Social Indicators Research (2021) 155:583–599
https://doi.org/10.1007/s11205-020-02590-7

ORIGINAL RESEARCH

Socio-economic Drivers of Food Security among Rural Households in Nigeria: Evidence from Smallholder Maize Farmers

Adebayo Isaiah Ogunniyi[1] · Samuel Opeyemi Omotoso[2] · Kabir Kayode Salman[2] · Abiodun Olusola Omotayo[3] · Kehinde Oluseyi Olagunju[4] · Adeyemi Oladapo Aremu[3,5]

Accepted: 8 December 2020 / Published online: 20 January 2021

Abstract

Issues relating to food availability, accessibility/affordability, and food utilization remain paramount among different stakeholders such as policymakers and academics. Using data from 250 maize farming households in Nigeria, the study used Foster–Greer–Thorbecke and probit regression model to investigate the factors determining households food security. The food insecurity measure shows that 23.2% points of the households express the incidence of food insecurity while 5.5% points and 1.8% points were found to have depth and severity of food insecurity, respectively. After controlling for households' socio-economic and demographic characteristics, the probit regression model suggested that, among others, value of output sold, education, credit access and participation in government safety nets program significantly influenced food security among the maize farmers in the study area. Based on our findings, effort should be intensified to enhance the productivity of land through improved production practices. There should be high-level awareness that will increase farmers' participation in safety net programs. Thus, government at all levels (local, state, and federal) should have adequate budget allocation to this course in order to improve the livelihood outcomes of the farming households.

Keywords Food expenditure · Food security drivers · Farming households · Nigeria

✉ Abiodun Olusola Omotayo
omotayoabiodun777@gmail.com

[1] International Food Policy Research Institute (IFPRI), Abuja, Nigeria

[2] Department of Agricultural Economics, University of Ibadan, Ibadan, Nigeria

[3] Food Security and Safety Niche Area, Faculty of Natural and Agricultural Sciences, North-West University, North West Province, Private Bag X2046, Mmabatho 2790, South Africa

[4] Economics Research Branch, Agri-Food and Biosciences Institute (AFBI), Belfast, United Kingdom

[5] Indigenous Knowledge Systems (IKS) Centre, Faculty of Natural and Agricultural Sciences, North-West University, North West Province, Private Bag X2046, Mmabatho 2790, South Africa

1 Introduction

Food is a vital need for all humans which must be satisfied for a healthy and productive living. Issues related to food security vis-à-vis availability, accessibility/affordability, and sustainable utilization remain pertinent for policymakers and academics (Aborisade and Bach 2014). This may have stemmed from the fact that malnutrition may result in dire health and physical consequences (FAO 2012; Ogunniyi et al. 2020; Omotayo 2020). Arising from the 1996 World Food Summit was a holistic definition of food security which incorporates the four domains of food security namely; availability, access, utilization and stability. Food security was defined as ability of all people to have physical and economic access, at all times, to safe nutritious food to maintain a healthy and active life (FAO 1996, 2012; Bashir et al. 2018a, b).

Conversely, a household becomes food insecure when such a household is unable to afford, or have access at all times to such quantity and quality of food that makes for healthy living (Obayelu and Orosile 2015). Food insecurity can be viewed as an extreme form of poverty (Kakwani Kakwani and Son 2016), a state of deprivation of basic human needs to which a person, household, community, or nation can be subjected (Brimah et al. 2015). According to Maslen et al. (2013), individual or group of individuals who lacks access to adequate, healthy and nutritious food (malnourished) on a sustainable basis could be described as being "food-poor". Lack of resources to acquire enough food for individual or household results in insufficient nutrition, poor calorie intake and poor nutrition; a low-income household may not be immune to hunger and the concomitant health challenges since constrained economic access to food would result in poor nutrition (malnutrition) which may either be chronic or transitory in nature (Mutisya et al. 2015).

