Does social capital improve farm productivity and food security? Evidence from cocoa-based farming households in Southwestern Nigeria

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ARTICLE INFO

Keywords:
Social capital
Farm productivity
Food security
Cocoa based farming households
Southwestern Nigeria

ABSTRACT

This study investigated the impact of social capital on farm productivity and food security among cocoa-based farming households in Southwestern Nigeria. A multistage sampling procedure was employed to select 300 cocoa-based farming households for the study. Two-step Heckman and three-stage simultaneous models were used for the analyses. The results of a two-step Heckman model revealed that asset, age of household head, years of education, gender, farm size, land tenure, loan interest rate and extension visits were the determining factors influencing the probability of participating in social groups. While the level of participation in the social groups were determined by age of household head, years of education, membership in agricultural organization, off farm income, land tenure, interest rate, distance to credit sources, extension visit, decision making index, cash contribution index, and labour contribution index. The simultaneous equation models showed that social capital was positive and significantly influenced farm productivity and food security of the cocoa-based farming households. A unit increase in the instrumented social capital increased the household’s farm productivity and food security by 0.577 kg/₦ and 0.861 calories, respectively. The study concluded that social capital enhanced farm productivity and improved food security of the cocoa-based farming households. The study therefore, recommends that rural credit should be given to cocoa farming households based on their social collateral. This would enhance cocoa farming households’ access to productive resource and thus achieve financial leverage that would further boost farm productivity. Enhanced farm productivity would improve their food security status.

1. Introduction

Food insecurity remains a challenge among cocoa-based farming households of Southwestern Nigeria. Both quantitative and qualitative research attest to the growing incidence, depth and severity of food insecurity among cocoa-based farming households (Oluyole, 2011; Ojo and Adebayo, 2012; Fawehinmi and Adeniyi, 2014; Oluyole and Taiwo, 2016). Many cocoa-based farming households (about 60 percent) in Southwestern Nigeria are food insecure (Oxfam, 2012; Adeniyi and Ojo, 2013; Oluyole and Taiwo, 2016). Over 20 percent of the food insecure households face severe food insecurity (Oluyole, 2011; Agbola, 2014) and subsist on less than the recommended daily per capita calorie requirement of 2280 kilocalories (Oluyole and Taiwo, 2016; Saleh, 2018). Furthermore, the shortfall of the recommended kilocalorie intake among these households increased from 9 percent in 2009 to 26 percent in 2016 (Oluyole et al., 2009; Oluyole and Taiwo, 2016).

A number of factors including age, farming experience, farm size, income, educational level, resource use efficiency, economic access to food and the nutritional value thereof, affect households’ welfare (Obayelu, 2012; Asa and Archibong, 2016). The prevalence of food insecurity among cocoa-based farming households has also been ascribed to low farm productivity (Hamzat et al., 2006; Kehinde et al., 2016; Oluyole and Taiwo, 2016). Numerous studies on farm productivity in Nigeria reveals that most cocoa-based farms (about 70 percent) are cultivated far below their optimum productivity (Oluyole et al., 2013; Obasi et al., 2013; Oluyole and Taiwo, 2016). The sub-optimal productivity on cocoa-based farms has continued to worsen, because of poor resource bases (Egbetokun et al., 2014). One of the ways to address the situation is through improved access to financial resources such as credit (Adepoju and Salman, 2013). However, smallholder farmers have limited access to financial resources, which result in inadequate basic farming inputs such as fertilizers and pesticides (Okojie et al., 2010).
The Nigerian government and other non-governmental agencies have set up credit institutions and programmes aimed at improving cocoa farming households’ access to credit (World Bank, 2014). However, the vast majority of these institutions and programmes have failed, because they provide credit to the farmers at government subsidized interest rates (Ajani and Tijani, 2009; Aniyiro, 2015). Currently, the lack of credit support to cocoa producing farmers is a major problem, as very few have access to formal credit (Okojie et al., 2010; Fuleh, 2013; Tambi and Lum, 2020). According to Lawal et al. (2009) and Agbola et al. (2016), constrained cocoa farmers seek social capital through participation in social networks as an alternative way to access credit. In addition, Tambi and Lum (2020) posited that cocoa production can be increased through capital acquisition from social networks, which is practically known as social capital. Therefore, social capital creates a means through which cocoa farmers enhance their cocoa production (Fuleh, 2013).

Studies have shown that access to financial resources could be enhanced through participation in social capital groups, which include local groups, farmers’ associations and religious associations (Olagunju and Adedayo, 2008; Odehode and Adetunji, 2010; Ogunleye et al., 2017). Muhammad et al. (2011) and Adong et al. (2013) have separately established that a higher level of participation in social groups improves households’ access to financial resources. In Southwestern Nigeria, however, farming households’ lack of participation (33 percent) in social groups have overshadowed the effect of improving access to financial resources (Omotesho et al., 2016; Adeoye and Ugabali, 2017), which hinges on a complex set of factors (Nwaobiala et al., 2014). There is still no consensus whether these factors are the farming households’ socio-economic characteristics, or forms and strength of social groups, or social capital available to farming households (Omotesho et al., 2016). Hence, further studies on the various forms of social capital and social groups available to farming households as well as the effects of socio-economic and social capital variables on participation in social groups becomes imperative.

Evidence is mounting in Nigeria that social capital as an endogenous input, has a positive effect on different economic outcomes (Adepoju and Oni, 2012; Iyanda et al., 2014). Currently few studies have addressed the issue of farm productivity and food security within the context of social capital, despite its potential to mitigating shortfalls in households’ income and food supplies, especially in times of crises (Adepoju and Adejare, 2013; Oyebanjo et al., 2013, Uloh, 2015; Oluwole and Taiwo, 2016; Asa and Archibong, 2016; Balogun et al., 2017). Furthermore, these linkages have not been explored among cocoa-based farming households. This study focused on understanding the effect of social capital on farm productivity and food security among cocoa-based farming households in Southwestern Nigeria. The study determined the factors influencing cocoa-based farming households’ participation and level of participation in social groups. The effects of social capital on farm productivity and food security of cocoa-based farming households were analysed.

The interaction between the capitals ensures a sustainable livelihood strategy i.e., enhanced farm productivity against food insecurity. For example, rural people depend directly on natural resources from agriculture for their livelihoods. Thus, any change in crop yield or livestock output affects their livelihood and could result in food insecurity. While traditional capital (physical, natural, human and financial) does not fully lead to improvement in food security, social capital directly and indirectly ensures food security through improved farm productivity (Degefa, 2009). The rationale behind social capital is that and individual’s family, friends, and associates constitute an important asset, one that can be called upon in a crisis, enjoyed for its own sake, and/or leveraged for material gain (Putnam, 1995).

With regards to food security, social capital has the power to mitigate shocks to income and food supplies especially in times of crises. Members of social groups who know and trust each other may be more likely to give each other food or money to buy food. This conceivably largely influences the consumption possibilities of individuals in terms of access to food, especially households with limited financial or food resources. Households with higher levels of social capital are less likely to experience hunger. With regards to farm productivity, social networks may indirectly affect productivity by influencing the adoption of improved farming practices and technologies through free flow of information among its members (Katungi, 2007; Liverpool and Winter-Nelson, 2011). Social capital may also directly influence productivity through supply of labour from the social relationships available to the individual. This is important in the increasing phase of rural-urban migration, which has created restrictions in the supply of rural farm labour. Farm productivity is important in ensuring food security among farmers; higher farm productivity translates into larger food supplies and consequently lower food prices for consumers and lower food expenditure for rural farm households (Liverpool-Tasie, 2012). Also, increased farm productivity means increased incomes, and improved ability to ensure food security. This interlinkage is the focus of this study to provide a better understanding of how farm productivity leads to increased food security and the role social capital plays in this process. When farmers are faced with limited access to credit, they are motivated to improve their access. This study is built on the premise that a farmer can join and actively participate in social groups or networks to access credit without collateral in order to improve farm productivity and food security. It is assumed that the decision to join a social group or not is determined by household demographic factors, farm attributes and institutional factors, which is measured by individual group members’ decision to borrow. The next stage is the level of participation in social groups, which is measured by the amount farmers borrowed. This is influenced by an additional set of social capital dimensions.

2. Theoretical framework

Many theorists have explained food insecurity within the context of declining food availability and entitlement to food, political economic influences, food shortage as a disaster, and the Sustainable Livelihoods Framework (SLF) (Millman and Kates, 1990; Sen, 1981; Blaikie et al., 1991; Devereux, 1995). The SLF is the most suitable for this study, because it describes food insecurity as an outcome of undesirable livelihoods (Devereux, 2001; DFID, 1999). The SLF is an investigative theoretical framework that is based on how people use their capitals to improve their livelihood outcomes inclusive of farm productivity and food security. The framework focuses on the five main capitals in livelihood activities, which can be used to build resilience in the face of food insecurity. Livelihood capital, which forms the basis for developing strategies against food insecurity, determines the degree or extent of responsiveness of people to food insecurity (Morton, 2007). Livelihood capitals include natural, physical, financial, human and social capital.
inhabitants to engage in farming. They grow both permanent and annual crops. The climate is ideal for the cultivation of crops like maize, yam, cassava, millet, rice, plantain, cashew and cocoa. The region accounts for over 155,000 tons of cocoa, which represents 85 percent of Nigerian supplies.

