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Determinants Of Climate Change Adoption Strategies By The Women Headed Farmers: An Empirical Analysis

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Abstract

Globally climate change is occurring at an alarming rate, Ethiopia has been identified as one of the most vulnerable countries to this change. The impact of climate change is vary by gender. Hence, this study is investigate the impact of climate change on agricultural production, water resource, and assesses the perception of WHHs and determinants of climate change adaptation strategies applied by WHHs to reduce the impact of climate change. The study employed multi-stage random sampling procedure to select study area as well as sample respondents. Primary data have been collected from 168 women sample respondents using interview schedule, Focus Group Discussions, Key Informants Interviews, and observation methods. Descriptive statistics and multinomial logistic regression were used to analyze the quantitative data. While narration and triangulation techniques were used to analyze the qualitative data. The study result indicated that 90.5% of the respondents believed that temperature was increased and similarly 92.3% witnessed that rainfall decreased in their village. The multinomial logistic model result on climate change adaption strategies revealed that level of education, frequency of extension visit, farm size, distance to nearest road, TTLU, participation in any extension service trainings on climate change, and have informed/ perceived- about climate change were the key factors to influence women farmers to choose of adaption strategies significantly at p<10%. As climate change is the main problem, which is beyond the capacity of WHHs, it is quite pertinent to capacitate WHHs government and any developmental organization should play meaningful roles to create opportunities that helped them to engage in those activities that are less sensitive to climate change.

Keywords: Climate change, Women headed households, Agriculture, Adaption measures

Introduction and rational of the study

Climatologists and other scientists have warned for more than half a century that the accumulation of CO_2 and other GHGs (greenhouse gases) in atmosphere is leading to global warming and other significant climatic, ecological, and societal changes(IPCC International Panel on Climate Change, 2007).Climate change occurring at an alarming rate. The origins and impacts of climate change is caused by the rich world countries, but affecting most seriously the poor developing countries. In the poor countries, climate variability and extreme events have devastating impacts on communities, causing loss of life, human suffering, and the destruction of the infrastructure and natural resource base upon which many livelihoods depend (Fankhauser, et al 2014).

Climate change affect people in Africa more than anywhere else in the world. With its harsh impacts livelihoods of agrarian society's severe drought, among others, hitting the world's poorest nations the hardest. For example due to the climate change effect drought is manifested in both Ethiopia and Australia reputedly; however Australia has low climate vulnerability and sensitivity, and very high readiness to adapt. But, the poor farmers, mostly women headed in Ethiopia are the most vulnerable one to its negative consequence and as a country low readiness to adapt (Baumert et al. 2005).Women represent 70% of the poor throughout the world and the effects of climate change will fall disproportionately upon this social category (UN Women Watch 2009). In many developing countries like Ethiopia climate change affect women and men headed households differently. Ethiopian women have limited access of agricultural extension service and be less adaptive to the effect of climate induced disasters Ragasa C, (2012). Gender roles attributed to women and men not only determine power relations but also determine their ability to adapt to the impacts of climate change, (Dankelman, 2010).

Deresa et al (2008) stated that Ethiopia is one of the most vulnerable to climate change impacts. Climate is extremely variable particularly over the arid and semi-arid parts of Ethiopia like Tigray. Tigray region is one of the most known regions which highly dominated by arid and semi-arid climate. Weldearegau, argued that (2018) climate variability is not a recent situation to Ethiopia. Tigray is one of Ethiopia's most vulnerable regions to drought and environmental change; weather and climate affect the lives women and livelihoods of poor farmers. In the region the impact of climate change and climate variability have been causing for the majority of its inhabitants to be food insecure and malnourished for decades (Alemayehu et al., 2009).

Women households (WHHs) are believed to lack the basic assets that could help them survive through harsh living situations (Mirutse 2006). WHHs in the region are extremely suffering particularly in the case of rural SahartiSamrewereda their livelihoods are depended on climate sensitive subsistence farming system.According to study conducted in Tigray region by Mirutse (2006) the basic constraint to adopt climate shocks that is moisture stress and other drought induced problems in WHHs and forced them to enter late sowing seeds at the rain season and to enter into share-cropping arrangements with men. In order to put the lands that they owned into use, they had to rent them out to others in the local community. This arrangement along with the drought situations made these households food insecure for over half of a year.

Visser et al., (2012) on his study stated that "Weather-related disasters such as floods, storms, heat waves and droughts can have enormous implications for the environment and economic development. Historic examples of severe disaster impacts are (1) the drought in Ethiopia and Sudan that resulted in over 400,000 deaths through famine in 1983, Still according (FDRE) Ministry of Water Resources and National Meteorological Agency (2007) Ethiopia is extremely vulnerable to climate change impacts due to an assemblage of social, economic, and environmental factors. According to the study of Asheber (2010) In Tigray drought impact women to more severely affected than men due to water collection burden; time spent increased and more physical labor exerted. Poor countries, including Ethiopia, faced worse problems, low capital investment, low and erratic rainfall patterns, fast growing population, and low access to basic services, provided the usual detrimental combination of elements leading to chronic poverty as a result of climate change (Deressa et al .,2009).

There are very few research studies in Ethiopia focused on variability of rain fall, climate change awareness, vulnerability and risk assessment which shows that more households are to be food insecure in the future 40.5% than present, as far as researcher knowledge is concerned there is no research studies conducted on the impact of climate change on women headed householdsin SahartiSamrewereda. Hence, there is a need to examine the impact of climate change on women headed households for mainstreaming climate change issue on women

livelihood development, information services for planers and technology transfer to supporting the needy women. This study will fulfill the existing research gap with respect to climate change impacts on women headed households.

Objectives of the research

To identify adaption measures applied by women headed households to minimize the impact of climate change.

To examine the factors which influence the farmers to choose climate change adoption measures.

Brief review of literature

Climate is all weather occurring over a long period of time in a given place. Climate includes: average weather conditions; regular weather seasons; and special weather events, such as cyclones, drought and floods. Climate tells us what it's usually like in the place where we live (UN women 2015) such as water bodies, highlands and valleys.

Climate change refers to any change in climate over time, whether due to natural variability or as result of human activity. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC 1992), which defines 'climate change' as a change of climate which is attributed directly or indirectly to human activity that alter the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. Climate change is emerging as one of the most pressing issues facing the global community with its potential to alter the course of development and human progress, posing crucial concerns not only for the well-being of nature but also for the very survival of human beings (Kapoor 2011)

Climate change is now affecting every country on every continent. It is disrupting national economies and affecting lives, costing people, communities and countries dearly today and even more tomorrow (UN and climate change 2015). According Extreme Weather Events Germany watch People all over the world have to face the reality of climate variability and in many parts of the world an increasing variability. Between 1996 and 2015, more than 528, 000 people died worldwide and losses of US$ 3.08 trillion (Sönke et.al 2017). Global research shows that women and children are 14 times more likely to die or be injured than men due to a disaster, an effect that decreases or disappears as social inequalities between men and women decrease. In addition to high fatalities, loss of homes and livelihoods, women and girls also experience more intangible losses. They are subject to a number of secondary impacts, including sexual GBV and trauma, loss or reduction of economic opportunities, and increased workloads. Increased rates of Sex GBV, including rape, for example, were reported in the Solomon Islands after the tsunami in 2007 (UN OHCHR, 2011; Neumayer and Plumper, 2007).

