NIGERIAN AGRICULTURAL JOURNAL
ISSN: 0300-368X
Volume 55 Number 3, Dec 2024 Pg. 1-11
Available online at: http://www.ajol.info/index.php/naj
https://www.naj.asn.org.ng

Effects of Perceived Extent of Climate Variations and Socioeconomic Characteristics on Food Crops Farmers' Income in Southwest Nigeria

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Abstract
The Nigeria agricultural sub-sector is often susceptible to climatic changes and vulnerability, thus leading to immense stresses on the plants, livestock and soil fertility. Therefore, this study aimed to establish farmers' local knowledge of climate change and determine the effects of perceived climate change incidence on food crop farmers' income. The study was conducted in the four divisions of Ogun State, Nigeria using a multi-stage sampling technique to select 480 crop farmers. Data collected were analyzed using descriptive statistics, dominance analysis, and linear regression. Results indicated that the mean score of incidence of variation experienced by farmers, household headship, sex of farmer, level of formal education, household size, farm size, and distance of the market from the farm were the factors that significantly affected the annual farm income generated by farmers. Furthermore, low usage of adaptation strategies was evident in the study area. The study recommended policies targeted at cassava and maize farmers to boost food crop production in the state. In addition, the formulation of policies centered on increasing the income-generating ability of the farmers to enhance their usage of coping strategies to ameliorate the adverse effects of climate change.
Keywords: climate change variation, farmers' knowledge, food crop, income, socioeconomic characteristics, Nigeria

Introduction

Studies described agriculture in the developing world as one of the economic sectors most vulnerable to climate change (Slingo *et al*., 2005; Challinor *et al*., 2005; Benhin, 2008; Kurukulasuriya and Mendelsohn, 2008; Knox *et al*., 2010). According to most of these studies, climate change has the potential to increase the stress on crop plants, allow pest and disease multiplication, and weed competition to significant yield losses.

Climate is a primary determinant of agricultural productivity especially in rainfed agriculture and any significant climate changes will influence crop and livestock productivity, hydrologic balances, input supplies, and other components of managing agricultural systems. Furthermore, evidence has shown that the global climate is changing, and this will significantly affect human beings' socioeconomic activities, livelihood, food security, and health (Clarke *et al*., 2012: Amjath-Babu *et al*.,

2016; Ayanlade *et al*., 2017). The negative effects of climate change on agricultural yields will be exacerbated by more frequent weather events and in extreme cases, according to Brussel (2009), the degradation of agricultural ecosystems like desertification. This is likely to increase the dependence on food importation and the number of people at risk of famine.

Mark *et al.* (2008) highlighted some of the direct impacts of climate change on agricultural systems as; seasonal changes in rainfall and temperature, which could impact agro-climatic conditions, altering growing seasons, planting and harvesting calendars, water availability, pest, weed and disease populations; alteration in evapotranspiration, photosynthesis and biomass production; and alteration in land suitability for agricultural production. African smallholder farmers have no alternative but to adapt to climate change and climate variability.

Several practical options for adaptation exist. According to Santiago (2001), adaptation involves adjustment to enhance the viability of social and economic activities and to reduce their vulnerability to climate, including its current variability and extreme events as well as longer-term climate change. Adaptation to climate is the process through which people reduce the adverse effects of climate on their health and well-being and take advantage of opportunities that their climatic environment provides. Some of the identified coping strategies by food crop farmers on climate change include crop diversification, mixed cropping, livestock farming systems, using different crop varieties, changing planting and harvesting dates, mixing less productive, drought-resistant varieties, and high yield water sensitive crops (Jagtap, 1995).

Agriculture adaptation involves two types of modifications in production systems. The first is increased diversification that involves engaging in production activities that are drought tolerant and or resistant to temperature stresses as well as activities that make efficient use and take full advantage of prevailing water and temperature conditions, among other factors. Crop diversification can serve as insurance against rainfall variability as different crops are affected differently by climate events. The second strategy focuses on crop management practices geared towards ensuring that critical crop growth stages do not coincide with very harsh climatic conditions such as mid-season droughts. Crop management practices that can be used include modifying the length of the growing period and changing planting and harvesting dates.

