CLIMATE CHANGE: VULNERABILITY AND ADAPTATION, A CASE STUDY OF MEN AND WOMEN FARMERS IN ERITREA

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by
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Yordanos Tesfamariam, candidate for the degree of Master of Arts in Justice Studies, has presented a thesis titled, *Climate Change: Vulnerability and Adaptation, A Case Study of Men and Women Farmers in Eritrea*, in an oral examination held on December 5, 2013. The following committee members have found the thesis acceptable in form and content, and that the candidate demonstrated satisfactory knowledge of the subject material.

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Abstract

This study is based on qualitative research conducted by the writer using semi-structured interviews with key informants, including elderly male and female farmers. An analysis based on a theoretical framework of vulnerability and coping mechanisms was also conducted on the lived experience of farmers in Berik, in the Central Highlands, and Barentu/Sosona, in the lowlands of Gash Barka, related to climate change, including some practical recommendations they made to help them in their daily struggles for food security.

Eritrea is a sub-Saharan African country suffering from food insecurity due to climate change. Subsistence-level rain-fed mixed crops and livestock comprised 95% of its agricultural products. Low rainfall and droughts adversely affect these products. Adaptation strategies are related to accessing natural resources, as well as political, economic, social, and cultural factors. Furthermore, climate change does not affect everyone in the same way. Female-headed farms, which comprise 30% in Eritrea, are affected differently than those headed by males and their adaptation strategies differ, especially in food production. Even though female-headed farms are important producers they do not have equal access to resources provided by the Ministry of Agriculture because they are not considered to be primary farmers. This situation is exacerbated by the limited availability and affordability of agricultural inputs such as land, fertilizer, seeds and labour. Four prevailing root factors emerged during this study.

First was rain variability which impacted heavily on food security. Second were social/cultural views of women which prevented them from being regarded as equal primary farmers. Third was the indefinite national service, which removed farmers from
their family farms, especially males. Fourth were state farms that sold products for foreign currency and used national service workers for labour, which conflicted with the needs of family farms.
Acknowledgements

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Post Defense Acknowledgment

I am very grateful to my external examiner Dr. Carol Schick for her constructive feedback, editing and suggestions.
Dedication

This thesis is dedicated to my beloved Ade Hiwet Solomon Berkit. Thank you for raising me to be the person that I am today. You are a rock in my life and will always have a special place in my heart.

Thank you to my aunt Ascalu and uncle Goitom for genuinely having been there during my childhood and for many wonderful memories. I am forever grateful for having had you in my life.

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## List of Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>DoE</td>
<td>Department of Environment</td>
</tr>
<tr>
<td>EDHS</td>
<td>Eritrea Demographic and Health Survey</td>
</tr>
<tr>
<td>ENSO</td>
<td>El Niño-Southern Oscillation</td>
</tr>
<tr>
<td>EPLF</td>
<td>Eritrean People’s Liberation Front</td>
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<tr>
<td>FAO</td>
<td>Food and Agricultural Organization</td>
</tr>
<tr>
<td>FGDs</td>
<td>Focus Group Discussions</td>
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<td>FHHs</td>
<td>Female Headed-Households</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GoE</td>
<td>Government of Eritrea</td>
</tr>
<tr>
<td>Ha</td>
<td>hectare</td>
</tr>
<tr>
<td>IDRC</td>
<td>International Development Research Centre</td>
</tr>
<tr>
<td>IFAD</td>
<td>International Fund for Agricultural Development</td>
</tr>
<tr>
<td>INC</td>
<td>Initial National Communication</td>
</tr>
<tr>
<td>INGO</td>
<td>International Non-Government Organization</td>
</tr>
<tr>
<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
</tr>
<tr>
<td>LSMS</td>
<td>Living Standards Measurement Survey</td>
</tr>
<tr>
<td>M</td>
<td>Meters</td>
</tr>
<tr>
<td>MHHs</td>
<td>Male Headed-Households</td>
</tr>
<tr>
<td>Mm</td>
<td>Millimeter</td>
</tr>
<tr>
<td>MoA</td>
<td>Ministry of Agriculture</td>
</tr>
<tr>
<td>MoLG</td>
<td>Ministry of Local Government</td>
</tr>
<tr>
<td>MoLWE</td>
<td>Ministry of Land Water Environment</td>
</tr>
<tr>
<td>Nakfa</td>
<td>Nakfa is Eritrean currency</td>
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<tr>
<td>NFIS</td>
<td>National Food Information System</td>
</tr>
<tr>
<td>NGO</td>
<td>Non Governmental Organization</td>
</tr>
<tr>
<td>NUEW</td>
<td>National Union of Eritrean Women</td>
</tr>
<tr>
<td>NSEO</td>
<td>National Statistics and Evaluation Office</td>
</tr>
<tr>
<td>PFDJ</td>
<td>People's Front for Democracy and Justice</td>
</tr>
<tr>
<td>SNC</td>
<td>Second National Communication</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package for the Social Sciences</td>
</tr>
<tr>
<td>TICD</td>
<td>Toker Integrated Community Development</td>
</tr>
<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
</tr>
<tr>
<td>UNFCCC</td>
<td>United Nation Framework Convention on Climate Change</td>
</tr>
<tr>
<td>UNISDR</td>
<td>United Nation International Strategy for Disaster Reduction</td>
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<td>WFP</td>
<td>World Food Programme</td>
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CHAPTER ONE: INTRODUCTION

This introductory chapter discusses the research rationale, states the research objective and situates the research by contextualizing it within the discourse on global environmental change and the relationship between humans and their environment.

Gender discourse, how gender is viewed and the basis of gender as socially constructed, is also discussed in the context of Eritrea. The chapter concludes with an outline of the remainder of the study.

1.1 Introduction to the study

This study explores the impact of climate change\(^1\) on the rain-fed subsistence mixed crop and livestock based agriculture\(^2\) of farmers, both men and women, in Eritrea\(^3\). Their coping mechanisms are also described. Climate change and related disasters occur worldwide but have particularly severe effects on agriculture in the developing world, having a negative impact on food production (Dankelman, 2002; Morton, 2007; R. Kasperson & J. Kasperson, 2001). The Intergovernmental Panel on Climate Change\(^4\) (IPCC, 2007), in its Fourth Assessment Report, stated that human-

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\(^1\) Climate change is “… any change in climate over time, whether due to natural variability or as a result of human activity” (IPCC, 2007, p. 2).

\(^2\) Subsistence agriculture is “a type of farming that produces enough to meet the consumption needs of a farming family, but no surplus product for sale in markets” (Castree, N., Kitchin, R., & Rogers, A., 2013, p. 497).

\(^3\) Eritrea is a sub-Saharan African country in the Horn of Africa. The war for liberation from Ethiopia lasted for 30 years (1961-1991) and was led by the Eritrea People’s Liberation Front (EPLF). Two years after the end of the war, a UN supervised referendum was conducted and independence was formally declared in May 1993 (Gebremedhin, 2002). Since 1993 Eritrea has been a single-party state, run by the EPLF now under the name People's Front for Democracy and Justice (PFDJ). Eritrea has the second largest army in Africa with 300,000 men and women. National Service is compulsory and indefinite. The defense budget remains a heavy burden for the country at 25.7% of the Gross Domestic Product (GDP) in 2002 (Last figures available) (Library of Congress, 2005).

\(^4\) IPCC is an international body which assesses climate change. It was established in 1988, by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO). IPCC provides scientific data regarding climate change and its impact. Scientists voluntarily contribute to IPCC from all over the world. [http://www.ipcc.ch/](http://www.ipcc.ch/)
induced climate change was a reality, causing lower rainfall in already dry areas, hotter temperatures and extreme weather. Male and female subsistence farmers are vulnerable to climate variability and will need to adapt. According to IPCC (2001), “Vulnerability to climate change is the degree to which systems are susceptible to, and unable to cope with, the adverse impacts of climate change, including climate variability and extremes” (p. 6). Neil Adger (2006, p. 270) argued that “vulnerability to environmental change does not exist in isolation from the wider political economy of resource use.” Vulnerability to climate change is dynamic and context specific. It is affected by poverty, gender and societal conditions (Adger, 2006; Nelson, Meadows, Cannon, Morton, & Martin, 2002; R. Kasperson & J. Kasperson, 2001; Ziervogel, Bharwani, & Downing, 2006).

Irene Dankelman (2002) and Mary Mellor (1997) argued that the impact of climate change was not gender neutral. According to Mellor (1997) environmental problems had a greater “impact on rural women than on men” (p. 195). The vulnerability of women and their capacity to adapt to climate change differed from that of men because their roles, opportunities, and access to resources were not the same (Alber, 2009; Dankelman, 2002; Kakota, Nyariki, Mkwambisi, & Kogi-Makau, 2011; Tandon, 2007).

IPCC authors Michel Boko et al, (2007) predicted that climate change would have a more serious effect on Africa than on any other continent. Northern Africa is likely to experience continued problems related to water, specifically water availability, accessibility and demand. They argued that demand would exceed the limits of Africa’s economically usable land-based water resources before 2025. In some African countries
agricultural yields are projected to be reduced by 50% by 2020. As much as 90% reduction in crop net revenues may be experienced by 2100 by subsistence farmers and isolated rural populations (Boko et al, 2007; Collier, Conway, & Venables, 2008; Jones & Thornton, 2003; R. Kasperson & J. Kasperson, 2001).

The negative consequences of climate change in Africa are already apparent. Frequent floods, droughts and shifts in agricultural systems, impacting local people (Collier et al., 2008; R. Kasperson & J. Kasperson, 2001). This is considered to be an effect of the continent’s widespread poverty that limits adaptation capabilities and increases over-dependence on agriculture. It also increases the effects of other stressors (Collier et al., 2008). Climate change leads to increases in crop pests and livestock diseases and the frequency and distribution of bad weather conditions. This has a negative impact on water supplies and irrigation systems and results in increased soil erosion (Morton, 2007; Thompson et al., 2007). Smallholder and subsistence farmers in the developing world have special difficulty surviving climate variability and its effects as their livelihoods rely almost entirely on agricultural activities (Morton, 2007; R. Kasperson & J. Kasperson, 2001). They continue to lack the resources and capacities, such as off-farm labour and money, to make the changes in their way of life that would help them adapt.

1.1.1 Statement of the research problem

Eritrea is situated in sub-Saharan Africa. This part of the continent is dry and experiences water scarcity. The harvest depends on rainfall. Scarcity of rain, therefore, leads to food insecurity (Government of Eritrea [GoE], 2004; Habte, 2002; International Fund for Agricultural Development [IFAD], 2006; United Nations Development
Programme [UNDP], 2008). In Eritrea 95% of agriculture is rain-fed making agriculture vulnerable to climatic risk in this and other parts of Sahelian Africa (Gebremedhin, 1993; Habte, 2002). Agriculture, for example, crop and livestock farming, is a way of life across Eritrea (Gebremdhin, 1996, 2002; GoE, 2004). The country is an agricultural country characterized by a high level of food insecurity. In good rainfall seasons agricultural production meets only 60% of the country’s food needs, while in bad rainfall seasons agricultural production could easily fall below 25% of food needs (GoE, 2004; Habte, 2002; IFAD, 2008; UNDP, 2008). IFAD (2008) states that, “Even in years with adequate rainfall, about half of the food that the country requires has to be imported” (p. 1).

1.1.2 Research objective and research questions

This research is focused on two regions of Eritrea: Berik in the Central Highlands, and Barentu /Sosona in the Lowlands of Gash Barka. This study uses qualitative methodology to illustrate both male and female subsistence farmers’ lived experience. Primary data was collected using focus groups and semi-structured interview questions (Appendices E and F).

General objective: This study identified the vulnerability of the livelihood of farmers who are engaged in mixed crop, rain-fed agriculture in Eritrea. Both male and female farmers are exposed to stressors resulting from climate change in specific contexts and social conditions.

This research was guided by the following specific research questions:

- What is the impact of climate variability, specifically drought, on the livelihood of the men and women farmers in Berik and Barentu/Sosona?
During poor harvests, where do farmers think they should obtain the remainder of the unmet food shortages?

How does vulnerability to climate change affect gender roles and social customs in Berik and Barentu/Sosona?

What coping mechanisms are farmers currently using to reduce their exposure to climate change?

What adaptations do these farmers believe they could use in the future to reduce their exposure to climate change?

This research provides information for policy development geared to Eritrea’s subsistence farming. Policy developed from the standpoint of gender (men and women) and policy developed with their participation seems more likely to meet the needs of vulnerable subsistence farmers and be more effective in addressing their risks related to climate variability. This study increases our understanding of how Eritrean male and female subsistence farmers experience the impact of climate change and of their coping mechanisms. As such, it makes an important contribution to research related to male and female subsistence farmers in sub-Saharan Africa.

1.1.3 Scope of the study

This research is limited to a description and analysis of the farming and adaptive capacities of the male and female subsistence farmers of the Eritrean regions of Berik and Sosona who engage in mixed-crop and livestock production. This research has not dealt with the state farm spate irrigation agricultural systems in the Lowland of the Gash Barka region (Haile & Steenbergen, 2007). In Barentu/Sosona of the Lowlands of Gash

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5 Spate irrigation is “a type of river basin water management that is unique to semi-arid environments” (Haile & Steenbergen, 2007, p. 48).
Barka the Kumana population subsistence farmers were studied. In Berik, Central Highlands, it was the Tigrinya people that were the focus of the study.

1.2 Climate change: the context

According to Dankelman (2010) the interface between ecological and social processes is a social one. The environment is changed by humans as it changes the human’s themselves. As such, the persistent interactions of human beings with the environment have had a direct and indirect impact on the physical environment (For example: hunting and gathering, agricultural and the industrial societies). Dankelman (2010) states that “In the 19th century, human interventions in the physical environment intensified, with increasing demands for wood, coal, minerals, crops and other natural product” (p. 4). In the industrialized world overuse of agriculture, forestry and mining, as well as the pollution of water and air were increasingly apparent. As such, the late 19th century saw the beginnings of Nature Conservation organizations (Dankelman, 2010).

In the mid-20th century Silent Spring by Rachel Carson (1962) created awareness of the need for environmental management and nature conservation. This period also marked the beginning of the study of human-environmental interactions (Dankelman, 2010). In the 21st century, we are concerned about climate change and what it means for our survival. Robin Leichenko and Karen O’Brien (2008) argued that there are many ways of understanding global environmental change. Each is based on a particular approach to science, however, those “that accept global environmental change as real and pressing issue” (p.15). There three global discourses: the biophysical, the critical and the human environment. As Fikret Berkes and Carl Folke said, “there is no single universally accepted way of formulating the linkages between human and natural
systems” (1998, p. 9). For the purpose of this thesis the human-environmental discourse is conceptualized as follows:

1.2.1 Human-environmental discourses

Human-environmental discourses “emphasize the linkages between social and physical systems” (Leichenko & O’Brien, 2008, p. 17). Humans are part of the environment, part of a “coupled social-ecological system” (p.17) continually interacting with their physical and social contexts. The biophysical and social contexts are not separate and distinct systems. These discourses view the natural environment as inseparable from human activities (Leichenko & O’Brien, 2008). According to Leichenko and O’Brien (2008), within the human-environment discourse there are two major sub-categories: the works of Roger E. Kasperson, Jeanne X. Kasperson and Dow Kirsten (2001) and Turner et al., (2003) “focuses on a contextualized understanding of the human-environment system” (p. 17). The works of Holling (2004); Walker and Salt (2006) and Young et al., (2006) are influenced by “ecological perspectives and systems theory, with an emphasis on coupled social-ecological systems” (p.17). While these two major sub-categories have emerged from different scholarly backgrounds, however, they use similar language, including that of vulnerability, resilience, and adaptation.

They argued that research into global environmental change must include a study of ecologies and social systems as the environment is strongly influenced by human activity (Leichenko & O’Brien, 2008). The recognition of multiple stressors is also important if we are to understand why some regions, individuals, or groups adapt better to global environmental changes than others (O’Brien & Leichenko, 2000; O’Brien et al., 2004a). The effects of multiple factors and stressors, such as economic disruption,
war, and sickness, must be recognized as being significant in this view of the study of environmental change (Ziervogel et al., 2006). Adaptation and social learning are also important components of this view of the study of global environmental change (Holling, 2004).

In human societies we see can see many ways of reacting to environmental change. These reactions can be influenced by weather, and technology, as well as the levels of knowledge and understanding of the social and technical infrastructures of specific societies and their institutional capacities. Coping mechanisms and means of adaptation also differ according to access to resources which, in return, determines the adaptive capacity of individuals and societies. Inequality of access is influenced by all of these factors (O’Brien, St. Clair, & Kristoffersen, 2010). Pre-existing equity issues, including race, gender, caste, ethnicity and class, within specific societies, are closely linked to adaptive capacity (O’Brien et al., 2010). Specific problems of adaptation to environmental change cannot be separated from the processes that create these inequalities in the first place. O’Brien et al., (2010) argued that “the equity dimensions of climate change are not limited to questions of historical responsibility for greenhouses gas emissions, but encompass a much broader range of questions about the underlying and often inequitable factors that contribute to vulnerability” (p. 8).

1.2.2 Social justice

Defined broadly, social justice includes principles of equity and fairness. Society’s contribution to the results of climate change has become a real and a significant threat to the environment (Hurlbert, 2011). On the one hand, the causes of climate change are to be found in large measure in the activities of the nations of the
developed world. On the other hand, the effects of climate change are predominantly felt in the developing world (Hurlbert, 2011; R. Kasperson & J. Kasperson, 2001). Loss of life, negative effects on the economy and development are experienced most in the least developed world. These countries and regions also experience the negative stresses that are the result of globalization, population growth, urbanization, resource depletion, degradation of the environment, dependence on global markets, and growing poverty. Climate change interacts with all of these in ways that are difficult to predict (R. Kasperson & J. Kasperson, 2001; O’Brien et al., 2004a; O’Brien & Leichenko, 2008).

One of the issues most clearly affected is that of gender relations in some countries undergoing the agricultural effects of climate change. The global gender relations between men and women worldwide are undergoing significant changes. The ways that men and women cope with all of the changes outlined above are different from each other.

1.3 Gender: the context

1.3.1 Gender ideology in Eritrea

Patriarchal ideologies have strong influences on tradition and culture in the Horn of Africa (Gebremedhin, 2002; Tesfagiorgis, 2011). The male-dominated structure of Eritrean societies is socially constructed by deeply-rooted traditions. These are widely accepted as the cultural norms, values, and guidelines that control the social interactions and relations between the two genders (Gebremedhin, 2002; Kibreab, 2009). The Eritrean socio-cultural context is complex. There are 9 different ethnic groups each with a different ideology about gender roles. In this study the focus is on two ethnic groups;
the Tigrinya\(^6\) (in the highland, Berik sub-region) and the Kunama\(^7\) (in the lowland, Barentu / Sosona sub-region, Gash Barka) of the country. Eritrea is a patriarchal society, with the possible exclusion of the Kunama ethnic group who practice matrilineal relations. Kunama women play prominent roles in their society (Gebremedhin, 2002; Tesfagiorgis, 2011). Traditional Kunama religion is monotheistic without the formal hierarchies and practices of Islam or Christianity (Ranard, 2007). Atsuko Matsuoka and John Sorenson (2001) stated that ethnic groups such as the “Kunama did accord relatively higher status to women, but they were considered primitive cultures, inferior to groups with hierarchical gender stratifications systems” (p.121) such as the Tigrinya ethnic group.

Among the Kunama polygamy is a common practice among both men and women. It is also common for single women to have children from multiple partners. The Kunama place a strong emphasis on relationships with the mother’s extended family (Ranard, 2007). The Tigrinya ethnic group is mainly Christian and a family is formed by marriage. Divorced or single women with children are undesirable (Gebremedhin, 2002; Kibreab, 2009; Tesfagiorgis, 2011).

1.3.2 Women’s Movement in Eritrea

The Women’s Movement in Eritrea began with the work of the Eritrean People’s Liberation Front (EPLF)\(^8\). In the early 1970s, women were pushing for participation in the liberation. National Liberation struggles such as in Mozambique, Zimbabwe and

\(^6\) The Tigrinya are an ethnic group and also one of the official languages (it is also spoken in Ethiopia). The Tigrinya are the majority with approximately 50% of the country’s population (Gebremedhin, 2002).

\(^7\) The Kunama are also an ethnic group and also a language spoken only by the Kunama and they are the minority making up only 2% of the population.

\(^8\) EPLF during liberation encouraged the development of mass organizations such as the National Union of Eritrean Women (NUEW) and National Union of Eritrean Youth and Student (NUEY&S) (Gebremedhin, 2002).
Vietnam were putting women’s issues on the agenda, so the EPLF was influenced by those movements (Zerai, 1994). In the EPLF during the struggle for independence Eritrean female soldiers accounted for 30-35% of the liberation army (Zerai, 1994). During this period EPLF encouraged the development of the National Union of Eritrea Women (NUEW) also locally known as *Hamade*. It was established in 1979 and was not autonomous but was accommodated within the structure of EPLF. During the liberation NUEW was to mobilize and organize women to participate in the national liberation struggle. In the post-independence period the main objective of the organization became to participate in the reconstruction of the country while empowering women to struggle for their rights.

Worku Zerai is an ex-combater who was the fourth woman to join the liberation struggle in the 1970s (Wilson, 1991). She currently lives in Eritrea and is an independent gender consultant. She stated that “…the struggle for the emancipation of women was given secondary importance” before and after independence (1994, p. 66). The activities of NUEW demonstrate that the organization was mainly concerned in doing supportive work for the government. In short, NUEW implemented all EPLF’s policies on women. It has adopted these policies, as its objectives (Zerai, 1994).

Certainly, the National Union of Eritrean Women (NUEW) promoted social revolution, arguing against cultural practices that severely repressed women, however, “it did not try to attack patriarchy or to change the sexual division of labour” (Zerai, 1994, p. 66). Women’s involvement in the struggle constituted an effective strategy for

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9 NUEW was under the direct control of the Department of Public Administration (mass organization). After 1987 it came under the President’s direct administration. After independence it became autonomous but this is nominal as the president of the union is a member of the parliament and a member of the EPLF’s executive committee. She is accountable to parliament and the EPLF, which makes the autonomy of the union nominal (Zerai, 1994).
their empowerment (Yehdega, 1995). Since independence, NUEW continues to be led by former female soldiers with the influence of the government. They work tirelessly towards the advancement of women in Eritrea. The NUEW has over 200,000 female members; civilians, former soldiers, and those presently in the armed forces. According to Anita Spring (2002) these “women provide a lobbying force for gender equity” (p. 20). (Gebremedhin, 2002; Tesfagiorgis, 2011; Zerai, 2002a). The government of Eritrea and NUEW has a commitment to improving the status of women, at least in policy. Women’s rights are acknowledged in various EPLF’s documents such as in the National Democratic Program in 1977 as amended in the Second Congress in 1987 and in the National Charter in 1994. According to Zerai (2002a), however, some forms of discrimination are still allowed by law, for example against married women who have no independent rights to farmland and housing. New marriage laws also do not address wife beating (Zerai, 1994). In practice, therefore, slow progress has been made (Gebremedhin, 2002).

