Gender Difference in Climate Change Perception, and Adaptation Strategies: The Case of Central Zone of Tigrai Region, Ethiopia

Haftom Gebregziabher Hagos[1]* Hagos Tikue Gebrewahid[2], and Gebremichael Gebrehiwot[2]

Abstract

Climate change is not a new phenomenon; it has been happening since the birth of the planet. It has a different impact on men and women due to the difference in their vulnerability and adaptive capacity. The objective of the study was to assess the gender difference in climate change perceptions, coping mechanisms, adaptation strategies, and adaptation barriers in the Central Zone of Tigrai National Regional State, Ethiopia. In this study, 389 respondents were included using a multi-stage stratified sampling technique. Questionnaire, key informant interviews, focus group discussions, and field visits were used as data collection tools. The quantitative data were analyzed using frequency, percent, mean, and chi-square. Similarly, the qualitative data were analyzed by content analysis. The analyzed result showed that both male and female household heads observed a slight change in temperature without significant difference, but they observed a decline in the rainfall differently. Both male and female household heads perceived the cause of climate change to be both a supernatural force and human activities without a significant difference. Both male and female household heads used selling livestock, food aid, and loans as coping mechanisms in a different way. Similarly, both male and female household heads differently adapted soil and water conservation, adjustment of livestock management, and environmental rehabilitation. Nevertheless, both are challenged by a shortage of oxen, crop pests and diseases, erratic rainfall, and lack of available agricultural inputs. To improve farmers' climate change adaptation, policies and strategies should be favored to the vulnerable group of people.

Keywords: Adaptation strategies, Barriers, Climate Change, Gender, Perception.

---

[1]Department of Political Science and Strategic Studies, Mekelle University, e-mail: dhaftompsir2012@gmail.com

[2]Department of Civics and Ethical Studies, Aksum University, e-mail: hagost957@gmail.com,

[3]Ethiopian Police University College, e-mail: Gebrish2014@gmail.com

**Corresponding author e-mail:* dhaftompsir2012@gmail.com

1. Introduction

Climate change is one of the most pressing global problems. It challenges both human beings and the environment (IPCC, 2007). The impact of climate change is being felt across the world, although it affects different regions differently. For instance, in South Asia and Africa droughts, in Europe heatwaves, and on the Atlantic coast the devastating cyclones are the prominent events (IPCC, 2007, 2014). Currently, the impact of climate change is becoming worst. For example, globally, about 1.3 billion people are living in fragile ecological areas due to climate change (Habtezion, 2016). In the year of 2018 around 62 million people were affected by weather and climate-related events. From these, 35 million people were affected by floods, and 9 million people were affected by drought (WMO, 2019). Climate change's effect in Africa is severe (MFAN, 2018). Africa's ground and surface water are decreasing from time to time (IPCC, 2007, 2014). In the number of people affected by climate-related natural disasters like drought, Africa was the second continent (MFAN, 2018). It is predicted that by 2050 between 350 and 600 million people will be risked by water stress in Northern and Southern Africa due to severe and prolonged drought (Habtezion, 2013). Especially, the effect of climate change is more serious in Sub-Saharan African countries (Gbetibouo, 2009). Likewise, Ethiopia is one of the drought's proven countries in the region. The country is faced with the problem of increasing air temperature, unpredictable rainfall, sometimes complete failure of seasonal rains that are liked to climate change (ECRGE, 2011; MFAN, 2018). These pose a significant threat to the agriculture sector and the livelihood of the people (Deressa et al., 2009).

Gender Difference in Climate Change Perception, and Adaptation Strategies: The Case of Central Zone of Tigrai Region, Ethiopia

Studies indicated that climate change has a differentiated impact on men and women (Brody et al., 2008; Habtezion, 2013, 2016). Broadly speaking, rural women are the most vulnerable to climate change and are at high risk (Nabikolo et al., 2012; Rao et al., 2019). Factual data shows 80% of the displaced people are women. Besides, 70% of the world's poor people are women (Habtezion, 2016; Partey et al., 2018). Globally, seventy percent of women live in less than one dollar a day (Vincent et al., 2010). Approximately, more than 75% world's working hours are cover by women but women own only 10% of the world's property and cover 8% of the world's cabinet (UNDP et al., 2009 as cited in Vincent et al., 2010). More than 60% of women in Sub-Saharan Africa are working in the climate-sensitive sector (FAO, 2011, 2019).

Alongside, climate change added extra workload on women, by making them to travel long distances to collect firewood and fetch water (Habtezion, 2013). Compared to men, women take the largest share of the hardest impact of climate change (Brody et al., 2008; Habtezion, 2013). Furthermore, the poorest and most marginalized women are the most vulnerable to climate change impact and they are more affected by the change than their counterpart men (Habtezion, 2016). Particularly, Ethiopian women are the most vulnerable groups of people to the changing climate (FAO, 2011, 2019).

There are different reasons why more women are vulnerable to the impact of climate change than men. First of all, most women are structurally excluded from family and political decisions and are less aware of climate-smart agriculture (Habtezion, 2013; Twyman et al., 2014). Moreover, women are having less access to climate change

information and to education that are the largest unpaid workers (Brody et al., 2008; Habtezion, 2013). Women have less adaptive capacity than men. Although sometimes women have access to a resource such as livestock, land, and credit, they are limited to control these resource (Habtezion, 2013, 2016; Jost et al., 2015; Vincent et al., 2010). Since women are restricted to domestic works such as collecting firewood, fetching water, cooking, washing, hygiene, and raising small livestock and managing vegetation gardens, they are segregated from climate information (Brody et al., 2008; Habtezion, 2016). Women were not equipped with swimming, and tree climbing skills to escape from natural hazards like flooding (Brody et al., 2008). The majority of women's works are dependent on natural resources (Vincent et al., 2010). This reason makes them a victim of climate change and more vulnerable than men, though it challenges both men and women. These circumstances make women and men perceive the risk of climate change differently. Their response to the change is also different (Brody et al., 2008).

Even though the government of Ethiopia is devoted to empowering women and ensuring gender equality, Ethiopia is still the lowest country to ensure gender equality in the world. Ethiopian women also have still less adaptive capacity (FAO, 2011, 2019). Lack of access to an asset, socio-cultural norms of the society, lack of adequate representation in decision-making processes, and access to policy attention make women vulnerable to the impact of climate change (FAO, 2011, 2019; MFAN, 2018). The work division in the rural community also caused women to

be victims of climate change (Rao et al., 2019). The rises in temperature, drought, and erratic rainfall challenge the livelihood of poor women in Ethiopia and have worsened their burden (Deressa et al., 2009). Generally, Ethiopian women have significant responsibilities in climate-sensitive sectors. Women in the current study area also face similar challenges.

