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Is Adaptation to Climate Variability Gendered? Evidence from a Developing Country, Ethiopia

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

Universally, it is agreed that adaptation is largely a social issue (as opposed to purely biophysical or technological). However, it is surprising that gender, one of the social issues is not yet playing a more explicit role in adaptation studies. Hence, in this twenty first century, when we are still experiencing gender inequality, ensuring successful adaptation of all community members to climate variability and change is less likely due to the prevailing gender power differences in terms of having access to key resources and services which has significant contribution for adaptation. This article attempts to uncover the gender difference in having access to resources and its impacts on adaptation to climatic shocks with cross sectional data from 452 households in Ethiopia and time series data on climate variability and agricultural production of the period 1981-2012. Trend analysis and statistical measurements were used to analyze the data. The study found out that there are gendered impacts of climate variability longitudinally and spatially. Moreover, there are differences in adaptation strategies pursued by female and male farmers to overcome climate variability and extremes. Therefore, there is a need for gendered intervention in terms of policies and actions to enhance adaptation and reducing recurring food insecurity.

Keywords: Climate; variability; adaptation; gender; developing county; Ethiopia.

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1. INTRODUCTION

In developing countries, women and men are still shaped by inequalities that discriminate against and marginalize certain social groups by denying them their right of access to resources, opportunities, and power. The most pervasive of these inequalities, and the one which affects all communities, is gender inequality. Gender inequality is a fundamental abuse of woman's human rights, as well as a major factor for magnified vulnerability to climate variability and changes and strong barrier to sustainable development. Across the world, women tend to hold less power and to have control over fewer resources than men, at every institutional level. Women's disadvantage – their unequal access to resources, legal protection, decision making and power, their reproductive burden, and their vulnerability to violence – consistently render them more vulnerable than men to the impacts of climate change and disasters. Understanding how gender relations shape women's and men's lives is therefore critical to effective climate change adaptation programming [1].

Adapting to climate change is about reducing vulnerability to current and projected climate risks. Vulnerability to climate change is determined in large part by people's adaptive capacity. A particular climate hazard, such as a drought, does not affect all people within a community – or even the same household – equally because some people have greater capacity than others to manage the crisis. The inequitable distribution of rights, resources and power –as well as repressive cultural rules and norms – constrains many people's ability to take action on climate change. This is especially true for women. Therefore, gender is a critical factor in taking adaptive measures to climate change [2].

Farmers' adaptation to climate change depends on control over land, money, credit and tools; low dependency ratios; good health and personal mobility; household entitlements and food security; secure housing in safe locations; and freedom from violence [3]. Studies elsewhere conducted indicate that women are often less able to adapt to climate change than men since they represent the majority of low-income earners, they generally have less education than men and are thus less likely to be reached by extension agents and they are often denied rights to property and land, which makes it difficult for them to access credit and agricultural extension services. Moreover, gender biases in institutions often reproduce assumptions that it is men who are the farmers [4]. As a result, new agricultural technologies – including the replacement of plant types and animal breeds with new varieties intended for higher drought or heat tolerance – are rarely available to women farmers [3].

Nevertheless, recent evidence demonstrates that women who are already experiencing the effects of weather-related hazards –such as erratic rainfall patterns, epidemics, flooding and extended periods of drought – are developing effective coping strategies, which include adapting their farming practices [5]. Therefore, it is important to investigate as to how farmers in developing countries like Ethiopia are reacting to the impact of climate variability and changes. Based on such needs, the objective of this research is set to measure the level of differences between women and men in their adaptation to climate change impacts.

2. METHODOLOGY

2.1 The Study Location

The study area is central part of Ethiopia, with specific location of Yaya Gullele, Hidha Abote and Derra districts of North Shewa Zone of Oromia regional state. Zonal total population is 1,431,305 and total land area is 10,323 km^2. The area is mountainous with only plain in the lowland areas. The altitude ranges between 1300-2500 meters above sea level. It is divided into three agro-ecologies, namely, 15% highland (>2500 meter above sea level), 40% midland (1500-2500 meter above sea level) and 45% lowland (500 -1500meter above sea level) [6]. The area gets rainfall during both *Belg* (February to April) and *Meher* (June to September) seasons. The average annual rainfall of the area ranges from less than 840 mm to 1600 mm. Mean annual temperature varies between 15°C and 19°C [7].

The community practices mixed farming; crops and livestock. The average land holding is 1.1 hectare. Due to the continuous reduction of farmland to degradation by frequent flooding and drought, farming is intruded into steep sloping areas, forest lands and expanded to marginal lands and communal lands. The crops, livestock and other livelihoods of the community are subjected to damage to climate change induced hazards. This coupled with the continually

decreasing farm size have serious impact threatening farmers adaptive capacity and livelihood improvements.

