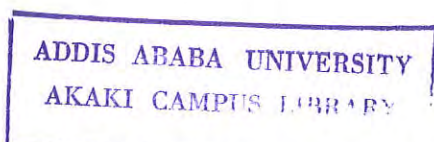


Addis Ababa University
School of Graduate Studies
College of Development Studies
Center for Environment and Development Studies

**Analysis of Gender Vulnerability to Climate Change and Variability: The Case of Bako
Tibe District**

By:
Zina Regassa



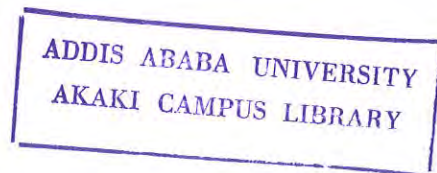
**A Thesis Presented to the School of Graduate Studies of Addis Ababa University in Partial
Fulfillment of the Requirements for the Degree of Master of Arts in Environment and
Development**

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Addis Ababa, Ethiopia
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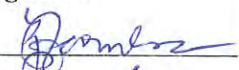
Addis Ababa University
School of Graduate Studies
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Analysis of Gender Vulnerability to Climate Change and Variability:
The Case of Bako Tibe District, Oromia region



By
Zina Regassa

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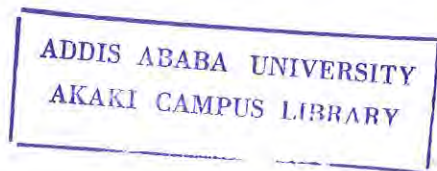
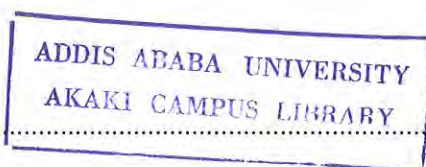


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Acronyms

ARDO.....	Agricultural and rural development office
BARC.....	Bako Agricultural Research center
CBOs.....	Community Based Organizations
CSA.....	Central Statistical Agency
FAO.....	Food and agricultural organization
HH.....	Household hold
IPCC.....	Intergovernmental Panel on Climate Change
OPPD.....	Oromia Physical and socio-economic profiles of Districts
PCA.....	Principal Component Analysis
TLU.....	Tropical Livestock Unit
UN.....	United Nation
UNDP.....	United Nation Development Program
UNFCCC.....	United Nation Framework Convention on climate Change
WEDO.....	Women Environment and Development organization
WHO.....	World Health Organization

Abstract

Recently, climate change is becoming a global phenomena , but its impact is unevenly distributed among the regions, economic class, age class and between males and females. This study analyzes the vulnerability of gender to climate change and variability in the three dominant agro ecologies of Bako Tibe district . Multi-stage stratified random sampling was designed, for which the sample kebele, that represent the respective agro ecology, was purposively selected while the sample households were randomly selected, keeping the male and female headed household representatives equal in each kebele(agro ecologies).Accordingly,138 households were surveyed in the district, for which 46 household in each representative agro ecology and finally, equal proportion of both gender were selected. FGDs ,key informant interview and observations were employed to collect primary data while secondary data was basically collected on metrological data from Bako Agricultural Research Center(BARC) for lowland agro ecology and Shambu metrological station for the other two agro ecologies. The study used integrated vulnerability assessment method through the construction of indices from the selected indicator of exposure, sensitivity and adaptive capacity. The indicators were weighted using Principal Component Analysis (PCA). The overall result of gender profile activity assessment shows unequal distribution of workloads and unfair traditional work division between males and females figuring that females discharges a higher work load and constrained with unfair work division in relative to males. This unequal distribution of work load and unfair work division darken the overall picture of females in the community and shapes the degree of vulnerability to climate change ,since it hampers the asset formation ,ownership and control of females, that further brings a lower livelihood asset possession in relative to males. The results of gender vulnerability analysis shows that females are relatively vulnerable to climate changes compared to the males in their respective agro ecology even though their vulnerability level varies across agro ecologies. The study implies that better possession of livelihood asset even under the stress full climatic condition lowers vulnerability level .The separate vulnerability analysis of male and female in different agro ecology shows that the existing exposure in a locality is often modified at household level depending upon the inherent adaptive capacity of gender to give the picture of overall vulnerability(i.e. lowland agro ecology). Using only the biophysical indicators of vulnerability (exposure and sensitivity) can thus lead to an erroneous policy implication. Furthermore, intra-agro ecology analysis of gender vulnerability indicates that poor males and females with low adaptive capacities are vulnerable, irrespective of where they are located. Policy measures and development efforts should be focused towards improving the adaptive capacity of the rural households especially females, while keeping the post-disaster emergency relief measures in place for localities with higher exposure to climate extremes. The females with lower livelihood asset should be the primary target of any interventions.

Keywords: Gender, Vulnerability, Climate change and variability, Agro ecologies

CHAPTER ONE

1. INTRODUCTION

1.1 Back Ground and Justification

It is obvious that climate change is already affecting every region of the world and to every human race. Africa is also among the continent that climate change is highly manifested in alarming rate through the expansion of desertification, increasing in temperature and the fluctuation in the precipitation (IPCC, 2007).

It is commonly perceived that climate change exerts relatively a severe consequence on developing country than developed country (Olmos, 2001; IPCC, 2007; UNDP, 2009) and Africa is one of the continent expected to suffer a higher level of vulnerability to the effects of climate change and variability. According to the fourth assessment of IPCC(2007), "Africa is one of the most vulnerable continent to climate change and variability, due to its multiple stressor and low adaptive capacity". However, its impact is not only unevenly distributed among regions, but also differently distributed in terms of economic development, age class, income group, ecosystem and gender within a given region (IPCC, 2007) .

Recently, there is a growing consensus that climate change is not gender neutral, since its impacts are not uniform. According to this view, gender inequality is reflected in terms of vulnerability to climate change. This is because , if gender dimension is not properly addressed in climate change discourse, climate change will aggravate the prevailing gender gaps so that affect poor men and women disproportionately in less developing countries (Parika, 2007; WEDO, 2007; Commission on the Status of Women, 2008; BRIDGE, 2008).

Climate change vulnerability is also viewed as determined by the level of physical risky and the capability of social response to the climate change impacts. However, the level of social response especially from gender perspective is determined by the status of gender equality, which is reflected in terms of roles, responsibility and relationship between men and women in the society. This is because understanding differentiated impacts of climate change requires knowing the level of gender inequality that in turn shapes vulnerability (World Bank et al., 2009).

In general, these differentiated roles and responsibility in the society in turn contributes to the non uniformity of vulnerability between men and women to the impacts of climate change (Easterling, 2000; Wisner et al., 2004). Further, the studies of Schalatek (2009) also details that the disproportional impacts of climate change is associated with the prevailing social norms, traditional norms and different power structures between men and women. For instance, gender inequalities in terms of roles and responsibilities contributes to unequal formation and access to livelihood resources like natural, human, financial, social and physical that in turn determine their ability to withstand with climate change related hazards. This is because Brody et al., (2008) and Scott (2008) reminds that there are a higher level of vulnerability especially to the poor's, when these resources lags behind in order to cope up with climate change impacts. Further, various studies on impacts and vulnerability to climate variability forwards that societies that are deprived from mechanism and resource in order to cope and adapt to climate variability are highly vulnerable (Nobre et al., 1992; Burton, 1997; Handmer et al., 1998).

According to this view, just like that of differentiated response of gender to climate change and variability due to the internal social structure, these biased social structure also shape external climate hazards (i.e. Natural disaster) to be gender differentiated. For instance, Niemeyer and Plumber (2009) highlights that the impacts of Natural disaster disproportionately affect men and women, since climate change will likely aggravate the existing pattern of discrimination.

Gender discrimination exists in every parts of the world though the degree of its bias varies. In Ethiopia, there is a clear gender gap, between men and women, basically in unequal access to resource, education, employment, basic health services, and even violence (NTPE, 2003). Such bias will result in the differentiated capacity, resource and information, differentiated roles and responsibilities between male and female, which are an important tool in climate change adaptation. Similarly, adaptive capacity at household level is determined by healthy, education, access to information, financial and natural resource, social networks, the absence and presence of conflicts (Brooks, 2013).

Therefore, analyzing gender vulnerability requires recognizing how various factors like physical, social including the ownership and control of livelihood assets as well as attitudinal (perception)

are interconnected. Such factors determine the degree to which climate change affects men and women as well as define their ability to adapt.

Hence, this study is aiming to link gender and their vulnerability to climate change in the agro-ecologies of Bako Tibe District, based on the gender livelihood asset including their roles and responsibility in the community, in order to bring an understanding on how to locate men and women in climate change discourse.

1.2 Problem Statement

It is obvious that climate change is happening in Ethiopia, since the last 50 years (NMA, 2006). Recent vulnerability mapping report also confirms that Ethiopia is the most vulnerable country to the effects of climate change due to its least adaptive capacity (McSweeney and Licciano, 2008).

It is also well agreed that climate change impact is disproportionally distributed among regions , age group, ecosystem, economic class, and gender(IPCC,2007;UNFCCC,2007;Kraub,2007) ,implying that climate change is not gender neutral phenomena (UN,2008). Especially, various studies forwards that poor men and women in developing country are expected to be disproportionally affected by climate change (Dankelman,2002; Parika, 2007; WEDO, 2007; Commission on the Status of Women,2008; BRIDGE, 2008).

Beside this, some climate change literature forwards that womens are relatively more vulnerable to the climate change and variability impacts than their men counter parts (Denton,2002; skutsch,2002),giving a low position in terms of role and responsibility to women's in the society. However, this generalization is challenged by the non uniformity of climate change impacts among all society, especially between men and women ,since the degree of gender inequality and livelihood strategy varies across the country. Will bank (2007) strongly supports this idea as climate vulnerability varies across space and social groups. More importantly, Bohlet et al.,(1994) also strongly argue that vulnerability is adjusted as context specific, i.e unequal access to opportunity than outcomes. This implies that vulnerability is depending on the local circumstance. In addition, the studies of Deressa et al.,(2009) on Ethiopian farming community in all regions of the country also notes the non homogeneity in socio-economic and environmental attributes of the community, which in turn contributes to differentiated vulnerability to climate change and variability.

Hence, understanding gender vulnerability requires how gender inequality and discrimination persists in terms of roles and responsibility, resource control including the ownership of livelihood assets, in addition to biophysical attributes, which in turn shapes their degree of climate change vulnerability in a specific community.

In Ethiopia, there is no strong empirical study on the gender dimension of climate change. However, there is a clear gender based discrimination between men and women especially in unequal access to resource, education, employment, training (NTPE, 2003). Such inequality affects the ability of men and women to cope up with climate change in a similar way. Rather, climate change will enlarge the prevailing inequalities, exacerbating the difference, between men and women, in their adaptive capacity and then vulnerability to climate change (WEDO, 2007).

Beside this, the traditional way of vulnerability assessment has its own drawback since it does not consider climate change from gender dimension, given such pertaining inequalities between men and women. The failure to recognize the gender dimension of climate change will lead to a low participation of the all concerned stakeholders in climate change adaptation and policy measures. This is because, while addressing the issue of climate change, disregarding both men and women, girls and boys, implies neglecting a larger part of people whose well-being is required to be improved (Brodty et al., 2008).

In Bako Tibe district, the sex ratio of women to men is 51:49 (CSA, 2010), which discloses almost equal the figure of men and women even though shares a similar gender discrimination on Ethiopian level (see NTPE, 2003). In addition, recently, the district faces different climatic shocks like drought and unusual weather events especially in the lowland and midland agro ecology (the Districts Agricultural Bureau and Rural Development Office, 2010).

Given such climatic shocks added with the prevailing gender discrimination, it is better to analyze whether men and women are differently vulnerable to the effects of climate change or not.

Hence, this study is aiming to analyze the vulnerability of gender to climate change and variability in different agro-ecologies of Bako Tibe District, so as to locate men and women properly in climate change adaptation and other related measurements.

1.3 General objective of the study

The general objective of the study is to analyses the vulnerability of gender (men and women) to climate change and variability in different agro ecologies of Bako Tibe District.

1.3.1 Specific Objectives

The study has the following specific objectives.

- To examine gender roles and activities in the district.
- To asses gender perception difference to climate change and variability in the district.
- To identify the vulnerable group in each agro ecologies of the district.

1.4 Research Questions

- Is there any difference in roles and activities between males and female?
- Do males and females perceive and experience climate change impacts differently?
- Which gender is the most vulnerable to climate variability in the respective agro ecologies of the district ?
- Which agro ecology is the most vulnerable to climate change and variability from gender dimension in the district?

1.5 Scope and Limitation of the study

The study was conducted in Bako Tibe District ,covering all the three dominant agro ecologies of the district. The scope of the study is limited to analyzing gender vulnerability based on the roles and activities of the gender, the perception of the gender and the level of gender livelihood assets in face of climate change (during the climate related shocks) .

The limitation of the study is that there is no metrological data in its respective agro ecologies of the study area especially for the midland and highland agro ecologies. Hence, the researchers has used the adjacent district's metrological reports for theses agro ecologies(since they are found in the same altitude and expected to experience a similar climatic conditions).

Further, the indicators used to construct the vulnerability index was selected based on the review of literature in the study area, with particular reference to gender vulnerability to climate change, this study is not used for another purpose apart from gender and climate change. In addition, the specific community under study is also another point to be remembered when planned to use for another purpose

1.6 Significance of the Study

The study has an advantage to the gender study in relation to climate change in general and the community under study in particular, in identifying the socio-economic and socio-cultural factors that hampers and determines the capacity of men and women while responding to climate change.

Since involving both men and women in climate change policy, programming and implementation benefit all the members of the community (Alebachew, 2011), the study has an advantage to assess the vulnerability of these social groups from gender dimension in order to disclose how to assign men and women in climate change policy and measurements.

Climate change policy measurement are based the status of that particular vulnerability. For instance, the central to adaptation is vulnerability (Ahmed and Mustafa,2007).Hence, the study has a particular relevance to the gender vulnerability study in general in informing the concerned policy maker to adjust their policy framework and measurement mechanism to see from gender perspectives.

1.7 Organization of the Study

The study has organized into five chapters. The first chapter outlines an introduction about the overall study directions while the second chapter deals with literature related to gender vulnerability and climate change emphasizing from sustainable livelihood frameworks and assets.

The third chapter details the approaches and methods used for the study. Chapter four presents the main findings as well as discussion of the study result.

Chapter five, the last chapter, summarizes the study as a conclusion and recommendation for the gender vulnerability to climate change.

CHAPTER TWO

2. REVIEW OF LITERATURE

2.1. Gender Related Concepts and definitions

The gender related concepts used in this study is highlighted as below.

Gender refers to roles, responsibilities, rights, relationships and identities of men and women that are defined or ascribed to them within a given society and context and how these roles, responsibilities and rights and identities of men and women affect and influence each other (UNDP, 2009; Alebachew and Atesede, 2011).

Gender Analysis is a systematic study of differences in the conditions, needs, participation rates, access to resources and development, control of assets, decision making powers etc. between women and men (European Commission, 2004). A gender analysis begins with the collection and analysis of sex-disaggregated data (i.e. information that is collected and presented separately on men and women). Women and men often perform different roles, which leads to different experiences, knowledge, talents and needs. Gender analysis explores these different roles and experiences so that policies, programmer and projects can identify and meet the different needs of women and men. Gender analysis also facilitates the strategic use of distinct knowledge and skills possessed by women and men.

Gender Discrimination occurs when individuals are treated differently on the basis of their sex. This affects both women and men. For example, when a woman is paid less for the same work as a man, this is gender discrimination. Generally speaking on a global level, gender discrimination leads to women being disproportionately represented among the poor, the less educated, the underpaid, the assaulted and the powerless.

Gender Roles is roles defined by society which are different for women and men. For example, in some societies men are expected to farm, while in others it is the responsibility of women. Traditional gender roles often mean that women have multiple responsibilities in the home, in the workplace and in the community while men's roles are most often focused in the workplace and community and not as much in the home(BNRCC ,2011).The roles that men and women play are influenced by the cultural and sometimes religious norms of the society, there in that

society, other people's expectations and the image the individual wants to develop for him/herself. Changes in gender roles often occur in response to changing economic, natural or political circumstances, including development efforts. In general, to how men and women should act, think and feel according to norms and traditions in a particular place and time.

Gender division of labor concerns the allocation of the tasks and responsibilities of men and women at home, at work and in society according to patterns of work that are felt to be acceptable a particular place and time (UNDP,2009; Alebachew and Atsedo, 2011)

Gender gaps refer to societal differences between men and women that are felt to be undesirable.

Gender Perspective implies has several implication according to the BNRCC (2011).It implies the difference between the needs and priorities of men and women, the views and ideas of both women and men; the implications of decisions on the situation of women relative to men are considered

Gendered access to resources, facilities, services, funds, benefits and decision making refers to the differences between men's and woman's rights and opportunities to make use of these resources and to take part in decision making, due to norms and values existing in a particular place and time(Saniye,2009).

Gender Disaggregated Data; This refers to a process of data collection and analysis that focuses on issues of particular relevance to women and men, girls and boys, and their different roles and positions within society.

2.2 Gender and climate change; The link

Climate change is 'rapidly creating new conditions for development in poor countries', primarily by inflicting increasing variability and uncertainty on the lives and livelihoods of their rural and urban populations, and by increasing the frequency and intensity of natural hazards (Cannon and Mueller-Mahn, 2010).Without adequate mitigation and adaptation to climate change its direct and indirect impacts will cause 'substantial damage to human wellbeing and prosperity' (UNDP 2008).There is an emerging consensus that 'any effective development planning process' needs to take climate change into consideration (McGray et al. 2007).

With an increasing understanding of climate change as a development issue not only requiring scientific but also social, political, economic and behavioral solutions, the need to ensure these solutions are gender-responsive should be self-evident. As a scientifically proven, global phenomenon (IPCC 2007), the impacts and perceptions of climate change vary at the local level, and they also vary between women and men, girls and boys. Including both men and women in decision-making on climate change adaptation and mitigation, and understanding the reasons for and implications of their different roles, responsibilities and capabilities is, therefore, clearly essential for poverty reduction and gender equality as well as successful climate-resilient and low-carbon development. Moreover, when addressing global poverty, not taking both women and men, and girls and boys into account would mean neglecting a large part of the people whose well-being we seek to improve (Brody et al. 2008).