Even though adaptation researches have been targeting the vulnerable population, the numbers of vulnerable groups are increasing and attention has not been given to the difference between men and women within the impact of climate change. Adaptation would be effective and efficient if gender differences were properly addressed and the interest of the vulnerable group of society was understood (Vincent et al., 2010). The difficulties of women's tasks and their contribution to the economy have not been duly recognized; however, women's contribution to the country's economy is vital (Brody et al., 2008; Habtezion, 2013). Considering these sections of the society during policy and strategy development is necessary to build a sustainable economy and climate resilience society (Kasa et al., 2015). A study indicated that adaptation efforts should systematically and effectively address the gender-specific impact of climate change (Brody et al., 2008). Hence, as the climate change effect is different among women and men, the adaptation policies, programs, and other measurements should be developed based on gender-disaggregated information and gender sensitivity (Habtezion, 2016; Röhr, 2007). Therefore, it is imperative to investigate the linkage between climate change and gender in the study area.

Another motivational factor to conduct the current study is the fact that although different researches in Ethiopia have been conducted related to climate change and variability, the linkage between climate change and gender did not get enough attention in the study area. Therefore, this study aimed to investigate the linkage between climate change and gender in the Central Zone of the Tigrai National Regional State, Ethiopia. Furthermore, the study explored gender-based climate change and variability perception. The study also examined the difference between male and female household heads in perceiving the cause of climate change. Additionally, this study investigated coping mechanisms and adaptation strategies adopted by male and female household heads to counter the impact of climate change and variability. Finally, the study identified barriers of climate change adaptation strategies in respect to gender in the Central Zone of Tigrai National Regional State, Ethiopia.

2. Theoretical Framework of the Study

Climate change is the long-term change in the mean of the climate that persists for an extended period. It is a gradual process that at least takes three decades and above (IPCC, 2007, 2014). However, climate variability is the fluctuation on the average of the climate, which takes a short time frame most of the time for a month, season, or year. The persistent change in the climate hurts the ecological, social, and economic well-being of society (IPCC, 2007, 2014).

Climate change perception refers to how people are sensing the changing climate and how they perceive it. Most of the time, people's perception depends on expectation rather than instrumental records (Aberra, 2012). Another issue in climate change perception is the degree of risk caused

by climate change. For example, if people are seriously hampered by extreme events like drought, and flooding than unusual, people start to be conscious of the change. Generally, people's perceptions have been determined by people's expectations and the degree of the impact of the change (Aberra, 2012; Leiserowitz, 2005). Perception guides people's decisions, actions, and preferences. Understanding people's perceptions is a crucial component for policy-makers to draft appropriate policy and it is a pre-condition for adaptation. But people's climate change perception is influenced by different factors like access to information, age, educational level, and the environment they live in (Leiserowitz, 2005). In the current study, perception refers to the opinion of the people on climate change and how both the male and female household heads perceive the change.

Currently, a certain level of climate change becomes an unavoidable event. To respond to the adverse effect of climate change, various adaptation and/or coping strategies were employed. The main difference between coping and adaptation is timing. Most of the time, adaptation is a long-term and planned response to the expected and predicted impact of climate change while coping is a short-term and unplanned response to the unexpected impact of climate change. Adaptation is important to limit the potential risk of the unavoidable event of climate change, but coping is the issue of survival (IPCC, 2007, 2014). adaptation intends to minimize the adverse impact of climate change and preparing for the expected changing climate, by adjusting in the human and natural system (IPCC, 2007, 2014). Generally, "*adaptation is the adjustment in natural or human system in response to actual or expected climatic stimuli or*

their effects, which moderates harm or exploits beneficial opportunities" (IPCC, 2007, P. 6). In the context of this study, adaptation means the current adjustment of the people to cope with the existing problem of climate change, and at the same time, it is a preparation for future similar climate-related problems. On the other hand, a coping mechanism is an immediate action taken to respond to the adverse effect of climate extreme events like drought and flood.

Gender is a socially constructed difference in role and responsibility among men and women. At the same time, it is the skewed power relationship to access and control over resources and decision-making between men and women in a given cultural, social context, and geographical location. Unlike gender, the sex of men and women is determined biologically (Vincent et al., 2010). Cultural variables and social responsibilities are determining men's and women's access to social and economic resources. Women are excluded from household and political decision-making processes (Brody et al., 2008; Habtezion, 2013). Due to the difference in access to resources, and their role and responsibility in the family and community, women are affected than men by the impact of climate change. In most societies, women are responsible to feed the family. Their responsibility like collecting firewood, fetching water, and rising small livestock are more dependent on natural resources and are vulnerable to climate change (Vincent et al., 2010). Generally, the interrelationship between climate change and gender has two faces. On the one hand, gender inequality makes women the larger victims of the change. On the other hand, the change in

climate leads to exacerbating the existing gender inequality (Habtezion, 2013).

Therefore, to address the gender-differentiated impact of climate change and inequality access to resources, it is important to design gender-sensitive policies. In addition, it is essential to ensure access to and control of resources by females equally with their male counterparts. Ultimately, it is important to achieve sustainable climate change and development in the community by empowering women. Because the failure of women to adapt to climate change does not only enlarge gender inequality but also undermines the national climate change response and sustainable development (Brody et al., 2008).

3. Materials and Methods

3.1. Description of Study Area

The study was conducted in three rural districts[3] of the central zone of Tigrai National Regional State, Ethiopia. It is one of the seven administrative zones of Tigrai National Regional State in Ethiopia. It is bordered by Eritrea in the North, the Eastern zone in the East, the Northwestern zone in the West, and the Amhara Region in the Southern part. Geographically, it is located between 13° 47' 6.3" north and 38° 49' 14" east. The estimated terrain elevation above sea level is 1197 meters. Based on the population projection, the total population of the study zone is, 1,431,672 million. Most of the

[3] District is an administrative unit which is a collection of Kebeles, commonly called Wereda

population live in rural areas which are estimated at around 1,167,612 million and 264,061 population live in urban areas as well (CSA, 2013).

The livelihood of the people is dependent on rain feed subsistence agriculture in topographically mountainous farmland. Besides, petty trade, pottery, daily labor work, and handcraft are sources of many people's livelihoods in the study area. Teff, barley, wheat, sorghum, and maize are the major crops grown in the study area according to the three districts' Agriculture and Rural Development Bureau.

