ACCESS TO FINANCE, INDIGENOUS TECHNOLOGY AND FOOD SECURITY IN NIGERIA: CASE STUDY OF ONDO CENTRAL SENATORIAL DISTRICT

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Abstract

Research purpose: Food security remains a major component of economic development. Many developing nations are facing challenges of food insecurity, which had contributed to starvation and other societal problems. With adequate food intake, human healthy living is assured. This study investigates the impact of access to formal finance and indigenous technology and knowledge on food security in Ondo central senatorial district in Ondo state, Nigeria.

Methodology: In total, 216 farmers were sampled, and data were collected through a well-structured questionnaire and focus interviews. Data collected were analysed using descriptive statistics and logit estimation technique.

Findings: Descriptive statistics show that there are more male farmers (61.1%) than female counterparts (38.9%), with most of the farmers (42.7%) in their ages 56 years and above and with 51.9% having primary education. Majority of the farmers (65.7%) engage in arable crop farming, while 15.2 and 19.1% engage in cash crop and livestock farming, respectively. The econometric model reveals that age, income, gender, education, marital status, religion, family size, assets owned and distance are major determinants of a farmer's decision on account ownership, savings and borrowing. Indigenous knowledge of soil fertility, disease-resistant and quickly-growing crops, food storage, local weather, water management, pest and diseases control are significant determinants of food security in Ondo central senatorial district. Likewise, account ownership, savings and borrowing from formal financial institutions are significant determinants of food security.

Practical implications: It is, therefore, important that efforts to ease access to formal financial services and improve indigenous technology to serve as complement to modern farming techniques to achieve food security be made a priority by government and private institutions.

Keywords: Indigenous technology; Food security; Access to formal finance

JEL codes: Q12; Q14; Q16

Introduction

The importance of food and how best to secure it has created a desire for many policy formulations across the globe. Food security has remained a top agenda for countries all over the world, particularly in developing countries where a significant proportion of the population suffers from malnutrition and other problems associated with food production, availability, affordability and utilisation (Allen, 2013; Lang and Barling, 2012). As stated by the Food and Agricultural Organisation (FAO), "food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2010, 2008). The above definition of food security by FAO could be summarised as three As: availability, affordability and accessibility (Lang and Barling, 2012). Food insecurity, on the other hand, could be described as non-availability, non-affordability and non-accessibility of food.

In Nigeria, food insecurity has been considered as one of the major causes of poverty (Osabohien *et al.*, 2018; Amaza *et al.*, 2009; Omotosho *et al.*, 2008; Okuneye, 2001). Human capital development in terms

of health and education are hindered with inadequate food intake both in quantity and quality, which in turn, adversely affect the natural output and economic growth. Improved food security is crucial in the alleviation of poverty, promotion of people's health and labour productivity. It also contributes to the political stability in a country and ensures sustainable development of citizens (FAO, 2010). Attainments of food and nutritious security have been the top agenda for countries all over the world. Food security is attainable when regular and adequate food is available, accessible and contains the maximum nutrient for daily dietary requirements to live a healthy and active life at all times (FAO, 2010). The importance of food security as a tool for poverty alleviation and economic growth is also entrenched in the Sustainable Development Goals (SDGs) (Dada, 2020; Gil *et al.*, 2019; Mukhtar and Haruna, 2018; Perez-Escamilla, 2017; Griggs *et al.*, 2013).

Access to finance and technology, especially indigenous technology, is an important factor that increases productivity and enhances food security in developing countries (Tweheyo, 2018; Osabohien *et al.* 2018; Chang, Chatterjee and Kim, 2014; Abdu-Raheem and Worth, 2011; Shiferaw, Hellin and Muricho, 2011; Kristjanson *et al.* 2005). In the literature, access to finance has played a positive role in increasing the standard of living, self-confidence and also in the diversification of livelihood strategies and thus increasing their productivities and income (Osabohien, *et al.* 2020; Onyiriuba, *et al.*, 2020; Dejene, 2019; Kopparthi and Kagabo, 2012; Anyiro and Oraku, 2011 Bauchet *et al.* 2011). As noted by Bauchet, *et al.* (2011), access to formal finance to peasant farmers is a veritable tool to meet a farm's needs (purchase of farm implements), improve farmers' productivities, thus enhancing food security. Acquired funds could also be used to diversified farming operations, which tend to increase income base of farmers and consequently increase productivities and food security (Dejene, 2019; Tenaw and Islam, 2009). Sustained increase in farm productivities (consequently, food security) is enhanced, and farmers are able to smooth consumption if they have access to formal credit (Osabohien, *et al.* 2020; Anyiro and Oraku, 2011). Amazingly, the agriculture sector, which is the major driver of food security, has received less access to finance in developing countries due to high credit risk (Chang, Chatterjee and Kim, 2014; Kopparthi and Kagabo, 2012).