A multistage sampling procedure was employed to select respondents for this study. The first stage involved purposive selection of two (2) states from Southwestern Nigeria (Osun and Ondo States). The second stage involved purposive selection of three (3) Local Government Areas (LGAs) from each selected State. In Osun State, Atakumosa East, Atakumosa West and Ile Ife North LGAs were selected while Ondo West, Idanre and Ile Oluji/Okeigbo LGAs were selected in Ondo State. The states and LGAs were selected, because of the predominance of cocoa production. Virtually all the local communities within these LGAs are involved in cocoa production. At the third stage, there was proportionate sampling of social groups in each LGA based on their availability. The number of selected social groups was a function of the number of social groups available in a particular LGA. The proportionality factor that was used in the selection of social groups is stated in Eq. (1):

\[ X_i = \frac{n_i}{N} \times 30 \]  

\( X_i \) is the number of social groups sampled from LGAs; \( n \) is number of social groups in the particular LGAs; \( N \) is total number of social groups in all the LGAs. At this stage, 30 out of 244 social groups were selected to ensure equal representation of social capital groups in the LGAs. In the final stage, simple random sampling was used to select ten (10) cocoa-based farming households in each of the selected social groups. In all, a total of 300 cocoa-based farming households were selected for the study.

3.2. Analytical techniques and model specification

Descriptive statistics were summarised to describe the socio-economic characteristics of the cocoa-based farming households. Data were also analysed using social capital indices, food security index, Heckman two-step and three stage least square models.

3.2.1. Social capital indices

The indices of social capital under study are cash contribution, labour contribution, decision making, heterogeneity, membership density, meeting attendance and aggregate social capital. The different social capital dimensions were constructed following Adepoju and Oni (2012), (Balogun et al., 2011, 2015).

3.2.2. Cash contribution index

This is the amount paid as membership per annum in an association. The total cash contributed to the various associations, which the household belonged was calculated. The actual contribution for each household was rescaled by dividing the amount by the maximum fee in the data to obtain the index.

3.2.3. Labour contribution index

This is represented by the number of days that household members worked for their various groups. It represents total number of days worked per year as membership contribution. This was rescaled using the method described for cash contribution.

3.2.4. Decision making index

This is the summation of how the respondents rank their participation in the decision making of their three most important groups. The members of the group were asked to evaluate their level of contribution to decision making subjectively (very active, active, passive, and very passive). This response was scaled from 3 to 0. An average of the rank for the three groups was calculated to obtain the index.

3.2.5. Heterogeneity index

This is an aggregation of diversity of members from the three most important institutions to the households. Initially, the three most
important groups for each household were identified. For those groups, a number of supplementary questions such as internal homogeneity of the group was asked. This was rated according to twelve criteria, which included neighbourhood, kin group, occupation, economic status, religion, political affiliation, sex, age group, level of education, cultural practices, belief and trust (Balogun and Yusuf, 2011). For each response, a yes was coded as 1, while a no was coded as 0. A maximum of 12 was allotted for each association to represent the highest level of heterogeneity. The scores of the three associations for each household was then divided by the maximum score of 36 to obtain the index.

3.2.6. Membership density index

This is measured by the number of active household memberships in existing associations. A complete inventory of all groups was made, each household was given the inventory and asked to identify the groups to which they belonged. The proportion of membership of group by individual was found to obtain the index.

3.2.7. Meeting attendance index

The index was obtained by adding the attendance of household members at meetings and relating it to the number of scheduled meetings per annum for the three most important associations they belonged to.

3.2.8. Aggregate social capital index

This is the multiplicative social capital index. The index was calculated using the products of density of membership, heterogeneity index and decision-making index of cocoa-based farming households in their various social groups.

3.2.9. Total factor productivity index

Total factor productivity (TFP) is the ratio of the value of total farm output to the value of the total inputs used in farm production. Following Key and Mcbride (2003) and Rahji (2007), the farm productivity of cocoa-based farmers was determined using the following formula in Eq. (2):

\[
\text{TFP} = \frac{Yi}{\sum PiXi}
\]

where \( Y \) is quantity of output in Kg; \( P \) is unit price of ith variable input; and \( Xi \) = quantity of ith variable input.

The TFP could also be measured as the inverse of average unit cost of production (equation 3):

\[
\text{TFP} = \frac{Y}{\frac{1}{AUC}} = \frac{Y}{\sum PiXi}
\]

where \( Y \) is quantity of total farm output using conversion factor (grain equivalents) in Kg; \( TVC \) is Total Variable Cost in naira; \( AVC \) is Average Variable Cost in naira; \( P \) is unit price of ith variable input; and \( Xi \) = quantity of ith variable input. This approach ignores the role of Total Fixed Cost (TFC) as this does not affect both the profit maximization and the resource-use efficiency conditions. Besides, it is fixed and thus a constant variable in the model.

3.2.10. Food security index

Calorie consumption was used as proxy for measuring food security. A calories consumption model was specified and estimated for 2018/2019 cropping season. Households’ daily food consumption (daily calories intake) was obtained from household own food production, food gift and purchases to supplement own food production. The data on actual food consumed (crop and non-crop) by each household per month was obtained and converted into kilograms. The energy content of 1 kg of each foodstuff (crop and non-crop) was obtained using a nutrient composition table of commonly eaten foods in Nigeria, as specified in Table 1.

Following Adeniyi and Ojo (2013), a food security index was constructed and the food security status of each household was determined based on the food security line using the recommended daily calorie intake (2,850 Kcal/day) by the Food and Agriculture Organization (FAO), after the conversion of all household members’ calorie intake into adult equivalent. The formula for converting all household members’ calorie intake into adult equivalent is specified in Eq. (4):

\[
\text{ADEQ} = (A + 0.5 C)^{0.9}
\]

where ADEQ = adult equivalent units; \( A \) = number of adults (15 years and above); and \( C \) = number of children in a household (below the age of 15 years).

Per capita calorie intake was calculated by dividing the estimated total household calorie intake by the household size after adjusting for the adult calorie intake equivalent. The daily per capita calorie intake was then estimated by dividing total household per capita calorie intake by 28 days. The safe minimum daily intake is 2,280 kcal per adult equivalent per day (FAO, 2005). This delineates the food security line for this study. Any household that falls below the food security line is classified ‘food insecure’ and above ‘food secure’. According to Fakiyese (2001) and Adeniyi and Ojo (2013), food security (Z) index was calculated by the formula in Eq. (5):

\[
Z_i = \frac{Y_i}{R}
\]

where \( Z_i \) is the food security status of the cocoa-based farming households; \( Y_i \) is the daily per capita calorie intake of \( i \)th household; and \( R \) is food security line for the study. Thus, if \( Z_i = 1 \) (food secure households) for \( Y_i \geq \text{food security line} (2,280 \text{ kcal}) \) and \( Z_i = 0 \) (food insecure households) for \( Y_i < \text{food security line} (2,280 \text{ kcal}) \).

3.3. Heckman two-step selection model

Following Kangogo et al. (2013), Heckman two-step selection model was adopted to estimate the factors affecting cocoa-based farming households’ participation and level of participation in social groups. The rationale behind the model is that the level of participation is conditional to the decision to participate in a social group. The amount borrowed is used as proxy for level of participation in groups and is a non-random variable. In light of the above, the decision to participate and the level of participation in a social group have to be determined separately in order to avoid selection bias. The first stage is the probit model that measures the decision to participate in social groups as specified in Eq. (6):

\[
Y_i^* = B_iX_i + \mu_i
\]

where \( Y_i^* \) is a dummy variable of participation in social groups. For instance, 1 denotes yes and 0 denotes otherwise. \( X_i \) is characteristic of \( i \)th respondent hypothesized to influence decision of \( i \)th respondent to participate in a social group and \( B \) is the parameters to be estimated.

In the second stage, level of participation was estimated using variables which are characteristics of the \( i \)th respondent and additionally social capital dimension variables. The model is expressed for \( i \)th respondent with \( Y = 1 \) (i.e., those that participate in social groups) as in Eq. (7):

\[
Z_i^* = \alpha_iw_i + \mu_i
\]

where \( Z_i^* \) represents the level of participation for \( i \)th respondent, \( \alpha_i \) and \( w_i \) are household characteristics and social capital variables of the \( i \)th respondent, respectively. However, the joint distribution of the errors in the selection and amounts equation is distributed as shown in Eq. (6):

\[
\text{Corr} (\mu_i, \mu_j) = P
\]

If \( P \neq 0 \), then there are omitted variables in the initial model correlated with \( Xi \), which can be corrected by including IMR in the
participated in social groups; where \( \alpha \) is the IMR. The new equation (equation 14) for the second stage regression is therefore:

\[
Z_i^* = a_i + \rho_i
\]  

where \( Z_i^* \) represents the level of participation for \( i^{th} \) respondent who participated in social groups; \( a_i \) and \( \rho_i \) are household characteristics and social capital variable of the \( i^{th} \) respondent, respectively; and \( P_i \) is the IMR.

### 3.4. Simultaneous equation model using 3SLS estimation procedure

Simultaneous equation model was used to analyse the impacts of social capital on farm productivity and food security of cocoa-based farming households. The relationship between food security and social capital among the farming households is indirect through its relationship with farm productivity. Since the variables in the model influence each other, adopting the simultaneous equation model will help reduce the incidence of multicollinearity and bias (Koutsoyiannis, 2003). For the purpose of this study, a key assumption is that social capital is generated through interactions of networks of people. This interaction generates benefits to individuals participating in the social groups. According to Portes (1998), social capital is an individual asset that could improve well-being of participants in the social groups. Due to this, the assumption is that it takes time and resources for social capital to be assessed. This assumption makes social capital to be an endogenous variable i.e., the characteristics and resources of friends, contacts, and groups may affect individual outcomes. Hence, this relationship causes the bi-causality between farm productivity, food security, and social capital, because they run in both directions. In addition, farm productivity and food security are statistically and structurally linked through the jointness of the distribution of the error terms and the non-diagonal covariance matrix. This implies that the random error components correlate with each other. Given the above conditions, the equations of the model are specified as the farm productivity Eq. (15):

\[
TFP_i = a + IX_i + \beta QC_i + bSC_i + e_i
\]  

where TFP\(_i\) is total factor productivity. The definitions of independent variables are: SC\(_i\) is social capital variables such as density of membership (proportion), heterogeneity (proportion), meeting attendance (proportion), cash contribution (proportion), labour contribution (proportion) and decision-making (proportion). \( X_i \) denotes socio-economic characteristics of the households such as gender (1 = male; 0 = female), age (years), household size (actual size), illiterate (1 = yes; 0 = otherwise), primary education (1 = yes; 0 = otherwise), secondary education (1 = yes; 0 = otherwise), tertiary education (1 = yes; 0 = otherwise), marital status (1 = married; 0 = otherwise), interest rate on loan (percent), farm size (hectares), time lag (days). \( e_i \) is unobserved disturbances.

