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Gendered Effects of Climate Change on Household Food Security: The Case of Some Selected Drought Prone Rural Kebeles of Dire Dawa Administration, Ethiopia

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Abstract: Climate change poses a serious threat to human food security through erratic rainfall patterns, increasing or decreasing temperature, decreasing crop yields and contributing to increased food insecurity. This study investigates whether men or women are more affected by climate induced household food security in rural kebeles of Dire Dawa Administration. The study also examines access and control over productive resources and the factors contributing to the differential effects of climate change on men and women household heads. A systematic random sampling procedure was employed to include 150 men and women household heads from four rural kebeles of the Administration. Standardized precipitation index and Gender disparity index on five agriculture domains such as participation in production, asset ownership and access to resource, income control, leadership and time use were used to measure the effects of rainfall intensity and productivity achievement to household food security respectively. Moreover, T-test and gender vulnerability analysis were also used to analyze the data. The results indicate that rainfall scarcity had occurred for nineteen years from the total of thirty years studied. Moreover, the mean empowerment index of women is below the threshold with differing gender division of labor in agriculture and low-calorie intake per day and more vulnerable due to effects of climate change. The findings of this study indicate the importance of enhancing institutional support to realize gender equality and minimize cultural, social, economic and institutional barriers that contribute to the differential effects of climate change on household food security.

Keywords: Climate change; Food insecurity; Food security; Gender; Standardized precipitation index

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1. Introduction

Nowadays climate change has major adverse consequences on the world‛s ecosystems and societies though the severity differs significantly across regions, and countries (Warner, 2013). Climate change is widely recognized as a socioeconomic and environmental problem that receives attention for its impact on global food security (FAO, 2013).

Poor countries suffer more, with the poorest in the poor countries likely to suffer most due to the impacts of climate change such as drought, floods, extreme weather events and reduced food and water security (World Bank, 2012). The same source further contends that climate change affects women and men disproportionately with the poorest being the most vulnerable of which 70% of the world's poor are women.

In countries of sub-Saharan Africa like Ethiopia, Kenya and Mali poor rural households are highly vulnerable to the adverse impacts of climate change due to widespread poverty, low levels of human and physical capital, poor infrastructure, and heavily dependence on rain fed agricultural system (IFPRI, 2015). Ethiopia is often cited as one of the most vulnerable countries and with the least capacity to respond and adapt to climate change (Kreft *et al*., 2015). Bewket *et al*. (2015) also stated that Ethiopia is highly vulnerable to climate change impacts due to underdevelopment and widespread poverty, coupled with gender imbalance that increased the burden on women. According to Alebachew (2011), rural women are the most disadvantageous group than men due to gender disparity in access and control over productive resources such as credit, extension services and land. The same source further underscores that they are more dependent on natural resources for their livelihood thus threatened by climate change which in turn increase their vulnerability. A study conducted by Osman (2015) in Haramaya district, observed that women are more vulnerable than men in times of climate change because of gender inequality that places them at risk. In addition, a study made by Carmi (2016) in Fedis Woreda reported that drought increases women's workload, their health is severely compromised due to reduced food intake and women have fewer chances than men to engage in income-generating activities. In line with this, Bewket et al. (2015) also stated that due to climate change, the condition of water collection and fuel wood is taking a longer time than before, and the shortage of fuel wood implies that food preparation has become more tedious for women household heads.

According to the Catholic Relief Service Ethiopia (2012), women in the study area have higher time burden than men, and women's time is not their own. They are paying a higher price for deepening poverty and food insecurity; loaded with all unpaid domestic duties and productive activities. These multiple and demanding duties are often not considered and, as a result, women became more vulnerable and food insecure than men when they experience climate related drought. Women living in vulnerable communities are frequently discriminated against the distribution of resources that are critical for adaptation and resilience, i.e. land, credit and information. In addition, they are often underrepresented in decision-making processes that seek to address climate change (CAR, 2014). These facts call for more empirical evidences through employing different techniques like Standardized precipitation index and Gender disparity index which were not employed by studies mentioned above in Ethiopia so as to capture as many factors as possible. The objectives of this study are therefore to uncover the difference between men and women pertaining to: a) vulnerability to climate change and b) effects of climate change on household heads (HHHs) food security.

2. Research Methods

2.1. Description of the Study Area

Dire Dawa is found between 090 28′1″to 090 49″North Latitude and 410 38′1″ to 420 19.1″East Longitudes. It has nine urban and 38 rural kebeles (The lowest administrative unit). The current population of the Administrative rural kebeles was projected to 144,596 of whom 73528 are men and 71068 are female with 32.07% rural inhabitants. There were 22,240 rural household heads in the study area (DARDO, 2014)[1].

Dire Dawa is characterized by an arid and semi-arid climate with low and erratic rainfall. It has a bimodal rainfall distribution with April as a peak for the small (spring) and August for big (summer) rain with June as dry spell. The average minimum and maximum rainfall amount and temperature of the area were 357.3 and 955.7 mm and 19.3^{0}c and 33.5^{0}c, respectively (DDASA, 2015).

