



Research article

Gender perspectives of climate change adaptation in two selected districts of Ghana

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ABSTRACT

This study analyzed gender differences in climate adaptation by farming households in Ghana. This involved 300 farmers from two districts of Ghana and the data analyzed using descriptive statistics. The results showed severe climate impacts on the livelihoods of females than males in Ghana. On the contrary, the adaptive capacity of males was found to be higher than that of females. This was supported by the observed differences in gender climate adaptation where both male heads and male household members had higher mean climate adaptations than both female heads and female household members. Overall, the climate adaptation strategies mostly adopted by both males and females include changing planting dates, row planting, planting early maturing and drought tolerant seed varieties, mixed farming, intercropping and refilling of farm plots. Except for zero tillage and intercropping, male farmers had high adoption levels than female farmers. It is concluded that the observed gender adaptation differences were due to the levels and intensity of adoption other than differences in the type of strategies adopted by the different gender groups. The Ministry of Food and Agriculture should consider integrating climate adaptation policies into current agricultural policies such as “planting for food and jobs” policy.

1. Introduction

The negative impacts of climate change have been widely acknowledged and documented, especially by policy makers and researchers, including the Intergovernmental Panel on Climate Change (IPCC) who are interested in a sustainable global future. Evidence show that the already vulnerable societies, individuals and classes are more prone to the threats and impacts of climate change (Björnberg and Hansson, 2013). Women are known to be harder hit by climate impacts compared to men. This is partially due to differences in the ownership of economic resources, including labour and capital, and also due to entrenched cultural norms and beliefs, social and political discriminations that work against women (Eastin, 2018; Björnberg and Hansson, 2013). The generally high poverty levels among women also predispose them to severe climate impacts and reduce their adaptive capacities.

Politically, the underrepresentation of women in decision making processes is a characteristic of modern democratic societies (Björnberg and Hansson, 2013) and this has led to mostly male-favored policies in almost all aspects of life. Despite a general decline, women are often less likely to be employed, and paid higher wages compared to men. This

economic disadvantage and wage discrimination make women more vulnerable to the impacts of climate change because they lack adequate resources that would help reduce their vulnerability. These factors work together to determine the expected differences in the impacts and vulnerabilities of women and men. The implication is that climate change and its associated shocks and disasters could worsen existing gender inequalities, especially due to a decline in women's economic and social rights (Eastin, 2018; Mckune et al., 2015). Already, this is being documented among researchers. For instance, Adzawla and Kane (2019) estimated that observable impacts of climate change and variability have led to an increase in gender welfare gap among farm households in northern Ghana. This justifies calls for gender mainstreaming into climate discussions (Alston, 2014).

One strategy of responding to climate change is through climate adaptation mechanisms. Climate adaptation is often adopted as an anticipatory, reactive or proactive measure to reduce climate impacts (Adzawla and Kane, 2019). Climate adaptation requires adjustment by humans to the actual and expected results of climate change. Coincidentally, recent environmental initiatives in Africa are centered on climate adaptation (Epule et al., 2017). Climate adaptation other than

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climate mitigation is important to provide short term and localized benefits from climate shocks to households. Thus, making climate adaptation an effective strategy for farm households. Although climate adaptation provides significant advantages, it can also produce undesirable environmental impacts (Enríquez-de-Salamanca et al., 2017) and this must also be given the needed attention (Juhola et al., 2016).

Like other aspects of climate change, adaptation is not gender neutral. For instance, Alhassan et al. (2018), and Mersha and Laerhoven (2016) established differences in climate adaptation among gender groups. Mersha and Laerhoven (2016) explained that observed difference in gendered climate adaptation are as a result of gender barriers and not a preferred decision by men and women. Admittedly, there is growing research on climate adaptation across the world (Alhassan et al., 2019; Assan et al., 2018; Wrigley-Asante et al., 2017; and Abid et al., 2016). However, considering the significant role of gender in development, it is required that research within the climate change domain should address gender concerns. As such, research into identifying how gender groups, especially women, can adapt effectively to climate change is required (Mckune et al., 2015). For Carr and Thompson (2014), the failure to include gender in projects or developmental interventions would lead to outcomes that are not optimal.

