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Socio-Economic Determinants of Vulnerability to Climate Variability and Change across Gender in Southeast Nigeria

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Abstract

This study assessed vulnerability problems in Southeast Nigeria. The specific objectives were to, assess vulnerability to impacts of climate variability and change (CVC) and their differences across gender and identify socio-economic determinants of vulnerability in the area. Mixed research methods and approaches, including key informant interview, focus group discussion, field observations and household survey (questionnaire), were used to collect qualitative and quantitative data. The data were analysed and presented using mean, chi-square and multinomial logit regression. Common vulnerability problems for the entire sample (pooled data) as well as men and women headed households include poverty, less ownership of asset, rain fed nature of farming among others. Vulnerability conditions of women in terms of their institutional and user characteristics, showed that they were significantly different ($p \leq 0.05$) from men in issues of limited availability of cropping lands ($X^2=67.71$), political will-power ($X^2=64.48$) and aids ($X^2=59.12$). Socioeconomic characteristics of respondents affects their vulnerability problems such as limited availability of aids ($P \leq 0.000$; Cox and Snell $R^2 = 0.53$; $-2\log$ likelihood ratio = 45.78); less ownership of assets among others. Socio economic determinants of vulnerability include age, income, education among others. The study recommends the use of gender-specific and equitable interventions such as providing trainings in line with needs of men and women to improve their information, technologies, knowledge and capacity to reduce vulnerability in the area.

Keywords: vulnerability; gender; climate change; socio-economic determinant

Introduction

Vulnerability to CVC is concerned with relative susceptibility of people, countries and individuals to effects and impacts of CVC. Climate change threatens to set back development efforts by

decades, placing least developed countries and Sub-Saharan African countries and already vulnerable populations in an even more precarious position (Solomon, 2014). Natural disasters do not affect people equally. In the 21st century, there is no reason for any human to not have access to clean and safe, life preserving water which are lacking for the vulnerable populations (McCleod, 2014). With the prevalent climate change, this becomes highly challenging. Farmers' vulnerability is characterized by increasing pressures on the natural resources from a growing population, limited and insecure access to water and fertile soils, and soil degradation resulting from overuse, combined with the breakdown of traditional coping mechanisms, barriers to alternative livelihoods and consequently threatened human (Kok, Ludeke, Lucas, Sterszel *et al.*, 2016). In Nigeria, CVC impacts exert differentiated burdens based on vulnerability of farmers and their households. Most countries in sub-Saharan Africa (including Nigeria) are likely to suffer the effects of climate change more than other countries in the world (Okoli and Ifeakor, 2014). Vulnerability refers to the extent that a given population may suffer harm from exposure to a hazard related to various socio-economic and demographic characteristics (Dong, Liu, Liao, Tang, & Li, 2015). The vulnerability conditions of farmers vary across locations and their socioeconomic characteristics. For example, the proportion of a population with higher education is a sign of technological strength, which is an important indicator of the ability to mitigate and adapt to climate change (Dong *et al.*, 2015).

Socioeconomic characteristics of individuals including their age, gender, income, education and others can determine their levels of vulnerability to CVC. While exposure to a hazard may be the same among different social groups, the impacts are determined according to the varying capability of each group in handling the effects of hazards (de Loyola Hummell, Cutter, & Emrich, 2016). Those with higher socio-economic status fare much better in the face of disaster due to the fact that they have the resources to protect themselves; those that reside on the bottom of the socio-economic The main drivers of vulnerability include livelihood strategies, access to food, water and health facilities (Monirul Alam, Alam, Mushtaq, & Clarke, 2017) Farmers who are more susceptible to poverty, have lower incomes, are more likely to be economically dependent and have limited access to land, finance and credit. Farmers with limited levels of education are likely to be more vulnerable to CVC. Researchers, increasingly acknowledge the importance of effectively including gender in works aimed at addressing CVC (Bernier *et al.*, 2015; Bryan, Bernier, Espinal, & Ringler, 2018; Jost *et al.*, 2016; Kristjanson *et al.*, 2017).

