

## Research Article

### An Evaluation of Effect of Climate Change on Food Security of Rural Households in Cross River State, Nigeria

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**Abstract:** The study focused on the linkage between climate change and food security of rural households in Cross River state. The specific objectives are to ascertain the level of food security of rural households and impacts of climate change factors on the food security of rural households. Cross River State is located within Latitude 05°13' 26'' North and longitude 08° 17' 44'' East with an estimated population of 2,888,966 persons. The state is a coastal area usually affected by climate events (flooding) coupled with existing oil spillage hazard. Multistage sampling procedure was used to select local government areas, communities and rural households for the study. Data were obtained from both primary and secondary sources and analyzed using descriptive statistic, food security index and correlation matrix. The mean annual income of the rural farming households in Cross River state was N71, 895 (\$412) revealing a low annual income with a large household size of 9 persons. The food security index in the State was found to be moderately food insecure with food security having statistically significant relationship with the climate change factors. The impact perceived by the rural households on climate events was severe. The percentage of losses of annual income was 67.07%. It is therefore recommended that Government and donor agencies should provide a short-term relief measures to alleviate the food insecurity situations in the state and entrench a policy of long term development of agriculture. The rural farming households should be encouraged to carry out climate change adaptation and mitigation measures in alleviating the food insecurity situation in the state.

**Keywords:** Climate change, cross river state, food security, Nigeria rural household

## INTRODUCTION

FAO's vision of a world without hunger is one which most people are able by themselves, to obtain the food they need for an active and healthy life and where social safety nets ensure that those who lack resources will get enough to eat" (FAO, 2007f). The achievement of the vision is a big question in Cross River state due to climate change impacts.

Climate change is a major threat to food security in many regions of the developing world, which are largely dependent on rainfed and labor-intensive agricultural production (Parry *et al.*, 1999, 2004; IPCC, 2001a). Although the issue of food security is directly linked to climate variability and change (Winters, 1999; Reilly, 1995), it must be noted that climate is not the single determinant of yield, nor is the physical environment the only decisive factor in shaping food security (Parry *et al.*, 2004). But climate change would severely compromise agricultural production and access to food (IPCC, 2001a). This applicable to the developing countries, so climate change study as it relate to food security must be taken seriously due to its negative impacts. This is in line with the finding of the

United Nation (2005) which observed that growing populations and poor agricultural productivity have been the main reasons for food shortages in the regions of Sub-Saharan Africa and Southern Asia.

Food security is an essential element of overall well-being. Increasingly, in the last decade attention has been focused on means of eliminating food insecurity and hunger world-wide. The 1992, international conference on nutrition and the 1996 World Food Summit both emphasized the critical need to decrease food insecurity and hunger globally. Detailed understanding of food security globally is of greater significance in this study.

Food security exists, according to the world food summit draft plan of action, when all people at all times have physical and economic access to sufficient, safe and nutritious (and some would add culturally acceptable and adequate), food to meet their dietary needs for an active and healthy life (World Food Summit, 1996a). In other words, food security depends on the availability, accessibility, adequacy and acceptability of food.

The number of people without enough food to eat on a regular basis remains stubbornly high, at over 800

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million and is not falling significantly. Over 60% of the world's undernourished people live in Asia and a quarter in Africa (FAO, 2002). Food insecurity remains a global threat and human tragedy. Food insecurity results in considerable health, social, psychological and behavioural consequences and is undeniably linked to poverty. Climate change refers to the variation in the earth's global climate or in regional climates over time. It describes changes in variability or average state of the atmosphere overtime scales ranging from a decade to millions of years (Ikeme, 2001).

Food security is an environmental issue, because hunger as a result of food insecurity drives people to exploit marginal lands, misuse water supplies, exhaust soils and deforest the land. The forest also provide habitat for myriads of wildlife that are hunted for games to meet the protein needs of the rural household. According to FEPA (1992), the World Bank reports estimate that the animal term losses from deforestation to Nigeria will be around US\$750 million except mitigative measures are taken. The world's vegetation can be described as the renewable green gold (Odeyemi, 1998) on which the long term sustainability of life on earth rests. It is the single source of primary biological production that sustains the human population and animal species.

