FACTORS AFFECTING VULNERABILITY TO CLIMATE CHANGE AND CHOICE OF LIVELIHOOD OF IFAD-VCDP FARMERS IN BENUE STATE, NIGERIA

OHA, E., NMADU, J. N., YISA, E. S., SALLAWU, H., COKER, A. A. A. and MOHAMMED, U. S.

Department of Agricultural Economics and Farm Management, Federal University of Technology, Minna, Niger State, Nigeria.

E-mail of corresponding author: oha.pg825665@st.futminna.edu.ng

Abstract

This study investigated factors affecting vulnerability to climate change and choice of livelihood of IFAD-VCDP farmers in Benue State, Nigeria. Primary data were collected through personal interviews from 240 sampled IFAD-VCDP farm households. The household vulnerability index and Beta regression model were used to analyze the data. The results of household vulnerability revealed that 4.58% of the households were lowly vulnerable to climate change, 36.67% were moderately vulnerable and 58.75% were highly vulnerable. The estimates of the Beta regression model revealed that adaptive capacity, years of formal education, farm income, non-farm income, credit use,total livestock unit, household size and total livelihood activity influence the farmers'vulnerability.IFAD-VCDP farmerswere found to be vulnerable to climate changehence it was therefore recommended that government and NGOs should assist in increasing the adaptive capacity of the farmers by conducting campaign on climate change adaptation techniques, encourage the farmers to invest more in non-farm activities to serve as coping strategies and financial institutions should assist farmers with agricultural loan.

Keywords: Farmers Vulnerability, Climate Change, Beta regression, IFAD-VCDP.

Introduction

Among the natural resources, climate is the predominant factor that influences food crop production. Climate is the state of atmosphere, which is created by weather events over a period of time. A slight change in the climate will affect agriculture (Food and Agriculture Organisation (FAO), 2015). According to Intergovernmental Panel on Climate Change (IPCC) 2016 report, climate change is a change in the state of the atmosphere which is attributed directly or indirectly to human activity that alters the composition of the global and/or regional atmosphere and which is in addition to natural climate variability observed over comparable time periods.Agriculture is one of the sectors most vulnerable to changes in the climate (IPCC, 2016). Recent studies Emmanuel (2017); Asha (2018) have shown that projected losses in the production of cocoa and rice threaten national economies and also the regional and global supply chains of these respective industries. The projected impacts of climate change are a threat to crop production in regions that currently experience food insecurity (Victor, 2016). In Africa and South Asia, major grains including wheat, rice, maize and sorghum are projected to suffer mean yield losses of 8% by 2050 with some crops, notably wheat in Africa, expected to experience a yield change of -17% (Baliraj, 2016). The impacts of climate change on agriculture are already being felt. In Nigeria, climate change is estimated to have reduced yields of rice by 4% (FAO, 2015). Although the impacts of climate change will impact national and global industries, it is the marginalised and impoverished rural communities in developing countries like Nigeria whose livelihoods are dependent upon small scale agriculture who are particularly vulnerable (Ala, 2013).Vulnerability is a widely used concept by different fields of specialisation and thus with different definitions (Füssel, 2007). The concepts and definitions of vulnerability used by different scholars revolve around the explanation of lack of adaptive capacity in both social and natural systems. The knowledge of vulnerability of different social systems and the adaptation measures taken assist policy in vulnerability reduction through strengthening adaptive capacity.

The International Fund for Agricultural Development (IFAD) intervention in Nigeria is focused on Value Chain Development Programme (VCDP) because of the challenges faced by smallholder farmers such as low productivity, poor access to market, poor processing technology, lack of adequate information, high costs of farm inputs, inadequate credit system, the vicious cycle of poverty and the recent challenge which has seemed formidable and climate change (IFAD, 2013). The Value Chain Development Programme is a development initiative which is an approach to tackle the challenges faced by smallholder farmers. The six-year programme is aimed at improving cassava and rice value chains in six states, namely; Anambra, Benue, Ebonyi, Niger, Ogun and Taraba by proffering solutions to low productivity, limited access to productive assets and inputs, paucity of opportunities for value addition, inadequate support services such as extension services and research, inability to access rural financial services, inadequate market and rural infrastructure (IFAD, 2013).

