Community Based Watershed Development for Climate Change Adaptation in Choke Mountain: The Case of Upper Muga Watershed in East Gojjam of Ethiopia

By

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A Thesis Submitted to the School of Graduate Studies of Addis Ababa University in Partial Fulfillment of the Requirements for the Degree of Master of Arts in Development Studies (Environment and Development)

June 2011

Ethiopia

Addis Ababa University

School of Graduate Studies

Institute of Development Studies

Center for Environment, Water and Development

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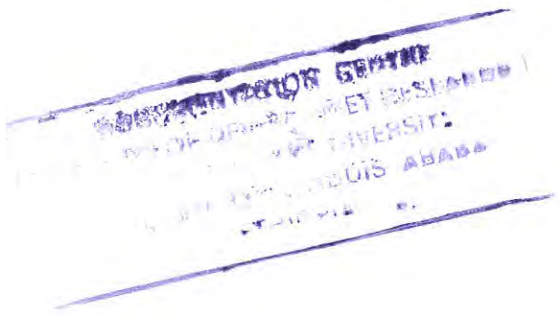

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

INSTITUTE OF DEVELOPMENT STUDIES (IDS)

Title

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DEVELOPMENT STUDIES

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Acronyms and Abbreviations

ANRS =Amhara National Regional State

ASE =Agri-Service Ethiopia

CBO = Community Based Organization

CIFOR =Centre for International Forestry Research

CMRI = Choke Mountain Rehabilitation Initiative

CPK = Community Member Key Informants about the Project

DFID = Department for International Development

CSA = Central Statistics Authority

EPA = Environmental Protection Authority

EPK = Expert group Key Informants about the Project

ESCWA =Economic and Social Commission for Western Asia

FAO = Food and Agricultural Organization of the United Nation

FVs = Farmers Varieties

GEF = Global Environment Facility

IDS =Institute of Development Studies

IFAD = International Fund for Agricultural Development

IFAS = Institute of Food and Agricultural science

IFPRI = International Food Policy Research Institute

IGAD = Inter Governmental Authority on Development

IGES =Institute for Global Environment Strategies

IPCC = Intergovernmental Panel on Climate Change

IWM = Integrated Watershed Management

IUCN =International Union for Conservation of Nature and Natural Resources

K = Key Informants about Climatic Element Trend

MALMAT =Mountain Agricultural Land Management and Appropriate Technology

MDG = Millennium Development Goal

MDGNA = Millennium Development Goal Need Assessment

MoARD = Ministry of Agriculture and Rural Development

MoFED =Ministry of Finance and Economic Development

MoWER = Ministry of Water and Energy Resources

NAPA = National Adaptation Plan for Action

NMA = National Metrological Agency

UNCCD =United Nations Convention to Combat Desertification

UNDP = United Nation Development Programme

UNFCCC = United Nation framework Convention on Climate Change

USAID = United States Agency for International Development

WARDO = Woreda Agricultural and Rural Development Office

WB = World Bank

Acknowledgements

I have received valuable support from many people from the start to the accomplishment of this thesis. So I am very glad to use this opportunity to express my indebtedness to all those who extended me to be energetic and enthusiastic to handle every work that I faced in the process.

First and for most my heartfelt thanks and appreciations go to my research advisor Dr. Belay Simane whose unreserved support and professional comments were quite instrumental in shaping the study. He has been kind enough to give advice, relevant literatures and respond to all my frequent inquires by devoting his precious time.

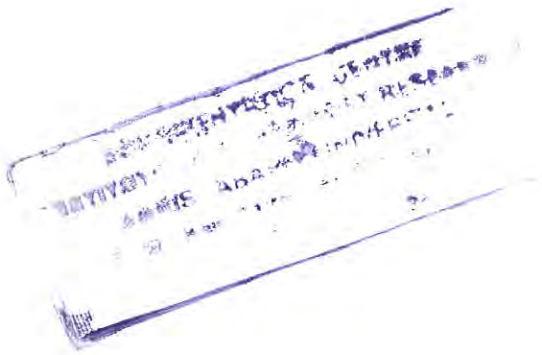
My Special thanks extend to Dr. Feyera Senbeta, who gave me his critical and constructive comments during my proposal defense.

My deepest gratitude also goes to Debay Tilat Gin Woreda Agricultural and Rural Development Office members and Ambaber Primary School teachers. Without their assistance, the collection and assembling of the data would have been difficult. Moreover, I would like to give warmest thank to Ato Esmelalem Meherte who guided me on how to handle the overall work and supplied valuable information about the project. I am also highly grateful to thank for the valuable contributions and supports of Ato Beweket Amede, Ato Reta Hailu, Ato Genanew Agitew, Ato Yalew Adane, Ato Tilahun Fentie, Ato Dagnew Negash, Ato Shegaw Yesigat, Ato Anteneh Yehuala, Ato Getu Ambaye, Ato Engedaw Yeshialem , Ato Ayetenew Abie and the IDS registrar Tsega Berhan. I have gotten valuable pieces of advice and support in one way or another from all these mentioned colleagues.

My heartfelt thank extends to my mother Tinkish Sharew Negash, who is courageous and visionary in rural periphery of Ethiopia that enrolled me to school and has been offering me to do this opportunity and it is impossible to achieve this with out the continuous support of her.

Lastly, my sincere and deepest thank goes to my wife W/ro Agegnehush Yeshialem. She has always encourages me in addition to carrying out handling the household responsibilities and taking care of our two children (Ezra and Rute) alone because of I devote my full time for this thesis.

Table of Contents



List of Tables

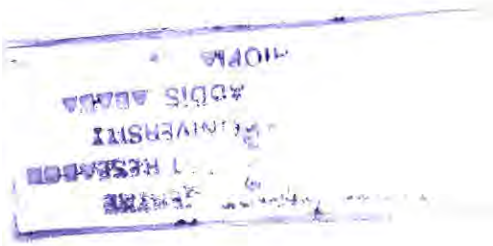
List of Figures

List of Boxes

Abstract

In recent years, climate change and its impacts on livelihood resource have become a key issue in Ethiopia. The main undesirable impacts on livelihood resources include land degradation, soil erosion, deforestation, loss of bio diversity, recurrent drought, flood, wet land, and water body drying, and emergence of new crop and animal diseases. All these contribute to food insecurity and subsistence farming with a difficulty to break through the poverty trap. Thus this thesis has attempted to examine how community based watershed development project has a significant impact to reverse the aforementioned undesirable impacts, and will contribute to the development of climate change adaptation mechanisms, adaptive capacity, and livelihood improvements. This thesis has also made the objective of assessing the positive impact of community based watershed development project on the development of climate change adaptation mechanism and livelihoods in Choke Mountain in the case of Upper Muga Ambaber Community Based Watershed Development Project. To address the investigation and assessment of the above objective the research method uses both qualitative and quantitative types of research design. In order to collect valuable information while semi structured questionnaire, focus group discussion guide checklist, key informant guide checklist, and observation check list tools are used. The primary data sources considering such things in the sampling process as gender, age, wealth status and CBO membership document review format is used to quick handling of the required documents as a secondary data source. Similarly, different statistical methods are used for the data analysis. These include percentage of frequencies, bar graphs, X^2 test, independent and paired sample t test and one way ANOVAs. The key finding of the thesis presents that the adaptive capacity of the area before the intervention was low/very low. However, after the intervention the status of livelihood resources especially; income, soil fertility, land productivity, forest, water and food supply become improved, (biophysical and financial resources). Even if it has some gaps in the process of implementation such as lack of participatory decision making process, targeting problem to address the poor, the young and the women, weak stakeholder linkage and some conflicts over utilization of communal livelihood resources (forest and range land),which means lacks for the development of social and human capital. It is concluded that the project can play a significant role to improve the adaptive capacity and livelihood condition of the local people. Then to fill the gap and go along the sustainability of the project, the investigation recommended frequent negotiation and lobby from the concerned stakeholders to improve human and social capital and solve the conflict. Then the project stakeholders shall think to retarget for the benefit of disadvantaged group.

Key wards: Community based organization, vulnerability, adaptation, and adaptive capacity



CHAPTER ONE

INTRODUCTION

1.1. Background

The horn of Africa is one of the least developed and most vulnerable regions to climate change and variability. Climate variability creates risks in many climate sensitive sectors such as in agriculture, livestock, water resources, and health. Climate variability and extremes also affect the welfare and livelihoods of rural populations. In addition, the horn of Africa is particularly vulnerable because of the dominance of rain-fed rather than irrigated agriculture for food production. Many factors contribute and compound the impacts of current climate variability in Africa and will have negative effects on the continent's ability to cope with climate change. These include poverty, illiteracy and lack of skills, weak institutions, limited infrastructure, lack of technology and information, low levels of primary education and health care, poor access to resources, low management capabilities, and armed conflicts. The overexploitation of land resources including forests, increment in population, desertification and land degradation pose additional threats (UNFCCC, 2007).

Climate change vulnerability analysis for Ethiopia suggests that climate change over the coming decades presents a serious threat to various economic and social sectors (natural resources basis, particularly biodiversity, ecosystems, water, agricultural and human health) as the frequency and intensity of drought is likely to increase (EPA, 2006). Common climate related hazards in Ethiopia include drought, floods, heavy rains, strong winds, frost, heat waves (high temperatures), lightning etc (NAPA, 2007).

Adaptation to climate change is the adjustment of a system to moderate the impacts of climate change, to take advantages of new opportunities or to cope with the consequences. Thus, much adaptation by communities will be autonomous and facilitated by their own social capital and livelihood resources (O'Brien and Leichenko, 2000). Many agricultural adaptation options have been suggested in various literatures, they encompass a wide range of scales (local, regional, global), actors (farmers, firms, government), and types. These are; (a) micro-level options, such as crop diversification and altering the timing of operations. (b) Market responses, such as income

diversification and credit schemes, (c) Institutional changes, and (d) technological developments—the development and promotion of new crop varieties and advances in water management techniques (Gbetibouo, 2009). Therefore, this study mainly focuses on local level scales with micro level options of the local communities' ways of responding to climate changes using their own resources and administrative capacity.

1.2. Problem Statement

In recent years, environment has become a key issue in Ethiopia. The main environmental problems in the country include land degradation, soil erosion, and deforestation, loss of biodiversity, desertification, recurrent drought, flood and water and air pollution. A large part of the country is dry, sub-humid, semi-arid, and arid, which is prone to desertification and drought. The country has also fragile highland ecosystems that are currently under stress due to population pressure and associated socio-economic practices. Drought and famine, flood, malaria, land degradation, livestock disease, insect pests and earthquakes have been the main sources of risk and vulnerability in most parts of the country. Especially, recurrent drought, famine and, recently, flood are the main problems that affect millions of people in the country almost every year (NAPA, 2007).

The presence of irregularities and volatilities of the climatic trend has made a lot impact on livelihood resources such as on economic resources; it makes the level of economic development low and access to basic services poor. Ethiopia is highly dependent on rain fed agriculture. Institutional, environmental and resource based knowledge is poor. Sect oral implications of climatic risks include; 1) *agriculture*: food insecurity is an integral part of poverty in Ethiopia; climate change is projected to reduce yields of the wheat staple crop by 33% (WB, 2007a). 2) *Water resources*: run-off to Nile tributaries (Abay and Awash rivers) is projected to be reduced by up to one third due to climate change. 3) *Health*: climate change is projected to cause encroachment of malaria from lower altitudes in Somalia and Afar regions to higher altitudes in Tigray and Amhara. 4) *Energy*: Deficient in access to modern energy can create a vicious circle of environmental, economic and social reversal (NAPA 2007).

The field assessment survey in ANRS shows that many households are only able to produce sufficient food to meet their food requirements for less than six months of the year. Much of Ethiopia in general and the Amharic Regional State in particularly have characterized by

mountainous agriculture with slope gradients ranging from 5-45%. Much of the annual rainfalls come in short violent events of up to 100 mm/day, the exposure of denuded slope areas to these types of rainfall results in Ethiopia having one of the most serious soil degradation problems in the world. Annual rates of soil loss in the Amhara region in some steep lands and overgrazed slopes exceed 300 tons/ha/year, or 250 mm/year. Nationally, on over 2 million hectares, the soil depth is so reduced that the land is no longer able to support cultivation (ANRS, 2000).

Why it is in Debaye Tilate Gine woreda in east Gojjam Zone? Because of its location in the Northern Highlands of Ethiopia where agricultural land is becoming a serious tight spot to Agriculture- based livelihood for all farmers and severe natural resource degradation. It is among the highland area of the region with high population density, severe natural resource degradation and it is exploited for several millennia. In study site, in addition to where the problem of resource degradation is severe and management system are some, how low the adaptation mechanisms are not well examined to address how the farmers in the project area sustain their livelihoods in sustainable manner and adapt climate changes. The Choke watershed has deteriorated from a surplus producing to a food deficit area within a span of 20 years with more and more land being abandoned and/or productivity declining to levels below that which could maintain even mere subsistence. Furthermore the over view preliminary project entry assessment shows that most livelihood resources are not in such a way that handle to climate change hazards (Belay and Shibru, 2007). On the contrary, there is an intervention sustainable watershed development project, which targets to improve the situation. Nevertheless, the achievement is not known. Hence, there is a need to investigate how this project answers the felt need of the community. This study tries to assess how the Community Based Institutions make decisions autonomously using their own livelihood resources and administrative capability to enhance adaptive capacity and build sustainable livelihoods in Upper Muga watershed.

1.3.Objectives

1.3.1. General Objective

The general objective of the study is to assess the contribution of community based watershed development project for the development of climate change adaption mechanisms among the local communities; in Choke Mountain in the case of Upper Muga Ambaber Community Based Water shed development project.

1.3.2. Specific Objectives

The specific objectives of this research project are;

1. To identify key livelihood resources, main climate changes and vulnerabilities in the project area

2. To assess climatic change hazards main impact on key livelihood resources

3. To examine the role of community based watershed development project for climate change adaptation mechanisms

4. To assess the contribution of community based watershed development project for climate change adaptive capacity

1.4. Basic Research Questions

The basic research question of this study is:

What are the roles of community based institution for reducing climatic change hazard vulnerabilities and enhancing adaptation mechanisms and adaptive capacity?

1.5. Significance of the Study

Currently livelihood security and climate change adaptation is a prime objective of the country and as a result, a lot effort has been implemented to achieve it. The choke mountain sustainable watershed development project is one of these parts. Though such intervention project exists; it was not properly evaluated and documented to draw lessons. Then this research project could contribute a part to sight development stakeholders and try to address some issues, which give meaning to local community contexts for the current livelihood and climate change adaptation miracles in this site. it is designed in way that contributing to add part of knowledge how community based water shed development projects interact and act as both an approach and a tool plus to solve part of practical problems related to livelihood sustainability and climate change adaptation strategies for the academicians. Further, it can help who design project intervention, programs, policy makers, and development practitioners to solve the practical problems faced in the process of climate change adaptation mechanism developments in such similar projects.

1.6. Scope and Limitations of the Study

This study has considered the performance of the community based watershed development project in the case of Upper Muga watershed in Debay Tilat gine Woreda of the Amahara National Regional State. The survey as the whole compared the cases of both the Community Based Organization members and non-members of the sample households, before and after the project intervention. It examines the extent of climate change hazard impacts on their lives how the project intervention serve as a means of responding to these hazards and lead to building of livelihood improvements and enhance adaptive capacity at the local level. Regarding to its limitations the preliminary baseline survey assessment before the project was not in such a way of this investigation demands and the climatic element (rainfall and temperature) site recorded data is not available in the site even if the investigation critically demanded these recorded data.

1.7 Organization of the Study

This research paper has organized in five chapters. The first chapter comprises with a general introduction, statement of the problem, the research objective, significance of the study and scope and limitation of the study. The second chapter presents review of related literature of the study. The third chapter deals with the description of the study area and research methods. The fourth chapter presents the key livelihood resources, vulnerabilities, main climate changes and its impact on livelihood resources, community based watershed development project contribution for development of adaptation mechanisms and adaptive capacity. The last chapter encompasses the conclusion and recommendation section.

CHAPTER TWO

LITERATURE REVIEW

2.1. Concepts and Definitions

Some important terms or concepts have been defined to understand the overall contexts of the study. These are essential to explain the adaptive mechanisms of the people to triumph with climate changes in the study area. These terms and concepts are used for practical as well as analytical purposes.

Community Based Organization: It is abroad-based development approach that in variably ensures the effectiveness and sustainability of interventions. Empowerment of resource users – how can participatory planning systems become the norm institutionally for managing watershed and other ecosystems. And it is premised on two very important concepts :(1) Exploring the community's social capital-that is, the traditions, culture, values and socially institutionalized forms and making the most of it toward attaining goals. (2) Identifying the core groups that can spearhead the implementation of development projects and ensure the sustainability of all development activities, empowering the community to institutionally own and ensure the sustainability of the development under taking is tantamount to constructing a building on concrete ground (Racelis, 1999).

Community based Watershed development: Involvement of local people is the core of micro watershed based -resources conservation, as (Sharma *et al* 1997 as cited in Woldeamlak, 2003) defines Watershed development as: 'utilization and conservation of land ,water and vegetation resource at farm households and micro- watershed level for continuous improved livelihood and human development'. The ultimate objective is thus development at the local level through appropriate use and management of natural resources by the main stakeholders at the local level. In other words community based watershed development acknowledges that individual farmers or communities as a group are the best manager of the resources because they realize that their dependence on the resources for livelihood is nearly absolute. Recent evidence are emerging from experience of many countries of the world that Integrated and or community based watershed development generally leads to effective resources conservation and improved rural livelihoods (Woldeamlak, 2003)

Climate change: It is Changes in climate (such as temperature, precipitation, wind) that differ significantly from previous average conditions and are seen to endure, bringing about corresponding changes in ecosystems and socioeconomic activity or. It refers to a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or because of human activity (IPCC, 2007b).

Vulnerability: Vulnerability to climate change means different things to different people. The Intergovernmental Panel on Climate Change describes; vulnerability as the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change (IPCC, 2001). Or vulnerability of any system (at any scale) is reflective of or a function of the exposure and sensitivity of that system to hazardous conditions and the ability or capacity or resilience of the system to cope, adapt or recover from the effects of those conditions(Smit *et.al*, 2000).

Exposure: The other central concept related to vulnerability is exposure, meaning in general the degree, duration, and/or extent in which the systems is in contact with to the climatic hazards or subject to, expose for external stress or it is the nature and degree to which a system experiences environmental or socio-political stress (Adger, 2008).

Sensitivity: Sensitivity is the degree, to which a system is affected, either adversely or beneficially, by climate-related stimuli. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea-level rise) (IPCC, 2001).

Adaptive capacity: It is the capacity of a system to adapt if the environment where the system exists is changing. It is applied to e.g., ecological systems and human social systems. Adaptive capacity is defined as the "potential, capability, or ability of a system to adapt to climate change stimuli or their effects of impacts", implying that in principle adaptive capacity has the potential to reduce the damages of climate change, or to increase its benefits (ibid).

Adaptation: Adaptation involves adjustments to in ecological, social or economic system to enhance the viability of social and economic activities and to reduce their vulnerability to climate, including its current variability and extreme events as well as longer-term climate change. The term

adaptation means any adjustment, whether passive, reactive or anticipatory, that is proposed as a means for ameliorating the anticipated adverse consequences associated with climate change (Smit *et al.,* 2000).

Resilience – Amount of change a system can undergo without changing state. (IPCC, 2001).or it is a tendency to maintain integrity when subject to disturbance. (UNDP, 2005)

Livelihood: It comprises the capabilities, assets (stores, resources, claims, and access) and activities required for a means of living. Livelihoods is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term (Chambers and Conway, 1992).

2.2. Community Based Organization and Community Based Watershed Development

Community-Based Institutions are established with to empower the community and thereby help it become master of its own destiny by mobilizing and using it own resources (knowledge, material, money, social capital, etc.). Moreover, they demanding-on the behalf of the poor and the marginalized groups whose voice are seldom or never heard-that the government may not fully respect the community's inalienable human, social and economic rights. A Community-Based Institution normally helps ensure the sustainability of the development activities by developing in the community a sense of ownership with regard to the activities. It is an approach that provides equal opportunity to the members of the community without discriminating against one of them based on gender, race or anything else (Edgar and Robert, 1972 as cited in ASE, 2007)

The institutionalization of community development will bind the community together and give them extra trust to regenerate the economic and social milieu and largely, broaden their vision to protect and manage the environment. In other words they will begin to see beyond their erstwhile short sighted momentary tapping of advantages (Warburton, 1998, as cited in ASE, 2007).A central characteristics of current community development is its institutionalization in formal programs of physical renewable of neighbourhoods and estate of economic and social regeneration, and of environmental protection and management (ASE, 2007).

Community Based Water shed development is serve as a tool to harmonize the use of water, soil, forest and pasture resources in a way that conserves these resources while raising the agricultural production both by conserving moisture in the soil and by increasing irrigation through tank and aquifer based water harvesting (WB, 2005 as cited in IGES, 2008). Hence, watershed developments in the rain fed areas do have significant impact of poverty reduction. Mean cost benefits ratio of watershed programs are around 1: 2, which has significant in terms of social sector investment. Benefits: The integrated watershed management has number of direct and indirect benefits ;to mention some of the benefits are; reduce soil erosion, better water availability and quantity, reduce deforestation, enhance forest produce availability, enhanced cattle milk production , improved livestock production, better crop production more bio mass and fuel wood availability. Moreover, the overall benefit includes; reduce migration, create more employment, improved the health condition, improved adaptive capacity to climate change and contribute a lot for social development (IGES, 2008).

More recently, watershed management programs sought to embed the local participatory planning processes initiated as part of the participatory watershed initiatives within broader social and political processes more explicitly (FAO, 2006). The focus shifted from working directly with local groups on land and water issues to supporting multi-stakeholder negotiation platforms to address a range of issues including but not limited to natural resource management. Compared to past efforts, more emphasis is placed on conflict resolution and linking social, institutional and hydrological scales. Where earlier projects promoted the participation of stakeholders, and often focused specifically on local communities, projects that are more recent seek to foster collaboration between different types of stakeholders and stakeholder groups (FAO, 2006).

2.3. Climate Change and vulnerabilities

Climate change creates both risks and opportunities worldwide. By understanding, planning for and adapting to a changing climate, individuals and societies can take advantage of opportunities and reduce risks. Vulnerability to the impacts of climate change is a function of exposure to climate variables, sensitivity to those variables, and the adaptive capacity of the affected community. Often, the poor are dependent on economic activities that are sensitive to the climate. For example,

agriculture and forestry activities depend on local weather and climate conditions; a change in those conditions could directly influence productivity levels and diminish livelihoods (USAID, 2007).

In its Third Assessment Report (TAR), the Intergovernmental Panel on Climate Change (IPCC) concluded that the globally averaged surface temperature increased 0.6 ± 0.2°C in the 20th century. This trend has expected to persist, with a 1.4 to 5.8°C increase predicted for the current century. Warming will vary by region and be accompanied by significant changes in precipitation, sea level rise, and changes in the frequency and intensity of some extreme events. These changes will affect natural and human systems independently or in combination with other determinants to alter the productivity, diversity, and functions of many ecosystems and livelihoods around the world. Yet these impacts will not be distributed or felt uniformly, as those "with the least resources have the least capacity to adapt and are the most vulnerable", the poor are already vulnerable to climate risks. Settlement on marginal or unstable lands such as steep slopes or floodplains heightens their exposure to the impacts of climate hazards. Heavy dependence on ecosystem services can place their welfare and survival at the mercy of environmental conditions. As the availability and quality of natural resources decline due to natural and human-induced pressures, so does the viability and security of their livelihoods. With limited capacities and resources at their disposal to respond to stresses such as droughts and floods, their ability to meet basic needs and move out of poverty is constrained. Climate change, therefore, threatens to exacerbate existing vulnerabilities and further entrench development disparities. Those, who have the least stand to suffer the most, thus, with regional changes and impacts already being observed, the need for adaptive response measures is imperative. For the poor and other vulnerable people, the need is urgent (IPCC, 2001). Vulnerability to shocks is thus a key component of poverty. Poor people generally depend more on ecosystem services and products for their livelihoods than do wealthy people. The means by which a poor family gains an income and meets its basic needs has often met by multiple livelihood activities. Poor people are therefore severely affected when the environment is degraded or their access to it restricted. This link between poverty and the environment has been recognized for some time (Bass *et al.*, 2005, as cited in CIFOR, 2005).

Causes for vulnerability of Ethiopia to climate variability and change include very high dependence on rain fed agriculture which is very sensitive to climate variability and change, under-development of water resources, low health service coverage, high population growth rate, low economic

development level, low adaptive capacity, inadequate road infrastructure in drought prone areas, weak institutions, lack of awareness, etc. Vulnerability assessment based on existing information and rapid assessments carried out under NAPA has indicated that the most vulnerable sectors to climate variability and change are Agriculture, Water and Human health. In terms of livelihood approach, smallholder rain-fed farmers and pastoralists are found to be the most vulnerable (NAPA, 2007).

2.3.1 Natural Resource Status and Vulnerability

The main challenge is the sustainable management of natural resources and environmental protection, the very foundation upon which the socioeconomic development of the region depends. The region experiences persistent economic crises, which largely, have roots in severely degraded natural resources and the environment. This, exacerbated by recurrent droughts and other natural and man-made disasters, results in perpetual poverty and under-development which in turn accelerates the degradation of natural resources and the environment, thereby closing the vicious cycle. An urgent need, therefore, exists for member states of the IGAD region to break the vicious cycle by specifically ensuring environmental sustainability in their economic and social activities. Such a strategy would realize the vision of the founding fathers of IGAD whereby the people of this region would develop a regional identity and live in peace and a clean environment having alleviated poverty through appropriate and effective economic, food security, environmental protection, and natural resources management programmes. There is a need to understand that environmental, social, and economic opportunities have fit very well with the concept of sustainable livelihoods. An environmentally sustainable livelihoods strategy must create gainful employment for income, production and recognition (where employment provides recognition of food security for any population); lead to poverty reduction; improve the well-being and capabilities of people; encourage livelihood adaptation and reduce vulnerability through resilience; and promote sustainability of the natural resources base (IGAD, 2007).