Even though, developing countries in Africa like Ethiopia are contributing very less amount of CO_2 to global they are the most venerable to climate change effects (Bewket W. 2012; IPCC, 2013). Because of its agricultural orientation, widespread poverty, and limited institutional capacity, Africa is widely recognized as the region most threatened by climate change, for example According to global climate risk index Sönke et, al (2017) in 2015,countries belongs to Africa like Mozambique, and Malawi were at the highest of the list of the most affected countries in the world. Krishnamurthy (2013) Indicated that climate risk and food insecurity are closely related, and that climate risk exacerbates food insecurity, particularly in sub-Saharan Africa and South Asia.

Extreme events, such as floods, droughts, and heat waves, especially when occurring in a series, can significantly erode poor people's assets and further undermine their livelihoods in terms of labor productivity, housing, infrastructure, and social networks. Indirect impacts, such as increases in food prices due to climate-related disasters and/or policies, can also harm both rural and urban poor people who are net buyers of food (Olsson, 2014). Many factors contribute to vulnerability, and these factors undermine capacity for self-protection, block or diminish access to social protection, delay recovery or expose some households to greater or more frequent hazards than other households (Notenbaert et al. (2013).

Adaptation can be defined as adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. It is a process through which societies make themselves better able to cope with an uncertain future. Adapting to climate change entails taking the right measures to reduce the negative effects of climate change (or exploit the positive ones) by making the

appropriate adjustments and changes (Adger et al., 2007).Climate in Ethiopia is largely influenced by altitude and latitude as well as topographic feature of the country. The country lies near the equator in a zone where the maximum heat of the sun is received (national metrological agency, 2016).In Ethiopia, climate change and associated risks are expected to have serious consequences for agriculture and food security. This in turn will seriously impact on the welfare of the people, particularly the rural farmers whose main livelihood depends on rain-fed agriculture. The level of impacts will mainly depend on the awareness and the level of adaptation in response to the changing climate (Tagel and Anne, 2013).

Indeed, a strong relationship exists between climate change and environment-based livelihoods, which, in turn, are closely linked to gender (Alexander et al., 2011). In all developing countries, it has now been demonstrated that women are more vulnerable to climate changes and effects because two-thirds of women are poorer, they receive less education, and they are typically not involved in political and household decision-making processes that affect their lives (Rodenberg, 2009).Climate change impacts are widely observed in Africa where it has directly affected climate-dependent activities and indirectly impacted on social aspects such as poverty, conflict, education and health (Orindi and Murray, 2005). According to the Intergovernmental Panel on Climate Change, IPCC, (2007), Africa is one of the most vulnerable continents to climate change and variability because of multiple stresses and its low adaptation capacity.

Peterman et al, (2014) and Ragasa, (2012) argued that agricultural vulnerability to climate change depends on cropping practices and access to land, as well as the use of farming inputs and tools. Individuals who have access to land, water, fertilizer, and other inputs, as well as who adopt sustainable agricultural practices are more likely to adapt to the impacts of climate change, yet access to and knowledge of these tools and practices is gendered.In many settings, women are less likely to possess the knowledge and financial capital needed to improve their farms. Peterman (2014) stated that cropping decisions are also impacted by the ability of women and men to secure access to capital and agricultural resources. Around the world, women tend to have less access than men to cash and credit. Women are also less likely to have access to tools, seeds, and fertilizer, as well as high quality water supplies, all of which increase women's vulnerability to the effects of climate change.

Methodology

The study was undertaken in Tigray region; Saharti Samre wereda. The wereda is one of the four rural wereda in South Eastern Zone of Tigray region that has 23 tabias/ Kebele: 21 rural tabias& 2 urban tabias. Samre is bordered on the south by the Amhara Region, on the west and north by the Central Zone, on the northeast by Enderta, on the East by HintaloWajirat, and on the southeast by Southern Zone. Towns in this woreda include Gijet and Samre. The wereda capital is called Samre & is located 57 km from regional capital Mekelle (SSARD 2017).

For the purpose of the study a cross-sectional survey design has been used to undertake the study. The survey method is more appropriate in order to have accurate data from the study area. In addition to the survey research design, to address effectively the research problem, qualitative technicwas used. Both and quantitative qualitative data were collected from primary and secondary sources. Primary data were collected directly from sample respondents with the help of interview schedule. The secondary data were collected from different documents obtained from Saharti Samre plan and Finance office, reports, journals, thesis, published and unpublished documents from relevant organizations which are appropriate to the study.