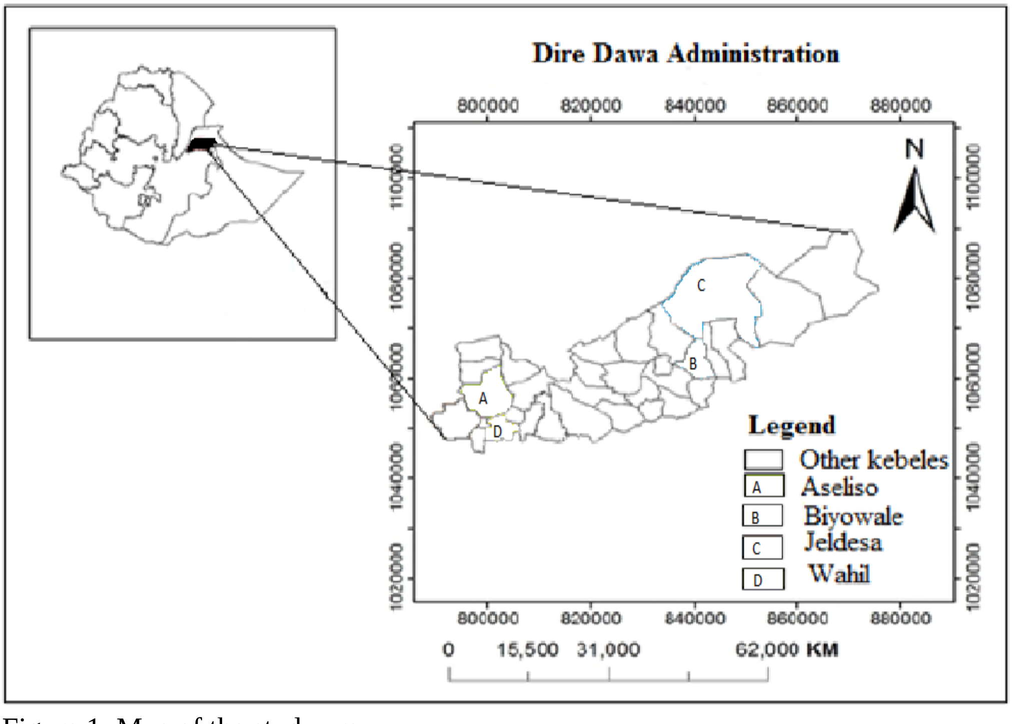

Figure 1: Map of the study area
Source: Ethio GIS, 2016

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[1] *Population size was projected based on the 2007 housing and population census using the exponential growth formula:* $P_t = P_o e^{rn}$

Agriculture is the major economic activity with mixed farming system as the dominant source of livelihood. Although a variety of crops are grown in the area, sorghum is the most widely cultivated followed by maize. In the mountain foot slopes, valley bottoms and river terraces, a variety of crops are grown under rain-fed and irrigation systems. These include vegetables such as onion, tomato, pepper and cabbages; cash crops like *khat*, coffee, and fruits like papaya, banana and guava. Besides, rural households are engaged in livestock rearing (DDAEPA, 2011).

2.2. Research Design, Sampling Technique and Analysis

Mixed method, particularly the concurrent triangulation approach, was used as research design to gather and use quantitative and qualitative data at the same time and to cross validate the information from different sources (Creswell, 2003). Systematic random sampling procedure was used as sampling technique to select household heads. Aseliso, Biyowale, Jaldesa and Wahil *kebeles* were selected because they were identified as drought prone areas and vulnerable to effects of climate change (DARDO, 2014). In the four *kebele*, there were 3, 846 household heads of which female HHHs were 271 and male HHHs were 3,675 with fifty percent women living with their husbands (DARDO, 2014). Accordingly, the sample size for this study consists of 150 HHHs, i.e. 73 men and 77 women from the four *kebeles*.

In addition to descriptive statistics such as mean, standard deviation and percentages, t-test was used to compare male and female headed households with respect to variables of interest using SPSS version 20. Moreover, gender disparity index and vulnerability analysis to climate induced food insecurity were employed to analyze the gender differentials due to climate change.

2.2.1. Rainfall analysis

Standardized precipitation index (SPI), which is designed to measure drought intensities or rainfall deficit in a given location for a given period of time, was used. The probability of precipitation distribution is changed into a normal distribution using statistical formula given below (Cancelliere *et al*., 2007). The mean and variance of SPI for the location and desired period is zero and one respectively (WMO, 2012; Guttman, 1999).

$$SPI = \sum \frac{(xi - \bar{x}i)}{\sigma xi}$$

Where:

SPI = Standardized Precipitation Index

xi = Rainfall amount of each year observation

$\bar{x}i$ = Mean annual rainfall (i. e summation of all year divided by the number of year)

σxi = Standard deviation of the rainfall for observed year

SPI was developed in 1993 at Colorado State University by T. B. McKee, N. J. Doesken and J. Kleist to calculate SPI value table which is used to analyze dryness and wetness. While negative SPI values show rainfall scarcity or dryness, positive

SPI values show surplus rainfall. As negative SPI values decrease and reach at -2 or below show extreme drought cases of that particular area in the given period of time. On the other hand, as SPI positive values increase and reach at +2 or above refer to extreme wet condition (WMO, 2012).