The food security equation is as follows (equation 16):

\[
E_i = a + TFP_i + \beta SC_i + \sum X_i + \mu_i
\]  

where \( E_i \) is per capita calories consumption. The definitions of independent variables are: SC\(_i\) are social capital variables such as density of membership (proportion), heterogeneity (proportion), meeting attendance (proportion), cash contribution (proportion), labour contribution (proportion) and decision-making (proportion). \( X_i \) are socio-economic characteristics of the households such as gender (1 = male; 0 = female), age (years), household size (actual size), illiterate (1 = yes; 0 = otherwise), primary education (1 = yes; 0 = otherwise), secondary education (1 = yes; 0 = otherwise), tertiary education (1 = yes; 0 = otherwise), marital status (1 = married; 0 = otherwise), farm size (hectares), asset (\( N \)), saving (\( N \)), primary occupation (1 = farming; 0 = otherwise).
otherwise), distance to farm (Km). TFP, is the predicted value of total factor productivity and $\mu_i$ is unobserved disturbances.

There are a number of approaches to deal with endogeneity as discussed earlier. However, the 3SLS IV approach is efficient as it accounts for all forms of bias, provided a suitable instrument is identified. A suitable instrument must correlate with the endogenous variable, but uncorrelated with the dependent variable and error term under study (Murray 2006; Burgess et al., 2016). Such an instrument produces an unbiased and consistent estimate for the endogenous variable under study (Gujarati 2003). The 3SLS estimation procedure also reduces correlation among the endogenous variables and the equations’ error terms to generate more efficient parameter estimates. The 3SLS estimation procedure involves a combination of SUR and 2SLS estimation procedures. The SUR model addresses the statistical and structural cross-equation error among the equations, while 2SLS addresses bi-causality between farm productivity, food security, and social capital.

In the operationalization of the model, the 3SLS model requires at least two sets of equations and the estimation procedure consists of three stages (Washington et al., 2011). In the first stage, instrumented values for all endogenous variables are generated. The initial stage is to test for the exclusion restrictions of the instruments (Wooldridge 2013). In other words, we apply the first stage, which is the reduced-form equation for our endogenous regressor through the following reduced-form equation for $Y_2$ (equation 17):

$$Y_2 = \beta_0 + \beta_1 Y_1 + \beta_2 P_2 + \beta_3 P_3 + \beta X + \eta_i$$  \hspace{1cm} (17)

where $Y_2$ is the endogenous variable (aggregate social capital), $\beta$ is the estimated parameters, $P_i$ are the instrumental variables, $X$ are the independent variables, and $\eta_i$ is our error term. Partial correlation at least between $P_i$ and $Y_2$ is necessary to fulfill the requirement that the instruments affect the endogenous regressor. Therefore, we can apply the second stage and specify the structural equation as follows in Eq. (18):

$$Y_1 = \beta_0 + \beta_1 Y_2 + \beta X + \epsilon_i$$  \hspace{1cm} (18)

where $Y_1$ is the unbiased estimation of our dependent variables, $\beta$ is the estimated parameter, $Y_2$ is the “purged” endogenous variable, $X$ represents other explanatory variables and $\epsilon_i$ represents error term. This stage is critical to generate consistent instrument values to estimate the SUR parameter estimates.

In the second stage, the estimates are based on the residuals from a 2SLS estimation of each structural equation, and are estimated by using the SUR model to compute consistent estimates for the covariance matrix of the equation disturbances (the relationship between $\epsilon_1$ and $\epsilon_2$). The basic philosophy of the SUR model is the estimation of jointness of the equations. The covariance matrix of the associated disturbances by SUR model introduces additional information over and above the information available when the individual equations are considered separately. Thus, all the separate relationships are considered simultaneously to obtain a consistent and unbiased estimation. Following Emong et al. (2016), the estimated error terms are computed as follows (Eqs. (19), (20), and (21)):

$$\hat{\sigma}^2_{\epsilon_1} = \frac{\sum_{i=1}^{n} \epsilon_1^2}{n}$$  \hspace{1cm} (19)

$$\hat{\sigma}^2_{\epsilon_2} = \frac{\sum_{i=1}^{n} \epsilon_2^2}{n}$$  \hspace{1cm} (20)

$$\hat{\sigma}^2_{\epsilon_1\epsilon_2} = \frac{\sum_{i=1}^{n} \epsilon_1 \epsilon_2}{n}$$  \hspace{1cm} (21)

The complete set of the variance-covariance of the error terms follows in Eq. (22):

$$\begin{bmatrix}
\hat{\sigma}^2_{\epsilon_1} & \hat{\sigma}^2_{\epsilon_1\epsilon_2} \\
\hat{\sigma}^2_{\epsilon_1\epsilon_2} & \hat{\sigma}^2_{\epsilon_2}
\end{bmatrix} = \frac{\sum_{i=1}^{n} \epsilon_1^2 \sum_{i=1}^{n} \epsilon_2^2}{n}$$  \hspace{1cm} (22)

In the last stage, the covariance matrix estimated in the second stage with the instrumented values, is estimated using a GLS-type estimation to obtain consistent and unbiased 3SLS model parameters. Given these conditions, GLS estimator was computed as follows in Eq. (23):

$$\hat{\delta}_{GLS} = \left( Z' \left[ \Sigma^{-1} \otimes P \right] Z \right)^{-1} \left( Z' \left[ \Sigma^{-1} \otimes P \right] y \right)$$  \hspace{1cm} (23)

3.5. Specification tests

Following Cawley and Meyerhoefer (2012), and Howley et al. (2015), the Sargan over identification test was conducted for the IV models. If the P-value is not significant, it means that the instrument is not correlated with the error term and therefore it is valid (Gujarati 2003).

4. Results and discussions

4.1. Socioeconomic characteristics of cocoa farming households

The descriptive statistics of the surveyed cocoa farming households are presented in Table 2. About 7.3% of the respondents are illiterate, 37.3% completed primary education, 44.6% completed secondary education, and 10.6% had tertiary education. If completion of primary school is taken to be a sound literacy level, 92.7% of the respondents could read or write. It can be deduced that the literacy level of the sampled farmers is relatively high. Most of the respondents (73.0%) are married. This shows that majority of the respondents have a spouse who could assist in the farming operation, thereby reducing cost of hiring labour. This reiterates that cocoa production is mainly a family business maintained by the household in accordance with Ojo and Jibowo (2008). The result also reveals that more than half of the sample households (79%) belong to agricultural-based organisations. This implies that there is a social interaction and exchange of ideas among cocoa-based farming households in the study area. About 87 percent of the respondents are men, which indicates that men are more active and involved in cocoa production activities in the area than women, because of stress involved in cocoa farming. More than half (56%) of the respondents listed farming as their primary occupation. Although most respondents are primarily involved in farming, some are involved in other occupations. This might be a strategy to mitigate the impact of crop failure or to improve their standard of living. The majority of the respondents (89%) own land that they either purchased or inherited. This could encourage farmers to adopt improved technologies to improve their farm productivity and ensure their household food security.

An average cocoa farming household head is 51 years old, which implies a relatively old sample population. Generally older people stay in the villages and younger people move to cities for an education, learning a trade and in search of white-collar jobs. This invariably poses a danger for farm productivity and food security among the aged farming categories. This finding corroborates Oputanya and Ibuinu (2014) and Oluwatayo (2015) who found that an average cocoa farmer in the Southwestern Nigeria is old. An average cocoa-based farming household in the study area has about 5 ha of land, which confirms the general belief that cocoa farming operates at smallholding levels. This is in line with the findings of Adeogun (2006) who reported that the majority of farmers in five cocoa producing states of Nigeria have farms of between one and five hectares. An average cocoa-based farming household in the study area comprises about seven people. This indicates that the household supplies the most labour for agriculture, which is in agreement with Idrisa et al., 2012. The mean non-farm income of the respondents is N104956. This
implies that farmers in the study area engage in economic activities other than farming. Activities mentioned included commercial motorcycle riding and produce buying among young farmers. Others included petty trading among the women, bricklaying, and rent on assets among the old farmers. The average yearly savings is ₦50983 and the average worth of cocoa farming households’ assets in the study area is ₦99284. The yearly saving and value of households’ assets indicate asset endowment and overall economic well-being. The average interest rate in the study area is 1.17, which implies that social groups provide loans to their members at low interest rates. The average loan processing period in the study area was 20.11 (±13.17) days. Thus, the social groups in the study area provide short term loans (Baddout et al., 2009). The results further revealed that households in the study area trekked an average distance of 0.70 km from their homestead to social group locations or designated buildings. This implies that the social groups’ location is far from the homestead of the households, which could affect attendance of meetings at the designated social group buildings.