Asides the fact that malnutrition has become the major culprit for the observed health burden of diseases with increasing under-five mortality, obesity, and susceptibility to infection (IFPRI 2016), poor nutrition status has serious downside effects on economic development. On the other hand, a healthy population tends to be productive because they are in stable physical and mental conditions (Harris 2016). The cognitive capacity of an individual may be a product of the quality of diet to which such an individual is exposed, especially right from conception (Cheatham 2013). Hence, a society maybe at a disadvantage with respect to having capable and productive minds in the workforce which leads to backwardness in growth and development due to poor quality of human capital (Hanushek 2013).

In Nigeria, per capita calorie intake over the past two decades has fallen below the recommended level (Babatunde et al. 2010). Evidence from the Global Food Security Index (GFSI), Nigeria ranked 91 in 109 countries and had a 37.1 weighted score out of 100 (GFSI 2015). Worse still, the smallscale farmers who dominate the agricultural landscape and food production of the nation also witness socio-economic and institutional constraints that hamper their productivity (Oyebanjo et al. 2015). Prominent among the food crops cultivated by these farmers are staple cereal crops such as rice, maize, sorghum, millet and wheat. In addition, maize is especially cultivated and can be processed into many forms for both human and livestock consumption (Adesiyan 2015).

Particularly, studies (Obayelu and Onasanya 2016; Adesiyan 2015) found that sustainable intensification of maize cultivation can ensure equitable income growth and food security among the poor farming households and bring about sustainable development in Nigeria. Although extant literature (Obayelu and Orosile 2015; Adepoju and Adejare 2013; Adeyemo and Olajide 2013; Oladeebo et al. 2017) have examined determinants of food

security among households in rural Nigeria, this study provides an additional understanding of rural household food security status through empirical analysis of the drivers of food security among smallholder farmers who cultivate maize in Ogun state, Nigeria.

Moreover, the dependence of food security on socio-economic factors affecting access and affordability of food implies that correlates of food security are likely to be found at household and individual levels (Wineman 2016). Differing socio-economic statuses and uneven livelihood resource endowment of various households have implications for their strength, risk exposure and capability to prevent, mitigate or cope with risks for positive livelihood outcomes among which is improved food security (Krantz 2001; Awotide et al. 2011; Bashir et al. 2018a, b; Daud et al. 2018; Ganiyu and Omotayo 2016; Ogunniyi et al. 2020). On this basis, the study sought answers to pertinent questions such as: what is the food security status of the smallholder maize farming households? What are the factors that influence food security status of the households?

2 Conceptual Framework

Maize contributes significantly to average annual food production, total food availability, caloric intake and total food demand among households in Nigeria (Muhammad-Lawal and Omotesho 2008). Being predominantly smallholder, growers of maize in Sub-saharan Africa (SSA) consume part of the crop they cultivate. The consumption of the staple in Africa ranges from 52 to 328 g/person/day while the highest consumption is recorded in the Americas, precisely 267 g/person/day in Mexico (Ranum et al. 2014). Improved food security revolves around four major cardinal dimensions namely food availability, food access, food utilization and food stability.

Food availability connotes that food must be readily available for consumption through improved agricultural production, market access, uniform distribution to all. An increase in productivity of maize farmers will lead to more readily available food (Muhammad-Lawal and Omotesho 2008) especially with the need to feed over 9 billion by the year 2050 which requires 60% increase over the current production food level (Béné et al. 2015). Producing more food to achieve food security means that the economic and biological challenges confronting the food systems have to be overcome. The fact that maize can be planted and harvested twice annually makes it a crop high relevance to food security. With *food access,* households are able to acquire food by having the adequate financial capability to purchase it. This may require efforts at making food affordable through controlled pricing or sustainably enhancing the financial wherewithal of households. Especially with the release of improved and drought-tolerant varieties which reduces the risk of crop failure, maize cultivation can boost household income and livelihood on a sustainable basis. Thus, households can also be financially buoyant to purchase other classes of food items to make a balanced diet. Thus, maize farming households may enjoy stable, physical and economic access to food all things being equal.