2.2 Data and Analysis

The data was collected from452 households in 2012/2013. Trained enumerators under the supervision of the researcher were deployed to collect the data from household's head (both male and female) by using questionnaire. The sampling techniques was multi stage random sampling, where at first 3 districts were randomly selected from north Shewa zone. Then each district was stratified agro-ecologically as highland, midland and lowland. Finally households were randomly selected from each agro ecology proportionally to population size. The questionnaire used for an interview addressed household characteristics, landholding, crops and livestock production, climate variability/change induced shocks, climate change perception, coping mechanisms, adaptation strategies pursued, level of resilience, and other relevant information. Climate data relevant for this analysis was obtained from the National Meteorological Service Agency (NMSA) for a 31-year period. Climate change induced shocks, their impacts, and production data were obtained from the Central Statistical Authority (CSA) and agricultural offices for 10 years (2002 – 2012). The study was also supplemented with qualitative data collected through focused group discussion.

For the purpose of the gender disaggregated analysis of the physical, social, human and economic factors of adaptation among female and male farmers during and after the occurrences of extreme climate events, trend analysis was applied to secondary data to see how climate variables and their impacts change over time. Statistical tools like percentage, average and tests of significance using t-test was used to analyze data collected from households to measure gendered adaptation to climate variability. Figures and tables were used to present the analytical results.

3. RESULTS AND DISCUSSION

3.1 Gender and Livelihood

3.1.1 Resource endowments by gender

Women form a disproportionate share of the poor among the community of the study area and are highly dependent on local natural resources. Moreover, because of gender differences in property rights, access to information, participation in cultural, social and economic roles, the effects of climate change are likely to affect men and women differently. Following the occurrence of droughts, landslides, epidemics and flood in the central part of Ethiopia, warning information are transmitted by men to men in public spaces, but rarely communicated to the rest of the family and as many women are not allowed to leave the house without a male relative. Moreover, as in many other Ethiopian communities, most women never had the opportunity to learn how to positively live with climate change induced shocks. Another clear illustration of the difference between women and men are in terms of crop and livestock production systems, educational level, social capital, and practice of environmental management. Table 1 presents differential asset ownership by gender, and the gendered difference were found to statistically significant.

Table 1. Socio-economic characteristics and resources endowment by gender

1

Types of resources	Female	Male
Illiterate (%)	90.30	67.20*
Wealth Status (% reported to be poor)	80.00	62.00
Institutional participation (≥3 institutions)	36.10	84.50*
Average farmland owned(ha)	0.86	1.15**
Average number of farm plots	2.50	3.80**
Average area under irrigation (ha)	0.00	0.06**
Average who do not own oxen (%)	0.98	1.56**
Average livestock ownership (TLU[1])	1.80	2.91**
Land conservation (% conserved)	25.00	50.00*

Sources: Own computation from 2012/13household survey
**, ** Significant at 5% and 10% probability levels respectively using t-test*

[1]*TLU refers to tropical livestock unit*

Lack of Education is one of the socio-economic characteristics of households that have detrimental impact on livelihood performance. Education guides decisions to take positive actions to adapt to climate change in many ways. The study area was characterized by very low literacy rate, despite being close to Africa's political capital. The survey results show that about 90.30% of the women who headed households and 67.20% of the men who headed households were illiterate. Both figures are large in absolute terms; however, the level of illiteracy is high for females as compared to males. The illiterate are always challenged to adopt improved technology, comprehend agricultural extension messages, generate relevant agricultural information from multiple sources, adopt improved production technics, etc. Therefore, female farmers are disproportionately negatively affected by illiteracy.

Participation in different social institutions is a measure of social capital and has significant impact in terms of reducing vulnerability and fostering adaptation to climate change shocks. Study conducted in developing countries including Ethiopia has reported a strong positive relationship between access to information and the adoption behaviors by farmers [8]. Moreover, Maddison [9] and Nhemachena and Hassan [10] showed that access to information through participation in local institutions, extension, etc. increase the chance of adapting to climate change through informed decision making. The local institutions in the study area include *Edir*[2], *Equb*[3], *Mehiber*[4], and *Senbete*[5]. Participation in such institutions are high for the males as compared to the females (Table 1). Hence, in the study area male farmers do have better opportunities to get access to the necessary agricultural and climate information as they do have better level of involvement in many local institutions.

If small, and declining, average farm size is one key element of Ethiopia's agricultural challenge, another is the fact that average yields per hectare are also low, that challenges households adaptation to changing climatic conditions [11]. Hence, ownership of land and other basic assets like livestock, perennial crops, access to irrigation and others are strong measures of wealth and have the ability to determine vulnerability and adaptive capacity. In this regard, female headed households in the study are disproportionately affected by the ownership of such resources (Table 1). Thus, it is apparent that male farmers have better capacity to take adaptation and mitigation measures such as growing during non-rainy seasons, diversifying their enterprises, get access to credit through collateral guarantee, and try new improved technologies. This is because the male farmers do have bigger size of farm land in multiple locations and have a better access to irrigation as compared to the female counterparts. Ownership of more number of livestock ensures alternative means of survival outside the crop sub sector; ensure timely cultivation of land following the rainy seasons, serve as sources of manure, and more. When disaggregated by gender, livestock ownership and oxen ownership level is different in the study area, where male farmers own more livestock and oxen as compared to their female counterparts. Thus, one can easily see the better position the male farmers can resume from the livestock ownership and their bi-products.