Tesfa Gebremedhin (2002) argued that “Gender equality is impossible without strong political commitment[s] and fundamental changes to societal norms and values” (p. 67). Male and female roles in Eritrea are still defined along gender lines and in accordance with traditional values because there has been no sustained effort to transform major customary institutions (Gebremedhin, 2002, Zerai, 2002a). Women’s political representation in the country is still very low. Zerai (1994) stated that since women have been fighting on all fronts alongside of men, one expects gender equality. However, in reality gender equality has not occurred and there has been little change. As
a result the government has not addressed the private sphere regarding the sexual
division of labour. For example, Tigrinya women are forbidden to plow.

Zerai (1994) concluded by arguing that women’s involvement in the liberation
was not for emancipation but for liberation against an enemy (Ethiopian regime) and
imperialism. Emancipation is something that is learned in the struggle for liberation. It
cannot be isolated from the overall changes in Eritrean society. Social life is still in poor
condition in which more than 85% of the people are dependent on food aid. To bring a
change in the life of Eritreans including women, therefore, the economy has to be
completely re-designed so that people can get adequate services. However, overall one
cannot deny that women in Eritrea have made some gains. For example they have been
able to infiltrate and play a part in those structures and institutions that have been the
domain of males for centuries.

1.3.3 Effects of social constructions of gender

Gebremedhin (2002), Amina Mama (1995) and Judith Butler (1990) argued that
gender is a socially constructed category. Men and women are shaped by their use of
sexual and gender-related categories within specific cultural and social contexts. These
categories define and describe the rules by which the society will and does function.
They enable the structuring of social relations such as marriage, child rearing, kinship
and economic life. According to Gebremedhin (2002), in Eritrea discrimination by
gender started at birth. Sons are celebrated more joyfully than daughters, except in the
Kunama ethnic group. The Kunama celebrate both sexes equally. Patriarchal ideology
has had a generally negative impact on Eritrean women, but the result has not been the
same throughout the country, which is differentiated by class, ethnicity, and religion (Gebremedhin, 2002; Kibreab, 2008; Matsuoka & Sorenson, 2001).

In the Tigrinya ethnic group the child’s sex is very important as sons carry on the continuity of family lines. Daughters, upon adolescence, become the responsibility of their husbands (Gebremedhin, 2002). Men are trained from childhood in basic skills thought to be important for their futures as husbands and heads of households. Women are raised to become subservient daughters, wives, and mothers. They have little say in decisions (Gebremedhin, 2002; Kibreab, 2008; Matsuoka & Sorenson, 2001).

Gebremedhin (2002) and Mussie Tesfagiorgis (2011) argue that in the Tigrinya and other Eritrean societies most inequalities arise from socially constructed gender differences. But in the case of the Kunama, who do not have a patriarchal society, decisions are made by consensus. Gebremedhin (2002) state that most Eritrean ethnic groups assigned different roles to men and women. “Society identifies “women’s work” and “men’s work” and allows a different set of rewards and benefits for men and women” (p. 56). The work that men do is considered to be more valuable than that of women in most Eritrean societies. In fact, division of labour has led to an exclusion from rights and from access to resources and has been justified by assigned gender roles, for example, in agriculture women’s labour was considered secondary to that of male farmers in all groups except the Kunama (Gebremedhin, 2002).

Berit Brandth (1994) stated that agriculture is male dominated. Farms were inherited by men so that women’s access to farming has been through marriage in many parts of the world (cited in Alston, 2000). According to Gebremedhin (2002), in Eritrea, long standing agrarian ideology also defined “men as farmers and women as farm wives.
rather than as partners in the farm operation” (p. 164). Farm women’s roles in Eritrean agriculture are extensive although they differ in different ethnic groups. For example: Kunama women are engaged in all aspects of farming. Tigrinya women, with the exclusion of plowing, participated in all agricultural work like planting, weeding, harvesting, threshing, winnowing and storage, but not plowing. In the Berik highland plowing is done by oxen and only done by men (Gebremedhin, 2002, Zerai, 2002b).

Zerai argued that Tigrinya women were forbidden to plow using oxen. It is believed that handling oxen requires a lot of muscle power and, therefore was a domain of men (2002b, p. 14). Farming was seen as requiring muscle and it was believed that muscle was manly. Cultural beliefs such as “crops do not grow on land plowed by a woman”, or that “if a woman winnows produce, it will be blown away by the wind” are common (Zerai, 2002b, p. 14). In contrast the Kunama women can plow land using camels (Gebremedhin, 2002).

1.3.4 Gender issues in agricultural institutions

Similar inequalities exist in gender relations and agricultural institutions. According to Spring (2002), during the 1980s and 1990s, women farmers were not represented in Ministries of Agriculture throughout Africa, Asia, and Latin America. Attempted solutions included changing the Ministries to include women in development, agriculture, or rural production. Furthermore, some made program changes so that the Ministries “…began to function as a focal point or coordinating unit …other units …began to mainstream women in all their activities, including credit, technical assistance, and training” (p. 20).
In Eritrea since 1993, the Ministry of Agriculture has been supporting farmers. The Ministry revealed that there was “no disaggregated data on women’s participation and access to its services, such as agricultural inputs [and] credit” (Ministry of Agriculture, 2002, cited in Spring, 2002, p. 19). Women were also left out of extension programs and commercial farming as these had only male participants. In Eritrea 30% of rural households are headed by women (Haile, 2002; Spring, 2002; Zerai, 2002b). At the political or institutional level women’s work on the farm is often invisible to the Eritrean Ministry of Agriculture (MoA) because it is hidden by material factors such as ownership of land, physical farm work (For example, plowing) and decision-making power (Gebremedhin, 1996; 2002, Spring, 2002, Zerai, 2002b). Women’s work in agriculture has been as supportive rather than primary. This view was supported by the Ministry of Agriculture, male farmers and Ministry staff. As a result women are associated with the Ministry of Home Economics Unit (HEU) and the National Union of Eritrea Women. This often results in women’s exclusion from the Ministry of Agriculture services (Spring, 2002). Women are also not usually entitled to control the agricultural products of their labour (Gebremedhin, 2002; MoA, 2002; Zerai, 2002b). The view that women’s work in agriculture is secondary has had negative consequences on rural societies, contributing to their vulnerability. Lower adaptive capacity has often been the result, especially in drought and other times of climactic difficulty (Alston, 2000).

1.4 Double vulnerability

According to Gotelind Alber (2009), while climate change has an impact on everyone, women and girls are affected differently from boys and men. Women are the most vulnerable social group in many developing countries. Social factors such as
gender divisions of labour, power relations and culture-specific gender norms and roles result in discrimination in areas of rights and access to resources. Thus women are severely affected by the impact of climate change, because they often lack the assistance required to adapt.

O’Brien & Leichenko (2000), examined the impact of “climate change and economic globalization” using “the concept of double exposure” which referred to “the fact that regions, sectors, ecosystems and social groups will be confronted both by the impacts of climate change and by the consequences of globalization” (p. 222). They argued that all people and regions had some level of vulnerability to the effects of climate change. The developed and developing world experience damage and loss of life, while developing countries feel the impact of climate related hardships more severely than developed countries (R. Kasperson & J. Kasperson, 2001; O’Brien & Leichenko, 2000).

Clearly, the poorest and most marginalized people are the most vulnerable to climate change and its various impacts (Boko et al., 2007). Generally, too, majority of women are the poorest people in developing countries. They are thus more vulnerable to climate change because they are almost totally dependent on the natural resources available in their localities (Nelson et al., 2002). So in variable climates they are even more vulnerable than the men of their regions. Social and cultural conditions make these vulnerabilities even more severe (Kakota et al., 2011).

As such, it is important to understand current vulnerabilities so that appropriate strategies can be developed to cope with future impacts (Bohle, Downing, & Watts, 1994). It is likely that women will continue to support households and communities. It
is important, therefore, to understand current vulnerabilities so that appropriate strategies can be developed to cope with future impacts (Bohle, Downing, & Watts, 1994). Therefore, as these communities adapt to climate change, women’s roles in food production and water are of central importance. However, “given the traditionally limited role of women in decision-making processes … women’s needs, interests and constraints are often not reflected in the … agricultural sector which are important for poverty alleviation, food security and empowerment” (Gebremedhin, 2002, p. 162). Therefore, without women’s voices the solutions considered may be weaker than they would be if the knowledge and understanding of women were to be part of the process.

1.5 Summary

Subsistence farming in Eritrea is significantly affected by climate change. This chapter has outlined these effects as seen by both men and women in the Berik and Sosona sub-regions of Eritrea. This study uses human environmental and gender-related perspectives to analyze and describe these effects from the viewpoint of the farmers who experience them.

1.6 Thesis outline

This thesis has five chapters. Chapter Two examines literature relevant to the study and the theoretical frameworks used to structure and analyze the findings. Chapter Three explains the methodology used in this research for data collection and interpretation. Chapter Four presents the qualitative data found in the interviews, focus groups and observations made by farmers in two regions of Eritrea that were the focus of the study. Major themes from interviews and focus groups were analyzed using a theoretical framework drawn from the literature on vulnerability assessment. Chapter
Five completes the thesis with a summary of key findings and a discussion of the recommendations by participants, including implications of the findings.

Recommendations for future research follows.
CHAPTER TWO: LITERATURE AND THEORETICAL REVIEW

This chapter is divided into two sections. The first section provides a review of literature about climate, drought and rainfall relevant to this study. The second section discusses the theoretical framework of this study; vulnerability assessment.

2.1 Subsistence farming in Eritrea

Subsistence farming of mixed crops and livestock dominates the livelihood of the Eritrean farmers in the study regions. The whole farming system, from preparation to finish, is done by human and draught animal power. Land, seeds, fertilizers, labour and livestock are essential assets of households. In Eritrea 95% of agriculture is rain-fed (Gebremedhin, 1993, 2002; Habte, 2002; Haile, 2002; Mariam, 2005). As such, subsistence farmers are affected by low rainfall variability with recurrent and increasingly longer drought periods. These determine people’s ability to practice soil improvements such as fallowing and growing high yield crops like legumes, which add nitrogen to the soil. Moreover, agricultural inputs such as fertilizers, seeds and tools, also distress agriculture. As a result yields are either low and/or poor in quality. Another problem is soil erosion.

Farmers in the Highlands grow crops such as sorghum, barley, wheat and maize. The priority legume crops are chickpea, lentils, field peas and fava beans (National Food Information System [NFIS], 2005). In the Gash Barka Lowlands, sorghum, millet and oil crops such as sesame and groundnuts are grown. The Government of Eritrea’s (GoE) food security policy of 2004 stated that the “Majority of Eritreans farmers live close to subsistence levels even during normal agricultural seasons; they complement their
income by working as manual labour and selling firewood to support themselves and their families” (p. 2).

About 80% of the population\textsuperscript{10} lives in the countryside. According to the National Statistics and Evaluation Office (2003), 66% of Eritreans lived below the poverty line. About 70% of the rural populations depended on subsistence farming. Solomon Haile, Head of Planning and Statistics of the Ministry of Agriculture (MoA) reported that in 2002, 47% of households were female-headed nationally and 30% of these were located in rural areas (Haile, 2002). Most of these were considered poverty stricken households (DoE, 2009; Haile, 2002; Zerai, 2002a).

According to the Government of Eritrea (1994) \textit{Proclamation No. 58/1994}, the Eritrean government, the People's Front for Democracy and Justice (PFDJ) owns the land. Citizens had ‘user rights’ both for farming and housing. Any open land is owned by the government. By law and tradition the ownership of land is allocated to the head of a household. By definition in Eritrea the head of a household is male. Married women do not have land user rights. Women are allocated land only if they are widowed, unmarried or divorced with children; or if they have been members of the liberation army; or if they became pregnant during their national service\textsuperscript{11}. Any woman who is unfit for marriage or for national service may also have user rights (Zerai, 2002a, p. 6). Land is allocated by the Department of Environment (DoE) in co-operation with the Ministry of Local Government (MoLG). Local land administrative committees in every village decide who

\textsuperscript{10} No census has ever been taken in Eritrea; however, the Ministry of Local Government estimated the total population at 3.2 million as of 2001 (National Statistics and Evaluation Office [NSEO], 2003, p. 3).
\textsuperscript{11} By law, Eritrean nationals (men and women) from 18 to 40, are expected to take part in Active National Service (ANS) Proc. 82/1995, Art. 8. This involves a total of 18 months, including 6 months of military training and 12 months of working in development projects like road building etc. In May 2002, the Eritrean government extended the national service indefinitely. The name was changed to the \textit{Warsai-Yikaalo} Development Campaign (WYDC). The Ministry of Defense pays soldiers from 150 to 500 Nakfa (3.75 to 12.50 USD) under the pretext of national reconstruction (Kibreab, 2009).
is eligible for land. Each village committee must include at least one woman. However, in practice, village elderly men have the final say (Zerai, 2002a). “Diesa (communal or village land ownership) is the dominant land tenure system in Eritrea. The majority of the farm population falls under this [“user right”] system” (Habte, 2002, p. 66).

About 3.6% of the total land area is in the highlands where population density per cultivated area is very high. As a result, the farm sizes are getting smaller and smaller. The average farm size in the highlands (Berik) is estimated to be 1 hectare\textsuperscript{12}. In the highlands population pressure and thus farm size are very important. The Gash-Barka has more land, and a much lower population density. As a result the farm size per household is estimated to be 2 hectares (Habte, 2002).

2.1.1 Climate and agro-ecology of Eritrea

Eritrea is geographically diverse and has several different climates. Eritrea has central and northern highlands extending for about 350 kilometers from north to south. The flat coastal plains of the eastern lowlands and the flat plains of the western lowlands have hills. Altitude ranges from 1,500 to 2,400 meters above sea level in the highland area and from 0 to 500 meters in the eastern lowlands and about 700 to 1,400 meters in the western lowlands (DoE, 2007, p.1). These “topographic variations have considerable effect on the rainfall patterns of the country” (DoE, 2001, p.2).

Eritrea’s Department of Environment (DoE) (2007) stated that climate change led to water deficits. This is already being observed in Eritrea. The climate “is highly variable, influenced by the expanding Sahel-Saharan desert”, high-pressure monsoons, low-pressure systems, “proximity to the Red Sea and the physical features [of the land] typically, the mean annual temperature declines by 1°C for each 200-meter rise in

\textsuperscript{12} 1 hectare = 2.47 acres
As a result the ambient temperatures in Eritrea vary. The eastern lowlands have an annual mean temperature of 31° C - 48° C and may reach “as high as 48° C. In the highlands area the annual mean temperature is 21° C and the maximum is 25° C. In the western lowlands, the annual mean is 29° C and the maximum [is] 36° C” (p.1).

According to Bekuretsion Habte (2002) Eritrea is divided into 6 major agro-ecological regions on the basis of biological and physical characteristics: climate “conditions, altitude, mean rainfall, landforms, dominant soil types and land use” The regions are the “Central Highlands, [the] Western Escarpment, the South Western Lowlands, the North Western Lowlands, the Green Belt and the Semi-Desert Coastal Plains” (p. 60). According to the Department of Environment (DoE) (2001) the 6 regions are in turn subdivided into 55 sub-regions. This agro-ecological classification is important in the context of soil and water conservation. As shown in Table 1, much of Eritrea is occupied by dry lands, with three-quarters of the country falling in the arid or semi-desert regions. In most years rainfall is less than 500 millimeters in all these areas, and, this combined with a very high potential of evapo-transpiration (1, 700 -2,100 mm), results in dry conditions (DoE, 2001).

Table 1: Agro-ecological regions of Eritrea

<table>
<thead>
<tr>
<th>Regions</th>
<th>Elevation (m)</th>
<th>Annual rainfall (mm)</th>
<th>Mean annual temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moist Highlands</td>
<td>1600-3018</td>
<td>500-700</td>
<td>15-21</td>
</tr>
<tr>
<td>Arid Highlands</td>
<td>1600-2820</td>
<td>200-500</td>
<td>15-21</td>
</tr>
<tr>
<td>Sub-Humid</td>
<td>600-2625</td>
<td>700-1100</td>
<td>16-27</td>
</tr>
<tr>
<td>Moist Lowland</td>
<td>500-1600</td>
<td>500-700</td>
<td>21-28</td>
</tr>
<tr>
<td>Arid Lowland</td>
<td>400-1600</td>
<td>200-500</td>
<td>21-29</td>
</tr>
<tr>
<td>Semi-Desert</td>
<td>100-1355</td>
<td>&lt;200</td>
<td>24-32</td>
</tr>
</tbody>
</table>

Source: Department of Environment (DoE, 2001, p.12).
2.1.2 Rainfall in Eritrea

According to the Department of Environment (DoE) (2001) Eritrea has three rainfall seasons. The *kremti* (summer from June to September) is the main rainy season for the highlands and western regions of the country. The *kremti* rain comes with the south-westerly monsoons winds, flowing from the Atlantic Ocean. These winds are concentrated mainly in July and much of the rain falls in August. There is also the *azmera*, a short rainy season (between April and May) for small portions of the highland areas. In the winter (November to March) most of the rain falls between December and February. This rainfall covers the coastal part of the country and the eastern and southern escarpments. These winter rainfall patterns and amounts are affected by differences in geographic regions and are influenced by the northeast continental winds that blow from the Red Sea. The two sources of fresh water, underground and surface water, are both replenished by rain. There are no lakes; “all rivers are seasonal; except the Setit River, which is part of the Nile basin” (DoE, 2001, p. 51). Seasonal rivers dry early at the end of the *kremti* (in August). The short duration and reduced amount of rainfall also affects the supply of irrigation water by reducing ground water levels and by drying stream flows (DoE, 2001).

2.1.3 Drought

According to Donald Wilhite (2005) drought can be defined in many ways and there is no precise and universally accepted definition. This makes decisions about the existence and severity of drought difficult. Wilhite (2005) argued that drought definitions should be region specific because each climate system had distinctive climate characteristics. Nevertheless, he argued that basically drought was caused by a lack of rain.
Justin Sheffield & Eric Wood (2011) outlined four drought categories:

1. **meteorological drought**, a significant negative deviation from mean precipitation;
2. **hydrological drought**, a deficit in the supply of surface and subsurface water;
3. **soil moisture or agricultural drought**, a deficit in soil moisture, driven by meteorological and hydrological drought, reducing the supply of moisture for vegetation;
4. **socio-economic drought**, a combination of the above three types leading to undesirable social and economic impacts (p.12).

According to Sheffield and Wood (2011) and Wilhite (2000, 2005) drought is a complex phenomenon which affects more people than any other natural hazard. Its impacts are not easily predicted. They affect larger areas and cause greater damage than earthquakes, tropical storms, hurricanes and floods. Wilhite (2005) stated that drought occurs over time and in areas of high and low rainfall. It affects economies, societies and environments. Drought is a part of normal climate, but if it lasts a whole season and negatively affects the local population and environment it becomes a disaster. When studying drought it is important to consider both its natural and social dimensions.

### 2.1.4 Drought in Eritrea

The Eritrean Department of Environment (2007, p. 2) states that in Eritrea the climate is mostly arid with about 70% of the land area classified as hot and arid, receiving an average rainfall of less than 350 millimeters annually. The eastern lowlands have an average annual rainfall of between 50 and 200 millimeters; while the northern areas, within the eastern limits of the Sahel, receive less than 200 millimeters a year of rain. Southern areas experience an average annual precipitation of 600 millimeters. The central highland areas receive about 400-500 millimeters per year. The main feature of the rainfall pattern is extreme variability within
and between years, and spatial variation over very short distances. In Eritrea drought affects crop production. It appears to come in cycles of 3 to 7 years.

Precipitation below 300 millimeters resulted in severe drought. For example, in the *kremti* season, from 1905 to 1990, below 300 millimeters, that being nearly two thirds (62.9%) of the total annual rainfall, was recorded during the months of July and August. The *azmera* season was also variable. The averages for April and May were less than 300 millimeters at the Asmara airport meteorological station. It is not only that the total rainfall was low, but that the short duration of the *kremti* season resulted in serious problems for crop production (DoE, 2009).

According to the Department of Environment (DoE) (2009) meteorological station records for Asmara, the capital city of Eritrea, in the central highlands region, suggest that the rainy season has become shorter. The *azmera* rainy season often failed and the *kremti* heavy monsoons ended in August instead of September. A shortage of precipitation (below normal) for the *kremti* was observed in 1941, 1968, 1969, 1972, 1973, 1979, 2000, 2003 and 2004 due to an event known as the El Niño-Southern Oscillation (ENSO). During these years early planting and late maturing crops such as sorghum, maize, and finger millet were not harvested. Ravinder Rena (2006) stated that in 2004 some parts of the Eritrea actually recorded zero amounts of rain, which resulted in crop failure. According to the Department of Environment (2009) this failure refers to the abnormal conditions in the tropical Pacific Ocean that occur, on average, every 3 to 7 years. It is believed that this is caused by the long-term variability of El Niño. Rainfall over the past century has declined considerably and the periods between the onset and cessation of rainy seasons have been getting shorter and more erratic which have reduced season growing periods.
According to Eritrea’s Department of Environment’s (DoE) Initial National Communication (INC) Report in (2001), over the past century rainfall has declined considerably in Eritrea. Since the 1960s weather patterns have changed significantly. Farmers said that the rainy season has been getting shorter since the 1970s or 1980s (DoE, 2001). Agricultural drought is related to the timing and nature of the rain: when rain comes, delays in the start of the rainy season, the match between rain and crop growth stages, rainfall intensity, and the frequency of rain. The rainy seasons start later and finish earlier. The kremti, which used to last from June to September, now occurs mainly in July and August. The azmera (April and May) has disappeared. Winter, which lasted from November to March, is now mainly from December to February. The rains are erratic and have reduced seasonal growing periods (DoE, 2001).

Drought wastes the only seeds that Eritrean farmers have, those stored from the previous year or purchased from the market. The Department of Environment (DoE, 2007) stated that change in rainfall duration meant that “some wheat and millet varieties, as well as some native cultivars are disappearing from production” (p. 5). High temperatures also affect yields and yield quality in semi-arid and arid regions such as Eritrea (Haile & Steenbergen, 2007).

