Journal of Sustainable Development in Africa (Volume 16, No.7, 2014)
ISSN: 1520-5509
Clarion University of Pennsylvania, Clarion, Pennsylvania

THE INFLUENCE OF CROPPING INTENSIFICATION ON VULNERABILITY TO FLOODS AMONG FARMING HOUSEHOLDS IN KWARA STATE, NIGERIA

Shehu Abdulganiyu Salau and Ibrahim Folorunsho Ayanda
College of Agriculture, Kwara State University, Malete, Nigeria

ABSTRACT

In the past four decades, economic losses due to natural hazards such as, floods disasters have increased in folds and have also resulted in major loss of human lives and livelihoods *thereby putting sustainable development at risk*. Thus, this study assesses the influence of cropping intensification on vulnerability to floods among farming households in Kwara State, Nigeria. Descriptive statistics and logit regression analyses are the analytical tools employed to achieve the research objectives. The results showed that household head type, farm size, cropping intensification, distance to input market and education of household heads are the important variables explaining vulnerability to floods in the study area. Also, the result indicated that economic, cultural, technological, structural and social coping strategies are the important strategies employed by farming households to deal with the negative impact of flood in the area. The most (20%) widely adopted coping strategy is replanting (cultural) which is closely followed by crop diversification (economic). *For sustainable development of the area* favourable inputs and output markets as well as other policies that could facilitate households' access to agricultural inputs and education are hereby suggested. *Public awareness programmes and campaigns on the relationships linking sustainable development, natural hazards, vulnerabilities and disasters, to enhance disaster reduction measures should be encouraged.*

Keywords: Climate Change, Hazards , Logit Regression, Sustainable Development, Vulnerability And Farming Households

INTRODUCTION

Excessive release of greenhouse gasses (C02, CH4, CFs) into the atmosphere by man trap much of the heat that would otherwise escape from the earth, resulting in global warming (Ayoade 2004). This produces diverse effects on both physical and biological systems. McCarthy et al. (2001) identified some observed changes with linkage to climate change to include shrinkage of glaciers, coastal storm surges, high temperature, intense wind and high precipitation. In the past century over 95% of disaster deaths occurred in developing countries, and direct economic losses were more than doubled in low-income and high-income countries (Arnold and Kreimer 2004). Disasters are 'situations or events which overwhelm local capacity, necessitating a request to a national or international level for external assistance; an unforeseen and often sudden events that cause damage, destruction and human suffering' (CRED 2010). According to study by CRED (2010) about 335 natural disasters (excluding biological disasters) were reported globally in 2009 as a result of climate change. *The escalation of severe disaster events triggered by natural hazards and related technological and environmental disasters is increasingly threatening both sustainable development and poverty-reduction initiatives. The loss of human lives and the rise in the cost of reconstruction efforts and loss of development assets has forced the issue of disaster reduction and risk management higher on the policy agenda of affected governments as well as multilateral and bilateral agencies and NGOs.*

Destructive natural events occur regularly across the world, although most do not cause enough damage to be considered natural disasters. Among those that do, floods are the most common. Floods have the greatest damage potential of all natural disasters worldwide and affect the greatest number of people (UN 2001). Flooding is among the most significant issues affecting sustainable development in Nigeria. It affects many hundreds of thousands of households annually causing recurrent losses of material goods and endangered lives. In 2012 for instance, more than 4,700 inhabitants of communities in Edu and Patigi LGAs of Kwara State, were rendered homeless (This Day Newspaper 2012). Moreover 3,200 hectares of rice plantation under the authority of Tada-Shonga Irrigation Scheme in Edu LGA have been washed away by flood. So severe were the losses that the Federal Government rightly declared it an emergency.