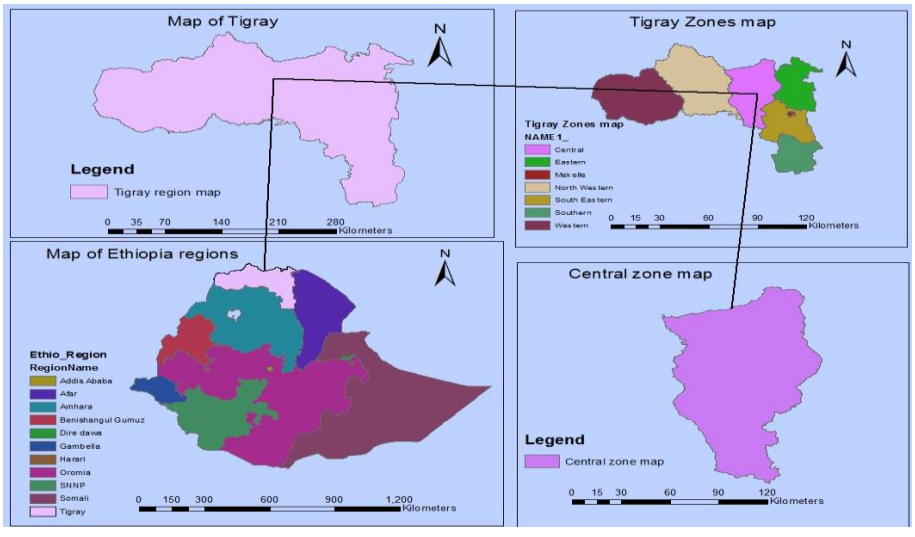

Figure 1: Map of Central Zone of Tigrai, Ethiopia (Source: Researchers Work GIS, 2019)

3.2. Research Design, Approach, and Data Sources

Concerning the objective and nature of the research question, the study employed both quantitative and qualitative (mixed) methods to make the study more reliable for triangulation. Cross-sectional survey studies were

also employed. Primary sources of data were obtained from household survey questionnaires, key informant interviews, focus group discussions, and field observation.

3.3. Sample Size and Sample Size Determination

Both probability and non-probability sampling techniques were used. A multi-stage stratified sampling method was employed to select districts, Kebeles, and household heads. All the rural districts of the Zone are categorized into three traditional agro-ecological zones: Qolla, Hawusi Degua, and Degua. Tanqua Abergel (Qola), Tahtay Maychew (Hawusi Degua), and Ahiferom (Degua) districts were selected randomly out of the nine rural districts within the central zone. Besides, two kebeles from each district were selected randomly.

Employing Yamane's (1967) formula, 398 household heads were selected using a 95% confidence level.

$$n = \frac{N}{1+N\,(e)^2} = \frac{77795}{1+77795\,(0.05)^2} = \frac{77795}{195.488} = 397.9 \approx 398$$

household heads.

Where: -

n = desired sample size the researchers use,

N = total number of household heads in the selected three rural districts,

E = level of precision at 0.05, and

1 = constant number

Both male and female household heads have equally participated. Finally, individual household heads from each kebele were selected through a systematic random selection system from each kebeles'

household head list. Every k^{th} farmer in the sample frame was selected after the first observation has been picked randomly.

Table 1: Numbers of Selected Districts and their Traditional Climatic Zones

Zone	No. of Districts	Selected Districts	Total Household Heads	Climate Zone	Selected Household Heads
Central Zone	9 rural Woredas	Ahiferom	37,483	Degua ≈ highland	192 (96 FHHs & 96 MHHs)
		Tahtay Maychew	21,545	Hawusi Degua ≈ midleland	110 (55 FHHs & 55 MHHs)
		Tanqua Abergele	18,767	Qola ≈ lowland	96(47 FHHs & 47 MHHs)

Sources: CSA, 2013, Researchers' Own Design

3.4. Data Collection Methods

Data collection instruments such as household survey questionnaires, interviews with key informants, focus group discussions, and field observation were used to collect the required data. The questionnaire and interview addressed all the specific objectives of the study.

The questionnaire (structured) has both closed and open-ended questions. The questionnaire was prepared in the English language, but to ensure clarity and understandability, it was later translated into the

local language Tigrigna. The survey was conducted among 398 male and female household heads, which are selected through a systematic random section within the six kebeles in the three districts. The survey was conducted from April 2019 – July 2019.

Interview, focus group discussion, and field observation were conducted to fulfill the emerging questions which were not answered in the questionnaire. The interviews were conducted with 44 key informants. To be inclusive, 20 agriculture and rural development workers/experts, and 24 farm household heads have participated. From the 20 agricultural and rural development workers/experts which participated in the focus group discussion, 12 are at the kebele level (2 at each kebele), 6 at the district level (2 at each district), and 2 at the Zone level. The interview with agriculture and rural development workers/experts was held to capture detailed information about climate change and the linkage between gender and climate change in the local area.

To balance the gender issue 12 female and 12 male household heads were interviewed. In each kebele, 2 male-household heads and 2 female-household heads were interviewed. In the selection of the household heads, not only the gender issue but also age is taken into consideration. Female and male household heads were selected for different reasons. Some were selected for their experience of severe drought and famine, and others based on their awareness of climate change. Both the experts and female and male household heads were selected by purposive sampling. The interviews consist of both structural and semi-structural questions.

Focus group discussants were selected by the purposive sampling technique. To understand the perception of the different sections of society on climate change and variability, a purposive sampling technique was used in the current study. Besides, the different climate change adaptation strategies and the barriers in the local area were considered. One focus group discussion was held at each kebele. The size of each focus group discussion consisted of 8-12 members; the composition of one focus group was female and male household heads (young and aged farmers), local religious leaders, local leaders, and kebele agriculture and rural development experts/workers. The focus group discussants were selected with the help of agricultural and rural development experts/workers. The information raised by the different sections of society was recorded separately. Finally, the different ideas raised by heterogeneous groups were summarized based on the content of the discussion. To ease the discussion, open-end questions with a checklist were prepared. Personal observations were conducted along the survey area with the help of local leaders and agricultural and rural development workers from April 2019 – July 2019.

3.5. Data Analysis Methods

The qualitative data collected through open-ended questionnaires, interviews, focus group discussion and field observation were analyzed using content-based analysis. The quantitative data were analyzed using frequency, percent, mean, and chi-square. Chi-square was used to show an association between climate change and gender. To analyze the data Statistical Package for Social Scientists SPSS version 20 was used.

4. Results and Discussion

4.1. Characteristics of the Survey Respondents

Results show that about 42.1% of male-household heads and 30.5% female-household heads were married (Table 2). Regarding the educational background of the survey respondents, 21.1% of female-household heads and 14.7% of the male-household heads unable to write and read while 20.3% of female-household heads and 10.7% of meal-household heads able to write and read. The remaining survey respondents, 15% of male-household heads and 18.2% of female-household heads, attended formal education (Table 2). Fifty percent of the respondents' family responsibility is under the wife whereas, 45.4% of the respondents are under the responsibility of the husband (Table 2).

Table 2: Characteristics of the Survey Respondents by Gender

Respondents Characteristics	Response	Sex of Respondents		
		Male F (%)	Female F (%)	Total F (%)
Marital status	Single	10 (2.5)	13(3.3)	23(5.8)
	Married	166(42.1)	120(30.5)	286 (72.6)
	Divorced	17(4.3)	19(4.8)	36(9.1)
	Widows	4(1.0)	45(11.4)	49(12.4)
Education Level	Unable to write and read	58 (14.7)	83(21.1)	141(35.8)
	Able to write and read	80(20.3)	42(10.7)	122(31.0)
	Attended grade 4	20(5.1)	45(11.4)	65(16.5)
	Attended grade 8	20(5.1)	16(4.1)	36(9.1)
	Attend grade 9 and above	19(4.8)	11(2.8)	30(7.6)
Family responsibility	Under husband	179(45.4)	0(0.0)	179(45.4)
	Under wife	12(3.0)	185(47.0)	197(50.0)
	Under Sons and daughters	6(1.5)	12(3.0)	18(4.6)

Source: Survey Result (2019)

The mean age of female-household heads is 47.9 years (min = 22 years and max = 70 years), while the mean age of the male-household heads is 49 years (min 30 years and max = 82 years). The mean productive family size is about 4 persons, and the maximum productive family size is 9 whereas the minimum productive family size is one. The mean family size is 6 persons, and the maximum and the minimum number of individuals in each household is 12 and 2 respectively. On average, both male and female household heads have over 25 years of farming experience **(**Table 3).