Different studies made in the recent past (mainly in the years 1975-1995) also indicated that: (a) 28% of the highlands of Ethiopia (14.5 million ha) is severely degraded land while another 24% of it (13 million ha.) is moderately degraded land. (b) Estimates of deforestation vary from 150,000 to 200,000 hectares per annum. (c) The burning of dung as fuel instead of using it as a soil conditioner is estimated to cause a reduction in grain production by some 550,000 tones annually. (d) Estimates

of progressive losses in grain and livestock production due to accelerated soil erosion, if not arrested, will reach about 170,000 tones and 2 million TLUs by the year 2010. Close observation also shows that the effects of land degradation such as sedimentation, flooding, deterioration of fresh water supply from springs, streams, and lakes, and losses of other environmental benefits are becoming more clear and obvious in the country. The loss of Lake Alemaya is a clear evidence for the deterioration of fresh water supply. In addition to this 40% of the total area of the country (0.448 million sq.km or 44,800,000 ha.) needs immediate soil and water conservation treatment. This area includes both cultivated and uncultivated lands that need soil and water conservation treatment in the mixed-farming complex (high rainfall and low rainfall or drought prone areas) and pastoral areas, the assumption of 40% of the country as needy of soil and water conservation treatment is more on the conservative side (MDGNA, 2004).

2.3.2 Gender Aspects of Vulnerability

Climate change will disproportionately affect poor regions, communities and people, as they have the least resources to adapt. Women are estimated to make up about 70% of the world's poor and, thus, are likely to be strongly affected by climate change .Vulnerability and adaptive capacity are socially differentiated along lines of age, ethnicity, class, religion and gender. There are structural differences between men and women through, for example, gender-specific roles in society, work, and domestic life. These differences affect the vulnerability and capacity of women and men to adapt to climate change. In the developing world in particular, women are disproportionately involved in natural resource-dependent activities, such as agriculture, compared to salaried occupations. As these activities are directly dependent on climatic conditions, changes in climate variability projected for future climates are likely to affect women through a variety of mechanisms: directly through the availability of water,, vegetation and fuel wood, and through health issues relating to vulnerable populations (especially dependent children and the elderly). Water scarcity and declining rainfall levels may force women to walk longer distances to have access to water and fuel wood, and thus reduce the amount of time they can spend cultivating their fields (resulting in lower yields) and/or earning money through a variety of income-generating activities. Most fundamentally, the vulnerability of women in agricultural economies is affected by their relative insecurity of access to

rights over information, knowledge, resources, and sources of wealth such as agricultural land (IPCC, 2007c).

Since women in the developing world are largely responsible for producing and providing food for their families, the impact of climate change on agriculture also means that women – who already constitute the majority of poor people - are most adversely affected. Women depend more than men do on the ecosystems that are threatened by climate change, but they lack access to and control over natural resources, technologies and credit. Action Aid's research shows that, as a result, women are more vulnerable than men to seasonal and episodic weather phenomena and to natural disasters resulting from climate change (AAI, 2009) and (IFAD, 2009) literature describes the same thing what are mentioned above.

2.3.3 Climate Condition in Ethiopia and Choke Mountain

2.3.3.1 Temperature, Rain Fall and Drought Trend in Ethiopia

The average annual temperature (1961-1990) was 23.08'C (Cline 2007 as sited in WB, 2007). Ethiopia is characterized by diverse climates, which translate into diverse vegetation zones. Coldest temperatures - about 5°C (November to January) over the highlands of Central, North, and Southeast part of the country. Warmest temperatures also - about 37°C (March to May/June) in Northeast (Afar) and SE lowlands (WB, 2007b). Climate projections for Ethiopia have been generated using the software MAGICC/SCENGEN (Model for the Assessment of Greenhouse-gas Induced Climate Change)/ (Regional and global Climate Scenario Generator) coupled model (Version 4.1) for three periods centered on the years 2030, 2050 and 2080. For the IPCC mid-range (A1B) emission scenario, the mean annual temperature will increase in the range of 0.9 -1.1 C by 2030, in the range of 1.7 - 2.1 °C by 2050 and in the range of 2.7-3.4 °C by 2080 over Ethiopia compared to the 1961-1990 normal (NAPA, 2007).

Ethiopia has experienced at least five major national droughts since 1980, along with literally dozens of local droughts. Cycles of drought create poverty traps for many households, constantly thwarting efforts to build up assets and increase income. Survey data show that between 1999 and 2004 more than half of all households in the country experienced at least one major drought shock. These shocks are a major cause of transient poverty: had households been able to smooth consumption, then poverty in 2004 would have been at least 14% lower a figure that translates into 11 million fewer people below

the poverty line, since poverty observed during the years is 47% and poverty predicted with no drought is 33% (WB, 2007a).

Annual mean rainfall ranges from about 2000 mm (SW) to about 100mm (NE Lowlands of Afar). Present average precipitation is 2.04 mm per day, annual averages between 1961-1990 (Cline 2007, as sited in WB, 2007b) On a country aggregate level Average precipitation 1.97 mm per day simulations suggest that the average daily rainfall amount will lie around 1.97 mm between 2070-2099 (Cline 2007, as cited in WB, 2007b). Precipitation over the last three decades has been especially irregular over many of the *kiremt* receiving areas .Decreases in rainfall amount will be exacerbated by higher evaporation rates associated with the increasing temperatures. Projections of precipitation are more uncertain than projections on temperature and considerable regional variations exist (WB, 2007b)

2.3.3.2 Rain fall variability and Temperature Trend in Choke Mountain

The choke mountain site recorded data on rainfall from 1970 to 2007 shows that the annual and seasonal rainfall total followed an increased trend over the period; however, it is characterized by great seasonal variations. Due to this, the research finding assures an increase in flood and drought frequency, and change in the timing of rains followed by panting date change (Beweket, 2010). The trend analysis of climatic recorded data 1970 to 2006 of both annual mean minimum and maximum temperatures of the choke mountain area, follow increasing trends as well as animal and cropping pattern mix change in the site. This is in accordance with the perception of most farmers (89%) believes there is an increase of temperature in the area (Beweket, 2010).

2.4. Climate Change Adaptation Mechanisms

Adaptation mechanisms includes; Genetic improvement to produce drought tolerance crops, translocation of crops, and change in cropping pattern, afforestation to condition soils, improve water infiltration, provide shade to increase water use efficiency, diversification to nonfarm activities, crop insurance and micro credit scheme. Environment; afforestation and re afforestation, community management of forest and natural resources to ensure sustainable harvest and regeneration. Economic growth and trade: diversifications of livelihoods, local value addition, improve access to market and finance (e.g. micro credit), technology transfer, using carbon trading opportunities, to increase revenue while putting in place measures that reduce emission. Energy: enhance dam

structural parameters (Hydro electric and irrigation), proper management of water resources, disaster management, improved energy efficiency (wind, solar), capacity building for local communities to assist for proper natural resource management and technology transfer (USAID, 2007).Ecosystem-based Adaptation can directly meet the needs of Community Based Adaptation and poverty reduction initiatives. Ethiopia has included a significant number of Ecosystem-based Adaptation activities within its National Adaptation Programme of Action, published in June 2007(IUCN, 2009).

2.4.1 Community Based Watershed Development – A successful Tool for Climate Change Adaptation

Community Based Watershed management concepts play an important role for rural communities to adapt to impacts of climate change. The holistic concept of resource management that refers to a watershed or hydrological defined planning area follows a systematic approach with a major focus on sustainable development and manifold techniques. Farmers learn to assess the potentials as well as the challenges of their watershed; they work to improve soil moisture as well as groundwater recharge by watershed development measures increasing infiltration – even under increasing climate uncertainties. Further more, it improves both the livelihood resources as well as the poor community adaptive capacities from climatic uncertainty. In general, they improve their resilience towards natural disasters resulting from climate change and reduce their dependency on just one income factor. Thus, they drastically reduce their vulnerability (Foerch, 2009; Jodha, 1995; Johnson and Knox, 2002).

It is suggested that adaptation to climate change is inevitably local and that institutions influence adaptation and climate vulnerability in three critical ways. a) They structure impacts and vulnerability, b) they mediate between individual and collective responses to climate impacts and thereby shape outcomes of adaptation, and c) they act as the means of delivery of external resources to facilitate adaptation, and thus govern access to such resources (Agrawal, 2008). While natural resources continue to be important livelihood assets for the poor – even the landless poor and it is indicated that countries with well-developed social institutions are considered to have greater natural resource management and building adaptive capacity than those with less effective institutional arrangements (Beck and Nesmith, 2001; and Fisher, 2004)

A livelihood comprises the assets (Natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relations) that determine the living gained by the individual or household and their coping strategies from climatic risks (Ellis, 2000).Institutions influence the livelihoods and adaptation of rural households in three important ways. (1)They structure the distribution of climate risk impacts. How particular social groups and populations will be affected by climate hazards is in part a function of the physical and structural characteristics of the hazard. (2) They constitute and organize the incentive structures for household and community level adaptation responses, which shape the nature of these responses. (3) They mediate external interventions into local contexts, and articulate between local and extra-local social and political processes through which adaptation efforts unfold. External interventions in the shape of finances, knowledge and information, skills training, new institutional inputs, and technological support can assume many different forms. Local institutions shape the acquisition and distribution of these interventions in fundamental ways, thereby affecting the degree of success of such interventions Institutional functions include information gathering and dissemination, resource mobilization and allocation, skills development and capacity building, providing leadership, and relating to other decision makers and institutions (Agrawal, 2008) .

2.4.2. Why are Smallholder Farmers Important for Climate Change Adaptation?

Some 470 million farms - 85% measuring less than two hectares - produce 80% of the world's food and in many cases, their share of global production is growing. Given their involvement in the world's food system and current and expected climate impacts adaptation strategy that ignores smallholder farmers is doomed to failure. Although they produce most of the world's food, smallholder farmers and landless workers are among the most economically disadvantaged groups in the world. Resource-poor smallholder families make up 75% of the world's poor, half of the world's undernourished, 75% of Africa's malnourished children, and the majority of people living in absolute poverty. So helping smallholder farmers to adapt to climate change should also help to reduce hunger and poverty. A more sustainable model of agriculture, focused on promoting local food supply, organic products, and biodiversity, will have a substantial mitigation benefit. Effective adaptation for smallholders requires that they follow a 'sustainable agriculture' model. While the country is highly dependent on the agricultural sector for the income, foreign currency, and food security, small-scale farmers who employ largely rain-fed and traditional practices dominate the

sector. A state which renders Ethiopia highly vulnerable to climate variability (as seen during past persistent drought), and thus to climate change which is projected to reduce yields of the wheat staple crop by 33 % (NAPA, 2007)

Due to climate change, Africa is especially susceptible to land degradation, which affects at least 485 million people or 65 per cent of the entire African population. It is estimated that two thirds of African land is already degraded to some degree and accounts for a 3 per cent annual loss in agricultural GDP. It is in Africa that the link between poverty, land degradation, and desertification is the strongest. Poor farmers on rain fed farms in low latitudes are immediately vulnerable to warming, and reductions in crop productivity are expected to have serious economic impacts. For example, African farmers on rain fed farms would lose annual net revenue of US$28 per hectare (ha) per degree Centigrade (◦C), while farmers in India would lose 9 per cent of their net revenue/ha/◦C.(IFAD,2009).

2.4.3. Natural Resource Management and Climate Change Adaptation

Natural resource conservation aims at maintaining a high level of productivity sustained economically and indefinitely in preventing and controlling deterioration of the resources bases. Soil, water, plants and animals are natural resources .The conservation and proper management of these resources have greater impact in agricultural production and environmental protection, while the improper utilization of these resources leads to ecological imbalance and eventually to environmental degradation together with weakened the adaptive capacity of the farmers for climate change events and hazards. The main types of conservation methods are divided in to two, which are physical conservations and biological conservations. Physical conservations include level terraces, bench terraces, graded terraces, minimum tillage/conservation tillage, terracing and land forming, land shaping, water harvesting, cut of drains, water ways, and check dams. The biological soil and water conservation includes: Different Agronomic practices(crop rotation, inter cropping, strip cropping, alley cropping, cover/green manure crops ,mulching/crop residue management, contour cultivation, soil management, conservation tillage and compost making),grass strips, agro-forestry practices, control grazing, cut and carry system ,grass land improvement, area closure and vegetation and re-vegetation(MoA,2001).

The application of targeted conservation of natural buffer systems as a strategy for adapting to climate change offers several potential co-benefits: Biodiversity conservation, Poverty alleviation, and livelihood improvement. Biodiversity provides many direct benefits, including the natural resource base essential for many, livelihoods, genetic material for breeding and new medicines, aesthetic beauty, and tourism revenues. Moreover, according to the World Resources Institute, "the diversity of species undergirds the ability of an ecosystem to provide most of its other goods and services. Reducing the biodiversity of an ecosystem may well diminish its resilience to disturbance, increase its susceptibility to disease outbreaks and decrease productivity". In addition to directly providing livelihoods, therefore, biodiversity is important in ensuring the long-term viability of natural buffer systems in the face of disaster (IUCN, 2001).

2.4 .4.Adaptive Capacity and its Indicators

The adaptive capacity Inherent in a system represents the set of resources available for adaptation, as well as the ability or capacity of that system to use these resources effectively in the pursuit of adaptation. Such resources may be natural, financial, institutional or human, and might include access to ecosystems, information, expertise, and social networks. The implementation of adaptation strategies requires resources, including financial capital, social capital (e.g., strong institutions, transparent decision-making systems, formal and informal networks that promote collective action), human resources (e.g., labour, skills, knowledge and expertise) and natural resources (e.g., land, water, raw materials, biodiversity) (Brooks, 2004). Capacity – A combination of all the strengths and resources available within a community, society or organization that can reduce the level of risk, or the effects of a disaster. (Capacity may include physical, institutional, social or economic means as well as skilled personal or collective attributes such as leadership and management (UNDP, 2005)

IPCC (2001) identifies eight broad classes of determinants of adaptive capacity these are:- (i) available technological options., (ii)Resources and their status., (iii) the structure of critical institution and decision making authorities., (iv) The stock of human capital. (v) the stock of social capital (vi) the system's access to risk-spreading processes, (vii) information management and the credibility of information supplied by decision makers, and (viii) the public's perceptions of risks and exposure(IPCC,2001).

2.5. Factors Affecting the Communities to Develop Adaptation Mechanisms

The main features determining a community or region's adaptive capacity and/or to take adaptation mechanisms, include economic wealth, technology, information and skills, infrastructure, institutions, and equity .Therefore we can say households' management of climatic risk is a function of education, wealth, natural resources statuses, social organization, local knowledge, technology ,information ,infrastructures, equity and institutional relationships among other factors. The role of rural local institutions in this regard is critical. Not only do institutions affect how households are affected by climate impacts, they also shape the ability of households to respond to climate impacts and pursue different adaptation practices, and mediate the flow of external interventions in the context of adaptation. The nature of access of different households and social groups to institutions and institutionally allocated resources is a critical factor in their ability to adapt successfully. The main variable which hider or enhance adaption mechanisms at the community level are: poverty, inequality, social capital, social entrepreneurs, institutional, Interconnections, institutional density, institutional effectiveness, gender composition, cultural factors (whether Indigenous) and age compositions (Agrawal, 2008)

The countries with well-developed social institutions are considered to have greater adaptive capacity than those with less effective institutional arrangements. Areas with better infrastructure are expected to have a higher capacity to adapt to climate change. In their analysis of the vulnerability of Indian agriculture India's infrastructure development index—which includes the availability of transportation, irrigation, banking, communication, education, and health facilities—to measure adaptive capacity (Temesgen *et al*, 2008).

2.6. Community Based Watershed Development Project

The goal of this project is improving food security status and alleviating poverty of the local community in Upper Muga watershed. The central objective of the project is to conserve and manage the biodiversity resources of the watershed in an integrated way. Then the goal of the project is conserve the genetic resources and promote sustainable livelihoods. By: Create public awareness and empower the communities regarding integrated mountain management to sustain the resources, Promote community-based sustainable land and water management ,Increase agricultural

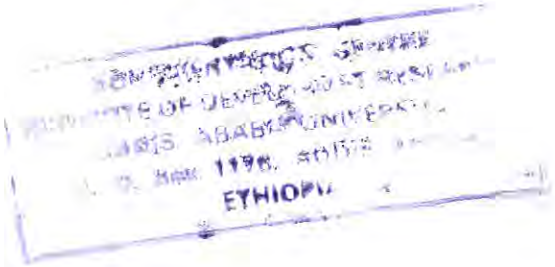
productivity, food security, and biological sustainability; and Promote Afforestation and reforestation.

The project activities expected to achieve for the enhancement of livelihoods, of the local communities, while combating land degradation, maintaining the hydrological balance conserving the biodiversity and the soil of the Chocke mountain ecosystem to improve the overall livelihoods of the local community and reduce their vulnerabilities for the climatic hazards and climate change events. Therefore, to end these projects assign the following specific objectives;

- Conserve biodiversity at farm level
- Reduce the high rate of deforestation at the watershed level
- Improve crop productivity
- Reduce the extent of soil erosion in the watershed
- Improve livestock production
- Strengthen information and knowledge management
- Implement proper water management
- Build and strengthen the overall capacity of the Cooperative members.
- Restore and stabilize the natural resource base (soil, forest and water)

Then these over all leads to expect increase production and income opportunities of the farmers diversified; organic agriculture promoted; the farming system made more stable, robust and sustainable; risks due to natural calamities reduced . Build and strengthen the overall capacity of the Cooperative members Mountain ecology improved in sustainable way at a sub-watershed level then these over all expected to lead enhanced adaptive capacity and ensure the community sustainable livelihoods in this project site (Belay, 2007).

The gullies and degrade lands have been rehabilitated using both physical and biological measures appropriate to the specific situation and the availability of the necessary inputs. Establishing community wood lot: The specific activities that should be performed under this activity include establishing community forestry of Eucalyptus tree and Arundinaria. Improving crop productivity: In order to improve the crop productivity in the Upper Muga watershed, the major activity, which will be carried out by the CBO, is compositing and different soil and water conservation structures and practices. Range land and pasture management: rangelands, pasture and livestock directly or



indirectly support the livelihood of most communities. Sustainable use of these resources is of paramount interest not only the sustenance of local population but also for the conservation of rare flora and fauna species. Water capture and carbon sequestration, and preservation of cultural and natural landscapes .many of goods and services that the high mountain rangelands and pastures provide have uses and consequences beyond national boundaries .Each household supplement what their livestock graze at the assigned plot with fodder grown on their own small farm .A cut and carry system has been adopted. The majorities of Choke mountain people are dependent on marginal, sloping agricultural lands and commonly used forests and pastures for their livelihoods. Watershed management provides an integrative framework for sustainable livelihoods and natural resource management. As the demand for land increases with growing population pressure, and as soil nutrients are depleted through intensified agriculture, there is continuing expansion on to new slopes and unsustainable use of old ones. Sloping land agriculture is susceptible to high rates of soil erosion, loss of soil fertility, and poor retention of water (Belay and Shibru, 2007).

The project comprises more than 20 CBOs and expends more than 9 million Ethiopian birr for rehabilitation and watershed development purpose. The CBOs and expense details are attached in the annex I

2.7. Conceptual Framework

For this study project, the Sustainable Rural Livelihoods (SRL) Framework has been used to organize the search for indicators. The analysis of links between livelihoods and natural resource use and has been widely discussed in recent years (Scoones, 1998). It assumes that rural people depend on five different "capital assets" (natural, human, physical, social, and financial capital) to sustain their livelihoods (Vilei, 2007).

A specific livelihoods framework has been developed to assist with implementation of sustainable livelihood methodologies. The livelihoods framework is a tool to improve our understanding of livelihoods, particularly the livelihoods of the poor. The framework is centered on people. It does not work in a linear manner and does not try to present a model of reality. Its aim is to help stakeholders with different perspectives to engage in structured and coherent debate about the many factors that affect livelihoods, their relative importance, and the way in which they interact. This, in turn, should

help in the identification of appropriate entry points for support of livelihoods (DFID, 1999) and (Chambers and Conway's, 1992).

Vulnerability context: The vulnerability context within which people pursue their livelihoods includes trends: such as economic trends, resource trends. Shocks: such as conflict, economic shocks, health shocks and natural shocks. These factors can have a direct impact on people's assets and the options available to them to pursue beneficial livelihood strategies. Shocks can destroy assets directly or force people to abandon or prematurely dispose of them as part of their coping strategies

Livelihood assets: People and their access to assets are at the heart of livelihoods approaches. Human capital: skills, knowledge, health, and ability to work, social capital: social resources, including informal networks, membership of formalized groups and relationships of trust that facilitate co-operation .Natural capital: natural resources such as land, soil, water, and forests. Physical capitals are basic infrastructure, such as roads, water and sanitation, schools, ICT; and producer goods, including tools and equipment. Financial capital: - including savings, credit, and income from employment, trade and remittances.

Policies, Institutions, and Processes (PIPs): These are element of the livelihoods framework and cover the complex social, economic, and political context within which people pursue their livelihoods strategies. Policies, institutions, and processes include the inter-related issues of social relations. The way in which gender, ethnicity, culture, history, religion and kinship affect the livelihoods of different groups with a community, Social and political organization: The social norms, customs and behaviors (or 'rules of the game') that define people access to resources.

Livelihood strategies: Livelihood strategies are the combination of activities that people choose to undertake in order to achieve their livelihood goals. They include productive activities, investment strategies, and reproductive choices. The choice of strategies is a dynamic process in which people combine activities to meet their changing needs.

Livelihood outcomes: Livelihood outcomes are the achievements of livelihood strategies, such as more income, increased well-being, reduced vulnerability, improved food security, and a more sustainable use of natural resources. Livelihood outcomes are the goals to which people aspire, the results of pursuing their livelihood strategies (Kollmair and Juli, 2002).

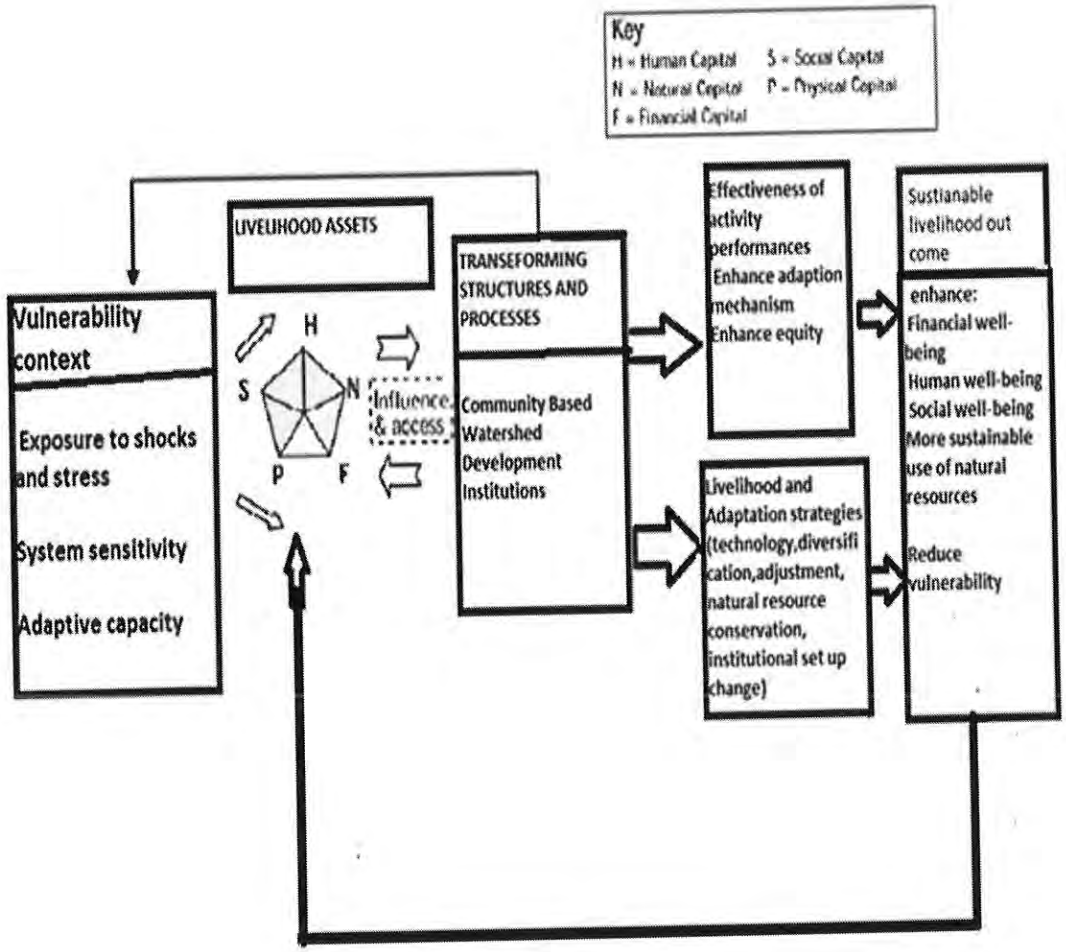


Figure 1: Conceptual Frame Work

Sustainable livelihood and climate change adaptation mechanism framework adopted from the DFID sustainable livelihood framework (1999)

CHAPTER THREE

DESCRIPTION OF THE STUDY AREA AND RESEARCH METHODES

3.1 Description of the Project Area

The study site, Choke Mountain Watershed, is located approximately between coordinate 10033'06" to 10050'24" North latitude and 37042'36" to 37058'24" East longitude. Topographically, the watershed lies in the altitudes range of 3000 to 4413 m.a.s.l. Because of these altitudinal variations, about 27%, 82%, and 9.7% of the watershed is found in W/Dega (Midland), Dega (Highland) and Wurch (Hail) traditional agro ecological zones respectively. The watershed is found entirely in Eastern Gojjam Zone of six Woredas such as; Bibugne, Debay Tilatgin, Gozamen, Hulet Eju Enssie, Machakel, and Senan (Bewket, 2010).The specific site of the project found at distance of 350 km North West of Addis Ababa and 60 km east from Dbere Markos, which is the zonal capital of the woreda. It has a population of 128045, from which, 64102 are male and 63943 female .From this 123035 live in rural area (61714male and 61321 female) which is 96.1 of the population found in rural areas. Within the woreda the specific site of the project have a total population of 5900 from which 2985 are males and 2915 are females (CSA, 2008). The woreda has a total land size of 60918ha, and 55% of the woreda soil is red brown soil and 45% of soil is black or verity soil. Most part of the woreda characterized by Dega types of climate and its topography is sloppy and mountainous nature, which is sensitive to climatic hazards especially with rainfall variability and intensity (WARDU, 2011).

