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Adaptive Capacity of IFAD-Value Chain Development Programme Farmers to Climate Change Risks in North Central Nigeria

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A R T I C L E I NFO

Key Words,

Adaptive capacity,

IFAD-VCDP

Climate change

Adaptive Capacity

index

ABSTRACT

The study examined the level of adaptive capacity of International Fund for Agricultural Development-Value Chain Development Programme (IFAD-VCDP) farmers to climate change in North Central Nigeria. A multi-stage sampling technique was employed in the selection of respondents. A total of 483 respondents were selected for this study. Adaptive capacity index in addition to descriptive statistics were the analytical tools engaged in this study. The study revealed that the beneficiaries of programme in Benue State focused more on the household level adaptation strategies, while the beneficiaries in Niger State focused more on the farm level adaptation strategies. Meanwhile, the farmers employed both farm and household level adaptation strategies so as to reduce the impact of climate change on their welfare. An average respondent in Benue State is moderately adaptive to the strategies used with average adaptive capacity value of 0.55, while an average respondent in Niger State is highly adaptive to the strategies used with average adaptive capacity value of 0.68. A typical respondent in the study area is a moderate adapter with average adaptive capacity of 0.62. Educational systems that encourages skills acquisition seems to make more impact on adaptive capacity than those that are purely theoretical. It was therefore recommended that government and NGOs should assist in increasing the adaptive capacity of the farmers by conducting educational campaign and training on climate change and adaptation techniques, making reliable climate and weather information accessible to all farmers, climate change should be mainstreamed in all agricultural institutions and organizations, and also need for integration and collaboration between several government and non-governmental organizations involved in climate change adaptation for the usefulness of the recipient farmer at the local level

Introduction

Climate is one phenomenon that has played and continues to play a major role in shaping the environment that serves as a source of livelihood for man. The effects of its elements on man and the environment are so vital that it can hardly be ignored. Africa is one of the most vulnerable continents to environment and climate change because of multiple stress and low adaptive capacity (Intergovernmental Panel on Climate Change [IPCC], 2014). Many believe that agriculture is the most susceptible sector to climate change, considering the uncertainty that surrounds long-term patterns of environmental change and their likely impacts on the livelihood activities and options of the poor farm households (Brown and Crawford, 2008). Adaptation has been recognized as an important strategy to reduce these impacts because it can lower vulnerability, and can increase resilience to climate change (Asian Development Bank (ADB), 2009). The enhancement of adaptive capacity is an effective means of facilitating adaptation to climate change and variability especially for vulnerable groups such as small-scale farmers in developing countries (IPCC, 2014). Adaptation is the ability to respond and adjust to actual or potential impacts of changing climate conditions in ways that moderate harm or takes advantage of any positive opportunities that the climate may afford. It includes policies and measures to reduce exposure to climate variability and extremes as well as the strengthening of adaptive capacity. Despite the unpredictable nature of these challenges, human and natural systems have the capacity to cope with the adverse circumstances, but with continuing climate

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change, adaptation is needed to maintain this capacity. The propensity of a system to adapt to impacts of climate change is known as adaptive capacity (Noble et al, 2014).

The Value Chain Development Programme (VCDP) is a six-year development initiative of the Federal Government of Nigeria (FGN) and International Fund for Agricultural Development (IFAD) programme that focuses on supporting cassava and rice value chains for small farmers in the six states of Anambra, Benue, Ebonyi, Niger, Ogun and Taraba. Within each state, the programme is being implemented in five (5) Local Government Areas (LGAs) selected on the basis of objective criteria. Consequently, 30 LGAs were targeted under the programme. VCDP is well anchored in Nigeria government's vision for agricultural transformation through commodity value chain approach, with emphasis on enhancing productivity and access to markets for rice and cassava smallholder farmers. The Government of Nigeria and IFAD contrived the VCDP by adopting the value chain approach, to enhance productivity increases, promotion of agro-processing, access to markets and opportunities to facilitate improved engagement of the private sector, and farmers' organisations themselves, in the development effort. The programme seeks to adopt a holistic and demand-driven approach to addressing constraints along the cassava and rice value chains (Value Chain Development Programmme (VCDP), 2016).