According to Government of Eritrea (2004), the country suffered its worst drought from 1998-2003. From 1999-2001, drought conditions, followed by inadequate azmera and kremti rains, lead to poor agricultural performance. Afrol News (2003) stated that 2002 had the lowest rainfall of the past 15 years. In 2000-2005 the lives of more than a third of the population were negatively affected. As such, the country’s crop production was between 13 to 18% of previously normal years. In 2002 only 10% of

The Ethiopian Review (2011) stated that in 2009, in Gash Baraka, crops almost completely failed. Gash Barka normally produces about 80% of the country’s sorghum, Eritrea’s staple cereal. According to Luc Van Kemende (2011), in 2011, satellite images showed that Eritrea’s Red Sea region had been hit by drought conditions similar to those in Somalia, Ethiopia and Djibouti. This led to the worst annual crop production in 17 years and below average livestock prices and excessive livestock mortality (Herlinger, 2011).

2.1.5 Human consequences of drought

The Horn of Africa has a chronic history of drought. From 1900-2011 more than 18 famine periods occurred (Chumo, 2011). In Eritrea drought strikes every 3 to 7 years. Since the 1950s the results of drought have been severe. Crop and livestock production suffered (DoE, 2009; MoA, 2002).

Drought is common in the African Sahel (DoE, 2009). According to Sheffield and Wood (2011) the Sahel region of Africa is the transition region between the tropical climate of the Guinea coast and the Saharan desert. Many long dry periods, like the 1910-1914, 1940-1944, and more recently in the 1970s and 1980s, have had serious social and environmental consequences. The United Nations International Strategy for Disaster Reduction (UNISDR) stated that “disasters account for less than 20 percent of all disaster occurrences in Africa, but they account for more than 80 percent of all people affected by natural disasters in the continent” (UNISDR 2009, p. 2).
According to the Ministry of Agriculture (2002) catastrophic droughts occurred in Ethiopia and it was thought that they logically\textsuperscript{13} also occurred in Eritrea in 1913-1914 and in the early 1940’s as well as in 1957-59, 1964-1965, 1972-74, 1984-85 and 1987. The starvation of millions of people as a result of drought occurred between 1984 and 1985 (DoE, 2009). Mengistu Russum (2002) stated that people from the pastoral communities of the lowlands of Ethiopia suffered and were displaced. In total from 1970 to 1989 there were about 11 droughts. As a result of droughts and war from 1970 to 1985, livestock numbers in Ethiopia decreased by 50\% to 70\%. In the 1980s and 1990s droughts resulted in severe human and livestock losses (Habte, 2002).

2.1.6 Gender and drought

An examination of gender in connection with drought is part of this study. According to Nidhi Tandon (2007), during droughts women and young girls are most vulnerable. Women, children, the elderly and the disabled are all at a greater risk than the general population when drought and other hardships occur (DoE, 2009; Kakota et al., 2011; Mellor, 1997, Nelson et al., 2002). In Eritrea water scarcity is a major issue. In fact, 85\% of the population depends on groundwater for their main source of water supply for domestic use, irrigation and livestock. The wells and surface sources of water have been increasingly depleted as a result of recurrent drought (Mariam, 2005). Women and young girls in rural communities walk long distances in search of water in addition to preparing food, gathering firewood and child rearing. A shortage of drinking water has also resulted in poor hygiene. This makes people vulnerable to diarrhea and other water borne diseases. In addition this leads to a high rate of malnutrition (Mariam, 2005).

\textsuperscript{13}In Eritrea a history of drought and resulting famines has not been documented. Eritrea was colonized by and merged with Ethiopia until its independence in 1991. Droughts in Eritrea and in Ethiopia have been assumed to be the same (MoA, 2002).
Women are the caregivers for children, the sick and the elderly. This makes their days long and stressful. Women have the responsibility of looking after everyone else’s interests before their own. As such, during food shortages, women and young girls eat less which, in turn, affects their health (Matsuoka & Sorenson, 2001, Tandon, 2007). As a result, women and young girls experience high levels of personal stress as they face the hardships of droughts and other environmental consequences.

2.2 Theoretical framework: Vulnerability

Theories explaining the outcomes of climate change for agricultural and rural livelihoods differ. Studies falling within both human environmental and critical discourses have explored the consequences of climate change for farmers and rural communities. This literature recognizes that the impact of climate change is not the same for everyone, even within similar communities and environments. Social and environmental farming practices, such as technology, different ideas about how agriculture should work, and about who should farm also affect the experience of farmers (Liverman, 1990; O’Brien, Eriksen, Schjolder, & Nygaard, 2004b). These studies were location-based, as in the case of the Arctic Inuit communities of Canada (Ford & Smit, 2004; Smit & Wandel, 2006; Turner et al., 2003). They illustrate how context produces different outcomes and how context both affects and is affected by changes in the biosocial environment (Turner et al., 2003). Such studies emphasize that rural livelihoods are influenced by multiple stressors; including climate change and other sources of stress (Ziervogel et al., 2006). There are two major approaches to the assessment of the effects of climate change on human populations. These are: impact assessments and vulnerability assessments, the latter of which inform this study.
2.2.1 Vulnerability assessment

Vulnerability assessment is widely applied in global environmental change studies, in particular the human environment. These studies emphasize the linkages between social and physical systems or communities (Leichenko & O’Brien, 2008). Vulnerability has many definitions (Table 2). The concept of vulnerability evolved from food security research (Sen, 1981, 1990). Then it was applied to risk assessment in the event of natural hazards (Hewitt, 1983) and to environmental change (J, Kasperson., R. Kasperson., & Turner, 1995). Vulnerability studies draw on the entitlements\textsuperscript{14} literature.

According to Mick Kelly and Neil Adger (2000) the concept of vulnerability helps us to understand the value of certain policies and interventions which might help people to find useful responses to the experiences of environmental hazards and changes. This is the starting point for analysing of the impact of climate change (Adger, 1999; Kelly & Adger, 2000; Leichenko & O’Brien, 2008). Vulnerability is defined, from this point of view, as a capacity to adapt. Vulnerability assessment, therefore, does not predict behaviour, but is determined by a capacity to respond. Other definitions include:

\textsuperscript{14} Entitlements as “the extent to which individuals, groups or communities are entitled to make use of resources determines … [the] ability of that particular population to cope with and adapt to stress” (Adger & Kelly, 1999, p. 256). Amartya Sen (1990) stated that entitlements, which extend beyond the above, have also been developed in an analysis of vulnerability to food insecurity and famine. This includes social relations factors like ethnicity, caste, and gender (Harris, Gillespie, & Pryor, 1990).
Table 2: Selected definitions of vulnerability within the climate change literature

<table>
<thead>
<tr>
<th>Definition</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Vulnerability to climate change is the degree to which systems are susceptibility to, and unable to cope with, the adverse impacts of climate change, including climate variability and extremes.”</td>
<td>(IPCC, 2001, p. 6).</td>
</tr>
<tr>
<td>Vulnerability refers to “the extent to which environmental and socio-economic changes influence the capacity of regions, sectors, ecosystems, and social groups to respond to various types of natural and socio-economic shocks.”</td>
<td>(Leichenko &amp; O’Brien, 2002, p. 3).</td>
</tr>
<tr>
<td>Vulnerability refers to “the state of individuals, of groups, of communities defined in terms of their ability to cope with and adapt to any external stress placed on their livelihoods and well-being.”</td>
<td>(Kelly &amp; Adger, 2000, p. 328).</td>
</tr>
<tr>
<td>“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.”</td>
<td>(Smit &amp; Wandel, 2006, p. 286).</td>
</tr>
</tbody>
</table>

Although a range of definitions exist (Table 2), vulnerability is generally accepted by the IPCC Third Assessment Report (2001) “as a function of exposure and adaptive capacity” (p. 6). According to Barry Smit and Johanna Wandel (2006, p. 286) “exposure and sensitivity are almost inseparable properties of” a community. Exposure and sensitivity “are dependent on the interaction between the characteristics of the” community and of the climate. The sensitivity of a “community to environmental risk (e.g. drought)” reflects “the likelihood” (p. 286) that the community may experience the particular conditions. It also reflects the place they live and the way they live in that place. All these affect their sensitivity to climate change, including drought.

“…characteristics of a community, settlement location, livelihoods and land use [practices] … reflect broader social, economic, cultural, political and environmental conditions” (p.286). These are referred to in the climate change literature as “drivers” or “sources” or “determinants” (p. 286) of exposure and sensitivity. They are similar to those characteristics that influence or constrain a system’s adaptive capacity.
Clearly, biophysical conditions influence vulnerability. Environmental and social changes are linked (Turner et al., 2003). O’Brien et al., (2004a) recognized that individuals and communities were often subject to more than one process of global change. Research approaches sensitive to this understanding combine an investigation of vulnerability to changing environmental conditions with an examination of exposure to other stressors such as disease, warfare or conflict, and economic disruptions (Eriksen & Lind, 2005; Ziervogel et al., 2006). Assessments of social vulnerability that are intended to identify the “… character, distribution and causes of vulnerability [ask] questions [that] include, who is vulnerable to climate change and why” (O’Brien et al., 2004b, p.3) (Kelly & Adger, 2000; O’Brien & Leichenko, 2000; O’Brien et al., 2004b; Smit & Ford, 2004).

Vulnerability draws attention to specific factors that influence exposure and adaption capacities, in order to explain how and why some groups and individuals experience negative outcomes from shocks and stressors (Adger & Kelly, 1999; Kelly & Adger, 2000; Leichenko & O’Brien, 2008). The most vulnerable are considered to be those who are most exposed to severe poverty, economic, social or environmental difficulties. Those most vulnerable are the least resilient (Bohle et al., 1994, Smit & Wandel, 2006).

2.2.2 Adaptation, adaptive capacity and coping mechanisms

According to Smit and Wandel (2006), the concept of adaptation had “... its origins in natural sciences, particularly evolutionary biology” (p. 283). Adaptation has been used as a theoretical concept in the social sciences, including in the study of “natural hazards, political ecology, and entitlements of food security” (Smit & Wandel,
Adaptation in the climate change literature has numerous definitions (Table 3). Climate change field analyses of adaptations emerged at the same time as a growing awareness of climate change (Smit & Wandel, 2006).

**Table 3: Selected definitions of adaptation in the literature**

<table>
<thead>
<tr>
<th>Definition</th>
<th>Source</th>
</tr>
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<tbody>
<tr>
<td>“Adaptive capacity is the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences”.</td>
<td>(IPCC, 2001, p. 6).</td>
</tr>
<tr>
<td>“Adaptive capacity is the potential or ability of a system, region, or community to adapt to the effects or impacts of climate change.”</td>
<td>(Smit &amp; Pilifosova, 2001, p. 881).</td>
</tr>
<tr>
<td>“Adaptation in the context of human dimensions of global change usually refers to the process, action or outcome in a system (household, community, group, sector, region, country) in order for the system to better cope with, manage or adjust to some changing conditions, stress, hazards, risk or opportunity”.</td>
<td>(Smit and Wandel, 2006, p. 282)</td>
</tr>
</tbody>
</table>

Most studies of climate change focused on impacts involve a discussion about adaptation. Analyzing adaptation to climate change has been considered important for two main reasons (Smit & Skinner, 2002). First, the effects of climate change are reduced by adaptation (Tol, Frankhauser, & Smith, 1997). Second, adaptation is an important response strategy or policy option to concerns about climate change (Smit, McNabb, & Smithers, 1996).

According to Barry Smit and Olga Pilifosova (2003), adaptive capacities are complex. The capacity of any household to cope with climate risks depends on the environment of the community. The adaptive capacity of the community is, in turn, dependent upon the resources of the region. Adaptive capacity, therefore, varies from community to community because each is different. From country to country, among social groups and individuals, and over time and space, responses differ. Smit and Wandel, (2006) illustrated that “a strong kinship network may play an important role in a
subsistence-based society and quite a different role in a developed world agribusiness context where financial and institutional structures will influence adaptability” (p. 288). The adaptive capacity of a local area is determined by politics, culture, economics, environment and other conditions (Smit & Pilifosova, 2003). Local ability to adapt can be influenced, therefore, by the way resources are managed and the financial, technical and information resources of the community and region (Adger & Kelly, 1999; Kelly & Adger, 2000; Smit & Pilifosova, 2001).

2.3 Analytical framework: Vulnerability assessment

James Ford and Barry Smit (2004) developed an analytical framework for vulnerability assessment illustrated in Figure 1 that has been used successfully to analyze indigenous communities in the Canadian Arctic. This framework assesses vulnerability based on exposure to climate change and adaptive capacity in two stages: current vulnerability and future vulnerability.

Figure 1: Analytical framework for vulnerability assessment (Ford & Smit, 2004, p. 396).
Ford and Smit’s (2004) vulnerability assessment framework has been adapted for this study, which explores environmental hazards experienced by the people of Berik and Sosona in Eritrea and their capacities for adaptation. This research identifies the vulnerability of the livelihood of farmers, who are engaged in mixed, rain-fed farming. Their exposure to stressors resulting from climate change in specific contexts and social conditions is described. A vulnerability assessment allowed for primary data (interviews, focus group discussions, and observations) to be collected from the community in order to identify its exposures and adaptations. The community identifies what was important to them and how they respond and adapt to climatic and non-climatic exposures (Smit & Wandel, 2006). This method then allowed the researcher to gain insight directly from male and female farmers in the two sub-regions of Eritrea that were studied.

According to Ford and Smit (2004) “the assessment of current vulnerability requires analyzing and documenting communities’ experience[s] with climatic risks (current exposure) and the adaptive options and resource management strategies employed to address these risks (current adaptive capacity)” (p. 395). An equally important component of this analysis was the identification of coping mechanisms used by farmers to deal with climatic and non-climatic conditions. These analytical steps revealed factors that facilitated or constrained the adaption process of these farmers. It should be noted that future vulnerability always builds on current vulnerability (Ford & Smit, 2004).
2.4 Summary

Rainfall variability, as well as a narrowing of the beginning and end of the seasons of rainfall has exacted a heavy toll on subsistence farmers in Eritrea. Climate changes have led to changes in the growing seasons. This had led to the crop failures being regularly experienced by 80% of Eritrean subsistence farmers. Their livelihoods are at risk annually. Water shortages caused by recurring droughts are a concern in Berik and Sosona that requires an immediate response. Many types of environmental problems are experienced by the communities and environments, but drought seems to be the most devastating in both. Drought has multiple affects both short and long term, on the livelihoods of the people and on their environments.

The theoretical framework adopted in this study addresses the assessment of the vulnerability and adaptive capacity of these farmers from multiple perspectives. Adaptation to climate change means a reduction of vulnerability to current and future climate risks. Vulnerability, therefore, is determined by adaptive capacities. A single climate hazard, like drought, does not affect men and women in the same way, because some people have greater capacity and access to resources than others. In this context, farm women are the least able to adapt to drought because of an inequitable distribution of resources and repressive cultural norms. Gender, therefore, is a critical factor in understanding vulnerability to climate change. Vulnerability and adaptive capacity, therefore, are closely linked. Adaptive capacity is determined by access to resources. Africa and Eritrea in particularly have low adaptive capacity to climate change due to economic, social, technological and political factors.
CHAPTER THREE: METHODOLOGY

This chapter discusses the research methodology used to explore the subsistence farming livelihood strategies of Berik in the Central Highlands and Barentu/Sosona in the Lowlands of Gash Bakra, Eritrea. Understanding the livelihood of farmers is important to assess their sensitivity and adaptability to climate change. This chapter describes the methods used in this study to obtain this data. It is divided into four sections. The first section describes the research methodology used to guide this research. Second, the steps taken in order to prepare for this research are discussed. Third the field research primary and secondary data collection are described. Lastly, the methods employed for data collection and interpretations are discussed.

3.1 Methodology

Qualitative case study methods have been chosen to collect data for this thesis. This method enables the researcher to gain direct insight into participants’ experiences. A qualitative researcher’s ontological assumption is that reality is complex and multiple. The “epistemological” assumption is that the relationship between the researcher and participants needs to be interactive. Participants’ voices must be heard (Silverman, 2005, p. 98). According to Robert Yin (2009), the case study method allows a researcher to maintain a holistic and meaningful view of real-life situations. This method is useful in exploratory research questions. Inductive research helps to develop an in-depth understanding of an issue or problem.

John Creswell (2009) stated that the major characteristic of qualitative research is that researchers are able to collect data from the field by talking to people and seeing them within their environments. Dorothy Smith (1990) argued that qualitative research is
interaction between the participants and the researcher. The researcher is considered to be both a knowledge seeker and a knowledge receiver. The researcher keeps a focus on learning the meaning given by the participants to a problem or issue. In this type of study, it is not the meaning that the researcher brings to the research or what writers express in the literature that is important (Creswell, 2009). The goal of this study was to explore participants lived experiences. The use of qualitative methodology provided flexibility in the environment where the participants experienced the issue under study.

3.2 Researcher position

According to William Tierney (2002) identifying the position from which the voice of the researcher emanates at the very beginning ensures that the researcher takes responsibility for their research. I am considered both an outsider and insider. An insider by birth, I was born and spent the first 17 years of my life in Eritrea. I am also considered an outsider in Eritrea as I am Canadian-Eritrean who lives and was educated in Canada. I revealed my interest and position as a researcher to my participants by letting them know that I am a student who was interested in learning about their lived experiences and ways of livelihood in farming. I also made it clear that my research would only be used for educational purposes, as I was not affiliated with any government and that my research was an independent study, clarifying that the International Development Research Centre (IDRC) only granted me a scholarship to cover my research expenses. All participants were also given small honorariums. I also approached this study with a sense of responsibility, trying to put my own biases aside. As Patricia Ann Lather (1991) argued that researchers should be self-reflexive at the time of conducting research as well as being open to new ideas. This includes shifting from one’s own understanding, and shifting attention to the meanings and
definitions of participants. My intention was always to give voice to my participants whether male or female. I am not aware of how my gender as a female researcher affected the research. Participants seemed more concerned about whether or not I represented the government status quo and if my research would produce action to solve their problems.

3.3 Research preparation

Ethical clearance for this study was approved by the University of Regina Research Ethics Board (Appendix A). Access to the research country and sites are important when collecting primary data (Silverman, 2005). The researcher, as someone born in Eritrea had that access. Prior to the field trip the non-profit women’s organization National Union of Eritrea Women (NUEW) was selected as a non-academic affiliated institution for the field research. This organization works well with women and the general public and is well-respected within and outside of the country. Upon the researcher's request the organization expressed an interest in the topic and was willing to assist with logistics, access to research areas and participants (Appendix B)

The field research took place in Eritrea during the 7 months from March 2\textsuperscript{nd} to October 3\textsuperscript{rd}/2011. Upon arrival in Eritrea, two weeks were spent with the National Union of Eritrean Women (NUEW). Access to the research areas was achieved after establishing a network with the organization. The hierarchical structure of Eritrean society heavily constrained research. As such, negotiations began at the regional level head office, then the sub-region of the Ministry of Local Government (MoLG) and finally, at the level of village leaders. All the responsible staff had to be informed along the way, which was time consuming. At the village level both the MoLG of each village and the NUEW local volunteer leaders were the key persons who organized the participants for this research.
3.4 Primary data collection

John Creswell (2009) and Davis Silverman (2005) advised that the using of multiple strategies helps to validate research findings. In this research multiple sources of data were approached in order to explore multiple avenues for understanding participants’ experiences. Data were obtained primarily from subsistence farmers, both men and women. This study obtained data from primary sources through field observation, focus group discussions, and interviews with elderly farmers and with key informant. Direct observation served as a means of enhancing the information collected in focus groups and interviews. This further helped the researcher to understand the participants’ experiences. Secondary sources were reviewed to cross-check the information provided by participants.

3.4.1 Study regions and villages

The criteria applied in selection of study regions and sub-regions included consideration of agro-ecological conditions; likelihood of good access to resources; gender roles in Eritrea; Eritrean production systems; ethnicity; religion; the presence or absence of development projects in the chosen regions and sub-regions. The two study regions are distinct and unique from each other as are their respective ethnic groups and economic, social and cultural ways of life (Gebremdhin, 1996, 2002). The central highlands region is divided into four sub-regions they are Berik; Serejeka; Gala Nefhi; and Asmara. The researcher selected the sub-region Berik as representative of the region. The Berik sub-region has 26 villages. The researcher selected 6 villages for in-depth study. These were Adi-Bidel, Tse’ada-christian, Tse’azega, Adi-Yakob, Da’ero and Ametsi (as shown in Figure 2), all of them inhabited by the Tigrinya ethnic group.
The second study sub-region is Sosona, an administrative area embracing six cluster villages in the sub-region of Barentu/Sosona in the Gash-Barka administrative region of Eritrea. These 6 villages, clustered under Sosona administrative are Ashoshi, Ugana, Gulishishi, Hawmena, Tedagul and Abaro (as shown in Figure 3). They are located some 15 kilometers to the east of the town of Sosona, which is the administrative seat of the region. The region is inhabited by the Kunama ethnic group. As a case study of Berik and Sosona, the findings and analysis only reflect the sub-regions of the study areas and are not necessarily reflective of the whole region.
3.4.2 Key informant interviews

Interviews with key informants were conducted at the sub-regional and village levels to explore the socioeconomic and livelihood strategies of the community. Four staff members who were local representatives of National Union of Eritrea Women and the Ministry of Local Government (MoLG) were also interviewed. As these staff members lived within the community, they had useful knowledge of the opportunities and struggles that were faced by the farmers of the regions. They contributed information such as what type of assistance was available to farmers and who provided it, if any this was also helpful as a cross-check to the participants’ responses.

3.4.3 Focus group discussions with farmers, men and women

Open-ended semi-structured interviews and focus group discussions were found to be appropriate strategies for this study because of their flexibility (Creswell, 2009). In the focus group discussions questions were asked in an interactive group setting where participants were free to talk with other group members. Questions did not need to be asked in any exact order as laid out in the interview or focus group discussion guides proposed for the study. This helped the researcher to incorporate new questions that may have arisen from the conversations with the participants. This allowed the researcher to modify interview protocols and to build on initial research intentions as new information was gathered. This provided a richer and potentially more valid data base for analysis. A purposefully selected sample was used in this research. Silverman (2005) and Creswell (2009) argued that purposefully selecting participants or sites would best help the researcher understand the problem and the research questions. Focus groups were also selected in a purposeful manner considering the information that was sought by this
research. In both sub-regions the National Union of Eritrean Women and the Ministry of Local Government sub-region personnel were the main contacts and the organizers of focus groups in each village.

