DRIVERS OF EXTENSION SERVICES AMONG IFAD-VCDP FARMERS IN CENTRAL NIGERIA

Sallawu[1]*, H., U. S. Mohammed[1], A. A. A. Coker[1] and J. N. Nmadu[1]

[1]Department of Agricultural Economics and Farm Management, Federal University of Technology, P. O. BOX 65, Minna, Niger State, Nigeria.
*Corresponding author: Email: halima.sallawu@futminna.edu.ng, Phone number +2348034532845.

ABSTRACT
The study analyzed factors that influence farmers' access to extension services in the study area. The study utilized data obtained from 483 farmers with the use of interview schedule questionnaire. The data were analyzed using vtree and Double hurdle regression model. The results revealed that 80% of the respondents are male with moderate adaptive capacity to climate change. In addition, farmers, with high adaptive capacity to climate change had higher level of education. Result of the double hurdle regression revealed that farmer's adaptive capacity to climate change, being a male, farm income, non-farm income, being poor, availability of social amenities, membership of association and increase in the distance of farmer's farm from the village had significant positive influence of number of extension services received by farmers with contacts. While ratio of livelihood activities, farm size, age, level of education, distance of farm to market, credit, livestock ownership, household size and working household members had significant negative influence on number of extension services received by farmers with contact. Furthermore, result of the zero-contact revealed that the odds can be increased by adaptive capacity to climate change, farm size, gender, credit, household size, poverty status, availability of social amenities and membership of association. While ratio of livelihood activities, livestock ownership and farming experience can decrease extension contact. It was there for recommended that extension agents should assist in increasing the adaptive capacity of the farmers by incorporating more climate change related techniques and adaptation strategies in their services, availability of functional social amenities should be a major focus when formulating policies and developmental issues as it influences extension services and farmers should be encourage to form associations so as to achieve the benefits associated with it.

Keywords: Hurdle Regression model, Adaptive capacity, Climate change, Livelihood activities, vtree, Stats package.

Introduction
The agricultural sector is the largest employer in Nigeria, it plays an important role in contributing to food security, poverty reduction, livelihoods improvement, rural development and the environment by employing more than 36% of the labour force and contributed about 22% to the country's GDP as at first quarter of 2020. Over 80% of Nigeria's farmers are small holder farmers (SHFs). These smallholder farmers are important drivers of the agriculture sector in the rural areas as they accounts for 90% of total agricultural production. These farmers, are endowed with limited resources, have become the mainstay of food supply for millions of people in Nigeria. Despite several government's efforts and well-intended policies, there is ample evidence that there has been very little progression and productivity of subsistence farmers in the country (Oyaniran, 2020). Agriculture is broadly divided into four sectors in Nigeria namely: crop production, fishing, livestock and forestry. Crop production remains the largest segment and it accounts for about 87.6% of the sector's total output. This is followed by livestock, fishing and forestry at 8.1%, 3.2% and 1.1%

respectively. Nigeria's agricultural productivity is insufficient to meet the food demanded of its growing population of over 200 million people, thus increasing the demand and supply gap in Nigeria. Food inflation rate spikes in Nigeria with 14.89% in November 2020 (National Bureau of Statistics (NBS), 2020). Just as in other African countries like South Africa (Bjornlund and Pittock, 2017), there is a considerable productivity and profitability gap amongst smallholder farmers in Nigeria. Some of the reasons for this were information, skill and resource gap which hinders the uptake of available and new technologies for improved production. Access to post-harvesting methods and technology can also be facilitated by agricultural extension services by training farmers on hedging post-harvest losses and value addition so as to reduce food wastage.

Against this backdrop, growth in the agricultural sector will not only satisfy the persistent demand of the increasing population but will also stimulate higher rates of growth in the economy through forward and backward linkages. Apparently the first question is how can these farmers be assisted to improve agricultural productivity in the face of disease outbreak, security crisis and climate change? Recently, the wake-up call by researchers is on farm technology adoption which leads to higher levels of output and at the same time ensures environmental sustainability. The uptake of improved technologies and adaptation strategies can be initiated by agricultural extension. Agricultural extension does not only serve as a source of information on new technologies for farming communities but also ensures access to improved technologies, climate change adaptation strategies and contributes to improving the welfare of farmers (Abdullah and Abdul-Rahman, 2016). It serves as a channel through which farmers' challenges could be identified for research and formulation of agricultural policies to the benefit of rural communities. The above potencies of agricultural extension make it necessary for every farmer to access the services. The second question is whether farmers are really accessing the services provided by extension agents in North Central Nigeria? Since much literature has not been documented on the factors that influence the farmers' access to extension services in the study area, this paper seeks to provide evidence of the drivers.