Food utilization relates to the appropriate selection and preparation of food which permits the body to effectively utilize the food it consumes. Maize can be consumed in numerous forms as industrial raw material in making livestock feed, starch, sweeteners, oil, beverages, glue, industrial alcohol, and fuel ethanol. Solely or together with other cereals, it is a primary component of local food preparations which contributes to caloric intake and total food demand among households in Nigeria (Muhammad-Lawal and Omotesho 2008). In the rainforest and the savannah agro-ecological zones of Nigeria, maize is a majorly

cultivated cereal crop that provides diet for many people (Onasanya and Obayelu 2016). The dimension of *food stability* relates to the consistency of food availability and access to people, which is reflected in food production and food prices within a given geographical location over a time period. Inconsistencies of food availability may manifest in dynamics of food security among households with more or less irreversible effects such as stunting as an indicator of under- and malnutrition in long-term (for years/decades); caloric and nutrient deficiency, as well as weight loss in the medium-term (months) and nutrition shocks in short-term (days and weeks) (von Braun 2014).

According to FAO, people, countries and the world would be truly food secure at all times if our livelihood systems are economically, socially and environmentally sustainable because food security is an integral part or an outcome of a livelihood strategy (Connolly-Boutin and Smit 2016). For households who majorly cultivate maize, sustainable production may contribute to the forces that shape food their food security status in addition to a host of other factors can interact to affect food security at a household or individual level. These factors include socioeconomic and institutional factors that affect vulnerability to food insecurity among households and individuals (Awotide et al. 2011). Given that maize crop can be planted and harvested twice annually, cultivating farmers can get stable income from sales of the crop either as fresh farm produce or dried grains. Based on the release of improved and drought-tolerant varieties which reduces the risk of crop failure, maize cultivation can boost household income and livelihood on a sustainable basis (Masuka et al. 2017).

3 Data and Descriptive Statistics

Data collected from maize farming households in rural areas of Ogun states, Nigeria using well-structured questionnaires. A multistage-stage sampling approach was employed in selecting the respondents from the four (4) existing agricultural zones namely Ilaro, Ijebu-ode, Abeokuta and Ikenne in Ogun state. At first, one agricultural zone (Ilaro zone) was purposively selected out of the four (4) zones in the state. The zone is divided into four (4) blocks namely; Oke-odan, Sawonjo, Ado-odo and Imeko. In the second stage, 5 cells were randomly selected from each blocks; the selected cells, Oke-odan, Ipokia, Ihunbo, Alari, Ilase, Sawonjo, Ibese, Igbogila, Igan, Oja-odan, Ado-odo, ilaro, Iwoye, Ere, Idolehin, Imeko, Aiyetoro, Shaala, Idofa and Idi-ayin, are the predominant maize producing areas in the state. Finally, a random selection of 13 farmers from each of the cells was selected to generate a total of 260. However, we were able to use 250 farmers due to incomplete interviews and some unaffordable outliers in some of the variables. The respondents targeted were household heads while information obtained were socio-economic/demographic characteristics, access to farm inputs, size of land cultivated, quantity of input required, household endowments, household expenditure, agricultural income and non-agricultural income etc.

Table 1 revealed the summary statistics of the data describing the socio-economic characteristics of households in the study area. The farmers were living at an average distance of 8.69 km from the nearest town. This is slight variation from the 13.54 km found by Osebeyo and Aye (2014) in Makurdi, North central Nigeria. Average age of 49.79 years was found among the household heads. This shows that most of the household heads were in their productive working age. This was closely similar to average age of 50.91 years reported by Adeyemo et al. (2016). Productivity resulting from

