Journal of Environmental Sustainability

Volume 8 | Issue 1 Article 6

2021

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Cover Page Footnote

Acknowledgements The authors truly value the involvement and kind gesture of the selected communities' people and their leaders.

Journal of
Environmental Sustainability
RESEARCH ARTICLE

Gender Barriers to Climate Change Adaptation Practices in Semi-deciduous Forest Zone of Ghana

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ABSTRACT: This study investigated the gender barriers to climate change adaptation practices in the semi-deciduous forest zone of Ghana. A mixed methods approach including household surveys with 210 farmers and 14 focus group discussions was employed in seven selected communities in the Ejisu-Juaben Municipality of the Ashanti Region. The following research questions were answered by the study: (i) What are the climate change adaptation practices implemented by male and female farmers in selected communities of the Ejisu-Juaben Municipality to reduce climate risks? and; (ii) What are the barriers obstructing male and female farmers in implementing climate change adaptation practices in the selected communities? Results showed that there were significant differences between farmers' implementation of climate change adaptation practices including changing planting dates, growing of resistant varieties of crops, growing of short-term harvesting crops and off-farm activities ($p < 0.05$). Results also showed that gender had statistically significant influence on climate change adaptation barriers including lack of access to credit facilities and high cost of improved crop varieties ($p < 0.05$). Our results suggest the need for appropriate policy interventions in the agricultural sector of Ghana to boost access to credit facilities and production for household food security. There is also the need for significant funding commitment to rural transport sector to aid agricultural produce transfer from farming centres to market places.

KEYWORDS: adaptation; barriers; climate change and variability; gender; Ghana

I. INTRODUCTION

The adverse ramifications of the changing climate and variability are well-known in sub-Saharan Africa (SSA) (Chijioke et al., 2011, Ngoran et al., 2015). Changing rainfall patterns, increasing temperatures, rise in sea levels and severe weather events including floods and droughts are posing significant threats to water and food security, human health and safety, and socio-economic development in this region (Mohammed and Uraguchi, 2013, Kusangaya et al., 2014).

Ghana is at risk to the negative consequences of the changes in climate with substantial implications on climate sensitive sectors including agriculture, forestry and energy (Asante and Amuakwa-Mensah, 2015). Agriculture which still remains the backbone of the Ghanaian economy contributing about 19.7% of the Gross Domestic Product (GDP) is greatly rain-fed (Food and Agriculture Organization [FAO], 2020). Therefore, slight alterations in the rainfall trend will have substantial ramifications on food production and the economy of the country. In addition to that, the agricultural sector is made up of about 70% of smallholder farmers who live in rural areas where there is limited access to formal financial services (Peprah et al., 2021) exacerbating the vulnerability of the sector to the threats of climate variability and change. For instance, limited access to financial services means low financial capital and low financial capital signifies low capability of farmers to finance adaptation or coping measures and recovery mechanisms to climate change risks (Defiesta and Rapera, 2014).

Despite the substantial challenges presented by climate change to farmers in Ghana, numerous studies have documented that farmers have been responding to these challenges by using adaptation practices including crop and livelihood diversification, temporary migration, reducing food consumption etc. (for example: Antwi-Agyei et al., 2014, Issahaku et al., 2020). Adapting to the changes in climate is about minimizing farmers' vulnerabilities to climate change threats and the relevance of adaptation practices in managing climate risks cannot be overstressed (Intergovernmental Panel on Climate Change [IPCC], 2014). While several studies on climate change adaptation have been documented (e.g. Antwi-Agyei et al., 2014, Fagariba et al., 2018, Issahaku et al., 2020), empirical evidence on the barriers to climate change adaptation practices have been limited (e.g. Antwi-Agyei et al., 2015, Fagariba et al., 2018). Also, just like other features of climate change, adaptation practices are not gender neutral. Hence, the ability to adjust to changes in climate differs among regions and social groups, where the women and poor are the most vulnerable as a result of gendered norms, ascribed roles and inequalities in resources and power (Arora-Jonsson, 2011).

