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Research Article

Vulnerability in the Face of Climate Change is No Respecter of Gender or Geography: The Case of Food Crop Farmers in Southwestern Nigeria

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Abstract

Climate change presents a critical environmental challenge with far-reaching socio-economic and biophysical consequences. This study examines the vulnerability of food crop farmers in southwestern Nigeria to climate change, focusing on gender and geographical disparities. Employing a convergent mixed-method research design, data were collected from 360 food crop farmers across Oyo and Osun States using structured interviews and key informant discussions. Findings reveal that male and female farmers are susceptible to climate change effects such as erratic rainfall, increased pests, and declining soil fertility. However, female farmers exhibit higher vulnerability due to limited land access, financial constraints, and dependence on subsistence agriculture. Adaptation strategies vary across genders, with male farmers favouring crop rotation and irrigation, while female farmers emphasize fertilizer application and weather monitoring before planting. Statistical analysis indicates a significant difference in vulnerability between agroecological zones, with food crop farmers in certain regions experiencing higher climate-induced risks. The study concludes that female farmers remain disproportionately affected while both genders actively engage in farming and employ adaptation measures. It recommends targeted interventions such as improved climate adaptation training, enhanced access to credit, and gender-sensitive agricultural policies to mitigate the impact of climate change on food security and rural livelihoods.

Keywords: Climate change; Geography; Food Crop Farmers

Introduction

Climate change is a serious environmental threat of global importance. The United Nations Environmental Programme (UNEP) defined climate change as extreme reactions of the weather phenomenon that create negative impacts on agriculture, water resources, human health, depletion of the ozone layer, vegetation, and soil, and doubling of carbon dioxide in the ecosphere [3]. Climate change has the potential to affect all natural and human systems and may be a threat to human development and survival, socially, politically, and economically.

Impacts of climate change can be broadly divided into two groups which are biophysical impacts that is, physiological effects on the quantity and quality of crops, vegetation, forests, and livestock; changes in quantity and quality of land, soil, and water resources; increase in weed and pest challenges; shifts in the spatial and temporal distribution of impacts; rise in sea level, changes in ocean salinity; rising sea temperature causing harm to fish and other aquatic lives while the socio-economic impacts include reduction in yields and production; reduced marginal GDP from agriculture; world market prices fluctuations; changes in geographical distribution of trade regimes; more people being at risk of hunger and food insecurity; migration and civil unrest [4].

The human factors have been proven to be responsible for the ongoing unequivocal climate change or global warming (12). These activities have led to an increase in the concentration of some gases called greenhouse gases (GHGs) in the atmosphere. The greenhouse gases (GHGs) are carbon dioxide (CO_2), methane (CH_4), Nitrous oxide (N_2O), and Chloro Hydro Carbons (CHCs). These four greenhouse gases result in what is known as global warming (an increase in the temperature of the globe). The industrialized and emerging nations are said to be responsible for the increase in the concentration of GHGs [13]. Nigeria's climate is gradually changing and its effect is felt in agriculture, especially in food crop production. Nigeria's diverse climate has about nine distinct ecological zones which range from an arid north (with both lowlands and a plateau region) to a tropical south. The south receives an average of 3,000 mm of rainfall while the north receives 500 mm of rainfall in the northeast. This is more the reason the south is prone to flooding and erosion because climate change tends to increase rainfall and lead to drought in the north where climate change may decrease rainfall (Federal Ministry of Environment [7]. Studies in Nigeria have shown that there have been variations in rainfall and temperature patterns. Climate trends in Nigeria include the following events: An increase in temperatures of an average of 0.8°C between 1960 and 2006, with a steep increase since 1980; larger increases in the northern region. Significant variability of precipitation between years and climate zones as well as a decrease in predictability for seasonal rains is also a part of the trend. Conflicting information exists on annual precipitation across the country, but some analyses show a decrease of 3.5 mm per month per decade between 1960 and 2006.

Climate change is expected to affect food crop production either positively or negatively. The effect of climate change brings about the concept of adaptability. The effect of climate change brings about altering the conditions of agriculture, forestry, and fisheries production as well as rural livelihoods, climate variability, and long-term changes will likely have serious impacts on the four dimensions of food security [5]. These dimensions include Food availability: food availability will decrease in some regions due to a reduction in food production from agriculture, forestry, and fisheries caused by extreme events, changes in the suitability or availability of arable land, and water, and the unavailability or lack of access to weather forecast technologies, and crops, crop varieties, and animal breeds that can be productive in changing conditions. Food access: this will face further constraints in some regions because of climate change events that can damage infrastructure and lead to loss of livelihood assets as well as loss of income and employment opportunities. Food supply stability: this will be influenced by fluctuations in food prices and a greater reliance on food imports and aids in some regions. Food utilization: this will be affected indirectly by food safety hazards associated with pests and animal as well as human diseases [8].

The concept of vulnerability is multidimensional cutting across the social, political, economic, and institutional aspects of human life. [24], explained vulnerability (in disaster management) as a measure of the capability of a given set of elements to withstand events of a certain physical character. [2], defined vulnerability (global environmental change) as the state of susceptibility to harm from exposure to stresses associated with environmental and social change and the inability to adapt favourably. [4] refers to vulnerability (medical health) as the inability of a system to withstand the effects of a hostile environment. The IPCC defines vulnerability within the third assessment report [19] as 'the degree, to which a system is susceptible to, or unable to cope with the adverse effects of climate change, including climate variability and extremes. Vulnerability is dependent on the character, magnitude, and rate of climatic variation a system is exposed to, its sensitivity, and its capacity to adapt.' It is therefore defined as a characteristic of a system and as a function of exposure, sensitivity and adaptive capacity. [17] opined that the globalization phenomenon coupled with climate change worked hand in hand to increase farmers' exposure to new and unpredicted circumstances in Africa. Also, the interaction between climate change and globalization brought about considerable change to farmers' way of coping with climatic variability and the adaptation strategies used by them.

Statement of research problems

Nigerian food crop farmers are vulnerable to climate change and variability wherever they are located and regardless of their gender. Changes in climatic conditions and their adverse impact have

heightened food crop farmers' vulnerability. Moreover, the region lacks the necessary technologies to reduce climate change impacts whereas the survival of food crop farmers in the region hinged on their ability to reduce the impact of climate change. Also, in some locations, female food crop farmers are the most disadvantaged in terms of climate change and variability [6,11]. Both genders are involved in farming of all kinds in all locations of southwestern Nigeria despite their vulnerability. Since the observation of climate change, these farmers remain in production, which shows they can cope with the vagaries of climate. However, there is a paucity of information on the vulnerability of food crop farmers due to their farming location and their gender. This study therefore intends to examine the vulnerability of crop farmers to climate change by gender; highlight the effects of climate change on food crop farmers and assess the adaptation strategies of these farmers by gender. The study will also interrogate if there is a significant difference in the vulnerability to climate change between genders among these groups of farmers in southwestern Nigeria.