The importance of indigenous knowledge as a key component of inclusive development is documented in the literature (Kamwendo and Kamwendo, 2014; Awuor, 2013; Kalpana Sastry Rashmi and Rao, 2011; Jera and Ajayi, 2008; Agrawal, 1995). Agrawal (1995) sees indigenous technology as a powerful aspect for sustainable resource use and balance growth. It is a dynamic way in which the people of a particular area understand their natural environment and how they organise folk knowledge of flora and fauna, cultural beliefs and history to enhance their livelihood (UNESCO, 2016). Ingram (2011) submitted that inclusion and usage of indigenous knowledge of particular people by any developmental agency always yields sustainable and positive results. Claxton (2010) argues that biodiversity, indigenous technology and sustainable development are highly related. A farmer's local technology gives opportunity to continuous cropping all year round without the use of chemicals and does not, in any way, degrade the environment.

With indigenous knowledge, people are able to make the right and correct decision on the type of soil to cultivate, when to cultivate such soil, type of crop to plant, food storage type and best way to process particular crop/foods. This, no doubt, positively affects agricultural productivities and nutrients of crops, as well as the income of farmers. Indigenous technology/knowledge on food security involves knowledge about soil fertility, disease-resistant and quickly germinating and growing crops, best way to conserve soil, pest and disease control, best method to preserve food, best/adequate storage and water management techniques (Kamwendo and Kamwendo 2014). Food insecurity can be addressed by sustainable agriculture, which has been described as an agricultural system adapted to a particular area so that crop and animal produce do not decline over time and are reasonably stable over normal fluctuation of weather (Troeth and Donahue, 2003). Agriculture in Nigeria is subsistence-oriented; households in the agricultural sector mostly produce on the basis of their demand on the household level. To achieve the objective of food security and nutrition for all and to reduce poverty through improving income of rural households, there is a need to progressively transform the agricultural sector away from subsistence-oriented production towards a large-scale production. This transformation process can be fuelled by agricultural productivity growth through easy access to formal finance (Khaki and Sangmi,

2017) and appropriate application and use of indigenous knowledge. This study, therefore, seeks to examine the role indigenous technology and access to finance play in food security in Nigeria. The rest of the paper is sectioned as follows; section 2 provides a detail explanation of the theoretical framework, section 3 focuses on the methodology and data sources and measurement, section 4 reports the empirical results, while section 5 presents the concluding remarks.

Literature review

This study explores a post-development theory developed in the 1980s as a critique to development theory and practices. Post-development theorists view all development as an imposition by the west on other continents of the world. The theory argues that the entire concept of development is a constructed reality in that 'development' is a western standard whereby the west is labelled as 'developed' and the rest of the world is perceived as 'underdeveloped' (Zial, 2007; Matthews, 2004). It is assumed that western world is having an ideal norm that serves as a standard for measuring the success of all other countries of the world, particularly the third-world countries (Parfitt, 2002). The development theory is a top-down and centralised approach to development, which believes in a universal standard for living and understanding life. Development theorists believe in a common measure of development, progress and growth, which are used to classify countries of the world. Countries that fail to meet greater percentage of these standardised criteria are classified as underdeveloped. However, post-development theorists argued that some of the yardsticks for measuring development may not be realistic or achieve desirable objectives for other population in other continents of the world. In fact, some measures of development are viewed as an intentional attempt to exterminate some indigenous values, norms and culture, thus forcing people to become dissatisfied with their ever-rewarding mode of life (Curry, 2003). People now see themselves as inferior to those in the first-world countries. Governments, particularly in third-world countries, wanting to achieve 'development', initiate and execute projects that are assumed to bring 'development' in accordance with the development theory without due recourse to meeting the potential need of the local populace. In most cases, developmental projects initiated by governments are not what are needed to improve the welfare of people. Development projects in most times fail to consider the cultural and economic values of people, thus leading to non-achieving the desire results. In other words, people need to be carried along to know their need before any project is undertaken for them. Post-development theorists argued that the assumed ideal value of progress/development is not universal and is actually 'modelled upon the European experience of progress' (Kippler, 2010). They argued that the traditional concept of development is authoritarian in nature and technocratic in execution. Whoever decides what development is and how to achieve it is typically in a position to tell which country had achieved it or not. Post-development theorists faulted the development theory that it relies on the universal standards for classifying and evaluating societies and, in fact, subordinates countless different perceptions and values of other people (Zial, 2007). Furthermore, post-development theorists argued that the development discourse has incorrectly removed the topic of development activities (poverty, food security, access to finance) from the political sphere and placed it in a scientific situation. By removing development issues from the political sphere and putting them into the hand of the technocrat or development expert, one is ignoring the root cause of inequalities and instead treating merely a symptom of an inequitable power distribution. To a post-development theorist, food security, poverty, access to finance, technology and famine are issues of power in Nigeria, and one cannot totally de-politicise it. Thus, access to productive assets, land, labour, water and, ultimately, formal finance is controlled by complex systems of tribal and local law, state intervention and development institutions (Smith, 2003). The post-development theory emphasises that the aspirations of development practices do not necessarily reflect the needs and aspirations of the population. Therefore, the aspiration of population should be sought and integrated into developmental practices and projects.