Several views have been expressed about the impacts of the irregularity of climate on food crop production, some claimed that rural and poor farmers are most affected; some said that farmers who depend on traditional livelihood systems such as farming, fishing, and pastoralism are most affected while some other researchers claimed that subsistence farmers are the most affected (Oyekale *et al*., 2009). Literature is replete with climate change and crop production in Africa especially in Nigeria. However, most of the studies concentrated on on-station actual and projected impacts as well as farmers' coping/adaptation strategies (Mendelsohn *et al*., 2000; Agoumi, 2003; Adejuwon, 2006; FAO 2007; Agbola and Ojeleye, 2007; Oyekale *et al*., 2009; Apata *et al*., 2010; Sowunmi and Akintola, 2010; Ayinde *et al*., 2011; Tunde *et al*., 2011). There has been little or no work in the area of farmers' local knowledge of climate change and its effect on their income. Finally, the dwindling price of crude oil price in the world market and the consistent rise in the Dollar exchange rate due to overdependence on importation are pointers to the fact that the Nigerian agricultural sector should be revitalized to meet local and international demand for consumption and industrial purposes. Based on the foregoing, this study aimed to establish farmers' local knowledge of climate change and determine the effects of the perceived level of climate change incidence on food crop farmers' income.

Methodology

Study area, sampling procedure, and method of data collection

The study was conducted in the four divisions of Ogun State, southwest Nigeria. A multi-stage sampling technique was used to select two Local

Government Areas (LGAs) from each of the four divisions in the State. In the second stage of the sampling technique, five communities/villages were selected from each of the LGAs. In all, 40 villages/communities were selected. From each village, 12 food crop producers were chosen using a systematic sampling technique, thus, constituting the third stage of the sampling. This procedure produced 480 crop farmers. Data used for the study were collected through a cross-sectional survey using well-structured questionnaires. Questionnaire administration was undertaken by local enumerators selected from the agricultural development sector. The enumerators were trained in the use of the questionnaires and the questionnaires were pre-tested in the local language in non-target villages before the survey. Out of the 480 questionnaires administered, 443 were used for data analyses. Thirty-seven were rejected due to incomplete information and data inconsistencies.

Method of data analysis

Descriptive statistics such as dominance analysis means, and relative frequencies were used to describe the socioeconomic characteristics of the farmers, their perception and understanding of climate change, and adaptation strategies. Perception statements on climate change were used to establish farmers' understanding of climate change with a five-point Likert scale as follows: Strongly agree (5), Agree (4), Undecided (3), Disagree (2), and Strongly disagree (1). The mean score for each perception statement was computed. The mean score was categorized into low (< 2.5), medium (2.5 – 3.5), and high (> 3.5). The level or extent of change experienced in the incidence of climate variations in recent years was determined using a three-point Likert scale as follows: Great Extent = 2; Minimal Extent = 1 and No Extent = 0. The mean of the level of change experienced in the incidence of climate variation was computed. The mean score was categorized into low (< 0.70), medium (0.71 – 1.40), and high (> 1.41). A linear regression model was used to determine the effects of the incidence of climate variation and selected farmers' socioeconomic characteristics on the annual farm income of the crop farmers. Explicitly, the estimating equation was

$Y = a + b_1X_1 + b_2X_2 + b_3X_3 \ldots\ldots\ldots\ldots b_{10}X_{10} + e$

where:

Y = Annual farm income (Naira)

X_1 = Mean score of incidence of climate variation experienced

X_2 = Household headship (yes = 1, 0 otherwise)

X_3 = Sex of respondent (Male = 1, Female = 0)

X_4 = Age of respondent (years)

X_5 = Marital status (Married = 1, 0 otherwise)

X_6 = Level of formal education (years)

X_7 = Household size (Number)

X_8 = Experience in food crop production (years)

X_9 = Farm size (Hectare)

X_{10} = Farm distance to market (km)

e_i = Error term

Results and Discussion

Socioeconomic characteristics of sampled food crop farmers

Dominance analyses of some important socio-economic variables are presented in Table 1. The results showed that an average food crop farmer was a male and married with a mean age of 48 years suggesting that the farmers were not old. This gives hope for a promising future of food crop production in the state. Table l also shows that the mean household size was six members with 76 percent of the respondents having between 5 to 10 people in the household. Furthermore, an average crop farmer in the study area had 25 years of farming experience. Respondents on average had seven years of formal education suggesting that the literacy level was fair among the sampled farmers. The literacy level of the respondents is expected to have a negative effect on their choice of inputs, the utilization of existing inputs, and understanding of climate change as well as their willingness to adopt climate change coping strategies. The mean income per production year made by food crop farmers was ₦578,710 while the annual income from non-farm activities was ₦147,464. From the descriptive statistics of the socio-economic profile of the farmers, it could be observed that 66 percent of the food crop farmers had less than two hectares of land implying that the farmers in the study area were operating on a small scale. In addition, 68 percent of sampled farmers did not receive any visit from extension agents in the 2017 planting season suggesting

deprivation of important productivity-enhancing information. About seventy-five percent of the farmers traveled between one to five kilometers from the house to the farm with a mean value of 4.7km while the average distance from the farm to the nearest major market was 6.5 km. The long time traveled could result in loss of time, loss of energy, and an increase in the cost of marketing.