Table 1. SPI classes

Index Value					Class
		SPI	≤	-2.0	Extremely dry
-2.0	<	SPI	≤	-1.5	Moderately dry
-1.5	<	SPI	≤	-1.0	Dry
-1.0	<	SPI	<	1.0	Neutral
1.0	≤	SPI	<	1.5	Wet
1.5	≤	SPI	<	2.0	Moderately wet
2.0	≤	SPI			Extremely wet

Source: Adopted from *Journal of the American Water Resources Association*, Vol. 35, No. 2, April 1999: 315

2.2.2. Women empowerment in agriculture index

The Women's Empowerment in Agriculture Index (WEAI) is the first comprehensive and standardized measure to directly capture women's empowerment in agriculture. The WEAI is composed of two sub-indices: The Five Empowerment Domains (5ED) and Gender desparity Index (GPI). It is used to measure women's empowerment relative to that of men by comparing the 5ED profiles of women and men household heads (Alkire *et al.*, 2013). The overall WEAI is constructed by calculating the weighted average of the 5DE and GPI as follows:

$$\text{WEAI} = (0.90 \times \text{5DE}) + (0.10 \times \text{GPI}) \quad (1)$$

$$5DE = H_e + H_n \quad (2)$$

$$GPI = 1 - H_e\,(R_p) \quad (3)$$

Where:

H_e Household women who are empower

H_n Household women who are not empowered

R_p Average empowerment gap between women compared with men

These 5ED are measured using 10 indicators; their corresponding weights are given. The weighted sum of these 10 indicators is the empowerment score or 5DE score of the household heads under study including Input in production decision; Autonomy in production; Ownership of assets; Purchase, sale and transfer of assets; Access to and decision to credit; Control over and use of income; Group member; Speaking in public; Workload; and Leisure. A person is defined as "empowered" if the score for 5DE is 0.8 or higher. The values for the WEAI and its sub-indices range between 0 and 1, higher number indicates greater empowerment.

2.2.3. Vulnerability analysis to climate change

A vulnerability analysis approach was used to evaluate the vulnerability context of men and women headed households' food security due to climate change. It is used to measure men and women headed households' amount of resources ought to be set aside in order to achieve food security for any chosen level of confidence (Scaramozzino, 2006). The vulnerability level of a household (V_h) at time t is defined as the probability that a household will find itself food insecure at $t+1$ period. This is a basic formulation of vulnerability as the risk of food insecurity is expressed as:

$$V_{hi} = \Pr\left(C_{h,t+1} \leq Z\right) = \int_{-}^{Z} f\left(C_{h,t+1}\right) dc \quad (4)$$

Where, $C_{h,\ t+1}$ is the household's consumption at time $t+1$ and Z is the appropriate consumption, dc is the daily calorie intake for men and women headed households.

The food security status of men and women is dependent on the household own production and income levels. Thus, production is influenced by a number of factors like labor, access to land, education, credit, and extension services. This suggests the following reduced form expression for production:

$$C_{ht} = C_{h,t+1}(X_h) \quad (5)$$

Where, X_h represents observable household characteristics like labor, access to extension, education status of the household head, age of the household head, etc. Substituting (5) into (6) we can rewrite the expression for vulnerability level as:

$$V_{ht} = \Pr(C_{h,t+1}\ (X_h) \leq Z/X_h) \quad (6)$$

The expression in equation (7) suggests that a household's vulnerability level is derived from the household's observable characteristics and this is compared to the standard consumption requirements (Z) given the same household observable characteristics.

$$\hat{V}_{ht} = \hat{P}_r(lnC_{h,t+1}\ (X_h) < lnZ/X_h) = \Phi\left(\frac{lnZ - X_h\hat{\beta}}{\sqrt{X_h\hat{\theta}}}\right) \quad (7)$$

The outcome of the above model measures the degree of vulnerability to food insecurity for men and women headed households. The probability of a household being vulnerable to food insecurity is ≥ 0.5 and the probability of a household not being vulnerable to food insecurity is < 0.5, using a threshold value of 0.5. In order to categorize men and women headed households into vulnerable and non vulnerable to food insecurity, a household requires minimum of 2200 kcal per day per adult. Thus, vulnerability to food insecurity can be expressed as a probability that a household fails to attain the minimum level of calorie intake (Chaudhuri, 2002).