Climate change impacts are already visible and the most recent scientific evidence shows the problem is worsening fast, with current trajectories of Greenhouse Gas (GHG) emissions and sea-level rise outpacing previous projections (IARU, 2009). Changing temperature and precipitation averages and a more variable, unpredictable, or extreme climate can alter today's yields, earnings, health and physical safety and ultimately the paths and levels of future development. These are already manifesting in Nigeria including Cross River state in terms of low agricultural yield and ill health such as malaria and borne diseases.

Climate change phenomenon affects agriculture in a number of ways. For example, uncertainties in the onset of the farming season, due to changes in rainfall characteristics (early rain may not be sustained and crops, planted at their instance may become smothered by heat waves). This can lead to an unusual sequence of crop planting and replanting which may result in food shortages due to harvest failure as was reported by Okoh *et al.* (2011). Extreme weather events such as thunderstorms, heavy winds and floods, devastate farmlands and can lead to crop failure. Pests and crop diseases migrate in response to climate changes and variations (e.g., the tsetse fly has extended its range northward) and will potentially pose a threat to livestock in the drier northern areas (FAO, 2002).

The consequences of hunger and malnutrition are adversely affecting the livelihood and well-being of a

massive number of people and inhibiting the development of many poor countries (Gebremedhin, 2000). These led to the following research questions:

- What is the relationship between climate change and the food security of the poor rural households' in the state
- What is the food security status of the rural household in the state
- What are the impacts of climate change events on food security of the rural households in the state

## MATERIALS AND METHODS

**The study area:** Cross River State is located within Latitude 05° 13' 26'' North and longitude 08° 17' 44'' East. The State is covered by a body of waters from the tributaries of the Cross River and the Atlantic Ocean. This renders the land very fertile and provides abundant aquatic resources for exploitation. Two-thirds of Cross River State is covered by tropical rain forests, making it one of the world's biodiversity hotspots. The state is also blessed with mineral resources like: oil and gas; clay; salt; lime stone; kaolin, barite and quartzite ([www.en.wikipedia.org](http://www.en.wikipedia.org)).

Cross River State has a land mass of 21,930 km<sup>2</sup> with a population estimated at 2.89 million persons (National Population Census (NPC), 2006). Forty percent of the estimated population constitutes the active population that is engaged in various economic activities; ranging from subsistence agriculture to urban commerce and transport business.

Agriculture has, since 1970, been acknowledged as the leading economic sector of the state. Agriculture currently employs about 80% of the State's labour force and contributes about 40% to the Gross Domestic Products (GDP) of the State ([Crossriverstate.gov.ng](http://Crossriverstate.gov.ng)).

The Cross River State capital is Calabar and the State has 18 local government areas namely; Abi, Akamkpa, Akpabuyo, Bakassi, Bekwara, Biase, Boki, Calabar Municipal, Calabar South, Etung, Ikom, Obanliku, Obubra, Odukpani, Obudu, Ogoja, Yakuur and Yala. Cross River state climate and weather is tropical but temperate in the north eastern fringes, with dry and wet seasons, with major Languages as Efik, Ejagham, Bekwarra and English.

Multistage sampling procedure was used in random selection of local government areas, communities and households for the research study. Firstly, six local government areas were selected from the 18 local government areas. Secondly, 2 communities from each of the local government areas were selected, making it up to 12 communities. Finally, twenty five rural

households were randomly selected from each of the sampled communities making it up to 300 households. Data for this study were obtained using structured questionnaire survey. Properly filled questionnaires utilized for this research study were 284.

**Data collection:** The mean of annual time series data from Nigerian Meteorological Agency (NIMET) that include the following; temperature and rainfall from January, 1971 to December, 2009 were collected for the study. The primary data (field survey data) were obtained using structured questionnaire survey.

**Method of data analysis:**

**Descriptive statistics:** Descriptive statistics were used to summarize the socio-economic characteristics and to examine the severity of food insecurity as well as the food security status among rural farming households.