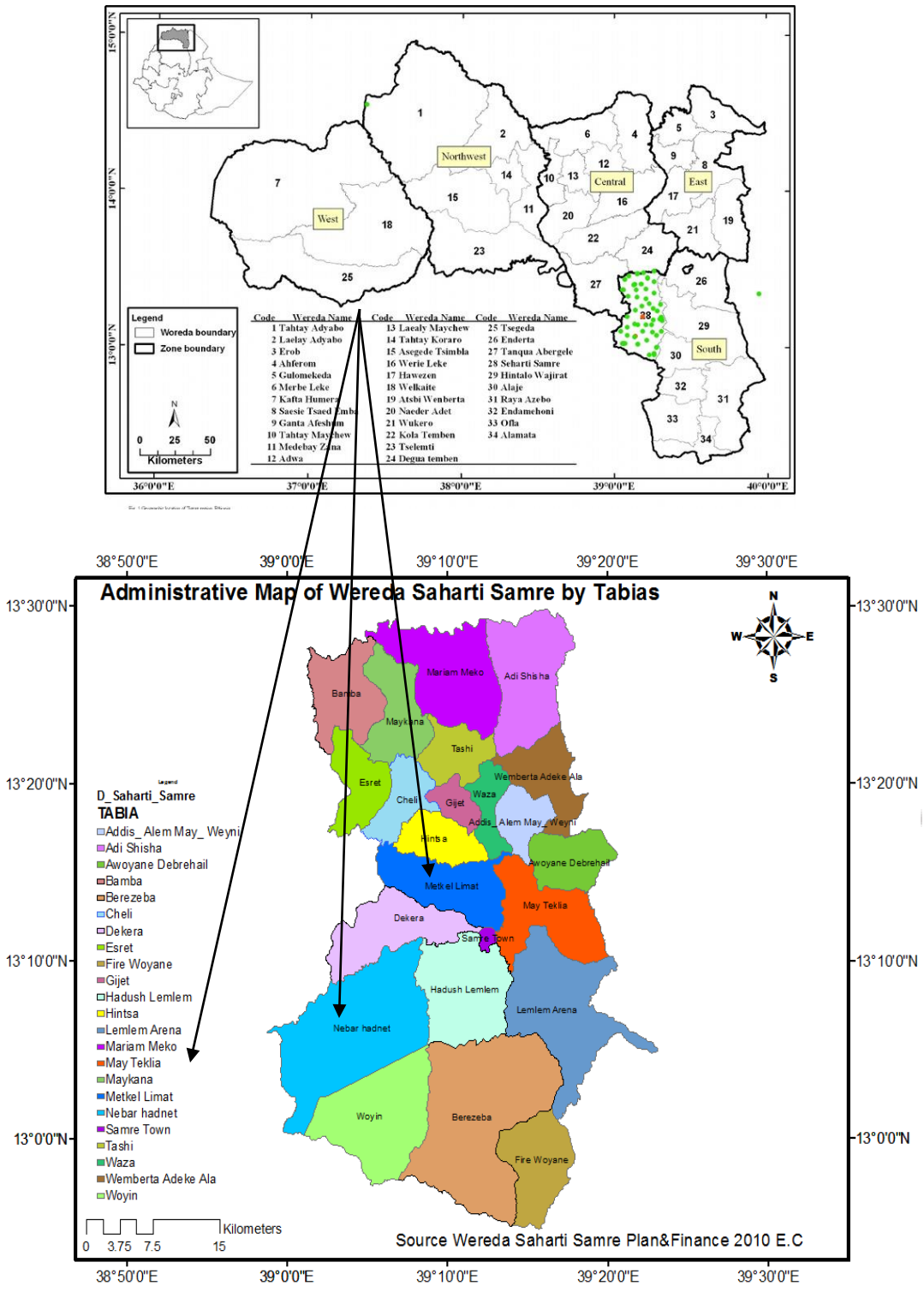

Figure 1 Map of the study area

Source: Woreda Saharti Samre Plan and finance 2010 E.C

This study used a multistage random sampling procedure both probability and non-probability sampling techniques for the selection of study area and sample respondents for the in depth study. In the first stage, the Saharti Samre wereda was selected purposively for the study. Because of climate change impact the wereda is found in drought-prone areas, and one of the 31 food insecure weredas and among the 7 hot spot drought affected place in Tigray regional state, in the wereda WHHs are highly vulnerable to climatic shocks and to cope up with the climate shocks small holder farmers, particularly, women headed households are seasonally migrate

for begging and engaging tiresome Works. Moreover, women and children are suffered in malnutrition as the consequence of the climate induced disaster drought.

In the second stage out of 21rural kebeles, three kebeles were selected by using stratified random sampling according to their agro ecological and the real number of WHHs. First Kebeles are categorized into traditional agro ecological stratum that was Kola, weynadega and Dega. Then from each agro ecological one kebele was selected by using simple random sampling. Accordingly three kebels were selected using lottery method based on their agro ecological. Hence the following kebels were selected (Table-1).

Table 1 Sample Kebeles and its population

S.no	Kebelle	MHHs	FHHs	Total	HHs in%
1	Amdi.weyane	1309	414	1723	24.02%
2	Lemlem	599	189	788	23.98%
3	NebarHadnet	1297	410	1707	24.01
Total				**4218**	

Source SahartiSamre plan and finance office, Samre.2019.

In the third stage, from each Kebelethe sample respondents were selected through simple random sampling techniques according to the population proportion to sample. A list of all population were collected from the kebele administration in the three kebele. From the sample frame168 (84 women spouse and 84 only WHH). To determine the sample size s http: ww.raosoft.com/samplesize.html (2019) were used. Based on the following questions the right sample size were given.

What margin of error can you accept? Level of precision **5%;** what confidence level do you need **95%**; what is the population size **4218;** what is the response distribution? **50 %(** Leave this as 50%), and your recommended sample size is **165**

Therefore, based on the sample survey calculator recommendation we use 168 respondents to have more precise sample size. This sample size was derived from Cochran's (1977) proportion

$$n = (Z)2 * (p)(q)/ d2$$

Z = 95% degree of confidence (1.95)

P = population proportion of target population

q = 1-p

d = Acceptable margin of error for proportion (Level of precision)

n = sample size

$$\mathbf{n = (1.9)2 * (0.5)(0.5)/(0.075)2 = 165}$$

The researcher collected data by using different data collection methods such as interview method, observation, Focus group discussion, and case study methods. The primary data was collected through the interview method on demographic characteristics, socioeconomic characteristics, women perception on impacts of climate change, and tried to determine adaptation measures implemented in the district. The interview schedule was designed and managed by well-trained enumerators to collect the relevance data from the respondents. Prior to the actual survey interview schedule was pretested on non-sample respondents in Samre town, then based on the result collected necessary modification was undertaken.

Qualitative data were also collected from KII, FGD, Case study and observation to triangulate the survey result reflectiveness. Both descriptive and inferential statistics (multinomial logistic regression /logit model) were used for data analysis. On the other hand, qualitative data analysis techniques have been used for analyzing qualitative data.

Results and discussions

Table 2: Climate adaptation technology adoption status based on Household category.

Respondent category	Climate adaptation technology adoption		Chi-square
	Yes	No	
WHH	21(25%)	63(75%)	5.25 (p=0.02)
MHH	35(42%)	49(58)	

Source: Owen survey, 2019

As indicated in Table 2 WHHs (75%) are less adopter of climate change adaption measurements and easily affected by climate change impacts than the MHH (58%) which is not adopted climate adaption technologies. The percentage difference between the two groups with regard to climate adaptation technology adoption status was found to be statistically significant at less than 5% probability level, this show that WHHs are less likely to adopters of climate change adaption measures. Martin (2016) finding in south Africa, also confirmed that WHHs are more vulnerable to climate variability is likely to reflect a marginalization of this group along several dimensions and also as expected, MHH are the least vulnerable to climate variability.

Table 3: Age distribution between WHHs and MHHs

S.N	Sex of HH	Frequency	Mean	S. Deviation	T
1	WHH	84	37.54	10.662	-2.8 (P=0.006)
2	MHH	84	42.40	11.873	

Source: Owen survey, 2019

Table 3 represents the average age of sample respondents, hence the average age of WHHs were 37.54 while that of MHH were 42.40. The independent t-test also shows the presence of significant mean difference between the age WHHs and MHH at t-value of -2.8 (p=0.006) which is highly significant difference at less than 1% level of significance.

