NIGERIAN AGRICULTURAL JOURNAL
ISSN: 0300-368X
Volume 53 Number 1, April 2022 Pg. 396-405
Available online at: http://www.ajol.info/index.php/naj
https://www.naj.asn.org.ng

Climate Variability and Causes among Rural Farmers in Southwest Nigeria: A Gender Situation Analyses

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Abstract
In most parts of developing world, women and girls bear the burden of climate variability, thus the need for gender disaggregated study on climate change perspectives for policy and decision making. This study examined gender perspectives on climate change awareness, causes and perspectives on climate change variables in Ekiti and Ogun States. With individual interview and Focus Group Discussions, data were collected from 358 male and 222 female farmers using a multi-stage sampling procedure. Descriptive statistics, Chi square, Pearson's Product Moment Correlation, and the t-test were used to analyze the data. Findings indicate that 29.6% of male and 41.9% of female were between the age of 41 and 50years. In addition, 13.5% male and 24.2% female farmers had no formal education. Majority of male (94.7%) and female (94.6%) farmers were aware of climate change. Furthermore, the respondents were aware of climate change as a result of personal experiences (male 62.1% and female 63.9%), traditional knowledge (male-55.2% and female-56.8%), and observations of climate indicators (male-96.1% and female-92.8%). Bush burning (male-80.0% and female-66.1%) and deforestation (male-70.1% and female-75.1%) were the most common causes of climate change as perceived by the respondents. Farmers' perspectives on climate variability and education (male χ^2-316.66 and female χ^2-523.39), as well as membership of associations (male χ^2-51.77 and female χ^2-64.46), had significant relationships ($p<0.01$). In order to curb and minimize activities that aggravate climate change, the study proposes gender-sensitive enlightenment regarding climate variability and causes.

Keywords: Climate change, Farmers, Gender, Variability, Causes

Introduction

Agriculture is the most important economic activity providing food, employment, foreign exchange and raw materials for industries in many developing of countries like Nigeria (Saleh *et al*., 2021; Lawal *et al*., 2021). These dominant roles of agriculture make it obvious that even minor climate deterioration can cause devastating socio-economic consequences (Olaniyi *et al*., 2013). Agriculture is the most vulnerable sector to climate change impacts because of its over-dependence on rain-fed systems (Antwi-Agyei and Stringer, 2021). Climate change according to Odjugo (2010) refers to variability in climate observed over a comparable period of time which is caused by two basic factors which include natural process (biogeographically) and human activities (anthropogenic). The evidence that climate change will adversely affect agriculture has become a crucial challenge (Enimus and Onome, 2018). Africa is one of the most vulnerable continents to climate change with the strongest economic impacts (Fadina and Barjolle (2018). Climate change is a reality in Nigeria as elsewhere in the world (Federal Ministry of Environment, 2020). Nigeria is strongly predisposed to severe negative impacts of climate change due to its fragile economy, weak resilience, and low adaptive capacity, as much of the economy is dependent on climate-sensitive ecosystems and natural resources (Federal Ministry of Environment, 2021). Nigeria's climate has been changing, this is evident in the increase in temperature, variable rainfall, rise in sea level and flooding, drought and desertification, land degradation, more frequent extreme weather events, effect on fresh water resources and loss of biodiversity (Elisha *et al.,* 2017). Declining precipitation amounts and increasing atmospheric temperatures are the most frequently reported and observable climate variability indicators by farmers in most Sub-Saharan Africa regions (Ochieng et al., 2017). Climate change affect almost all stages of the farming systems with rural farmers more vulnerable to its effects as a result of their low

