CLIMATE CHANGE VARIABILITY AND ASSOCIATED HEALTH EFFECTS AMONG FARMING HOUSEHOLDS IN ONDO STATE, NIGERIA

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ABSTRACT

Objectives: The study examined climate change variability and associated health effects among farming households in Ondo State, Nigeria. It specifically described the socioeconomic characteristics of the farming households, identified the health issues experienced as a result of climate change, and analyzed the determinants of health effect of climate change and other socioeconomic variables among farming households in the study area.

Methods: One hundred and twenty respondents selected through multistage sampling technique were used for the study. Data were collected with the aid of questionnaire and analyzed using descriptive and logit regression model.

Results: Majority (92.9%) of the respondents were male, married (82.1%) with a mean household size of six people and a mean age of 49 years. Headache (95.5%), dizziness (95%), malaria (92%), body weakness (91.1%), cough (81.3%), typhoid fever (67.9%), skin rashes (58%), and rheumatic pain (48.2%) were the major health problems experienced by the farming households as a result of climate change in the study area. The significant variables determining the health effects of climate change among farming households in the study area were temperature ($p<0.01$), relative humidity ($p<0.01$), rainfall ($p<0.01$), sunshine ($p<0.01$), pressure ($p<0.10$), sex ($p<0.10$), marital status ($p<0.01$), household size ($p<0.10$), farming experience ($p<0.01$), and income ($p<0.05$).

Conclusion: The health and well-being of the farming households were compromised by the vagaries in climatic condition in the study area. Hence, agricultural extension workers should be empowered to accommodate health education and preparedness measures that take into account, differences in the level of exposure, perceptivity, and acclimation capacity of different households may help to alleviate health effects of climate change on farming households in the study area.

Keywords: Climate change, Health, Farming households, Variability.

INTRODUCTION

Agriculture is a vital part of Nigerian economy as it contributes greatly to food production, raw materials for industrial production, employment generation, and foreign exchange earnings [1]. In spite of the dominance of petroleum, it contributed 23% to Nigeria's Gross Domestic Product in 2017 [2]. Despite the contribution of this sector to national development, it has been plagued with neglect due to over reliance on crude oil, poor infrastructure, poor input supply, and increasing changes in climate. Agricultural production in Nigeria is purely rainfed, hence, the country is highly susceptible to the impacts and threats of climate change variables, rainfall, temperature, and seasonal fluctuations [3].

Climate change is a major threat to economic development, impeding effective and efficient agricultural production globally. Climate change affects the social and environmental determinants of health and it is projected to cause about 250,000 additional deaths per year from malnutrition, malaria, diarrhea, and heat stress between 2030 and 2050 [4]. In Ondo State, climate change is evident in delayed onset of rains, erratic rainfall during the wet season, increases in number of dry days during the wet season, increases in temperature, and dry season. In recent years, farmers have been faced with the problems of poor yield occasioned by climate variability, especially delayed onset and erratic rainfall during the growing season, in addition, the problem of flood, high temperature, incidences of diseases, and pest infestations have also exacerbated famers' loss which, therefore, increases the incidence of

poverty and malnutrition [5]. Increasingly, climate change contributes to more frequent and acute droughts, floods, fires, and other weather-related disasters, thereby affecting farmers' health [6,7]. Changes in climate have also been recognized as a major contributor to the global burden of non-infectious diseases such as respiratory and airway diseases; cancers; cardiovascular diseases and strokes; food contamination and malnutrition; heat-related mortality and morbidity; and adverse effect on growth, developmental, and mental well-being [8]. According to WHO [9], climate change is expected to increase mean annual temperature, intensity, and frequency of heat waves in Nigeria, resulting to a greater number of people, the elderly, children, the chronically ill, and at risk of heat-related medical conditions. Furthermore, significant health threat has been connected with variation in the pattern and prevalence of utmost weather events such as flooding, droughts, coastal sea level rise, and storms resulting in massive internal displacement, accidents, morbidity, and mortality [10]. Furthermore, the impact of drought and flooding is associated with exacerbating effects of environmental pollution resulting to increased exposures of both humans and animals to such pollutants with threatening health outcomes [11]. It is against this backdrop that this study aimed at examining the health effect of climate change variability among farming households in the study area. Specifically, the study described the socioeconomic characteristics of the farming households, identified the health issues experienced as a result of climate change variabilities, and analyzed the determinants of health effect of climate change and other socioeconomic variables among farming households in the study area.

Aminu et al.