Gender dynamics are highly important in the issue of vulnerability especially in Africa where it is a major determinant of resource allocation. Women's unequal access to key agricultural inputs such as land, labor, knowledge, fertilizer, and improved seeds and seedlings contributes to the persistence of this gap (Farnworth *et al.*, 2016). CVC increases gender inequalities due to uneven adaptive capacity. CVC is expected to exacerbate current vulnerabilities and inequalities (Otto *et al.*, 2017). Therefore, attempts to ensure gender equality can help to reduce the impacts of climate change. Gender differences that affect vulnerability of farmers to climate variability and change make it imperative to consider gender in climate change. Gender inequities generally arise when certain gender groups are unfairly disadvantaged in resources that are available to other gender groups. There is evidence of gender-specific vulnerability and adaptive capacity to climate stresses (Vincent *et al.*, 2015). The gaps in agricultural productivity between plots managed by men and women vary across countries and crops, but ranges from 4% to 25% when measured as the value of agricultural production per hectare across Sub-Saharan Africa (Aguilar, Goldstein, & Oseni, 2015; Backiny-Yitna & McGee, 2015). The gender gap is also substantial in exposure to climate change and its impacts, and uptake of new practices that lower vulnerability (Kristjanson

et al., 2017). These gender issues and climate variability and change do not exclude the problems of men in Africa. The effects of climate change on our ecosystems are already severe and widespread, and ensuring food security in the face of climate change is among the most daunting challenges facing humankind (Food and Agriculture Organization (FAO), 2016). African men have more access and ownership of resources but recent climate variability and change impacts affects availability and access to these resources. Existing literature on gender and CVC response strategies in agrarian settings demonstrates that, quite often, men and women experience vulnerability to CVC distinctly and/or differentially (Carr & Thompson, 2014). Like other African countries, in Nigeria, men and women farmers differ in their vulnerability to impacts of CVC.

In Nigeria, men and women depend on agriculture for the survival. CVC turns out to be negative for Nigeria, with production losses and increase in crop prices, higher food dependency on foreign imports and Gross Domestic Product (GDP) losses (Bosello, Campagnolo, Cervigni, & Eboli, 2018). These have consequences for farmers' decision and management including enterprise choice and management (Munonye, 2017). The population growth and climate change are putting strain on the already dwindling natural resources found in Nigeria hence the country is facing some difficult issues in reducing vulnerability for a large percentage of its inhabitants, especially for women (Wilmoth, 2015). Gendered disparities seriously undermine the potential of women as drivers of agricultural growth in Nigeria, considering the population of women engaged in farming (Ugwuja & Nweze, 2018). Southeast Nigeria which has increased problem of limited access to agricultural resources also has peculiar issue of gender inequality. The evidence is growing on the substantial cost of neglecting the large 'gender gap' that persists in agricultural productivity and development in most countries (Ali, 2015; Peterman *et al.*, 2014; UNWomen, 2015). Limited studies including that of Ajaero, (2017) exist on interactions between socioeconomic characteristics, gender and vulnerability to CVC in Southeast Nigeria. Hence this paper sought to identify the socioeconomic determinant of vulnerability in order to reduce vulnerability conditions of men and women farmers in Southeast Nigeria. Specifically, it sought to assess the vulnerability conditions of farmers and the gender differences as well as socioeconomic determinants of vulnerability in Southeast Nigeria.

Methodology

This study was carried out in SE region of Nigeria with focus on Anambra State (Figure 1). The southeast zone is one of the six geopolitical zones in Nigeria. In the southeast geopolitical zone the sex ratio is male-dominated in three (Imo, Anambra and Abia) of the five states but female-dominated in Enugu and Ebonyi states (Wilson & Felix, 2018). For instance, data show a total population of 16,381,729 comprising of 8,306,306 males and 8,075,423 females, making a ratio of 50.70 males to 49.30 females for the zone (Wilson & Felix, 2018). The Southeast zone is a rainforest zone comprising of various trees. According to Mbanasor, *et al.*, (2015), the Southeast rainforest zone of Nigeria is a belt of tall trees with dense undergrowth of shorter species dominated by climbing plants.