infrastructural capacity as well as high dependence on weather signals for their farming activities (Ifeanyi-Obi *et al*., 2017). Climate will continual change as long as the natural process and human activities persist. Therefore, creating more awareness about climate change and its causes will go a long way in enlightening the rural farmers on activities that aggravate it. Also, awareness of climate change as well as risk perception are identified as the main motivations for adaptation behaviours (Arbuckle *et al.,* 2013; Mase *et al*., 2017). Perception of climate change involves asking how husbands and wives have perceived changes in average temperature and average rainfall and other indicators (Ngigi *et al*., 2016). One's perception of climate change is thought to be important because how an individual perceives change, including causes and threats, influences his decision on whether to adapt to climate change and to take action (Mazur *et al.*, 2013). Available research results indicate that the different gender groups (male, female, youth and aged) perceive and react differently to climate variation, and have different ways of coping and adapting to and mitigating its impacts (Ali *et al.,* 2014). The fact that the impact of climate variation is not gender neutral makes it more important to understand how men and women perceive and interpret climatic events so as to devise and advice on effective adaptation strategies that will secure their livelihoods (Mahama *et al*., 2021). Agricultural extension services are essential for agricultural productivity by providing farmers with useful farming and weather related information, skill and training that can enhance their productivity (Oluwole *et al*., 2016). Research have been conducted on climate change, including climate change awareness (Ajayi, 2014; Ado *et al.,* 2018: Akano *et al.*, 2022), perception (Ayanlade *et al*., 2018; Asrat and Simane, 2018), effects (Olaniyi *et al*., 2013; Ozor *et al*., 2015; Okunlola *et al*., 2018) and adaptation options (Adetayo *et al*., 2012; Fatuase and Ajibefun, 2014; Adzawla *et al*., 2019; Anugwa *et al.*, 2020), a research gap still exist with respect to gender perspectives of climate variability particularly in developing countries like Nigeria. Considering the significant role of gender in development, it is required that research within the climate change domain should address gender concerns (Adzawla *et al*., 2019). Therefore, investigations on climate change awareness, sources, causes, and perspectives on climate variables are still needed from a gender viewpoint. The goal of this study is to determine male and female farmers' (a) awareness of climate change and sources of awareness, (b) perspectives on climatic phenomena, and (c) perceived causes of climate change. The study hypothesized that 1) there is no significant difference in male and female farmers' perspectives on climatic variables, and 2) there is no significant association between male and female farmers' perspectives on climatic variables and their socioeconomic and production characteristics.

Methodology

Study Area

The study was conducted in Ekiti and Ogun States Nigeria. Ekiti State was carved out from the old Ondo State on October 1st, 1996. Geographically, the State is located in the Southwest of Nigeria between longitudes 4°51` to 5°45` east of Greenwich meridian and on latitudes 7°15′ to 8°5′N of equator. Ekiti State is bounded to the north by Kwara and Kogi States, to the west by Osun State, to the east by Edo State and to the south by Ondo State. The State occupies an area of 6,353kmsq and enjoys generally tropical climate with two distinct seasons. The annual temperature of Ekiti State ranges from 21° – 28°C (Oluwasusi and Tijani, 2013) with a mean annual humidity of 75% (Olujobi, 2015). The State is an upland zone and experiences a mean annual rainfall ranges between 1200mm and 1800 (Ugwuja *et al*., 2011). The major vegetation is rain forest, deciduous forest and semi-grasslands. Tropical forests exist in the south of the State, while guinea savannah occupies the northern peripheries of the State. Ogun State was created on February 3rd, 1976 from the old western region. Geographically, the State lies within latitudes 6° 12′N and 7° 47′N in the tropics and longitudes 3° 0′E and 5°0′ East of Greenwich meridian (Adeleke *et al*., 2015). The State covers 16,409.26 kilometres and shares an international boundary with the republic of Benin to the West and interstate boundaries with Oyo State to the north, Lagos and the Atlantic Ocean to the South and Ondo State to the east. The State is located in moderately hot, humid tropical climatic zone of Southwest, Nigeria. The climate of Ogun State follows a tropical pattern with two distinct seasons (the rainy season which lasts from March/ April to October/ November till March/ April). The annual rainfall of the State value ranges between 1,400mm and 1500mm with an average temperature of 30°C). The humidity is lowest at the peak of the dry season in February, usually at 37-54% and highest between June and September with a value of 78-85% (Adeleke, 2015). Ogun State has two main vegetations, namely, tropical rain forest and guinea savannah.