There is little evidence concerning how farming systems and agricultural practices can be altered appropriately to deal with changing weather patterns *to enhance sustainable development.* Farmers can adapt their farming systems to gradual upward trends in temperature, and even to incremental average annual changes in precipitation, since warming is less disruptive than is *climate variability*, manifested in so-called 'extreme events' (Rosenzweig et al. (2001)). Redesigning and adapting farming systems to a world of greater climatic variability will require many kinds of measures such as infrastructure investments, market modifications, policy incentives and other initiatives to buffer the effects of climate changes (Adger et al., (2003)). But there are also some things that farmers can do on their own to reduce vulnerability to climate variation and unpredictability. Cropping intensification which according to Tiffen et al. (1994), is the use of increased average inputs on smallholding for the purpose of increasing the value of output per hectare, can be to some extent "climate proofed" by promoting the growth and health of plants' *root systems*, and also by nurturing the robustness and fertility of the *soil systems* in which plants grow (Uphoff et al. (2006)). *Such sustainable development efforts* give plants better access to residual soil moisture and nutrients and enable them to cope better with various biotic and abiotic stresses. Soil that has, literally, more life in it will be more productive and better able to maintain its structure, minimize erosion, provide a steady supply of nutrients, and minimize the effects of pathogens. Thus there is a need to

assess the effect of cropping intensification on vulnerability to floods among farming households in Kwara State, Nigeria.

METHODOLOGY

The Study Area

The research was carried out in Edu and Patigi LGAs of Kwara state, Nigeria. The state was created on May 27, 1967 along with eleven other states in the federation. The state lies between latitude 7° 45N and 9°30N and longitudes 2°30E and 6°25E. The annual rainfall ranges between 1,000mm and 1,500mm. Average temperature ranges between 30^0C and 35^0C. The state has a land area of about 32,500 square kilometers and shares boundaries with Niger state in the North, Kogi state in the East, Ondo and Osun states in the South and Oyo state in the West, it also shares an international border with republic of Benin (Taiwo 2005) as shown in figure 1.



Figure 1: Map of Nigeria showing the position of Kwara State.

According to the 2006 National Population Census report, the population of Kwara state stood at 2.73 million. Popular ethnic groups found in the state include; Yoruba, Fulani, Batunu, Nupe, Bokobanu and Gambari. Over 90 percent of the rural populace is involved in farming (Kwara Ministry of Information 2004). The state has two main climatic seasons; the dry and wet seasons.

The natural vegetation of the state comprises the wooden and rain forest savannah. Major land forms in the state are plains, undulating hills and valleys. The favourable climate and the large expanse of land makes the wooded savannah in the state well suited for the cultivation of a wide variety of crops including cereals, tubers, legumes and vegetables like spinach, okra etc (kwara State Dairy, 2002)**.** The state is classified into four agro ecological zones by the Kwara State

Agricultural Development Project (KWADP). The classification is based on the ecology and administrative convenience. These are: Zone A: Baruteen and Kaima Local Government Areas; Zone B: Edu and Patigi Local Government Areas; Zone C: Asa, Ilorin East, Ilorin West, Ilorin South and Moro Local Government Areas; and Zone D: Ekiti, Ifelodun, Irepodun, Offa, Oyun, Isin and Oke-Ero Local Government Areas.

Method of Data Collection

The method of data collection includes an extensive literature search to conceptualize the study and to develop appropriate survey and analytical tools. A "transect walk" in the study area that facilitated the selection of the sampled villages was also carried out. Field data collection was done using structured questionnaires. The field survey was carried out with the farming household as the unit of analysis. For this study, vulnerability is defined as "the degree to which a system is susceptible to or unable to cope with, adverse effects of climate change, including climate variability and extremes. Essentially, there are two groups those affected by floods (vulnerables) and the unaffected (non-vulnerables).