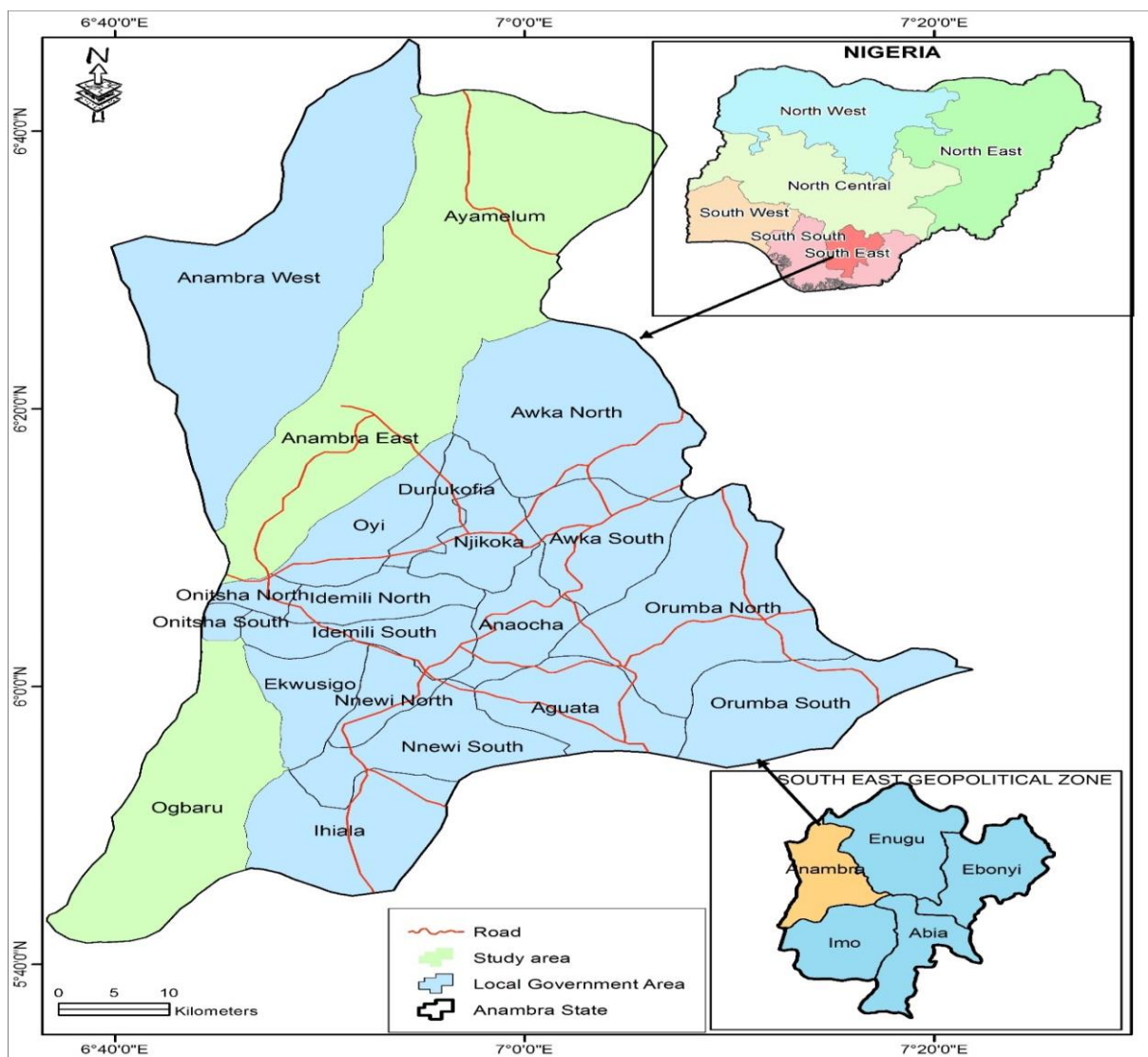


Figure 1:

Map of Nigeria showing study locations (Anambra East, Ogbaru and Ayamelum)

Source: Modified from divagis.org

The prolonged rainy season, resulting in high annual rainfall above 1,800mm, humidity of above 80% during the rainy season, and temperature of 27°C annually in this area; ensures adequate supply of water and promotes perennial tree growth (Mbanasor, *et al.* 2015). The majority of the inhabitants engage in agricultural production. Southeast zone also consists of traders (farmers sell their produce and other products) and major importers and exporters of goods are also present. Most farmers in the zone cultivate with the major aim of feeding their family and selling off the remnant to generate income (Ifeanyi-obi and Mathews-Njoku, 2014). A good number of educated people engage in white-collar jobs and either farm or trade as part-time activity.

