	100

FHHs = Female Headed Households

MHHs = Male headed households

SOURCE: Field data (July-August 2010)

As the data from informants and the case history reports established, the quality of farmland and its location influences women's access to male labour and draught oxen or horses. Some female headed households lacking adult male labour rent their land on share cropping arrangements. Others get access to male labour and oxen from close relatives. However, support from kin and neighbours is fast fading away and women requesting labour assistance or oxen are mostly left with the option of having to rent their land. In some instances, women in extreme poverty or under pressing financial crisis mortgage their land to sharecroppers, and take loans by giving their land as guarantee. But, this would involve a risk of falling in debt and usually lead to loss of land.

Livestock possession of female headed households

In addition to access to land, livestock possession is an important factor in rural food and social security. However, as a measure of their poverty and livelihood

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insecurity, rural women's access to livestock assets is very limited. Nearly 56% of the female headed households in Meket and one-third in Raya Azebo reportedly own no livestock (Table 39). Even among female headed households who own livestock, cattle possession is rare. With limited access to productive land and livestock assets, one may wonder how female headed households are coping with climatic and non-climatic risks; and wonder what viable livelihood strategies and adaptation options might be available for resource poor women.

Table 39. Livestock possession of female headed households

Livestock possession of FHHs	Wereda				Total (N=69)	
	Meket (N=29)		RayaAzebo (N=40)		No	%
	No	%	No	%		
With no livestock	16	58.6	14	35.0	30	43.5
With livestock	13	41.4	26	65.0	39	56.5
No oxen	11	84.4	19	73.1	30	76.9
1 oxen	2	15.4	6	23.1	8	20.5
2 oxen	-	-	1	3.8	1	2.6
No cow	6	46.1	12	46.1	18	46.1
1 cow	4	30.8	9	34.6	13	33.3
2 cows	3	23.1	4	15.4	7	18.0
3 cows	-	-	1	3.9	1	2.6
No shoats	5	38.5	11	42.3	16	41.0
1-3	7	53.8	13	50.0	20	51.3
4 and above	1	7.7	2	7.7	3	7.7
No equine	10	76.9	21	80.8	31	79.5
1	2	15.4	5	19.2	7	17.9
2	1	7.7	-	-	1	2.6

SOURCE: Field data (July-August 2010)

Although crop farming and livestock husbandry remain the most important livelihood sources, the exploitation and sale of natural resources, such as (fodder, fuel wood, and water, are important income sources for female headed households in the study area (Table 40). Petty trading, relief work and handicraft work are also additional sources of income. As can be seen from Table 40, female headed households appear to engage in diverse livelihood activities and income sources. However, a critical investigation of the income sources will show how vulnerable the livelihood sources of women are to climatic and socio-economic risks. For example, income from natural resources, such as livestock husbandry and crop harvest, is totally dependent on weather conditions. Rural

trading and handicraft activities are constrained by the lack of money and poor businesses skills while access to casual labour work, for example, fetching water, hairdressing, baking injera; and draught power for farming depend on social networking and access to information.

Table 40. Main livelihood activities/sources of female headed households (% of respondents)

Livelihood activities	Wereda		
	Meket (N=29)	Raya Azebo (N=40)	Total (N=69)
Crop production	93.1	90.0	92.7
Livestock husbandry/fattening	44.8	65.0	56.5
Petty trading	37.9	35.0	36.5
Selling fuel wood, dung, grass, charcoal	30.0	37.5	34.5
Food-for-work/ Relief assistance	55.1	60.0	58.0
Handicraft work (weaving, basketry, pottery)	13.8	15.0	14.5
Fetching water and baking injera	10.3	7.5	10.1
Hair dressing	3.5	10.0	7.2
Collecting/selling wild food	3.5	7.5	5.8
Remittances	10.3	5.0	7.2
Total	302.3 ²¹	332.5	323

SOURCE: Field data (July-August 2010)

4.6.4. Vulnerability to climatic and non-climatic risks

As shown in Table 41, about 46% of the respondent female household heads link drought, famine and food insecurity to climate conditions; 16% to local environmental degradation and 13% to diseases and about 6% to socio-economic limitations. More specifically, climate variability is mentioned as the most important factor for the vulnerability of female headed households by half of the respondents in Raya Azebo and one-third of the respondents in Meket. Other vulnerability factors cited by respondents include lack of access to financial and technological resources and livestock assets.

As discussed earlier, vulnerability to climate change is a function of climatic, i.e. rainfall, temperature, hailstorm and wind; and socio-economic factors. Access to the five basic livelihood assets, such as financial, physical, natural, social and human capital resources, determines the vulnerability and adaptive capacity of a community or a given household. In this regard, the landless, those without

²¹ Responses add up more than 100% due to multiple responses

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livestock and with limited knowledge and skill will be most vulnerable and least adaptive to climate change impacts (Table 41). That is why about 62% of the total respondents said that people without access to land and livestock assets are the most vulnerable groups in their respective communities.

With respect to women, about 18% of the respondents specifically mentioned women and women headed households as among the most vulnerable groups to the impacts of climate variability and change. A closer investigation of the data tells that woman headed households constitute the majority among the resource poor category-those with limited or no access to land, livestock and other productive resources. This coupled with socio-cultural restrictions and lack of access to socio-economic services and opportunities caused by lack of time, work burden, lack of education and awareness, or limited social network, exacerbate the poverty and food insecurity situation of resource-poor women, especially those living in female headed households.

Table 41. Vulnerability factors and vulnerable groups (% of respondents)

<i>Major cause of drought, famine and food insecurity</i>	Wereda		Total (N=69)
	Meket (N=29)	Raya Azebo (N=40)	
Rain failure/erraticity/heat waves	37.9	52.5	46.4
Intensive rain/hailstorm/frost/snow	13.8	5.0	8.7
Diseases and pests	6.9	17.5	13.1
Land degradation//soil erosion/deforestation	20.7	12.5	15.9
Socio-economic and political factors	13.8	7.5	10.1
God's order	6.9	5.0	5.8
Total	100	100	100
<i>Vulnerability factors/for FHHs</i>			
Climate (rainfall, temperature, hailstorm)	34.5	50.0	43.5
Nature (natural disasters, God's will)	17.2	12.5	14.5
Human (household characteristics) and institutional factors	6.9	10.0	8.7
Socio-cultural	10.3	2.5	5.8
Economic limitations (financial, technological, land, livestock)	31.1	25.0	27.5
Total	100	100	100
<i>Most vulnerable groups</i>	Meket (N=106)	Raya Azebo (N=117)	Meket (N=223)
The landless	34.9	27.4	30.9
Those with few or no livestock	28.3	35.0	31.8
Those with large family/high age	12.2	18.0	15.2

dependency			
Women/female headed households (lack of male labour)	18.9	16.2	17.6
Others	5.7	3.4	4.5
Total	100	100	100

SOURCE: Field data ---July-August 2010

4.6.5. Coping strategies of female headed households

Since Meket and Raya Azebo are drought-prone districts, the sample female headed households vividly recited the kind of disasters, such as drought, famine, crop failure, diseases outbreak and pest infestations, from which most villagers suffered gravely. Since the 1970s and 1980s, severe drought and famines had eroded the livestock asset bases of rural households and induced mass out-migrations.

During the household interviews and community discussions, informants were requested to mention the various strategies they employed in order to cope with food poverty and adapt to changing environmental and socio-economic circumstances. Accordingly, women respondents cited one of more of the following: consumption adjustments, reducing amount of food and the frequency of serving meals, shifting to eating ‘famine’ foods, skipping meals and preferential treatment of young and sick and elderly members, appeal for support from relatives, the government or external aid agencies, engaging in casual labour, collection and sell of fuel wood/dung, handicraft work, petty trading, sending children to relatives or hiring them for payments in other family’s home and desperate out-migration.

4.7. Responses and coping strategies

4.7.1. Local community responses and coping strategies

Rural Ethiopians in different agro-ecological conditions have long developed and accumulated a body of experiential knowledge and skills, practices and symbolic representations about their environment. In the dominantly crop farming regions of North Wello and Southern Tigray, local adaptation and coping strategies include traditional practices in the areas of soil and water conservation, changes in cropping patterns and planting practices, indigenous agro-forestry and community forestry, diversification of income sources through increased petty commodity production and trading, use of inter-household transfers and loans, mortgaging of land, credit from merchants and money lenders, food aid and out-migration. Although most of such local strategies are increasingly being weakened from repeated climatic and non-climatic stresses,

they are still key resources for empowering the rural communities and enhancing local resilience to the adverse impacts of climate change. In what follows, a brief analysis of each of the indigenous coping and adaptation strategies is given.

Farm responses

Crop diversification

Subsistence farmers in Meket and Raya Azebo try to adjust the planting, cultivation and harvesting of crops according to a flexible schedule constrained by water availability and resort to fallback strategies in worst-case scenarios. Genetic variability within the traditional agro-ecosystem enabled these farmers to exploit short-maturing and relatively drought tolerant cereals if the rains were delayed or deficient. Other cropping strategies would exploit micro-scale variations in soil moisture; and/or in fact creating these variations through crop-spacing controls.

In Meket, farmers try to exploit the local climatic and soil conditions by changing from monoculture with sorghum and maize predominating in the lowlands to crop diversification practices, which consists of a mixture of maize, teff, sorghum, legumes and some root crops. In addition, the peculiarities of each wet season demanded a slightly variant agronomic plan grounded in the detail of local rainfall characteristics. Most cropland, however, is dominated by mixed cultivation of wheat and barley, where both crops are planted, harvested, threshed and eaten as a single crop. Farmers say that this enables them to use land and the moisture and nutrients available in the soil more efficiently while reducing attacks by pests, which do less damage to the mixed crops than to pure stands. Small and marginal farmers with no or limited access to draught oxen tend to grow legumes, such as field peas and horse beans as it is not necessary to repeatedly plough the seedbed for these crops.

Farmers in Raya Azebo have a long record of adjustment of farm management practices and cropping techniques to cope with the variability of weather and climate. The adaptation measures include diversification to include cereal crops mainly teff and sorghum; fruits, including cactus; vegetables, such as tomatoes, green paper, and onions; cash crops, such as *gesho*; and beekeeping. Such arrangements help optimize the use of available water for crop growth. In fact, such crop diversification options are possible for some households with relatively good supply of water from access to irrigation and river valley areas. There is also growing tendency to cultivate eucalyptus by carefully protecting the plants with stone walls as in Meket and cactus as in Raya Azebo both as supplementary food for livestock using the cactus leaves and cactus fruits for human consumption and supplementary income sources.

Change in cropping pattern and calendar

Farmers in Meket and Raya Azebo say that rainfall variability, which is expressed through irregular distribution in time and space, can occur at any moment of the cropping season. It could happen either at the onset, middle or end of the cropping season. For this reason, they have modified their cropping pattern and season. If the onset of the rainy season delays, the significant majority of about 71% of households patiently wait for it. When it comes, they saw the same seed. If a dry spell happens, in the middle of a cropping season, the over-whelming majority or about 87% decide to re-cultivate their farmlands using short maturing varieties of crops. If the rain withdraws at an early stage in the season, about 53% would feed their wilting straws to livestock. In both districts, there is a tendency to farm and cultivate areas unsuitable for cultivation, such as hilly areas with steep slopes in Meket and flood-prone low-lying areas in Raya Azebo. This tendency is a result of land hunger as in Meket and water stress as in Raya Azebo and the need to exploit soils with relatively good moisture and organic content.

Some farmers cultivate periodically flooded river valleys and the escarpment leading up from these to the uplands with fruit and cash crops. These areas serve as buffers from climate risks, especially in the event that the main grain harvest fails. River valleys are also used in flood recession agriculture or dry season irrigated agriculture. *Rhamnus prinoides* (*Gesho*) and banana are grown along escarpments, and become particularly significant during drought years.

Utilization and management of biodiversity

Realizing the multiple uses of local tree species and the depletion of natural vegetation, rural households try to plant and manage some tree species, mainly eucalyptus in Meket and fodder plants in some areas of Raya Azebo. During the field work period, some households in Meket were observed selling and others buying seedlings, mainly eucalyptus but also *tid* (*Junipera procera*) and *weira* (*Olea europaea*). In Raya Azebo, the Wereda Agriculture Office in collaboration with RESTs' Coordination Office run local seedling stations and provide households with tree seedlings and nutritious legume trees, such as *sesbania*, *pigeon pea*, *cow pea* and various grass species, such as *Rhodes grass*, *Elephant grass*, *Alfalfa grass*, *Buffalo grass* and *Vetiver*, which are all important feed resource for livestock, and *tebeb*, *i.e.* indigenous flowering plant species for bees.



Plate 6. Tree planting and fodder development (Raya Azebo)

In order to assess the extent of tree and fuel management activities in the study localities, respondents were asked to indicate as to whether they plant and manage multi-purpose trees. The responses (Table 42) show that despite the harsh environmental conditions, for example, moisture stress and severe soil degradation problems, households somehow practice tree planting and forage development activities for economic, household energy, construction, and environmental conservation purposes (Plate 6).

The disaggregation off the data by sex shows that relatively more males accounting for 52% as compared to 21.5% females in Meket and 61.5% males as compared to 24.5% females in Raya Azebo are involved in tree planting activities. There could be several reasons for the gender disparity in tree and forage development activities. Informants cited lack of draught animal, lack of time, limited access to agricultural extension services and lack of access to tree seedlings as important factors for low participation of women in tree planting activities. Most female households rent out their land on sharecropping arrangements. However, in male headed households, it is not only the males who do the tree planting, but women members are also involved in the task of land preparation, watering and follow-up of tree seedlings and the use of the plants as fuel wood, construction materials, source of traditional medicine, household income, as shade trees and fodder for animals.