Muga River is one of the main rivers, which begin its flow in the Choke Mountain, and it ends as main tributary of Upper Blue Nile River. Ambaber is one of the CBOs found in Shime Kebele under the auspices of Debay Tilat Gin woreda Administration, in the upper stream of Muga river watershed. Then for this research, Ambaber and Upper Muga used synonymously without any difference. In addition, Ambaber Natural Resources Development and Tourism marketing cooperative is one of the cooperatives in the woreda, which was established in 2007. The total land area of the watershed in the Kebele is estimated to be 900ha with total household of 590.of which 500 are males and the rest of 90 are females, the remaining 747 households are non members of the CBOs, which is the total households of the Kebele is equal to 1337(CSA,2008) . The altitude of the

Kebele ranges from 3000 to 4000 meter above sea level. The people of the watershed mainly depend on agriculture to meet their basic needs. The average size of land holding is 0.8125ha.potatoes, pea, bean flaxseed, wheat and barley are the dominate crop of the area .Soil loss mainly through water erosion is sever with high rate of deforestation. Crop productivity has sharply decline over the last few decades. Communal grazing is the only source of animal feed in the area, but due to expansion of cultivated land, feed availability is declining at an alarming rate. The hydrograph is changing from time to time such that the peak flow can increase while the base flow in some area cease during the dry season thus resulting in shortage of drinking water for people and livestock(Belay and Shibru, 2007). The slope of the kebele is characterized by difficulties form the overall share constituting mountainous 60%, gorge 10%, hill 20% and flat land 10%. The land use share for different purpose are also presented as follows; land for farm land constitute 1253ha.,range land(400ha),forests land (360 ha) residential 157 ha and covered by water body(3ha) (Shime Kebele basic information document, 2011)

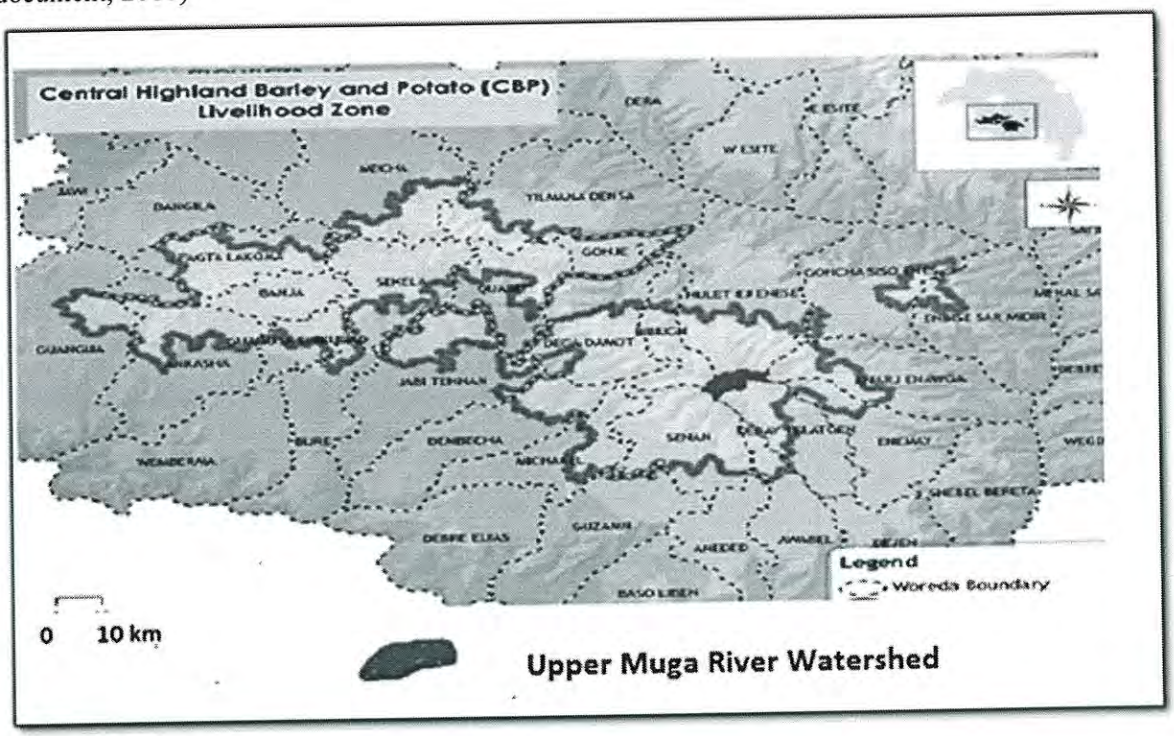


Figure 2 Map of the Study Site

Source: ANRS livelihood profiles, 2007

3.2. Research Approaches and Design

The research design is focus on cross sectional survey it assessed the overall activities at one shot. In addition, it uses both types of research approach, which is qualitative for the data that requires description and understanding of the climate change hazards impact on livelihood resources, project activities along with its contribution for the development of adaptation mechanism and capacity. Quantitative approach is also used for dealing with explanatory and descriptive type of data to make hypothetical-deductive analysis between the interdependent variables. Since this research has been undertaken under the open field condition, it included two types of research groups, which are quasi-experimental, between community based institution members and non-members.

3.2.1. Method of Data Collection

To ensure the research reliability, pilot test of the tools were implemented and reliability test also run using SPSS 19 version, as well the validity, different tools of data collection methods and sources were used and triangulated how, they differ or compatible in each process. The main data collection method used to address the research objectives are presented below

3.2.1.1. Household survey

The houses hold general information, key livelihood resources, and their status mainly the five assets (natural, physical, social, financial, and human capital), main climate change hazards, and its impacts on livelihood resources. Project activities, which have been implemented by community based institution with its implication to development of adaptation mechanisms and adaptive capacity, and livelihood improvement, were assessed by this method.

3.2.2.2. Focus Group Discussion

Four focus group discussions had been carried out with the two stratified categories in the Kebele, which is two from community based organization members comprising of one-group females, and the other group males. The second two groups were from non-organization members, which is similar to the intervention group. This is because to capture a gender disaggregated data from the

process. Each group comprises 6-8 individuals. The main objective of this method was to triangulate the survey method and investigate additional facts that were not addressed by the survey method.

3.2.2.3. Key Informant Interview

Key informant interviews and discussions had conducted with fourteen different individuals at Kebele and woreda levels. At the kebele level four farmers was selected, who have had expert knowledge and whose age is above 60(all males) to generate climatic data. Four community key informants who had given specific formation about the project, one Community Based Organization leader, one agriculture developments Agent, and one schoolteacher were participated to integrate the facts. In addition, at the woreda level one expert who is assigned project focal person, one cooperative expert and one Agricultural and Rural Development expert who is assigned as Natural resources conservation expert were used as key informant discussants.

3.2.2.4. Observation and photograph

To understand the overall conditions of topography, the cropland condition, patterns of the grazing land with its status, as well as how forest status and patterns are set at current times. Besides, to these; the main natural resources conservation mechanisms and/or methods that have been implemented by the local communities could be addressed by this method.

3.2.2.5. Document Review

To understand the project performances and effects due to the project activities; data from secondary source such as; published books from library and internet, unpublished documents at the kebele and woreda levels were reviewed. The documents were reviewed at the kebele level are; Development agent reports regarding to the project, Community based institutions report regarding to the project

3.3. Sample Size and Sampling Techniques

3.3.1. Sample size

Care has been taken to make the sample size of the study to be as representative as possible in accordance with the time and budget allocated. The rationale for deciding this sample size was based on factors like the homogeneity of population, cost of the survey, shortage of time, large number of

factors to be analyzed and the precision level required. The household number of the study area (Shime) kebele is 1337 from this 590hh are a member of Ambaber Community Based watershed development sustainable land management and ecotourism cooperatives. Therefore, the total sample size of the study was determined according to Israel in 1992 and it is equal to 94, but to increase the accuracy additional 2 persons added and of which 48 of them are CBO members and the remaining are non-members and sum it up equal to 96 respondents.

3.3.2 Types of Sampling and Procedures

The study involved a multistage sampling. The strategy to identify the study area and sampling procedures followed the following steps. First, the Zone and the Woreda was purposefully selected the reason this was justified in the problem statement section. Stratified sampling, the first categorical division is between members of the Community Based Organization and non-members of the institution. Second extended category is within the members and non-members of the institution by the wealth category, on equal basis in each category further, there is a need to address the gender balance between male and female ratio, in order to understand how both categories respond to climate change hazards therefore at 25% of the sample was female-headed households. After accomplishing the strata and having to the sampling frame, systematic random sampling was implemented in each stratum to accomplish the whole process.

3.4. Types of Data Collected

The main types of data that had collected were key livelihood resources characteristics (financial, social, natural, physical and human). Stress and shocks hazarded by climate change in this specific site (floods, drought, erratic rainfall...etc), and Key impacts of the climate change hazards on livelihood resources. Farmers adaption mechanisms and adaptive capacities due to the intervention.

3.5. Data Collection and Analysis Tools

3.5.1. Data Collection Tools

The main data collection tools that were used in this research project are Observation checklist, Key informant guide, Focus group discussion guide, Semi Structured Interview schedule (open ended, close ended and scale item questions are addressed) and project performance check list.

3.5.2 Data Analysis Methods

Explanation and description had been implemented for qualitative data. This study followed a kind of comparative analysis among CBO members and non-members of the sample households. Descriptive statistics such as mean, percentages and frequency were employed to analyze the gathered data. Measures of statistical significance like independent and paired sample t test, chi-square tests (x^2), one way ANOVA and bivariate correlation were used to analyze the hypotheses of independent variables against dependent variables.

3.6. Variables and Hypotheses

The variable, implementation of climate change adaptation mechanisms was analyzed as a dependent variable where the value of 1= implementation of the adaptation mechanisms activities where as 0= do not implement those adaptation mechanisms. The independent variables used in the analysis and a prior hypotheses are portrayed below

Age of household head it is hypothesized to it has inverse relation for implementation of those adaptation mechanisms

Sex of the Household it is hypothesized the probability of developing adaptation mechanisms of male household headed is significantly higher than that of female-headed house holds

Family Size it is hypothesized the probability of developing adaptation mechanisms of households of large family size is significantly higher than that of small sized house holds

Educational level it is hypothesized the probability of climate change adaptation mechanisms implementation of higher education level is significantly higher than that of lower level/illiterate

Land Holding Size it is hypothesized the probability of adaptation mechanisms implementation of large land holding size households is significantly higher than that of small size land holding/no land at all households

Number of oxen it is hypothesized the probability of adaptation mechanisms implementation of large number of oxen is significantly higher than that of small number/no oxen at all house holds

Wealth status it is hypothesized the probability of climate change adaptation mechanisms implementation of for better off and medium are significantly higher than that of very poor and poor households

CBO membership it is hypothesized the probability of developing adaptation mechanisms of CBO member households is the same to that of non-member CBO households.

Access to credit it is hypothesized the probability of climate change adaptation mechanisms implementation of have access to credit is significantly higher than that of no access of credit

Access to Agricultural extension service it is hypothesized the probability of climate change adaptation mechanisms implementation of have access to Agricultural extension service is significantly higher than that of no access to extension service

The dependent variables that are analyzed against the above independent variables are the implementation of the following activities;

- Soil conservation mechanisms (graded bund, cut off drain, waterway development and construction of check dams) Improve fertilizer utilization
- Compost preparation
- Improve irrigation utilization
- Afforestation
- Produce yield from new crops for the area
- Community forest protection and management
- Produce yield from new animals for the area
- Rehabilitation of degraded lands
- Area closure management and rehabilitation
- Improvement of animals through hybrid
- Feeding of animals using cut and carry system Plant early mature crops
- Feeding of animals through rotational grazing Prepare hay from crop residue
- Prepare hay from communal grazing Improve forage development
- Conserve local high yield and disease resistant varieties
- Utilization of fuel saving stove
- Generating income from off farm activities (wage labour, selling of grass, crop residues, fuel wood, commercial wood, spinning and basket making)
- Generating income from non farm activities (weaving, tanning, black smith, mini hotel activities, trading and remittance)

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1. The Socio Economic Characteristics of the Respondents

To give overview for the other sections presenting socio economic data is vital. This section specifically deals with the basic socio- economic characteristic of the households. The major characteristics included in this section are; age, education, sex, family size, land size, fertilizer and improved seed utilization, saving and credit access. The details of these and other respondents' socio economic characters are presented below.

Table 1: Socio Economic Characteristics of the Respondents

Age	Frequency	Percent	Education level	Frequency	Percent
Young(18-30)	20	20.8	illiterate	67	69.8
Adult(31-60)	55	57.3	read and write	25	26.0
Elder(above 60)	21	21.9	first cycle	4	4.2
Total	96	100	Total	96	100.0
Sex	Frequency	Percent	CBO membership	Frequency	Percent
Male	72	75	member	48	50.0
Female	24	25	non member	48	50.0
Total	96	100	Total	96	100.0
wealth category	Frequency	Percent	family size	Frequency	Percent
very poor	24	25	1-3	8	8.3
Poor	24	25	4-6	43	44.8
Medium	24	25	7-9	25	26.0
better off	24	25	10-12	20	20.8
Total	96	100	Total	96	100.0
food availability	Frequency	Percent	Oxen size	Frequency	Percent
full year	52	54.1	no oxen	4	4.2
9 months	29	30.3	1-2	64	66.7
6 months	10	10.4	3-4	23	24.0
less than 4 months	5	5.2	5-6	5	5.2
Total	96	100	Total	96	100.0
land size in timad	Frequency	Percent	Improved seed user	Frequency	Percent
no land	10	10.4	yes	37	38.5
Less than 1timad	17	17.7	no	59	61.5
1-3 timad	20	20.8	Total	96	100.0
3.1-5 timad	33	34.4	Fertilizer user	Frequency	Percent
5.1-7 timad	16	16.7	yes	34	35.4
Total	96	100.0	No	62	64.6
			total	96	100

Source: own field survey, 2011

In addition to the above socio economic characteristics, 35.4% and 37.5% of the respondents responded that the majority of their farmland is steep or very steep respectively. Critical observation and the focus groups discussion indicate there is an expansion of farmlands to the rangelands and cultivation of the steep and very steep slopes. As justified by the group discussion this is because of large population pressure in the area. As indicated/shown on the table, the socio economic characteristics of respondents is found to be with large family size, illiterate, fragmented land holding, low agricultural technology utilization (Improved seed and fertilizer) and they plough steep and very steep slope lands. Then it can generalize that the area is characterized by low socio economic condition and have low adaptive capacity if climatic hazards occurred.

4.2. The Key Livelihood Resources of the Study Area

To understand both communal livelihood condition of the area and main private livelihood resources a short meeting was made among few individuals and with two development agents. Based on the discussion, indicators of wealth were drawn according to local criteria of measuring. As a result, the size of farmland, number of oxen, cows, sheep and horses are found to be the major indicators of wealth in the area studied. On the bases of these, for a person to be called rich he or she should own one and above hectare farmland, two and above oxen, two and above cows, three and above sheep and two and above horses. On the other hand a household be grouped in a medium wealth category one should have *3 timad* (0.75 hectare of farmland), an ox, two to three sheep, a cow and a horse. Moreover, households are considered poor if they have an ox and (2 timad) 0.5 hectare of farmland, and very poor if they have below (1 timad) 0.25 hectare of farmland as well as nothing of these items. Then it is understandable from the survey data that the area key private livelihood resources in the area are farmland, oxen and other livestock resources (cows, sheep, and horses). The main communal livelihood resources include water body, grazing lands, and forests. The evidences obtained confirm also that 7% and 93% of respondents agreed that farmland is a very important and extremely important livelihood resource in that order. It also showed that 10% and 90% of the respondents explained number of oxen, number of livestock and water are very important and extremely important resources respectively. These all declared that the three resources are vital in the site. The forest and communal grazing land resources were mentioned as the key livelihood resources. 3%, 23% and 74% of respondents respectively claimed that it is important, very important,

and extremely important for forest resources. For communal grazing also, 20% and 79% of the respondents confirmed respectively that it is a very important and extremely important resource.

Next to these human resources, labor availability, education service, training, and health service resources come to second by getting 60% of respondents' verification, as they are very important. Moreover, 40% of respondents justified that they are extremely important. Social resources such as family support, social support and social relation resources lay on the 3rd position by having 55% of respondents saying very important and 45% of respondents saying they are extremely important. 4th are formal financial and social institutions such as market, credit, agricultural extensions, kebele administration offices, farmers' multipurpose cooperatives, sustainable land management and eco-tourism marketing cooperatives. These are called as the main livelihood resources with physical assets (a primary full cycle school, a health post, a farmers' training centre and communication structures) by having 50% respondents articulating very important and 30% respondents responding as extremely important livelihood resources. The argument extends agricultural technology resources (fertilizer and improved seed varieties) as the 5th important resources by confirming 50% of respondents giving their reasons as a very important one and 20% of respondents explaining them as extremely important resources. The other resources, which are mentioned important next to these, are informal social and economical resources such as *equb*, *idir* and *mahiber* to which 50% of the respondents responding, as they are very important and 15% responding, as they are extremely important.

This frequency description is also explained by the next pie chart. The pie chart shows the mean count of respondents on selected key livelihood resources of the project site from the value of ,1= not so much important, 2= important, 3= very important and 4= extremely important resource.

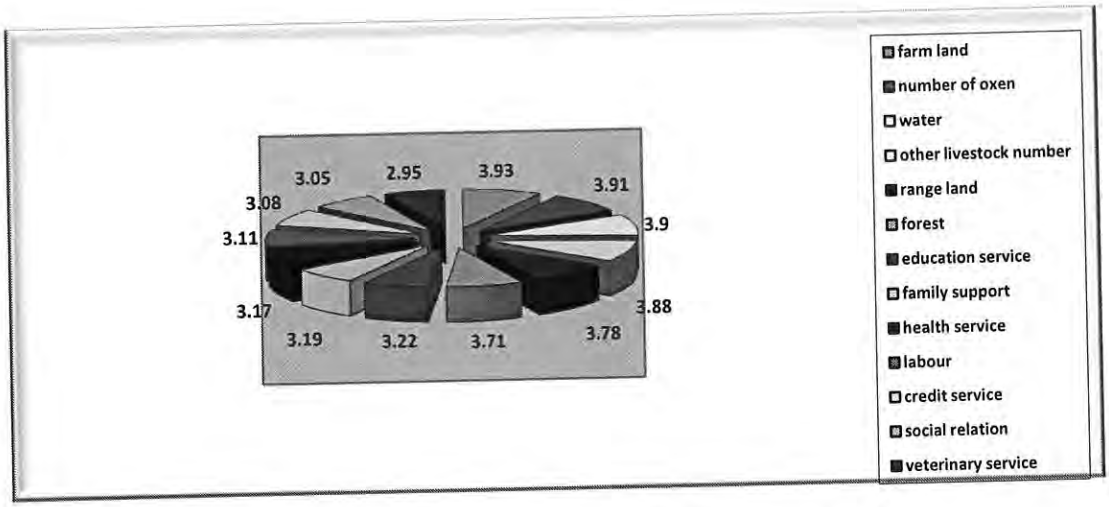


Figure 3: Mean Count of Respondents view on selected key livelihood Resources

Source: Own field survey, 2011

The choice and rank of these key livelihood resources are investigated using statistical analysis in terms of age, sex, wealth, educational level and land holding size. The x^2 analysis of the key livelihood resources indicates that labour is based on educational level: $p=0.00(X^2=22.5, df=4)$. Respondents with better off educational status believe that labour resource is very important. This implies due to their awareness they give more value for such types of resources. Likewise, forest and social relationship livelihood resources portray significant difference with wealth status and land size holding of respondents: $p=0.004(X=19, df=6)$ and $p=0.008(X^2=22.2, df=9)$, correspondingly. Wealthier respondent responded extremely important and very important than the other groups for social relationship and all very poor and less than 1timad land size holding and no land at all responded extremely important for forest livelihood resource. The cause of their variation may be the better off wealth more dependent on social relations to accomplish their tasks, where as the very poor and less/no land at all depend their lives on communal forest resources since they have no land to plant trees on and income to buy fuel for their consumption.

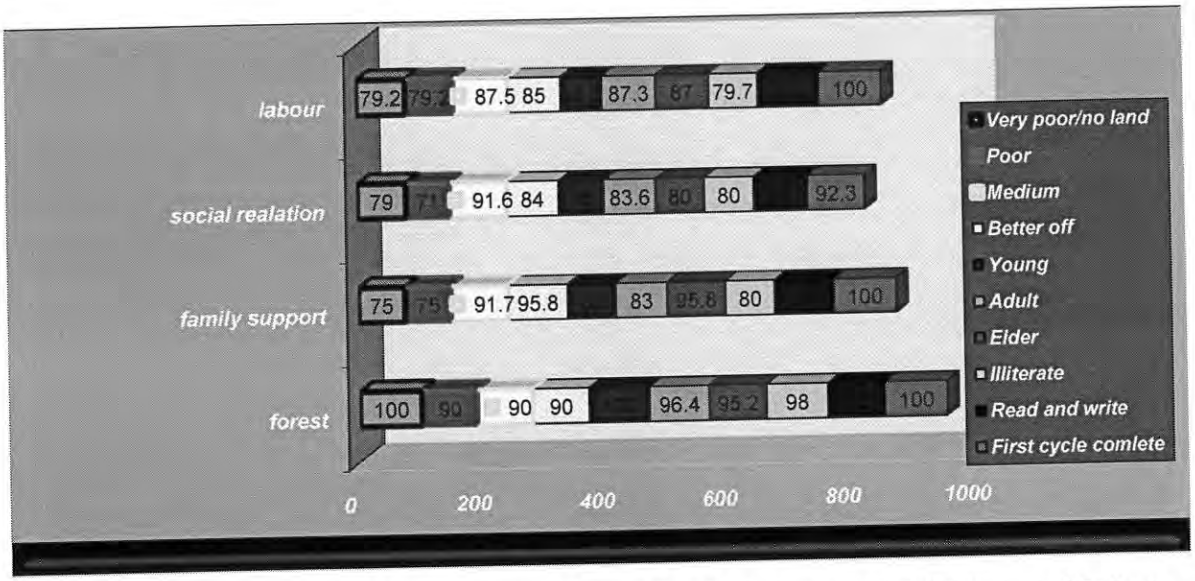


Figure 4: Different Community Groups View on Forest, Family Support, Social Relation, and Labour Resources

Source: Own field survey, 2011

This is because of the poor people depend on the communal and environmental sensitive resources since they have no other alternative to lead their lives (see also USAID, 2007; CIFOR, 2005 and IPCC, 2001)

The data obtained from the focus group discussion also supports all the above-mentioned arguments with few additional points. All the four focus group discussants confirmed that the aforementioned key livelihood resources with the addition of the area's topographic nature making the site extremely important not only for the local communities but also at the country level being the source of many rivers and biodiversity centre. As indicated by the survey results and focus group discussions it assures common natural resources (water, communal grazing land, forest) and private livelihood resources (farm land, oxen and live stock number) as a key critical resources by justifying the above facts. Further more, the two female focus group discussions justified their accepting the first six key livelihood resources. Subsequently to these they gave emphasis on adding the next items at the second place such as market, health service and grinding mill as critical resources.

The respondents' views towards the key livelihood resources are also supported by several literatures. These literatures appreciate the geographical importance of the sources of many rivers,

biodiversity and forest resources to maintain the area's biodiversity and water resources as well. Regarding the private, the key livelihood resources in the area for somebody to be poor and better off are also the same to this finding. Accordingly, for somebody to be said very poor he/she should have 0-2 *timad* (0-0.5ha) land, no oxen, and 0-2 sheep. Those in the poor category have 0-3 *timad* (0-0.75ha) land, 0-1 oxen, 2-4 sheep, and 1horse.Those in the medium/middle category have 3-5 *timad* (0.75-1.25ha) land,1-2 oxen,1-3 cattel,4-5 sheep, and 1 horse (ANRS, 2007). Then both communal and private key livelihood classifications of the respondents coincided with the literature except little differences regarding the wealth category division. This also occurred due to area specification since the livelihood zone assessment comprises 27 Woredas. These all lead to conclude that the above resources are really the key livelihood resources of the project site.

Based on the data obtained from and the literature reviewed, it is concluded that the area's key livelihood resources (financial and natural assets) are oxen, other livestock (sheep and horse), and farmland. The common natural resources (water body, mainly spring and river, communal grazing land and forests) are the key livelihood resources. In addition to this some literatures and the focus group discussions added the geographic importance of the site, which is characterized as a source of many rivers, all of which are the tributaries of Blue Nile, and it is a centre of bio diversity. Next to these, human and social resources are considered critically important resources when compared with other local livelihood resources.

4.3. Climate Changes, Vulnerabilities and Climate Change Impacts

4.3.1. Farmers View about Trend and Change of Temperature

This finding has examined three main indicators to understand climate changes in to the project site. These are trends of; temperature, rainfall, and wind pattern changes that are presented for each of them one by one in the following section. As described by the respondents, the trend is explained in two ways, the trend of hot day in a season and trend of hot season in a year bases changes. As a result, 33% and 60% of respondents said that there is an increasing and very increasing pattern of changes for hot days in the past few years. Similarly, 44% and 46% respondents responded that there is an increased and very increased hot season in a year basis, respectively. Then 90% respondents justified that hot season becomes long and its trend is increasing and/or very increasing. The respondents also demonstrated that there is a reduction and loss of snow cover, which was not

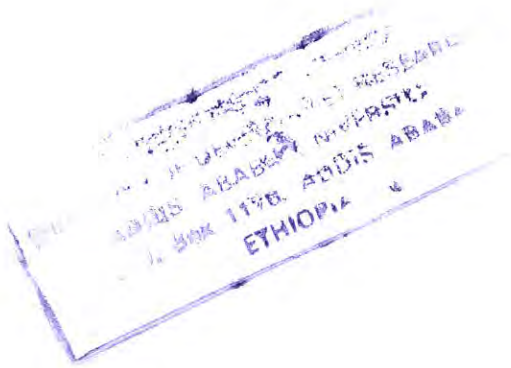
common before 30 years. This change works also the same to wearing style of the local communities. The loss of snow cover and change of wearing style of the communities are indicated by 92% and 87% of the respondents, consecutively. Furthermore, 70%, 78% and 90% of the respondents said they observed new animal disease, new crop and animal type due to temperature increase in the site, successively.

Before closing the section, let it present the data in terms of long experience in the site and it is better to see what is responded in terms of age. The X^2 shows p=0.000(df=4, X^2 =45) for different age category which has an implication of significant difference among age groups towards explanation of trends of hot day in the past 20-30 years. As the graph presented at the end of the section shows elderly and adult group respondents assured that there is a significant difference in the trend of hot day change than the youngest groups, and most of the youngest group said no change of trends. Hence, it is generalized that there is an increase in temperature in the area beyond what is explained by the above frequency, since temperature trend change needs experience and live in the area for longer time. Likewise, the X^2 distribution for hot season among age group indicates p=0.000(X^2=50, df, =4). The reason for this significant difference among age groups is similar to the hot day trend change mentioned above.

