Effects of Climate Extreme Events on Households Food Security in Taraba State, Nigeria

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Abstract

Climate is particularly important, as a driver of food system performance at the farm end of the food chain, affecting the quantities and types of food produced and the adequacy of production-related income. Poor households will be hardest hit by soaring food prices since they have few coping mechanisms at their disposal. For such households, occurrence of Climate change extreme events will have an immediate impact on the quantity and quality of food they consume. Hence, the study sought to determine the effects of climate extreme events on food security of households in Taraba State. Primary data on the intensity and frequency of extreme events, socioeconomic characteristics of households, food security status based on the Household Food Insecurity Access Scale (HFIAS) was used for the study. One hundred and twenty households for the study were sampled by means of a multistage random sampling technique. Results show that the occurrence of drying up of streams and river, heat wave and harmattan duration experienced by the households positively affected the food insecurity of the household, and was significant at $p \leq 0.05$, Also, the frequency of occurrence of heavy and long periods of rain also led to an increase in food insecurity and was significant at $P \leq 10\%$. The study also found that food insecurity increases with an increase in household size and the longer diseases and pests lasted in or around the households the more food insecure they were. The study recommends that weather forecast stations monitoring climate occurrences be established and efforts made to inform households of these occurrences, so that they can adapt accordingly..

Key Words: Climate change, Climate change extreme events, Food security, Household food insecurity access scale

Introduction

Climate change most often results in further food insecurities, particularly for the resource poor in developing countries who find it difficult to meet their food requirements through market access. (FAO, 2008). It also affects agricultural food systems in all countries, exporters and importers alike, as well as those at subsistence level. In developing countries, climate change will cause yield declines for most important crops, and so the socio-economic impacts of climate change will increase the number of people at risk of hunger and food insecurity, migration and civil unrest (Enete et al., 2011). Climate is particularly important, as a driver of food system performance at the farm end of the food chain, affecting the quantities and types of food produced and the adequacy of production-related income. Poor households will be hardest hit by soaring food prices since they have few coping mechanisms at their

disposal. For such households, higher food prices will have an immediate impact on the quantity and quality of food they consume.

Safeguarding food security in the face of climate change also implies avoiding the disruptions or declines in global and local food supplies that could result from the occurrence of climate change extreme events changes in temperature and precipitation regimes and new patterns of pests and diseases (FAO, 2008). Enete et al (2011), noted that the food security threat posed by climate change is greatest for Africa, where agricultural yields and per capita food production have been steadily declining, and where population growth will double the demand for food, water and forage in the next 30 years. In northern Nigeria in particular, the impact of flood on the poor who lost most of their assets and civil unrest in localized areas, will threaten household food security. According to FEWS NET prediction, erratic rainfall in 2011, and low moisture affected crop production and fishing activities in the North regions of Nigeria (FEWS NET, 2011).The study sought to identify, describe and document evidences of climate change extreme events and also to determine the effects of climate extreme events on food security of households in Taraba State.

Methodology

Study was carried out in Taraba State, Nigeria. Taraba State is located in North East Nigeria and is a multi-ethnic state with over 80 different languages. Primary Data was used for the study. A set of pre-tested and well-structured interview schedule was used to gather information on the households: socio economic characteristics, food security status based on the HFIAS module, climate change effects on food security perceptions of the respondents, and evidences of climate change. The data collection lasted for two months, July to August, 2012.

Multi-stage sampling technique was used in selecting samples for this study. First, three agricultural zones, Zing, Wukari and Bali were randomly selected out of the four agricultural zones. Secondly, a proportional random sampling was used to select five local governments Jalingo, Lau, wukari, Bali, and Kurmi from the selected agricultural zones. Thirdly, two communities were randomly selected from each local government, amounting to ten (10) communities. Finally, twelve (12) households were randomly selected from the list of households in the communities obtained from their *Sarki* (community chief) making the sample size a total of one hundred and twenty (120) respondents.

Measurement of the food Security Status

Rasch model was used to assign food security scales or scores to households participating in the food security survey modules (HFIAS). The Rasch model seeks to model the probability that an examinee will correctly answer a test question or item as a function of the difficulty of the item and the latent (unobserved) ability of the examinee. The probabilistic Rasch model is defined as:

$$\text{Pi}(\boldsymbol{\theta}) = \frac{1}{1 + \exp\left[-1.7(\theta - \text{bi})\right]}$$

where $\boldsymbol{\theta}$ is the capability of the respondent, bi is the difficulty of the ith item, and Pi($\boldsymbol{\theta}$) is the probability of a correct answer on the ith item. In terms of measuring food security using the HFIAS, the latent ability of the respondent $\boldsymbol{\theta}$ is the extent of food insecurity and hunger experienced by the household and the difficulty of the ith item bi is the severity of the food insecurity measured by the item (question) (Opsomer, *et al*, 2003). The Rasch model then finds the probability that a household with food insecurity $\boldsymbol{\theta}$ will respond positively to the ith question with severity bi. (Froelich & Jensen, 2002).

