Agris on-line Papers in Economics and Informatics

Volume XV Number 2, 2023

Are Agricultural Households Resilient to Food Insecurity in Nigeria?

Grace Oluwatofunmi Popoola[1], Olawamiwa Reuben Adeniyi[1], Raphael Ajayi Omolehin[2]

[1] Agricultural Economics and Extension unit, College of Agriculture, Engineering and Sciences, Bowen University, Iwo, Osun State, Nigeria

[2] Department of Agricultural Economics and Extension, Faculty of Agriculture, Federal University of Oye-Ekiti, Nigeria

Abstract

Food insecurity remains a threat to Nigerians especially agricultural households who are the most vulnerable. This study focuses on the structure of the resilience of agricultural households to food insecurity in Nigeria using the World Bank's Living Standard Measurement Studies Integrated Survey on Agriculture (LSMS-ISA), covering four rounds (2010/2011, 2012/2013, 2015/2016 and 2018/2019) using a total of 4975, 4394, 4226 and 4797 households respectively. Data were analysed using Descriptive Statistics, Multiple Indicators Multiple Causes Model and the Random Effects Probit model. The pillars of resilience to food insecurity among agricultural households include access to basic services, asset, agricultural practice and technology, social safety net, adaptive capacity and stability. Results showed that only about 34% of households were resilient to food insecurity during the periods under review. The most essential determinants affecting food insecurity resilience are access to basic services, assets, stability, adaptive capacity and social safety net. Age of household head, livelihood strategy employed, geo-political zones and location of residence significantly influence food insecurity resilience of households. Farmers' income and food access must be improved as well as their adaptive capacity to food insecurity in order to help them become more resilient to food insecurity and inevitably help in achieving the Sustainable Development goal two of ending hunger in all its forms and improving food security which is one of the main policy thrust of the Nigeria's economic and sustainability plan and the National Development Plan.

Keywords

Food insecurity, resilience, agricultural households, Nigeria.

Popoola, G. O., Adeniyi, O. R. and Omolehin, R. A. (2023) "Are Agricultural Households Resilient to Food Insecurity in Nigeria?", *AGRIS on-line Papers in Economics and Informatics*, Vol. 15, No. 2, pp. 69-82. ISSN 1804-1930. DOI 10.7160/aol.2023.150206.

Introduction

Achieving food security is an important objective of the Sustainable Development Goals (SDGs) (Mollier et al., 2017; FAO et al., 2021). Globally, there is an upward trend in hunger and food crises situation. The incidence of food insecurity and undernourishment is on the increase in Africa, specifically in Nigeria. Undernourished people have increased from 791 million in 2015 to 821 million in 2018, which is around one person out of every nine globally (FAO, IFAD, UNICEF, WFP and WHO, 2018). Furthermore, the performance of Nigeria in World rankings on food security related indices remains low. For instance, Nigeria ranked 96th among 113 countries with food insecurity problems (Global Food Security Index (GFSI), 2018) in 2019, the situation was worse has it now ranked 94th (GFSI, 2019). The Global Hunger Index (GHI) remained at 103rd position out of 119 and 121 countries in 2018 and 2021 respectively (GHI, 2018; GHI, 2022). This is an indication of a serious hunger problem. The GHI score further affirmed the country as a famine-threatened country, falling in the serious and alarming categories. Reports revealed that about 4.5 million people in the northeast of Nigeria are currently battling with famine and violence caused by Boko Haram (VOA 2017; UNDP, 2017) while others experience minimal food-security concerns (FEWS NET, 2017). Also, in 2017 the UNDP Human Development Index (HDI) was 0.532 and ranked 157th out of 189 countries (UNDP, 2018). In 2021, it was 0.535 and the country ranked 163rd position out of 191 countries (UNDP, 2022). This puts the country in the low category of the human development below the sub-Saharan Africa

threshold of 0.55 in 2021 (UNDP, 2022).

About 2 billion people were reported living in moderate or severe food insecurity and the country ranks 38 out of 100 countries with food insecurity problems (FAO et al., 2019) and about 14 million people are malnourished. On the national level, there continues to be an upsurge in the demand for food as population increases but production is unable to meet the demand (Owoo, 2020). This has left a high proportion of rural households' food insecure (Akinyele, 2009; Adepoju et al., 2015). Food production is threatened due to increased food demand, scarcity, population boom, variable input and output prices, rising energy costs, administrative control, and, most critically, linked climatic changes. Over the last few years, natural, economic and political dangers have become increasingly common and severe for homes, farms, firms, economies, and even entire countries (Zseleczky and Yosef, 2014). The insurgency in the North East of the country have further worsened food security outcomes, more especially for vulnerable women and children (WFP, 2022). This has made resilience to become a major issue in policy and scholarly debates. It is also imperative for agricultural households to be able to withstand these unprecedented shocks that affect their livelihood. According to d'Errico et al. (2016), the capacity of a system to withstand these risks is termed resilience. In a food security setting, resilience is described the capacity of a household to maintain a level of well-being (i.e. being food secure) after exposure to shocks.

Previous literature has examined the concept of resilience to food insecurity and its determinants (Alinovi et al., 2008; Alinovi et al., 2010; Vaitla et al., 2012; Kasie, 2017; d'Errico et al., 2018; Ansah et al., 2019; Atara et al., 2020). Alinovi et al. (2008) emphasized household capacity to resist and absorb a shock among Palestinian households. They stated that the ability of a household to adapt to new scenarios depends on the options available to that household to make a living, such as access to assets, income-generating activities, public services, formal and informal social safety nets, institutional environment and resistance capacity. Alinovi et al. (2010) measured empirically the outcomes of different livelihoods strategies in terms of household resilience to food insecurity among Kenyan households which they classified according to their own livelihood strategies by using the Ward's cluster analysis technique on data from the Kenya Integrated Household Budget Survey 2005-2006. They found out that Kenyan household livelihood strategies are pastoralist, agro-pastoralist, smallholder farmers, large-holder farmers, entrepreneurs and wage-employees. Using resilience analysis framework developed by Alinovi et al. (2008) they revealed that the large-holder farmers' cluster is the most resilient, whilst the pastoralist is the least resilient.