3. Results and Discussion

3.1. Climate Change

3.1.1. Changes in rainfall and temperature

In the study area maximum rainfall distribution is expected during two seasons of the year: spring (April) and summer (August). Thus, March, April, May, July, August and September are months of maximum precipitation distribution. SPI of the study area was calculated and presented in Figure 2 based on the six months precipitation data records of Dire Dawa city for thirty years.

The SPI chart for Dire Dawa showed that rainfall scarcity had occurred for nineteen years from the total of thirty years studied. As a result, Dire Dawa administration suffered from major rainfall scarcity in the years 1986, 1988, 1989, 1990, 1991, 1992, 1995, 1999, 2000, 2002, 2003, 2004, 2005, 2008, 2009, 2011, 2014, 2015, and 20116. Particularly, in 2014, the value of SPI approached to the level of extreme drought. However, the SPI value of the study area for eleven years was positive and in 1996 and 2010, it acquired a relatively better amount of rainfall (Figure 2).

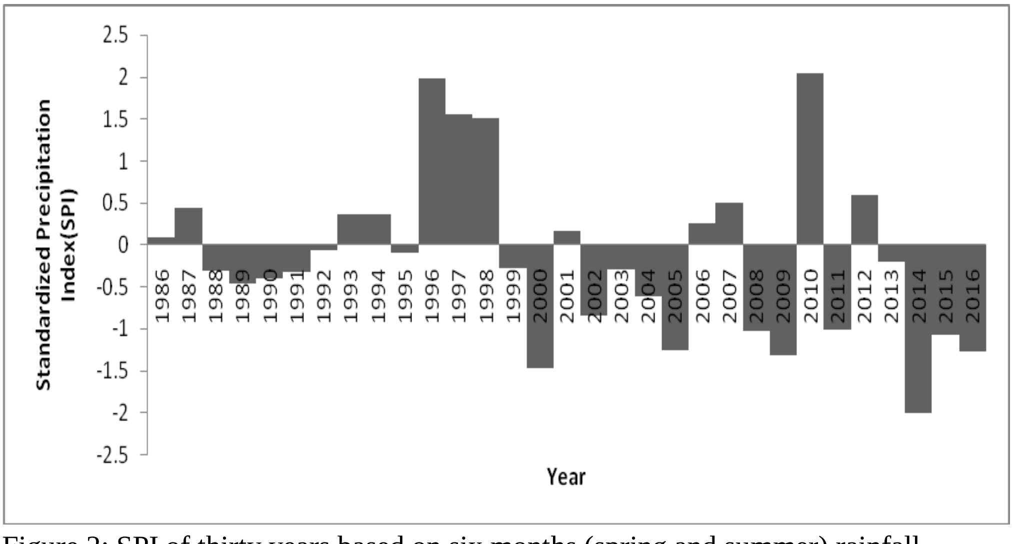

Figure 2: SPI of thirty years based on six months (spring and summer) rainfall
Source: National Metrological Agency, 2017

Long-term changes in historical minimum, maximum and average annual temperatures were used to assess changes in temperature. The data show that there was a slight increase in minimum and maximum temperatures over the last 30 years period. This variation of temperature accentuates the risks of drought prevalence. In turn, this fluctuation causes a dry spell season, reduce crop yield and affects household food security. This finding is consistent with a study conducted by Abebe (2017) who reported that temperature anomalies result profound effects on agriculture. Furthermore, men and women informants perceived change in rainfall fluctuation during the last 10 years is also evident from focus group discussion and Key Informant Interview over the last 10 years. Accordingly, they reported that there was rainfall shortage which in turn caused frequent occurrence of drought in the study area. They further reiterated that agricultural yield like sorghum and maize were observed.