The issue of climate change has become more threatening not only to the sustainable development of socio-economic activities of any nation but to the totality of human existence. Various studies by IPCC (2007); IPCC (2012); IPCC (2014) had identified Africa as one of the most exposed continents to suffer the devastating effects of climate change because of inadequate adaptive capacity. Limited knowledge and information on weather and climate has contributed to most farmers relying on own experience, local knowledge, and obsolete farming ideas and technologies in their farming decisions, despite the changing environmental factors. This has led to low agricultural productivity, and postharvest losses exacerbating food insecurity and poverty among farmers. Over the centuries, smallholder farmers have learned to adjust to environmental change and climate variability. But the current speed and intensity of climate change are outpacing their capacity to adapt. This study seeks to determine the level of adaptive capacity of the farmers in the light of the foregoing.

Adaptation depends greatly on the adaptive capacity of an affected system, region, or community to cope with the impacts and risks of climate change (IPCC, 2012). Therefore, understanding of adaptive capacity and their enhancement reduces the vulnerability of a region, community or household and promotes sustainable development (Abaje, et al, 2015). Systems are considered more or less vulnerable depending on two factors: the severity of the specific stressful event for example, flood and the degree of adaptive capacity that is, the ability to cope with the impacts from such an event. The capability to adapt is a fundamental determinant of how vulnerable a specific system is to external and internal stresses (Keskitalo, 2004). For climate change, this attribute is referred to as "adaptive capacity", which is defined as the ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (McCarthy et al., 2001). Thus, focusing on adaptive capacity as actions that lead to adaptation can serve to enhance a system's coping capacity and increase its coping range thereby reducing its vulnerability to climate hazards (Brooks and Edger, 2004). Agricultural adaptation to climate change is indispensable. However, the degree of adaptation depends on adaptive capacity levels and it only takes place if the appropriate resources are present. Adaptive capacity comes before the adaptation itself, as it represents the potential of a system to adapt (Brooks, 2003). Adaptive capacity at the level of the individual farm has been identified as critical for successful climate change adaptation (Wamsler and Brink, 2015). This is because farmers are not responding sufficiently to recent climate changes (Burke and Emerick, 2016). Adaptive capacity is not a static attribute of the system (Smit and Wandel, 2006), it can be improved over time, which makes it an important factor to be examined and discussed from both a research and a policy point of view. It is therefore important to account for adaptive capacity in order to avoid incorrect assumptions about adaptation options available to the farmer. One needs to consider the adaptive capacity to obtain a realistic picture of adaptation (Marshall et al., 2013). The objective of this study is to determine the level of adaptive capacity of IFAD-VCDP farmers in North Central Nigeria

Research Methods

The study was conducted in Niger and Benue States of Nigeria. Niger State is one of the 36 States of Nigeria, created out of the defunct North Western State on 3rd February, 1976. Situated in the North central geo-political Zone. The location of the State is between Latitudes 8° 20' and 11° 30' North of the equator and Longitudes 3° 30' and 7° 20' East of the Greenwich

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Meridian. The provisional results of the 2006 National Population Census (NPC) show that the State has human population of 3,950,249 (NPC, 2006). Going by the population growth rate in Nigeria of 2.5% (World Bank, 2016), the population of the State was projected to 5,312,642 as at 2018. The State is comprised of 25 Local Government Areas (LGAs) grouped into three agricultural Zones: I, II and III, with each zone having 8, 9 and 8 LGAs respectively. There are three major ethnic groups in the State, *Nupe, Gbagyi*, and *Hausa*. Other tribes are *Kadara, Koro, Dibo, Kambari, Kakanda, Dukkawa, Dakarkari, Gana-Gana, Kamuku*. Niger State covers a total land area of 83,266,779 kilometres or about 8.3 million hectares which represent 8% of the total land area of Nigeria. About 85% of the land is arable and the vegetation consists mainly of short and scattered trees. The State experiences distinct dry and wet seasons with annual rainfall varying from 1,100 mm in the northern part to 1,600 mm in the southern parts. The temperature ranges from 23ºC to 37ºC and daylight duration is averagely 8.5 hours and it has a relative humidity of 40% (Niger State Agricultural Mechanization and Development Authority (NAMDA), 2013). The major economic activity is agriculture (farming, fishing and livestock rearing).

