Original Research Article

FARMERS' PERCEPTION OF CLIMATE VARIABILITY EFFECTS ON ARABLE CROP PRODUCTIVITY IN ONDO STATE, NIGERIA

Abstract

This study investigated the perceptions of arable farmers in Ondo State, Nigeria, about the effects of climate variability on the production of their crops, as well as the coping methods employed to reduce the perceived consequences. Using a multistage random sample approach, 120 participants were selected for the study. The gathered information was analysed using descriptive statistics and correlation. The average age of the farmers was found to be about 49 years, and the majority of them (45%) had formal education up to primary school level. Findings indicated that a rise in temperature, an increase in precipitation, a longer rainy season, and a shorter dry season were the most noticeable indicators of climate variability. Furthermore, the majority of farmers reported that a shorter dry season (71.7%), a longer rainy season (65%), a rise in rainfall (55.8%), and an increase in temperature (50.8%) enhanced agricultural output. Crop rotation (83.3%), planting of different crops (82.5%), adoption of mixed cropping (78.3%), moving to a different area (66.7%), use of chemicals, fertilizers, and pesticides (65.8%), different planting dates, increasing farm size, and planting of cover crops (65%), and planting of different varieties (64.2%) are the major coping strategies adopted by the majority of farmers. The results of the correlation analysis shows that planting different crops, planting different varieties, planting at different times, relocating to different areas of land, expanding farm size, adopting irrigation practice, and employing chemicals, fertilizer, and pesticides were significantly correlated with some of the selected socio economic characteristics of the respondents. This study reveals that farmers are well-informed about climate variability and the dangers and challenges it poses to production, and that they take the necessary precautions to manage these risks. This study advises providing farmers with anticipated climatic information so that they are fully informed, prepared, and proactive for future planting seasons, as opposed to being only reactive.

Keywords: Perception, Climate variability, Coping Strategies, Arable Crop, Productivity

Introduction

The agriculture sector employs more than 70 percent of Nigeria's active labour force. As a result, agriculture creates a tremendous burden on the environment in order to provide humans with food and fibre (Apata *et al.*, 2009). Regardless of farmlands and crops, climate plays a decisive impact in agricultural productivity (Akintonde *et al.*, 2016; Adegnandjou and Dominique, 2018). The adverse effects of climate change have an impact on agricultural production, from planting to harvesting. Similar to the rest of sub-Saharan Africa, Nigeria is very vulnerable to the effects of climate change (Intergovernmental Panel on Climate Change (IPCC), 2007; Akintonde *et al*., 2016). Concerns regarding the effects of climatic unpredictability have prompted a substantial amount of research on agriculture and climatic variability. According to Fadumila (2012), climate variability is expected to impact livestock and crop output, as well as other agricultural system components and hydrologic input sources.

The majority of arable crops consumed in Nigeria are produced by small-scale farmers in the country's south-western area (Akintonde *et al*., 2016). These farmers must contend with an inconsistent climate. This is seen by the late arrival of rainfall and the drying up of minor rivers and streams that were formerly believed to run year-round (Apata *et al*., 2009). As a result, agricultural production among small-scale farmers is unquestionably hampered by climatic factors, especially since about 90 percent of agricultural activities are dependent on rainfall (Fadumila, 2012).

Climate influences many aspects of plant development and yields (Sivakumar *et al.*, 2005; Eludoyin, Nevo, Abuloye, Eludoyin, and Awotoye, 2017). Extreme climatic conditions are a key constraint on agricultural production in rain-fed farming systems. These conditions deviate from the norm and are capable of inducing regressions in numerous key environmental indicators, such as air temperature and water balance (Odekune, 2004; Eludoyin *et al.*, 2017). Extreme climatic conditions may be temporary, yet they can have a significant impact on ecological and agricultural growth. This scenario consists of significant rainfall during periods when crops require a dry spell (Maracchi *et al.*, 2005). The majority of research has uncovered spatial and temporal changes and frequently bases its conclusions on secondary data; however, few original data have been collected on small-scale farmers' perceptions of the effects of climate variability on crops (Eludoyin *et al.*, 2017).