According to Bickel et al., (2000), two measures of households' food security can be obtained from the data collected using the

HFIAS module, which are HFIAS scale score and categorical score

- *Household Food Insecurity Scale Score*

The sum of the occurrence during the past 12 months for the whole food insecurity-related conditions was calculated as: Sum occurrence question response code (Q1 + Q2 + Q3 + Q4 + Q5+ Q6 + Q7 + Q8 +Q9...+...Q_n). The full scale scored is ten (10) to the complete 18 and 10 question for households with and without children respectively.

- *Household Food Insecurity Access (HFIA) categories*

First, a HFIA category ***variable*** is calculated for each household by assigning a code for the food insecurity category in which it falls. The four food security categories are created sequentially, in the same order as shown below, to ensure that households are classified according to their most severe response. HFIA category are 1 = Food Secure, 2=Mildly Food Insecure, 3=Moderately Food Insecure, 4=Severely Food Insecure.

Measurement of the Extreme Events

There was no meteorological station in Taraba State, where data on extreme events could be found. This necessitated the collection of primary data on their climate conditions from households that were verified by the office of the Taraba State Agricultural Development Programme (TADP) .

Floods: flood frequency looked the number of times the flood came and the duration constituted how long the flood last before it cleared or dried

Cyclones: the frequency of occurrence varied in days but the duration was one day. Some of the respondents said its duration last between 20 minutes to one hour 30 minutes so the duration was approximated to one day, since, they were not exact on the number of hour but were certain it doesn't exceed one day. *Storm surge*: same as cyclone.

Erosion: The frequency considered the number of sites affected within 12 months while the duration looked at the time they noticed this erosion and when it was controlled. Fromtheir responses most of the erosion sites has lasted for about a year and has not been controlled.

Loss of freshwater supplies: the frequency looked at how many days they did not have fresh water for domestic purposes either due to drying up of water or contamination from flood or other pollutants and the duration considered how long it took before they could access fresh water.

Erratic rainfall patterns: it occurred more often than most events and usually last for one day, whether it is heavy or just a drizzle most of the respondents said it lasted for a day.

High rate of pest/disease incidence: frequency looked at the outbreak of human, animal and plant pest and diseases, like Lassa fever, cholera, crop pest etc. and the duration was on how long it lasted in the area before it was controlled. For those that experienced more than one outbreak, the duration was recorded for the one that lasted longer.

Drought: the frequency of occurrence and how long it lasted before the rain came back was measured.

Long period of dry season /harmattan: in this case, it was only the duration that varied as it occurs only once in the year, that isat the end of the rainy season. Hence, the problem was only the duration of the season.

Heavy and long period of rainfall: the frequency of occurrence, counted how many days it happened within a year from the time of the interview and the duration was measure in hours of rainfall to be able to capture the intensity of this rain.

Less rainfall: The frequency of less rain fall is usually during the rainy season, so it occurs once and the duration was measured in the number of day in the year

Increase weed infestation: many of the respondents said it occurred, once, that is during the rainy season and they cannot keep track of how many times they weeded both their surroundings and farms in the last one year because of incessant growth of weeds. The duration looked at how long it took the weeds to grow back after weeding.

Loss of soil fertility. Most soils lose their fertility once and the number of hectares also was considered as frequency and the duration considers the length of time that the respondent noticed this soil infertility.

Drying up of streams/rivers: this measured how many times the streams/rivers dried up and the duration measured how long it lasted before the stream normalized.

Results and Discussion

Socio Economic Characteristics of the Respondents

This section presents the respondent's socio-economic characteristics suchtribes, religion, household size, gender, age, marital status, highest educational qualification in the household, years of formal education, number of persons in the household with paid employment, occupation, monthly income, and monthly expenditure on food. The table 1shows that greater proportion (80.4%) of the respondents were Christians, while 19.6% were Muslims. About 82% of the household heads were males, while 17.6% were females, this showed that there were more male headed households in the study area.