Methodology

A convergent mixed-method research design was employed for this study. A convergent parallel design is a method that enables a researcher to simultaneously carry out both the quantitative and qualitative elements of the research process in the same phase. The study was carried out in Southwestern Nigeria. Two States namely Oyo and Osun States were purposefully selected in southwestern Nigeria because the two states give a good representative of the 3 main agro-ecological zones found in the Southwestern States of Nigeria and due to the predominantly food crop farmers in the two states. The ecological zones are the rainforest, guinea savannah, and the derived savannah. Oyo State is located in the Southwestern Region of Nigeria. Latitude 8^{o} and Longitude 4^{o}east bisect the State into four nearly equal parts. The State is bounded in the South by Ogun State and in the North by Kwara State. To the West, it is bounded partly by Ogun State, and partly by Benin Republic while in the East, it is bounded by Osun State. Three vegetation regions are marked out in the State. These are Forest, Derived Savannah, and Savannah regions. The forest region has a much higher relative humidity and rainfall pattern that supports tree crop cultivation while the savannah region with low humidity and rainfall patterns supports mainly arable crops such as maize, cowpea, and sorghum. Osun state is made up of 30 local government councils and one area office. It lies between longitude $4^{0}$and 6^{0} Compare and relate east of the Greenwich Meridian, latitude 5^{0} and 8^{0} - north of the equator. This means that the state lies entirely in the tropics. The state is bounded in the West by Oyo State, in the North by Kwara State, in the East by Ondo State, and the South by Ogun State. This is shown in Figure 2. Agriculture is the traditional occupation of the people of Osun State. The tropical nature of the climate favours the growth of a variety of food and cash crops. The main cash crops include cocoa, palm produce, and kola, while food crops include yam, maize, cassava, millet, rice, and plantain. The vegetation consists of high forest and derived savannah towards the north. The climate is tropical with two distinct seasons.

A multi-stage sampling procedure was employed to select food crop farmers from the two states. The first stage was the selection of the two states, while the second stage involved the selection of two Agricultural Development Programme (ADP) zones from four in each state. The third stage involved the selection of three Local Government Areas (LGAs) from each of the selected zones. The fourth stage involved a proportionate selection of 30 communities from the selected LGAs. Six male and six female arable crop farmers were selected from each community making a total of 180 male food crop farmers and 180 female food crop farmers making a total of 360 food crop farmers from the two states. The snowballing technique was used to locate the respondents for the interview. The respondents interviewed were food crop farmers who have experienced the negative effects of climate change on their farmers. The interview schedule and key informant guide were used as instruments to collect data from the respondents. Two male and female farmers were interviewed as key informants from each of the zones making a total of 16 key informants.

Measurements of variables

The dependent variable for the study is the vulnerability of food crop farmers to climate change. Vulnerability implies that someone is inadequately protected and thus unable to resist failure and thereby susceptible to unpleasant situations. This study uses the three variables that determine the values of vulnerability, which

are climate exposure, sensitivity, and adaptive capacity. Vulnerability = sensitivity + exposure –adaptive capacity. This in turn, can be written as: V = (wS1 +wS2 +…+wSn +wE1 +wE2 +…+wEn) –(wA1 +wA2 +…+wAn) Where V is the vulnerability index, w is the weight obtained from the scores, A1 to An are the indicators for adaptive capacity, S1 to Sn are the indicators for climate change sensitivity, and E1 to En are the indicators for the climate exposure of the food crop farmers. Vulnerability score = Exposure score Sensitivity score – Adaptive capacity score. The vulnerability score gives the dependent variable score.

Results and Discussion

Age

The results of the finding in Fig. 1 show that the mean age of male farmers in Osun state was 46.85 ± 9.95 years, while that of female was 48.96 ± 9.96 years. The highest modal class for male was 50-59 years while for female it was 0-29 years. This shows that young female farmers are more than their male counterparts. The finding shows that adult female farmers were older than their male counterparts in Osun state. In Oyo State, the situation was different, the mean age of male farmers in Oyo state was 55.04 ± 15.50 years while that of female was 51.49 ± 17.65 years. Unlike what is observed in Osun state, the age of male farmers was higher than that of female farmers. The modal class in Oyo state farmers was 50 – 59 years for both male and female farmers. However, the study shows that farmers in Oyo State (both male and female FCFs) were older than those in Osun State. In Southwest (total), the modal class was 50-59 years for both male and female farmers. When the age of farmers in the Southwest was considered, it was found that male farmers were slightly older than the female farmers, 51.22 ± 13.31 years for male and 50.31 ± 13.89 years for female. The negative effects of climate change might be responsible for driving away young and vibrant females from farming. Also, it was observed that Oyo state has more non-farm business enterprises that could engage the females than in Osun state where farming seems to be the enterprise that saves people from poverty. This finding agrees with (1) that the active age of farmers is between 30 and 59 years which indicates that farmers within this age group still have high entrepreneurial intention to be engaged in food crop production.

Marital status

Results in Table 1 show that the majority (73%) of male and female (64%) in Osun state were married. The condition is the same in Oyo State where 96.9% of male and 81.3% of female were married. Only 19% of the male respondents were single in Osun state while 2.1% were single in Oyo state. In the Southwest, 86.1% of male crop farmers were married as against 73.0% for female. This implies that a large number of the food crop farmers in southwestern Nigeria are married. Therefore, they are adults with responsibilities. Also, there is a tendency to get labor from their family members. This finding is in support of that of [20] that most farmers were married and had financial commitment to their family members hence their reasons for working hard.