The sampling procedure was based on representation in terms of the various socioeconomic groupings, including farmers from deferring income groups. Socioeconomic status was determined based on the judgment of the local administration and National Union of Eritrean Women leaders. Equal gender representation was important for this research and both genders were represented equally among participants. The age requirement for participation was 18 years and above. Social status of participants was considered in order to have representation from a variety of households that currently exist in the regions. Marital status was also considered. Female Headed-Households (FHHs), whose husbands were in national service were also included in this study sample. Focus groups were organized in each village with 6-8 participants. Focus groups of men and women were held separately so that each group would feel comfortable during the discussions.

A total of 24 focus groups were conducted with men and women farmers in both sub-regions. To ensure voluntary participation, every participant gave verbal consent. This was important due to the low literacy levels of the participants. Letters of consent were translated from English to the local language and read to the participants in Tigrigna for the sub-region of Berik, and in Kumana language for the sub-region of Barentu/Sosona (Appendices C & D). The consent letters outlined the voluntary nature of the study and stated that no names would be used during the data collection. To minimize information loss an audio recorder was used. All except one male focus group
refused to be audio recorded so the discussion was transcribed by hand using the “space
between the questions to record responses” a method recommended by Creswell (2008,
p.183). Interviews were one hour long and focus groups were approximately of 1 to 3
hours. Interviews and focus groups were guided by a set of semi-structured questions
designed to probe the participants understanding of their lived experiences (Appendices
E & F).

The focus group protocol included questions intended to elicit demographic
information as well as information about land ownership, drought, and climate change
and adaptive mechanisms. The focus groups were encouraged to discuss their
experiences as farmers. At the end of the sessions they were asked if there was anything
that they would like to add. The focus groups and interviews in Sosona were conducted
with the assistance of an interpreter in the Kunama language. This process was lengthy
because after the interpreter asked a question the response was also translated into the
Tigrinya language. The researcher was guided by the questioners and if needed she
added follow-up questions. In the sub-region of Berik the focus groups and interviews
were conducted in Tigrigna (the researcher's language) and were audio recorded. Each
focus group took between one and two hours. At the end of each fieldwork session the
focus groups and interviews were written out and translated into English.

3.4.4 Interviews with elderly farmers, men and women

Eight elderly farmers, four men and four women were selected from the Berik
sub-region in the representative villages of Adi-Bidel and Tsaazega and in the Sosona
sub-region from the villages of Ugana and Ashoshi. Participants were aged between 60
and 80. The purpose of conducting interviews only with these elderly farmers of men
and women in addition to the focus groups was to gather insightful data regarding the pattern of drought from those who might reasonably have been expected to have experienced numerous and varied droughts. It was also important to learn about the coping mechanisms used by these farmers over the years.

3.4.5 Direct observation

Concerning observation, I became aware of the research of Creswell (2009), who stated that researchers should engage in multiple observations during the course of collecting data and that they should use an observational recording protocol that consisted of “... moving into the setting and observing as an insider” (p. 182). This was intended to build trust among participants and familiarity with their settings.

During my data collection I spent extended periods of time in 12 villages. This helped me to develop my understanding of their livelihoods. I also attended market days, where exchanges of a variety of goods and services took place. I was also invited to attend an elementary school graduation ceremony. I gained many important insights, therefore, by regularly participating in the everyday social, economic and cultural lives of the participants. This helped me to understand their lives and livelihoods. Taken together, these sources later helped me to reflect on the data in a more informed manner.

3.4.6 Limitations of the study

There are a number of methodological limitations to this study. The sample size gathered was from only 140 households of men and women engaged in focus groups. Additionally, only 8 interviews with elderly men and women farmers were organized and 4 interviews with key informants. The problem that overshadowed data collection was that farmers in the sub-region of Berik were extremely worried about the late rainfall
during the data gathering period (on July 12, 2011). The uncertainties of weather, the late rain that might result in drought or simply the late arrival of a good rainfall season to come, occupied them with worry about what might happen and with considerations of what they could do without rain during this harvest season. Thus it was extremely difficult to discuss past drought years and their coping mechanisms during those droughts, while they were worried about their present situation.

3.4.7 Secondary sources

Secondary sources were reviewed in order to provide a context for the study. Relevant available data-published and unpublished documents and government papers were gathered. However, information about Eritrea on any subject of study is extremely difficult to find. It is hard to find peer reviewed journal articles and there are various reasons for this. The country does not have a computerized library data-base. The only university has been closed since 2002. Various colleges exist with their faculties spread throughout the country, but they seldom publish articles. Scholarly research within the country is scarce and it is difficult for external researchers to gain access to the country (Appendix B).

3.5 Data interpretation and analysis

Data analysis in this study used in-depth semi-structured interviews and focus group discussions. These were complemented by key informant interviews. Direct observation and secondary sources were used to cross-check the information gathered from the participants. All data were assessed to identify the components of vulnerability, of exposure, and of adaptation and coping mechanisms used by the participants.
The semi-structured interviews with elderly men and women focused on questions regarding drought and coping mechanisms (Appendix F). A focus group questionnaire guide (Appendix E) was divided into four sections. Section one asked questions about demographics. Section two discussed women and farming. Section three talked about the vulnerability of farmers and the last section asked questions regarding current and future coping mechanisms. To analyze the demographic questionnaires a spreadsheet was developed (Appendix G). The spreadsheet was prepared to use with the Statistical Package for the Social Sciences (SPSS) software, which further generated descriptive statistics about participant characteristics.

Analysis of the data for interviews and focus groups, except for one, began with a review of the audio and transcribed material. Data was organized according to the interview and focus group guide and then sorted into themes and sub-themes Table 4 below shows an example of this process. The themes and sub-themes were then further analyzed using a theoretical framework drawn from the literature on vulnerability and adaptive capacity. Once all data were categorized into themes and sub-themes, during the writing of the findings chapter, tables found to be useful to present descriptive statistics were generated in relation to identified vulnerability and coping mechanisms by participants.

Farmers-identified exposures and coping mechanisms were cross-checked and supported with secondary sources. Farmers were also asked to discuss their vulnerabilities and current coping mechanisms. When they complained about their situations, they were asked to make recommendations about what they thought would be helpful for current and future situations. These are included in Chapter Five.
### Table 4: A sample of the analysis process

<table>
<thead>
<tr>
<th>Themes</th>
<th>Sub-themes</th>
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<tbody>
<tr>
<td>4.1 Demographic characteristics</td>
<td>4.1.1 Sample characteristics</td>
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<td>4.1.2 Age and marital status</td>
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<td>4.1.3 Education status</td>
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<td>4.1.4 Adult children in indefinite national service</td>
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<tr>
<td>4.2 Farmers perceptions of climate change</td>
<td>4.2.1 Climate – temperature</td>
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<td>4.2.2 Rainfall variability</td>
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<td>4.2.4 Flood</td>
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<td>4.2.5 Drought and coping mechanisms</td>
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<td>4.2.6 Pest infestations</td>
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<td>4.2.7 Water</td>
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<tr>
<td>4.3 Households resources:</td>
<td>4.3.1 Land</td>
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<tr>
<td>Agricultural inputs</td>
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CHAPTER FOUR: ANALYSIS AND DISCUSSION OF FINDINGS

This chapter presents the qualitative data from the interviews, focus groups and observations of farmers in Berik, Central Highland region and Barentu/Sosona, Gash Barka region of Eritrea. Major themes from interviews and focus groups are analyzed using a theoretical framework drawn from the literature on vulnerability assessments and adaptive capacity. This chapter is divided into the following sections: Section 4.1 describes the demographic characteristics of the participants; Section 4.2 discusses farmers’ perceptions of climate change; Section 4.3 outlines the lack of households’ agricultural inputs; Section 4.4 discusses the agricultural production of these farmers; Section 4.5 shows who is most vulnerable to food shortages and why; and Section 4.6 describes the coping mechanisms used by the participants.

4.1 Demographic characteristics

According to the demographic questions a spreadsheet was developed (Appendix G). The demographic characteristics data were analyzed with the Statistical Package for the Social Sciences (SPSS), and descriptive statistics were generated.

4.1.1 Sample characteristics

The total number of participants in focus group discussions from the two study regions was 140 households, 56 (40%) from Berik and 84 (60%) from Sosona (Appendices H & I study villages of Berik and Sosona population). There were equal numbers of male and female participants from Berik, 28 each (20%), while there were more female participants, 44 (31.4%) in Sosona as compared to 40 (28%) males. Efforts were made to have equal numbers of participants from each sub-region; however, there were 20% more participants from Sosona. This can be explained by multiple factors.
During the data collection in Sosona farmers were available. They had free time prior to the planting season in early May and June. These are relatively slow months. In Berik data was gathered during the months of July and August, which is planting season. Hence, farmers were busy even though we had arranged for focus groups to be held during Coptic Christian holidays in order not to interfere with busy schedules. But these are the times that farmers were also busy with non-farming activities such as marketing, village affairs and social obligations.

4.1.2 Age and marital status

A breakdown of participants by age shows the highest number of male participants was 20 in the age group 51-60 (14.3%). The lowest number was over 70, which accounted for only (5%). This age analysis showed that the young generation was not engaged in family farming, as they were doing national service. A total of 25 female participants were in the age group 41-50 (17.9%). A total of 65 (46.4%) married male participants contrasted sharply with only 38 (27.1%) married females. There were 18 widowed females and 3 divorced females. There were no divorced or widowed males, showing that Eritreans encouraged them to remarry. In Berik 43 (30.7%) participants were married and in Sosona 60 (42.9%) were married. Berik counted 10 (7.1%) widows and Sosona counted 8 (5.7%). Female Headed-Households (FHHs) accounted for 34.3% of the total households participating with Sosona reporting a slightly higher percentage (17.9%) followed by Berik (16.4%). The high rate of female-headed households in both study areas has been caused by 30 years of war, the border conflict with Ethiopia from 1998-2000 and indefinite national service since 2002 (Kibreab, 2009). In Sosona polygamy is the main contributing factor.
4.1.3 Education status

Literacy empowers people by enabling them to find and use information for effective use of land and other recourses. The literacy rate in the two study areas is very low. Eighty participants (57.1%) were illiterate of whom 27 (19.3%) lived in Berik and 53 (37.9%) in Sosona. Fifty-two (37.1%) of the participants had elementary education. There were more illiterate females 44 (31.4%) than males 36 (25.7%) in the two study areas.

4.1.4 Adult children in indefinite national service

Households whose adult children were in indefinite national service were more numerous in Berik, with 12 (70.6%) and only 1 (5.9%) in Sosona. When further disaggregated by age group, those who had adult children in national service, the age group between 41-50 and 51-60, respectively had 13 (9.3%) and 10 (7.1%) children in national service. Only 4 (2.9%) participants above the age of 70 had children in national service. This can be explained by the fact that the national service policy was implemented in 1994 (Kibreab, 2009). Those who were 41-50 and 51-60 had relatively younger adult children who were in the army. Those above 70 had adult children who participated in the war for independence.

4.2 Farmers perceptions of climate change

Both men and women farmers were asked in focus groups and interviews to discuss their knowledge of the environment and climate change. Their knowledge about the environment and farming was based on an observation of patterns. According to an elderly farm woman from Adi-Bidel village, in Berik, a “wind blowing from south to north brings rain but when it blows from north to south there is no rain.” Elderly
farmers, therefore, could determine whether it would rain or not by judging from which direction the wind blew. Furthermore, their analysis of the kinds of wind and the direction from which they blew helped them to determine whether the farming season would produce a good or bad harvest. In both research areas, the elderly stated that there are four kinds of winds: one that caused illness, one that brought war, one that dried crops and one that caused clouds in the forest which were bad for crops.

Farmers stressed the importance of wind by arguing that rain was a vital source for rain-fed agriculture, but that the kind of wind that was good for crops was also essential. They used the example of the 2010 farming season when rain was plentiful. At that time, the approximate equivalent of two years rain fell in one year. It filled reservoirs, rivers and ponds but it was not good for crops. It produced too much moisture and yield productivity was very low. There is an old saying that when it comes to farming that: “It is not the rain that matters, rather it is about what gives good quality of yield” (Elderly farmers in Sosona). There could be a small amount of rain, but this type of rain could be a lot better for yield productivity than having lots of rain and ending up with low yields as happened in 2010. An elderly male farmer in Ashoshi village, Sosona said “I remember in 1933 there was a very dusty wind and I recall an elderly person telling me that this kind of wind is of good fortune it is for the harvest, and the harvest was plenty that season.”

Farmers discussed rain variability patterns that they had witnessed for decades. Both male and female farmers, when asked about climate change also discussed the major stressors in terms of temperature, rainfall variability, water scarcity, deforestation, flood, and drought.
4.2.1 Climate – temperature

Farmers in Berik and Sosona said that the climate, in terms of temperature, was quickly changing and becoming unpredictable. In the past farmers said that they were easily able to follow the cropping calendar, however, during the past decades it has become harder to follow as the weather has been changing so rapidly that they were unable to keep up with the changes. Farmers in both Berik and Sosona stated “Today we never know the behaviour of the weather as it changes quickly, in particular during farming season.”

Farmers commented that in the past the weather used to be balanced. Of course it changed, but the changes were more consistent and predictable. Now during the summer it is sunny and gets extremely hot. During the winter delays in rainfall as well as strong winds bring with them extremely cold air, especially in the mornings and evenings. These changes of wind and temperatures are rapid and all happen in the same day, destroying crops before they have had a chance to mature.

Health issues were also discussed as a main concern for female farmers in both study areas. Changes in temperature and wind have an impact on their health. For example, it was said of changes in wind before rain arrives that: “We have been observing this change for quite some time now. This kind of strong wind brings all kinds of sickness with it. Climate related health issues are the challenges that we are faced with today” (Berik and Sosona participants). The sicknesses they mention include malaria, diarrhea, and dengue fever (locally known as “welcome”), encephalitis, yellow-fever, cholera and other vector-borne diseases. A woman from Gulishishi village,
Sosona, further stated that with all this sickness: “when we go to the hospital there are no good medicines to make us better.”

### 4.2.2 Rainfall variability

Both men and women farmers reported that they were experiencing climate change in particular in terms of rainfall variability. This included erratic rainfall, delays in the onset of rain, rain failures, low rainfall or too much rain. In some years rain began and ended earlier and in other years it began late and ended early. When farmers were asked what they thought caused rain variability, they said, “Rain comes from God. We depend on rain and we cannot do anything without it. We do not have any other options, except to pray to God for good rain, it is in God’s hands. We are also aware that deforestation has something to do with rain variability” (Berik and Sosona participants).

### 4.2.3 Deforestation

Deforestation was discussed at length in both study areas as a main cause of rain variability. This was particularly so in Sosona where they remembered that “Our land used to be covered with forest, but today, almost all of it is gone and left with open fields now” (Sosona elderly men and women farmers). They also said, “We are left with no forestation and the consequences of having less rainfall or no rain at times” (Elderly farm woman, Ashoshi village, Sosona). In Berik both male and female focus groups revealed that many places used to be covered with forest. They stated that “Before we were not aware that cutting live trees can cause hardship in our livelihoods, but now we know as our livestock do not have grazing land” (Berik male and female focus groups).

Since independence, awareness about the importance of trees is communicated at the
village level as farmers are engaged in tree planting programs implemented by the Ministry of Agriculture.

Regarding forestation, farmers explained that fallen leaves help to hold moisture in the soil. The leaves also serve as fertilizer. Long ago, when there were strong winds, there was no disturbance to the soil. Even when it rained heavily the trees would slow down the rainfall and protect the soil from washing off. The grass never dried and water was retained which was good for the dry season in January, February, March and April. Today, however, extensive deforestation has resulted in soil erosion. Farmers have witnessed soils becoming degraded and the water-holding capacity of watersheds has been seriously reduced. This led to violent flash floods that cause soil erosion. According to Food and Agriculture [FAO] (1994), soil losses were estimated at about 15-35 tons per year per hectare. At the beginning of the 20\textsuperscript{th} century the forest cover of Eritrea was 30\% of the total land area. By the 1990s it was only 0.8\% (Table 5).

<table>
<thead>
<tr>
<th>Table 5: Timeline deforestation</th>
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<tbody>
<tr>
<td><strong>Years</strong></td>
</tr>
<tr>
<td>1916 -1974</td>
</tr>
<tr>
<td>1976-1978</td>
</tr>
<tr>
<td>Since Independence 1991</td>
</tr>
<tr>
<td>2007-2009</td>
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</tbody>
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Farmers stated that during the Haile Selassie Ethiopian regime in Eritrea for 58 years the cutting of live trees was practiced and some types of trees that grew during this

\textsuperscript{15} Eritrean People’s Liberation Front (EPLF) and Eritrean Liberation Front (ELF) are the two liberation groups that were formed during the Liberation War for independence from Ethiopia.
period do not exist today. During the Derg regime (another Ethiopian regime) in Eritrea the mass cutting of live trees continued. In 1983 it was remembered by participants that freshly-cut live trees were transported to Ethiopia. The Liberation War also contributed to mass deforestation as live trees were cut by the Liberation Front for trench support (Elderly men, Ashoshi village, Sosona).

Deforestation is also caused by the clearing of land for agricultural purposes like commercial farming in Gash Barka (World Bank, 1994). Another contribution to deforestation is that wood is an important source of fuel in Eritrea. Sale of wood and charcoal is also a source of income for many. In the Highlands wood is also used for building traditional houses called hidmo. In fact, the Department of Environment (2001) reported, “… at least 100 live trees have to be cut to construct a traditional house” (p. 63). However, participants of this study stated that they did not use live trees for building traditional hidmo houses. Dry wood was used and this does not contributed to deforestation.

**Deforestation coping mechanisms**

Since 1991 the government of Eritrea, has taken the responsibility of forest management by appointing a community watchman in the Central Highlands. It is now illegal to cut down live trees and trespassers are fined by the Ministry of Agriculture. Both men and women farmers in Berik reported that they were engaged in community tree planting, a program led by the Ministry of Agriculture and the National Union of Eritrean Women. The local government administration office keeps records. The requirement is that at least one adult member of a household should be engaged in tree planting. There is a consequence for not showing up, such as difficultly accessing
government shop subsidies. In Sosona there is no tree planting program and participants mentioned that it would be a good idea for them to engage in as well.

4.2.4 Flood

Flooding was discussed as one extreme weather event in both study areas. In Sosona floods with strong winds have destroyed traditional hut houses\(^\text{16}\), while in Berik floods have destroyed wooden. Floods are also dangerous for livestock and shepherd boys. Young boys become shepherds as young as 6 years of age. Participants stated that strong winds and floods often happened so fast that young boys and their livestock were trapped with no place to take shelter. In attempting to cross water, they often end up swept away by the flood with their livestock.

4.2.5 Drought and coping mechanisms

Drought was discussed at length as one of many major extreme weather events that impacted farmers in both study areas. The relatively recent major droughts in these regions marked in the minds of the participants of focus groups and interviews were those of 2007, 2008 and 2009. These three drought years resulted in crop failures. Of these three drought years farmers recalled that 2008 was by far the worst. Farmers in Adi-Bidel village, Berik, revealed that 2008 was a difficult period because crop production was extremely low for both human food and livestock feed. Although there were no deaths recorded for humans, livestock deaths were at their highest.

In Tse’ada-christian village, Berik, male focus groups among farmers serving in the national service were asked about drought years and coping mechanisms. They

\(^{16}\) In Sosona the Kunama live in hut houses built with straw or stone/mud. Hut houses are suitable for hot climates such as Gash Barka.
responded that they knew when the drought period was, but that they were not with their families to help them cope.

They said:

How our wives managed to overcome the drought years we do not know. The only money they had was barely enough to purchase food from the market with our salary\textsuperscript{17} of 500 Nakfa\textsuperscript{18} [12.50 USD] monthly. This is a very small amount of money, but our wives managed it somehow. We were of no help to them because we were far away from home in the army. We couldn’t do anything besides be worried about them. Our wives endured the crying of our hungry children (Tse’ada-christian village, male farmers serving in national service).

Farmers were then asked to discuss the past drought years and their coping mechanisms. Sosona farmers were open to this discussion. Berik farmers on the other hand, were not willing to discuss coping mechanisms. They stated that “it was bad times and they do not want to remember it at all.” They quickly re-directed the discussion to talking about what they were currently (2011) facing with the delay in the onset of rain.

Farmers in Berik, particularly Da’ero village, found it difficult to talk about the past drought. In addition they were also faced with a pest infestation in 2011. In Da’ero village the male focus group said “What is the point in remembering past drought while this year [2011] we are faced with a lack of rain?” They overcame the past drought and now they are concerned about this year [2011]. Farmers stated that “If there is help for now that is good, but asking about past drought and not providing help is useless for us”(Male focus group in Da’ero villages, Berik).

\textsuperscript{17} National service monthly wage is 500 Nakfa (12.50 USD). Wives can pick up their husband’s monthly payment from their administration sub-regional office. The monthly payment is barely sufficient for survival.

\textsuperscript{18} Nakfa (ERN) is a unit of Eritrea currency officially introduced in November 1997. “In April, [2005] it became illegal for individuals to hold and exchange foreign currency. As of January 1, 2005, the government set the foreign exchange rate at US$1 = ERN15” (Library of Congress, 2005, p. 11). The currency at the black market rate is 1 USD = 40 Nakfa (as of March, 2011).
In both study areas, Berik and Sosona, purchasing grains from the market is one of the ways farmers cope with drought. During droughts the government imports grain from Sudan, locally known as *wedi-aker*[^19]. This grain is similar to red sorghum. Farmers complained that the quality was poor for making *injera*. *Wedi-aker*, as drought relief is distributed to vulnerable groups[^20] and it is also made available at the market to the general public at a lower price. Both male and female farmers, however, need to find sources of cash in order to purchase grains. Participants in both study areas identified the ways in which they collected money (Table 6).

Management of grains and food is also very important in times of shortages of food and particularly during droughts. This means that the grain they purchase must last them longer and so they eat less. In Berik there is also a government shop that provides subsidized grains and essential food items. Farmers earn cash by selling livestock, firewood and handicrafts in both areas. When the prices of grains increase, the price of livestock decreases. This means that when farmers sell their livestock it is for a lower price than when they purchased it. They do not make a profit but they must sell their livestock because they need the cash. In Berik the valuable asset that Tigrigna women have is gold jewelry as it is traditional that when a woman gets married the husbands will provide the bride with gold jewelry. In times of hardship the couple may decide to sell it.

[^19]: *Wedi-aker* is a crop that requires more rain and grows in Sudan. It is a high-yield and late-maturing crop.