Benue State was created from the former Benue-Plateau State in 1976. The State lies in the North Central Nigeria between Latitudes 6°25ˡ and 8° 8ˡ North of the Equator and Longitudes 7°47ˡ and 10° 0ˡ East of the Greenwich meridian, with total landmass of 34,059 square kilometres as well as estimated population of 4,219,244 (NPC, 2006). Going by the population growth rate in Nigeria of 2.8% (World Bank, 2016), the population of the State was projected to 5,707,674 as at 2018. Benue State comprises of 23 LGAs divided into three Agricultural Development Project zones. It is inhabited predominantly by the *Tiv* and *Idoma* people. Other ethnic groups include *Igede, Etulo, Abakwa, Jukun, Hausa, Igbo, Akweya,* and *Nyifon*. The State experiences two distinct seasons, the wet season and the dry season. The rainy season lasts from April to October with annual rainfall in the range of 150-180mm and average precipitation of 1500mm. The dry season begins in November and ends in March. Temperatures fluctuate between 21^{0}C to 37^{0}C in a year, with mean temperature of 28^{0}C. Benue State has abundant human and material resources, most of the people in the State are farmers while inhabitants of the riverine areas engage in fishing as their primary or secondary occupations (Benue State Agricultural and Rural Development Authority (BNARDA), 1998).

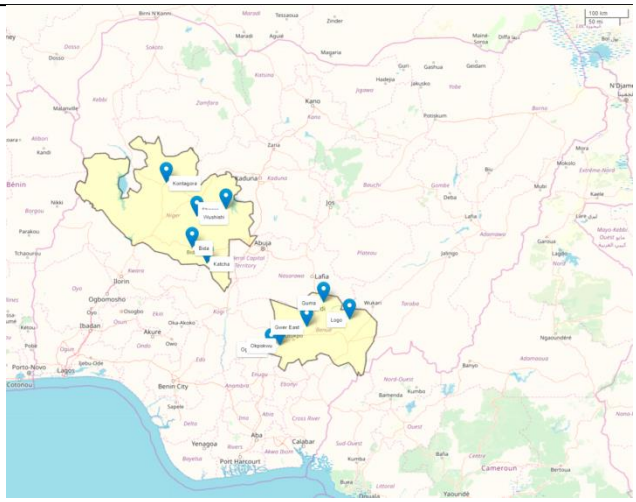

Figure *1*: Map of Nigeria showing the study areas.

Multi-stage sampling technique was employed in sampling the location and the collection of primary data for this study. In the first stage, the two (2) participating States in North Central Nigeria under IFAD – VCDP that is, Niger and Benue States were selected purposively based on their participation in the IFAD-VCDP. In the second stage, all the five (5) participating Local Government Areas (LGAs) in each State were selected, given a total of ten (10) LGAs. In the third stage, sampling of farm households in each community was determined proportionately using Krejcie and Morgan (1970) formula and adopted by Ardakani *et al.* (2012). The formular is presented in eqn. (1)

$$S = \frac{X^2 NP(1-P)}{d^2(N-1)+X^2P(1-P)} \quad (1)$$

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 483 respondents were selected for this study. Data for this study were collected using interview schedules with the aid of trained enumerators. The data were analyzed using adaptive capacity index and descriptive statistics. Adaptive capacity is a complex, multidimensional and broad concept, consisting of several subcomponents (Below *et al*., 2012). Given this complexity, adaptive capacity is commonly synthesized in an index, making it more comprehensive and operational.
The levels of adaptive capacity of the farmers were determined using adaptive capacity index. The adaptive

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capacities of farmers were measured by considering eight attributes such as knowledge, use, availability, accessibility, consultation, affordability, benefit and sources of information. Adaptive capacities of farmers depend on certain factors or attributes such as their knowledge on and number of times they use a particular adaptation strategy. Other factors are the availability, accessibility, affordability and economic benefit of the adaptation strategy. Also, the number of consultations that a farmer makes and sources of information on a particular adaptation strategy affect whether the farmer will be lowly or moderately or highly adaptive to climate change. In measuring the adaptive capacities quantitatively, farmers were asked to indicate their degree of attainment of each attribute. The procedure for the measurement of each attribute is presented in Table 1, 2 and 3. The highest degrees of attainment of each of the attributes or factors affecting adaptive capacities were scored 1 whereas the lowest degree were given a score of 0.2. The score level for a farmer with higher degree of attainment of each attribute is 0.8, while moderate degrees were scored 0.6. Lastly, the score level for lower degree of achievement is 0.4. Therefore, the degree of each farmer's knowledge on each adaptation strategy will be sought. In terms of knowledge, the higher the degree, the better knowledge the farmer will have on a particular adaptation strategy.