Table 3: Mean Continuous Variable of Respondents by Gender

Sex of Household Heads		Farming Experience in years	Age of the Respondents	Productive Family Size	Total Family Size
Male	Mean	24.8629	49.0254	4.0000	6.6041
	Std. Deviation	11.54081	11.68308	2.04540	2.26003
	Minimum	4.00	30.00	1.00	2.00
	Maximum	50.00	82.00	9.00	12.00
Female	Mean	26.2462	47.9289	3.3604	4.9645
	Std. Deviation	14.13777	12.08326	1.94229	2.11500
	Minimum	2.00	22.00	1.00	2.00
	Maximum	60.00	70.00	8.00	12.00
Average	Mean	25.5546	48.4772	3.6802	5.7843
	Std. Deviation	12.90695	11.88241	2.01755	2.33497
	Minimum	2.00	22.00	1.00	2.00
	Maximum	60.00	82.00	9.00	12.00

Source: Survey Result (2019)

4.2. Climate Change Perceptions with Respect to the Gender of Household Heads

Result shows that 44.7% of male-household heads and 40.1% of female-household heads had perceived the change in climate (Figure 2). Unlike the quantitative data of the current study, women did less perceive of climate change than men as noted during the group discussions. This indicates that male-household heads are more observant of climate change as compared with their counterpart female-household heads. Such kind of perception difference between male and female household heads can be attributed to several factors such as access to information and access to education that are observed during the focus group discussion and interview.

Similarly, other studies indicated that women have limited access to institutional and economic resources, and they are denied from access to or alienated from political and household decisions (Brody et al., 2008; Jost et al., 2015).

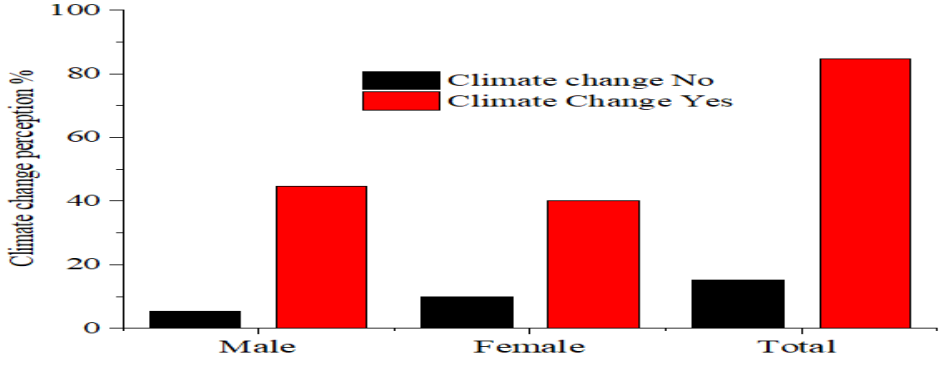

Figure 2: Climate Change Perception over the Last 30 years by Gender (Survey Result, 2019)

4.3. Climate Variability Perceptions Among Gender Household Heads

Regarding the perception of climate variability, 39.6% of male-household heads and 43.7% of female-household heads perceived the change (Figure 3). Most of the interviewed females remembered weather-related disasters like drought and floods in the last three decades than their male counterparts. Female-household heads' farmlands are vulnerable to flooding than the male-household heads' farmland, as the kebele leaders reported. In regard to the variation of climate, female-household heads are more perceptive than male-household heads. Another study indicated that women are more sensitive to climate risk than men (Brody et al., 2008). The possible reasons are, rural women are responsible for the tasks such as fetching water, collecting firewood and tending of small crops and small animals along with the household chores; those activities are climate-sensitive (Brody et al., 2008; Rao et al., 2019).

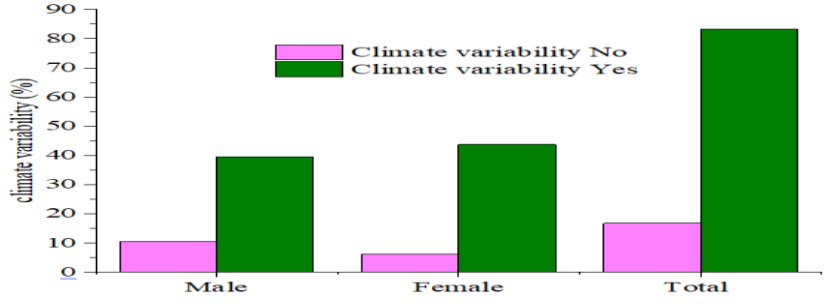

Figure 3: Climate Variability Perception over the Last 30 years by Gender (Survey Result, 2019)

3.2 Male and Female Household Heads' Observation of the Long-term[4] Change in Temperature and Rainfall

The study aimed to investigate the male and female household heads' observation of the change in temperature and rainfall in the past 30 years. Table 4 shows 30.2% of male-household heads and 28.4% of female-household heads observed a slight rise in temperature without significant difference [P<0.05]. Similarly, agricultural and rural development workers of the three districts reported that the temperature had increased and drought had become frequent and severe in the local area in the last three decades. Both men and women key informants observed high air temperature. Elder men and women key informants and focus group discussants perceived the rise in the air temperature. Like the respondents, reports show that Ethiopian temperature has been increasing by 0.37 ℃ (Celsius) every ten years (Tadeg, 2007). Different studies also indicated that Ethiopia's future climate change is uncertain (Gebrehiwot & Van der Veen, 2013; Hadgu et al., 2014; Meze-Hausken, 2004).

Regarding the survey of respondents' observation of rainfall, about 32.2% of male-household heads and 23.9% of female-household heads observed a slight decrease in the rainfall amount with a significant difference [P<0.05] (Table 4). Unlike the quantitative data, all focus group discussants, without difference among men and women, observed a reduction in the rainfall amount and fluctuation in the last three decades in the study area. Their observation was stated in such a way:

[4] In the context of this study, the term 'Long-term' indicates the length of time consisting of three decades and above

The local area was characterized by bi-modal (summer and spring) rainfall distribution. But nowadays the rainfall patterns changed and the amount of rainfall is also reduced. Summer starts late almost in the middle of July and offsets in the middle of August. Its volume has also been decreasing from time to time with high variability. The spring season also became uncertain, and we cannot be sure regarding the time and the amount of rainfall.