The data obtained from the focus group discussion also constitute with what is obtained from the survey. Nevertheless, it added some more issues. According to the discussion ,during summer if the hail rainfall rains, the snow cover remains on the ground 7-10 days. Now the snow is lost immediately after hail rainfall rains. In terms of coldness also, it was very cold almost throughout the whole year. During that, time the inhabitants of Choke wear thick cloth and "sheep skin" which is locally called "*Debello*" to resist the coldness. So far, coldness feels during raining times and early in the morning and the people adapts the area by wearing different kinds of cloths.

The trends of temperature increase pattern in Ethiopia explained by (NAPA, 2007). In addition, the 30 years trend of temperature analysis of both annual mean minimum and maximum temperatures in Debre Markos station shows continuous increasing trends (Bewket, 2010). The respondents' views agreed with some literatures and can be generalized there is an increment in temperature in the area that indicates one of the climate element is changing permanently.

To enrich the data by other tools, the investigation was made among four key informants whose ages are above 70 years and these results are similar to the above facts.



Box 1: Elder People Witness about the Climate Trend of Choke Mountain Area

According to k1 whose age was 72 and could be observe to give comparative explanation of the temperature condition of the Choke site now and before 30 years he justifies it changes from "wurich" and "dega" to "wenadega" and "kola" types of climate zones which are the characteristics of lower altitude sites by referring to the neighborhood woreda called Enemay. The daytime becomes hot which was not the attribute of the site before 30 years and the density and time coverage foggy days now becomes much decreased. Another key informant (K2) validated these all arguments. Another key informant (K3), whose age was 75, also confirmed the situation as follows; he added a few more things as the density of fog was very thick even some one could not see and differentiate things from a distance of 100 meters. The people expressed its density and thickness in Amharic as "yegume sir enkurte" literary means "Let's cut the roots of the fog", since it was too thick and dense. Nevertheless, it is now common to see clear sky every season. He extended his argument saying that adapting of new crops, which are called peas and beans; new animal to the area, which is called goats, can adapt and live in the area, which was not observed previously. New animal and crop diseases that are common phenomenon of lowlands like Trypanosomasis (Aselege, in Amharic); aphids (keshekesh, in Amharic) become common phenomenon to the site.

Still another Key informant (K4), whose age was 78, also gave the same feedback as the previous three. Moreover, he added that the hot days as well as the cold times especially in the morning are very sensitive to living. Coldness and hotness interchange with in small interval including in an hour time, which was not a common phenomenon in the area before 30 years. Additionally, it was very common to observe large snow cover in the mountain peaks in Novembers and Decembers, but now it has become impossible. He also beard out that if hail rain, rains, the snow remains on the ground for one to two weeks. He extends his argument and validated the previous verifications is that every local community has 7-8 sheepskin cloths, which is locally called "Debello. In addition, 3-4 thick cloths made up of grass to protect themselves from fog and rain called "Gessa". However, few individuals now put this type of cloth as the museum to remind that time

Source: Key informants, 2011

4.3.2. Farmers view about Wind Pattern Change

There is a remarkable change regarding this element, wind, in the area compared to 20-30 years back. 13.5%, 72.9% and 13.5% of the respondents asserted that the increased pattern is with no change, increased and very increased pattern of blowing of strong winds in the site respectively. With regarding to the area exposure by strong and unfamiliar wind within 20 years basis the area is characterized by more exposure of to these hazards and these events is described by the table at the end of the section.

Similar to temperature trend, the trend of wind across time is analyzed among age groups, the X^2 shows p=0.000(X^2=30, df, =4). It implies a significant difference among them. Those elderly people justified that there is more strong wind occurrence in the area than other groups. This is made because to understand climatic pattern change in a specific site, experience and living longer time in that place are so important. Therefore, it can be generalized that the wind pattern change in the site is greater than what is presented by the frequency. The data generated from the key informant supports the above facts.

4.3.3. Farmers View about Rain Fall Trend Change

The trend of rain fall amount, duration, intensity and variability, along with temperature and wind pattern trend changes over time in the study area is presented by the below line graph

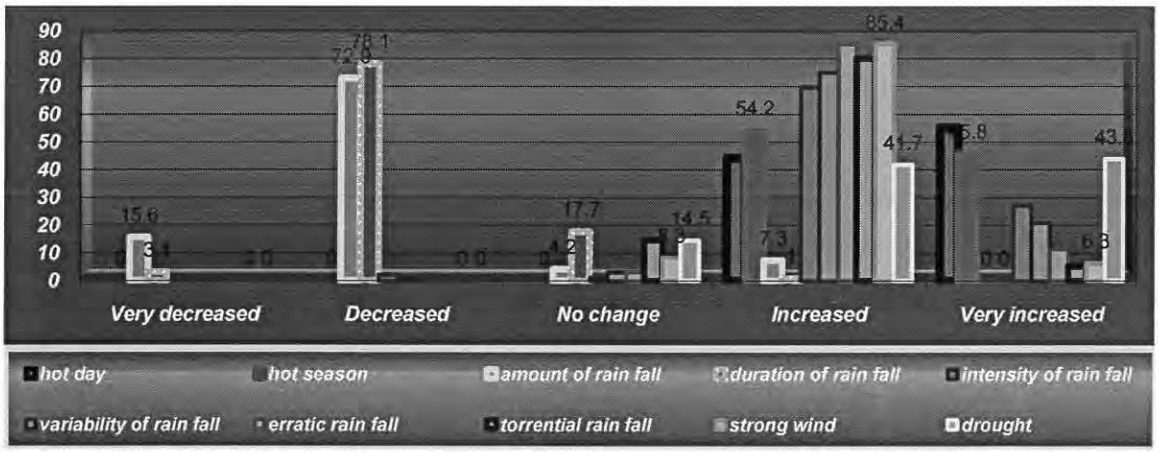


Figure 5: Summarized Climatic Element Pattern Graph of the Study Site

Source: Own field survey, 2011

As indicated by the graph all patterns of climatic element trends are on the position of increasing or very increasing except the amount and duration of rainfall become on the trend of decreasing and very decreasing position. This all indicates the respondents have noticed that there is a permanent pattern change, in temperature, rainfall, and wind. The result of the study demonstrated that there is a disturbance and a change in amount, duration, intensity, and variability of rainfall together with an increase pattern of drought.

The frequency data shows those of elder groups show proportional difference for both the trend decrement and increment climatic trend elements therefore, for further confirmation, these variables are computed among age groups using statistical analysis and the results are presented as follow. The amount and duration of rainfall the X^2 analysis indicates p=0.000 (X^2=30.7, df=6), and p=0.000 (X^2=56.7, df, =6) respectively. This implies significant difference among age groups. The main reason for this difference is that those elderly people justified as there is a decreasing and very decreasing amount and duration of rain fall than the other groups and the adults supported this fact, but the youngest did not go with equal proportion to the other groups as demonstrate by the next graph. The trend of variability and intensity of rainfall and drought occurrence trend analysis among the age groups, the X^2 of those three trends shows there is a significant difference among age groups. In the statistical analysis of Variability p=0.00(X^2=81.9, df=6), intensity p=0.000(X^2=64.5, df=4) and drought p=0.000(X^2=56.3, df=4). Those elderly respondents responded that there is a large increase of variability, and intensity of rainfall, as well as drought than other groups and adults agreed on more variability, intensity, and drought frequency trend than youngsters. Similar differences are observed in the trend of torrential and erratic rainfall trend in the area. The X^2 for erratic rain fall p=0.001, (X^2=19.7, df=4) and for torrential rainfall p=0.000, (X^2=27.4, df=4), as mentioned before those experience and live longer time in the area justify there is a very increase and an increase of torrential and erratic rain fall trend than the other groups. The magnitude of change is greater than what is demonstrated by the frequency table. Finally, from the overall analysis it could conclude that climatic elements change in the project site is so significant and observed by those experienced people. Then, like the above climatic elements, generalization these trend changes are so large when explained by those experienced people and the trend change is beyond what displayed on the frequency table. For further clarification, those respondents who respond there are an increment and very increment in climatic elements based on age groups.

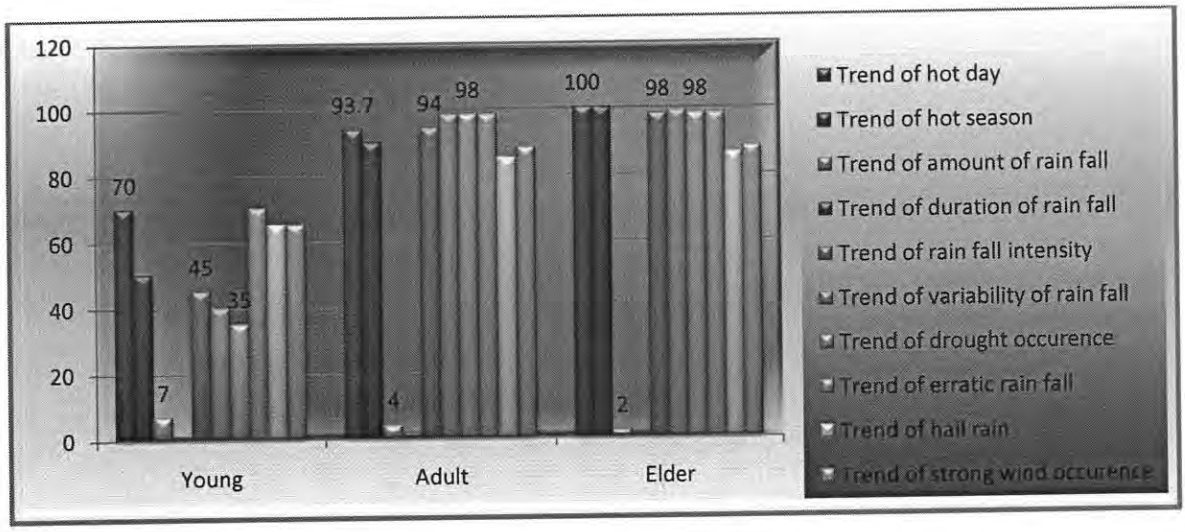


Figure 6: Respondents View on Climate Pattern Change Based On Age Groups

Source: Own field survey, 2011

Regarding the amount and intensity of rainfall there are controversial literatures. Climate models suggest an increase in global average annual precipitation during the 21st century (IPCC, 2007c) and these changes of precipitation will vary from region to region. An increase in the intensity of precipitation events, particularly in tropical and high-latitude region that experience overall increase in precipitation also predicted. Even if this literature noted regional precipitation projections from climate models must be considered with caution because they demonstrate limited skill at small spatial scales (IPCC, 2007d). Similarly, the Debere Markos site recorded data on rainfall from 1970 to 2007 shows that the annual and seasonal rainfall total followed an increased trend over the period; however, it is characterized by great seasonal variations. Due to this, the research finding assures an increase in flood and drought frequency, and change in the timing of rains (Beweket, 2010).but this argument contradict with (WB, 2007b) there is decrement trend of rain fall amount in Ethiopia

All focus group discussion, the literatures, and the key informants' evidence coincide with the survey analysis, except such literature contradictions in amount of rainfall. What the key informants add are described in the below box.

Box 2: Elder People Saying about Rainfall and Wind Pattern Trend of the Study Area

As k1 assured there is a significant increase of drought frequency, and in most seasons, the rainy season comes lately and leaves early. Additionally, as well the rainfall intensity before 20-30 years was small with long duration. Sometimes the rainfall duration covers two to three days without breakage. Now the area is characterized by high intensity with short duration.

K2 also validated this idea by referring specific years of severe drought, such as 1976, 1987, 1989 and 1991E.C. Likewise, the drought of 1991 E.C was very sever and there was a great livelihood resources loss in the area. Concerning the intensity and duration of rainfall, this argument is similar to the previous key informant. What he added is the erratic nature of the rainfall. Before 20-30 years he said, its pattern was regular beginning from March and ending October but now there is a rainfall in December and January that is not a common phenomenon in the area.

Moreover, another K4 key informant assures, not only are the rains falls and temperature pattern changed but also the wind pattern. He assured that there is strong wind now that is different from what was there before 30 years. The wind blow is also dry then it makes the crop wilt and the land dry. Nevertheless, even during winter there was no rain former time the Choke mountain soil was known by holding proper moisture through out the year. Then it results in reducing productivity in the area.

Source: Key informants, 2011

On the bases of all these, it is concluded that there is a significant temperature, rain fall and wind pattern change and accordingly it is generalized that the area is characterized by climate change. The investigation agrees with all the above literatures in terms of rainfall variation, increment of intensity, and frequency of drought. What remains for the debate is the amount of annual rainfall. As mentioned above the WB, 2007b and Bewket's Debre Markos station analysis show an increment, however, the World Bank literature it demonstrates rainfall decrement trend. Then, what it concluded is the IPCC lacks area specificity. On the other hand, the project site and Debere Markos Town lay at

different Agro Ecological Zones. The project site lies on Dega and wourich type but Debere Markos is characterized by Woiena dega type of climatic zone. Then it is difficult to accept the Debere Markos station data to the study area. In addition, the primary evidence shows there is a decrement of rainfall in this specific site.

4.4. The Vulnerability of the Project Area

Vulnerability is nothing but the interaction of the area with such analytical frameworks as sensitivity, degree of exposure and adaptive capacity.

4.4.1. Area Sensitivity

It is the access and the status of private and communal owned livelihood resources such as, economical, social, physical, natural, and human resources. The details of each based on the finding of the study are presented below:

As distinguished in the key livelihood resources section, it has been identified that farmland, oxen and other livestocks are critical resources. Now it is the time to look in to the status of these key livelihood resources particularly before the intervention of the project.

Table 2: Key Livelihood Resource Status before the Intervention

Resource type	Status	frequency	percent	Resource type	Status	frequency	percent
Soil fertility status	very infertile	43	44.8	land productivity	medium	15	15.6
	infertile	53	55.2		low	55	57.3
	Total	96	100.0		very low	26	27.1
Forest resource	very degraded	27	28.1		Total	96	100.0
	degraded	67	69.8	Social relation	Weak	30	31.3
	Good	2	2.1		moderate	42	43.8
	Total	96	100.0		strong	24	25
Livestock production status	medium	30	31.3		Total	96	100.0
	Low	51	53.1	institution linkage	Weak	26	27.1
	very low	15	15.6		moderate	53	55.2
	Total	96	100.0		strong	17	17.7
Land degradation	moderate	14	14.6		Total	96	100.0
	severe	49	51.0	Do you Save	Yes	21	21.9
	very severe	32	33.3		No	75	78.1
	Total	95	99.0		Total	96	100

Source: own field survey, 2011

As indicated above table and on socio economic characteristics, the farmlands of the respondents are fragmented, less productive, severely degraded, and the soil is infertile and very infertile. Further the majority farmland slopes is characterize by steep and very steep and it is sensitive to erosion. Besides, 97% of the respondents agreed that there was high soil erosion in the area and only 3% from the total population responded in a different way. Likewise, about 70% of the respondents reported that the causes of soil erosion are poor cultivation, steep slope cultivation, torrential rainfall, increased deforestation and over grazing on grazing lands. At the comparable time 100% and 55% of respondents used cow dung and crop residue respectively, as sources of biomass energy for their energy consumption and there is a continuous clear up of these resources rather than decompose in the soil. This indicated that the farmland status of the site before the intervention was very poor due to the above mention challenges. The data from the focus group discussion and critical observation showed that the farmland, even at current time, not managed by the project is still declining. Not only the natural assets are in the poor status condition but also the social relation and the institutional linkage along with income saving capacity are weak and very low respectively. These all leads the area was very sensitive to damage if hazards had been emerged. Next, let it understand the trends of change these key livelihood resources, the data obtained from the respondents shows the status trends of these resources were on the way of decline and very decline trends. These details are presented by the below table

Table 3: Key Livelihood Resource Status Trend of Change before the Intervention

Resource type	Trend of change	Frequency	Percent	Resource type	Trend of change	Frequency	Percent
Soil fertility	decreased	73	76.0	Crop land productivity	decreased	88	91.7
	no change	23	24.0		no change	8	8.3
	Total	96	100.0		Total	96	100.0
Annual income	increasing	28	29.2	Forest resource	decreased	88	91.7
	decreasing	51	53.1		no change	8	8.3
	very decreasing	10	10.4		Total	96	100.0
	no change	7	7.3	Soil erosion	no change	4	4.2
	Total	96	100		increased	62	64.6
Water resource	very decreased	35	36.5		very increased	30	31.3
	decreased	61	63.5		Total	96	100.0
	Total	96	100.0	Local food supply	increasing	28	29.2
Range land productivity	very decreased	35	36.5		decreasing	62	64.6
	decreased	60	62.5		no change	6	6.3
	no change	1	1.0		Total	96	100.0
	Total	96	100.0				

Source: own field survey, 2011

As shown on the *table 3*, land productivity decreases and high erosion in the area consequently, it is lead that the trend of income and food supply of the site, was on a declining state. As a result, one basic question raised in the discussion was what made the things worse. First, the farmland status was on the position of losing its soil fertility, and land productivity was on sever and very severe state with no soil conservation culture. The other one is that local communities did not use agricultural technologies, especially fertilizer and improved seed as indicated in *table 1*. The main reasons for this are two: the costly nature of the inputs and fear of natural hazards associated with climate change signifying for 60% and 65% of the respondents respectively. They endorsed that they were not using fertilizers because of these two rationales. Accordingly, it is generalized that why local communities do not adopt technologies is not simply because of ignorance but because their livelihood status is subsistence; they could not handle the costs and natural hazards affect their livelihoods due to climatic changes. As a result, the local communities were not economically well doing. The focus group discussion gave also witness and confirmation to validate this issue in the project site. The data found from the focus group discussion and key informants matched this evidence. Furthermore, such factors as deforestation, lack of proper water resource management, and existence of border conflict between the project site and bordering kebeles are accounted whereas the geographical nature of the area makes it vital and centre for biodiversity. However, the key livelihood resources are diminished, especially forest resources status was under question. In addition to this, 57% of the respondents confirmed that the source of bio fuel energy comes from communal forests. Subsequently, it leads the area to be degraded and highly vulnerable to climate change before the intervention.

All the above the poor status and the decline trend of the resource status of the area are also rationalized by the literatures (ANRS, 2007; Belay and Shibru, 2007; Belay, 2007; MDGNA, 2004, and Azmeraw, 2010). Both the finding and the literature substantiate that the areas livelihood resource status were low and very low, and it was extremely further declining and worse for those very poor and poor communities.

4.4.2. Degree of Exposure

This section deals with at what extent the study area is exposed to climatic hazards; these events are presented in the climate change indicator and pattern of change section. What is added in this section

is that at how much times these hazard events were frequent in the site. This details are presented by the below table.

Table 4: Respondents View about Exposure for Climatic Hazards

Hazard type	Frequent of occurrence	frequency	percent	Hazard type	Frequent of occurrence	frequency	percent
Drought	2-3 times	47	48.9	Torrential rain fall Total	2-3 times	30	31.3
	4-5 times	33	34.4		4-5 times	43	44.8
	6-7 times	14	14.6		6-7 times	20	20.8
	>7 times	2	2.1		>7 times	3	3.1
	Total	96	100		Total	96	100
Flood	2-3 times	29	30.2	Strong wind	2-3 times	48	50.0
	4-5 times	31	32.3		4-5 times	27	28.1
	6-7 times	20	20.8		6-7 times	17	17.7
	>7 times	16	16.7		>7 times	4	4.2
	Total	96	100.0		Total	96	100
Erratic rain fall	2-3 times	40	41.7	Rain fall comes lately	2-3 times	7	7.3
	4-5 times	30	31.3		4-5 times	22	22.9
	6-7 times	22	22.9		6-7 times	38	39.6
	>7 times	4	4.2		>7 times	29	30.2
	Total	96	100		Total	96	100
Hail rain	2-3 times	44	45.8	Rain fall Leaves early	2-3 times	4	4.2
	4-5 times	33	34.4		4-5 times	22	22.9
	6-7 times	8	8.3		6-7 times	32	33.3
	>7 times	11	11.5		>7 times	38	39.6
	Total	96	100		Total	96	100

Source: own field survey, 2011

Moreover, regarding the trends of the entire elements above the respondents certified their trends are increased and very increased; these trends are displayed at figure 5 in this section. When it examines the soil erosion trend due to the above unfamiliar climatic trends, 75% and 23% of them gave a witnessed for increasing and very increasing trend respectively.

The focus group discussions held with represented individuals confirmed the fact, as it is a day-to-day common phenomenon of the site. To this end, the area is characterized by high exposure to climatic change related hazards resulted due to an increased temperature. Due to this, new human and animal diseases and crop pests are emerged and distributed, these all are attached in table 7 below in hazards impact section.

This fact was assured by Choke Mountain farming community. Prevalence of human, animal and plant diseases that were uncommon in the area became common. Moreover, increased drought and

flood frequency, rainfall comes early or lately, dry up of water bodies, shortening of plants growing period become the common phenomena. Moreover, as noted by Bewket (2010), loss of some plant and animal species, reduced agricultural products, and decline of soil fertility, change, with larger proportion of respondents in the highland, highly significant ($p<0.01$) trends was observed in increased drought and flood frequency, rainfall distribution, decline of soil fertility or productivity, and decreased available water.

4.4.3. Adaptive Capacity

As it mentioned in the literature review, adaptive capacity includes available technological options, resources and their status, the structure of critical institution and decision making authorities, the stock of human capital, the stock of social capital, the system's access to risk-spreading processes, information management and the credibility of information supplied by decision makers. For evidence, some of the physical and social capital resource access are presented by the below table.

Table 5: Infrastructure Access of the Study Area

Access to institutions/ Information	Responses	frequency	Percent	Distance from the site	Access to institutions/ Information	Responses	frequency	Percent	Distance From the site
Gravel road	yes	96	100	3-6km	multipurpose cooperative	Yes	90	93.8	7km
Primary school	yes	96	100	4-6km		No	6	6.2	
Health post	Yes	92	95.8	7km	Amhara Credit &Saving Institution	Yes	28	29.2	30km
	No	4	4.2			No	68	70.8	
Health centre	Yes	30	31.2	30km	Health information	Yes	57	59.4	
	No	66	68.8			No	39	40.6	
Farmers Training Centre	Yes	76	79	7km	Market information	Yes	61	63.5	
	No	20	21			No	35	36.5	
Improved seed supplier	Yes	24	25	30km	Climate related information	Yes	17	17.7	
	No	72	75			No	79	86.7	
Veterinary clinic	Yes	88	91.7	7km	Credit service	Yes	49	51	30km
	No	8	8.3			No	47	49	

Source: own field survey, 2011

The resource status and their trends are presented in this section above in the system sensitivity part and some of the socio economical characteristics of the respondents are presented in table 1 in the socio economic description part.th above table shows the resource access. As it has been indicated on the table, the respondents recognize and acknowledge the access of the primary school and gravel car

road. The other resources are found at least far from 7 km from the watershed site and they are less dense to serve for adaptation purposes. Moreover, most of the infrastructures found at the woreda capital did not aware by the respondents. Besides, to this as indicated in *table 1* in the socio economic section the respondents are in a position of low agricultural technology utilization mainly fertilizer and improved seed, most of them are illiterate and there is high land fragmentation and plough very steep slopes accompanied by high erosion.

Table 6: Respondents View about the Local Infrastructure Service Status

Infrastructure	Status of services	frequency	Percent	Infrastructure	Status of services	frequency	Percent
Gravel road	I don't know	0		Improved seed supplier	I don't know	2	2.1
	Not good	32	33.3		Not good	76	79.1
	Good	64	66.7		Good	18	18.8
	Total	96	100		Total	96	100
Primary school	I don't know	0	0	Veterinary clinic	I don't know	4	4.2
	Not good	16	16.7		Not good	75	78.1
	Good	80	83.3		Good	17	17.7
	Total	96	100		total	96	100
Health post	I don't know	1	1	Fertilizer supply institution	I don't know	6	6.5
	Not good	79	82.3		Not good	72	74.7
	Good	16	16.7		Good	18	18.8
	Total	96	100		total	96	100
Health centre	I don't know	1	1	Credit supply institution	I don't know	9	9.4
	Not good	82	85.5		Not good	78	81.2
	Good	13	13.5		Good	9	9.4
	Total	96	100		total	96	100
Farmer Training Centre	I don't know	1	1	Climate Related Information	I don't know	11	12.4
	Not good	78	81.3		Not good	83	85.5
	Good	17	17.7		Good	2	2.1
	Total	96	100		total	96	100

Source: own field survey, 2011

As it signify by the table the existed infrastructures at the kebele and woreda level described as not on the way of good and very good position rather than most of the respondents responded their services are on the way of not good and they did not satisfied by the service of these infrastructures. Additionally, the institutional linkage and responsibility to conserve and manage natural resources is examined. It was confirmed by 76% of the respondents that it was in a low status.

The focus discussions supported the above facts with a few additional points. Before the project intervention, conservation and protection of natural resource culture, financial, institutional set up

and linkage to respond for climatic hazards especially for management of communal rangelands, forests, and water body resources were low. Moreover, there were and still there are conflicts between the project site and neighboring kebeles as well as some internal conflicts within the watershed site, which contribute to the unwise use of these resources. All these factors have made the resilience capacity of the environment so low together with low economic status, low technology utilization, low environmental awareness, and absence of institute responsibilities and linkage to manage the natural resources.

The other point focus group discussions held with those who are most vulnerable verified that the poor and the very poor groups become the victims of those hazards. They justify the magnitude of severity in Amharic called "Yalew Yikenisal, Yelelew Yimotal" literally means someone who is rich or on the position of better off wealth status can adapt the climatic hazards even if his wealth decreases other than somebody on the position of poor. However, the poor probability of existence becomes less and his chance is died by the hazards. The ANOVA for wealth category and independent t test for gender details of climatic hazards impact among the group are attached in annex III and V respectively shows similar meaning what is justifying by the group discussion. Standing from all this it can conclude that the area is characterized by low adaptive capacity to handle climatic change hazards and the poor and women are more vulnerable to climate changes.

The existing literatures also support the findings that climate changes affect natural and human systems independently or in combination with other determinants to alter the productivity, diversity, and functions of many ecosystems and livelihoods around the world. Yet these impacts will not be distributed or felt uniformly, as those "with the least resources have the least capacity to adapt and are the most vulnerable." The poor are already vulnerable to climate risks (IPCC, 2001). The majority of the world's poor are the most vulnerable to climate change. Especially, poor women are more likely to become direct victims of climate change disasters ,further Climate change thus risks magnifying existing inequalities and reinforces the disparity between women and men and their capacity to cope (IFAD, 2009).