Table 1: Score levels of farmers' achievement of attributes

Degree	Likert score	Adaptive score	Attributes			
			Knowledge	Use	Availability	Accessibility
Highest	5	1	Very Well	Several	Very regular	Easily accessible
Higher	4	0.8	Well	Twice	Regular	Accessible
Moderate	3	0.6	Fairly Well	Once	Occasionally	Not easily accessible
Lower	2	0.4	Not sure	Not sure	Not sure	Not sure
Lowest	1	0.2	Not well	Never	Never	Not accessible

Source: Adopted from Larbi (2015) and modified.

Table 2: Score levels of farmers' achievement of attributes

Degree	Likert score	Adaptive score	Attributes		
			Consultation	Affordability	Benefit
Highest	5	1	Very frequently	Very cheap	Very beneficial
Higher	4	0.8	Frequently	Cheap	Beneficial
Moderate	3	0.6	Occasionally	Not sure	Not sure
Lower	2	0.4	Not sure	Expensive	Not beneficial
Lowest	1	0.2	Never	Very expensive	Not very beneficial

Source: Adopted from Larbi (2015) and modified.

Table 3: Score levels of farmers' achievement of attributes

	Likert score	Adaptive score	*Sources of information
Always	5	1	
Sometimes	4	0.8	
Neutral	3	0.6	
Rarely	2	0.4	
Never	1	0	

* 1=Radio, 2=Farmers association/cooperatives, 3=Agricultural development project, 4=Television, 5=Non-governmental organisations, 6=Metrological agency, 7=Newspapers, 8=Internets.
Source: Adopted from Adams (2017) and modified.

The adaptive capacity (AdapCap) of an i^{th} farmer to j^{th} adaptation strategy was calculated as shown in the equation (2) below:

$$AdapCap_{ij} = \frac{K_{ij} + U_{ij} + V_{ij} + A_{ij} + C_{ij} + F_{ij} + B_{ij} + I_{ij}}{N_A} \quad (2)$$

Where:

$AdapCap_{ij}$ = adaptive capacity of an i^{th} farmer to a j^{th} adaptation strategy;

K_{ij}, = knowledge of the i^{th} farmer on j^{th} adaptation strategy;

U_{ij} = level of usage of j^{th} adaptation strategy by i^{th} farmer;

V_{ij} = availability of j^{th} adaptation strategy to i^{th} farmer;

A_{ij} = accessibility of j^{th} adaptation strategy to i^{th} farmer;

C_{ij} = level of consultation on j^{th} adaptation strategy by i^{th} farmer;

F_{ij} = affordability of j^{th} adaptation strategy by i^{th} farmer;

B_{ij} = economic benefit of j^{th} adaptation strategy to i^{th} farmer;

I_{ij} = sources of information on j^{th} adaptation strategy by i^{th} farmer;

N_A = the sum of applicable attributes.

The average adaptive capacity of farmers to j^{th} adaptation strategy will be calculated using the equation below:

$$\text{Average } AdapCap_{ij} = \frac{\sum_i \sum_j AdapCap_{ij}}{N} \quad (3)$$

Where:

N is the number of observations and other variables are as previously defined.

NAPReJ
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Table 4: Degree of adaptive capacity of farmers

Degree of adaptive capacities	Ranges of indices for $AdapCap_{ij}$	Ranges of indices for $AveAdapCap_j$
Low	$0 > AdapCap_{ij} \leq 0.33$	$0 > AveAdapCap_j \leq 0.33$
Moderate	$0.33 > AdapCap_{ij} \leq 0.66$	$0.33 > AveAdapCap_j \leq 0.66$
High	$0.66 > AdapCap_{ij} \leq 1.00$	$0.66 > AveAdapCap_j \leq 1.00$

Source: Adopted from Larbi (2015) and modified.