Vaitla et al. (2012) examined resilience and livelihoods change in Ethiopia. They adopted a "livelihood change" approach, consisting of modelling the pre-existing conditions with assets, natural resources, physical assets, financial assets and human and social capital. These are the fundamental elements of resilience, which after interaction in a vulnerability context (factors outside human control) and an institutional context (human factors outside the household's control) enable households to react to a shock. Kasie (2017) examined shock exposure, livelihood strategies and risk response options in Ethiopia. He reported that livelihood strategies employed by households was related to food income. Similarly, diverse livelihood options increase the resilience capacity of households to food insecurity. The location of residence and the nature of livelihood option influences the choice of risk-coping strategies. It was concluded that weak adaptive capacity and high exposure to shocks were responsible for poor household resilience to food insecurity. d'Errico, et al. (2018) also investigated the resilience to food insecurity among Tanzanian and Ugandan households. The adaptive capacity of these households was the most important dimension contributing to resilience to food insecurity in the study areas. The adaptive capacity strongly depended on education and the number of income-earning members in the household. The future food security status of households depended on current household resilience capacity. Ansah et al. (2019) provided a review of concepts and methodologies on household resilience and food security. The study found that food security higher resilience capacity is positively related to food security and less child malnutrition. Evidently from the literature, there are assertions that households require some form of livelihood options to keep with a certain level of food security. Literature is also still limited in the Nigerian context on resilience to food insecurity.

This study is important given the contextual realities in Nigeria. The changing climate, increasing population, rising food prices and worsening

environmental conditions that significantly affect food security. Household resilience strategies and policy responses are therefore needed to attend to these pressing issues. These concerns are further espoused in Nigeria's Medium-term National Development Plan (2021-2025) and the Sustainable Goals 1 and 2. This study focuses on examining whether agricultural households in Nigeria are resilient to food insecurity. Despite the importance of the resilience concept, there are limited studies that have empirically examined household resilience to food insecurity. Some of those available in literature include Alinovi et al. (2010) in Palestinian households; Alinovi et al. (2010) in Kenya; and Boukary et al. (2016) in Niger; and d'Errico et al. (2016) in Tanzania and Uganda. To date, there is limited empirical research on resilience to food insecurity and its determinants among agricultural households in Nigeria. This study therefore fills the gap with respect to resilience to food insecurity studies in Nigeria.

This study is situated within a broader national policy of the government through the Nigeria's Economic and Sustainability Plan and the National Development Plan (2021-2025), with agriculture as one of the priority sectors and food security being a major component. It will help achieve the Sustainable Development Goal (SDG) two of ending hunger, achieving food security and improve nutrition and promote sustainable agriculture and provide insights to policy makers, researchers and relevant stakeholders on what they have to do in order to cope with food insecurity among agricultural households in Nigeria. The FAO Resilience Index Measurement Analysis II (RIMA-II) was employed for assessing household resilience and aims to answer these pertinent questions: How resilient are agricultural households to food insecurity? How do different resilience attributes contribute to overall resilience capacity of agricultural households? What factors influence the resilience capacity of agricultural households to food insecurity?

Materials and methods

Scope of the study

The scope of the study is Nigeria. Nigeria is one of the Sub-Saharan Africa (SSA) nations located in the western part of Africa. The country has 36 states and the federal capital territory. It shares its boundaries with the Republic of Benin to the west, the Niger Republic to the north, the Republic of Cameroon and Chad Republic to the east, and the Atlantic Ocean forms a coastline of about 960 km^2 to the south. The country has a total land mass of about 92,377,000 hectares out of which 91,077,000 hectares are solid land area. Nigeria has a population of about 217,863,698. Agriculture remains the base of the Nigerian economy, providing the main source of livelihood for most Nigerians. The agricultural sector in Nigeria employs 70% of the nation's working force and has 84 million hectares of fertile land suitable for staple food crops including cassava, yams, corn, coco-yams, cowpeas, beans, sweet potatoes, millet, plantains, bananas, rice, sorghum, fruits, and vegetables.

Type and source of data

This research work employed the World Bank's Living Standard Measurement Studies Integrated Survey on Agriculture (LSMS-ISA), covering four rounds (2010/2011, 2012/2013, 2015/2016 and 2018/2019). The use of panel data is premised on the length of the time period covered which helps to better determine the potential of households to withstand and bounce back to the previous level of well-being. This is the only panel data available for agricultural households in Nigeria. Thus, the data is most appropriate for the study at hand.

Analytical techniques

Measurement of household resilience to food insecurity

The resilience index capacity of agricultural households in Nigeria was analyzed with the FAO's RIMA II as employed by FAO, (2013). Resilience is an intricate term that can be measured through latent variable modeling, the technique that analyzes household resilience statistically. Two steps were taken in the analysis following FAO (2016). First, the principal component analysis (PCA) was used to show the pillars of household resilience. These pillars are access to basic services, asset, agricultural practices and technology, social safety net, stability and adaptive capacity. The indicators for each pillar are presented in Table 1.

Pillar	Indicators	Indicator description
Access to basic services (ABS)	Access to electricity	A dummy variable indicating whether a household has electricity at home or not
	Distance to water source	A continuous variable measuring the time that it takes to walk to the nearest water source
	Credit	A dummy variable measuring whether any household member has borrowed credit over the observation period irrespective of the credit source (formal or informal) and nature (in cash or in kind)
	Telecommunication	A dummy variable for having access to a telephone (fixed or mobile), equal to 1 if the household shows any telephone expenditure and 0 otherwise
	Access to information	A dummy variable: 1 if the household head access to information through television, radio or any other means of accessing information and 0 if otherwise
	Distance to the nearest primary school	A continuous variable measuring the time that it takes to walk to the nearest primary school
Assets (AST)	Ownership of Bicycle, motorcycle, radio, TV, Car, Livestock, farm size (ha)	A dummy variable equal to 1 if the household owned asset over the survey period, 0 otherwise; Farm size in hectares
Agricultural practice and technologies (APT)	Fertiliser use	A dummy variable equal to 1 if the household used fertiliser over the survey period, 0 otherwise
	Pesticide use	A dummy variable equal to 1 if the household used pesticide over the survey period, 0 otherwise
	Extension contact	A continuous variable equal to the average number of contacts that the household head received during the last 12 months.
Social safety nets (SSN) and Adaptive capacity (AC)	Cash transfers received	A dummy variable equal to 1 if the household received cash transfers or 0 otherwise
	Employment ratio	It measures the ratio between the number of household members currently employed and the household size
	Education average	This is the mean of the years of education completed by the household's members

Source: Alinovi et al. (2008 and 2010), FAO (2013)

Table 1: Pillars and indicators for household resilience to food insecurity.

The Principal Component Analysis (PCA)

Each component of the PCA gives a linear weighted sum of the variable indicators, resulting in a collection of orthogonal (uncorrelated) components/indices. Filmer and Pritchett (2001) expressed PCA in terms of the original variables in an index form. This done for each household.