Table 1 Distribution of household's socio-economic characteristics

Variables	Description	Mean	Std. Dev	Min	Max
DIST	Distance from village to the nearest town (km) (kilometers)	8.69	5.03	0.00	28.00
GEST	Participation in Growth Enhancement Support Scheme (GESS) (1 if participated, 0 otherwise)	0.40	0.49	0.00	1.00
AGFAR	Age of farmers (years)	49.79	12.65	25.00	105.00
GENFAR	Gender of farmers (1 male, 0 female)	0.83	0.37	0.00	1.00
NOYRSSCL	Number of years spent in school	7.50	4.98	0.00	18.00
HOUSIZE	Household size in numbers	7.69	4.72	1.00	37.00
VEXT3YRS	Visit from extension agents in the last 3 years (1 if yes, 0 otherwise)	0.80	0.40	0.00	1.00
PFLDSEM	Participated in field days (1 if yes, 0 otherwise)	0.52	0.50	0.00	1.00
ACCIFIWV	Access to improved farm inputs (1 if yes, 0 otherwise)	0.54	0.50	0.00	1.00
TOTFAREXP	Total farming experience (years)	29.70	13.81	4.00	90.00
TOTAREAFFLD	Total surface area of your farm (hectares)	3.95	3.61	0.40	30.00
TOTLDMAIZE	Total land area devoted to maize (hectares)	2.44	2.44	0.30	23.00
VALOUTPUT	Value of output (kg)	48.62	8.62	30.00	70.00
ACCMKTINFO	Do you have access to market info (1 if yes, 0 otherwise)	0.81	0.39	0.00	1.00
ACCMBILE	Access to mobile phone (1 if yes, 0 otherwise)	0.97	0.17	0.00	1.00
ASSCIETY	Do you belong to any association (1 if yes, 0 otherwise)	0.44	0.50	0.00	1.00
ACCRDT	Access to credit (1 if yes, 0 otherwise)	0.28	0.45	0.00	1.00

Source: Field study, 2014

under taking economic activities during this active age could result in food security for the households. The sampled household heads had an average of 7.5 years of formal education, which is similar to the findings of Nwaiwu (2015) in the South Eastern Nigeria and Adepoju and Salman (2013) in Osun and Oyo states of the South Western Nigeria. In agreement with the findings of Nwaiwu (2015), the average years of farming experience was 29.70 years, indicating that majority of them had longterm farming experience which could boost their productivity. The farmers had an average farm size of 3.61 ha out of which an average of 2.44 ha was devoted to cultivating maize. These deviate from the 1.73 ha found by Kobe et al. (2018) and the 1.2 ha cultivated maize land found in Oyo state (Ibitola et al. 2019). However, farmers cultivate less than 10 ha and maybe classified as majorly smallholder farmers (Mgbenka et al. 2015). The small-size farm cultivated may have implications for their level of productivity and income. Food expenditure among the households was ₦ 27, 619.31 on the average.

3.1 Food Insecurity Measurement

3.1.1 Foster–Greer and Thorbecke (FGT) Food Security Analysis

The Foster–Greer and Thorbecke (FGT) class of decomposable poverty measure was adopted to show the various food security statuses of the households. Household food security line was drawn as the two-thrids of the mean per capita household food expenditure (MPCHFE) and statuses of the households were derived either as food secure or food insecure; households whose MPCHFE is above the line was categorized as food secure while those below were food insecure. Measures of food insecurity incidence, gap and severity were also estimated. Similar to previous studies (Amaza et al. 2009; Fawehinmi and Adeniyi 2014; Obayelu and Orosile 2015; Omotayo 2016; Sani and Kemaw 2019), the FGT measures are mathematically derived as:

$$P_{\propto} = \frac{1}{N}\left(\frac{z - y_i}{z}\right)^{\propto} 1\left(y_i \le z\right) \tag{1}$$

where $1\left(y_i \le z\right)$ denotes that food insecurity gap does not exist for households with mean per capita expenditure above the food security line. α = the FGT food insecurity index which takes values 0,1,2, for P_0 = food insecurity headcount; P_1 = food insecurity depth and P_2 = food insecurity severity respectively. It is also referred to as the elasticity of individual's food insecurity with respect to the normalized gap $(z - y_i)$ such that a 1% increase in the insecurity gap of a food insecure person leads to an α percent increase in the individual's food insecurity level (Foster et al. 2010)

n Total number of households.
z Food security line.
q Number of households below the food security line.
y_i Per-capita monthly food expenditure of the *i*th household.