Agricultural extension services can provides a critical support services for rural farmers in order meet the new challenges confronting agricultural transformation and food system in Nigeria, including constraints imposed by security crisis, corona virus and other health challenges that affect rural livelihoods and deteriorating natural resource base in the face of climate change. A major rationale for extension services, farmer education programmes, and various forms of formal and informal agricultural training is the desire to enhance and expand farmers' knowledge and thus improve adaptive capacity (Tomlinson and Rhiney, 2018).

Literature review

Extension traditionally has played a role in providing information and promoting new technologies or new ways of managing crops and farms. Extension also links farmers to researchers and other actors in the innovation system. Farmers, extension agents, and researchers have to work together on farmers' fields to prioritize, test, and promote new crop varieties and management techniques (Ozor and Nnaji, 2011; Mustapha *et al.* 2012). In the view of Francis and Addom (2014), agricultural extension also known as agricultural advisory services are relevant to smallholder farmers, who remain the bedrock of the agricultural and food supply chains in developing countries. It play a crucial role in promoting agricultural productivity, increasing food security, improve rural livelihoods and promote agriculture as an engine of pro-poor economic growth by providing farmers with timely and relevant information, access to credit, and better market prices which could go a long way in addressing global poverty and improving agricultural productivity.

Agricultural extension is defined as a series of embedded communicative interventions which supposedly help to resolve problematic situations (Leeuwis and Aarts, 2011). According to Francis and Addom (2014) the aim of agricultural extension services are: Improve the wellbeing of individuals and communities; Change production systems so that they improve rural livelihoods and sustain the resource base; Improve agriculture and the social, economic and political status of rural communities; Improve the wellbeing of farm families; Improve productivity and livelihoods for farmers; Increase and improve farmers' incomes and productivity on a sustainable basis; Enhance farmers' production; Attain higher levels of efficiency in the farm enterprise; Attain food security and improve rural livelihoods. Lending credence to this, Msuya *et al.* (2017) pointed out that one important way of improving food security is through agricultural extension programmes. The authors revealed that agricultural extension has multiple goals, including transferring knowledge from global, national, and local researchers to farmers, helping them clarify their own goals and assessing their opportunities, educating them about decision-making processes, and promoting desirable agricultural development. In line with this, Waha *et al.* (2018) affirmed that extension services can aid farmer decision-making on viable livestock and crop diversification options to follow.

In this study, agricultural extension is to link farmers to information and knowledge sources for increase food security and reduce poverty at household level leading to economic growth, sustainable development and self-sufficiency. The productivity of farmers is increased through application of appropriate knowledge in response to production challenges such as pests, diseases, and changes in weather patterns (FAO, 2017). Agricultural extension can also play a role by ensuring that efforts towards increasing productivity are sustainable. Sustainable agricultural production ensures that current production activities do not compromise the production chances in the future. One way of achieving this is through agro-ecological practices (FAO, 2018). Agro-ecological practices are premised on empowering farmers as key agents of change while fostering co-creation of knowledge, integrating traditional, practical and local practices and skills for sustainable production (FAO, 2018).

According to Raidimi and Kabiti (2019), extension can link farmers to reliable and cheap sources of agricultural inputs and outputs, thereby culminating to low production cost and increased income. This contributes to the attainment of the sustainable development goal of ending hunger. Institutional linkages are vital, especially in the face of climate change, disease outbreak and crisis where rapid information generation and application is needed for adaptation, recovery and sustainability purposes. Extension organizations, research institutions, farmer groups and organizations, as well as universities and colleges are all important stakeholders in the extension educational process. However exploring and institutionalizing linkages with other institutions is a strategy that extension organizations can use to keep current with new information. They also provide dynamism in information generation that can greatly enhance agricultural extension information needs and subsequently improve service provided to farmers, thereby resulting in sustainable food security (Raidimi and Kabiti, 2019).