Table 42. Tree planting activities in the study area (% of respondents)

Do you plant trees in your backyard/farmland	Wereda			
	Meket		Raya Azebo	
	MHHs	FHHs	MHHs	FHHs
Yes	52.5	21.5	61.5	24.5
No	47.5	78.5	39.5	75.5
Total	100.0	100.0	100.0	100.0
<i>Purpose of tree planting</i>				

Sale	34.3	17.5	22.5	20.5
Household energy	29.5	65.7	7.5	22.5
Construction	24.7	10.5	28.7	15.7
Fodder for livestock and bees	21.5	5.6	41.5	31.5
Soil and water conservation	19.6	11.5	32.8	7.5
Others	7.5	-	-	4.3
Total	137.1	110.8	133.0	102.0
<i>Primary source of fuel</i>				
Trees, bushes...	25.5	28.0	71.5	67.5
Animal dung	45.5	66.5	-	21.3
Crop residues	29.0	5.5	28.5	11.2
Total	100.0	100.0	100.0	100.0

MHHs: Male headed households

FHHs: Female headed households

SOURCE: Field data (July-August 2010)

Although the collection of plants for food is usually not as important a component of rural household diets as milk and butter, wild plants provide them with a supplement and an emergency resource during times of drought or economic stress. But some destitute groups rely more heavily on wild plants, collecting them regularly either for home consumption or for sale. In some communities, as in Ade-Halga, for instance, collection and preparation of wild food is often the domain of women and young children, either collectively or individually, especially as an economic activity. Plant and animal parts are also used for medicines. These can make up either the bulk of the medicine, or are used for their symbolic value. Traditional herbal healers in Meket kebele 026 and Ade-Halga in Raya Azebo say they respect the plants by not damaging the whole plant, even when they are after the roots.

In both study districts, farmers use indigenous and other dryland trees for a variety of purposes:

- Water purification
- As food stuff for people
- Feed for livestock, especially in the dry season
- Wild fruits/“famine foods”
- Dry timber for wood fuel and charcoal
- Building material for houses, fencing, roofing
- Veterinary medicine for a variety of livestock diseases
- Human medicines for a variety of locally known diseases
- A variety of cultural and social purposes.

Despite the people's incredible efforts to protect and conserve the local environment, because of the increasing risks of drought and other climatic hazards, most edible wild fruits, medicinal as well as flowering plants are no longer available. Three consecutive years of rain failure with only meager harvests was just too much for many people in Raya Azebo and Meket to rely on famine foods. As such, the tradition of partially compensating damaged, reduced or even lost crop harvests by the collection of wild foods is no longer a viable option for many resource deprived households.

On the other hand, as shown in Table 42, rural families rely heavily on the natural vegetation and increasingly on dung cakes and crop residues. Farmers understand that their land is degraded and getting drier. They knew that their land needed organic fertilizers, such as dung and compost. But they find no alternative other than using dung or crop residues for fuel or feed their cattle. Hence, land degradation occurs not because the farmers are ignorant, greedy or short-sighted. It happens because they are driven by poverty to get as much out of the land as possible in the short term. They know they are losing the land but they have to feed their families and make ends meet.

From crops to eucalyptus trees

Tsegaw Ayalew used to cultivate beans, sorghum and maize in his less than a hectare (0.8 hectare) of farm land. These days he is guarding the eucalyptus trees and the grass that is growing in his backyard and *wejed meriet* that he planted two years ago. That is a radical change for a 28 year old farmer who is used to sowing,

weeding and harvesting a variety of bean and cereal crops over the severely degraded land. Now he takes turns to guard the eucalyptus tree and the grass with his son. But Tsegaw is not the only farmer who shifted from crop cultivation to planting of eucalyptus trees. Because of the high adaptability, fast growth and better market for eucalyptus, more and more crop farmers in his village are abandoning crops and increasingly resorting to eucalyptus farming in previously cereal crop production farms and backyards (Plate 7).

Tsegaw and his fellow villagers belong to *Shewa ber* village in Mesfina kebele 024 in the district of Meket. They are subsistence farmers whose livelihoods depend on land husbandry in an ecology that is fragile, degraded and dominated by rugged and rocky hills, and interrupted by gullies. The area receives half the annual rainfall compared to the central and south-western highland areas of the country. For generations, crop cultivation supplemented with livestock herding and other small income generating activities, including harvesting and marketing of natural resources, handicraft, casual labor and petty trading, were the main livelihood activities for the villagers.



Plate 7. Eucalyptus farms in Meket

Within one generation, the pattern of life was threatened and this is now changing. Successive droughts and resource degradation has drastically reduced the fertility and productivity of the land while population pressure has also meant the land has to support more households. Climate change manifesting itself in terms of prolonged and successive years of drought and livestock, crop and human diseases contributed to erosion of household assets and increased malnutrition of children and women in the community. As a result, farmers in the village are shifting towards the planting and cultivation of eucalyptus trees. The villagers saw an immense potential from the eucalyptus plant in its ‘drought-tolerant’ and ‘fast growing’ nature and contribution to household income. The villagers see a sharp rise in the market demand and price of eucalyptus trees and they see this as a way out of their situation, at least for the time being.

A common criticism associated with eucalyptus trees is the depletion of soil nutrients. In contrast to commonly used agro-forestry species, eucalyptus does not fix nitrogen- an essential element for soil health and sustainability. This has negative effects on agricultural practices on and near eucalyptus woodlands. Surveys have indicated that eucalyptus out competes crops for water and nutrients causing significant decreases in crop output. Malik & Sharma (1990), for instance, assessed the impact of eucalyptus on water uptake by agricultural crops. By studying profiles of water, soil temperature and pan evaporation, and combining these data with crop output from plots with and without rows of eucalyptus, they concluded that grain yields of mustard and wheat decreased linearly with increasing moisture extraction. From a distance of 10 meters away from the trees, a 47% reduction in mustard yield and 34% reduction in wheat yield have been observed. Further, eucalyptus extracted 5 times more water from the 0-150 cm profile as compared with mustard. The authors concluded that eucalyptus should not be row planted adjacent to crops in arid and semiarid regions with deep water table conditions.

Eucalyptus can, therefore, impose significant environmental costs when out competing crops and other vegetation. On the other hand, eucalyptus may provide essential additional income to farmers. Especially during dry periods, eucalyptus trees have a higher probability of surviving due to their ability to tap deep-water sources with their roots. Eucalyptus farmers in Meket appreciate eucalyptus for its fast growth and erect stem. The foremost benefit of eucalyptus is the wood that can be used or sold. Branches, twigs or leaves can be used as fuel wood. When felled, a new and erect stem quickly grows from the rootstock.

Tsegaw and his co-villagers are well aware of the potential harm eucalyptus tree may have on their farms and the environment. Despite some attempts by the local government especially from the kebele and district agricultural extension workers and development agents to raise awareness about the harmful impacts of eucalyptus tree especially on soil moisture, soil productivity and water availability, villagers see no alternative to eucalyptus.

Some attempts to introduce bee keeping and improve soil condition by treating gullies and constructing sand terraces implemented through the government's safety-net program are bearing fruit. But the re-introduction and planting of indigenous trees that could withstand the harsh ecological condition of the area and the introduction of drought and termite resistant multi-purpose tree species are among "good" interventions that some villagers, especially church elders and community leaders, consider as replacements for the fast invading eucalyptus tree. Thus, trade-offs between potential socio-economic benefits and the environmental risks associated with planting these trees therefore need to be carefully evaluated.

Indigenous agro-forestry and live fencing

Farmers try to integrate some drought-tolerant and deep-rooted tree species, such as *Acacia spp.* (grar) and *Ziziphus spina-christi* (kurkura), and olive tree (woira), which pump out nutrients from deep inside the soils. These trees provide additional benefits, including fruit (kurkura), firewood, charcoal and fodder. They also provide environmental services by controlling run off, curbing soil erosion and enhancing soil moisture with the help of their roots and canopy (Morgan & Dowlatabadi, 1996). On the other hand, farmers plant different species, including *Opuntia ficus-indica*, *Euphorbia abyssinica*, *Tecoma Stan*, *Cassina didymobtrya*, *Agava sisilana*, *Justicia schimperina*, around the homestead along farm boundaries and along permanent drainage ditches. Live fences are used to stabilize the embankment of drainage ditches and also to avoid physical damage by humans and uncontrolled livestock. The farmers using live fence get multiple advantages, including fuel wood, construction material and fodder.

Controlled grazing and cactus farming

Kahsay Mulugeta used to herd cattle and shoats in the rangelands in Ade-Halga area and along the Afar border which are dominated by cactus, acacia and thorny bushes. He also used to cultivate teff and sorghum in his 1.5 hectare of farm land. These days he is cultivating cactus and supporting his extended family (of 9 members). Kahsay, with the support from REST and the Wereda Agriculture Office, has abandoned the practice of free grazing and he is now fattening bulls and milking cows through cut-and-carry system. He feeds his cattle the cactus leaves, crop residues and residues of local drinks, such as *Arekie*, *korefie* and *tella*. In addition, the cactus fruits are important source of food and additional income during time of most need (usually July-September) (Plate 8).

Kahsay and his fellow-village men are well aware that grazing resources are increasingly getting scarcer and patchier. They are also informed about the economic and environmental implications of controlled or zero-grazing and feeding cattle through cut-and-carry system. They recognize that some households in their village are keeping cattle at their backyards feeding them crop residues, tree leaves and cactus leaves. The challenge they faced is how they can manage large number of cattle under the cut-and-carry system. Some even say that ‘we don’t have labor problem. Most households in our locality have extended families and young people who are free whole day and can help in herding the cattle. The problem is lack of feed resources. Besides, free grazing provides the freedom and opportunity to meet people...’ Despite such remarks, if provided with necessary technical and logistical support, households like Kahsay are happy to allow their women members to fatten cattle and sheep in their backyards.



Plate 8. Cactus farming and selling

Indigenous soil and water conservation practices

Water harvesting and management

In the northern parts of Ethiopia, traditional water harvesting and management by farmers has a long history. There is ample evidence which shows that ancient churches, monasteries and castles used to collect rainwater from rooftops

(Fattovich, 1990). Even to this day, there are several traditional rain water harvesting and management techniques in Meket and Raya Azebo, which have been used by rural communities in areas of water shortage since long ago. In the lowland areas, where natural sources of water are lacking, collection of rainwater from roofs, pits on rock outcrops and excavated ponds are common practices (Plate 9). With the introduction of corrugated iron sheet roofing as of the turning of the last century, houses are fitted with gutters to collect rainwater that is stored in makeshift collection facilities like oil drums.

Since all the four sample kebeles are semi-arid areas with poor rainfall conditions and severe moisture stress, farmers use runoff irrigation as a source of a few lifesaving irrigation supplies. In Hawelti kebele and in the Chercher plains around Mehoni town in Raya Azebo, runoff irrigation is widely practiced. The practice in some villages also includes use of ridge ties to retain the moisture around the plants. Similarly, farmers in Meket have been exercising the art of conserving soil and water. The traditional rainwater harvesting techniques use the soils as a media, particularly using bench terraces and trash lines on their cultivated lands.



Plate 9. Water harvesting for livelihood diversification

The water harvesting technique used by farmers in Meket resemble those in the Konso area since the method is applied from the lower to the upper slope positions and it forms a belt (crops are grown along the belts) in the catchment. The technique accommodates different kinds of physical and biological conservation measures. The strategy targets to maximize the use of rainwater and maintain soil fertility. In Raya Azebo, traditional rain water harvesting practices include moisture conservation, flood diversion and spreading, level bund, micro basins and trash lines.

Small-scale irrigation practices

The development of small-scale irrigation allows farmers to improve soil fertility and agricultural productivity while reducing their vulnerability to drought and related shocks. In the study area, there is also a growing tendency to use small-scale irrigation agriculture as a complement to rain-fed crop production to obtain badly needed income to cover household expenses and other obligations. In Meket, farmers in low-lying areas and along river banks use irrigation water to produce cereals, beans and some cash crops while in Raya Azebo there are opportunities from irrigation development schemes by external development agencies other than those run by the local government.

Structural soil conservation practices

Sand terraces

Stone bunds or stone terraces are the most commonly used soil conservation strategy in Meket (Plate 10). The extremely unfavorable topography and undulating nature of the terrain and the severity of the soil erosion problem forced farmers to construct sand terraces along their plots. The shallow and dusty nature of the soils coupled with the availability of sandstones encouraged households to construct sand terraces to protect the soil from being washed away by flood during the rainy season. Despite the lack of scientific measurements and analysis, farmers construct the stone terraces along the contour lines. Before piling up the stones as bunds, the farmers prepare foundation trenches in order to make the bunds stable.



Plate 10. Sand terraces in Meket

Unploughed strips and water ways

There was a long standing practice among farmers to deliberately leave unploughed strips within their own farm plots. This helps them to reduce the impacts of flooding and the loss of topsoil while the grasses growing along the unploughed strips are used as important feed resources particularly for draught

animals or milking cows. However, land shortage and population pressure is pushing more and more households either to plough some portion of the unploughed strips or totally avoid unploughed strips. On the other hand, in order to protect the soil from being washed away by run-off over overland flow and drain excessive water during the rainy season, farmers also construct traditional ditches as waterways.