However, limited research have been conducted on the gendered adaptation practices to climate risks in Ghana (Adzawla et al., 2019, Wrigley-Asante et al., 2019). For instance, Adzawla et al. (2019) reported that the adaptive capacity of men is greater in contrast to women in the Zabzugu and South Tongu districts of Ghana citing reasons such as the levels and magnitude of adoption as the main differences between the gender groups. Similarly, Wrigley-Asante et al. (2019) revealed adaptation practices to be gendered with males predominantly employing on-farm practices relative to their female counterparts in the transition zone of Ghana. Nonetheless, empirical evidence examining the gender barriers to climate change adaptation particularly in the semi-deciduous forest zone of Ghana has been lacking. Hence, this study addresses the research gap by answering the following questions: (i) What are the climate change adaptation practices implemented by male and female farmers in selected communities of the Ejisu-Juaben Municipality to reduce climate risks? (ii) What are the barriers obstructing male and fe-

male farmers in implementing climate change adaptation practices in the selected communities of the Ejisu-Juaben Municipality?

Findings from this study will assist policymakers to devise appropriate policies and interventions that will address gender barriers to climate change adaptation strategies in Ghana and beyond. These policies will help address gender inequalities among farmers to ensuring sustainability in agriculture. Findings from the study will also contribute to the accomplishment of the United Nations Sustainable Development Goals (SDGs) including Goals; G1 (No poverty), G2 (Zero Hunger), G10 (Reduced Inequalities) and G13 (Climate Action).

II. MATERIALS AND METHODS

2.1 Description of study area

The municipality is found within longitude 6° 15′ W and 7° 00′ W and latitude 1° 15′ N and 1° 45′ N (Figure 1), occupying an area of land size 582.5 km^2 (Ghana Statistical Service [GSS], 2014). It is found in the centre of the Ashanti Region. The municipality has two rainfall peaks. The major rainfall season has an average annual of 1,200 mm – 1,500 mm which begins in March and ends in July every year whereas the minor rainfall season has an average annual of 900 mm – 1,120 mm from September to November (GSS, 2014). The months from December – February are generally hot, dry and dusty. The lowest average annual temperature (25 °C) is recorded in August while the highest (32 °C) is recorded in March (Ghana Statistical Service, 2014).

Agriculture, commerce and service sectors make up a large proportion of the working class in the municipality. However, most of the inhabitants in the municipality are into farming. Crop farming (food and cash crop farming) and animal husbandry are the commonest agricultural practices in the municipality with most households practicing a blend

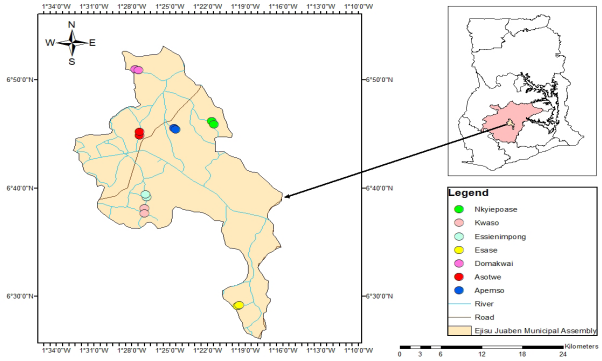

Figure 1: Map of the Ejisu-Juaben municipality showing the study communities

of both. A large proportion of the farmers (greater than 90%) are engaged in food crop farming (GSS, 2014) and the crops cultivated include: maize, cassava, plantain, rice, cocoyam and vegetables. Cocoa, oil palm and citrus are the dominant tree crops cultivated in the municipality (GSS, 2014).

Seven rural farming communities namely Apemso, Kwaso, Essienimpong, Nkyirepoaso, Domakwai, Esase and Asotwe (Figure 1) were consciously chosen from the municipality for data collection due to their high degree of farming activities.

2.2 Study design and participatory methods

This paper employed the use of cross-sectional study design to identify the climate change adaptation practices used by the farmers in reducing climate risks and the barriers confronting them in undertaking a particular adaptation practice in the municipality. This study design was employed due to the fact that it helped us to collect all the variables needed at the same time in a given population (Busk, 2014). The study used a mixed methods approach including focus group discussions (FGDs) and household questionnaire surveys. With the household surveys, probability sampling method was used to select 30 households randomly in each community. The respondents were made up of farm-

ers who had stayed in the community for at least 10 years. The purpose was to understand the present and past situations of farming activities in connection with climate variability. Both closed-ended and few open-ended questions were administered on a one-to-one basis with male or female household heads in each community. The discussions took place from March to April in the year 2018 and were centred on probing the socio-economic characteristics of the farmers, the adaptation practices used to minimize climate risks and the barriers confronting them in implementing these adaptation practices. Questionnaire administration was done in local language (Asante Twi) and the respondents consented to participate in the discussions by giving their verbal approval.