[^20]: Vulnerable groups according to the government are martyrs’ parents, wives and children, including wives of husbands who are currently doing in the national service (Berik male and female participants).
## Table 6: Drought coping mechanisms identified by males and females in study areas

<table>
<thead>
<tr>
<th>Resources/ Activities</th>
<th>Berik</th>
<th>Sosona</th>
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<tbody>
<tr>
<td>By eating less</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>By selling or using any assets they have saved (if they have any)</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>By borrowing money from family, friends, and neighbors.</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>By taking credit loans from government organizations to purchase grains.</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>By working at traditional gold mining and selling what they find and using the money to purchase grains (only in Sosona study area)</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Remittance(^{21})</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>By selling firewood and charcoal</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>By selling handicraft</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>By selling livestock</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>By selling nonessential furniture</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Petty trade, tea, coffee, popular local drinks beer called <em>siwa</em>(^{22})</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>By selling wives’ gold jewelry</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Drinking coffee in the morning to shutdown appetite</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Wives of husband in national services have a monthly wage 500 Nakfa (12.50 USD)</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Making the traditional bread <em>Kitcha</em>(^{23})</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Making the wild plant, <em>Gaba</em>(^{24}) into bread</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Starvation</td>
<td>x</td>
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In Berik farm women reported that they made *kitcha* homemade bread for their children. They divided the bread into smaller pieces and gave it to children three times a day. The rest of the bread they hid and kept in a secure place out of their children’s reach. In Sosona they use the wild plant locally known as *gaba* that is found in the Gash Barka area as the last option. Participants stated that the use of *gaba* as a coping mechanism has been practiced for centuries during droughts because it grows even then. They said that “*It is always with us and in our reach without cost of money. And it grows everywhere we have easy access to it*” (Sosona male and female participants). The men

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\(^{21}\) Remittances from “abroad estimated to account for 32%” of the GDP per year (Library of Congress, 2005, p. 8).

\(^{22}\) *Siwa* is made using pulses and finger millet.

\(^{23}\) *Kitcha* is made of wheat flour, water, and salt, relatively thin unleavened bread.

\(^{24}\) *Gaba* is the popular wild plant that can be made into a bread by smashing and processing it into a kind of concentrated bread to be used during shortages of food and droughts. It is also a good source of food for long journeys during migrations.
travel long distances in search of *gaba* and the women do the preparation of the *gaba* into bread. The women participants stated that it involves a lot of work to prepare, but once it is made into bread it is really good and can be eaten once a day. It is filling for adults. For young children it is a bit difficult as it is not soft bread.

In Sosona, the elderly, both men and women, said that during their youth even when there was a drought they still had milk available from livestock, but today the livestock often has no food and, therefore there is no milk. Another important coping mechanism during drought is working at the traditional gold mines. This has become very important for survival to earn cash. The cash from selling gold is used to purchase grains from the market.

In Berik a popular coping mechanism by the majority of the participants is remittance from family members. In both study areas, credit loans from the Ministry of Agriculture and the National Union of Eritrean Women are provided. Farmers are given cash loans to generate income, but the majority of farmers use these loans to purchase grains during droughts. Farmers disliked the use of loans. They stated that they must repay them with interest. They argued that getting a loan to purchase grains is not a good idea. They worried about the interest and about not paying it back on time. Still, during hardships, the loans were helpful. Loans got them through tough times, but they wished that the interest was lower than the current 12%.

*Livestock drought and coping mechanisms*

During a consistent drought livestock fodder is a major problem. In the 2007, 2008 and 2009 droughts there was scarcity of fodder for livestock. Three years of consistent drought was terrible. There was no grazing land. There was no water. They
were hungry and thirsty. This resulted in a large number of livestock deaths. In Abore village, Sosona, during the 2009 drought 25 animals died of starvation. Thirteen died of sickness. In 2010, 30 cows died. In Tse’azega village, Berik, in the 2008 drought a high number of livestock deaths were recorded. They recalled that from one family 10 animals died.

One of the popular coping mechanisms during drought is livestock fodder storage\(^{25}\). They purchase hay when it is cheaper than it will be in drought periods. During drought livestock fodder is difficult to find and livestock starvation occurs. For example if farmers have large numbers of livestock they can sell some of the livestock and purchase fodder for the rest of them.

4.2.6 Pest infestations

Both male and female farmers reported that pest infestation such as grasshoppers, locusts, white flies, ball worms and sting bugs are responsible for crop losses and are a major challenge in both study areas. Male farmers in Berik stated that when they noticed pests appear, first and foremost they informed the local government administration office. This office then reported to the Ministry of Agriculture and normally they would get back to the village with solutions. For example there was a pest outbreak in 2008 and the Ministry provided farmers with chemical spray at the subsidized price of 400 Nakfa (10 USD) while the price at the black market was 800 Nakfa (20 USD).

Farmers in Da’ero village and Adi-Bidel village stated that pests have appeared once again for the 2011 crop calendar.

A male farmer expressed his frustration by saying:

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\(^{25}\) Hay is stored as a fodder for times when there is a lack of range feed. In Berik the storage is raised above the ground on stones and then surrounded by a thorny fence. In Sosona it is stored above the reach of livestock and termites high in the branches of trees or on wooden makeshift tall racks.
We have planted our taff, maize, barley during the month of May and June, and because rainfall did not come on time, according to the cropping calendar, it is only recently in July that it has started to rain. Those crops seeded previously were wasted and we planted sorghum in July. If this rain continues our hope is from sorghum for this year [2011], but we are facing major problems now with pest outbreak. They will destroy our sorghum, we must do something about it now (From Da’ero village male farmer, age 63).

The Ministry often does not respond on time to address the problem of pests. Among the farmers there is a much greater feeling of mutual responsibility and when the Ministry of Agriculture fails to address the problem of pests or delays providing them with chemical spray, farmers come together and take matters into their own hands. They find ways to get rid of pests using branches of trees and any other farming tools they can find useful to remove or kill pests. Farmers stress that time is critical in dealing with pests and failing to take timely measures can result in a reduced yield. These farmers will not take that risk.

4.2.7 Water

Water is a scarce resource in Eritrea. The availability of water is either a strength or a problem that is experienced in both study areas. Participants, males and females, in each village were asked to discuss water availability for human and livestock consumption. Participants provided a detailed description of their water systems. For human consumption, water taps, hand-pumps, and wells dug 12 meters deep using traditional drills are available. For livestock, ponds are available in some villages (Appendix J and Appendix K).

Farmers stressed the importance of access to clean water for drinking and for their livestock. During the dry season (January, February, March and April) it is extremely difficult to find water for livestock. Livestock ponds are empty until the onset
of *kremti* rain. Male farmers travel long distances with their livestock in search of drinking water during the dry season.

In Adi-Bidel village, Berik, a hand-pump was constructed in 1994 by the government. This drill supplied clean drinking water for 7 years. But for the last 10 years it has been broken and not yet been fixed. The water department is aware of the situation and recently they have come to re-examine the water pump three times and reports have been passed to the headquarters in Asmara, but nothing has been done about it. The only source of water available is the stream. Young girls and women fetch water from a stream that is located in the hills 25 minutes walking distance. Whenever available, donkeys are used to transport water. Otherwise women used a 20-litre plastic jerry can.

The Sosona villages of Aboro, Gulishisi, and Hawmena do not have access to clean water. These villages have manmade drill-wells that are 12 meters deep and have been around for over 60 years. The problem of those wells is that sand covers them during the winter time rainy season. When spring comes they re-dig the well and use it again for drinking.

Participants also discussed the importance of maintaining the hand-pumps. Hand-pumps are easily broken especially as they are often used by children. Participants stated the importance of a sense of ownership by the community in taking good care of their water resources. In Da’ero village, Berik, they have a water committee that consists of three men and a hired guard. The tap water is fenced and locked with a key. The guard has the key and a daily water fetching schedule from 6am to 10am and from 3pm to 6pm is enforced. Each household pays 10 Nakfa (25 cents USD) on the 5th day of each month for this service. The price is fixed regardless of the amount of usage. In Da’ero village
the water tap has broken only once. Although it took one month to fix it, the National Department of Water fixed it without any cost to the community.

The male focus group was asked why there were no women elected to be part of the water committee. They said that the villagers elected three men, but it would have been good idea to include a woman. The female focus group was also asked about the water committee and why a woman was not part of it. They agreed that it was a good idea, but no one thought of it. They did recall that in the previous committee there was one woman.

4.3 Households resources: Agricultural inputs

Both male and female farmers in Berik and Sosona believed that farming was hard work. In fact, they argued that, while the type of farmland and rainfall they have was beyond their control, preparing their land for planting was still their responsibility. As such, agricultural inputs like labour and fertilizer are essential for land productivity and increased yields.

4.3.1 Land

As discussed in Chapter Two, land is owned by the government of Eritrea and citizens have user rights. All households are entitled to these, which characterized by the diesa system (village ownership). In Berik, a land committee was designated to identify eligible households for gibri26 (full or half-share). Land redistribution takes place every seven years through a village elder committee.

Both male and female farmers were asked if women had farmland user rights. It was found that married women did not have land in their names; rather land was in the

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26 Gibri means full share which is one hectare in Barka, Central Highland. One-member households receive a half hectare (0.5 hectare).
names of male heads of households. Women only had land if they headed households with children (divorced, widowed), entitling them to a full share of one hectare of farmland. In Berik single women without children, who had completed their mandatory national service, received half a hectare. Furthermore, single females over the age of 25, could receive half a hectare of farmland because they were considered unfit for the army.

In Barentu/Sosona, Gash Barka, the traditional kunama inheritance of land is matrilineal through female relatives rather than males. Participants in Sosona said that since 2007 a new system has been introduced by the government and a full-share became two hectares per household. Land distribution is not tied to the obligation of completing national service in Sosona.

In Berik, Central Highland, farmland distribution is done according to soil-type fertility which is classified into three types (high, moderate and low) and is then evenly distributed. Every household receives a plot of land from each soil fertility category.

4.3.2 Labour

Plowing

In Berik, Central Highlands, the land is different than that of Sosona, Gash Barka Lowlands. Berik is categorized as not very fertile and requires lots of labour to prepare before and after the planting season. Plowing is a major activity in the Highlands. For example, on average, land is plowed about five times in Berik. The opposite is true for the Lowlands, particularly in Gash Barka where the land is so fertile that it only needs to be plowed once prior to seeding time. Focus group discussions with both male and female farmers also revealed that long ago, the Kunama people of Sosona did not plow their land, but now they do. This is partially due to deforestation. As such, they have
adapted to the changes of their land and plow their land once prior to seeding. Over time the Kunama have learned that plowed land is more productive.

**Gender division of labour**

In both study areas, male and female focus groups were asked whether or not they viewed the role of women in farming as primary or secondary. In Berik and Sosona the majority of males responded that it was secondary to that of males except in women-headed households. Females in both study areas viewed themselves and their roles in farming as primary when households were headed by women. Even in Berik, the wives of men doing national service regarded themselves as primary farmers because their husbands were not fulfilling their roles as farmers. Among married women there were also differences of opinion. They argued that they had equal partnerships with their husbands and considered themselves as primary farmers. A few married women in Berik among the Tigrinya people, however, viewed themselves as secondary farmers because their husbands plowed the fields, making them primary. As discussed in Chapter Two, Tigrinya women are culturally forbidden to plow, making them dependent on male labour.

In all Sosona villages, female and male focus groups revealed that women could plow their own land without cultural restrictions. It all depended on their willingness, strength and motivation. Some participants in Sosona said that both husband and wife worked together to plow their land. When asked what percentage of women did plow, the majority of them said they have plowed once or twice but that most often, men did the plowing.
They also said in Sosona that there was no shortage of male labour because they were not heavily engaged in the national military service. In fact, in Sosona they are still able to practice seeking local community help known as wefera\textsuperscript{27}, in which the able-bodied prepared the land for planting together. The person being assisted would provide food and drink for everybody. In Berik, however, it was found that shortage of male labour due to indefinite national services were a problem. Both male and female participants in Berik further explained that not allowing Tigrinya women to plow was overly restrictive. In fact, households not having male members were vulnerable, especially female-headed households. They often engaged in sharecropping arrangements\textsuperscript{28} to deal with this shortfall.

The gender division of labour and control of resources are important in rural livelihoods as illustrated in Table 7. The division of labour influences access to labour among households. For example, it was found that some activities were strictly limited to specific genders in both ethnic groups.

\textsuperscript{27} Wefera is a traditional communal coping mechanism practice by the Kunama ethnic group to help vulnerable members of a community such as the elderly, the disabled and women-headed households to prepare land for seeding on time.

\textsuperscript{28} Sharecropping arrangements dictated that a female would receive 50\% of the output of her farm if she provided seeds and fertilizer. If a sharecropper provided seeds and fertilizer she would only receive 25\%. 
Table 7: Gender division of labour and control of resources by gender and ethnicity

<table>
<thead>
<tr>
<th>Activity or resource</th>
<th>Tigrigna Berik</th>
<th>Kunama Sosona</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Man</td>
<td>Woman</td>
</tr>
<tr>
<td>Land preparing plowing</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Seeding</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Weeding</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Harvesting</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Threshing</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Grain storage</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Grain marketing</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Cash for work</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Causal labour</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Livestock grazing</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Livestock sale</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Sale of craft, egg, traditional local beer <em>siwa</em></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Traditional hair sale</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Vegetables sale only in Amesti village, Berik</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Traditional gold mining during drought in Sosona</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meal preparation and grain grinding</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Parenting child rearing, care of the elderly, care of in-laws and the sick</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Collection of fire wood for home consumption only and water fetching</td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>


As a rule, tasks performed by men are controlled by men and those performed by women are controlled by women. Livestock grazing in both ethnic groups was only performed by young boys and men. Kunama women were involved in all aspects of labour except livestock grazing. Likewise Tigrigna women are also involved in farming activities except plowing and seeding as plowing and seeding are the responsibilities of men. This creates a situation where female-headed households become dependent on access to male labour.

The women of both the Tigrinya and Kunama are also solely responsible for domestic work such as cooking, cleaning and washing clothes. They are also responsible for parenting, as well as taking care of children, the sick, elderly in-laws and extended
families. In addition, they must fetch water and firewood with the help of their young girls. Grain grinding in most villages was not done by mechanical grain mills but was ground by hand exclusively by women. Taking grain to a mill to be grounded was usually done with the help of young girls and, occasionally, by men. Women are also often engaged in small business like the sale of crafts, eggs and a local beer drink *siwa*. In general, findings show that farm women experience excessive workloads in both ethnic groups.

**Labour shortage of young generation males and females**

Traditionally, children are regarded as a labour asset for farming families. In fact, larger families used to be the norm and were seen as an advantage for this reason. Children help with farming from an early age. For example, young boys begin looking after family livestock and help plowing from as young as 12 years of age. At the same time, young girls help their mothers with domestic work, looking after siblings and fetching water and firewood. When they come of age, they get married and look after their own families while supporting their ageing parents. But today in Berik, Central Highlands, farmers said that family size was no longer an advantage because of compulsory schooling and military service at the age of 18. Children who did not attend school were simply taken into military service at an earlier age to become soldiers.

In this context, a male farmer in Da’ero village, Berik made the statement that:

*Today we have reached the time where our children are not accessible to us, because of our government policy about national service. They go away from home to Sawa Warsai-Yikaalo Secondary School camp to complete their grade 12th and military training. After that they are engaged in the indefinite national service.*
On the one hand, in Berik, Central Highlands a new trend of migration is occurring among rural youth. Thousands are escaping the country due to the indefinite national service, paying a wage that is barely sufficient for survival. On the other hand, in Sosona, Kunama youth do not necessarily migrate because they are not engaged in military service.

### 4.3.3 Livestock

Livestock production is very important for rural livelihoods. Ownership of livestock serves multiple purposes. Livestock is an important asset and can be sold to generate income or to gain access to extra crops or labour. Livestock also produces dung which is used as soil fertilizer, household fuel or for other domestic purposes such as building material. The main types of livestock found in the study areas were oxen, donkeys, (camels in Sosona) cattle, sheep, goats and poultry. Oxen and camels are also important as draft animals. In Berik, Central Highlands, only oxen are used for plowing, as the land is not suitable to plow with camels. In Sosona, Gash Barka, oxen and camels are used. Oxen are an asset for farmers in both study areas and are valuable to own, but the majority of farmers do not own them as they are too expensive to buy (See Table 8). They are also too expensive to maintain throughout the year, due to shortages of feed. Clearly, this shortage of draft animals is a major problem for farmers in both study areas.

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29 Livestock serves in times of need, such as a shortage of feed. Even though the sale of livestock during drought results in low prices, at least farmers can sell their livestock and use the cash to purchase cereals.

30 Oxen or camels are used for plowing using a wooden plough pulled by a camel or a pair of oxen.
Livestock prices vary depending on the timing and the season. Normally livestock prices are high when grain prices are low. When grain prices are high, livestock prices drop. In Berik oxen are the most expensive to own, while in Sosona it is camels, while the prices of donkeys and chickens are the same in both areas. Sheep are less expensive in Berik than in Sosona. “Donkeys are also important household sources for transportation, as well as for fetching water, and fuel wood. Sheep and chickens provided meat, eggs and milk for household consumption or to sell for income” (Berik and Sosona participants).

**Livestock treatment**

Farmers discussed the importance of the livestock treatment that is available through the Ministry of Agriculture (MoA) in both study areas. The Ministry provided yearly anti-parasite treatments, coming to each village to treat the animals for endo-and ectoparasites. If it happens that some farmers miss this opportunity, then they must make an effort to visit the Ministry office in town to receive treatment for their animals. If they do not it is a problem since the treated and un-treated animals drink from the same ponds, so if one un-treated animal gets sick then they all get sick. As such, all livestock owners must treat their animals.

### Table 8: Livestock prices in both study areas as of August 25, 2011

<table>
<thead>
<tr>
<th>Livestock</th>
<th>Berik, Central Highland</th>
<th>Sosona, Gash-Barka</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nakfa</td>
<td>USD</td>
</tr>
<tr>
<td>Camel</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Oxen</td>
<td>20,000 – 25,000</td>
<td>500 - 625</td>
</tr>
<tr>
<td>Donkey</td>
<td>5,000</td>
<td>125</td>
</tr>
<tr>
<td>Goat</td>
<td>3,000</td>
<td>75</td>
</tr>
<tr>
<td>Sheep</td>
<td>4,000 - 5000</td>
<td>100 -125</td>
</tr>
<tr>
<td>Chicken</td>
<td>300 –400</td>
<td>7.50 – 10</td>
</tr>
</tbody>
</table>

Source: Personal gathered information (2011).
**Fertilizer**

Both male and female focus groups in both study areas reported the advantages of animal dung locally known as *duke’e*. Dung is highly valuable as a soil fertilizer\(^{31}\) and fuel\(^{32}\). There are three types of fertilizer discussed by farmers in Berik (Table 9). *Duke’e* animal dung is sold at high prices by private ranchers that average farmers cannot afford. The municipal waste is distributed by the Ministry of Agriculture at subsidized prices that farmers can afford. *Madabera* chemical fertilizer is also provided by Ministry of Agriculture in a limited supply per household of 12.5 kilogram. Farmers said that this is not enough to cover their plots and that they had to purchase more from the market at double the price. At the same time, there are often shipping delays which miss seeding time.

**Table 9: Types of fertilizer in preference**

<table>
<thead>
<tr>
<th>Types of fertilizer</th>
<th>Description</th>
<th>Kilogram</th>
<th>Government Subsidies Ministry of Agriculture</th>
<th>Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duke’e Animal dung</td>
<td>Cattle raised by ranchers</td>
<td>1000</td>
<td>1000 - 1,250</td>
<td>5000</td>
</tr>
<tr>
<td>Municipal wastes</td>
<td>Collected from forestry</td>
<td>1000</td>
<td>25 - 31.25</td>
<td>-</td>
</tr>
<tr>
<td>Madabera chemical fertilizer</td>
<td>Ministry of Agriculture</td>
<td>12.5</td>
<td>4</td>
<td>320</td>
</tr>
</tbody>
</table>


All farmers in both study areas preferred to use livestock dung. They said that using animal dung was beneficial as it did not require excess rain, which works perfectly considering the erratic rainfall in Eritrea. Farmers also stated that because they owned fewer livestock, animal dung was scare. As such, they had to purchase fertilizer from the

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\(^{31}\) Animal manure is collected and piled just outside the compound for months until it is taken to the fields.

\(^{32}\) Dung is also used as a cooking fuel, particularly from cattle.
market. Chemical fertilizer, however, requires lots of water and it is not suitable for rain-fed agriculture.

Farmers were then asked why they chose to use municipal wastes and madabera chemical fertilizer knowing that it takes a lot of water and that they did not have enough rain. They said that they did this as a last option. Municipal waste fertilizer was better than seeding without any fertilizer, which at least provides fodder for livestock if not food for human consumption.

### 4.3.4 Tractors

Farmers were asked if they had access to tractors and also if they had found them to be useful. In Sosona the use of plowing with tractors is popular because their land only needs to be plowed once. In Berik farmers do prefer tractors for the first plowing but for the second and third plowing they prefer to use oxen. Comparing land productivity that has been plowed with a tractor or oxen shows that the resulting output is not the same. In fact, plowing with oxen results in higher yields.

Using tractors is well accepted by the farmers in both study areas. However, there are a number of issues that they have experienced. For example, some farmland is not suitable for tractors because of hills and stones. Tractors services also are often not delivered on time for plowing and affordability remains an issue.

In Sosona, out of 6 villages only the 1 village, Abore, had farmland not suitable for tractors. In Berik the use of tractors is also not widely practiced because the farmland is comprised of hills and valleys as discussed in Chapter Two. Out of the 6 study villages in Berik only 2 villages, Tse’ada-christian and Tse’azega, had suitable farmland for
tractors. Adi-Yakob village, however, uses tractors from time to time, citing some bad experiences. An elderly male farmer expressed his frustration by recalling that:

*It was about 5 years ago [2007]. We went through all the trouble to arranged and collected money from farmers for tractors service. Finally the tractor arrived and we were glad to see them. Unfortunately the tractor man looked at our farmland and said that this farmland is too dry and too hard to be plowed by tractor and left. We were disappointed. What can we do this is the only land we have* (Elderly male farmer, Adi-Yakob village).

The Ministry of Agriculture is responsible for contracting tractors and the process is long. Farmers must first organize themselves into a group of 10 to 25 and have land worth a total of 8 hours of work for tractors. A few farmers are in charge of doing the paperwork for an application and payment. They wait until a tractor is assigned to them. In a majority of the cases, however, tractors do not arrive on time to plow the land. Both female and male farmers in both study areas complained about these delays because they delay planting. Participants in Tse’ada-christian said “*We had plowing our farmland with tractors for over 18 years now [2011] But because there were few tractors available, they do not come on time, people who do not have choice wait while others ploughed their land using oxen*” (Female farmer, Tse’ada-christian village).