In the country, across all parts, the levels of land degradation are also high, with over 60% of the population living in areas that suffer from severe or very severe human-induced degradation. Among the causes of this problem are clearance of woodlands and forests, unsustainable arable farming techniques, the use of dung and crop residues for fuel rather than as fertilizer, and overstocking of grazing lands [11]. More specifically, over the last few years, the central part of Ethiopia has been subjected to continuous degradation by water and wind erosion. The productivity of the farmlands has continually reduced to the extent that some of the farm plots cannot yield without more commercial fertilizer than is currently used [12]. To some extent some of the farm plots have been abandoned by households due to its loss of productivity even with extra fertilizer application. Thus conservation of available farmland is an important adaptation and mitigation mechanism to regain fertility and combat some of the climate change induced shocks. However, conservation of farmland depends on various factors such as the amount of land available, labor availability in a family, financial capacity and gender of the land owners. Especially, female headed

[2]*Idir is a local institution formed by neighbours to support each other especially after the death of a relative*

[3]*Equb is a saving and credit association formed by the local community to cover their critical financial needs for agricultural activities and social expenditure*

[4]*Mahiber is organized by community members of close relationship to make regular festivals at one's home on a revolving basis*

[5]*Senbete organizes socialization activities conducted once in a month at the Coptic orthodox Christian churches on Sunday*

households often fail to bring their farmlands under physical and biological conservation because they own small area of land, lack labor and financing. This is evidenced by the fact that they were able to build conservation structure. Hence, women farmers' land can experience a higher degree of vulnerability to erosion resulting from flooding as compared to that male's farm plots.

3.1.2 Access to institutional services

Access to institutional services within the agricultural system plays a great role in ensuring household adaptability to changing climate. Households that get required institutional facilities can easily cope with and bounce back in the aftermath of natural shocks. Literature evidences that households who are better endowed with social capital through the dense of their social network have a better capacity to immediately bounce back and reduce their vulnerability conditions [13]. The major institutional services available in the agricultural production system in the study area include agricultural extension services, early warning information, improved seed and inputs provisions, rural credit, and market information. The provisions of such services are not evenly distributed across farmers in a district or zone. The accesses to such services depend on the financial capacity of farmers, physical access, farm size, types of enterprises produced by farmers and more. More specifically, gender plays a key role in the pursuit to get access to institutional services.

According to Justina and Emily [14], the economically poor, and female headed households often lack the power to influence in getting access to basic agricultural services in developing countries. What is more worse is when the female farmers happen to be very poor, which hampers their privilege to enjoy institutional services to cope with climate change induced challenges. Male farmers by far have greater advantage in using the locally available services (Table 2). The figures in the tables were tested for level of significance and found that all of them are significant at probability level that ranges between 1% and 10%.

In all areas of agricultural and social services needed by farmers to adapt and mitigate climate change induced shocks, the male farmers outnumbered the female farmers in terms of getting access to the services in the central part of Ethiopia. Hence, the social power of women can be seen to be subordinate to the male farmers. Key information; like early warning, market information and extension services, which are important to save lives and livelihood of farmers during the ear of climate change is less accessible to women. This put the women farmers at greater level of vulnerability to climate change induced shocks as compared to their male counterparts.

3.1.3 Agricultural activities

In the central part of the country, the dominant crops produced for consumption as well as market are *teff*, maize, wheat, barley, sorghum, millet, wild oats, faba bean and pea, which comprise more than 97% of the total production [15]. Other less dominant crops are beans, potatoes, cabbages, onions and carrots. The level of diversification of crop commodities depend on available land, agro ecology, labor availability in a family, access to irrigation, and access to key inputs. Gender disparity in terms of household head also determines the number of commodities produced per year and types of commodities selected. Study revealed that female headed households engage in the production of dozens of crops, some of which are comparatively disadvantageous to them. This is an indication of an agrarian mentality and opting to meet all subsistence need by producing at home. On average female farmers engage in the

Table 2. Access to institutional services by gender

Types of service available	Female	Male
Access to extension services (%)	80.10	91.60**
Frequency of extension visit/month	0.34	0.80***
Access to agricultural credit (%)	31.90	57.90*
Areas under improved seed (ha)	0.00	0.20***
Areas under commercial fertilizer (ha)	0.10	0.60***
Access to market information (%)	36.00	62.90*
Access to early warning information (%)	38.60	60.60*

Sources: Computed from household survey of 2012/13
, **, * significant at 1, 5, and 10% probability levels using t-test*

production of 7 more crops at a time while the male headed households produce around 4 types per year. Even though diversification is one of the mitigation strategies against unforeseen climate change induced shocks, there is always an optimal level, beyond which household tend to gain low return [16].