Six indices of social capital among the cocoa-based farming households are identified. The density of membership to associations is 0.636, which means that cocoa-based farming households belong to 6 out of 10 associations. Households belong to various associations in order to promote and protect their business interests. The degree of heterogeneity (0.644) is considerably high in the area of study. This suggests heterogeneous characteristics such as different ethnicities, occupations, religion and neighbourhoods among the cocoa-based farming households. The decision-making value (0.571) is fairly high in the associations, which implies that most of the cocoa farming household members are actively involved in decision making within the social group they belong. The meeting attendance value is 0.318, which means that the cocoa-based farming households do not attend most of the scheduled statutory meetings. This could be attributed to the fact that the households trekked an average of 0.70 km to designated meeting points. Hence, they only attend meetings whenever important decisions are to be made. The cash contribution value is 0.652, which means that the cash commitment to associations by cocoa-based farming households is relatively high. This shows that cocoa-based farming households are committed to contributing cash to their respective associations. Also, labour contribution has a value of 0.541, which means that the mean labour contribution is 54 days annually. This result compares favourably with Ajani and Tijani (2009). The aggregate social capital, which is the multiplicative value of density of membership, heterogeneity index and decision-making index is 0.568. The result shows that a fairly high level of social capital exists among cocoa farming households in the study area.

### 4.1.1. Factors influencing cocoa-based farming households’ participation in social groups (stage 1)

The factors that influenced the decision to participate in social groups are shown in Table 3. These characteristics include asset, age, years of education, gender, farm size, land tenure, loan interest rate, and extension visit. The negative signs of marginal effects reduce probability of household participation in social groups while positive signs increase the probability of participation. Assets of households significantly affects the probability of participating in social groups. An additional unit of households’ asset decreased the decision to participate in social groups by 10.9 percent. This implies that increase in asset ownership decreases probability to participate in social groups. The age of household head significantly affected the probability of participating in social groups. A year increase in age of household head increased the decision to participate in social groups by 54.8 percent. This could be attributed to the fact that social groups might prefer older farmers to their younger counterparts, because older farmers are more responsible and secured to participate. In addition, due to some cultural beliefs in Africa, younger people might be prevented from participating in social groups. Years of education of household head significantly affected the probability of

| Variables | Average values/ % |
|-----------|-------------------|
| Illiterate (%) | 7.33 |
| Primary education (%) | 37.3 |
| Secondary education (%) | 44.6 |
| Tertiary education (%) | 10.6 |
| Marital status (%) | 73.0 |
| Membership in agricultural organisations (%) | 79.0 |
| Gender of households (%) | 87.0 |
| Extension contacts (%) | 93.0 |
| Primary occupation (%) | 56.0 |
| Land ownership (%) | 89.0 |
| Age of household head | 51.34 (19.38) |
| Total household farm size | 5.68 (3.89) |
| Household size | 7.07 (2.59) |
| Asset | 99284 (79977) |
| Off farm income | 104956 (87371) |
| Interest charged on loan | 1.17 (0.64) |
| Time lag | 20.11 (13.17) |
| Distance to credit source | 0.70 (0.46) |
| Meeting attendance | 0.318 (0.125) |
| Heterogeneity | 0.644 (0.327) |
| Cash contribution | 0.652 (0.470) |
| Decision-making | 0.571 (0.228) |
| Density of membership | 0.636 (0.284) |
| Labour contribution | 0.541 (0.223) |
| Aggregate social capital | 0.568 (0.490) |

Figures in parentheses are standard deviation.

**Source:** Field survey, 2018
participating in social groups. An increase in years of education of household head increased the decision to participate in social groups by 7.7 percent. This implies that education gives farmers the ability to access and comprehend information regarding the terms and conditions required to participate in social groups. The gender of household head significantly affected the probability of participating in social groups. A male household head increased the decision to participate in social groups by 17 percent. This could be attributed to the fact that male headed families are willing to take more risk than female headed families. In addition, due to some sociocultural values and norms of Africans, male farmers have more freedom to participate in different social groups compared to the female farmers.

The farm size of household significantly affected the probability of participating in social groups. An increase in hectares of farm size increased the decision to participate in social groups by 28 percent. The result implies that farmers with large farms possess the ability and collateral to participate in social groups. Land tenure status of household head significantly affected the probability of participating in social groups. Secure land increased farmers’ decision to participate in social groups by 28 percent. This could serve as a push factor to participate in social groups in order to put resources to optimum use. Loan interest rate significantly affected the probability of participating in social groups. A one percent increase in interest rate decreased the decision to participate in social groups by 46.6 percent. This implies that high interest rate constitutes a hindrance to loan access. Extension contacts significantly affected the probability of participating in social groups. A contact of household with extension agents increased the decision to borrow by 5.4 percent. This is because extension services could provide farmers with essential information regarding participation in social groups.

4.1.2. Factors influencing cocoa-based farming households’ level of participation in social capital groups (stage II)

The results of the factors influencing cocoa-based farming households’ level of participation in social capital groups are presented in Table 3. These include age of household head, years of education, membership in agricultural organization, off farm income, land tenure, interest rate, distance to credit sources, extension visits, decision making, cash contribution, and labour contribution. The age of household head significantly affected level of participation in social groups. A year increase in age of household head increased the level of participation in social groups by 3.68 percent. This could be ascribed to the fact that as farmers get older, they become more productive and increase their level of participation in social groups. Years of education of household head significantly affected level of participation in social groups. A year increase in years of education of household head increased the level of participation in social groups by 2.085 units. This is because education equips farmers to make informed decisions about their level of participation in social groups. Being a member of agricultural organisation increased the level of participation in social groups by 2.085 units. This is attributed to the fact that membership in an agricultural organisation increases access to credit. Non-farm income significantly affected level of participation in social groups. An increase in non-farm income of households decreased the level of participation in

| Variables | Coefficient | t-stat | Marginal effect | Coefficient | t-stat |
|-----------|-------------|--------|----------------|-------------|--------|
| Asset     | -0.316***   | -2.88  | -0.109***      | 0.217       | 0.90   |
| Age       | 5.137***    | 2.76   | 0.548***       | 3.164***    | 2.73   |
| Years of education | 0.195*** | 2.94   | 0.077***       | 0.662***    | 3.41   |
| Membership in agricultural organisation | 0.263 | 0.97   | 0.197          | 2.085***    | 3.47   |
| Farming experience | 8.320 | 0.14   | 0.274          | 7.801       | 0.81   |
| Off farm income | 0.003 | 0.40   | 0.001          | -0.041***   | -3.48  |
| Gender    | 0.526***    | 2.67   | 0.170***       | 0.772       | 1.24   |
| Farm size | 2.247***    | 2.60   | 0.280***       | 0.408       | 0.25   |
| Household size | 3.930 | 1.08   | 0.403          | 5.528       | 1.02   |
| Land tenure | 1.309*** | 5.79   | 0.301***       | 1.858***    | 4.71   |
| Interest rate | -1.375*** | -6.50  | -0.466***      | -1.225***   | -6.09  |
| Distance to credit source | 0.191 | 0.20   | 0.102          | -0.010***   | -2.83  |
| Extension visits | 0.140*** | 2.15   | 0.054**        | 0.768**    | 2.14   |
| Primary occupation | 0.072 | 0.14   | 0.058          | 0.063       | 0.79   |
| Meeting attendance | -0.986 | -0.61  |                |             |        |
| Decision making | 1.424*** |        |                | 3.45        |        |
| Cash contribution | 9.923*** |        |                | 8.90        |        |
| Labour contribution | 3.353*** |        |                | 3.80        |        |
| Heterogeneity | 5.605 |        |                | 1.29        |        |
| Membership density | 0.377 |        |                | 0.70        |        |
| Constant | 2.775***    | 2.64   |                | 4.784***    | 2.75   |
| Mills:  lambda | -0.012*** | -2.98  |                |            |        |
| rho | -0.772 |        |                |            |        |
| Sigma | 0.703 |        |                |            |        |

Number of obs: 300
Censored obs: 159
Uncensored obs: 141
Wald Chi2 (10): 37.2
Prob > Chi2: 0.001

***, **, and * represent significance levels at 1%, 5% and 10%, respectively.

Source: Field Survey, 2018
Social amounts of non-farm income would less likely need external funds. Land tenure significantly affected level of participation in social groups. Households with secure land increased the level of participation in social groups by 1.858 units. This could serve as a push factor to farmers to increase their level of participation in social groups. Low interest rate significantly affected level of participation in social groups. A one percent increase in loan interest rate decreased the level of participation in social groups by 1.225 units. High interest rates constitute a hindrance to the level of participation in social groups. Distance to credit source significantly affected level of participation in social groups. A kilometre increase in the distance to credit source decreased the level of participation in social groups by 0.010 units. Farmers who live near the social group’s designated building have a location advantage, which increases their level of participation in social groups. Extension visits significantly affected level of participation in social groups. Households’ contact with extension agents increased the level of participation in social groups by 0.768 units. Extension services provide essential information to farmers regarding participation in social groups. Decision-making significantly affected level of participation in social groups. An increased unit of the decision-making index increased the level of participation in social groups by 1.424 units. This is ascribed to the fact that decision making keeps individuals abreast of the association’s benefits. Cash contribution significantly affected level of participation in social groups. A naira increase in cash contribution increased the level of participation in social groups by 9.923 units. This implies cocoa-based farming households who made adequate financial contributions to social groups have access to substantial amounts of credit compared to households who did not. Labour contribution significantly affected level of participation in social groups. An increase in labour contribution increased the level of participation in social groups by 3.353 units. This implies that cocoa-based farming households who make adequate labour contributions in social groups have access to substantial amounts of credit compared to households who do not.