Research methodology

In the literature, there is no consensus on the universal measurement of food security. Agencies attempting to record food security often have difficulty differentiating between varying community, household and individual levels of food security (Webb *et al.*, 2006). Some measures of food security

include agricultural production, food storage levels, caloric intake, per capita income or nutritional status (Ballard, Kepple, Cafiero and Schmidhuber, 2014; Allen, 2013; Hoddinott and Yohannes, 2002). Measures such as food balance sheets, household budget and spending survey, individual food intake survey and anthropometric and biochemical assessment have also been used in the literature (Chang, Chatterjee and Kim, 2014; Headey and Ecker, 2013). These measures, however, only inform on the consequence of food insecurity, rather than measuring it. For the purpose of this paper, food security was measured based on the perception of the source discussing food security. This is in consonance with the post-development theory, which argues for democratic involvement of the targeted recipients on developmental project (i.e., individual values) (Curry, 2003). Respondent farmers were allowed to subjectively rate and give the level of food security in their household with a set of structured questionnaires administered on them.

A multi-stage sampling procedure was used to select the sampled villages. Three villages were randomly selected from each of the six local government of Ondo central senatorial district, making a total of 18 selected villages. And, 12 farmers were selected from each village with a purposively sampling technique, totalling 216 farmers across the senatorial district.

Questionnaires were prepared on the variables of interest and administered to the selected farmers in survey studies. Necessarily, data were collected from the sampled farmers by interviewing them and translating the questionnaires written in English language into the farmers' native languages. Responses were collected and analysed using both descriptive and logit regressions. Logit regression was explored to analyse the factors that influence the decision to access and use financial services by farmers. It also analysed the effect of use of indigenous technology on food security.

Logistic regression is used in this study to find the association between a categorical dependent variable and a set of independent (explanatory) variables. It is a predictive analysis used to describe data and to explain the relationship between one dependent binary variable and one or more nominal, ordinal, interval, or ratio-level independent variables. Logistic regression is best used when both the dependent and independent variables have large number of zeroes. It is a model that can effectively tackle the problem inherent with censored variables, and it can incorporate both discrete and continuous components (Greene, 2008). In this study, the likelihood of taking a certain decision by a farmer is estimated assuming a logistic distribution. Logistic distribution is deemed fit for the study, not only that it can effectively assess the determinants of farmer decision as regards formal market participation and likelihood of achieving food security, but can also help to solve the problem of heteroscedasticity that usually beset cross-sectional data. The baseline model for access of finance on farmer is specified thus:

$$y_{ij}^k = \beta_0 + \beta_1 x_{1ij} + \dots + \beta_n x_{nij} + \alpha_1 H_{1ij} + \dots + \alpha_n H_{nij} + \varepsilon_{ij} \dots \dots \dots (1)$$

$$i = (1 \dots \dots \dots 216), \quad j = (1, 2, 3), \quad k = (1, 2, 3)$$

where y_{ij} is the probability that a farmer i in village j has k number of financial services. k is decomposed into account ownership, savings and credit in formal banks, each as dependent variable of account ownership, savings and credit. $x_{1ij} \dots x_{nij}$ are the socio-economic and demographic attributes of farmer i in village j , $H_{1ij} \dots H_{nij}$ are the household characteristics of farmer i in village j . ε_{ij} is the error term, which is normally distributed $(0, \sigma)$.