The evidence of gender differences in climate vulnerability is a primary reason for the differences in climate adaptation by men and women. Women are often constrained in decision making and access to resources that can improve their livelihoods (Carr and Thompson, 2014). These resources and other sociocultural differences for instance, have led to the cultivation of crops with different biophysical characteristics by men and women (Carr and Thompson, 2014). Evidence also showed that while many male farmers cultivate drought resistant crop varieties, female farmers on the other hand, engage in the cultivation of traditional crops and mixed cropping (Wrigley-Asante et al., 2017). Similarly, males have been found to adopt improved seed varieties, soil fertility conservation practices and soil and water conservation practices than females (Assan et al., 2018). Wrigley-Asante et al. (2017) also found that while men were more interested in on-farm adaptation strategies, women are more interested in off-farm adaptation strategies such as petty trading. Assan et al. (2018) also observed that many male farmers compared to their female counterparts adopted strategies that would help them respond appropriately to climate shocks. These empirical evidences show that climate adaptation is either low for females than males or the strategies adopted by males is different from that adopted by females.

However, the significant roles of women in climate adaptation cannot be underrated. This is particularly due to the fact that women are important agents of change. Empirical studies such as Sundström and Mccright (2014) observed that women are more concerned with the environment than men. This implies that the quality of the environment is more a priority to women than men, an indication that women may adopt more mitigation strategies than adaptation strategies. However, considering the localized effects of climate adaptation compared with mitigation, there is the need to improve climate adaptation of females, especially in agrarian settings such as Ghana. The first step to this objective is to identify the existing gender differences in climate adaptation in order to identify specific areas that need to be given more priority. Therefore, this study analyzed the gender perspectives of climate adaptation in Ghana. This study is different from previous studies that considered gender and climate adaptation because the former defined gender within a binary (e.g. male heads vs female heads) framework and this has led to nuance results. For instance, the vulnerability of a female household head who controls the resources of the family may be less than the vulnerability of a male household member whose use of family resources is subject to the decision of the household head. Similarly, defining gender as male and female assumes that the male farmers, irrespective of their access to resources such as finance and information on new technologies, have high adaptive capacity to climate change than females. This assertion may not often be valid. In this study therefore, both inter- and intra-household gender definition are adopted to

minimize the limitations from the binary definition of gender in the form of male and female.

2. Methodology

2.1. Study areas

This study was carried out in South Tongu and Zabzugu districts of the Volta and Northern regions of Ghana, respectively. The South Tongu district is in the southern part of Ghana and occupies a land area of 643.57square kilometer. Its capital is Sogakope. The district is a coastal district with associated climate change impacts. There are two rainy seasons in a year in the district, the major and minor season, characterized by different raining intensities. The major occupation of the people is farming, particularly, maize and rice crop farming. Zabzugu district is in the Guinea savannah zone (northern Ghana) and covers an area of 1,100.1 square kilometer. Unlike South Tongu district, the Zabzugu district experiences a unimodal rainfall distribution with a mean annual rainfall of 1,125mm. Majority of the households in the district also engage in agriculture and produce crops such as maize, rice and groundnut. Also, these two districts were involved in a climate adaptation strategy program that was led by the Ministry of Food and Agriculture. Therefore, farmers in the district are largely aware of most climate adaptation strategies in the area.

2.2. Sampling procedure and sample size

The study sampled the South Tongu and Zabzugu districts purposively to represent the south and the north of Ghana, respectively. The consideration of these two districts was based on their peculiar characteristics being defined by their ecological zones and also because some climate related projects have been implemented in the past by MoFA and other stakeholders in these two districts. Specific reference was given to Integrated Climate Risk Management Projected which was implemented in the two districts between 2013 and 2019. This project promoted climate adaptation mechanisms as a way of reducing the risks associated with the increasing climate shocks such as floods and droughts. Five communities were selected each from the two districts using simple random sampling procedure. Excel was used in generating random numbers for each community and the first five communities with the highest random numbers in each district were selected. In the final stage of the sampling, simple random sampling procedure was used to select 30 farmers from each selected community. A list of farmers for each selected community was obtained from the office of MoFA in the two districts and entered into Microsoft excel software. A random probability of inclusion was generated for each farmer and the first 30 farmers with the highest probabilities of inclusion were selected in each community. This gave a total sample size of 300 farmers (150 per each district). In order to understand the role of household's power-play in gendered climate adaptation, simple random sampling of the respondents was blind on the status of the respondents. This means that the sampled respondent from a household could either be a household member who operated his or her own farm or a family head who operated their own farm. As such, there was no predetermined number of members within each sampled group. Table 1 shows the distribution of sampled elements at each sampling stage.