4.2. Effects of social capital on farm productivity and food security of cocoa-based farming households

4.2.1. Test of validity of the instrumental variables

4.2.1.1. Correlation test. To test for validity of the instrumental variables used in the 3SLS estimation procedure, a correlation analysis between aggregate social capital, farm productivity and food security with the proposed instruments was carried out. The proposed instruments were length of residency, charity donation, membership in religious group, and membership in ethnic groups. The results of the correlation analysis were presented in Table 4. The membership in ethnic groups has significant correlations with aggregate social capital, but an insignificant correlation with farm productivity and food security. It also has the highest correlation coefficient (0.455) with the social capital. This conforms to the findings of Adepoju and Oni (2012).

4.3. Farm productivity and food security of cocoa-based farming households

Table 5 shows that the average per capita calorie daily intake for cocoa-based farming households in the study area was 1873 kilocalories per person per day. This is far lower than the recommended minimum requirement of 2280 kilocalories per person per day for developing countries including Nigeria. The proportion of the households in the study area that fell below the food security line was 71 percent. The total factor productivity was 0.544 kg/N. The result implies that for every N1 incurred in a cocoa-based farm, there was approximately 0.544 kg of output produced. This suggests that the farmers were fairly productive at the time of the study. Hence, there is little return to their investment.

4.4. Effect of social capital on farm productivity of cocoa-based farming households

Table 6 depicts the effect of social capital on farm productivity of cocoa-based farming households in Southwestern Nigeria. The basic model is shown in the first column of Table 6. The rationale behind this model is to examine the farm productivity of the households while they are not involved in social capital activities. The Chi² showed that the econometric modelling is appropriate and correctly specified. Age of household head significantly influenced farm productivity of the cocoa-based farming households. This implies that a unit increase in age of household head decreased households’ farm productivity by 0.836 kg/N. This is attributed to the fact that ability to do farm work and farm output reduces with ageing. Household size significantly influenced farm productivity of the cocoa-based farming households. This implies that a unit increase in household size increased households’ farm productivity by 0.865 kg/N. This is attributed to the fact that family labour available for farming could increase farm output. The results agree with Atagh (2013). Primary and secondary education significantly influenced households’ farm productivity. The implication of this is that a unit increase in primary and secondary education increased households’ farm productivity by 0.014 and 0.113 kg/N, respectively. This could be traced to the fact that education empowers farmers to access required skills and to utilise existing resources on the farm to boost their productivity. Farm size significantly influenced farm productivity of the cocoa-based farming households. This implies that a unit (ha) increase in the farm size increased households’ farm productivity by 0.214 kg/N. This is ascribed to the fact that resources on large farms would increase farm productivity. Interest rate significantly influenced farm productivity of the cocoa-based farming households. This implies that a percentage increase in interest rate decreased households’ farm productivity by 0.346 kg/N. This is because high interest rate discourages farmers from applying for loans and the amount of the loans farmers receive. Correspondingly, this reduces the quantity and quality of farm inputs that the farmer buys and negatively affects productivity farmer. Loan time lag significantly influenced farm productivity of the cocoa-based farming households. This implies that a unit (day) increase in loan time lag decreased households’ farm productivity by 0.660 kg/N. This is because
long loan time lags would delay the procurement of a loan, which implies that farm inputs will not be available to the cocoa farmers at the right time, quantity and quality. This affects productivity of the farmers due to the seasonal nature of agriculture. This model suggests that households’ socio-economic characteristics, farm specific and credit variables play a significant role in improving farm productivity.

The second column of Table 6 shows the inclusion of six additive forms of social capital variables identified in this study. These include density of membership, decision making, cash contribution, labour contribution, meeting attendance and heterogeneity. The rationale behind the model is to examine the farm productivity of the households while they are involved in social capital activities. This new model has a better farm productivity level as reflected in a Chi^2 of 45.34. This suggests that households’ farm productivity improve as members become involved in the affairs of their social groups. This model shows that the effect of social capital on farm productivity can be traced to meeting attendance, decision making, membership density, and cash contribution. This finding is line with the findings of Balogun et al. (2017; 2018). Meeting attendance significantly influenced farm productivity of the cocoa-based farming households in the study area. This implies that a unit increase in attendance of meetings increased households’ farm productivity by 6.959 kg/₦. This is because farmers who recurrently attended group meetings have access to resources and information to improve their productivity. Decision making significantly influenced farm productivity of the cocoa-based farming households. This implies that a unit increase in active participation in decision of the group decreased households’ farm productivity by 4.824kg/₦. This means that farmers’ involvement in association matters is of no benefit to their farm productivity. Density of membership significantly influenced farm productivity of the cocoa-based farming households. This implies that a unit increase in the number of groups to which a farmer belongs increases productivity by 1.007 kg/₦. This is attributed to the fact that farmers’ membership in social groups enhances their access to loans, which increases their farm productivity. Cash contribution significantly influenced farm productivity of the cocoa-based farming households. This implies that a naira increase in the amount contributed, increased farm productivity by 0.450 kg/₦. This is attributed to the fact that farmers’ commitment in many social groups enhances their access to loans, which can be used to increase their productivity. Cash contribution significantly influenced farm productivity of the cocoa-based farming households. This implies that a naira increase in the amount contributed, increased farm productivity by 0.450 kg/₦. This is attributed to the fact that farmers’ commitment in many social groups enhances their access to loans, which increases their farm productivity. 

| Variables                             | Units | Average values/percentages |
|---------------------------------------|-------|-----------------------------|
| Food security line                    | kilocalories | 1873                        |
| Food insecure households              | percent | 71                           |
| Farm productivity                     | Kg of output produced | 0.544                      |

Table 5. Farm productivity and food security of cocoa-based farming households.

| Variables                             | Units | Average values/percentages |
|---------------------------------------|-------|-----------------------------|
| Gender                                |       |                             |
| Age                                   |       |                             |
| Household size                        |       |                             |
| Illiterate                            |       |                             |
| Primary education                     |       |                             |
| Secondary education                   |       |                             |
| Tertiary education                    |       |                             |
| Marital status                        |       |                             |
| Farm size                             |       |                             |
| Interest rate                         |       |                             |
| Time lag                              |       |                             |
| Meeting attendance                    |       |                             |
| Decision making                       |       |                             |
| Membership density                    |       |                             |
| Cash contribution                     |       |                             |
| Labour contribution                   |       |                             |
| Heterogeneity                         |       |                             |
| Aggregate social capital              |       |                             |
| Instrumented social capital           |       |                             |
| Social capital × social capital residual |   |                             |
| Constant                              |       |                             |
| R^2                                  |       |                             |
| Chi^2                                 |       |                             |

Table 6. Effect of social capital on farm productivity of cocoa-based farming households.

| Variables                             | Basic model | Additive model | Multiplicative model | Model with instrumental variable | Model with interaction of social capital with unobservables |
|---------------------------------------|-------------|----------------|----------------------|----------------------------------|----------------------------------------------------------|
| Gender                                | Coeffi      | t-stat         | Coeffi               | t-stat                           | Coeffi                        | t-stat                      |
| Age                                   | -0.836***   | -2.54          | -0.157***            | -3.31                           | -0.781***                    | -2.53                       | -0.670                     | -0.53                       | -0.688**                    | -2.26                       |
| Household size                        | 0.865**     | 2.32           | 0.863***             | 2.43                            | 0.865                        | 1.48                        | 0.375***                   | 2.60                        | 0.788**                     | 2.35                       |
| Illiterate                            | 0.159       | 0.26           | 0.029                | 1.07                            | 0.003                        | 0.06                        | 0.094                      | 0.29                        | 0.153                       | 0.48                       |
| Primary education                     | 0.014***    | 3.46           | 0.230                | 0.01                            | 0.136***                     | 3.36                        | 0.526***                   | 3.61                        | 0.520***                    | 4.08                       |
| Secondary education                   | 0.113***    | 2.75           | 0.797                | 0.57                            | 0.111***                     | 2.75                        | 0.073***                   | 2.66                        | 0.139***                    | 2.85                       |
| Tertiary education                    | 0.084       | 0.56           | 0.010                | 1.43                            | 0.079                        | 1.72                        | 0.708                      | 0.86                        | 0.681***                    | 2.60                       |
| Marital status                        | -0.348      | -0.75          | 0.788                | 0.43                            | 1.404                        | 0.03                        | 0.740                      | 0.73                        | 1.117                       | 0.72                       |
| Farm size                             | 0.214***    | 2.64           | 0.189                | 0.14                            | 0.254***                     | 2.72                        | 0.275***                   | 2.60                        | 0.337                       | 0.34                       |
| Interest rate                         | -0.346***   | -2.57          | -0.247***            | -2.53                           | -0.220                       | -0.65                       | -0.187***                  | -3.35                       | -0.431                      | -1.19                       |
| Time lag                              | -0.660***   | -3.68          | -0.177               | -0.81                           | -0.219                       | -0.63                       | -0.517                     | -0.92                       | -0.371                      | -0.32                       |
| Meeting attendance                    | 6.959**     | 2.22           |                     |                                 |                             |                            |                            |                             |                            |                            |
| Decision making                       | -4.824*     | -1.67          |                     |                                 |                             |                            |                            |                             |                            |                            |
| Membership density                    | 0.450**     | 2.05           |                     |                                 |                             |                            |                            |                             |                            |                            |
| Cash contribution                     | 1.007***    | 3.46           |                     |                                 |                             |                            |                            |                             |                            |                            |
| Labour contribution                   | 0.273       | 0.75           |                     |                                 |                             |                            |                            |                             |                            |                            |
| Heterogeneity                         | 0.128       | 0.39           |                     |                                 |                             |                            |                            |                             |                            |                            |
| Aggregate social capital              | 0.513***    | 2.76           |                     |                                 |                             |                            |                            |                             |                            |                            |
| Instrumented social capital           | 0.577***    | 4.07           |                     |                                 |                             |                            |                            |                             |                            |                            |
| Social capital × social capital residual |   | 0.218***      | 3.67                |                                 |                             |                            |                            |                             |                            |                            |
| Constant                              | 2.454***    | 2.95           | 3.556***             | 3.65                            | 4.313***                     | 3.00                        | 5.643***                   | 3.68                        | 4.846***                    | 3.50                       |
| R^2                                  | 0.037       | 0.427          | 0.404                |                                 | 0.264                        | 0.246                       |                            |                             |                            |                            |
| Chi^2                                 | 28.17***    | 45.34***       | 45.36***             |                                 | 42.13***                     | 40.73***                    |                            |                             |                            |                            |

Table 5. Farm productivity and food security of cocoa-based farming households.