Besides, the current rainfall variability has continued and the projections ranged from -25% to +30% in the 2050s. And the Ethiopian climate scenario indicated that temperature increases from a slightly warmer and wetter to a much hotter and drier scenario, (ECRGE, 2011).

Table 4: Male and Female-household Heads Observation of the Long-term Change in Temperature and Rainfall

Climate Parameters	Household Head by Gender	Household head response						
		Highly increased	Slightly increased	No change	Slightly decreased	Highly decreased	Unsure	X^2 (P-Value)
Temperature	Male F (%)	62(15.7)	119(30.2)	2(0.5)	9(2.3)	2(0.5)	3(0.8)	10.220
	Female F (%)	61(15.5)	112(28.4)	6(1.5)	18(4.6)	0(0.0)	0(0.0)	(0.069)
	Total F (%)	123(31.2)	231(58.6)	8(2.0)	27(6.9)	2(0.5)	3(0.8)	
Rainfall	Male F (%)	9(2.3)	9(2.3)	15(3.8)	127(32.2)	37(9.4)	0(0.0)	26.3373
	Female F (%)	7(1.8)	33(8.4)	33(8.4)	94(23.9)	30(7.6)	0(0.0)	(0.000)**
	Total F (%)	16(4.1)	42(10.7)	48(12.2)	221(56.1)	67(17)	0(0.0)	

Source: Survey Result (2019); ** Significant at 5%

4.4. Impact of Climate Change on Farmers' Livelihood

As shown in Figure 4, about 86.8% of the respondents confirmed their livelihood is affected by climate change. As regards the gender disparity on the impact of climate change, 43.9% of male-household heads' and 42.9% of female-household heads' livelihood has been affected. The impact of climate change does not show a significant difference between male and female household heads (Figure 4). Unlike the quantitative data, kebele and district agricultural and rural development workers/experts reported female-household heads are more affected. Other studies indicated more women than men died from a natural disaster. For example, women are 14 times more likely to die than men during flooding (Habtezion, 2013). Similarly, in Bangladesh, the death rate of women is 5 times higher than that of men in the 1991 cyclone and flooding (Brody et al., 2008).

It is difficult to predict the impact of climate change at the individual level. But the researchers asked the respondents to rank the impact. The survey respondents categorized the impact of the change as high, which is supported by 19.3% of male-household heads and 23.9% of female-household heads (Figure 5). From climate extreme events, drought (40.9%) is the most serious problem in the study area followed by erratic rainfall (36.3%) (Figure 6). Besides, old-aged female and male key informants expected the future climate to become worst. In a study conducted in Nyando and Wote in Kenya, and Rakai in Uganda, both female and male household heads reported drought as the most common climate shock (Twyman et al., 2014). Similarly, in a study conducted in

the Teso sub-region, eastern Uganda, 63% of men and 53% of women expected climate change effects to become more severe in the future (Kisauzi et al., 2012). Climate change report predicted that global warming will increase in the 21st century than in the 20thcentury due to continued green house gas emission. Particularly, water stress is affecting about 25% of the African population (IPCC, 2007).

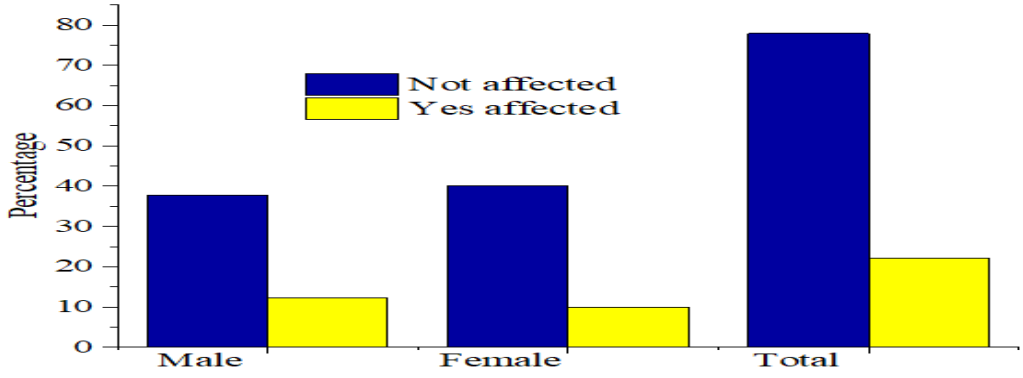

Figure 4: Effect of Climate Change on Farmers' Livelihoods by Gender (Survey Result, 2019)

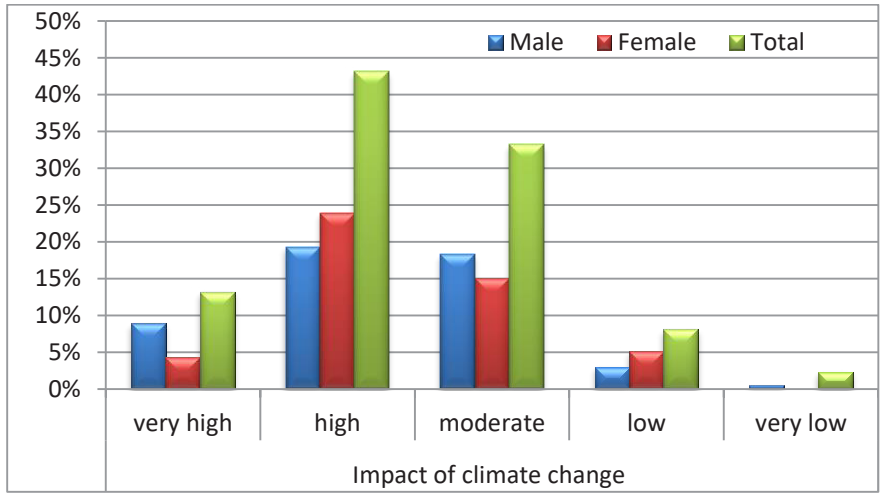

Figure 5: Impact of Climate Change by Gender (Survey Result, 2019)

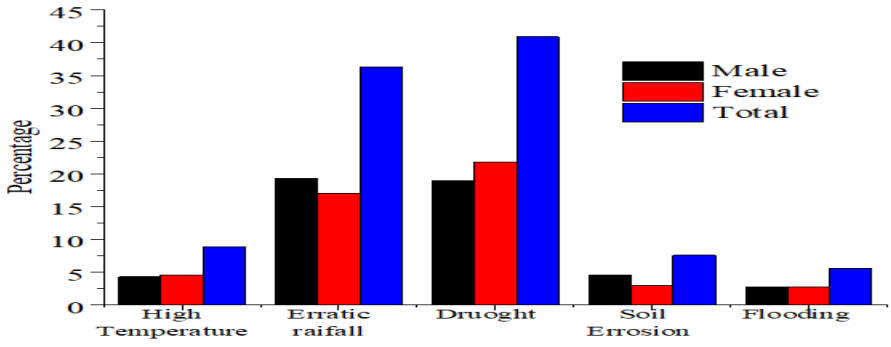

Figure 6: Climate Change Extreme Events by Gender (Survey Result, 2019)

4.5. Perceived Causes of Climate Change by Gender

Most of the key informants and group discussants perceived climate change to be caused by different factors. The majority (64.2%) of the male and female household heads perceived that climate change is the result of natural forces and mistreatment of nature by human beings without difference [P<0.05], as shown in Table 5. Besides, religious leaders perceived climate change to be the act of supernatural power. Unlike this, both male and female old aged focus group discussants responded human being are the main agents for the change, and they expressed this conception as follows: "*We have been observing depletion of natural resources, air, and water pollution and other related issues that have been changing recently, not because of supernatural forces but because of the carelessness of human being in their management of nature/ the environment*." The cause of climate change is both anthropogenic and natural; the contribution of the latter to climate change as compared with the former is insignificant (IPCC, 2007).