According to Deressa *et al.,* (2009), Below *et al.,* (2015), and Chinchongue *et al.,* (2015), the perception of climate risk and adaptation on the part of farmers is essential for the development of an agricultural policy that promotes food security. Farmers have implemented a variety of adaptation strategies to mitigate the effects of climate on crop productivity. In addition, Adegnandjou and Dominique (2018) found that farmers have an advanced understanding of climate change. These alterations include a reduction in the length of the dry season, an increase in temperature, disturbances of rainfall (early cessation, poor distribution, and rainfall delays), and severe gusts. In addition, they discovered that farmers in Benin employed other techniques, including the use of organic fertiliser, mulching, and crop and livestock diversification.

On the other hand, some research has been conducted in Africa on farmers' sensitivity to climate change and adaptation strategies, specifically Comeo (2013) in Ivory Coast, Simelton *et al.* (2013) in Malawi and Botswana, Assoumana *et al.,* (2016) in Niger, and Gebreeyesus (2017) in Kenya. Notwithstanding the number of studies conducted in Africa, climate variations like as increases and decreases in precipitation, longer and shorter rainy seasons, extreme heat, and longer hours of sunlight continue to pose a significant danger to the productivity of farmers. Thus, there is still a need for research on farmers' perceptions of the effects of climatic variability and coping strategies. Specific objectives include assessing the farmers' perceptions of climatic variability, evaluating the perceived impact of climatic variability on crop productivity in the study area, identifying the various coping strategies adopted by the farmers, and determining the relationship between the socioeconomic characteristics of the farmers and their coping strategy choices.

Methodology

This research was conducted in Ondo State, Nigeria. The state is located between 5 45' and 7 52' North latitude and 4 20' and 6 03' East longitude. (Adelaja *et al.,* 2018). It is bordered by Edo and Delta states to the east, Ogun and Osun states to the west, Ekiti and Kogi states to the north, and the Atlantic Ocean to the south. According to the National Nutrition and Health Survey (NNHS) (2018), the state's estimated population is 4,863,334 individuals. The state has a land area of approximately 15,000 square kilometres (FOS, 2007). People in this state primarily engage in agriculture, producing crops rice, maize, yam, tomato, plantain, and tree crops like cocoa, rubber and kola nut.

This study's respondents were chosen via a multistage random sampling procedure. The state is divided into agro-climatological zones. First, three Local Government Areas (LGAs) from each zone were selected at random. Second, two villages were chosen at random from each of the selected local government areas. Thirdly, ten respondents were selected at random from each of the chosen communities. For this study, a total of one hundred twenty (120) farmers were questioned. For data collection, a standardised questionnaire that had been pre-tested was used. Data were analysed with descriptive statistics and correlation analysis. Also, a 5-point Likert rating scale as follows: Strongly disagree (SD) was awarded 1 point, Disagreed (D) was awarded 2 points, Undecided (U) was awarded 3 points, Agreed (A) was awarded 4 point, Strongly Agreed (SA) was awarded 5 point was used to assess farmers' perceptions regarding the impact of climate variability on their crop yield.

The perception index was constructed to rate the farmers' opinions as follows:.

$$\text{Perception Index} = \frac{SA*5 + A*4 + U*3 + D\times2 + SD\times1}{\text{Total number of observers}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{(i)}$$

Results and discussions

Socio-economic characteristics of farmers in the study area

The socioeconomic characteristics of farmers in the study area is as presented in Table 1. From the Table, the average age of the farmers is about 49years, 59.1% of farmers were between the ages of 30 and 50, while 36.7% were older than 50 and 4.2% were younger than 30. The findings are consistent with those of Eludoyin *et al*. (2017) and Kebede and Gizachew (2017), who found that the majority of farmers were between the ages of 36 and 55. The gender distribution reveals that the majority of farmers were male (73.3%), while only 26.7% were female. This indicates that males predominate in farming while females are mostly involved in the selling of agricultural products. This is consistent with the findings of Eludoyin *et al.*, (2017), who found that males carry out the majority of farming tasks, while females are predominantly involved in the processing and marketing of farm outputs. Also, the study found that a greater proportion (87.5%) of farmers were married. This indicates that farmers are receiving more assistance on their farms. Almost 60.8% of the population chose farming as their major occupation, while 39.2% chose non-agricultural work as artisans or civil servants. This suggests that the majority of respondents are farmers, possibly due to the availability of land in the research location.