4.5. Impacts of Climate Change Hazards on Key Livelihood Resources

4.5.1. Negative Impacts on Key Livelihood Resources

In this section, the study shows at what extent these hazards make an effect and damages on these key livelihood resources identified in the section 4:2 above (farmland, livestock, rangeland, forest and water resources) and their income are examined. As it was discussed, the area is highly exposed to strong soil erosion and flooding and these result in the declining of soil fertility status.

Table 7: Climatic Change Hazards Impact on Key Livelihood Resources

Damaged resource	Extent of damage	frequency	Percent	Damaged Resource	Extent of damage	frequency	Percent
Reduction soil fertility	medium	19	19.8	Washed away Seed and Fertilizer	medium	26	27.1
	high	38	39.6		high	57	59.4
	very high	39	40.6		very high	13	13.5
	Total	96	100.0		Total	96	100.0
Water quality and quantity	medium	21	21.9	Reduce Food supply	medium	24	25.0
	high	60	62.5		high	50	52.1
	very high	15	15.6		very high	22	22.9
	Total	96	100.0		Total	96	100.0
Cause for Water born human diseases	low	42	43.8	Reduce saving Capacity	low	13	13.5
	medium	18	18.8		medium	28	29.2
	high	36	37.5		high	48	50.0
Reduction education enrolment	Total	96	100.0		very high	7	7.3
	medium	53	55.2		Total	96	100.0
	high	39	40.6	Reduce credit Utilization	low	10	10.4
	very high	4	4.2		medium	40	41.7
	Total	96	100.0		high	42	43.8
Cause for labour migration	low	25	26.0		very high	4	4.2
	medium	27	28.1		Total	96	100.0
	high	41	42.7	Enhance new animal disease	low	9	9.4
	very high	3	3.1		medium	51	53.1
	Total	96	100.0		high	31	32.3
Enhance new Crop Pest	low	10	10.4		very high	5	5.2
	medium	38	39.6		Total	96	100.0
	high	45	46.9	Crop damage By hail rain	medium	20	20.8
	very high	3	3.1		high	64	66.7
	Total	96	100.0		very high	12	12.5
					Total	96	100.0

Source: own field survey, 2011

As described by the table the climatic hazards resulted in medium and high damage on the livelihood resources of the study area. Based on the finding it could be said that impacts have a great implication for the area livelihoods to be subsistence and poverty to be rampant.

Furthermore, the distribution of these impacts among wealth and age groups and between genders groups are analyzed using one way ANOVA and independent sample t test. In all cases $p>0.05$, such as reduction of soil fertility, crop damage by pests, crop damage by hail rain, reduction of forest size and water volume of the area as well as the increment of fertilizer and seed washing away by erosion. This means there is insignificant difference among the different community groups. This implies that these hazards are affecting the local community equally without significant difference and a problem of all local community. On the contrary, the independent sample t test based on gender in shortage of drinking water, weakening of public support, reduction of family education enrolment; increase of migration from the area, reducing saving capacity and credit utilization, reducing food supply, and reducing agricultural input utilization shows significant and these details are attached in annex II, III and V. This is also indicated by the next mean climatic hazard impact count between the two sexes.

Table 8: Mean Climatic Hazard Impact between Gender Groups

Types of impact	Male	Female
Drinking Water shortage	2.5	3.38
Weakening of public support	1.96	2.6
Reduction of family education enrolment	2.01	2.71
Increase migration from the area	1.78	2.58
Reduce saving capacity	2.19	3.04
Reduce credit utilization capacity	2.13	2.96
Reduce food supply	2.25	3.25
Reduce agricultural input utilization	2.11	2.79

Source: Own field survey, 2011

The male mean count on average basis indicates the impact of hazards on their lives are medium, where as the female count indicates high. The independent sample t test and mean climatic hazard impact count between the two sexes indicates that female groups are sensitive and more damaged by the climatic negative impacts than male respondents. This implies that the climatic hazard impact not only at the current times weakened the women household headed but also the future adaptive capacity, since it restricts technology utilization and reduces the saving capacity.

Similarly, one way ANOVA among different age groups for the hazard impact such as; on shortage of fuel wood p=0.001(F=7, df=2),weakening of public support p= 0.000(F= 12.7, df=2),weakening of local institution support p=0.000(F=13.5, df=2). Moreover, reduction of family education enrolment, p=0.000(F=14.7, df=2), reduction of family support, p=0.000(F=13.6, df=2), reduction of saving capacity, p= 0.000(F=10.7, df=2) and reduction of credit utilization p=0.000(F=11.2, df=2). It extends also reduction of agricultural input utilization, p=0.000(F=13.3, df=2) and increasing local food shortage p=0.000(F= 20.6, df=2) are depicted next. These all-significant differences are also supported by the mean climatic change hazard impact count among different age groups.

Table 9: Mean Climatic Hazard Impact among Age Groups

Types of damage	Young	Adult	Elder
Shortage fuel wood	2.8	2.41	2.98
Weakening of public support	2.5	1.81	2.6
Weakening of the support from local social institution	2.55	1.77	2.5
Reduction of family education enrolment	2.65	1.85	2.64
Reduction of Family support	2.6	1.54	2.55
Reducing saving capacity	2.85	2.03	2.98
Reducing credit utilization capacity	2.85	1.95	2.83
Reducing agricultural input utilization	2.8	1.92	2.74
Increasing local food shortage	3.0	1.95	2.88

Source: Own field survey, 2011

The adult mean count on average basis indicates that the impacts of the hazards on their lives are medium, where as the youngest and elder group count indicate high. There is also a significant difference among different age groups. It also shows which group is more vulnerable to the hazards with magnitude. Most significant difference is observed between the adults and the youngsters as well as between the adults and the elders. All these details are shown by the multiple comparisons attached in Annex II. The adults are less vulnerable to those of youngsters and elderly groups. This is may be because the adults have more experience than the youngsters to cope with the hazards do. On the other hand, the significant difference between the elders and the adults indicates that not only experience but also capability and capacity have a value to handle the hazards.

Likewise, the one-way ANOVA analysis based on wealth is made. The result for shortage of fuel wood, absence of public support, local institution support, rate of damage by water born diseases, reduction of family education, migration rate, extent of livestock damage by the new diseases,

absence of saving and credit utilization, agricultural input utilization, labour wage rate and food shortage are indicated in all cases p= 0.000(df=3). Except the fuel shortage case p= 0.002, but F value varies and (F value lies =5.2—90).In addition to this the multiple group comparisons value among the groups are attached in the annex III. These significant differences among the groups are also indicated by the next mean climatic hazards affects count among different wealth status groups.

Table 10: Mean Counts of Climatic Hazards Impacts, Among Wealth Status Groups

Types of impacts	Very poor	Poor	Medium	Better off
Shortage of fuel wood	2.92	2.71	2.63	2.21
Reduction of public support	3.04	2.5	1.5	1.46
Reduction of local institution support	2.71	2.71	1.5	1.46
Rate of damage by water born disease	2.75	2.13	1.0	1.33
Reduction of family educational enrolment	3.04	2.71	1.5	1.5
Rate of migration from the area	3.04	2.71	1.33	1.33
Extent of Livestock damage by new emerging diseases	2.63	1.88	1.46	1.67
Reduction of saving capacity	3.46	2.88	1.54	1.75
Reduction of credit utilization capacity	3.38	2.79	1.5	1.67
Reduction of agricultural input(fertilizer and improved seed)	3.0	2.83	1.54	1.54
Reduction of labour wage rate	3.25	2.54	1.58	1.54
Food shortage	3.38	2.79	1.75	1.58

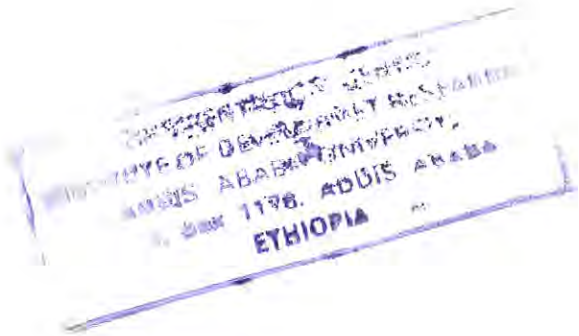
Source: Own field survey, 2011

The very medium and better of mean count on average basis indicate that the impact of hazards on their lives are medium and low, where as the very poor and poor count indicates high. The table shows the magnitude difference among the wealth status and the poor and the very poor are more damaged by the hazards than the medium and the better off. The detail multiple group comparisons, which is, attached in the annex III shows that in most cases there is no significant difference between the very poor and the poor and also there is no significance difference between the medium and the better off. Therefore, the significant difference shown is between the very poor and medium, between very poor and better off, between poor and medium, and between poor and better off. Then it can be generalized that the poor and very poor are greatly affected by the climatic hazards than the medium and the better off wealth groups status.

The focus group discussion revealed more or less the same to the survey, but what is added is owing to the change in the pattern of temperature and rainfall in the area. A number of animal diseases are emerged which were not common before 30-35 years. Like "Aselege" (Trypanosomisis), "Deremen"

(Ulcerative Lyphangits) and "kuro" (upper respiratory infection) on horses. "Kufegne", "Berer" (faciola/bootle jaw/) "Nefesha" on sheep, crop diseases such as Smut, Rust, Early and late blight, and "keshe kesh" (aphids). The lands become dry, reduce productivity, and lead to drying of forage, crop, and forests. As the group argues, the area was productive before 20 years opposite to the current phenomenon. Since strong wind is now a common phenomenon of the area, it makes the crop, forage and forest trees become and die. Furthermore, this makes soil loss moisture quickly. It also makes the land too hard to plough and decreases its' productively tremendously. The strong wind not only damages livestocks, land, soil and crop but also their houses. The house of the local community damaged by this hazards and on the kebele level about 25-50 houses are damaged by a strong wind on a yearly basis. The facts from the key informants also demonstrated the same to that of the results' of the survey and focus group discussion. Hence, it is generalized that the facts from survey, focus group discussion, and key informants coincide and the climate change hazards have impact on key livelihood resources and the area is vulnerable to the climate change hazards.

The presence of irregularities and volatilities of the climatic trend has made a lot of impact on livelihood resources and different sectoral such as agriculture, water, health and energy. It makes the level of economic development low, and access to basic services poor (NAPA 2007) and (WB, 2007b).From the overall vulnerability it is likely that women, very young or the very old and the poor will suffer more from the effect of climate change (Agrawal ,2008) and (ANRS, 2007)



Box 3: Elder People Witness about the Climate Change Hazards Impact on the Study Area

K1 justified that diseases emergency on wheat and barley crop increases over time and an increase of soil erosion due to high intensity of rainfall ,which was not Character of Choke area. Hence, "Temiz" and "Senefe Kollo" do not only reduce production but also they are on the phase of extinction from the area. K2 also extends his explanation saying that there is an emergent new disease in the area which attacks both animals and human beings called in Amharic "Mogn Bagegn''. Herb plant that is called in Amharic "Chekugn" is lost from the area. It was common when the area characterized by foggy and continues rain. This herb plant had a medical value for the local people and served as a medicine for long years. A type of animal in Amharic called "Felefel" in Amharic which seems like a rat lives in the soil in the upper ground part that causes drying of forest trees becomes a serious problem of the site including the project area closure, which was not observed before 30 years.

What is more added by K_3 is that due to existence and burden of all the above evils, there are large migrations out from the area. According to his witness, from all his seven family members, three of them are males who leave the area, and went to Addis Ababa. They engage in daily labourer to lead their livelihoods. He also extends his argument by verifying that there is a decrease in barley production when it goes down to the mountain, which was highly productive before. In addition, he recommends establishment of rural towns along the roadside and there is a need to employee the youngsters in non-farm activities to minimize the risks.

Source: Key informants, 2011

The findings of the research are found to be parallel with what are mentioned by the literature. The area productivity and production was declined due to increment of drought and rainfall variability as

well as high intensity. The forest resources are degraded and are on the way of extinction. The water resources either diminish its size or make it lost at all due to the loss of environmental stability. Regarding health, due to the increment of temperature low land animal diseases (Trypanosomasis) and crop pests (aphids) emerge and become common to the area. Due to the consumption of crop residue and cow dung for energy consumption purpose the soil fertility-declining trend continues. Afterward, it is concluded that the vicious poverty trap of the area due to climatic hazard continues, unless similar interventions like this project are implemented in the area.

4.5.2. Opportunities for the Local Communities

In the previous section, the discussion has focused on the negative dimension of climate change hazard effects of climate change on key livelihood resources and technology utilization among the local communities. This section tries to discus some of the positive impacts of climate change patterns in this specific site. Especially, in relation to temperature increase the local communities are getting new opportunities, which were not observed before. The local communities were able to describe the opportunity and associated changes in many ways for instance, 90% and 88% of the respondents described that the area is becoming suitable for new crops and animals, which were not common in the Choke site. The data from the focus group discussion was also consistent with this idea. They added not only new animals adapt the area but also animals that are bought and brought from other areas (out of Choke Mountain) did not adapt the area, but also now, they can adapt it easily. For example, horses from lower altitude can adapt and live in Choke Mountain but it was difficult in the past. Animals that were not common before can also live and adapt the area. For instance, goat was not common before, but now it is a common domestic animal in the area. Crops that did not grow formerly also emerge and can give yields although the productivity is low.

The data obtained from the key informants also indicated similar to the above description. However, what K_3 added is that:-

> *The duration and sensitivity of coldness at the last time was so long and intense. Then it was difficult to accomplish certain tasks on short period, but now such trend decreases and the local community can accomplish given tasks easily. This trend change is not only important for task accomplishment but also it makes the movement easy.*

This results in easy exchange of information and diffusion of new technologies in the fast rate than before. Thus, though its opportunity is not so much, it exists and the local communities are on the way to maximize and consume these opportunities. To end comparing the negative impacts and the positive ones negative impacts are so huge by far.

4.5.3. The Role of Community Based Watershed Development for Climate Change Adaptation Mechanisms

4.5.3.1. Climate Change Adaptation Mechanisms Implemented By the Community Based Watershed Development Project

The main climate change adaptation mechanisms that the project has been carrying out since its introduction in the site as well as in the local communalities are; soil conservation, compost preparation, afforestation, forest protection from deforestation, area closure protection and management, water management, cut and carry system. Moreover, conserving and promoting of high yield local crop varieties, not only yield but also disease resistance, conserving indigenous forest species and awareness rising to conserve natural resources. These all are expected to enhance the resilience capacity of the ecosystem. As well, clinical treatment for human and animal diseases, this comes due to temperature increase. Further, maximize new opportunities from the climate change such as growing new crops (peas and beans), having new animals (example goat), and adoption and using of other new technologies which contribute to enhance their production along with handling the change. In addition to this the main activities the project tried to implement are: improving fuel saving stove, planting community wood lot circulating grazing for grazing lands, preparing hay from communal grazing land and crop residues, afforestation and protection of forests from damage.

According to IPCC, 2001; IUCN, 2009; Kurukulasuriya and Mendelssohn 2008 as cited in IFAD, 2009 document demonstrates, these above mechanisms are on the domain of climate change adaptation mechanisms. For that reason, the local level climate change adaptation mechanisms are in the domain of the above literature. These are explained that is both deal with changing planting date and cropping pattern, protecting and restoring of healthy eco system and adjustment of such ecological and economical system to respond to the change. Based on the data generated from the survey and different source the local communities as well as supported by the literatures, the Choke Mountain communities are towards implementing climate change adaptation mechanisms.

Table 11: Respondents Main Climate Change Adaptation Mechanism Implementation Status

implemented activities	respon ses	frequ ency	percen t	implemented activities	respon ses	frequ ency	Percen t
plant community wood lot	Yes	39	40.6	participate in community forest protection	yes	55	57.3
	No	57	59.4		no	41	42.7
	Total	96	100		total	96	100
prepare compost	Yes	57	59.4	participate in area closure management	yes	54	56.3
	No	39	40.6		no	42	43.7
	Total	96	100		total	96	100
implement soil conservation	Yes	61	63.5	participate in water resource development	yes	53	55.2
	No	35	36.5		no	43	44.8
	Total	96	100		total	96	100
participate in rehabilitation of degraded lands	Yes	53	55.2	practice rotational grazing system	yes	59	61.5
	No	43	44.8		no	37	38.5
	Total	96	100		total	96	100
participate in managing range lands	Yes	55	57.3	implement afforestation	yes	52	54.2
	No	41	42.7		no	44	45.8
	Total	96	100		total	96	100
implement cut and carry system	Yes	56	58.3	multiply and use local high yield crop	yes	54	56.2
	No	40	41.7		no	42	43.8
	Yes	50	52.1		total	96	100

Source: own field survey, 2011

The table demonstrates most of the respondents describe the proposed activities are implemented, especially compost preparation, community forest protection from deforestation, implementing cut and carry system and rotational grazing are implementing more than the other activities.

Next, the project performance status of the local communities between community based watershed development members and non-members have been assessed. It is examined by using frequency table and independent sample t test between members and non-members of the project beneficiaries. The frequency percentage share of the Community Based Watershed Development member shows that there is a large share implementation and/or participation in the process of implementing the above mentioned project activities. Most of the CBO members, above 80% of the respondents, described that they participated or implemented the entire above mentioned project activities individually. However, it was only less than 35% of non-member respondents supported the above idea for most activities. Although above 50% believed, they participated or implemented to prepare compost, manage communal grazing land, and prepare hay from crop residue. The other tool, an independent sample t test of the mean performance difference between members and non-members, validates this fact and it has a significant mean difference for implementation of all activities

performance p=0.000-0.001(t=3-18.13, df =94) which proves a significant application difference between communities based watered development project members and non members. Then, it disproves the null hypothesis in that was no performance difference between the two groups and accepts the alternative hypothesis in which there is a significance difference between the two groups. This is because the project target groups more internalize resource conservation techniques so that key resources of the area become in good position, owing to the intervention.(Azmera,2010 also find the same results what is demonstrated here)

From the focus group discussions, the following major points came out that are almost consistent with the survey result. The discussants explanation about what types of trees and areas were rehabilitated. These were rehabilitation of indigenous local species such as "Koso" (Hygenia abyssinica), "Asta" (Erica arborea), "Enjori" (Morus mesozygia), "Gemey" (Hypericum revelutum) and other bush and grass species plants. Additionally, plantation of new species trees such as; high land Bamboo (Arundinaria alpina), "Nech bahirzaf" (Euclptus globulesis), "Key bahirzaf" (Euclptus cameldulesis), "Tid" (Junipers procera) was done. These all reforestation, plantation, and rehabilitation have been practicing in 20 hectares area closure degraded lands. Similarly, other 25-hectare communal grazing lands are properly managed and used to feed their animals on rotational basis. Apple plantation, compost preparation, feeding their animals using cut and carry system, multiplying and distributing of farmers local important varieties mainly (white barley; black temeze and Senef kollo barley) distributing on individual basis and promote to revive, liming to reduce the acidity nature of the soil are the main implementing activities in the site. On the other hand, the non-member focus group discussion respondents notice what have been implemented on communal basis. Yet lacks what are performed on individual basis of the member communities. The official key informants also prove what the CBO member focus group discussions portray. From the triangulation, it can be generalized that there is a strong project performance by the community-based institution, but some activities are not understand and noticed by the non-member communities.

The secondary data obtained from the second year project annual report of the woreda also indicated that training for 102 community members (84 males and 18 females) about cooperative rules and regulations, water and soil conservation, nursery site establishment, compost preparation and utilization were the major contribution of the project. From the activity accomplishment 9.5, ha soil

bund and 1900m^{3}compost have been constructed and prepared, respectively. About 15600 seedlings have been planted which, includes "Koso", Junipers, eucalyptus and Bamboo. "Black senef kolo" on 2.4ha, black barely on 0.8 ha, white barely on 11.5ha have been multiplied. 25.5ha, pasture has been delineated for rotational grazing. 0.25ha gully rehabilitation, community wood lot plantation on 8.33ha and 20 ha forest area closure to rehabilitate and maintain the eco system (WARDO, 2011). The documents reviewed at the kebele level indicate similar figure with what is observed at the woreda level (Ambaber CBO, 2011). One of farmers' important local varieties, which has been multiplied and distributed to the local communities and area closures is used as cut and carry system by the project are shown by the below field photograph.

"White Timez barley" Cut and Carry system in communal grazing land

Figure 7: Multiplications of Farmers' Important Local Varieties and Range Land Utilization by Cut and Carry System

Source: Own field photograph, 2011

This and other related activities were supposed to the tasks of the CBO expected to accomplish as it explained in the project document designed by (Belay and Shibru, 2007). According to the finding gained in the research paper those proposed activities were partly implemented by the CBO within three years period.

4.5.3.2. Community Based Watershed Development Project Gaps

In addition to achieving the above objectives and activities, the institution has played some roles that contributed to the improvement of local people livelihoods. These roles include accessing communal natural resources with better service, empowering the community, promoting participatory decision making, equal commitment for all, encouraging collective action plan and drawing and adopting inclusive rules and regulations in the project site. Nonetheless, during implementation these activities the process faces some gaps and these are presented by the below table

Table 12: Some of the Project Gaps

Gap types	responses	frequency	percent	Gap types	responses	frequency	percent
Lack of targeting For women	yes	77	80.2	CBO play to develop collective action and plan	yes	17	18
	no	19	19.8		no	77	82
	Total	96	100.0		Total	94	100
Lack of targeting For youth	yes	81	84.4	CBO play to develop inclusive rules and regulations	yes	32	34
	no	15	15.6		no	62	66
	Total	96	100.0		Total	94	100
Weak Information Exchange	yes	67	69.8	CBO leader lack skill to mobilize the community	yes	70	72.9
	no	29	30.2		no	26	27.1
	Total	96	100.0		Total	96	100.
Lack of proper Linkage	yes	75	78.1	CBO play to empower the people	yes	26	28
	no	21	21.9		no	68	72
	Total	96	100.0		Total	94	100
do not volunteer to have more membership	yes	74	77.1	CBO play to enhance participatory decision making	yes	31	33
	no	22	22.9		no	63	67
	Total	96	100.0		Total	94	100

Source: own field survey, 2011

Even if participation difference exists between CBO members and non-members in natural resource management and conservation, the extent of participation in decision making to decide on administrative and institutional issues are still low. As indicated by the table most of the respondents explain these all problems were existed in the project implementation process.

So far further confirmation whether there is significant difference exist between the two groups it is analyzed by the statistical tool and this are presented as follows. targeting the youth (p=0.8,,t=,0.27,df=94) and women(p=0.8,t=0.25,df=94), it did not develop proper linkage from other institutions(p=0.8,t=0.24 df=94), weak information exchange(p=0.1,t=1.6,df=94) were expected in

the process of activity performance. The CBO management were not volunteer to incorporate more members to the institution (p=1, t=0.000, df=94); they did not develop a skill to mobilize the community (p=0.4, t=0.9, df=94) to manage livelihood resources and develop common ownership feeling over the natural resources. These processes of achievement contradicted what was expected, both above 70% of community based institution members, and 77% of non-members admitted that the institution did not implement the above process activities, respectively. The independent sample t test, as it indicated in the bracket, also agreed with this idea and P=0.1up to 1, for the mentioned gaps, which indicated no significant difference between the two groups. Then, it is able to conclude that the institution does not practice these processes of implementing activities. These all are real problems exist in the institution that need act to be solved and ensure sustainability of the project performance.

The insignificant difference between the two groups in the existence of gaps existed and the roles were not well performed by the Community-Based Institution, most of them were supported by the non-member focus group discussion respondents. Even if the by-laws of the CBO indicates there is General Assembly meeting three times on a year basis and evaluate the financial as well as the performance of the CBO activities, this has not been made in a year basis as confirmed by the CBO focus group discussion also. The non-members of CBO respondents stated that the existence of such gaps was so great that is why they did not become members of the institution. The justification extends if these gaps do not get corrected as soon as possible strict conflict would arise between members of the institution and non members, especially on the consumption of communal resources (planted trees in the area closure), since Choke is common to all benefiting for some groups from the communal resources is unethical. Furthermore, they extended their argument, they claimed and wanted to be members of the institutions but the management body of the institution increased entrance fee, and they had no trust on the administrative body of the institution. However, both group discussions portrayed the existence of border conflicts between the project site and bordering kebeles that was a problem for the better establishment of the project. The three communities and other three official experts substantiated the above idea and the presence of gaps in the implementation process with some additional information. Especially, the key informants assured what was mentioned by the non-members' focus group discussion. They added the protection of area closure lies on few individuals who were two guards and CBO management bodies. This shows lack of common

ownership over the degraded land and degrades the institutional value and image. Moreover, the area closure initially established in four different sites and these are "Wofcho Mewkeria", "Beriewch wodekubet", "Mentaws Esthete" and "Gembaramu Gedel". However, only the two sites that had self-initiated guards (Wofcho Mewkeria and Beriewch wodekubet) become functional. The other point explained by official key informants (EPK1) is that some training concerning the cooperatives and natural resource management had been given to the institution leaders and for some members of the institution. Nonetheless, it was not enough to equip the leaders and the members as expected. The remaining two official key informants agreed with this idea and justified the existence of such gaps. The other issue confirmed by the focus group discussion, community, and official key informants is that the institution lacks proper leader, ownership, and professional support. The Woreda Land Administration and Environmental Protection Office explain it except the establishment of one environmental club they did not know and support for the CBO. The woreda cooperative promotion office also did not support this institution like other cooperatives. Even the Kebele Agricultural development agents did not pay a frequent visit and support of the institutions. That is why the internal and external disputes were not solved timely. Thus from the overall triangulation it is possible to conclude that there is existence of such implementation process gaps in the site.

Similar findings were expressed in the Adaba- Dodola participatory forest management project of the Oromia region that lack of sufficient number of professionals with participatory forest management background, organizational aspects, conflict resolution techniques, and benefit sharing scheme are some of the prevailing constraints in the execution of participatory forest management approach (Tsegaye et al., 2004). On the other hand, community-based institutions are established to empower the community, thereby help it to become master of its own destiny by mobilizing and using its own resources (knowledge, material, money, social capital, etc.). As well as it demands on behalf of the poor and the marginalized groups whose voices are seldom heard-that the government may not fully respect the community's inalienable human, social and economic rights (Edgar and Robert, 1972 as cited in ASE 2007). The project document (Belay, 2007) expects equity, empowerment and information management together with capacitated the local communities, however these vital issues still did not achieved in the study site.