Sampling Technique and Sample size

The farming households in Patigi and Edu Local Government Areas (LGAs) of Kwara State constituted the target population for this study. This was because the major flood disaster of 2012 occurred in these 2 LGAs (This Day Newspaper, 2012). A two-stage sampling technique was used to select sample for the study. The first stage involved a purpose selection of Patigi and Edu LGAs of Kwara State. In the second stage, 10 villages were randomly selected from the list of affected communities in each of the two LGAs. In each village, 4 farming households each were randomly selected among the farming households that were affected by floods and those that were not affected to make up a sample size of 160 farming households. However, only 150 questionnaires were returned and analysed.

Analytical Techniques

Descriptive statistics and logit regression model are the analytical tools employed to achieve the research objectives. The Logit regression model is characterised by a binary dependent variable with mutually exclusive and exhaustive outcomes. The dependent variable is the vulnerability status of the respondents, which is one if vulnerable to flood and zero otherwise. This was used to achieve objective four of the study. Following Maddala (1990) and Babcock et al (1995), the model specification gives rise to a system of two probabilities as:

$$\Pr ob\left(Y_{i=j}\right) = \sum^{2} \frac{e^{\beta jXi}}{e^{\beta kNi}} \qquad (1)$$

Where J = 0 or 1

Expanding equation 1:

$$\Pr ob(Y_i = j) = \frac{e^{n_j x_i}}{e^{n_0 x_i} + e^{n_i x_i}} \qquad (2)$$

The equations above have interdeterminancy problem and need to be removed. This calls that we assume that n_0 in the denominator is zero i.e. $n_o = 0$. Then, $e^{n\,Xi} = 1$, hence

$$\Pr ob(Y_i = j) = \frac{e^{n_j x_i}}{1 + e^{n_i x_i}} \qquad (3)$$

$$\Pr ob(Y_i = j) = \frac{e^{n_j x_i}}{1 + n^2 e^{n_k x_i}}$$

Then, the probability of being vulnerable (j = 0 or 1) is:

$$\text{Prob } (Y_i = 0) = \frac{1}{1 + \sum_{k=1}^{2} e\beta_k X_i} \quad (4)$$

$$\text{Prob } (Y_i = 1) = \frac{e\beta_1 Xi}{1 + \sum_{k=1}^{2} e\beta_k X_i} \quad (5)$$

Where β_j is a vector of parameters to be estimated.

The variables for the logit analysis are:

Y = Vulnerability of households to flood which is 1 if vulnerable and 0 if otherwise

X_1 = Household heads type where male headed households =1 and 0 otherwise

X_2 = Farm Size in hectares

X_3= Non-farm income in naira

X_4 = Cropping Intensification which was measured using Shriar, (2005) index.

X_5 = Distance to the nearby market in km

X_6 = Education of household head where formal education = 1 and 0 otherwise

RESULTS AND DISCUSSION

Socio-economic characteristics of the Household Heads

The age of the farming households' heads ranged between 35 and 67 years with an average of 47.8 years as shown in Table 1.

Table 1.. Socio-economic Characteristics of the Household Heads

Variables	Frequency	Percentage
i) Age of the Household Head		
21-40 years	37	24.7
41-60 years	96	64.0
61-80 years	17	11.3
Total	150	100
ii)Sex of the Household Head		
Male	119	79.3
Female	31	20.7
Total	150	100
iii)Marital Status of the Household Head		
Married	117	78.0
Single	26	17.3
Widower/Separated	6	4.7
Total	150	100
iv)Household Size		
1- 5	15	10.0
6- 10	69	46.0
11-15	66	44.0
Total	150	100
v)Education Status of the Household Head		
Formal Education	78	52.0
No formal Education	77	48.0
Total	150	100
vi)Major occupation of the Household Head		
Farming	109	72.7
Agricultural Trading	19	12.7
Non-Agricultural Trading	22	14.6
Total	150	100
vii)Farming Experience of the Household Head		
1- 20	19	12.7
21-40	55	36.7
41-60	76	50.6
Total	150	100
viii) Major Crop Combinations		
Sole Rice	45	30.0
Maize/Cowpea	38	25.3
Sole maize	19	12.7
Maize/Sorghum	31	20.7
Maize/Groundnut	17	11.3
Total	150	100