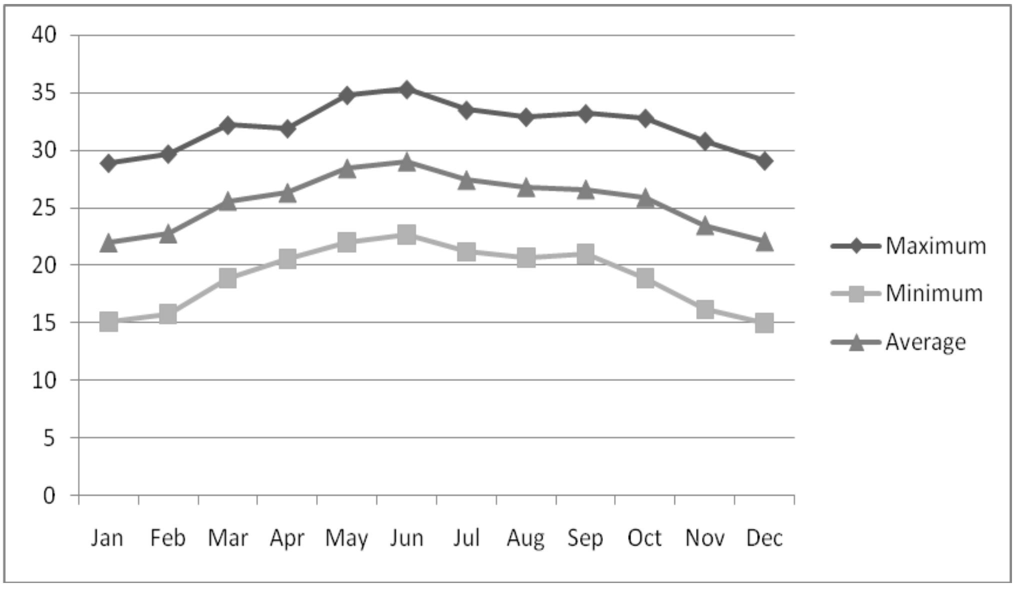

Figure 3: Long term annual temperature of Dire Dawa, 1986-2016
Source: NMA, 2017

Table 2 presents men and women's perception of changes in temperature. As a result, 37 % of the interviewed men and 19.48% of women HHHs perceived an increase in temperature whereas 21.9% of the interviewed men and 14.28% of women perceived and strongly agreed on an increase in temperature.

Table 2. Respondents' view on temperature change

Scale	Men		Women	
	Frequency	%	Frequency	%
Strongly agree	16	21.9	11	14.28
Agree	27	37	15	19.48
Somewhat agree	18	24.65	31	40.25
Disagree	9	12.32	13	16.88
Strongly disagree	3	4	7	9
Total	73	100	77	100

Source: Field survey, 2017

On the other hand, 40.25% of women respondents somewhat agree on the existence of changes in temperature. Meanwhile, 12.32% men and 16.88% women respondents disagree on change in temperature. This result is not consistent with previous studies which stated that women have a higher level of environmental consciousness (Campbell *et al*., 2013; Hunter, Hatch, and Johnson, 2004; Ozden, 2008). This in turn calls for more empirical studies to be conducted on the issue.

Responses from focus group discussions and key informant interviews also confirmed existence of climate changes manifested through higher temperature, shortage of rainfall, drought, and changes in the timing of rainfall. An elder person from Wahil Kebele has stated his observation of climate change as follows:

> Temperature is increasing from time to time and drought is recurring at short intervals. Some 30-40 years ago, we used to divert floods away from our crop lands. But nowadays when floods come from the highlands we divert it into our crop lands as we do not get enough rain for our crops. It is a time of hardship. Planted seeds and seedlings are often losing due to lack of rain and high temperatures.

3.2. Effects of Climate Change as Perceived by Respondents

Men and women HHHs were asked to describe their experience on the effects of climate change on their livelihood by taking key indicators into account. Table 3 presents vulnerability difference in some indicators of climate change between the two groups.

Table 3. Indicators of climate change and vulnerability

Variables	Men	Women	P value
	Mean	Mean	
Crop failure	2.48	3.27	0.035**
Food price	3.29	4.43	0.043**
Flood incident	1.49	1.15	0.015*
Disease incident	1.34	1.86	0.000***
Water scarcity	2.47	3.29	0.047**
Desertification	1.72	1.66	0.012*

Source: Field Survey, 2017; Note: significant at 1%*, 5%**, and 10%***

The results indicate that there is significant mean difference between men and women regarding their perceptions of the effects of climate change on their livelihoods. Accordingly, crop failure and food price increase are the main indicators reported by household respondents. This indicates that climate impact on crop production affects income of women and men differently by deteriorating their financial capital. The mean difference of men and women who experienced flood incidence is significantly different. This result is consistent with the study by Dankelman (2002) which reported that rural women in developing countries in particular, interact more directly with their environment, and are disproportionately adversely affected by climate change due mainly, in many cases, communities interact with their physical environment in a gender-differentiated way. Similarly, a study conducted by Rediat and Solomon (2015) has indicated that the study area has often experienced and affected by frequent and prolonged drought as well as rainfall extreme events like flood recurring at about 4.17 years interval. This extreme rainfall event has resulted in crop failure, drought, flood and has become the cause for the loss of many lives, property and damage to infrastructure. In this regard, it is worth mentioning the impacts of the 2004 and 2005 droughts incidence which caused food shortage to 85% of the rural population according to Dire Dawa Environmental Protection Authority (DDAEPA, 2011). The May 1984 catastrophic flood claimed 42 people, and property worth 10 million birr was lost. Whereas in August 2006, 256 people were killed, the where about of 244 people were unknown, and 10, 000 people became homeless. In 2010 in rural areas of the administration, the crop that was found in 124.6 hectares of land was completely destroyed. So, did soil and water conservation structures, rural roads, irrigation schemes and potable water supply sources which are estimated to be 28 million birr.

In the case of disease prevalence, an average of 1.34 of men and 1.86 of women has a different experience with a significant mean difference P=000. This finding is in line with the work of Denton (2002) which reported that the quality of women's health is low compared to that of men in their households and communities. The same source further contends that while health threats related to global warming linger, women are faced with more immediate health risks than men, due to their role in the gender division of labor.

The impact of climate change on agriculture reduces women households' crop production which directly exacerbates food shortage that will induce malnutrition, deteriorates their health and makes them additionally susceptible to diseases.