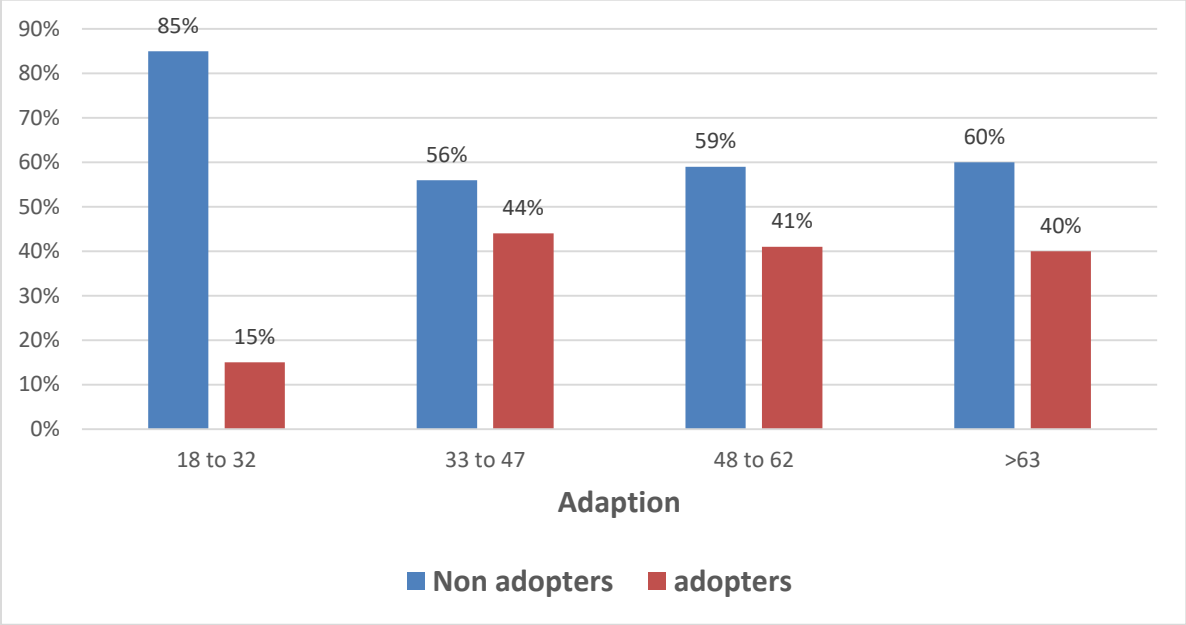

Figure 2 Women farmer agricultural technology adaption status based on age category. Source: Own survey, 2019

On Figure 4.1 the age category of 18-32 the young respondents described that only 15% of the respondents were able to adopted agricultural technologies to cope with the climate change impacts. However, from the age category of 33 to 4744% respondents have adopted modern agricultural technologies. From 48 to 62 age group, 41% of the respondents have adopted modern agricultural technology. Similarly FAO, (2005) noted that an adult farmer with experience in farming activities were able to adapt to climate change using different interventions than younger farmers with less experience. Hence, the result indicated that elders women farmers have better access of agricultural technology to adapt climate change this could be due to the accumulated experience and owning of different asset resource (e.g. access of land) that helped them to be better than the young with less assets holders.

Table 4: Farm land distribution based on HHs

Gender (Sex) of HH	Have farm land		Chi square
	No	Yes	
WHH	24 (28.57%)	60 (71.42%)	11.43
MHH	7 (0.83%)	77(91.66%)	P=(0.001)
Total	31	137	

Source: Own survey, 2019

Table 4 revealed that 91.66% of sample respondents of MHH have farm land. But only 71.42% the sample respondents of WHHs have farm land for their crop production. The chi-square test for access farm land of the two groups was found to be statistically significance at less than 1% probability level. According to the Land Worldwide study confirm that, less than 15% of agricultural land is held by WHHs. (Gender & Land Rights FAO 2015). In this study the FGD members also confirmed that MHH or women with spouse farmers get to relatively larger farm size through their husband but when she gets a divorce she do not access to the same land, this situation can lead divorced women to have less farm land and create less production capacity on the faced climate change threats.

Table 5 Main occupation & source of income of respondents

Source of income	Frequency	Percent
Agriculture	76	45.24
Agriculture & Aid-PSNP	32	19.05
Agriculture & Non Agriculture wedge /off-farm/ and Trade	36	21.5
Non- agriculture and AID/ PSNP	6	3.6
Non Agriculture wedge /off farm/ trade	18	11.0

N=168
Source: Owen survey, 2019

Table 5 depicts that about 86 % of the respondents were reported that mostly they are engaged on low productive agriculture and agriculture related practice. Among those 45.2 % of respondents rely agricultural activities and it is the only their source of income which is very sensitive to climate shock. However 44.6 % respondents in addition to agriculture they are also support their livelihood by off-farm employment like casual labor work, pity trade and other temporary works, trade, aid and PSNP, these activities are important in reduction the climate shock and help in improving agricultural production too.

Table 6:visiting of extension agent by gender of HH farmers

		visits extension agent during the last year		Total	Chi square
		No	Yes		
genders of HH	WHH	54(64%)	30 (36%)	84	16.104 (P=0.001)
	MHH	28(33%)	56 (67%)	84	

Source: Owen survey, 2019

The survey result indicates that 51% of the total sample households received agricultural extension services related to crop production and livestock production. Chi-square test was shown 16.104 with p = (0.00) which is significant at less than 0.01 level of significance difference between the two household categories. Based on the head of the household, 67% MHH have accessed the extension service and the WHH only 36 %, this indicated that the WS households have more opportunity to visit the extension office via their husbands. For this reason the result also indicated that the WHHs were less adapted agricultural technologies and climate adaptation strategies and they were more susceptible to climate related shocks.

Table 7: Respondents distributed by accessing of information on climate change

		No	Yes	Chi-square
WHH	No access	39(46.4%)	45 (53.6%)	18.194
MHH	Accessed	22(26.2%)	62 (73.8%)	P=0.001
	Total	61(36.3%)	107 (63.7%)	

Source: Own survey, 2019

The study results revealed that 63.7% of the sample respondents have accessed information on the climate change issue from trainings, mass-media and extension agents and friends; based on the group category while MHH (73.80%) and WHHs (53.57%) respectively have access climate change information. Furthermore, all the respondents (100%) were agreed that climate change was already happened in their village within the last10 years. The difference of climate information access between the two group sample respondents is statistically significant (Chi square= 18.194 with P= 0.001).