Innovare Journal Of Agri. Sci, Vol 9, Issue 4, 2021, 10-13

METHODOLOGY

Study area

The study was carried out in Ondo state, Nigeria. Ondo State is one of the six states that made up Southwest Nigeria, created on February 3, 1976. The state has its headquarters in Akure. Ondo state borders Ekiti State to the north, Kogi State to the northeast, Edo State to the east, Delta State to the southeast, and Ogun and Osun States to the southwest. It lies between longitude $4^0 30''$ and 6^0 east of the Greenwich Meridian and latitude 5^0 45 and $8^0 15''$ north of the equator. The state has a total land area of 15,500 km^2 and a population of 3,460,877 as at 2006 census. The state has a tropical climate with its characteristic high temperature all the year round, heavy rainfall during the rainy season (April–October), and dry wind during the dry season (November–March). This favorable climate accounts for predominance of farming activities in the state. Both arable and permanent crops are widely grown in the state. Apart from crop farming, inhabitants also engaged in occupations such as fishing, logging, trading, and civil service

Sampling procedure

Multistage sampling technique was used in selecting the respondents for this study. Ondo State is divided into two agricultural zones which are Ondo North and Ondo South. The first stage involved the random selection of one Local Government Area (LGA) from each agricultural zones, namely, Owo LGA from Ondo North zone and Okitipupa LGA from Ondo South zone. In the second stage, simple random sampling technique was used to select four villages in each LGA making a total of eight villages. At the last stage, 15 farming households were randomly selected from the selected villages making a total of 120 respondents for the study. However, a total of 112 respondents were used for analysis as others were discarded due to incomplete information. The total number of questionnaires used for analysis represented 93.3% of the total number of sampled farming households.

Both primary and secondary data were used for the study. The secondary data were collected from Nigerian Meteorological Agency, Ondo chapter, to elicit latest information on climate change variables. The primary data were obtained from a field survey through the use of a well-structured questionnaire, administered through personal interview. The questionnaire was designed to elicit information on the socioeconomic characteristics of the farmers and health effects of climate change among the farming households.

Analytical techniques

Descriptive statistics such as mean, frequency, and percentages were used to analyze the socioeconomic characteristics and health problems experienced by the farming households in the study area.

Logit regression model

This was used to analyze the determinants of health effect of climate change variables and socioeconomic factors among farming households in the study area. The model is specified as follows:

$$Z_i = b_o + b_1 x_1 + b_2 x_2 + b_3 x_3 + \ldots + b_n x_n \qquad \text{Eq. (1)}$$

The dependent variable (Z_i) is a dummy. It takes the value of 1 if there is any health problem as a result of climate change among the farming households and 0 if otherwise.

Where:

X_1 = Temperature (0^C); X_2 = Rainfall (mm); X_3 = Relative humidity (%); X_4 = Sunshine (hours); X_5 = Wind (knots); X_6 = Pressure (Pa); X_7 = Age (years); X_8 = Sex (dummy); X_9 = Education (years); X_{10} = Marital status (1 if married, 0 otherwise); X_{11} = Household size (number of people); X_{12} = Farm size (ha); X_{13} = Farming experience (years); X_{14} = Cooperative society (dummy); X_{15} = Access to credit (dummy); X_{16} = Extension contact (frequency); and X_{17} = Income (₦)

RESULTS AND DISCUSSION

Socioeconomic characteristics of the respondents

Table 1 presents the result of the socioeconomic characteristics of the respondents in the study area. The result reveals that majority (92.9%) of the respondents were male while 7.1% were female. This implies that farming activities were male dominated in the study area. This could be due to the fact that farming activities are highly laborious and capital intensive and therefore beyond the capacity of most women. This is consistent with the findings of Ume *et al.* [12]. Age distribution of the respondents shows that majority (51.8%) of the respondents were above 50 years of age. The mean age of 49 years implies that the respondents are getting old. This result agrees with the findings of Okoye *et al.* [13] that the ability of a farmer to do manual work, take risk, and adopt innovation, especially as the climate changes, decreased with age.