Education in one of the basic needs and is fundamental for the growth and development of human beings in both developed and developing countries. Both education and training induce learning, a process that modifies knowledge and behaviour through teaching and experience. Training is communication intended for the purpose of developing skills, modifying behaviour, and increasing competence, targeted at a defined population and focusing exclusively on what needs to be known. The purpose of education is gaining

knowledge and developing intelligence in a basic sense, whilst targeting specific skills transfer (Raidimi and kabiti, 2019). In Nigeria, formal education in agriculture is offered by 17 colleges of agriculture. In addition, 38 universities offered various agricultural related courses with 31 agricultural research institutes. Non-formal agricultural education is offered by a range of providers including Government agricultural extension organisations, Non-governmental organisations (NGOs) as well as private sectors. Several researchers Chittoor and Mishra (2012); Stevens and Van Heerden, (2016); FAO (2018); Raidimi and Kabiti (2019) agreed that no country can develop without well aligned education systems which respond to the immediate needs of the people. Improving agricultural production for sustainable food security and economic growth may not be achieved without an effective agricultural extension service which is well linked to research institutions relevant to farmers' needs. The appropriateness and relevance of research findings and subsequent information used by extension agents to advice farmers is thus paramount for realizing meaningful agricultural production. Training institutions such as universities provide dynamism in information generation through their research and training activities that enhance agricultural extension information needs and subsequently important services provided to farmers, thereby resulting in sustainable food security and economic growth.

Methodology

The study was conducted in North Central Nigeria. The States that make up the North Central zone are Benue, Kogi, Kwara, Nasarawa Niger, Plateau and Federal Capital Abuja. Central Nigeria covers a total land area of 242,425km^2 and lies between Latitude 4^0 and 14^0 North and Longitudes 3^0 and 14^0 East. The area has a projected population of 27,937,252 as at 2019 based on the National Population Census (NPC) (2006) of 2.5% growth. Multi-stage sampling technique was employed in the collection of primary data for this study. In the first stage, two (2) participating States in North Central Nigeria under the IFAD - VCDP were selected. In the second stage, all the five (5) participating Local Government Areas (LGAs) in each State were selected, giving a total of ten (10) LGAs. In the third stage, sampling of farm households in each community were determined proportionately using Krejcie and Morgan (1970) formula and adopted by Ardakani *et al*. (2012). Data were obtained through administration of questionnaire to 483 farmers. The data were analysed using Barrowman (2019) vtree package in R and Double Hurdle regression model. When the distribution of the response variables is assumed to have a remarkable number of zeroes and a high level of skewness, or when dealing with modelling skewed count data with an excess of zeroes, it is well known that the usual Poisson regression can be inappropriate (Schubert and Telcs, 1989). Also, if we tried to modelled the dependent variable using an Ordinary Least Squares model with all or only positive observations, the results would be biased and some efficiency loss may follow (Amemiya, 2006). The Tobit model proposed by Tobin and Goldberger could be applied under the assumption that zero observations were due to economic factors, but this approach would not explain zero observations caused by non-extension contact (Tobin, 1958; Chen *et al*., 2020). In order to address these limitations, more flexible count data models such as hurdle models need to be adopted (Chen, 2020). The hurdle models are two component models: the first component is constituted by a Dirac distribution at zero, while the second component, that is, the count component is a truncated integer valued distribution modelling strictly positive count. Extension services (Y) is defined as the total number of extensions contact services received by the farmers. This study employs the double hurdle model with the assumption that extension contact choice and extension service received are two distinct. Double hurdle model formulated by Cragg (1971); and extended by Mullahy (1986), assumes that farmers make two sequential decisions with regards to extension contact choice and services received. The following two hurdles must be overcome

before obtaining positive extension service. The first hurdle is Logit model as described in equation (1).

Index equation $d = Z\alpha +$ (1)

Threshold index equation $d = \{1 \text{ if } d > 0, \text{ and is } 0 \text{ if } d \leq 0\}$ (2)

Where d denotes latent discrete extension contact choice that denotes binary censoring, the value of d is 0 when farmers had no extension contact and 1 other wise and α is a vector of parameter.