Two focus group discussions (FGDs) were held in each community (one for male farmers and the other for female farmers) to complement the household surveys. Respondents who showed in-depth knowledge in the household surveys were purposively selected for the focus group discussions. This was done to allow the female farmers to express themselves freely in the absence of their male counterparts. The essence was to produce gender-specific information. The discussions were audio-recorded after seeking permission from the participants and later transcribed. FGDs in each community lasted for about an hour. Responses from both household surveys and focus group discussions were kept confidential.

2.3 Data analysis

Households' survey data were analysed using descriptive statistics including percentages and frequencies. A non-parametric statistic including chi-square test was employed to establish the relationship between gender and farmers' adaptation practices as well as the barriers to the use of the adaptation practices. Confidence interval was set at 95%. Chi-square statistic is represented as:

$$X^2 = \sum \frac{(O_i - E_i)^2}{E_i} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where:

X^2 = Chi-squared

O_i = Observed value

E_i = Expected value

Statistical Package for Social Sciences (SPSS) version 21 was the analytical tool used in the computations. Data from the focus group discussions were subjected to thematic analysis where we examined the data closely and identified the emerging topics, ideas and patterns of meaning that came up repeatedly (Braun and Clarke, 2019).

III. RESULTS AND DISCUSSIONS

3.1 Socio-demographic characteristics of respondents

The male farmers constituted majority of the respondents (n = 110; 52%) as opposed to the females (n = 100; 48%) (Table 1). About 48% of the females (n = 48) were within the age category of 41 – 50 years as compared to about 43% of the males (n = 47). About 117 of the respondents (56%) had primary education. About 148 of the respondents (71%) had a household size of 6 to 10 individuals. Forty-two of the males (38%) had 20 to 30 years of farming experience relative to 29% of the females.

Table 1: Socio-demographic characteristics of respondents

Variables	Gender		Total (n = 210)
	Males (n = 110)	Females (n = 100)	
Age (years)			
30 – 40	27 (24.5)	20 (20.0)	47 (22.4)
41 – 50	47 (42.7)	48 (48.0)	95 (45.2)
51 – 60	26 (23.6)	27 (27.0)	53 (25.2)
Above 60	10 (9.1)	5 (5.0)	15 (7.1)
Education			
Non-formal education	37 (33.6)	28 (28.0)	65 (31.0)
Primary education	56 (50 .9)	61 (61.0)	117 (55.7)
Secondary school education	15 (13.6)	7 (7.0)	22 (10.5)
Tertiary education	2 (1.8)	4 (4.0)	6 (2.9)
Household size			
1 – 5 individuals	23 (20.9)	20 (20.0)	43 (20.5)
6 – 10 individuals	75 (68.2)	73 (73.0)	148 (70.5)
11 – 15 individuals	10 (9.1)	5 (5.0)	15 (7.1)
16 – 20 individuals	2 (1.8)	2 (2.0)	4 (1.9)
Years of farming experience			
Below 20	28 (25.5)	36 (36.0)	64 (30.5)
20 – 30	42 (38.2)	29 (29.0)	71 (33.8)
31 – 40	24 (21.8)	24 (24.0)	48 (22.9)
Above 40	16 (14.5)	11 (11.0)	27 (12.9)
Type of land ownership			
Inherited	85 (77.3)	69 (69.0)	154 (73.3)
Leasehold	14 (12.7)	18 (18.0)	32 (15.2)
Crop share	9 (8.2)	12 (12.0)	21 (10.0)
Communal land	2 (1.8)	1 (1.0)	3 (1.4)
Years lived in the community			
Below 20	9 (8.2)	12 (12.0)	21 (10.0)
20 – 30	26 (23.6)	20 (20.0)	46 (21.9)
31 – 40	31 (28.2)	32 (32.0)	63 (30.0)
Above 40	44 (40.0)	36 (36.0)	80 (38.1)

Numbers in parentheses are percentages whilst numbers without parentheses are frequencies

3.2 Adaptation practices used by male and female farmers in the study communities

Both male and female farmers had been implementing adaptation practices to lessen climate risks in the study communities. The adaptation strategies varied from crop diversification to off-farm activities. There were significant differences between male and female farmers' implementation of adaptation practices including change of planting dates, growing of drought resistant crop varieties, growing of short-term harvesting crops and off-farm activities ($p < 0.05$) (Table 2).