The types of crops commodities combination is also important to make advantage of changing climate or adapt to the changes. In the study area male farmers allocate more than 98% of their land to the cultivation of important cereals, while female headed households allocate only 50% of their land to the production of cereals.

3.1.4 Non-farm activities

In the studies of climate change, non-farm engagement is a measure of economic vulnerability that has meaningful impact in boasting adaptive capacity of farm households. Household who diversify their income sources to non-farm and make considerable percentage of their income from non-farm is relatively better in adapting to changes as opposed to those who do not engage in the non-farm sector [17]. In this central part of Ethiopia, where the study was conducted, about 17.50% of households have engaged in non-farm activities. About 12.70% and 3.80% were engaged in one type and two types of non-farm activities, respectively. In general female headed households have engaged in many number of non-farm enterprises as compared to the male headed once. More than 20% of the female headed households engage in non-farm, while it is less than 15% for the male headed households. The average annual earning per household is more than birr 420 (around 22 USD) for female headed and less than birr 270 (14 USD) for the male headed ones. Thus it is apparent that female headed households tend to diversify their income to non-farming as a mitigation strategy for the low income realized from the farming sector.

From this result, it can be deduced that the female farmers' position in terms of diversifying their income sources into non-farm as adaptive capacity is better than their male counterparts. As the female farmers lack land and other agricultural production resources, in the long run, one of the greatest areas of focus to improve their adaptive capacity will be by supporting them to improve the non-farm engagement further.

3.2 Gender and Differential Impact of Climate Change Induced Shocks

The community's disaster profile for the study area indicates that the major determinant factors that make a community vulnerable to shocks include economic, physical, social, and ecological factors. Gender, which is one of the social factors, is an important measure for the level of vulnerability to climatic shocks. The above findings show that, women are in general far more vulnerable than men. This is in relation to proportionally higher losses when climatic shocks strike as well as lower capacity to recover immediately. In relation to gender, inadequate access to health facilities by women as compared to men is found to increase people's loss when exposed to both livestock and human epidemic diseases. The effect of farmland locations and fertility also determines households' susceptibility to the risks. Women farmers who do not have access to large area of land and fertile plots are relatively more vulnerable to risks associated with climate change as compared to males. This basically emanates from the position given to women in a society and their capacity to access productive resources through inheritance from their parents. Such vulnerability also depends on the frequency of natural shocks, experience of people to adapt to climate variability and change, degradation of farmlands to erosion and more. Social factors like low level of literacy or lack of awareness of hazard related issues have been another bottleneck in the districts to easy recovery from disaster impacts. The same argument is supported by Gutu et al. [13].

Over a span of few decades, extreme meteorological events, such as spells of high temperature, heavy storms, droughts, and others have seriously disrupted the crop production systems of smallholder farmers. The farming community was identified as the most vulnerable because of its dependence on agricultural production for its livelihood. Within the farming community, small-scale, rain fed subsistence farmers as well as pastoralists were identified as more vulnerable to changing climatic conditions than others [18]. Recent evidences have also shown possible changes in the variability as well as in the mean values of climatic variables Gutu et al. [15]. Where certain varieties of crops are grown near their limits of maximum temperature tolerance, heat spells are becoming particularly detrimental. Similarly, frequent droughts, especially in the low-lying regions, not only

reduced water supplies but also increased the amount of water needed for plant transpiration.

With regard to the number of people affected by climate change induced shocks for the past 10 years, more people became vulnerable. For instance in 2002, less than 130,000 people were seriously affected by the combination of the above natural shocks, while in 2011 more than 240,000 people were affected by the same. When this is disaggregated by gender, the percentage of female farmers affected surpasses the percentage of male farmers. Fig. 1 reveals the differential impact of climate change on gender and the rate at which the impact is growing.

Two things are apparent from Fig. 1, because the sensitivity and exposure of the household's lives and livelihood to climate change is increasing more than the rate of increase in household's adaptive capacity, the number of people affected has increased with every incidence of climatic shock. Secondly, the rate of increase in the magnitude of climatic shock is putting female households increasingly at more risk than their male counterparts as can be seen from the slope of Fig. 1. The slope of the trend line for female farmers is 0.27 and that of the male farmers is 0.06. The trend line is getting steeper for the female than the male. Using t-test, the difference in annual rate of increase of the number of people getting vulnerable by gender is statistically significant at 1% probability level. Some of the reason for such is because of women's low position in accessing agricultural services, shortage of farmlands, less number of livestock, lack of access to institutional services, and others.