Table 1
Sample distribution.

Sampling stage	Frequency
Number of studied districts	2
Number of communities per district	5
Number of respondents per community	30
Total number of respondents	300

2.3. Data collection and analysis

The data were collected with a semi-structured questionnaire for the 2018 cropping season. The information covered a wide range of topics including the various climate adaptation strategies adopted by each farmer and the associated benefits and costs of adopting the strategies. The data was collected by trained extension officers who could speak the local languages of the farmers. Farmers were made to declare their consent to participate in the study by either providing their names or signatures. However, the respondents were made to know that their consent did not prevent them from further decline to participate in the study during interview.

The data were analyzed using descriptive statistics (means and percentages) and the results presented in tables. Because the sample groups were more than two, the use of student's t-test to determine the significant difference between the groups mean values is inappropriate. Therefore, the study proceeded to estimate the analysis of variance (ANOVA) that allows to compare the mean values of four sampled groups. This was based on the null hypotheses that the mean values were statistically the same. The estimation of ANOVA was justified by the normal distribution of the sample.

3. Results and discussions

3.1. Distribution of household headship by gender

Table 2 shows the distribution of the selected respondents based on their sex and household headship status. This formed the basis and the definition of gender in this study. Thus, the current study moved beyond the definition of gender using household headship (male heads versus female heads) or farm management (male managers versus female managers) in previous studies. In this study, these two measurements are combined, and gender is defined as male heads, male members (male farm hands/managers), female heads and female members (female farm hands/managers). These are determined based on their position in the family; thus, a household head was conceptualized as a person who is the leader of a family at a particular point in time, while a farm hand/manager is a person who is a member of a family and operates a personal farm. Contemporary feminist research and the intersectionality-inspired literature on gender, expressed the limitation of defining gender as man and woman or as a stand-alone maker of social differentiation since this ignores significant variations in terms of knowledge, power and resources within the groups (Carr and Thompson, 2014). Therefore, gender should be defined along the local specific activities and identities such as income, age, location and race (Carr and Thompson, 2014). Admittedly therefore, the definition of gender in this study considers household's power relations within the gender framework.

From the result (as indicated in Table 2), 61.3% of the respondents are household heads with the remaining 38.7% being household members. The distributions show that 59.3% of the respondents are male, of which 84.3% and 15.7% are heads and household members, respectively. The remaining 40.7% of the sample are female, of which 27.9% and 72.1% are heads and household members, respectively. This shows that while majority of the male respondents are household heads; majority of the female respondents are only household members who operate their own farms. This is because household headship in almost all Ghanaian

Table 2
Household headship position by sex.

Sex	Household heads		Household members		Total	
	Freq.	%	Freq.	%	Freq.	%
Male	150	84.3	28	15.7	178	59.3
Female	34	27.9	88	72.1	122	40.7
Total	184	61.3	116	38.7	300	100.0

Source: field data, 2019.

cultures is a reserved duty more for the males. Generally, females assume household headship status only when there is no male adult in the household especially due to divorce, death of husband or when the husband or male adult has travelled out of the community for a longer period.

3.2. Perceived severity of climate change on farms

Table 3 shows the perceived effects of climate change on farms as revealed by the respondents. This is based on a follow-up question (in your opinion, what is the level of severity of climate change on farming activities in your community?) that was asked. A three-point scale alternative responses (i.e. very severe; averagely severe; and not severe) was provided to the respondents. Prior to this question, the respondents were asked whether climate change had any effect on farms or not. This was affirmed positively by all the respondents. Overall, 40.3% of the respondents indicated a very severe impact of climate change on their farms, while 59% and 0.7% indicated a mild and no climate impacts, respectively. Except for female heads, over half of the other gender groups revealed that climate change had mild impacts on farming. Specifically, 65%, 57.1% and 58% of the male heads, male household members and female household members indicated a mild impact of climate change on farming, while 35.3% of female heads indicated a mild climate impact on farming. Evidence (Wheeler and Braun, 2013; Lobell et al., 2011) suggest that climate change is leading to a reduction in the yield of most staple crops, with the agricultural sector being one of the most vulnerable sectors to the impacts of climate change. Again, women have higher climate vulnerability indices, particularly due to their low access to productive resources (Carr and Thompson, 2014). Therefore, it is consistent that majority of the female heads who often lack resources and support from males revealed very severe impacts of climate change on the farms.