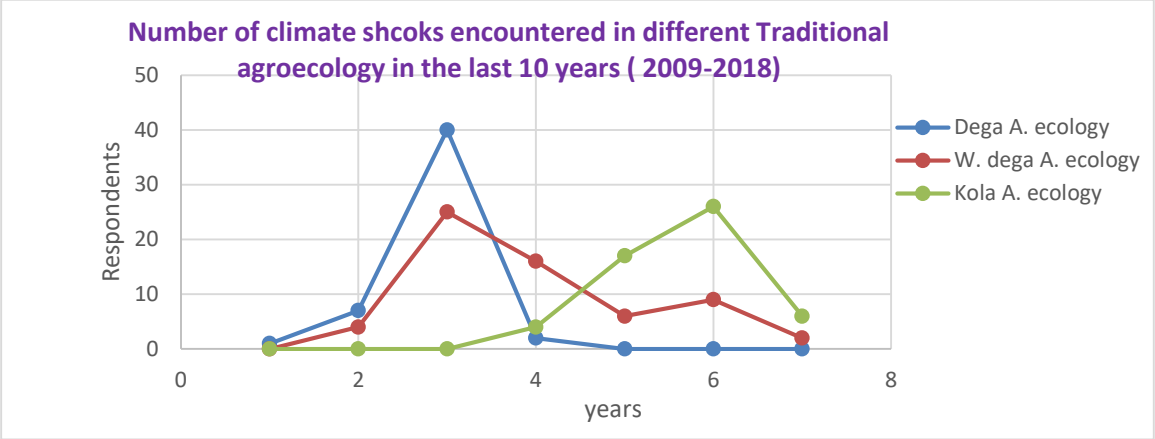

Figure 3climate shocks happened in the study area. Source: own Survey, 2019

In the Dega agro-ecological villages' drought and hail were manifested on average 3years within the last ten years, in Weyane Dega villages within the ten year 4 to 5 years shown different disasters and in kola agro-ecological village were 6 to 7years were manifested shown different disasters' like drought, erratic rain, and flood and animal diseases.

Table 8 TTLU in the study area

	Mean	S. Deviation	T	p
MHH	2.45	1.19		
WHH	1.29	1.23	-6.70	0.00***
Total	1.92	1.36		

*** Significant at 1%. Source: own Survey, 2019. Source: Own survey, 2019

Majority of respondents in the research area are engaged on both crop and livestock production. Livestock served as the main adaption mechanism and source of income for the poor women in the study area. According to the study result 87.5 % of the respondents were owned livestock such as cattle, sheep, goat, donkey, honey bee colony, and poultry. Climate change also impacted adversely on the livestock production. Table 8 reveals that the respondents are having livestock on average mean 1.92 livestock unit and the standard deviation was 1.36. according to the household category WHHs own on an average mean was (1.29) and WS was (2.45), and the mean difference between the two groups with regard to owing of livestock (TTLU) was found to be statistically significant at less 1% probability level, this indicated that owning of livestock has been determine significantly difference between the respondents. So, WHHs have less probability of adoption of climate change than the WS. According to the FGD discussed and observation of the researcher particularly in Amdiweyan keble, due to different project interventions a lot of WHHs farmers owned improved cows and shoats which enable them to cope with the climate shocks and improved their household incomes.

Case study

Tsiray, 42, has 4 dependent children; she was one of the poor woman households at the study area. After she divorced from her husband, she had been suffered to lead the family, faced economic problems and hurt psychologically. However, in the mean time she was selected among the poor woman household beneficiaries of the Climate Resilience project and got six sheep from the project through revolving fund. Using this opportunity she properly reared the sheep and increased to elven sheep and sold them to in good price during the holiday season and purchased a heifer breed cow by 12,000 ET. Birr. After a month this heifer breed cow got a calf. Tsiray, started working hard and properly handle the cows and has been started to utilize milk. Currently, Tsiray has owned two dairy cows and one calf and provides 25 liters of milk to the market, started to earn good income and save money, properly send her children to school and change her livelihood wellbeing.

Table 9: climate adaptation and coping mechanisms implemented by WHHs

Climate adaptation measures	Mean	SD	Remake
Practice soil and water conservation	**4.46**	**0.854**	S. Agree
Using Irrigation or Rainwater harvest	**2.42**	**1.230**	Disagree
Integration of livestock farming system.	3.48	1.262	Agree
Changing crop varieties (Fast maturing).	3.37	1.156	Agree
Crop rotation	3.55	1.379	Agree
Using intercropping practices.	2.83	1.550	Agree
Planting drought tolerance & early matured varieties	3.61	1.447	Agree
Using of compost and organic manure	3.98	1.126	Agree
Use of different means of livelihood Non farming.	3.31	1.508	Agree
Selling of animals as response to shock.	3.82	1.461	Agree
Rearing of shoat and poultry	3.89	1.461	Agree
PNSP (safety net)	3.67	1.676	Agree
Reduction of consumption level	**4.45**	**0.996**	S. Agree
Migration of family	3.45	1.604	Agree

Source: own Survey, 2019

Table 9 shows that only one intervention that is practicing SWC and one coping mechanism reduction of consumption were rated as strongly agree with the 4.46 and 4.45 respectively. The remaining ten climate smart intervention were also rated as agree from the mean value of 3.98 to 3.31 above the cutoff point 2.50. However, the intervention irrigation and rainwater harvest were rated disagree with mean of 2.42 (below 2.50 cutoff point) mainly by the WHHs. This implied that most of the women farmers have the low awareness on the interventions and carry out different climate smart agricultural adaptation measures.

The result revealed that women farmers are adopted different climate smart agricultural measures that help to reduce the impact of climate change. This results are similar with Okuil et al. (2012) Saual (2015) research results conduct on climate change adaption measurements indicated that women farmers in Nigeria and Tanzania adopted strategies in reducing climate impact using changing of crop varieties, planting of early mature seed varieties and in other part of the world like Nepal other climate smart agriculture practice, crop diversification, organic farming, and agro forestry practices have been carried out to fulfil the dual responsibility of food security, and livelihood support, while conserving soil and water resources (Shankar A,2018).

Key informants from agricultural office of Saharti Samre stated that due to training programs organized by different organization, women farmers are able to employ various climate smart Agriculture (CSA) practices like SWC, inter crop, agro forestry, use compose and other organic manure on their farm land and livestock. Even though some of CSA activities are implemented in the study area but most of the respondents and some developmental agents were not familiarized and aware with the CSA activities.

Table 10: Causes of climate change

Causes of climate change	Frequency	Percent
Natural process	37	22.0
Anthropogenic actions	17	10.1
Bothe Natural & Anthropogenic effect	81	48.2
I don't know	33	19.6
Total	168	100.0

Source own survey 2019

Table 10 presents the causes of climate change. The study results revealed that 22% of the respondents said that the natural processes, while10.10% respond that it is due to anthropogenic actions only, and the majority respondents 48.20% said that it is caused by both natural & anthropogenic effect; finally the remaining 19.6 % sample respondents said that don't know. Knowing the cause of climate change helped them to develop right adaptation and mitigation methods to the manifested climate shock and for ensuring community adaptive capacity and climate justice.