Table 1a Socio-economic characteristics of the household heads

Household socio-economic variable	Variable components	Percentage
Religion	Muslim	19.6
	Christian	80.4
Gender	Female	17.6
	Male	82.4
Marital status	Single (never married and widowed)	35.2
	Married	64.8
Household type	With child	83.3
	Without child	16.7
Occupation	Civil servant	52.8
	Farmer	13.0
	Private sector employed	15.7
	Artisan	.9
	Trader	14.8
	Unemployed	2.8
Highest educational qualification in the household	No qualification	10.3
	First school leaving certificate	13
	O level	15.7
	OND/ NCE	25.9
	HND/first degree	30.5
	Post graduate Certificate	4.6

Source: Field survey, 2012

Table 1b Socio-economic characteristics of the household heads

Socioeconomic Attribute	Minimum	Maximum	Mean	Std. Deviation
Age	24.00	78.00	45.6574	10.70432
Household size	1.00	50.00	8.2593	6.68569
Years of formal education	0.00	18.00	8.9259	5.61324
Number of person with paid employment	0.00	10.00	1.8056	1.59120
Income (₦)	4000.00	2.00E5	4.6768E4	39407.73688
Food expenditure (₦)	3000.00	1.50E5	2.6204E4	22616.74964

Source: Field survey, 2012

Most of them (64.8%) were married while only 35.2 % were single. Households that had children under 18 years of age were 83.3%, showing that most households in the area had children whom they were still responsible for their feeding. Greater proportion (52%) of the household heads were civil servants while farmers, private sector employees, artisans, traders, and the unemployed constituted 13%, 15.7%, .9%,14.8%, and 2.8% of the respondents respectively. This shows that majority of adult Nigerians are employed in the civil service. Greater proportion (30.5%) of the households had Higher National Diploma/first degree as the highest educational qualification in the household, this was followed by Ordinary National Diploma/National Certificate of Education holders which constituted 25.9%, the least was Post graduate degree holders which constituted 4.6% of the respondents. Those with O'Level, first school leaving certificate, and no qualification represented 15.7%, 13%, and 10.3% of the respondents respectively.

Results also show that the household heads were between the ages of 24and 78 years, with a mean age of 45.7years, which depicts an active population. Formal education by household heads was limited to a mean duration of 8.9 years this includes those that did not attend formal education and those who spent a maximum of 18 years schooling. The mean number of persons employed in the households was 1.8.This includes those that had no paid employment and those that had the maximum of 10 persons employed in the household. The employment considered in this study were both formal and informal sector employments, like civil service, farming, trading, fishing, etc. that the person engages in for about 3 days in a week. A person is categorized as being employed when s/he is engaged in a regular work that earns income. The monthly income of the households was between ₦4,000 and ₦200,000, with a mean monthly income of ₦46,768. The mean monthly expenditure of the households on food was ₦26,204, this include those that spent the minimum of ₦3000 and those that spent the maximum of ₦150,000 per month on food. The household size which shows the number of human beings the household had to feed was between one and 50 persons, while the mean household size was about eight persons. These socio economic characteristics if properly harnessed provide the household good tools for decision making, which invariably affects the household food security. Cultural variables like tribe and language may have affected food security, but were not analysed because they were so many that some languages and tribes had only one representative in the sample, so no meaningful conclusion can be drawn from it. The study covered about 40 tribes which includes Wurkum, Tigun, Tangale, Jukun, Yakuben, Itchen, Kaka, Wurkun, Mumuye, Jenjo Mambila, Tiv, Chunchun, Kamba, Hausa, Winlau, Kanuri, Bandawa, Shamo, to mention

but a few. The languages of the households were as numerous as their tribes which is in accordance with the information in Taraba state government web site (Taraba Government, 2011).

Evidence of Climate Change Extreme Events in Taraba State

Climate change extreme events in Taraba State were identified, and measured using frequencies of occurrence and duration.

Frequency of occurrence was obtained by asking the respondents how many times such phenomenon occurred in the last one year, while the duration elicited from them how long it lasted from the day or time of occurrence to when it normalized or stopped. For some of the events that occurred for more than once, the highest duration was recorded. Heavy and long period of rainfall was the only event that the duration was measured in hours. This was done to know the intensity of rainfall in this area.

The percentage distribution of the respondents on weather extreme events experienced, the frequency of occurrence and duration of each event are shown in figure 1 and table 2 respectively.