3.3. Farmers' reported levels of climate adaptation

The farmers indicated their level of adaptation to climate change as shown in Table 4. This was measured on a five-point Likert scale with alternative responses (i.e. (5) very high; (4) high; (3) average; (2) low; and (1) very low). A question was posed to the farmers as: 'what is your personal assessment of how you are able to adapt to the changes in climatic conditions?' This was against the background that a preamble that described climate change, adaptation and resilience was explained to the farmers beforehand. From the results, 51% of the farmers indicated they had high climate adaptability. About 8% of the respondents indicated a "very high" climate adaptation level. While 34% indicated an average climate adaptation level, 6.6% revealed that their adaptation level was low or very low. In terms of gender distribution, majority of all gender groups except female members, revealed a high climate adaptation level. Generally, over 78% of male members indicated a high to very high climate adaptation level, while 51.1% of female members indicated a high to very high climate adaptation level. The implication from this

Table 3
Perceived severity of climate change on farming.

Sex status	Level of severity of climate impact							
	Very severe		Averagely severe		Not severe		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Male head	52	34.7	98	65.3	0	0.0	150	100.0
Male member	12	42.9	16	57.1	0	0.0	28	100.0
Female head	21	61.8	12	35.3	1	2.9	34	100.0
Female member	36	40.9	51	58.0	1	1.1	88	100.0
Pooled	121	40.3	177	59.0	2	0.7	300	100.0

Source: Field data, 2019.

Table 4

Farmers' revealed levels of climate adaptation.

Revealed adaptation level	Male head		Male member		Female head		Female member		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Very low	1	0.7	1	3.6	1	2.9	1	1.1	4	1.3
Low	12	8.0	1	3.6	1	2.9	2	2.3	16	5.3
Average	45	30.0	4	14.3	13	38.2	40	45.5	102	34.0
High	81	54.0	17	60.7	19	55.9	36	40.9	153	51.0
Very high	11	7.3	5	17.9	0	0.0	9	10.2	25	8.3
Total	150	100.0	28	100.0	34	100.0	88	100.0	300	100.0

Source: Field data, 2019.

finding is that more males revealed above average climate adaptation levels than their female counterparts. Hence, males reckoned themselves as higher climate adapters. The results of the females could be explained by their high climate vulnerabilities.

3.4. Observed gender differences in climate change adaptation

A review of climate adaptation literature in Ghana (such as [Alhassan et al., 2019](#); [Assan et al., 2018](#); and [Wrigley-Asante et al., 2017](#)) provided a list of several strategies adopted by farmers. The identified strategies were provided to the farmers to indicate which of them they adopted and have been practicing up till the 2018 production season. The results in [Table 5](#) show the various climate adaptation strategies adopted by the farmers within a gender perspective. These strategies involved various on-farm strategies that farmers use in crop production and had practiced in the 2018 cropping season. A total of 20 strategies were identified and presented to the farmers to indicate their adoption of each strategy. The ANOVA test results show that there are statistically significant differences in the adoption levels of crop rotation, land rotation, repeated sowing, tractor ploughing, animal ploughing, cover cropping, mulching, bunding and organic farming between the gender groups.

The results show that the primary adaptation strategy adopted by the farmers is to change the planting date for their crops in order to respond to erratic, particularly, late onset of rainfall. Except three female members, all farmers from other gender groups had changed their planting dates from the previous production seasons. Thus, for instance, the farmers did not plant their 2018 seeds within the same periods as they did in 2017; instead, they had adjusted based on the rainfall conditions of the previous year. Previous studies ([Alhassan et al., 2019](#); [Solomon and](#)

[Edet, 2018](#); [Arimi, 2014](#); [Bryan et al., 2013](#)) have also established that changing of planting date is one of the topmost climate adaptation strategies adopted by farmers. Specifically, [Solomon and Edet \(2018\)](#) found that 100% of their sampled farmers adjusted their operational times to accrue higher productivity and farm returns. On gender difference, [Alhassan et al. \(2019\)](#) estimated that females have higher probability of changing their planting dates due to their high vulnerability to climate change, for which they must necessarily take such actions.