Sampling, data collection and analysis

Multi-stage procedure was employed to select the study area for this research. At stage one; two States (Ekiti and Ogun States) were purposefully selected from the six States in southwest Nigeria because of their similarities in ecological features. At stage two, 2 zones were randomly selected out of the three zones in Ekiti State and four zones in Ogun State Agricultural Development Programme. At stage three; six and eight blocks were randomly selected from the zones chosen from Ekiti and Ogun States respectively. Finally, respondents were randomly selected from the lists of farmers belonging to National Agricultural Cooperative (NACOOP) in each of the selected States. For Ekiti State, there were 1400 members of NACCOP and 1002 for Ogun State. Using Krejcie and Morgan's (1970) method for sample size determination, a sample size of 302 NACOOP members comprising 175 male and 128 female were selected in Ekiti State. In Ogun State, a sample size of 278 NACOOP members comprising 184 male and 94 female farmers was selected.

For data gathering, the study used both a questionnaire survey and Focus Group Discussions (FGDs). A Focus Group Discussion refers to a group of people who have been purposefully assembled at a place to take part in a discussion on a topic of relevance (Bhattacherjee, 2012). The focus groups for this study were conducted with separate groups of male and female farmers, each with 8-10 participants, and the discussions lasted between 30 and 60 minutes. A FGD was conducted in each of the selected blocks making a total of fourteen (14) FGDs. The sessions were moderated using a checklist and recorded with a video which was later transcribed. Farmers' awareness, sources of awareness, perspectives on climate variability, and causes of climate change were all elicited using a questionnaire. The questionnaire was pre-tested, with a reliability coefficient of 0.79, 0.72, and 0.65 for climate change awareness, perspectives and causes of climate change respectively. Farmers' awareness, sources of awareness and causes of climate change were measured in dichotomous variables of 'yes or no' while perspectives of climatic variability were rated on a 3-point rating scale of 'increased (3), decreased (2) and no change (1) (Uddin *et al*., 2017; Tarfa *et al*., 2019). Individual responses were summed to determine climatic variability perspectives score. The descriptive and inferential statistics used in this study were tables, percentages, and frequency counts, as well as Chi square, Pearson's Product Moment Correlation, and t–test.

Results and Discussion

Socioeconomic and Production Characteristics

In Table 1, the socioeconomic and production characteristics of male and female farmers are presented. It shows that the average age of male and female farmers was 49 and 45 years, respectively. The results could indicate that the respondents were in their active age. The pattern of this result is similar to that of Owombo *et al.* (2014) who reported 46.3years and 45.5 years for male and female respondents respectively. The majority of male (82%) and female (85%) farmers were married. The result obtained in this study is inconsistent with Amadi *et al*. (2019) who reported 89% and 92% of male and female farmers. The probable reason could result for the fact that their respondents were purposively sampled consisting of equal number of males and females. Also, the respondents had an average of six people per household. This might indicate availability of family labour for uptake of labour intensive climate change adaptation measures. The findings of this investigation corroborate the assertions of Okunlola *et al*. (2018) and Adeagbo *et al*. (2021) who reported an average of 6 persons per household in a study conducted on climate change in southwest Nigeria. In comparison, 13.5 % of male and 24% of female farmers had no formal education, according to the survey. This could indicate that more male farmers completed the basic stage of schooling, allowing them to have broadened ideas on the causes of climate change. This outcome is consistent with previous reports by Anugwa *et al*. (2020) which indicated more male respondents with an average of 8years schooling as against 4years for female respondents. Furthermore, men respondents had an average of 23 years of farming experience, while female farmers had an average of 19 years. This could indicate that male farmers are likely to be more knowledgeable of climate change and its causes than female farmers. The average farming experience observed in the study is a bit higher than what was reported for male (21.1years) and female farmers (14.7years) by Owombo *et al*. (2014). The study also found that 53.2% of male farmers and 58.1% of female farmers were members of crop producers' associations. The result follows higher percentage of female farmers than male belonging to farmers' associations reported by Adetomiwa *et al*. (2022). Membership of associations could provide avenue for discourse among farmers on climate variability. Furthermore, the majority of the respondents had an annual income of less than N21,000. This finding of this study corroborates the report of Ifeanyi-Obi *et al*. (2017) who obtained a mean annual income of N20, 000 for the majority of their respondents in a study conducted on adaptation to climate change. This could indicate that the respondents farm at a subsistence scale and might not be able to have financial resources to respond to climate variability.