Regarding the issue of affordability for tractors, farmers said that they find ways to pay. An elderly woman in Tse’ada-christian village said that “*In order to pay for tractors service we borrowed money or sold our gold jewelery. As ploughing our land is very important, it determined our yield.*” Participants argued that the government -subsidized price for tractors was reasonable compared to those private tractors (Table 10). Both the government and private tractors services are under the Ministry of Agriculture, therefore the process and waiting period are similar.
<table>
<thead>
<tr>
<th>Sub-regions</th>
<th>Year</th>
<th>Hectare/hour</th>
<th>Government subsidises Ministry of Agriculture</th>
<th>Private price under Ministry of Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nakfa</td>
<td>USD</td>
</tr>
<tr>
<td>Sosona</td>
<td>2007</td>
<td>2 to 2 ½ hours for 2 hectares</td>
<td>150</td>
<td>3.75</td>
</tr>
<tr>
<td>Sosona</td>
<td>2010</td>
<td>2 to 2 ½ hours for 2 hectares</td>
<td>250 -300</td>
<td>6.25 -7.50</td>
</tr>
<tr>
<td>Berik</td>
<td>2010</td>
<td>1 hour for 1 hectare</td>
<td>240</td>
<td>6.00</td>
</tr>
</tbody>
</table>


Government subsidized tractor services are not easy to access as their priority is the state farms in Gash Barka. Therefore, the majority of farmers in Sosona use private services. In Gulishish village, Sosona farmers pointed out that the price has increased enormously as Table 10 shows. In 2007, it was 150 Nakfa but in 2010 it doubled. They think that this must have been due to a shortage of oil and gas witnessed in the country.

**4.4 Crop production**

Crop production is determined by climate, rainfall and agriculture inputs such as labour, both human and draught power and fertilizer. Access to land and livestock ownership are also essential for crop production.

**4.4.1 Cropping calendars**

Cropping calendars are important for timely farming activities, although exact times for plowing and planting are determined by the onset of the rainy seasons (Table 11). The major activities are land preparation, planting, weeding, cultivation, harvesting and threshing.
Table 11: Cropping calendar for major crops in both study areas

<table>
<thead>
<tr>
<th>Crop</th>
<th>Season</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Season</td>
<td>Dry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Azmena short rainy</td>
<td></td>
<td></td>
<td>Kremti main rainy</td>
<td></td>
<td></td>
<td>Dry</td>
</tr>
<tr>
<td>Sorghum</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>P</td>
<td>L/P</td>
<td>P</td>
<td>C</td>
<td>W</td>
<td>H</td>
<td>T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>P</td>
<td>L/P</td>
<td>P</td>
<td>W</td>
<td>L</td>
<td>H</td>
<td>T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L/P</td>
<td>P</td>
<td>W</td>
<td>L</td>
<td>H</td>
<td>T</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>P</td>
<td>L/P</td>
<td>P</td>
<td>C/H</td>
<td>W</td>
<td>H</td>
<td>T</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taff</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>P</td>
<td>P</td>
<td>W</td>
<td>W</td>
<td>H</td>
<td>H</td>
<td>T</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finger millet</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>P</td>
<td>P</td>
<td>C</td>
<td>W</td>
<td>H</td>
<td>T</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearl millet</td>
<td>L</td>
<td>L/P</td>
<td>L/P</td>
<td>C</td>
<td>W</td>
<td>H</td>
<td>T</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sesame</td>
<td>L</td>
<td>L/P</td>
<td>L/P</td>
<td>W</td>
<td>W/H</td>
<td>H/T</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chickpea</td>
<td>T</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L/P</td>
<td>P</td>
<td>H</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faba bean</td>
<td>L</td>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L/P</td>
<td>P/W</td>
<td>H</td>
<td>T</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Adapted from (Haile, G., Haile, A., & Asghedom, 2010).
L= Land preparation, P= Planting, C= Cultivation, W= Weeding, H= Harvesting, T= Threshing

Extended land preparation can be done during the dry seasons and continue up to the *azmena* short rainy season until the onset of rain. Plowing is only done shortly after the onset of rain. Therefore, timely plowing is very important. As farmers stated the *azmena* short rainy season hardly exists any more. Plowing is carried out during June or July depending on the onset of rain. Shortly after plowing it is time for seed planting.

Farmers in both study areas reported that they preferred to use their own seeds from previous harvests. In fact, they argued that it was not a good idea to purchase market seeds. They preferred to store enough for seeds from the year before. At the same time, not all farmers successfully save seeds from the previous year, tending to consume them all. They then borrowed seeds from neighbours or family members. The Ministry of Agriculture in both study areas also loaned seeds to farmers prior to planting season which had to be repaid at harvest.
Sowing, weeding, harvesting and threshing have to be done quickly. Weeding usually happens during August. Harvesting is done during October/November depending on the variety of crops. Threshing is done by oxen and is carried out during November/December followed by grain storage in December/January. Variations in the dates for planting and harvesting occur, depending on the timing of the rains and crop variety.

Generally farmers in Berik and Sosona chose to grow more than one crop. This was dictated by factors such as altitude, soil type and the onset of rains. Crop failures due to shortages of rain are very common. Farmers have also developed cropping mechanisms to deal with crop failures. At the beginning of a cropping season, a late maturing crop is planted such as finger millet. If this crop fails due to over flooding or a shortage of rain or pest infection, it is replaced by an early maturing crop such as maize or sorghum.

Farmers in both study areas explained that they planted maize in May. If rain came early enough, they preferred to cultivate one plot with maize. This is because maize could be ready for at the end of August when households often had serious shortages of food. Land used for finger millet could also be used for maize or sorghum if the rain started late. It could also be used for barley or wheat if the rain started even later.

Data collected from elderly men and women farmers also revealed that cropping calendars had changed over time. In fact, the cropping season is narrowing with the delays in the onset of rain and ending a month earlier in August instead of September (see Table 12 below).
Table 12: Past and current cropping calendars

<table>
<thead>
<tr>
<th>In the Past</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 9th to 15th used to be the beginning of planting season</td>
<td>End of June or the beginning of July For example, in 2011 the onset of rain was June 29th in Sosona. Planting took place first week of July. In Berik, for 2011, the onsets of rain vary from village to village. In Adi-Bidel village they were still waiting for the onset of rain by July 19th.</td>
</tr>
<tr>
<td>June till September there was plenty of rain.</td>
<td>Now often times heavy rain in July and August, by the end of August rain stops.</td>
</tr>
<tr>
<td>Even with low rainfall, they had average yield.</td>
<td>After planting rain stops without having sufficient rain for the crops to mature, this leads to crop failure.</td>
</tr>
</tbody>
</table>

Source: Interviews with elderly male and female farmers (2011).

Sosona farmers were also asked about what they thought of the 2011 climate for the cropping calendar to that date. They said that they had a late start. They were hoping to receive the first rain by the beginning of June, but the onset of rain did not arrive until June 29. The amount of rainfall that day was good and promising. They were grateful and hopeful that it would continue this way. If so, they thought that they might have a good harvest, regardless of the late planting. They said that it now depended on the rest of the rainy season.

In the six study villages of Berik the first rain arrived at different times. Some of the villages such as Adi-Yakob, Tse’ada-christian, and Ametsi received their first rain in the first week of July. However, Adi-Bidel, Da’ero and Tse’azega villages were still waiting for the onset of rain by July 19. In Adi-Bidel village, Berik both men and women farmers expressed their frustration at the delay of rain:

*It has rained in nearby villages like Adi-Yakabe; it seems that it is only in this village that it is delayed so far. We’re waiting patiently for God to send rain our way, it can happen, there is hope. If other villages had rain, then it will come. It is a good thing that those other villages had rain, this gives us hope.*
Farmers strongly believed that rain comes from God. As such, when they experience delays in the onset of rain, they organize prayer groups. As observed in July 19th a religious ritual was done by women alone in Adi-Bidel village, Berik. They gathered for prayer at the village church (St. Michael). They walked a long distance as a pledge to God asking for rain and a harvest. They concluded their walk by gathering at the church to pray. After prayer they had a traditional coffee ceremony together as a community.

Since other villages nearby had already received the onset of rain for the year, Adi-Bidel village and Da’ero village prepared their land and planted in sorghum, maize and finger millet without receiving any rain. The crop for this year’s maize that was planted in May or early June is failing but is supposed to be harvested in August so far, the rain is not promising. *Taff* is a total failure this year as it needs intensive plowing 3 or 4 times. It is easily destroyed by weeds; however, it is resistant to most pests and diseases. If it rains from now on, however, they believe that they can harvest the sorghum.

### 4.4.2 Crop yield: Food availability

Male and female focus groups in both study areas were asked to discuss their grain availability in good, bad and average years. Food availability is an important indicator to find out the number of feeding months that their own production covered for their families. Table 13 presents a food availability seasonal calendar, dividing food availability for good, bad and average seasons.
Table 13: Food availability seasonal calendar during good, bad and average harvest

<table>
<thead>
<tr>
<th>Season</th>
<th>Dry</th>
<th>Azmena short rainy</th>
<th>Kremti main rainy</th>
<th>Dry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>Jan</td>
<td>Feb</td>
<td>Mar</td>
<td>Apr</td>
</tr>
<tr>
<td>Good</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bad</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


As indicated above, in good years, maize was available in September when other crops were not yet ready for consumption. Staple grains like sorghum and pearl millet were widely available in good years for 4 months from October until January. In good years, too, moderate availability of food occurred for 3 months from February until April. Even in good years, however, a hunger season lasted for 4 months starting in May until September. In bad years, however, production was at its lowest and food availability only lasted for the 2 months of October and November. From as early as December to March for 4 months, food was only moderately available.

Food scarcity lasted for 6 months with a hunger season as early as April until September. In bad years purchasing grains from the market was also at its highest. More specifically, food availability was only for 5 months from October to February. Food was moderately available for 4 months during September, March, April and May. Food was scarce for 3 months from June to August. It is important to note that both male and female farmers in Berik and Sosona have never been self-reliant. Furthermore, the gap between food production and food requirements has been getting wider. Currently food production covers only about 5 months of food requirements. Seven months of food shortage is a long stretch for farmers with low adaptive capacity.
4.4.3 Factors that contribute to low yields

Participants identified the main constraints of crop production. Table 14 shows the list of factors that contributed to low yields.

**Table 14: Farmers identified factors that contributed to low yields**

<table>
<thead>
<tr>
<th>Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increases in temperature and strong wind</td>
</tr>
<tr>
<td>Scarcity of rain</td>
</tr>
<tr>
<td>Recurrent drought</td>
</tr>
<tr>
<td>Weeds, pests and diseases</td>
</tr>
<tr>
<td>Shortage of labour*</td>
</tr>
<tr>
<td>Heavy rainfall (For example, 2010 farming season) low yield</td>
</tr>
<tr>
<td>Deforestation, soil erosion</td>
</tr>
<tr>
<td>Draught power oxen and camels</td>
</tr>
<tr>
<td>Increased in female-headed households</td>
</tr>
<tr>
<td>Lack of fertilizer animal dung and decreasing soil fertility</td>
</tr>
<tr>
<td>Seed shortage and poor quality</td>
</tr>
<tr>
<td>Lack of maintenance of soil and water conservation practice (fallow, crop rotation)</td>
</tr>
</tbody>
</table>


As shown above in Table 14, the majority of farmers argued that stressors in terms of temperature and rainfall scarcity were the main reasons. Sometimes, however, as in 2010, a heavy rainfall also resulted in low yields. Increases in temperature and strong winds also produced low yields. Other causes included shortages of draught power and a lack of animal dung because of livestock shortages.

Shortages of male labour for plowing were a major concern in Berik, due to the indefinite period of national service. Consequently land cultivated by female-headed households has increased in Berik. This has contributed to low yields because it lacks labour and plowing and agriculture inputs such as fertilizer. A lack of maintenance of soil and water conservation practices like fallowing and crop rotation are also very

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33 A shortage of labour was reported by Berik participants who stated that the absence of male labour since 1994 due to national service was significant.
limited. Fallow periods have also been shortened as more land is brought under cultivation, resulting in decreased soil fertility and increased soil erosion.

4.5 Who is most vulnerable to food shortages and why?

In both study areas, male and female farmers were asked to discuss and identify which social groups were most vulnerable to food shortages and why. Table 13 illustrates a food availability calendar for good, bad and average harvest years in terms of the number of feeding months that are covered by farmers’ own production. Table 15 displays the vulnerability of social groups. Results were recorded as a ranking from most to least vulnerable. The most vulnerable households were those who lacked the assets and resources to diversify their livelihoods in terms of both farm labour and coping with food shortages. This would include the number of livestock owned; farm labour shortages and lack of income generating activities. The least vulnerable were those who had assets and could manage the situation by diversifying these assets and resources.

Table 15: Farmers identified vulnerable social groups by food availability

<table>
<thead>
<tr>
<th>Social groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disabled men and women farmers</td>
</tr>
<tr>
<td>Elderly with adult children in national service</td>
</tr>
<tr>
<td>Female-headed households</td>
</tr>
<tr>
<td>Wives of husbands in national service</td>
</tr>
<tr>
<td>Vulnerability by family size</td>
</tr>
</tbody>
</table>


4.5.1 Disabled men and women farmers

Disabled people were most vulnerable as farming requires physical labour. They also lack the assets and resources to purchase grains as there is no government support for the large numbers of the elderly disabled who depend entirely on their communities for their survival.
Adi-Bidel village a disabled woman (blind) said that “... it would be useful if people in the community were to help with plowing. Unfortunately, I have not received any help from the community or the government.”

4.5.2 Elderly with adult children in indefinite national service

Elderly men and women with adult children in national service are the most vulnerable in Berik. The elderly need all the help they can get from their adult children. Sons are needed to help with plowing and farm maintenance. Daughters are needed to look after their health and do difficult domestic chores. In reality, the majority of the elderly offer their land for sharecropping. As such, the elderly only have food for a few months out of the year. In Sosona labour shortages were not a concern as they had low rates of indefinite national service at 5% compared to Berik at 71%.

4.5.3 Female-headed households

Single women without children only receive half a hectare in Berik and one hectare in Sosona. Women with children receive one hectare regardless of the number of children in Berik and in Sosona two hectares. In Berik female-headed households cannot take advantage of early planting and late maturing crops because they cannot plow their land on time, leaving them more at risk of low yields. They are dependent on male labour and sharecropping is the only choice they have, sharing a small percentage of their yields. When the women provided seeds and fertilizer they got 50% of the harvest. Otherwise, they only got 25%.

In Amesti village, Berik, women said that the Ministry of Agriculture did subsidize a limited amount of fertilizer to all farmers, but most often female-headed farms missed out on this opportunity, because they lacked money. By the time they
borrowed the needed money from relatives it was too late. This lack of money further decreased their harvest yields. The duration of food availability for female-headed households is estimated to be below the average, meaning less than 5 months of food.

4.5.4 Wives of husbands in indefinite national service

A married woman with a husband doing indefinite national service commented, “I am looking after our five kids with no husband to plow our land ... as my husband only comes home during his holidays one month in a year from his station in Assab” (from Tse’ada-Christian village, Berik). Although his monthly wage of 500 Nakfa (12.50 USD) is helpful, it is barely enough. It buys only a few items (Table 16). Wives responsible for feeding their children disproportionately suffer most in times of food shortages, as they watch their children go hungry. Wives with husbands doing national service, therefore, often use sharecropping to farm their land. In this way they receive either 50% or 25% of the harvest.

4.5.5 Vulnerability by family size

In general the Highlands are densely populated and land size is very small. Regardless of family size, however, only one hectare of land is available per household. In Sosona two hectares of land are given per household regardless of family size. The participants in this study, however, can have up to 10 children, and they must go to school all day. The household, therefore, has more mouths to feed but fewer workers and consequently, there is less food availability.

4.6 Coping strategies

The coping mechanisms used by both male and female farmers are essential for their survival. In Berik and Sosona these can be grouped into two types: (1) coping at an
asset level includes informally asking for help from family members or neighbours or (2) asking for formal assistance from the government and/or an International Non-Profit Organization (INGOs).

4.6.1 Management of assets and resources by farm women

There is a strong tradition of sharing and a culture of solidarity within rural communities. In fact, support networks of neighbours are as important as the support of families or, in some instances, even greater. The role of women is very important, therefore, to maintain strong kinship and community ties.

Both male and female farmers reported the importance of household resource management. Male focus groups further revealed the importance of farm wives. Farm wives are responsible for making sure to manage well whatever resources a husband brings home, whether gains, livestock or money. Men expect women to be good managers, to make a few resources last for as long as possible. This places greater stress on women farmers, especially during droughts. Women farmers said that the hardest thing for them was seeing their children go hungry during these droughts or yearly periods of food shortages.

Given the above, clearly saving is very important. During good harvests, therefore, farmers store grains, purchase livestock, and save money or other assets for times of hardship. Depending on circumstances, some households have a lot of assets while others have only a few or even none. It goes without saying that those with assets cope more easily than those without. Money is saved among Tigrinya women in Berik
by what are locally known as Aekoub\textsuperscript{34} groups. Throughout developing countries these are also known as “merry-go-rounds” or rotating savings groups (Spring, 2002). This money is invested in production equipment or for any other purpose by established agreement within a group. Participants who are engaged in this type of saving reported that they used the money to purchase grains during droughts and periods of food scarcity. Participants also stated that poor women could not save money in this way because they had no extra money to put aside.

\textbf{4.6.2 Income generating opportunities}

\textit{Selling livestock and day labour construction}

Selling livestock is an important source of cash primarily for male farmers. Selling poultry, chickens and eggs is usually done by women. Selling firewood and charcoal is limited as a permit is needed to cut down live trees. As such, available firewood is mostly used for home consumption. In any case, job opportunities are very limited in both study areas. A few farmers engage in day labour farming activities such as harvesting and weeding etc. Male participants in Berik also explained that they often do seasonal construction work building houses. Since 2005, however, the government has shut down all construction work in the country. Some houses were not even completed when this occurred. Female focus groups in Tse’ada-christian villages, Berik, also stated that 1 out of 28 women are engaged in traditional hair-styling as source of business income.

\textsuperscript{34} Aekoub saving groups are usually composed of eight to twelve members who meet regularly as decided by the group. Each member contributes a fixed amount of money and collection is given to one of the members according to an order established at the outset (Spring, 2002).
Gardening vegetables

Sosona farmers do not grow vegetables but 4 out of 5 Berik villages do. Adi-Bidel village does not. The four villages in Berik that do grow vegetables have small plots for home consumption. In Ametis village farmers grow vegetables for both home consumption and for sale. Ametis village female farmers, however, do not have permits to sell during regular market hours. As such, they sell their vegetables on a weekly basis, every Saturday from 5 am to 7 am on the sidewalks of the market streets in the Asmara, capital city of Eritrea.

Traditional gold mining

Farmers in Sosona often engage in traditional gold mining as a source of cash during drought periods. Both male and female farmers, however, argued that they were farmers and not interested in this work. During droughts, the government is flexible about this but not during non-drought periods. Farmers explained that traditional gold mining processes are dangerous work. As such, women found it difficult. Men usually did the digging and women did the washing. The gold was then sold to private gold shops rather than government gold shops because prices were higher. For example, when a private sale of 1 gram (0.001 kilogram) fetches 1,200 Nakfa (30 USD), it would only fetch 600 Nakfa (15 USD) in a government shop, being divided between the farmer and the government. As such, the take-home for the farmer would be only 300 Nakfa (7.50 USD). Some women own tea shops that sell food and drinks to workers.

4.6.3 Government subsidies shops

There are government subsidized shops only in the Central Highland region. The rest of the five regions in the country do not have them including Sosona, Gash Barka.
Table 16 shows the list of food items and the limited supplies available for a family of five for two months.

**Table 16: Government shops subsidized food items per 2 months for a family of 5**

<table>
<thead>
<tr>
<th>List of essential food items</th>
<th>Limited supply in Kilograms</th>
<th>Government Subsidies Ministry of Agriculture</th>
<th>Market</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Nakfa</td>
<td>USD</td>
</tr>
<tr>
<td>Grain (Sorghum)</td>
<td>25</td>
<td>250</td>
<td>6.25</td>
</tr>
<tr>
<td>Sugar</td>
<td>1</td>
<td>15</td>
<td>0.375</td>
</tr>
<tr>
<td>Coffee</td>
<td>1</td>
<td>250</td>
<td>6.25</td>
</tr>
<tr>
<td>Tea bags</td>
<td>1 bag</td>
<td>30</td>
<td>0.75</td>
</tr>
<tr>
<td>Cooking oil</td>
<td>5</td>
<td>225</td>
<td>5.50</td>
</tr>
<tr>
<td>Macaroni (poor quality)</td>
<td>3</td>
<td>150</td>
<td>3.75</td>
</tr>
<tr>
<td>Salsa</td>
<td>1</td>
<td>60</td>
<td>1.50</td>
</tr>
</tbody>
</table>

Source: Government subsidy coupons list of items (As of 2011).

Both men and women farmers in Berik argued that the government subsidies shop was useful as the prices were low compared to the market which was double the price (see Table 16). However, the supply estimated by the government was insufficient, being 25 kilograms of sorghum for a family of five for two months. This is not enough to last for two weeks let alone two months. As such, farmers explained that they needed to purchase food from the market for the remaining time to meet their food needs. A majority of farmers, however, could not afford the market prices and felt that the government supply should be increased.

**Credit loans**

The National Union of Eritrea Women (NUEW) and Ministry of Agriculture (MoA) also have a credit loan program at 12% interest to help farmers engage in income-generating projects.

**National Union of Eritrean Women (NUEW)**

NUEW credit loans are designed for women, providing 3000 Nakfa (75 USD) for income-generating projects. The following are success stories that were shared by
women in Sosona and Berik who received loans which they had to repay with interest. In Ashosil village one woman used the money to open her own small grocery shop next to her hut house. Another purchased a donkey to take water to the traditional gold mining area where she owned a tea shop. A third opened a small shop where she sold tea, a popular local beer called *siwa* and other types of soft drinks. In Tedagul village, five of the focus group participants used the money to purchase livestock. Another woman used the money for tractor service to plow her land in 2010. She repaid the money by working in the traditional gold mines.

In Amesti and Adi-Yakob village, Berik, with the collaboration of the NUEW land was given to vulnerable female farmers in the category of female-headed households with children and a martyred husband. Females with children and husbands doing national service were given government land suitable for gardening. They were also given one pumping motor, but limited supplies of oil and gas increased prices to 200 Nakfa (5 USD). This program ended after one year but during this time those households did benefit from gardening potatoes and tomatoes. NUEW also provided support to a widow whose husband was a martyr. She received a sewing machine worth 2,500 Nakfa (52.50 USD). She used it to generate income by sewing clothes.