3.3 Gender and Climate Change Adaptive Capacity

Under changing climatic conditions, the need for farmer's adaptation to the change is non-optional. How robust the mitigation measures may be, still certain level of adaptation is necessary because of the following conditions: (a) historic emissions and inertia of climatic systems [19], (b) while mitigation may take several decades to manifest, most adaptation activities take effect immediately, (c) adaptation measures can be applied on a regional or local scale and their effectiveness is less dependent on the action of others and (d) adaptation beside addressing the risk associated with changes in the climate in the future, typically they reduce risk associated with current climate variability. Hence, the farming systems of smallholder farmers should always be checked over times to see how far it is adjusting itself to contexts.

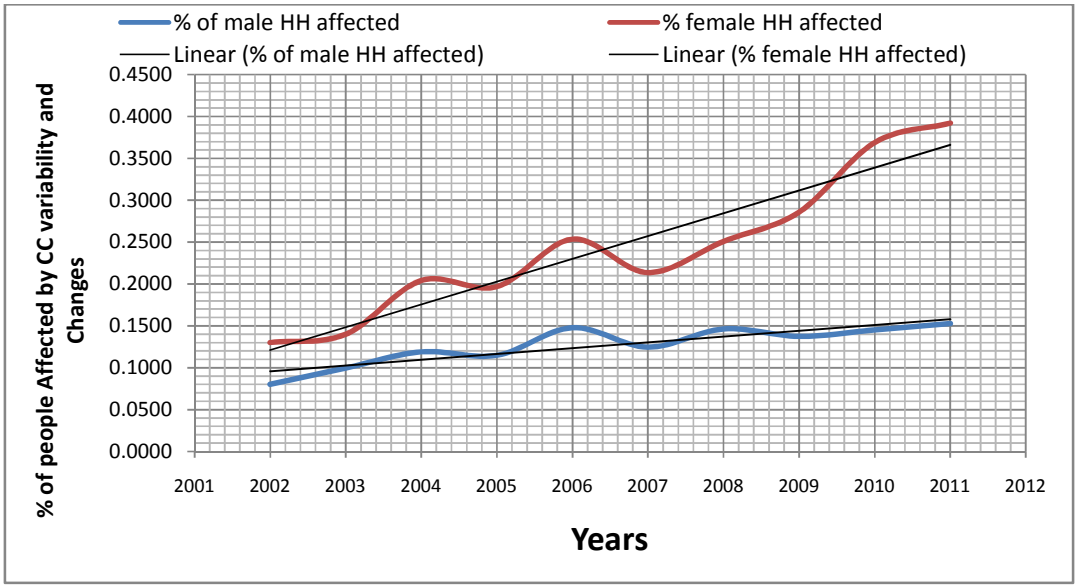

Fig. 1. Trends in the percentage of both male and female farmers affected by climate change induced hazards

Sources: Computed form the data obtained from CSA and agricultural office

Farmers in the study area have experienced adaptation to climate change. However, the question is what proportion of them were able to make intentional actions to adapt and to what extent is that they were able to adjust the way they do their operations? Survey result indicate that 41.67% of the female farmers perceive themselves as appropriately adapted to climate change, whereas only 37.95% of male farmers perceive themselves as adapted. From this; it appears that the female's own perception of adaptation level is greater than that of their male counterpart. However, adaptation to climate change should not be seen by own perception alone, but by the number of effective adaptation options a farmer deliberately take and by the level of their livelihood's capacity to absorb, react and bounce back from climatic disturbances as well.

Farmer's adoption of such methods as switching crop varieties (with increased resistance to heat stress, shock and drought), introducing more suitable crops, or shifting from crops to grazing, can often be undertaken by individual farmers. Governments can provide reliable weather projections or information about suitable crop and livestock alternatives to help farmers increase production efficiency or can design policies that facilitate the migration of people from one location to another or the transition from one profession to another [20,21]. However, adaptation does not guarantee that farming will be able to continue in an area, or if it does, that farm incomes will remain unchanged.

In the context of the study area, Gutu et al. [15] wrote that some of the adaptation measures will involve shifting agricultural production from one location to another (like moving from lowland areas to midland and the vise versa). The cost of such adaptation measures depends, inter alia, on the adaptation measures undertaken and the target group considered. Female farmers are particularly exposed to the risks because, unlike male agricultural producers, they have considerably more difficulty absorbing crop shortfalls and also because they are less integrated into the market both to sell their produce and engage in alternative means of livelihood. These farmers are also more interesting because, the national agricultural development strategy of the federal democratic republic of Ethiopia gives deliberate emphasis to boost their production and productive in driving the national development agenda. Because it is believed that they have a higher production potential, and they hold the greatest potential for contributing to food security and to the development of their areas.