Water scarcity is a proxy indicator of impact of climate change. In view of this fact, Table 3 shows existence of mean difference between the two groups which is statistically significant P= 0.047. This in turn shows that women are more affected than men due to women are responsible to fetch water for cooking food, cleaning house, clothes hygiene and sanitation of children and family. During drought women have to travel 1 to 2 hrs to fetch water away from home thus time spent increased and more physical labor exerted. This routine task increases the burden of women than men respondents in the study area too.

With regard to desertification, the mean difference 1.72 of the men and 1.66 of the women has showed a significant mean difference P= 0.012 which implies that the degree of respondents' vulnerability to climate change between the two groups is not the same.

3.3. Asset Ownership

3.3.1. Land access and possession

The study assessed the patterns of land ownership between the two groups. Accordingly, 46.57% of men and 14.28% of women respondents acquired land by inheritance. On the other hand, 14 (19.17%) of the men owned land from their families by marriage. However, 20.77% of widows and divorced women gained the land by marriage and inheritance from their husbands. Similarly, 7.79% of both men and women were certified together by marital inheritance from their family.

Table 4. Land ownership and possession by gender

Means of access to land	Men		Women		Both	
	Frequency	%	Frequency	%	Frequency	%
Inheritance	34	46.57	11	14.28	-	-
Marriage	14	19.17	16	20.77	6	7.79
Land redistribution	25	34.24	24	31.16	20	26
Total	73	100	51	66	26	34

Source: Field survey, 2017

In another case, 34.24% of the men and 31.16% of the women have become owners through land redistribution by the government, and 26% were certified in both husband and wife names. However, the Ethiopian revised family law has aligned a joint land certification program for husband and wife. Contrary to this, CSA (2007) indicated that the number of male landowners (land certified) outnumbers the female landowners almost five times, i.e. 9.6 million versus 2.3 million, respectively. As a result, the land certification program has not narrowed the gender gap. Similarly, a study conducted by Bezabeh and Hoden (2010) has indicated that land tenure is not directly linked to more gains for women as intended.

The FGDs held also have demonstrated that due to social and cultural influences, women in the study area have been forbidden to plough and inherit land because they are considered as an outgoing from family and belong to someone.

3.3.2. Access to education

Table 5 shows the literacy level between men and women where most alarming trend of low level is observed among women HHHs. Consequently, of the total women respondents, 68.8% were unable to read and write. The comparable figure for men was only 33 (45.2%). This finding is consistent with UNW (2014b) report on women/girls education which states that the gender parity index reveals gaps in all levels of education and most significantly at secondary and tertiary levels. For example, the gender parity index (GPI) at primary level was 0.98 in 2009/10 and has dropped to 0.96 in 2012/13 indicating higher gaps in the enrollment of girls attributed to socio-economic challenges such as women/girls responsibilities for time-taking household chores (UNW, 2014b).

Table 5. Educational status by gender

Education	Men		Women	
	Frequency	%	Frequency	%
Unable to read/write	33	45.2	53	68.8
Primary school	28	38.35	15	19.48
High school	12	16.4	9	11.68
Total	73	100	77	100

Source: Field survey, 2017

Qualitative data obtained from key informant interview indicated that primary school enrollment rate is nearly the same at the beginning among girls and boys. But as school grades go up, the number of girls dropping out of school and completions of primary school become down and lower than boys due to low recognition of girl's education and cultural influence in the community.

3.3.3. Access to credit

Credit service is measured in terms of men and women households' access to formal and informal credit sources. Table 6 indicates that 26.65 % of the men and 45.45 % of the women get credit from neighbors.

In case of formal sources, i.e. farmers' cooperative and microfinance institutions, 20.54% of the men and 11.68% of the women access credit from farmers' cooperative. Likewise, 37% of the men and 15.58% of the women informants obtain credit service from microfinance institutions indicating that men have a better access to formal credit service than women (Table 6). According to the FGD participants, the amount of credit that women obtain from their respective neighbors and local lenders were small and have little or no impact in changing their livelihood conditions.

Table 6. Credit sources by gender

Credit source	Men		Women	
	Frequency	%	Frequency	%
Neighbors	18	26.65	35	45.45
Local lenders	13	17.8	21	27.27
Farmer cooperative	15	20.54	9	11.68
Microfinance	27	37	12	15.58
Total	73	100	77	100

Source: Field survey, 2017

Key informant interview (KII) participants further reiterated that women have a fear of back pay and have no asset to collateral arrangements to access credit from micro-finance institutions.

3.3.4. Extension service and input use

Respondents were asked about frequency of contacts with development agents (DAs) in the last three months. Accordingly, men have had the highest frequency, i.e. four times or more. On the contrary, women had relatively less frequency of contact with development agents (DAs), i.e. 11(14.26% (Figure 4). This implies that men have access to formal information sources which likely increase households' food production and reduce the risk of food insecurity and climate related hazards. Extension service provision has a significant factor that explains whether or not farmers use fertilizer, improved seed, and the rate of use of these inputs (Catherine *et al*., 2013). The same source further contends that the difference in terms of access to extension services (particularly with respect to advice on fertilizer) could be the factors leading to the observed difference between male and female HHHs.