According to Damas and Israt (2004) many factors contribute to vulnerability, and these factors act to undermine capacity for self-protection, blocks or diminish access to social protection, delays recovery or expose some groups to greater or more frequent hazards than other groups. The factors that contribute to vulnerability include rapid population growth, poverty and hunger, poor health, low levels of education, gender inequality, fragile and hazardous location, and lack of access to resources and services, including knowledge and technological means and disintegration of social patterns (social vulnerability). Damas and Israt (2004) further report that other causes of vulnerability include lack of access to information and knowledge, lack of public awareness, limited access to political power and representation (political vulnerability). When people are socially disadvantaged or lack political voice, their vulnerability is exacerbated further (Majahodvwa *et al.,* 2013). Economic vulnerability is related to a number of interacting elements, including its importance in the overall national economy, trade and foreign exchange earnings, aid and investments, international prices of commodities and inputs, and production and consumption patterns. Environmental vulnerability concerns land degradation, earthquake, floods, hurricane, drought, storms, water scarcity, deforestation, and other threats to biodiversity (Damas and Israt, 2004). Lending credence to this, Makoka and Kaplan (2005) argued that vulnerability is caused by a broad range of political, institutional, economic, environmental and socio-cultural factors such as insufficient knowledge, lack of personal and financial resources and inadequate legislation.As a result, vulnerability must not be restricted to a simple cause-effect relationship.

The present inability of food crop production sector to meet the foods demand of Nigerians and the challenge posed by climate change emphasized the need for the assessment of how vulnerable as well as the contributing factors to the vulnerability of food crop farmers to climate change. Failure to know these determinants of vulnerability will inhibit the designing and formulation of appropriate policies to meet food crop production demands of the country. Also, the expected determinants offarmers' vulnerability to climate change varies among regions, sectors, social groups and communities due to the fact that resources are distributed unevenly. Studies in the past have mainly focused on the effect of climate change on farmers. The factors affecting vulnerabilities of farmers to climate change in the study area has not been carried out and well documented enough to generate appropriate policy action. Therefore, this study will try to fill these knowledge gaps by determining the factors affecting vulnerability to climate change and choice of livelihood of IFAD-VCDP farmers in Benue State, Nigeria.

Methodology

The study was conducted in selected Local Government Areas (LGAs) of Benue State, Nigeria. The State is one of the six states constituting the North Central region of Nigeria with its headquarters in Makurdi. Benue State is located between Latitudes $6^0 30^1$ N and $8^0 10^1$ N and Longitudes $6^0 33^1$ E and 10^0E. The State covers a total land area of 33,955 square km.Thehuman population of the State is 3,950,249 people in 2006(National Population Commission, 2006). With the state population growth rate of 3.05% (NPC, 2016), the projected population of the state is 6,474,150 people as at 2019. The wet season begins in April and ends in November while the dry season starts in December and ends in March. The average annual rainfall in the State is 1,290 mm. Temperature is fairly regular and ranges from 25.5^0C in August to 30.0^0C in April. The soil types support sustainable production of arable crops. The major spoken languages are Tiv, Idoma and Igede. Others are Agatu, Akpa, Basa, Eloyi, Etulo, Iyive, Izi-Ezaa-Ikwo-Mgbo, Kukele, Oring, Otank and Wannu. The major occupation of the people is farming. Major crops cultivated are rice, yam, cassava, groundnut, millet, soybeans, maize, citrus, mango, sorghum, sweet potato, cocoyam, guava, oil palm, tomatoes, cowpea, cashew and okra.