Table 5: Perceived Cause of Climate Change by Gender

Household Heads Gender	Causes of Climate Change				
	Only Anthropogenic Causes	Only Natural Causes	Both Anthropogenic and Natural Causes	Undecided	X^2 (P-Value)
Male F (%)	24(6.1)	32(8.1)	120 (30.5)	21 (5.3)	2.831
Female F (%)	25 (6.3)	24 (6.1)	133 (33.8)	15(3.8)	(0.418)
Total F (%)	49 (12.4)	56(14.2)	253 (64.2)	36 (9.1)	

Source: Survey Result (2019)

4.6. Farmers' Coping Mechanisms to Climate Shocks by Gender

Farmers in the study area have taken varied strategies to cope with climate shocks. Both male and female household heads used a reduction in consumption (64.7%) and the seasonal migration (62.7%) as coping strategies without significant difference [P<0.05]. Both male and female household heads used selling livestock and other assets (72.6%), food aid (76.4%), and loans from governments and friends (61.2%) as coping mechanisms with a significant difference [P<0.05] (Table 6). But only 35.0% of the respondents used temporary migration to save the whole family as a coping mechanism with a difference among male and female household heads (Table 6). Similarly, studies conducted in Ethiopia identified consumption reduction, credit from money lenders and merchants, selling assets and livestock, and migration were as the major coping mechanisms of farmers to the climate shocks (Adimassu & Kessler, 2016; Amdu et al., 2013). In addition, in Uganda borrowing money and reduction of consumption was the dominant coping mechanism of farmers in the time of shocks such as drought (Guloba, 2014). Vincent et al. (2010) also stated that women often used migration as coping mechanisms.

Table 6: Household Coping Mechanisms by Gender

Coping Mechanisms	Household Heads Response	Household Heads Gender			
		Male F (%)	Female F (%)	Total F (%)	X^2 (P-Value)
Reducing consumption level	No	71 (18.0)	68(17.3)	139(35.3)	0.10
	Yes	126(32.0)	129(32.7)	255(64.7)	(0.752)
Selling livestock and other assets	No	45(11.4)	63(16.0)	108(27.4)	4.132
	Yes	152(38.6)	134(34.0)	286(72.6)	(0.042)**
Food aid or government assistance	No	31(7.9)	62(15.7)	93(23.6)	13.526
	Yes	166(42.1)	135(34.5)	301(76.4)	(0.000)**
Seasonal migration in search of daily labor	No	66(16.8)	81(20.6)	147(37.3)	2.442
	Yes	131(33.2)	116(29.6)	247(62.7)	(0.118)
Temporary migration to save the whole family	No	147(37.3)	109(27.7)	256(65.0)	16.104
	Yes	50(12.7)	88(22.3)	138(35.0)	(0.00)**
Loans (government and friends)	No	96(24.4)	57(14.5)	153(38.8)	16.252
	Yes	101(25.6)	140(35.5)	241(61.2)	(0.00)**

Source: Survey Result (2019); ** Significant at 5%

4.7. Adaptation Strategies of Farmers to Long-term Change in Temperature and Rainfall

Farmers' were asked whether they made some adjustments in their farming practices in response to the changes in temperature and rainfall

by adopting some particular strategies or not. The majority of both male and female household heads adapted soil and water conservation (95.9%), adjustments of livestock management (65.2%), and environmental rehabilitation (71.3%) with a significant difference [$P<0.05$] (Table 7). In contrast, female-household heads focus group discussants, and key informants reported they are not interested to participate in communal soil and water conservation campaign because they are busy caring for children and preparing food at home. On the other side, diversification of crop varieties (85.0%), switching from farm agriculture to non-farming activities (58.9%), application of fertilizers and chemicals (82.2%), and changing cropping calendar (74.1%) are adopted by the majority of the respondents without a difference [$P<0.05$] among male and female household heads as shown in Table 7. Furthermore, using irrigation (49.5%), permanent change in resident site (34.8), and other adaptation strategies (43.9%), (such as diversification of livelihood sources, agroforestry, water harvesting, seasonal migration, and so on) were not adaptable by a majority of the respondents (Table 7).

In studies conducted in Uganda, Rakai district, Kyegeza village, micro-irrigation, and water harvesting were exclusively used by men; while both men and women equally adopted new crop management practices (Jost et al., 2015). Women in Bangladesh, Chandipur Village, use manure as fertilizer (Jost et al., 2015). In Eastern Uganda, female household heads are less adapted to climate change than male (Nabikolo et al., 2012). Another study conducted in the four sites of Africa,

namely, Nyando and Wote in Kenya, Rakai in Uganda, and Kaffrine in Senegal, found out that both men and women practiced soil and water conservation, changing crop variety, changing types of crop, changing planting date, planting tree on-farm as a response to the changing climate (Twyman et al., 2014). Likewise, in Kaffrine (Senegal) men have higher participation in on-farm and women on off-farm activities (Twyman et al., 2014). In Ethiopia, at the national level, about 50% of female-households and 58% of male-household heads applied chemical fertilizers, and 11.3% of female-household heads and 88.7% of male-household heads participated in vegetable irrigation (FAO, 2019).