Based on the adaptive capacities of the attributes, three indices were established namely, low, moderate and high. Table 4 shows the categories of adaptive capacities to which each farmer falls within. It also shows the categories of average adaptive capacities (low, moderate and high) of each adaptation technology. Farmer i is lowly adaptive to adaptation strategy j if the adaptive capacity calculated falls in the range of $0 >$ Adap- Capij ≤ 0.33. The range for moderate and high adaptive capacities is $0.33 >$ AdapCapij ≤ 0.66 and $0.66 >$ AdapCapij ≤ 1.00 respectively.

In order to isolate the factors determining the choice of an adaptation strategies by the farmers under study, a beta regression model was estimated. Beta regression provides a more robust estimates since the response variable is a rate (Cribari-Neto & Zeileis, 2010). The implicit model is presented in equation (4).

$$y = f(\beta_j X_{ij}) \quad (4)$$

Where y = degree of adaptive capacity which is transformed into beta density, a more robust value by eq. (5).

$$\pi(y,p,q)=(\Gamma(p+q))/(\Gamma(p)\Gamma(q))\{y^{(p-1)}[(1-p)^{(q-1)}]\}, \quad 0<y<1 \quad (5)$$

p, q > 0 and $\Gamma(\cdot)$ is the gamma function;

X_{ij} = **sources of income** (Farm income NGN, Non-farm in NGN), **socioeconomic factors** (Years spent in formal education, Household size, farm size in ha, Number of farm plots, **highest educational achievement** {Primary School (completed), Primary School (never attempted), Secondary (completed), Secondary (never attempted), Secondary (on-going), Polytechnic (completed), Polytechnic (never attempted), Polytechnic (on-going), College of Education (completed), College of Agriculture (completed)l College of Technology (never attempted), College of Health Technology (never attempted), University (completed), University (never attempted), University (on-going), Adult Education (on-going), Qur'anic education (never attempted), Qur'anic Education (on-going)}; and

β_j = parameters to be estimated.

However, the above independent variables were selected as the most appropriate determinants of adaptive capacity of the farmers after some preliminary investigation of the appropriate variables to be included. The estimation was achieved using Beta regression package (Cribari-Neto, & Zeileis, 2010) in R352 (R Core Team, 2019).

Results and Discussion

The degree of adaptive capacities of IFAD-VCDP farmers in Benue and Niger States is presented in Table 5 while the estimates of the factors determining the degree of adaptive capacities is presented in Table 6. The frequency distribution of the respondents based on their degree of adaptive capacity is presented in Table 7 and the degree of adaptive capacity to each adaptation strategy is presented in Fig. 2.

The result in Table 5 revealed that the respondents in both States were highly adaptive to diversification into non-farm activities with the highest score value of 0.669 while they least considered mixed farming was the lowest with the value of 0.585 as adaptation strategy. The result further indicated that out of the 26 adaptation strategies used, the respondents were highly adaptive to only two and moderately adaptive to 24 of them. It was also revealed that among the adaptation strategies, delay social ceremonies and changing harvesting date have the same value of 0.627, change from crop to livestock production and reducing herd number have the same value of 0.610, also savings and increase/reduce farm size are equal with value of 0.600. The findings indicated that the beneficiaries of IFAD-VCDP in the study area employed both farm and household level adaptation strategies so as to reduce the impact of climate change on their welfare.

The result for IFAD-VCDP farmers in Benue State revealed withdrawing children from school had the highest score of 0.663, while the mixed cropping was the lowest with value of 0.464. The result of the findings also revealed that out of the 26 adaptation strategies used, the respondents were moderately adaptive to 25 and highly adaptive to only one ($0.33 \geq 0.66$). The findings indicated that the beneficiaries of IFAD-VCDP in Benue State focus more on the household level adaptation strategies rather than farm level adaptation strategies.