Source: Field survey, 2013

Sex distribution varies appreciably, 20.7% and 79.3% of the household heads were females and males respectively. The average household size is 10 persons in the study area. Most (65.1%) households are polygamous in nature. Polygamous nature of the people probably explains the large family size recorded in the area. Majority (72.7%) of the household heads are predominantly farmers, while others were involved in both agricultural and non-agricultural trading, business and civil service as their secondary sources of livelihood. Most (52%) farming household heads are literate with most of

them having primary education. The farming households head's years of experience ranged between 5 and 45 years with an average of the average of 38.1 years. Farming experience is expected to have a considerable effect on their productive efficiency. Basically, five crop combinations were popular among the sampled households. Sole rice had the largest number of occurrence (30%). This may be due to the easy adaptation of rice to the environment. Maize-cowpea, maize-sorghum, sole maize and maize-groundnut are the second, third, fourth and fifth widely adopted crop mixtures.

Determinants of vulnerability to Flood

The impact of social vulnerability on sustainable development provide insight on the importance of how socio-demographic characteristics combine to influence human vulnerability to hazards and communities' ability to cope with hazards. Table 2 shows the distribution of maximum likelihood estimate of farming households' vulnerability to floods as related to their socio-economic characteristics in Kwara state.

Table 2. Maximum likelihood estimate of farming households' vulnerability to floods

Variables	Coefficient	Std Error	Z	P-value
Constant	10.034	2.081	4.82	0.000
Household head type (X_1)	-3.849	0.858	-4.48	0.000
Farm Size (X_2)	0.932	0.367	2.54	0.011
Non-farm income (X_3)	-0.379	3.93	-0.10	0.923
Cropping Intensification (X_4)	-0.147	0.062	-2.37	0.018
Distance to market (X_5)	-0.122	0.043	-2.81	0.005
Education of household head (X_6)	-3.825	1.193	-3.21	0.001

LR (Chi^2) (6) =84.15; Prob > Chi^2 = 0.000; Pseudo R^2 = 0.4060

The results shows that household head type, farm size, cropping intensification, distance to input market and education of household head are the important variables explaining vulnerability to floods in the study area. A positive sign on a parameter indicated that a higher value of variable tends to increase the farming households' vulnerability to floods. Similarly, a negative value of coefficient implied that higher values of the variables would reduce the households' vulnerability to floods *and enhance sustainable development.*

Gender differences could determine disparities in the impact of floods. The result shows that household head type (male or female headed households) had significant negative coefficient. This study supports previous studies that households headed by women suffered disproportionately during flooding. There are several reasons why women-headed households were more vulnerable to the risk of flooding. Most women in the study area are not able to compete favorably with men for available resources. This is because cultural norms inhibit their ability to obtain and keep a job in the formal sector of the economy. Thus, gender is an important factor in gender disparities in mitigating and responding to flooding in the state.. These researchers often attribute higher female vulnerability to the role of women in caring for their family, and the fact that women would ensure that everyone is safe and together before evacuating during a disaster, which likely translates into higher mortality statistics for both women and children (Jones 2004). The cropping intensification of the household had significant negative coefficient. *This has implications for vulnerability to flooding and sustainable*

development of the households. This is because households who intensify crop production and uses other land management practices are more sustainably developed and are less vulnerable to floods.