Crops produced and farm size

Analysis of the farm size, crops cultivated, and the number of farmers cultivating the crops in the study is presented in Table 2. The results revealed that cassava, produced by 93 percent of the farmers was the most cultivated crop followed by maize produced by 89 percent of the farmers while pepper came third with 115 farmers (26 percent). Furthermore, groundnut and watermelon were not popular among the farmers in the study area. The study also revealed that the mean farm size for all the crops was less than two hectares except banana/plantain which was 2.89 suggesting that the majority of the farmers were still operating on a small scale.

Farmers' understanding of climate change in the study area

Analysis of the perception statements on climate change (presented in Table 3) revealed that the crop farmers in the study area expressed their understanding of climate change when the mean score for all the perception statements considered in the study was either medium or high ranging from 2.74 to 4.85. Specifically, the perception of farmers on the effect of climate change on soil fertility had the highest mean score of 4.85 while their perception of if climate change is a form of punishment from gods had the lowest mean score of 2.74. Generally, 50 percent of the perception score had a mean score of more than 4 thus establishing the fact that farmers had a great understanding of climate change.

The extent of change experienced in the incidence of climate variables.

The extent of change experienced in the incidence of climate variations by crop farmers in the study area was established using a three-point Likert scale (great extent = 2, minimal extent = 1, and no extent = 0). The results presented in Table 4 revealed that the extent of change experienced in the incidence of climate variations by crop farmers in the study area had a mean score ranging from 0.76 to 1.61 suggesting medium and high extent of change. The extent of change in the growing season had the highest mean score (1.61) while flooding had the lowest mean score (0.76). Poor crop yield (1.43) and an increase in cost of production (1.50) were the two other factors greatly experienced by farmers. This revelation confirmed that crop farmers experienced changes in their production due to the variation in climate. This could have a great effect on their crop output and income-generating abilities.

Effect of perceived climate change on farmers' income

A regression model was used to ascertain the possible effect of the perceived extent of change experienced by farmers on the annual farm income of the crop farmers. Some selected socioeconomic variables were also included in the model. The analysis of variance revealed an F value of 98.19 which was significant at one percent. The coefficient of determination value of 0.70 implies that the independent variables were able to explain the dependent variables by 70 percent. The regression results presented in Table 5 revealed that the mean score of incidence of variation experienced by farmers, household headship, sex of farmer, level of formal education, household size, farm size, and distance of the market from the farm were the factors that significantly affected the annual farm income generated by farmers.

Climate change adoption strategies

The evidence provided in the study has shown that crop farmers in Ogun State were aware and had an understanding of climate change and the level of change experienced in the incidence of climate change variation. Unless appropriate adaptation measures and strategies are taken, climate change will continue to affect farmers' production levels and income generated from farming. However, using these strategies requires information from farmers since their ability to adapt and cope with climate change depends on their knowledge, skills, experiences, and other socioeconomic factors

(Mahargan *et al*., 2011; Olasheinde, 2015). The results presented in Table 6 showed that farmers used several adaptation strategies. This revelation was also reported by Pangapanga *et al*. (2012) who reported farmers adopted several strategies to cope with the incidence of climate change. Notwithstanding their understanding of climate change, about 41 percent of the farmers used mixed cropping as coping strategies which happened to be the most used coping strategies. A possible explanation is that usage and subsequent adoption of any strategy comes at a cost and since the majority of the rural farmers are poor, they may not have the required financial capabilities to use the strategies such as application of fertilizer, irrigation, shifting cultivation due to high cost of land clearing. This explanation was supported by the findings of Adebisi-Adelani and Oyesola (2014) and Lipper *et al*., (2014) when they reported that households have low adaptive capacity to the adverse effects of climate change due to widespread poverty, low infrastructural and technological development, inequitable land distribution, low education levels and absence of social safety nets among other factors. In addition, low level of coping capabilities was also reported by Nwafor (2007); Japtap (2007), and Odjugo (2010).