Figure 1 shows that about 97% of the households experienced heatwave in the last 1 year (July, 2011 – Aug. 2012). This was followed by long period of dry season/harmattan and high rate of pest/disease incidence as reported by 90.7% of them. About 90% of the households experienced loss of fresh water and drying up of streams/rivers. The percentages of households that experienced flood, storm, erosion, erratic rain, heavy rain, less rain, increased weed, and loss of soil fertility constituted 68%, 65.7%, 73.1%, 82.4%, 86.1%, 64.8%, 84.3%, and 85.2% of the respondents respectively. The least experience of the extreme events was drought as reported by 55.6% of them, followed by cyclone (56.5%). These figures indicated that the number of extreme events experienced by

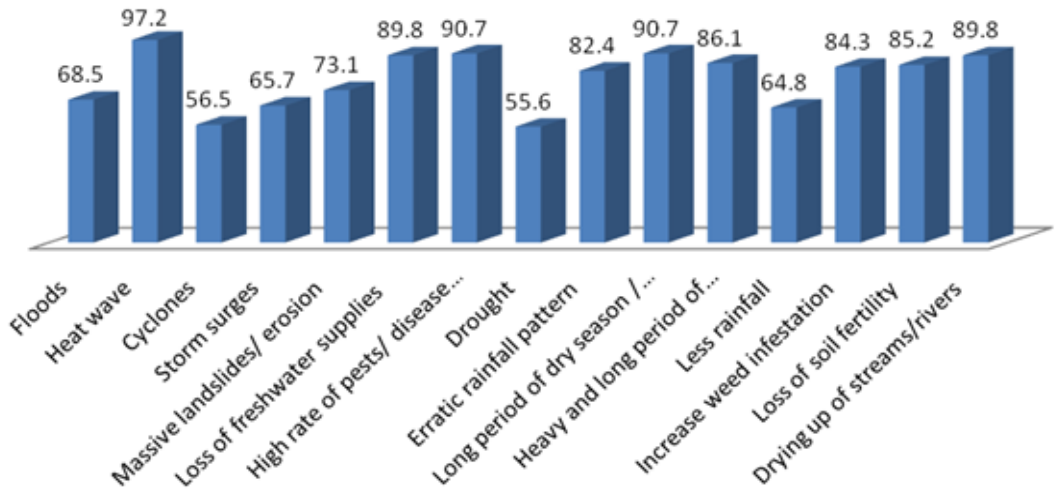

Figure 1: Percentage Distribution of Households on Experience of Climate Change Extreme Event

these respondents was high, when compared with the world records of climate change extreme events as reported by OXFAM (2011), and Rosenzweiget al (2001). There is no arguing the fact that even one weather extreme event can be associated to climate change crisis (Hasen, 2012), so this area experiencing more than 10 events in one year can be said to be high.

February to June in some parts of Taraba like Lau and Jalingo and was shorter in some other part like Kurmi and Wukari Local Government Areas. The frequency of occurrence of heat wave in the area was constant while the duration ranged from 70 to 250 days but the mean duration was 130.34 days. Cyclone and storm in the area had a mean frequency of 2.9833 and 3.1111 respectively while their

Table 2: Frequency of Occurrence of Each of the Weather Extreme Events and the Duration

Weather events frequency of occurrence/annum	Mean	Std. Deviation	Weather events duration/annum	Mean	Std. Deviation
1. Flood	2.1351	1.2311	1 flood	16.3699	14.6283
2. Heat wave	1.0000	.0000	2 Heat waves	1.3034	50.2714
3. Cyclones	2.9833	2.1978	3 Cyclones	1.0000	.0000
4. Storm surges	3.1111	1.9827	4 Storm surges	1.0000	.0000
5. Massive landslides/ erosion	1.6076	.8073	5Massive landslides/ erosion	2.5416	120.8782
6. Loss of freshwater supplies	3.8776	4.5026	6 Loss of freshwater supplies	59.0918	47.905
7. High rate of pests/ disease incidence	4.1800	2.3544	7 High rate of pests/ disease incidence	96.0400	43.9901
8. Drought	1.6167	1.0591	8 Drought	40.7500	21.2664
9. Erratic rainfall pattern	22.4091	13.0407	9 Erratic rainfall pattern	1.0000	.0000
10. Long period of dry season / harmattan	1.0000	.0000	10 Long period of dry season / harmattan	2.1993	38.0240
11 Heavy and long period of rainfall	3.0106	1.3873	11 Heavy and long period of rainfall	6.6809	1.6079
12 Less rainfall	1.0000	.0000	12 Less rainfall	35.4853	24.0475
13 Increase weed infestation	1.0674	.2521	1 3Increase weed	6.0000	2.62851
14 Loss of soil fertility	1.1398	.4798	14Loss of soil fertility	2.4398	125.3941
15 Drying up of streams/rivers	1.4747	1.137	15 Drying up of streams/rivers	1.0519	33.1283

Source: Field survey 2012.