All focus group discussions assures except the CBO management body did not accept (the CBO management body was not so much interested to have more membership), achieving equity based on

wealth, gender, and age, public awareness and empowerment, participatory decision making, information sharing and exchange, institutional linkage to other stake holders were the main problems of the study site. The CBO management body was not so much interested to have more membership (and external formal institutions at Kebele and Zonal levels do not cooperate with the CBO as planned) except the focal person of the project at the zone level. Different Administrative bodies that come from the zone to site regarding to conflict managements, do not bother about the project implementation and management activities rather they want to minimize the conflict over unwise use of natural resources and avoiding the area closure that is managed by the project. Therefore, to ensure sustainability of the project and act as a model for effective adaptation mechanism with sustainability of the local livelihood there is a need to solve and addresses all the issues mentioned above.

4.5.3.3. Factors Affect farmers to Develop Adaptation Mechanisms

In order to understand what constraints are found during implementation of adaption mechanisms in the study area, in this section the research try to address how different community groups develop adaptation mechanisms and what are the barriers that hinder these community groups were examined. Among the different age categories, youngsters whose ages are between18-30 were interviewed. They responded that they do not implement most of the activities mentioned above or they do not participate in communal resources management and conservation. Most of youngster respondents declared that they do not implement or participate to develop adaptation mechanisms. However, the adult respondents whose age was from 31-60 attested that they implement or participate in the development of the above-mentioned adaptation mechanisms. Furthermore, those of elders whose age was above 60 approved they implement or participate in the implementation process were low.

While it is shifted to the performance difference between male and female respondents, the majority of the female respondents approved they did not implement the above climate change adaptation mechanisms. Next, what happened between CBO members and non-members is discussed. In most activities, the CBO member group respondents indicated that they implement or participant in the implementation process of climate change adaptation mechanism activities greater than the non-member respondents.

Activities of wealth category climate change adaptation mechanisms performance coincide with the previous argument. The fact shows that very poor and the poor respondents verified that they are implementing those activities with low performance. On the other hand, the medium and the better off respondents showed better performance than others did .Then these all group comparison is presented by summary graph of implementation of each activity by each group of the community. For your clarification, the value of the average implementation is calculated on the base of the value 1= implement the activities 0= do not implement the activities. Then if the average value=0.55 means that group of community implement this activity on average basis by 55%.

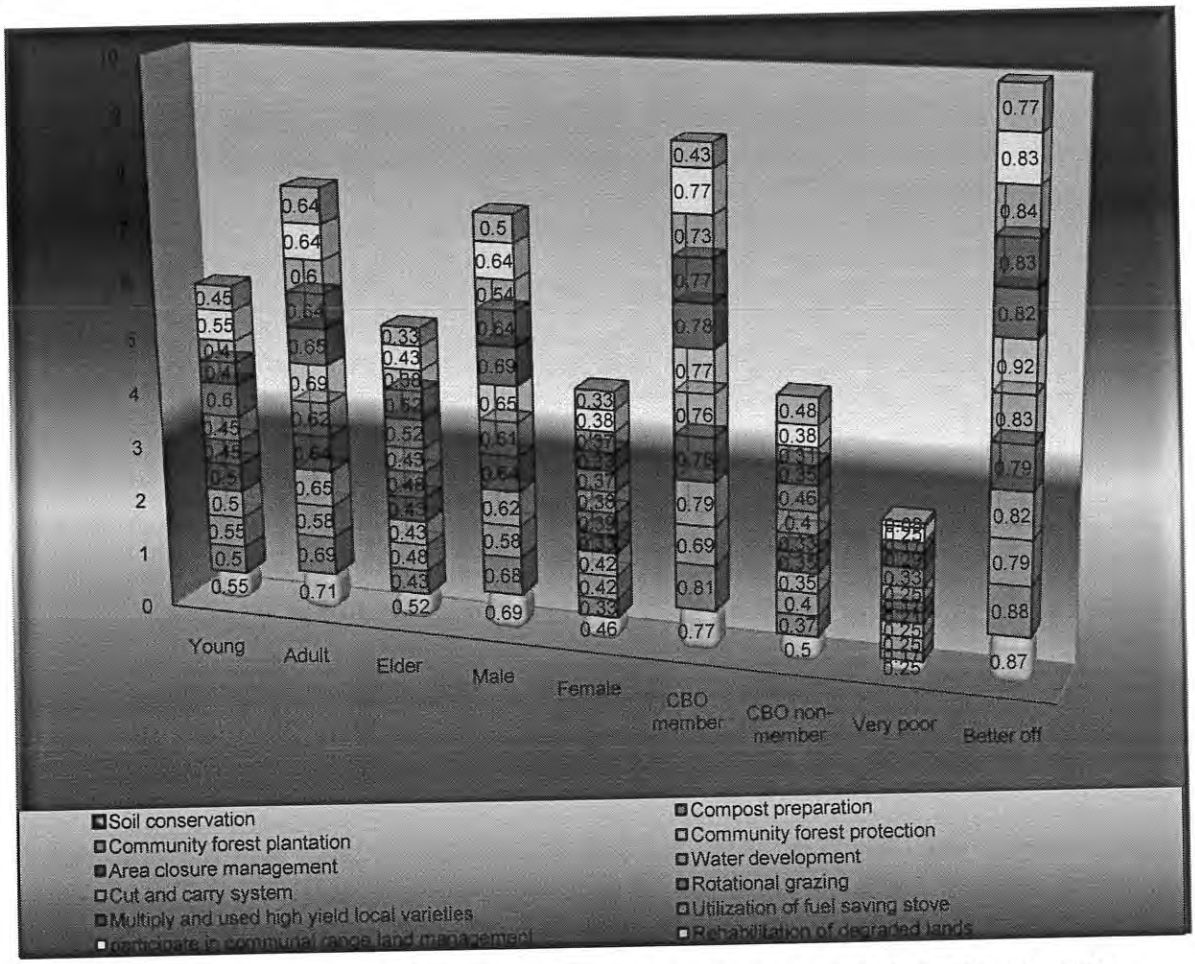


Figure 8 : Average Adaptation Mechanism Implementation Statuses by Different Groups of the Community

Source: own field survey, 2011

Before going to the determinant factors affecting farmers to implement climate Adaptation mechanism, it is better to discuss whether the main climate change adaptation mechanisms of the local communities have a relation or not. These are: - soil conservation, compost preparation, afforestation, forest protection area closure management, water development, cut and carry system, rotational grazing, disease resistance and high yield crop conservation, fertilizer and using fuel saving stove have correlation or not. These all are analyzed using bivariate correlation analysis tools. The result shows (r=0.5-0.8) in the correlation exchange all are at "P" value of 0.000. Then, this indicates implementing of one adaptation mechanism has a relation to implement other adaptation mechanisms. Then to identify the main factors that affect the local communities to implement the adaptation mechanism performance. Not only the correlations of dependent variables but also it is good to see how it is correlated with independent variables such as based on age, sex, wealth and CBO members and non-members, family size, land size, oxen number and educational level with what other factors hinder or provoke for the implementation of climate change adaptation mechanisms are. The bivariate correlation of sex indicates r-value ranges =0.4-.0.7 with p value of 0.000-0.003, for the CBO category r=0.4-0.73 at p value of 0.000-004.The bivariate correlation for family size, land size and number of oxen r=0.25-0.3, 0.2-0.44 and0.2-0.4 with p value of 0.001-0.013, 0.000-0.007, and 0.000-0.049, respectively. However the r value for educational status significant for only compost preparation p=0.026 and r=0.23, for soil conservation p=0.045 and r=0.2, for participation of degraded land rehabilitation and range land management p=0.03 and 0.004 with r=0.22 and 0.3, sequentially. This implies the independent variable, sex, CBO member ship, wealth status, family size, land size, and oxen number have a relation with the implementation of the above adaptation mechanisms and educational level for four selected items mentioned above.

4.5.3.3.1. Results of Independent t test Analysis for Adaptation Mechanism

Gender differential in response to climate change and taking adaptation measures have also been investigated. The implementation status of the above-mentioned dependent variable by gender shows there is a significance difference between the two groups. The independent t. test also indicated the P value was equal to 0.000(t=4.3-9.4, df =94) for all mentioned above variables which has an implication of a great significance mean difference between the two groups and accept the null hypothesis.

Data from the focus discussion also draws various reasons for low implementation status of adaptation mechanisms. Especially the two female group discussions justify, they have not the exposure to exercise such activities, most of their time is confined with home management, and childcare, furthermore, even if they have knowledge to such measures due to cultural bound they have not the power to decide to implement such activities. This implies that in Ethiopian context, most farming activities have implemented by male groups due to exposure; therefore, the implementation of these activities is more associated with males than females.

Likewise, gender the hypothesis testing between CBO members and non-members shows there is a significance difference between the two groups with the exception of fertilizer application. In fertilizer application even if there is no significance difference between the two groups, slightly CBO non-members use more fertilizer than member groups. This may be because CBO members develop more inclination for organic agriculture than using fertilizer. Therefore, the independent t test p value ranges from p= 0.000-0.015(t=2.48-5.98, df=94) for all the above mentioned dependent variables except fertilizer application. This implies that there is a significant difference between the two groups in adaptation mechanisms implementation signifying CBO members can implement or participate in the implementation of adaptation mechanisms more than non-members participate with a meaningful difference. Then reject the null hypothesis and accept the alternative hypothesis that is there are significance implementation difference existed between the two groups.

Similar finding were investigate in the Choke mountain water shed the existences of significant difference in the implementation of conservation mechanisms between Members of the CBO and non-member together with significance difference between male headed farmers with female headed farmers(Azmeraw,2010)

In addition to the above statistical analysis, other additional facts are analyzed. All these support the above findings and above 80% of the respondents responded, lack of proper information exchange, lack of knowledge, low income, less access of credit, lack of agricultural extension service, weak linkage of CBO from other stake holder are the main obstacles which hinder the implementation of climate change adaptation mechanisms in the study area. The independent sample t test between CBO members and non members shows p >0.05(t=-6.3-1.5, df=94) for all the above mentioned problems which is insignificant difference for the existence of the above problem and both agreed that these are the main problems and barriers that hider the implementation of climate change

adaptation mechanisms in the site. Even if the access of credit and agricultural extension service is less to the study area, their impacts to wards implementation of adaptation mechanism were analyzed using independent t test. The respondents who has access to credit service are practicing more compost preparation and community forest protection and management than non credit users with p=0.042 (t=2.1, df =94) and p=0.004 (t=3, df=94) respectively .moreover, the user of agricultural extension service have a tendency of implementing various adaptation activities than non users with significance difference. These are; soil conservation p=0.011(t=2.6), compost preparation p=0.005(t=2.85), afforestation p=0.016(t=2.5), community forest management p=0.004(t=3), management of area closure p=0.003(t=3.01), participating in water development p=0.002 (t=3.02), using cut and carry system p=0.004(t=2.9). Not only the above activities but also; rotational grazing p=0.008(t=2.8), conserve disease resistant and high yield varieties p=0.003(t=3.1), using fertilizer p=0.001(t=3.3), improve irrigation utilization=0.007(t=2.75). Moreover, income generation from off farm activities p=0.007(t=3.93), promote and use new crops and animals to the area p=0.004(t=2.99) and p=0.006(t=2.83) respectively all of them at df =94.These all are the main adaptation activities practiced by the extension users with meaningful difference than non users. Similar finding were generating by Bewket 2010, in Choke Mountain for adaptation development status difference due to the access difference in extension service.

4.5.3.3.2. Results of One Way ANOVA Analysis for Adaptation Mechanism

The Implementation performances of soil conservation, compost preparation, cut and carry system, multiply and use high yield local varieties, use fuel saving stove, rotational grazing, and participation in community forest plantation, area closure management, communal rangeland management, community forest protection, and water development. The analysis of the implementation of the above activities by different wealth groups indicate there is a significant difference among the wealth groups and accepts the null hypothesis. It proved that most types of adaptation mechanisms were well implemented by the better off wealth categories. The statistical analysis of the of the one way ANOVA supports these arguments and it lies between p=0.000-0.003(F=4.8-15.1, df=3) for all performances. In addition, to this the post hock analysis of most activities shows the significance difference is existed between the very poor and medium, very poor and better off, poor and medium, poor and better off. However, no significance difference between the consecutive category divisions that is between poor and very poor, between medium and better off .this indicates the acceptance of

null hypothesis that is adaptation mechanism are more implemented by the wealthiest groups than the poor and very poor with large proportion difference. Whereas even if some differences observed in the frequency proportion for education level, in this method analysis result for education shows there is no significance difference among different groups of education level. Then the study subjected to reject the null hypothesis and accept the alternative hypothesis there is not significance difference among the groups. However, this does not mean education do not contribute for the development of climate change adaptation mechanism. The reason why its contribution is low indicates that the teaching learning process might have lacked experiential learning to achieve practical application of such activities in their daily lives. Similarly, analysis of one-way ANOVAs based on age groups was made the significance difference is only observed for some adaptation implementation mechanisms. These are; compost preparation p=0.043(F=3.2), cut and carry system application p=0.046(F=3.2), and improve fertilizer application p=0.43(F=3.3) with (df=2)for all analysis. Further the direction of the difference tested by post hock analysis these significance difference is existed between the adult and elder groups however, there is no significance difference between the youngest and the adult group. Then even if significance difference is observed only for some of the local adaptation mechanisms, the adaptation mechanism implementations have inverse relation with age groups. Similar finding were observed in participation of Watershed development those of elder groups are observed when it compare to other age groups (Azmeraw, 2010). This implies for the response of climate change vulnerabilities rather than experience the determinate factor that affect the community to take measure is implementation performing abilities and capabilities.

The one-way ANOVAs analysis of having large land size for the implementation of soil conservation p=0.000(F=5.6), compost preparation p=0.000(F=8.3), participate in community forest plantation p=0.035(F=2.7). Also for participating in community forest protection p=0.001(F=5.04), participate in area closure management p=0.002(F=4.7), participate in water development p=0.001(F=5.5), implement cut and carry system p=0.001(F=5.2) participate and implement rotational grazing p=0.018(F=3.2). Multiply and use high yield local varieties p=0.026(F=2.9), fuel saving stove p=0.009(F=3.6), participate in rangeland management p=0.002(F=4.7) and for rehabilitation of degraded lands p=0.000(F=7.8) at all degree of freedom (df=4). Further the post hock multiple group comparison analysis indicates the significance difference is existed between no land and having land

size between 3.1-5 timad, having less than one timad and having land size between 3.1-5 timad, no land and having land size between 5.1-7 timad, having less than one timad and having land size between 5.1-7 timad. However, there is no significance difference between the consecutive land holding size that is between no land and less than one timad and between 3.1-5 timad and 5.1-7 timad land holding sizes. These all indicates the significant difference exist when the extremes far apart. The analysis leads to accept the null hypothesis and confirmed land holding size have a great contribution for the implementation or participation in the implementation process of adaptation mechanism.

Likewise, the oxen size implication for the implementation of adaptation mechanism analyzed by this method. Nevertheless, it is significant only for some dependent variables such as for preparation of compost p=0.003(F=5.1), participate in community forest protection p=0.022(F=3.4), participating in water development p=0.033(F=3.1), participating in rangeland management p=0.023(F=3.4), and rehabilitation of degraded lands p=0.002(F=5.5). For all cases (df=3). However, the multiple comparison of post hock analysis indicates there are a significant difference between having 5-6 oxen and no oxen in the implementation of soil conservation (p=0.02), participate in community forest planting (p=0.27), participate in management of area closure (p=0.024), water development (p=0.023). Along with, cut and carry system (p=0.023), multiply and use high yield local varieties (p=0.024) and range land management (p=0.022). Similarly, the multiple comparison analysis between having 5-6oxen and having 1-2 oxen have significance difference in participating in area closure management (p=0.35), water development (p=0.024), communal range land management (p=0.027). Moreover, implement cut and carry system (p=0.04) and multiply and use high yield local varieties (0.024). Then it can accept the null hypothesis the larger oxen number can practice or participate in the implementation of adaptation mechanisms with significance difference of having no oxen and/or less oxen number. However, the family size analysis by this method indicates there is no significance difference between having large size and small size households. It leads the rejection of the null hypothesis and accepts the alternative hypothesis. The implication of this is family size could not be the determinant factor for the implementation of adaptation mechanisms where as the oxen size become one of the determinant factors for the implementation of those mechanisms.

Harmonizing all these arguments the determinant factors that hinder implementing main adaptation mechanisms can be drawn. As expressed by t test, and one way ANOVAs and there is a significant difference of implementing adaptation mechanisms between male and female, among age groups, different oxen size groups, different land size holding groups, among wealth categories, between CBO members and non members. But the regression result of observed and predicted values shows that the implementation of main climate change adaptation mechanisms are highly interlinked with CBO membership and wealth categories with an insignificance difference in changing the planting date. Not all these refer sex, age, land size, family size, education level, and number of oxen, as contributing factors for implementing adaptation mechanisms. First, it is important to understand land size and number of oxen included in wealth status since the bivariate correlations are r=0.909 at p=0.000 for land size, r=0.66 at p=0.000 for number of oxen. Regarding to other variables they have a contribution but they are not strong as CBO membership and wealth status categories. Thus it is concluded that the first determinant factors for the implementation of climate change adaptation mechanism are being a CBO member, medium, and in a better off wealth status. The second factor did not targeting disadvantageous groups such as females and elders, low land size and oxen holding, weak information exchange, lack of credit and agricultural extension service.

Moreover, the data found from the focus group discussions and key informants go parallel with what was described by the quantitative data. The focus group discussion raised a few issues of the obstacles for both implementing project activities and climate adaptation mechanisms as the existence of conflict between the watershed development kebele communities and its neighbourhoods. The conflicts were between Ambaber and Shewa kebele (Sinan Woreda),Ambaber and Dede kebele (Beugne Woreda), Ambaber and Gedeb kebele (Beugne Woreda), Ambaber and Dangula (Sinan Woreda), and Ambaber and Sultan hale (Hulet Ejju Enessie Woreda). The main reasons for the conflict were consumption of forest and communal grazing land including the project area closure site. Due to these, the two sites of the project, which are called Gambaramu Gedel and Mentaw Eshet, are not functional. In addition to computing communal resources, there was no clear boundary between the project site and neighbouring kebeles. Besides, according to their explanation, due to the intervention of the project, communal resources (forest and grazing lands) are better than the other kebeles. Accordingly, the discussion people in other kebeles claimed to consume these resources by saying cow and honey bee have not clear demarcation to consume whatever they want

and the Choke is commented to all. Therefore, having area closure and protecting the cows from grazing is an illegal activity according to the neighbourhood kebele context. Even if this argument is not accepted by the project, site communities the neighbourhood kebeles were claimed to use these resources freely. The other factors that hinder to perform the climate change adaptation are the existence of high population pressure on natural resources, especially changing grazing lands to farmland and fragmentation of lands to do such activities. Still, the formal institutions at kebele, woreda, and zonal levels did not give recognition for the CBO and its implementation of adaptation mechanisms are other critical points.

The literature also supports the research finding as follows. Some of the major barriers for adaptation gains from the on-going national initiatives include lack of strong coordination, low-level public literacy, high-level poverty, inadequate capacity to exchange information among project stakeholders. The determinant factors for climate risk management and be able to handle or adapt climate change at the community and household level are:- poverty and/or wealth status, dependence on risky resources, asset portfolios and status, occupation level, skill sets (training). Moreover, social capital, institutional interconnection information availability, inequality, labour availability, institutional access, technology availability and the nature of technology, literacy, gender balance and/or composition, age composition and distribution (NAPA, 2007, IPCC 2001 and Agrawal, 2008). Similar finding were found in the participation of conservation practices that had age has inverse relation to take conservation measure. CBO members can practice more awareness and develop more conservation practices than non-members develop, women participation in those practices is low, and there is significance difference between male and female household heads. which means those of males have developed more conservation mechanisms than females, even if family size and education contributed positively towards development of conservation mechanisms there is no significance difference between relatively large land holding size and higher education level (Azmeraw,2010).

4.6. The Contribution of Community Based Watershed Development Project for Enhancing Adaptive Capacity

4.6.1. The Overall Project Contribution

By accomplishing the above tasks, the project tried to achieve the following project outcomes. These are - conservation of biodiversity, reduction deforestation, improvement crop and animal production and productivity, reduction of soil erosion, improvement of water management. Further, enhancement of information and knowledge management, conservation of the local natural resources, promotion of organic agriculture, strength of the overall capacity of the cooperative members, increment of economic activities and improve the resilience capacity of ecosystem

In order to assess these all, focus group discussions were made and the results are presented as follows; first, both groups (CBO members and non-members) agreed with the improvement of some livelihood resource status. Resources are on the way of improvement and transferred from the very low to medium status on relative bases when it was compared with before the intervention. Nevertheless, the non-member of CBO focus group discussion did not clearly explain the project impacts like to that of CBO members' focus group discussion responses.

To understand positive impacts the project another tool was used to investigate the facts that were found by interviewing the woreda and kebele experts. The key informants' justifications matched with what the CBO member focus group discussion explanation and they generalized the project is on the way of improving livelihood resources. All assures the existence of difference among the livelihood resources status, which is under the project and other similar areas outside the project.

To substantiate these facts frequency comparing what was found before and after the project trend is made for some key livelihoods of the study area .Most of the respondents believe that there are an improvement of these livelihood resources, when it compare before the intervention.

Table 133: Farmers View about Livelihood Resource Status Trend Change after the Intervention

Resource type	Response	Frequency	Percent	Resource type	Response	Frequency	Percent
average income	no change	48	50	area water status	no change	24	25
	increased	48	50		increased	41	42.7
	total	96	100		total	96	100
soil fertility	no change	43	44.8	land productivity status	no change	43	44.8
	increased	28	29.2		increased	49	51
	very increased	25	26		very increased	4	4.2
	total	96	100		total	96	100
rehabilitation of degraded land	no change	26	27.1	Saving Capacity	no change	62	64.6
	increased	37	38.5		increased	34	35.4
	very increased	33	34.4		total	96	100
	total	96	100	utilization of credit	no change	62	64.6
crop production and productivity	no change	42	43.8		increased	28	29.2
	increased	48	50		very increased	6	6.3
	very increased	6	6.3		total	96	100
	total	96	100	area local food supply	no change	44	45.8
animal production and productivity	no change	46	47.9		increased	48	50
	increased	47	49		very increased	4	4.2
	very increased	3	3.1		total	96	100
	total	96	100	area farming system stability	no change	43	44.8
community relation and trust	no change	59	61.5		increased	50	52.1
	increased	37	38.5		very increased	3	3.1
	total	96	100		total	96	100
area institution decision making	no change	64	66.6	Education enrolment	no change	46	47.9
	increased	32	33.3		increased	40	41.7
	total	96	100		Total	96	100
area forest status	no change	31	32.3	Equity	no change	62	64.6
	increased	65	67.7		increased	34	35.4
	total	96	100		total	96	100
reduce soil erosion	No change	14	14.6	resilience of ecosystem	No change	15	15.6
	Increased	67	69.8		Increased	64	66.7
	Very increased	15	15.6		Very increased	17	17.8
	Total	96	100		Total	96	100
Conservation of bio diversity	No change	24	25	promotion of organic agriculture	No change	24	25
	Increased	52	54.2		Increased	62	64.6
	Very increased	20	20.8		Very increased	10	10.4
	Total	96	100		Total	96	100

Source: own field survey, 2011

As it indicated by the table, most respondents agree with a lot improvement and change in natural resources together with financial assets. There is great proportion of improvement change in the physical environment such as; conservation of biodiversity, reduces soil erosion, improve soil

fertility, improve forest, water and land productivity status, improving the ecosystem resilient capacity as well as improving farming stability. Moreover, there are also in improvement change due to the project for financial resources, these includes; improving crop and animal production, local food supply and an increment of average income. . However, little improvement in credit utilization, enhancing saving capacity, area ways of institution decision making, improving community relation and trust, and ensuring equity among and between different groups of the community. These all implies some parts of the livelihood resources are on the way of improving and enhancing the adaptive capacity but social ,physical, and human livelihood resources are not improving as expected by the project and it need attention and further efforts to ensure the project sustainability as well as leading sustainable livelihood in the study area.

From the overall accomplishment to elucidate the community based watershed development project impacts for the local community adaptive capacity between and among different community groups, the study was proposed two important hypotheses.

The project can contribute significantly for the enhancement of adaptive capacity of the project site community; however, due to diffusion of ideas and way of doing practices the benefit from the project distributed evenly between and among the different local community groups.

4.6.2. Respondents View about the Study Area Adaptive Capacity After the Implementation of Community Based Watershed Development Project

To understand the extent of trend reverse frequency of the above items before and after the intervention has made, it indicates proportional response difference for those resources, which responds on the trend of improvement of resources after the intervention are higher than before the intervention. Thus to understand these differences are significant or not, these facts were analyzed using paired sample t test. The P value for soil fertility p=0.000(t=8.2 df=95), forest status, p=0.000(t=14.02,df=95) water resource status, p=0.000(t=9.4,df=95), land productivity improvement p=0.000(t= 10.3 df=95), food supply improvement p=0.038(t=2.1,df=95) and for income P value = 0.003(t=3 df=95). It indicated that there is a significance difference in these resources statuses trend before and after the project. To this end, it implies that the project can make a significant positive impact on the above-mentioned resources. Then the assessment lead it to conclude accept the null hypothesis there is significant mean difference of the project in their income and other key livelihood

resources and it can contribute a lot for the local people for the enhancement of their adaptive capacities. These significant differences of the project impact before and after the intervention are summarized and seen in the bar graph below. The graph shows the respondents' proportion that supports the resource trends are on an increasing trend.