*significance at 10 percent, ** significance at 5 percent, *** significance at 1 percent. Source: Field Survey, 2018
productivity by 0.513 kg/N. This implies that participation in social groups enhances members’ welfare, including farm productivity. However, accounting for strong bi-directional causality between social capital and farm productivity (Balogun and Yusuf, 2011), using the aggregate social capital model, the original social capital was replaced by an instrumental variable (Length of residence). This choice was guided by correlation and Sargan result of the instrumental variables with the social capital and farm productivity, as suggested by Okunmadewa et al. (2007), Omonona et al. (2008), Balogun and Yusuf (2011), Adepoju and Oni (2012), and Balogun et al. (2017; 2018). The instrumental variable leads to a higher coefficient for the social capital than in the actual social capital model. This implies that the direct effect of social capital outweighs the reverse effect. A unit increase in the instrumented social capital would increase household’s farm productivity by 0.577 kg/N.

Nevertheless, accounting for linear interaction of social capital with unobservables, the coefficient decreases to 0.218. This result is adopted, because it takes into account the interactions between social capital and the unobservable effect on farm productivity. Based on the result, social capital is endogenous to farm productivity and it should be explored among people of similar characteristics in order to improve their productivity. Thus, social capital is an important factor in improving cocoa farming households’ farm productivity in Southwestern, Nigeria.

### 4.5. Effect of social capital on food security of cocoa-based farming households

Table 7 depicts the effect of social capital on food security of cocoa-based farming households in Southwestern Nigeria. The basic model is shown in the first column of Table 7. The rationale behind this model is to examine the food security (calorie per capita adult equivalents) of the households while they are not involved in social capital activities. The Chi² value showed the econometric modelling is appropriate and correctly specified. Age of household head significantly influenced food security of the cocoa-based farming households. This implies that a unit increase in age of household head decreased their food security by 0.394 calories. This is because old household heads’ farm productivity decline as they grow older, which impacts negatively on their households’ food security. Household size significantly influenced food security of the cocoa-based farming households. This implies that an additional member to the households decreased the food security status by 0.527 calories. This is because large households put pressure on household resources including food. Illiteracy significantly decreased the food security by 0.775 calories. However, primary and secondary education significantly increased households’ food security by 0.512 and 0.551 calories, respectively. This could be attributed to the fact that education provides farmers with knowledge of food groups, which eventually improves their food security. Farm size was positive and significantly influenced food security of the cocoa-based farming households. A unit increase in farm size increased the food security by 0.834 calories. This is because resources and cultivation on large farms can increase food production. Farm productivity significantly influenced food security of the cocoa-based farming households. The implication of this is that a unit increase in the output of farmers increased the food security status by 0.307 calories. This is because increase in farm productivity can increase a household’s propensity to consume more through increased food production or by having income available to buy food at any time. Savings significantly influenced food security of the cocoa-based farming households. The implication of this is that a naira increase in savings of

### Table 7. Effect of social capital on food security of cocoa-based farming households.

| Variables                  | Basic model | Additive model | Multiplicative model | Model with instrumental variable | Model with interaction of social capital with unobservables |
|----------------------------|-------------|----------------|----------------------|-----------------------------------|-----------------------------------------------------------|
|                           | Coefficient | Coefficient | Coefficient | Coefficient | Coefficient | Coefficient | Coefficient | Coefficient | Coefficient |
|----------------------------|-------------|-------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Gender                     | 0.874       | 0.94        | 0.515      | 1.30        | 0.573       | 1.48        | 0.341       | 0.82        | 0.247       | 0.58        |
| Age                        | -0.394***   | -2.83       | -0.583     | -0.94       | -0.884***   | -3.56       | -0.406***   | -2.68       | 0.281       | 0.83        |
| Household size             | -0.527***   | -2.82       | -0.695**   | -2.15       | -0.661      | -0.80       | -0.441***   | -3.14       | -0.016      | -1.48       |
| Illiterate                 | -0.775**    | -2.07       | -0.069     | -1.15       | -0.817**    | -2.11       | -0.225**    | -2.35       | -0.037**    | -2.39       |
| Primary education          | 0.512**     | 2.03        | 1.499**    | 2.65        | 0.524**     | 2.07        | 0.399**     | 2.04        | 0.438**     | 2.45        |
| Secondary education        | 0.551**     | 2.18        | 0.698**    | 1.82        | 0.551**     | 2.18        | 0.128***    | 3.61        | 0.507***    | 2.68        |
| Tertiary education         | 0.158       | 1.70        | 0.212      | 0.89        | 0.157       | 1.64        | 0.497       | 0.38        | 0.317       | 1.69*        |
| Marital status             | 0.270       | 0.67        | 0.150      | 1.53        | 0.156       | 0.13        | 0.382       | 1.60        | 0.274       | 0.86        |
| Farm size                  | 0.834***    | 3.85        | 0.841      | 0.85        | 0.255***    | 2.90        | 0.287       | 0.17        | 0.241**     | 2.29        |
| Farm productivity          | 0.307***    | 3.45        | 0.432      | 1.58        | 0.329***    | 3.18        | 0.185***    | 3.29        | 0.143***    | 3.35        |
| Asset                      | 0.663       | 1.54        | 0.127***   | 3.21        | 0.675***    | 3.56        | 0.0177      | 0.15        | 0.175***    | 3.31        |
| Savings                    | 0.125***    | 3.14        | 0.276***   | 3.11        | 0.226       | 1.45        | 0.144***    | 2.73        | 0.137***    | 2.94        |
| Primary occupation         | 0.153       | 1.08        | 0.160      | 0.76        | 0.146       | 0.45        | 0.499       | 1.32        | 0.297       | 1.23        |
| Distance to farm           | -0.247      | 0.89        | -0.329     | -0.40       | -0.572**    | -2.04       | -0.653      | -0.90       | -0.489***   | -3.53       |
| Meeting attendance         | 0.269**     | 2.47        |            |             |             |             |             |             |             |             |
| Decision making            | 0.819**     | 2.30        |            |             |             |             |             |             |             |             |
| Cash contribution          | 0.401***    | 2.55        |            |             |             |             |             |             |             |             |
| Membership density         | 0.161***    | 2.76        |            |             |             |             |             |             |             |             |
| Labour contribution        | 0.703       | 1.51        |            |             |             |             |             |             |             |             |
| Heterogeneity              | 0.644       | 1.07        |            |             |             |             |             |             |             |             |
| Aggregate social capital   | 0.807***    | 3.43        |            |             |             |             |             |             |             |             |
| Instrumented social capital| 0.861***    | 2.86        |            |             |             |             |             |             |             |             |
| Social capital × social capital residual | 0.428***  | 3.49        |            |             |             |             |             |             |             |             |
| Constant                   | 2.703***    | 5.22        | 3.387      | 2.81        | 2.689       | 5.16        | 3.373***    | 3.32        | 2.647***    | 3.86        |
| Adjusted R²                | 0.237       | 0.379       | 0.254      | 0.249       | 0.292       | 0.292       | 0.462***    | 48.76***    | 0.462***    | 48.76***    |

*significance at 10 percent, ** significance at 5 percent, *** significance at 1 percent Source: Field survey, 2018
the households increased the food security by 0.125 calories. This is because households may adjust to continual lack of access to credit and save money to improve their food security. The model suggests that households’ socio-economic characteristics, farm specific and credit variables play a significant role in improving food security in the study area.

The second column of Table 7 shows the inclusion of six additive forms of social capital variables identified in this study. These include density of membership, decision making, cash contribution, labour contribution, meeting attendance and heterogeneity. The rationale behind the model is to examine the food security of the households while they are involved in social capital activities. This new model has a better food security level as reflected in the Chi² of 45.50. This suggests that household food security improves as households become involved in the affairs of their social groups. This model shows that the effect of social capital on food security is traceable to meeting attendance, decision making, membership density and cash contribution (Adepoju and Oni, 2012). Meeting attendance significantly influenced food security of the cocoa-based farming households. The implication of this is that a unit increase in attendance of meetings increased the food security of farmers by 0.269 calories. This is due to the fact that participants who recurrently attended group meetings have access to farming and entrepreneurial abilities to improve their farm productivity, which improves their food security status. Decision making index significantly influenced food security of the cocoa-based farming households. The implication of this is that a unit increase in participation of household members in the decision of the group increased the food security by 0.819 calories. This is because farmers who participated actively in decision making of the social groups are well situated to enjoy the benefits of their association, which improves their food security. Cash contribution significantly influenced food security of the cocoa-based farming households. The implication of this is that a naira increase in the amount contributed to their social groups increased food security by 0.401 calories. Farmers’ cash commitment in many social groups enhance their access to loan for consumption purposes, thereby resulting in improved food security. Membership density significantly influenced food security of the cocoa-based farming households. The implication of this is that a unit increase in the number of social groups a farmer belongs to, increases food security by 0.161 calories. As individuals increase the number of groups, they have active participation; the probability of accessing loans for consumption purpose in many groups is high, thereby resulting in improved food security.