Area closure

Area closures used as one type of land management implemented on degraded, generally open access land are a mechanism for environmental rehabilitation with a clear biophysical impact on large parts of degraded commons, especially in parts of Raya Azebo (Plate 11). In traditional area closure systems, the resource-user groups or local communities agree to protect some areas from livestock and human interference for a short period of time. The users agree as to when to close and protect the area and open it again for common access. The practice is not common in Meket. In some hilly and previously forested areas, the local communities are encouraged to protect the area for sometime through common management practices and utilization of the resources through cut-and-carry system. When the grasses mature, the community is allowed to share the product. The grass is used for feeding livestock, thatching roofs and making ropes and baskets.



Plate 11. Area closure in Raya Azebo

Soil fertility management practices

Manuring

Farmers used to increase the fertility of the soil and enhance agricultural productivity through traditional composting and adding animal dung on the soils. However, this tradition is seriously weakened by the shortage of fuel wood and the demand for dung as a source of fuel. The tendency is to use some manure from backyards and farms located near the homestead and replace organic manures with artificial fertilizers.

Crop rotation and intercropping

Farmers in the study area employ rotational cropping and intercropping as techniques to maximize economic gains while maintaining and restoring the fertility of the soil by altering different types of crops or growing different varieties of cultivars on the same cultivated field. The practice is particularly effective in maintaining the nitrogen status of the soils where leguminous plants are included in the rotation. Legumes are very effective in restoring nitrogen because of the activities of the nitrogen-fixing bacteria, i.e. *rhizobium spp*, in their root nodules. Such practices are known to disrupt insect cycles and reduce frequency of pest incidence.

Crop management practices

Peasant farmers in North Wello and Southern Tigray practice refined systems of seed selection, storage and propagation, and cultivate a wide variety of crops. The diversification of crop production is a strategy adopted not only to supply the household requirements but also to spread risk from climate variability and crop pests. Almost each one of the crops has cultivars that are adapted to the unpredictable climate and soil conditions (Dessalegn, 1991). They keep fast growing varieties for the drier seasons and slow-maturing and high yielding ones for the wetter years. They also vary cultivars depending on soil and topographic conditions. Such adaptations provide some kind of security against the uncertainties of climate and socio-economic risks.

Livestock management strategies

Mixed agriculture is the norm rather than the exception in most rural areas in northern Ethiopia. As such, farmers in Meket and Raya Azebo maintain some cattle and/or shoats where cattle represent a vital 'technology' that interfaces between patchy grazing resources and crop farming. Livestock not only provide draught power and manure, but also a measure of social status and economic security since they can be sold to raise cash when needed. In Meket, cattle are generally the preferred species because they are the main source of draught power, and also provide fuel in the form of dung cakes. In Raya Azebo, however, because of the variability of climate and associated hazards and risks, relatively wealthy farmers try to keep a mix of large and small ruminants, grazers and browsers.

With increasing climate risks, such a move towards herd diversification is crucial to minimize risks while providing draught power and other subsistence needs through optimal utilization of available resources. Diversification and splitting livestock across a number of widely dispersed herds reduces risk, while different functional sub-herds (e.g. milking and fattening ones) allow for the manipulation of different animals' ecological and economic potentials according

to capacities and needs. But, poor farmers cannot afford to maintain an ox for draught power let alone other herds to buffer climatic and non-climatic risks.

Shrinking grazing land and scrubby bush provides only limited forage. Hence cattle are allowed to feed on sorghum and teff straw and other crop residues as supplementary feed with draught oxen receiving preferential treatment. As population pressure has increased, the area under cultivation has expanded, and most of the land previously used as communal grazing is now taken up by agriculture. Forage has become such a scarce resource that some farmers in Raya Azebo have even started growing fodder plants during the dry season.

Social and economic strategies

Migration

The fact that migration is an important form of risk diversification has been made clear in the literature (Mesfin, 1986; Dessalegn, 1991; Markos, 1997; Alebachew, 2000). In Meket and Raya Azebo, migration is an important strategy for rural households against economic insecurity and environmental stress. Historical evidence from the area strongly suggests that there were large short and long distance movements of people from environmentally degraded areas and areas with low economic opportunities to areas of relatively good employment opportunity (Dessalegn, 1991). In the present study, two main types of migratory movements of people were identified: *wage labor* and *migratory labor*.

Wage labour: Wage labour includes temporary and short distance labour at village level or the neighbouring areas in return for cash or food or other agricultural products. This category primarily includes agricultural labour on smallholder farms for cash or on the basis of the share cropping system; livestock herding; and similar activities. In the case of sharecropping, which exists in different variations, the employees conduct the agricultural work at another person's farm in return for part of the harvest. The general pattern is that better-off households or female-headed households without labour capacity employ people from poor or landless households to conduct the agricultural labour. It is also common practice for poor households who do not hold draft animals to contribute labour in return for the use of draught animals from more well off households. In these cases, the agricultural labour does not contribute an additional income to the household but only secures the farming of the land.

Migratory labour: Migratory labour includes long distance movements of people in order to escape poverty, drought, or seek urban employment or employment on large state farms or on better-off farm activities in other areas. In the latter case, the employee can take advantage of the seasonal differences between different areas due to climatic conditions or the production of different

crops. In this way, a farmer can at the same time secure his own agricultural production while earning an income outside his own agricultural season.

In order to get some insight about the experience of household members and their motives for migrating, the sample household heads were requested to mention their migration history and the migration experience of any other household member.²² The responses are tabulated in Table 43. As the data show, 34% of the male and 28% of the female respondent household heads in Meket and about 21% of the male and 12.5% of the female household heads in Raya Azebo have some kind of migration experience in the past. The responses for the migration of other household members of the respondent household heads also show migration as an important household strategy to escape drought, poverty and fulfill other socio-economic aspirations of the individual migrants.

Table 43. Migration history of respondents and their household members

Meke					
<i>Do you have any migration experience before?</i>	<i>Migration history of informants</i>		<i>Do you have any household member who has migrated to other areas?</i>	<i>Family migration experience</i>	
	Male (N=77)	Female (N=29)		Male (N=77)	Female (N=29)
Yes	33.8	27.6	Yes	53.2	64.3
No	66.2	72.4	No	46.8	35.7
Total	100.0	100.0	Total	100.0	100.0
<i>Reasons stating out-migration of informants and their household members</i>					
<i>Reasons for out-migration</i>	<i>Male</i>	<i>Female</i>	<i>Reasons for out-migration</i>	<i>Male</i>	<i>Female</i>
Poverty	29.9	6.0	Marriage	-	10.3
Employment	44.1	37.9	Socio-cultural factors	-	13.8
Land shortage/Landlessness	27.3	6.9	Other reasons	7.9	3.9
Drought	40.3	17.2	No answer	4.3	6.9
Education	6.1	-	Total	159.9	102.9
<u>Raya Azebo</u>					

²² The discussion here is exclusively on migratory movements involving relatively long distances, for example crossing of some administrative boundaries, and the person staying at the destination area for 3 months or more.

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<i>Do you have any migration experience before?</i>	<i>Migration history of informants</i>		<i>Do you have any household member who has migrated to other areas?</i>	<i>Family migration experience</i>	
	Male (N=77)	Female (N=40)		Male (N=77)	Female (N=40)
Yes	20.8	12.5	Yes	40.3	55.0
No	79.2	87.5	No	59.7	45.0
Total	100.0	100.0	Total	100.0	100.0
<i>Main reasons for out-migration of informants and their household members</i>					
<i>Reasons for out-migration</i>	Male	Female	<i>Reasons for out-migration</i>	Male	Female
Poverty	11.3	26.4	Marriage	1.3	7.1
Employment	29.5	35.1	Socio-cultural factors	5.2	2.5
Land shortage	3.9	-	Other reasons	9.1	2.5
Drought	40.3	52.5	No answer	5.2	4.6
Education	2.6	5.3	Total	108.4	136

SOURCE: Field data (July-August 2010)

The responses clearly show the significance of rural push factors, particularly drought, economic insecurity and land shortage, in the migration of people from rural areas of Meket and Raya Azebo. Despite the strong association between climatic and economic push factors for male and female migration, the disaggregation of the data by sex reveals the significance of socio-cultural factors for female urban-ward migration. Social and kinship ties are very strong in rural Ethiopia, and mobility of one's children from one household to another is not uncommon, particularly during stress times. Such movements reflect the importance of kinship ties. Sending children and other young relatives to help grand parents, uncles and other relatives who have no children is a traditional norm in these areas.

In the FGDs, one informant refers to the seasonal migration of people into the Raya Valley recalling that “*Until recently, Raya was at the receiving end. Most rural migrants from Wello and other parts of Tigray used to visit our area for seasonal employment in the agricultural fields.* However, she commented: “*Time has reversed everything. Now it is our men’s turn to migrate*” (Meaza, 28, Ade-Halga kebele).

Marketing of livestock and livestock products

Sale of livestock and livestock products is the main source of cash income for rural households who own livestock. Although the price of livestock is influenced by the size and condition of the animals and the season of the year

and the distance from the main marketing centers, there is marked seasonal fluctuation in the price of livestock. In general, livestock prices are higher during the rainy season and fall during the dry season. During the dry season, animals lose body weight due to shortage of feed. In addition, poor families lacking other options also desperately need to sell or exchange their animals before further loss of condition and to buy grain for family consumption; and this contributes to further falls in prices.

In all the study kebeles livestock products like milk and butter are marketed in the nearby small towns and market places. Unless forced to do so by some pressures, such as the impacts of drought and food poverty or by some social obligations and traditions, such as to exercise certain festivities or rituals, selling livestock is not a popular option. This is especially true of poor farmers with a single ox or a cow. During the advent of a drought and insecurity, households who own livestock respond by selling small stocks, mainly a sheep or a goat to purchase food. However, if the drought situation gets worse and its duration is longer, households will be forced to sell cattle that are the main sources of draught power, economic security and social prestige in the community structure. The sale of livestock is not only differentiated by species and size but also by sex. In other words, oxen and cows are sold at last when the situation worsens and all other options are not viable.

Informal safety-nets²³

In both Meket and Raya Azebo, two kinds of informal safety-nets were identified from the community discussions. These are vertical transfers where rich or relatively better-off families provide support to poorer households and horizontal transfers where resource-poor households share resources at their disposal. Vertical transfers are usually made out of affection, duty, patronage or other moral or religious obligations, and reciprocity may not be expected, where as horizontal transfers are often made to spread risk or smooth consumption over time with the expectation that help given will be reciprocated when required in the future.

²³Informal safety-nets are a subset of rural peoples' coping strategies that involve drawing on support from friends, relatives, neighbors and co-villagers. There is a strand in development studies, going back at least to Scott's (1976) influential book "The moral economy of the peasant" depicting subsistence oriented rural households in poor and developing countries as bound together by affection and mutual self-interest in a complex web of support networks that serve to spread risk and to protect vulnerable members. Such strategies involve drawing on other households and include transfers between friends or neighbors (such as interest-free loans) but not exploitative transfers (such as high interest moneylender loans).

In the sample areas, people have developed indigenous institutions, such as the *equb*, *edir*, *wenfel*, *jigi*, etc., and different traditional safety-net mechanisms for redistributing wealth and supporting poorer or vulnerable community members. The indigenous institutions also provide foundations not only for social support mechanisms but also for saving and credit systems. Throughout the rural areas, practices, such as sharing of seeds, flour, milk and food items, are crosscutting support mechanisms that are used by all communities.. The assistances given at village level help in fulfilling the immediate needs of the poor in terms of food in the form of grain, milk, and other livestock products. The poor also help others in terms of labor contributions in land preparation, weeding, harvesting or herding livestock justifying the mutuality of the support system. In this case, besides having access to food, the poor can get heifer to plough their land, grow crops or restock their herd.

Informal safety-nets and resource sharing mechanisms were effective when most of the rural households were relatively better-off or food secure. With increasing drought episodes and erosion of rural assets, the system is no more effective as it used to be in the not long past. As reported by informants and local experts in Meket and Hawelti in Raya Azebo, the increased frequency of drought, erosion of household assets and the increasing number of 'landless' and 'destitute' farmers are the most important reasons for the decline in the traditional social safety net mechanisms. But, the indigenous resource distribution and sharing mechanisms provide potential means of targeting the poor and women in development interventions.

Consumption adjustments

As the analysis in the above section showed, during acute drought period, poor households are forced to change their normal food intake and adjust their consumption so that they can easily adapt to the resources at hand and the type of vegetation available in their locality. Consumption adjustments frequently involve adjusting diets to basic and cheap food items, supplementing with edible wild plants, and reducing frequency of meals and servings. But, there are limits to lowered consumption levels. While food consumption levels are already low, the spread of various diseases degenerate the ability of body to adapt to lowered food intake. The critical food security challenge in such environments is not to attain food consumption at all times for healthy and productive life in line with a universal threshold but to survive now by meeting a minimum threshold.

Adjustment mainly refers to reduction of the amount of food intake during the day from three times to twice or even once, giving priority to children and the elderly, and shifting from teff and barley *injera* and butter, milk and milk products to consuming *injera* made of sorghum, wheat and *berberie* or *shiro wet*. In some cases, destitute households resort to eating wild food.

Resorting to wild or “famine” foods

The consumption of wild plants is still very common in food-insecure rural areas of Meket and Raya Azebo. The linkage has given rise to the notion of ‘famine-foods’ - plants consumed only at times of food stress and therefore an indicator of severe drought and famine conditions. Local people know about the importance and the contribution of wild plants to their daily diet as well as being aware of possible health hazards, such as stomach irritation, occasionally occurring after consumption of certain wild plants. Elders and other knowledgeable community members are the key sources or ‘reservoirs’ of plant lore. Among the most common wild plants consumed by destitute households and children in Meket and other parts of North Wello are, for example, fruits and leaves from *Ficus spp*, *Carissa edulis*, *Rosa abyssinica*, *Vrtica simensis Steud*, *Amaranthus angustifolius*, and *Ficus Palmate*. In Raya Azebo, the following wild food types were mentioned during the community discussions: *Beles*, *Hamle tilian*, *Hamle tete*, *Kuenti* and *Ango shahay*.