Factors affecting Climate change adaption strategies

Prior to the estimation of the model parameters, it is crucial to look into the problem of multicollinearity or association among the potential explanatory variables. Variance inflation factor (VIF) was used to check the multicollinearity problem in continuous variables and contingency coefficient (CC) was used for dummy variables. Based on the result of VIF, the data had no serious problem of multicollinearity. This is because, for all continuous explanatory variables, the values of VIF are by far less than 10. Therefore; these continuous explanatory variables were included in the model. Similarly, as a result of CC investigations there were no association difficulties between different hypothesized discrete variables, since the respective coefficients were very low (less than 0.75). The contingency coefficients calculated for the dummy variables show a weak degree of association among the variables. Therefore, the dummy variables were included in the model. The model shows that the presence of sufficient evidence to explain women farmers' climate change adaptation strategies as indicated logit likelihood ratio (176. 294), and chi-square (188.755) which is highly significant at less than 1% probability level.

The result of regression analysis presented in table 14. Table 14 shows that education, distance to nearest road, frequency of visiting agricultural extension office, access to trainings related to climate change issues, and access to climate information, farm size and TTLU were statistically significant for the dependent variables. In addition in all cases the estimated coefficients were compared with base category of combination of SWC+ poultry and shoat rearing.

Table 11: Factors which influence women farmers' to choose Climate change adaptation strategies.

Choice adaptation strategies	Variable	Coefficient	P- value	Exp (B)
SWC + crop +shoat rearing	Intercept	13.230	.209	
	Age WHHs	-.339	.293	.713
	Education	-2.659	.073*	.070
	No. family	-1.118	.244	.327
	No. years in village	.334	.237	1.396
	Farm size	-.298	.897	.742
	Distance to road	2.207	.042**	9.090
	Frequency visiting	3.053	.087*	21.172
	TTLU	.840	.353	2.317
	Yield 2015	-1.379	.416	.252
	[Gender HH=0]	-1.999	.395	.135
	[HPECC=0]	5.674	.058	291.183
	[heard CC=0]	-10.386	.018**	3.087
SW+ crop +Migration	Intercept	.735	.952	
	Age WHHs	-.361	.680	.697
	Education	-2.546	.108	.078
	No. family	.013	.990	1.013
	No. years in village	.565	.518	1.759
	Farm size	-6.572	.081*	.001
	Distance to road	2.382	.030	10.823
	Frequency visiting	3.200	.099*	24.526
	TTLU	1.176	.239	3.241
	Yield2015	-2.300	.224	.100
	[Gender HH=0]	-1.815	.483	.163
	[HPECC=0]	5.713	.103	302.776
	[heard CC=0]	-10.079	.027**	4.193E
WC+ Poultry and shoat+ Migration	Intercept	3.599	.744	
	Age WHHs	-.214	.600	.807
	Education	-1.679	.269	.187
	No. family	-1.472	.156	.230
	No. years-Village	.414	.271	1.513

	Farm size	-.420	.875	.657
	Distance to road	2.304	.034**	10.014
	Frequency visiting	.961	.631	2.613
	TTLU	1.777	.067	5.909
	Yield2015	-2.344	.193	.096
	[Gender HH=0]	-.918	.712	.399
	[HPECC=0]	7.183	.031**	1316.897
	[heard p. CC=0]	-10.032	.024**	4.395E-005
SW+ crop+ shoat+ Migration	Intercept	12.989	.209	
	Age WHHs	-.106	.719	.899
	Education	-2.587	.077**	.075
	No. family	-.734	.429	.480
	No. years-Village	.122	.624	1.130
	Farm size	-.579	.791	.561
	Distance to road	2.092	.054**	8.101
	Frequency visiting	2.836	.108	17.049
	TTLU	.963	.266	2.620
	Yield2015	-2.131	.197	.119
	[Gender HH=0]	-1.498	.507	.224
	[HPECC=0]	6.079	.035**	436.797
	[heard CC=0]	-8.936	.037**	.000***
	Probability > chi square	188.755		0.000
	Log likelihood	176.294		

Source: survey data (2019)

Note * significant at less than 1%, * * significant at less than 5%, and *** significance at 1%.

- Basic categories = SWC + poultry and shoat rearing

Determinants of SWC, Crop and shoat

Education level: As the model result indicated in Table 14 Education was negatively and significantly affecting the combination adaption with probability level of significant at 0.07 (i.e. P<10%) on the combined adaption strategies of SWC, planting of drought and early mature crop varieties, rearing of shoat. The odds ratio indicates that when women farmers are have got an access of education they are reducing to engage on adaption strategies of SWC, planting of drought and early mature crop varieties, rearing of shoat by 7% factor times. This negatively relation might be attributed to limited engagement of educated youngsters in agriculture. Instead they are actively engaged on trade and other off farm job opportunities available in their village and out of their villages. To the contrary other researchers revealed that education increase the probability of adopting climate change. Off course, the researchers observed that few young male farmers are employed themselves in irrigation practice and implementing different adaption strategies like water harvesting, using improved seed and making compose and working on cattle fattening but their number not is as such significant.

Distance to road: As the model result found distance to road has positive and significantly influenced the respondent's choice of combined adaption strategies of SWC, planting of drought & early mature crop varieties, and rearing of shoat with probability level of significant at 0.04 (i.e. P<5%). The results also indicated that the distance from home increased by one Km, the probability of implementing combined adaption strategies of SWC, planting of drought & early mature crop varieties, and rearing of shoat increased by 900% times.

Frequency of extension visit: the MNL result shows women farmers' frequency of visiting the extension service has positive and significant contributed with the probability level of significant at 0.08 (i.e. P<10%) to adopt the combination adaption strategies of SWC, planting of drought & early mature crop varieties, and rearing of shoat. The odds ratio indicates that as women farmers increasing visiting of agricultural extension or development agents (DAs) by quarterly the probability of participation on SWC, planting of drought & early matures crop varieties, and rearing of shoat increased by 2100% times.

HPE Climate information: Result of regression model showed that the WHHs participation in any training on agricultural extension related to climate change issue has positive and significantly influenced to adopting climate change adaptation strategies of SWC, planting of drought & early mature crop varieties, and rearing of shoat at significant probability level of 0.05 (P=O.05), the odds ratio suggested that of women farmers have obtained access of participation on agricultural related climate change trainings increased the probability of adopting of SWC, planting of drought & early mature crop varieties, and rearing of shoat increased by about 29100 times.