The second hurdle involves an outcome equation which uses a truncated model to determine the drivers of extension services. In this stage, the study uses data only on positive values. The truncated model is expressed in equation (3).

$y = x\beta + V$ (3)

Double –Hurdle model $y = \{y \text{ if } d = 1 \text{ and } y > y0 \text{ and is } 0 \text{ if } d \leq 1 \text{ and } y \leq y0\}$ (4)

Where: y = latent extension services, x is a vector of explanatory variables, and and V are corresponding error terms in equation (1) and (3) distributed as:

$\sim N(0, 1)$,

$V \sim N(0, \sigma^2)$ (5)

$y0$ is the threshold or the minimum extension service. Only if d and y are both positive, a positive extension service y can be observed. The probability of y 0 is given in equation (6):

$P(y = 0) = \Phi(\ Z\alpha)$ (6)

Then the density of y conditional on being positive is given under the assumption of a mean zero and variance as in equation (7):

$f(\rightarrow 0) = \frac{\{[\,]\}}{(\,)}$ (7)

Thus, using the maximum likelihood estimation, α and μ were estimated using the Logit model to regress all samples. β and V were estimated using truncated normal estimator with all positive samples. The empirical model used to estimate the Logit and the truncated models of extension service is specified in equation (9).

$y = + LD + AC + FS + AGE + LE + GEN + DFM + FI + NFI +$
$CRE + LS + HS + PS + SA + WM + MA + FE + DFH +$ (9)

Where;

y = Extension contacts for the Logit model which takes the value of 1 for contact with extension agents and 0 otherwise; y_i is the number of extension services received by the farmer in a year for the truncated model;

LD = Livelihood activities (ratio of livelihood activities);

AC = Adaptive capacity of the farmers to climate change (adaptive capacity index);

FS = Farm size (hectares);

AGE = Age of the farmer (years);

LE = Level of education (number of years spent in school);

GEN = Gender of the farmer (Male = 1; Female = 0);

DFM = Distance of farm to the market (Kilometers);

FI = Farm income (₦);

NFI = Non-farm income (₦);

CRE = Credit use (₦);

LS = Livestock ownership (Tropical Livestock Unit);

HS = Household size (number of persons);
PS = Poverty status (poor = 1; non-poor = 0);
SA = Availability of social amenities (number of social amenities);
WM = Household working members (number of household members working);
MA = Membership of association (number of associations the farmer belong);
FE = Farming experience (years of farming experience);
DFH = Distance of farm from home (kilometer);
= Intercepts/constant terms;
= Parameters to be estimated;
= Error terms.

RESULT AND DISCUSSIONS

The farmers' demographic characteristics as depicted in Figure 1 revealed that 80% of the farmers were male, indicating that the beneficiaries of IFAD-VCDP is male dominated. The result further revealed that 78% of the female beneficiaries possess moderate adaptive capacity to climate change. In addition, 80% of the female farmers had medium farm sizes and 50% of those with medium farm sizes are in the middle age group. The results further revealed that the 69% of the male beneficiaries possess moderate adaptive capacity to climate change out of which 73% have medium farm sizes and 72% of them are in the adult age group.

In terms of the level of education, results in Figure 2 indicated that farmers with high adaptive capacity to climate change had higher level of education to tertiary level. While farmers with moderate adaptive capacity had fair level of education to at least primary level.