Table 2 shows the mean and standard deviation of the frequency of occurrence and the duration of each climate change extreme events in the area for the period of one year between July 2011 to Aug. 2012. Flood occurred in this area at the average of 2.1351 times and took the mean value of 16.3699 days before it dried up or came back to normalcy. Heat wave was recorded to have occurred once and that was during the dry season. This severe heat occurred around

duration was constant because each time it lasted for only one day.

Erosion occurrence in the area had a mean of 1.6076 times, while its mean duration was 254.16 days which include the minimum of 14 days and the maximum of 356 days. The mean occurrence of loss of freshwater supplies was 3.8776 times, while the mean duration was 59.0918 days in the year. Coupled with the outbreak of Lassa fever, cholera and plant pest/diseases in the area, high rate of

pest/disease incidents, had a minimum occurrence of 1 incident in the area, maximum of 15 incidences and a mean occurrence of 4.1800 incidences, the mean duration of these incidences was about 96 days. This is in agreement with the report of Agbo (2012) and Uguru (2012), that pests and diseases migrate in response to climate change and that new and yet to be identified diseases are devastating food production and human health. Drought occurrence had a mean of 1.6167 times and a mean duration of about 41 days.Erratic rainfall pattern was high in the area as the respondents reported that it was difficult for the households to know when it will rain. It has the mean occurrence of 22.4091 times and when it rains like that, it did not exceed a day, so the duration was 1 day and constant.

The northern part of Nigeria is characterised with long period of dry season/harmattan, especially the North East within which Taraba is located (Adeniyi et al., 2009). The mean duration of State was 219.93 days. This period is long compared to some other parts of the country like the East, South or even North Central where the rainy season stabilizes by April and stops in October, the maximum duration of this harmattan recorded in the survey was 280days (9.3 months) while the minimum was 100days for the period of coverage. The dry season lasted longer in Lau and Jalingo when compared to the number of days of dry season in Kurmi and Wurkari Local Governments. Harmattan occurred in these areas once in a year as reported by the respondents, which made the frequency to be constant.

It was noted that Taraba State was experiencing heavy and long period of rain (DREF, 2005). According to Uguru (2012), the frequency of heavy rain has increasedleading to floodingin some parts of Nigeria. The mean occurrence of heavy rain in the state for the past 12 months was 3.0106 times. The Duration was measured in hours of rain; (hour was used in order to capture the intensity or severity of the rainfall). The mean duration of heavy and long period of rain was 6.6809 hours. The respondents experienced less rainfall in some months of the year during the rainy season. Since it occurred only during the rainy season, its frequency was assumed to be 1 and so constant. The mean duration of less rainfall was 35.4853 days and it occurred around August/September of 2011 as reported by the respondents.

Increase in weed infestation was noticed in the area, this is in agreement with the finding of Agbo (2012), that there is an increase in weed infestation due to climate change. Increase in the growth of weed and the appearance of new types of weeds were identified by the respondents in the area, this was reported to have occurred during the rainy season, and the respondents reported that after weeding it took between 2 to 14 days for the weed to grow back. This figure was for both households that used manual weeding and those that used herbicides. The mean duration of weed infestation was 6 days. Some of the respondents indicated that some soil around their homes and in their farms are losing fertility. The mean occurrence (which is in number of ha) of loss of soil fertility was 1.1398 and the mean duration, which elicited from the respondents the time they first noticed it to the time of the interview or when they were able to restore, was about 244 days. There are many rivers and streams in Taraba State which include river Taraba, the branch of River Benue etc., these rivers are means of livelihood to many Taraba indigenes. The mean occurrence of drying up of these rivers and streams was 1.4747 times. When it dried it stayed for the mean period of 105.19 days before the water returns back to its normal state.

Food security status of households in Taraba State Nigeria

Table 3 shows the distribution of the households based on their food security status. The households are placed in the order of severity of food insecurity. The severity increased from 0 – 9.3 for households with children and 0 – 7.9 for households without children. A household on the scale of 1. 0 is more food secure than the household on the scale of 2.2 but both households are classified as being food secure i.e. category 1. The scale is divided into four (4) categories namely: food secure, food insecure without hunger, food insecure with hunger (moderate), food insecure with hunger (severe) coded as 0, 1, 2, 3 respectively.