Famine foods are often considered to be a low-status food and consumption regarded as a source of shame. In normal times, only children, youngsters and the poorest families collect and consume regularly wild food. In both Meket and Raya Azebo, farmers interviewed stated that wild-food plant species are not consumed by the majority of the population except when there is a serious shortage of food. But, for the poorest collection and consumption of wild-food may make up an important portion of their daily dietary intake.²⁴ However, with increasing aridity and drought, options for smoothing consumption are also getting fewer.

Off-farm activities

This form of activity takes place outside the agricultural sector and includes the following activities: handicraft, petty trade, and assorted non-farm activities, including collection of fuel wood, collection of water for payment, production and sale of charcoal, the collection and sale of timber, salt trade, quarrying, etc.

²⁴ Also, not all people encountered were willing to provide information about wild-food and particularly famine-food. Some of the farmers were grinning when questioned, obviously feeling ashamed and maybe offended by questions about such sensitive issues as the consumption of famine food. Local traditions, beliefs and religious constraints pose serious limits to food insecure and destitute households to resort to eating “famine foods” or wild animals. This means that the range of food available to people during times of stress are narrowed considerably.

Handicraft works

In the study area, the most common types of handicraft are found to be weaving, basketry, pottery, constructing work, blacksmithing, and woodcarving. Weaving is by far the most important type of handicraft performed in Meket. The major part of the handicraft products is sold locally to fellow villagers or at local markets, and few craftsmen market their products through traders.

Local production and sale of food and beverages

This form of non-farm activity is mostly practiced by women as a side activity to the agricultural activity and includes the preparation and sale of food and beverages, especially alcoholic beverages, such as *tella* (local beer), *shameta*, *korefie*, *arekie* and honey wine. Such products are sold locally within the village or in nearby markets.

Assorted income-generating activities

This group of activity covers a range of different sub-activities, such as remittances, oxen rent, house rent, collection and sale of fuel wood, preparation and sale of charcoal, sale of timber, collection and sale of hay, sale of honey, salt trade, extraction of mineral resources, provision of medical services, provision of religious services, sale of milk and butter, etc. Provision of health and religious services includes traditional forms of treatment, such as pleading with the *zars* to cure possession by evil spirits, immersion in holy waters, herbal treatment, or consultation with a soothsayer to identify the illness and its cause.

Women dominate in petty rural trades that include the marketing of milk, butter, cereals and honey, while men are predominant in the marketing of livestock and mineral resources, such as salt and sand. Buying grain from remote and low-price areas and transporting it to accessible and deficit areas could be an option for small-scale traders, particularly women. The reason why this form of trade is not more widespread is probably because it demands pack animals and start-up capital for purchasing the grain items, which are both beyond the reach of poor households. Table 44 provides a summary of the adaptation practices employed by households in the study area.

Table 44. Broad categories of adaptation options and practices in the study area

Categories	Adaptation practices
Agronomical/biological measures	Manures and composting Weed control Closing of soil cracks Stone terraces/bunds Unploughed/grass strip Traditional waterways Area closure Tree planting Fodder development Live fencing Chemical fertilizers /pesticides Rain water harvesting Dip irrigation
Water harvesting and management	Small-scale irrigation (river diversion) Flood water diversion and control Excavation of springs, traditional ponds Water control structures Soil moisture management Manuring/composting Change of crops/cultivars Re-sowing/re-planting
Crop/seed management	Post harvest practices (seed storage for higher viability) Change in the timing, location and mix of crops grown Homestead gardens (live fences, cactus, eucalyptus)
Fuel management	Tree planting Dung cakes Informal safety-nets (resource sharing)
Social and economic strategies	Off-farm activities (handicraft, petty trade, bee-keeping) Land rental/sharecropping Remittances, savings and credit arrangements Sending children to better-off relatives/hiring them Disposing of productive assets Consumption adjustments Resorting to “famine foods” Emergency aid/public works program Borrowing money/grain from relatives, moneylenders Out-migration

SOURCE: Field data (July-August 2010)

The limitations of traditional coping strategies and informal safety nets

As outlined in the previous sections, rural people in Meket and Raya Azebo, because of their location in marginal environments, are often characterized by livelihood strategies that have been evolved to manage vulnerabilities to climate change and socio-economic stresses. These are often referred to as *ex-post* coping strategies or reduce overall vulnerability to climate shocks, i.e. commonly referred to as ‘adaptive strategies’. However, it is important to recognize that not all current local strategies to cope with hazards are efficient or appropriate for long term adaptation (See Table 45 for the difference between coping and adaptation). Some household coping strategies, which are based on short-term considerations, survival needs, lack of information or imperfect foresight, can worsen environmental degradation and thereby diminish future adaptive capacity and livelihood options (Eriksen, 2001).

Table 45. How is adaptation different from coping?²⁵

<i>Coping</i>	<i>Adaptation</i>
Short-term and immediate	Oriented towards longer term livelihood security
Oriented towards survival	Continuous process
Not continuous	Results are sustained
Motivated by crisis, reactive	Uses resources efficiently and sustainably
Often degrades resource base	Involves planning
Prompted by lack of alternatives	Combines old and new strategies and knowledge
	Focused on finding alternatives

SOURCE: Care International (2009:7)

On the other hand, the use of the term ‘coping’ or ‘adaptation’ to define such traditional household practices aimed at ensuring the immediate survival of destitute and poor households may sometime hide the true fact that many such households are trapped in a cycle of starvation, destitution and desperation or insecurity. The problem is that most strategies employed by destitute households, such as consumption smoothing, resource sharing or eating less nutritious and sometimes unhealthy wild food, affects the health, nutritional status and immunity of people. Strategies which rely on disposal of productive assets, such as sale of livestock or household property, deplete the household’s asset base and thereby undermine its future viability.

²⁵ The distinction between these two categories is frequently blurred: What start as coping strategies in exceptional years can become adaptations for households or whole communities.

Informal safety net mechanisms for asset redistribution become obsolete strategies if there are too many losses and too many people in need every year. On the other hand, strategies that rely on the exploitation of scarce natural resources, such as charcoal making and sell of firewood, degrade the natural resource base and greatly reduce the resilience of the local ecosystem to the impacts of climate change. Such household 'coping' strategies are 'erosive' (de Waal, 1989), unsustainable and hence need to be discouraged and replaced by long term and forward looking or asset building and resilience enhancing adaptation strategies. The unsustainability of many traditional coping strategies in the face of current climate change is already visible, and has been mentioned by community members, NGOs and government officials in Meket and Raya Azebo.

Limitations of indigenous environmental management practices

The main limitations of indigenous environmental conservation, including soil and water management practices, arise from the fact that they are mostly too limited in spatial coverage, intensity of their application and in enhancing agricultural productivity for the long run (Belay, 1998). Population pressure and the severe shortage of farmland encourage farmers to increasingly destroy some traditional soil and water conservation structures built in previous times, such as traditional ditches, waterways, unploughed/ grass strips, etc., and put them under cultivation. Expansions of crop cultivation on steep slopes also expose the soil to erosion and other hazards. On the other hand, devegetation and the shortage of firewood encourage households to use dung cakes for household energy rather than as organic manure or compost to enhance the fertility, organic content and hence productivity of the soil.

Traditional conservation methods are also weak to withstand repeated stresses from erosion, landslides and other climatic and natural hazards. The shortage of farm land is also making it difficult for farmers to practice the traditional soil fertility enhancing practices, including rotational cropping and intercropping. Farmers are forced to concentrate on the cultivation of the main staple crop or a cash crop and cannot afford to frequently cultivate the legumes that were traditionally included in the rotation. For instance, a somewhat disturbing tendency reported by agricultural extension workers and local administration officials in Meket is that more and more farmers are planting eucalyptus trees on their backyards as well as on their farm plots outside the homesteads.

Declining availability of traditional 'coping' options

The general trend observed in all the study kebeles is towards a decline in availability and effectiveness of coping options because of repeated rainfall and crop production failures, progressive impoverishment, and declines in possibilities for income earning from other sources and regions. With recurrent

drought and resource degradation, options for smoothing consumption are getting fewer. As a result, well-established cultures of wealth redistribution and supporting the weakest and most vulnerable members have been weakened by climate change; and communities impoverished by successive droughts are now finding it harder and harder to provide for their poorest members. Many drought victims have fallen through the gaps in the traditional safety net. The traditional or informal safety net and resource sharing arrangements are weakened because of erosion of rural assets. Wild fruits are no longer viable options during drought seasons. Hence, more and more people are increasingly being dependent for their survival on external support and food aid. Some have been forced to migrate off their land and abandon their farming life, reflecting their economic destitution and failure to cope.

Constraints to the development of non-farm and off-farm activities

Cultural bias towards crafts and commerce

It is widely known that handicrafts and trades enjoy a very low status in parts of rural Ethiopia, including the Amhara Region and in parts of Tigray. During the Imperial epoch, Ethiopian culture was influenced by the feudal system according to which only those who did not belong to the nobility nor had access to land would engage in crafts and commerce. Blacksmiths were especially despised by the local communities. According to Alula Pankhurst (2001), an old idea that still prevails according to which blacksmiths possess supernatural powers and can turn themselves into hyenas at night. Consequently, blacksmiths were feared, but also largely discriminated by the local community. Other craftsmen, such as weavers and potters likewise, constituted isolated and largely despised classes and tended to belong to minority groups. The cultural bias against crafts and commerce is prevailing even today. Moreover, even in cases where non-farm activities make up more than half of the income obtained, the person still retains the status of a farmer as the main one to conceal his/her identity as a blacksmith.

Poverty and illiteracy

Low level of literacy limits rural peoples' innovative behaviour as it tends to restrict people's knowledge of their own experience or what has been transmitted by tradition. The fact that people in the sample localities are extremely poor and often have to struggle hard just to survive also prevents them from taking up new activities, which demand a start capital, knowledge of markets, etc., and involves a risk. It could be argued that the farmers might simply be too impoverished to take up new activities. Persons who, on the other hand, do hold some cash presumably will prefer to invest in cattle with the double function of investment and social security rather than investing in risky, low-status and unfamiliar non-farm activities.

The aid-dependency syndrome

According to the 1993 National Policy on Disaster Prevention and Management, no relief assistance should be allocated to able-bodied persons without the exchange of labour. Consequently, the regional governments in Amhara and Tigray have launched Employment Generation Schemes (EGS) where people receive food aid in return for work on different kinds of development projects, such as road construction, environmental rehabilitation, etc). The NGOs operating in the areas have taken up the same principles of organization for many projects, and in many cases environmental rehabilitation, conservation and construction work is conducted with the assistance of local people, who then receive food aid or cash in return for their labour, which is otherwise known as food-for-work or cash-for-work projects.

Despite the fact that free relief aid is given only in severe situations of food shortage and people have to work for the relief, one can talk about a dependency syndrome as people apparently give priority to waiting and qualifying for selection for food-for-work and Employment Generation Schemes rather than involving in other income-generating activities²⁶. From the point of view of the individual peasant, participation in EGS and food-for-work schemes has many advantages. It does not demand any start up capital nor does it require any specific skills; it takes place within the kebele; and it does not involve any risk for the individual peasant. Self-initiated income-generating activities in contrast are highly risky; and often require initial capital and specific skills in accounting and handicraft; and involve risk taking behaviour.

The lack of market opportunities

The overall problem of lack of market opportunities covers a range of sub-problems. The first problem is the low purchasing power of local customers since the majority are poor subsistence farmers. Within the urban centres, a group of government and NGO employees reside; but this group is still too small to make up a market for different commodities and products. Secondly, partly due to the low purchasing power of the farmers, the prices of various forms of non-farm items are likely to follow the ups and downs of the food situation. In so-called good years or periods when some purchasing power exists, the prices of non-farm items go up, whereas in periods of destitution and food insecurity, there is no market for non-farm items, and the prices are likely to decrease. This means that production and sale of non-farm commodities and products do not

²⁶ Suffice is to mention what a young farmer told participants in a community discussion at kebele 026 in Meket. Since the attention of the government and the local administrations on the food/cash-for-work/ program is on environmental rehabilitation activities on common grazing areas and along the hills, the young farmer complained, there is no support for constructing sand terraces in individual farm plots.

serve as a safety net valve for the farmers as it follows the fluctuations in agricultural income.

Thirdly, since the major part of non-farm commodities or items are based on or are related to agricultural production, low production influences the volume and quality of the non-farm activities. Fourthly, competition from factory-produced commodities or items poses a danger to the locally produced crafts and many traditional non-farm activities. The widespread sale of second-hand clothes, for instance, competes with locally produced traditional clothes like *gabbi*, *kuta*, *natal* and *yehabesha kemis*; and locally produced pottery is threatened by the import of cheap manufactured tableware from countries like China.

Inefficient infrastructure and environment

As in the case of lack of market opportunities, the problem of inefficient infrastructure and environment covers a range of sub-problems. Firstly, roads are generally very poorly developed in the rural areas, especially in Mekele. A great number of villagers are consequently located far from all-weather roads and have to use much time and resources on transporting goods and raw materials on donkeys, mules or man/woman-back. As poor households normally do not own pack animals, the costs of hiring animals might preclude many from involving in non-farm activities, which most often renders by necessity moving out of the village.