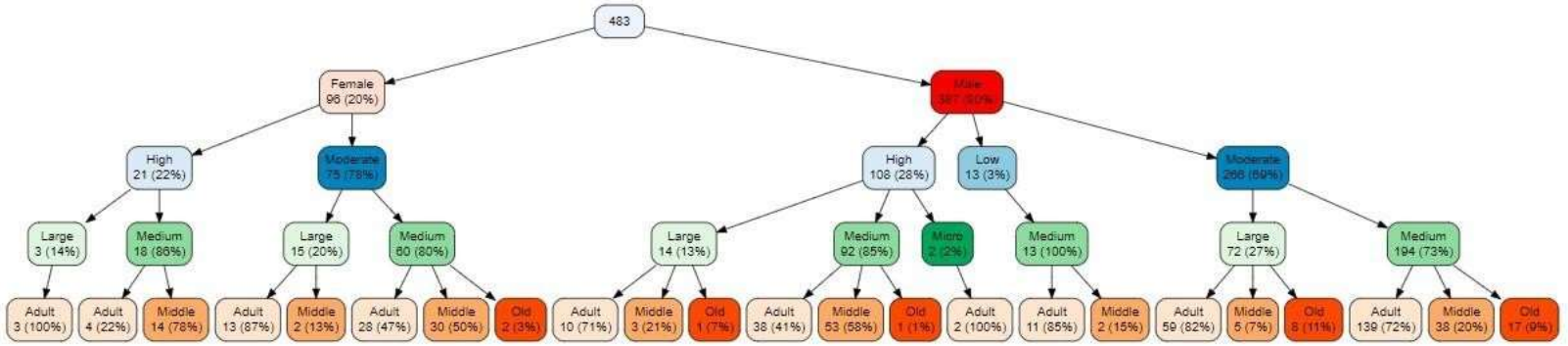

Figure 1: Demographic characteristics of the farmers in North Central Nigeria.

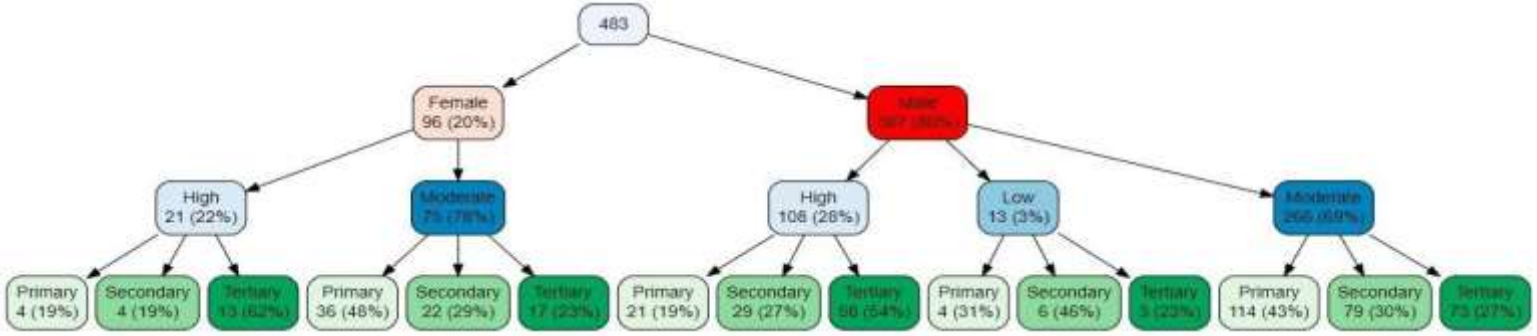

Figure 2: Educational status of farmers in North Central Nigeria with respect to their adaptive capacity.

Estimates of the double hurdle regression on the number of extension services received by IFAD-VCDP farmers in North Central Nigeria as depicted in Table 1 revealed that the average contact is 0.0978, which seems to be low. But the contact can be increased by a unit increase in the farmer's adaptive capacity (32387.29) to climate change, a switch in the gender of the beneficiary (1.149), a naira increase in farm income (1.043), Non-farm income (1.009), a switch in the poverty status of the farmer (1.138), a unit increase in the number of social amenities in the area (1.174), increase in the number of associations the farmers belong to (2.775) and a kilometre increase in the distance of farmer's farm from the village (1.016) increases the probability of extension service received. The positive relationship between poverty status and extension contact is in line with the findings of Osuji and Henri-Ukoha (2017) who posited that extension services provide informational training that helps to unlock the natural talents and inherent enterprising qualities of farmers, enhance their ability to understand, evaluate and adopt new techniques and innovations that would lead to increased farm productivity and reduces poverty. The positive coefficient of social amenities implies that it has positive influence on extension service received by the farmers probably through easy transportation of inputs and farm produce to the market, storage facilities as well as means of information and communication. The positive relationship between membership of association and extension service might be due to the fact that being a member of farmers' association has positive impacts such as secure land right, reduces households' financial constraints, increases social capital, entrepreneur skill and bargaining power of the farmers. This is in accordance with the findings of Asfir (2016) who affirmed that farmers' association/cooperative provide better option to promote sharing of knowledge and information.