The average size of a household was eight individuals. This indicates that farmers are assisted by a larger number of members of their households. About half of farmers (49.2%) have between 1 and 10 years of agricultural experience, 18.3% have between 11 and 20 years of experience, 16.6% have more than 30 years, and 15.8% have between 21 and 30 years of farming experience. The majority of farmers (45%) have primary education, while 32.5% have secondary school and 22.5% have tertiary education. This indicates that the majority of farmers are educated and knowledgeable enough to use appropriate farming practises. Similarly, farmers are better informed about the adoption of relevant technologies to mitigate climate change concerns. 73.3 percent of farmers have farms smaller than 2 hectares, 25 percent have farms between 2.1 and 4.0 hectares, and only 1.7% have farms larger than 4 hectares.

Table 1: Socio-economic Characteristics of Farmers in the Study Area (n=120)

Variables	Freq.	%
Age (years)		
Less than 30	05	4.2
30- 40	31	25.8
41- 50	40	33.3
Above 50	44	36.7
Mean ± std.	48.44±11.54	
Sex		
Male	88	73.3
Female	32	26.7
Marital		
Married	105	87.5
Single	14	11.7
Divorced	01	0.8
Primary occupation		
Farming	73	60.8
Non-farming	47	39.2
Household size		
1-10	98	81.7
11-20	19	15.8

Above 20	3	2.5
Mean + std.	7.9+5.4	
Farming experience		
1-10	59	49.2
11-20	22	18.3
21-30	19	15.8
Above 30	20	16.6
Mean + std.	18.0+12.8	
Educational level		
Primary education	54	45.0
Secondary education	39	32.5
Tertiary education	27	22.5
Farm size (ha)		
Less than 2	88	73.3
2.1- 4.0	30	25.0
Above 4.0	2	1.7

Source: Authors' Field Survey, 2018

Farmers' Perception of Climate Variability Effects

Using a 5-point Likert scale, Table 2 displays the distribution of farmers' perceptions of climate variability's impact on crop production in the research area. Based on the perception index values, the majority of farmers perceived increased temperature (4.30) as the most evident climatic variability, followed by increased rainfall (3.93), a longer rainy season (3.67), a shorter dry season (3.56), a shorter rainy season (3.29), and a decrease in temperature (3.15). (3.14). In the research area, farmers encountered significant climatic variations, according to the findings. Kebede and Gizachew (2017) opined that the majority of farmers saw unusually high and low temperatures and unexpected precipitation as evidences of climatic unpredictability. Our findings concur with their assertions. Likewise, the findings concur with those of Adegnandjou and Dominique (2018). The study revealed that 90.8% of farmers reported that the climate had changed, with the most notable changes being disturbances of rainfall (early cessation, rainfall delays, and distribution of poor rainfall), an increase in temperature, violent winds, and a reduction in the length of the short dry season. Furthermore, 89% of respondents perceived rainfall disturbances to be evident in the study area.

Table 2: Distribution of Farmers' Perception on Climate Variability Effects

Climatic Variables	SA freq. (%)	A freq. (%)	U freq. (%)	D freq. (%)	SD freq. (%)	Perception Index (X)	RANK
Increase temperature	60 (50.0)	49 (40.8)	1 (0.8)	7 (5.8)	3 (2.5)	4.30	1st
Decrease temperature	19 (15.8)	45 (37.5)	6 (5.0)	34 (28.3)	16(13.3)	3.14	7th
No change in temperature	11 (9.2)	18 (15.0)	20 (16.7)	28 (23.3)	43 (35.8)	2.38	8th
Increase rainfall	50 (41.7)	42 (35.0)	6 (5.0)	14 (11.7)	8 (6.7)	3.93	2nd
Decrease rainfall	16 (13.3)	47 (39.2)	9 (7.5)	35 (29.2)	13 (10.8)	3.15	6th
No change in rainfall	10 (8.3)	13 (10.8)	26 (21.7)	33 (27.5)	38 (31.7)	2.37	9th
Shorter raining season	23 (19.2)	46 (38.3)	7 (5.8)	31 (25.8)	13 (10.8)	3.29	5th
Longer raining season	41 (34.2)	39 (32.5)	7 (5.8)	25 (20.8)	8 (6.7)	3.67	3rd
Shorter dry season	31 (25.8)	46 (38.3)	11 (9.2)	23 (19.2)	9 (7.5)	3.56	4th
Longer dry season	23 (19.2)	28 (23.3)	12 (10.0)	28 (23.3)	29 (24.2)	2.90	10th