The patterns of rainfall have altered due to the changing climate and farmers have frequently employed changing planting dates to reduce the risks associated with climate change (Tesfaye and Seifu, 2016; Wrigley-Asante et al., 2019). However, about 81% of the females (n = 81) used this adaptation strategy as opposed to about 61% of the males (n = 67). The observed gender differences could be due to their vulnerabilities to climate change. Generally, females are more susceptible to changes in climate relative to males and hence they have high likelihood of adopting this strategy as a necessary action to reduce their vulnerability to climate risks. This lends support to previous studies by (Twyman et al., 2014, Adzawla et al., 2019, Alhassan et al., 2019) conducted in Ghana and other parts of Africa.

Growing of drought resistant crop varieties is an adaptation practice used by farmers to minimize climate change threats (Fisher et al., 2015, Wossen et al., 2017). The importance of growing drought resistant crop varieties is to enhance crop yields particularly in the face of extreme temperature and decreased rains. Majority of the male farmers (n = 71; 65%) used this strategy as opposed to the females (n = 44; 44%) (Table 2). This is consistent with previous studies (Alhassan et al., 2019, Fisher et al., 2019, Wrigley-Asante et al., 2019) conducted in SSA where they found that male farmers used drought tolerant varieties of crops more than females. The possible reason that could be attributed to this is that males have control over household financial resources to be able to purchase drought crop varieties as compared to their female counterparts (Anaglo et al., 2014, Fisher et al., 2019).

Growing of short-term harvesting crops was another practice used by the farmers in the Ejisu-Juaben Municipality. Two of the farmers reported these in the focus group discussions.

> *"I prefer planting short-term harvesting maize varieties such as Mamaba because they yield positive harvest within three months thereby protecting me in case of drought or low rainfall" – (Male focus group participant, Kwaso, April, 2018).*

> *"I was advised by an agricultural extension agent to plant short-term harvesting crops and since then I have never regretted heeding to that advice. With the rainy season predicted to last for only three months, I will also encourage other farmers to plant short-term harvesting crops to yield a positive harvest" – (Female focus group participant, Apemso, April, 2018).*

According to the farmers, short-term harvesting crops yield a positive harvest within few months of planting to protect them from low rainfall or drought. Furthermore, the planting of short-term harvesting crops ensure quick economic return on the harvest. Despite the benefits associated with the use of this adaptation strategy, there were significant differences between male and female farmers usage of this strategy ($p < 0.05$). Majority of the male farmers (n = 78; 71%) employed this strategy as opposed to 41% of the female farmers (n = 41). Consistent with previous studies (Bryan et al., 2018, Adzawla et al., 2019) conducted in SSA,

this could be attributed to the fact that short-term harvesting crops generally require government subsidies and with female farmers having low access to financial resources, they tend to have low access to these production inputs.

The farmers in the selected communities also relied on off-farm activities including petty trading, tailoring, masonry and carpentry to manage climate risks. Off-farm activities by farmers act as a source of additional income to them where most use the money generated to enhance agricultural production by purchasing improved seeds, machineries, fertilizers and hiring labour (Ahmed and Melesse, 2018). Nonetheless, there was a statistically significant association between gender and engagement of off-farm activities ($p < 0.05$). Majority of the females employed this strategy (n = 63; 63%) as compared to the males (n = 36; 33%). This is in line with a previous study which found that women farmers are anticipated to undertake off-farm practices in contrast to the men (Ahmed and Melesse, 2018). The possible reason that could be attributed to this is that female farmers undertake off-farm practices to counterbalance their comparable lower on-farm earnings.