Adaptation to climate change by these smallholders and the likely improved agricultural production are directly interrelated. Farmers who adopted adaptation strategies have higher production under stressful climatic situations than those who do not [15]. Based on marginal effect estimates, households with more adaptation measures tend to produce more per hectare than those with fewer options. This provides evidence that, the effect of climate change will be reduced by a significant magnitude if households take adaptation measures. Variety of adaptation measures are adopted by smallholder farmers of North Shewa and Fig. 2 presents the range of there adaptation strategies.

Nevertheless, the density of adaptation measures adopted depends on other several internal and external conditions of household's characteristics. These include, households farming and business locations, age of household's head, access to information, access to market, educational level, household's social capital, access to institutional services (extension, credit, etc), ownership of key assets (Livestock, perennial, etc), access to irrigation and more importantly gender of the household head [15,9,10,22]. In many respects, the number of adaptation strategies and level of adoption differ between male headed and female headed households. Due to their relative social power, access to productive assets (good size of farm land in different locations, perennial crops, livestock, productive labor, etc), access to institutional service especially credit and agricultural extension during climate shocks, climatic information and other key resources, the likelihood of adopting more number of adaptation strategies among the male headed family is far greater than that of the female headed ones. That is why female farmers are more vulnerable during and after climatic shocks.

What is more interesting is the difference in reactive measures with which male and female are responding to climate change, and the changes that are occurring in gender roles and relations to accommodate socio-economic and environmental changes. Majority of the adaptation measures' adopted and those with which the male farmers prevailed over their female counterparts are production related adaptation measures. These include switching varieties (high yielding, drought tolerant and

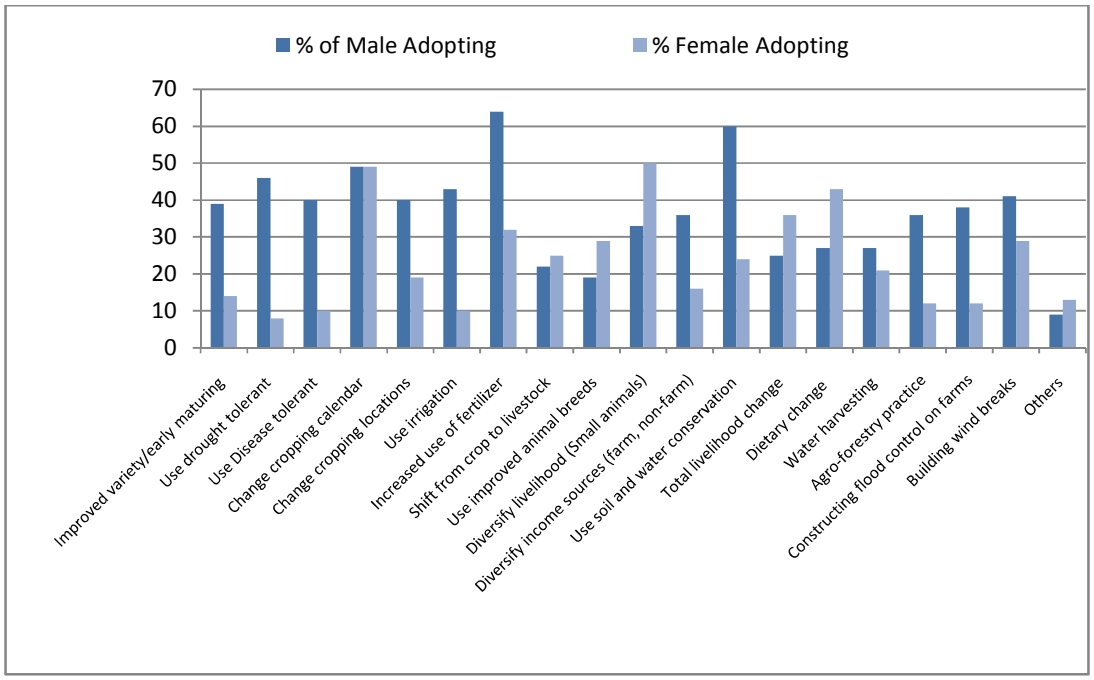

Fig. 2. Adaptation strategies adopted by households (Gender disaggregated)
Sources: Household survey data in 2012/13

disease tolerant), shifting cropping location between different agro-ecologies, increased used of commercial fertilizer, use of soil and water conservation measures for soil fertility regaining, water harvesting, agro-forestry practices, and flood control. These are positive indicator of how much the agriculture of male farmers can withstand climatic shocks as compared to that of female farmers. The adoption of such option in fact depends how much a farmers is endowed with agricultural farms lands and complementary production resource. Therefore, it worth concluding that the ways in which agricultural resource ownership are distributed between male and female unequally determines the nature of adaptation strategy.