The adoption of early maturing seed varieties was the second most adopted adaptation strategy among the farmers. In recent times, there have been continued introduction of early maturing seed varieties by research institutions across the country. These are aimed at responding particularly to the increasing erratic and short duration rains. The result shows that the adoption of early maturing seed varieties was high for males compared to females. This could be associated with the generally low access to production inputs by female farmers. Related to early maturing seed varieties is the adoption of drought resistant seed varieties. Majority of the farmers had adopted drought tolerant seed varieties, but this was higher for non-household heads compared with household heads. Also, the adoption of drought tolerant seed varieties was higher for males (73.5%) than females (68.4%). This is consistent with the findings of [Wrigley-Asante et al. \(2017\)](#) where males were found to adopt drought tolerant varieties more than females. Similarly, [Deressa et al. \(2009\)](#) found that male household heads had more probability of using different crop varieties as a climate adaptation strategy than female household heads.

Row planting is the third most adopted climate adaptation strategy for both male and female farmers. This was higher for male household members (96.4%), followed by female heads (88.2%), male heads

Table 5

Adoption of climate adaptation strategies.

Adaptation level	Male head		Male member		Female head		Female member		Total		Test	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	F-Value	P-Value
Change planting date/periods	150	100	28	100	34	100	87	98.9	299	99.7	0.8	0.494
Early maturing varieties	147	98	27	96.4	32	94.1	83	94.3	289	96.3	0.88	0.450
Drought tolerant varieties	108	72	21	75	21	61.8	66	75	216	72	0.47	0.700
Crop rotation	84	56	17	60.7	8	23.5	47	53.4	156	52	4.44	0.005
Land rotation	50	33.3	16	57.1	5	14.7	26	29.5	97	32.3	4.5	0.004
Mixed farming	100	66.7	23	82.1	18	52.9	56	63.6	197	65.7	2.03	0.110
Row planting	131	87.3	27	96.4	30	88.2	73	83	261	87	1.18	0.319
Intercropping	95	63.3	21	75	23	67.6	63	71.6	202	67.3	0.85	0.467
Re-filling	126	84	26	92.9	27	79.4	70	79.5	249	83	1.03	0.381
Repeated sowing	86	57.3	18	64.3	10	29.4	46	52.3	160	53.3	3.46	0.017
Strip cropping	19	12.7	6	21.4	4	11.8	12	13.6	41	13.7	0.55	0.649
Zero tillage	71	47.3	17	60.7	23	67.6	45	51.1	156	52	1.85	0.138
Tractor ploughing	109	72.7	21	75	16	47.1	63	71.6	209	69.7	3.19	0.024
Animal ploughing	19	12.7	8	28.6	2	5.9	14	15.9	43	14.3	2.4	0.068
Cover cropping	50	33.3	18	64.3	5	14.7	28	31.8	101	33.7	6.06	0.001
Mulching	70	46.7	21	75	12	35.3	29	33	132	44	5.84	0.001
Bunding	22	14.7	9	32.1	4	11.8	9	10.2	44	14.7	2.86	0.037
A-frame contour farming	12	8	3	10.7	3	8.8	6	6.8	24	8	0.16	0.925
Organic farming	30	20	13	46.4	5	14.7	18	20.5	66	22	3.85	0.010
Green manuring	60	40	11	39.3	9	26.5	42	47.7	122	40.7	1.57	0.196
N	150		28		34		88		300			

Source: Field data, 2019.