All farmers in Southeast zone of Nigeria constituted the population for the study. Multi-stage sampling technique was used to select the sample. In the first stage, Anambra State was purposively used for the study out of five states in the Southeast zone due to the massive engagement in agricultural production across gender and the nature of the area which made it

prone to erosions, droughts, flooding and environmental hazards caused by climate change. In the second stage, three local government areas (Ogbaru, Ayamelum and Anambra East) (as shown Figure 1 above) were purposively selected from the State due to predominance of large scale farmers in the area. In the third stage, two town communities (Atani and Ogbakuba in Ogbaru, Ifite-Ogwari and Anaku in Ayamelum and Aguleri and Igbariam in Anambra-East) were selected from each of the local government areas. In the fourth stage, random sampling technique was used to select the 150 men and 150 women headed households from a list of farm Households obtained from the State Ministry of Agriculture. Household survey was used to collect quantitative and qualitative data in the study. Descriptive words and adjectives were used to elicit qualitative information during the survey. The survey was used to collect data on socio-economic and institutional characteristics of sampled households. A focus group interview checklist was used to gather information from the focus groups. The method aims to obtain data from a purposely selected group of individuals rather than from a statistically representative sample of a broader population (Nyumba *et al.*, 2017). A group of eight respondents were purposively selected for each group based on their farming experience for more than 30 years and their in-depth knowledge of the area. Key informant interview were conducted in order to obtain more information and validate the existing information. The same checklist of open ended questions used for FGD were discussed during the key informant interview in-order to triangulate and validate the information obtained from the FGDs. Field observation was used in the study to improve the validity of information obtained. This method provided additional information that was used to understand the existing situations in the study locations. Respondents' homes and farm locations, methods of farming and products were observed among other things.

Vulnerability of respondents were measured by listing different vulnerability problems for respondents to rate on a three point Likert-type scale of serious problem (2), not serious problem (1) and not a problem at all (0). Some of the listed vulnerability problems included limited water bodies; increased flood prone areas, limited irrigation capacity among others. Vulnerability to climate variability and change impacts from a gender perspective were analysed and presented with mean, standard deviations and chi-square statistics in SPSS. Chi-square test is applied to data classified into categories, or labelled using nominally scaled variables (Yekinni, 2015). Pearson chi-square was used to analyse gender differences in the vulnerability conditions of respondents'. Cut-off point for the mean score was 1.0; Standard deviation of 1.0 shows similarity of responses to the mean. Significant gender difference in the vulnerability problems were determined using 95% confidence interval. Multinomial Logit Regression was also used to analyse the socioeconomic and institutional determinants of respondents' vulnerability. Dependent variables were different vulnerability conditions such as technology costs, fragmented crop lands, limited mechanization, rain-fed farming among others. To model the choices or responses of dependent variable (which has more than two categories) in relation to some predictor or explanatory variable (socioeconomic and demographic characters which can be discrete, continuous or categorical) Multinomial Logit Regression is used (Dimelu, Olaolu, Madukwe and Chukwu, 2015). The independent variables were age, farming experience (years of farming), years of formal education, source of information on climate change, type of farming, access to credit among others.

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Results and Discussion

Vulnerability of Farmers to CVC Impact and Gender Dynamics

User Characteristics-Related Vulnerability Problems

Table 1 shows that the major user characteristics-related vulnerability problems for the entire sample (pooled data) as well as men and women include: poverty, less ownership of asset and rain fed nature of farming. Table 1 also showed some gender differences in the vulnerability problems in the area. Compared to men headed households, women headed households were more vulnerable ($p \leq 0.05$) to vulnerability problems of poverty, less ownership of assets and fragmented cropping lands.

Table 1: Users characteristics-related vulnerability conditions across gender

Variables	Pooled data		Men		Women		Gender differences X ² -value
	Mean	S.D	Mean	S.D	Mean	S.D	
User Characteristics							
Poverty	1.53	0.65	1.39	0.73	1.66	0.52	19.12*
Less ownership of asset	1.52	0.65	1.40	0.72	1.65	0.55	14.68*
Rain-fed nature of farming	1.33	0.72	1.44	0.70	1.21	0.74	8.78
Fragmented cropping lands	0.86	0.70	0.67	0.58	1.78	0.97	67.71*
Limited irrigable land	0.32	0.59	0.38	0.601	0.25	0.56	9.23

* $P \leq 0.05$ Source: Field Survey (2018)

This finding is line with that of Agu, Ekpo and Ajator (2015) that crop yield falls because the farmers practiced rain-fed agriculture and hence fundamentally dependent on the vagaries of weather. This also corroborates findings of Balogun and Akinyemi (2017) that fragmentation of holdings has negative implications for agricultural development. Consequently, the user characteristics-related vulnerability problems in the area were rain-fed nature of farming less ownership of assets and poverty. During FGD a Participant stated that “*we have limited asset, less income and limited capacity to withstand CVC impacts*”. This agrees with Agu *et al.*, (2015) that as the farmers strive to overcome poverty and advance economic growth, this phenomenon (climate change) threatens to deepen vulnerabilities. It further agrees with Agu *et al* (2015) that the area has a high vulnerability to climate change because of poverty, poor infrastructure and high population pressures. The implication of this finding is that respondents (men and women) had vulnerability problems of poverty and limited assets.