Assume there is a set of R-variables (a^*_{1j} to a^*_{rj}) representing the R-resilience attributes of each householdj. PCA specifies each variable normalized by its mean and standard deviation.

For example, $b_{1j} = (b^*_{1j} - b^*_1)/s^*1$, where b^*_1 is the mean of b^*_{1j} across household and s^*_1 is its standard deviation. These attributes are expressed as linear combinations of a set of underlying components for each household j is shown in equation 2:

$$a_{1j} = y_{11}W_{1j} + y_{12}W_{2j} + \ldots + y_{1r}W_{rj} \quad (1)$$

$j = 1 \ldots J$

$$az1j = y_{r1}W_{1j} + y_{r2}W_{2j} + \ldots + y_{rr}W_{rj} \quad (2)$$

W's = components

y's = coefficients on each component for each variable.

Secondly, Systems of equations were used to specify the link between resilience (the unobserved latent variable), food insecurity indicators (outcome variables) and the pillars.

Algebraically, it is presented as:

$$RCI_i = f(IFA_i, A_i, APS_i, APT_i, SSN_i, S_i, ACi) \quad (3)$$

Where RCI = Resilience capacity index; IFA = income and food access; A = assets; APS = access to public services; APT = Agricultural Practices and Technologies; SSN = social safety-nets; S = stability; and AC = adaptive capacity.

In this study, Agricultural Practices and Technology (APT) was included to show the technological levels in farming activities.

$$RCI = \sum_j W_j F_j \quad (4)$$

The MIMC model contains the measurement equation (4), which are the observed indicators of food security and the structural equation (5), that links the predicted attributes to resilience capacity.

$$[Food\ expenditure] = [\Lambda 1] \times [RCI] + [\varepsilon_2, \varepsilon_3] \quad (5)$$

$$[RCI] = [\beta_1, \beta_2] \times [IFAi, A_iAPS_iAPT_iSSN_iS_iAC_i] + [\varepsilon_1] \quad (6)$$

$$Food\ expenditure = \Lambda 1 RCI + \varepsilon_2 \quad (7)$$

Random Effects Probit Model

Following Guilkey and Murphy (1993), equation 8 presented the model to identify the correlates of household resilience to food insecurity:

$$Y_{it}^* = X_{it}\beta + \mu_i + \varepsilon_{it} \quad (8)$$

The simplified form is given in equation 9:

$$Y_{it}^* = \beta_1 + \beta_2 X_{it} + \mu_i + \varepsilon_{it} \quad (9)$$

X_{it} = 1 x T vector of regressor

β is a T x 1 vector of coefficients

$\mu_i \sim IN(0,\sigma_\mu^2)$; $\varepsilon_{it} \sim IN(0,\sigma_\varepsilon^2)$; μ_i and ε_{it} are mutually independent.

Y_{it}^* is an unobserved latent variable. The observed random variable Y_{it} is defined by:

$$Y_{it} = \begin{cases} 0\ if\ Y_{it}^* \leq 0, \\ 1\ if\ Y_{it}^* > 0. \end{cases} \quad (10)$$

Hence, following Kasie (2017), households were considered as resilient to food security shocks if R_i, t + 1 > 0.5 where R_i, is the resilience measure, given a value of one and non-resilient otherwise (value of zero).

Variables used for correlates of resilience include; sex of household head (male 1 otherwise 0), Age of household head (years), Age squared (years), Household size (number), Squared of household size (number), Educational level (no education = 1, primary education = 2, secondary education = 3, tertiary education = 4), location and period of survey (wave 1 = 1, wave 2 = 2, wave 3 = 3, wave 4 = 4).

Results and discussion

Socioeconomic characteristics of agricultural households

The socio-economic characteristics of agricultural households is shown in Table 2. Results revealed that most household heads were male across the time periods. Across rural and urban locations, most households were male-headed. In total, it was about 84.9%, 85.1%, 85.4% and 82.3% in the 2010/2011, 2012/2013, 2015/2016 and 2018/2019 periods respectively. This position holds true for a typical Nigerian household and is supported by the Nigerian National Bureau of Statistics (2014); Ugwuja et al. (2011) reported that males are more likely to be involved in agriculture than females because of the rigorous nature of the work, however women are involved in harvesting, processing and marketing of agricultural produce. According to National Survey and Segmentation of smallholder households in Nigeria, nine in ten smallholder household heads in Nigeria are men (Anderson et al., 2017). The age of individuals in a nation reveals the extent to which there will be economic growth and development (Bloom et al., 2010; Maestas et al., 2016). Most of the household heads were between 25-54 years of age across rural and urban location. However, the proportion within this category decreased between the periods 2010/2011 to 2015/2016 and increased in 2018/2019 season. The average age of household heads was 49.6 ± 15.5, 51.8 ± 15.1, 53.4 ± 14.4 and 49.8 ± 15.5 years respectively for the periods. This implies that majority of the household heads are in their active or productive age and are involved in various agricultural activities. This result is consistent with the findings of Folorunso et al., (2018) and Oyetunde-Usman and Olagunju (2019) who reported that most agricultural households are in their productive years. This is contrary to the old believe that the average farm population is aging and as reported in the International Fund for Agricultural Development (IFAD) rural development report in 2019.

These agricultural households were mostly married. In total, 79.7%, 80.8%, 81.1% and 77.5% were married in 2010/2011, 2012/2013, 2015/2016 and 2018/2019 respectively. This implied that the married were more involved in agricultural production. Results also showed that most households across rural and urban area in Nigeria had between four to six household members. The mean household size was slightly lower in urban households than rural households across the survey time periods. In total, there was an average of six household members in 2010/2011 and 2012/2013 seasons, increased to seven household members in 2015/2016 and however decreased to six members in 2018/2019 season. This reflects the preponderance of large households in Nigeria. The presence of large household size among