Whereas Livelihood activities (0.023), farm size (0.786), Age (0.982), level of education (0.973), Distance of farm to market (0.994), Credit (0.974), Livestock (0.763), Household size (0.951) and Working household members (0.877) decreases the likelihood of extension service received by the farmers. The possible reason for a negative relationship between livelihood activities and extension services which is in agreement with the findings of Kassa (2019), is that the farm households might diversified their livelihoods into activities that probably would generate higher return besides farming.

The baseline odds of having extension contacts against zero contact (i.e. those who received no contact at all) is 0.0032. The odds can be increased by adaptive index (154938.2), farm size (1.909), a switch in gender (2.577), Credit (1.067), Household size (1.224), Change in poverty status (4.360), Social amenities (1.306) and Association (11.526). Whereas Livelihood activities (0.0), Livestock (0.7134) and Farming experience (0.9497) can decrease extension contact by times the figure in parenthesis.

It is imperative to note that the greatest positive influence of extension contacts by all the farmers, those who received some visits and those who did not, is the level of adaptive capacity to climate change, indicating that the issue of climate change demands greater attention of extension staff by the farmers. This result is in line with the findings of Maguire-Rajpaul *et al*. (2020) who affirmed that increase in farmers' adaptive capacity improved access to agricultural information. However, male farmers are likely to access quality extension services (Ragas *et al.*, 2013) through various channels than their female counterparts. This result is also in agreement with the findings of Maonga *et al*. (2017) who found out that as farmers gets older they tend to be become reluctant to agricultural technology adoption including access to agricultural support

services. More so, farmers who are highly educated seldom attend field level extension services because they might have broader information base including publication and consultations. In addition, lack of readily available markets discourages farmers from accessing agricultural extension services.

Table 1: Estimates of the double hurdle regression model of number of extension services received by IFAD farmers in North Central Nigeria

Variables	Estimate	Std. Error	z value	dy/dx
Count model				
(Intercept)	-2.325***	0.302	-7.694	0.097***
Livelihood activities	-3.731***	0.783	-4.765	0.023***
Adaptive capacity index	10.385***	0.291	35.629	32387.290***
farm size	-0.240***	0.009	-26.717	0.786***
Age	-0.017***	0.002	-6.261	0.982***
level of education	-0.026***	0.002	-11.544	0.973***
Gender	0.138***	0.041	3.332	1.149***
Distance of farm to market	-0.005***	0.001	-6.901	0.994***
Farm income	0.042***	0.012	3.274	1.043**
Non-farm	0.008***	0.002	3.785	1.009***
Credit	-0.025***	0.004	-6.408	0.974***
Livestock	-0.270***	0.014	-19.193	0.763***
Household size	-0.049***	0.005	-8.862	0.951***
Poverty status	0.129***	0.031	4.087	1.138***
Social amenities	0.160***	0.013	11.948	1.174***
Working members	-0.130***	0.006	-20.956	0.877***
Association membership	1.020***	0.057	17.687	2.775***
Farming experience	0.001	0.001	0.769	1.001
Distance farm from village	0.016***	0.001	13.806	1.016***
Zero hurdle model coefficients (binomial with logit link)				
	Estimate	Std. Error	z value	dy/dx
(Intercept)	-5.740***	1.709	-3.358	0.0032***
Livelihood activities	-38.917***	6.911	-5.631	0.000***
Adaptive capacity index	11.950***	2.286	5.227	154938.2***
farm size	0.646***	0.113	5.713	1.909***
Age	0.029	0.025	1.173	1.030
level of education	0.028	0.027	1.038	1.028
Gen	0.946**	0.392	2.414	2.577**
Distance of farm to market	0.005	0.017	0.304	1.005
Farm income	-0.117	0.088	-1.329	0.889
Non-farm	0.004	0.025	0.168	1.004
Credit	0.065**	0.028	2.271	1.067**
Livestock	-0.337***	0.103	-3.278	0.7134***
Household size	0.202**	0.079	2.542	1.224**
Poverty status	1.472**	0.583	2.525	4.360**
Social amenities	0.267**	0.109	2.435	1.306**

Working members	0.118	0.112	1.062	1.126
Association	2.444***	0.606	4.034	11.526***
Farming experience	-0.051**	0.024	-2.13	0.949**
Distance farm from village	0.041	0.033	1.254	1.042

Signif. codes: '***' at 1%, '**' at 5%, '*' at 10%.
Source: Field survey, 2018.