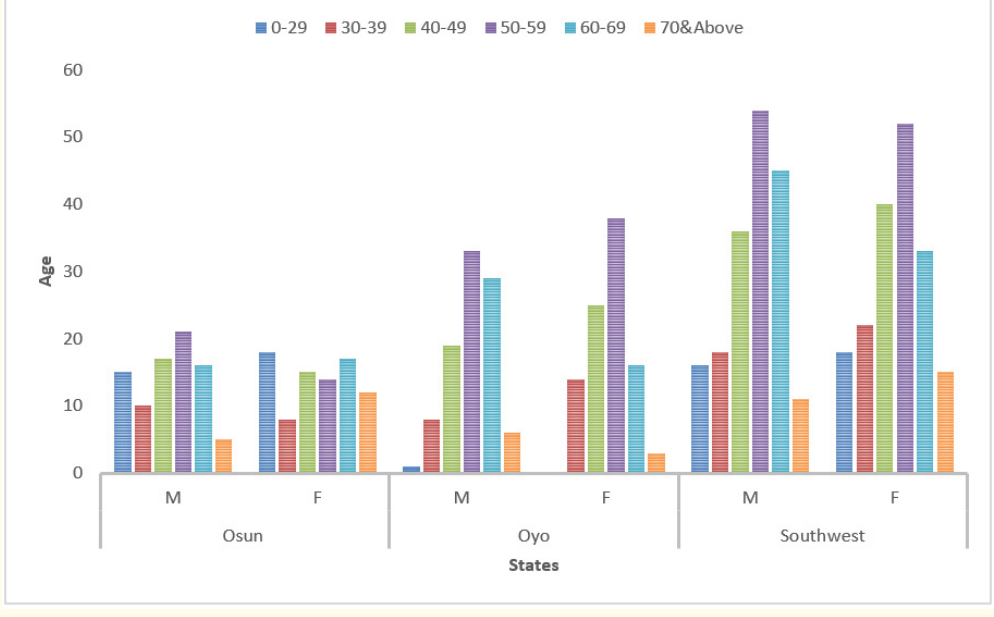

Figure 1- Source: Field study, 2023.

Household size

The results in Table 1 show the mean household size of male and female respondents in southwestern Nigeria. The mean household size of the male and female farmers is 13.05 ± 5.34 and 9.64 ± 3.03, in Oyo state while that of the male and female in Osun state is 6.31 ± 3.8 and 3.95 ± 1.86, respectively. The overall mean household size of the male farmers is 9.91 ± 5.76while that of the female is 6.96 ± 4.20. Furthermore, in Oyo state, the overall mean household size is 11.34 ± 4.65 while that of Osun state is 5.1 ± 3.63. The overall mean household size in Southwestern Nigeria is 8.43 ± 5.25. This indicates that the household size of respondents in Oyo state is higher than that of Osun state. In addition, the household size of male FCFs is higher than that of their female counterpart in southwestern, Nigeria. Many of the respondents have large household sizes which will assist them in getting free or cheap sources of labour for their farming activities. Also, having more mouths to feed will propel the farmers to work harder to protect their source of livelihood as well as make provision for their family members by adapting to climate change. This corroborates the finding of [8] that the average household size of rural dwellers is 9 in Ondo state, a state in Southwestern Nigeria.

Educational status

Results in Table 1 show the educational status of respondents in the study area. Of the male respondents, 21.1 percent have no formal education, 23.3 percent have primary education, 35 percent have secondary education, and the remaining 20.6 percent have tertiary education. Among the female, 32.8 percent have no formal education, 20 percent have primary education, 30.6 percent have secondary education, and the remaining 16.7 percent have tertiary education. About 68 percent and 78.6 percent have formal education in Oyo and Osun states respectively. This shows that a larger percentage of food crop farmers in Oyo and Osun states are educated though at different levels and male farmers are more educated than their female counterparts. In total, that is southwestern Nigeria, 26.9 percent have no formal education, 21.4 percent have primary education and 32.8 percent have secondary education, while the remaining 18.9 percent have tertiary education. The implication of this may be that the educational status of food crop farmers will enhance their knowledge of climate change as well as make well-informed decisions towards adaptation strategies. This is supported by the work of [1] that the majority of farmers are literate and they make well-informed decisions on issues affecting them.

Years of formal education

Results in Table 1 show the years of formal education of respondents in the study area. About 38 percent and 32.8 percent spent 0-5 years of formal education, 21.6 percent and 17.2 percent had 6-10 years of formal education, 38.9 percent and 38.3 percent had11-15 years of formal education while 18.3 percent and 11.0 percent had 16 years and above of formal education among male and female respondents respectively. In total, 27 percent had 0-5 years of formal education, 32.2 percent had 6-10 years of formal education, 27.2 percent had 11-15 years of formal education and 13.61 percent had 16 years and above. This shows that the more the years spent in acquiring formal education, the more exposed and knowledgeable about happenings in one's environment. Also, the way an educated person will perform any occupational activities in terms of goal and result attainment will differ from that of a person without formal education. The mean year of formal education of male and female farmers in Osun state is 9.61 ± 6.22 and 8.05 ± 6.49. This is in corroboration with the findings of [1,20] which affirmed that a farmer's level of acquired knowledge through formal education is a function of the ability to make profitable decisions, especially in terms of investment and adaptation to risk management to reduce production losses.

Religion

Results in Figure 2 show the religious affiliation of the male and female respondents in southwestern Nigeria. In Oyo state, 43.8 percent male and 53.1 percent female were Christians, 52.1 and 42.7 percent were Muslims, 4.2 and 3.1 percent were traditional worshipers while 0 and 1 percent practiced other religions apart from the three popular religions. Also, among the male and female respondents in Osun state, 41.7 and 41.7 percent were Christians, 51.2 and 42.9 percent were Muslims while the remaining 7.1 and

Table 1: Distribution of Respondents by some selected socio-economic characteristics.