The model on the effect of indigenous technology on food security is specified below:

$$FS_{i,v}^k = \gamma_0 + \gamma_1 x_{1iv} + \dots + \gamma_n x_{niv} + \alpha_1 F_{1iv} + \dots + \alpha_n F_{niv} + \varphi_1 P_{1iv} + \dots + \varphi_n P_{niv} + \dots + \varepsilon_{iv} \dots \dots (2)$$

$k = (1 = \text{food availability}; 2 = \text{food accessibility}; 3 = \text{food utilisation})$, $FS_{i,v}^k$ is the probability of achieving food security. Food security was proxied by availability, accessibility and utilisation. $x_{1iv} \dots x_{niv}$ are the socio-economic and demographic attributes of farmers i in village v ; $F_{1iv} \dots F_{niv}$ are the indigenous knowledge/technology of farmer i in village v , $P_{1iv} \dots P_{niv}$ are formal financial services, ε_{iv} is the error term that is normally distributed. Indigenous knowledge/technology of farmer consists of knowledge on fertility of local soil, local soil conservation, food preservation, local food

processing, food storage, disease-resistant and quickly growing crops, water management techniques (Kamwendo & Kamwendo, 2014).

Dependent variables: The dependent variables in equation (1) are in three categories representing farmers' access to and use of formal financial services. These services are account ownership, savings and credit. Account ownership represents the probability of having account in a formal bank. It is one ($y = 1$) if farmer has account in formal bank and zero otherwise ($y = 0$). Savings and credit denote the probability of using formal bank because a farmer may just open account without using it. Therefore, the probability is equal to one ($y = 1$) if farmer saves, also one ($y = 1$) if farmer borrowed from a bank in the last 12 months and zero ($y = 0$) otherwise.

The dependent variable in equation (2) consists of components of food security. Food security is decomposed into three categories, namely: food availability, food accessibility, food utilisation:

1. Food availability is defined as the type and amount of food produced locally. It is also an amount of particular food that is available to a certain group of people at a specified time.
2. Food accessibility: This depicts the ability of household (farmer) to have access to available quantity of food. It is defined as the price of food against household farmer's purchasing power. It is having the necessary resources for the purchase of good and varieties of food for consumption.
3. Food utilisation depicts the nutritional values (vitamins, mineral, proteins) contained in the food consumed. It involves the nutritional security, which guarantee adequate dietary intake that helps the body to resist and recover from disease. People have to be assured of safe and nutrition food. The food consumed has to provide sufficient energy to enable the consumer to carry out routine physical activities.

Independent variables: These are variables that are expected to influence the dependent variables. These variables are commonly used in the food security literature (Khaki and Sangmi, 2017; Ali and Erenstein, 2016; Chang, Chatterjee and Kim, 2013; Ibnouf, 2011; Ratcliffe *et al.*, 2011; Yen *et al.*, 2008). The variables are age of the farmer, gender, marital status, religion, educational status, family size, farm size, distance to/from bank, asset owned, account ownership, saving and credit. For regression on the probability of achieving food security, additional independent variables, namely, knowledge about local soil fertility, knowledge about disease-resistant and quickly growing crops, capacity to forecast local weather, usage of indigenous preservation, usage of indigenous food processing and food storage are added. Each of these variables takes the value of 1 if a farmer reports having knowledge and/or using them, and 0 if otherwise.

Data on food availability, food accessibility and food utilisation were generated from questionnaire.

Research results

The section describes the results of the main findings of the study. The descriptive statistics and the logistic results are explained.