Farmers' Awareness of Climate Change

Result shows that the majority of male (94.7%) and female (94.6%) farmers were aware of climate change. This finding could imply that the respondents were aware of climate indicators and hence noticed changes in those indicators. This outcome is consistent with the findings of Idrisa *et al.* (2012), Anyoha *et al*. (2013), Adebayo *et al*. (2016), Falola and Achem (2017), Ado *et al.* (2018), Anugwa *et al*. (2020), and Akano *et al*. (2022) with majority of respondents aware of climate change.

Farmers' Sources of Awareness of Climate Change

Personal observation of climate indicators (male-96.1%, female- 92.8%), personal experiences (male-62.1%, female-63.9%), and traditional knowledge (male-55.2%, female 56.8%) were found to be the major sources of climate change awareness. These findings could indicate that the respondents' sources of climate change awareness were from personal efforts. Personal experience (Tologbonse *et al*., 2011; Issa *et al*., 2015) and personal observation (Okoro *et al*., 2016; Nnachi *et al.,* 2020) were reported as the most important sources climate change awareness. Television (male-9.7%, female-4.9%), radio (male-15.5%, female-12.2%), print media (male-10.9%, female-4.5%), and extension agents (male-10.9%, female-4.5%) were the least sources of climate change awareness. This is an indication that climate change information were least obtained from these sources by male and female farmers. These finding is similar to the reports of Kisuazi *et al*. (2012) who reported that women farmers had less access to radio (35%) and extension agents (40%) as against male farmers' access to radio (73%) and extension agents (60%). Also, Ume *et al*. (2021) reported that 65% of male and 35% of their female respondents had access to extension agents in a study

conducted on climate change. Participants in FGDs also affirmed that they were aware of climate change due to '*Secondary school education and training from parents'.* This result aligned with observations by Bolaji *et al*. (2020) and Nnachi *et al.* (2020) who reported that their respondents stated that climate change information were taught in schools.

Farmers' Perspectives on Climatic Variability

Male and female farmers' perspectives on climatic variability are presented in Table 4. The study shows that male and female farmers respectively perceived a decrease in frequency of rainfall (70.5% and 75.4%), increase in temperature (73.8% and 77.5%), increased duration of droughts (49.9% and 64.4%), increase in storm (67.6% and 48.2%), increase in flood (58.8% and 66.2%), increase in heat waves (58% and 66%) and no change in hail (62% and 58%). Participants in FGDs added that:

'*The usual dry spell in August (August break) which is usually fifteen days is more than 30 days'*
'*We observe increased heat and cold instead of rainfall*'
'*Rainfall is not predictable like before'*

The result could indicate that both categories of farmers could perceive variation in climatic variables. Scientists in different parts of Nigeria have documented the evidence of increased temperature (Tunde, 2011; Defang *et al.,* 2012; Tarfa *et al.*, 2019), low rainfall (Defang *et al.,* 2012; Tarfa *et al*., 2019), increased drought (Kisauzi *et al*. (2012; Tologbonse *et al*., 2010) and increased floods (Tarfa *et al*., 2019). Female farmers could have had more perspectives on rainfall, temperature and drought, due to their household roles in production (wetting, processing) and domestic tasks (fetching of water, washing, cleaning and cooking.

Farmers' Perceived Causes of Climate Change

The respondents' perceived causes of climate change were bush burning (male-80.0% and female-66.1%), deforestation (male-75.1% and female-70.1%), and sin (male-76.0% and female-65.7%) (Table 5). The inference is that those who are aware that human activities are causing climate change are more inclined to refrain from contributing to it. This is a similar outcome to anthropogenic and natural cause (Tunde, 2011), human activity, deforestation (Okunlola *et al.* 2018; Idrisa *et al*., 2012), gas flaring (Ozor *et al*., 2015) and ozone depletion (Bolaji, 2020) perceived as the causes of climate change. The respondents in FGDs added that climate change could result from:

*"Punishment from God and/*or gods
"The earth is old"
"Consequences of industrialization and felling of big trees which send away deities and pythons that bring rain
"Extreme hail is usually result from improper performance of rituals and the *use of bigger pebbles for rituals".*

Furthermore, the respondents' perception that sins caused climate change is an indication that farmers still have a limited scientific understanding of the causes of climate change. This finding is in consonance with Tunde (2011) and Nnachi *et al*. (2020) findings who reported that farmers perceived that climate change is a product of God and God's annoyance.