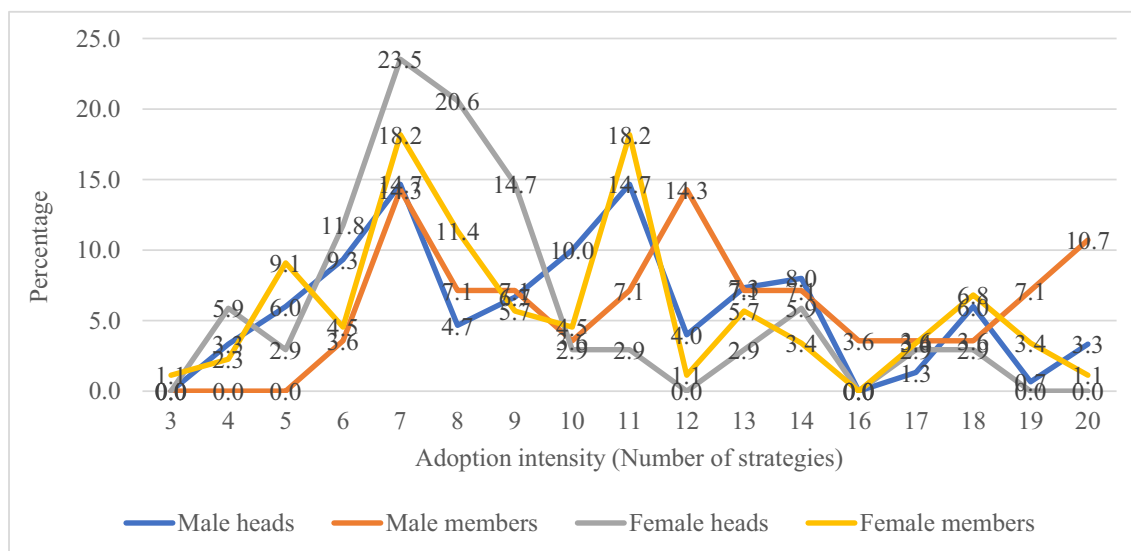


Fig. 1. Adoption intensity of climate adaptation strategies.

(87.3%) and lowest for female household members (83%). Cumulatively, row planting was high for males compared to females. Planting in rows has become a common farming practice that farmers adopt especially with the aim of improving yields. This is because, planting in rows allow farmers to carry out their farm activities and make judicious use of farm space and inputs, including soil water. Considering the labour involvement in row planting, it is consistent that males would adopt the practice more than female farmers.

Over 50% of both male and female farmers engaged in mixed farming, although this was higher for males than females. Mixed farming involves the cultivation of crops and the rearing of animals by the same farmer at the same time and place. It has become an important adaptation strategy to climate change due to the high impact of climate change on crop yields. In order to spread risks within agricultural activities, crop farmers also engage in the rearing of animals such as poultry and livestock, which sometimes provide labour and fertilizer for crop farms. In most Ghanaian communities, these animals are used to secure income for households' food and nonfood needs. Ngigi et al. (2017) explained that while husbands (males) are more inclined to livestock related adaptation strategies, wives (females) are inclined to crop related adaptation strategies.

The study revealed that except for zero tillage and intercropping, the adoption of all climate adaptation strategies was higher for males than females. For the result, 54% of males and 59.4% of females engaged in zero tillage while 69% and 70% respectively of male and female farmers engaged in intercropping. These findings are not surprising since female farmers either do not have access to tractors for ploughing large farm lands and also engage in the production of crops that necessarily meet household food needs of the farmers. Therefore, these could not be voluntary adaptation by the female farmers but due to socioeconomic conditions. Related to this study, Wrigley-Asante et al. (2017) also found that female farmers adopted mixed cropping more than male farmers in Ghana.

3.5. Adoption intensity of climate adaptation strategies

In Table 5, the adoption level of each adaptation strategy was presented. The findings show that the adoption of the strategies is not mutually exclusive. Therefore, there is the need to understand the adoption intensity of climate adaptation strategies within the various gender groups. The analysis of the data revealed a mean climate adaption of 10.3 for male heads, 12.5 for male household members, 8.6 for female heads and 10.0 for female household members. A test of significant

difference of the mean adoption intensities revealed an F -value of 4.96 and a P -Value of 0.0023. This implies that there is a statistically significant difference in the adoption intensity among gender groups. Thus, the males have a significantly higher adaptive potentials than the female farmers. This is consistent with Solomon and Edet (2018) and Deressa et al. (2009) who found that male farmers had higher probabilities of adopting climate adaptation strategies than their female counterparts. Ngigi et al. (2017) argued that the adoption of climate adaptation strategies by gender is interplayed with responsibilities, social norms and access to resources.