Conclusion and recommendations

A typical farmer in North Central Nigeria is a male with moderate adaptive capacity to climate change. In addition, farmers, with high adaptive capacity to climate change had higher level of education. The study also concludes that adaptive capacity to climate change, gender, farm income, non-farm income, poverty status, availability of social amenities, membership of association and distance of farmer's farm from the village were the positive drivers of extension services received by farmers with contacts. While ratio of livelihood activities, farm size, age, level of education, distance of farm to market, credit, livestock ownership, household size and working household members were the negative drivers of extension services received by farmers with contact. The study further conclude that the odds of zero contact can be increased by adaptive capacity to climate change, farm size, gender, credit, household size, poverty status, availability of social amenities and membership of association. While ratio of livelihood activities, livestock ownership and farming experience can decrease extension contact. It is imperative to note that the greatest positive influence of extension contacts by all the farmers both visited and zero contact is the level of adaptive capacity to climate change, indicating that the issue of climate change demands greater attention of extension staff by the farmers. The study is limited to the North Central Nigeria based on the funds available to the researchers, the study therefore suggested a broad research that would cover the whole country focusing on all farmers. Based on the findings of this study, the following recommendations were proffered: Extension agents should assist in increasing the adaptive capacity of the farmers by incorporating more climate change related techniques and adaptation strategies in their services. Availability of functional social amenities should be a major focus when formulating policies and developmental issues as it influences extension services. Farmers should be encourage to form associations so as to achieve the benefits associated with it.

Acknowledgement
This study was conducted from funding supports of Academic Staff Union of Universities (ASUU) and TETFUND Institutional-Based Research Intervention (IBRI) FUND. Grant No. **TETFUND/FUTMINNA/2016-2017/6th BRP/08.**

REFERENCES

Abdallah, A. & Abdul-Rahaman, A. (2016). Determinants of access to agricultural extension services: Evidence from smallholder rural women in Northern Ghana. *Asian Journal of Agricultural Extension, Economics & Sociology*, 9(3): 1-8.

Amemiya, T. (2006). Tobit models: a survey. *Journal of Econometrics*, 24(1): 3–61.

Asfir, S. (2016). Determinants of rural households' livelihood strategies: Evidence from Western Ethiopia. *Journal of Economics and Sustainable Development*, 7(15): 103-109.

Barrowman, N. (2019). vtree: Display information about nested subsets of a data frame. R package version 5.0.0. https://CRAN.R-project.org/package=vtree.

Bjornlund, H. & pittock, J. (2017). Exploring the productivity and profitability of small-scale communal irrigation systems in sub-Saharan Africa. *International Journal of Water Resources & Development*, 33(5): 658-689.

Chen, L., Guan, X., Zhuo, J., Han, H., Gasper, M., Doan, B., Yang, J. & Ko, T. (2020). Application of double hurdle model on effects of demographics for tea consumption in China. *Journal of Food Quality*, 10(1): 1-6.

Chittoor, J. & Mishra, S. (2012). Agricultural education for sustainable rural development in developing countries: Challenges and policy options. *Journal of Education & Learning*, 6(2): 119-132.

Cragg, J. (1971). Some statistical models for limited dependent variables with application to the demand for durable goods. *Econometrica*, 39(5): 829-844.

Food and Agriculture Organization of the United Nations, (FAO) (2017). The state of food security and nutrition in the world 2017: Building resilience for peace and food security. Available at: http://www.fao.org/3/a-I7695e.pdf. Accessed on 1/12/2021.

Food and Agriculture Organization of the United Nations, (FAO) (2018). The 10 elements of agro-ecology: Guiding the transition to sustainable food and agricultural systems. Available at: http://www.fao.org/3/I9037EN/i9037en.pdf. Accessed on 1/12/2021.