Table 7: Household Climate Change Adaptation Strategies by Gender

Types of Adaptation Strategies	Household's Decision to Adapt	Household Heads Gender			
		Male F (%)	Female F (%)	Total F (%)	X2 (P-Value)
Soil and water conservation	No	2(0.5)	14(3.6)	16(4.1)	9.381
	Yes	195(49.5)	183(46.4)	378(95.9)	(0.002)**
Irrigation	No	97(24.6)	102(25.9)	199(50.5)	0.254
	Yes	100(25.4)	95(24.1)	195(49.5)	(0.614)
Diversification of crop varieties	No	25(6.3)	34(8.6)	59(15.9)	1.615
	Yes	172(43.7)	163(41.4)	335(85.0)	(0.204)
Switching from farm agriculture to non-farming activities	No	73(18.5)	89(22.6)	162(41.1)	2.684
	Yes	124(31.5)	108(27.4)	232(58.9)	(0.101)

Applying fertilizers, chemicals, and pesticides, and compost	No Yes	29(7.4) 168(42.6)	41(10.4) 156(39.6)	70(17.8) 324(82.2)	2.502 (0.114)
Adjustment of livestock management practices	No Yes	56(14.2) 141(35.8)	81(20.6) 116(29.4)	137(34.8) 257(65.2)	6.994 (0.008)**
Environmental rehabilitation activities	No Yes	41(10.4) 156(39.6)	72(18.3) 125(31.7)	113(28.7) 281(71.3)	11.924 (0.001)**
Changing cropping time/calendar	No Yes	52(13.2) 145(36.8)	50(12.7) 147(37.3)	102(25.9) 292(74.1)	0.053 (0.818)
A permanent change in residence site	No Yes	119(30.2) 78(19.8)	138(35.0) 59(15.0)	257(65.2) 137(34.8)	4.040 (0.044)**
Other adaptation strategies	No Yes	102(25.9) 95(24.1)	119(30.2) 78(19.8)	221(56.1) 173(43.9)	2.978 (0.054)**

Source: Survey Result (2019); ** Significant at 5%

4.8. Barriers to Climate Change and Variability in Adaptation Strategies

Farmers of the study area are challenged by different barriers when they try to adapt to climate change. These barriers do not only challenge those who could not adapt to the change but also influenced the adaptors as the kebele agricultural and rural development workers' reported. Table 8 shows a shortage of land (86.0%) and the decline of land fertility (70.3%) have challenged both male and female household heads

differently [P<0.05]. Studies, in Eastern Uganda, climate change adaptation influencing factors, affected male and female household heads differently (Nabikolo et al., 2012). However, the shortage of oxen (65.2%), crop pest and disease (74.9%), erratic rainfall (78.9%), and lack of availability of agricultural inputs (66.2%) also challenged both female and male household heads without a difference [P<0.05] as indicated in Table 8.

The agricultural and rural development experts expressed that "*less access to improved seeds, farmers' reluctance to accept new agricultural technologies and natural factors such as erratic rainfall*" are the chronic obstacles that challenged both male and female household heads. Both men and women key informants added the price of the agricultural inputs is another barrier. Studies conducted in Ethiopia (Adimassu & Kessler, 2016; Amdu et al., 2013; Deressa et al., 2009) identified: lack of knowledge, lack of information, lack of belief/trust on the available technology, lack of agricultural inputs, absence of agricultural policy, land scarcity, access to extension and credit, limited access to education, distance from the market, and wealth, age and gender of the household head are the major barriers of climate change.

Table 8: Climate Change and Variability Adaptation Barriers by Gender

Kind of Climate Change Barriers	Household Heads Response	Household Heads Gender			
		Male F (%)	Female F (%)	Total F (%)	X2 (P-Value)
Shortage of land	No	16(4.1)	39(9.5)	55(14.0)	11.179
	Yes	181(45.9)	158(40.1)	339(86.0)	(0.001)**
Shortage of labor	No	127(32.2)	123(31.0)	250(63.5)	0.175
	Yes	70(17.8)	74(18.8)	144(36.4)	(0.676)
Shortage of oxen	No	74(18.8)	63(16.0)	137(34.8)	1.354
	Yes	123(31.2)	134(34.0)	257(65.2)	(0.245)
A decline in land fertility	No	50(12.7)	67(17.0)	117(29.7)	3.513
	Yes	147(37.3)	130(33.0)	277(70.3)	(0.061)**
Crop pest and diseases	No	51(12.4)	48(12.2)	99(25.1)	0.121
	Yes	146(37.0)	149(37.8)	295(74.9)	(0.729)
Land degradation	No	116(29.4)	102(25.9)	218(55.3)	2.013
	Yes	81(20.6)	95(24.1)	176(44.7)	(0.156)
Erratic rainfall	No	44(11.2)	39(9.9)	83(21.1)	0.382
	Yes	153(38.8)	158(40.1)	311(78.9)	(0.537)
Lack of awareness	No	132(33.5)	108(27.4)	240(60.9)	6.140
	Yes	65(16.5)	89(22.6)	154(39.1)	(0.013)**
Lack of availability of agricultural inputs	No	71(18.0)	62(15.7)	133(33.8)	0.919
	Yes	126(32.0)	135(34.3)	261(66.2)	(0.338)

Source: Survey Result (2019); ** Significant at 5%

5. Conclusion and Recommendation

Currently, climate change and variability is a serious problem in Ethiopia. Especially, the problem is extremely serious and widespread in Northern Ethiopia where agriculture is the most vulnerable to the change in the climate. As a section of society, the rural women that have low adaptive capacity and limited access to resources and information are the

most vulnerable groups of people. Both male and female household heads observed a slight rise in temperature without significant difference, but they observed a decrease in rainfall amount differently. Male-household heads were found to be more observant of climate change while female-household heads were more observant of climate variability. More female household heads are victims of climate change than their male counterparts. Furthermore, both male and female household heads attributed climate change to both supernatural forces and the mistreatment of the environment by human beings, without a significant difference.

In like manner, reduction in consumption and seasonal migration are applied as coping mechanisms by both male and female household heads without a significant difference. But, selling livestock and other assets, food aid, or government assistance loan from the government and other lenders are used as coping mechanisms by both male and female household heads differently. Both male and female household heads adapted soil and water conservation, adjustment of livestock management, and environmental rehabilitation with a significant difference. Diversification of crop varieties, switching from farm agriculture to non-farming activities, application of fertilizers and chemicals, and changing crop calendar are adopted by both male and female household heads without a significant difference. Furthermore, the shortage of land and the decline of land fertility challenged both male and female household heads differently. In contrast, shortage of oxen, crop pest and disease, erratic rainfall, and lack of agricultural inputs are common barriers for both male and female household heads.

To make farmers proactive and ready for the expected and/or unexpected climate change impact, gender-based dissemination of climate-related information is paramount importance. To make both male and female household heads easily adaptive, providing responsive institutions with easy access to agricultural inputs, and credit is necessary. Enhancing the adaptive capacity of both male and female household heads is also important.

6. Acknowledgments

The researchers would like to thank the people of Ahferom, Tanqua Abergel, and Tahitay Maychew for their welcoming approach and hospitality. The researchers are also grateful to Aksum University for financing this study.

7. Declaration of interest

The authors declare that there is no conflict of interest in this research.

References

Aberra, Y., (2012). Perception of climate change among the members of the House of people's Representatives. *Ethiopia. Journal of risk research,* Routledge.

Adimassu, Z., & Kessler, A. (2016). Factors affecting farmers' coping and adaptation strategies to perceived trends of declining rainfall and crop productivity in the central Rift valley of Ethiopia. *Environmental Systems Research, 5*(13), 1-16.

Amdu, B., Ayehu, A., & Deressa, A. (2013). Farmers' perception and adaptive capacity to climate change and variability in the upper catchment of Blue Nile, Ethiopia. *African Technology Policy Studies* Network working paper No. 77.