Heard/perceived about CC: this independent variable has positive and significantly influencing adaptation strategies of SWC, planting of drought & early mature crop varieties, and rearing of shoat at significant probability level of 0.01 (P=O.01). The odds ratio result revealed that as the women farmers have hard and perceived about the climate change issue they will have the probably of adopting adaptation strategies of SWC, planting of drought & early mature crop varieties, and rearing of shoat increased by about 300 times.

Determinants of SWC, crop and migration

Farm size: As the model result indicated in Table 14 farm size has negative and significantly influenced women farmers 's choice of adaptation strategies of combination of SWC, planting of drought and early mature crop varieties and migration with probability significant at 0.08 (i.e. P<10%) and the odds ratio indicates that the farm size decrease by one hectare of farmland the probability of adopting combination of SWC, planting of drought and early mature crop varieties and migration increased by about 0.1% times being other variables constant. To the contrarily, in other studies conducted in central refit vale of Ethiopia Family size has a significant and positive effect on climate change adaptation, increasing the probability ($p < 0.01$) of planting food and fodder trees, integrating crop with livestock, and soil and water conservation measures (Abrham Belay et.al 2017)

Distance to road: As the MNL result indicated that the distance to road has positive and significantly influenced the respondent's choice of combined adaption strategies of SWC, planting of drought & early mature crop varieties, and migration with probability level of significant at 0.03 (i.e. P<5%). The finding also indicated that the distance from home increased by one Km, the probability of implementing combined adaption strategies of SWC, planting of drought & early mature crop varieties, and migration increased by 1080% times

Frequency of extension visit: the output result of the model shows women farmers' frequency of visiting the extension service has positive and significant contributed with the probability level of significant at 0.09 (i.e. P<10%) to adopt the combination adaption strategies of SWC, planting of drought & early mature crop varieties, and migration. The odds ratio indicts that as women farmers increasing visiting of agricultural extension (DAs) by one day the probability of participation on SWC, planting of drought & early mature crop varieties, and migration increased by 2452% times, being other variables constant.

Heard/perceived about CC: The result of regression model showed that heard or perceived of information about climate change has positive and significantly influencing adaptation strategies of SWC, planting of drought & early mature crop varieties, and migration at significant probability level of 0.02 (P<O.05). The odds ratio result also revealed that as the women farmers have heard and perceived about the climate change issue which will have the probably of choosing adaptation strategies of SWC, planting of drought & early mature crop varieties, and migration by about 419 times more.

Determinants SWC, Poultry, shoat, and migration

Distance to road: As the model result indicated in Table 14 the distance to road has also positive and significantly influenced the respondent's choice of combined adaption strategies of SWC ,rearing of poultry& shoat plus migration with probability level of significant at 0.03 (i.e. P<5%).The odds ration finding also indicated that the distance from home increased by one Km, the probability of implementing combined adaption strategies of SWC, planting of drought & early mature crop varieties, and rearing of shoat will increase by 1001% times, being other variables constant.

TTLU: The results of the MNL model showed that TLU has a positive and significant influence on combination adaption strategies of SWC, planting of drought & early mature crop varieties, poultry and shoat and migration with probability level of significant at 0.06 (i.e. P<10%).The odds ratio effect for this variable indicates that the respondents' education level increase by one unit of livestock the probability of women farmers adapting will increase by 590%, being other variables constant.

HPE Climate information: regression results showed that respondents participation in any training on agricultural extension related to climate change issue has positive and significantly influenced to adopting climate change adaptation strategies of SWC, rearing of poultry & shoat plus migration at significant probability level of 0.03 (P<O.05). The odds ratio suggested that of women farmers participation on agricultural related climate change trainings increased the probability of adopting of SWC, and rearing of portray & shoat plus increased by about 192% times.

Heard/perceived about CC: this independent variable has negatively influencing adaptation strategies of SWC, rearing of poultry and shoat at significant probability level of 0.02 (P<0.05). The odds ratio result also suggested that the WHHs have not heard and or not perceived about the climate change matter, their probably of choosing adaptation strategies of SWC, and rearing of portray & shoat plus migration will be decreased by 439% times, other variables being constant.

In addition, the variable **heard or perceived about CC** has also influencing negatively the combined adaptation strategies of SWC, planting of drought & early mature crop varieties, rearing of shoat and migration at significant probability level of 0.00 (P<0.01). The odds ratio suggested that the women farmers have participation on agricultural related climate change trainings decreased the probability of adopting of SWC, and rearing of portray& shoat by about 300% times. Similarly, study by Abraham B. et al, (2017) also shows that farmers who had access to climate change information adopting early mature crop varieties and SWC measure at probability significant at 1% level of significance.

Conclusion and recommendations

With regard to perception, about 73.8 % WS and 53.57 %WHH respondents perceived climate change occurred in their villages. The WS have more aware and recognized better of the WHHS this shows that WHHs are less aware the phenomena of climate change. Off course, the 97.6 % WHHs were said that drought was happened frequently in the past ten years and affecting their livelihood negatively and depended them on food aid.

Recommendations

- To address the adverse impact of climate change it is important to consider the role of women in climate change adaptation programs to respond to climate change. Therefore, government bodies in sectors mainly agriculture and water resource office should strongly mainstream gender and work to empower women farmers.
- According to findings of the study large number of WHHs are able to adopt climate change strategies in Amdiweyane kebele. Therefore, such kind of intervention should also scale up and replicated in other kebles of the wereda mainly on the low land areas having Kola agroecology.
- The results of the MNL model showed that livestock has a positive and significant influence on combination adaption strategies of SWC, planting of drought& early mature crop varieties and all the study kebeles are potential on livestock resource hence, recommends concerned bodies to develop appropriate strategies particularly to WHHs and other poor MHH.
- Variables like access of trainings on climate related to agricultural issue and having access of information and perceiving climate change shows positive and significant influence on SWC, adoption of drought tolerance and early matured crop varieties and rearing of poultry and shoat on the women farmers. Therefore, such kind of activities should be expanded and need due attention to create climate resilience community in the area.
- Furthermore, to improve WHHs farmers' adoption of climate adaption strategies on their livelihood need to expand formal and informal education and strengthen extension advice, providing series of trainings

and awareness creation activities are necessary to increase the knowledge of WHHs on climate change and on climate smart agricultural technologies, this help in creating climate resilience WHHs.

- Farmers training centers and extension education centers at kebele level were not well equipped and not functioning as it planned; they should be good demonstration centers for different climate smart agriculture activities. In addition, the agricultural research intuitions should provide agricultural technologies like improved drought tolerance crop varieties and introducing appropriate technologies in livestock sector to gives more milk and meat to make the rural community more beneficiary from its farm plot and animals.