Secondly, the lack of energy and water supply likewise restricts rural peoples' involvement in non-farm production and activities. Thirdly, farmers generally have few opportunities of obtaining information on price and market development for different types of non-farm items, as, for example, livestock and handicrafts. This obviously hampers the farmers in exploiting price fluctuations, and makes them more vulnerable to being cheated by, for instance, traders. With regard to migrant wage labour, some large employers, such as commercial farms, announce their demand for labourers through local authorities or in the radio. However, in most cases, farmers leave their home areas to search for work without any prior knowledge about employment opportunities. Fourthly, the lack of organisational support from cooperatives, for instance, or other organised institutions with regard to provision of credit, training in accountancy and product promotion, etc., evidently hampers the development of non-farm activities. Recently, steps have been taken to promote and develop cooperatives and micro- and small-scale enterprises; however, these types of organizations might not be within the reach of poor farmers.

Fifthly, the problem of provision of credit and the general lack of financial resources in the farming communities obviously also hamper taking up non-farm activities. In most cases, agricultural income is so small that it hardly covers the most fundamental needs of the households; and finding resources to start up non-

farm activities is simply unattainable. Moreover, even in cases where farmers manage to start up non-farm activities, the resources are often so strained. In addition, due to the lack of provision of credit also, they can only purchase input and raw materials at peak demand periods when the prices are highest. The access to credit, for instance through the micro and small- scale enterprise programmed, is generally given to groups rather than individuals and, in most cases, is not within the reach of poor farmers. Sixthly, the lack of viable training opportunities, for example in handicraft and business, obviously also restricts the farmers' engagement and possible success with non-farm activities.

Strength of and lessons to be learnt from traditional coping strategies

Indigenous knowledge and coping strategies are the basis for local-level decision-making in many rural communities in Ethiopia. It has value not only for the socio-economic set up in which they evolve, but also for policy makers, development planners and institutions striving to improve conditions in rural localities. Incorporating indigenous knowledge and coping strategies into institutional climate change adaptation policies and strategies can lead to the development of effective adaptation strategies that are cost-effective, participatory and sustainable (Robinson & Herbert, 2001). In this regard, there are important lessons that can be drawn from the climate change adaptation practices of rural communities for improving the responsiveness, effectiveness and sustainability of future adaptation investments in rural Ethiopia. These lessons arise from the strengths of traditional strategies, which include their multi-functionality, flexibility, reliance on internal resources, low external input and compatibility to the local ecosystem.

Multi-functionality and multiple benefits

Indigenous resource management practices have multiple functions and benefits, such as reducing and arresting soil erosion, reducing soil detachment and sediment transportation, enhancing soil fertility, maintaining biodiversity, decreasing seed and genetic loss, decreasing water logging by encouraging the use of traditional ditches, and controlling the spread of weeds and insects, for example through crop rotation. Grass strips serve as an experimental site by farmers for testing newly introduced crop varieties or agricultural inputs. On the other hand, practices like live fencing and agro-forestry serve as farm boundaries, fences for homesteads, crops or plantations, and tools to reclaim cropland.

Flexibility and complementary practices

Indigenous practices are characterized by some kind of dynamism in the sense that they are continuously adapted to changing climatic, bio-physical, socio-economic and political circumstances as they are continuously transferred over

successive generations. For example, farmers usually change the position, size, gradient, width or spacing of traditional ditches, grass strips or waterways depending on the nature and intensity of rainfall and run-off or the type of crops, the location of the farm plots and the demand of the household. On the other hand, the construction and maintenance of indigenous land and water management practices is compatible to and highly integrated with the existing land use systems. The traditional conservation measures are also complementary to each other. Agronomic, such as crop rotation, manuring, contour ploughing, mixed cropping, and mechanical, such as sand terraces, ditches, check dams, practices are complementary to each other with a particular plot. Each practice might have different functions, but aim to curb land degradation, enhance soil fertility and productivity.

Efficient input and labor utilization

Indigenous adaptation strategies draw heavily on local resources, materials and labor, viz. the ox plough, family labor and resource contributions from kinfolk and neighbors. For instance, indigenous soil fertility and crop management practices, such as manuring, crop rotation or contour ploughing, need no other external labor or resource inputs. The construction and maintenance of indigenous structural soil conservation practices, such as grass strips, sand terraces or traditional ditches, may not require external input or unlimited labor and finance.

Diversification

Diversification is the character of most indigenous adaptation strategies. Whether in crop farming, land management or livestock husbandry, or in off-farm and non-farm income generating activities, indigenous coping practices tend to rely on diversity than specialization and excessive reliance on external resources that characterize most institutionally introduced adaptation strategies. In crop farming, seed genetic diversity help farmers to practice inter, cover and multiple cropping so that a failure of one crop due to drought, crop pests, or diseases may be compensated by the other. In livestock, farmers try to maintain a profile of both grazers and browsers in order to exploit the patchy grazing and browse resources. In non-farming activities, household members may engage in different activities, such as handicrafts, bee-keeping, petty trade, etc. Whenever possible, rural households invest in the education and training of their children either in academic and/or vocational and skills training centers so that the children when get employed will help as safety nets and insurance at old age.

Effectiveness in reducing soil erosion and crop damages

Local farmers in Meket and Raya Azebo districts have age-old tradition of conserving water and soil resources. These include the use of traditional ditches,

waterways, terraces, grass strips, agro-forestry, area closure, and application of organic manure, crop rotation and intercropping and sometimes use of zero-tilling practices in cultivation, mulching, and other soil-management techniques. Natural fertilizers and mulches moderate soil temperatures and extremes, suppress diseases and harmful pests, and conserve soil moisture.

The construction of traditional soil and water conservation structures in some areas have succeeded in partially halting soil erosion, gully formation and excessive loss of water resources. The widespread use of indigenous plant materials, such as agrochemicals to combat pests that normally attack food crops, has also been reported among small-scale farmers in Hawelti in Raya Azebo and kebele 026 in Meket. It is likely that climate change will alter the ecology of disease vectors, and such indigenous practices of pest management would be useful adaptation strategies. Other indigenous strategies that are adopted by local farmers include restoring lands by using green manure; constructing stone terraces; managing low-lying lands and protecting springs; and river banks can be improved with outside technologies for wider applications and enhanced outcomes.

4.7.2. Institutional and policy responses

Adaptation responses from government

Policy responses

Ethiopia has ratified the UNFCCC and its related instrument, the Kyoto Protocol, and submitted its initial national communications in 2001 and NAPA in 2007 to the UNFCCC. Recently, the country has prepared a new climate change adaptation strategy document to replace the NAPA and submitted its NAMA plan to the UNFCCC in January 2010. The recently introduced five year (2010-2014) Growth and Transformation Plan (GTP) is the only national plan that directly addressed climate change and environment issues in a separate section.

Other than GTP, the various national policy initiatives and sectoral programs in place since 1991 also address climate change, albeit indirectly. Such policy and program initiatives include the national environmental policy; the agriculture and rural development strategy; the water resources management and health sector development policy; the national policy on disaster prevention and preparedness; the national policy on biodiversity conservation; the pastoral policy; the population policy; and the national policy on women. However, the country has not yet developed a separate climate change policy as such. Even then, the effective implementation of the existing environmentally-oriented policies and programs is severely constrained by lack of technical, logistical and

technological capacity; poor coordination and linkage between federal and regional institutions and government organs; oversight of long-term environmental impacts over short-term economic benefits; and low level of public awareness (NMA, 2007; Alebachew & Negusu, 2009).

Programmatic, emergency and development interventions

Emergency aid and safety-net

During emergency situations and at times of environmental crisis, such as drought, floods or disease outbreaks, poor and destitute households increasingly depend on external support repeatedly appealing for emergency assistance. Relief and rescue operations are followed by rehabilitation activities aimed at restoring the lives and livelihood of the affected people. The food security and disaster prevention and preparedness office at the district and sub-district levels work together with other sector offices and local NGOs at the initial stage of a hazard to study and report the situation to relevant authorities for immediate attention and support. During the community discussions, informants from all the pilot areas reported that the government supported those critically food insecure and destitute households through its productive safety net program. In both Meket and Raya Azebo, support in the form of cash and food- for-work projects, microfinance and credit arrangements and some capacity building activities are undertaken. Poor households were also given selected seeds and fertilizers on credit.

Development interventions

A very important role is expected from national and local governments and development agencies in the prevention and management of climatic and natural disasters in a highly degraded environment like in Meket and Raya Azebo. In this regard, the management of natural resources and linking of such efforts with cross-cutting issues, such as poverty reduction, alternative livelihoods, empowerment of women, health and education development sectors, will help strengthen the capacity of vulnerable households, livelihoods and ecosystems to adapt to changing climatic and socio-economic circumstances.

In each of the study districts, there are relevant sector offices, including food security, environmental and land administration and environment, disaster prevention and preparedness units or committees, which provide early warning information to assess the rainfall and temperature conditions, risks of flood and disease hazards and report to the relevant authorizes and support agencies. There are also district and sub-district level units on land administration and environmental management, crop protection, water, health, education and gender issues. Despite the sectoral nature of the structure and organization of each of the

units or offices, they have direct or indirect roles in the management of disasters and protection of assets.

The rural development and food security offices perform some development schemes that enhance access to water through catchments, wells and boreholes. In addition, they carry out some environmental protection and rehabilitation programs. The health and education offices provide education and health services while women's affairs units struggle to overcome gender bias; and empower women through education and awareness raising campaigns, trainings and legal and counseling services.

NGO interventions: Roles and general observations

The role of non-state actors in the promotion of environment friendly technologies and sustainable development through natural resource management, capacity building, disaster management, social protection and the provision of health care are vital in reducing vulnerability and building local resilience. In addition, the NGO sector assists vulnerable groups by mobilizing communities, resources, technologies and expertise. NGOs also share their field-level experience and help to build the capacity of state actors. Because of their location, proximity and resources, most NGOs are ideally placed to design and pilot development schemes in the form of asset protection, livelihood diversification, social service provision and natural resource and climate related hazard management that the Federal Government or Regional States may be unable to implement on a large scale. Also, NGOs are ideally placed to note the relative success or failure of government programs, sectoral strategies and their own development schemes.

The NGOs operating in the study area play a significant role in local development and emergency activities. Although rural households have been struggling and strategizing to prevail amid deteriorating environmental conditions, it appears that most of the local coping strategies have reached their limits and become less effective to help them adapt or mitigate the multifaceted impacts of climate change. Realizing the potentially dire situation in the area, some NGOs have been actively engaged in emergency relief, capacity building, environmental rehabilitation and related development activities. In Raya Azebo wereda, REST runs an integrated watershed development project, while the Ethiopian Catholic Secretariat, the Ethiopian Orthodox Church and CARE have emergency relief and development interventions. In Meket wereda, World Vision, Food for the Hungry International, CARE and the Ethiopian Orthodox Church have implemented relief and livelihood projects. The projects implemented by the NGOs have had considerable impacts, but also numerous problems in addressing the impacts of climate change and bringing about secure and sustainable livelihoods.

The NGO sector can assist vulnerable groups in remote and isolated areas through mobilization of communities, resources, technologies and expertise, through localized but more inclusive and empowering development practices, through direct action on the ground, sharing field-level experience and building the capacity of state actors, including wereda administrations. Despite their limitations in scope, sustainability of projects and related uncertainties, soil management and water harvesting practices, agro-forestry systems, micro-finance and loan schemes, and the provision of social and economic services in the remotest and disadvantaged areas have been major contributions. On the other hand, most of the NGOs are small and horizontally structured with short lines of communication and expertise at different levels and are therefore capable of responding flexibly and rapidly to clients' needs and to changing circumstances. Most are also characterized by a work ethic conducive to generating sustainable processes and impacts on disadvantaged communities and sectors. The NGOs' concern with poor and destitute farmers means that they often maintain a field presence in remote locations, where it is difficult to keep government staff in post.

Generally, climate change is not well integrated and factored in the development activities of most NGOs. More importantly, even when climate change is mainstreamed, the multifaceted, structural and deep rooted nature of the socio-economic and climatic problems in remote rural areas cannot be solved with fragmented, piecemeal and narrowly designed sector approaches and projects. In this case, NGOs' small size and limited financial and technical resource means that their projects rarely address the structural factors that underlie rural vulnerabilities and poverty. Small size and differences in philosophy and orientation also militate against learning from each other's experience and against the creation of effective partnership and collaborative actions, whether at district or regional levels.

Some 'fashionable' themes, such as HIV and AIDS, children and women issues, etc., and a few selected locations and towns have become so densely populated by a diversity of NGOs that problems have arisen in terms of competition for the same clientele and covering other remote and less favored areas like Meket. Donor pressure to achieve short-term impacts, combined with short-lived phasing out of projects and a lack of cross-learning, has led in some cases to the promotion of inappropriate and unsustainable technologies like the concentration of water points at some locations that are not particularly convenient to communities or the construction of boreholes that are not climate-proofed.

The experience of REST in Raya Azebo

The Relief Society of Tigray (REST) is an indigenous nongovernmental organization working on relief, rehabilitation and long-term development programs in the National Regional State of Tigray since 1978. Originally established within the context of the then civil war in 1978, today REST is the largest nongovernmental organization in the Tigray region pursuing a wide range of relief, rehabilitation and development programs. Over the years, REST has also accumulated considerable experience in executing and managing participatory and community based development programs. A key element in REST's success has been and continues to be the close relationship it built up with the government, the communities and local institutions in Tigray. REST's key areas of intervention include integrated watershed management-based agricultural development; water harvesting and supply; livelihood diversification; micro-finance; basic social services, such as health, nutrition, and education; HIV/AIDS and emergency responses. In Raya Azebo district, REST has been implementing integrated watershed management programs; economic and livelihood diversification, emergency and recovery assistance, water supply development activities, such as hand-dug wells, spring development, shallow and deep boreholes, rain water harvesting; irrigation construction, such as underground water tankers, series of ponds, spring construction and river diversion; and child support programs.