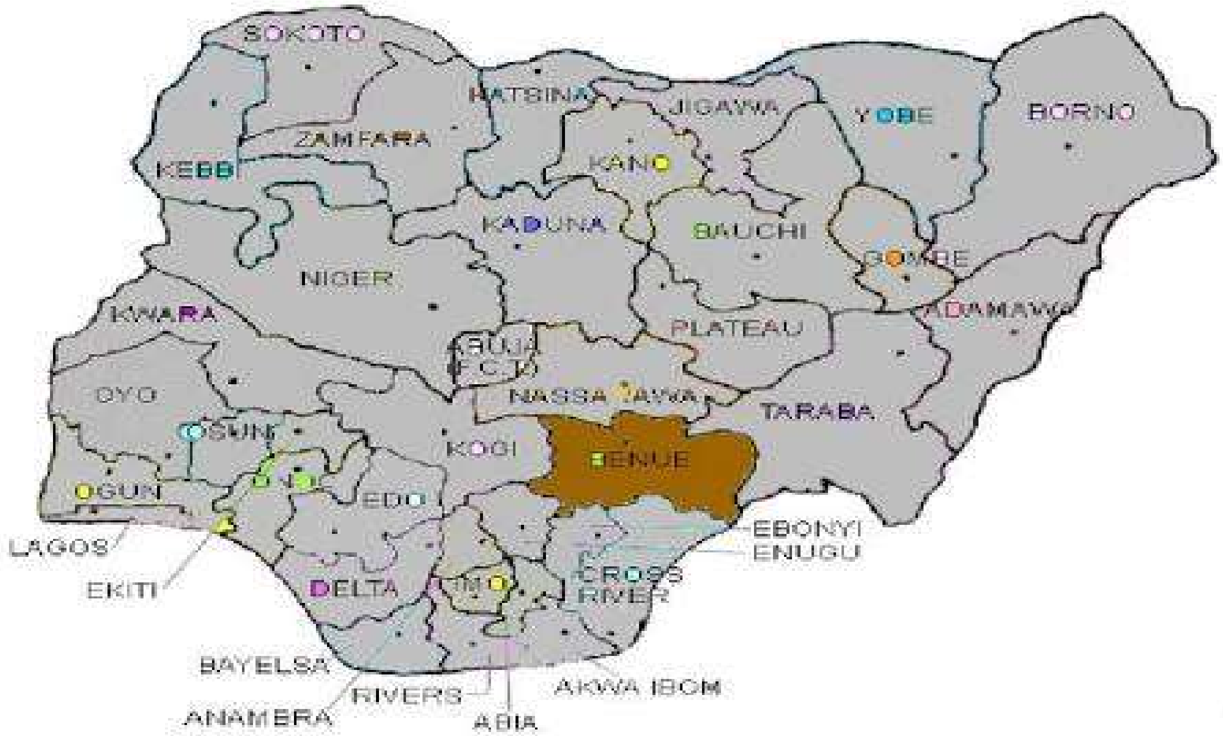

Figure 1: Map of Nigeria Showing the study area.

Both primary and secondary data were used for this study. A multi-stage sampling technique was employed in sampling the location and the collection of primary data for this study. The first stage involves a purposive selection of all the five (5) IFAD – VCDP participating Local Government Areas (LGAs) that is, Gwer-East, Guma, Logo, Okpokwu and Ogbadibo. In the second stage, proportionate number of communities was randomly selected from each LGA.The third stage involved the sampling of farm households in each community. This was determined proportionately using Krejcie and Morgan (1970) formula and adopted by Sallawu *et al.* (2020). The formular is presented in eq. (1)

$$S = \frac{X2NP(1-P)}{d2(N-1)+X2P(1-P)} \qquad \text{eq.(1)}$$

Where:
S= The required sample size,
$\mathcal{X}^2$= Table value of chi-square for 1 degree of freedom at the desired confidence level (1.96),
N = Population size,
P = Population proportion (assumed to be 0.80),
d^2= Degree of accuracy squared expressed as a proportion (0.05) and
1= Constant.