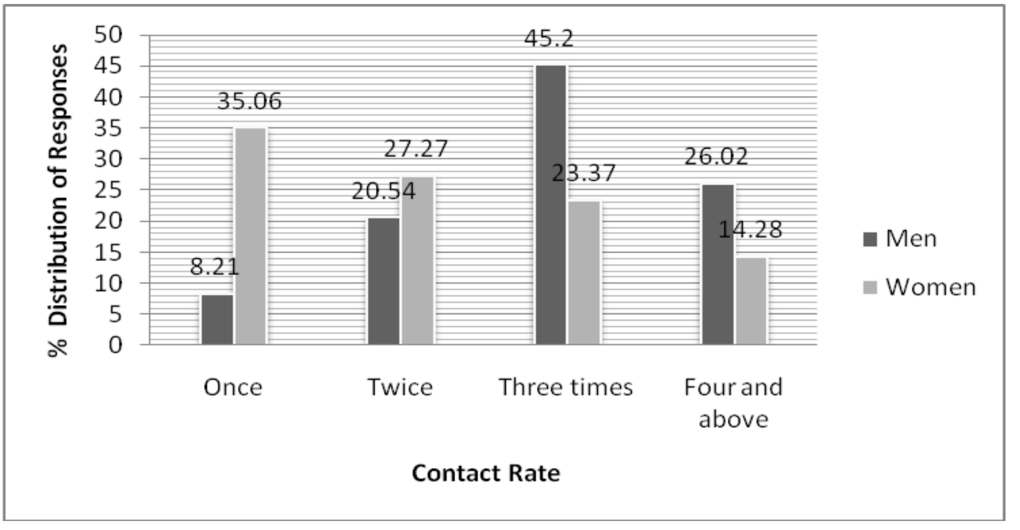

Figure 4. Percentage distribution of extension contacts by gender
Source: Field survey, 2017

3.4. Household Food Security

3.4.1. Food security indicators

To measure food security, different methods have been highlighted in the literature such as actual food consumption at the household level by a 24-hour recall, calorie intake, household income, household expenditure, productive assets, number of months of enough food, dietary diversity and crop diversity(Kristjanson *et al*., 2012; Bashir and Schilizzi, 2013).Dietary energy supply measured in kilocalorie (kcal) was used to determine food security status of a household; since it is the single most important indicator of food adequacy level (Qureshi, 2007). Accordingly, there is statistically significant mean difference in the average daily calorie intake between men and women HHHs P= 0.000. This is consistent with the finding of Adugna *et al*. (2016) which the average daily calorie intake of men is very close to the country's threshold (2200 kcal) for Ethiopia than their counter part.

The average land access of the men 1.57 and 1.02 of the women shows a significant mean difference P=0.047. This is consistent with the study by Arega (2013) which found female headed households owned less than male headed households. Likewise, the mean difference between the men (3.44) and the women (2.37) pertaining to crop production is statistically significant P=.001 which is consistent with land utilization survey of Ethiopia conducted by CSA that reveals the average size of landholding for women is 0.69 hectares vs. 1.23 hectares for men (CSA, 2013).

Table 7. Indicators of food security

Variables	Men	Women	P value
	Mean	Mean	
Daily calorie intake (kcal)	2016.42	1875.11	0.000***
Land access	1.57	1.02	0.047**
Crop production	3.44	2.37	0.001***
Livestock ownership	4.19	1.44	0.013*
Extension service	2.89	1.17	0.042**
Family size	5.5	4.14	0.023*

Source: Field Survey, 2017; Note: Significant at 1%*, 5%**, and 10%*** levels

With regard to livestock ownership, on average the mean 4.19 of men and 1.44 of women showed that men have a better experience in livestock wealth accumulation. The mean difference between the two groups is statistically significant P= 0.013 which has indicated men are more food secure than women households. This in turn increases the likelihood of escaping harsh climate conditions by selling and securing income.

As far as provision of extension services is concerned, women have the lowest experience in terms of contact with development agents. The average mean difference of the men 2.89 and 1.069 of the women showed significant mean difference between the two groups P= 0.042. The study by Gbetibouo (2009) argued that farmers with access to extension services are likely to get better information on climate hazards as well as proper utilization of farm inputs.

Another indicator of food security is family size of HHHs. The mean difference men 5.5 and women 4.14 is statistically significant P= 0.023. This means that each additional member of a household increase food insecurity.

3.5. Measuring Gender Disparity in Agriculture

The Women’s Empowerment in Agriculture Index (WEAI) is used to measure women’s empowerment relative to men within their households. This method tracks women’s engagement in agriculture in five domains: production, resources, income, leadership, time use and these in turn comprise ten indicators (Alkire *et al*., 2013).