Beside this, behavioral patterns of women and men, young and old, rich, and the activities carried out by women and men differ significantly, and they both impacted and perceive climate change differently and they react differently to it (Margaret, 2010). Similarly climate change responses need to be gender aware, taking into consideration the different needs of women and men, the inequalities that compound the impacts of climate change for women and the specific knowledge women and men can contribute to solutions (Georgina, 2011)

The report of IPCC (2001) also not only pointed out that the impacts of climate change will be differently distributed among different regions, generations, ages, classes, income groups, occupations and sexes, it also explains the increasing inequalities in wellbeing and in access to food, clean water and other resources that will be exacerbated by the disproportionate impact of climate change on less developed countries and people living in poverty in all countries (Julia and Appolonia, 2009).

Climate change has several implications for human security especially given its wide-ranging impacts on critical livelihood sectors and on communities with the least capacity to adapt. While women are important actors in managing natural resources and environmental change, it is also important to focus on the complex questions about how different social groups experience vulnerability to climate change. Both biophysical and social vulnerability have implications for economically poor and socially excluded women and men that shape their livelihood strategies.

Climate change is superimposed on existing vulnerabilities. However, given that access and management of environmental resources are socially constructed (Masika et al, 1997), it is fair to assert that women and men experience vulnerability to environmental change differently, and hence, environmental degradation will have differential impacts on women and men.

Economic poverty and vulnerability are not uniformly correlated – but economically poor people and socially excluded groups tend to suffer disproportionately from vulnerability. Vulnerability also varies across space and social groups (Wilbanks, 2007). The exposure, sensitivity and responses to climate perturbation and to stresses and shocks of one social group may vary quite significantly from another and differ across regions, countries and even within a given community. Given that vulnerability is a contested term, the emphasis should be on the elements that conspire to constrain the ability of one social group to act and mitigate climate related risks.

Formal or informal institutions have the ability to empower or constrain social actors in adaptation action (Gupta, 2010). Vulnerability assessment is contingent on a good understanding of institutions and roles in the distribution of resources and the enforcement of rights and regulations for the management of environmental goods (Kelly and Agder, 2000). Hence, for narrowing the current differential vulnerability between social groups, the biggest challenge is the way in which institutions are able to level the adaptation playing field. Institutions may be able to allow women equal access to frame their adaptation questions and ensure that critical flows of information, knowledge and other resources – fundamental for a climate resilient adaptation – are not excluding economically poor women based on their social status, class, caste, gender or other domains of difference.

The current debate on the intersection between gender and climate change needs to promote understanding about how multiple vulnerabilities and receptors compete to further reduce the adaptive capacity of economically poor and socially excluded women and men in ways that further alienate them from knowledge. For example, men farmers tend to share critical types of information and resources but women are often served last because they are often excluded from and have limited access to the core strategic groups that meet in such knowledge hubs. It is often these asymmetries – demonstrated through access to knowledge, farming inputs, infrastructure

and learning hubs through farmers groups – where adaptation processes and knowledge need to go through a collective process of framing, validation and monitoring.

Linking gender and climate change, therefore, implies understanding how to locate men and women within the climate change discourse. It is therefore vital that gender equality considerations, as well as men's and women's different needs, perspectives and knowledge, be taken into account when planning adaptation activities to climate change impacts.

2.3. Factors for differentiated gender vulnerability to climate change

To understand and address the differential impacts of climate change and disasters, it is, therefore, important to understand how gender inequality shapes vulnerability (World Bank 2009). Nevertheless, there are a number of issues that point to the crucial role of gender when understanding the causes of climate change, aiming to mitigate it, and working towards successful adaptation to inevitable climate change: For instance,

Women and men in their respective social roles – are differently affected by the effects of climate change. Reasons are inter alia to be found in different responsibilities for care work and income generating work, in dependency on natural resources because of lacking access to environmental services, or in knowledge and capacities to cope with the effects because of differences in the access to education and information systems. For instance, due to a gender division of labor and social norms, men and women have different roles and responsibilities, knowledge, and skill and will therefore be exposed to different risks (FAO, 2007).

Women and men differ with regard to their respective perceptions of and reactions to climate change. It is well known, especially in industrialized countries, that women have a higher risk perception than men, and thus also recognize climate change as a more serious problem than men do. Gender differences are crucial when it comes to assessing adequate measures, too. While men trust in technical solutions, women vote stronger for lifestyle changes and reduction of energy consumption.

Men and women also have different needs and priorities following a disaster. Some women have clear physical needs such as obstetric-gynecological care or feminine hygiene products. More

broadly, they also tend to prioritize different activities from their male counterparts. “Men tend to focus almost exclusively on productive activity, including agriculture and waged income. Women tend to prioritize physical and psychological health, economic opportunities, and their children's welfare.” (Delaney et al,2000).

Social roles and responsibilities of women and men lead to different degrees of dependency on the natural environment. Women are usually the ones engaged in household subsistence activities, thus degradation of forests, watersheds, foreshores and agricultural land in developing countries can have a severe effect on their ability to perform the daily household maintenance tasks. For instance, However, these differentiated roles and responsibility in the society in turn contributes to the non uniformity of vulnerability between men and women to the impacts of climate change (Easter ling, 200; Wisner et al., 2004).

In general, the main cause for differentiated gender vulnerability to climate change and variability especially in the rural parts are';

2.3.1 Gender disparities in accessing and controlling livelihood assets (resources)

There is an asymmetrical power relations between women and men is their unequal access, control and ownership of resources such as land, property, livestock, labor, and development resources including credit, agricultural inputs, technologies, trainings, and information. For instance, land is the most important asset that households depend upon for agriculture and sustaining their livelihoods (FAO, 2011). It is a material and productive resource, which is critical for farming and food production. However, land also has powerful social, cultural, economic, political, symbolic, spiritual and status-defining meanings (FAO, 2011;Verma, 2007a). Yet women's ownership, security and control over land as a critical resource represents one of the widest disparities in gender relations and equality. These trends are becoming even more serious in current contexts where land grabbing by powerful elite, corporate, multi-national and foreign interests is disenfranchising women from land ownership and control even further (Daley, 2011; Behrman, 2011).

Women also have differential control and ownership of livestock within agriculture, rangeland and household management. Livestock are important to wealth saving and security in times of crises, for dowry and brides' wealth, and act as powerful symbols of wealth and property

(Verma,2007b). Women's ownership of livestock is shaped and constrained by economic opportunities, opportunity costs of women's labour (Kristjanson et al., 2010), as well as cultural norms, gender biases and power relations. Given that gender relations reflect differential wealth and power, in some contexts, women and children own and handle smaller livestock, which are a crucial part of the food security of an estimated 678 million of the world's rural people keeping livestock (Devendra and Chantalakhana, 2002).

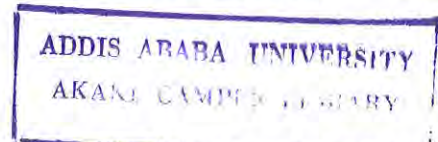
Women also have differential access to income generating opportunities, wage labor, markets, income and socio cultural and political-economic institutions. Often, women do not control the proceeds of their own labor from income generating activities or wage labor (Verma, 2001). This is especially true where income earned is paid to the "household head" or "title deed owner" of land (ibid., ibid.) or where men as the "heads" of their households have out migrated but they or other elder men in the extended family continue to control decisions.

2.3.2 Skewed gender division of labor and work loads

Women play a critical role in agricultural and livelihoods, often bearing significant responsibility for managing critical productive resources such as land, water, livestock, biodiversity, fodder, fuel, and food. They also contribute work and energy towards income generation and carry out a disproportional amount of daily labor compared to men in household and community spheres, such as cooking, cleaning, child care, care of older or sick family members, providing work for collective projects and during weddings, funerals and other cultural ceremonies (Nellemann,2011).

The unequal gender division of labor is further skewed by climate change, as distances travelled by women increase to access natural resources (such as water, fuel wood, fodder, food, pastures, medicinal plants, fuel, and crops) and as production schedules take hits under rapidly changing environments and climate conditions. In fragile mountain ecosystems, women are rendered particularly vulnerable where the slopes of agricultural fields are steep, landslides and erosion are common and accessibility to basic services such as transport, education, health care and development services is limited. In such mountain contexts, women carry out and are chiefly responsible for the arduous and dangerous task of collecting and carrying water, fuel wood and fodder for everyday sustenance.

In general, the socially constructed gender specific vulnerability of women, lower access to resource and assets combined with limited decision making power built into everyday socio-economic patterns that leads to the relatively higher female vulnerability rates compared to those of men.

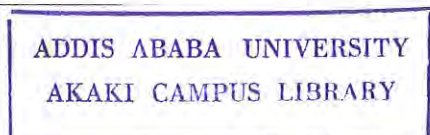


2.4 Climate change and women's vulnerability

Women in the global South are particularly vulnerable to the impacts of disasters due to skewed power relations and inequitable cultural and social norms. At the same time, women are essential for developing sustainable adaptation options due to their knowledge, multiple and simultaneous responsibilities and as well as roles in productive areas. These include all sectors from agriculture, rangelands, biodiversity and forests, to households, income-generation, livelihoods and other socio-cultural and political-economic institutions and relations. Worldwide, women are an estimated 43% of the work force in agriculture. In Asia and Africa, this proportion is higher, often above 50%, especially in mountain regions. Hence, women play a key role in adaptation efforts, environmental sustainability and food security as the climate changes

During extreme events such as drought, floods and other climate-related disasters, women face additional risks, due in large part to gender inequities that result in women bearing the disproportional brunt of disaster impacts. Moreover, women are often discouraged from learning coping strategies and lifesaving skills, such as how to climb trees or swim. Both factors put them at a disadvantage when floods hit. Often women are not permitted to evacuate their homes without consent from their husbands or elder men in their families or communities. Gendered cultural codes of dress may inhibit their mobility during crises, resulting in higher disproportionate mortality during many disasters. During such events, women and girls are frequently subjected to intimidation, gender-based violence sexual harassment and rape. Women and girls also face an even more serious risk with the onslaught of climate-induced disasters: organized trafficking.

After a natural disaster, economic and security challenges may lead women who are in charge of households and livelihoods to seek temporary relief, shelter and amenable living conditions in acutely insecure contexts, making them potential targets for exploitation and human trafficking. Disasters that lead to increased physical, social and economic insecurity, and affect women and



children, are among some of the push factors that give rise to trafficking. Therefore, insecure disaster regions must be considered as potential areas for such harmful activities.

Women experience acute and differential impacts given the accelerated pace of climate change. These impacts exacerbate existing inequities in socially constructed gender roles, responsibilities, perceptions and skewed power relations that tend to disadvantage women. However, women also provide vital hope for successful adaptation through their critical knowledge, experience, agency and unique role in agriculture, food security, livelihoods, income generation, management of households and natural resources in diverse eco-systems, and participation in a variety of socio-cultural, political-economic and environmental institutions.

2.5 Climate change and variability in Ethiopia

The UNFCCC (2007) defines climate change as change of climate that is observed over long periods of time, attributed directly or indirectly to human activity, above that caused by natural climate variability. However, according to IPCC (2001) climate change refers to any change in climate over time, whether as result of human activity or due to natural variability. Observed and projected climate related changes will have significant impacts on ecosystems, societies and on individuals. These changes will affect people and communities differently depending on their exposure and adaptive capacity (Margaret, 2010).

The Intergovernmental Panel on Climate Change (IPCC) concludes that the negative impacts of climate change will strongly affect people and communities with the least resources and least capacity to adapt. The gender dimension of climate change is specifically recognized by the IPCC.

As highlighted in the climate change literature, the key impacts of climate change are associated with sea level rise, changes in the intensity, timing and spatial distribution of precipitation rise, changes in temperature and the frequency, intensity and duration of extreme climate events. Africa being a home to many of the world's poorest nations, has already demonstrated its vulnerability to the effects of current climate variability (e.g. effects of events such as droughts and floods) (Agnes, 2010).

Throughout its long history, Ethiopia has suffered from climatic variability and extremes. Rain failures have contributed to crop failure; death of livestock, hunger and famines in the past. According to NMA (2006) as cited in Alebachew and Atsede, (2011), the country experienced 10 years and 11 dry years over 55 years analyzed, demonstrating the strong inter-annual variability. The UNDP Climate Change Profile for Ethiopia also shows that the mean annual temperature increased by 1.30c. Between 1960 and 2006, at an average rate of 0.280c per decade. The results of IPCC midrange emission scenario show that compared to the 1961-1990 average mean annual temperature across Ethiopia will increase by between 0.9 and 1.1°C by the year 2030 and from 1.7 to 2.1°C by the year 2050, whereas precipitation is expected to show some increase (Alebachew and Atsede, 2011).

Beside this, over the years, the frequency of droughts and floods has increased in many areas resulting in loss of lives and livelihoods. In particular, reports point to the increased incidence of meteorological drought episodes, food shortages and climate-sensitive human and crop diseases in the northern highland and southern lowland regions of the country. Climate change is expected to exacerbate the problem of rainfall variability and associated drought and flood disasters in Ethiopia (NAPA, 2007).

Moreover, according to the report of World Bank (2010) Drought and famine, flood, malaria, land degradation, livestock disease, insect pests, and earthquakes have been the main sources of risk and vulnerability in most parts of Ethiopia (WB, 2010). It is concluded that current climate variability is already imposing a significant challenge to Ethiopia by affecting food security, water and energy supply, poverty reduction, and sustainable development efforts, as well as by causing natural resource degradation and natural disaster.

2.5.1 Gender and climate change in context of Ethiopia

Intergovernmental Panel on Climate Change (IPCC) forwards that climate change impacts will be differently distributed among different regions, generations, age classes, income groups, occupations and genders" (IPCC, 2001). The IPCC also notes that the impact of climate change will hamper development and harm human living conditions and lifestyles. The effects will fall disproportionately upon developing countries and the poor within all countries, and thereby exacerbate inequities in health status and access to adequate food, clean water, and other

resources. Today, women represent about 70 per cent of the poor throughout the world. Ethiopia is one of among the poorest country in the world where the impacts of climate change is expected to be higher

There is no hard empirical evidence in Ethiopia on the relation of gender and climate change. However, The vulnerabilities of men and women in Ethiopia to climate change impacts can best be illustrated through a close assessment of the nexus between gender, climate change and socio-economic as well as natural disaster, in addition to the prevailing gender discrimination in terms of roles and responsibility between men and women. For instance, Women in Ethiopia occupy low status in the society. In spite of their contributions to the well being of their family and community affairs, women experience lower socio-economic status in general and hence is marginalized from making decisions at all levels. Women are facing multiple forms of deprivation. Gender based discrimination, lack of protection of basic human rights, violence, lack of access to productive resources, education and training, basic health services, and employment are widespread (NCTPE, 2003).

In Ethiopia, women's constitute nearly half of the country's population, and most of them are living in dire economic condition with endemic poverty and poor working and living conditions. Not surprisingly, these social and demographic groups are also the most vulnerable, least prepared and likely worst affected by climate change (Aklilu and Alebachew, 2009). It follows that any response to climate change should be sensitive to their needs and priorities, and thus aim at building their resilience and adaptive capacities. Women's limited access to resources and decision-making processes increases their vulnerability to climate change. Rural women have the major responsibility for household water supply and energy for cooking and heating, as well as for food security, and are negatively affected by drought, uncertain rainfall and deforestation. Because of their roles, unequal access to resources and limited mobility, women in many contexts are disproportionately affected by natural disasters, such as floods, and fires (Betsiet, 2011).

Ethiopian women are largely responsible for nearly all reproductive tasks such as fetching of water, cooking, washing, cleaning and childcare. In most cases, men are the heads of household and therefore the principal decision-makers in the household. Ethiopian women

have longer working hours than men; they carry much of the burden of reproductive work in addition to their productive activities (Gemechu et al ,2009).

Similarly, the division of tasks varies between commodities and between locations, it is possible to make some broad generalizations. In crop production, men are typically responsible for the heavier manual tasks, such as land preparation and tillage with oxen; they also play a dominant role in seed selection, reflecting their better access to information and perform skilled jobs. Women are often involved with activities that require dexterity and attention to detail, such as raising seedlings in nurseries, transplanting and weeding (Lemelem et al ,2010).

In general different studies indicated the low status of women in developing countries in general and in Ethiopia in particular. Lack of access to productive resources such as land; lack of access to education, employment opportunities, basic health services, and protection of basic human rights; low decision making; violence and harmful traditional practices are some of the indicators of these socioeconomic marginalization of women in the country (UNFPA, 2008).

2.6 Review of empirical study on gender vulnerability to climate change

Various literature on gender and climate change shows different results with from various perspectives especially on the vulnerability of men and women. Majority of the study shows that females are more vulnerable to the impacts of climate change .However, males are also

vulnerable some selected livelihood activities. For instance, the studies of Okuli (2012) in western Nigeria on fishing community shows that males whom their livelihood depends on the fishing has become more vulnerable climate related shocks than the female engaged in other livelihood activities.

However, majority of the studies on gender and climate change shows that women's are relatively more vulnerable to the impacts of climate change and variability than their male counter parts due to a various and chained social, economic ,environmental and natural disaster reasons. Indeed, women's are particularly vulnerable to climate stress, more than men (FAO 2011; Dankelman 2010; Women Watch,2009).

Socially, the studies of Denton (2002) reveals that women's are more vulnerable to the effects of climate change due to unequal power relationship ,limited to livelihood resources like financial,

natural, social, human and economic opportunities. Cultural restrictions also increase vulnerability to climate change for women and girls. For example, climatic strain on natural resources could create additional workload for women by increasing difficulty in accessing fuel wood and water. Women are 14 times more likely to die than men during a disaster, as there may be cultural and behavioral restrictions on their mobility, including restrictive dress norms in many societies, girls are not encouraged or taught how to swim or climb a tree; this significantly reduces their survival chances in the event of climatic hazards such as flooding.

The other reasons is associated with the livelihood strategies of women's. Women are more dependent on their environment. women and men tend to perceive different risks as important and attribute different meanings to material realities and environmental changes (Moore,1993) and the experiences they face due to socially constructed roles, responsibilities and identities. Aguilar (2008)observed that women in developing societies are more vulnerable to environmental change because they are socially excluded and lack equal access to resources, culture and mobility.