Majority of the respondents (32 households) with children were in the scale of 7.4 and 9.3 which constituted 16 households in each of those scales, while majority of the households without children (8 households) were in the scale of 7.9. Households in the scale of 7.9 (for households without children) and 9.3 (for households with children) were the most food insecure households in the area.

Table 3 Food security scale and categories of the households

Number of Households with children	Food security scale values	Number of Households without children	Food security scale values	code	Category
0	0.0	0	0.0	0	Food secure
0	1.0				
		0	1.2		
0	1.8				
		0	2.2		
0	2.4			1	Food insecure without hunger
1	3.0				
		0	3.0		
0	3.4				
		0	3.7		
0	3.9				
0	4.3				
		1	4.4		
0	4.7			2	Food insecure with moderate hunger
		1	5.0		
4	5.1				
0	5.5				
		1	5.7		
1	5.9	1	5.9		
10	6.3				
		6	6.4		
7	6.6			3	Food insecure with severe hunger
11	7.0				
		1	7.2		
16	7.4				
		8	7.9		
9	8.0				
15	8.7				
16	9.3				
Total (%) 83.3% respondents		Total (%) 16.7% respondents			

Source: Field Survey, 2012

For ease of understanding the food security status of the households, respondents were categorized into four. Figure 2 is showing the percentages of the households in different food security categories

Food insecure with severe hunger: Majority of the households were food insecure with severe hunger. This group constituted 77.8% of the respondents in the area. This means that one or more member(s) of the households had experienced hunger. For the households that fall into this category they have reported a good number of food insecurity conditions. This category of households, if they have children had already reduced the food intake of their children, and the children are experiencing hunger, while the adults in both types of households had experienced hunger and had seriously reduced their food intake and for that the nutrition is assumed to be negatively affected.

Food insecure with moderate hunger: the percentage of households categorized as being food insecure with moderate hunger constituted 20.4% of the respondents. In this group, adults' food intake had repeatedly been reduced but not the children's and the adults must have had sensation of hunger.

Food insecure without hunger: only 1.9% of the households were food insecure without hunger. This set of respondents was mostly concerned with the sufficiency and appropriateness of their food in terms of its nutrition. They have very little evidences of food insecurity. This group was involved in making adjustments on the quality and quantity of food they eat. They have witnessed little or no reduction in their food intake.

Food secure: none of the respondents were food secure. Being food secure means they have little or no indication of food insecurity. This shows that all thehouseholds did not have access, at all times, to enough food for an active, healthy life for all household members

Effect of Climate Change Extreme Events on Food Security

Nigeria is faced with environmental pressures that have negatively affected the socio-economic fabric, particularly in the areas of Agriculture and food security (Agumbah, 2010). Tables 3 and 4 are showing the households perception of the effects of climate

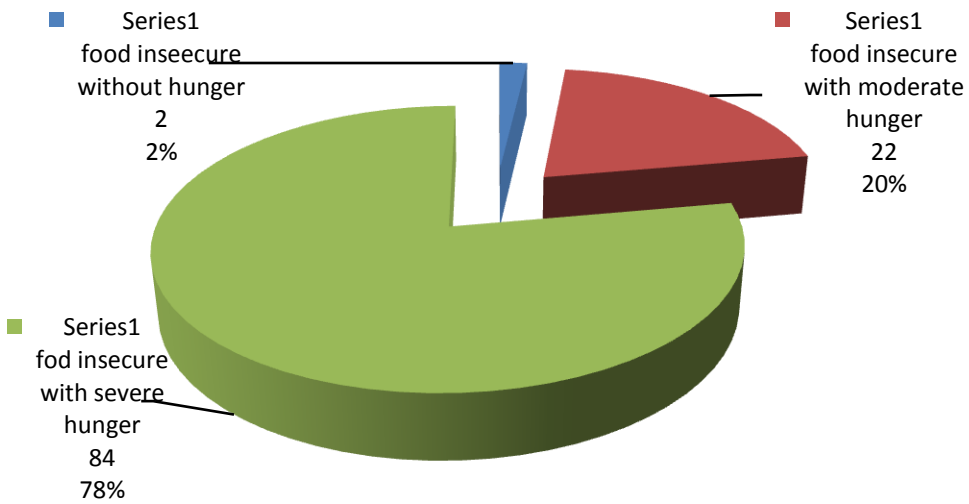

Figure 2: Food security categories of the households.