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Table 5: Degree of adaptive capacities of IFAD-VCDP farmers in Benue and Niger States

	Pooled		Niger		Benue	
Adaptation strategies	Adaptive capacity	Rank	Degree of adaptive capacity	Adaptive capacity	Rank	Adaptive capacity	Rank
Diversification in to non-farm activities	0.669	1	High	0.744	5	0.594	7
Use of disease resistant variety	0.662	2	High	0.724	9	0.6	6
Planting early maturing crops	0.653	3	Moderate	0.769	2	0.537	15
Planting different crop varieties	0.64	4	Moderate	0.752	4	0.529	18
Fish farming	0.631	5	Moderate	0.623	21	0.639	3
Changing planting date	0.63	6	Moderate	0.726	8	0.535	16
Changing harvesting date	0.627	7	Moderate	0.716	10	0.539	14
Delay social ceremonies	0.627	7	Moderate	0.652	17	0.603	5
Okada service	0.621	8	Moderate	0.67	14	0.571	10
Cultivation different crops on separate plots of land	0.619	9	Moderate	0.772	1	0.467	25
Mono /sole cropping	0.619	9	Moderate	0.762	3	0.477	23
Conservation agricultural practices	0.618	10	Moderate	0.743	6	0.492	22
Mixed cropping	0.617	11	Moderate	0.769	2	0.464	26
Avoid hospital	0.613	12	Moderate	0.579	23	0.648	2
Animal fattening	0.612	13	Moderate	0.661	16	0.563	11
Change from crop to livestock production	0.61	14	Moderate	0.614	22	0.607	4
Reducing herd number	0.61	14	Moderate	0.665	15	0.555	13
Relocation to different site	0.609	15	Moderate	0.644	18	0.574	9
Withdraw children from school	0.605	16	Moderate	0.546	24	0.663	1
Changing herd composition	0.604	17	Moderate	0.628	20	0.581	8
Small scale business/ agro-business	0.603	18	Moderate	0.673	12	0.533	17
Reduce amount of meal	0.601	19	Moderate	0.643	19	0.559	12
Increase/Reduce farm size	0.6	20	Moderate	0.692	11	0.5	21
Savings	0.6	20	Moderate	0.728	7	0.473	24
Planting of trees	0.588	21	Moderate	0.672	13	0.503	20
Mixed farming	0.585	22	Moderate	0.644	18	0.526	19
Mean	0.61616			0.68292		0.54952	

Source: Field survey, 20118.

Table 6: Degree of adaptive capacities of IFAD-VCDP farmers in Niger State

Variables	Pooled	Niger	Benue
(Intercept)	-0.8595 **	0.1109	-0.0365
	(0.3008)	(0.09784)	(0.1982)
Farm income NGN	-6.289e-08 ***	4.698e-09	-1.43e-08
	(1.635e-08)	(1.541e-08)	(1.587e-08)
Non-farm in NGN	1.0631e-07 ***	2.544e-10	-7.157e-07
	(2.271e-08)	(1.0869e-08)	(4.1694e-07)
Years spent in formal education	0.01037 ***	0.0121 ***	-0.001989
	(0.00314)	(0.00228)	(0.00303)
Household size	0.06002 ***	0.04059 ***	0.0616 ***
	(0.004198)	(0.002838)	(0.005066)
farm size in ha	0.01236	-0.0275 ***	-0.05165 ***
	(0.0074)	(0.00476)	(0.01103)
Number of farm plots	0.0364 *	0.0359 ***	0.0621 **
	(0.01494)	(0.008689)	(0.02285)
Primary School (completed)		0.05903	-0.0588
		(0.06178)	(0.0385)
Primary		0.0880	
School (never attempted)			
		(0.0564)	
Secondary (completed)	0.1023	0.0804	
	(0.08226)	(0.0652)	
Secondary (never attempted)	0.1302	0.1217	
	(0.0824)	(0.0650)	
Secondary (on-going)			0.3956
			(0.2820)
Polytechnic (completed)	0.2019		
	(0.15459)		
Polytechnic (never attempted)	0.19254		
	(0.14770)		
Polytechnic (on-going)	0.36215 *		0.24587
	(0.18216)		(0.18670)
College of Education (completed)	0.06938		
	(0.05278)		
College of Agriculture (completed)	0.20318 *		
	(0.09075)		
College of Technology (never attempted)			0.24507 *
			(0.1217)
College of Health Technology (never attempted)			0.118998
			(0.1242)
University (completed)	0.3148		
	(0.2362)		
University (never attempted)	0.48179 *		
	(0.2308)		
University (on-going)	0.2812		
	(0.2741)		
Adult Education (on-going)	0.2841 *	-0.0945	
	(0.1374)	(0.0633)	
Qur'anic education (never attempted)	-0.35808 ***	-0.06242 *	
	(0.04681)	(0.0309)	
Qur'anic Education (on-going)		-0.08326 *	
		(0.03908)	
(phi)	37.73 ***	197.31 ***	60.002 ***
	(2.398)	(17.86)	(5.43)
N	483	243	240
logLik	546.99	482.36	321.15
AIC	-1053.97	-934.73	-616.30