Table 2: Adaptation strategies by farmers

Adaptation strategies	Gender		Total (n = 210)	Pearson Chi-square	*p*-value
	Males (n = 110)	Females (n = 100)			
Crop diversification	69 (62.7)	50 (50.0)	119 (56.7)	3.455	0.063
Changing planting dates	67 (60.9)	81 (81.0)	148 (70.5)	10.161	**0.001**
Irrigation	2 (1.8)	1 (1.0)	3 (1.4)	0.249	0.618
Growing of drought resistant varieties of crops	71 (64.5)	44 (44.0)	115 (54.8)	8.925	**0.003**
Fertilizer application	10 (9.1)	4 (4.0)	14 (6.7)	2.182	0.140
Growing of short-term harvesting crops	78 (70.9)	41 (41.0)	119 (56.7)	19.082	**0.000**
Off-farm activities (e.g. petty trading, masonry, carpentry etc.)	36 (32.7)	63 (63.0)	99 (47.1)	19. 264	**0.000**

Numbers in parentheses are percentages whilst numbers without parentheses are frequencies.

3.3 Barriers to the use of adaptation practices in the study communities

The farmers reported some key barriers obstructing them from implementing adaptation strategies. The adaptation practices identified by the farmers varied from poor access to weather and climate information services to poor access to and control of land (Table 3). The majority of the respondents (n = 156; 74%) revealed lack of access to credit facilities as a major barrier restricting them from implementing climate change adaptation practices. Focus group participants also complemented this barrier in the discussions. For instance, some of the participants reported these:

> *"Lack of access to credit facilities hinder me from purchasing improved crop varieties that can produce higher yields and ensure household food security" – (Male focus group participant, Essienimpong, April, 2018)*

> *"Lack of access to credit facilities is the major barrier hindering us from implementing appropriate adaptation strategies in this community. The main reason for most of the farmers happen to be the high interest rate charges on loans" – (Female focus group participant, Esase, April, 2018)*

This finding compares favourably with previous studies (Antwi-Agyei et al., 2015, Masud et al., 2017, Fagariba et al., 2018) indicating that lack of access to credit facilities impede the ability of susceptible smallholder farmers to undertake climate change adaptation practices. This is because rain-fed farming is frequently regarded an insecure business. Even when the credit is available, most smallholder farmers may not have the collateral to access such credit facilities (Antwi-Agyei et al., 2015). Although both male and female farmers were confronted with this challenge, there were still significant differences between them ($p < 0.05$). Most of the female farmers (n = 88; 88%) were faced with this barrier in contrast to the male farmers (n = 68; 62%). This is not surprising as most male farmers tend to have more financial resources as compared to their female counterparts. While females make substantial contributions to agriculture particularly in low-income countries, they are unable to maximize production and less likely to participate in commercial farming when compared to males, which is associated with less access to financial resources (Croppenstedt et al., 2013, Carranza and Niles, 2019).

Lack of access to ready markets was the second highest barrier (n = 154; 73%) to implementation of adaptation strategies by the selected communities. Rural households depend largely on access to markets for their agricultural production and it is crucial for agriculture to become the main driver of pro-poor growth (Kamara, 2014). The farmers reported some reasons for lack of access to ready markets including poor organization and influence of the farmers, weak transport and communications system and limited market information. For instance, a focus group participant reported this:

> *"In general, the market for our fresh produce is a challenge and the reason attributed to this is weak transport and poor road network linking our communities to the urban centres" – (Male focus group participant, Nkyirepoaso, April, 2018).*

This finding is confirmed by previous studies (Antwi-Agyei et al., 2015, Ndamani and Watanabe, 2015, Shackleton et al., 2015) conducted in SSA indicating that access to ready markets is a key constraint to climate change adaptation practices.

High cost of improved crop varieties was a critical climate change adaptation barrier reported by the farmers (n = 144; 69%). Adoption of im-

proved crop varieties has the potential of enhancing crop yields to respond to the threats of erratic rainfall patterns and increasing temperature because of their ability to withstand these extreme conditions. However, the farmers bemoaned the high cost of the improved crop varieties. For example, one of the farmers reported this in the FGDs.