Brody, A., Demetriades, J., & Esplen, E. (2008). Gender and climate change: mapping the linkages (a scoping study on knowledge and gaps prepared for DFID). UK: BRIDGE, *Institute of Development Studies (IDS)*: Retrieved from http://uneca.org/acpc/publication/docs/DFID_Gender_Climate_Change.pdf.

Central Statistical Agency (CSA). (2013). Population projection of Ethiopia for all regions at wereda level from 2014–2017. *Central Statistical Agency of Ethiopia*, Addis Ababa, Ethiopia.

Deressa, T. T., Hassan, R. M., Ringler, C., Alemu, T., & Yesuf, M. (2009). Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. *Global environmental change, 19*(2), 248-255.

Ethiopia Climate-Resilient Green Economy (ECRGE). (2011). Ethiopia's Climate-Resilient Green Economy. *Green Economy Strategy*, Addis Ababa, Ethiopia.

Food and Agricultural Organization (FAO). (2011). Ethiopia Country Programming Framework 2012-2015. *Addis Ababa*, AU and ECA.

Food and Agricultural Organization (FAO). (2019). National gender profile of agriculture and rural livelihoods-Ethiopia. *Country Gender Assessment Series,* Addis Ababa, Ethiopia.

Gbetibouo, G. A. (2009). Understanding farmers' perceptions and adaptations to climate change and variability: The case of the Limpopo Basin, South Africa. *Intl Food Policy Res Inst (IFPRI) discussion paper 00849 (Vol. 849)*. Washington, DC. Retrieved from www.fao.org/fileadmin/user_upload/.../docs/ifpri_limpopo_dp00849.pdf.

Gebrehiwot, T., & van der Veen, A. (2013). Assessing the evidence of climate variability in the northern part of Ethiopia. *Journal of Development and Agricultural Economics, 5*(3), 104-119.

Guloba, M. (2014). Adaptation to climate variability and change in Uganda: Are there gender differences across households? The United Nations University World Institute for Development Economics Research (UNU-WIDER), Helsinki, WIDER Working Paper, No. 2014/107, ISBN 978-92-9230-828-5, http://dx.doi.org/10.35188/UNU-WIDER/2014/828-5.

Habtezion, S. (2013). Overview of linkages between Gender and climate change – Policy Brief (Asia and the Pacific). Policy brief 1, United Nations Development Programme (UNDP) , *New York*, USA.

Habtezion, S. (2016). Gender and climate change: Overview of linkages between gender and climate change. Policy brief 1, United Nations Development Programme, *New York*, USA, www.undp.org/gender.

Hadgu, G., Tesfaye, K., Mamo, G., & Kassa, B. (2014). Analysis of farmers' perception and adaptation methods to climate variability/change in Tigrai Region, Northern Ethiopia. *Research Journal of Agricultural and Environmental Sciences, 1*(1), 15-25.

Intergovernmental Panel on Climate Change (IPCC). (2007). Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the IPCC, [M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden & C.E. Hanson, Eds.], *Cambridge University Press*, Cambridge, UK, 987pp

Intergovernmental Panel on Climate Change (IPCC). (2014). Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the IPCC [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White Eds.]. *Cambridge University Press*, Cambridge, United Kingdom, and New York, NY, USA, pp. 1-32

Jost, C, Kyazze, F, Naab, J, Neelormi, S, Kinyangi, J, Zougmore, R, Aggarwal, P, Bhatta, G, Chaudhury, M, Tapio-Bistrom, ML, Nelson, S, Kristjanson, P. (2015). Understanding gender dimensions of agriculture and climate change in smallholder farming communities. *Climate and Development*. Retrieved from http://dx.doi.org/10.1080/17565529.2015.1050978

Kasa, L., Warner, J., & Kieran, C. (2015). Patterns of agricultural production among male and female holders: Evidence from agricultural sample surveys in Ethiopia: *International Food Policy Research Institute (IFPRI);* Addis Ababa, Ethiopia.

Kisauzi, T., Mangheni, M., Sseguya, H., & Bashaasha, B. (2012). Gender dimensions of farmers' perceptions and knowledge on climate change in Teso sub-region, eastern Uganda. *African Crop Science Journal, 20*(2), 275-286.

Leiserowitz, A.A. (2005). American Risk Perceptions: Is Climate Change Dangerous? *Risk Analysis, 25*(6): 1433-1442.

Meze-Hausken, E. (2004). Contrasting climate variability and meteorological drought with perceived drought and climate change in northern Ethiopia. *Climate Research, 27*(1), 19-31.

Ministry of Foreign Affairs of the Netherlands (MFAN). (2018). Climate change profile: Ethiopia. P.O. Box 20061 | 2500 EB The Hague | The Netherlands. www.government.nl/foreign-policy-evaluations.

Nabikolo, D., Bashaasha, B., Mangheni, M. N., & Majaliwa, J. G. M. (2012). Determinants of climate change adaptation among male and female-headed farm households in eastern Uganda. *African Crop Science Journal, 20*(2), 203-212.

Partey, S. T., Dakorah, A. D., Zougmoré, R. B., Ouédraogo, M., Nyasimi, M., Nikoi, G. K., & Huyer, S. (2018). Gender and climate risk management: evidence of climate information use in Ghana. *Climatic Change*, 1-15; https://doi.org/10.1007/s10584-018-2239-6

Rao, N., Lawson, E. T., Raditloaneng, W. N., Solomon, D., & Angula, M. N. (2019). Gendered vulnerabilities to climate change: insights from the semi-arid regions of Africa and Asia. *Climate and Development, 11*(1), 14-26.

Röhr, U. (2007). Gender, climate change, and adaptation: Introduction to the gender dimensions. Background paper prepared for Both Ends briefing paper "Adapting to climate change: How local experiences can shape the debate". *Berlin*, Genanet, August.

Tadeg, A. (Ed.) (2007). Climate change National Adaptation Programme of Action (NAPA) Of Ethiopia. *National Meteorological Agency (NMA),* Addis Ababa: Ethiopia.

Twyman, J, Green, M, Bernier, Q, Kristjanson, P, Russo, S, Tall, A, Ampaire, E, Nyasimi, M, Mango, J, McKune, S, Mwongera, C, Ndourba Y. (2014). Adaptation actions in Africa: Evidence that gender matters.

CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), *Copenhagen*, Denmark, Available online at: www.ccafs.cgiar.org.

Vincent, K., Wanjiru, L., Aubry, A., Mershon, A., Nyandiga, C., Cull, T., & Banda, K., (2010) Gender, climate change, and community-based adaptation. A guidebook for designing and implementing gender-sensitive community-based adaptation programmes and projects: *United Nations Development Programme (UNDP),* New York, USA.

World Meteorological Organization (WMO). (2019). WMO Statement on the State of the Global Climate in 2018. WMO NO. 1233, *Geneva*, Switzerland.

Yamane, T. (1967). Statistics: An introductory analysis, 2nd Ed., *New York*: Harper and Row.