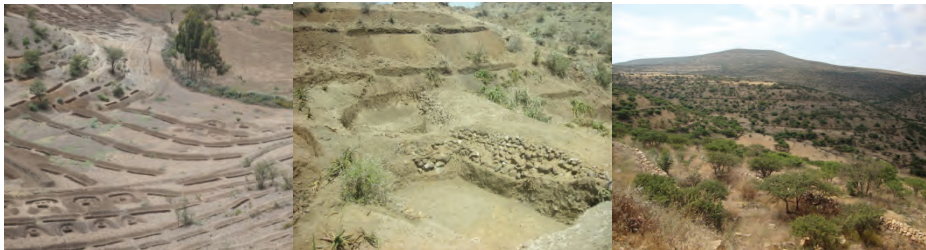


Plate 12: Soil and water conservation structures on farm land (left) and communal land (right) (SOURCE: REST Coordination Office in Raya Azebo)

Integrated watershed development

Over the past two decades, in order to achieve its organizational objectives in Raya Azebo, REST has implemented integrated watershed development projects with particular focus on the following activities:

- Conservation and development of key environmental assets: water, soil and forest resources;
- Building of community institutions, for example, watershed committees, to plan water and sanitation actions, mobilize labor force, target poorest households, facilitate implementation and follow up;

- Soil and water conservation structures on communal land as well as on farmland;
- Water harvesting using small trenches;
- Gully reclamation activity;
- Range land rehabilitation through area closure and controlled or zero grazing; and
- Reforestation of degraded lands.

Livelihood enhancing and economic diversification

The livelihood diversification component of the program in Raya Azebo includes the following components, among others:

- Support for households to improve use of natural resources and diversify their livelihood activities;
- Technology transfers that enhance the use of natural resources, such as water resource use;
- Promotion of better livestock production practices that encourage destocking and controlled grazing;
- Livelihood diversification through livestock production, beekeeping, etc.;
- Expansion of rural access roads and improving access to markets; and
- Enhancement of household income through promoting high value crops and fruits.

Weather-indexed crop insurance

Although agriculture is a primary source of rural livelihoods in the study area, climate change has made smallholder farmers' lives more risky. Providing safety nets to protect these farmers from extreme weather is more important than ever. Weather index insurance is an attractive alternative for managing weather and climate risk because it uses a weather index, such as rainfall, but it is not in widespread use in the country.

Recently, REST in collaboration with Oxfam America, Nyala Insurance Company, Dedit Credit and Savings Institution (DECSI), Swiss Re and the International Research Institute for Climate and Society at Columbia University, has introduced weather index crop insurance for smallholder farmers growing teff in some drought-prone areas of Tigray, including those in Raya Azebo. Typically, weather index crop insurance provides compensation to poor farmers when drought strikes during a growing season. In addition, credit enables use of additional farm inputs, particularly certified drought-resistant seed and fertilizer that can increase yields.

In this insurance scheme, the focus has been on using risk reduction and risk transfer skills to improve the financial and food security situation for farmers within selected drought-prone villages like Ade-Halga. The pilot project in Ade-Halga is part of the collaborative Horn of Africa Risk Transfer for Adaptation (HARITA) project, including the aforementioned organizations. The crop insurance scheme first began in Adi Ha area in 2008. The intervention in Ade-Halga built on the experience of the 2008 pilot project. The pilot weather risk insurance project in Adi Ha reportedly achieved uptake by 20% of the village consisting of 200 households with 38% of enrollees from female-headed households. 65% of enrollees were participants in the national Productive Safety Net Program and most have worked on projects designed to build greater resilience to climate change within their communities in return for cash they use to pay for crop insurance.

While it is too early to evaluate the success of REST's intervention, such cost effective and scalable index insurance designs meet the needs of low income farmers and also work in data and resource-poor remote areas. Experience elsewhere in Africa attests that the scheme has proved to be a valuable tool for unlocking rural credit and hence improving rural livelihoods (Giné & Yang 2009).

Although Ethiopian farmers have good knowledge of their environment and the climate risks, they have risk-averting behavior. Partly due to their poverty, insecurity and past experience, and partly due to lack of education, information and awareness, most small scale farmers are not willing to take risks. This means that the introduction and promotion of a weather index insurance system in rural Ethiopia will take much time and need an extraordinary effort from the organizations working with subsistence farmers. This may require expanding efforts to raise awareness: and build the confidence and capacity of the farmers so that they will understand and be receptive to the role of the insurance system to the security of their livelihoods and the sustainability of their production system.

4.7.3. Determinants to climate change adaptation and local barriers

Determinants

It is widely accepted that the distribution of vulnerability to climate hazards and environmental degradation is not equal among and within households, and across communities and localities. Although location-specific climatic patterns are key factors in assessing risks and threats, levels of education, awareness, wealth status and economic development, infrastructure, social equality and political influence of communities will affect the extent of their vulnerability to climate variability and change (IPCC, 2001). During the community discussions and

expert interviews in both Meket and Raya Azebo, household characteristics, access to agricultural services, credit facilities, market outlets, social networks and the nature, location and size of farmlands are frequently mentioned as the most important determinants for households' ability to cope with and recover from drought and agricultural shortfalls.

Seasonal climate variables influence farmers' crop choices while the timing of the seasonal rains affects the timing of land preparation and sowing. Households with better education, awareness about climate change and access to information and other critical services, such as extension services, credit, technology and input supply, tend to adapt better through either modifying their current agricultural or other practices and/or adopting new practices. Familial ties and social networks are also very important, especially in sharing resources and raising awareness and income diversification practices. The story and experience of two households quoted in the following paragraphs explain the reality adequately:

"I am a demobilized soldier. I have some education and urban experience... My wife is young and educated (grade 7 completed). We used to keep a good number of cattle and shoats. We were better-off in the village; we were leading a happy life. Our house was full of grains. We were among the few households who can afford to send our children to attend high school... Things start to change in 2007. Drought and consecutive rain failure and prolonged drought affected our crops and herds. Our cattle became sick and emaciated... We sold the oxen and bought shoats and two camels. The year before last year, we decided to move to Mehoni town. So, we sold the remaining cattle and built a small house near the town. Now, my wife is fattening bulls and selling milk and butter. We manage to grow papaya, banana and fodder plants in the garden. We have four beehives and this year we have planted some flowering seedlings for the bees" (Ataklti, 38, Mehoni, Raya Azebo)

"In 1984 our village was hit by drought and there was widespread famine. We decided to send one of our daughters to Woldiya to attend school with her aunt. 8 years ago she completed her education and got a government post in Lalibela. She bought a small house at Mesfina town. We rented the house to two extension workers for 80 Birr... we are now family with our renters. Thanks to them our relation with the kebele administration is good and we have good access to extension services and credit... we have modern beehives... We grow sugarcane and some fruit crops" (Ansha, 53, Kebele 026, Meket).

The above quotations show how better access to information about climate and production, social networks, and agricultural and technological services can improve adaptation planning and implementation at household levels. Improved access to reliable information, combined with access to institutional support, mainly extension and credit, ensure that rural people have the information for decision making and the means to take up adaptation measures. Interventions aimed at promoting farm level adaptation need to emphasize the critical role of

providing information and the means to implement adaptations through accessible and affordable farm-level climate adaptation technologies, access to credit facilities, farmer education and market development.

Local barriers to adaptation

A growing body of climate change research shows the relevance of identifying and addressing the major limiting factors and barriers to successful adaptation. Barriers to climate change adaptation can broadly be categorized into three distinct yet inter-related groupings (Jones, 2010). The first group of barriers consists of human, informational and resource-based limits relating to knowledge and skills, economic resources and technological limitations. The second groups of barriers are those physical limits comprising the natural limitations to adaptation associated largely with the natural environment. These range from ecosystem thresholds to geographical and geological limitations. The third group consists of social barriers which comprise the psychological, behavioral and socio-institutional elements that dictate how individuals and societies react in the face of climate change; and are important components of adaptation that are often neglected within wider adaptation debates.

As discussed earlier, households in the study districts employ a wide range of measures to curb erosion, retain soil moisture and maintain agricultural production in the harsh environment. But, a range of factors influence their ability to respond to environmental conditions. When asked about the constraints they faced in adapting to the effects of climate change, respondents most often cited lack of financial limitations or lack of money and poverty (Table 46). Natural constraints, such as poor agro-ecological conditions and shortage of water resources, and inadequate infrastructure, such as agricultural technologies and limited infrastructural services, were given as other important factors. Apart from these, personal and behavioral factors, socio-cultural set-up and governance structures, which may include human and social capital, social status and networks and political connections, are highly conditioning factors affecting the capacity to adapt.

It is very important to appreciate and address the actual and perceived barriers to adaptation. One of the main barriers and impediments to climate change adaptation in the agricultural sector is poverty. Respondents also suggested that government could play a greater role. For example, respondents in Meket are keen for the government to provide greater financial support for the construction of water infrastructure and to help secure more investment for agricultural activities. Informants in Raya Azebo emphasized for the government to expand extension and credit facilities and to increase its investment in environmental rehabilitation and irrigation development.

Climate change and rural livelihoods in northern Ethiopia

Table 46. Barriers to climate change adaptation (% of respondents)

Barriers	Wereda			
	Meket		Raya Azebo	
	Male	Female	Male	Female
Financial	55.3	72.9	58.1	67.8
Natural (land and water shortages, poor soil, slope...)	53.5	44.5	37.5	38.7
Agricultural inputs, farm size)	31.1	5.7	24.3	21.5
Technological	23.5	7.6	10.4	12.3
Infrastructural/socio-economic services	21.2	12.8	11.6	3.5
Personal and household (information, education, family size, networks)	12.1	37.5	9.6	21.3
Socio-cultural and political	11.5	21.4	3.9	5.6
Others	8.3	10.6	2.1	7.3
Total	226.5	213.0	157.5	178.0

SOURCE: Field data (July-August 2010)

One consequence of failing to adequately address the actual or potential limits or barriers to adaptation is maladaptation, i.e. consisting of actions and processes that increase vulnerability to climate change-related hazards (UNFCCC, 2002). Maladaptive actions and processes often include individual and household actions, such as charcoal or fuel wood making, farming marginal lands, overgrazing and desperate migration, which are basically undertaken out of desperation and the quest for survival. They also include planned development policies and measures that deliver short-term gains or economic benefits but lead to exacerbated vulnerability in the medium to long term (UNDP, 2009).

In this regard, effort is needed to increase awareness in order to overcome social barriers, and alter restrictive and maladaptive perceptions, norms and cultural constraints. Initiatives to foster adaptation will ultimately fail if they do not empower and inform individuals who remain confined in their adaptive behavior and have limited access to key resources. In this connection, the most successful interventions are those that build upon existing appropriate cultural norms, while addressing local development issues that help to alleviate climate vulnerability and make use of clear efforts to contextualize initiatives within the broader socio-cultural environment (Ayers & Huq, 2009).

4.7.4. Suggested strategies for responding to climate change

During the community discussions, participants were requested to suggest strategies which they think are vital to improving rural livelihoods, reducing vulnerabilities and enhancing local resilience to the impacts of climate variability and change in their respective localities. The following is a list of the strategies suggested by the community members:

- ***Development of water infrastructure:*** Participants from all the four rural kebeles suggested the development of essential water infrastructure. This included water and flood diversion, development of small-scale irrigation and construction, and rehabilitation of traditional ponds and springs as important strategies to overcome the stress from water shortage for domestic consumption, crop and livestock production.
- ***Tree planting and forage development:*** During the focus group discussion in Hawelti in Raya Azebo district, participants stressed the need to curb soil erosion and drought through planting multi-purpose trees. Participants from Ade-Halga, on the other hand, emphasized forage development as a way out of the current problem of overgrazing and livestock emaciation in their locality.
- ***Terracing on farm lands:*** Through its safety-net program that includes cash and food-for-work projects, the Government of Ethiopia has supported local efforts and aggressively expanded soil and water conservation measures, such as sand terraces, water ways and cut-off drains, in most villages in Meket district. However, most conservation activities were implemented on commonly owned hilly and mountainous areas and this tendency has exacerbated the loss of top soil in low-lying farm areas. That is why community members from kebele 024 and 026 suggested support for the construction of biological and physical conservation structures at the farm level so as to curb the problem of sheet and gully erosion along individual farm plots and river valleys.
- ***Access to employment opportunities and credit facilities:*** young participants from Meket specifically mentioned the need for improving access to low-interest rate credit facilities and expanding non-farm employment opportunities targeting youth and women groups.
- ***Access to electricity:*** In the community discussion with farmers from selected rural villages in Kebele 026 in Meket district, young and women participants suggested that if they can get access to electrical energy, unemployed youth from rural villages will be able to establish micro-businesses and enterprises, such as metalwork, woodwork, tea houses, etc.

The participants in the discussion believed that this would ease the pressure on scarce land resources and reduce the out-migration of young people.

- ***Control and management of diseases:*** In view of the expansion of health risks, discussion participants from Ade-Halga and Dibeko mentioned the need to develop systematic monitoring and periodic assessment systems and disease prevention and control programs.
- ***Improving access to information, education and socio-economic services:*** The lack of economic and social services and infrastructural provisions in rural areas exacerbates the impacts of climate variability and change. In this regard, community discussion participants stressed the need to reduce the vulnerability of rural livelihoods to volatile terms of trade; increase access to marketing outlets and information; raise education and awareness levels; and develop alternative and complementary livelihoods for rural communities. According to district and zonal experts in Woldiya and Flakit of North Wello zone and Maichew and Mehoni of Debubawi zone in Tigray, in order to ease the impacts of population pressure and unsustainable resource uses, continuous education and awareness raising campaigns concerning the importance of limited family size and family economics, as well as the provision of reproductive health services need to be expanded.