> *"Improved maize and rice varieties are very good in achieving adequate yields. However, they are very difficult and expensive to buy. We plead with the government to come to our aid" – (Female focus group participant, Domakwa, April, 2018).*

Gender had a significant effect on high cost of improved crop varieties ($p < 0.05$). About 84% of the female farmers (n = 84) reported this as a critical barrier as opposed to about 55% of their male counterparts (n = 60). This could be due to the fact that male farmers tend to have control of household financial resources as compared to the females as already highlighted.

IV. CONCLUSIONS

The changes in climate pose significant threats to the socio-economic development in Ghana particularly to rural agricultural households. Though Ghanaian farmers have been implementing climate change adaptation practices to minimize climate risks, this study investigated the gender barriers to the implementation of these adaptation practices using Ejisu-Juaben Municipality in the semi-deciduous forest zone of Ghana as a case

Table 3: Barriers to adaptation strategies

Adaptation strategies	Gender		Total	Pearson Chi-square	*p*-value
	Males (n = 110)	Females (n = 100)	(n = 210)		
Poor access to weather and climate information services	56 (51.0)	64 (64.0)	120 (57.1)	3.665	0.056
Lack of access to ready markets	75 (68.2)	79 (79.0)	154 (73.3)	3.135	0.077
High cost of improved crop varieties	60 (54.5)	84 (84.0)	144 (68.6)	21.087	**0.000**
Lack of access to extension services	61 (55.5)	67 (67.0)	128 (61.0)	2.934	0.087
Lack of access to credit facilities	68 (61.8)	88 (88.0)	156 (74.3)	18.797	**0.000**
Poor access to and control of land	29 (26.4)	33 (33.0)	62 (29.5)	1.109	0.292

Numbers in parentheses are percentages whilst numbers without parentheses are frequencies.

study. Findings indicated that the farmers have used a host of adaptation practices in the study communities. However, there were significant differences between farmers' implementation of adaptation practices including change of planting dates, growing of resistant varieties of crops, growing of short-term harvesting crops and off-farm activities. Key reasons attributed to the observed gender differences were control of household financial resources and vulnerability to climate change. Findings also showed that the farmers are confronted with some barriers thereby restricting them from undertaking particular adaptation practices. Lack of access to credit facilities was reported as the major barrier followed by lack of access to ready markets. Gender had significant influence on barriers including lack of access to credit facilities and high cost of improved crop varieties. Majority of the female farmers reported these barriers as more critical than the male farmers implying their low access to household financial resources as opposed to the males. These barriers can have substantial implications on rural livelihoods and food security. Hence, it is imperative that policy makers devise appropriate policies that will address the gender barriers to climate change adaptation practices in Ghana. For instance, the government can quickly adopt policy interventions in the agricultural sector to boost access to credit facilities and production for household food security. More rural and community micro credit and financial institutions should be established to support rural farmers particularly the female farmers and other rural activities. Addressing the constraint of lack of access to ready markets requires policy shifts at the district and regional levels–and significant funding must be committed to rural transport sector to aid the transfer of agricultural produce from farming centres to the marketplace. Strengthening social capital, such as farmer organisations, can guarantee that farming households have the ability to negotiate in the marketplace and obtain better prices for their farm products.

V. STATEMENT OF RESEARCH ETHICS

Research methods employed in this study followed all appropriate ethical standards. The respondents were informed and given their consents before participating in this research.

VI. ACKNOWLEDGEMENTS

The authors truly value the involvement and kind gesture of the selected communities' people and their leaders.

Funding: No external funding was received by the authors.

VII. REFERENCES

[1] Adzawla, W., Azumah, S.B., Anani, P.Y. and Donkoh, S.A., (2019). Gender perspectives of climate change adaptation in two selected districts of Ghana. *Heliyon*, 5(11), p.e02854. https://doi.org/10.1016/j.heliyon.2019.e02854.

[2] Ahmed, M.H. and Melesse, K.A., (2018). Impact of off-farm activities on technical efficiency: evidence from maize producers of eastern Ethiopia. *Agricultural and Food Economics*, 6(1), 1-15. https://doi.org/10.1186/s40100-018-0098-0.

[3] Alhassan, S.I., Kuwornu, J.K. and Osei-Asare, Y.B., (2019). Gender dimension of vulnerability to climate change and variability: Empirical evidence of smallholder farming households in Ghana. *International Journal of Climate Change Strategies and Management*. 11, 195-214. https://doi.org/10.1108/IJCCSM-10-2016-0156.