2.7 Conceptual Framework of the Study

This study analyzed the vulnerability of gender to climate change and variability based on the integrated vulnerability assessment using vulnerability indicators, which is constructed from biophysical and socioeconomic factors. These biophysical and socio economic indicators were systematically framed under the three the IPCC vulnerability factors (sensitivity, adaptive capacity and exposure).Then, vulnerability analysis was done based on the three factors of the IPCC(2001)definition of vulnerability to climate change, which states "vulnerability is a function of the character, and rate of climate variation to which a system is exposed, sensitive and its adaptive capacity" . According to this definition, vulnerability includes an external dimension that is represented by the exposure of a system to climate variations, as well as a more complex internal dimension comprising its sensitivity and adaptive capacity to these stressors (Füssel and Klein,2006).Thus, vulnerability is seen from both internal and external dimensions in this study. The study conceptualizes that, sensitivity and adaptive capacity is seen from gender livelihood activities (internal factors),while exposure was separately seen as the external factor to the these livelihood.

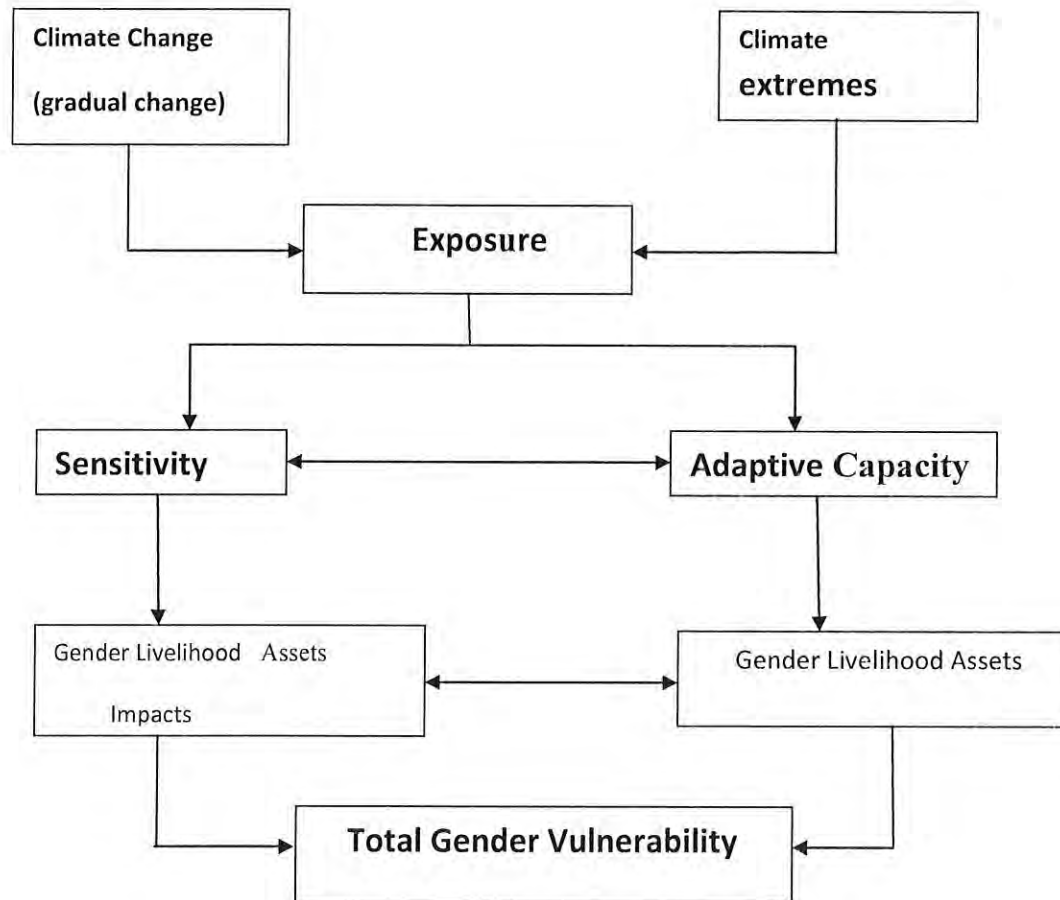
According to O'Brien et al.(2004),exposure to climate stress is manifested either by changes in climate variability or long term changes in climate conditions including the frequency of extreme events. As the conceptual figure suggests that, gender in the district is exposed to both extreme climate events(basically flood and drought) and gradual climate change(basically precipitation and temperature).Then, exposure is conceptualized to affect both sensitivity and adaptive capacity. For instance, if the frequency and amount of gradual change in climate variables is high, it affects the livelihood activities of the gender(like reducing yield or food status, healthy, status of land fertility),which increase the gender sensitivity. Exposure has also a relation with adaptive capacity. For example, higher level of exposure will challenge the adaptive capacity of the gender.

Sensitivity is given by the degree to which a system is affected or modified by an external or internal disturbance following Galloping (2003) in this study. This implies that both exposure (external factor) and adaptive capacity (the internal factor) affects the level of sensitivity as it is shown in the diagram. Hence, livelihood impacts of climate related disasters were taken as the sensitivity indicator following the works of (Marshall et al.,2009). Hence, externally, sensitivity is affected by the level of exposure while adaptive capacity is the internal coping mechanism that positively or negatively contributes to sensitivity in this study.

Adaptive capacity is described as the potential or ability of community, system or region to adjust or resist to the effects of climate change including climate extremes and variability (IPCC ,2001).Here, the method of resistances is proposed as the asset and entitlements that male's and female's mobilize in a face of hardship. In another way, coping up with hardship is the matter of expanding and sustaining these livelihood assets(Moser, 1998). Hence, in this study, adaptive capacity is measured by the five rural livelihood assets developed by DFID (1999).The livelihood activities and assets are expected to be vary between men's and female's due to the differentiated roles and responsibility that gender bears in the community.

In general, as it is depicted in the diagram, given a fixed level of exposure, livelihood sensitivity and gender adaptive capacity interchangeably affect each other. This implies that, the higher sensitivity (higher livelihood impacts),lower adaptive capacity of the gender vice versa. Hence,

the gender vulnerability is the summation of its sensitivity and adaptive capacity. The conceptual framework of the study is shown in figure 1



Source; Adapted and modified from Deressa et al.,(2008)

Figure 1: Conceptual framework of the study

CHAPTER THREE

3. STUDY AREA DISCRIPTION AND RESEARCH METHODOLOGY

3.1. Description of the study area

3.1.1 Location

Bako Tibe District is located in western part of the country, in West Shoa Zone of Oromia region state.

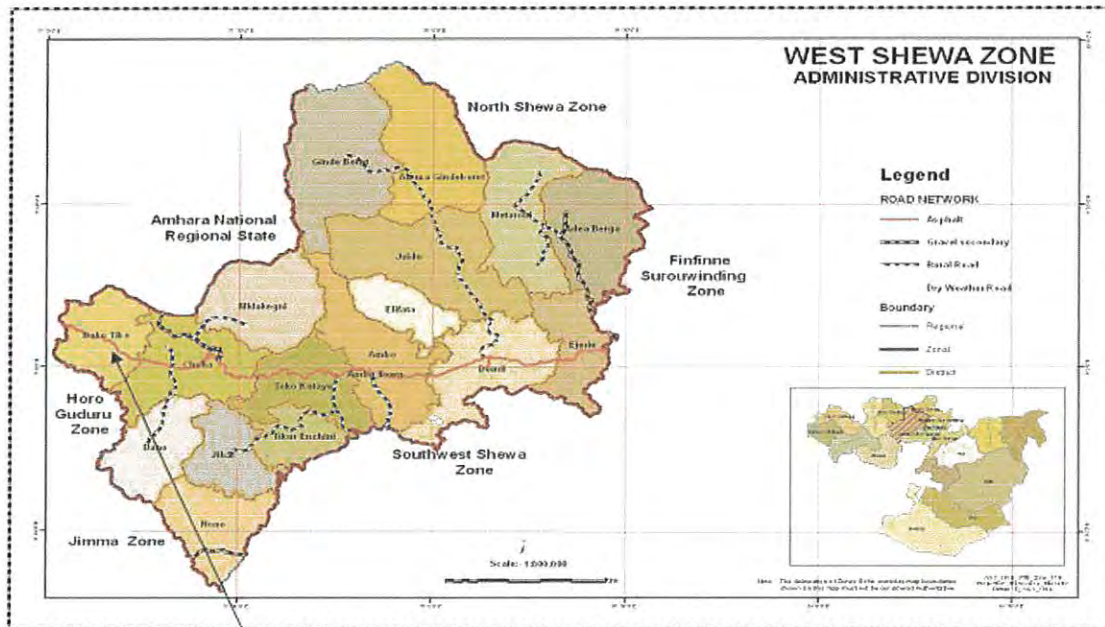


Fig. 4.1: Map of Woreda Division of the West Shoa Zone and the Case Study Woreda (source: Oromia Physical Planning Office)

Case Study Woreda

Figure 2: Map of district's Division of the West Shoa Zone and the Case Study district

Source: Oromia Physical Planning Office, 2013

It is found at the distance of 250 km from Addis Ababa and 125km from Ambo (the zonal capital city).It lies approximately between $8^{\circ}56^0$ and $9^{\circ}06^0$ Northern latitude, $37^{\circ}17'$ and $37^{\circ}12'$ eastern longitude with the altitude of 1450-2800m above sea level.

According to the report of the District's Agriculture and Rural Development Office(2011),Bako Tibe has the total area of 80,876 hectares. It is bounded by Jimma Ganati District of Horo-Guduru Wallaga Zone in the north, Jimma Rare District of Horo-Guduru Wallaga in the north-west, Wama Boneya and Gobu-Sayyo districts of East Wallaga Zone in the west and south west and Chaliya District of West Shoa zone in the south. According to the traditional climate classification, the district is classified into three agro ecologies namely highland, midland and lowland. Then, three sample kebele's are drawn from these respective agro ecologies .In its location, highland agro ecology is the furthest of all ranging from 10 km from to 30 km from the capital city while the lowland agro ecology is nearest to all infrastructure relatively ,since the capital city of the district is found in this agro ecology. The midland is found between the highland and lowland agro ecologies in the district. Hence, the representative kebele's of each agro ecology has their own distance from the districts capital, Bako, since they are drawn from these respective agro ecologies. However, the distribution of the population is not uniform across each agro ecologies so that it is unevenly distributed over some agro ecology while densely populated over the other. Most of the populations are living in mid and high land where the climate and soil seems to be conducive and the Malaria epidemic is not a threat like that of low land part.

3.1.2 Population

According to the population projection of CSA (2011), basing on the housing census of CSA (2007), the total population of the district is estimated to 139,051 where 68,991 are males and 70,060 are females. Hence, the sex ratio of the district is nearly 49:51 from male to female.

According to the CSA(2007) housing census, majority of the population is composed of Oromo ethnic group (95%) and the other ethnic group constitutes nearly 5%. Majority of the population lives in rural are (81.4%), and 18.6% is urban dwellers. Active and productive labor force is estimated to be 54% while economically dependent population constitutes about 46 percent. There is no significance difference between rural and urban average family size, which is five person per family on average (CSA,2008). The average population density is 217.9 person per kilometer square.

3.2 Research Methodology

3.2.1 Site Selection and Sampling Procedure

The study was conducted in Bako Tibe district, which is located in West Shoa Zone of Oromia regional state. In order to select the study location and fixing sampling kebele's, various site selection mechanism and sampling procedure has been conducted .

From the outset, out of 18 districts of West Shoa Zone, Bako Tibe district was purposely selected since the district represents all the dominant agro-climatic condition of the zone, beside its periodic shocks to climate related hazards. The district encompasses all the three traditional agro ecology of the zone namely Dega (highland), W/dega (midland) and Kola (lowland) agro-ecologies expecting that it represent the remaining agro ecology of the zone. Hence, the study had conducted in each agro ecologies of the district. The district has 31 kebele administrative units, for which four(4) kebele's are under urban administration while the remaining twenty seven(27) kebele's are under rural administrative. Out of these rural kebele's, twelve(12) kebele's are found in lowland agro ecologies while that of midland is ten(10) kebele's. The remaining five kebele's are found in the highland agro ecology. Majority of the district's land coverage is falling under the lowland agro ecology. Since the study is targeted to assess the vulnerability of rural community to climate change, it doesn't consider the four city kebele administrative to the sample.

Mult-stage stratified random sampling has been designed for the study for which purposive and random sampling technique is employed to select sample kebele and households respectively. Then, three kebele's was selected purposely from each agro ecologies of the district, ,expecting that these three kebele's represents their respective agro ecologies; one kebele administrative from one agro-ecological zone to serve as a typical representation for the rest of the kebele administrative in that agro ecology. Accordingly, the sample kebele selected were Sombo for highland ago ecology, Gutoo for midland agro ecology and finally ,Dambi Dima for lowland agro ecology.

Finally, in order to drive gender vulnerability to climate change, the household that belongs to the selected kebele's were categorized into female and male headed households. A family is given to be female headed if the female heads her home due to divorce, widowed . In addition, females is also counted as the head of household if a male head is away from the home for more than six month in a year (Hahn, M.B., et al,2009) .

Then, the sample size was calculated as follows. In order to get the number of household in each kebele of the district , assuming each kebele's consists of equal amount of house hold, then we divide the total number of house hold in the district to the total number of kebele's in the district(27810/31=897 house hold in each kebele).

- ✓ Then, the sampling frame is (897*3=2691), due to the fact that the researcher had take three representative kebele's from their respective agro-ecology.

After this ,we use a simplified formula developed by Yamane (1967:886) to calculate the sample size, assuming 95% desired level of Confidence Interval with $\pm 8\%$ precision. Then,

$$n = \frac{N}{1 + N(e)^2}$$

Where n is the sample size,
 N is the population size, and
 e is the level of precision.

Hence, the total sample size for the three agro ecology(as a district) become 148 with 95 % and at $\pm 8\%$ precision level. However, due to the financial problem and time constraint, the researcher reduces ten households from the calculated sample size so that 138 households were used for the survey in the three sample kebele's (agro ecologies),for which 46 household were taken from each kebele administrative. Then, out of 46 respondents in each kebele, since equal number of male and female headed house hold was proposed to represent the gender in their respective locations, equally 23 respondents for male headed and 23 for female headed household was randomly selected and surveyed, according to their respective kebele administrative. Then, totally out of 138 sample size,69 respondents are female headed while the rest of respondents are male headed in the district.

3.2.2 Data types and sources

The study used both survey and metrological data as the main of source of information in order to meet the study target, which represents primary and secondary data sources respectively.

The primary data collected through a survey includes both qualitative and quantitative in its approach. Primary qualitative data was collected on the gender roles and activities, resource control and ownership as well as on gender perception in relation to climate change and variability while the primary quantitative data were collected through household survey in order to quantify the vulnerability level of a gender especially in assessing the adaptive capacity and sensitivity level of gender livelihood assets to climate related shocks. In addition, qualitative primary data was collected through Key Informant Interview (KII),Focus Group Discussion(FGD) and direct observation of the researcher aiming to triangulate with the house hold survey data.

Secondary quantitative data was collected mainly on metrological issues, which is sourced from Bako Agricultural Research Center(BARC) and Shambu metrological station in order to assess the districts exposure level to climate change .The rain fall and temperature data for lowland agro ecology was sourced from BARC while Shambu metrological station was used as a the main source of data for the midland and highland agro ecologies. For highland and lowland agro ecologies, climate data was received from the adjust district (Shambu), since they are found on similar altitudes. In addition, the data's for natural disaster was taken from the districts

agricultural and rural development office for each agro ecology. Beside this, Central statistical Agency (CSA), District's Agricultural and Rural Development Office (ARDO) as well as published and unpublished articles related to climate change and gender were also used as the secondary sources of the data.

In general, the research has used both primary and secondary data sources. The primary data was generated from household survey, interviews, Focus group discussions, whereas secondary data was obtained from metrological stations, archives, document files, internet sources ,research journals and articles, different reports, proceedings and books.

3.2.3 Data Collection Techniques

Different data collection tools were employed to gather information from primary and secondary data sources.

Primary data was basically collected through house hold survey, focus group discussion(FGDs) and Key Informant Interview(KII) and the researchers field observations as detailed below.

Household survey; the survey was aimed and designed to have an insight and understanding on the kind of gender roles, perception and livelihood assets in the district that are essential to determine the vulnerability level of men and women in all rounded ways. Hence, the survey were employed in order to asses and find out biophysical, socio-economic factors and socio-cultural variables and indicators to measure the level of vulnerability of these social groups from multiple dimension.

Hence, a detailed information on the major research issues was generated through a survey from sampled households. Open ended and close ended questionnaires were prepared to collect data on the basic research targets especially on the gender roles ,activities ,decision making level ,resource control and ownership as well as the degree of gender livelihood assets in determining their level of vulnerability during a climate related shocks .

Key Informant Interview(KII); The informant interviews were conducted with different individuals at different levels. In all the sample kebele, interview was conducted with elderly informants composed of both men and women ,and experts with gender, environmental and agricultural back grounds. At kebele level, individual interviews were conducted with elderly

people aged more than 65 years, thinking that they have sufficient knowledge about the area and be able to memorize well the historical climate trends including the gender issues. In addition, experts with gender and agriculture backgrounds in both kebele and district level was interviewed. Especially, the agricultural experts at each kebele and district level were interviewed about the status of climate change in the area including its impact on the communities livelihood activities from gender perspective. Further, the women's affairs at the district level was interviewed deeply about the status of gender equality in terms of roles, responsibility, resource ownership and control including gender work load. In general, eight (8) key informants were conducted for which 3 was agricultural experts in their respective kebele's including one aged informant from each kebele's while two informants were from the district level (one from women's affairs and the other agricultural expert office) .

Focus Group Discussions(FGDs) Discussions focused on the research issues were carried out among groups classified by sex and age. Separate discussion was held with male and female social groups categorizing as a young and old groups separately so as to avoid specific group's idea dominancy and to capture gender, and age disaggregated data. There were a total of twelve(12) FGDs as a district, for which four (4) FGDs in each kebele(agro ecology), and each group involved six to eight individuals who were not involved in household survey. In order to guide the discussion, semi-structured checklists were designed specific to the research issues.

In general, The exact formulation of the questionnaires for both household survey including FGDs and KII is included in Appendix 1.

Field Observation ;Using this technique, data about the social, environmental and economic condition was cross-checked with the survey. In order to do so, transect walk was conducted with the guidance of kebele agricultural experts including voluntary farmers together with the researcher. Hence, the researcher has got the opportunity to compliment the farmer's response to the actual observations.

Secondary data was collected basically from BARC for the lowland agro ecology and Shambu metrological station for the midland and highland agro ecologies especially on the metrological data (temperature and precipitation)over 30 years. In addition, data's like the availability of

natural disaster, division of the districts agro ecology including their respective kebele was collected from the agricultural and rural development office of the district.