3.2 Determinants of Food Security

Achieving food security at the household level is contigent on addressing a number of factors household-specific socio-economic factors (Kuku-Shittu et al. 2013; Adelekan and Omotayo 2017). Identifying these factors in terms of both magnitude and directions of relationship with household food security statuses involve using appropriate econometric techniques. Given the dichotomous nature of food security status variable, probit regression was employed to identify the drivers of food security among households in the study area. Probit model becomes a relevant functional form to appeal to when there exist a dichotomous or polychotomous dependent variable; the binary probit applies in the cases whereby the dependent variable present only two outcomes while the polychotomous applies when there are more than two outcomes (Adeyemo et al. 2016; Ndakaza et al. 2016). The model is stated as:

$$y^* = \beta_i x_i + \varepsilon_i$$

$$\begin{cases} y = 1 \;\; if \;\; y^* > 0 \\ y = 0 \;\; otherwise \end{cases}$$

where y^* is the unobserved latent variable assuming value 0 for Food insecure households and 1 Food secure households. x_i represents a vector of the independent variables, ε_i represents the random error term The independent variables are the correlates of food security.

4 Results and Discussion

4.1 Food Security Among Households and Per Capita Monthly Food Expenditure

Table 2 reports the estimates of the food insecurity levels of the households studied. Based on food insecurity measure generated from the adopted poverty measure, food insecurity head count (P_0) represents the proportion of household below the food security line (Foster et al. 1984). Food insecurity depth (P_1) represents the expenditure proportion required to allow households below the food security line acquire the minimum food expenditure that moves them out of food insecurity. The food insecurity severity index (P_2) represents how severe the insecurity situation among the households was. With the MPCHFE of ₦ 3965.495 and food security line estimated at ₦ 2643.663. Food insecurity incidence of 23.20% was found indicating that 76.8% of the households were food secure. Meanwhile ₦ 218.10 additional food expenditure is needed to draw a food insecure household out of food insecurity domain as indicated by the 5.5% food insecurity points.

Table 2 Food insecurity levels among farm households

Food insecurity indices	Value
P_0	0.232
P_1	0.055
P_2	0.018
Mean per capita household food expenditure (MPCHHFE)	₦3965.495
Food insecurity line (i.e. 2/3 of MPCHHFE)	2643.663

4.2 Distribution of Food Insecurity Indices by Socio-Economic Characteristics

As shown in Table 3, households were described through their socio-economic characteristics based on the food insecurity measure generated by the adopted Foster et al. (1984). Higher count (P_0) implies higher incidence of food insecurity, higher P_1 implies higher depth of food insecurity and higher P_2 values implies more severe food insecurity situation. Incidence of food insecurity of 33% was higher among the male household heads than the 29% found among their female counterparts. Among the male headed households, 8.3% increase in per capita food expenditure is needed to draw the food insecure households to food insecurity line as against 7.7% increase required for the female-headed households.

Table 3 Distribution of households by socio-economic and food security indices

Variable	Food security indices		
	P_0	P_1	P_2
Gender of respondent			
Female	0.29	0.077	0.026
Male	0.33	0.083	0.030
Marital status			
Married	0.470	0.131	0.051
Otherwise	0.214	0.047	0.013
Age of respondent			
≤25	0.000	0.000	0.000
26–50	0.284	0.069	0.021
51–75	0.319	0.077	0.029
76–100	0.841	0.299	0.118
≥101	0.000	0.000	0.000
Respondent household size			
≤5	0.064	0.001	0.002
6–10	0.245	0.054	0.015
11–15	0.555	0.149	0.056
≥16	0.714	0.244	0.109
Membership of Association			
No	0.360	0.089	0.029
Yes	0.283	0.075	0.029
Land ownership status			
No	0.344	0.089	0.034
Yes	0.284	0.071	0.021
Size of maize farm owned (ha)			
≤5	0.320	0.081	0.027
6–10	0.303	0.033	0.004
11–15	0.000	0.000	0.000
16–20	1.000	0.688	0.474
≥21	0.000	0.000	0.000
Use of pesticide and herbicide			
No	0.283	0.081	0.028
Yes	0.381	0.084	0.031

Though contrary to expectation, this results agree with Adekoya (2014). The probable reason for this result may be due the role of women regarding food preparation and child care which makes them spend their income on food and their children's needs (Fortmann 2009).