Table 1 shows the demographic attribute of the farmers' participants. There are more male farmers (61.1%) than female counterparts (38.9%). A significant proportion of farmers were in the age of 56 and above. This is followed by farmers in the age bracket 45–55. This reveals that farming is mostly practised by old people, while the younger generation prefer other economic activities to farming (especially white-collar jobs). With respect to education, more than half of the farmers interviewed (51.9%) obtained primary education. This is followed by those having secondary education (30.1%). Only 9.7% farmers attained tertiary education, and 8.3% never had formal education. With regard to the type of farming activities, farmers were found to engage in different farming activities to widen their chances of having and maintaining food security and to reduce the risks of depending on one form of farming activity. This is in consonance with the findings of Tweheyo (2018) and Eyong (2007) that engaging in a variety of farming activities protects farmers against cultural, economic and social shock as well as increases a farmer's income.

Table 2 summarises the indigenous method used for storing a farm's produce. Various methods were identified. In all, local stores constructed with local technology were found to be mostly used. This was followed by the use of basket, sack, clay pot and granaries. Reasons cited for using these traditional methods include ease in construction, production of healthier food/crops, cost effectiveness and cultural conformability.

Table 1. Demographic characteristics of farmers (Source: authors' computation from fieldwork, 2020)

Character	Frequency	Percentage
Sex		
Male	132	61.1
Female	84	38.9
Total	216	100
Age		
15–22	-	-
23–33	15	6.9
34–44	32	14.8
45–55	77	35.6
56+	92	42.7
Total	216	100
Education		
No formal education	18	8.3
Primary	112	51.9
Secondary	65	30.1
Tertiary	21	9.7
Total	216	100
Farming operation		
Arable crop farming	182	65.7
Cash crop farming	42	15.2
Livestock	53	19.1
Total	277	100

Table 2. Food storage method (Source: authors' computation from fieldwork, 2020)

Methods	Frequency	Percentage
Granary	16	7.4
Clay Pot	20	9.3
Basket	62	28.7
Sack	43	19.9
Local store constructed with indigenous technology	75	34.7
Total	216	100

Table 3 shows the coefficient and marginal effect on the decision by a farmer to use formal financial services. The result from Table 3 shows that there exists a significant relationship between age of farmer, income, gender (male), education, marital status (married), religion, family size, farm size, asset owned and distance with account ownership. The results reveal that the probability of owning a formal bank account by farmer reduces with family size and distance, but increases with age, income, gender (male), higher education attainment, married, Christian and larger farm size. This corroborates the findings of Johnson and Zarazua (2011) and Efobi *et al.* (2014) who found that the probability of owning an account by women reduces because the income of women is slimmer compared to their male counterparts.

Table 3: Logistic regression results on decision on financial services by farmers (Source: authors' computation from fieldwork, 2020)

Independent variable	Dependent variables					
	Account ownership		Saving		Credit	
	Coefficient	Marginal effect	Coefficient	Marginal effect	Coefficient	Marginal effect
Age	0.0402*	0.0835	0.072*	0.0084	0.2432*	0.0047
Income	0.0921*	0.0621	0.0865*	0.0025	0.624*	0.0793
Gender	0.3524**	0.0025	-0.2061**	0.0015	0.725**	0.0006
Education	0.1024**	0.0021	0.0271**	0.0041	0.085**	0.0201
Marital status	0.067*	0.0231	-0.0621*	-0.0021	0.0921**	0.0321
Religion (<i>Christian = 1</i> <i>Others = 0</i>)	0.0015**	0.0011	0.0331**	0.0129	0.0816**	0.0006
Family size	-0.2401**	-0.0013	-0.0426**	0.0036	0.4083**	0.0241
Farm size	0.0645**	0.0200	0.0523**	0.0076	0.4256**	0.4327
Asset owned	0.6042*	0.0052	0.1321*	0.0212	0.0214*	0.0008
Distance	-0.2837**	-0.0032	-0.7214**	-0.0621	-0.0752**	-0.0021

where *, **, *** are 10, 5 and 1% level of significance, respectively. All models have been checked for multicollinearity.

Women are usually overburdened with household expenses, which further reduces their meagre income. In addition, the result reveals that farmers who are Christian are more likely own a formal account than other religious believers. With respect to savings, variables such as age, income, gender, education, marital status, religion, family size, farm size, asset owned and distance were all significant in the model. The results are not unexpected because with increase in age, income, education and asset owned, farmers are more enlightened to put their wealth in a safer place. Surprisingly, our results show that women farmers do save than male counterparts. This seems to contradict many findings in the literature but supported by the work of Ibnouf (2011) who found that a female farmer saves more than the male counterpart in the western Sudan region. However, this might be as a result of higher family demand pressure on male farmers that hinders them to save. Greater proportion of male income is spent on family need and consumption, with almost nothing left to save.