Gender differences in user characteristics-related vulnerability reveals that women household heads were more vulnerable due to their poverty, less ownership of assets and fragmented croplands. These findings corroborate with Amusa, Okoye and Enete (2015) that female-headed farm households had higher climate change vulnerability while male-headed households had relatively lower vulnerability. Field observation and FDG revealed that women strive to ensure that they can feed their households with the little resources available. The women face many problems related to poverty. During key informant interview, participants reported, “*Traditionally, women in this area do not own lands, houses and other assets*”. This corroborates with Enwelu, Morah,

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Dimelu and Ezeano (2014) that in Anambra State, women generally have limited access to farm land in the communities for subsistence farming. It further agrees with Enwelu *et al.*, (2014) that women's right to the husband's land is secure as long as the marriage lasts and unmarried women are not allowed to inherit landed property in Anambra State even though they are actively involved in agricultural activities. This also agrees with Ekpo and Agu (2014) that women inherit land and property rights from neither their fathers nor husbands. This agrees with Ekpo and Agu (2014) that increased women's access to land and credit facilities, diversification of their livelihoods and changes in socio-cultural practices is necessary to support women to fully realize their potential for enhanced response capacity to climate change impact. Consequently, these gender differences that made women more vulnerable to CVC in the area need to be considered to reduce vulnerability.

Information and Communication Technology-Related Vulnerability Problems

Table 2 shows respondent's Information and communication technology related vulnerability problems for the entire sample (pooled data) and across the gender groups. The common vulnerability problems for the entire sample (pooled data) were problems of technology cost ($\bar{x}=1.71$), electricity or power supply ($\bar{x}=1.67$), unavailability of technology ($\bar{x}=1.65$) among others. Similarly, data in Table 2 show that these women were had more vulnerability problems ($p<0.05$) of limited mechanization, trainings and knowledge.

Table 2: Information and communication technology-related vulnerability problems across gender

Variables	Pooled data		Men		Women		Gender differences
	Mean	S.D	Mean	S.D	Mean	S.D	X ² -value
Information and technology							
Technology cost	1.71	0.54	1.61	0.62	1.62	0.42	1.02
Erratic power supply	1.67	0.56	1.58	0.63	1.55	0.47	8.78
Unavailability of technology	1.65	0.58	1.56	0.67	1.54	0.44	1.54
Limited mechanization	1.57	0.63	1.46	0.74	1.69	0.46	27.53*
Limited trainings	1.56	0.60	1.54	0.64	1.58	0.56	10.31*
Limited knowledge	1.40	0.69	1.37	0.77	1.42	0.60	19.25*

* $P\leq 0.05$. Source: Field Survey

This implies that limited technology, high cost of technology and erratic power supply constitute vulnerability conditions of farmer in the area. FGD and field observation revealed that technologies for increasing production, labour reduction and postharvest handling of crops are limited in the area. This corroborated the findings of (Tucker *et al.*, 2015) that high levels of poverty, and associated factors such as lack of technologies and networks, are sources of vulnerability. This supports the report of (Elum & Momodu, 2017) that electricity demand in Nigeria surpasses current supply and has been a great hindrance to the country's economic and technological development. Improved technologies are limited and lacking in this area. Food production with the use of improved technology also demands constant energy and power supply. Implication of this is that limited improved technology and inadequate power supply hamper agricultural production in the area. Hence, they are more vulnerable to CVC disasters.

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Gender differences in the vulnerability problems shows that limited knowledge, mechanization and trainings were identified as more vulnerability problems of women than men. Women have lesser knowledge of improved farm techniques and trainings than their male counterpart in the area. In some cases, due to many roles and responsibilities of women, they hardly participate in trainings in the area. Limited mechanization also impedes production capacity of women farmers more than men in the area. Women farmers use less mechanization and more manual labour working mostly by them and with household labour. The implication of these findings is that women engage in small-scale production due to limited mechanization and in case of any environmental disaster due to CVC they are more vulnerable. Consequently, in the face of CVC women becomes more vulnerable due to limited knowledge, trainings and mechanization.