SA: Strongly agree, A: Agree, U: Undecided, D: Disagree, SD: Strongly Disagree
Source: Authors' Field Survey, 2018.

Effects of climate variability on crop productivity

The impacts of climatic change on crop yield in the study area are presented in Table 3. Almost fifty-four percent of farmers claimed that an increase in temperature boosts agricultural productivity, while forty-five percent stated the opposite. Around forty percent of the farmers answered that a reduction in temperature boosts agricultural yield, while a greater proportion stated that a decrease in temperature did not increase crop productivity. Almost 60% of farmers reported that increasing precipitation enhances agricultural yield. Forty percent (40%) of respondents indicated that reduced precipitation enhances crop yield.

Table 3: Distribution of Farmers based on Effects of Climate Variability on Crop Productivity

Climate variability	**Yes**		**No**	
	Freq.	**%**	**Freq.**	**%**
Increase temperature	65	54.2	55	45.8
Decrease temperature	44	36.7	76	63.3
Increase Rainfall	71	59.2	49	40.8
Decrease Rainfall	48	40.0	72	60.0
Shorter Raining Season	25	27.5	87	72.5
Longer Raining Season	78	65.0	42	35.0
Shorter Dry Season	97	81.8	23	19.2
Longer Dry Season	11	9.2	109	90.8

Source: Authors Field Survey, 2018

Coping strategies practised by farmers against climate variability

Table 4 displays the farmers' coping measures against climate unpredictability in the research area. As a means of coping with climate variability, the majority of farmers (83.3%) engaged in crop rotation, 82.5% planted different crops, 78.3% engaged in the adoption of mixed cropping, 66.7% moved to different areas, 65.8% used chemicals, fertilisers and pesticides, 65% adopted in different planting dates, increased farm size and planted cover crops, and 64.2% engaged in the planting of different varieties of crops. They indicate that farmers use a variety of methods to limit the effects of climate unpredictability on crop production.

Table 4: Distribution of farmers based on adopted coping strategies against climate variability

Coping Strategies	**Frequency**	**Percentage**
Planting of different crops	99	82.5
Planting of different varieties	77	64.2
Different planting date	78	65.0
Move to a different area	80	66.7
Increase farm size	78	65.0
Change from Crop to livestock	32	26.7
Adopt irrigation	59	49.2
Use of chemicals, fertilizer and pesticides	79	65.8
Use of insurance	28	23.3
Spiritual	40	33.3
Planting of cover crop	78	65.0
Crop rotation	100	83.3
Planting of sole crop	42	35.0
Monitoring of some changes in weather variables	69	57.5
Adoption of mixed cropping	94	78.3
Take off Farm Job	18	15.0

Source: Field Survey, 2018

Relationship between socioeconomic characteristics and choice of coping strategy

The association between socioeconomic variables and the coping technique chosen to alleviate the consequences of climate variability in the research area is presented in Table 5. Age, Sex, Home Size (HHS), and Years of Farming Experience (YOF) have a positive association with the planting of different crops to mitigate the influence of climate variability on crop production, although only household size has a significant correlation of 5%. This suggests that an increase in any of these variables will result in a greater propensity to plant alternative crops in response to climate unpredictability. On the other hand, the educational level (EDU) shows a negative link with the planting of various crops as a method of climate variability mitigation. This shows that a rise in the educational level of farmers will result in a decrease in the planting of diverse crops as a mitigation strategy, and vice versa. As farmers' knowledge levels rise, they will become more aware and devise more effective methods for controlling climate variability. In addition, the results suggested that Age and HHS have a positive link with the planting of different kinds in response to climate variability. This suggests that an increase in Age and household size will result in an increase in the propensity to utilise planting of several types to cope with climate variability. Nonetheless, Sex (-.058), Farm Size (FSZ) (-.060), Educational Background (-.051), and Age of Farmer (-.010) exhibit a negative link with the planting of diverse types as a strategy of coping with climate unpredictability. This indicates that an increase in any of these variables will reduce the use of planting new types as a coping mechanism.