There is a significant relationship between age, income, male, education marital status, religion, family size, farm size and distance with borrowing. As farmer grows older in age, there is higher likelihood to have increased family and village responsibilities. To cope with this, an additional income and income base to support the family are needed, thus necessitating the need for additional money (loan). Besides, the marginal effect of credit constraint is higher at younger age since bank requirements for loan are sometimes unaffordable at younger age. This is in line with the finding of Kereta (2007) that young people in Ethiopia are less likely to access credit than the middle aged. Result in Table 3 also shows that farmers with relatively large family have higher probability to demand for credit. This might be attributed to pressure on household consumption from higher dependence, thus necessitating the need for credit (Chen and Chivakul, 2008). Likewise, the results reveal that Christians are more likely to demand for loan than Muslim and other religious believers. This might be as a result of Islamic belief of non-interest banking, which pushes them away from approaching formal banks to procure an interest-yielding loan.

As hypothesised, married farmers are more likely to demand for loan than unmarried farmers due to greater family size, which had resulted in higher family expenditure on consumption. With respect to education, the results conform to the hypothesis that educated farmers are more likely to demand for credit. Educated farmers have the potential to expand income and thereby own assets necessary for collateral, better able to appreciate the need of credit and have less cost as they face fewer difficulties in collecting and evaluating the information needed to apply for loan (Magri, 2002). Farmers with larger farm size have higher likelihood to demand for credit in a formal bank. The larger the cultivated farm size, the more the farmer utilises more farm input such as labour, fertiliser and other farm inputs, and the more the needs for more finance, which can be obtained from banks. Table 3 shows that farmers with higher income are more likely to borrow from a formal bank than those with low income. Besides,

banks are more willing to give loan facilities to farmers with higher income, particularly those with large and many farmlands and other farm assets. This is to ensure an easy and greater opportunity to recover their loans in case of default. Likewise, as a farmer's income increases, there is tendency to have increased saving and investment. Investment results in increasing the economic activities, which sometimes require large capital and running expenses, which can be obtained through loan from formal banks. As expected, the probability of obtaining credit from formal bank reduces with distance. The farmers reported that long distance to formal bank was not the only problem, but that roads were not motorable and worse during the rainy season, which could keep them stark in villages for weeks because vehicles could not come to their villages. This is supported by the finding of Dejene (2019) who examines the impact of micro-credit on food security of rural smallholder farmers in Gesha District of southern Ethiopia

Apart from the financial inclusion of the farmer discussed above, the likelihood result of the effect of indigenous technology and access to finance on food security are shown in Table 4. The coefficients as well as the marginal effects are shown in the table. The pseudo R^2 values of 0.532, 0.603 and 0.516 for food availability, food accessibility and food utilisation, respectively, imply that almost 53.2, 60.3 and 51.6% variation in the likelihood to achieve food security (availability, accessibility and utilisation) in Ondo central senatorial district is explained by the explanatory variables included in the model. It reveals that essential variables that influence food security were captured.

Table 4. Logistic regression on food security (Source: authors' computation from fieldwork, 2020)

Independent variable	Dependent variable					
	Food availability		Food accessibility		Food utilisation	
	Coefficient	Marginal effect	Coefficient	Marginal effect	Coefficient	Marginal effect
Age	0.0306*	0.0241	0.0532*	0.0204	0.0021*	0.0101
Gender	0.0351**	0.0324	0.0326**	0.0106	0.0602**	0.0204
Education	0.0624**	0.0003	0.0062**	0.0203	0.0031**	0.0245
Marital status	0.0321	0.0012	0.0030	0.0604	0.0602	0.0121
Religion	0.0106	0.0321	0.0072	0.0312	0.0214	0.0046
Family size	0.3201**	0.0046	-0.0123**	0.0603	-0.0301**	0.0060
Farm size	0.6021**	0.0782	0.0254**	0.0236	0.0623**	0.0547
Knowledge own soil fertility	0.1024*	0.1264	0.0321*	0.0906	0.0051*	0.1572
Knowledge on disease-resistant and quickly growing crops	0.0324*	0.1168	0.0602*	0.0824	0.0421*	0.1205
Indigenous food preservation	0.1074*	0.0667	0.0301*	0.1172	0.1062*	0.0852
Indigenous food storage	0.6261**	0.1416	0.0651**	0.1260	0.3051**	0.1029
Ability to forecast weather	0.3210**	0.0062	0.0008**	0.0517	0.0562**	0.0842
Local water management techniques	0.0072**	0.0001	0.0308**	0.0121	0.0721**	0.0705
Pest and disease control	0.3901*	0.1020	0.0643*	0.1002	0.0804*	0.0821
Account ownership	0.0140*	0.0102	0.0203*	0.1001	0.0062*	0.0310
Savings	0.0233*	0.0342	0.0036*	0.0321	0.0214**	0.0301
Credit	0.0301*	0.0102	0.0023*	0.0601	0.0143*	0.0602
Pseudo R^2	0.532		0.603		0.516	
Loglikelihood	-512.230		-502.338		-423.01	
Probability	0.000		0.000		0.000	
Observations	216		216		216	