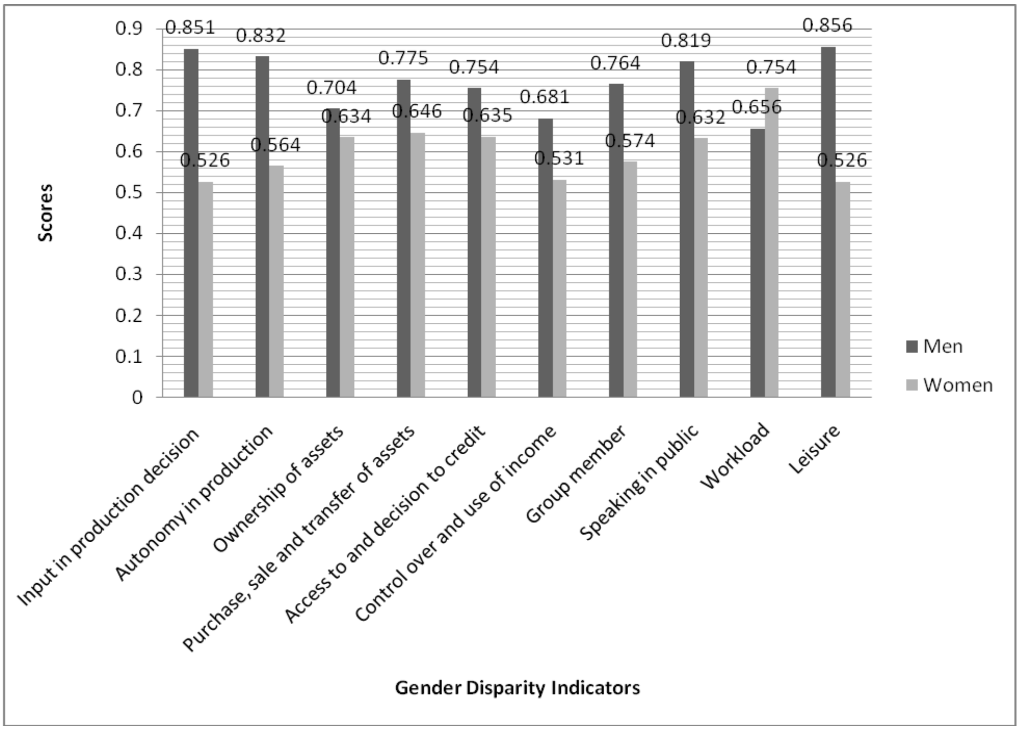

Figure 5. Gender disparity indicators
Source: Field survey, 2017

Figure 5 depicts results of the indicators used to assess women's empowerment in agriculture. The overall result of the mean value of the men 0.7692 is higher than the mean value of women of 0.6022. This show the sampled women HHHs have less empowerment. According to IFPR (2012) and Alkire *et al*. (2013), for women to achieve empowerment in each domain, the overall women empowerment index should be 0.8 and above. Accordingly, the result implies that limited input and autonomy of women in production decision making, lack of control over resources and access to credit service, and lack of leadership role in the community are the main gender disparities in agriculture. This is consistent with the UNW (2014a) which reports that gender roles in agriculture and socio-cultural norms often restrict women's access to vital resources such as credit and extension services as well as other agricultural inputs. Moreover, World Bank (2014) stated that while male farmers spent 23 hours a week on their farm females only did 14.4 hours. This implies that women spend fewer hours on agricultural activities and face overall burden due to a high number of unpaid activities they have to perform in domestic work. However, all those roles they play had not been recognized. This is because traditionally the society provides women low status.

4. Conclusion and Recommendation

The following concluding remarks may be drawn from the major findings presented above. Women mostly spend their time around home doing domestic activities thus they are observed to engage in homestead farming. This implies that their experience of mobility is minimum compared to men. Especially, during drought disaster accessing water and fuel wood becomes difficult and increases their burden of time and labor. As a result, women's role in domestic activity is greater than that of men. Despite this, empirical evidences have showed that climate change has adverse effects on food security status of men and women differently. Manifestations in terms of decline in amount and seasonal variability of rainfall, increased temperature, crop failure, disease incident, water scarcity and expansion of desertification were clearly observed and disproportionality affect men and women. Moreover, despite many efforts made to close the gap that exist between the two sexes in rural Ethiopia, evidences convincingly show that much has remained to get done. Partly to achieve this and reduce burden and vulnerability, strengthening institutions working towards gender have to be strengthened in a way to solve the problems.

Hence, in order to reduce the risks of food insecurity, both sexes must have equal access to instruments that not only help them manage risks and respond to shocks in the short term, but also improve their resilience and promote their food security in the long run. Accordingly, governments, donors, and private sectors must develop and scale up approaches that benefit women more and yet support men as well. Furthermore, improved knowledge base about the nexus of gender and climate change and consequential impacts through researches should be expanded at different levels.

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