Chi square Test of Associations between Male and Female Farmers' Perspectives on Climatic Variability, Socioeconomic and Production Characteristics

Results in Table 6 show that male and female farmers' perspectives on climate variability had significant ($p<0.01$) associations with education (χ^2= male-316.66, female-523.39), and membership of association (χ^2= male-51.77, female-64.46). The findings could imply that the farmers' education and association membership had a substantial impact on their perceptions of climatic variability. This indicates that when a farmer's degree of knowledge and membership of a farmers' association increases, so does their perspectives on climatic variability, and vice versa. The findings are consistent with previous research on climate change perception which found a link between perception and education (Falaki, 2013; Roco *et al*., 2015; Asrat and Simane, 2018).

Correlation Test of Relationships between Male and Female Farmers' Socioeconomic and Production Characteristics and their Perspectives on Climatic Variability

Results on Table 7 shows that there is no significant relationships between age ($r=-0.085$, $p>0.05$), family size ($r=-0.053$, $p<0.05$), average annual income ($r=0.019$, $p<0.05$), and farming experience ($r=-0.047$, $p<0.05$) of male farmers and their perspectives on climatic variability. The findings from this study is inconsistent with similar studies who reported a positive relationship between age (Issa *et al*., 2015), farming experience (Montle *et al*., 2014; Ayanlade *et al.,* 2018), income (Akanda and Howlader, 2015) and farmers' perspectives on climatic variability. For female farmers, significant relationships existed between family size ($r= 0.137$, $p<0.05$)), average annual income ($r=0.293$, $p<0.01$), and their perspectives on climatic variability. This result is similar to Uddin *et al.* (2017) who reported that farm income and family size are influential factors to perception of climate change.

Test of Difference between Male and Female Farmers' Perspectives on Climatic Variability

Results on table 8 show the means of farmers' perception of climate change indicators ranged from 3.93 and 1.04 for male and from 2.65 and 1.38 for female farmers. In addition, male farmers had two (2) higher means in climate change indicators while the female farmers had five (5) higher means. Furthermore, two statistical significant differences were observed in temperature ($t=-1.45$, $p<0.01$) and heat waves ($t=-0.17$, $p<0.05$) for female farmers. Male and female farmers had different perspectives on climate indicators, with female farmers having higher perceptions than male farmers, according

to these studies. This study corroborates the studies of Ubisi *et al*. (2017) who observed differences between male and female farmers' perception of climate change and Nuamah-Asare and Botchway (2019) who reported that female farmers were slightly positive on their perception of climate change than male farmers.

Conclusion

Farmers' awareness, sources of awareness, causes of climate variability, and perspectives on climatic variability were gender disaggregated. Findings show that the majority of male and female farmers were aware of climate change. Their awareness thus confirms to scientific and meteorological data. According to this study, female farmers had less access to all information sources of climate change examined in this study with the exception of traditional knowledge; this could limit the ability of female farmers to obtain relevant scientific information on climate change and thus hindered their responses. In addition, male and female farmers perceived bush burning, deforestation, and sin as the major causes of climate change while other human activities (burning of fossil fuels and ozone depletion) contributions to climate change were rated low. Although, the majority of male and female farmers perceived that rainfall has decreased. Both male and female farmers perceived that temperature and drought have increased, but larger percentage of female than male perceived the increase. On the other hand, larger percentage of male farmers perceived storm to have increased while less than half of the female farmers perceived the increase. Also, slightly more than half of male and female farmers perceived an increase in flood and heat waves whereas, larger percentage of male and female farmers observed no change in hail. However, differences in male and female perspectives on changes in temperature and heat waves were observed with the females having higher perspectives. The findings make a concrete case for gender concern in climate change response programmes and policies. Addressing the differences in sources of awareness, causes and perspectives on climate variables sharpens climate change policies in their role of bringing about gender equitable and sustainably adaptation to climate change. Climate change adaptation policy hence, should take into consideration the need to close the gaps in access to information sources like radio, television, extension agents and print media as well as education at large.