3.2.4 Method of data analysis and processing

In order to attain the intended objective of the study, both qualitative and quantitative methods of data analysis were employed.

In order to assess the gender roles and activity, **Harvard analytical framework** in combination with gender planning frame work was used in order to asses, understand and document the differences in gender roles, activities, needs and opportunities between males and females contextually, which is also forwarded in UNDP (2008).Accordingly, socio-economic activity profile, access and control over profile and intra- household level of decision making profile was selected to assess the gender roles and activities.

The gender perception on climate change and variability including the perception on temperature and precipitation was also assessed through descriptive stastics .Further, in order to complement the accuracy of gender perception, further analysis was conducted by undertaking a linear trend analysis on temperature and precipitation change over the last 30 years.

Finally, the qualitative surveyed data on gender roles ,activities and gender perception was analyzed using descriptive stastics (count ,frequency, percentage and chi-square) on SPSS software, aiming to characterize the gender roles, activities, resource ownership and control over, and decision making level including the their perception towards climate change and variability.

Quantitative data analysis; The level of gender vulnerability were quantified using indicator method(integrated vulnerability assessment) through vulnerability index computation. Then, index calculation was done for the three IPCC contributing factor(adaptive capacity, sensitivity and exposure) including the selected sub-indicators of these factors in order to quantify the level of gender vulnerability. To this end, Principal Component Analysis (PCA) was employed in order to determine the weights of selected variables in constructing vulnerability index. Finally, the component score of each variable was computed using PCA in STATA. The detailed explanation of this quantitative analysis, including the model and variable explanation, is given under the below sub-topic of method to vulnerability analysis.

3.2.1. Method of vulnerability analysis

Different researchers have attempted various mechanisms to analyze and measure the vulnerability of people. However, Deressa et al.,(2009) argues that indicator and econometric methods are widely employed to measure vulnerability to climate change and variability. This study uses an indicator method to analyze the gender vulnerability to climate change and variability.

Within the frame work of indicator method, the three major analytical method is used ,in order to asses vulnerability. These are socio economic, biophysical and integrated vulnerability assessment(Deressa et al.,2009).For this study purpose, the researcher has used integrated vulnerability assessment approach that combines both socio-economic and biophysical method to determine the level of vulnerability. The indicators in both biophysical and socio-economic were systematically combined together in order to determine the level of gender vulnerability in the district. The works of Cutter et al. (2000) and O' Brien et al. (2004) is a good example of integrated assessment method.

The studies of Fussel (2007) and Fussel and Klein (2006) argues that the integrated method of vulnerability analysis is coherent to the IPCC (2001) definition of vulnerability, that states the construction of vulnerability from adaptive capacity, sensitivity, and exposure. Hence, the biophysical approach match to the sensitivity and exposure (Fussel and Klein (2006) while the socio-economic is largely considered as an adaptive capacity (Fussel 2007).

3.2.1.1 Model specification for vulnerability analysis

Before proceeding to the model specification, it is important to discuss on how to give a weight on the indicator listed under the three IPCC factors(section . 3.2.4.2).Then, with regards to the weighting of the indicator (w in the below representation), some researcher follows equal weighing system(Nelson et al,2005;Vincent,2004) assuming that all indicators of vulnerability have equal weights so that give equal weights ,but this method is criticized for the probability of over weighing or under weighing of a vulnerability indicator. In order to avoid this problem, other methodological approaches like expert judgment were used (Vincent, 2007;Adger and Vincent, 2005),however, this method is still not free from criticism due its subjectivity or

limitation in relation to the lack of specialist on the subject matter or lack of consensus among expert themselves (Gbetibouo and Ringler,2009).

Hence, this study has used a Principal Component Analysis (PCA) for the weighing of indicator following (Deressa et al, 2008;Filmier and Pitched ,2001),which is preferred and recommended compared to the two former approaches(Nelson et al.,2010b;Gbetibou and Ringler,2009; Boruf, Cutter and Shirley,2003).

Then, PCA was running for all the indicator of adaptive capacity, sensitivity and exposure in order to assign weight for the selected indicator.

The loadings from the first component of PCA, were used as the weights for the indicators. The magnitude of the weights describes the contribution of each indicator to the value of the index. Therefore, in order to construct the vulnerability indices, indicators of adaptive capacity, which are positively associated with the first principal component analysis, and indicators of sensitivity and exposure; which are negatively associated with the principal component analysis were taken. From the weights obtained for indicator within each asset category, individual index values for each asset type was constructed to analyze which asset group contributes the most to the total adaptive capacity(for comparison).

With regards to the model specification to quantify the level of gender vulnerability, the researcher used the IPCC definition of vulnerability. According to IPCC(2001),Vulnerability is defined as a function of adaptive capacity, sensitivity and exposure shortly. Then, following the works of Deressa et al.(2009) and Moss et al, (2001), the direction of relationship in vulnerability indicators (i.e. their sign) was assigned; positive value to adaptive capacity and negative value to sensitivity and exposure. Then, the model specification for vulnerability is given as .

$$Vulnerability = Adaptive\ capacity - (sensitivity + exposure)1$$

The equation implies that vulnerability is the difference between adaptive capacity of a household and its sensitivity and exposure to climate change induced hazards. For instance, the lower adaptive capacity ,the higher vulnerability and vice versa. Then, the gender livelihood asset takes a critical role, here, since it is represented by adaptive capacity.

Since each three factors components is composed from various indicator, the detailed model specification is given as

$$V_i = (w_1 N_{1j} + w_2 N_{2j} + \dots + w_n N_{nj}) - (w_{n+1} M_{1j} + w_{n+2} M_{2j} + \dots + w_{n+n} M_{nj}) \dots \dots \dots (2)$$

Given that V_i is vulnerability index while N_s are elements of adaptive capacity and M_s are elements of exposure and sensitivity. Here, the value of N_s and M_s are the normalized values, that will be derived by subtracting the mean from the observed value and dividing it to its standard deviation for each indicator (variables) .i.e. $N_{ij} = (n_{ij} - n_1^* / s_1^*)$, where n_1^* is the mean of n_{ij} (adaptive capacity indicative) across the three agro ecologies while s_1^* is their standard deviations. The same procedure was used for normalizing exposure and sensitivity indicators. Here, the normalized values of male and female was calculated separately across the sample kebele's (agro ecologies).

Then, whole matrix of N_{ij} is given as

$$N_{ij}/M_{ij} = \left\{ \begin{array}{c} (N_{11} + N_{12} + \dots + N_{1x}) - (M_{11} + M_{12} + \dots + M_{1x}) \\ . \\ (N_{y1} + N_{y2} + \dots + N_{yx}) - (M_{y1} + M_{y2} + \dots + M_{yx}) \end{array} \right\} \dots \dots \dots (3)$$

where j and i implies the number of rows (i.e. variables of adaptive capacity, exposure and sensitivity) and the number of columns (the three agro ecologies) respectively.

Then, the vulnerability index of male and female in each location is given as

$$V_i = \begin{pmatrix} w_1 \\ w_2 \\ w_3 \end{pmatrix} \times \begin{pmatrix} (N_{11} + N_{12} + \dots + N_{1x}) - (M_{11} + M_{12} + \dots + M_{1x}) \\ . \\ (N_{y1} + N_{y2} + \dots + N_{yx}) - (M_{y1} + M_{y2} + \dots + M_{yx}) \end{pmatrix} \dots \dots \dots (4)$$

For which 'w_s' are the first component score of each variable computed using Principal Component Analysis in STATA.

Finally, the total gender vulnerability of the each location is the average of both men and women vulnerability of that specific agro ecology. Then, it is given as

$$V_t = 1/2(V_f + V_m) \dots \dots \dots (5)$$

Where V_t represents the total vulnerability in each agro ecology is while V_f female vulnerability in a and V_m males vulnerability.

Explanations of model variables (indicators)

Since the model variables are constructed based on the IPCC definition of vulnerability, which are a function of adaptive capacity, sensitivity and exposure, then the indicators to construct vulnerability function is categorized under these three factors as follows.

Adaptive capacity indicators

Different scholars gives various contextual meanings to adaptive capacity even though, the center of their point is similar .For instance, Smit and Wandel (2006), considered it as a coping ability, flexibility, robustness while Brooks (2003) considers it as the ability of a system or society in restructuring its behavior or capacity in order to cope up with the external shocks. According to IPCC (2001),adaptive capacity is described as the potential or ability of community, system or region to adjust to the effects of climate change including climate extremes and variability.

Hence, adaptive capacity is a context specific and varies from country to country, from community to community, even among social groups and individuals, and over time (IPCC ,2001; Smit and Wandel ,2006).

Adaptive capacity is determined by the level of skills, access to resource, information, education, wealthy, technology, infrastructure (McCarthy et al, 2001). Hence, vulnerability analysis consists of both threats of external environment and the responsiveness of a system and its ability to recover from these negative external environments (Grossman,2009). The method of resistances

are the asset and entitlements that individuals, household or communities mobilize in a face of hardship. Vulnerability and livelihood are closely linked so that coping up with hardship is the matter of expanding and sustaining these livelihood assets (Moser, 1998).

Therefore, vulnerability is linked with asset ownership. i.e. the less asset people have, the more they are vulnerable and vice versa. In this study, adaptive capacity was constructed from the five livelihood assets: Hence, adaptive capacity is measured by rural livelihood framework developed by DFID (1999) and Elis (2000). Where this livelihood framework consists of five types of assets-natural, physical, social, financial and human capitals (Chambers and Conway's, 1992).The variable under each asset category was selected based on the review of literature in the study area with a great consideration of their suitability to express gender disaggregated data.

1.Human Capital

Human capital is represented by educational level, training, health and food status of the gender as detailed below.

i) *Educational level* ;Here educational level is positively hypothesized with human capital and then adaptive capacity. For instance, the more literacy rate, the less vulnerability by providing capacities and access to information so that increase the ability to cope up with changes (LeiChenko et al, 2002).Hence, the number of years of schooling of house hold head was taken for the analysis in this study

ii) *Training* ; Here, training with regards to the communities livelihood activity ,is expected to enhance the adaptive capacity of a community so that the higher the number of training, the higher adaptive capacity. Hence, the number of times household takes the training was taken for the analysis, in the past one year.

iii)*Food status(sufficiency)*; In this study, food status of a house hold was measured based on whether the family was food sufficient or not throughout the past one year. The family who has a sufficient food throughout the year is assumed to have a better adaptive capacity at the time of drought than those of food insufficient. Hence, dummy value one was assigned for those have a sufficient food throughout the year and zero otherwise.

V) Healthy status; A better healthy status is required for effective agricultural production. Hence, family member that do not miss their work or school due to healthy problem was considered in order to check the healthy status in this study. Especially, according the available literature in the area, malaria is the most chronic disease that threatens the health wellbeing of the community. Hence, better healthy status is expected to enhance gender adaptive capacity in this study. Hence, dummy value one was given for those who do not miss their work or school and zero otherwise.

2)Social capital

Better social cohesion and network is expected to enhance the adaptive capacity of a household during a difficulty through a mutual assistance, due to climate shocks. To this study, social capital was represented by the role (position) of house hold head in the community, membership in community based organization(CBOs) and participation in community politics (vote and elections). The variables that represent the social capital of the gender is described and used as the below justification.

i) Role in the community; This is indicator asses the role, in terms of position, that a gender discharge in the community. Then, the number of position that household discharges in the community was counted and used as their role in the community ,for this study.

ii) Belongingness in CBOs; Belongingness in a community based organization (CBOs) is hypothesized to increase the adaptive capacity of a gender at the time of drought or shocks through a moral and financial assistance. Hence, for this study, the number of social part that household take a part was positively hypothesized with adaptive capacity. This social group includes both formal and informal group.

iii) Participation in community politics; Participation in an election to both community level and national election is expected to enhance the ability of household to get information about their leaders and determines their future fate to resist shocks as a collective through a better representatives. Hence, participation in a community politics is assumed to have a positive value to their adaptive capacity. Hence, the number of times each household participated in both community and national election since 2010 was considered for this study.

3) Physical Capital

Physical capital was measured based on two principal indicators in this study. Both agricultural inputs and technology profile were considered as the main indicator, which are expected to be positively hypothesized with adaptive capacity. Then, several variables are included under this two major components as indicated below.

Modern agricultural inputs; These sub indicator was composed of three (3) main variables like the usage of modern insecticide and pesticide, modern fertilizer and improved seeds. Then, the more access and use of these modern agricultural input, the higher yields the household will drive and then the more adaptive capacity they generate at the time of shocks. Hence, the method to use this variables in the study analysis is highlighted as follows.

i) Insecticide and pesticide; The usage of modern agricultural inputs like insecticide and pesticide is expected to enhance the agricultural activity and then productivity so that positively hypothesized with adaptive capacity. Dummy value one was assigned if the household uses insecticide and pesticide for their agricultural activity and zero otherwise.

ii) Modern fertilizer application; Fertilizer is used to maintain soil fertility and hence, the households that uses modern fertilizer is expected to have a better yield than those who do not uses. Hence, application of modern fertilizer is positively hypothesized with adaptive capacity. Dummy value one was assigned for households who uses modern fertilizer and zero otherwise.

iii) Improved seeds; Dummy value one was assigned for households that uses modern improved seeds and zero otherwise.

Technology Profile; Technology profile was composed of irrigation technology, types of household house and the ownership of modern communication media .Then, the house hold that owns these technology were assumed to have a better adaptive capacity. Hence, the detail of variable usage is described as below.

i) Modern communication media; This consists of the ownership of Radio and mobile as well as Television to some extent in rural setting currently. then, the ownership of these communication is hypothesized to increase the gender information about climate related phenomena so that

positively hypothesized with adaptive capacity. Dummy value one is assigned for those who use modern communication media (either Television, mobile or radio) and zero otherwise.

ii) Type of household house; Traditionally, thatch roof, thatch or wooden wall ('Mana Cita' in the local language) is commonly known in Ethiopian context. However, currently, thatch is too scarce due to the change in climate and even not represent the quality house comparing to iron roof, wood/stonewall (which is recently known) in the study area. Hence, dummy value one is given for iron roof and wood/stone wall house type and zero otherwise.

4. Financial Capital

Financial resource is an important element for household's adaptive capacity. For this study, Financial Capital was represented by access right to credit as well as wealth profile of household like ownership of livestock (cow, ox, goat, donkey, mule and sheep), gross household income, livelihood diversification and household savings were taken as the indicator of financial asset. These indicators were analyzed according to the below explanation.

i) Access to credit; This variable checks whether the gender has access right to financial organization like rural micro finance, credit association etc. Hence, the dummy value one was given if the gender have access right and zero otherwise.

ii) Livestock Ownership; The assumption in this is that the higher livestock household have ,the higher adaptive capacity they will have at the time of shocks or drought. Here, the amount of livestock like Ox, cow, goat, sheep, horse, mule and donkey were asked, which are expected in rural settings. Then, it was converted to Tropical Live stock Unit (TLU) following the works of stock et al.,(1999) in order to summarize as one variable. Hence, household's livestock asset was asked separately since the household's adaptive capacity is different based on the type of livestock they own. For instance, households who own ox have a greater adaptive capacity than who owns goats.

iii) Livelihood diversification; This, variable includes all the livelihood activity that households practices in their day to day activity. The assumption is that, the higher the number of livelihood activity, the greater the adaptive capacity the household will have because the risks of climate

shocks will be distributed over the diverse livelihood incomes. Then, all the farm and off farm activities were counted as their livelihood activity so that expressed in number.

v) *Gross annual income*; This variables contains all the gross income that household drives from agricultural (farm) activities and non-farm activities . Hence, the greater income that household generates, the higher the adaptive capacity they will have at the time of shock since the risks are distributed over this diverse sources and amount of income. Then, the gross amount of income collected from different source are summed and used as one variable for the analysis.

vi) *Annual saving amount*; This variable considers the total annual saving of household on average from their gross income. In addition to the income at disposal, household saving is a critical for returnable investment like family education or used as a recovery mechanism at the time of shocks like drought or sudden crop and animal disease. Hence, the higher saving amount, the higher adaptive capacity that gender will have. Then, the average annual amount of saving was used for this adaptive capacity analysis.

vii) *Crop diversification*; This variable considers all types of crop and horticultural products the family grows. Hence, it was taken and expressed intermesh of number of cash crop the household grows. The hypotheses is that, the higher crop diversity, the higher adaptive capacity that household will have.

5. Natural Capital

The availability and ownership of basic natural resource is important asset in rural setting. Especially, land is an important asset that gender posses in this area privately. Then, the amount of irrigated land and the nature of the land slope determine the efficient utilization of land asset especially in the study area. Hence, the indicators under the natural capital was three and highlighted as follows.

i) *Farm land size*; Households that have a sufficient land is expected to have a better adaptive capacity in maintaining crop diversity ,expanding his agricultural activities and also renting their land to generate incomes. Hence, the amount of land that household own was taken and collected in terms of hectare, since the current land lease of Ethiopia puts all the farmland of farmers, in

terms of hectare. Hence, the amount of land that household possessed in terms of hectare were used for this study purpose.

ii) *Percentage of irrigated land*; According to the available literature, irrigation is commonly practiced in the district especially in the midland and lowland agro ecologies so that the researcher take the percent of irrigated land to the total farm land size in order to assess the households adaptive capacity. The hypothesis is that ,the higher irrigation the household uses, the higher adaptive capacity they will have during a climate related shocks like droughts.

iii)*Slope of farm land*; The slope of farmland is very determinant in order to maintain soil fertility (in reducing soil erosion).Then, plain land slope is preferable than hilly and sloppy in order to maintain soil fertility and the increase agricultural productivity. For this study plain land slope takes the dummy value one and zero otherwise.