Conclusion

The evidence provided in this study revealed that cassava and maize were the most cultivated crops in the state. Farmers in the study area had an adequate understanding of climate change and the level of change experienced in the incidence of climate variation. The mean score of incidence of variation experienced by farmers, household headship, sex of farmer, level of formal education, household size, farm size, and distance of the market from the farm were the factors that significantly affected the annual farm income generated by farmers. Furthermore, low usage of adaptation strategies was evident in the study area. The study recommended policies targeted at cassava and maize farmers to boost food crop production in the state. In addition, the formulation of policies centered on increasing the income-generating ability of the farmers to enhance their usage of coping strategies to ameliorate the adverse effects of climate change.

Acknowledgment

This research work with reference number OOU/IBR.006 was sponsored by Olabisi Onabanjo University and Tetfund under the Institution Based Research (IBR) scheme.

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Table 1: Dominance analysis of crop farmers' socioeconomic characteristics

Socioeconomic Characteristics	Dominant indicator	Min	Max	Mean	SD
Sex (male = 1,female = 0)	79% were males	0	1	0.79	0.408
Age (years)	64.6% were aged between 40-59	20	76	47.78	10.742
Marital Status (married = 1, others = 0)	91% were married	0	1	0.91	0.287
Formal education (years)	72.7% had 6 to 12 years	0	17	7.37	4.390
Household size (number)	76.3% had between 5-10 people	1	18	6.29	2.502
Farming Experience (years)	52.7% had between 10-25 years	2	55	24.67	11.504
Annual Farm income (N)	62.9% earned less than N500,000	35,000	10,000,000	578,710	1917812.2
Annual nonfarm income (N)	65.2% earned less than N150,000	0	1,800,000	147,464	240815.2
Farm size (ha)	66.5% had less than 2 ha	0.1	43	1.94	3.631
Home to farm (km)	74.6% travelled between 1-5 km	0.4	24	4.76	3.512
Farm to Market (km)	53.5% travelled between 1-5 km	0.8	30	6.53	4.458
Extension agent visit (No)	68.5% did not receive any visit	0	10	0.61	1.48

Source: Field survey, 2017 ***Min = Minimum*** ***Max = Maximum*** ***SD = Standard deviation*** ***N365 = $1***

Table 2: Crops produced, farm size, and the number of farmers (n=443)

Crop	Number of farmers	Relative frequency	Mean farm size (Ha)	Standard deviation
Maize	396	89.4	1.61	2.347
Cassava	412	93.0	1.96	3.599
Rice	20	4.5	0.8	0.385
Leafy vegetable	69	15.6	1.30	4.127
Tomato	78	17.6	1.31	3.872
Pepper	115	26.0	1.12	3.214
Melon	14	3.2	1.75	2.664
Groundnut	7	1.6	0.65	0.472
Banana/Plantain	31	7.0	2.89	6.131
watermelon	5	1.1	1.12	0.576

Source: Field survey, 2017

Table 3: Perception of farmers on climate change (n=443)