Food insecurity incidence increased with age as could be seen across the age categories. It was highest (84.1%) among households headed by individuals within 76–100 years age bracket. Highest depth (2.99%) and severity (11.8%) were also among household headed by individuals within this age bracket, which agrees with the findings by Ogundipe et al. (2019). However, households headed by individuals in the extreme age categories of ≤ 25 years and ≥ 101 years experienced no food insecurity. This could be due to the fact that while households headed by individuals that were ≤ 25 years old are more economically active and could engage in profitable livelihood activities (Umeh and Asogwa 2012; Matchaya and Chilonda 2012), those headed individuals that were ≥ 101 were aged and as opined by Cai et al. (2012), these elderly individuals would most likely enjoy remittance supports from their migrant children and family members.

With respects to household size, larger households had more incidences of food insecurity. While households with ≤ 5 members had 6.4% food insecurity incidence, those with ≥ 16 members had 71.4% incidence. In consonance with Adekoya (2014), the same trend was found with regards to both depth and severity of food insecurity given the highest values of 24.4% and 10.9%, respectively among households with ≥ 16 members. Although incidence of food insecurity decreased with the size of maize farm cultivated among the households, it is surprising and contrary to expectation that households cultivating 16–20 hectare of maize farm had the highest (100%) food insecurity incidence and corresponding 68.8% and 47.4% for depth and severity of food insecurity, respectively. These findings may well be due to inefficiency in resource use as found by Opaluwa et al. (2014) among maize farmers in Kogi State, Nigeria.

4.3 Determinants of Food Security Among Households

We present in Table 4 the drivers of food security among the smallholder maize farmers in Ogun State, Nigeria. Additionally, we assessed the gender differential of drivers of food security among the maize farming households. The results show that distance from village to the nearest town, participation in GESS, gender of household head, household size, visit from extension agents in the last 3 years, participation in field days/seminar training, access to improved farm input, total farming experience, value of output, access to market information, membership of any association and access to credit significantly affect food security among the maize farmers in the study area.

Years of education negatively and significantly influence the probability that a household would be food insecure. Similar results were obtained in the three context considered (pooled, male-headed and female-headed households). This implies that a household becomes less vulnerable to food insecurity with increasing educational attainment. Imperatively, the higher the number of years of schooling, the lowers the probability that a household head, either headed by male or female, will be exposed to food insecurity. This conforms to other studies (Babatunde et al. 2010; Adeyemo and Olajide 2013; Adamu et al. 2015; Ogunniyi et al. 2016; Olagunju et al. 2019; Omotayo 2017). These studies suggested that education attainment decreases food insecurity headcount. Education is expected to lead to increased earning potential and improve occupational and geographical mobility of labour. Higher levels of educational attainment will provide higher levels of welfare (such as food security) for the household.

Table 4 Probit regression estimates of socioeconomic drivers of food security

Variables	Pooled households		Male-headed households		Female-headed households	
	(1)	(2)	(3)	(4)	(5)	(6)
	Coefficient	Marginal effects	Coefficient	Marginal effects	Coefficient	Marginal effects
Distance from village to the nearest in kilometers	0.033	0.006	0.019	0.003	0.676***	0.304***
	(0.037)	(0.006)	(0.039)	(0.007)	(0.242)	(0.001)
Participation in GESS	−0.051	−0.008	−0.392	−0.068	−11.420*	−0.120***
	(0.391)	(0.065)	(0.468)	(0.082)	(6.402)	(0.002)
Age of farmers in years	0.025	0.004	0.0451*	0.803***	0.293***	0.132***
	(0.021)	(0.003)	(0.027)	(0.004)	(0.090)	(0.0003)
Gender of farmers	0.648***	0.099*				
	(0.096)	(0.052)				
No. of years spent in school	−0.072*	−0.012**	−0.628***	−0.112***	−0.172***	−0.755***
	(0.038)	(0.006)	(0.043)	(0.007)	(0.005)	(0.0002)
Household size	0.345***	0.057***	0.281***	0.050***	1.943**	0.874***
	(0.089)	(0.012)	(0.092)	(0.014)	(0.823)	(0.003)
Visit from extension agents in the last 3 years	0.508	0.077	−1.213**	−0.171***	−10.950	−0.539
	(0.466)	(0.065)	(0.549)	(0.067)	(6.904)	(0.532)
Participation in field days	−0.976**	−0.163**	−1.406***	−0.257***	1.610	0.001
	(0.388)	(0.072)	(0.452)	(0.095)	(2.636)	(0.003)
Access to improved farm input	−0.763**	−0.129**	−0.374	−0.067	−21.520**	−0.985***
	(0.369)	(0.064)	(0.412)	(0.074)	(9.086)	(0.027)
Total farming experience in years	−0.057***	−0.009***	−0.067***	−0.012***	−0.272***	−0.122***
	(0.019)	(0.004)	(0.023)	(0.004)	(0.075)	(0.0004)
Total surface area of your farm in hectares	0.046	0.008	0.039	0.007	−4.405	−0.002
	(0.108)	(0.018)	(0.123)	(0.022)	(2.699)	(0.006)
Total land area devoted to maize in hectares	−0.209	−0.035	−0.172	−0.031	1.728	0.001
	(0.275)	(0.042	(0.277)	(0.047)	(2.578)	(0.002)