A higher percentage (33%) of the respondents had primary education. The modal educational level of primary education implies that the respondents had low level of education which could slow down the rate of innovation adoption in the study area. This result corroborates the reports of Adebayo *et al.* [5] that educated farmers adopt measures that could mitigate the effects of climate change faster than uneducated farmers. Furthermore, 82.1% of the respondents were married with

Table 1: Distribution of respondents by socioeconomic characteristics n=112

Description	Frequency	Percentage	Mean	Std. dev.
Sex				
Male	104	92.9		
Female	8	7.1		
Age				
≤40	31	27.7	49.22	13.696
41–50	23	20.5		
>50	58	51.8		
Educational status				
None formally	27	24.1	Primary	
Primary	37	33.0		
Secondary	34	30.4		
Adult/vocational	5	4.5		
Tertiary	9	8.0		
Marital status				
Single	5	4.5		
Married	92	82.1		
Divorced	15	13.4		
Household size				
≤5	46	41.0	6	2.360
6–10	61	54.5		
≥10	5	4.5		
Total farm size				
<0.5	41	36.6	0.97	0.062
0.51–1	46	41.1		
>1	25	22.3		
Farming experience				
≤20	49	43.8	23.88	14.144
21–40	48	42.8		
>40	15	13.4		
Cooperative society				
No	66	58.9		
Yes	46	41.1		
Credit access				
No	107	95.5		
Yes	5	4.5		
Extension contact				
No	80	71.4		
Yes	32	28.6		
Income				
<100,000	43	38.4		
100,000–150,000	24	21.4		
151,000–200,000	37	33.0		
>200,000	8	7.1	150,330.36	7045.618

Aminu et al.

Innovare Journal Of Agri. Sci, Vol 9, Issue 4, 2021, 10-13

a mean household size of six people. This implies that the farming households are moderately sized and this could impact on family labor availability in the study area. Table 1 further reveals that 41.1% of the respondents cultivated between 0.51 and 1 hectares of farmland. The mean farm size of 0.97 hectares implies that the respondents were small-scale farmers. Distribution by farming experience reveals that most (43.8%) of the respondents had farming experience of 20 years or less, 42.8% had between 21 and 40 years' experience, while 13.4% had more than 40 years farming experience. The mean farming experience of about 24 years implies that the respondents were well experienced in farming and this could help them understand the changes in climate better than inexperienced farmers. This result is in line with the findings of Ume *et al.* [12], Ozor [14], that experienced farmers are always able to respond timely and cope with the vagaries in climate because they have a better understanding of the terrain, risks, and sign of climate change as it applies to their trade. Furthermore, majority (58.9%) of the respondents did not belong to cooperative association, 95.5% had no access to credit facilities, and 71.4% had no contact with extension agents. These imply that the respondents were not likely to have the opportunity to have effective interaction with other farmers, have poor access to production input, farm information, and untimely dissemination of research results and technical assistance on climate change in the study area.

Health problems experienced among farming households as a result of climate change

The results on the health problems experienced among farming households as a result of climate change variability in the study area are presented in Fig. 1. The result reveals that headache (95.5%) was the highest illness experienced in the farming households as a result of climate change variability in the study area. This could be as a result of excessive sunshine and increased temperature induced by climate change in the study area. Other health problems experienced were dizziness (95%), malaria (92%), body weakness (91.1%), cough (81.3%), typhoid fever (67.9%), skin rashes (58%), and rheumatic pain (48.2%). These health problems would result in absenteeism from farm work, decreases farmers working capacity, decrease ability to adopt innovation, and explore diverse farming practices in the face of changing climatic conditions in the study area. Hawks and Ruel [15], Munongo and Chitungo [16] pointed out that, in agrarian communities, poor health reduces income; efficiency and productivity which, in addition, decreases farmers' ability to manage health problems and impede economic development.

Determinants of health effects of climate change and other socioeconomic variables among farming households in the study area

Result in Table 2 reveals that temperature (p<0.01), relative humidity (p<0.01), rainfall (p<0.01), sunshine (p<0.01), pressure (p<0.10), sex (p<0.10), marital status (p<0.01), household size (p<0.10), farming experience (p<0.01), and income (p<0.05) were the significant climate change and socioeconomic variables determining the health effects of climate change among farming households in the study area.

The coefficient of temperature had direct significant relationship with health problems at 1% alpha level in the study area. This implies that the probability that the farmers or any member of their households would experience health problems as a result of climate change increases with increase in temperature in the study area. This result corroborates the findings of Hajat *et al.* [17] that there is a link between high death rate and high temperature and heat waves as a result of climate change in the United Kingdom. In the same vein, the coefficients of rainfall, relative humidity, sunshine, and pressure were found to be positive and significant at 1% and 5% alpha levels, respectively. This implies that the probability of experiencing health problems as a result of climate change increases with increase in intensity of relative humidity, rainfall, sunshine, and pressure in the study area. This result is a strong indication that increase in these climate change variables has the tendency to inflict more harm not only on farming

Table 2: Logistic regression result on effect of climate change and socioeconomic factors on the health of farmers in the study area