[4] Alvi, M., (2016). A manual for selecting sampling techniques in research, Munich Personal RePEc Archive. https://mpra.ub.uni-muenchen.de/id/eprint/70218.

[5] Anaglo, J.N., Boateng, S.D. and Boateng, C.A., (2014). Gender and access to agricultural resources by smallholder farmers in the Upper West Region of Ghana. *Journal of Education and Practice*, 5(5), 13-19.

[6] Antwi-Agyei, P., Stringer, L. C., and Dougill, A. J. (2014). Livelihood adaptations to climate variability: insights from farming households in Ghana. *Regional Environmental Change,* 14(4), 1615–1626. https://doi:10.1007/s10113-014-0597-9.

[7] Antwi-Agyei, P., Dougill, A.J. and Stringer, L.C., (2015). Barriers to climate change adaptation: evidence from Northeast Ghana in the context of a systematic literature review. *Climate and Development*. 7(4), 297–309. https://doi.org/10.1080/17565529.2014.951013.

[8] Arora-Jonsson, S., (2011). Virtue and vulnerability: Discourses on women, gender and climate change. *Global environmental change*, 21(2), 744-751. https://doi.org/10.1016/j.gloenvcha.2011.01.005.

[9] Asante, F.A. and Amuakwa-Mensah, F., (2015). Climate change and variability in Ghana: Stocktaking. *Climate*, 3(1), 78-99. https://doi.org/10.3390/cli3010078.

[10] Braun, V., and Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health*, 11(4), *589–597.* https://doi:10.1080/2159676x.2019.1628806.

[11] Bryan, E., Bernier, Q., Espinal, M., & Ringler, C. (2018). Making climate change adaptation programmes in sub-Saharan Africa more gender responsive: insights from implementing organizations on the barriers and opportunities. *Climate and Development*, *10*(5), 417-431. https://doi.org/10.1080/17565529.2017.1301870

[12] Busk, P. L., (2014). Cross-Sectional Design. *Wiley StatsRef: Statistics Reference Online.* https://doi.org/10.1002/9781118445112.stat06684.

[13] Carranza, M. and Niles, M.T., (2019). Smallholder farmers spend credit primarily on food: gender differences and food security implications in a changing climate. *Frontiers in Sustainable Food Systems*, 3, 56. https://doi.org/10.3389/fsufs.2019.00056.

[14] Chijioke, O.B., Haile, M. and Waschkeit, C., (2011). Implication of climate change on crop yield and food accessibility in Sub-Saharan Africa. *Centre for Development Research. Bonn: University of Bonn*.

[15] Croppenstedt, A., Goldstein, M. and Rosas, N., (2013). Gender and agriculture: Inefficiencies, segregation, and low productivity traps. *The World Bank Research Observer*, 28(1), 79-109. https://doi.org/10.1093/wbro/lks024.

[16] Defiesta, G., & Rapera, C. (2014). Measuring adaptive capacity of farmers to climate change and variability: Application of a composite index to an agricultural community in the Philippines. *Journal of Environmental Science and Management*, 17 (2).

[17] Fagariba, C.J., Song, S. and Soule Baoro, S.K.G., (2018). Climate change adaptation strategies and constraints in Northern Ghana: Evidence of farmers in Sissala West District. *Sustainability*, 10(5), 1484. https://doi.org/10.3390/su10051484.

[18] Fisher, M., Abate, T., Lunduka, R.W., Asnake, W., Alemayehu, Y. and Madulu, R.B., (2015). Drought tolerant maize for farmer adaptation to drought in sub-Saharan Africa: Determinants of adoption in eastern and southern Africa. *Climatic Change*, 133(2), 283-299. https://doi.org/10.1007/s10584-015-1459-2.

[19] Fisher, M., Habte, E., Ekere, W., Abate, T., & Lewin, P. A. (2019). Reducing gender gaps in the awareness and uptake of drought-tolerant maize in Uganda: The role of education, extension services and social networks. *Journal of Gender, Agriculture and Food Security (Agri-Gender)*, *4*(302-2020-394), 38-50. DOI: 10.22004/ag.econ.301197

[20] Food and Agriculture Organization [FAO], (2020). Ghana at a glance. http://www.fao.org/ghana/fao-in-ghana/ghana-at-a-glance/en/ 2020 (Accessed 15 August 2021).