Francis, J. & Addom, B. J. (2014). Modern ICTs and Rural Extension: Have we reached the tipping point? Rural 21, 01/2014: 22-24. Grameen Foundation 2016. Community Knowledge Worker. Available at http://www.grameenfoundation.org/what-wedo/agriculture/community-knowledge-worker Retrieved on 2/2/2021.

Kassa, W. A. (2019). Determinants and challenges of rural livelihood diversification in Ethiopia: Qualitative review. *Journal of Agricultural Extension and Rural Development*, 11(2): 17-24.

Leeuwis, C. & Aarts, N. (2011). Rethinking communication in innovation processes: Creating space for change in complex systems. *Journal of Agricultural Education & Extension*, 17(1): 21-36.

Maguire-Rjpaul, V. A., Khatun, K. & Hirons, M. (2020). Agricultural information's impact on the adaptive capacity of Ghana's smallholder cocoa farmers. *Frontiers in Sustainable Food Systems*, 4(28): 1-19.

Maonga, B. B., Chilemba, J. & Maganga, A. M. (2017). Determinants of smallholder farm household decision to access agricultural support services in Malawi. *International Journal of Development and Sustainability*, 6(1): 16-32.

Msuya, C. P., Annor-Frempong, F. K., Magheni, M. N., Agunga, R., Igodan, C., Ladele, A., Huhela, K., Tselaesele, N. M., Msatilomo, H., Chomo, C. & Zwane, E. (2017). The role of agricultural extension in Africa's development: The importance of extension workers and the need for change. *International Journal of Agricultural Extension,* 5(1): 51-58.

Mullahy, J. (1986). Specification and testing of some modified count data models. *Journal of Econometrics*, 33(1): 341-365.

Mustapha, S. B., Undiandeye, U. C. & Gwary, M. M. (2012). The role of extension in agricultural adaptation to climate change in the Sahelian zone of Nigeria. *Journal of Environment and Earth Science*, 2(6): 48-59.

National Bureau of Statistics (NBS) (2020). Quarterly Report. Available at: www.nigerianstat.gov.ng. Accessed on 15/2/2021.

Osuji, E. E. & Henri-Ukoha, A. (2017). Determinants of poverty among arable crop farmers using sustainable soil management techniques in Imo State, Nigeria. *International Journal of Biosciences, Agriculture and Technology*, 8(8): 55-63.

Oyaniran, T. (2020). Current state of Nigeria agriculture and agribusiness sector. African Continental Free Trade Area (AfCFTA) workshop.

Ozor, N. & Nnaji, C. (2011). The role of extension in agricultural adaptation to climate change in Enugu State, Nigeria. *Journal of Agricultural Extension and Rural Development,* 3(3): 42-50.

Ragas, C., Berhane, G., Tadesse, F. & Taffesse, A. S. (2013). Gender differences in access to extension services and agricultural productivity. *Journal of Agricultural Education and Extension*, 19(5): 1-10.

Raidimi, E. N. & Kabiti, H. M. (2019). A review of the role of agricultural extension and training in achieving sustainable food security: a case of South Africa. *South African Journal of Agricultural Extension*, 47(3): 1-5.

Schubert, A. & Telcs, A. (1989). Estimation of the publication potential in 50 U.S. states and in the District of Columbia based on the frequency distribution of scientific productivity. *Journal of the American Society for Information Science*, 40: 291–297.

Stevens, J. B. & Van Heerden, P. S. (2016). Knowledge brokering and dissemination of irrigation management guidelines for training of extension advisors. Report No. KV, 356,16.

Tobin, J. (1958). Estimation of relationships for limited dependent variables, *Econometrica*, 26(1): 24–36.

Tomlinson, J. and Rhiney, K. (2018). Assessing the role of farmer field schools in promoting pro-adaptive behaviour towards climate change among Jamaican farmers. *Journal of Environmental Studies & Science*, 8(1): 86-98.

Waha, K., Van Wijk, M. T., Fritz, S., See, L., Thornton, P. K., Wichern, J. & Herrero, M. (2018). Agricultural diversification as an important strategy for achieving food security in Africa. *Global Change Biology*, 24(8): 3390-3400.