**Food security index:** Food security index was used to determine the level of food insecurity among the rural households that have been affected by flood and or other climate hazard over the past 38 years. Food security equation used by Feleke *et al.* (2003) and ways of measuring household food security status by Hoddinott (2001) were adopted for this study. The equation is stated as:

$$C^* = C_j - Y_j \tag{1}$$

Food security indicator for this study is defined by frequency and the number of different food consumed over a period of time.

where,

- C\* = Food security index of rural farming household
- C<sub>j</sub> = Quantity of food consumed (N = 1 to 5)
- Y<sub>j</sub> = Expected required food to be consumed (N = 5)
- If C\* = 0 = The household will be said to be a food secured household
- If C\* < 0 = Then the household will be said to be food insecure

The required food = carbohydrate, fat/oil, vitamin, mineral and protein given food. Hoddinott (2001) outlined four ways of measuring household food security status; among them is dietary diversity which involves determining the frequency and the number of different foods consumed by an individual over a period of time. Dietary diversity method of measurement was preferred to other methods as it is very difficult to calculate exactly the quantity of rural household food

consumption in kilogram's or calories as most daily food consumed by the rural farming households are not measured (Emaziye and Okoh, 2012).

Therefore, food security index of the rural farming household were obtained based on the frequency and the number of different foods consumed by household daily over a period of time (Carbohydrate, Vitamins, Water, Proteins, Minerals and Fat/oils). Water was excluded as all the rural households consume water daily; hence a food secured household is expected to consume all the 5 categories (Carbohydrate, Vitamins, Proteins, Minerals and Fat/oils).

Expected required food to be consumed (Y<sub>j</sub>) = 5

Quantity of food actually consumed daily (C<sub>j</sub>) ranges from 1 to 5

Food security index of rural household (C\* = C<sub>j</sub> - Y<sub>j</sub>) = 5-5 = 0 (food secured household)

While C\* < 0 is food insecure household, but for the purpose of this study the food insecure household category was further categorized into mild food insecure, moderately food insecure and severe food insecure household.

Food security index of rural household (C\* = C<sub>j</sub> - Y<sub>j</sub>) = 4-5 = -1 (Mild food insecure)

Food security index of rural household (C\* = C<sub>j</sub> - Y<sub>j</sub>) = 3-5 = -2 (Moderately food insecure)

Food security index of rural household (C\* = C<sub>j</sub> - Y<sub>j</sub>) = 2-5 = -3 (Severe food insecure)

**Correlation matrix:** Correlation matrix was used to determine the relationship between calculated climate Change variables coefficient of variation and food security of rural household in Cross River state.

$$Fs = A_{t_{cv}}T_{cv} + A_{r_{cv}}R_{cv} + A_{y_{cv}}Y_{cv} + e \tag{2}$$

where,

- Fs = Food Security
- T<sub>cv</sub> = Temperature coefficient of variation (%)
- R<sub>cv</sub> = Rainfall coefficient of variation (%)
- Y<sub>cv</sub> = Food production (yield) coefficient of variation (%)
- e = Error term
- A<sub>t<sub>cv</sub></sub>, A<sub>r<sub>cv</sub></sub>, A<sub>y<sub>cv</sub></sub> = Model parameters

**RESULTS AND DISCUSSION**

**Socio-economic characteristics of respondents:** The mean annual income of the rural farming households in Cross River state was N71, 895 (\$ 412) revealing a low annual income level which shows a poverty situation of the rural household of less than \$1 a day. The mean age

Table 1: Socio-economic characteristics of respondents in cross river state, Author computed result, 2011

Variables	Respondents	Percentages
Age (Years)	(n = 284)	(%)
30 – 39	34	11.9
40 – 49	118	41.6
50 – 59	103	36.3
60 – 69	29	10.2
70 – 79	0	
Mean	49 years	
Gender		
Female	126	44.4
Male	158	55.6
Marital Status		
Single	19	6.7
Married	178	62.7
Widow	51	18.0
Widower	6	2.1
Divorced	30	10.5
Educational Status		
Informal	84	29.6
Primary	117	41.2
Secondary	57	20.1
Tertiary	26	9.1
Mode	Primary school	
Household Size		
2 – 4	9	3.2
5 – 7	40	14.1
8 – 10	108	38.0
11 – 13	82	28.9
14 – 16	45	15.8
Mean (persons)	9	
Annual Income (₦)		
21,000-60,000	134	47.2
61,000-100,000	144	50.7
101,000-140,000	5	1.8
141,000-180,000	1	0.3
181,000-220,000	0	0.0
221,000-260,000	0	0.0
Mean (₦)	71, 895 (\$412)	