Table 4 (continued)

Variables	Pooled households		Male-headed households		Female-headed households	
	(1)	(2)	(3)	(4)	(5)	(6)
	Coefficient	Marginal effects	Coefficient	Marginal effects	Coefficient	Marginal effects
Log of value of output	−1.088***	−0.180***	−1.106***	−0.197***	22.800**	0.103***
	(0.057)	(0.018)	(0.028)	(0.047)	(10.720)	(0.033)
Access to market information	−1.452**	−0.295**	−1.081*	−0.220*	−21.170***	−0.100***
	(0.581)	(0.132)	(0.565)	(0.128)	(6.914)	(0.0003)
Access to mobile phone	1.355	−0.150**	0.679	0.100	−0.879***	0.410***
	(0.944)	(0.067)	(0.974)	(0.117)	(0.074)	(0.007)
Membership of any association	−0.736*	−0.119*	−0.894*	−0.153**	−13.310**	−0.199***
	(0.399)	(0.063)	(0.467)	(0.077)	(6.547)	(0.049)
Access to credit	0.334	0.058	0.339	0.063	7.912**	0.027***
	(0.461)	(0.082)	(0.562)	(0.105)	(4.002)	(0.006)
Constant	6.721***		6.346***		47.460***	
	(2.584)		(1.811)		(2.190)	

Robust standard errors in parentheses

***p < 0.01, **p < 0.05, *p < 0.1

Distance to the nearest town positively influenced food insecurity status among the households. The result suggest that as the distance to the nearest town increases, probability of experiencing food insecurity increases by 30.4% only for the female-headed households. This implies that households living far from urban towns are more likely to be food insecure. This is due to the fact that such households may not be able to access input market which may in turn affect their productivity and income. Participation in the Federal government growth enhancement support scheme (GESS) programme positively influenced food insecurity among female-headed households. Participating in GESS programme increases the probability of being poor by 30.4% among the female-headed households. This is consistent with expectation, following the finding of Adenegan et al. (2018) and Omotayo et al. (2017) that participation GESS increased the farmers' on-farm income.

Gender of household head is positively related to food insecurity status of farming households in the study area. The result show that being a male household head increases the probability of being food insecure by 9.9%points in the pooled data. Although this contradicts findings of Obayelu and Orosile (2015) and Awotide et al. (2011), but it complies with Milazzo and Van de Walle (2015) which found that the declining aggregate food insecurity incidence has been observed among the female-headed households in Africa. Interestingly, size of households had a positive and significant influence on their food insecurity status. An addition to the size of the household increases the probability of being food insecure by 5.7% points in the pooled estimates. The same unit addition increases the probability of being food insecure by 5.0% points and 87.4% points among male and female-headed households respectively. This is in line with previous studies (Omotesho et al. 2007; Ogunniyi et al. 2017, 2018) that found a similar relationship between household size and food security. The result suggest that intra-household food allocation may be affected with larger household size and food per capita expenditure may likely decline due to large family size.