agricultural households might be so that family members could be useful as a source of labour. This position is consistent with the assertion of Oluwatayo et al. (2008) who said that higher household size provides enough persons for family labour. In line with this reasoning, large household size may serve as an advantage or disadvantage. This can be explained in terms of increased family labour which may create the need for farm expansion which can only be achieved when household members receive sufficient and higher incentives for working on family plots than participating in other household activities (Jerumeh and Omonona, 2018). However, Shapiro (1990) presented a different opinion that there could be a decline in farm size as household size increased due to incentive problems as well as diversification issues. With respect to education of household heads, the same percentage of household heads mostly had both primary and secondary education (39.7%) in 2010/2011. In 2012/2013 and 2015/2016 seasons, higher proportion of household heads had primary education (40.3% and 36.8% respectively). However, in 2018/2019, most heads had secondary education (35.1%). This implies that most household heads in rural areas in the sample have at least primary education. This could have negative effect as opined by Nyako (2013) or positive effect as observed by Mohammed et al. (2016) on their food security status. The mean farm size was 1.01 ± 1.6 ha, 0.90 ± 1.3 ha, 0.88 ± 1.5 ha and 0.95 ± 1.7 ha in the 2010/2011, 2012/2013, 2015/2016 and 2018/2019 seasons respectively. This is because agriculture is practiced mainly by smallholder farmers in Nigeria and about 88 percent of them are considered small family farms (FAO, 2018). Extension visits was about two visits in 2010/2011, 2012/2013; almost no visits in 2015/2016 and about 2 visits in 2018/2019 period. Results showed that irrespective of location (rural or urban), frequency of extension visits was very low. The results therefore reflected the precarious state of agricultural extension services in the country as coverage and visits were extremely low. This will hinder the dissemination of improved agricultural technologies with resultant effect on agricultural production. This finding is in line

Socio-economic characteristics	2010/2011	2012/2013	2015/2016	2018/2019
Age of Household Head (in years)				
Mean+SD	49.6±15.5	51.8±15.1	53.2±14.5	49.8±15.5
Sex of Household Head				
Male	4225 (84.9)	3740 (85.1)	3609 (85.4)	3947 (82.3)
Female	750 (15.1)	654 (14.9)	617 (14.6)	850 (17.7)
Marital status				
Never Married	215 (4.3)	126 (2.9)	86 (2.0)	249 (5.3)
Married	3965 (79.7)	3554 (80.8)	3426 (81.1)	3720 (77.5)
Widowed	628 (12.6)	584 (13.3)	571 (13.5)	663 (13.8)
Divorced/Separated	167 (3.4)	130 (3.0)	143 (3.4)	165 (3.4)
Household Size (in persons)				
Mean+SD	5.5±3.1	6.2±3.2	7.0±3.5	6.0±3.7
Level of education				
No formal education	499 (10.0)	573 (13.0)	483 (11.4)	485 (10.1)
Primary education	1977 (39.7)	1770 (40.3)	1554 (36.8)	1576 (32.9)
Secondary education	1559 (39.7)	1432 (32.6)	1297 (30.7)	1685 (35.1)
Vocational training	54 (1.1)	33 (0.7)	28 (0.7)	51 (1.1)
Tertiary education	869 (17.5)	865 (19.7)	860 (20.3)	985 (20.5)
Adult education	17 (0.3)	-	9 (0.2)	16 (0.3)
Farm Size (ha)				
Mean±SD	1.01±1.6	0.90±1.3	0.88±1.5	0.95±1.7
Extension Visit				
Mean+SD	1.8±3.2	2.11±2.5	0.24±1.1	1.67±1.1
N	**4975**	**4975**	**4975**	**4975**

Source: Authors' computation, 2022

Table 2: Socioeconomic characteristics of agricultural households.

with studies of Ogunsumi (2008) and Ajala et al. (2013) that farmers-extension ratio continues to decline and there remains little or no contact with extension agents. Thus, a proactive step to remedy this situation is crucial.

Resilience capacity of agricultural households

The FAO-RIMA-II approach gives an estimate of RCI and the correlation of different attributes to resilience. In order to profile household resilience to food insecurity, the continuous measure of resilience R_i, $t + 1$, were used to categorize a household as resilient or not resilient with reference to the normative minimal threshold probability, ($P = 0.5$), under which a household's probability of meeting or exceeding the normative well-being threshold intolerably low. Hence, following Kasie (2017), households were classified as resilient to food security shocks if the measure of resilience, R_i, $t + 1 > 0.5$, and non-resilient if otherwise. Results showed that only about 34% of households were resilient to food insecurity during the period under review. This is presented in Table 3. This low proportion is a worrisome situation for the country as it depicts that most agricultural households are vulnerable to shock exposure, lack access to basic services, in poor safety nets and low in adaptive capacity, poor in agricultural practices and low in technology and weak asset base. There is therefore the need to address these pillars among agricultural households as they hold the key to national food security. This resilience index further reveals the low capacity of agricultural households in Nigeria to withstand shocks.

Resilience status	Percentage (%)
Resilient	33.97
Non-resilient	66.03
Total	**100**

Source: Authors' computation, 2022

Table 3: Resilience status of agricultural households to food insecurity.

Linking resilience and food security

The MIMC was used in linking resilience and food security (Table 4), the coefficient of the variable access to basic services was fixed to one by default, so as to estimate relative size and level (FAO 2016). Coefficients estimated are statistically highly significant at 1 percent with the expected sign, meaning that greater access to assets, agricultural practice and technologies, social safety net influence RCI positively, and promote better adaptive capacity. For a single standard deviation change in an exogenous variable ceteris paribus, the RCI response is stated in units of standard deviation (Bollen, 1989). The effect of assets, agricultural practice and technologies, social safety net and adaptive capacity in the model on RCI reveal that a one standard deviation positive change in AST, APT, SSN_AC positively affect the magnitude of the RCI by 1.59, 1.08, 8.54 standard deviations respectively.

Per capita food expenditure was also positively and significantly correlated with resilience capacity index by 0.034 standard deviations. This implies that households will become more resilient with increase in per capita food expenditure.

	Coefficient	Standard error	Z	P>|z|
Structural component				
Access to basic services (ABS)	1 (constrained)			
Assets (AST)	1.5945***	0.2681	-5.95	0.000
Agricultural Practices and Technology (APT)	1.0761***	0.2188	-4.92	0.000
Social Safety Nets and Adaptive Capacity (SSN_AC)	8.5419***	2.9734	-2.87	0.004
Measurement component				
Per capita food expenditure	0.0342***	0.0024	14.030	0.000
Goodness of fit				
X^2	162.492			
p-value	0.000			
RMSEA	0.020			
Pr RMSEA	1.000			
CFI	0.843			
TLI	0.824			

Source: Authors' computation, 2022

Table 4: Resilience Capacity Index (RCI)

The implication of these findings revealed that the interaction of social safety nets and adaptive capacity mostly affect resilience among these households. This position is consistent with the findings of D'Errico et al (2018), Devereux and Getu (2013), Gallopin (2006) where social safety nets and adaptive capacity contributed significantly to resilience capacity in the sampled countries. The positive relationship between household resilience and food security revealed that the probability of households becoming food secure increases with improved resilience capacity of agricultural households. It is therefore instructive to conclude that the FAO RIMA-II approach has been able to establish that the resilience capacity of agricultural households is dependent on a number of pillars, with which the operationalization of resilience can be tackled at the policy level. In this study, we have used it over a panel data covering four periods which further reinforced the appropriateness and relevance of the resilience measure.

