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Full Length Research Paper

Changing food security: The challenges of climate change in Ukpeko, Etsako East, Edo State Nigeria

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Rural communities' livelihoods as well as the economies in developing countries depend on rain-fed agriculture (crops), fisheries, and livestock herding, which are heavily affected by changes in climate.The impact of climate change has become more catastrophic at different levels and has greatly exacerbated food insecurity in communities already vulnerable to hunger. This study analyses the interconnectivity between food security, climate change and flood risk and the critical challenges for food production in Ukpeko and Ogwoyor. Both primary and secondary data were used for this study, along with 120 participants. At 5% significant level, the result shows that flooding had a negative relationship with crop and fish production, leading to a complete loss of livelihoods and the eventual displacement of the people of the two communities studied. In addition, there is a correlation between climate change and changing poverty/vulnerability levels across the two communities. The evidence from the research supports the need for country specific adaptation of and migration development of climate-smart food systems that are more resilient when it comes to the impact of climate change on food security and in relation to displacement. This paper suggests a more nuanced policy alternative that secures livelihoods and protects agricultural lands most associated with vulnerable local populations.

Key Words: Food security, climate change, flooding, displacement, food production.

INTRODUCTION

Given population growth, climate change and other environmental challenges, which hinder food production, thereby leading to food and nutrition security, food production is one of the principal challenges facing many developing countries; Achieving food and nutrition security in rural communities that are prone to a myriad of climatic changes has become a complex issue.

In the recent years, the debate on climate change has led to a renewed interest in its effects on agriculture. Its impact on agriculture and food security is felt primarily through changes in crop yields, water availability, pests and diseases, animal health and other biophysical factors (Jalloh et al, 2007). Such biophysical changes propagate through a number of components of the socio-economic system and ultimately, impact the livelihoods of people in a variety of ways (UN, 2012; Pedercini et al., 2012). Given climate is a critically important factor for agricultural productivity, any increase in temperatures; changes to the rainfall pattern and/or decrease in water availability, tends to decrease potential yields for most crops in both rich and poor countries (Thornton et al. 2007; Gommes et al., 2009).

One of society's key sensitivities to climate change is food. Rising temperatures and changes in rainfall patterns affect agricultural yields of both rain-fed and irrigated crops(Gommes et al., 2009; Edward et al., 2014). A lengthy period of insufficient or excessive rainfall, a sudden hot spell or cold snap, climatic extremes such as flooding or storms, can have a significant impact on local crop yields and livestock production.

In 2012, the farmers and fishermen in Ukpeko and Ogwoyor were severely affected by heavy flooding that destroyed both farm land and fishing areas, which the community depend on for their livelihood. Recent climate change induced disasters, such as severe storms and extreme flooding have impacted on natural eco-systems, which have created consequences for the environment such as the impact on wild animals and livestock, human displacement, damage to agricultural farms, sources of drinking water and sanitation services. Rural livelihoods in and around such areas have been particularly devastated with a significant portion of the population experiencing dramatic decreases in food, nutrition, health

and economic insecurities, particularly among the already vulnerable population in the Ukpeko and Ogwoyor communities living along the River Niger.

This study analyses the interconnections between food security, climate change and flood risk on the one hand and on the other the direct consequence in relation to the critical challenges for food production in Ukpeko and Ogwoyor communities in Etsako East, Edo State Nigeria.

Area of Study

Ukpeko and Ogwoyor are small agrarian communities of 3,600 and 2,100 people respectively. Located on Latitude 7.2, longitude 6.63333, DMS latitude 7° 12 min 0 sec, and DMS longitude 6° 37 min 59.99 sec with an altitude of 396 feet above sea level bordering Kogi and Edo States (Ministry of Agriculture and Natural Resources, 2009 – 2012).Ukpeko and Ogwoyor share a common border in the North with the Igbira (Kogi State), and Idah across the river Niger in the East. Ukpeko and Ogwoyorare comprised of close-knit families within the village that are categorised by language, history and farming/fishing patterns. They produce food crops such as cassava (*Manihotesculenta*), potatoes, rice (*Oryzasativa*), (*Ipomoea batatus*) and fish (Onakuse, 2012).