Biophysical Characteristics-Related Vulnerability Problems

Data in Table 3 shows that biophysical characteristics related vulnerability problems of the entire sample, men and women headed households were increased flood prone areas ($\bar{x}=1.77$), shorter growing season ($\bar{x}=1.27$) and more uncertainty of planting time ($\bar{x}=1.51$).

Table 3: Biophysical characteristics-related vulnerability problems across gender

Variables	Pooled data		Men		Women		Gender differences X ² -value
	Mean	S.D	Mean	S.D	Mean	S.D	
Biophysical Characteristics							
Increased flood prone areas	1.77	0.44	1.77	0.45	1.76	0.43	2.65
More uncertainty about time of planting	1.51	0.78	1.57	0.70	1.55	0.86	5.73
Shorter growing season	1.27	0.90	1.39	0.83	1.15	0.96	7.59
Extinction of crops	0.87	0.80	0.80	0.75	0.85	0.76	3.04
Limited water bodies in study location	0.34	0.27	0.41	0.39	0.36	0.24	2.57

Source: Field Survey

Flood disaster has been identified as a major challenge in Southeast, Nigeria. For example, according to Onyeneke, Mmagu and Aligbe (2017), Oguta, located in Imo State in the rainforest region of Nigeria, are among the most flood prone areas. Recurrent floods due to overflow of the Oguta Lake create favorable conditions for crop cultivation and livestock keeping, but in the case of an extreme flood, it threatens the lives and livelihoods of the people (Onyeneke *et al.*, 2017). The areas are low lying and located close to River Niger and its tributaries, other rivers and water bodies, which makes them prone to floods. Furthermore, many parts of Anambra and Enugu States of Nigeria are ravaged by sheet and gully erosion (Okoli and Ifeakor, 2014). Some of the worst hit areas include the Agulu-Nanka axis, the area around Nkisi River, Amawbia and Ozubulu areas of Anambra State erosion (Okoli and Ifeakor, 2014). In the face of changing climate this floods become recurrent and affect residents in the area. In addition, limited rainfall resulting to shorter growing season and more uncertainty about time of planting makes them less able to survive climate problems in the area. These findings imply that some biophysical features and characteristics of the locations make respondents vulnerable to CVC impacts.

Institutional arrangement-related vulnerability problems

Data in Table 4 show that vulnerability conditions of the entire sample, men and women headed households, which related to institutional arrangements in the area were limited aids, limited

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political will-power and limited irrigation. It also shows that women headed household have more problems ($p < 0.05$) of limited aids and limited political will-power.

Table 4: Institutional arrangement-related vulnerability problems across gender

Variables	Pooled data		Men		Women		Gender differences X ² -value
	Mean	S.D	Mean	S.D	Mean	S.D	
Institutional arrangements							
Limited aids	1.60	0.66	1.33	0.77	1.87	0.37	59.12*
Limited political will power	1.15	0.91	1.19	0.86	1.51	0.82	64.48*
Limited irrigation capacity	0.97	0.89	0.91	0.73	0.82	0.82	5.55
Land tenure system	0.45	0.76	0.50	0.76	1.41	0.75	5.55
Limited land	0.39	0.22	0.39	0.28	0.39	0.26	14.35

* $P \leq 0.05$. Source: Field Survey; Cut-off point for mean score = 1.0; SD < 1.0 (showing similarity of responses to the mean)

This implies that for farmers to reduce their institutional vulnerability problems, policies and programs should be based on their felt needs and most needed aids. Policies and projects formulated to supply aids to farmers are planned with little inputs from respondents. During FGD, farmers in the area reported that “*decisions on cost of farm inputs, mechanization and price of output vary a lot and we do not have the needed power to determine the rate of these variations and most times, we produce with high cost and sell at low cost.*” These problems limit their profitability and they need more power to decide on prices of cost items in their production. Climate change has a direct impact on the productivity of physical production factors such as soil’s moisture and soil fertility and this affects farming outputs which in turn impacts negatively on food security (Okoli and Ifeakor, 2014). They indicated that when they manage to harvest their produce in the face of environmental and climatic challenges, they still bear much impact of losses due to limited market of their produce.