Pillars of resilience to food insecurity

Access to basic services (ABS)

Table 5 shows the contribution of the different attributes of resilience. Access to basic services help households become more resilient, such as increasing the effectiveness of their asset access. Access to electricity, distance to water source, access to credit, telecommunication, access to information and nearness to the nearest primary school were considered. The variables positively impact distance to the nearest primary school, mobile phone access (telecommunication), access to information and access to electricity on access to basic services (ABS). However, access to credit negatively affects the latent variable ABS.

Assets (AST)

The component asset is computed with variables such as ownership of bicycle, motorcycle, radio, television, car, livestock and farm size. These variables demonstrate a positive impact of ownership of radio, motorcycle, television and car on the latent variable agricultural assets. However, livestock ownership, farm size and ownership of bicycle negatively affect the latent variable AST.

Agricultural Practice and Technologies (APT)

Fertilizer use, pesticide use, frequency of extension contact, herbicide use, machinery use and animal traction were the variables used for this pillar. The variables show the same trend and demonstrate a positive impact of the use of pesticide, animal traction, herbicide and machinery on the latent variable agricultural practice and technologies. However, frequency of extension contacts negatively affects the latent variable APT as shown in Table 5. The reason might be use of agricultural practices and technology helps increase productivity.

Social Safety Net (SSN) and Adaptive Capacity (AC)

This component captures social safety net in the form of cash transfers available to agricultural households. Also, the adaptive capacity also considers the level of education and the employment ratio. Both were used to capture the level of safety nets and adaptive capacity of households. Results showed that there is a positive impact of employment ratio and level of education on the latent variable social safety net and adaptive capacity. However, cash transfers received negatively affect the latent variable SSN_AC as shown in Table 5.

Pillar	Indicators	Factor scores
Access to basic services (ABS)	Access to electricity	0.2592
	Distance to water source	0.0865
	Credit	-0.0401
	Access to information	0.3214
	Telecommunication	0.5136
	Distance to the nearest primary school	0.5577
Asset (AST)	Bicycle	-0.0847
	Motorcycle	0.3841
	Radio	0.6343
	TV	0.3833
	Car	0.1975
	Livestock	-0.4894
	Farm size	-0.1327
Agricultural Practice and Technologies (APT)	Fertilizer Use	0.4126
	Pesticide use	0.4677
	Extension contact	-0.038
	Herbicide	0.4521
	Machinery	0.4445
	Animal Traction	0.4557
Social Safety Net (SSN) and Adaptive Capacity (AC)	Cash transfers received	-0.1148
	Level of education	0.6650
	Employment ratio	0.7379

Source: Authors' computation, 2022

Table 5: Principal Component Analysis results of the attributes of resilience.

Disaggregation of resilience to food insecurity by selected characteristics

The distribution of agricultural household resilience score by selected characteristics is shown in Table 6. With respect to livelihood strategies, the results show that households that engaged in wage employment have the highest resilient score (0.5214) followed by services (0.0912). Those primarily engaged in agriculture are the least resilient (-0.0413). This imply that the more agricultural households engage in agriculture, the less likely they are resilient to food insecurity.

With respect to geo-political zones, it can be seen that households in the South South are the most resilient (0.1557), followed by South West (0.0999) and North Central (0.0646). The worst-off are those in the North East (-0.2550), North West (-0.0054) and South East (-0.0917). The possible reason for this could be due to insecurity in the Northern East and West geopolitical zones which has caused the displacement of people and worsened the living conditions of households.

Finally, on the location of residence of agricultural households, it is shown that households who reside in urban areas are most resilient (0.1422) while those in rural areas are worst-off (-0.0737).

Characteristics	Factor loadings
Livelihood strategies	
Agriculture	-0.0413
Services	0.0912
Wage employment	0.5214
Geo-political zone	
North Central	0.0646
North East	-0.2550
North West	-0.0054
South East	-0.0917
South South	0.1557
South West	0.0999
Location of residence	
Urban	0.1422
Rural	-0.0737

Source: Authors' computation, 2022

Table 6: Disaggregation of resilience by selected characteristics.

Correlates of agricultural household resilience to food insecurity

Findings of the binary probit panel regression are as presented in Table 7. Chi-square distribution and log-likelihood ratio showed that the model is fit. The factors that significantly influenced household resilience to food insecurity were geo-political zones, location of residence, increase in price of inputs, increase in the price of main food items and time.

The geo-political zone in which agricultural households are located greatly affect their resilience to food insecurity. Households in the Northern East and West geopolitical zones, Southern East and West geopolitical zones are negatively and significantly related with resilience to food insecurity at 1%, 1%, 1% and 10% respectively. This implies that being located in these zones reduces the probability of being resilient to food insecurity at a decreasing order from North East to South West. This explains that no geo-political zone of the country is immune to the persistent food insecurity challenges in the country and the worsening state of basic services, asset base, production technologies and exposure to shocks of various kinds.

Households residing in rural areas were significant at 1% and negatively related with the likelihood of being resilient to food insecurity. Households who live in rural areas are less probable to be resilient to food insecurity than households residing in urban areas. This infers that food security is more pronounced in rural areas than in urban. The reason for this is not far-fetched. There are no infrastructures available to the rural poor, little or no access to basic services, no safety nets and there is high exposure to shocks. All these predispose households to food insecurity with little or no adaptive capacity.

Resilience capacity can be reduced substantially by shocks (FAO, 2016). Gustafson (2013) reported that spike in price of food items, drought, floods and economic crises greatly impact food and nutrition security state of households which causes poverty and inability to access sufficient food. Increase in price of inputs and major food items significantly influenced household resilience to food insecurity. Increase in price of inputs was significant at 1% and negatively related with the likelihood of households' resilience to food insecurity. This means that increase in price of agricultural inputs decreases likelihood of the households being resilient to food insecurity. The probable reason for this is that agricultural households are mostly vulnerable to high prices, most especially for inputs used in their production activities. In a similar vein, increase in price of major food items was significant at 1% and negatively related with the likelihood of being resilient to food insecurity. Households who experience increase in price of major food

items are less probable to be resilient to food insecurity. Therefore, increase in food prices will likely decrease their resilience to food insecurity.