On the other hand, female farmers have taken considerable number of non-agricultural adaptation strategies, which include shifting to rearing small ruminant animals, switching to non-agricultural activities like labor works, total migration from agricultural production activities to others, dietary changes and other options. Hence, female farmers' less endowment with the necessary agricultural resources always force them to opt for non-farm production adaptation options. From both male and female farmers there are households who could not take up any of these adaptation options. About 2.9% of the farmers have not adopted any adaptation measure while 38.7% from both genders have taken only one or two measures that may not ensure well adaptation to climate change as it is evident from their food production levels. The same argument was also supported by Gutu et al. [16] where failing to adopt optimal number of adaptation mix weakens adaptation to climate variability and changes.

In adoption of adaptation options, a primary factor for genders difference is largely because of the capital available at the reach of the households. These capitals include human (family size and number of able bodied individuals as measured by Adult equivalent), natural (typically land and associated resources), social (number of networks, relatives and institutional participation), financial (amount of money that can be earned from the different livelihood activities) and physical (in the farming community, this can be particularly livestock ownership measured in tropical livestock unity) [23]. Families with diverse and better level of such capital have easily adapted by reshaping their livelihoods. Hence capital endowment is base for the households to go for better number adaptation options and even the extent of taking a particular adaptation option. Therefore, one of the reasons for differential level of adaptation

between female and male farmers is due to the level of their capital endowments. Fig. 3 shows gender difference in capital endowments.

Households who are better endowed with these resources were able to choose innovative and critical adaptation strategies and performed to make their agricultural operations resilient to the climatic shocks. With further analysis, adoption of many adaptation strategies alone is not a sufficient indicators to say that a household is well adapted, however, there is a need to have indicators to measure the practices of those adaptation strategies have been translated into conditions that ensures lives and livelihood secure during and after climate change induced shocks. The particular issues surrounding the development of indicators for measuring effectiveness in adaptation have been discussed in a number of publications [24]. The nature of adaptation makes it particularly challenging for monitoring and evaluation using standard approaches (e.g. via individual, quantitative, outcome-based indicators) because of a range of factors, many of which describe that contexts across countries are significantly different and more specifically, the conditions under which smallholder operates are different even within a particular country.

Therefore, with the smallholder contexts, where there are frequent occurrences of climate shocks, adaptive indicators should be localized. This is because there can never be a one fit all indicators. Hence, such indicators can be the ability to produce food during and after stressful seasons, the capacity to prevent the divestment of productive asset, health conditions of household members, level of savings maintained, time taken by households to bounce back after stressful seasons, level maintaining existing economic opportunities, and more. Some of such indicators being categorized as economic, social and environmental were used by Supine and Christy [25]. Hence, it is important to measure the level of differences among male and female farmers with regard to such adaptation indicators. These indicators are in fact opposite to vulnerability indicators, even though they are not equal. (Fig. 4) presents the adaptation indicators by gender.

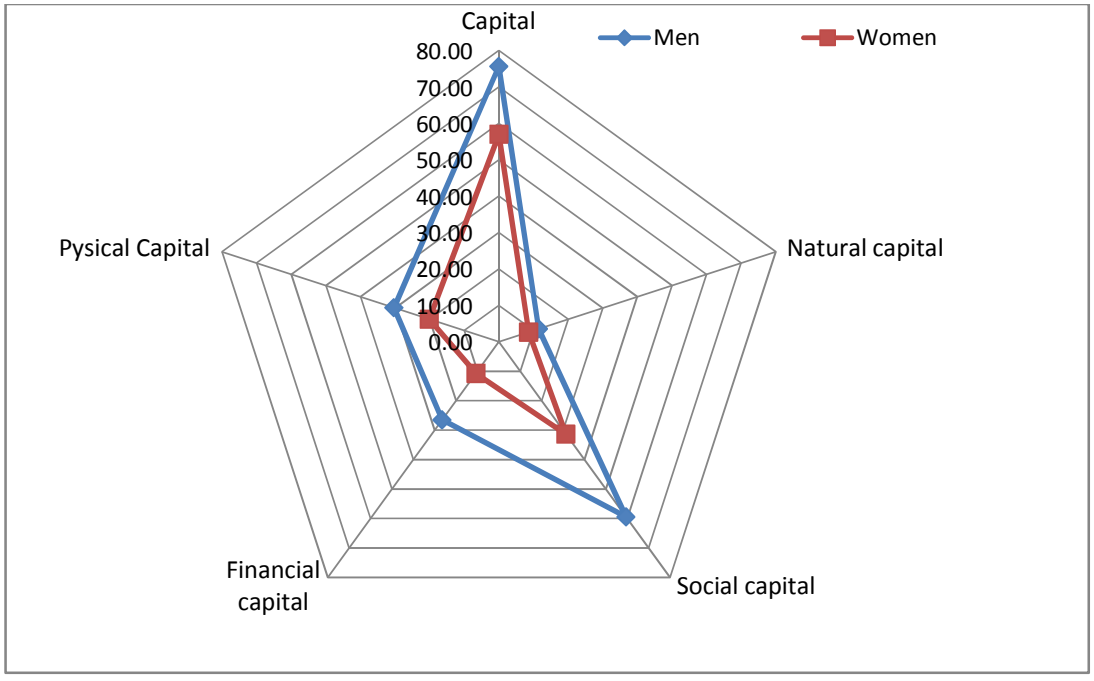

Fig. 3. Capital endowments by gender disaggregation
Source: Computed from survey 2012/213