Author computed result, 2011

Table 2: Distribution of respondents according to food security index, Source: Field surveys data, 2011

Food security index	Cross river (n = 284)	Percentages
Food secured (0)	12	4.1
Mild food insecure (-1)	119	41.9
Moderately food insecure (-2)	122	43.0
Severe food insecure (-3)	31	11.0
Mean	Moderately food insecure	

Field surveys data, 2011

of respondents is 49 years. Most of them engage in farming activities and males dominate as the household heads (Table 1). The household size has a mean of 9 persons showing a large household size while primary school level of education was dominant in the state. Most rural households were married confirming that they were conscious on the level of climate change variables that affect food security in the state.

**Rural household food security index:** Table 2 shows the food security index in Cross River State to be moderately food insecure on the average. This is

Table 3: The relationship between climate change variables (temperature and rainfall) and food security in cross river state, Author computed result, 2011

Correlation	Food security (FS)	Temperature (Tcv)	Rainfall (Rcv)
Pearson	Fs 1.000	.	.
Correlation	Tcv .	1.000	
Sig. (1-tailed)	Rcv .		1.000
	Fs .	.000	.000
	Tcv .000	.	.
	Rcv .000	.	.
	Fs 5	5	5
	Tcv 5	5	5
	Rcv 5	5	5

Author computed result, 2011

Table 4: Distribution of respondents according to the level of impact of losses, Field survey data, 2011

Impact of losses	Cross River (n = 284)	Percentages
No effect (0)	31	10.9
Low (1)	21	7.4
Moderate (2)	38	13.4
Severe (3)	117	41.2
Very severe (4)	77	27.1
Mode	Severe	

Field surveys data, 2011

Table 5: Distribution of respondents according to estimated annual income losses (₦), Field survey data, 2011

Estimated losses (₦)	Cross river (n = 284)	Percentages
20,000 – 39,000	60z	20.1
40,000 – 59,000	184	64.8
60,000 – 79,000	40	14.1
80,000 – 99,000	0	0.0
Mean (₦)	48,221	

Field surveys data, 2011

confirmed by Olayemi (1996) that the issue of food insecurity is of high importance in Nigeria because average calorie and protein intake is grossly inadequate and that estimates showed that at least 41% of the population is food insecure: with 16% being severely undernourished. This situation if not properly checked will lead to non achievement of one of the millennium Development Goals (MDGs) initiative aimed at achieving food security globally (in particular the MDG1 – to eradicate extreme poverty and hunger).

**The relationship between climate change variables (temperature and rainfall) and food security in cross river state:**

The correlation matrix results in Table 3 reveals that rural household food security has a statistical significant relationship with the climate change variables (temperature and rainfall) in Cross River State. The results revealed that temperature and rainfall were contributors toward rural household food security in the state since they were statistically significant.

**Level of impact of losses:** Table 4 reveals that rural households in Cross River state perceived a severe impact of losses. This impact was as a result of climate

change events such as flooding that destroyed most of their agricultural production (yield). This brought a colossal loss in income arising from the loss in agricultural output.

The average estimated annual income losses per households of N48, 221 (\$ 321.47) recorded in the state. The percentage of annual losses to annual income was 67.07% losses (Table 5).

### CONCLUSION AND RECOMMENDATIONS

The mean annual income of the rural farming households in Cross River state was N71, 895 (\$ 412) revealing a low annual income level. This shows a poverty situation of the rural household of less than \$1 a day. The mean age of respondents is 49 years dominated by male headed households with a mean household size of 9 persons. The percentage of annual losses to annual income was 67.07% with a severe impact of losses witnessed in the state. Food security index in Cross River State reveals moderate food insecurity situation. The study revealed that temperature and rainfall were contributors toward rural households' food security in the state since they were statistically significant. The determination of the effects of climate change variables and events on rural households' food security will assist in the evaluation of rural households' economic and physical access to their daily food needs for a healthy life. Government and donor agencies should provide a short-term relief measures to alleviate the food insecurity situations in the state, as rural households are moderately food insecure. The rural farming households should be encouraged to carry out climate change adaptation and mitigation measures in alleviating the food insecurity situation in the state.

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