Time was significant at 1% and negatively related with the likelihood of households being resilient to food insecurity. It is observed that as agricultural households progressed through time, the likelihood that they become less resilient to food insecurity increase. This could be attributed to the worsening state of the Nigerian economy in recent times in terms of access to basic services, infrastructure, agricultural production technologies, poor safety nets and asset base that has weakened agricultural households' adaptive capacity.

	Coefficient	Standard error	Z	P>|z|
Female-headed household	0.0313	0.0479	0.65	0.514
Age (years)	-0.0055	0.0052	-1.06	0.288
Age squared	0	0	0.63	0.530
Household size	0.0139	0.0106	1.30	0.193
Household size squared	-0.0001	0.0006	-0.24	0.808
Marital status	-0.0083	0.0283	-0.29	0.770
Livelihood strategy				
Services	0.0893	0.0802	1.11	0.266
Wage employment	-0.0005	0.0623	-0.01	0.994
Level of education				
Primary Education	-0.0082	0.0463	-0.18	0.860
Secondary Education	0.0042	0.0469	0.09	0.928
Tertiary Education	0.0648	0.0507	1.28	0.201
Geo-political zone				
North East	-0.1371***	0.0487	-2.81	0.005
North West	-0.1598***	0.0485	-3.30	0.001
South East	-0.1613***	0.0498	-3.24	0.001
South South	-0.0007	0.0475	-0.02	0.988
South West	-0.0831*	0.0501	-1.66	0.097
Location of residence				
Rural	-0.1105***	0.032	-3.45	0.001
Shocks				
Death or disability of a working adult	0.0662	0.0583	1.14	0.256
Death of one who sends remittances	0.0932	0.0754	1.24	0.216
Poor rain that caused harvest failure	-0.1388	0.096	-1.45	0.148
Flooding that caused harvest failure	-0.0341	0.0736	-0.46	0.643
Increase in price of inputs	-0.2753***	0.0941	-2.93	0.003
Fall in the price of outputs	0.095	0.0713	1.33	0.183
Increase in the price of major food items	0.1592***	0.06	2.65	0.008
Time				
2012/2013	-0.1818***	0.0643	-2.83	0.005
2015/2016	-0.4342***	0.1515	-2.87	0.004
2018/2019	-0.3544	0.3035	-1.17	0.243
Constant	0.1451	0.2097	0.69	0.489
lnsig2u	-2.7367	0.7652		
Sigma_u	0.2545	0.0974		
Rho	0.0608	0.0437		
Log likelihood = -5832.1001 N= 4226	Prob > chi2 = 0.0000			

Note: ***, **, * represent 1%, 5% and 10% significance level respectively
Source: Authors' computation, 2022

Table 7: Determinants of household resilience to food insecurity.

Conclusion

This study examined the resilience capacity of agricultural households in Nigeria using the General Household Survey Panel dataset covering four rounds of survey (2010/2011, 2012/2013, 2015/2016 and 2018/2019). A total of 4,975, 4,394, 4,226 and 4,797 agricultural households were examined for those periods. Information on socio-economic characteristics, household expenditure, shocks, social safety nets, access to basic services, assets, agricultural production technologies and adaptive capacity were examined. Agricultural household resilience to food insecurity result revealed that only about 34% were resilient to food insecurity during the period under review. Attributes of resilience influence resilience capacity positively and promote better adaptive capacity. This implies that these attributes are key to explaining resilience to food insecurity among households in the study area, most especially, social safety net and adaptive capacity pillar. The factors that significantly influenced household resilience to food insecurity were geo-political zones, location of residence, increase in price of inputs, increase in the price of main food items and time. There is therefore the need for measures to enhance agricultural households' income and food access, and adaptive capacity towards food insecurity. The food insecurity situation should be addressed in all geo-political zones of the country especially in the northern zones as they were least resilient to food insecurity. Rural households should also be given more attention through improvement in access to basic services, assets, agricultural practices and technology, social safety net and adaptive capacity. Increase in price of inputs and food items negatively affects households' resilience to food insecurity. As such, efforts should be targeted at addressing increase in price of food items and subsidize farm inputs for agricultural households.

Acknowledgements

I appreciate Bowen University for the all-round support in providing a conducive environment for the study. No financial support was received for this study.

Corresponding authors
Grace O. Popoola, Ph.D
Agricultural Economics and Extension Unit, College of Agriculture, Engineering and Sciences
Bowen University, Iwo Osun State, P.M.B 284 Iwo, Osun State, Nigeria
ORCID: http://orcid.org/0000-0002-4122-8242
E-mail: naturalmercy@gmail.com; grace.popoola@bowen.edu.ng

References

[1] Adepoju E. O., Preston, M. A. and Gonzalez, G. (2015) "Health Care Disparities in the Post-Affordable Care Act Era", *American Journal of Public Health*, Vol. 105, pp. 665-667. ISSN 1541-0048. DOI 10.2105/AJPH.2015.302611.

[2] Ajala, A. O., Ogunjimi, S. I. and Farinde, A. J. (2013) "Assessment of Extension Service Delivery on Improved Cassava Technologies Among Cassava Farmers in Osun State Nigeria", *International Journal of Applied and Agricultural Research*, Vol. 1-2, pp. 71-80. ISSN 0331-5428.

[3] Akinyele, I. O. (2009) "*Ensuring Food and Nutrition Security in Rural Nigeria: An Assessment of the Challenges, Information Needs and Analytical Capacity*", Nigeria Strategy Support Program (NSSP) Background Paper, No. 007. International Food Policy Research Institute. [Online]. Available: https://www.ifpri.org/publication/ensuring-food-and-nutrition-security-rural-nigeria-0 [Accessed: April 15, 2021].

[4] Alinovi, L., d'Errico, M., Mane, E. and Romano, D. (2010) "Livelihoods strategies and household resilience to food insecurity: an empirical analysis to Kenya", European Report on Development. [Online]. Available: file:///C:/Users/ctyroka/Downloads/alinovi-romano-d_errico-mane_livelihoods_resilience_food_insecurity_kenya.pdf [Accessed: April 15, 2021].

[5] Alinovi, L., Mane, E. and Romano, D. (2008) "Measuring household resilience to food insecurity: Application to Palestinian households", In: *Agricultural Survey Methods*, E-ISBN 9780470665480, ISBN 9780470743713. DOI 10.1002/9780470665480.