Gender differences in the result show that women have more vulnerability problems of limited aids and political will-power. These corroborate with Amusa, Okoye and Enete (2015) that female headed farm households had higher climate change vulnerability while male headed households had relatively lower vulnerability. Similarly, Ekpo and Agu (2014) suggested that increased women’s participation in decision-making at all levels and changes in socio-cultural practices is necessary to support women to fully realize their potential for enhanced response capacity to climate change impact. In addition, women have less power in decision-making, less leadership positions as well as limited political will power. Most of their farming activities are with the use of primitive technologies and their farm decisions guided or made by men because they have limited power. This corroborates report of Okafor and Akokuwebe (2015) that the various economic, political, social and systemic practices serve as obstacles to effective participation of women in politics, governance and decision making in Nigeria. Provision of aids for women including incentives like fertilizer and other inputs can help to boost their production. Odoemelam, Alamba and Lekan-Akomolata (2014) showed that differences in yield between male and female farmers, not because the female farmers are less skilled but because they are constrained by access to agricultural inputs and resources. Limited availability of aids for women limits their productivity and increase poverty. Consequently, these gender differences made women more vulnerable to climate vulnerability and change in the area.

Socio-Economic Determinants of Vulnerability to Impacts of CVC

Table 5 shows the socioeconomic determinants of vulnerability conditions of respondents other than gender. Based on data in Table 5 socioeconomic characteristics of respondents affects their vulnerability conditions such as limited availability of aids (P-level =0.000; Cox and Snell $R^2 = 0.53$; -2log likelihood ratio = 45.78); less ownership of assets; limited training and fragmented crop land. Results in Table 5 shows that age, formal education, household size, annual income, number of climate change trainings, size of land cultivated and ownership of land affects respondents' vulnerability conditions. Age of respondents affects their vulnerability problems of limited availability of aids ($p= 0.000$) and limited training ($p= 0.000$) at 1% level of probability. Results show that for a unit change in age, the log odds of limited availability of aids and limited training will increase by 3.051 and 3.097 respectively. Implication of this finding is that age is one of the socioeconomic determinants of availability of aids and trainings of respondents. Hence, age of respondents affects the amount of aids and trainings they receive.

Also, results show that for a unit change in education, the log odds of limited availability of aids and limited training decreased by -3.144 and -4.200 respectively. Educational levels of respondents affect the vulnerability problem of availability of aids and trainings. Education is necessary in dealing with impacts of CVC and reducing vulnerability. Level of education affects respondents' access to aids and trainings. In other words, limited availability of aids and limited training decreased with increase in education.

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Table 5: Socioeconomic determinants of vulnerability

Explanatory variables	Coefficient	Standard error	Wald	Exp (B)
Limited availability of aids				
Age	3.051	0.827	0.841	100.185*
Formal education	-3.144	0.381	20.151	110.957*
Household size	-0.66	1.311	0.044	1.064
Annual income	0.18	0.981	0.064	0.881
Number of climate change training	-1.128	0.066	34.41	128.01*
Size of land cultivated	-0.081	0.072	0.157	0.817
Ownership of land	0.148	3.122	0.397	0.558
Intercept	16.98	2.049	49.09	88.90*
-2log likelihood ratio	45.78			
Chi-square	67.90			
Cox and Snell R ²	0.53			
Less ownership of asset				
Age	0.088	0.596	0.751	1.775
Formal education	0.503	0.441	28.072	0.675
Household size	-1.909	1.264	40.065	188.823*
Annual income	-4.160	0.091	30.05	191.854*
Number of climate change trainings	0.328	0.064	0.041	0.901
Size of land cultivated	-1.188	0.076	38.99	140.31*
Ownership of land	-1.140	0.044	50.11	190.00*
Intercept	12.76	2.011	65.01	79.10*
-2log likelihood ratio	66.19			
Chi-square	71.60			
Cox and Snell R ²	0.61			
Limited training				
Age	3.097	0.023	42.01	198.01*
Formal education	-4.200	0.044	48.00	170.00*
Household size	0.316	1.010	0.090	0.060
Annual income	0.28	0.371	0.043	0.110
Number of climate change trainings	-4.173	0.022	76.11	153.01*
Size of land cultivated	0.143	0.066	0.269	0.188
Ownership of land	0.202	2.830	0.002	0.543
Intercept	19.04	2.311	23.05	80.00*
-2log likelihood ratio	55.09			
Chi-square	52.00			
Cox and Snell R ²	0.58			
Fragmented Crop land				
Age	0.910	0.372	0.261	1.288
Formal Education	0.009	0.444	0.101	91.011
Household size	0.303	1.202	0.055	1.500
Annual Income	-1.161	0.111	30.03	59.04*
Number of climate change trainings	0.154	0.155	0.404	0.011
Size of land cultivated	0.211	0.011	0.091	0.722
Ownership of land	-1.190	0.032	64.00	113.01*
Intercept	23.06	1.055	34.00	74.01*
-2log likelihood ratio	89.00			
Chi-square	96.00			
Cox and Snell R ²	0.61			