Farm size on the other hand had significant positive coefficient. This implies that the larger the farm size the higher the chance of being vulnerable to flood. Distance to the input market and education of household heads have negative significant coefficients. This implies that the closer the household to the input market the lower the chance of being vulnerable to floods. This may be because the closer the household to the market the higher the probability of using hybrid seeds and other agrochemicals. This result agrees with earlier findings by Reardon et al. (2001). The coefficient of education is negative and significant at 1% level. This implies that improved education has higher probability of reducing vulnerable of households to floods. This may be because households' heads that are educated have access to regular information on current issues related to climate change and agriculture. Education and awareness raising are important ways to provide households with the knowledge and skills to prepare for and recover from flooding. The log-likelihood (-61.565) indicates that there is no close relationship within the variables and the omnibus test of the model. The overall fit test indicate a chi-square value of 84.15 which is significant ($p<0.01$) implies that the model as a whole fit significantly better

Coping and Adaptation Strategies of Farming Households

In the past, few farming households adopted the strategies for coping with floods. However, recently, after the most devastating flood s in 2012, households became more vulnerable and adopted different coping strategies. *For sustainable development of the area* farming households have different perceptions on disaster and develop different efforts to overcome the floods. The capacities to cope with the disaster impact is however different depending on social groups; poor and rich, men and women, young and old, indigenous or non- indigenous, etc. Being located in the flood-prone area, majority of the people are aware of the danger involved and they have tried to protect and cope with flood effects. The coping mechanism employed by farming households to deal with the negative impact of flood *to enhance sustainable development* could essentially be grouped into economic, cultural, technological, structural and social coping mechanisms. The economic coping mechanism involves economic activities and diversification, including those strategies of the community linked to materials goods and resources, for instance, having more than one source of income. For example 15.3%, 8% and 8.6% of the respondents adopted crop diversification, livestock diversification and selling of assets respectively as their most widely used coping strategies as presented in Table 3.

Table 3 Most widely used Coping and Adaptation Strategies among the Farming Households

S/N	Coping Strategies	Frequency	Percentage
1	Crop diversification	23	15.3
2	Livestock diversification	12	8.0
3	Early mature crop varieties	10	6.7
4	High yield varieties	12	8.0
5	Low input varieties	5	3.3
6	Replanting	30	20.0
7	Labor migration	4	2.7
8	Selling assets	13	8.6
9	Food storage	4	2.7
10	Construction of houses to prevent floods	11	7.3
11	Assistance from relations	10	6.7
12	Assistance from Community	4	2.7
13	Assistance from Government	2	1.3
14	Assistance from NGOs/CBOs	2	1.3
15	Abandoned activity	5	3.3
16	Migrated	3	2.0
	Total	150	100

Source: Field survey, 2013.

The technological/structural coping mechanism refers to the structural activities employed by households living in the flood-prone area to cope with flood losses or damages. These include the construction of houses to prevent floods or the use of materials that can minimize the flood losses and damage. About 7% of the respondents adopted this coping strategy. The social/organizational coping mechanisms are those activities and or social relationship and network among the community and local government that can help people to minimize the flood losses and damage (e.g. the supply of relief materials and establishment of refugee camps to house displaced farming households until the flood recedes). The result indicates that 2.7%, 1.3% and 1.3% of the respondents got assistance from relations, immediate community and state government respectively.

CONCLUSION

Although humans can do little or nothing to change the incidence or intensity of most natural hazards, they have an important role to play in ensuring that natural events are not converted into disasters by their own actions. It is important to understand that human intervention can increase the frequency and severity of natural hazards. This study assesses the influence of cropping intensification on households' vulnerability to floods in Kwara state, Nigeria. The findings showed that household head type, farm size, cropping intensification, distance to input market and education of household heads are the important variables explaining vulnerability to floods in the study area. Also, the result indicated the most widely adopted coping strategy is replanting (cultural) which is closely followed by crop diversification. *This study demonstrated that low cropping intensification, the continuing loss of environmental defences and accelerating global change are increasing threats to human well-being and are putting sustainable development at risk.* There is need to improve the infrastructure, such as roads, water supply, electricity, health centres and schools. Good access road and electricity will surely help in opening up and diversifying economic activities in these communities instead of depending on agriculture alone. Also, provision of schools and communication facilities will reduce illiteracy level and increase environmental awareness among the communities. *The development of public awareness programmes and campaigns on*

the relationships linking sustainable development, natural hazards, vulnerabilities and disasters, to enhance disaster reduction measures are hereby encouraged. The media should also assist in educating the public on flood consequences *to enhance sustainable development of the area*. These will help improve the welfare of the communities *and vulnerability reduction will result in important savings in the future.*

REFERENCES

Adger, W. N., Huq S., Brown, K., Conway, D.., and Hulme, M. (2003). Adaptation to climate change in the developing world, *Progress in Development Studies* 3, 179-205.