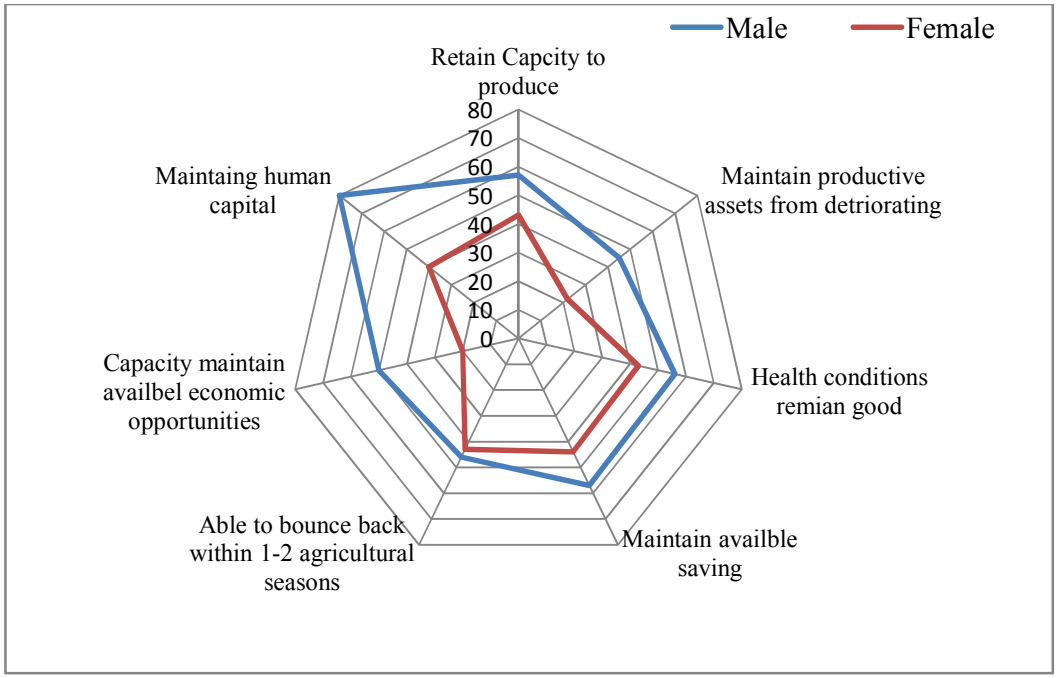

Fig. 4. Indicators of adaptive capacity disaggregated by gender
Source: Computed from household survey of 2012/13

4. CONCLUSION

Impact of and adaptation to climate change is gendered in central part of Ethiopia, because of the feminization of poverty, existing gender inequalities to access key livelihood resources, and gendered roles in society. The position of female in terms of having a command over social, physical, financial, natural and human capital is very much limited compared to that of male farmers; these in turn limits the adaptive capacity. That is why the adaptation strategies taken by female farmers are mainly non-production related strategies, whereas those of the male farmers are those that can enhance the production potential. In this light, it is worth concluding that the agricultural activities of the male farmers are by far more adapted and resilient than that of the female farmers. Therefore, in the years to come as the occurrence of extreme weather events intensify, it is obvious that the female farmers livelihood will be more vulnerable compared to that of males if measures are not taken to build females' adaptive capacities.

In almost all of the indicators of adaptation level female farmers score low. These are clear measure how far women are less adapted than male. Despite having provisions for inclusion of females representatives in (local) governance processes under the present government, gender relationship having a bias towards males does not allow women to meaningfully participate in any decision making for a, have access to climate and early warning information, and other key livelihood actions in a community. This has left the females virtually with no meaningfully opportunity to contribute towards the reduction of their vulnerability and building their adaptive capacity. Therefore, in the future if females' adaptive capacity should be strengthen the following actions needs to be taken by the government and all development actors:

- Raising awareness regarding the anticipated elements of risks that target female farmers;
- Building the capacity of female farmers to access timely and reliable early warning information through agricultural extension workers, public gathering, etc which will enable them to anticipate and act properly;
- Females' access to key natural capitals like land through inheritance and government's affirmative action, financial capitals through credit facilitated by the government on a group collateral basis especially during times of crisis, physical capitals (like farm equipment, facilities

providing social services, etc) and social capitals through engaging females in the different local institutions should be enhanced by government as well as development practitioners to enable females acquire adaptation strategies;

- There should by an identification of gender related best practices and adaptation models for communities in disaster prone areas and share across the wider community of female farmers. This can be done by the government though academic research or can be done by development agencies that have best practices in the country or in other countries to document and share with all.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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