Perception statements on climate change	Response						
	SA 5	A 4	U 3	D 2	SD 1	Mean score	
Farmers do not know the causes of climate change	37.02 (164)	35.21 (156)	4.51 (20)	9.26 (41)	14.00 (62)	3.72	Medium
Climate change is caused by the negative activities of man on the environment	13.09 (58)	36.34 (161)	21.44 (95)	17.16 (76)	11.96 (53)	3.71	Medium
Climate change is a form of punishment from the gods	6.55 (29)	24.38 (108)	25.28 (112)	23.70 (105)	20.09 (89)	2.74	Medium
Farmers need enlightenment on the causes of climate change	26.86 (119)	46.05 (204)	8.58 (38)	7.67 (34)	10.84 (48)	3.80	High
Changes in rainfall patterns and intensity an evidence of climate change	18.96 (84)	59.59 (264)	12.64 (56)	5.42 (24)	3.39 (15)	3.93	High
The remarkable alteration of rainy and dry seasons is due to changes in climate	20.54 (91)	54.18 (240)	16.93 (75)	6.09 (27)	2.26 (10)	3.85	High
Climate change is the cause of high sunshine intensity and temperature being experienced in most areas	22.57 (100)	52.60 (233)	15.80 (70)	7.00 (31)	2.03 (100)	4.07	High
Rivers are drying up due to climate change	27.77 (123)	44.92 (199)	11.29 (50)	11.29 (50)	4.74 (123)	3.98	High
Climate change has an impact on soil fertility	33.63 (149)	47.40 (300)	11.06 (49)	6.09 (27)	1.81 (8)	4.85	High
Pests and diseases of plants and animals have increased due to climate change	39.05 (173)	44.70 (198)	4.97 (22)	6.32 (28)	4.97 (22)	4.07	High
Many areas now experience increased drought due to changes in climate	30.70 (136)	52.14 (231)	7.90 (35)	6.55 (29)	2.71 (12	4.04	High
Predicting the weather is now more difficult due to climate change	42.21 (187)	50.34 (223)	3.39 (15)	3.61 (16)	0.45 (2)	4.30	High
There has been a change in relative humidity in many areas due to changes in climate	33.18 (147)	53.95 (239)	8.13 (36)	4.51 (20)	0.23 (1)	4.16	High
There has been an increase in the movement of herdsmen towards southern Nigeria due to climate change.	48.08 (213)	34.31 (152)	6.32 (28)	8.58 (38)	2.71 (12)	4.14	High
There has been a reduction in crop yield due to climate change	42.44 (188)	43.79 (194)	4.29 (19)	7.22 (32)	2.26 (10)	4.17	High
Climate change is an occurrence that can be checked	22.80 (101)	30.93 (137)	31.60 (140)	11.74 (52)	2.93 (13)	3.59	High

SA=Strongly Agree A=Agree U=Undecided D=Disagree SD=Strongly Disagree
Source: Field survey, 2017 Figure in parentheses = frequency

Table 4: The extent of change experienced in the incidence of climate variation (n=443)

Incidence	Great Extent (2)	Minimal Extent (1)	No Extent (0)	Mean score	Remark
Drought	38.60 (171)	41.31 (183)	20.09 (87)	1.19	Medium
Flooding	19.41 (86)	36.57 (162)	44.02 (195)	0.76	Medium
Increased temperature	18.74 (152)	46.73 (207)	34.54 (83)	1.15	Medium
Changes in planting time	64.11 (284)	32.51 (144)	3.39 (15)	1.61	High
Pest and disease attack	34.54 (153)	56.21 (249)	9.26 (41)	1.25	Medium
Poor crop yield	49.21 (218)	44.92 (199)	5.87 (26)	1.43	High
Delay in harvesting	27.54 (122)	57.56 (255)	14.90 (66)	1.13	Medium
Increase in cost of production	58.01 (257)	34.31 (152)	7.67 (34)	1.50	High
Poor health of farmers	33.18 (147)	44.92 (199)	21.90 (97)	1.11	Medium
Destruction of farms by cattle	46.05 (204)	29.80 (132)	24.15 (107)	1.22	Medium
Low farmers' income	41.53 (184)	46.73 (207)	11.74 (52)	1.30	Medium

Source: Field survey, 2017 ***Figure in parentheses = frequency***

Table 5: Regression results of the effect of perceived climate change on income

Variables	Coefficient	t-value	Sig. Level
(Constant)	371968.967	1.048	0.295
Mean score of incidence of variation experienced	-332145.135**	-2.591	0.010
Household headship (1 = household head, 0 otherwise)	561556.589**	2.374	0.018
Sex of respondents (1 = male, 0 otherwise)	-488771.667*	-2.082	0.038
Age of respondents (years)	6553.793	0.845	0.399
Marital status of respondents (1 = married, 0 otherwise)	75083.956	0.373	0.709
Level of formal education (years)	29869.805**	2.388	0.017
Household size (number)	-63381.059***	-2.638	0.009
Farming experience (years)	-7676.762	-1.046	0.296
Farm size (hectare)	432046.620***	29.946	0.000
Farm distance from major market (km)	-30118.329**	-2.564	0.011
F-value	98.188***		
R Square	0.70		
Adjusted R Square	0.69		

Source: Field survey, 2017 ****** 1% ** 5% * 10%***

Table 6: Adopted climate change coping strategies (multiple responses allowed)

Strategies	Frequency	Relative frequency
Soil conservation	157	39.50
Change in planting date	150	33.86
Use of agroforestry product	5	1.13
Planting of improved seeds	42	9.48
Mixed cropping	182	41.08
Shifting cultivation	75	16.93
Irrigation	30	6.77
Application of agrochemicals	127	28.67
Mulching	72	16.25
Application of fertilizer	114	25.73

Source: Field survey, 2017