[21] Ghana Statistical Service, Ejisu-Juaben, (2014). https://www2.statsghana.gov.gh/ (Accessed 29 July 2020)

[22] Intergovernmental Panel on Climate Change (IPCC), (2014). Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Geneva, Switzerland, pp. 151.

[23] Issahaku, G., Abdul-Rahaman, A. and Amikuzuno, J., (2020). Climate change adaptation strategies, farm performance and poverty reduction among smallholder farming households in Ghana. *Climate and Development*, 1-12. https://doi.org/10.1080/17565529.2020.1860884.

[24] Kamara, A.B., (2004). The impact of market access on input use and agricultural productivity: Evidence from Machakos District, Kenya. *Agrekon*, 43(2), 202-216. https://hdl.handle.net/10520/EJC18275.

[25] Kusangaya, S., Warburton, M. L., Van Garderen, E. A., and Jewitt, G. P., (2014). Impacts of climate change on water resources in southern Africa: A review, *Physics and Chemistry of the Earth,* 67(1) 47-54. https://doi.org/10.1016/j.pce.2013.09.014.

[26] Masud, M. M., Azam, M. N., Mohiuddin, M., Banna, H., Akhtar, R., Alam, A. F., & Begum, H. (2017). Adaptation barriers and strategies towards climate change: Challenges in the agricultural sector. *Journal of cleaner production*, *156*, 698-706. https://doi.org/10.1016/j.jclepro.2017.04.060

[27] Mohammed, E.Y. and Uraguchi, Z.B., (2013). Impacts of climate change on fisheries: implications for food security in Sub-Saharan Africa. *Global Food Security, Nova Science Publishers, Inc*, 114-135.

[28] Ndamani, F. and Watanabe, T., (2015). Farmers' perceptions about adaptation practices to climate change and barriers to adaptation: A micro-level study in Ghana. *Water*, 7(9), 4593-4604.https://doi.org/10.3390/w7094593.

[29] Ngoran, S.D., Dogah, K.E. and Xue, X., (2015). Assessing the impacts of climate change on water resources: The Sub-Saharan Africa perspective. *Journal of Economics and Sustainable Development*, *6*(1), 185-193.

[30] Peprah, J.A., Koomson, I., Sebu, J. and Bukari, C., (2021). Improving productivity among smallholder farmers in Ghana: does financial inclusion matter?. *Agricultural Finance Review*. 81(4) 481-502. https://doi.org/10.1108/AFR-12-2019-0132.

[31] Shackleton, S., Ziervogel, G., Sallu, S., Gill, T., & Tschakert, P. (2015). Why is socially-just climate change adaptation in sub-Saharan Africa so challenging? A review of barriers identified from empirical cases. *Wiley Interdisciplinary Reviews: Climate Change*, *6*(3), 321-344. doi: 10.1002/wcc.335

[32] Tesfaye, W., & Seifu, L. (2016). Climate change perception and choice of adaptation strategies: Empirical evidence from smallholder farmers in east Ethiopia. *International Journal of Climate Change Strategies and Management*. Vol. 8 No. 2, pp. 253-270. https://doi.org/10.1108/IJCCSM-01-2014-0017

[33] Twyman, J., Green, M., Bernier, Q., Kristjanson, P. M., Russo, S., Tall, A., ... & Badiane Ndour, N. Y. (2014). Adaptation actions in Africa: evidence that gender matters. *CCAFS Working Paper* no. 83. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

[34] Wossen, T., Abdoulaye, T., Alene, A., Feleke, S., Menkir, A., and Manyong, V. (2017). Measuring the impacts of adaptation strategies to drought stress: The case of drought tolerant maize varieties. *Journal of Environmental Management,* 203, 106–113. https://doi.org/10.1016/j.jenvman.2017.06.058.

[35] Wrigley-Asante, C., Owusu, K., Egyir, I.S. and Owiyo, T.M., (2019). Gender dimensions of climate change adaptation practices: the experiences of smallholder crop farmers in the transition zone of Ghana. *African Geographical Review*, 38(2), 126-139. https://doi.org/10.1080/19376812.2017.1340168.