Table 1:Indicators of Adaptive Capacity

Types of Livelihood Asset(Major component)	Sub-components	Hypothesized relationship between indicator and vulnerability.	Unit of measurements
Human Assets	Academic	The higher years of schooling, the higher adaptive capacity and the lower vulnerability	number
	Training	The higher training taken, the higher adaptive capacity and the lower vulnerability	number
	Food sufficiency	The higher food sufficiency, the higher adaptive capacity during climate hazards.	dummy value
	Healthy status	The better healthy status of the family, the higher adaptive capacity and the lower vulnerability	dummy value
Social Assets	Role(position)in the community	The better the position the gender have in the community, the better information and money the genders gains, hence, the better adaptive	number

		capacity (the lower vulnerability).	
	Membership in CBOs	The higher membership in formal and non formal CBOs, the higher mutual cooperation during hazards, the lower vulnerability.	number
	Political participation	The higher Participation in community vote or elections, the higher adaptive capacity	Dummy value
Physical Assets	Insecticide/pesticide usage	The higher usage of insecticide and pesticide, the higher the yield that the gender will generate ,the lower vulnerability .	Dummy value
	Fertilizer	The better fertilizer usage ,the higher agricultural output ,the higher adaptive capacity(hence, the lower vulnerability)	Dummy value
	Improved seeds	The higher usage of improved seed, the higher yield the derived from small plots, hence the higher adaptive capacity	Dummy value
	Communication media	The better ownership of communication media like TV, radio and mobile, the higher information gained about climate related issue, the higher adaptive capacity.	Dummy value
	Quality of Household house	The better Kind and quality of household house, the better adaptive capacity during the loss of thatch due to climate change.	Dummy value
Financial Assets	Access right to credit	The better access right to borrow money from financial institution, the better adaptive capacity during climate shocks.	Dummy value
	Livestock in TLU	Number of livestock (ox, cow, donkey, horse, mule, sheep, goat) house hold have, the better they will adaptation (the lower vulnerability).	count
	Livelihood	The higher number of farm and nonfarm activity,	number

	diversification	the better distribution of risks over this activity, the higher adaptive capacity	
	Gross annual income	The higher gross income, the better adaptive capacity during shocks.	count
	Saving amount	The higher saving amount of HH, the better investment on education, healthy, the better adaptive capacity during shocks.	count
	Crop diversity	The higher the number of crops that household grows, the higher adaptive capacity.	count
Natural Assets	Farm land size	The higher size of farm land, the better opportunity to expand agricultural activity, hence ,the higher adaptive capacity.	number
	Percent of irrigated land	The higher percentage of irrigated land to total farm land,, the higher adaptive capacity during drought.	number
	Slope of farm land	Better slope of farm land ,the lower erosion ,the better adaptive capacity during floods(the lower vulnerability).	Dummy value

Sensitivity indicators

Sensitivity is given by the degree to which a system is affected or modified by an external or internal disturbance (Gallopín,2003). Livelihood impacts of climate related disasters were taken as the sensitivity indicator following Ehrhart.,et al (2009) as well as Marshall et al. (2009).

Three sub-components were considered for this study purpose in order to measure the sensitivity level of gender livelihood activities.

i)Fatalities ;This is expressed in terms of the number of family part that was seriously injured or died due to natural disasters like (flood, drought, cyclone, heavy rain, shortage of food) during

the past ten years. Then, the higher in the occurrence of fatalities, the higher will be the sensitivity of household to climate change.

Damage to properties; This subcomponent is composed from two variable based on their significance to the livelihood of a rural community in the study area .

i)Livestock death; The number of total livestock death since the last ten years, as a result of floods, drought, high animal diseases were surveyed and considered seasonal variability in rain fall and crop diseases. The natural death of animals was not considered to this damage to properties. Then, the livestock in terms of ox, cow, goat and sheep's were asked separately and converted to TLU following the works of stork(1991) and hence, positively related to sensitivity (the higher livestock death, the higher sensitivity) .The conversion formula is given in appendix2

ii) Crop damage; Crop damage was seen from the sudden decrease of crop yield due to natural disaster and climate variability like high floods, fluctuation in rain fall amount,

After the type of crops that was periodically exposed to climate related hazard was identified through the survey, then they were estimated in terms of local measurements basing on the value of that year. Then, it was valued in terms of Ethiopian birr finally for this study purpose. Hence, the higher crop damage ,the higher sensitivity to climate change.

Income structure; The income diversification or structure determine the degree of gender vulnerability. Here, the hypothesized assumption was that, natural resource based income (which driven from agriculture, livestock, forest products, handicrafts and honey) is more sensitive to climate change than non-natural based income (i.e. petty business, remittance, skilled non-farm job) in its essence. Hence, two variables was considered here basing on their percentage share to total income. i.e. the percentage share of natural based income to total income and the percentage share of non -natural based income to total income.

i Share of natural resource based income to total income; Here, the percentage of share of natural based income to total income was taken for the analysis. It is positively hypothesized that the higher share of natural based income(the higher share of income generated from farm activity than nonfarm activity), the higher sensitivity to climate change at the time of shocks.

Table 2:Indicators of sensitivity

Major indicators	Sub-components	Description of sub components	Unit of measurement
Fatalities	Fatalities Natural disaster ,flood, cyclone	The higher fatalities due to natural disaster, the higher sensitivity to climate change ,hence, the higher vulnerability.	Number of family members
Damage of properties	Livestock damage	The higher number of livestock death due to natural disaster, the higher sensitivity to climate and the higher vulnerability	Values in TLU
	Crop damage	The higher crop damage, the higher sensitivity and the higher vulnerability.	Value in Ethiopian birr
Income structure	Share of natural based income to total income	The higher share of farm income to total income, the higher sensitivity to climate change hence, the higher vulnerability.	%
	Share of non-natural based income to total income	The higher Share of income from non-farm activity, the lower vulnerability to climate change	%

Exposure indicators

Exposure is related to the degree of climate stress on a system, which is manifested either by changes in climate variability or long-term changes in climate conditions including the frequency of extreme events(O'Brien et al.,2004).

In this study, exposure is represented by historical changes in climate variables (temperature and precipitation) and frequency of natural disaster in the study area. The detail usage of this variables is described as below;

i)Extreme climate events; the number of times climate related natural disaster like floods, droughts, heavy erosion was under taken in the study area. Such data was collected from house hold survey and complimented with secondary data taken from agricultural and rural

developments of the district from 2004 to 2014. Then, the higher extreme climate events, the higher sensitivity of gender livelihood assets so that it is positively hypothesized with exposure.

ii) Historical change in climate variables ;In this change in climate variables, three variables were taken for the analysis. These are average annual minimum and maximum temperature ,and the average yearly precipitation ,which was taken from 1983 to 2013. Then, this three scenario was sourced from BARC for lowland agro ecology and Shambu metrological station for midland and highland agro ecology respectively. It has been hypothesized that the higher the rate of change to this climate variables (increase in mean temperature and decrease in the amount of precipitations) ,the higher exposure of households to climate change and extremes.

Table 3: Indicators of Exposure

Major component	Sub-components	Hypothesized relationship between indicator and vulnerability.	Unit of measurements
Extreme climate events	Frequency of natural disaster	The higher frequency of natural disaster ,the higher exposure so that the higher vulnerability	Number
Changes in climate variables	Changes in annual min. temperature	The increasing temperature and decreasing precipitation ,the higher vulnerability to climate changes.	Coefficient of trend
	Changes in annual maximum temperature		
	Change in average annual precipitation from		

CHAPTER FOUR

4. RESULTS AND DISCUSSIONS

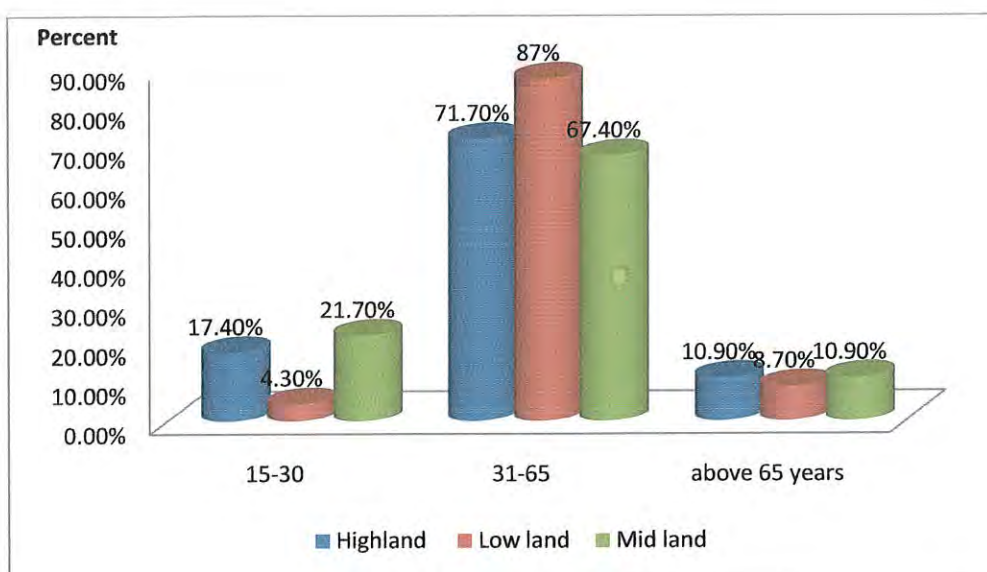
4.1 Socio-demographic characteristics of the respondent

1. Age distribution of sample households

Age was considered in that various age groups in a family may determine the adaptive capacity of families. Hence, figure 3, below provides the distribution of households across the different agro ecological zones.

As shown in the diagram , majority of the surveyed households (71.5%) in highland, 87% in low land, and 67.4% in the mid land agro ecological zones were found between 31 – 65 age group whereas 17.4% in high land, 4.3% in lowland, and 21.7% of the surveyed households in mid land agro ecology were found between the age group of 15-30 years. 10.9% of households in high land, 8.7% in low land and 10.9% households in mid land were aged above 65 years. On aggregate, 14.5% (20), 75.4% (104) and, 10.1% (14) of the total surveyed households lie under the age groups 15-30, 31-65 and above 65 years old respectively. However, a statistically insignificant association was found between age and agro-ecology of the surveyed households where $\chi^2=6.631$, $df=4$, $P=0.157$.

From gender perspective, age distribution of households indicate that majority of both male and female headed households fall between the age of 31-65.while the remaining respondents in both household heads roughly falls between 16-30 and >65.



Source; Own field survey,2014

Figure 3: Age distribution of the surveyed households

2 . Marital status of respondents

The marital status of sample kebele in their respective agro ecology is given in the below

Sample Kebele		Male HH				Female HH				χ^2
		Married	Divorced	Widowed	Total	Married	Divorced	Widowed	Total	
Sombo	Count	21	2	0	23	0	20	3	23	88.84*
	Percent	91	9	0	100	0	87	13	100	
Guttoo	Count	21	2	0	23	17	6		23	df=2
	Percent	91	9	0	100	74	26	0	100	
Dambi	Count	19	1	3	23	0	14	9	23	
Dima	Percent	83	4	13	100	60	40		100	

Source; Own field survey,201 * indicates 1% significance level .

Table 4: Marital status of respondents

As shown in the above figure, among the total household majority of male headed households 88% are married while there was no married female headed household in the study area.

When this is interpreted at kebele level, the majority of male respondents are married across all kebeles while female respondents consist of divorced and widowed. Widowed Female respondents are great in number in Gutoo 74% and Sombo 87% compare with that of male respondents in this kebele. the chi-square test also reveals the existence of statistical significant variation between male and female headed households in the three kebeles at 99% confidence level where $\chi^2 = 0.000$, $p > 0.001$.

1. Family size

Agro ecology	Family sizes of sampled respondents								χ^2
	1-3		4-6		Above 6		Total		
	Count	%	Count	%	Count	%	Count	%	
High land	21	45.7	18	39.1	7	15.2	46	100	7.309 ^{NS}
Low land	25	54.3	20	43.5	1	2.2	46	100	df=4
Mid land	29	63%	13	28.3	4	8.7	46	100	P=0.120

Source: own survey (2014)

Table 5: family sizes of the sample households

As illustrated in table 1, in high land 45.7% of the sample respondents, in low land 54.3% and in mid land 63% of the sampled respondents had an average family size between 1-3 members per household where as 39.1%, households from high land, 43.5% households from lowland and 28.3% of the surveyed households in mid land had between 4 -6 family members. 15.2 households from high land, 2.2% from lowland, and 8.7% from mid land had above 6 family members. Majority of the surveyed households in all the surveyed agro ecological zones had between 1-3 family members. Statistically, no significant correlation was found between family size and agro ecological zones of respondents.

4.2 Gender Based Roles and Activities

For the analysis of gender based roles and activities, three indicators were assessed in the study area from gender perspectives, as it has indicated in the methodology part, basing on the Harvard analytical framework in modification to the study area. These were gender activity profile assessment, gender access and control over resource as well as the degree of gender decision making intra-household activity and in other activities. The results are briefly outlined as below

4.2.1 Activity profile assessment of gender

For the assessment of activity profile assessment of a gender, the researcher categorizes the major activities undertake in the day to day activities into three main areas in given household; Food preparation, Agricultural activities including livestock related activities and Non-Agricultural activities. These was intended to compare and contrast the work load and the work division between men and women, in order to analysis its subsequent implication to their adaptive capacity as well as to their vulnerability to climate change in the broad sphere. Then, the respondents were asked to give their views whether these activities are mostly done by men, female or both equally based on their house work experience.

Under these three major indicator, several variables were included in order to examine from all dimension. For instance, food preparation were assessed based on the level and frequency of gender participation on cooking wat, making injera, collecting fire wood and fetching water with in the household while agricultural activities was seen from ploughing, seed dispersal, weeding, harvesting and threshing. The non agricultural activities were derived from the day to day activity of the males and females around the home ,which are composed from feeding and caring child, house cleaning, selling and buying home consumptions. This variables were taken since they are necessary requirements in order to come up with a complete gender activities within a given household with special reference to the study area .

With regards to food preparation in the district, analysis of the surveyed data shows that ,the activity is entirely the work of the females. For instance, cooking, making injera , collecting firewood and fetching water are predominately undertaken by females (both in male and female headed households) by 97 %,97 %,96 % and 84 % respectively in the district.This findings reveals that there were no reports that these activities were absolutely conducted by the men in

both men and female headed households. However, the remaining percentage is conducted jointly in assisting each other.

With the activities related to non-agricultural activities, the analysis of the surveyed data reveals that these activities are also primarily undertaken by females (in both male and female headed households) across the agro ecologies in the district. For instance, females perform 71 % and 86% of feeding and caring child including house cleaning respectively. The similar percentage holds true in selling products and buying home consumption.

In activities related to agricultural activities, the survey result implies that majority of agricultural activity especially Ploughing, harvesting and threshing are undertaken by men's while higher percentage of seed dispersal and weeding is undertaken by both sex's jointly in 45% and 78% respectively. Especially, ploughing is 100% the activity of men in both male and female headed households in all agro-ecologies and harvesting and threshing is sometimes undertaken jointly by both sex's though majority of these activities are still undertaken by males. Such work division especially on ploughing, harvesting and threshing gives an absolute advantage to male headed households including the males due to the fact that female headed households get difficult to perform these activities alone (if they have male son or not able to recruit another male daily labors). Hence, Such traditional work division is imposed on females so that 40% of female headed households in the district give their land and ox to share ('Kitte' in the local language), according to the survey. This will affect their adaptive capacity since it limits their maximum effort to use their available resources alone comparing to their men counterparts as well as affect their financial capital by bringing extra expense to them.

In livestock related activities, especially on milking, manuring and composting are predominately undertaken by females in the district. For instance, Milking was reported 100% as the only task of females while manuring and composting are also basically conducted by female in 66% and 58% respectively. In contrast, males conduct 16% of manuring and 14% composting in the district while the remaining percentage is jointly performed in the district. Statically, significant relation was not observed between sex of household and livestock related activities in the district where $\chi^2=5.194$ $p=0.11$. In this regard, the survey reveals 75% of the livestock related activities are conducted by females on average while the remaining is jointly performed.

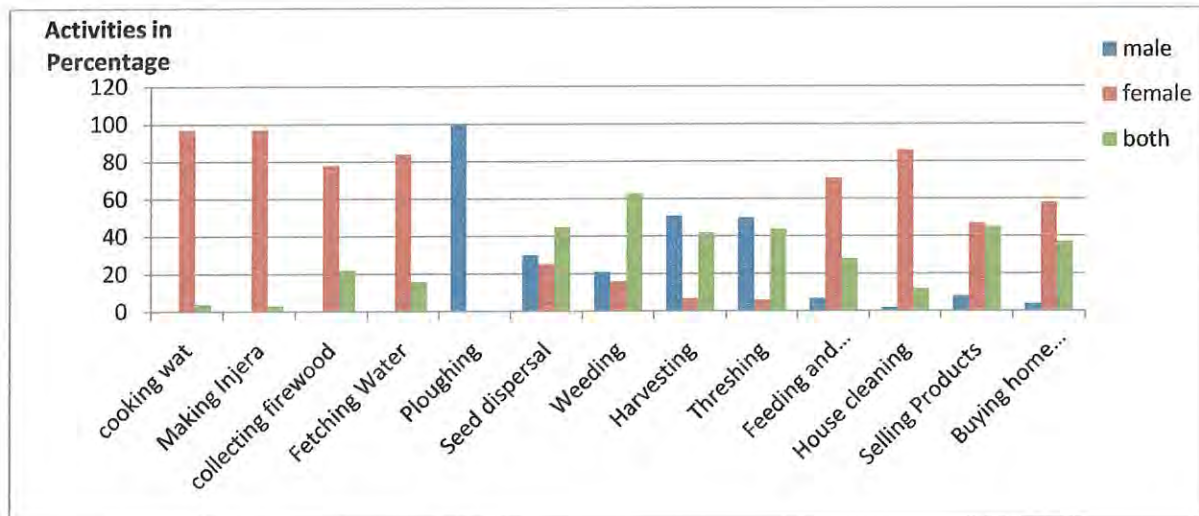
Sex	Activities	Milking		Manuring		Composting		χ^2
		Count	%	Count	%	Count	%	
Male	male	0	0	12	17	12	18	5.914 ^{NS} <i>df</i> =2
	female	69	100	40	58	34	49	
	both	0	0	17	25	23	33	
Female	male	0	0	10	15	7	10	
	female	69	100	52	75	46	67	
	both	0	0	7	10	16	23	

(NS= indicates Not Significant at less than 10% confidence level), source: Own calculation, 2014

Table 6 :Gender work division on Livestock Related activities in Bako Tibe district.

In general, as we observe from the below picture, there is no equitable division of work between male and females (both in male and female headed households). This unbalanced work division shows that female's discharges a higher workload so that forced to work a longer hour in works related to home activities including the fields works(agricultural activities).Females are participating both in field and home work while males has a better participation in to field works especially to agricultural activities and less involvement in the home work .In this regard, female headed households suffers highly in work load in relative to male headed households because of their higher participation in agricultural activities. Females in general and female headed house hold in particular faced an extra hardship due to a higher workload in relative to their male counterparts. These increases their vulnerability to the impacts of climate change by lowering their adaptive capacity to diseases and other related hardships at the time of shocks.