Since the additive form of social capital improves the food security of the households, there is a need to investigate the endogeneity effect of social capital on the economic outcome. The introduction of multiplicative social capital variable in the third column of Table 7 lays the foundation for investigation into the endogeneity effect of social capital. The inclusion of this variable led to slight improvement in the Chi² of 48.91. This result is similar to the finding of Agbonola et al. (2016). Along with the socio-economic/demographic variables, aggregate social capital significantly influenced the food security of cocoa-based farming households. The implication of this is that a unit increase in aggregate social capital increased the food security of the farmers by 0.807 calories. This implies that participation in social groups enhances members’ welfare including food security.

However, accounting for strong bi-directional causality between social capital and food security (Balogun and Yusuf, 2011) using the aggregate social capital model, the original social capital was replaced by an instrumental variable (length of residency). The instrumental variable method leads to a bit higher coefficient for the social capital than in the actual social capital model. This implies that the direct effect of social capital outweighs the reverse effect in the explanation of the correlation between the two variables. A unit increase in the instrumented social capital would increase the food security of households by 0.861 calories. However, with the control for linear interactions of social capital with unobservables, the coefficient reduced (0.428). This result is adopted, because it takes into account the interactions between social capital and the unobservables in its effect on food security. Based on the result, social capital is endogenous to food security and should be explored among people of similar characteristics in order to improve their food security status. Thus, social capital is an important factor in improving the cocoa farming households’ food security in Southwestern Nigeria.

4.5.1. Sargan test of instrumental variables

The instrumental variable approach is the most efficient way to account for all forms of endogeneity, provided suitable instruments are identified. However, the necessary condition is that the proposed instrument must be correlated with the endogenous explanatory variable, but uncorrelated with the dependent variable and error term (valid) (Murray, 2006; Burgess et al., 2016). On the basis of correlation analysis, two instruments such as length of residency and membership in ethnic group were identified. The next challenge is identifying a suitable instrument satisfying sufficient conditions of the Sargan test of over identification. In this regard, Sargan standard overidentification test for validation of the instruments was carried out. The satisfying condition is that the instrument’s p value must exceed significance values of 0.1, to be a valid instrument (Gujarati, 2003; Cawley and Meyerhoefer, 2012; Howley et al., 2015; Cawley et al., 2018). The Sargan result of overidentification test is presented in Table 8 and only length of residency is reported to be a valid instrument, because its p value exceeds significance values of 0.1. Thus, on the basis of correlation and Sargan analyses, length of residency was selected to address the endogeneity issue from participation in social networks. Therefore, our estimates on the impact of social capital on farm productivity and food security is unbiased and consistent.

5. Conclusion and policy recommendations

This study is centred on the effect of social capital on farm productivity and food security. The study also determined the factors affecting the probability and level of household participation in social groups. Data collected were analysed by Heckman two-step procedure and 3SLS models. The factors influencing the probability of household participation in social groups were asset, age, years of education, gender, farm size, land tenure, loan interest rate, and extension visit. The factors influencing the level of household participation in social groups were age of household head, years of education, membership in agricultural organization, off farm income, land tenure, interest rate, distance to credit sources, extension visit, decision making, cash contribution, and labour...
contribution. The determinants of farm productivity of the cocoa-based farming households were age, household size, years of farming experience, farm size, interest rate, loan time lag, and social capital indexes such as meeting attendance, decision making, density of membership. The determinants of food security of the cocoa-based farming households in the study area were age, household size, years of education, years of farming experience, farm size, farm productivity, savings, and social capital indexes such as meeting attendance, decision making, density of membership. It is evident from the result of two-way causal relationship between social capital and farm productivity and food security that social capital groups greatly improve farm productivity and food security of cocoa-based farming households. The study concluded that social capital in no small measure improves farm productivity of the cocoa-based farming households. This will in turn improve their income and household food security. We recommend that any intervention to combat the problem of food insecurity among cocoa-based farming households should implement appropriate measures that improves productivity. Such measures should involve encouraging cocoa farmers to join social groups to improve their farm productivity. Also, agricultural credit should be given to cocoa farming households based on their social collateral. This would enhance cocoa farming households’ access to productive resource and thus achieve financial leverage that would further boost farm productivity on cocoa-based farms.

Declarations

Author contribution statement

Kehinde A. D.: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Adeyemo R.: Conceived and designed the experiments; Performed the experiments; Wrote the paper.

Ogundje A.A.: Conceived and designed the experiments.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability statement

Data will be made available on request.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

References

Adeniyi, O.R., Ojo, O.A., 2013. Food security status of rural farming households in Iwo, eyidie and ayaedae local government areas of Osun state, south-western Nigeria. Afr. J. Food Nutr. Sci. 13 (5), 8209-8223.

Adeogun, S.O., 2008. Adoption of cocoa rehabilitation techniques among cocoa farmers in selected states of Nigeria. An unpublished Ph.D Thesis in the Department of Agricultural Extension and Rural Development. University of Ibadan, Ibadan Nigeria, p. 86.

Adeoye, S.O., Ugahili, U.B., 2017. Smallholder food crop farmers participation in bank of agriculture (Boa) loan scheme in Ogun state, Nigeria. Agrossearch 17 (2), 51-66.

Adepoju, A.A., Salman, K.K., 2013. Increasing agricultural productivity through rural infrastructure: evidence from Oyo and Osun states, Nigeria. Int. J. Appl. Agric. Apicult. Rev. 9 (1&2), 1–10.

Adepoju, A.O., Adejai, K.O., 2013. Food insecurity status of rural households during the post planting season in Nigeria. J. Agric. Sustain. 4 (1), 16–35.

Adepoju, A.A., Oni, O.A., 2012. Investigating endogeneity effects of social capital on household welfare in Nigeria: a control function approach. Q. J. Int. Agric. 51 (1), 73-96.

Adongo, A., Mwaara, F., Okobo, G., 2013. What factors determine membership to farmer groups in Uganda? Evidence from the Uganda census of agriculture 2008/9. J. Sustain. Dev. 6 (4), 37-50.

Aghola, P.O., 2014. Factors influencing Food insecurity among small holder farmers in Nigeria. Afr. J. Agric. Res. 9 (27), 2104-2110.

Aghola, W.L., Yusuf, S.A., Olofinyinmi, M.T., 2016. Effect of social capital and access to microcredit on productivity of anable crop farmers in Kwarra state, Nigeria. J. Agric. Vet. Sci. 9 (20), 9-16.

Ajani, O.I.Y., Tijani, G.A., 2009. The role of social capital in access to microcredit in Ekiti State, Nigeria. Pakistan J. Soc. Sci. 6 (3), 125-132.

Amuoyobie, B.J., Banire, A.S., Kehinde, A.D., Owoesenele, A., Latiffou, I., 2018. Analysis of farm productivity in integrated tree cropping systems of southwestern Nigeria. J. Exp. Agric. Int. 24 (5), 1-8.

Aryi, M., 2015. The effect of social capital on access to micro credit among rural farming households in Anhia state, Nigeria. Agronomus 15 (1), 59-75.

Asa, U.A., Archibong, E.M., 2016. Social capital and food security among rural farming households in Akwa Ibom State, Nigeria. J. Art Soc. Sci. Human. 2 (2), 15-19.

Atagher, N.M., 2013. Effects of Benue ADP’s Cassava Production Technologies on the Productivity and Incomes of Women Farmers in Benue State, Nigeria PhD Thesis. University of Nigeria, Nsukka, Nigeria.

Baddoud, A., Lightsey, R., Montier, J., Guerero, F., 2009. A survey of payday borrowers, Huron consulting. pro-Borne data analysis. In: Texa Appleseed. Texa Appleseed, U.S.A., pp. 1-30.

Balogun, O.L., Ogunnia, L.J., Ayo-Bello, T.A., Afoji, O.J., 2018. Effects of social capital on productivity of cassava farmer in Oggun State, Nigeria. J. Agric. Sci. 63 (1), 99-112.

Balogun, O.L., Yusuf, S.A., 2011. Effects of social capital on welfare of rural households in South-western states, Nigeria. J. Agri. Sci. 7 (3), 506-514.

Balogun, O.L., Yusuf, S.A., Olofinyinmi, M.T., 2017. Effects of social network on production output of maize farmers in Kwarra state, Nigeria. Glob. Adv. Res. J. Agric. Sci. 6 (2), 31–38.

Balogun, O.L., Yusuf, S.A., Olofinyinmi, M.T., 2013. Social capital and micro-credit effects on poverty among the rural households in Southwestern, Nigeria. ARPN J. Agric. Biol. Sci. 6 (3), 6140-6145.

Balogun, O.L., Bello, T.A., Afoji, O.J., 2015. Determinants of farm productivity among fluted pumpkin (Telfaria occidentalis Hook. F) farmers in ikenne local government area, Ogun state, Nigeria. Ethiop. J. Environ. Stud. Manag 8 (2), 152-160.

Blach, P.M., Cannon, T., Davis, W., Winner, B., 1991. At Risk: National Hazards,people’s Vulnerability and Disasters. Routledge, London and New York.

Burgess, S., Dubbridge, F., Thompson, S.G., 2016. Combining information on multiple instrumental variables in mendelian randomization: comparison of allele score and summarized data methods. Stat. Med. 35, 1880-1906.

Cawley, A., O’Donoghue, C., Hanne, K., Hilliard, R., Sheehan, M., 2018. The impact of extension services on farm-level income: an instrumental variable approach to combat endogeneity concerns. Appl. Econ. Perspect. Pol. 40 (4), 585-612.