In addition, Age, Sex, HHZ, FSZ, and EDU show a positive correlation with various planting dates as a coping mechanism. This indicates that an increase in any of these variables will result in an increase in the propensity to use varied planting dates as a coping mechanism. Yet, only YOF displays a negative correlation with various planting dates. This indicates that an increase in the use of this variable will result in a decrease in the use of varied planting dates as a climate-mitigation strategy. Age, Sex, HHZ, and FSZ all exhibit a positive correlation with relocating to a different region as a means of minimising the effects of climate variability, with only HHZ demonstrating a significant correlation at 5%. This indicates that any rise in any of the variables will result in a greater propensity to relocate as a strategy of coping with climate variability. Yet, EDU and YOF show a negative correlation with relocating to a different region to mitigate the influence of climate unpredictability. This indicates that any increase in these variables will reduce the utility of relocating to a new region as a climate mitigation strategy.

Increasing farm size has a favourable correlation with HHS, FSZ, and EDU as a strategy of coping with climate variability. This indicates that an increase in any of these variables will result in a larger farm. Nonetheless, Age, Sex, and YOF have a negative correlation with rising farm size, but only Age has a meaningful correlation at 5%. This indicates that an increase in any of the variables will reduce the reliance on farm size as a coping mechanism.

Age, Sex, HHS, and FSZ have a positive association with the shift from crops to livestock farming as a means of managing climatic variability, but only HHS has a significant correlation at 5%. This indicates that an increase in any of these variables will result in a greater shift from crop to livestock production. In contrast, EDU and YOF show a negative link with the shift from crop to animal production as a strategy of mitigating the influence of climatic variability. This indicates that an increase in any of these variables will reduce the utilisation of crop-to-livestock conversion.

Age, HHS, and YOF are positively correlated with the adoption of irrigation as a climate variability adaptation strategy. This indicates that an increase in any of these variables will enhance the likelihood of users adopting irrigation as a coping mechanism. Yet, Sex, FSZ, and EDU have a negative link with irrigation as a strategy of minimising the influence of climate fluctuation. This indicates that any rise in any of these variables will reduce the adoption of irrigation as a mitigation strategy.

The link between HHS, FSZ, and EDU and the usage of chemical, fertiliser, and pesticides to mitigate the effects of climate variability is favourable. This indicates that a rise in any of these variables will result in an increase in the use of herbicides, fertilisers, and pesticides to mitigate the influence of climate variability. Nevertheless, Age, Sex, and YOF show a negative link with the use of chemicals, fertilisers, and pesticides to mitigate the influence of climate variability. This demonstrates that an increase in any of these variables will reduce the need of chemicals, fertilisers, and pesticides as a mitigation strategy. There is a link between HHS and FSZ and the usage of insurance as a coping technique. This indicates that an increase in any of these variables will result in a rise in insurance utilisation. Age, Female, Education, and Years of Experience have a negative link with the utilisation of insurance as a coping technique. This indicates that an increase in any of the variables will reduce the use of insurance as a mitigation strategy. Age, Sex, HHS, FSZ, and YOF all have a positive link with the use of spirituality as a coping mechanism, however only Age and HHS had a significant correlation at 5% and 1%, respectively. This indicates that an increase in any of these variables will result in a rise in the use of spirituality as a strategy of reducing climatic variability. However, only EDU has a negative relationship with spirituality usage. This demonstrates that an increase in any of the variables will reduce the usage of spirituality as a coping mechanism.