Variable	Osun state		Oyo state		Southwest	
	M	F	M	F	M	F
Marital status						
Single	16(19)	2(2.4)	2(2.1)	1(1.0)	18(10)	16(8.9)
Married	62(73.8)	54(64.3)	93(96.9)	78(81.3)	155(86.1)	132(73)
Divorced	1(1.2)	3(3.1)	---	---	---	4(2.2)
Separated	2(2.4)	2(2.4)	3(3.1)	2(1.1)	5(2.8)	4(2.2)
Widowed	4(4.8)	12(14.30	1(1)	11(11.5)	5(2.8)	23(12.8)
Household size						
0-5	6(6.3)	30(31.3)	35(41.7)	57(67.9)	41(22.8)	87(48.3)
6-10	30(31.3)	18(18.8)	37(44)	25(29.8)	67(37.2)	43(23.8)
11-15	25(26)	36(37.5)	11(11.5)	2(2.4)	36(20)	38(21.1)
16-20	27(28.1)	12(12.5)	1(1.2)		28(15.5)	12(6.7)
20and above	8(8.3)					8(4.4)
Mean	13.05	9.64	6.31	3.95	9.91	6.96
SD	**±5.34**	**±3.03**	**±3.8**	**±1.86**	**±5.76**	**±4.2**
Educational Status						
No formal	30(31.3)	31(32.3)	8(9.5)	28(33.3)	38(21.1)	59(32.8)
Primary	25(26)	19(19.8)	17(20.2)	17(20.2)	42(23.3)	36(20)
Secondary	27(28.1)	25(26)	36(42.9)	30(35.7)	63(35)	55(30.6)
Tertiary	14(14.6)	21(21.9)	23(27.4)	9(10.7)	37(20.6)	30(16.7)
Years of formal education						
0-5	28(29.2)	30(31.2)	10(11.9)	29(34.5)	38(21.1)	59(32.7)
6-10	26(73.8)	18(18.8)	13(15.5)	13(15.5)	39(21.6)	31(32.3)
11-15	31(32.3)	36(37.5)	39(46.4)	33(39.3)	70(38.9)	69(38.3)
16 plus	11(11.4)	12(12.5)	22(26.2)	9(10.7)	33(3.1)	21(11.7)
Mean	7.86	8.22	11.61	7.86	9.61	8.05
SD	**±6.20**	**±6.52**	**±5.61**	**±6.49**	**±6.22**	**±6.49**

15.5 percent were traditional worshipers. In southwestern Nigeria, 42.8 and 47.8 percent were Christians, 51.7 and 42.8 percent were Muslims, 5.6 and 8.9 percent were Traditional worshipers and 0 and 0.6 percent practiced other religions among the male and female respondents respectively. This implies that the two well-practiced religions in southwestern Nigeria are Christianity and Islam among the male and female respondents and that traditional religion is more practiced in Osun than in Oyo state and more among female than male. In addition, religions with their various beliefs have a way of influencing the perception of farmers towards adopting innovation or technologies including adaptation strategies to climate change. This affirms the findings of [21], that religious beliefs influence people's beliefs about different aspects of life and whether they will accept certain technologies or not.

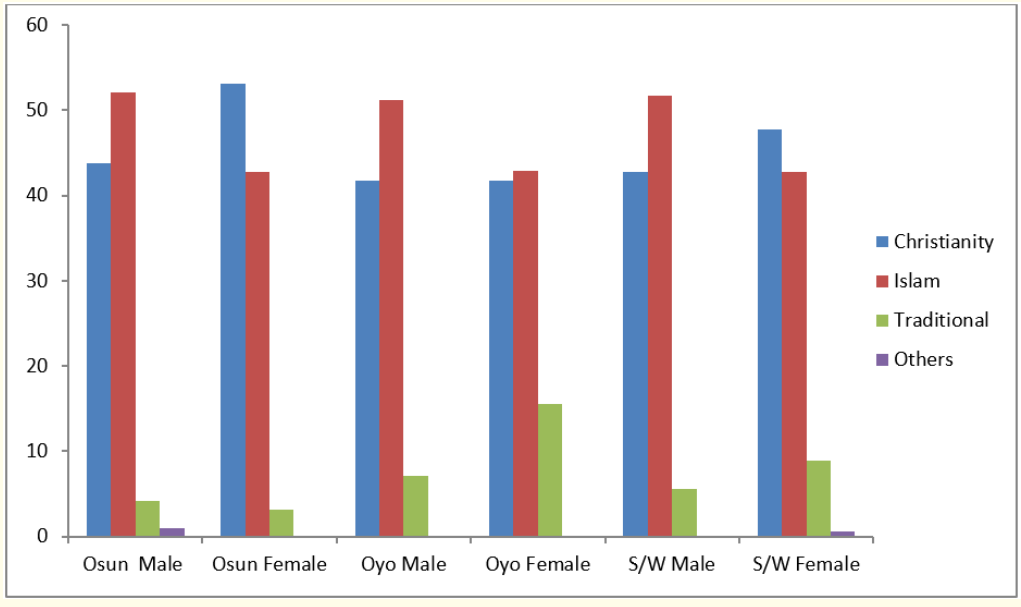

Figure 2: Distribution of Respondents based on Religious Affiliations.

Types of farming practiced

Results in Figure 3 show that the majority (77.8%) of the respondents and 55 percent practiced both subsistence and commercial types of farming, 8.3 percent and 30.6 percent practiced subsistence type of farming while the remaining 13.9 percent and 14.4 percent practiced commercial type of farming for male and female respondents, respectively. In total, 66.4 percent practiced both subsistence and commercial farming, 19.4 percent practiced subsistence type of farming while the remaining 14.2 percent practiced commercial type of farming. A large number of the male farmers practiced both commercial and subsistence and few of them practiced subsistence farming while more female farmers practiced subsistence type of farming. This may be as a result of inadequate or non-availability of farmland for food cropping activities. This shows that most of the farmers practiced both types of farming while the number of people practicing subsistence agriculture is relatively low, especially among the male farmers in the study area.

Cosmopoliteness

Results in Figure 4 show that all the respondents (100%) in southwestern Nigeria have had contact with other people apart from those in their vicinity. In Oyo state, 11.5 and 11.5 percent of male and female respectively have visited other farms in their village, 33.3 and 35.4 percent have visited other villages in their local government area, 34.4 and 35.4 percent have visited villages from other local government areas, and 20.8 and 13.5 percent have visited other states while none and 4.2 have traveled out of the country for male and female respondents respectively. In Osun state, none of the male and 2.4 percent of the female have visited other farms in their village, 6 and 19 percent have visited other villages in their local government area, 32.1 and 34.5 percent have visited villages from other local government areas, and 61.9 percent male and 44 percent female have visited other states, respectively while none of them have traveled out of the country. In total, 6.1 and 7.2 percent male and female have visited other farms in their villages, 20.6 and 27.8 percent have visited other villages in their local government area, 33.3 and 35 percent male and female have visited villages from other local government areas, 40 and 27.8 percent have visited other states for male and female respondents respectively while just a few of them (2.2%) of the female have traveled out of the country. This implies that there was a high level of external orientation among both the male and female FCFs in the study area and they have been exposed to ideas of people from other places. Also, the males were more traveled than the female but not internationally because the female farmers that have traveled internationally may have done so to assist and care for their children who newly gave birth to child/children. This conforms to the work of [22]. This exposure is a good indication of the positive influence on their knowledge of FC farming, climate change, and its adaptation strategies.