*Ministry of Agriculture (MoA)*

The Ministry of Agriculture provided credit loans to farmers, the majority being male. Most said that they disliked these loans because they had no way of actually making a profit having to repay them with interest. For example, many farmers wanted a loan to purchase livestock. However, owning livestock is risky because of droughts but the loans still have to be repaid with interest. As a result, farmers do not regard these
loans as advantageous. In Berik, for example, members of a male focus group had used these loans. Three of them repaid them with interest. One started a business trading livestock. Another purchased and sold oxen at a profit. The third purchased grains to feed his family during a drought and borrowed money from his relatives to repay the loan.

In 2003, the Ministry of Agriculture provided loans of 5,000 Nakfa (125 USD) to purchase small pumping motors to encourage male farmers to get involved in vegetable gardening for home consumption and for sale. The price for pumping motors was reasonable in 2003 and many farmers did use this opportunity to increase their gardening capacity. However, since 2003 the price of pumping motors has increased to 8000 Nakfa (200 USD), then 10,000 Nakfa (250 USD), then to 15,000 Nakfa (375 USD) and now [2011] 25,000 Nakfa (625 USD). The current price is untouchable and gardening has decreased since 2003.

In Berik male farmers agreed that farming tools such as forks, plough tips, plough beams, and yokes were available at a lower price from the local office of the Ministry of Agriculture; however, the quality of tools was poor. The market is a better place to purchase farming tools of better quality but they are more expensive. In Sosona they used to receive farming tools until 2008, but not now. In both study areas seeds are loaned to farmers prior to planting season and have to be returned by the following harvest.

4.6.4 Partnerships between international donors and local organizations

Partnerships between international donors, government ministries and local organizations are the way projects are managed in Eritrea. In both study areas male and
female focus group participants were asked to discuss the assistance that was provided for them. In Amesti village, Berik, for example, they talked with excitement about soon getting clean drinking water. An international non-profit organization had donated all the equipment for a pipe water system. They dug 30 meters deep for water storage. The government handled the rest of the installation. In Berik participants recalled the African Centre for the Constructive Resolution of Disputes (ACCORD)\(^{35}\) which provided oxen to vulnerable female-headed households. *The government and its donors do support vulnerable women, whose husbands were martyrs. These women were given oxen. Where she was able to loan her oxen to a man to plow her land, she received 100% of her yield productivity* (Female farmer in Berik).

Farmers in Sosona were also asked to discuss any support that they had received in the past. The water system for human drinking water hand-pumps and for livestock ponds were projects conducted by Toker Integrated Community Development (TICD)\(^{36}\) and it is funding partner the Aid Organization of the Evangelical Churches of Switzerland (HEKS), being implemented by the *Kona Dirga* project staff. The Ministry of Agriculture, Gash Barka branch, officially headed the project. In the Ugana village, Sosona, a hand-pump for drinking water was installed by TICD and HEKS and was located near the market where the six surrounding villages of Sosona do their Market Day, which was on Wednesdays only. The entire market used this water then and it was also a source of drinking water for three villages, Ugana Ashoisl, and Tedagul. They

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\(^{35}\) ACCORD is a South African civil society organisation.

\(^{36}\) Toker Integrated Community Development (TICD). Since 2006 TICD has registered as a local NGO after Vision Eritrea. Only these two NGOs achieved registration status and in 2011 they were asked to shut down by the government of Eritrea (personally collected data at a meeting).
also built livestock ponds with rip-rap\textsuperscript{37} for Sosona villages, Tedagul, Ugana, Gulishishi and Hawmena. During data collection (July, 2011) in Gulishishi village, both men and women farmers were working in rip-rap ponds as day labourers. The same organization also provided all of the equipment for installing washrooms in their backyards. All the necessary work was done by the project beneficiaries. For example, in Tedagul village, Sosona, six of the focus group participants were the beneficiaries of this project.

A partnership among TICD, NUEW and HEKS also introduced \textit{Adhanet} energy-efficient stoves because Eritrea has a serious shortage of wood for fuel (Geisler, 2008). Improved traditional \textit{mogogo} stoves, known locally as \textit{Adhanet}, are used in order to reduce forest depletion and environmental degradation. \textit{Adhanet} energy-efficient stoves can also be locally manufactured by selected trained individuals. These trainers can then train other village members. In fact, women like \textit{Adhanet} stoves because they emit less heat and smoke than traditional \textit{mogogo} stoves, resulting in cleaner and healthier household environments.

\begin{itemize}
\item a permanent, erosion-resistant ground cover of large, loose, angular stones.
\end{itemize}

\section*{4.7 Summary}

Climate in terms of temperature and rain scarcity is the major stressor experienced by farmers in both study areas. Farmers saw the hardship of drought from 2007 through 2009. Among these years 2008 was by far the worst drought as food for humans and livestock was scarce. The problems of food shortage were exacerbated by pest infections and water scarcity. Agriculture inputs such as land, male labour, draught animals and fertilizer are essential for increased yields. However, farmers lacked these

\textsuperscript{37} Rip-rap is a method of a using permanent, erosion-resistant ground cover of large, loose, angular stones.
resources. Food shortages were experienced by all farmers in both study areas. However, there was an increased level of vulnerability related to vulnerable social groups. For example, disabled men and women were among the most vulnerable. Vulnerability by family size was the least vulnerable in this study.

Coping mechanisms such as saving grains and eating less were practiced by all farmers but in particular within female populations. Purchasing grains from government shops and the market was the most popular ways to increase food stores. However, farmers needed to find ways to collect cash from off-farm income generating activities such as livestock sales and petty trades.
CHAPTER FIVE: CONCLUSION

Chapter Five contains a summary of key findings, recommendations of participants and a discussion of their possible implications. There is a special focus on the changes that would be required to make the recommendations work equally for all farmers, especially the more vulnerable female-headed households. Qualitative research was conducted with male and female farmers in Berik, Central Highlands and Barentu/Sosona, Gash Barka in Eritrea. The findings of this research were discussed in Chapter Four. This chapter, however, focused on a dozen key findings put forward by participants. These are addressed in the recommendations and implications section.

5.1 Climate change, social justice and gender

As discussed in Chapter One, this study contextualizes climate change within the discourse on global environmental change and the relationship between humans and the environment. As humans change the environment, the environment also changes humans. For example, climate change has become one of our most pressing environmental concerns and the entire world is facing its effects. Therefore, the combined social contribution to the negative impact of climate change has itself become a threat to the environment. This is based on the integral relationship between the environment and society. Social justice further elaborates on the complexity exploring how developing and developed countries face the hardships associated with extreme climate change. This is particularly apparent in the developing world, where access to resources and adaptive strategies are limited; therefore, they will suffer greatly.

Eritrea is among the least developed countries in the world and is located in the semi-arid climate of sub-Saharan Africa. Subsistence farmers are affected by low rainfall
variability with recurrent and increasingly longer drought periods. The country endures political unrest and unfavorable economic and military government policies that damage the strength of the people and the country as a whole. Furthermore, the impact of climate change worsens the already poor conditions of food sovereignty and rural livelihoods.

In a country where 95% of agriculture is rain-fed, the narrowing of the rainy season from 4 months to only 2 months is caused by climate change. Food and water are basic needs. Everyone needs them to survive. The quality and quantity of food nutrition is also vital for all households, particularly in women-headed households. However, farmers in Eritrea are struggling just to feed their families. According to farmers in Berik and Sosona even a good year of production only covers 5 months of food, while the remaining 7 months are divided between 4 months of moderate supply and 3 months of food scarcity (see Table 13). This food shortage reality is accompanied by limited government subsidized food supplies which provide farmers in Central Highlands region with 25 kilograms of sorghum for a family of 5 for 2 months. This is an insufficient in terms of both amount and nutritional value. In addition, farmers face hardships to earn cash in order to purchase food from the government shop and market because very few economic opportunities exist for farmers to generate income.

Adaptation strategies to climate change are related to accessing natural resources; as well as economic, social, political and cultural factors. According to Adger (2006, p.6) “vulnerability to environmental change does not exist in isolation from wider political economy of resources use.” The impact of climate change on both male and female farmers is viewed through the lens of multiple stressors that consider the ecology and
social environment. This includes climate, politics, economics, poverty, gender, ethnicity, religion and the issue of entitlement to resources.

Although farm women are important food producers and providers, they have limited access to and control of resources. Land user rights, for example, in the Central Highlands is tied to the political requirement of complying with mandatory indefinite national service for both males and females. Also, married women do not have land user rights in their names. Instead, land is in the names of the male heads of households (husbands). Women only have land if they are heads of households with children.

This study indicates that, while both male and female farmers are exposed to stressors resulting from climate change in specific contexts and social conditions, the effects of stressors play out differently based on gender. Put another way, climate change is one level of vulnerability and gender is a second level. This second level of vulnerability also affects women’s capacity to adapt to climate change. As discussed in Chapter One, women faced discrimination of gender and specifically in relation to the division of labour. This resulted in women being excluded from the Ministry of Agriculture services. This is what is meant by double vulnerability.

The study findings demonstrated that gender was a crucial factor as farm women were more vulnerable than male farmers. The difference in responses from male and female participants regarding their vulnerability and adaptability further attests to the important of a gender-focus study. While both male and female farmers are vulnerable to climate change, however, farm women are more vulnerable to the impact of climate change. They must also face a society that discriminates against farm women by not recognizing them as primary farmers.
For example, Tigrinya women are forbidden to plow, while Kunama women are free from this discrimination due to its cultural acceptance. Research findings also demonstrated that female-headed households in Berik, Central Highlands, were the most vulnerable group, in comparison to female-headed households in Sosona, Gash-Barka for three reasons: (1) Tigrinya women were excluded from plowing due to cultural restrictions. Therefore, they become dependent on male relatives or use sharecropping when there were available men in the community; (2) this issue was made worse by the government policy of indefinite national service for the Central Highlands. This removed male farmers from their families, resulting in increased women-headed households carrying the burden of being bread winners, (3) unable to plow, Tigrinya women were considered to be secondary farmers, resulting in exclusion from access to the support of agricultural inputs such as fertilizer and seeds from the Ministry of Agriculture.

The issue of culture is very important in this research as findings vary due to cultural, traditional and religious norms. We all generally accept that culture is not static but dynamic. We also understand that traditional cultures take a life time to change or evolve. There are also cultural practices that may not change. In this study the concern is the role of farm women in the patriarchal society of Eritrea (with the possible exclusion of the Kunama ethnic group who practice matrilineal relations). In any case, the importance of female-headed farms makes it clear that cultural restrictions like preventing Tigrinya women from plowing need to be examined.

The above discrimination of Tigrinya women reduces their yields as sharecropping arrangements dictate that a female would receive 50% of the output of her farm if she provided seeds and fertilizer. If not, she would only receive 25%. The
majority of farm women, however, do not have access to fertilizer, as the supply provided by the Ministry of Agriculture gives priority to male farmers. Furthermore, farm women lack the cash to purchase it from the market. As a result, not allowing Tigrinya women to plow and not having access to fertilizer, results in a reduction of their yields. In this way, gender issues are preventing farm women from fully participating as equal stakeholders. Furthermore, the issue of gender inequality is made worse by government policies affecting their access to labour, seeds and fertilizer.

5.2 Summary of key findings

The summaries of key findings are divided into two sections corresponding to the developed analytical framework. The first section is a discussion about the vulnerability of participants and the second section shows the coping mechanisms used by participants.

5.2.1 Vulnerability

- Temperatures have become unpredictable with strong winds, as well as hot and cold breezes that are not suitable for crops.
- Rainfall variability is a major problem with delays in rain leading to crop failures and droughts.
- Deforestation is a primary cause of rain variability due to the mass cutting of live trees as shown in Table 5.
- Water availability is seriously constrained for both humans and livestock in both study regions (Appendices J and K).
- Food scarcity lasts for 7 months with a hunger season as early as April until September. In bad years purchasing grains from the market is also at its highest
price. Six months of food shortage is a long stretch for farmers with low adaptive capacity.

- Food shortages are experienced during good and bad harvest years. Yields are not sufficient to feed families year round. As a result, they must purchase grains from the market. While all households are vulnerable to food shortages, however, there are different levels of vulnerability identified by the respondents (Table 15).

- Cropping calendars show that the growing seasons for crops are narrowing due to the late arrival of the onset of rain (July instead of June) and ending earlier (August instead of September). See Table 11 and Table 12 for past and current cropping calendars.

- Shortages of male labour in Berik, Central Highlands, are a major problem due to indefinite national service.

- Agricultural inputs like the use of animal dung; better seeds; labour; draught power; tractor services; farming tools and pest infestations are essential for increased yields. However, the Ministry of Agriculture’s delays in services and a lack of consistent services are contributing to lower yields as shown in Table 14.

- Credit loans are an important source of cash to generate income but a lack of business opportunities and off-farm jobs prevents farmers from repaying these loans, which have an interest rate of 12%.

5.2.2 Coping mechanisms

- Management of assets and resources by farm women is very important. As such, men expect women to be good managers and to make few resources last for as
long as possible. This places greater stress on farm women, especially during droughts.

- Community solidarity is highly valued as one of the major survival coping mechanisms within Eritrean culture. Borrowing money or grains from families, friends and neighbours during food shortages or droughts is commonly practiced.

- Remittances from family members that live abroad are major contributors to individual families in Eritrea and to the country GDP in general.

- During droughts farmers in both study areas purchase grains from the market. There is also a government shop for residents of the Central Highlands region only. In order to earn cash for purchasing grains farmers sell livestock, handicrafts, firewood and charcoal and wives sell gold jewelry (only in Berik, Central Highlands). They also engage in a petty trade of tea, coffee, and a popular local beer called *siwa*.

- Off-farm work is limited in both study areas and in the country in general. In Barentu/Sosona Gash Barka, during droughts they search for gold, digging and washing it by hand. They sell whatever they can find and use the money to purchase grains from the market.

- Wives of husbands in national service received a monthly salary of 500 Nakfa (12.50 USD) at the sub-regions offices.

- Sharecropping has also been used for centuries to overcome the fact that Tigrinya women are not allowed to plow their land. But this method is becoming impossible to maintain in the 21st century because male labour is not available.
• Making the wild plant gaba into bread (found only in Sosona) and using of flour to make a local traditional bread known as kitcha (in Berik). Eating less is an important food strategy practice among participants in both study areas, in particular among women.

• Farmers have developed cropping mechanisms to deal with crop failures. At the beginning of a cropping season, a late maturing crop is planted such as finger millet. If this crop fails due to over flooding or a shortage of rain or pest infection, it is replaced by an early maturing crop such as maize or sorghum.

• Partnerships among international donors, local organizations and government ministries are involved in projects such as drinking water installment for humans (hand-pumps) and livestock (ponds). The improved traditional mogogo stove, known locally as Adhanet are energy-efficient stoves manufactured by selected trained women locally. This improved stove has health benefits and saves on wood.

5.3 Recommendations by participants and their implications

Both male and female participants in both study areas were encouraged to discuss their recommendations for the issues that were important to them. The results were as follows:

Food: Food shortages are alarming in both good and bad years (Table 13). In good years food production only provides food for 5 months. For the remaining 4 months food is available moderately and for the last 3 months food is scarce. Therefore, farmers supplement their food by purchasing grains from the market. Residents of the Central Highlands region also have access to a limited supply of government subsidy food items.
**Government shops:** Grain and other essential food items are sold at subsidy prices (Table 16). This government shop is only designated for residents of the Central Highlands region. The other five regions in Eritrea do not have access to this service. According to participants, as of 2011, the government grain subsidy supply was limited to only 25 kilograms for a family of 5 for the duration of 2 months. However, farmers argued that this amount was not enough and suggested that the government needs to make adjustments to both the amount of grain and the duration. They argued that it should be increased to 50 kilograms for a one month supply. In order for the government to make these changes they will need to re-evaluate and re-design this program. Annual monitoring and assessment is essential. For example, the World Food Programme (WFP) standard is 12 kilograms of cereals per individual per month. This would mean 60 kilograms for a family of 5 monthly. The average size of a family according to an Eritrea Demographic and Health Survey (EDHS) is 4.5 individuals per family (National Statistics and Evaluation Office [NSEO], 2003).

**Drought:** Crop failures and droughts are common in Eritrea. The three consecutive droughts between 2007-2009 are a classic example. The coping mechanisms farmers used during those years of drought are listed in Table 6. Access to a variety of grains is extremely difficult as they are not available and when they are, they are expensive. During droughts the government imports *wedi-aker* from Sudan to be sold in markets at subsidy prices. Farmers suggested that during droughts the government should provide drought relief food aid to all households according to family size. As such the government needs to find ways to earn foreign currency other than from state-owned farms so that farmers get more domestically grown products for their own food needs.
**Water:** Drinking water for both humans and livestock is a major issue for the majority of the study villages (Appendices J and K). Access to water is scarce and maintaining water systems, hand-pumps and drill-wells is also a problem. As already mentioned many villages have water systems in place but they are no longer in operation because they are broken and waiting to be fixed. In Berik village, Central Highlands, 3 out of 6 existing water systems are broken. In Adi-Yakab village, Berik, they have not had clean water since 2007 because of a broken motor. There is also a limited gasoline supply. The villagers preferred electric motors. In Sosona, Gash Barka, the water systems in 4 out of 6 villages are broken. While they are waiting (some of them for over 3 years) for the water system to be fixed they use open unprotected wells with a bucket and rope that are very dangerous. The Ministry of Land, Water and Environment (MoLWE) needs to assess the condition of each village water system and fix them. Farmers willingly make small cash contributions towards fixing their water systems. The Ministry also needs to seek funding from donors. Farmers also need to have a sense of ownership toward their water systems and need to set up committees of both men and women to look after their water systems.

**Livestock:** Mixed farming (crop production and livestock rearing) is practiced in both study areas. Livestock is used for draught animals, animal dung and cooking fuel. Farmers also preferred animal dung as organic fertilizer, because it provides better yields in erratic rainfall, as well as better long-term restoration of soil fertility and moisture. Livestock is expensive to purchase (Table 8) and to maintain; as such, shortages of feed and water are major problems. Livestock is also crucial to reduce vulnerability. This can be addressed by increased ownership of livestock and by ensuring availability of feed.
and water. The government needs to lower the price of livestock and fodder and provide consistent access to drinking water during dry seasons.

**Flood:** In both study areas floods pose a threat for livestock and for herders who are often swept away with their livestock. In Adi-Yakab Village a bridge made of wood has been destroyed by floods. Farmers suggested that they need the bridge to be built with stone and cement. The Ministry of infrastructure needs to budget for these materials and the labour to build them. The Ministry and international donors could provide the finances, expertise and materials. The farmers could do the labour, providing them with cash and giving them a sense of ownership.

**Deforestation:** Mass cutting of live trees is a major issue in both study areas (Table 5). However, in the Central Highlands community tree planting is practiced by the Ministry of Agriculture. But in Sosona, Gash Barka, participants stated that there are no preventive measures regarding the loss of trees. They suggested that community elders should manage forests with the cooperation of the Ministry. They could implement a program that is suitable for Sosona, Gash Barka.

**Wood:** Selling firewood is commonly cited as income generating (Government of Eritrea, 2004). However, in Eritrea it is illegal to sell firewood without a permit. For example, on the road from Asmara to Gash Barka there are checkpoints to search for firewood and charcoal. As observed during field research, soldiers take away charcoal from individuals. According to participants, individual farmers are prevented from buying, selling or using firewood, but in practice the military takes firewood to their families or sells it in the black market. The Ministry of Agriculture Department of
Forestry needs to investigate the corruption of higher ranking soldiers to resolve this issue.

**Gender division of labour:** These are cultural and ethnic influences. For example in Tigrinya and Kunama male and female tasks are strictly assigned to either gender (Table 7). In general, findings show that farm women experience excessive workloads in both ethnic groups. In particular, shortages of male labour in the Central Highlands exacerbate the workload. Both male and female farmers suggested that female-headed households need to be given priority to be supported by the Ministry of Agriculture and other organizations. Women’s workloads, in general, also need the serious consideration and support of services that decrease their workloads. For example, access to donkeys would help with daily activities like fetching water, firewood, grains, etc.

**Gender mainstreaming in Ministry of Agriculture:** The Ministry of Agriculture (MoA) is the primary services provider for all farmers in the country. However, female farmers are excluded from the Ministry of Agriculture and are under the jurisdiction of the Home Economics Department or are assumed to be taken care of under the National Union of Eritrean Women (NUEW) programs (Spring, 2002). Support for farmers should be gender-sensitive considering females as primary farmers when they are heads of households. A young woman farmer with two children in her 20s argued that:

> As a divorced woman returning to her home village, she had access to one hectare of land. She is grateful for the government policy that allowed a divorced woman to have access to land in her village although not in her ex-husband’s village. However, she added that land on its own is not good enough. She needed agricultural inputs such as oxen for plowing, male labour and fertilizer to grow food to feed her children.

She stressed the importance of access to services for female farmers within the Ministry. The Ministry of Agriculture needs to re-design their programs and budgets to include
female farmers as heads of households to have equal access to all Ministry services. The Ministry needs to directly place female heads of households as primary farmers under their jurisdiction equal to male farmers.

**Delays of services:** Farmers in both study areas reported delays of services for agricultural inputs by the Ministry of Agriculture as a serious problem, like tractors for timely plowing and timely treatments for pest outbreaks. Both male and female farmers argued that the Ministry of Agriculture needed to work more closely with them to address their concerns as soon as they are brought forward. The Ministry of Agriculture also needed to take into consideration the cropping calendar to deliver timely services to farmers. The Ministry also needed to supply sufficient services. Overall, they needed to re-evaluate the adequacy of all of their services and provide them effectively.

**Shortages of male labour:** Except among the Kunama ethnic group that live in Sosona, Gash Barka, shortages of male labour are experienced across the country as the major problem. This is due to indefinite national service. In fact, this policy is considered to be outrageous and misused.

**Indefinite national service:** There is no end timeline for national service in Eritrea. This exhausts its youth (both male and female) who are voting with their feet by illegally crossing the borders, putting their lives in danger. This has already claimed many lives. This loss of youth is particularly harmful for farming. Increasingly, households are being headed by women with no husbands to plow the land. Given the above, the Ministry of Defense needs to re-think its indefinite national service policy.

**Monthly wages:** The monthly 500 Nakfa (12.50 USD) that wives of husbands in national service receive monthly is very little money. This monthly payment needs to be
increased according to the actual cost of living in Eritrea. The Ministry of Defense also needs to increase national service salaries.