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source; Own field survey,2014

Figure 4: Gender work division and work load in Bako Tibe district.

The data and information gathered from focus group discussion also confirms a similar result generated from the survey. Both male and female participants in the focus group discussion agreed that females have relatively a higher workload than their men counterparts. The findings from both discussant indicates that higher workload of female's is especially due to their growing rate of involvement in works outside the home (in agricultural) activities than the rate involvement of their male counter parts in to home related activities. For instance, females including men attendant in the discussion highlights that female are involved in the activity outside home especially for the activities related to manuring, composting, seed dispersal and weddings in order to assist their husband .In the reverse, the males have an insignificant contribution to the home works like cooking, fetching ,collecting firewood, milking and other similar activities though the traditional bond of assigning home works only to females is changed to some extent ideally.

Further, with regards to roles and responsibilities, the focus group discussion forwards that the traditional division of labor especially in threshing and harvesting in general and ploughing in particular affects the female headed households .This is because since female headed household do not take a part in this activity alone ,they give their land and other necessary assets to share in irrespective of the level of their resource. In addition, this lowers the educational career of male's

child's in female headed since it is expected to cover this shortcomings, which further constrain the development of human capital in the family. This all higher work load of women added with unequal distribution of work division affects the human and financial capital of females especially female headed households ,then lowers their adaptive capacity (which in turn have a big picture on their vulnerability to climate change).

These findings of gendered based activity is consistent with the studies of Agnes(2010) in south Africa on climate change and gender. This study proofs the existence of unequal roles and responsibility among genders so that female are suffering from extra work load and then works a longer hour than their men counterparts.

4.2.2 Resource Ownership and Control Profile

Resource ownership and control over profile has been analyzed based on the resource that are essential in rural livelihood activities .These resources includes land, cattle, money or cash and various equipments(which are the elements of the five rural livelihood assets). Then, a better ownership and control over these resource is assumed to have a positive contribution to adaptive capacity and then defines one's vulnerability level to climate change and variability. Both in male and female headed household, the ownership of resources like land, cattle, money and equipments are basically jointly owned by both female and males within their respective household.

In male headed households, resource like land is mostly owned by both sexes, which is around 96.3% while there is a difference in ownership of equipment between male and female within the household. Joint Ownership is also similar on cattle's and cash(money) where both are the owners in the male headed households. In the ownership of equipments, around 56% is commonly owned while the remaining parts are under the ownership of males. With regards to land ownership, data from key informant interview especially kebele administrative officials and focus group discussion, shows that land ownership is joint where both male and females have equal right over land approved by providing land certificates to them. However, land ownership was not as much inclusive of females before years where only males considered being the owner of the land. In the case of female headed households, the land ownership is exclusively

owned by female since she leads the family and responsible for all activities in the family if there is no young child in her home.

In general, It is assumed that a good access and ownership of resource like land, cattle and money has an important role on the adaptive capacity of individuals. Ownership of this resource within the household has a similar pattern where the majority of ownership is joint especially in male headed households (which are absolutely owned by males before). However, such kind of attitude is developed recently according to females discussants ,during focus group discussion, where they don't have equal access and ownership on such resources compared with to the males within the family.

Despite of the joint resource ownership especially in both male and female headed household, the resource control over resource have a different figure as we see from table 7.

Sex of household	Activities done by	Land	Cattle	Money/cash	Equipments
		Percent	Percent	Percent	Percent
Male HH	Male	84	51	65	58
	Female	3	3	7	3
	Both	13	46	28	39
	Male	25	9	14	13
Female HH	Female	55	36	43	41
	Both	20	55	42	46
χ^2		42.569* $df=1$			

(* indicates significance at less than 1% confidence level) source: Own calculation, 2014

Table 7: The profile of gender control over resources in both male and female headed households

In male headed household, the control over resource(land, cattle, money or cash and majority of the equipment) is under the dominance of males. Especially, land and money is highly controlled by the male in 85% and 65% respectively. This implies that, females have a little contribution in

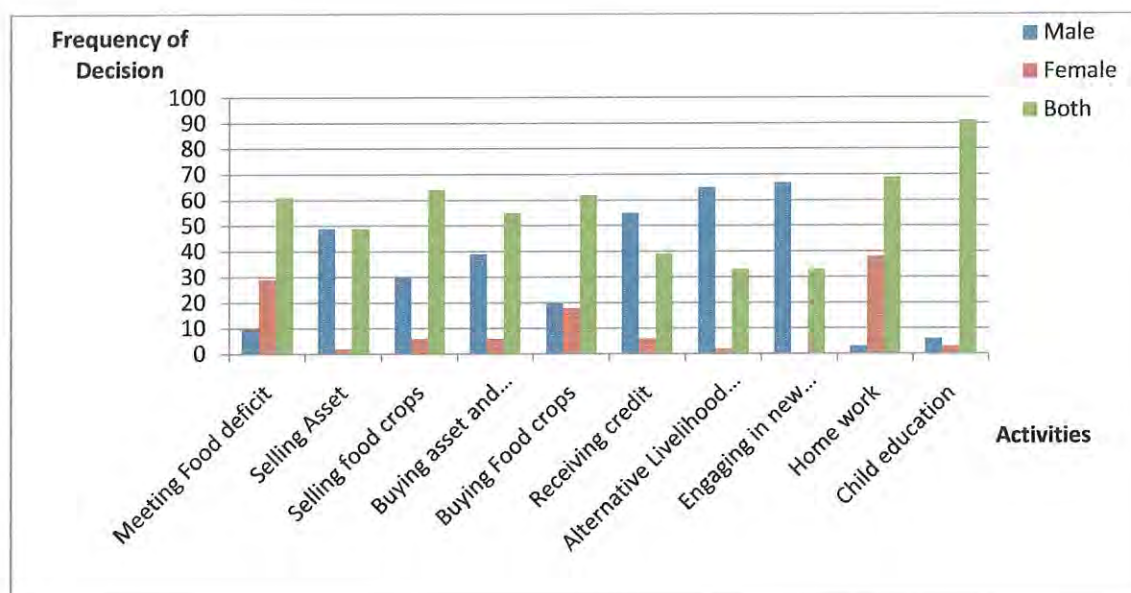
the decision to expenditure, land renting or leasing compared to males in male headed households. statically, significant relation was observed between sex of household and the control over resource in the district at $\chi^2=42.569$, $df=1$, $P=0.007$.

In female headed households, female are responsible in controlling these resources(land, money, cattle and equipments).For instance, majority of the land (55%)is controlled by the females while the other resource is commonly controlled among the families. However, the joint ownership shows a better figure in female headed households compared to the male headed households.

The discussion with focus group also reveals that male controls over these resource high in male headed house hold while females also share the same character when they are head of their family. Unlike female headed households, control over source is limited among females in male headed households where the majority of decision is made by their male counterpart. In general, the implication is that, females have a lower control over resource than male in the district.

4.2.3 Decision Making level

The survey portrays that most of the decision making is conducted jointly by males and female, still the dominance of males is visible compared to females. The assessment result shows that women's decision making level is higher in a less productive areas than more productive areas, that adds a little value to their adaptive capacity ,especially in male headed households. As we observe from the decision making level of male headed house hold, Unlike that of males, female contributes a lower percentage to the household decision unless it is open for both for decision.



source : Own field survey,2014

Figure 5: Percentage of decision making level in male headed households.

As we observe from figure 5 , male headed household decision making level as an example, even though majority of the activity is conducted by the joint decision of the both male and female, the involvement of men is higher compared to females in majority of the activities. For instance, activities like receiving credit from credit organization(relatives),engaging in alternative livelihood activities and engaging in new income generating are primarily dominated by the male in 55%,65% and 67% respectively. The contribution of female decision to the same activity is only limited to below 6%. In addition, male have also an absolute dominance over females with regards to the decision on the selling and buying family assets .However, female has also the dominance in the decision with regards to home works like meeting up family food deficit and home work like decision to food preparation.

In the case of female headed households, there is a variation on decision making since the woman become in charge and makes most of the decisions. However, there was also a case where the two (male and female within the family),made decision jointly. However, in opposite to male headed households, decision like selling seeds ,selling food crops and buying family assets are dominantly conducted by females than their males counter parts in their family.

Basically, meeting up a family food deficit, home hold work and child education is entirely open to the decision of female than male by 59%,62%and 15% respectively.

In general, there is some improvements (changes) in gender relation to the females participation that are important for their lives even though, the participation of men's is still high in making decision on major issues than woman's within family . This in turn will hinder females from expressing their ideas and opinions, thus, affects their participation in their common life. Since the participation of females are limited by the dominance of their men counter parts on their common asset, they have a greater probability to be vulnerable at the time of climate risk, in reversing their shocks through decision on their livelihood assets.

The key informant, especially the women affairs and the FGDs from both groups of men and females ,also reveals that the improvement of family decision making especially on the involvement of the female as a new sprit. However, they forward that still the dominance of the males are high especially in male headed households compared to female headed households.

This is consistent with some findings of Agwu and Okhimamhe (2009) on the four communities of Nigeria. Even though, the communities present different situation, the study generally that reveals that females reduced access to economic resources that often a marked economic dependence on their husbands, which leads to their reduced participation in decision-making at home and in the public sphere. According to this study, men are generally those who make decisions regarding the use of family income, especially in the case of major expenses (while women often make decisions regarding expenses related to food and their children). Similarly, study of Agnes(2010) on gender and climate change in South Africa conducted on the gender and climate change in South Africa also presents similar finding where there exists a higher participation of men's in decision making and control over major resources.

4.3 Gender Perception on climate change and variability

4.3.1 Perception on climate extremes

Regarding the climate extremes in the study area, male and female headed household has been asked whether there is climate change or not in their respective area based on their perception and observation. The major climate components of climate variability (according to the available literature with reference to the study area) are oriented to the respondents in assisting to memorize the happenings of the hazards in the past ten years. Accordingly, the gender perception is summarized in table 8.

Sex	Answer	Frequency	Percent	χ^2
Male	Yes	48	70	42.123*
	No	21	30	
	Total	69	100	
Female	Yes	47	68	df=2
	No	22	32	
	Total	69	100	

(* indicates significance at 1% confidence level), source: own field survey, 2014

Table 8: Perception on climate extremes

With regards to the gender perception in the district including each sample kebele's ,statically, significant relation was observed between sex of households and perception on climate extremes in the district where $\chi^2=42.123$, $df=2$, $p=0.002$

However, male households tend to be perceive the changes slightly than that of female headed households. For instance,70% of males in the district perceive that there is a climate variability compared to that of 30 years while 30% of respondent perceive that climate is similar to that of 30 years.

In female headed households, most of the female respondents (68%) perceive that there is a natural hazards in their area compared to that of 30 years while a small percentage of female respondents(32%) perceive climate is the same to that of 30 years in the study area

The perception of male and female is assessed by agro ecologies and summarized according to table 9.

Household		Sombo (highland)		Guttoo (midland)		Dambi Dima(Lowland)	
		Yes	No	Yes	No	Yes	No
Male	Count	20	3	9	14	19	4
	Percent	87	13	39	61	83	17
Female	Count	19	4	9	14	19	4
	Percent	83	17	39	61	83	17
χ^2		88.86* $df=2$					

(* indicates significance at less than 1% confidence level) source: own field survey, 2014.

Table 9: Gender perception on climate extremes by sample kebele's (agro ecology)

Like that of at district level, still, at kebele (agro ecology) level, statically, significant relation was found between gender perception across agro ecology. However, in Guttoo (midland) ,most of the respondent do not perceive climate variability in their area regardless of their sex. Just,61% of the male headed respondent do not perceive the change while 39% of them perceive the change ,which holds similar trends in females respondents. In contrast to this, in highland agro ecology ,equal percentage of male and female respondent i.e. 83% perceive the change in climate while 17% of both sex do not perceive the change.

In highland and lowland sample kebele's, higher percentage of the respondent perceive as there is climate variability in the area comparing to the Dambi dima (midland agro ecology). For instance, In lowland agro ecologies,87% of the men confirms the change while 83% of the female respondents perceive the climate change in the area. Generally, there is almost a similar trend in perception between male and female headed respondents across the agro ecologies.

However ,the data from the districts agricultural and rural development office shows that there is a higher occurrence of climate variability especially the prevalence of drought, high flood, cyclone high land degradation in almost in all agro ecologies of the district. The data from focus group discussion also confirms the same things to the survey results. The attendant especially from the agricultural experts deeply explained that highland agro ecology is highly prone to

flood and massive soil erosion due to its fragmented land topography. In addition, they forward that lowland agro ecology has no such environmental problem(so that not exposed to flooding and high erosion),but this agro ecology is highly suffering from rainfall variability, drought, massive crop and animal diseases. Hence, the group discussion reach in conclusion that midland agro ecology is relatively better except some crop and animal disease.

4.3.2 Perception on Temperature change

With regards to the temperature change in the district, a respondent in each agro ecology has asked whether there was a temperature change or not in their respective area based on their observation during the past 30 years. Then, the respondent have given the option to say decrease, no change and increase according to their perception. The respondents answer is summarized according to the below table.

Sample kebele's	Male HH			Female HH			χ^2
		Decreased	No Change	Increased	Decreased	No Change Increased	
Sombo	Count	2	5	16	7	13	3
	percent	9	21	69	30	57	13
Guttoo	Count	0	12	11	0	8	15
	percent	0	52	48	0	35	65
Dambi	Count	0	1	22	0	2	21
Dima	percent	0	4	96	0	9	91

(*implies Significant at 1% level) and NS= implies Not Significant at less than 10% level)

Source: own calculation, 2014

Table 10: Gender perception on temperature change across the sample kebele's

In Sombo, both male and females perceive a decrease in temperature by 9% and 30% respectively. However, in this agro ecology, majority of the females (57%) perceive as no change in temperature while 59% of male respondent perceive as an increment over the last 30 years.

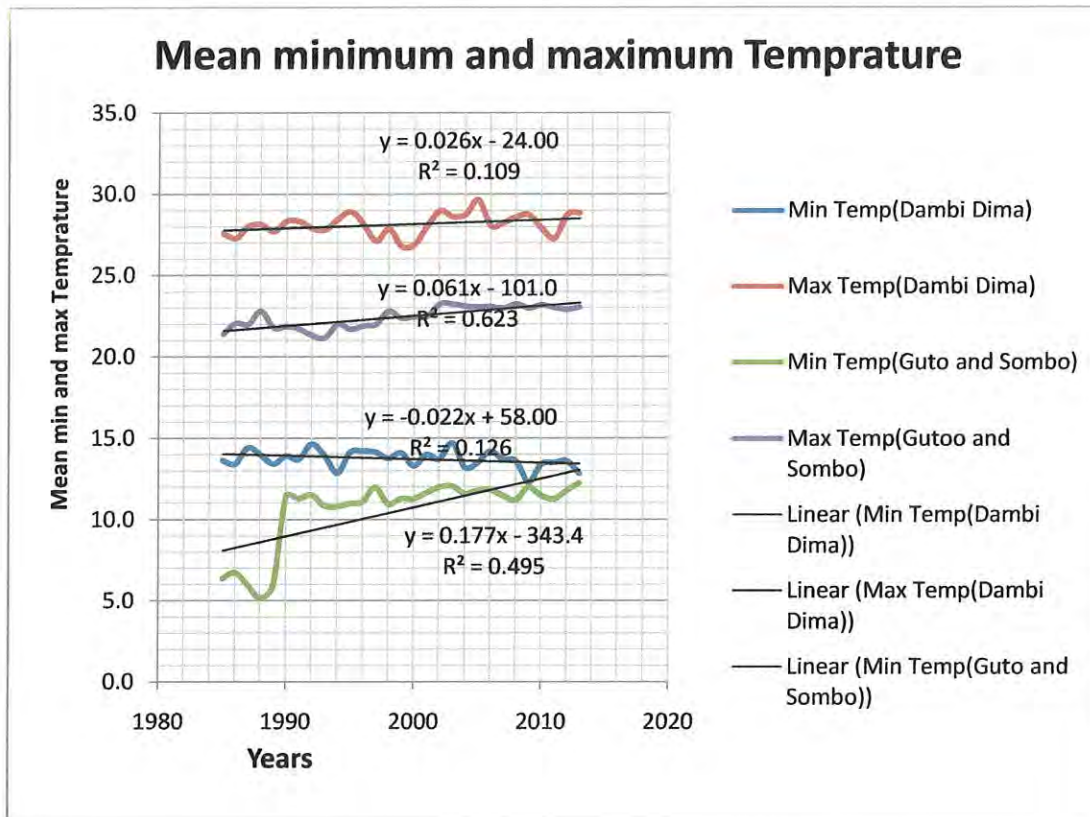
In Guttoo (midland agro ecology), majority of the respondent forwards as there is a temperature increment in their area. In male headed households, 52% perceive as no change while 48% perceive its increment. Similarly, in female headed household, 35% perceive as no change while

65% of the females reports the increment. In general, in this agro ecology, there is no report in temperature decrement , however, 43 % the respondents perceive as there were no change in temperature while 57% of the respondent perceive the increment.

In Dambi Dima(lowland agro ecology), majority of the respondent perceive the increment in temperature. In male headed house hold,96% perceive as the increment while the remaining percentage report as it is .Similar trend was seen in female headed household where 91% perceive the change while only 9% reports as no change. In general, in this agro ecology, almost 93% of the respondent perceive an increase in temperature for which 45% accounts to female perception while 48% to the male respondents

Generally, according to the survey, majority of the respondents (male and female headed households) in the three agro ecologies perceive that temperature is increasing from time to time over the last 30 years. On average, the survey indicates that 64% of the respondents perceive the increment in temperature while 31% perceive as it was decreased. Only 5% perceives as the no change in temperature over the intended years. However, statically significant variation was not observed in the lowland and midland agro ecology between gender on their perception to temperature change, for which $\chi^2=1.41^{NS}$.

According to figure in 6, the minimum and maximum temperature trend analysis also verdict the findings of gender perception to a little extent. As its mentioned in the methodology part, highland and midland agro ecology is represented by the same temperature data while lowland agro ecology is represented alone. The trend analysis shows that there is a higher variability of temperature across the years in all agro ecologies including a slow increasing trend especially in the lowland than the other agro ecologies.