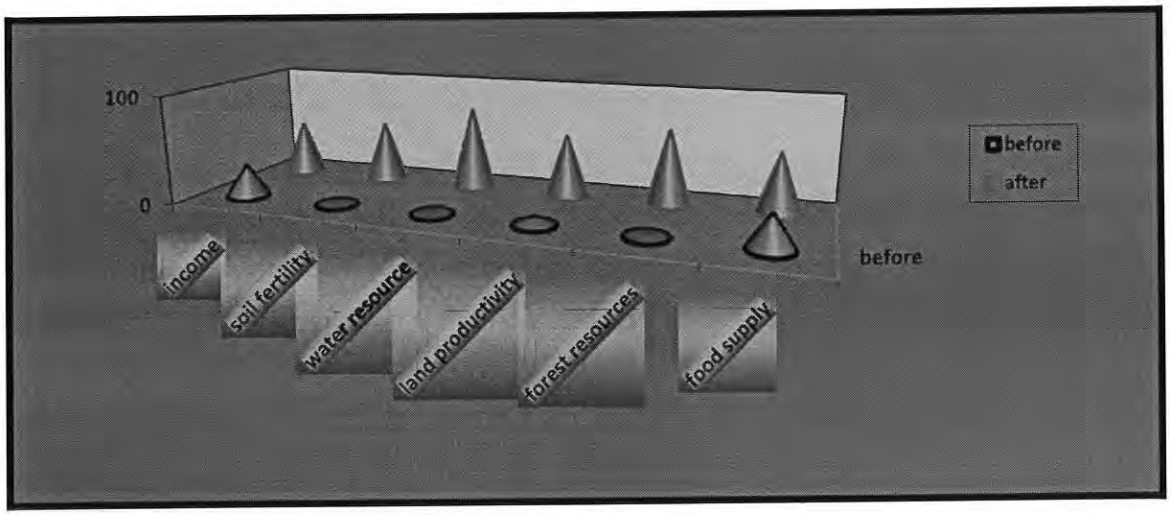


Figure 9: Respondents View on Key Livelihood Resource Status Trends before and after the Intervention

Source: Own computation, 2011

Regarding to the resource status before and after the intervention was discussed by group discussants; all focus group discussions held assured that there are improvements of livelihood resources, especially the natural resource of the project site are improved a lot due to the project intervention. They justify degraded lands are rehabilitated, former lost springs are remerged, the communal grazing land productivity improved, former indigenous tree forest status improved. The field observation conducted during data collection process also confirmed the fact with regard to the current impact on the natural resources by comparing with and without the project to similar sites in the study area.

Figure 10: Photo of Rehabilitated Forest and Re-Emerged Spring after the Intervention

Source: Own field photograph, 2011

Similar findings were brought to bear in Adaba-Dodola of participatory forest management project in Oromia region. It has brought some impact in the livelihoods of the members. Working with people not only the betterment of forest cover within short period of time but also significant economic benefits could have been achieved. The importance of the forest resource as a livelihood option, particularly to the people living in the forest, has been clearly demonstrated. Some changes in the forest condition and improvement of livelihood of the forest dweller groups have been observed after the establishment of participatory forest management. On the other hand, the similar area and section not managed by the project has a high degree of deforestation and misuse of this resource (Tsegaye et al., 2004). The project document (Belay, 2007) proposes these the above results are as an outcome of the project intervention and they are on the way of achieving.

Then all these are expected to lead to enhanced adaptive capacity and ensure the community sustainable livelihoods in this project site.

4.6.3 Project Benefit for CBO membership and Gender difference

The project impacts across CBO members and non-members were analyzed; for instance, income growth proportion/additional income due to the project have been indicated, 29% of the members and 48% the non-members endorsed that there is no change in income. The other 71% and 52% of the members and non-members contradicted that there is an income increment due to the project. The independent t test also indicated that there is a significant difference in income between the two groups with P Value = 0.000(t=3.7 df=94). Similarly, the other components of the adaptive capacity of the CBO members significantly differ with those non-members. These are; the household food supply p=0.000(t=3.47), saving p=0.000(t=3.8), increment of farm land productivity p=0.000(t=3.7),crop production p=0.024(t=2.3),both education and health expense increment p=0.000(t=5.3) with (df=94) for all cases. This leads reject the null hypothesis and accept the alternative hypothesis, there is significant benefit distribution difference between the groups in this case between CBO members and non-members. This implies since the members of the CBO exercise more adaption mechanisms than non-members do with significant difference therefore, the benefit response from the project also difference and more proportion have taken by those of members of the CBO community groups.

Social institution arrangement can play a role to have grater adaptive capacity than less effective social institution arrangements (Temesgen .et al, 2008)

In the same way, with regard to the distribution difference between male and female-headed households only 22% of males' said that there is no change in income. The remaining 78% supports an increase of income. While female respondents constitute 87% gave evidence that there is no change in come. The independent sample t test of P value = 0.000(t=8.3, df =94). The significance in income difference between male and female respondents assured that those male respondents have more income than female respondents due to the project intervention do. In addition to income like the above community groups the other components of improvement benefit distribution between the two groups are analyzed, it indicates significant difference between male headed and female-headed households. These include increment of food supply p=0.042(t=0.5), conserve bio diversity

p=0.001(t=3.5) credit utilization, saving capacity, farmland productivity, animal productivity and crop production improvements p=0.000 for these all items and (t value lay between3.5-9), education and health expenses improvement distribution also difference with p=0.002 and 0.025 and (t=3.2 and2.3) respectively. The research finding rejects the null hypothesis and accepts the alternative hypothesis there are benefit share difference between male headed and female-headed households with significant difference. As it has discussed in the implementation of climate change adaptation mechanism those of male headed have practiced more adaptation mechanisms with significant difference this might contribute for this response difference.

4.6.4. Project Benefit for Different Age and Wealth Category of the community

To understand how the project impact is distributed across different age groups, wealth categories, sexes, and CBO memberships especially for income, the data were analyzed by using different analytical tools as presented below. From the youngsters only 5% to 10% believed that there is an increase income. The rest 85% rationalized that there are no change in income due to the project. From the elders also 47% of them believed there is no change in income. The rest 53% believed there is change income. As we move to the adults, only 18% of them justified there is no change in income while the rest 82% validated that there is 5% to 15% of increasing in income due to the project.

Likewise, the distribution of income the different wealth categories also shows the same trend to the above. The very poor and poor community sections agreed on with no change in income due to the project which is supported with 54% and 50% correspondingly, where as only 8% of the medium and 4% of the better off substantiated that there is no change in income. The rest 92% of the medium and 96 % of the better of attest that there is an increase of income raises 5-15%. Not only income but also differences of frequency in different wealth categories in terms of health expense increment, educational expense increment, crop and animal production improvement, farm land productivity improvement, saving capacity improvement, credit and conserve bio- diversity, promote organic agriculture and farming stability to give appropriate yield are presented in the next line graph. The line graph shows mean increment of the following item value 1= no change, 2 = increasing 3= very increasing

The one way ANOVAs for income increment among the group shows there is a significance difference among the groups with p=0.000(F=50.7,df=3). Further more, the multiple group comparisons of one way ANOVA demonstrates the significance income difference between very poor and medium, very poor and better off, poor and medium, poor and better off. On the other hand there is no significance difference between very poor and poor and between medium and better off. This difference is depicted by multiple group comparison tables (in the below table 14). This implies that the difference exists when the categories are far apart. These trends were not only observed in income but also for other components. These are in crop production p=0.000(F=24.2 df=3) animal production, p=0.000(F=23.9 df=3) land productivity, p=0.000(F=24.5 df=3) saving capacity, p=0.000(F=28.6 df=3). As well as credit utilization p=0.000(F=19.9 df=3), soil fertility=0.000(F=22.7,df=3), health expense increment p=0.000(F=16,df=3), educational expense increment p=0.000(F=13.2,df=3). Moreover, conserve biodiversity p=0.000(F=24.2 df=3) become the same to the income trend difference. In other words, this significant difference exists only between the very poor and medium, poor and medium, very poor and better off, and poor and better off. Which, indicates that the difference exists when there is a big difference and those of the medium and the better of gained more advantage than the other groups. These all-go head to reject the null hypothesis and accept the alternative hypothesis with the notion there is a significant difference between and among different groups of the community in this case different groups of the wealth category. Those of the better off and the medium can harvest more benefits from the project opportunity than those of the poor and very poor groups.

With regard to age groups as the fact shows more or less the same trend like the wealthiest groups. These are; income p=0.000(F=15.2,df=2), crop production p=0.000(F= 10.7,df=2) for animal production p=0.000(F=12.6,df=2) for land productivity p=0.000(F=9.2,df=2). And for improving saving capacity p=0.001(F=7, df=2) for promoting credit utilization, p=0.003(F=4.4,df=2). Also for improvement of conserve bio diversity, p=0.001(F=10.3,df=2). The multi group comparison of the post hock analysis demonstrated that all these significant differences existed between adult and elder groups as well as between adult and youngest categories. However, no significant difference existed between elders and youngsters. Not only age, gender, CBO member ship and wealth contributes for the significance difference of income among different groups of the community but also oxen size, family size, and land size also contributed these differences as demonstrated by the below table.

Table 144 One Way ANOVA Multiple Group Comparison of Income among Different Groups of the Community

(I) land size in timad	(J) land size in timad	Mean Difference (I-J)	Std. Error	Sig.	(I) age of respondents	(J) age of respondents	Mean Difference (I-J)	Std. Error	Sig.
no land	Less than 1timad	.041	.138	.765	young	adult	-1.064*	.205	.000
	1-3 timad	-.050	.134	.709		elder	-.367	.246	.300
	3.1-5 timad	-.779*	.125	.000	adult	young	1.064*	.205	.000
	5.1-7 timad	-.837*	.139	.000		elder	.697*	.202	.002
Less than 1timad	no land	-.041	.138	.765	elder	young	.367	.246	.300
	1-3 timad	-.091	.114	.425		adult	-.697*	.202	.002
	3.1-5 timad	-.820*	.103	.000	(I) wealth category	(J) wealth category	Mean Difference (I-J)	Std. Error	Sig.
	5.1-7 timad	-.879*	.120	.000	very poor	poor	.292	.170	.321
1-3 timad	no land	.050	.134	.709		medium	-1.250*	.170	.000
	Less than 1timad	.091	.114	.425		better off	-1.167*	.170	.000
	3.1-5 timad	-.729*	.098	.000	poor	very poor	-.292	.170	.321
	5.1-7 timad	-.788*	.116	.000		medium	-1.542*	.170	.000
3.1-5 timad	no land	.779*	.125	.000		better off	-1.458*	.170	.000
	Less than 1timad	.820*	.103	.000	medium	very poor	1.250*	.170	.000
	1-3 timad	.729*	.098	.000		poor	1.542*	.170	.000
	5.1-7 timad	-.059	.105	.578		better off	.083	.170	.961
5.1-7 timad	no land	.837*	.139	.000	better off	very poor	1.167*	.170	.000
	Less than 1timad	.879*	.120	.000		poor	1.458*	.170	.000
	1-3 timad	.788*	.116	.000		medium	-.083	.170	.961
(I) oxen size	(J) oxen size	Mean Difference (I-J)	Std. Error	Sig.	(I) family size	(J) family size	Mean Difference (I-J)	Std. Error	Sig.
no oxen	1-2	-.375	.238	.118	1-3	4-6	-.465*	.191	.017
	3-4	-.870*	.250	.001		7-9	-.560*	.201	.007
	5-6	-1.000*	.310	.002		10-12	-.750*	.207	.000
1-2	no oxen	.375	.238	.118	4-6	1-3	.465*	.191	.017
	3-4	-.495*	.112	.000		7-9	-.095	.125	.449
	5-6	-.625*	.214	.004		10-12	-.285*	.134	.036
3-4	no oxen	.870*	.250	.001	7-9	1-3	.560*	.201	.007
	1-2	.495*	.112	.000		4-6	.095	.125	.449
	5-6	-.130	.228	.568		10-12	-.190	.149	.205
5-6	no oxen	1.000*	.310	.002	10-12	1-3	.750*	.207	.000
	1-2	.625*	.214	.004		4-6	.285*	.134	.036

Source: own field survey, 2011

It is understandable in the above all cases the project has been contributed a lot to the improvement of livelihoods and adaptive capacity of the community of the study area however, the distribution of the benefits among and between different groups of the local community did not maximize equally. As it indicated by the statistical analysis those of adult groups, maximize from the opportunity than

other two groups, the wealthiest than the poor, the CBO member than the non-members, and the male-headed household than female-headed household and for all cases it rejects the null hypothesis and accepts the alternative hypothesis.

For further clarification, some of these impacts among age groups, sexes, and CBO members and non-members are summarized by the next bar graph. The bar graph shows mean increment of the resources items: value, 1= no change, 2 = increasing, 3= very increasing

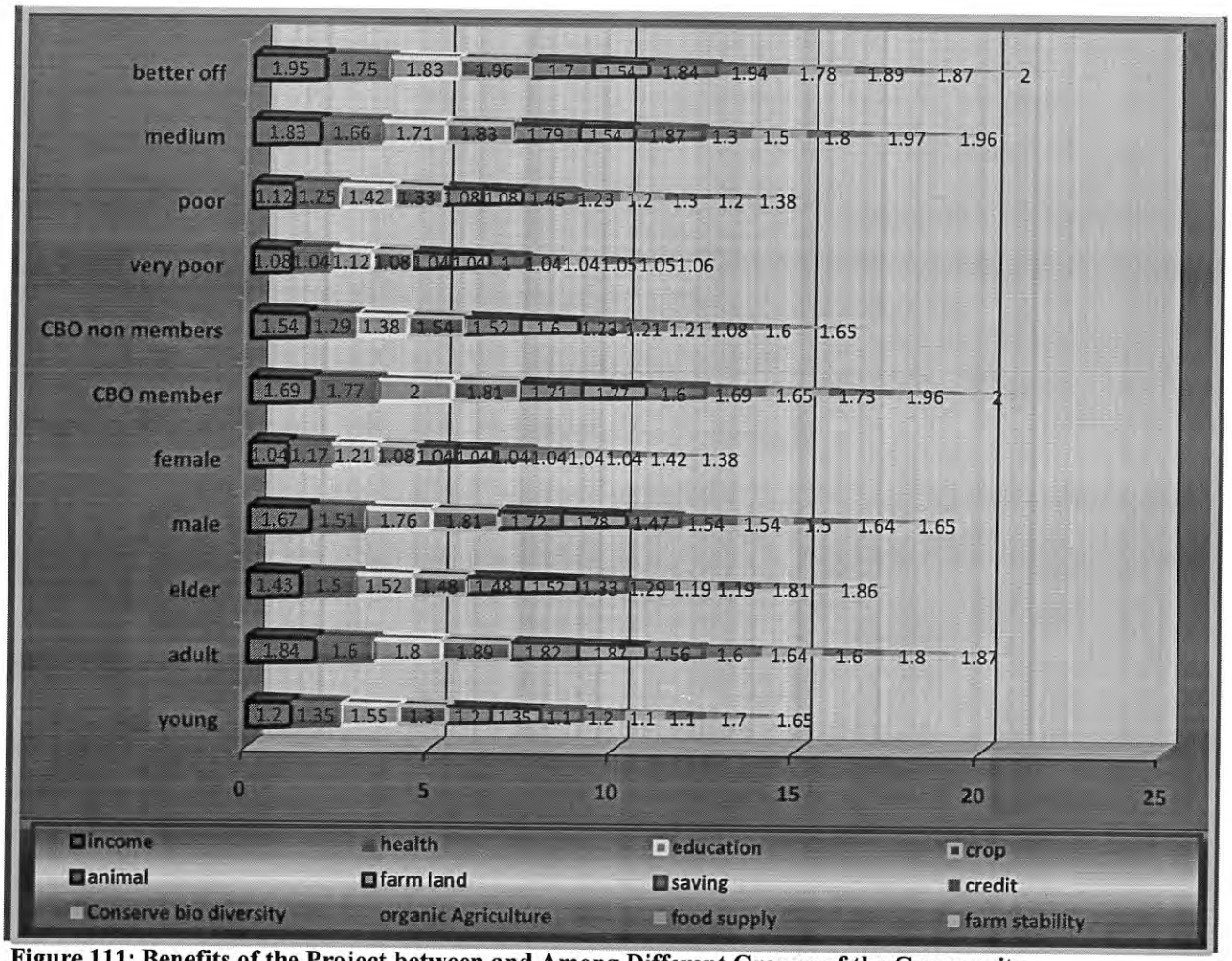


Figure 111: Benefits of the Project between and Among Different Groups of the Community

Source: Own field survey, 2011

The data obtained from the focus group discussions and the three official key informants reported consistent with the above discussion. Accordingly, for the local communities, both members and non-members, there was a reduction of soil erosion, an improvement in soil fertility, and crop and

animal productivity. Moreover, there are a stability of farming system, a reduction of vulnerabilities and an increment of the resilience of the environment. All of them also agreed that the natural resources of the watershed (soil, water, forest, and rangeland) were conserved and have been improved and there has been an ecological sustainability at the watershed level. For example, the water quality and availability increased over time. Before the project intervention, the local residents walked an hour to fetch water but now it takes only 10-20 minutes, since new water source was re emerged around their homes. Six new springs, which were lost, formerly have been re-emerged in the area closure site. The project has also contributed increment in income, land productivity and livelihood security at the watershed level.

Literatures on similar types of project interventions demonstrate that there is an improvement of livelihood resources; for example, the use of water, soil, forest and pasture resources. reduction of soil erosion, betterment of water availability and quantity, reduction of deforestation, enhancement of forest production, improvement of cattle milk production ,promotion of livestock production, and betterment of crop production more bio mass and fuel wood availability and enhance adaptive capacity to climate change (IGES, 2008;IGES,2000; Kollmair and Juli, 2002).

From the discussion so far, it is understood that there has been a significant improvement in soil fertility, land productivity (crop and animal), water status, forest status, rangeland status, income and rehabilitation of degraded lands. In general, the communities' livelihoods have been improved and their adaptive capacities, especially natural and financial capital to resist the climatic change hazards have increased together with the area resilience capacity. The local communities' lives and the physical environment status have been improved. The intervention has contributed all the above changes in terms of promoting climate change adaption mechanism, and improving their livelihoods and adaptive capacity. However, there have been some benefit distribution differences among age, wealth groups, and between CBO members and non-members, and male and female respondents. This makes the project lined with the usual trend those better off continues better and the disadvantaged groups remain at their position. Therefore, this study suggests that there is a need to give emphasis for these gaps and try to correct it by retargeting, stakeholders' coordination at different levels and strengthening institutional linkage together with the development of social capital.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

Based on the facts presented in forgone chapters, the key findings of the study in summary are presented in this chapter. Based on the finding of the study, the chapter also forwarded possible ways, which can be used for the local implementer of the project, planners and concerned stakeholders.

To start with, livelihood assets of the study area, the key livelihood resources have been indentified to be farmland, human labour, number of oxen, and other livestock (cow, sheep and horse), water, forest and rangeland. The status of these key livelihood resources and other assets were reported to be low and very low as the evidences indicated was also becoming so worse and it was decreasing or very decreasing overtime before the intervention.

The study has also indentified the main causes for the changes in trend, these are climatic change hazards (torrential and erratic rainfall, drought and strong wind) and human pressures such as high deforestation and forest degradation because increasing demands of the surrounding communities' natural resources such as source of bio-fuel energy (fire wood) that depend on forests and crop residues. The expansion of farmlands towards forests have also accompanied by high population density, it has forced the local people to plough very sloppy lands that lead to high erosion.

Based on data generated from study, there is a climate change in the project area especially, temperature increases, hot seasons also becomes longer and changes observed in rainfall pattern and fluctuate in its amount, duration, intensity and variability together with occurrence of strong wind, which was not a common phenomenon in the area before 20-30 years have been observed. Furthermore, the vulnerability of the area is characterized by high exposure trend for drought, late coming and early leaving of rainfall, erratic and torrential rainfall as well as high sensitivity/low resources status that together have exposed the study area to hazards. The adaptive capacity of the area has also been identified to be very low and the area did not have a culture of using technologies for adaptation, and hence less alternative employment opportunity for diversification of their income. In addition, the climate change hazards also resulted in many negative consequences on key

livelihood resources that damage and make the soil eroded, the water dry, plant growth stunt, and together with damaging their houses. Consequently, key livelihood resources of the area to become low in productivity, enhance forest degradation, crop and animal production undermined. Despite remarkable decrement have been observed little opportunities have been created in the area like; new crop (peas and beans) and animal (goat) adaptation and making the area ease for communication and information exchange compared to what was there before 30 years. However, due to lack of focus and institutional linkage problem the communities did not maximize the opportunities.

The Community Based Development Institution could do many activities to support the local communities' livelihood, such as; area closures, rotational grazing, cut and carry system, liming, preparation of compost, multiplication and distribution of farmers' important local varieties, and forestation and forest protection. These have enable the achievement of conservation of biodiversity at the local level, reducing deforestation, improved land productivity, reduction of soil erosion, promotion of water development, enhancement of organic agriculture, and increment of the resilience capacity of ecosystem and economic returns from what the communities are engaged in.

Nevertheless, the study demonstrated that the project has some gaps in the process of implementation. These include the project did not target at the disadvantaged part of the community, especially youngsters, females and very poor segments of the communities. Moreover, the institution management body also lacks skills and knowledge to absorb the local community and they are in volunteer to have more membership. This tendency leads to conflict over the ownership and utilization of communal resources. Unless, it is resolved immediately through frequent discussion and contact with the concerned stakeholders, the things may be worse in the future and the project may not achieve its goals. At the same time, there has been a serious conflict between the project site and the neighboring 5(five) kebeles over the consumption of communal resources (rang land and forest). This also needs attention that otherwise leads to a threat for the project existence and its sustainability. The other gaps, which have been observed, are lack of knowledge and information to implement the activities, lack of linkages of the CBO with other institutions and providing recognition for the community based institution activities and objective performance.

According to the study, there has been an importance in credential change in most of the activities mentioned above by the local communities with some deviation among age, sex, CBOs membership, and non-membership as well as wealth categories. Regarding to the determinant factors affecting the

local community to implement those adaptation mechanisms, the investigation has indicated the determinant factors that have contributed against or towards implementation were wealth and CBO membership and non-membership ,land size ,oxen number ,gander difference, agricultural extension service and age categories. Those had better off and CBO members, relatively large land size and oxen number have performed better than the other group with significant difference. In addition, the other factors, which have contributed to the implementation of adaptation mechanisms are; differences in age group (in that adults have more implement). Gender (males have become more implementer than females), agriculture extension service who have access to extension service have practicing adaptation mechanisms more than the non-users. Next to these accesses to credit services, lack of institutional linkage support and recognition for the implementation of those activities, existence of internal and external conflicts were also among the determinate factors for the implementation of those activities.

This study also tried to address the issues of enhancement of adaptive capacity in connection with the intervention. The quantitative paired sample t test indicated that there has been an improvement of key livelihood resource status along with the trend change from decreasing to increasing. To discuss specifically there has been an improvement in terms of soil fertility, land productivity, water, and forest resource status with an increase in crop and animal production that have lead to income increment in the area, which is consistent with qualitative data. Although there has been an income distribution difference among age and different wealth groups, and between male and female headed households, between members and non members of the institution it is concluded that the project resulted in the development of effective adaptation mechanisms, reduction of vulnerability, enhancement of adaptive capacity and improvement of the livelihoods of the local communities. Regardless of some curial gaps existed in the operational process and need immediate action that are mentioned before in this section and the discussion part.

5.2. Recommendations

Based on the facts obtained from the study, this particular research forwarded the following recommendations.

- Since the status of the key livelihood resources before the project was low and/or very low and its trends were decreasing and/or very decreasing, but it is found to be after the project intervention the situations have been reversed. Therefore, such interventions should be designed and promoted to the other similar areas.

- Most researchers argue that in Ethiopian context the phenomenon happening frequently is climate variability, not climate change. However, according to the farmers view this paper assures that there is climate change and a permanent pattern and trend change in temperature, rainfall and wind. As a result, people around the project site exercise permanent change on wearing style, crop pattern change and a complete snow cover loss that were not commonly observed in the area before 30 years. Therefore, further investigation is needed to validate the finding of this paper to address the real problems of the community and design proper adaptation mechanisms

- In the study site, there is no climatic data recording instruments (temperature, rainfall and wind Pattern), however; climatic investigation seeks more instrumental record of information about these elements, and the area is one of the bio diversity spot and geographical importance site. Therefore, there is a need to establish climatic information recording station in the area to have clear image about the site.

- In the investigation it could not portrayed the extent of impact or magnitude of change brought by the project intervention due to the absence of clear baseline data. Therefore, to understand the exact effects of the project there is a need to clear base line survey data and clear inventory of key livelihood resources status before entry of the project.

- The climate change impacts have resulted in many hazards on the key livelihood resources and can come with few opportunities for the local community. Then the professionals shall work hard to understand these impacts and try to develop proper adaptation mechanisms.

- In addition to climatic hazards, the key livelihood resources of the area are so poor due to unwise use of resources such as farming of very steep slopes, conserving their soils using soil conservation technologies is not so much, and conflicting over the consumption of these resources. Then the concerned institution should think of and implement for participatory land use planning with a frequent contact and discussion with the local communities to minimize conflict and implement participatory land use planning.

- All concerned development stakeholders at different level hierarchy should understand the geographic importance of the area, which is the source of many rivers and biodiversity, mix and having knowing this taker of it for its maintenance and rehabilitation.

- In the rehabilitation process there has been eucalyptus plantation however, the sample collected from four types of land use types in the Choke watershed form natural forestland, cultivated land, grazing land and eucalyptus plantation. The soil property from cultivated land, grazing land and eucalyptus plantation shows significantly high sand content but lower $_{Ca}{}^{2t}$ and $_{Mg}2^{t}$ Contents and less cat ion exchange capacity compared to natural forest. Furthermore, eucalyptus plantation area have statistically significant higher bulk density than the other three types of land uses and lower in organic content as well as nitrogen content form the natural forests (Woldeamlak, 2003). Therefore as a rehabilitation project plantation of eucalyptus in community area closure in this important biodiversity center should not be recommended. Instead, it is better to plant eucalyptus on individual woodlot on unproductive land and hedges along the peripheral lands for fuel wood and construction consumption.

- Based on the overall assessment, it was found that the project has a significant contribution on key livelihood resources: water, forest, land/soil, and income. Concerned bodies should therefore scale up these good practices to other similar areas with a better treatment to avoid gaps, which occur in the implementation process (especially conflict management, stakeholders' participation and institutional linkage).

- During the implementation of the project, it has been observed that there was uneven distribution of activities and income among age groups, wealth groups, gender group, member, and non-members segments of the community. Therefore, targeting to the disadvantaged sides i.e. youth, women, the

very poor, and the CBO to have more members should be take in into consideration by the project stakeholders.

- Regarding ownership, support and promotion of the institutional activities and institutional linkage the kebele, woreda, zone (Agriculture and Rural Development, Environmental Protection and Land Administration, Cooperative promotion and Administration offices) should take the responsibility to strengthen it further.
- To solve the current internal and external conflicts in the watershed site not only awareness and training but frequent discussions and contacts with the local communities must be made.
- Frequent expertise visit with practical method and result demonstration teaching method is needed to adopt soil conservation technologies since soil conservation is not effective only using, conservation tillage, cut off drains, developing water way, area closure, cut and carry system and rotational grazing.
- Lastly, it is understandable that the intervention has significantly achieved a change towards better implementation of climate change adaptation mechanisms and the enhancement of the adaptive capacity as well as the improvement of the livelihood conditions of the local communities. However, this contribution should be continually made for a sustainable development of people's lives by minimizing the gaps, which have been observed in this study.