Participating in field days/agricultural seminar training reduced the probability that the households would be food insecure by 16.3% points in the pooled analysis. Among the male-headed households participating in field days/agricultural seminar reduces probability of being food insecure by 25.7% points. The result suggests that training as a form of human capital development can boost income generating capacity and alleviate poverty and food insecurity (Khan and Ali 2014). Access to information about improved maize variety favoured food security as it reduces the probability of being food insecure by 12.9% points from the pooled estimates. The implication of this access to information about sources of improved seed varieties are more likely to be food secure. Whereas among the female headed households, access to such information reduces probability being food insecure by 98.5% points, it had no significant effect among the male-headed households. This food insecurity reduction may be due to the positive impact of such information on adoption of improved seed varieties and the associated boost in productivity as observed by Ndaghu et al. (2015).

Quantity of maize output recorded (kg) favoured food security among the households. The probability that the households would be food insecure decreased by 18% points based on the pooled estimates. While probability to experience food insecurity reduced by 19.7% points among the male-headed households, the contrary was found among female-headed households where probability of being food secure increased by 10.3% points per kg increase in quantity of maize output produced. However, this is contrary to expectation as women are believed to have less access to productive resources and as such less productive than their male counterpart as found by Tibesigwa and Visser (2016). Access to mobile phone communication favoured food security by reducing the probability of being food insecure by 15% points in the pooled estimates. This is justified as the use of mobile phone

promote productivity, reduces transaction cost and boost farmers' income (Ogunniyi and Ojebuyi 2016).

For the female-headed households however, probability of being food insecure increased by 41% points contrary to expectation. With respect to membership of any association, the pooled estimates showed that the probability of being food insecure reduced by 11.9% points. Likewise for both male and female-headed households, belonging to any association reduced probability of being food insecure by 15.3% and 19.9% points, respectively. By implication, belonging to such association is a form of social capital that may help farmers to increase their income by boosting their bargaining power for higher product pricing and lower input cost, which is in agreement with the report by Ahmed and Mesfin (2017). Finally, access to credit was a negative correlate of food security. Among female-headed household, having access to credit increase the probability of being food insecure by 2.7% points against a priori expectations. However, Ngema et al. (2018) reported similar situation among households in Maphumulo local municipal council of South Africa.

5 Conclusion and Policy Recommendations

Understanding the level and drivers of food security would enhance policy trajectories and give policymakers proper insight in designing and implementing more effective policies and programs for the poor and thereby helps to give comfortable pathways to improve food security in Nigeria. This study examined the socioeconomic determinants of food insecurity among maize farming households in Ogun State, Nigeria using a cross-sectional dataset. The food insecurity measure shows that 23.20% of the households express the incidence of food insecurity while 5.5% and 1.8% were found to have depth and severity of food insecurity. The food insecurity disaggregation shows that food insecurity is higher among female-households than the male-headed counterparts. It was evident that larger households had a higher incidence of food insecurity. The incidence of food insecurity was higher among maize farmers that operate on less than 5 hectares compare to those with larger farm size. When we modeled the drivers of food insecurity, controlling for household socio-economic and demographic characteristics, the probit regression model showed the factors that are significant in determining food security among the maize farmers in the study area.

The current study revealed some issues that are relevant for policy in the Nigerian context. The reported incidence of food insecurity across male-headed and female-headed households calls for an imperative and, well-articulated food insecurity alleviation program across the country. Given that high value of outputs has a likelihood of reducing food insecurity, effort should be intensified to improve the productivity of land through better production methods (such as the use of improved agricultural technologies, access to extension services). Understandably, improved productivity will lead to increase revenue which can translate into high purchasing power that will enhance food expenditure and eventually reduce food insecurity. Due to the importance of education in reducing food insecurity, educational development should be approached systemically. Particularly, households with low levels of education should be given priority in expanding access to education, while existing educational institutions in the areas should be strengthened.

Acknowledgements The authors would like to thank their respective institutions for providing the enabling environment for this research. The authors are also grateful to the Editor and two anonymous reviewers of

this article for very insightful comments and suggestions of great benefit to the paper. The usual disclaimer applies.

Author Contributions All authors contributed to the design of the study, data collection, data analysis and development of the manuscript. All authors read and approved the final manuscript copy before the submission.

Availability of Data and Materials Data are available upon request from the author A. I. Ogunniyi.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval Ethical clearance letter was required and taken for the research.

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