Table 4: Respondents Rating of the Effects of Climate Change Extreme Events on the Food Security of the Households

Variables	Minimum	Maximum	Mean	Std. Deviation
Floods	1.00	3.00	2.3378	0.70763
Heat wave	2.00	3.00	2.8208	0.38538
Cyclones	1.00	3.00	2.0333	0.68807
Storm surges	1.00	3.00	2.0694	0.77508
Massive landslides/ erosion	1.00	3.00	2.3797	0.60561
Loss of freshwater supplies	1.00	3.00	2.2857	0.62590
High pests/ disease incidence	1.00	3.00	2.7100	0.47768
Drought	1.00	3.00	2.2333	0.69786
Erratic rainfall pattern	1.00	3.00	1.9659	0.49011
Long period of dry season / harmattan	1.00	3.00	2.8431	0.39162
Heavy and long period of rainfall	1.00	3.00	2.4043	0.64457
Less rainfall	1.00	3.00	1.9853	0.65774
Increase weed infestation	1.00	3.00	2.1573	0.47431
Loss of soil fertility	1.00	3.00	2.3978	0.53446
Drying up of streams/rivers	1.00	3.00	2.5859	0.58919

change and the regression result of the effects of climate change respectively.

Table 4 presents the rating of effects of the extreme event experienced by the households on their food security. The effects were rated using a three point likert scale, based on the degree of perceived impact of these climate change extreme events on the food security. The scale had three (3) point rating of high impact = 3, low impact = 2 and no impact =1. These three-point scale was used to ensure that the respondent made a contribution, since there is no room for neutrality.

The mean score showed that heat wave, long period of dry season/harmattan, high rate of pests/disease incidence, drying up of streams/rivers, flood, storm, erosion, loss of fresh water, drought, heavy and long period of rain, weed infestation, loss of soil fertility were rated by the respondents as having high effect on the food security of the households. On one extreme, it is clear that the four climate change extreme events that had the most effects on the household food security were heatwave, with a mean score of 2.82, long period of dry season with a mean of 2.84, high rate of pest and diseases with a mean of 2.71 and drying up of stream with approximate mean of 2.6. According to Berkes and Jolly (2001) the effects of some of these climate change events are more severe than others. At the other extreme less rainfall, erratic rainfall pattern and Cyclones were considered by the households as having less impact on their food security within the period of coverage.

Looking at Using the HFIAS module, the respondents were categorized into three food insecurity groups –food insecure without hunger, food insecure with moderate hunger and food insecure with severe hunger. Figure 3 presents the relationship between the rate of households' experiences of climate change extreme events and their level of food insecurity. This showed that food insecurity and climate change extreme events were linearly and positively related. Looking at the graph, it is clear that the rate of extreme events increased the household food insecurity. The rate at which a household experiences climate change extreme event is dependent on the location of the household, the hygiene, and nature of house they inhibit amongst others. The rate was captured as the number of extreme events in relation to the total identified extreme events experienced by each household.

Households in different categories of food insecurity, differed in their experiences of the extreme events, as the number of extreme events experienced increased food insecurity also increased. Each of the food insecurity categories households in the study had at least experienced 30% – 40% of the extreme events. This may be the reason there was no food secure household in the study. Majority of households in category 3 (food insecure with severe hunger) had experienced about 90% - 100% of the extreme events. Majority of households in category 2 (food insecure with moderate hunger) experienced about 70% - 80 % of the extreme events. While households in category 1(food insecure without hunger) experienced only about 30% - 60% of the extreme events. The above analysis shows that as the number of extreme events increased, the severity of food insecurity increased.

Table 5 presents the regression result of the effects of climate change extreme events on the food security of the households. Regression model was used to determine the effects of climate change extreme event on the household food security in the study area.

$Y = f(XI, X2, X3, X4...X29) + e$

Where Y is the HFIA Scale score and X1…Xn are the socioeconomic variables of the respondents, and the intensity and number of frequencies of climate change extreme events

Correlation analysis to determine the level of collinearity among the extreme events was run before the data were fitted for regression. The regression analysis of the climate change extreme events and food insecurity scale showed that of all coefficient of the independent variables that were positive, (note that positive parameter estimates mean that these variables increased the likelihood of answering yes to any of the questions, implying an increase in food insecurity) pests and diseases positively affected food insecurity and was significant at $p \leq 0.01$ level of significance. That shows that the longer these diseases and pests lasted in or around the households the more food insecure they were. Drying up of streams and river, heatwave harmattan, and rate of extreme events experienced by the households positively affected the food insecurity of the household, and was significant at $p \leq 0.05$ level of significance. The frequency of occurrence of heavy and long period of rain also affected food insecurity and was significant at ≤ 10%. These climate change extreme events positively affected food insecurity, confirming the findings of Rosenzweig, Ana, Yang, Epstein, & Chivian (2001), Oxfam (2011) and so many other researchers and development agencies, that these events will adversely affects food security.