*P≤0.05. Source: Field survey. *indicates significant at 1% level of probability

Similarly, Amusa *et al.*, (2015) using education of household head as an indicator, reported that male-headed households were less vulnerable to effects of climate change relative to female headed households. Hence, education levels of respondents affect the amount of aids trainings

they received and consequently their vulnerability to CVC. The findings (in Table 5) imply that for a unit change in household size, the log odds of less ownership of assets decreased by -1.909. In other words less ownership of asset decreased with increase in household size. Household size of respondent affects their vulnerability problems of less ownership of asset ($p=-1.909$) at 1% level of probability. Hence, household members help to reduce vulnerability of farmers because of the labour and other resources that members of the household provide. Similarly, for a unit change in number of climate change trainings, the log odds of less ownership of assets and limited trainings (Table 5) decreased by -1.128 and -4.160 respectively. Number of climate change trainings also affect vulnerability conditions of respondent because it affects their availability of aids (Table 4.10; $p=0.000$) and trainings ($p=0.000$). Similarly, Amusa *et al.*, (2015) reported that male-headed households were less vulnerable and have more training to cope with climate change relative to female-headed households. Hence, more climate change trainings and information are needed to help reduce vulnerability to CVC in the area.

In addition, ownership of land and size of land cultivated affect vulnerability conditions of respondents including less ownership of asset ($p=0.000$) and fragmented cropland ($p=0.000$). For a unit change in ownership of land, the log odds of less ownership of assets and fragmented cropland decreased by -1.140 and -1.190 respectively. In addition, for a unit change in size of land cultivated, the log odds of less ownership of asset decreased by -1.180. In other words, less ownership of asset and fragmented cropland decreased with increase in size of land cultivated and ownership of land. Similarly, Amusa *et al.* (2015) found that determinants of vulnerability include farming income, years of formal education, farm size, land ownership and trainings. Similarly, Amusa *et al.*, (2015) reported that considering farm size, male-headed households have low vulnerability index compared to female-headed households. Therefore, ownership of land and size of land cultivated affect respondent's vulnerability problem of limited assets and fragmented cropland. Annual income affects respondents' vulnerability conditions by affecting their ownership of asset and fragmented croplands. Increase in income reduces vulnerability problems of less ownership of assets and fragmented cropland. This corroborates the findings of Amusa *et al.*, (2015) that increase in famers' income in Northcentral and Southwest Nigeria increased their coping capacity and access to more response technologies among the farmers. This implies that less ownership of asset and fragmented cropland decreased with increase in annual income. Hence, vulnerability conditions will decrease with increase in annual income.

Conclusion and Recommendation

This study concludes that vulnerability of respondents varies across gender especially in terms of respondents' information, technology, biophysical, institutional and user characteristics. Comparisons of vulnerability issues of men and women headed households show significant difference in the issues of limited availability of aids, asset, knowledge, trainings, cropping lands among others. Socio-economic determinants of vulnerability of respondents include age, education, household size, number of climate change trainings, size of land cultivated and ownership of land.

In order to reduce the vulnerability of men and women farmers this study recommends more support to improve information, technology, assets and knowledge of the farmers in line with their specific needs. Special support like improved dissemination of weather forecasts and improved information in local languages is needed to empower men and women farmers in order to reduce vulnerability in the area. In particular, women need more access to aids, cropland and trainings to boost their agricultural production and reduce their vulnerability. Any support from government,

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policy makers and donor agencies to compliment and improve the farmer's knowledge, existing technologies, crop improvements, financing, strengthening capacities of existing farming groups and encouraging livelihood and crop diversification will reduce their vulnerability.

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