*** p < 0.001; ** p < 0.01; * p < 0.05. Values in parenthesis are standard errors.
Source: Field survey, 2018.

Table 7: Distribution of respondents based on the level of adaptive capacity

Level of adaptive capacity	Benue (%)	Niger (%)	Pooled (%)
Low < 0.33	-	-	-
Moderate 0.33 ≥ 0.66	227 (94.58)	93 (38.27)	320 (66.25)
High > 0.66	13 (5.42)	150 (61.73)	163 (33.75)
Average adaptive capacity	0.55	0.68	0.62

Source: Field survey, 2018.

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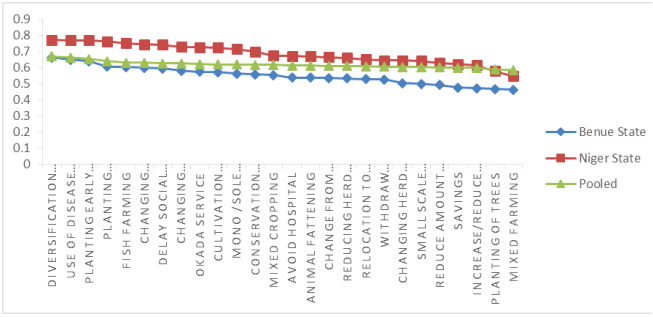

Fig. *2*: Level of adaptive capacity of farmers in North Central Nigeria.

The degree of adaptive capacities of IFAD-VCDP farmers in Niger State revealed that cultivation of different crops on separate plots of land had the highest score among the adaptation strategies adopted with value of 0.772, while withdrawing children from school had the lowest value of 0.546. The result also shows that out the 26 adaptation strategies employed, the respondents were highly adaptive to 17 and moderately adaptive to nine of them. The adaptive capacity indices calculated for mixed cropping and planting early maturing crops are equal with value of 0.769. Also, the adaptive capacities values of relocation to different site and mixed farming are equal with value of 0.644. The findings indicated that the beneficiaries of IFAD-VCDP in Niger State focus more on the farm level adaptation strategies than household level adaptation strategies.

The results in Table 6 shows that farm income[-], non-farm income, years spent in formal education, household size, farm size[-], number of farm plots, Polytechnic (on-going), College of Agriculture (completed), College of Technology (never attempted)[-], University (never attempted), Adult Education (on-going), Qur'anic education (never attempted)[-], Qur'anic Education (on-going)[-] significantly affected adaptive capacity of the farmers under the IFAD-VCDP. These findings tend to indicate that educational system that encourages skill acquisition seems to impact more positively than those that are purely theoretical (Kabobah *et. al*., 2019). Due to limited capacity, increasing farm size is averse to adaptive capacity since the farmer also has to be able to manage family and cultural issues that might affect him, hence a reduction in farm size reduces farm income as hinted by Armitage (2005). The negative impact of Qur'anic education simply shows that on its own, the system does not improve the economic wellbeing of the farmers but can be a very good tool to build the morals of the farmers which can reduce incidence of crimes in the communities and consequently increase productivity and welfare. In addition, it is possible that the technology being promoted under the IFAD-VCDP does not allow them to concentrate on their 'more rewarding' traditional ways of farming. In Benue State, larger farm size suppresses adaptive capacity as well as lack of training in technology. This finding is similar to the findings in Europe by Science for Environment policy (2007). Therefore, in order to coping with the burden of managing larger farm size without any technology appreciation, they tend to withdraw their children from school to engage them 'more productively' in farming operations.