A total of 240 respondents were selected for this study. Data for this study were collected using interview schedules with the aid of trained enumerators. The secondary data were sourced from Food and Agriculture Organization (FAO) (2019) and Nigerian Meteorological Agency (NIMET) (2019). The data were analyzed using vulnerabilityindex and Beta regression model. Vulnerability is a complex, multidimensional and broad concept, consisting of several subcomponents (Below *et al*., 2012). Given this complexity, vulnerability is commonly synthesized in an index, making it more comprehensive and operational hence the level of vulnerability of farmers to climate change was estimated using vulnerability index. The vulnerability index was calculated using three indicators of exposure, sensitivity and adaptive capacity with sub indicators presented in the Table 1.

Table 1: Indicators and sub-indicators of vulnerability, and description of the variables

Components of Vulnerability	Sub-indicators	Indicators	Description of indicators
EXPOSURE	Extreme event	Frequency of flood in last 10 years	Number of flood event from 2009-2019
		Frequency of drought in last 10 years	Number of drought events from 2009-2019
	Climatic variables	Average annual precipitation	Mean annual precipitation
SENSITIVITY	Demography	Unemployment in family	Number of unemployment of family aged 15-65 / total number of family members
		Family involved in agriculture	Number of family directly involved agriculture/total number of family member
		Number of child	Number of family's child below 15 years old / total number of family member
	Vulnerable social group land	Child under 5 years old	Number of family's child below 5 years old / total number of family member
		Adults above 65 years old	Number of family above 65 years old / total number of family member
	Land	Average land size	Total farm size owned / number of land pieces
		Farm size of each family member	Total farm size owned / numbers of family members
	Agricultural productivity	Crop diversity index	CDI= 1 / number of crops grown by a household + 1
		Chemical fertilizer consumption	Consumption of chemical fertilizer in hectare
		Land cultivated by drought resistance varieties	% of land cultivated by drought resistance varieties to whole owned land
ADAPTIVE CAPACITY	Economical capability	Net farm income	Net income obtained from the farm
		Crop insurance	% of farm land covered by crop insurance / or credit
		Livestock unit	Ownership of number of livestock unit
		Irrigated to rain-fed land	Rate of irrigation to land-fed under cultivation land
		Income from agriculture	% of income from agriculture to all income
	Social capability	Land ownership	Household farmland ownership (ha)
		Family member involved in agriculture	Number of family member involve in agricultural activity
		Technical advice consulting	The level of taking technical advice consulting
		Family member participating in social communities	% of family members participating in social communities
	Human resources capability	Adult family members	Ratio of family members aged 15-65 years to all
		Household head education	Household numbers of years education
		Highest number of year education	Highest numbers of years education in household
	Institutional capability	Access to nearest health center	Distance to nearest health center (km)
		Access to main road	Distance to nearest main road-asphalt (km)
		Access to healthy drinking water	Access to healthy drinking water (yes = 1, no = 0)
		Access to market	Distance to nearest city (km)
		Access to infrastructure	Access to road (road, electricity, gas and telephone)
		Access to educational facilities	Access to educational facilities such as school, high schools and library
		Access to governmental credit	Access to governmental credit (yes = 1, no = 0)
		Access to communication channels	% of access to communication channel (radio, TV, satellite, phone)
		Access to agricultural impute	% of access to agricultural impute (machinery, irrigation system, pesticide, fertilizer)

Adopted from Jamshidi *et al,* (2018) and modified.

The factors affecting vulnerability to climate change were analyzed using beta regression model. Since the response variable is bounded in the open unit interval (0, 1), the assumptions of normal distributed errors and homoscedasticity, as they are required for least-squares models, are not reasonable in this context. Such variables can be modelled with standard regression models after logit-transformation (logit(Y) = log(Y/ (1-Y))) or directly using beta-regression (Cribari-Neto and Zeileis, 2010). Beta regression is a model used in a case where the response variable is between 0 and 1. It is more appropriate than ordinary least squares regression because of "bounding-effects" caused by the values not being sufficiently being far away from 1 or 0. The response variable is transformed into beta density, a more robust value by equation (2).