Source; Data from BARC and Shambu metrological station,2014

Figure 6: The temperature trend analysis of the districts by kebele's (agro ecologies)

Similarly, as a country, climate trends reported in Ethiopian's First National Communications to the UNFCCC, climate change is clearly visible in temperature of Ethiopia; with an increasing trend in time($0.37^{\circ}\text{C}/\text{decade}$).Hence, the gender perception is on the same line with the analysis of temperature trend in the district .However, there is slight variation among gender (male and female) on their perception to this increment .Females perception is low in relative to their men counter parts. For instance, majority of the females in the highland perceive as no change is happening to the temperature, which is not in the same direction to the trend analysis. This may increases their vulnerability, since the adjustment livelihood activities lags with their understandings.

4.3.3 Perception with change in Precipitation(rainfall)

Just like that of Temperature perception, here, the respondents were asked to rate their observation as ‘‘decrease, no change and increase’’ as a categorization scheme to their perceptions. Then, the outcome of the survey is summarized as below.

Sample kebele's	Male			Female			χ^2
	Decreased	No Change	Increased	Decreased	No change	Increased	
Sombo	count	16	7	0	12	11	0
	percent	70	30	0	52	48	0
Gutoo	count	17	6	0	15	8	0
	percent	74	26	0	65	35	0
Dambi	count	20	3	0	14	6	3
Dima	percent	87	13	0	61	26	13

(* indicates significance at 1% confidence level) source; Own survey,2014

Table 11: Gender perception on Precipitation across the sample kebele's (agro ecologies)

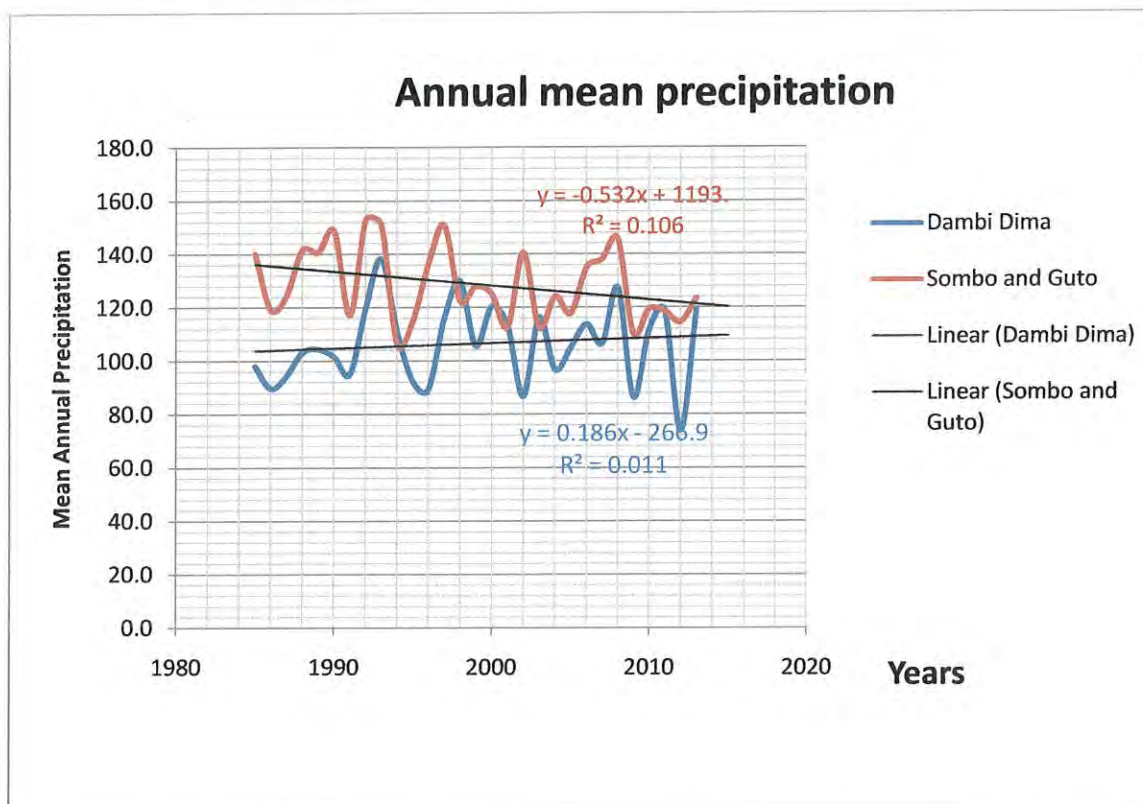
In the sample kebeles, 70% of the male in Sombo (highland agro ecology) perceive as there is a decrement in amount of rain fall while 52% females in the same kebele perceives the decrement .In other words, neither of the household perceive the increment of rain fall in this kebele. Similarly, the men household in Gutoo and Dambi Dima perceives a rainfall decrement with 74 % and 87% respectively .Females in the three agro ecology reports a lower perception to increased rainfall over the intended time frame works compared to the males.

At district level, 56% of male respondents perceive a decrease in rainfall amount while 44% of the female falls in the same category. This implies that males are relatively perceiving a rainfall decrement than their female counter parts. However, higher percentage of female (61%) perceive as there is no change in rainfall in the district than males. Statistically, the sex and the perception to rainfall change has a significant relationship across each agro ecology ,for which $\chi^2=1.46^{NS}$

Generally, according to the survey, majority of the respondents (male and female headed households) in the three agro ecologies perceive that rainfall is decreasing from time to time over the last 30 years. On average, the survey indicates that 68% of the respondents perceive the decrease in rainfall amount while 30% perceive as it is to before 30 years. Only 2% perceives the

increase in rainfall. Stastically, significant relation was not found between the sex of household and agro ecology on the perception to precipitation.

As we observe from the below diagram, the rain fall trend analysis (in each agro ecology) of the 30 years shows a high an annual variability (fluctuation) and also reflects a different trends across agro ecologies. Basically, the rainfall trend shows a fluctuation (variability) and decreasing trend from time to time in highland and midland agro ecologies than the lowlands as it is depicted in the diagram. However ,the precipitation in lowland agro ecology shows linearly an increasing trend. Hence, the gender perception in low land agro ecology is not good in comparing to the other agro ecologies.



Source; Data from BARC and Shambu metrological station,2014

Figure 7: The Precipitation trend analysis of the district by kebele's (agro ecologies)

4.4 Analysis of gender vulnerability; Results from Vulnerability Index

4.4.3 Measuring gender vulnerability level by agro ecology

For the analysis of gender vulnerability in each agro ecology, PCA was run on all the indicators listed in table 1(indicators of adaptive capacity),table 2(indicators of sensitivity) and table 3(indicators of exposure).Based on the earlier arguments in the usage of PCA in constructing indices, the first PCA which is positively related with adaptive capacity indicators and the other which is negatively related to sensitivity and exposure indicator was selected. Higher values of vulnerability index shows less vulnerability and vice versa, since adaptive capacity is positively loaded and the other IPCC factor(sensitivity and exposure) is negatively loaded.

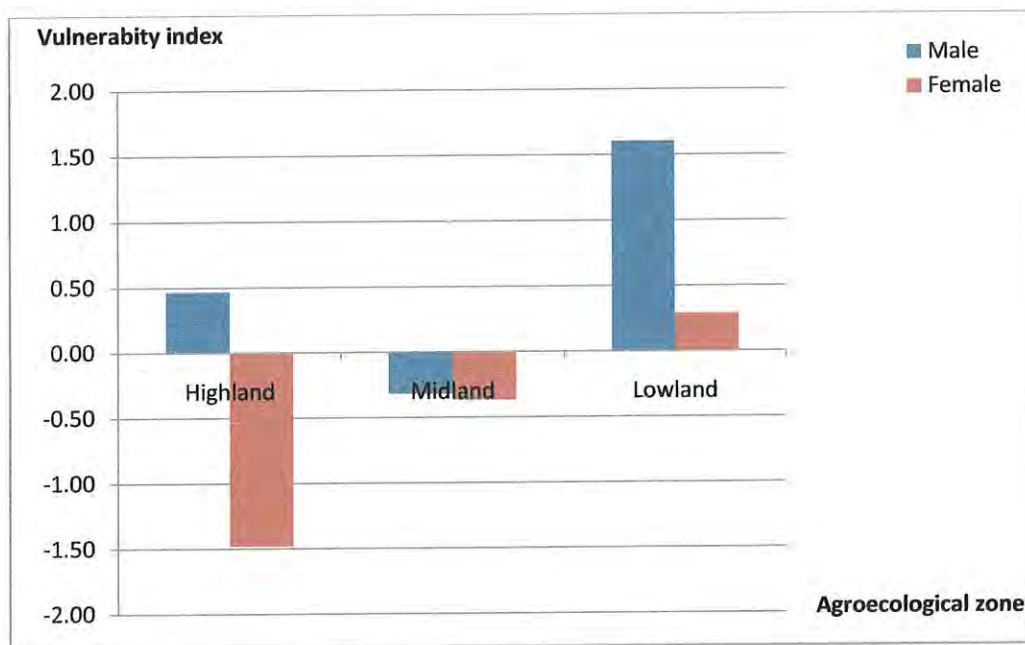
From the weights obtained for each indicator within each asset category, individual index values for each asset type was constructed to analyze which asset group contributes the most to total adaptive capacity. The same procedure was used for the indicators of sensitivity and exposure.

In construction of indices, factor scores from the first component were employed to construct indices for each agro ecology .These factor scores of the first component were given in Appendix 3.Then, each index computation for each variable uses these factor score along with their normalized value. Appendix 4 represents the male normalized values of each variable by their mean and standard deviation while appendix 5 represents the normalized values of female across each agro ecology.

Then, based on the formula given in equation 4 ,in the methodology part, the vulnerability index of each agro ecological zone was calculated for both male and female separately. The higher vulnerability index shows lower vulnerability level and vice versa. Then, in order to identify the vulnerability level of each agro ecology from gender dimension, we use the average vulnerability of male and female in their respective agro ecology using equation 5.

Finally, the net effect of adaptation, sensitivity and exposure computed from principal component analysis with respect to male and female in each agro ecological zone is given diagram 8.

The vulnerability indices of gender (male and female)in each agro ecology



source; Own calculation,2014

Figure 8: The vulnerability indices of gender in each agro ecology

It is apparent from the figure that the net value is only positive for both male and female living in the lowland areas; while it is negative for those living in midland and highland agro ecologies. On average, the most vulnerable agro-ecology is the highland followed by mid land agro ecology. Lowland agro ecology is the least vulnerable in the context of the study area due to its high potential in natural and financial capital relatively . In the extraction of vulnerability level, the weighted indices of each livelihood asset is used for comparing the contribution of that sub-component to the overall vulnerability for that specific agro ecology or gender .Hence, the higher weighted value of the indicator, the better measurement in that the gender or agro ecology has in that specific variables and vice versa.

In highland agro ecology, the higher vulnerability of gender comes from the highest vulnerability of females in relative to men .Compared to other agro ecology ,the weighted indices of the livelihood asset indicator shows relatively a lower value (physical ,natural and human) especially in crop diversity, livelihood diversification, irrigation potential, ownership of communication

media and level of academic qualifications so that this agro ecology has no better measurement in these specific factors, compared to the other agro ecologies. Hence, these livelihood asset indicators shows strong deviation negatively from other agro ecologies so that contributes highly to the vulnerability of this agro ecology, in addition to other factors. From gender perspectives, females in this location are the most vulnerable in relative to the other agro ecology. Especially, the higher vulnerability of female is aroused from the low access to academic (high illiteracy rate), lower agricultural training, lower access to fertilizer, lower farm land size, low amount of land under irrigation as well as high dependency on natural resource based income especially on forest products are among the major impediments that the factor analysis reveals compared to their male counter parts. According to the focus group discussion and key informant data, this agro ecology is far from all infrastructure facility so that the communities are not easily accessible for education, agricultural training including low access to market, which lags their livelihood diversifications, as the factor analysis reveals. In support of this argument, according to Deressa et al., (2008) findings on the vulnerability of rural farming community in Ethiopia, communities that are far from infrastructure is prone to climate vulnerability than those nearer to the infrastructural facilities.

In the Mid land agro ecology, compared to the highland agro ecology, the vulnerability of men and female did not show a significant variation. The weighted indicator values of its livelihood asset shows that the gender in this agro ecology is highly suffering from food insufficiency, lower level of academic and training with regards to agriculture, smaller amount of farm land size, low saving amount and relatively low irrigation potential both in male and female headed households. The vulnerability of females are relatively higher compared to males especially due to health problem (i.e. malaria), low livelihood diversification, low access to insecticide and pesticide compared to other the assets. However, the vulnerability level of female is lower than that of highland agro ecology by far, since the women's in this agro ecology are better in their financial and natural capital than the highlanders.

In relative speaking, lowland agro ecology is the least vulnerable to the impacts of climate change and variability due to its comparative advantage in the possession of financial and natural capital including human capital both in male and female household supported with a being in a stressful condition (high natural hazards). From the listed variables considered in vulnerability

analysis, the lowland is not vulnerable because of a better livelihood assets (natural, physical and financial) especially better livelihood diversification under, higher gross annual income, better saving amount, higher crop diversity (due to the availability of fruit and vegetables), a comparative lower dependence on agricultural income (better income from nonfarm activity), relatively larger farm size with optimal number of farm plots, moderate slope of farm lands, better size of land under irrigation, better access to early warning information (since there is a higher level of communication media). From gender dimension, even though both male and females data do not show a high significant variation, still females are relatively vulnerable due to a lower level of gross annual income and saving amount in relative to their men counter parts. However, females in the lowland agro ecology is better than the those located in highland and midland agro ecologies. This is due to their higher social and human capital (in addition to the natural ,physical and human capitals) benefitting from the proximity to all infrastructure (since it is nearest to the Bako town, the districts capital).

According to the interview with the districts agricultural offices, the lowland agro ecology (Dambi Dima kebele) is among the one within the range of their center of excellence in agricultural research in cooperation with Bako Agricultural Research Center (BARC) so that the communities in this agro ecology is the out most beneficiary from this higher expertise's. Especially, the lowland communities of Bako Tibe are known for their mass production of maize benefitting from new findings of this agricultural research center. As a evidence, the weighted value of the factor analysis on the usage of improved seeds shows a greater variation positively compared to the other agro ecologies. In general, Added with a higher flat land topography ,high potential to irrigation and higher range of crop diversity, the informant interview underlines that the proximity to this agricultural research consolidated their agricultural output and there by livelihood assets not to easily vulnerable to the climate related shocks like the other agro ecologies. In support of this finding, even though the type of community under study is different (not from gender perspective), this study finding is consistent with the major findings of Bezabih, Getu, and Mengistu (2012) on the climate induced vulnerability of rural community based on agro ecological classification, in northern shoa of Ethiopia ,that reveals the lowland community is relatively better in vulnerability than other agro ecologies (highland and midland agro ecologies) to the impacts of climate change.

CHAPTER FIVE

CONCLUSSIONS AND RECOMMENDATIONS

5.1 Conclusions

The research was aimed to contextualize gender vulnerability to climate change and variability from multidimensional view. The study reflects that, gender livelihood assets takes the central point in determining the vulnerability of men and females in the district. These livelihood assets were gradually originated from the roles, responsibility and activities that the gender discharges in the community. Hence, in order to analyze vulnerability level, the researcher assessed ,initially, the gender activities, resource ownership and control ,decision making level including the gender perceptions in order to better acquainted and quantify the vulnerability of men and women in different agro ecologies of the district.

The assessment of gender based roles and activities in the district shows that females have a higher work load and unfair traditional work division. Especially ,the higher work load of females are highly associated with their higher participation in the field works(agricultural activity) ,in addition to their home activity. Conversely ,males are not participating in the home activity in equal rate to female involvement in the field work .In addition, the study proofs that there is a traditional work division that limits females from ploughing, harvesting and threshing so that female in general ,female headed household in particular, requests males who perform these activities. Hence, the study result reflects that this unbalanced work division and workloads exposes females to additional expenditure and also healthy problems, which in turn affects their financial and human capital compared to their male counter parts. If such trend continuous in the study area, climatic stress on natural resource especially on water and forest resources exposes an additional burden on females, in bringing an additional threat even to their traditional works of collecting fire wood or fetching water. This is because ,they will be ordered to travel longer distances to fetch water or wood, that limits their opportunities to branch out into other non-traditional and self-improving activities such as education ,better healthy, so that exposing them to severe health risks or lower their adaptive capacities.

In addition, the decision making level of gender with in a house hold also shows a higher involvement of males than females and still the percentage of females participation in decision

making shows a lower figure. Further, the analysis of the gender decision making level shows that females are limited to around the home like child caring, decision to solve deficit while the males have a greater contribution to activities that determine the livelihood of the family like selling and buying fixed assets, buying and selling and livestock's, the decision to participate in a new income generating activities, that clearly shows the imbalance between male and female in decision making level. These under representation of women in decision making limits their ability to contribute their unique gender specific expertise as a community in combating climate change in general and increase their vulnerability in particular.

In resource ownership and control over profile, the findings of the study shows that a good improvement has been seen in equitable resource ownership especially in the land, cattle ,money and other equipments relatively. However, statically significant variation was observed between male and female headed households in resource control over profile. Basically, the study result shows that resource control over is still under the control of males especially in male headed household. Such biased roles, unequal access and control over resource prevents females from the decision to sell, rent and doing something on their livelihood asset at the time of emergency ,implying that women's are easily vulnerable at the time of climate related hazards like drought, flooding and fires.

With regards to gender perception on climate change and variability in the sample kebele's, statically significant variation was not observed between male and female headed households in the districts or across agro ecologies .However, on average, males tends to perceive the change than female. With this their lower perception, females may face a difficulty in coping up with a short term and long term climate variability's especially to the higher variability of rainfall in the district, as one can observe from trend analysis.

The results of vulnerability analysis shows that females in residing in all sample kebele (all agro ecological zones) are more vulnerable to climate change and variability, compared to the males. At agro ecology level from gender perspective, highland agro ecology is the most vulnerable while lowland agro ecology is relatively the least vulnerable to the impacts of climate change. The results imply that adaptive capacity of a gender, through their livelihood asset ,is the most important component to determine the overall vulnerability of the locality. Even, Improving the

adaptive capacity also has indirect implications on improving the sensitivity of the gender. For example, creating opportunities for non-farm income (financial income) reduces the extensive dependence of the community on natural resource based income, thereby reducing gender sensitivity towards climate change and extremes. The gender vulnerability comparison across agro ecology also shows that the gender or areas with higher livelihood assets(e.g. lowland) has a better adaptive capacity even in being under stressful condition of natural hazards.