Cawley, J., Meyer-Heerof, C., 2012. The medical care costs of obesity: an instrumental variables approach. J. Health Econ. 31, 219-230.

Degefu, T., 2009. An assessment of the role of local institutions and social capital in household food security: a case study at two rural communities in omoora zone, amhara region. In: Eg, S., Aspen, H., Tefera, B., Bekele, S. (Eds.), Proceedings of the 16th International Conference of Ethiopian Studies, Deveroux, S., 1993. Theories of Famine. Harvester Wheatsheaf, London.

Deveroux, S., 2001. Livelihood insecurity and social protection: a re-emerging issue in rural development. Dev. Pol. Rev. 19 (4), 507-519.

DFID, 1999. Sustainable Livelihoods Guidance Sheets. DFID, London.

Egbetokun, O.A., Omomoona, B.T., Obiyole, K.A., 2014. Economic analysis of sickness and labour productivity among cocoa farmers in obafemi owode local government area of Ogun state. J. Biol. Agric. Healthcare 4 (20), 78–84.

Enobong, F.U., Bishop, E.O., Ohisuma- Theresa, O.S., 2016. Comparative analysis of three-stage least squares and multivariate regression method of estimating parameters of simultaneous equation models. J. Basic Appl. Sci. 6 (7), 7-14.

Fakiyemi, O.M., 2001. Encouraging growth to reduce poverty in Nigeria. C.B.N: Nig. Econ. Fin. Rev. 39 (2), 61–91.

Fawehinmi, O.A., Adeniyi, O.R., 2014. Gender dimensions of food security status of households in Oyo State, Nigeria. Global J. Health Sci. 14 (1), 7–15.

F.A.O., 2005. Food Security, Agricultural and Development Economics Division . Food and Agriculture Organization of the United Nations.

Fuleh, C.B., 2013. Small-scale versus large-scale cocoa farming in Cameroon: which farm type is more efficient for the future? Agric. Food Environ. Pol. Analysis 829, 1401–4084.

Google map. Retrieved at. https://www.researchgate.net/figure/Map-of-Nigeria-showing-the-Southwest-States-Source-articlesapuborgsors_fig1_322661602%2012/03/2019.

Gujarati, D.N., 2003. Basic Econometrics. McGraw Hill, New York.

Hameem, R.A., Olaiya, A.O., Sanusi, R.A., Adejai, A.R., 2006. State of Cocoa Growing, Quality and Research in Nigeria: Need for Intervention. A Technical Presentation at the Biannual Partnership Programme of the World Cocoa Foundation, Bruxelles, Belgium. Distinct Global Concepts Company (DGCC), Lagos, Nigeria.

Heckman, J.J., 1979. Sample Selection Bias as Specification Error. Econometrica 47 (1), 153–161.

Howley, P., O’Neill, S., Atkinson, R., 2015. Who needs good neighbors? Environ. Plann. A 47, 909-956.

Idrisa, Y.L., Ogunbamure, B.O., Madukwe, M.C.J, 2012. Logit and Tobit analyses of the determinants of likelihood of adoption and extent of adoption of improved soybean seed in Borno State. Nig. Greener J. Agric. Sci. 2 (2), 37–45.

Iqbal, A., Afzal, C.A., Chayah, C.A., Liao, G., 2014. Social capital and access to credit among cassava farming households in Ogun State, Nigeria. J. Agric. Environ. Sci. 3 (2), 175–196.
Kangogo, D.K., Job, L., Gicuru, L., 2013. The Influence of Social Capital Dimensions on Household Participation in Micro-credit Groups and Loan Repayment Performance in Uasin Gishu County, Kenya. Unpublished M.Sc. Thesis Submitted to Department of Agricultural and Applied Economics of Egergon University.

Katungi, E.M., 2007. Social Capital and Technology Adoption on Small Farms: The Case of Keenan D.P., Olson C, Hersey JC and S M Parmer ‘Measures of Food Insecurity/Security. Journal of Nutrition Education 33 (1), 49–58.

Kehinde, A.D., Adeyemo, R., Amujoyebe, B.J., Bamire, A.S., Idristou, L., 2016. Gender differentials and fertilizer adoption among small holder farmers in cocoa based farming system of Southwestern, Nigeria. Int. J. Agric. Pol. Res. 4 (12), 276–281.

Key, N., Mcbride, W., 2003. Production contracts and productivity in the U.S. Hog sector. Am. J. Agric. Econ. 85 (1), 121–133.

Koutsouyiannis, A., 2003. Theory of Econometrics, second ed. Palgrave Publishers, New York, N.Y. 10010, p. 681

Lalw, J.O., Omonota, B.T., Ajani, Y., Osi, A., 2009. Effects of social capital on credit access among Cocoa farming household in Osun State, Nigeria. Agric. J. 4 (4), 184–191.

Liverpool-Tasie, L.S., 2012. Farmer Groups, Input Access, and Intragroup Dynamics A Case Study of Targeted Subsidies in Nigeria. IFPRI Discussion Paper 01197.

Ojo, M.A., Jibowo, A.A., 2008. Socio-economic characteristics in income generation in Osun State, Nigeria. J. Agric. Sci. Environ. 13, 92–103.

Ogundile, A.S., Adeyemo, R., Ramírez, A.S., Kehinde, A.D., 2017. Assessment of profitability and efficiency of cassava production among government and non-government assisted farmers association in Osun State, Nigeria. Afr. J. Rural Develop. 2 (2), 225–233.

Ojo, E.O., Adebayo, P.F., 2012. Food security in Nigeria: an overview. Eur. J. Sustain. Dev. 1 (2), 199–222.

Ojo, M.A., Jibowo, A.A., 2008. Socio-economic characteristics influencing role performance of rural community power actors in agricultural extension delivery system in Osun state, Nigeria. J. Agric. Rural Dev. 2, 27–40. Swaziland Printing and Publishing Company Limited Mbabane, H100 Swaziland.

Okojie, C., Monye-Emina, A., Eghafona, K., Osaghae, G., Ebiakhamen, J.O., 2010. Institutional Environment and Access to Microfinance by Self-Employed Women in the Rural Areas of Edo State. NSSP Brief No. 14. International Food Policy Research Institute, Washington, D.C.

Okunmadewa, F.Y., Yusuf, S.A., Omonota, B.T., 2007. Effects of social capital on rural poverty in Nigeria. Pakistan J. Soc. Sci. 4, 331–335.

Ohagandu, F.I., Adeyemo, R., 2008. Evaluation of the operational performance of the Nigerian agricultural credit cooperative and rural development bank (NACRDB) in South-western Nigeria. Int. J. Agric. Econ. Develop. 1 (1), 53–67.

Olutayo, I.B., 2015. Healthcare service delivery system and households’ welfare status in urban southwest Nigeria. J. Hum. Ecol. 50, 181–187.

Oluyole, K.A., 2011. Food security status among cocoa growing households in Ondo and Kwara states of Nigeria: a discriminant analysis approach. Afr. J. Food Nutr. 11 (7), 617–623.

Oluyole, K.A., Taiwo, O., 2016. Socio-economic variables and food security status of cocoa farming households in Ondo state, Nigeria. Asian J. Agric. Extens Econ Sociol. 9 (1), 1–7.

Oluyole, K.A., Oni, O.A., Omonota, B.T., Adenegan, K.O., 2009. Food security among cocoa farming households of Ondo State, Nigeria. ARPN J. Agric. Biol. Sci. 4 (5), 7–14.

Oluyole, K.A., Usman, J.M., Oni, O.A., Adewole, O.O., 2013. Input use efficiency of cocoa farmers in Ondo State, Nigeria. J. Finance Econ. 1 (1), 8–10.

Omonota, B.T., Akinterinwa, A.T., Awoyinka, Y.A., 2008. Credit constraint and output supply of cowan farmers in Oyo state Nigeria. Eur. J. Soc. Sci. 6 (3), 382–390.

Otunaiya, A., Lawal, M.A., Kehinde, A.F., 2016. Determinants of level of participation of farmers in group Activities in Kwara state, Nigeria. Agric. Fac. Gazioumanpasa Univ. 33 (3), 21–27.

Purum, R., 1995. Bowling alone: America’s declining social capital. J. Democ. 6 (1), 65–78.

Putnam, R.D., 1995. Bowling alone: America’s declining social capital. J. Democ. 6 (1), 65–78.

Rahji, M.A.Y., 2007. Rural infrastructure, farm output and productivity nexus in a multicropping system, the case of Oyo state, Nigeria. In: Proceedings of the 21st Annual National Conference of Farm Management Association of Nigeria, 3–6 September 2007. Olabisi Onabanjo University, Yewa Campus, Ayetoro, Nigeria, p. 165.

Saleh, M.K., 2013. Food security and Productivity among urban farmers in Kaduna state, Nigeria. J. Agric. Ext. 22 (1), 171–180.

Sen, A., 1981. Poverty and Famine: an Essay on Entitlement and Deprivation. Oxford Clarendon Press.

Tambi, M.D., Lum, M.M., 2020. Effects of social capital on cocoa production in Cameroon. Int. J. Bus. Econ. 2 (1), 1–17.

Uloth, E.J., 2015. Analysis of Food Security Status in Fishing and Farming Households of Oron Local Government Area. unpublished B. Agric. Department of Agricultural Economics and Extension, University of Uyo. Washington, S., Karlaftis, M.G., Mannering, F.L., 2011. Statistical and Econometric Methods for Transportation Data Analysis, second ed. CRC Press, Boca Raton, FL.

World Bank, 2014. Participation and civic engagement. Retrieved from http://go.worldbank.org/FKWKNE86V0.

Woolridge, J.M., 2013. Introductory Econometrics - A Modern Approach. Cengage, South-Western.