where *, **, *** are 10, 5 and 1% level of significance, respectively. All models have been checked for multicollinearity.

The results in Table 4 show that all the explanatory variables, except religion and marital status, are statistically significant in achieving food security in the Ondo central senatorial district. Importantly, all the variables on indigenous technology are positively significant in influencing food security. The

results further express that age, gender, education, family size and farm size are significant determinants of food availability, food accessibility and food utilisation. The bigger the farm becomes, the higher the likelihood to increase farm productivities, which results in more farm products. With respect to family size, a bigger family size has more workforce for farming operation, which results in more farm produce. However, higher family size with a significant number of dependants exerts consumption stress on the household limited income, thus making accessibility to food difficult. This is also applicable to household food utilisation.

With respect to indigenous knowledge on soil fertility, there is higher likelihood to have security in terms of food availability in the Ondo central senatorial district. This is not surprising because the knowledge on soil fertility will assist the farmer to know the type of crops that are most suitable on different soils to yield maximum output. This also guarantees the nutrient value of the crops (food utilisation). The probability of having adequate food production also increases with indigenous knowledge on 'disease-resistant and quickly growing crops'. Farm produce increases when 'disease-resistant crops are planted and monitored'. Likewise, regular and timely supply of food crop to market is always guaranteed when crops having the shortest time maturation with good quality are planted. Evidence had shown that disease-resistant crops contain more nutrients than other crops (Louette & Smale, 2000). Food accessibility is also made feasible with regular food supply to the market with reasonable prices. Indigenous technology of food preservation does not only increase the likelihood of adequate food supply, but also ensures better nutrients in food/crops. Smoking of food, for instance, does not only prolong food shelf-life but also preserves it from contamination. The results also indicate that an increase in the likelihood of having food accessibility and utilisation is highly associated with indigenous technology of food storage. This corroborated the submission of Aregu (2014) that meat that is preserved with local technology contains less fat and more nutrients needed for healthy consumption. Traditional granary food storage and other indigenous knowledge of food storage increase the likelihood to have adequate food supply, ensure food accessibility and utilisation (Okoye and Oni, 2017). Crops like maize, millet and grains such as bean are stored in granaries. Awuor (2013) corroborated that grains encourage farmer to work harder to have more granaries, thus gives them assurance of food security.

The likelihood of having adequate food availability supply, substantial nutrients in food for healthy consumption is found to increase with increased use of indigenous food processing at 5% significant level. This further stresses the importance of indigenous food preservation and storage. In addition, the ability of farmers to forecast local weather was found to have a positive impact on all the components of food security in the Ondo central senatorial district. An increase in the quantity and quality of food crops might be a result of good weather forecast that helps farmers to know the specific period and location to cultivate land, plant crop, apply pest control and harvest crops.

The probability of having adequate food supply, better access to food and improved crop nutrients is also found to increase with indigenous knowledge of water management techniques. The likelihood of having adequate food production, easy access to food and required nutrients in food crops increase with farmer's local technology of managing water in food processing, preservation and storage. This is in consonance with the finding of Irving (2011) that nutrient security involves the knowledge of the right feeding process, cooking practices, clean environment and safe drinking water that guarantee adequate dietary need, which help the body to resist and recover from disease.