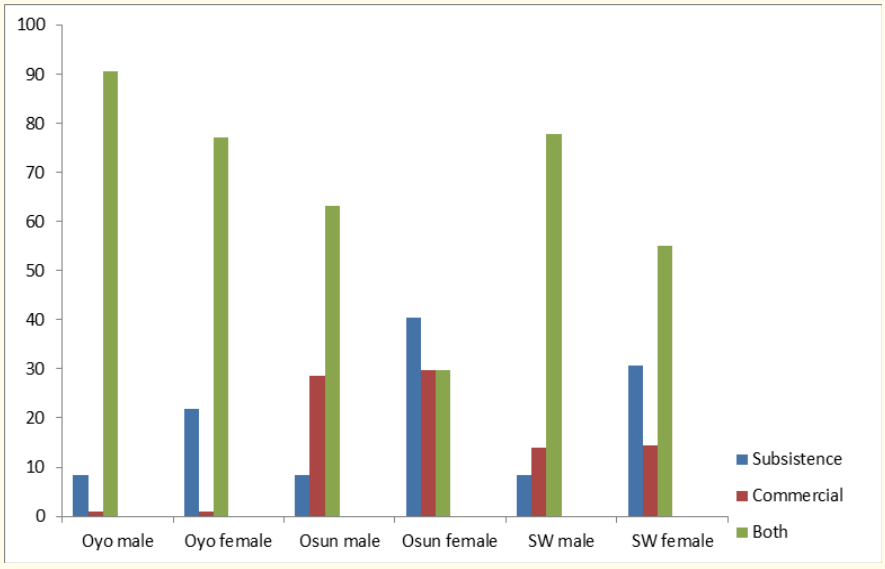

Figure 3: Bar chart showing type of farming activities of food crop farmers in Southwestern Nigeria.
Source: Field study, 2023.

Vulnerability of food crop farmers to climate change

Results in Table 2 show that the calculated mean score of vulnerability of male food crop farmers in southwestern Nigeria was 29.32 ± 11.54 while that of female food crop farmers was 28.16 ± 13.73. This implies that the calculated mean score of the vulnerability of male farmers is higher than that of their counterparts in southwestern Nigeria. This simply means that female food crop farmers are more vulnerable than male farmers in southwestern Nigeria which may be a result of the male farmers cultivating a large expanse of land and the more land cultivated, the less the negative effect of climate change on the economy of such farmers. If one crop fails, another one will survive. But for female farmers who cultivate little expanse of land, may experience more negative effects on their economy.

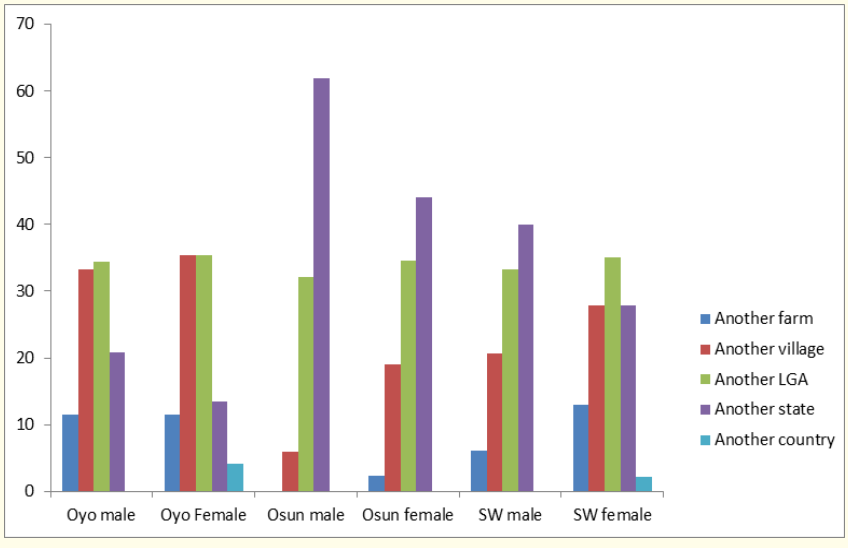

Figure 4: Bar chart showing Cosmopoliteness of male and female FCFs in S/W Nigeria.
Source: Field study 2023.

Also, as discussed earlier, more female farmers are into subsistence agriculture compared to male farmers who are more into commercial farming and a combination of both subsistence and commercial farming. The impact of climate change is felt more by female farmers than by male farmers in southwestern Nigeria because the male farmers cultivate large expanses of land and are endowed with more resources to tackle the negative impact of climate change. Interpretation of vulnerability in this section hinged on the aforementioned approach whereby the higher the value, the lesser the vulnerability, while the lesser the value, the higher the vulnerability [12,13].

Figure 5 further explains the percentage vulnerability of food crop farmers in southwestern Nigeria. The figure shows that 49.31% of male in Oyo state were vulnerable to climate change while 50.69% of female were vulnerable to climate change. More than half (51.37%) male farmers in Osun state were vulnerable to climate change while 48.63% of female farmers were vulnerable to climate change. In southwestern Nigeria, 51% of the male farmers were vulnerable to climate change while 49% of female were vulnerable to climate change. This is in line with the study conducted by [3,23] that female farmers and female household heads were more vulnerable to the impacts of climate change. Also, [16] reported that socially constructed gender roles and their attendant responsibilities had resulted in differences in the perception and experiences of male and female farmers with regard to the effects of climate change and varied adaptation strategies.

Respondents	Exposure	Sensitivity	Impact	Adaptive capacity	Vulnerability
Oyo Male	21.25	34.7	55.95	19.43 ± 7.88	36.52 ± 8.74
Oyo Female	22.08	33.83	55.91	18.38 ± 7.70	37.53 ± 10.54
Osun Male	18.46	19.05	37.51	16.36 ± 5.10	21.15 ± 6.55
Osun Female	17.39	20.06	37.45	20.08 ± 4.57	17.37 ± 7.78
SW Male	19.45	27.86	47.31	17.99 ± 6.88	29.32 ± 11.54
SW Female	19.89	27.41	47.3	19.14 ± 6.52	28.16 ± 13.73
Grand Mean					28.36
S.D					8.04

Table 2: The total score of exposure, sensitivity, adaptive capacity, and vulnerability of food crop farmers in SW Nigeria based on gender.