Their main occupations include: crop farming, fishing and hunting (which is defined by the following characteristics: (i) the farming activities form a livelihood strategy; (ii) the output is consumed directly; (iii) little or no farm input used in production; (iv) the proportion of output is low (Onakuse, 2012).

Agriculture and Food Security

Agriculture occupies a special and important place in the communities of Ukpeko and Ogwoyor. Agriculture not only ensures the production of food and fibre, it is essential to food security, social and economic development, employment, maintenance of the countryside, conservation of land and natural resources, and helps sustain rural life. (FAO, 2002; Thornton et al. 2007).Rain-fed agriculture remains the means through which subsistence agriculture is practiced in rural areas (Thornton et al. 2007).

Recognising the right to food is an important step in triggering more sustained action on climate change and food and nutrition security. As the dependence on agricultural produce for livelihood security increases under the influence of climate change**,** the frequency of extreme weather events is increasing, with the damage caused by water shortage and heavy rains resulting in regular flooding (Ringler et al., 2010; Molden et al. 2007; Shah et al., 2008).

Between July and October 2012, the Benue and Niger Rivers broke their banks on several occasions and submerged hundreds of thousands of acres of farmland. By mid-October the flooding had forced 1.3 million people from their homes and affected agricultural farmland across 14 states (FEWS, 2013).

The current challenges posed by climate change and its interaction with livelihood security are recognised globally. The World Bank (2010) made a plea for innovative ‘outside the box’ solutions to climate change adaptation and pointed out the need for environmentally sustainable solutions for food, water, energy and transport as integrated components for climate change adaptation and disaster risk management. While modern farming technologies and techniques have helped reduce this vulnerability and boost production in developed countries, subsistence farmers in developing countries are faced with increasing damage to their crops and livestock caused by the intensity of droughts and flooding(Tim wheeler and Joachim von Braun, 2013; Edward et al., 2014).

Over 5,020 farmlands linked to the Benue and Niger Rivers tributaries were washed away in 2012. In Ukpekoand Ogwoyor, over 1,254 hectares of rice, cassava and vegetables were destroyed. Other agricultural activities such as fish farms and crops e.g. cassava, potato and vegetable farms were also affected. Beyond the erosion of soils and farmlands, infrastructures such as schools roads and houses were washed away (see Photo 1).

Cassava is a particularly important crop grown by subsistence farmers for household consumption. It is the fourth most important source of calories and provides about 8% of average daily consumption (Tim Wheeler et al., 2013). However, 20.1% of Maize, 31.4% of Rice producing areas was affected by the flooding.

Easterling et al., (2007) argued that smallholder and subsistence farmers, pastoralists and artisanal fisher folk will suffer complex, localised impacts of climate change. Those whose adaptive capacity is constrained, will experience the negative effects on yields of low-latitude crops, combined with a high vulnerability to extreme events. The Nigerian National Bureau of Statistics (2007) asserts that rapid climate change continues to threaten livelihoods of local communities living along the river Niger while their ability to pursue traditional subsistence food sources such as fishing, hunting and farming has been undermined.

Floods can be caused either by an excess of rainfall leading to greater surface runoff or by storm surges raising the sea level. Human activity can also increase the risks, for example, by paving over areas which were previously covered by vegetation, reducing the capacity of the land to absorb rainfall and causing it to run off more quickly. Extreme weather events are usually associated with unusual (‘anomalous’) atmospheric circulation patterns (ODI, 2007; Nelson et al., 2009). Excess rainfall is caused when the atmosphere becomes ‘stuck’in one pattern of circulation, resulting in wet weather for an extended period in some regions. In such a scenario, soil and groundwater reservoirs become saturated; leading to flooding as additional rain runs off

Photo 1. Picture showing destroyed farmlands 2012

off the land surface(Thornton et al. 2007).