Reference

AAI (Action Aid International). (2009). *Sustainable Agriculture and Climate Change; an Action Rough Guide.* Johannesburg: AAI South Africa.

Adger, W. N.et.al. (2003). *Adaptation to Climate Change in the Developing World.* London: Tyndall Center for Climate Change Research, UK.

Agrawal, A. (2008). *The Role of Local Institutions in Adaptation to Climate Change Paper Prepared for The Social Dimension of climate Change.* Washington DC: Social Development Department, the World Bank.

Ambaber CBO (Ambaber Community Based Organization). (2011). *Ambaber Community Based Organization Annual Report.* Shime Kebele: Ambaber, East Gojjam.

ANRS (Amhara National Regional State). (2000). *Amhara National Regional State Food Security Research Assessment Report.* BahirDar: USAID, Collaborative Research Support Team, Ethiopia.

ANRS (Amhara National Regional State). (2007). *Livelihood Profile Assessment of Amhara Region.* Bahir Dar: ANRS Agricultural Bureau, Ethiopia.

ASE (Agri-Service Ethiopia). (2007). *Policy, Strategies and Guidelines for the Establishment and Development of Community Based Institutions(CBIs).* Addis Ababa: ASE, Ethiopia.

Azmeraw Ayehu. (2010). *Effectiveness and Governance of Community Based Participatory Watershed Management, in Choke mountain; the case of Chemoga Watershed.* East Gojjam: Unpublished MA thesis in Addis Ababa University, Ethiopia.

Beck, T., & Nesmith, C. (2001). Building on Poor peoples Capacities: The Case of Common Property *Resources* in India and West Africa. *World Development* , 29(1): 119-133.

Belay Simane & Shibru Tedla. (2007). *Improved Land Management Practices of Choke Mountains to sustain Blue Nile Rivers: A trans-boundary water management.* Addis Ababa: ESAT, Ethiopia.

Belay Simane. (2007). *Integrated Choke Mountain Ecosystem Rehabilitation Project.* Livelihood Approach: Project Concept paper.

Bewket Amede. (2010). *Local Level Analysis of Farmers Adaptation to Climate Change and variability:The case of Choke Mountain.* East Gojjam: Unpublished MA Thesis in Addis Ababa University,Ethiopia.

Brook, N. (2003). *vulnerability, Risks and Adaptation: a conceptual framework working paper 38.* Retrieved 03, 21, 2011, from tyndall Center for Climate Change Research, University of East Anglia, Norwich: www.tyndall.ac.uk

Chambers, R., & Conway, G. (1992). Sustainable Rural Livelihoods: practical Concept for the 21st Centure. IDS *Discussion Paper296.* Brighton: IDS,UK.

CIFOR (Center for International Forestry Research). (2005). Tropical Forest and Adaptation to Climate Change in search of Synergies, Edited by Carmenza Robled,Markku Kanninen and Lucio Pedroni. *CIFOR.* Bogor ,Indonesia.

CSA (Central Statistics Authority). (2008). *The 2007 Housing and Population Census Result for Amhara Region.* Addis Ababa: CSA, Ethiopia.

DFID (Department for International Development). (1999). *Sustainable Livelihoods Guidance Sheets.* London: DFID,UK.

DFID (Department for International Development). (2000). *Sustainable Livelihoods Guidance Sheets.* Retrieved October 15, 2010, from DFID: www.Livelihood.Org/Info/Info Guidancesheets.Htm

Ellis, F. (2000). *Rural livelihoods and Diversity in Developing Countries.* Oxford: Oxford University Press.

EPA (Environmental Protection Authority). (2006). *Project of Coping with Drought and Climate Change to UNDP-GEF.* Addis Ababa: EPA, Ethiopia.

FAO (Food and Agricultural Organization of the united Nation). (2006). *The New Generation of Watershed Management Programmes and Projects: A Resource Book for Practitioners and Local Decision-Makers based on the findings and recommendations of A FAO Review.* Retrieved September 20, 2010, from FAO Forestry Paper: Www.FAO.Org/Docrep/009/A0644e/A0644e00.Htm

Fisher, M. (2004). Household Welfare and Forest Dependence in Southern Malawi. *Environment and Development*, 9(2):135-154.

Forch, G. (2009). *Integrated Watershed Management- a Successful Tool for Adaptation to Climate Change. Siegen*: University of Siegen, Germany.

Gebebtibouo, A. (2009). *Understanding Farmers Perception and Adaptations to Climate Change and Variability the Case of the Limpopo Basin.* Johannesburg: IFPRI Discussion Paper 00849,South Africa.

IFAD(International Fund For Agriculture Development). (2009). Research and Innovation for Smallholder Farmers in the Context of Climate Change. *Discussion Paper for Government Council,18-19 February.* Rome: IFAD.

IGAD(Inter Governmental Authority on Development). (2007). *IGAD Environment and Natural Resource Strategy.* Addis Ababa: IGAD.

IGES (Institute for Global Environment Strategies). (2008). Sustainable Livelihood Based Water Management-"Watershed Plus" Approach. *1st Working Group Meeting of Eria Anindya Bhattacharya 31st July,2008,.* Manila: IGES.

IPCC (Inter governmental Panel on Climate Change). (2007c). *Climate Change 2007: The Physical Science Basis. Contribution of Working Group 1 to The Fourth Assessment Report of The IPCC(Solomon,S.,D.Qin,M.Manning(eds)).* Cambridge,UK: Cambridge University Press,.

IPCC (Inter governmental Panel on Climate Change). (2007b). *Climate Change, The Fourth Assessment Report (AR4).* Cambridge, UK: Cambridge University *Press.*

IPCC (Inter governmental Panel on Climate Change). (2001). *Climate Change2001,The Third Assessment Report.* Cambridge: Cambridge University press.

IPCC (Inter governmental Panel on Climate Change). (2007d). *Summary for Policymakers; In Climate Change 2007: The physical Science Basis. Contribution of Working Group 1 to the Fourth Assessment Report of the IPCC(Solomon.et,al(eds)).* Cambridge, UK and New York, USA: Cambridge University Press.

Israel, G. (1992). *Sampling, the Evidence of Extension Program Impact, Program Evaluation, and Organizational Development.* IFAS, University of Florida.

IUCN (International Union for Conservation of Nature and Natural Resource). (2001). *Adapting to Climate Change: Natural Resource Management and Vulnerability Reduction. Background paper to the Task Force on Climate Change, Adaptation and Vulnerable Communities.* IUCN.

IUCN (International Union for Conservation of Nature and Natural Resource). (2009). *Ecosystem-Based Adaptation: A Natural Response to Climate Change.* IUCN.

Jodha, N. (1995). Studying Common Property Resources: Biography of Research Project. *Economic and Political Weekly* , 30(11):556-559.

Johnson, N., & Knox, A. (2002). Participatory Natural Resource Management in watersheds: *Concepts*, Issues and Challenges for Research. *Annuals of Arid Zones* , 40(3):1-20.

Kollmair, M., & Juli, G. (2002). The Sustainable Livelihoods Approach. *Input Paper for the Integrated Training Course of NCCR North-South Aeschiried, Switzerland(9-20,september 2002).* Compiled by M.Kollmair and St.Gamper,Juli 2002 Development Study Group, University of Zurich(IP6).

MDGNA (Millennium Development Goal Need Assessment). (2004). *The Rural Development and Food Security Sector in Ethiopia.* Addis Ababa: MoFED, Ethiopia.

MoARD (Ministry of Agriculture and Rural Development). (2001). *Soil and Water Conservation Manual, Guide Line for Ethiopia.* Addis Ababa: Reviewed by Daniel et al MoA.

NAPA (National Adaptation Plan for Action). (2007). *Climate Change NAPA of Ethiopia.* Addis Ababa: MoWER and NMA, Ethiopia.

O'brien, K. L., & Leichenko, R. (2000). *Double Exposure, Assessing the Impacts of Climate Change within* The *Context of Economic Globalization.*

Racelies, M. (1999). "Poverty Eradication: Asset Reform or 'Photo-Ops?" Philippine Daily Inquirer Rural Nonfarm Labour Market in Africa. *World Development 25(5)* , 735-747.

Scoones, I. (1998). Sustainable Rural Livelihoods: A Framework for Analysis. *IDS Working Paper No.72.* Brighton: IDS,UK.

Shime Kebele. (2011). *Shime Kebele Basic Information Document.* Shime Kebele, Debaye Tilate gine Woreda, East Gojjam.

Smit, B.et al. (2001). *"Adaptation to Climate Change in the Context of Sustainable Development and Equity" In Climate Change 2001: Impacts, Adaptation and Vulnerability.* Cambridge: Cambridge University Press, UK.

Temesgen Deressa. et.al. (2008). Measuring Ethiopian Farmers' Vulnerability to Climate Change Across Regional *State. IFPRI Discussion Paper 00806, October 2008, Environment and Production Technology Division.*

Tsegaye Bekele.et .al. (2004). Impacts of Participatory forest Management Practices in Adaba-Dodola Forest Priority Area of Oromia Region, Debub University, Wendo Genet College of Forestry. *Ethiopian Journal of Natural Resources.6(1)* , 89-109,Shashemene, Ethiopia.

UNDP (United Nation Development Programme). (2005). *Adaptation Policy Frame work for Climate Change, Developing strategies, Policies and measures.* UNDP.

UNFCCC (United Nation Framework Convention on Climate Change). (2007, July 07). *Climate Change: Impacts, Vulnerabilities and Adaptation in Developing Countries report on the workshop on climatic related risks and extreme events.* Retrieved October 10, 2010, from Noted by The Sectretariat. FCCC/SBSTA.UNFCC.Bonn,Germany.: Http://unfcc.int/resource/docs/2007/sbsta/eng/o7

USAID (United States Agency for International Development). (2007). *Adapting to Climate Variability and Change a Guidance Manual for Development Planning.* Addis Ababa, Ethiopia: USAID.

Vilei, S. (2007). Locally Derived Indicators for Evaluating Sustainability of Farming System. *Conference on International Agricutural Research for Development.* Edited by Tropentag University of Kassel-Witzenhausen and University of Gottingen, October 9-11,2007.

WARDO (Woreda Agriclture and Rural Development Office). (2011). *Upper Muga Community Based Ecoturism and Marketing Cooperative Annual Report. Kuye*: Debaye Tilategine Woreda Agricultural and Ruarl Development office.

WB (World Bank). (2007a). *The Littel Green data Book,2007,Values are Based on Country(Ethiopia) surveys Conducted between 1989 and 2005.* Addis Ababa: WB, Ethiopia.

WB (World Bank). (2007b). *Ethiopia, Climatic Risks Fact Sheet.* Addis Ababa: WB, Ethiopia.

Woldeamlake Bewket. (2003). *Towards Integrated Watershed Management in Highland Ethiopia: The Chemoga watershed case study.* Wagningen University Netherlands.

Annexes

Annex I Choke Mountain CBO Profile

	Choke mountain Natural Resources Development and Tourism Marketing Cooperative profiles							
no	woreda	kebele	Watershed name	Year of establish ment	beneficiary by household			project cost in ETB
					M	F	total	
1	Sinan	Abazaje Woyibegn	Ababelie	2008	1228	182	1410	387735
2	Sinan	Abazaje Woyibegn	Abajime	2007	267	49	316	471827
3	Sinan	Dangule	Abo	2008	2286	442	2728	442,260
4	Bibugn	Gebre Giorgis	Adagn Mdhanealem	2007	320	50	370	490,153
5	Bibugn	Dede Eyesus	Addis Alem	2008	368	41	409	483,732
6	Debay Tilat Gin	Sheme	Upper Muga	2007	500	90	590	405,550
7	Bibugn	Arusi Mesesabiya	Bahru Arusi Dong	2008	167	29	196	388,050
8	Debay Tilat Gin	Namira Michael	Boreborit	2008	224	28	252	330,480
9	Sinan	Dangule	Chemoga	2007	280	50	330	436,031
10	Debay Tilat Gin	Namira Yebalat	Dedeke	2008	148	25	173	380,975
11	Bibugn	Debre Giorgis	Gedeb Giorgis	2008	373	45	418	636,130
12	Sinan	Shewa Kidan Mihret	Godeb	2008	319	67	386	492,655
13	Bibugn	Yewonber Kidus Yohannes	Meleya	2008	259	13	272	430,330
14	Sinan	Telezamo Debre Mitmaq	Temcha	2007	320	50	370	463,248
15	Debay Tilat Gin	Namira Gocha	Tsion Choke	2008	220	7	227	434,705
16	Debay Tilat Gin	Debre Eyesus	washa	2007	197	21	218	432,554
17	Sinan	Tegodare	Work Awtulet	2008	270	50	320	482,832
18	Debai Tilat Gin	Eneqoy	Wyifn Adikim	2007	401	46	447	446,452
19	Debay Tilat Gin	Wedeb Eyesus	Yegomira	2008	146	9	155	474,030
20	Debay tilat gin	Naziret Mdhanealm	Yjibara meda	2007	297	17	314	442,947
21	Sinan	Tamawet Gedel Bet	Zumander	2008	316	49	365	444,342
Total budget disbursed								9397018

Annex II Multiple Comparisons of Climatic Hazard Impact among Age Groups

Dependent Variable	(I) age of respondents	(J) age of respondents	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
climatic hazards impact for shortage of fuel wood	young	adult	.391	.167	.055	-.01	.79
		elder	-.176	.200	.653	-.65	.30
	adult	young	-.391	.167	.055	-.79	.01
		elder	-.567*	.164	.002	-.96	-.18
	elder	young	.176	.200	.653	-.30	.65
		adult	.567*	.164	.002	.18	.96
climatic hazards impact on public	young	adult	.691*	.187	.001	.25	1.14
		elder	-.095	.223	.905	-.63	.44

reduction of public support	adult	young	-.691*	.187	.001	-1.14	-.25
		elder	-.786*	.183	.000	-1.22	-.35
	elder	young	.095	.223	.905	-.44	.63
		adult	.786*	.183	.000	.35	1.22
Climatic hazards impact on reduction local institution support	young	adult	.777*	.183	.000	.34	1.21
		elder	.050	.219	.972	-.47	.57
	adult	young	-.777*	.183	.000	-1.21	-.34
		elder	-.727*	.180	.000	-1.16	-.30
	elder	young	-.050	.219	.972	-.57	.47
		adult	.727*	.180	.000	.30	1.16
climatic hazards impact on reduction of family education enrolment	young	adult	.805*	.187	.000	.36	1.25
		elder	.007	.223	.999	-.53	.54
	adult	young	-.805*	.187	.000	-1.25	-.36
		elder	-.797*	.183	.000	-1.23	-.36
	elder	young	-.007	.223	.999	-.54	.53
		adult	.797*	.183	.000	.36	1.23
climatic hazards impact on reduction to saving capacity	young	adult	.823*	.244	.003	.24	1.40
		elder	-.126	.292	.903	-.82	.57
	adult	young	-.823*	.244	.003	-1.40	-.24
		elder	-.949*	.240	.000	-1.52	-.38
	elder	young	.126	.292	.903	-.57	.82
		adult	.949*	.240	.000	.38	1.52
climatic hazards impact on credit utilization reduction	young	adult	.895*	.237	.001	.33	1.46
		elder	.017	.284	.998	-.66	.69
	adult	young	-.895*	.237	.001	-1.46	-.33
		elder	-.879*	.233	.001	-1.43	-.32
	elder	young	-.017	.284	.998	-.69	.66
		adult	.879*	.233	.001	.32	1.43
how hazards impact on reduction of agricultural input utilization	young	adult	.882*	.209	.000	.38	1.38
		elder	.062	.250	.967	-.53	.66
	adult	young	-.882*	.209	.000	-1.38	-.38
		elder	-.820*	.205	.000	-1.31	-.33
	elder	young	-.062	.250	.967	-.66	.53
		adult	.820*	.205	.000	.33	1.31
climatic hazards impact on local food supply decrement	young	adult	1.045*	.194	.000	.58	1.51
		elder	.119	.233	.866	-.44	.67
	adult	young	-1.045*	.194	.000	-1.51	-.58
		elder	-.926*	.191	.000	-1.38	-.47
	elder	young	-.119	.233	.866	-.67	.44
		adult	.926*	.191	.000	.47	1.38

Annex III Multiple Comparisons of Climatic Hazard Impact among Wealth Status

Dependent Variable	(I) wealth category	(J) wealth category	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Climatic hazards impact for shortage fuel wood	very poor	poor	.208	.184	.671	-.27	.69
		medium	.292	.184	.392	-.19	.77
		better off	.708*	.184	.001	.23	1.19
	poor	very poor	-.208	.184	.671	-.69	.27
		medium	.083	.184	.969	-.40	.56
		better off	.500*	.184	.039	.02	.98
	medium	very poor	-.292	.184	.392	-.77	.19
		poor	-.083	.184	.969	-.56	.40

		better off	.417	.184	.114	-.06	.90
	better off	very poor	-.708*	.184	.001	-1.19	-.23
		poor	-.500*	.184	.039	-.98	-.02
		medium	-.417	.184	.114	-.90	.06
Climatic hazards impact on public support	very poor	poor	.542*	.124	.000	.22	.87
		medium	1.542*	.124	.000	1.22	1.87
		better off	1.583*	.124	.000	1.26	1.91
	poor	very poor	-.542*	.124	.000	-.87	-.22
		medium	1.000*	.124	.000	.68	1.32
		better off	1.042*	.124	.000	.72	1.37
	medium	very poor	-1.542*	.124	.000	-1.87	-1.22
		poor	-1.000*	.124	.000	-1.32	-.68
		better off	.042	.124	.987	-.28	.37
	better off	very poor	-1.583*	.124	.000	-1.91	-1.26
		poor	-1.042*	.124	.000	-1.37	-.72
		medium	-.042	.124	.987	-.37	.28
Climatic hazards impact on social institution support	very poor	poor	.000	.144	1.000	-.38	.38
		medium	1.208*	.144	.000	.83	1.58
		better off	1.250*	.144	.000	.87	1.63
	poor	very poor	.000	.144	1.000	-.38	.38
		medium	1.208*	.144	.000	.83	1.58
		better off	1.250*	.144	.000	.87	1.63
	medium	very poor	-1.208*	.144	.000	-1.58	-.83
		poor	-1.208*	.144	.000	-1.58	-.83
		better off	.042	.144	.991	-.33	.42
	better off	very poor	-1.250*	.144	.000	-1.63	-.87
		poor	-1.250*	.144	.000	-1.63	-.87
		medium	-.042	.144	.991	-.42	.33
Climatic hazards impact damage by water boron diseases	very poor	poor	.625*	.158	.001	.21	1.04
		medium	2.250*	.158	.000	1.84	2.66
		better off	1.917*	.158	.000	1.50	2.33
	poor	very poor	-.625*	.158	.001	-1.04	-.21
		medium	1.625*	.158	.000	1.21	2.04
		better off	1.292*	.158	.000	.88	1.70
	medium	very poor	-2.250*	.158	.000	-2.66	-1.84
		poor	-1.625*	.158	.000	-2.04	-1.21
		better off	-.333	.158	.156	-.75	.08
	better off	very poor	-1.917*	.158	.000	-2.33	-1.50
		poor	-1.292*	.158	.000	-1.70	-.88
		medium	.333	.158	.156	-.08	.75
Climatic hazards impact on reduction of family education enrolment	very poor	poor	.333*	.120	.033	.02	.65
		medium	1.542*	.120	.000	1.23	1.86
		better off	1.542*	.120	.000	1.23	1.86
	poor	very poor	-.333*	.120	.033	-.65	-.02
		medium	1.208*	.120	.000	.89	1.52
		better off	1.208*	.120	.000	.89	1.52
	medium	very poor	-1.542*	.120	.000	-1.86	-1.23
		poor	-1.208*	.120	.000	-1.52	-.89
		better off	.000	.120	1.000	-.31	.31
	better off	very poor	-1.542*	.120	.000	-1.86	-1.23
		poor	-1.208*	.120	.000	-1.52	-.89
		medium	.000	.120	1.000	-.31	.31
Climatic hazards	very poor	poor	.333	.166	.194	-.10	.77

impact on rate of labor migration		medium	2.208*	.166	.000	1.77	2.64
		better off	1.708*	.166	.000	1.27	2.14
	poor	very poor	-.333	.166	.194	-.77	.10
		medium	1.875*	.166	.000	1.44	2.31
		better off	1.375*	.166	.000	.94	1.81
	medium	very poor	-2.208*	.166	.000	-2.64	-1.77
		poor	-1.875*	.166	.000	-2.31	-1.44
		better off	-.500*	.166	.018	-.94	-.06
	better off	very poor	-1.708*	.166	.000	-2.14	-1.27
		poor	-1.375*	.166	.000	-1.81	-.94
		medium	.500*	.166	.018	.06	.94
Climatic hazards impact damaging of animals by new emerging disease	very poor	poor	.750*	.201	.002	.22	1.28
		medium	1.167*	.201	.000	.64	1.69
		better off	.958*	.201	.000	.43	1.48
	poor	very poor	-.750*	.201	.002	-1.28	-.22
		medium	.417	.201	.169	-.11	.94
		better off	.208	.201	.728	-.32	.73
	medium	very poor	-1.167*	.201	.000	-1.69	-.64
		poor	-.417	.201	.169	-.94	.11
		better off	-.208	.201	.728	-.73	.32
	better off	very poor	-.958*	.201	.000	-1.48	-.43
		poor	-.208	.201	.728	-.73	.32
		medium	.208	.201	.728	-.32	.73
Climatic hazards impact on reducing of saving capacity	very poor	poor	.583*	.190	.015	.09	1.08
		medium	1.917*	.190	.000	1.42	2.41
		better off	1.708*	.190	.000	1.21	2.21
	poor	very poor	-.583*	.190	.015	-1.08	-.09
		medium	1.333*	.190	.000	.84	1.83
		better off	1.125*	.190	.000	.63	1.62
	medium	very poor	-1.917*	.190	.000	-2.41	-1.42
		poor	-1.333*	.190	.000	-1.83	-.84
		better off	-.208	.190	.694	-.71	.29
	better off	very poor	-1.708*	.190	.000	-2.21	-1.21
		poor	-1.125*	.190	.000	-1.62	-.63
		medium	.208	.190	.694	-.29	.71
Climatic hazards impact on reduction of credit utilization	very poor	poor	.583*	.183	.010	.10	1.06
		medium	1.875*	.183	.000	1.40	2.35
		better off	1.708*	.183	.000	1.23	2.19
	poor	very poor	-.583*	.183	.010	-1.06	-.10
		medium	1.292*	.183	.000	.81	1.77
		better off	1.125*	.183	.000	.65	1.60
	medium	very poor	-1.875*	.183	.000	-2.35	-1.40
		poor	-1.292*	.183	.000	-1.77	-.81
		better off	-.167	.183	.799	-.65	.31
	better off	very poor	-1.708*	.183	.000	-2.19	-1.23
		poor	-1.125*	.183	.000	-1.60	-.65
		medium	.167	.183	.799	-.31	.65
Climatic hazards impact on reduction of agricultural input utilization(improved seed and fertilizer)	very poor	poor	.167	.183	.798	-.31	.64
		medium	1.458*	.183	.000	.98	1.94
		better off	1.250*	.183	.000	.77	1.73
	poor	very poor	-.167	.183	.798	-.64	.31
		medium	1.292*	.183	.000	.81	1.77
		better off	1.083*	.183	.000	.61	1.56

	medium	very poor	-1.458*	.183	.000	-1.94	-.98
		poor	-1.292*	.183	.000	-1.77	-.81
		better off	-.208	.183	.665	-.69	.27
	better off	very poor	-1.250*	.183	.000	-1.73	-.77
		poor	-1.083*	.183	.000	-1.56	-.61
		medium	.208	.183	.665	-.27	.69
Climatic hazards impact on local food shortage	very poor	poor	.583*	.141	.000	.21	.95
		medium	1.625*	.141	.000	1.26	1.99
		better off	1.792*	.141	.000	1.42	2.16
	poor	very poor	-.583*	.141	.000	-.95	-.21
		medium	1.042*	.141	.000	.67	1.41
		better off	1.208*	.141	.000	.84	1.58
	medium	very poor	-1.625*	.141	.000	-1.99	-1.26
		poor	-1.042*	.141	.000	-1.41	-.67
		better off	.167	.141	.639	-.20	.54
	better off	very poor	-1.792*	.141	.000	-2.16	-1.42
		poor	-1.208*	.141	.000	-1.58	-.84
		medium	-.167	.141	.639	-.54	.20

Annex IV Independent T Test Value for Climatic Hazard Impact between Gender Groups

		t-test for Equality of Means				
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Climatic hazards impact on public support	Equal variances assumed	-4.114	94	.000	-.514	.125
Climatic hazards impact on social institution support	Equal variances assumed	-2.801	94	.006	-.389	.139
Climatic hazards impact on shortage of water	Equal variances assumed	-3.440	94	.001	-.694	.202
Climatic hazards impact on reduction of education enrollment	Equal variances assumed	-3.554	94	.001	-.486	.137
Climatic hazards impact on labor migration rate	Equal variances assumed	-2.339	94	.021	-.472	.202
Climatic hazards impact on credit utilization	Equal variances assumed	-2.294	94	.024	-.389	.169
Climatic hazards impact for loss of seed &fertilizer	Equal variances assumed	-3.259	94	.002	-.458	.141
Climatic hazards impact on local reduction of labor rate	Equal variances assumed	-2.750	94	.007	-.417	.151
Climatic hazards impact on reducing saving capacity	Equal variances assumed	-3.731	94	.000	-.847	.227
Climatic how hazards impact on reducing credit utilization	Equal variances assumed	-3.766	94	.000	-.833	.221
Climatic hazards impact on reduction agriculture input utilization	Equal variances assumed	-3.393	94	.001	-.681	.201
Climatic hazards impact on reduction of food storage	Equal variances assumed	-2.654	94	.009	-.458	.173

Declaration

I undersigned and declare that this thesis is my original work, has not been presented for a degree in any other university and that all sources of materials used for the thesis have been duly acknowledged.

Declared by

Name: Assefa Abelieneh

Signature _____

Candidate

Confirmed by

Name: Belay Simane (PhD)

Signature _____

Advisor