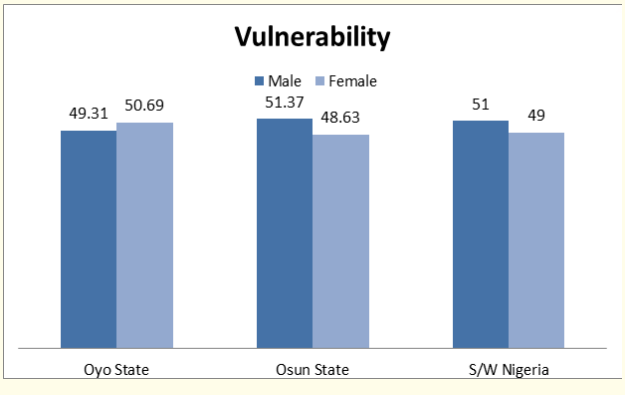

Figure 5: Bar Chart showing the percentage vulnerability of male and female food crop farmers in southwestern Nigeria. Field Study, 2023.

Source: Field study, 2023.

Perceived effects of climate change on food crop farmers and their productivity in Southwestern Nigeria

Results in Table 3 revealed that certain perceived effects of climate change were peculiar to male farmers which include: planting disease resistant variety of crops ($\bar{x}$ = 3.21,σ = 1.05), addition of other occupation to food crop farming ($\bar{x}$ = 3.05,σ = 1.03), change in production system ($\bar{x}$ = 2.99,σ = 1.05), premature ripening of fruits ($\bar{x}$ = 2.77,σ = 1.05), increase in infestation of pests and diseases ($\bar{x}$ = 2.57, σ = 1.00), diversification to livestock farming ($\bar{x}$ = 2.50 σ = 1.17) and poor access to farm roads as a result of flooding ($\bar{x}$ = 2.46 σ = 1.06). For female FCFs, the perceived effects of climate change include indiscriminate use of manure and fertilizer to boost soil fertility ($\bar{x}$ = 3.13, σ = 1.03), studying of weather conditions before planting ($\bar{x}$ = 3.09,σ = 1.0), foreign crops thriving in new places ($\bar{x}$ = 3.05,σ = 0.96), addition of other occupation to food crop farming ($\bar{x}$ = 2.77,σ = 0.95) and planting of disease resistant variety of crops ($\bar{x}$ = 2.76,σ = 1.07).

The least perceived effects for female farmers were as follows: an early manifestation of different weeds, an increase in loss of biodiversity, and an increase in crop yield with the weighted mean scores of 1.79 ± 0.89, 1.78 ± 0.82, and 1.60 ± 0.84. These findings imply that there are clear differences in the perceived effects of climate change on farmers on a gender basis in Southwestern Nigeria. This means that the perception of male and female in the region differs considerably.

This finding is in support of that of [18] which states that some direct impacts of climate change on the crop production system include altered growing seasons, availability of soil water for plant use, change in planting and harvesting calendars, as well as increased pest, weed, and disease populations. Also, [3] opined that some of the changes brought about by climate change are expected to be spontaneous while others are expected to involve gradual changes in temperature, patterns of rainfall, distributions of species distributions, and vegetation cover. Consequentially, climate change and its variations have both positive and negative impacts on arable crop production. This means that climate change has both harmful and beneficial effects on food crop farmers, it is not bad or negative.

Effects of Climate change	Mean SD	Rank	Mean SD	Rank
	M	σ	F	σ
Planting of disease resistant crop variety	3.21 ± 1.05	1st	2.76 ± 1.07	6th
Addition of other occupation to crop farming	3.05 ± 1.03	2nd	2.77 ± 0.95	5th
Change in production system	2.99 ± 1.05	3rd	2.07 ± 0.95	13th
Premature ripening of fruits	2.77 ± 1.05	4th	2.54 ± 1.09	7th
Increase in infestation of pests and diseases	2.57 ± 1.00	5th	2.21 ± 1.08	9th
Diversification to livestock farming	2.50 ± 1.17	6th	2.09 ± 0.88	12th
Poor access to farm roads as a result of flooding	2.46 ± 1.06	7th	2.17 ± 1.11	10th
Use of manure and fertilizer to boost soil fertility	2.24 ± 1.16	8th	3.13 ± 1.03	1st
Increase in loss of biodiversity	2.20 ± 1.04	9th	1.67 ± 0.81	17th
Crops no longer able to resist pests and diseases	2.16 ± 1.09	10th	2.52 ± 1.05	8th
I now study weather condition before planting	2.11 ± 1.04	11th	3.09 ± 1.00	2nd
Lower yield	2.06 ± 1.14	12th	2.04 ± 1.13	14th
High rate of weed growth	2.02 ± 0.94	13th	2.98 ± 0.99	4th
Foreign crops thriving in new places	1.83 ± 0.92	14th	3.05 ± 0.96	3rd
Early manifestation of different weeds	1.82 ± 1.02	15th	1.79 ± 0.82	16th
The prolonged dry season leading to drought	1.79 ± 0.96	16th	2.17 ± 1.15	10th
Crops no longer able to resist pests and diseases	1.78 ± 0.96	17th	1.94 ± 0.84	15th
Losses of crops	1.78 ± 1.01	17th	1.78 ± 0.76	18th
Climate change led to an increase in yield	1.76 ± 0.97	19th	1.60 ± 0.81	19th
Others (specify)	0.33 ± 0.47	20th	0.67 ± 0.47	20th
Grand Mean	2.43		2.37	
Standard deviation (σ)	0.22		0.47	

Table 3: Order of statement showing the perceived effects of climate change in Southwestern Nigeria on gender basis.

Adaptation strategies used by food crop farmers to cope with the negative impacts of climate change in Southwestern Nigeria

Results in Table 4 reveal the ranking order of different adaptation strategies used by male and female farmers in Southwestern Nigeria. From the results, it was revealed that the use of different planting dates and crop rotation ranked first and second for male and female farmers with weighted mean scores of (3.14 ± 0.96 and 3.18 ± 0.80) and (2.92 ± 1.16 and 2.69 ± 1.25) respectively. Ploughing or ridging across the slope ranked 3rd with a weighted mean score of 2.83 ± 1.17 for male farmers while this ranked 4th for female farmers with a weighted mean score of 2.62 ± 1.20. This is closely followed by multiple cropping with a weighted mean score of 2.61 ± 1.35 for male farmers while it ranked 3rd for female farmers with a weighted mean score of 2.66 ± 1.31.

Other adaptation strategies used by male farmers in Southwestern Nigeria are as follows: cultivation of early maturing crop varieties, cover cropping, cultivation of drought-resistant crop varieties, and cultivation of trees as windbreakers with the weighted mean scores of 2.50 ± 1.38, 2.47 ± 1.45; 2.21 ± 1.44, and 1.88 ± 1.55, respectively. The least adaptation strategies for male farmers are irrigation and farm crop insurance with the weighted mean of 2.59 ± 1.37 and 1.08 ± 0.38 respectively. The least adaptation strategies are farm crop insurance and irrigation with the weighted mean score of 1.13 ± 1.47 and 0.94 ± 1.40 respectively.