The intra-analysis of the components of vulnerability shows that the most vulnerable social groups ,especially females ,are the ones with the lowest adaptive capacity and they are also the ones facing sensitivity irrespective of the locality. Thus, among the various components of adaptive capacity, improving livelihood assets of females especially physical, human and natural capital improves their adaptive capacity and also reduces their sensitivity and finally decreases their overall vulnerability. For example, better irrigation facilities (physical assets) decreases the sensitivity of crops to droughts.

5.2 Recommendations

Based on the findings of the study, the researcher forwards the below adjustment and policy implication to minimize the gender vulnerability in the study area.

- Creating a conducive environment in provoking and restructuring gender activities ,work division and workloads, resource control, participation at all levels(household and community) in a manner that benefits both parts of these social groups in particular and the whole community in general.
- Awareness should be given to both male and females in order to raise the decision making level of females in their respective family and in the community as a broad.
- Local metrological station should be established especially in the midland and highland agro ecologies in order cope up with the higher of climate variability in the study area.
- Better infrastructural development needs to be undertaken in the district especially in midland and highland agro ecologies to increase the accessibility of farmers to different services ,hence, enhancing their adaptive capacity.
- Policy emphasis should be placed to create opportunities for non-farm livelihoods options in a manner that that reduce gender, especially females, dependence on natural resources based incomes.
- Policy direction should be proposed that improve women's livelihoods and strengthen adaptation by ensuring women's access, control and ownership of resources (such as land, livestock, property and income opportunities), and access to development resources such as credit, information, training and outreach, and culturally appropriate and labor-saving technology .
- Policy measures should be in place for the arrangement of activities like provision of post-disaster relief measures areas both with a higher exposure(i.e lowland agro ecologies) and lower adaptive capacity(i.e. highland agro ecologies).
- Finally, gender disaggregated data and focused research is further required to identify the gendered impacts, coping strategies and adaptation priorities of women and men in the study area

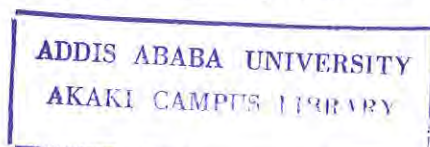
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Appendix 1: Household Survey

College of Development Studies
Addis Ababa University
Center for Environment and Development

Introduction

This survey is being carried out by **Zina Regassa** to collect a basic information (data) about Gender and climate change in Bako Tibe district, aiming to analysis Gender vulnerability to the impacts of climate change, in order to bring an understanding on how to locate men and women in climate change discourse ,for a sustainable adaptation and mitigation measures.

The objective of this questionnaire is to collect primary data on socio-economics, ecological, and climate variability data's that are required to analysis Gender Vulnerability to climate change and variability in the three agro-ecologies of Bako Tibe District

Hence, the researcher kindly requests you to give your response freely and accurately to the success of this study. All your information is confidential and only used for this research.

Lastly, I thank you for all your cooperation !

Household survey

Survey Information

Name of respondent _____

Name of enumerator _____

Date of Enumeration _____

Agro ecology; 1 =Lowland 2 =Midland 3 =Highland

Study area Bako Tibe district, Oromia region, Ethiopia

7 February,2014

General Information

I. Socio-demographic profile Characteristics

1. Sex of household; 1= Male 2= Female

2. Age 1= <15 (child headed family) 2=>15-30 3=>31-65 4=>65

3. Religion 1=Christian orthodox 2= Muslim 3=Protestant 4=other, specify _____

4. Marital Status 1=single 2= married 3= divorced 4=widowed 5=others _____

5. Size of family; Would you describe the age structure of your family, using the below table ?

		Sex (in number)		
		Male	Female	Total
5.1	<14 year			
5.2	15-65 years			
5.3	> 65 year			

II. Adaptive Capacity characteristics

1. Human capital

A) Academic and Training

1. Would you tell us your academic back ground ,in terms of years of schooling please?

_____ years (grades)

2. Would you name the highest academic background of you or your family, according to the below table ,please ?

Family Part	The highest Academic class (grades) in the family	Sex	
		Male	Female
Head of household			
Family member			

3. Have you ever get training, with regards to your livelihood (occupation), please? 0=No 1=Yes

3.1 If yes, how many times (in past one year)? _____ time(s)

B) Food status

1. Do you have enough food throughout the year ,please ? 0=No 1=Yes

1.1 If No, for how many months you are food insufficient? _____ month(s)

C) Healthy Status

1. Did you and any of your family members chronically ill (seek) i.e. due to malaria, in the past six months, so that

Miss your work/school? 0=Yes 1=No

If yes, then

1.1 How many member of your family miss their work/school? _____ person(s)

1.2 Identify the most frequently seeker sex; 1= Male 2= Female 3=Both

2.Social Capital

Membership in formal and informal groups, social connectedness and Network

1. Would you list your role(position) in your community, starting from the past one year, if any, please? (use; Only community member, Religious leader, community leader (Kebele administrative, committee in the got, One to five group leader as reference)

a) _____ c) _____
b) _____ d) _____

2.Do you belongs to any formal or informal social group? 0=No 1=Yes If Yes,

To how many social groups you belongs, please? _____social group(s)

(use; Ekub, mahiber, dir, Women's association, Farmers union as a reference)

3. Have you participated in election at community and national election, since 2010 ? 0=No 1=Yes

3.1 If yes, how many times? _____time(s)

3.Physical Capital

Modern Agricultural input and technologies Profile

1. Do you use insecticide and pesticide for your agriculture /livestock production? 0=No 1=Yes

2. Do you use modern fertilizer application to your farm land, please? 0=No 1=Yes

3. Do you use improved seeds, please? 0=No 1=Yes

4. Do you use irrigation technology for agriculture, please? 0=No 1=Yes

5. Have you a modern communication media(i.e. TV, mobile or Radio)in order to access information ,please? 0=No 1=Yes

6.Would you tell as the type of your house ,please ?

0=Thatch roof, thatch/wooden/stone wall 1=Iron roof, wood/stone/mud wall

3=Other, specify _____

4.Financial Capital

Wealthy Profile

1.Do you have access right to any financial organization for saving your resource or to get credit, please? 0=No 1=Yes If No why _____

2. Do you have livestock? 0=No 1=Yes

If yes, List the kinds and numbers of livestock, according to the below table

Type of Animal(s)	Size in number
Ox	
Cow	
Goat/sheep	
Horse	
Mule	
Donkey	

3.Would you list all livelihood activities you and your family(livelihood diversification) practice? a) _____ c) _____

- b) _____ d) _____
4. Would you tell us ,please, your Gross annual income
- 5.1 From agricultural or farm activity(crop,livestock,selling forest products)? _____ birr
- 5.2 From off farm activity(salaried job, skilled nonfarm job, labor wage) ? _____ birr
- 5.3 Remittance received from family or friends ? _____ birr
5. Do you save money at financial organization or in your home in this year ,please?
0=No 1=Yes If yes. how many _____ birr
6. Agricultural livelihood Diversification
- a) Do you or someone else in your family raise animals? 1=Yes 2=No
- b) Do you or someone else in your family raise animals? 1=Yes 2=No
- c) Do you or someone else in your family collect something bush from forest ,lakes and rivers to sell ? 1=Yes 2=No
- D) Do you or someone else in your family Hand craft
- E) please ,list if
7. Crop Diversification; Would you list the type of crop and horticulture you and your family grow, please?
- a) _____ c) _____
- b) _____ d) _____

5. Natural Capital

1. Do you have your own land, please ? 0=No 1=Yes
- If yes, Would you tell us the size of your farm land (in hectares?)
- 3.1 Cultivated land _____ 3.3 Grass and wood land _____
- 3.2 Homestead _____ 3.4 Irrigated land _____
2. How is the slop of your cultivated land? 1. Plain 2. Hilly 3. Highly and sloppy 4. Mountainous
5. Other, please specify _____

II. Sensitivity Characters

1. Did you and your family severely injured or died due to natural disaster (flood, drought, cyclone), please? 0=Yes 1=No If Yes,

1.1 How many members of your family is seriously injured or died directly or indirectly due to this natural disasters?

1.2 which member of your family is severe impacted? 1= Male 2= Female

2. Have you face some damage to your livelihood activity and due to natural disaster in the past 10 years, please? 0=Yes 1=No If Yes, fill the below table

2.1 Total livestock death due to flood/landslides/drought/hail over the last 10 years?

Type of animal death in this respective year	Year	No. of animal death in kind	Money value in that year
	2004		
	2005		
	2006		
	2007		
	2008		
	2009		
	2010		
	2011		
	2012		
	2013		

2.2 Total crop damage due to flood/ landslides/drought/ hail over the last 10 years, in birr

Damaged crop	Year	Unit of measurement	Money value
	2004		
	2005		
	2006		
	2007		
	2008		
	2009		
	2010		
	2011		
	2012		
	2013		

3. Would you tell us the amount of income you generate from the below activity annually, please?

Types of activity	Details of the activity	Income generated from each activity(birr)
Farm activity	Crop production	
	Livestock rearing	
	Selling forest products like fire wood, timber	
	Honey and hand craft	
	Other	
Nonfarm activity	Salaried job	
	Petty business	
	Remittance	
	Wage labor	
	Skilled nonfarm job	
	Other,	

III. Exposure characters

Climate profile

1. Natural disaster and climate extremes

1.1. How many times this area is affected by natural hazards like flood/cyclone/drought, from 2004 to 2014? __times

1.2. Which type of hazard is frequently happening in this area in the past ten years?

1=Drought 2=Cyclone 3=Flood 4=Shortage of rain fall a long time 5= Other_____

2. Historical change in climate variables taken and adjusted from Bako Agricultural Research Center

3.1 Rate of change in average annual minimum temperature (1984 – 2014)

3.2. Rate of change in average annual maximum temperature (1984 – 2014)

3.3. Rate of change in average annual precipitation (1984 – 2014)

Activity profile, resource control and ownership and gender decision making Assessment

I. Activity Profile by gender

1. Which of the following activities is your family members associated with by gender
(Write gender code) Gender code: 1=Male 2=Female 3=both

Activities		Conducted by
Food(meal) preparation	Cooking wat	
	Making injera	
	Collecting firewood	
	Fetching water	
Agricultural activities	Ploughing	
	Seed dispersal	
	weeding	
	Harvesting	
	Threshing	
Livestock related	Milking	
	Manu ring	
	Composting	
Non-agricultural activities	Feeding and caring for children	
	House cleaning	
	Selling products	
	Buying home consumption	

II. Access to and Control over profile

Resources	Access			Control		
	Women	Men	Both	Women	Men	Both
Land						
Cattle						
Money/Cash						
Equipment						

III. Would you fill the below table, based on the **decision making process** of your family by gender (write gender code) Gender code: 1=Male 2=Female 3=both

Decision Making	Gender Code
Meet up food deficit	
Selling family asset(livestock, machineries)	
Selling seeds	
selling food crops	
Buying asset ,livestock	
Buying food crops	
Buying seeds	
Receiving credit from relatives, credit associations	
Alternative Livelihood activities	
Engaging in new income generating activity	
Household work	
Child education	

Climate Change Perception Assessment

- Is today's climatic conditions like drought, rainfall, flood that is the same to that of 30 years?
1. Yes 2. No
- What do you say about the trend of hot days over the last 30 years?
1. Increased 2. Not changed 3. Decreased
- What do you say about the trend of precipitation of now days, comparing to over the last 20 years?
1. Increased 2. Not changed 3. Decreased

Check list for Focus Group Discussion

Name of Agro-ecology _____
Number of participants in FGD _____
Name of Moderator _____
Name of Recorder _____
Date of the discussion _____

1. Did you observe any change in weather condition in your area ?
 - 1.1 what are those changes you observed?
 - 1.2 What impacts you observed due to these changes ?
 - 1.3 Do you think that men and women face these impacts similarly ? why you think as such?
2. what kind of livelihood strategy does men and women involved in your area ?
 - 2.1 Has the community changed their livelihood strategy in the last 10/20 years?
 - 2.2 Do the changed livelihood strategy minimize or increase the work load of men or women ? why you think as such ?
3. What is the division of work between men and women in house hold, in farm production and in the community ?
 - 3.1) Is there an improvement in the division of work between men and women currently ?
5. Is there any mechanism that control and who has access to and control of the resources ? if yes explain

Checklist for Key Informants Interviews

Name of Agro ecology(community)_____

Name of Interviewer_____ Date of Interview_____

Information on Key Informant

Name of local leader_____

Type of Leader_____

How long you have been in this leadership position?_____ (in years)

Age_____(in years) Gender; 1=Male 2= Female

What is your educational Qualification ?

1=No formal education 3=Primary complete 5=Secondary complete

2=Primary incomplete 4=Secondary incomplete 6=Diploma holder 7=Degree and above

1. Did you observe any change in weather condition or climate change in your area ?

1.1. What are those changes you observed ?

1.2 What are the impacts you observed due to this changes

1.3 Do you think that men and women has the same adaptive capacity to this climate changes

2. Is there any system or platform where environmental problems or climate change information are shared to the society?

3. Do you think that men and women's are equally affected by climate change ? If not why ?

3.1 what should be done to change this situation ?

4. Do you think that women and men have the same work load in your area ? If No, who has a higher work relatively ? explain with examples

5. Do you think that men and women have the same livelihood assets as well as equal level of resource ownership and decision making in their family ? If No, why you think as such ?

Appendix 2:Tropical Livestock Unit conversion formula (TLU)

Animal TYPE	Unit
OX	1.00
Cow	1.00
Calves	0.2
Sheep and Goat	0.1
Horse and Mule	0.8
Donkey	0.4
Chicken	0.013

Source; stork,1991

Appendix 3: Factor score of the first principal component

components	Sub components	Factor scores
Human capital	Academic	0.597
	Training	0.533
	Food sufficiency	0.195
	Healthy problem	0.172
Social capital	Role(position)in the community	0.529
	Membership in CBOs	0.403
	Political participation	0.549
Physical capital	Insecticide/pesticide usage	0.344
	Fertilizer	0.371
	Improved seeds	0.367
	Communication media	0.059
	Quality of House hold house	0.012
Financial capital	Access right to credit	0.112
	Livestock in TLU	0.237
	Livelihood diversification	0.242
	Gross annual income	0.251
	Saving amount	0.246
	Crop diversity	0.247
Natural capital	Farm land size	0.704
	Percent of irrigated land	0.577
	Slope of farm land	-0.059
Sensitivity	Fatalities	0.158
	Livestock damage	-0.009
	Crop damage	0.073
	Share of natural based income to total income	0.48
Exposure	Frequency of Natural hazards	- 0.42
	Rate of change in minimum temperature	0.408
	Rate of change in maximum temperature	0.5
	Rate of change in Precipitation	-0.436

Appendix 4: Normalized values of variables for Males

Components	Sub-component	Sombo(HL)	Guttoo(Midland)	Dambi Dima(Lowland)
Human	Highest academic qualification	0.143	-0.298	0.441
	No. of training	0.180	-0.180	0.427
	Food sufficiency	0.261	-0.174	-0.029
	Healthy status	0.498	-0.144	-0.205
Social	Role in community	-0.022	0.324	-0.085
	Membership in CBO's	-0.020	0.100	-0.199
	Participation community politics	0.260	0.143	-0.354
Physical	Access to insecticide or pesticide	0.267	0.079	0.179
	Access to fertilizer	0.105	0.048	0.191
	Aces to improved seeds	0.191	0.048	0.209
	Ownership of communication media	-0.201	0.179	0.072
	House type	-0.115	0.061	0.061
Financial	Aces right to credit	0.191	0.098	-0.197
	Livestock in TLU	0.043	-0.276	0.476
	No. of Livelihood activities	-0.255	0.255	0.494
	Gross annual income	-0.007	-0.086	0.215
	Saving at HH	-0.022	-0.114	0.335
	Crop diversity of HH	-0.165	0.097	0.670
Natural	Farmland in hectare	0.214	-0.154	0.314
	% of irrigated land	-0.273	-0.063	0.472
	Slope of cultivated land	-0.531	0.181	0.544
Sensitivity	No. of died(injured) family	-0.114	-0.114	0.229
	Livestock death in TLU	-0.489	-0.104	0.593
	Crop damage in birr	-0.713	-0.009	0.721
	Share of natural resource based income	0.061	-0.003	-0.058
Exposure	Frequency of Natural hazards	0.325	0.497	-0.822

Rate of change in minimum temperature	0.540	0.540	-1.080
Rate of change in maximum temperature	0.246	0.246	-0.491
Rate of change in Precipitation	-0.397	-0.397	0.795

Appendix 5: Normalized values of variables for Females

component	Sub-component	Sombo	Guttoo	Dambi Dima
Human	Highest academic qualification	-0.321	-0.120	0.155
	No. of training	-0.290	-0.137	0.010
	Food sufficiency	0.145	-0.116	0.087
	Healthy status	-0.058	0.201	-0.293
Social	Role in community	-0.354	0.376	-0.238
	Membership in CBO's	0.277	-0.257	0.100
	Participation community politics	0.222	0.133	-0.404
Physical	Access to insecticide or pesticide	-0.275	-0.033	-0.234
	Access to fertilizer	-0.238	0.000	-0.105
	Access to improved seeds	-0.238	-0.209	0.00
	Ownership of communication media	-0.250	0.144	0.058
	House type	-0.122	0.058	0.058
Financial	Access right to credit	-0.238	0.048	0.098
	Livestock in TLU	-0.240	-0.236	0.234
	No. of Livelihood activities	-0.124	-0.025	0.020
	Gross annual income	-0.332	0.117	0.093
	Saving at HH	-0.173	-0.163	0.137
	Crop diversity of HH	-0.202	-0.198	0.068
Natural	Farmland in hectare	-0.168	-0.145	-0.060
	% of irrigated land	-0.409	-0.196	0.469
	Slope of cultivated land	-0.725	0.265	0.265
Sensitivity	No. of died(injured) family	-0.158	-0.158	0.316
	Livestock death in TLU	-0.742	-0.053	0.796
	Crop damage in birr	-0.658	-0.301	0.959
	Share of natural resource based income	0.215	-0.416	0.200
Exposure	Frequency of Natural hazards	0.325	0.497	-0.822
	Rate of change in minimum temperature	0.540	0.540	-1.080
	Rate of change in maximum temperature	0.246	0.246	-0.491
	Rate of change in Precipitation	-0.397	-0.397	0.795

Declaration

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

Declared by:

Name: _____

Signature: _____

Date: _____

The examiners' comments have been dully incorporated.

Confirmed by

Name: _____

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