The marginal effects of the logit results show that all the indigenous technological methods were not only statistically significant but impact greatly on all the components of food security. Keeping the other variable constant, the probability of having adequate food supply, easy access to food and required nutrient from food consumed will increase by 12.6, 9.06 and 15.7%, respectively, with the indigenous knowledge of soil fertility. Likewise, the ability of a farmer to know and use disease-resistant and quickly growing crops will increase food supply by 11.6%; it will also increase the likelihood to access food by 8.24 and 12.05% for food utilisation. With respect to knowledge on food preservation, there is 1.67% likelihood for food adequacy, 11.7% likelihood increase for easy access to food and 8.5% probability in food nutrients. This probability of achieving food security in terms of availability, accessibility and utilisation were found to increase by 14.2, 12.6 and 10.3%, respectively, with indigenous knowledge on food storage. This reveals a great impact of local methods of food storage on

having adequate food supply, easier affordability of food and higher likelihood of having food with better nutrients for dietary need.

The probability of having adequate food supply for consumption also increases by 6.7% with indigenous knowledge of food preservation. Also, the likelihood of having the required dietary nutrients in food crop/supply increases by 8.52% with local food preservation. This is not unexpected. Local food processing was found to be more hygienic and devoid of contamination (Idachaba, 1991). Food processed with local methods contains healthier nutrients for human consumption (Admire and Tinashe, 2014). This is confirmed with the magnitude of the marginal coefficient of food availability and utilisation. Indigenous ability to forecast weather increases the likelihood of food availability, food accessibility and utilisation by 0.6, 5.1 and 8.4%, respectively. From Table 4, indigenous knowledge on local water management technique and its application, on average, increases the probability of food availability, food accessibility and utilisation by 0.01, 1.2 and 7.05%, respectively. Likewise, the use of indigenous pest and disease control, on average, enhances more food availability supply than other method by 10.2%. Better access to food is also guaranteed by using indigenous pest and disease control. The probability of having better access to food increases by 10.02%. More dietary nutrients are assured with indigenous use of pest and diseases control by 8.21%.

Furthermore, in Table 4, there exists a significant relationship between account ownership and food availability, food accessibility and food utilisation. The probability of having adequate food production, easy accessibility and required dietary food nutrients increases with account ownership. With respect to formal saving, the probability of having adequate food production, easy accessibility and required food nutrients all increase by 34.2, 32.1 and 30.1%, respectively. Likewise, there is a significant relationship between the likelihood of having adequate food supply, better access to food and having greater nutrients in food crop/consumption and formal borrowing. This reveals the impact of indicators of financial inclusion (account ownership, savings and credit) on food security in the Ondo central senatorial district, Nigeria. A reasonable rationale for this is that having an account enables a farmer to save; have access to credit facility, which gives opportunity for farmer to acquire necessary resources to expand farming operation; and consequently, increased farm productivities. This ensures adequate food production and supply with affordable prices.

Conclusions

This research study was undertaken to investigate the impact of access to formal finance and use of indigenous technology on food security in the Ondo central senatorial district of Ondo state, Nigeria. The research was chosen purposely to address the problem of food security on which data were not usually available, particularly in the Ondo central senatorial district and in virtually all states in Nigeria.

The study explores the post-development theory to establish the fact that food insecurity among the poor rural community was highly attributed to policies that do not consider the resource base of the poor and that favour commercial farmers among other factors (Tweheyo, 2018). The study shed more light on the determinants and importance of a farmer's access to formal financial services and usage of local technology on achieving food security. Food security was disaggregated into three components, namely, food availability, food accessibility and food utilisation on which data were collected with a structured questionnaire and interview from the sampled farmers. The results reveal that a significant proportion of the farmers do not have account in formal banks. While, those who have were found not to actively use them. They still rely on informal means of savings and borrowing. Therefore, there is an urgent need for banks' branches, agents or correspondent banking system in rural communities to facilitate easy access to basic financial services. The findings from the study show that farmers still considered indigenous technology as an environmentally friendly and cost-effective way of food production, processing and storage. Farmers still prefer to rely and use local seed, processing and storage methods because they have lived, tried and tested them. Finally, the research reveals the importance and contribution of indigenous knowledge/technology on food security. Components of food security were positively influenced by all methods of indigenous technology. This confirms the role indigenous technology plays in achieving food security. Effort should, therefore, be made to improve local technology to serve as complement to modern farming techniques. Rural farmers should be adequately

consulted and actively involved in any developmental projects to improve food security because local farmers are more familiar with local need and challenges of their respective communities.

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