This result implies that some of the adaptation strategies used by male and female farmers in Southwestern Nigeria are similar while others differ with some ranking high for one gender and low for the other as the case may be. This is supported by the findings of [3] that there are similarities in the effect of climate change but differences in adaptation strategies used by male and female arable crop farmers in Enugu state, Nigeria. The adaptation strategies used by male arable crop farmers in Enugu (Southeastern part of Nigeria) include rainwater storage, terracing, planting of trees, and planting of cover crops, among others.

Adaptation Strategies	Mean SD	Rank	Mean SD	Rank
	M		F	
Use of different planting dates	3.14 ± 0.96	1st	3.14 ± 0.80	1st
Crop rotation	2.92 ± 1.16	2nd	2.69 ± 1.25	2nd
Plough/ridge across the slope	2.83 ± 1.17	3rd	2.62 ± 1.20	4th
Multiple cropping	2.61 ± 1.35	4th	2.66 ± 1.31	3rd
Shift cultivation	2.59 ± 1.37	5th	2.39 ± 1.41	6th
Mulching	2.53 ± 1.68	6th	2.27 ± 1.71	7th
Cultivation of early maturing varieties	2.50 ± 1.38	7th	2.23 ± 1.37	8th
Cover cropping	2.47 ± 1.45	8th	2.51 ± 1.37	5th
Cultivation of drought resistant varieties	2.21 ± 1.44	9th	1.99 ± 1.42	9th
Cultivation of trees as tree breaker	1.88 ± 1.55	10th	1.87 ± 1.47	10th
Irrigation	1.28 ± 1.72	11th	0.94 ± 1.40	12th
Farm crop insurance	1.08 ± 1.54	12th	1.13 ± 1.47	11th
Others (specify)	0.18 ± 0.38	13th	0.09 ± 0.29	13th
Grand mean =	2.17		2.04	
Standard Deviation =	0.85		0.85	

Table 4: Order of the adaptation strategies used by FCFs in Southwestern Nigeria on a gender basis.

Results in Figure 6 reveal the adaptation strategies used by FCFs in southwestern Nigeria as indicated by qualitative methods. Data collected through qualitative means were analysed with Atlas Ti. Adaptation strategies used by male FCFs in the study area include the use of indigenous methods of removing pests and diseases such as soaking neem leaves in detergent solution indicated in quotation 7:5 and crop switching and studying weather patterns before planting indicated in quotation 7:4 while the female participants stated use of a tractor for ploughing for ease of land clearing indicated with the quotation 28:3 and use of a tractor for ploughing due to inability to get manual labourer on the farm indicated with quotation 26:4. Adaptation strategy common to both male and female FCFs include application of fertilizer, agrochemicals and use of irrigation buttressed by wetting of crops when sun is too much indicated by the quotation 28:4, carrying out of irrigation indicated by the quotation 27:5 and going the extra mile to irrigate crops indicated by the quotation 8:11.

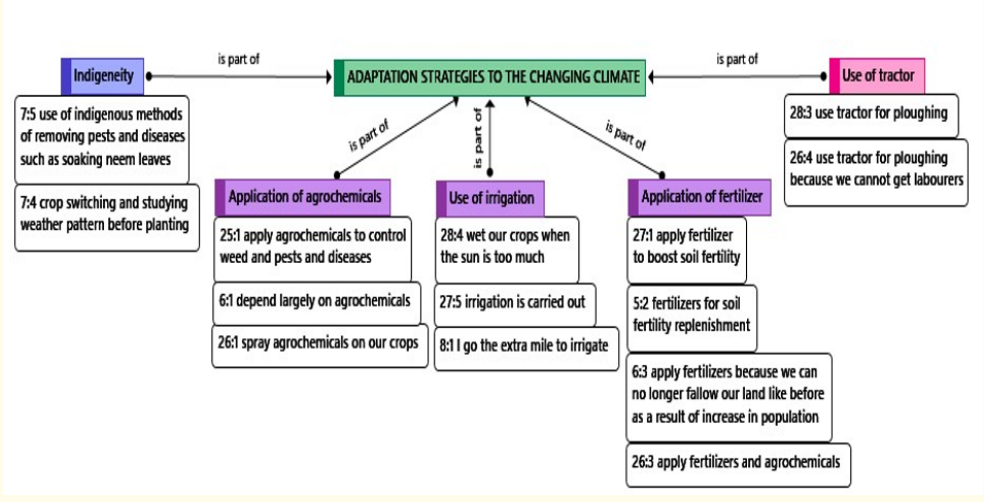

Figure 6: ATLAS.ti Network showing the adaptation strategies of FCFs in southwestern Nigeria.
Source: Field survey, 2023.
Keys
Blue: Adaptation strategies used by male farmers
Purple: Adaptation strategies used by male and female farmers
Pink: Adaptation strategies used by female farmers
White: Different forms of adaptation strategies.

The summary of the vulnerability across geography (Agroecological zones) and gender

Results in Table 5 show the matrix of the variables represented in a rotation of the four selected Agroecological zones (Ogbomoso, Saki, Iwo, and Osogbo) by gender (Male and Female Food Crop Farmers). The results show that there was no significant difference in the vulnerability of Male and Female FCFs in the Ogbomoso zone. Also, there was no significant difference in the vulnerability of Female FCFs in the Iwo zone and Male and Female FCFs in the Osogbo zone. Likewise, there was no significant difference in the vulnerability of Male FCFs in the Osogbo zone and Male FCFs in the Iwo zone and Female FCFs in the Osogbo zone as well as between Female FCFs in Osogbo zone and Male FCFs in both the Iwo and Osogbo zone.

In the Saki zone, there was a significant difference in the vulnerability of Male and Female FCFs, there was also a significant difference in vulnerability between Male and Female FCFs in the Saki zone and those in the Iwo and Ogbomoso zones. In addition, the table also revealed that there was a significant difference in vulnerability between Male FCFs in the Iwo zone and Male and Female FCFs in the Osogbo zone. There was also a significant difference in vulnerability between Male and Female FCFs in Ogbomoso zone and those in the Osogbo zone.