4.7.5. General assessment of institutional response measures

Drought, famine and relief aid in the form of food or cash-for-work and environmental rehabilitation programs in that seemingly perpetual cycle of hardship and suffering now appear to be commonplace in the drought prone and environmentally degraded kebeles in North Wello and parts of South Tigray. Vast amounts of resources and expertise have gone into relief and development to try to relieve the suffering and promote sustainable livelihoods of the local people. Yet, it is commonly acknowledged that not much has changed for the better. Any success has often been limited in size and scope. Progress has been hampered by the frequency and severity of climatic hazards, local resource degradation, the inadequacies of external interventions and the unresponsiveness of interventions to the peculiar local problems, and by the lack of genuine involvement of grassroots communities.

Transfers and safety nets are needed for moral, economic and political reasons. In this regard, institutional emergency interventions in the form of the transfer of food and cash, school feeding, supplementary feeding, food-for-work, safety net and other programs assist in “*the removal or reduction of deprivation or vulnerability*“ (Burgess & Stern, 1991: 42). In the absence of a comprehensive social security system, well designed safety nets can provide vital protection against drought, flood or other climate and naturally-induced transitory food

insecurity. Moreover, such transfers and feeding and public works programs can help protect or rebuild assets and can thus have positive impacts on livelihood enhancement and food security. Nonetheless, safety nets are no panacea; and these interventions should always be seen as complementing and not substituting interventions aimed at alleviating alleviation and maintaining environmental sustainability in the long run.

In the last two decades, governmental and non-governmental institutions have initiated and implemented various development interventions targeted at building local capacity, empowering women, expanding small-scale enterprises, enhance and diversify livelihoods, and rehabilitate the environment. Despite the limitations of financial resources, institutional capacity and logistics, these interventions have contributed to improving living conditions and building local resilience. On the other hand, recent trends in policy development and implementation increasingly towards decentralization, expanding infrastructure, improved coverage of primary health care and education, particularly for girls, have become enabling conditions which support community and institutional adaptation initiatives.

The challenge for external interventions in rural areas has so far been in the use of local and indigenous adaptation mechanisms in the planning, implementation and evaluation of such development interventions. In this regard, much remains to be done by governmental and non-governmental institutional actors in order to harness the value of indigenous ecological knowledge; empower and genuinely allow full participation of poor households; and consider environmental sustainability, technological adaptability and socio-cultural acceptability factors when designing and implementing development and adaptation programs and projects. In the process of suggesting a specific intervention, it is also important to consider the workload placed on women. This is because as women take up new activities, they still have to fulfill their usual tasks of childcare, food preparation, collection of firewood and fetching water, which, given the multi-faceted impacts of climate variability and change, have become more time-consuming. On the other hand, whilst development activities have adaptation benefits, for example in the form of no-regret or low-regret adaptation, it is also necessary to give explicit attention to climate-justified adaptation measures which may go beyond baseline poverty reduction and development interventions.

5. Conclusions and Policy Implications

5.1. Conclusions

Climate and climate variability are important elements of the complex web of factors influencing rural people's livelihoods. In the past few decades, North Wello and Southern Tigray have struggled considerably with vulnerability. In districts like Meket and Raya Azebo, climate variability and change have touched many aspects of farmers' livelihoods. Though long-term weather trends are difficult to predict, with limited rural and agricultural infrastructure in place, the effects of even moderate weather shocks can impact significantly on livelihoods fully dependent on tradition-bound subsistence rain-fed farming and the exploitation of natural resources.

Analysis of the historical climate data in the study areas reveals that there has been an increasing trend of rainfall variability, both in space and time, and a general tendency of atmospheric warming during the past three decades. Generally, mean annual rainfall distribution and temperature trends over the study areas are characterized by large spatial and temporal variations with a general trend towards rising temperatures and rainfall anomalies. Coupled with the erratic and variable rains, rising temperatures can exacerbate existing problems of soil moisture losses and infertility. This leads to further land degradations, destruction of the patchy vegetations and expansion of localized deserts.

Droughts, famines and epidemics are very common occurrences in Meket and Raya Azebo. Some of these have been associated with climatic variability and change. In the past few decades, there has been an increased frequency of meteorological drought episodes, famines and outbreaks of diseases in both districts. These meteorological droughts have claimed the lives of thousands of people, destroyed crops and contributed to the death of livestock. Because of changes in the patterns of the local climate, the people in the districts are exposed to chronic food shortages, and degradation of natural resources, mainly soil, water and vegetation covers. In addition, the risks of flooding hazards have significantly increased.

It is widely accepted that the distribution of vulnerability to climate hazards and environmental degradation is not equal across communities and localities. Although location-specific climatic patterns are key factors in assessing risks and adaptation potentials, adaptation at individual and household level depends on personal and household characteristics, such as wealth status, education, information, skills, social networks, access to resources, technologies and

opportunities and management capacities. Hence, the adaptive capacity of poor and non-poor households and between women and men to climate change depends largely on the extent to which they can draw on these variables within varied contexts. Those with the least resources have the least capacity to adapt and are the most vulnerable. The poor in the study districts tended to suffer disproportionately because of their immediate reliance on natural resources while at the same time they face fewer possibilities to diversify into less climate-sensitive activities or resources. In particular, climate change is affecting women and exacerbating the problems and inequities that rural women already face. Since women are generally bound by the need to collect food, fuel and water, as well as the cultural mores that prevent them from having equitable access to resources and opportunities, the impact on women following climate disasters is disproportional.

In Meket and Raya Azebo, adaptation by rural communities and farmers is normal and is constantly happening. Rural communities in these districts have the knowledge and practices to cope with adverse environments and shocks. These practices relate to the management of natural resources that includes primarily soil, water, vegetations, and a diverse portfolio of socio-cultural and economic strategies meant to protect, enhance or diversify livelihoods. Over coming decades, households will adapt their production decisions in response to many different factors. In addition to adapting to climate change, rural households will respond to changes in market conditions, population factors, new technologies, government policies, and, possibly, to the requirements of introduced climate change adaptation strategies and policies.

Despite their vulnerability to climate change and environmental degradation, rural women are also the unsung heroines. In the study area, women are observed struggling and strategizing to prevail amid deteriorating environmental conditions. They generally have developed a sense of how to cope with disasters and have found ways to adapt with climatic and non-climatic stressors. They have developed important knowledge and skills for orienting the adaptation processes, a product of their roles in society in the productive, reproductive and community spheres. In this regard, involving both women and men and their respective viewpoints in the climate adaptation process of planning and implementation is critical to ensure that the end solutions will actually benefit all members of a community.

It is important to note that not all current local strategies to cope with hazards are efficient or appropriate for long term adaptation. Informal safety net mechanisms for asset redistribution become obsolete strategies if there are too many losses and too many people in need every year. On the other hand, strategies that rely on the exploitation of scarce natural resources, such as charcoal making and sale of firewood, degrade the natural resource base and greatly reduce the resilience

of the local ecosystem to the impacts of climate change. Such household ‘coping’ strategies are erosive, unsustainable and hence need to be discouraged and replaced by long-term and forward looking or asset building and resilience enhancing adaptation strategies. The unsustainability of many traditional coping strategies in the face of current climate change is already visible; and has been repeatedly mentioned by community members, NGOs and government officials in the study districts.

Hence, institutional support is crucial so as to enhance the efficiency and effectiveness of local adaptation strategies and curb maladaptive practices. In this regard, the various governmental institutions and non-governmental organizations operating in the study area can make valuable contributions to rebuilding assets damaged by disasters; rehabilitating degraded environments; improving access to socio-economic services and opportunities; supporting or modifying existing resource management and livelihood diversification practices; and introducing new practices in the development of water infrastructures, sustainable land management and weather-indexed crop and livestock insurance mechanisms.

Climate change adaptation interventions in rural Ethiopia cannot be separated from other poverty reduction and sustainable development efforts because climate change acts upon existing vulnerabilities. In other words, since vulnerability to climate change is largely contextual, adaptation partly requires emphasis on baseline or business-as-usual, i.e. no-regret or low-regret, development activities. Evidently, improved social, economic and human development is synergistic with adaptation to climate change. However, it is also necessary to give explicit attention to climate-justified adaptation measures, which may go beyond baseline poverty reduction and development interventions. For example, land use planning related measures will be necessary to mitigate flood damages in flood-prone areas or maintain environmental integrity while facilitating investments in commercial agriculture.

Transfers and safety nets are needed for moral, economic and political reasons. In this regard, institutional emergency interventions in the form of the transfer of food and cash aid, school feeding, supplementary feeding, food-for-work, safety net and other mechanisms assist in “*the removal or reduction of deprivation or vulnerability*” (Burgess & Stern, 1991: 42). In the absence of a comprehensive social security system, well designed safety nets can provide vital protection against drought, flood or other climate and naturally-induced transitory food insecurity. Moreover, such transfers and feeding and public works programs can help protect or rebuild assets and can thus have positive impacts on livelihood enhancement and food security. Nonetheless, safety nets are no panacea by themselves; and these interventions should always be seen as complementing

and not substituting interventions aimed at alleviating poverty and maintaining environmental sustainability in the long run.

In the last two decades, the federal government and the regional governments in Amhara and Tigray have provided emergency assistance and implemented various development interventions in the form of livelihood diversification, soil and water conservation and environmental rehabilitation. NGOs operating in the study area have also provided emergency support and implemented various projects aimed at raising awareness, building local capacity, reducing and mitigating disaster risks, enhancing rural livelihoods and rehabilitating the environment. Despite the limitations of financial resources, institutional capacity, logistics and questions of sustainability, such institutional interventions have saved many lives, protected assets, rehabilitated degraded environments and enhanced local resilience. However, most institutional responses have in the main been grossly inadequate, sectoral, short lived and uncoordinated.

There are often several possible options for adapting to the impacts of climate change and environmental degradation in the study area. While identifying and selecting possible adaptation strategies, it is important to consider not only the cost effectiveness and practicality of the strategy selected but also its effectiveness in building capacity of vulnerable people; in increasing resilience to climate changes and environmental degradation; its compatibility with the socio-cultural set-up and the national adaptation objectives; as well as the extent to which it can have ongoing influence over policies, practices and attitudes of local communities and government officials.

5. 2. Lessons learned for institutional interventions

Unlike the case of industrialized countries that are compelled to drastically curb their carbon emissions, the practical measure expected from Ethiopia is to cope with the threat of climate change through the development of locally responsive and nationally appropriate adaptation and mitigation plans and practical measures. This should be combined with lobbying for and seeking international solidarity and assistance in the form of financial, technical, logistical and technological resources. In this regard, there are important lessons that external institutional actors should draw from the adaptation experience of poor people and local communities-people at the forefront of climate change adaptation. Among others, such lessons include:

- *A thorough understanding of local livelihoods and vulnerabilities:* knowing the assets that comprise peoples' livelihoods and climate-related factors and risks that shape vulnerability. This will help to ensure the design of appropriate and locally-relevant project activities that address immediate and long term priorities.

- *A strong understanding of the main climate risks in the area and how they impact livelihoods:* related to the point above, but worth emphasizing on its own is the need for information on climate conditions, climate-related hazards, observed changes and their impacts on local livelihoods.
- *The need to harness the value of indigenous knowledge and practices to plan and achieve resilience:* Adaptation interventions in drought-prone environments should be anchored in local circumstances and imperatives and built on existing indigenous coping strategies, including upscaling initiatives by local people who demand increased voice and accountability.
- *Community-driven implementation:* emphasizing the full and active participation of community members in the initiation, design, implementation, and monitoring of project activities to secure community support and promote a strong sense of ownership.
- *Community organization:* establishing or building upon social institutions- e.g., Village Self-Help Groups, women's groups, youth clubs, and village water or WASH sub-committees- to carry out activities in a structured, participatory and efficient manner.
- *Strong participation of women:* recognizing their role as household and community resource managers. It is equally important to promote their active involvement in project activities so as to ensure the success and sustainability of interventions.
- Any effective adaptation policy aimed at reducing vulnerability must be responsive to a wide range of economic, social, political and environmental circumstances.

5.3. Policy implications

The prospect of climate change in Ethiopia calls for immediate and concerted action to enable millions of rural people to escape poverty and insecurity. As a way forward, it is equally important to recognize that climate change could also be an opportunity for Ethiopia to alleviate poverty and embark on accelerated economic growth and societal transformation. Many of the adaptation measures that need to be taken, such as increased use of irrigation and improved seeds, environmental rehabilitation, better use of the country's hydropower resources, strengthened efforts at curbing malaria, and improved livelihood opportunities and expanded services, are good for the country's development. Thus, seen through the lens of sustainable development strategies, climate change highlights opportunities for Ethiopia that should not be missed, including:



Unleashing the potential for agriculture

While all of Ethiopia's economic sectors are vulnerable to climate change, agriculture is the most vulnerable. Hence, urgent and concerted efforts are needed to adapt to and mitigate the adverse impacts of current climate variability and future climate change. Recent food, water and energy crises have highlighted the fact that climate change may become a threat multiplier thus reinforcing the urgency for policy makers to move the agricultural agenda forward decisively.

In order to de-link economic performance from rainfall and enable growth and development, Ethiopia must take major investments in agricultural technology. Key areas for such an initiative include use of improved seeds, e.g. short maturing, heat and disease tolerant varieties; introduction of soil and moisture management practices; provision of advisory services in inputs, outputs and markets; provision of access to credit, insurance and infrastructure; and enhancement of institutions and management capacity. The combination of water, irrigation, hydropower, roads and other market infrastructure investments should produce dramatic synergies; and provide the incentives and opportunity for farmers to shift out of subsistence agriculture into market-oriented agriculture and non-agricultural activities.