$$\pi(y/p,q) = \frac{\Gamma(p+q)}{\Gamma(p)\Gamma(q)} y^{p-1}(1-y)^{q-1}, 0 < y < 1 \quad (2)$$

where:
$p>0$, $q>0$ and Γ (.) is the gamma function.
The mean and variance of y are shown in eqs. (3-4).

$$E(y) = \frac{p}{(p+q)} \quad (3)$$

$$var(y) = \frac{p+q}{(p+q)^2(p+q+1)} \quad (4)$$

Ferrari and Cribari-Neto (2004) proposed a parameterization by setting $\mu = p/(p+q)$ and $\phi = p+q$:

$$f(y;\mu,\phi) = \frac{\Gamma\phi}{\Gamma(\mu\phi)\Gamma((1-\mu)\phi)} y^{\mu\phi-1}(1-y)^{(1-\mu)\phi-1}, 0 < y < 1 \quad (5)$$

Where:

$0 < \mu < 1$ and $\phi > 0$

$$y \sim \beta(\mu,\phi) \quad (6)$$

The parameter ϕ is known as the precision parameter since, for fixed μ, the larger the ϕ the smaller the variance of y; $\phi^{-1}$is a dispersion parameter. Following Ferrari and Cribari-Neto (2004); Cribari-Neto and Zeileis (2010).

$$Y = \beta_0+\beta_1AC+\beta_2FS+\beta_3AG+\beta_4LE+\beta_5GD+\beta_6DM+\beta_7EC+\beta_8FI+\beta_9NI+\beta_{10}CR+\beta_{11}LS+\beta_{12}HS+\beta_{13}PS+\beta_{14}SA+\beta_{15}LA+\beta_{16}MA+e \quad (7)$$

Where

Y = Vulnerability index score (index 0-1)
AC = Adaptive capacity (index);
FS = Farm size (hectares);
AG = Age (years);
LE = Level of education (no of years spent in school);
GD = Gender (male=1, female=0);
DM = Distance to market (km);
EC = Extension Contact (yes=1, no=0);
FI = Farm income (naira);
NI = Non-farm income (naira);
CR = Credit used by farm household (naira);
LS =Livestock ownership by household (tropical livestock unit);
HS = Household size (numbers);
PS = Poverty status (poor =1; non-poor =0);
SA = Social amenities (numbers);
LA = Total livelihood activity (numbers);

MA = Cooperative/Membership of association (number of membership);
e = Error term;
β_0 = Constant term or intercept to be estimated;
β_1-β_{16}= Coefficients to be estimated.

Results and Discussion

Table 2 indicates the household vulnerability index of IFAD-VCDP farmers. After calculating the household vulnerability index, the household where classified into three groups according to the household vulnerability index. The first group (4.58%) with vulnerability value of less than 0.33 where labeled as low vulnerability which means that the household is in a vulnerable situation but still able to cope with number of external assistance. The second group (36.67%) with vulnerability value between 0.33 – 0.66 was classified as moderate group. They are the household that needs urgent but temporary external assistance to recover from a shock. Lastly, the high level of vulnerability group (58.75%) with values above 0.66 are class of household that are in serious situation but could be resuscitated through educational, financial, institutional and even political support to improve their adaptive capacity. In related study, Makoka and Koplan (2005), through the HVI, the household were also classified into three categories, lowly vulnerable, moderately vulnerable and highly vulnerable. They reveals in their research that about 39.6% of the household where lowly vulnerable, 58.2% where moderately vulnerable and 2.2% where highly vulnerable.

Table 2: Level of vulnerability of farmers to climate change.

Level of vulnerability	Frequency	Percentage
Low $> 0 < 0.33$	11	4.58
Moderate $\leq 0.33 < 0.66$	88	36.67
High $\geq 0.66 \leq 1.0$	141	58.75

Source; Field survey, 2019.