The increase in the extreme events frequencies has a negative impact on food security. The result of this regression further confirms the authenticity of table 4 on the respondents rating of the effects of the extreme events on food security.

Household size affected the household food insecurity and was significant at $p \leq 0.05$ level of significance. This means that food insecurity increases with household size. The larger the number of people in the household the more food insecure they were. Households that had a civil servant as their head were more food insecure, as this variable affected food insecurity and was significant at $p \leq 0.05$ The reason for this may not be clear but knowing that Taraba state is purely an agrarian state can explain the reason why civil servants were more food insecure when compared with farmers, trader, artisans, private sector employee etc.The state is known to be a significant food producer in Nigeria, so the farmers and some farm product traders may get cheaper and better quality food than the civil servants. These other occupations may not be earning more income than the civil

servants but they may have more access to cheap and healthier foods. This further shows the inappropriateness of using food expenditure or income methods as a sole indicator of food security.

Table 5:Multiple regression result of effects of climate change extreme events on the household food security

Variables	B	Std. Error	t	Sig.
(Constant)	4.153	0.640	6.487	0.000
Household size	0.047	0.019	2.501	0.015**
Income	-4.693E-6	0.000	-1.611	0.111
Age	-0.005	0.012	-0.390	0.698
Marital status	0.307	0.231	1.331	0.187
Occupation	0.430	0.217	1.979	0.051**
Flood occurrence	-0.152	0.110	-1.388	0.169
Flood duration	0.003	0.007	0.486	0.629
Heat wave duration	0.005	0.002	2.141	0.036**
Cyclone occurrence	0.018	0.059	0.311	0.757
Storm occurrence	-0.080	0.065	-1.230	0.223
Erosion occurrence	-0.074	0.152	-0.486	0.628
Erosion duration	0.000	0.001	-0.265	0.791
Loss freshwater occurrence	0.003	0.024	0.143	0.886
Loss of freshwater duration	-0.003	0.002	-1.210	0.230
Pest/diseases occurrence	-0.135	0.085	-1.583	0.118
Pest/diseases duration	0.010	0.004	2.805	0.006*
Drought occurrence	0.004	0.170	0.026	0.979
Drought duration	-0.005	0.006	-0.719	0.475
Erratic rain occurrence	-0.004	0.010	-0.388	0.699
Harmattan duration	0.005	0.003	2.043	0.045**
Heavy rain occurrence	0.158	0.090	1.755	0.083
Heavy rain duration	-0.008	0.054	-0.150	0.881
Less rain occurrence	-0.187	0.291	-0.642	0.523
Weed duration	-0.060	0.042	-1.414	0.161
Loss of soil fertility occurrence	0.123	0.225	0.546	0.587
Soil duration	-0.002	0.001	-1.579	0.119
Dry steam/ river occurrence	0.252	0.115	2.200	0.031**
Dry steam/ river duration	0.000	0.003	0.072	0.942
Rate of event experienced by household	1.745	0.749	2.331	0.023**
R^2	0.625,			
Adj. R^2	0.478,			
F-stat.	4.256			

NB: Significant at ≤ 0.01(*), significant at ≤ 0.05 (**), Dependent Variable: Food insecurity scale

Source: Field Survey, 2012.

Conclusion

The study showed that climate change extreme events have effects on the food security of the households, the more of these events experienced by the household the more food insecure they were, the study found out that the frequency and the duration of the events varied from place to place and from household to household.

Food security at the micro scale/level of household is a major concern of many governments. Every government should be interested in having a food secure society. A food secure society will result to a healthier, viable and productive society. So there is need to constantly monitor the food security of the society. There is need also, for the government to develop a system for monitoring the food security of its citizenry. It is important to monitor the occurrences of climate change extreme events in many regions of this country. The government and other non-governmental agencies should create awareness of forecasted occurrences of these climate events through different media like radio, television etc. in many regions of this country.

There is no good weather forecast station monitoring climate occurrences in Nigeria. It will help if good metrological stations are established in different states of Nigeria but most especially in the north east region of Nigeria. This will help in minimizing the shocks of these events on the people, as they will be more prepared against upcoming events even before they come. It has been noted that these climate change extreme events have adverse effects on food security, hence the governments should enlighten its citizens of the dangers of these extreme events and teach them ways of ameliorating the effects by creating awareness, improving the physical environment and creating an enabling environment for good economic activities.

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