Sex, HHS, FSZ, and EDU are positively correlated with the usage of cover crops to mitigate the effects of climate variability. This shows that an increase in any of these variables will result in a greater propensity to plant cover crops to mitigate the influence of climatic variability. Nevertheless, Age and YOF have a negative relationship with cover crop sowing. This suggests that an increase in any of the variables will decrease the usage of cover crop planting as a coping technique. The variables HHS, FSZ, and EDU are positively correlated with crop rotation as a coping technique. This indicates that a rise in any of these variables will boost crop rotation. Age, gender, and years of experience show a negative link with crop rotation. This implies that a rise in any of the factors will result in a decline in crop rotation. Sex, HHS, FSZ, and EDU are positively correlated with the coping strategy of growing the only crop. This indicates that an increase in any of these variables will result in a rise in the planting of the single crop. Age and YOF, on the other hand, have a negative link with the planting of the solitary crop. This demonstrates that an increase in any of the factors will reduce the planting of the sole crop.

There is a favourable link between HHS, FSZ, and EDU and the monitoring of some changes in weather variables as a coping mechanism. This indicates that an increase in any of these factors will result in a rise in the monitoring of certain weather variable changes. On the other hand, Age, Sex, and YOF have a negative link with the monitoring of certain weather variable changes. This suggests that an increase in any of the variables will result in a reduction in the monitoring of certain weather variable changes. Sex, FSZ, EDU, and YOF all correlate positively with the adoption of mixed cropping. 5% is a substantial association with sexuality. This indicates that an increase in any of these variables will result in a rise in mixed cropping adoption. Age and HHS, on the other hand, have a negative link with the adoption of mixed cropping. This indicates that an increase in any of the variables will lower the adoption of mixed cropping as a mitigation strategy. In addition, only HHS has a positive link with off-farm employment as a coping technique. This indicates that an increase in any of these variables will lead to a rise in the number of individuals taking off-farm jobs. Nevertheless, Age, Female, FSZ, Educational Background, and Years of Experience have a negative link with taking the off-farm employment. This suggests that a rise in any of the variables will result in a decline in the number of individuals working off-farm.

Table 5: Correlation Analysis Showing the Relationship between Socioeconomic Characteristics and Choice of Coping Strategy

COPING STRATEGY	AGE	SEX	HHS	FSZ	EDU	YOF
Planting of different crops	0.117	0.069	0.192*	0.008	-0.119	0.101
Planting of different varieties	0.035	-0.058	0.002*	-0.060	-0.051	-0.010
Different planting date	0.021*	0.071	0.175	0.067*	0.010	-0.035
Move to different area	0.073	0.013	0.204*	0.078	-0.045	-0.017
Increase farm size	-0.217*	-0.008	0.060	0.048	0.032	-0.156
Change from crop to livestock	0.021	0.023	0.186*	0.012	-0.076	-0.051
Adopt irrigation	0.010	-0.010	0.141*	-0.031	-0.006	0.059
Use of chemicals, fertilizer and pesticides	-0.131	-0.037	0.029	0.082*	0.138*	-0.157
Use of insurance	-0.011	-0.068	0.174	0.096	-0.082	-0.111
Planting of cover crop	-0.188	0.032	0.051	0.118	0.143	-0.169
Crop rotation	-0.096	-0.118	0.098	0.126	0.099	-0.007
Planting of sole crop	-0.118	0.087	0.000	0.015	0.012	-0.111
Monitoring of some changes in weather variables	-0.136	-0.175	0.167	0.018	0.117	-0.010
Adoption of mixed cropping	-0.050	0.186*	-0.125	0.096	0.073	0.062
Take off farm Job	-0.118	-0.063	0.142	-0.176	-0.090	-0.107

Source: Authors Field Survey, 2018.

Conclusion and Recommendation

This study reveals that the farmers in the study area are educated enough to recognise the climate unpredictability with the dangers and uncertainties it poses to their crop yield. Thus, many of them are proactive enough to implement diverse tactics to minimise the consequences of the varying climate conditions, while others have adopted a reactive approach and mitigation strategies. This therefore study concludes that farmers will be in a better position if they are provided with projected meteorological information. In light of this, the study suggests that a weather forecasting service be made available to farmers so that they will be fully educated, prepared, and proactive regarding future planting seasons, as opposed to merely being reactive. Similarly, both the public and the commercial agricultural extension providers should continue to educate the public on the realities of climate change and its potential effects on the yield of arable crops.

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