	Oyo State				Osun State			
	Mog	**Fog**	**Msa**	**Fsa**	**Miwo**	**Fiwo**	**Mos**	**Fos**
Mog	-	NS	S	S	S	S	S	S
Fog	NS	-	S	S	S	S	S	S
Msa	S	S	-	S	S	S	S	S
Fsa	S	S	S	-	S	S	S	S
Miwo	S	S	S	S	-	S	S	S
Fiwo	S	S	S	S	S	-	NS	NS
Mos	S	S	S	S	S	NS	-	NS
Fos	S	S	S	S	S	NS	NS	-

Table 5: Rotation Matrix of Vulnerability across geography (Agro-ecological zones) and gender.

Key:

Mog – Male FCFs in Ogbomoso Zone

Fog – Female FCFs in Ogbomoso Zone

Msa – Male FCFs in Saki Zone

Fsa – Female FCFs in Saki Zone

Miwo – Male FCFs in Iwo Zone

Fiwo – Female FCFs in Iwo Zone

Mos – Male FCFs in Osogbo Zone

Fos – Female FCFs in Osogbo Zone

S – Significant

NS – Not significant

Conclusion

The study concluded that vulnerability has no respect for gender, though farmers' response to climate change in terms of adaptive capacity is germane to less vulnerability; however, the impact of climate change is more on female food crop farmers than their male gender. The perceived effects of climate change on male food crop farmers show an alteration in planting and harvesting periods and that there are increased pests and weeds. Also, new weeds and pests are appearing. In the case of the female gender, they agreed that they use fertilizer to boost their food crop farming, and they also study the weather before they start to plant. Adaptation strategies of both genders are similar. Both genders use different planting dates and practice crop rotation among others. The study also showed that vulnerability affects both genders in all locations.

Recommendation

The study recommends targeted training interventions for all food crop farmers on improved climate adaptation strategies, access to credit to combat the effects of climate change, and gender-sensitive agricultural policies to reduce the impact of climate change on food security and rural livelihoods.

Bibliography

1. Adejumo L A. "Analysis of Research-Extension Input Linkage System for Sustainable Soil Management in Oyo State". An unpublished Ph.D. thesis submitted to the Department of Agricultural Extension and Rural Development, Faculty of Agriculture, Obafemi Awolowo University, Ile-Ife, Nigeria (2021).

2. Adger W. "Vulnerability". *Global Environmental Change* 16 (2006): 268-281.

3. Anugwa I Q., *et al*. "Gender differences in perceived vulnerability and adaptation strategies to climate change effects on arable crop farmers in Enugu State, Nigeria" (2021).

4. Ciurean Roxana L., *et al*. "Conceptual frameworks of vulnerability assessments for natural disasters reduction". Approaches to disaster management- examining the implications of hazards, emergencies and disasters (2013).

5. Ezra J. "Creating Climate Change Awareness on the Nigerian Citizens: Challenges for Social Studies Curriculum Planners and Implementers". (2010).

6. FAO. "Food and Agriculture Organization of the United Nation Publication. "Climate Smart Agriculture" Source book (2013).

7. FAO. "Climate change and food security: risk and responses". Food and Agriculture Organization of the United Nations. Italy, Rome. www.fao.org/publications (2016): 1-98.

8. Fayehun TM. "Effect of Community and Social Development Projects on the Livelihood of Rural Dwellers in Ondo state, Nigeria". Unpublished M.Sc. Thesis submitted to the department of Agricultural Extension and Rural Sociology, Obafemi Awolowo University, Ile – Ife, Nigeria (2021).

9. Federal Ministry of Environment. "United Nations Climate Change Nigeria". National Communication (NC). NC 2 (2014).

10. Food and Agriculture Organization of the United Nations. "The state of food and agriculture: women in agriculture closing the gender gap for developing". Rome (2011): 160.

11. Gutierrez-Montes I., *et al*. "Contributing to the construction of a framework for improved gender integration into climate-smart agriculture projects monitoring and evaluation: MAP-Norway experience". *Climate Change* (2018): 1-14.

12. Hinkel J. "Indicators of vulnerability and adaptive capacity: towards a clarification of the science policy interface". *Global Environmental Change* 21 (2011): 198-208.

13. Hinkel J., *et al*. "Review of methodologies for assessing vulnerability: Report submitted to GIZ in the context of the project". Climate Change Adaptation in Rural Areas of India composed byJochen Hinkel, Global Climate Forum (GCF); Lisa Schipper, Stockholm Environment Institute (SEI); and Sarah Wolf, GCF (2014).

14. IPCC (Intergovernmental Panel on Climate Change). "Climate change 2007: impacts, adaptation and vulnerability". Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden and C. E. Hanson (eds). Cambridge University Press, Cambridge, UK (2007): 976.

15. Ladan S I. "An appraisal of Climate Change and Agriculture in Nigeria". *Journal of Geography and Regional Planning* 7.9 (2014): 176-184.

16. Lambrou Y and Nelson S. "Farmers in a changing climate: does gender matter?" Food security in Andhra Pradesh, India. Food and Agricultural Organization (FAO) (2010).

17. Leichenko and O'Brien. "Environmental Change and Globalization: Double Exposures". Oxford University Press, New York, USA (2008).

18. Mark WR., *et al*. "Climate change and agriculture: threats and opportunities". Federal Ministry for Economic Cooperation and Development, Germany (2008).

19. McCarthy JJ., *et al*. " "Impacts, Adaptation, and Vulnerability". Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK (2001).

20. Ogunmefun SO and Achike AI. "Socioeconomic characteristics of rural farmers and problems associated with the use of informal insurance measures in Odogbolu Local Government Area of Ogun State, Nigeria". *Russian Journal of Agricultural and Socio-Economic Sciences* 38.2 (2014): 3-14.

21. Olaolu MO., *et al*. "Impact of national fadama development project phase (II) on poverty and food security among rice farming beneficiaries in Kogi State, Nigeria". *American Journal of Research Communication* 1.10 (2013): 280-295.

22. Olowoyo OA. "Gender Analysis of Land Use Intensity and Degradation among Arable crop Farmers in Southwest, Nigeria". An unpublished Ph.D. Thesis submitted to the department of Agricultural Extension and Rural Development, Faculty of Agriculture, Obefemi Awolowo University, Ile-Ife, Nigeria (2021).

23. Suhiyini IA., *et al*. "The 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* 11.2 (2019): 195-214.

24. Weichselgartner J and Bertens J. "Natural disaster reduction in Europe: a Don Quixotic project in the face of a changing world". *WIT Transactions on Modelling and Simulation* 81 (2002).