Variables	β coefficient	Wald	Sig.
Temperature	2.983***	4.413	0.000
Rainfall	0.107***	−3.344	0.001
Relative humidity	0.442***	2.675	0.009
Sunshine	0.160***	3.287	0.001
Wind	0.001	0.008	0.994
Pressure	1.312**	2.133	0.037
Age	0.182	1.348	0.181
Sex	0.192**	2.395	0.041
Educational level	0.008	0.322	0.748
Marital status	−0.259***	−3.423	0.001
Household size	−0.127**	−1.834	0.047
Farm size	0.023	0.296	0.768
Farming experience	−0.203***	−3.468	0.001
Cooperative society	0.014	0.215	0.830
Access to credit	0.004	0.030	0.976
Extension contact	−0.027	−0.419	0.676
Income	−0.096**	−2.407	0.033
Constant	1.054	0.260	0.796
Model summary			
−2 Log likelihood	Cox and Snell R square	Nagelkerke R square	Chi-square
114.59	0.347	0.855	7.345

**, ***Signify significance at 5% and 1% levels, respectively
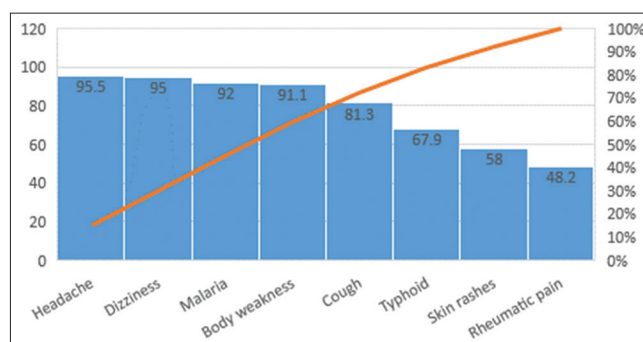
Fig. 1: Health problems caused by climate change on farming households

activities and the ecosystem but also on the farmers' health. According to WHO [9], "In addition to deaths from drowning, flooding causes extensive indirect health effects, including impacts on food production, water provision, ecosystem disruption, infectious diseases outbreak, and vector distribution. Longer terms effects of flooding may include post-traumatic stress and population displacement" [18] submitted that economic losses and turmoil caused by climate change can lead to mental health problems.

The coefficient of sex was positive and significant at 5% alpha levels. This shows that the probability of experiencing health problems among the farming households increases with sex, implying that male household member was more susceptible to diseases and health issues as a result of climate change than their female counterparts in the study area. This could be due to the fact that males were more involved in farming activities than their female counterparts in the study area. Conversely, marital status and household size were negative and significant at 1% and 5% alpha levels, respectively. This implies that married household heads with large household size were less likely to experience health problems as a result of climate change and vice versa in the study area. Large household size depicts more hands to work on the farm, thereby reducing the workloads, stress, and the attendant health problems in the study area. Farming experience was also found to reduce the probability of experiencing health problems in the study

Aminu et al.

Innovare Journal Of Agri. Sci, Vol 9, Issue 4, 2021, 10-13

area as it was negative and significant at 1% alpha level. Experienced farmers are able to device coping strategies to timely mitigate the effect of climate change, thereby reducing the health consequences. Finally, income of the farming households had an inverse relationship with health problems at 5% alpha levels in the study area. This implies that the probability of having health problems as a result of climate change reduces with income in the study area. Farming households with higher income were found to be less susceptible to diseases or health challenges as a result of climate change than those with lower income in the study area. Higher income earner households have resources to hire farm labor, thereby reducing the health effects of climate change on their households. According to Paavola [19], "socioeconomic factors, pre-existing medical conditions, and social deprivation are the key factors that make people vulnerable to health impacts of climate change and experience more adverse health outcomes than others."

The Nagelkerke R square was 0.855 which implies that about 85% of the variations in effect of climate change on the health of the farming households were accounted for, by the independent variables included in the model. The Chi-square of the regression model was significant at 1% alpha level indicating that the model fits the data well.

CONCLUSION

It is evident from the findings of this study that the health and well-being of the farming households were compromised by the vagaries in climatic condition in the study area. In addition, climate change related pressures facing farmers due to uncertainty in weather conditions and other variables aggravate the stresses intrinsic to farming. Therefore, agricultural extension workers should be empowered to accommodate health education and preparedness measures that take into account differences in the level of exposure, perceptivity, and acclimation capacity of different households to help alleviate health effects of climate change on farming households in the study area. Furthermore, meteorological stations should be adequately equipped with modern climate forecasting devices and the personnel well trained to make precise and timely weather information available to farmers for proper and effective adaptation purposes.

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