[6] Anderson, J., Collins, M., Musiime, D. and Thiam, M. (2017) "National Survey and Segmentation of smallholder households in Nigeria: Understanding Their Demand for Financial, Agricultural and Digtal Solutions", CGAP working paper pp.1-89. [Online]. Available: https://www.cgap.org/research/publication/national-survey-and-segmentation-of-smallholder-households-in-nigeria [Accessed: April 20, 2021].

[7] Ansah, I. G. K., Gardebroek, C. and Ihle, R. (2019) "Resilience and Household Food Security: A Review of Concepts, Methodological Approaches and Empirical Evidence", *Food Security*, Vol. 11, pp.1187-1203. ISSN 18764517. DOI 10.1007/s12571-019-00968-1.

[8] Atara, A., Tolossa, D. and Denu, B. (2020) "Analysis of Rural Households' Resilience to Food Insecurity: Does Livelihood Systems/Choice/Matter? The Case of Boricha woredu of Sidama Zone in Southern Ethiopia", *Environmental Development*, Vol. 35, ISSN 2211-4645. DOI 10.1016/j.endev.2929.100530.

[9] Bloom, D. E., Canning, D. and Fink, G. (2010) "Implications of population ageing for economic growth", *Oxford Review Of Economic Policy,* Vol. 26, No. 4, pp. 583-612. E-ISSN 1460-2121, ISSN 0266-903X. DOI 10.1093/oxrep/grq038.

[10] Bollen, K. A. (1989) "*Structural equations with latent variables*", John Wiley and Sons, Inc., New York. E-ISBN 9781118619179, ISBN 9780471011712. DOI 10.1002/9781118619179.

[11] Boukary G. A., Diaw, A. and Wünscher, T. (2016) "Factors Affecting Rural Households' Resilience to Food Insecurity in Niger", *Sustainability*, Vol. 8, No 3, p.181. ISSN 20711050. DOI 10.3390/su8030181.

[12] D'Errico, M., Pietrelli, R. and Romano, D. (2016) "Household resilience to food insecurity: evidence from Tanzania and Uganda", Paper presented at the *5th AIEAA Conference,* Bologna, Italy, June 16-17, 2016. [Online]. Available: www.aieaa.org/node/144 [Accessed: Feb. 15, 2022].

[13] D'Errico, M., Romano, D. and Pietrelli, R. (2018) "Household resilience to food insecurity: evidence from Tanzania and Uganda", *Food Security*, Vol. 10, No. 4, pp.1033-1054. ISSN 18764517. DOI 10.1007/s12571-018-0820-5.

[14] Devereux, S. and Getu, M. (2013) "Informal and formal social protection system in Sub-Saharan Africa", 1st ed., Fountain Publisher, Uganda, 316 p. ISBN 9789970252411.

[15] FAO (2013) "*Software for Fishery Statistical Time Series*", Fisheries and Aquaculture Information and Statistics Service, Food and Agriculture Organization of the United Nations. [Online]. Available: www.fao.org/fishery/statistics/software/fishstatj/en [Accessed: Jan. 17, 2022].

[16] FAO (2016) "*Analysing Resilience for Better Targeting and Action. Resilience Index Measurement and Analysis – II (RIMA-II)*", Food and Agriculture Organization Rome. ISBN 978-92-5-109235-4 [Online]. Available: https://www.fao.org/3/i5665e/i5665e.pdf [Accessed: Jan. 17, 2022].

[17] FAO IFAD, UNICEF, WFP and WHO (2021) "*The State of Food Security and Nutrition in the World 2021. Transforming food systems for food security, improved nutrition and affordable healthy diets for all*", FAO Rome ISBN 978-92-5-134634-1. [Online]. Available: https://www.fao.org/publications/sofi/2021/en/ [Accessed: Jan. 17, 2022].

[18] FAO, IFAD, UNICEF, WFP and WHO (2018) "*The State of Food Security and Nutrition in the World 2018. Building climate resilience for food security and nutrition*", FAO Rome, pp. 2-4. ISBN 978-92-5-130571-3. [Online]. Available: https://www.fao.org/3/I9553EN/i9553en.pdf [Accessed: Jan. 17, 2022].

[19] FAO, IFAD, UNICEF, WFP and WHO (2019) "*The State of Food Security and Nutrition in the World 2019. Safeguarding against economic slowdowns and downturns*", Rome, FAO. ISBN 978-92-5-131570-5. [Online]. Available: https://www.fao.org/3/ca5162en/ca5162en.pdf [Accessed: Jan. 17, 2022].

[20] FEWSNET (2017) "*Nigeria Famine Early Warning Systems Network*", [Online]. Available: https://fews.net/west-africa/nigeria [Accessed: Jan. 17, 2022].

[21] Filmer, D. and Pritchett, L.H. (2001) "Estimating Wealth Effects Without Expenditure Data-Or Tears: An Application to Educational Enrolments in States of India", *Demography*, Vol. 38, No. 1, pp.115-132. E-ISSN 1533-7790, ISSN 0070-3370. DOI 10.2307/3088292.

[22] Folorunso, S. T., Gama, E. N. and Ademiluyi, I. O. (2018) "Analysis Of Food Security And Poverty Status Among Agro-Pastoralists In Barkin-Ladi Local Government Area, Plateau State, Nigeria", *Fudma Journal Of Agriculture And Agricultural Technology* Vol. 4, No. 1, pp. 32-46. E-ISSN 2504-9496.

[23] Gallopin, G. (2006) "Linkages between vulnerability, resilience, and adaptive capacity", *Global Environmental Change*, Vol. 16, No. 3 pp. 293-303. ISSN 0959-3780. DOI 10.1016/j.gloenvcha.2006.02.004.

[24] GHI (2022) "*Global Hunger Index. Nigeria*". [Online]. Available: https://www.globalhungerindex.org/nigeria.html [Accessed: April 15, 2022].

[25] Global Hunger Index. GHI (2018) "*Forced Migration and Hunger*". 68 p. [Online]. Available: https://www.globalhungerindex.org/pdf/en/2018.pdf [Accessed: April 15, 2022].

[26] Global Food Security Index (GFSI) (2019) "Strenghten Food Systems and the Environment Through Innovation and Investment", *The Economist, Intelligence Unit*. [Online]. Available: https://cdn.teyit.org/wp-content/uploads/2020/02/Global-Food-Security-Index-2019-report-1.pdf [Accessed: April 15, 2022]. DOI 10.1215/9781478023654-005.