**State farms:** According to Eritrea’s presidential spokesperson, Yemane Gebremeskel, in relative peace time 90% of the army is engaged in state farming (IRIN, 2005). State farming does not directly contribute to food shortages. The majority of state farming is cash crop vegetables like lettuce and tomatoes that are exported to Saudi Arabia for foreign currency. Farmers suggested that husbands in national service need to look after their own farm instead of farming for the state. They need to plow their own land to feed their own children. Therefore, during land preparation, according to the cropping calendar, husbands in national service need to be given time off from the army during farming seasons. The Ministry of Defense needs to make arrangements, therefore, to send soldiers home to plow their land and return to their stations after harvest.

**Job opportunities:** Construction day labour or casual work is cited as income generating, but construction has been closed down since 2005 by the government. Other off-farm jobs hardly exist in the country. Farmers in Eritrea are not self-sufficient to feed their families during good, bad and average harvest years (Table 13). As a result, off-farm jobs are essential and are of increasing importance for household survival. Both male and female farmers suggested that the government needs to open construction work so that farmers can work during the non-farming season. It is also important to create job and business opportunities so that farmers can use credit loans to do business. The government of Eritrea could do this by shifting their priority from placing all youth in indefinite national service, while creating jobs and business opportunities to improve their livelihoods.
**Credit loans:** Credit is an essential coping mechanism. The majority of farmers do not use these services, however, for fear of an ability to repay the debt due to a lack of business opportunities and to high interest rates. This could be addressed by providing business opportunities and access to low-interest loans at a rate of 5% or lower as opposed to the current rate of 12%. The National Union of Eritrean Women (NUEW) and Ministry of Agriculture (MoA) needs to look at reducing this by using global best practice credit models.

**Gardening:** The Ministry of Agriculture had introduced loans 5,000 Nakfa (125 USD) to purchase pumping motors in 2003. This was done to encourage farmers to grow vegetables for consumption and for sale. Since then, the price of these motors has risen to 25,000 Nakfa (625 USD). This amount is untouchable by farmers. Farmers suggested that the price needs to be reduced or subsidized. The Ministry of Agriculture needs to look into ways to lower the prices of motors and also to provide low-interest loans.

**Transportation:** This is crucial for rural areas. Tse’azega village, Berik, Central Highlands, is finding it difficult to find transportation from Tse’ada-christian village to their village. There is only one unreliable private bus service. They recommended that they should have one government-designate bus from Asmara capital city to Tse’azega village. The Ministry of Transportation needs to find the budget to designate one government bus in this manner for the people of Tse’azega village.

**Health issues:** The practice of drinking coffee as a method to shut down appetite during droughts or food shortages has serious consequences for the health of adult women. As such, eating a small piece of bread with the coffee would help. The use of sugar in coffee with moderation would also be a source of energy, but sugar is seldom affordable.
Farmers suggested lower prices for sugar from 40 Nakfa (1.00 USD) to half that price. Also the government supply for sugar is at 1 kilogram per month for a family of 5 and should be increased to 3 kilograms per month (Table 16).

5.4 Personal reflections

The above recommendations and implications take into account the fact that any attempts to strengthen rural livelihoods must begin by listening to the recommendations of both male and female farmers. Their primary struggle is to put food on their tables, nothing more and nothing less. In fact, it is a lack of food that faces them throughout the year in their daily lives. The participants of this research also made it clear that they were not interested in only talking about their struggles; rather they wanted their voices to be heard and they wanted action. They wanted the government to implement their recommendations. They wanted practical solutions implemented at local levels to help increase their adaptive capacity to the changing of climate. Taken together, these men and women farmers are resilient, hard-working and willing to co-operate with the government, local non-government organizations and international donors to improve their farming so that they can adequately feed their families.

5.5 Future research

As discussed in Chapter Three, scholarly materials about Eritrea are scarce on the topic of climate change and agriculture. There are government documents developed by the Ministry of Agriculture (MoA) and the Ministry of Land, Water and Environment (MoLWE). The MoLWE documents include assessments of sectors that are vulnerable to climate change. Agriculture is one of them. But these documents are an overall assessment of the sectors (For example, mining, agriculture, fishing, water etc.) and do
not provide an in-depth study of the sectors. Although this study has initiated this inquiry, a better understanding of farmers’ adaptive capacities to climate change would be insightful, especially in relation to future climate scenarios. This would be especially true of female headed-households and should include a study of gender-related access to agriculture inputs. The current study illustrates the situation as it is now, including what farmers want to see to solve their present problems. It is my hope that this thesis will be transferred into a book as an expression of my ongoing commitment to these problems. Future research would be needed to investigate future trends and possibilities of both climate and social vulnerabilities. Analyzing the current situation of vulnerability, together with future climate scenarios, would be crucial.
REFERENCES


http://www.unhabitat.org/downloads/docs/1557_49017_ARCSC.pdf


Appendix A: Ethical clearance letter

OFFICE OF RESEARCH SERVICES
MEMORANDUM

DATE: January 11, 2011

TO: Yordanos Tesfamariam
    3940 Castle Road
    Regina, SK  S4S 6A4

FROM: Dr. Bruce Plouffe
      Chair, Research Ethics Board

Re: Climate Change and Adaptation in Eritrea: A Gender Perspective to Drought
    Vulnerability on Farm Women in the Gash Barka and Central Highlands Regions
    (File #47S1011)

Please be advised that the University of Regina Research Ethics Board has reviewed your
proposal and found it to be:

☐ 1. APPROVED AS SUBMITTED. Only applicants with this designation have ethical
approval to proceed with their research as described in their applications. For
research lasting more than one year (Section 1F). ETHICAL APPROVAL MUST
BE RENEWED BY SUBMITTING A BRIEF STATUS REPORT EVERY
TWELVE MONTHS. Approval will be revoked unless a satisfactory status report
is received. Any substantive changes in methodology or instrumentation must
also be approved prior to their implementation.

☐ 2. ACCEPTABLE SUBJECT TO MINOR CHANGES AND PRECAUTIONS (SEE
ATTACHED). Changes must be submitted to the REB and approved prior to
beginning research. Please submit a supplementary memo addressing the
concerns to the Chair of the REB. ** Do not submit a new application. Once
changes are deemed acceptable, ethical approval will be granted.

☐ 3. ACCEPTABLE SUBJECT TO CHANGES AND PRECAUTIONS (SEE
ATTACHED). Changes must be submitted to the REB and approved prior to
beginning research. Please submit a supplementary memo addressing the
concerns to the Chair of the REB. ** Do not submit a new application. Once
changes are deemed acceptable, ethical approval will be granted.

☐ 4. UNACCEPTABLE AS SUBMITTED. The proposal requires substantial additions
or redesign. Please contact the Chair of the REB for advice on how the project
proposal might be revised.

Dr. Bruce Plouffe

cc: Margot Hurlbert – Justice Studies

** supplementary memo should be forwarded to the Chair of the Research Ethics Board at the Office of
Research Services (Research and Innovation Centre, Room 109) or by e-mail to
research.ethics@uregina.ca

Phone: (306) 585-4775
Fax: (306) 585-4893
Appendix B: Letter of support National Union of Eritrean Women

To Whom it may concern,

The National Union of Eritrean Women (NUEW), acknowledges its delight to learn that Yordano Tsefamariam is interested to undertake her master’s thesis field research titled "Climate change in Eritrea and adaptation: A Gender perspective to Drought Vulnerability on farm woman in the Gash Barka Region". The NUEW is pleased to welcome Yordanos in Eritrea, since the topic is pertinent to the ongoing projects NUEW is working.

NUEW’s perspective of gender equality has many facets, of which climate change is one, which affects the majority of Eritrean women whose livelihood depends in agriculture. That is why Yordanos’s research will be relevant to NUEW, to identify the major areas of climate change and its implication for the farm women. The NUEW will facilitate in arranging meetings with the concerned government bodies and women in the community. Besides NUEW documents pertinent to the research will be available to Yordanos. The NUEW will also benefit from Yordanos, by involving her in the day to day activities of NUEW. Meetings will be arranged to share the know how such as irrigation farming and water management, from her part as well as the female community members, in particularly the women in farm related activities.

I look forward to having Yordanos join the NUEW in the near future.

Sincerely,

Laul G.
NUEW President
Asmara, Eritrea

Address
AV Gurelsa 10-12
1A173 Asmara

P.O. Box 239
Asmara - Eritrea

4°F°F Fax 291-1-120628

Tel 125444 /122012

Web Site www.nuew.org
nuew@nuew.org
Appendix C: Letter of consent for focus group

Presented on University of Regina letterhead

Title: Climate Change; Drought, Water, Adaptation, and Vulnerability in the livelihood of men and women farmers: A case study of Central Highlands and Lowlands of Gash Barka regions of Eritrea

Researcher: Yordanos Tesfamariam (306-596-1025 Canada), yordanos_27@hotmail.com
Supervisor: Margot Hurlbert (306-585-4779), margot.hurlbert@uregina.ca

Objective and Benefits of Study: This focus group discussion is being conducted as part of a graduate study program. As farm men and women are the experts about their personal lived experiences, the researcher would like to gain a better understanding of their livelihoods, in particular identifying relevant adaptive strategies that either increase or decrease vulnerability to drought.

Procedures:

1) Your participation is completely voluntary; you may decline participation or withdraw at anytime without penalty. You may refuse to discussed any specific questions;

2) Refusal to participate in this focus group will not result in any negative consequences;

3) All participants of this focus group have an obligation to keep the answers and discussion of their fellow focus group participants confidential and not repeat any of the information or responses outside of this focus group;

4) Your time to participate in this focus group is voluntary and will require 2-3 hours of your time with the group of 8-10 follow focus group participates;

5) As a participant, you will be free to discuss issues pertinent to this topic and will not be in any way coerced into providing confidential or sensitive information;

6) The focus group will be audio-taped, and all identifying information will be removed from the collected materials, up on the completion of data transcribing. The master list and consent form will be stored separately from the data collected. The master list will be destroyed when data collection are complete using paper shredder;

7) Direct quotations from the interview will be used, but your name will not be used;
8) A summary of the findings will be made available to participants upon request in Tigrigna.

This research has been approved by the University of Regina Research Ethics Board. If you have any questions or concerns about your rights or treatment as a research participant, you may contact the Chair of the Research Ethics Board by calling at 1-306-585-4775 or by emailing: research.ethics@uregina.ca

Your signature below indicates that you have read and understand the description provided; I consent to participate in the research project. I have received a copy of this letter of consent for my records.

___________________                       _____________________
Name participant                                   Date

In the event the consent is obtained orally, the researcher will sign and date this form: I read and explained this letter of consent to the participant which is also audio-taped before receiving the participant’s consent, and the participant had knowledge of its contents and appeared to understand it. In addition, consent is also audio-taped.

____________________                       _____________________
Signature of researcher                          Date

* This letter will be translated into Tigrigna.
Appendix D: Letter of consent for interview

Presented on University of Regina letterhead

Title: Climate Change; Drought, Water, Adaptation, and Vulnerability in the livelihood of men and women farmers: A case study of Central Highlands and Lowlands of Gash Barka regions of Eritrea

Researcher: Yordanos Tesfamariam (306 -596-1025 Canada), yordanos_27@hotmail.com
Supervisor: Margot Hurlbert (306- 585-4779), margot.hurlbert@uregina.ca

Title: This interview is being conducted as part of a graduate study program. As farm men and women are the experts of their personal lived experiences, the researcher would like to gain a better understanding of their livelihoods, in particular, identifying relevant adaptive strategies that either increase or decrease vulnerability to drought.

Procedures:

1) Your participation is completely voluntary; you may decline participation or withdraw at anytime without penalty. You may refuse to answer any specific questions. If you do decided to withdraw from participating all information you provide will be destroyed;

2) Refusal to participate will not result in any negative consequences;

3) There are no anticipated risks involved in this study and the only perceived cost to you is the 1-2 hours' time required for each of the 8 individual to participate in this interview process, which will take place at the comfort of the participating community gathering space;

4) As a participant, you will be free to discuss issues pertinent to this topic and will not be in any way coerced into providing confidential or sensitive information;

5) The interview will be audio-taped, and all identifying information will be removed from the collected materials, up on the completion of data transcribing. The master list and consent form will be stored separately from the data collected. The master list will be destroyed when data collection is complete using paper shredder.

6) Direct quotations from the interview will be used, but your name will not be used;

7) A summary of the findings will be made available to participants upon request in Tigrigna.

This research has been approved by the University of Regina Research Ethics Board. If you have any questions or concerns about your rights or treatment as a research
participant, you may contact the Chair of the Research Ethics Board by calling at 1-306-585-4775 or by emailing: research.ethics@uregina.ca

Your signature below indicates that you have read and understand the description provided; I consent to participate in the research project. I have received a copy of this letter of consent for my records.

____________________                       _____________________
Name participant                                    Date

In the event the consent is obtained orally, the researcher will sign and date this form: I read and explained this letter of consent to the participant before receiving the participant’s consent and the participant had knowledge of its contents and appeared to understand it. In addition, consent is also audio-taped.

__________________                       _____________________
Signature of researcher                          Date

* This letter will be translated into Tigrigna.
Appendix E: Focus groups topics

Demographics

1. Marital status? Single _____ Married _____ Widow _____ Divorced ______

2. Age? 20’s ____ 30’s____ 40’s ____ 50’s____ over 60 ____

3. Dependent children (under 18 yrs of age) _______________ Adult _____________

4. Female-head household? Yes _____ No ______

5. Level of literacy? ______________

6. For how long have you been farming? ______

Gender and farming

1. Do farm women view themselves as primary or secondary farmers?

2. Do farm women have ownership of land? If so, how has ownership of land improved their condition, if any?

3. Do farm women plow their land? If not, who plows the land? What are the limitations about plowing your land? If yes, what are the benefits of plowing your land?

4. Do farm women have accesses to resources (agricultural inputs, extension training, and loans)?

5. Are farm women involved in community decision making?

Vulnerability

6. What is the impact of climate variability, specifically drought, on the livelihood of the men and women farmers in Berik and Barentu/Sosona?

7. During poor harvests, where do farmers think they should get the remainder of the unmet food shortages?
8. How does vulnerability to climate change affect gender roles and social customs in Berik and Barentu/Sosona?

Adaptation/ Coping mechanisms

9. What adaptive strategies do the farmers of Berik and Barentu/Sosona think useful for reducing their vulnerability to climate change (For example, erratic rainfall, water scarcity, drought etc?)

10. What types of national/traditional coping strategies are available for farmers, men and women, during drought?

11. What coping mechanisms are currently being used by farmers to reduce their exposure to climate change? How can these coping mechanisms be seen from a sustainability point of view?

12. What adaptations do these farmers believe they could use in the future to reduce their exposure to climate change?

Closure: Thank you very much for taking the time to participate in this research.
Appendix F: Interview topics

Demographics

1. Marital status?  Single _____ Married _____ Widow _______ Divorced ______
2. Age?  Over 60 _____
3. Dependent children (under 18 yrs of age) ____________ Adult ____________
4. Female-head household?  Yes _____ No _____
5. Level of literacy? ___________
6. For how long have you been farming? ______

Drought and coping mechanisms

1. Tell me about the climate in this area?
2. Tell me about the rainy season? How long does it last?
3. Tell me about the droughts that you have experienced over your lifetime?
5. Tell me about the water sources within your village (For example, drinking, livestock, and domestic uses)? Have they changed?

Closure: Thank you very much for taking the time to participate in this research.
Appendix G: Sample of spreadsheet of demographic questions

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<tr>
<td>Marital Status</td>
<td>Married</td>
<td>Married</td>
<td>Married</td>
<td>Married</td>
<td>Widow</td>
</tr>
<tr>
<td>Head of the House</td>
<td>Men</td>
<td>Men</td>
<td>Men</td>
<td>Women</td>
<td>Women</td>
</tr>
<tr>
<td>Spouse State in National Service</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Level of Education</td>
<td>Illiterate</td>
<td>Illiterate</td>
<td>Illiterate</td>
<td>Illiterate</td>
<td>Illiterate</td>
</tr>
<tr>
<td>Children</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Adult Children in National Service</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix H: Study villages’ populations of Berik, Central Highland

<table>
<thead>
<tr>
<th>Village names</th>
<th>Family Size (number of household)</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adi-Bidel</td>
<td>502</td>
<td>1065</td>
<td>1007</td>
<td>2,172</td>
</tr>
<tr>
<td>Tse’ada-christian</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tse’azega</td>
<td>1,209</td>
<td>2,985</td>
<td>2,727</td>
<td>8,712</td>
</tr>
<tr>
<td>Adi-Yakob</td>
<td>173</td>
<td>439</td>
<td>424</td>
<td>863</td>
</tr>
<tr>
<td>Da’ero</td>
<td>32</td>
<td>78</td>
<td>65</td>
<td>143</td>
</tr>
<tr>
<td>Ametsi</td>
<td>362</td>
<td>978</td>
<td>864</td>
<td>1,842</td>
</tr>
</tbody>
</table>

Source: Sub-region Berik, Central Highlands Administer village Tse’ada-christian office. (Year for population collected unknowing) (obtained during filed research August, 2011).

Appendix I: Study village’ populations of Barentu/Sosona, Gash Barka

<table>
<thead>
<tr>
<th>Village names</th>
<th>Family Size (number of household)</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ugana</td>
<td>220</td>
<td>425</td>
<td>535</td>
<td>960</td>
</tr>
<tr>
<td>Abaro</td>
<td>89</td>
<td>165</td>
<td>225</td>
<td>390</td>
</tr>
<tr>
<td>Gulishishi</td>
<td>77</td>
<td>165</td>
<td>185</td>
<td>350</td>
</tr>
<tr>
<td>Ashoshi</td>
<td>109</td>
<td>224</td>
<td>286</td>
<td>510</td>
</tr>
<tr>
<td>Tedagul</td>
<td>104</td>
<td>245</td>
<td>265</td>
<td>510</td>
</tr>
<tr>
<td>Hawmena</td>
<td>117</td>
<td>211</td>
<td>259</td>
<td>470</td>
</tr>
<tr>
<td>Total</td>
<td>716</td>
<td>1435</td>
<td>1755</td>
<td>3190</td>
</tr>
</tbody>
</table>

Source: Sub-region Barentu/Sosona, Gash Barka Administer village Ugana office (Year for population collected unknowing) (obtained during filed research July, 2011).
## Appendix J: Water for humans/livestock in Berik, Central Highlands

<table>
<thead>
<tr>
<th>Village names</th>
<th>Water resources for humans</th>
<th>Water resources for livestock</th>
<th>Description / problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adi-Bidel</td>
<td>There is one hand pump and 2 streams.</td>
<td>Dam built in (2007) for livestock and domestic use. There is also a smaller size pond without stone rip-rap</td>
<td>The drilled well and tap water have been broken since 2001. There is no clean drinking water in this village.</td>
</tr>
<tr>
<td>Tse’ada-Christian</td>
<td>There are 6 tap water supply points, but there is a problem at the centre of water distribution</td>
<td>There are 2 hand drilled wells</td>
<td>The village is located near the capital city of Asmara, Eritrea. Therefore they have a government water tank truck that comes to the village at 10 Nakfa (25 cents USD) per barrel. Sometimes the truck does not show up for weeks.</td>
</tr>
<tr>
<td>Tse’azega</td>
<td>There are 6 taps that supply the village from a large dam.</td>
<td>Large pond with stone rip-rap</td>
<td>The 6 taps are well maintained, fenced and locked with a key. There is a well organized schedule for fetching water.</td>
</tr>
<tr>
<td>Adi-Yakob</td>
<td>There are 3 taps and 2 hand-pumps</td>
<td>For livestock there is a pond that was built in 1994 by the government of Eritrea.</td>
<td>The motor that distributed the water has been broken for 3 years now. Additional there is an issue of the availability of gasoline. The village would like to change to an electric motor.</td>
</tr>
<tr>
<td>Da’ero</td>
<td>Tap water from the Toker dam</td>
<td>There are 2 drill-well ponds for livestock.</td>
<td>The tap water is well maintained, fenced and locked with a key.</td>
</tr>
<tr>
<td>Ametsi</td>
<td>There are 2 drill-wells</td>
<td>There is a smaller sized pond for livestock</td>
<td>The 2 hand-pumps are broken. Residents use open unprotected wells with bucket and rope that are very dangerous.</td>
</tr>
</tbody>
</table>
### Appendix K: Water for humans/livestock in Barentu/Sosona, Gash Barka

<table>
<thead>
<tr>
<th>Village names</th>
<th>Water source for Humans</th>
<th>Water source for Livestock</th>
<th>Description /Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashoshi</td>
<td>They do not have access to clean water in their village.</td>
<td>Pond (built in 2005) without rip-rap</td>
<td>Located close to the market, this hand-pump is used by two villages, Ashoshi and Tedagul. On market day in Ugana village, every Wednesday of the week, this water pump is used by all market goers. Close to this hand-pump there is a site of traditional gold mining. They use this water to wash dirt in search of gold.</td>
</tr>
<tr>
<td>Tedagul</td>
<td>They do not have clean water in their village</td>
<td>Pond with rip-rap</td>
<td>They travel long distances (5-10 km) to fetch water from the Ugana village hand-pump.</td>
</tr>
<tr>
<td>Ugana</td>
<td>Hand-pump, solar powered well, roof water harvesting for the school and the local administration office</td>
<td>Pond with rip-rap</td>
<td>Hand-pump that was broken has been fixed recently (July 2011). The solar energy powered pump was broken and now residents use an open unprotected well with bucket and rope. The school tap water is not working. The roof-water harvesting pipes for the school and the local administration office are broken.</td>
</tr>
<tr>
<td>Abaro</td>
<td>They do not have clean water. There are 2 drilled wells.</td>
<td>Traditionally dug well</td>
<td>One drill has been broken for over 3 years and each household contributed 30 to 40 Nakfa (0.75 to 1 USD) to get it fixed.</td>
</tr>
<tr>
<td>Gulishishi</td>
<td>There are 2 traditional hand dug wells, each 12 meters deep and only one of them is in use.</td>
<td>Pond with stone rip-rap</td>
<td>There is no clean drinking water supply system. The unprotected traditional hand dug wells are unsafe with one tragic accident of a child drowning which rendered one of the wells unusable.</td>
</tr>
<tr>
<td>Hawmena</td>
<td>Drilled well. They do not have clean drinking water</td>
<td>One large pond with rip-rap and other smaller size pond</td>
<td>The drilled well broke in 2011; they were waiting for it to be fixed. They have collected 50 Nakfa (1.25 USD) per household as it costs about 2000 to 3000 Nakfa (50 to 75 USD)</td>
</tr>
</tbody>
</table>