This study evaluates the impact of flooding (climate change) on agricultural production in rural areas with specific focus on communities in Ukpeko and Ogwoyor. This paper further seeks to explore the impact of flooding on access to food and income across the two communities studied.

The Impact of Climate Change on Food security

The regular and severe flooding that has become the norm across Nigeria has had a serious impact on the agricultural sector. Changes in rainfall and other forms of precipitation are considered the most critical factors when determining the overall impact of flooding. While the impact climate change may have on regional rainfall pattern cannot be distinguished from natural variations, the data set from the Federal Government of Nigeria shows variations, a proof of climate change impact on known and recorded patterns across the regions of the country (Federal Government of Nigeria, 2011, Hassan A., 2012).

In the months of September and October 2012, severe flooding ravaged Nigeria, which disrupted various sectors of the economy. This was caused by excessive rainfall that fell in Nigeria and surrounding countries as well as water released from the Lagdo reservoir in the Republic of Cameroon (Integrated Regional Information Network, 2012).The large volume of water washed away farmlands, settlements and other critical infrastructure both for agriculture and human development.

The flooding destroyed over 70 hectares of farmland which had been planted with cassava, rice and maize; fruits and vegetables crops such as Amaranths, pepper, tomatoes. It also severely affected livestock, which included sheep, goats and cattle. The devastating effect of floods is not limited to agricultural farmland, arable and agro-forestry (soil infertility through leaching and erosion of rich topsoil) (Nelson et al., 2009). This study focuses on the short and long-term consequences on food and nutrition security for the two communities.

Climate change is challenging agriculture with increasing uncertainty and variability, particularly in terms of water and temperature regimes. Crops, livestock and people are increasingly suffering from disastrous floods and droughts (IPCC, 2007). A significant percentage of areas that produce the three main tuber food crops in Ukpeko and Ogwoyor: yam, cassava and sweet potatoes, were affected.

Climate affects food production directly through changes in agro-ecological conditions. Considering that climate is an important factor for agricultural productivity, any increase in temperatures and/or decrease in water availability will tend to decrease potential yields for most crops (Pedercini et al., 2012). As climate change becomes more drastic in terms of its impact on agricultural practices, marginal agriculture lands are increasingly affected by flooding, which results in more pressure on the land.

The impact of the 2012 flooding that wiped out agricultural systems and livestock in farms located along the River Niger and Benue demonstrated the just how vulnerable many are to the effects of climate change. Understanding farmers' responses to climatic variation is crucial, as it will assist the creation and implementation of appropriate coping strategies.

Nelson *et al.* (2009) shows that a variety of modelling tools have been developed for the assessment of the impact of climate change on agriculture and of adaptation strategies. But these models are not within reach of rural subsistence farmers. For example, the T21 SF is specifically developed with an emphasis on representing and analysing the dynamics of climate change and food security.

Different studies have shown that shifts in rainfall patterns and temperatures will contribute to the occurrence of extreme weather evens and natural disasters, which will impact heavily on agricultural production, global food prices and access to clean water (Heltberg, Siegel and Jorgensen, (2009); Sutton et al., 2013).

The regular changes in climate have harmed the livelihoods of the two communities over the years with the 2012 flooding further impoverishing those already struggling to survive to the extent that they are labelled 'climate refugees' due to displacement.

METHODOLOGY

The study was conducted in two communities (Ukpeko and Ogwoyor) who live along the River Niger and who depend on subsistence agriculture, fishing and small live-

stock production for their livelihoods. The communities experienced two distinct seasons - the wet season, which lasts from March to November and the dry season which lasts from November to February (Onakuse, 2012).

A multi-stage sampling technique consisting of some purposive sampling was adopted when it came to selecting both communities and respondents for this study (households and farming communities) living along the river Niger banks that were severely affected by the flooding.