Factors affecting vulnerability to climate change

Result of the Beta regression model and marginal effects on factors affecting vulnerability to climate change are presented in Table 3 and 4. Out of the 16 hypothesized explanatory variables in the beta regression model, 8 were found to be significantly affecting vulnerability at different probability levels. The likelihood ratio statistics (506.56) as indicated by Chi^2 ($\mathcal{X}^2$) statistics was significant at 1% probability levels, (Prob. > Chi = 0.0000) suggesting that the model have strong explanatory power.The coefficient of adaptive capacity (-0.309) is negatively signed and statistically significant at 1% probability level confirming to *apriori* expectation by having a negative relationship with vulnerability. This implies that as adaptive capacity of the household head increases, the vulnerability to climate change tends to decrease and vice versa. A unit increase in adaptive capacity would decrease the probability of a farm household shifting from low vulnerability category to high category by 30.93%.The coefficient of years of formal education (-0.004) is negatively signed and statistically significant at 5% probability level confirming to *apriori* expectation by having a negative relationship with vulnerability. This implies that as educational level of the household head increases, the vulnerability tends to decrease. A unit increase in years of formal education would decrease the probability of a farm household shifting from low vulnerability category to high category by 0.35%. This is probably due to the facts that education tends to open up more opportunity for income generation and general adoption of adaptive strategy to climate change.

Table 3: Estimates of Beta regression on factors affecting vulnerability to climate change

Variables	Coefficient	Standard error	Z value	P > |z|
Adaptive capacity	-1.276	0.165	-7.75***	0.000
Farm size	0.009	0.022	0.45	0.654
Age	-0.038	0.002	-1.62	0.106
Years of education	-0.014	0.007	-2.21**	0.027
Gender	-0.220	0.171	-1.29	0.197
Distance to market	0.145	0.012	1.23	0.220
Extension	-0.156	0.162	-0.96	0.335
Farm Income	-0.067	0.029	-2.30**	0.022
Non-Farm Income	0.023	0.009	2.50**	0.012
Credit	0.019	0.008	2.48**	0.013
Total livestock unit	-0.039	0.009	-4.60***	0.000
Household Size	0.019	0.005	3.70***	0.000
Poverty Status	0.186	0.188	0.99	0.323
Social amenities	-0.010	0.029	-0.36	0.722
Total Livelihood activity	-0.100	0.047	-2.13**	0.033
Cooperatives	-0.094	0.086	-1.09	0.274
Cons	0.1911	0.419	0.46	0.649
Scale cons	3.9446	0.090	43.56***	0.000
No of observation	240			
LR chi^2 (16)	506.56			
Prob>chi^2	0.0000			
Log likelihood	324.33102			

*** implies significant at 1%, ** significant at 5%, * significant at 10%

Source: Field Survey, 2019.

Table4: Marginal effectof Beta regression on factors affecting vulnerability to climate change

Variables	Coefficient	Standard error	Z value	P > |z|
Adaptive capacity	-0.309	0.039	-7.75***	0.000

Years of education	-0.004	0.002	-2.21**	0.027
Farm income	-0.016	0.007	-2.30**	0.022
Non-farm income	0.006	0.002	2.50**	0.012
Credit	0.005	0.002	2.48**	0.013
Total livestock unit	-0.009	0.002	-4.60***	0.000
Household size	0.005	0.001	3.70***	0.000
Total livelihood activity	-0.024	0.011	-2.13**	0.033
Constant	0.621	0.026	23.93***	0.000