Harnessing the multiple benefits of water resources

Ethiopia faces more extreme hydrological variability and seasonality. The heavy reliance on rain-fed subsistence agriculture, extremely low levels of hydraulic infrastructure and limited water resources management capacity, leave the country's economic performance virtually hostage to its hydrology.²⁷ Safe water is critical to the health and well-being of households (MDGs 4 to 6). In addition, water is also an essential input into agriculture and other productive activities, including the provision of hydropower (MDG 1). It is also essential for the long-term sustainability of ecosystems (MDGs 7).

There is close connection between the urgent need to increase access to modern energy and rewards from mitigation of greenhouse gases (GHGs) through clean energy. This presents Ethiopia with the opportunity to take bolder approach to water resources by adopting a multipurpose water resource development approach involving complementary water security infrastructure to manage hydrological variability encompassing storage, containment, ecological balances, water conservation, flood management, drought mitigation- hydropower development, and water for irrigation and food production. Within this context,

²⁷ The challenge brought about by climate change on the hydro-economy of Ethiopia is the fact that water plays a central role as the most significant input to almost all production. According to a recent study, hydrological variability currently costs the country over one-third of its growth potential (World Bank, 2006).

hydropower projects must adopt the principles of integrated water resources management. This should in turn take into account multiple uses of water (for energy, irrigation and drinking) and multiple objectives in managing and regulating water. Integrated water resources management goes beyond mitigation of project impacts to maximize environmental, social and broader economic benefits from hydropower infrastructure. These benefits may be public or private, revenue generating or non-revenue generating.

Massively expanding access to modern energy

Ethiopia is a country of diverse agro-ecology and biodiversity. It thus can harness the potential benefits from environmental services and economic opportunities that may arise from expanded and diversified energy production. With the expansion of the industrial and service sector, the mismatch between power demand and available supply has grown. In addition, the continued over-reliance on biomass energy among the rural populace has greatly eroded vegetation cover and ecosystem resilience.

Currently, Ethiopia is attempting to position itself in the dynamics around biofuels and other modern and more renewable energy sources, such as water, wind and solar. This is being done with a particular concern about maintaining a balance between food and energy security and supporting sustainable development in the country. This position is motivated by the country's fast demographic growth, the urgent need for energy security, and, more importantly, by the need for curbing environmental degradation and deforestation; boosting agricultural production; and achieving economic growth.

Since the lack of or unreliable energy is a major impediment to growth and transformation, adequate access to modern energy sources helps power other national development and Millennium Development Goals and meet the population's basic needs. However, much of the shift toward the development of modern and renewable energy sources like biofuels is occurring without careful consideration of the variability of current climate and the environmental and socio-economic implications of such systems. The good intentions of the Government as stipulated in the water sectors and biofuels development strategy documents can only be realized if interventions in the sector factor climate change and the requirements of environmental and social impact assessments. In this regard, improved planning, better coordination and legal enforcement are absolutely essential to ensure that energy development projects are designed and executed with appropriate social, economic and environmental safeguards and in consultation with affected communities.

Combining climate change adaptation and parallel approaches

Interventions to address disaster risks, social protection and climate change adaptation must deal with similar underlying drivers of vulnerability. Rather than attempting to address only the immediate concerns of each approach and waste resources unnecessarily, there is need to recognize complementarities and inter-relations between them. Climate change is an additional argument for commitment to integrating social protection and disaster risk management into development policy and planning at all levels.

Stepping up the fight against infectious diseases

Climate variability and change affect Ethiopia through food shortages, scarce potable water and poor hygiene. This often results in malnutrition and increased morbidity and mortality. Any extreme climate event or prolonged climate stress is likely to have an effect on the incidence of infectious diseases, especially in those areas with a high prevalence of malaria, tuberculosis, HIV and AIDS, and water-borne diseases. On the other hand, extreme climate events can impair health care infrastructure, health care services, delivery services, human resources; and trigger dislocation or out- migration among affected populations by exposing them to insecurity and conflict.

Despite encouraging growth and expansion of the health sector, Ethiopia continues to suffer from poor community health and well being.²⁸ Clearly, climate change is likely to exacerbate the incidence and impact of malaria, yellow fever, dengue fever, cholera, and other diseases. Thus, a lower burden of these diseases would be the best resilience thus providing an opportunity for strengthening the health system and scaling up investment in the surveillance, prevention and control, treatment, monitoring and evaluation systems, particularly at the local and regional levels.

Promoting land resource management and sustainable agriculture

Adapting agriculture to climate change in Ethiopia does not require reinventing agricultural practices. Instead, it requires adapting good practices to meet changing and often more difficult environmental conditions. As the study documented, there are various age-old indigenous and local soil and water conservation practices which have been practiced by the farmers in the study districts. These practices are widely implemented by farmers even in areas where new conservation practices are introduced and implemented. Indigenous resource management practices tend to be implemented in a more gradual and

²⁸ For example, nearly 70% of the population live and work in malaria prone areas. There has been expansion of malaria to areas relatively free from the diseases and resurgence in areas where the diseases was once under control. Altered temperature and rainfall patterns could also increase the incidence of yellow fever, dengue fever and cholera.

flexible manner with multipurpose aims and compatibility to the existing land use practices.

But the indigenous practices have major limitations in providing high yield. There are also limitations to expand and scale up the indigenous practices due mainly to land hunger and difficulties in arresting soil erosion completely. Modern technologies may help in strengthening or modifying the indigenous practices in terms of enhancing crop productivity and curbing land degradation. Thus the right mix of adaptations has the potential to significantly reduce the magnitude of potential adverse impacts or enhance beneficial impacts on agricultural productivity.²⁹ On the other hand, agricultural systems can be manipulated for the dual benefits of reducing greenhouse gas emissions and enhancing carbon sequestration.³⁰ Reducing soil carbon emissions and increasing soil carbon storage can increase infiltration and fertility; decrease wind and water erosion; minimize compaction; enhance water quality; impede pesticide movement; and enhance environmental quality.

Paying closer attention to social and gender issues

Rural women are particularly affected by climate change and local environmental degradation because they tend to play a greater role in natural resource management and ensuring household nutrition. Their role in the spheres of the household economy and the reproductive and productive arenas is innumerable and immensely critical. The deterioration in the productivity of environmental resources will affect them first and most.

Despite the preceding, however, rural women are not only victims of climate change but also effective agents of change in relation to both adaptation and locally appropriate mitigation actions. Women have a strong body of knowledge and expertise that can be used in ecological restoration, disaster reduction and

²⁹ Research has shown that the agricultural sector is especially adaptable given that technological, resource, and management changes can be undertaken relatively quickly (Mendelsohn, Nordhaus and Shaw, 1994).

³⁰ Agricultural soil carbon sequestration is estimated to generate gross annual revenues of nearly US\$ 1.5 billion. However, avoided deforestation is not currently eligible under the CDM of the Kyoto Protocol. But under the Bali Action Plan, the ongoing negotiation of a post-2012 international framework is considering policy approaches and positive incentives to promote and support what is called REDD+ and carbon sequestration potential from LULUCF. It is clear that when the REDD+ mechanism is adopted, Ethiopian smallholder farmers and the government could benefit from massive adoption of cropland/nutrient management, degraded soil restoration and organic farming. Estimates of the potential for agricultural conservation practices to enhance soil carbon storage range from 154-368 million metric tons (MMTCE), which compare to the 345 MMTCE of reduction proposed for the U.S. under the Kyoto Protocol (Lal et al., 1998).

adaptation strategies. Women's responsibilities in households and communities as stewards of natural resources has positioned them well for livelihood strategies adapted to changing environmental realities. Women tend, however, to be underrepresented in decision-making on sustainable development issues, including on climate change. This has impeded their ability to contribute their unique and valuable perspectives and expertise on climate change.

It is therefore absolutely essential that any development policy initiative or implementation takes into account the role of women, their special environmental knowledge and experiences, skills, as well as their vulnerability to the impacts of climate change. Measures that empower women in decision making and provide them equal access to resources, services and opportunities are very important and urgently needed.

Modifying and channeling rural out-migration

The increasing movement of young and adult male migrants because of 'rural push' factors and in search of 'greener pastures' is an extractive process. This drains rural areas of the most energetic and unencumbered workers resulting in the impoverishment of villages. This in turn compounds the poverty and insecurity that many rural women have to live with as family heads and economic providers.

In this regard, it is necessary to put in place rural development policies to curb migratory flows. The package of policies can include: providing markets for local products; diversifying livelihoods; promoting good business initiatives; and improving environmental sustainability and agricultural productivity. It is necessary to be cognizant of the fact that these measures will indirectly reduce the workload of women. But, it is also necessary to make the observation that it may not be desirable or even possible to totally stop or contain migration of young and ambitious people from rural areas like Meket or Raya Azebo.

In such situations, rather than wasting resources, time and effort in trying to stop the inevitable process, attempt should be made to channel migration into desirable paths and the energies of forced migrants into productive activities. Such a policy would maximize the role of migration as the necessary link between rural and urban labor markets, and contribute to development and rural transformation through effecting a more efficient allocation of labor among the various sectors and regions in the country.

Introducing and expanding weather-indexed crop/livestock insurance

Although agriculture is a primary source of rural livelihoods in Ethiopia, climate change has made smallholder farmers' lives more risky. Providing safety nets to protect these farmers from extreme weather is more important than ever. By enabling poor farmers to manage risk, weather-indexed insurance provides a

safety net that will prevent them from falling back into destitution in the case of severe drought. As experience elsewhere in Africa and also in some parts of Tigray by REST and its partners attests, the system has also proved to be a valuable tool for unlocking rural credit and hence improving rural livelihoods.

Typically, weather index crop insurance provides compensation to poor farmers when drought strikes during a growing season. In addition, credit enables additional farm inputs, particularly certified drought-resistant seed and fertilizer that can increase yields. But it is not in widespread use in the country. Thus, there is need to further assess the potential role of weather-indexed insurance system in reducing the risk of crop failure and livestock losses in the predominantly crop farming and livestock herding drought-prone areas of the country.

Reducing vulnerability through sustainable livelihoods and ecosystem based adaptation

If reducing current vulnerabilities is the starting point of adaptation, then poverty reduction is essential to the process, since poverty is both a condition and determinant of vulnerability. Yet poverty reduction requires an understanding of how local livelihoods are conducted and sustained because the assets and capabilities that comprise peoples' livelihoods often shape poverty and the ability to reduce it. By understanding the dynamics of poor people's livelihoods, we can begin to understand how they will be affected by climate change impacts; how they might respond with the resources they have; and how these conditions can be reflected and built upon for successful adaptation strategies.

Given the reliance of the poor on environmental services for their livelihoods, a central element of this adaptation approach should be ecosystem management and restoration activities. These include watershed rehabilitation, agro-forestry, and forest landscape restoration activities. By protecting and enhancing the natural services that support livelihoods, vulnerable communities can maintain local safety nets and expand the range of options for coping with disruptive shocks and trends. This combination of a secured natural resource base and reduced exposure to natural hazards and diversified livelihood activities can increase community resilience to future threats, including climate change. In fact, this approach to adaptation has the advantage of meeting immediate development needs while contributing to longer-term capacity development that will create a basis for reducing future vulnerabilities.

Awareness, education, empowerment and socio-economic services

A concerted effort is needed to increase education and awareness. Such an action can address socio-cultural restrictions in behavior and entitlement; and alter restrictive and maladaptive perceptions, norms and cultural constraints.

Initiatives to foster adaptation will ultimately fail if they do not empower and inform individuals who remain confined in their adaptive behavior and have limited access to key resources. On the other hand, the lack of economic and social services and infrastructural provisions are major constraints exacerbating the impacts of climate change in the study area.

With the preceding in the background, it is necessary to strengthen the rural economy by reducing the vulnerability of communities to volatile terms of trade; increasing access to marketing outlets and information; providing education and raising awareness levels; and developing alternative and complementary agricultural and non-agricultural livelihoods for the rural people. In order to ease the impacts of population pressure and unsustainable resource uses, continuous education and awareness raising campaigns concerning the importance of limited family size and family economics, as well as the provision of reproductive health services need to be essential components of such intervention.

All while continuing to promote key institutional and economic reforms

As Ethiopia continues to focus on accelerating economic growth and brining about structural transformation, the country has to grapple with the major challenge brought about by climate change. A major component of this challenge is to identify actions that will support ongoing development efforts while making the country more resilient to climate change. Thus, approaching climate change through a sustainable development lens would allow the country to maintain its focus on deepening key policy and institutional reforms needed in relation to management of the environment and natural resources. These reforms will also be highly beneficial to the country's long-term plan to move towards a carbon-free and climate resilient economy. An important source of increasing growth and bringing about transformation is improving the institutional and regulatory frameworks for climate change adaptation and natural resource management. In this regard, environmental fiscal reform³¹ can play an important role thus helping raise revenue while creating incentives that generate environmental benefits.

³¹ Environmental fiscal reform refers to the use of economic prices and incentives—taxes, fees and subsidies—to induce the sustainable use of natural resources and reduce environmental pollution and degradation. By encouraging more sustainable use of natural resources (such as forests, grasslands, water resources), reducing pollution from energy use and industrial activities, and stimulating the use of innovative clean technologies, it can also improve management of the environment. Such reform encompasses a wide range of taxation and pricing instruments, including taxes on the commercial exploitation of natural resources, and taxes and charges on water and air pollution.

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