Both primary and secondary data were used for this study. Secondary data came from National Bureau of Statistics. The primary data consists of 120 respondents' (60 respondents from each community). A purposive selection technique was used to draw as many samples as possible from the identified farmers.

The survey was conducted between July 2010 and July 2011. The period coincides with both early and late planting seasons. A total of 100 questionnaires were completed through the help of trained enumerators. Trained research assistants assisted the illiterate heads of households with the completion of the questionnaires and addressed issues raised. The data collected was analysed and variables of interest used to describe the outcomes of the findings.

The limitations encountered during the survey ranged from the validity of interview discussions. Some respondents were evasive when it came to answering questions about their farm income due to limited or non-existence of records. Furthermore, farmers were not happy to disclose personal information regarding their farming income because they could not see benefits associated with providing such information.

RESULTS AND DISCUSSION

Food and fish production are highly dependent on rainfall pattern. Recurring flooding coupled with the loss of land; a valuable factor of production suggests that the two communities studied will face food shortages as their means of livelihood are destroyed. Table 1 for example shows the decrease in cultivable land accessible to the two communities in 2012 as a result of flooding. While the land area remained constant at 3,514 square kilometres, the cop area for Ukpeko decreased by 110 acres as cultivation was affected by the flood while that of Ogwoyor decreased by 70 acres.

Flooding generally affects soil nutrient and moisture levels, water availability, and other conditions that provide the enabling environment for food production. Therefore, changes in the frequency and severity of floods pose challenges for farmers as the amount of crop produced from a given amount of land leads to reduced yield.

The decrease in cropped areas by acre has a direct impact on farmers' income due to reduced crop harvests. The complete lost in harvest also disrupts markets and reduces food flow, which leads to increased food prices across the surrounding communities. This leaves the farmers with no choice than to depend on family networks for survival.

The flooding and loss of land aggravates food insecurity as it leads to: loss and failure of productive agriculture and lack of access to food; severe decline in income due to flooding; destruction of crops and forced migration to other dry-lands communities with no available productive activity (See Photo 1 & 2).

Complete flooding (statistically significant at 5% level) had a negative relationship with crop and fishing, with the implication that complete flooding results in the total loss of livelihoods and eventual displacement. This may be due to the fact that 80.3% of the respondents practiced crop production and fishing simultaneously (Table 1). Though the effects of the other climate variables were not the focus of the study, variables such as drought had a negative relationship with food production and the intensity of environmental degradation. Farmers living and producing food along the river Niger and Benue who depend on the natural fertility of their soils are faced with leached soils, with little or no nutrient**;** and these constitute major concerns with respect to the long-term adverse effects on soil productivity and meeting food security needs.

Soil degradation is one of the most serious consequences of flooding. Land fertility in the flood affected communities shows a decrease in food production due to viable agricultural land losses. The decrease in agricultural land for food production means that as food production decreases food prices rise while land fertility remains on the decrease.

The effects of climate change are increasingly reflected in the adaptation measures chosen by the farming households, based on the fact that each farmer faces a set of discrete, mutually exclusive choices of adaptation measures. These measures are assumed to depend on a number of climate attributes, socio-economic characteristics and other factors X.

The explanatory variables used in the Multinomial Logit Models and hypothesised as determinants of respondents with little or no knowledge on how to adapt to climate change. These determinants are increased temperature (X_1), excessive rainfall (X_2), patterns of flooding (X_3), changed timing of rains (X_4), Crop production (X_5), cereal/ legume intercropping (X_6), crop production and fishing (X_7).

The signs of the marginal effects and respective coefficients may be different, as the farmers depend on the sign and magnitude of all other coefficients. There is a correlation between climate and poverty/vulnerability levels across the two communities. The more rain, the more vulnerable the dweller will become to the threat of climate change. This can explain the high level of displacement of poor people in the two communities.

The results shows that the two communities (Ukpeko and Ogwoyor) experience about 21.04% and 24.8% decrease in population respectively. Crops and fish production also declined due to displacement and out-migration of 18.3%.