*** implies significant at 1%, ** significant at 5%, * significant at 10%
Source: Field Survey, 2019.

The coefficient of farm income (-0.016) is negative and statistically significant at 5% probability level confirming to the *apriori* expectation by having a negative relationship with vulnerability. This implies that as farm incomeof the household head increases, vulnerability to climate change tends to decrease. A unit increase in farm income would decrease the probability of a farm household shifting from low vulnerability category to high category by 1.63%.The coefficient of non-farm income (0.006) is positive and statistically significant at 5% probability level. This is contrary to *apriori* expectation by having a positive relationship with vulnerability. This implies that as non-farm income of the household head increases, vulnerability to climate change tends to increase.A unit increase in non-farm income would increase the probability of a farm household shifting from low vulnerability category to high category by 0.56%.The coefficient of credit use (0.005) is positively signed and statistically significant at 5% probability level. This is contrary to apriori expectation of a negative relationship with vulnerability. This implies that as credit use increases, vulnerability of households to climate change tends to increase. A unit increase in credit use would increase the probability of a farm household shifting from low vulnerability category to high category by 0.47%. The possible reason for this might be due to high interest rate charged by the lending institutions and poor management of acquired credit by the household head. The coefficient of total livestock unit (-0.009) is negative and statistically significant at 1% probability level. This implies that as total livestock unit increases, vulnerability to climate change tends to decrease. A unit increase in livestock unit would decrease the probability of a farm household shifting from low vulnerability category to high category by 0.95%. The coefficient of household size (0.005) is positive and statistically significant at 5% probability level. This implies that a unit increase in the number of household members would increase the probability of a household shifting from low vulnerability category to high category by 0.48%.The possible reason for this might be due to increased responsibility on the household head due to increased dependent members of the household.The coefficient of total livelihood activity (-0.0243) is negative and statistically significant at 5% probability level. This implies that as the livelihood activity of the household increases, vulnerability to climate change tends to decrease. A unit increase in livelihood activity would decrease the probability of a farm household shifting from low vulnerability category to high category by 2.43%. The possible reason for this could beimproved livelihood of the households as a result of alternative source of income.These results are in line with the findings of Inayatullah *et al.,* (2012), who opined in their work in Swaziland that educational level of household head, age of household head, job experience of household head, number of employed members of household, index of livestock holding and per capita income of household affect farmers vulnerability to climate change and hence rural livelihood.

Conclusion and Recommendations

From the findings of this study, it can be concluded that majority (58.75%) of IFAD-VCDP farmers were highly vulnerable to climate change, suggesting they are in a state of emergency indicating that they need immediate attention and special expertise if they are to pull out of the situation they are in. About (36.67%) were moderately vulnerable to climate change, implying that in case of an external shock they would need some assistance for them to recover. Only 4.58% of the farm households were able to cope even though they were also vulnerable. The shift of a household from the state of low vulnerability to the state of moderate or high vulnerability or verse-versa was influenced by adaptive capacity, years of formal education, farm income, non-farm income, credit use, total livestock unit, household size and total livelihood activity of the farm household.It is therefore recommended that government should come up with appropriate intervention policies in order to help these households. Such policies should include educational policy as it has been shown to reduce vulnerability status of the farm households, government and NGOs should assist in increasing the adaptive capacity of farmers through campaign on climate change adaptation techniques, rural development policy that would create job opportunities in the rural areas would help reduce vulnerability of the farmers and hence improve the livelihoods of the households since it will provide them with an alternative source of income.

Acknowledgement

First and foremost, I would like to express my sincere gratitude and appreciation to my supervisor Prof. J. N. Nmadu for his invaluable guidance, support and accessibility despite his crowded schedules been the dean of the faculty. I would also like to thank my lecturers particularly our Head of Department in person of Prof. A. J. Jirgi for their valuable comments and suggestions.

My sincere acknowledgement goes to my colleagues at the Department of Agricultural Economics and Farm Management for their supports and cooperation. Finally, i would like to express my deepest gratitude to my parents, brothers, sisters and friends for their inspiration, support and encouragement.

References

Ala, C. M. (2013).Effect of climate change on farmers and adaptive capacity in Indiana.*AgBioForum*, 8(4): 197-204.

Asha, O. (2018). Measurement of resource productivity and the effect of climate change amongsmall holder rice farmers in Nigeria. *Modeling, Measurement and Control*, 12(2): 1–13.

Baliraj, R. M. (2016). A Model for technical inefficiency effect in stochastic frontier production functions for panel data.*Empirical Economics*,20(1): 325 –332.