References

Abrham Belay, John W, Teshale Woldeamanuel, and John F0.(2017). Smallholder farmer's adaptation to climate change and determinants of their adaptation decisions in the Central Rift Valley of Ethiopia. Agriculture & Food Security 20 6:24, 2-13. Nairobi, Kenya.

Adger, W. N.et al. (2007) Are there social limits to adaptation to climate change? Climatic Change, 93: 335–354.

Alemayehua, F., Taha, N., Nyssen, J., T Girma, A., Zenebe, A. Behailu, M., Poesen, J. (2009). The impacts of watershed management on land use and land cover dynamics in Eastern Tigray (Ethiopia), Resources, Conservation and Recycling. 53, 192–198.

Alexander P., Nabalamba A; Mubila, M., (2011) the Link between Climate Change, Gender and Development in Africa The African Statistical Journal, Vol 12, 119-140

Baumert et al. (2005). Navigating the Numbers: Greenhouse Gas Data and International Climate Policy. World Resources Institute. Available at http://www.wri.org/publication/navigating-the-numbers

Bewket W (2012). Climate change perceptions and adaptive responses of smallholder farmers in Central Highlands of Ethiopia, Int. J. Environ. Stud. 69(3):507-523.

Dankelman I, (2010). Gender and Climate Change: An Introduction, United Kingdom, Routledge

Deresa T, Hassan RM, Ringler C, Alemu T, Yesuf M (2008) Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. Glob Environ Change-Hum Policy.

FAO (2011). The state of food and agriculture women in agriculture closing the gender gap and for development Rome, Italy. Food and Agriculture Organization of the United Nations statistical database (FAOSTAT). Available at http://faostat.fao.org/

FAO (2015), Land management and land use Available at http//www.fao/docrep/land003/w2612/htm

Fankhauser, S.; McDermott, T.K.J. (2014) Understanding the adaptation deficit: Why are poor countries more vulnerable to climate events than rich countries? Glob. Environ. Chang. 2014, 27, 9–18.

Federal Democratic Republic of Ethiopia (2007) Ministry of Water Resources and National Meteorological Agency (NMA). Climate Change National Adaptation Programme of Action (NAPA) of Ethiopia. Addis Ababa: UNDP

IPCC. (2007). Summary for policymakers. In Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change,

IPCC (2007) "Projections of future changes in climate". IPCC. Fourth assessment report: climate change. www.ipcc.ch/publications_and_data/ ar4/wg1/en/ Accessed on 24 July 2018.

Kapoor, A. (2011). Engendering the Climate for Change: Policies and practices for gender-just adaptation.

Krishnamurthy K. Lewis, R.J.Choularton (2013) a methodological framework for rapidly assessing. The impacts of climate risk on national-level food security through a vulnerability index https://doi.org/10.1016/j.gloenvcha.2013.11.004.

Martin F., Raya .M Andre Women, (2016). Weather, and Woes: The Triangular Dynamics of Female- Headed Households, Economic Vulnerability, and Climate Variability in South Africa.

Mirutse D, Gebregiorgis, and Selam (2006) Female-Headed Households and Livelihood Intervention in Four Selected Weredas in Tigray, Ethiopia. Dry Coordination Group Report No. 44.

National Meteorology Agency (NMA) 2007Addis Ababa, Ethiopia. National Adaptation Programme of Action.Neumayer and Plumper. The Gendered Nature of Natural Disasters: The Impact of Catastrophic Events on the Gender Gap in Life Expectancy, 1981-2002.

Niemeyer and Plumper(2007,). The Gendered Nature of Natural Disasters: The Impact of Catastrophic Events on the Gender Gap in Life Expectancy, 1981-2002.

Notenbaert A, Karanja SN, Herrero M, and Felisberto M, Moyo S (2013): Derivation of a household-level vulnerability index for empirically testing measures of adaptive capacity and vulnerability. Regional Environmental Change 2013, 13:459–470.

Okuli W., Jonathan S. and Flavianus T. 2012. Gender and adaptation practices to the effects of climate change in Bahi and Dodoma Districts, Tanzania. Journal of Sustainable Development, 5 (12): 65-77.

Olsson L., M. Opondo, P. Tschakert, A. Agrawal, S.H. (2014) Livelihoods and poverty. In: Climate Change-Cambridge University Press, Cambridge, United Kingdom and New York, USA, pp. 793-832.

Orinda A. V., & Murray, L. A. (2005). Adapting to Climate Change in East Africa: A Strategic Approach, Gate keeper Series, 117, International Institute for Environment and Develop London,

Peterman A, Behrman JA, Quisumbing AR (2014) a review of empirical evidence on gender differences in non-land agricultural inputs, technology, and services in developing countries. Gender in Agriculture: Closing the Knowledge Gap, pp 145–186.

Ragasa C, (2012) Gender and institutional dimensions of agricultural technology adoption: a review of literature and synthesis of case studies Available at: http://ageconsearch.umn.edu/ bi stream/126747/2/IAAE.2012.gender.pdf

Rodenberg, B., 2009, Climate Change Adaptation from a Gender Perspective. German Development Institute.

Saharti Samre women affairs office annual report (2016) Samre town.

Saharti Samre Agricultural rural development office annual 2012 .Samre town.

Saharti Samre social affair office annual report 2015, Samre town.

Sönke K, David E., Inga M. 2017 GLOBAL CLIMATE RISK INDEX Who Suffers Most from Extreme Weather Events? Germany watch.

Sara Abebe Asheber (2010). Mitigating drought: Policy Impact Evaluation A case of Tigray Region, Ethiopia. Unpublished master thesis

Saual E, (2015).Impact of climate change on agricultural and food security in Niger: Challenge and opportunity. Global advanced research journal of Medicinal plant. 3(1) 001-009

Tagel Gebrehiwot, Anne Veen (2013) Farm Level Adaptation to Climate Change: The Case of Farmer's in the Ethiopian Highlands Environmental Management, Volume 52, Number 1, Page 29.

UN OHCHR (2011). Protecting the Rights of Internally Displaced Persons in Natural Disasters: Challenges in the Pacific. Discussion paper Challenges in the Pacific. pacific.ohchr.org/docs/IDP_report.pdf.

UN women (2015) why is climate change a gender issue? unwomen.org/en/digital.../2015/1/why-is-climate-change-a-gender-issue

UNFCCC (1992): United Nations Framework Convention on Climate Change

UN Women Watch 2009, Women, Gender Equality and Climate Change: www.un.org/womenwatch the UN Internet Gateway on Gender Equality and Empowerment of Women.

Visser H, Petersen AC (2012) Inferences on weather extremes and weather-related disasters: a review of statistical methods. Clim Past 8:265–286

Weldearegau, S.K & Tedla D.G (2018) Impact of climate variability on household food availability in Tigray, Ethiopia 7:6.https://doi.org/10.1186/s4006.