Photo 2. Picture showing Fishermen primary school in Ukpeko 2012.

Table 1. Changes in cropland, and fishing area after the flood

Ukpeko	**2010**	**2011**	**2012**
Cropped area (acres)	450	340	74
Sheep and goats (head)	2,568	2, 471	310
Fish area Sq. km	2,820	2,820	2,820
Ogwoyor			
Cropped area (acres)	310	240	52
Sheep and goats (head)	12,123	11,200	174
Fish area Sq. km	3,514	3.514	3,514

Source: Authors' field survey 2010-2013

Table 2. Probit Multiple Regression Parameter Estimates of the Effect of flooding on crop and fish production practices on food security.

Explanatory Variables	**Coefficient**	**Standard Error**	**t-values**
Constant Intercept	2.310	0.280	7.021
Crop production (X1)	0.057	0.268	2.373**
Crop production and fishing (X2)	−0.149	0.131	3.255*
Sole Fishing (X3)	0.030	0.102	0.357
Cropping and fishing Frequency (X4)	0.026	0.067	0.418
Manner of flooding (X5)	0.039	0.102	0.380
Complete flooding(X6)	−0.010	0.082	0.126
Partial flooding (X7)	0.019	0.095	0.200

Pseudo R3 = 71.2; Goodness of fit Chi =37 0.67; Prob. > Chi = 0.000
X Significant at 1% level (t=2.998)** Significant at 5% (t=1.895)
Source: Computed from field Survey data 2012

The recovery rate among poor farmers within the two communities on the rivers Niger and Benue depends on the weak local economy and the characteristics of the main Nigeria economic activities. Farmers and their families who are exposed to loss of farm incomes and access to nutritious food due to climate change activities also face the consequence reconstruction of destroyed infrastructure such as homes, schools, access road, and cropland.

CONCLUSIONS AND RECOMMENDATION

This study has shown that the long-term implications of climate change (flooding) whether complete or partial, destroy arable crop farms and open fishing areas of (85.7%) of the farmers surveyed while the remaining 14.3% are not into farming activities. Results of the Probit Multiple Regression Model inferred that continuous flooding of both crops and fishing areas continue to bring about environmental degradation, resulting in livelihood insecurity and displacement of inhabitants of the studied area. In addition to the longer-term climate change effects, climate variability has inflicted heavy economic losses along with food insecurity and hunger.

Within the limits of statistical reliability, it would be safe to conclude that substantial gaps exist in the current climate change discourse and its impact on smallholder agriculture in the study area. The critical flooding consequences emanating from this study are: soil nutrient depletion (soil degradation by erosion), loss of fishing areas, and complete displacement; all culminating in sustained low or non-production and by implication, perpetual livelihood insecurity and poverty.

The unpredictability and uncertainties of rainfall patterns, especially that which results in flooding requires policy development directed at limiting the effects on food production.

Also emanating from the existing agricultural challenges arising from the subsistence nature of agriculture and the recent climate variability, more households will experience complete loss of livelihoods if the projected increase in rainfall continues to raise the risk of floods. The study found a lack of access to critical information on climate change, thus, there is a need for effective and reliable access to such information. Deliberate efforts should be made by both governments and the private sector to include climate change adaptation to food security investment across the most affected region.

Climate and environmental change must inform agricultural policy. The impact of the 2012 flooding along the River and Benue rivers are clear signals. It is imperative that reliable and effective policy measures are formulated, implemented and made accessible to farmers. Rural farmer's uptake and response to the impact of climate change are very low. There is a clearly a need to design strategies that help the farmers/rural communities' respond effectively to global warming throu-

gh early warming alerts and interpretations in the language useful to farmers/rural communities.

This study therefore suggests a more nuanced policy alternative that protects livelihoods/lands of vulnerable local populations. The study advances solutions that are based on community ownership, local empowerment and longer-term resilience.

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