The results in Table 7 and Fig. 2 revealed that majority of the respondents in Benue State had moderate adaptive capacity which accounted for over 94% and only 5.42% had high adaptive capacity, with an average adaptive capacity of 0.55 which is moderate. This implies that an average respondent in Benue State is moderately adaptive to the strategies used. In Niger State, 38.27% of the respondents had moderate adaptive capacity, while 61.73% had high adaptive capacity, with an average adaptive capacity of 0.68 which is high. This implies that an average respondent in Niger State is highly adaptive to the strategies used. The highly adaptive responses of the farmers to the adaptation strategies in Niger State might probably be due to the climate change hazards experienced by the farmers in the past few years, for example incidence of flood. For the pooled data, 66.25% had moderate adaptive capacity and 33.75% had high adaptive capacity, with an average adaptive capacity of 0.62 which is moderate. This implies that a typical respondent in the study area is a moderate adapter and averagely might not have all the necessary resources to aid them adapt highly and effectively to climate change. Farmers with relatively higher adaptive capacity are able to adapt better to climate change by shifting from one adaptation method to another in response to the different climate risks. Employing different adaptation techniques enabled farmers to cope differently with the varying climate stresses being experienced. This is in line with the findings of Mabe *et al*. (2012) who pointed out that rice farmers in Northern region of Ghana are highly adaptive to the use of chemical or organic fertilizer, mulch, fallow farming and using early maturing rice varieties and moderately to the use of drought tolerance rice varieties, mixed cropping, mono-cropping and changing planting dates. Defiesta and Rapera (2014) also found that 60% of farming households in their study in Philippines had low adaptive capacity, 36% have moderate and only 4% have high adaptive capacity. This tend to suggests that farmers in Philippines generally adapted to climate change despite their levels of adaptive capacity in order

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to survive and maintain consumption.

CONCLUSION

This study concluded that the beneficiaries of IFAD-VCDP in Benue State focused more on the household level adaptation strategies, while the beneficiaries in Niger State focused more on the farm level adaptation strategies. Meanwhile, the farmers employed both farm and household level adaptation strategies so as to reduce the impact of climate change on their welfare. An average respondent in Benue State is moderately adaptive to the strategies used with average adaptive capacity value of 0.55, while an average respondent in Niger State is highly adaptive to the strategies used with average adaptive capacity value of 0.68. The highly adaptive responses of the farmers to the adaptation strategies in Niger State might probably be due to the climate change hazards experienced by the farmers in the past few years, for example incidence of flood. A typical respondent in the study area is a moderate adapter with average adaptive capacity of 0.62. The educational system that encourages skills acquisition seems to promote adaptive capacity of the farmers.

Arising from this, the study recommended that government and NGOs should assist in increasing the adaptive capacity of the farmers in order to employ more adaptation measures by conducting educational campaign and training on climate change and adaptation techniques. Government and donor agencies should assist in making reliable climate and weather information generated by the geographical information stations accessible to all farmers through communication channels like conventional platforms, such as radio, TV, and bulletins; farmer field schools; farmer-participatory climate workshops; and local climate information centres that together enhance the availability and accessibility of value-added climate information to farmers. In addition, climate change should be mainstreamed in all agricultural institutions and organisations by providing reliable weather and climate information and updates through extension services at the local level. Because availability and accessibility of weather and climate information plays crucial roles before and during the cropping season, and if properly mainstreamed in farm level decision-making, could enable farmers to mobilize requisite resources and apply them in a timely manner to reap maximum benefits from their investments.

There is need for integration and collaboration between several government and non-governmental organizations involved in climate change adaptation for the usefulness of the recipient farmer at the local level. The government particularly of Benue State should help focus more on education and health sectors so as to reduce the high adaptation strategies of withdrawing children from school and avoiding hospitals. Other agricultural programmes like the CBN Anchor Borrowers programme should emulate the IFAD-VCDP activities, especially the programme coordination in Niger State because the high productivity recorded by the farmers might be due to their high adaptive capacity to farm-level adaptation strategies. Also, farmers should be encouraged to insure their farms against risks so as to reduce the impact on their lives.

There is need to overhaul the present extension delivery systems so as to ensure that the right technologies are transferred to the farmers with modern implement like tractors. The incorporation of the Almajiri system of Qur'anic education into the formal educational system should be strengthened for greater efficiency and adequate investment is needed in the educational sector.

The study is limited to determine the levels of adaptive capacity of the farmers to climate change. Therefore, it is also recommended that further studies can be conducted to link adaptive capacity of the farmers to productivity.

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