Below, T. B., Mutabazi, K. D., Kirschke, D., Franke, C., Siebert, S., Siebert, R. and Tscherning, K. (2012). Can farmers' adaptation to climate change be explained by socio-economic household-level variables? *Global Environmental Change*, 22(1): 223-235

Cribari-Neto, F. and A. Zeileis (2010). Beta Regression in R. *Journal of Statistical Software* 34(2), 1-24. URL http://www.jstatsoft.org/v34/i02/.

Damas, P. and Israt, R. (2004). Vulnerability and poverty: What are the causes and how are they related.

Dirway, T. P. (2010). Application of the sustainable livelihood framework to the analysis of the provincial growth and development plan of the Eastern Cape – a case study of mass food production programme in Nkonkobe municipality and Baffalo City municipality.

Emmanuel, B. C. (2017). Challenges of agricultural adaptation to climate change: empirical evidence from southeast Nigeria. *Tropicultural*,29(4): 243-249.

Ferrari H & Cribari-Neto (2004).Linking Socio-economic and policy variables to technical efficiency of traditional agricultural production: empirical evidence from Nigeria. Poster paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia.

Food and Agriculture Organization (FAO) (2015).Adaptation to climate change in agriculture, forestry and fisheries: perspective, framework and priorities.

Food and Agriculture Organization of the United Nations (FAO).Food and agriculture data 2019. Available from: www.fao.org/faostat/en/. Accessed on 1st July, 2019.

Fussel D. F (2007). Determinants of African farmers' strategies for adapting to climate change: Multinomial choice analysis. *African Journal of Agricultural and Resource Economics*, 2(1): 83-104.

Inayatullah, J., Munir, K. K., Khan, M. A., Shakeel, H. and Tariq, R. (2012).Factors affecting rural livelihood choices in Northwest Pakistan.*Sarhad Jornal of Agriculture, 28*(4): 681-688.

International Fund forAgricultural Development (IFAD) (2013). Improving Young RuralWomen's and Men's Livelihoods -The most sustainable means of moving to a brighterfuture. Paper Review published in Centre for Alleviation of Poverty through Sustainable.

Intergovernmental Panel on Climate Change (IPCC) (2016).Contribution of working group II to the fourth assessment report of IPCC-summary for policy makers.Retrieved on July 12, 2019 from http://www.ipcc.ch/pdf/assessment-report/ar4/wg2-spm.pdf.

Jamshidi, G. Y. and Kaly, U. M. (2018).Challenges of agricultural adaptation to climate change in Nigeria: a Synthesis from the Literature,Field Actions Science Reports. Available at http://factsreports.revues.org/678.Accessed on 21 September, 2020.

Krejcie, R. V. and Morgan, D. W. (1970). Determining Sample Size for Research Activities.*Educational and Psychological Measurement*, 30(1): 607-610.

Majahodvwa S.N., Micah B. M and Absalom M. (2013). Factors affecting household vulnerability to climate change in swaziland. *Jornal of Agriculture, 10*(5):13-33.

Makoka, D. and Kaplan, M. (2005).*Poverty and Vulnerability*.University of Bonn, Centre for Development Research.

National Population Commission (NPC) (2006). Population Data in Nigeria.Retrieved on 20th February, 2019 from http://www.population.gov.ng/population-data-in-Nigeria.

National Population Commission (NPC) (2016). Population Data in Nigeria.Retrieved on 24th September, 2020 from http://www.population.gov.ng/population-data-in-Nigeria.

Nigerian Meteorological Agency (NIMET).E-Library 2019. Available from: www.nimet.gov.ng. Accessed on 3rd August, 2019.

Sallawu, H., Nmadu, J. N., Coker, A. A. A. and Mohammed, U. S. (2020).Factor path of constraints to adaptive capacity on climate change among IFAD-VCDP farmers in North Central Nigeria.*International Journal of Environment and Climate Change*, 10(2): 13-33.

Victor B. (2016). The effects of crop yield insurance designs on farmer participation and welfare. *American Journal of Agricultural Economics,* 80(1): 806-820.