Arnold, M., Kreimer, A. (2004). The socio-economic costs of disasters. In: A. Mathur, I. Burton, M. van Aalst (Eds), An Adaptation Mosaic: An Example of Emerging Bank Work in Climate Change Adaptation. Final Draft. World Bank Global Climate Change Team, The World Bank, Washington, DC, pp. 5–14.

Ayoade, J.O. (2004). *Climate Change.* Vantage Publishers, Ibadan

Babcock, B.A., Chaherli, N.M., and Lakshminarayan, P.G. (1995). Programme Participation and Farm-Level Adoption of Conservation Tillage: Estimates from a Multinomial Logit Model. Working Paper 95-WP136, Centre for Agricultural and Rural Development, Iowa State University, Ames, Iowa.

CRED, (2010). Annual Disaster Statistical review 2009, Centre for Research on the Epidemiology of Disasters (CRED), Brussels

Jones, B. (2004). *The Geography of Vulnerability: Who is at Risk to Multiple Hazards in GreaterVancouver.* University of Waterloo, unpublished PhD thesis.

Kwara State Dairy (2002). Kwara State Ministry of Information.

Maddala, G.S. (1990). *Limited Dependent and Quantitative Variables in Econometrics*. Cambridge:Cambridge University Press. Pp 21-65.

McCarthy, J., Canziani, O. F., Leary, N. A., Dokken, D. J. and White, C. eds.(2001). Climate change 2001: Impacts, adaptation, and vulnerability. Contribution of Working Group II to the third assessment report of he Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press.

Reardon, T., Barrett, C.B., Kelly, V., and Savadogo, K. (2001). Sustainable versus unsustainable agricultural intensification in Africa: Focus on policy reforms and market conditions. In: DR Lee , CB Barrett (Eds.): *Tradeoffs or Synergies? Agricultural Intensification, Economic Development and the Environment*. Wallingford, UK.: CAB International, pp. 365-383.

Rosenzweig, C., Iglesias A., Yang X. B., Epstein. R., and Chivian, E. (2001). Climate change and extreme weather events: Implications for food production, plant diseases, and pest, *Global Change and Human Health* 2, 90-104.

Shriar, A..J. (2005). Determinants of Agricultural Intensity Index "Scores" in a Frontier Region :An analysis of Data from Northern Guatemala. *Agriculture and Human Values* 22:395-410.

Tiffen, M., Mortimore, M. and Gichuki, F. (1994). *More People Lees Erosion: Environmental Recovery in Kenya.* Wiley, Chichester, UK.327pp.

United Nations (2001). Guild lines for Reducing Flood Losses *Report on International Strategy for Disaster Reduction*. UN Dept. of Economic and Socio Affairs 79pp.

Uphoff, N., Ball A., Fernandes E., Herren, H., Husson O., Laing M., Palm C. A., Pretty J. N., Sanchez P. A., Sanginga N., Thies J. (eds.) (2006). *Biological Approaches to Sustainable Soil Systems*, CRC Press, Boca Raton, FL.

ABOUT THE AUTHORS:

Shehu Abdulganiyu Salau, Lecturer I, Department of Agricultural Economics and Extension Services, College of Agriculture, Kwara State University, Malete.

Ibrahim Folorunsho Ayanda, Lecturer II, Department of Agricultural Economics and Extension Services, College of Agriculture, Kwara State University, Malete.