Fig. 1 shows the percentage of farmers who adopted a combination of specific number of adaptation strategies. This is to show within a gender perspective, whether or not few farmers adopted a combination of a small number of adaptation strategies or vice versa. In terms of the pattern of the adoption intensity of male heads, the minimum adoption intensity was 4 and the maximum intensity was 20. The percentage of adoption intensity for the male heads increased from 4 to 7 strategies, declined at 8 strategies and again peaked at 11 strategies. For male household members, the minimum number of strategies adopted was 6 strategies. The percentage of adoption intensity was highest at 7 and 12 strategies. For female heads, the minimum adoption intensity was 5 and the maximum adoption intensity was 18 strategies. About 23.5% of the female heads simultaneously adopted 7 strategies. The percentage of female members by adoption intensity shows an increasing percentage that peaked at 7 strategies, declined at 10 strategies and again peaked at 11 strategies. Only 1.1% of the female household members adopted all 20 strategies simultaneously. The implication is that the adoption intensity is highest for male members than the other gender groups. Specifically, 67.9% of male members adopted 10–20 strategies simultaneously while 55.3% male heads adopted 10–20 strategies. For females, the percentage that adopted 10–20 strategies was less than 50%; 47.7% for female members and 20.6% for female household heads. Empirically, Assan et al. (2018) observed that while 75% of female household heads adopted strategies to curtail climatic shocks, as high as 95% of male household heads adopted strategies in response to climatic shocks, and this supports the findings of this study.

4. Conclusions and policy implications

The impact of climate change on agriculture is evident and well documented. Farmers over the years have resorted to the adoption of adaptation strategies that could either reduce or spread the risks from climate change. Thus, research on climate adaptation mechanisms

among gender groups remain worth undertaking, especially, at the micro (local) level. This study analyzed the adoption of climate adaptation strategies by farmers in Ghana, considering one district each from the southern and northern parts of the country. Also, this study moves the frontier of gender climate adaptation analysis by defining four gender groups other than the binary definition (i.e. male and female) assumed by most previous studies. The study established that female heads reported significant severer impacts of climate change on their farms than the other gender groups. Also, from the farmers' own assessment of their climate adaptation levels, it is concluded that the males, particularly, the male household members followed by male heads had higher climate adaptation levels than the other gender groups. This is confirmed by the adoption intensity by the farmers which showed that more male members than the other gender groups adopted more than half of the total number of adaptation strategies considered in this study.

The main climate adaptation strategies adopted by both male and female farmers were changing planting dates to match with the season, row planting, planting early maturing and drought tolerant seed varieties, mixed farming, intercropping and retiling of farm plots. The gender difference in climate adaptation as observed in this study is due to differences in the levels and intensity of adoption and not the type of strategy adopted by the various gender groups. Thus, although all gender groups adopted similar types of climate adaptation strategies, many male farmers tend to adopt the climate adaptation strategies than their female counterparts. Since the primary aim of climate adaptation is to improve crop yields, it is concluded that these strategies are either preferred, compactible or improves the yield of the farmers, hence their high level of adoption by the farmers. This study has contributed to gender literature by outlining that even within the same sex group that often form the basis for gender construction, climate adaptation differs due to the difference in power and responsibility in a household. For instance, while the heads may have overall control over household resources and its usage, they may also have the responsibility to see to the welfare of each household member, which are not the case for individual household members. Ironically, the study established that household members in both male and female groups have higher adoption levels than the heads of households. Clearly, household heads have greater household responsibilities to perform in addition to integrating different adaptation strategies into their farm activities which may require extra time and farm work. It is therefore suggestive that climate adaptation discussions among agrarian communities should not be considered on household-basis but on individual farmer-basis. Overall, policy makers, particularly, the Ministry of Food and Agriculture should consider integrating climate adaptation policies such as organic farming and crop rotation practices into current agricultural policies of Ghana, such as "planting for food and job" (PJF) policy. PJF has become the major national agricultural policy document being implemented by MoFA. PJF seeks to improve the production of major crops in the country and also to enhance the role of agriculture in employment creation for Ghanaians. As such, integrating climate change adaptation strategies into this policy would allow for more investment in climate adaptation in Ghana. This would enhance the climate adaptation by farmers. Farmers, particularly female household heads, are advised to engage in organic farming and cover cropping on their farms. Non-governmental organizations such as IITA and IFDC working in the agriculture sector should also intensify their promotion and support for farmers, particularly the female farmers, to adapt to climate change effectively.

Declarations

Author contribution statement

William Adzawla: Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Shaibu Baanni Azumah: Performed the experiments; Analyzed and interpreted the data.

Paul Anani: Conceived and designed the experiments.

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