Table 1: Socio-economic and production characteristics of the respondents

Socioeconomic and production characteristics	Male farmers (n=358) Frequency (%)	Mean $\bar{x}$	Female farmers (n=222) Frequency (%)	Mean $\bar{x}$
Age (years)				
Below 20	0.03		0.05	
21-30	13.4		14.9	
31-40	15.1		20.3	
41-50	29.5	49	41.9	45
51-60	19.8		13.1	
Above 60	24.9		9.5	
Marital status				
Single	11.5		6.3	
Married	85.0		82.0	
Widow (er)	2.8		8.6	
Divorced/ separated	0.8		3.2	
Family size				
0-5	17.6		45.9	
6-10	73.5	6	52.3	6
11-15	7.5		1.8	
16-20	1.4		0	
Educational qualification				
No formal education	13.5		24.2	
Primary	35.2		18.4	
Secondary	12.9		21.7	
Post-secondary	38.5		37.8	
Farming experience (years)				
0-5	13.1		19.8	
6-10	18.2		18.5	
11-15	13.7		9.0	
16-20	11.7		14.0	19
Above 20	43.3	23	38.7	
Membership of associations				
Crop	53.2		58.1	
Livestock	25.1		18.9	
Average annual income				
Less than 21,000	43.3		42.8	
21,000-40,000	12.5		14.4	
41,000-60,000	21.7		22.5	
61,000-80,000	4.5		4.1	
81,000-100,000	3.9		5.4	
Greater than 100,000	13.9		10.9	

Table 2: Farmers' awareness of climate change

Awareness	Male farmers (%)	Female farmers (%)
Aware	94.7	94.6
Not aware	5.3	5.4

Table 3: Respondents' Sources of Awareness of Climate Change

Sources of awareness	Male (%)	Female (%)
Personal observations	96.1	92.8
Personal experience	62.1	63.9
Traditional knowledge	55.2	56.8
Television	21.7	14
Radio	15.5	12.2
Extension agents	9.8	4.9
Print media	10.9	4.5

Table 4: Male and Female Farmers' perspectives on changes in climate variables (%)

Perception (%)	Rainfall	Temperature	Drought	Storm	Flood	Hail	Heat waves
Male farmers (n=358)							
Increase	4.0	73.8	49.9	67.6	58.8	11.0	58.0
Decrease	70.5	9.5	28.0	18.0	18.0	38.0	10.0
No change	25.0	16.0	21.0	40.0	20.0	62.0	24.0
Female farmers (n=222)							
Increase	2.0	86.0	64.0	47.0	58.0	28.0	66.0
Decrease	75.4	10.0	18.0	15.0	18.0	20.0	8.0
No change	20.5	11.5	17.0	36.0	20.0	58.0	25.0

Table 5: Respondents' Perceived Causes of Climate Change

Causes of climate Change	Male (%)	Female (%)
Bush burning	80.0	66.1
Deforestation	75.1	70.1
Sin	76.0	65.7
Natural forces	25.2	22.0
Burning of fossil fuel	33.8	19.8
Ozone depletion	4.5	3.8

Table 5: Results of Chi square analysis

	Male farmers		Female farmers	
Variables	**χ^2 value**	**P alue**	**χ^2 value**	**P value**
Education	316.66	0.000**	523.39	0.000**
Membership of associations	51.77	0.000**	64.46	0.000**

P<0.01

Table 6: Results of correlation analysis between farmers' socioeconomic and production characteristics and their perspectives on changes in climate variables

	Male farmers		Female farmers	
Socio-economic characteristics	**r value**	**P value**	**r value**	**P value**
Age	-0.085	0.107	0.026	0.704
Family size	-0.053	0.313	0.137	0.042*
Average annual income	-0.019	0.714	0.293	0.000**
Farming experience	-0.047	0.373	0.100	0.138

P<0.05 **P<0.01

Table 8: Test of differences between male and female farmers' perspectives on climatic variability

Climate change indicators	Male farmers ($\bar{x}$)	Female farmers ($\bar{x}$)	t value
Rainfall	2.93	2.38	0.20
Temperature	2.56	2.65	-1.45**
Severe drought	2.26	2.47	-3.08
Storm	1.85	2.05	-2.16
Flood	2.35	2.32	0.31
Hail	1.04	1.49	-4.72
Heat waves	1.36	1.38	-0.17*

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