[27] Global Food Security Index (GFSI) (2022) "*Global Food Security Index 2022. Exploring challenges and developing solutions for food security across 113 countries*", [Online]. Available: https://impact.economist.com/sustainability/project/food-security-index Available: https://www.globalhungerindex.org/pdf/en/2018.pdf [Accessed: April 15, 2022]. Guilkey, D. K. and Murphy, J. L. (1993) "Estimation and testing in the random effects probit model", *Journal of Econometrics*, Vol. 59, No. 3, pp. 301-317. ISSN 0304-4076. DOI 10.1016/0304-4076(93)90028-4.

[28] Gustafson, D. J. (2013) "Rising food costs & global food security: key issues & relevance for India", *The Indian Journal of Medical Research,* Vol. 138, No. 3, pp. 398-410. ISSN 0971-5916.

[29] Jerumeh, T. R. and Omonona, B. T. (2018) "Determinants of transition in farm size among cassava-based farmers in Nigeria", *Kasetsart Journal of Social Sciences*, Vol. 41, No. 1, pp. 97-103. ISSN 2452-3151. [Online]. Available: https://so04.tci-thaijo.org/index.php/kjss/article/view/229987 [Accessed: March, 12, 2022]. DOI 10.1016/j.kjss.2018.02.008.

[30] Kasie, T. A. (2017) "Household resilience to food insecurity shock exposure, livelihood strategies and risk prone options: the case of Tach-Gayint District, Amhara Region, Ethiopia", 218 p., Doctoral thesis, the Institute of International Development Cooperation, University of Jaume, Castellón de la Plana. [Online]. Available: https://www.tdx.cat/bitstream/handle/10803/525850/2017_Tesis_Kasie_Tesfahun.pdf?sequence=1 [Accessed: March, 12, 2022].

[31] Maestas, N., Mullen, K. J. and Powell, D. (2016) "The effect of population aging on economic growth, the labor force and productivity", Working Paper 22452, National Bureau of Economic, Cambridge. DOI 10.3386/w22452.

[32] Mollier, L., Seyler, F., Chotte, J. L. and Ringler, C. (2017) "*SDG 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture*", In: A Guide to SDG Interactions: From Science to Implementation. eds Griggs,D. J., Nilsson, M., Stevance, A. and McCollum, D., Paris: International Council for Science, p. 52. [Online]. Available: https://council.science/wp-content/uploads/2017/03/SDGs-interactions-2-zero-hunger.pdf [Accessed: March, 12, 2022].

[33] National Bureau of Statistics report. NBS (2014) "*Nigerian Gross Domestic Product Report. Quarter Four. 2014*". [Online]. Available: NBS GDP Q4 2014.pdf [Accessed: April 15, 2022].

[34] Nyako, A. M. (2013) "The relationship between educational attainment and food security in Nigeria", Doctoral dissertation, Georgetown University, Washington D.C., USA. [Online]. Available: http://hdl.handle.net/10822/558648 [Accessed: March 28, 2022].

[35] Ogunsumi, L. O. (2008) "Analysis of Extension activities on farmers' productivity in Southwest Nigeria", *African Journal of Agricultural Research*, Vol. 3 No. 6, pp. 469-476. ISSN 1991- 637X.

[36] Oluwatayo, I. B., Sekumade, A. B. and Adesoji, S. A. (2008) "Resource Use Efficency of Maize Farming households in Rural Nigeria: Evidence from Ekiti State", *World Journal of Agricultural Sciences*, Vol. 4 No. 1, pp. 91-99. ISSN 1817- 3047.

[37] Owoo, S. N. (2020) "Demographic Considerations and Food Security in Nigeria", *Journal of Social and Economic Development*, Vol. 23, pp.128-167. E-ISSN ISSN 2199-6873. DOI 10.1007/s40847-020-00116-y.

[38] Oyetunde-Usman, Z. and Olagunju, K. O. (2019) "Determinants of Food Security and Technical Efficiency among Agricultural Households in Nigeria", *Economies*, Vol. 7 No. 4, pp. 103. ISSN 22277099. DOI 10.3390/economies7040103.

[39] Shapiro, D. (1990) "Farm Size, Household Size and Composition, and Women's Contribution to Agricultural Production: Evidence from Zaire", *Journal of Development Studies*, Vol. 27, No. 1, pp. 1-21. ISSN 0022-0388. DOI 10.1080/00220389008422179.

[40] Ugwuja, V. C., Adesope, O. M., Odeyemi, T. J., Matthews-Njoku, E. C., Olatunji, S. O., Ifeanyi-Obi, C. C. and Nwakwasi, R. (2011) "Socioeconomic Characteristics of Farmers as Correlates of Fertilizer Demand in Ekiti State, Southwest Nigeria: Implications for Agricultural Extension", *Greener Journal of Agricultural Sciences* Vol. 1, No. 1, pp. 048-054. E-ISSN 2276-7770.

[41] United Nations Development Programme. UNDP (2022) "*Human Development Report 2021-22. Uncertain Times, Unsettled Lives: Shaping our Future in a Transforming World*", [Online]. Available: https://www.undp.org/egypt/publications/human-development-report-2021-22-uncertain-times-unsettled-lives-shaping-our-future-transforming-world [Accessed: Sept. 20, 2022].

[42] United Nations Development Programme. UNDP (2017) "*High-level Political Forum on Sustainable Development. Voluntary national reviews*". [Online]. Available: https://sustainabledevelopment.un.org/vnrs/ [Accessed April 15, 2021].

[43] United Nations Development Programme "*Human Development Indices and Indicators: Briefing note for countries on the 2018 Statistical Update Nigeria*", [Online]. Available: http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/NGA.pdf [Accessed: April 15, 2021].

[44] Vaitla, B., Tesfary, G., Rounseville, M. and Maxwell, D. (2012) "Resilience and Livelihoods Change in Tigray, Ethiopia",Tufts University. [Online]. Available: https://fic.tufts.edu/publication-item/resilience-and-livelihoods-change-in-tigray-ethiopia/ [Accessed: Oct 14, 2022].

[45] Voice of America. VOA () (2017) "*UN: Aid Funds to Stop Famine in Nigeria's Northeast May Dry up by June*". [Online]. Available: https://www.voanews.com/a/nigeria-aid-funds-famine/3824518.html [Accessed: April 15, 2021].

[46] Zseleczky, L. and Yosef, S.. (2014) "Are shocks really increasing? A selective review of the global frequency, severity, scope, and impact of five types of shocks", *2020 Conference Paper,* Vol. 5., Building Resilience for Food & Nutrition Security, May 17-19, 2014, Addis Ababa, Ethiopia. publ. by International Food Policy Research Institute (IFPRI), Washington, D.C. [Online]. Available: http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/128147. [Accessed: Aug. 20, 2022].