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Electronic wallet technology and the enabling environment of smallholder farmers in Nigeria [1]

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Electronic wallet technology and the enabling environment of smallholder farmers in Nigeria

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Abstract

Purpose – The purpose of this paper is to critically examine the impact of growth enhancement support scheme (GESS) on the enabling environment of smallholder farmers in sub-Saharan Africa. Its special focus is to investigate the GESS impact on access to rural farm credit and transport cost of smallholder farmers in the agricultural transformation agenda (ATA) in Nigeria.

Design/methodology/approach – This paper adopts a survey research technique, aimed at gathering information from a representative sample of the population, as it is essentially cross-sectional that describes and interprets what exist at present. A total of one thousand, two hundred farmers were sampled across the six geopolitical zones of Nigeria.

Findings – Results from the use of a double-hurdle model indicate that the GESS has a significant impact on farmers' access to credit, but does not significantly affect rural farm transport cost, which subsequently influence the price of food in the country.

Practical implication – This implies that if the federal government of Nigeria is to work towards an ideal agricultural transformation agenda, transport networks should be closely aligned with the GESS priorities to provide connectivity to rural areas that provide most of the country's agricultural output.

Originality/value – This research adds to the literature on agricultural and rural development debate in developing countries. It concludes that embracing rural finance and transportation infrastructure should form the foundation of the ATA in Nigeria, which in turn would provide the enabling environment for more widespread rural economy in sub-Saharan Africa.

*JEL Classification***:** Q10; Q14; L96; O40; O55
Keywords: Agricultural transformation agenda, Double-hurdle model, Smallholder farmers' enabling environment, Growth enhancement support scheme, Electronic wallet technology, Sub-Saharan Africa.

1. Introduction

In Nigeria, the provision of financial services to commercial agriculture is widely recognized as a critical factor in enabling the private investors to participate in the agricultural sector (World Bank, 2014). Like most African countries, agricultural credit in Nigeria comes from both formal and informal credit sources. The informal sources include private moneylenders, farmers' associations and cooperative societies (Uduji *et al,* 2018a). The formal sources include credit from financial institutions such as: commercial banks, microfinance enterprises and credit unions. According to World Bank (2008), a major factor limiting agricultural production in Nigeria is poor access to the banking system by majority of the farming population; limited physical access to bank branches that keep investments in agriculture low, especially among smallholders despite the FGN stipulated mandate that a certain percentage of commercial bank branches must be apportioned to the rural sector. The World Bank (2014) report showed that in 2012, only about 14 percent of the rural population were banked; whereas 86 percent were unbanked; 37 percent of the adult male population had access to formal banking, a factor that might be responsible for low credit extension to rural households; only about 18 percent of the smallholders received credits from both formal and informal sources; despite the fact that the agricultural sector accounts for about 40 percent of the country's GDP. Further, a lack of collateral among smallholders and high interest rates ranging from 22 to 30 percent charged on loans to farmer borrowers, were identified among the major barriers to accessing farm credits by the rural dwellers (Uduji *et al,* 2018b). Other financial instruments like those offered by warehouse receipt systems and credit reference bureaus, which represent effective alternatives to conventional collateral in some countries are absent in Nigeria (World Bank, 2014). Against this backdrop, this investigation aims to examine the extent to which the GESS, in line with the ATA, has impacted on the smallholders' access to farm credit in rural Nigeria.

Nigeria liberalized agricultural input distribution and launched the growth enhancement support scheme (GESS) in 2012. GESS represents a shift from the previous fertilizer market stabilization programme to a new scheme that put the resource-constrained farmers at the center of the input subsidy policy (IFDC, 2013). The scheme delivers subsidized agricultural inputs to farmers through electronic wallet (instead of the previous paper vouchers), in which farmers use unique coded numbers that are delivered to their phones to redeem their input allocation from accredited agro dealers (Akinboro, 2014). A technical facilitator, Cellulant

Limited that oversees the GESS technology platform through which farmers are registered and the input subsidy delivered, manages the new scheme. The GESS is conceived and designed by the Federal Ministry of Agriculture and Rural Development (FMARD) to lift 20 million smallholder farmers out of subsistence into self-sufficiency; through a market-led approach to production, processing and marketing of agricultural products in the country (Olomola, 2015). It is structured to disengage government from farm input procurement and distribution, and shift the responsibility to private sector actors, such as financial institutions, producers, distributors, agro dealers, and warehouse receipt operators to own and operate the value chain for farm inputs and outputs. The electronic wallet is the convergence point through which farmers receive the GESS facility from the governments, and links them to the agro dealers, input suppliers, financial institutions, and insurance scheme (Adesina, 2013). The scheme is supposed to create a viable market based to stimulate demand for agricultural inputs by putting a cash component of the product value directly into the hands of the smallholder farmers (Akinboro, 2014).

In 2012, the federal government of Nigeria (FGN) launched the Growth Enhancement Support Scheme (GESS) to transform the delivery of agricultural input subsidies in the six geopolitical zones of the country. Under the GESS, the government's role shifted from direct procurement and distribution of agricultural input to facilitation of procurement, regulation of input quality, and promotion of the private-sector input value chain (Adesina, 2012). As a model, the GESS has faced criticism, and there has been debate over its utility and pragmatic application. While the advocates of GESS see it as a medium for potentially strengthening government-farmer relationship (Grossman and Tarazi, 2014; Uduji and Okolo-Obasi, 2018c; Olomola, 2015; Adenegan *et al*., 2018; Adebo, 2014); critics view it as grounds for new tasks to be required of old institutions (Fadairo *et al.,* 2015; Nwalieji *et al.,* 2015; Trini *et al,* 2014).

Meanwhile, because of inadequate access to farm land under the current Nigeria's land tenure system, many small farms are fragmented and scattered in different locations that raise transportation costs and makes mechanization more difficult and cumbersome; this may explain why only 46 percent (32 million ha) of the country's arable land is cultivated (World Bank, 2008). The price of food is affected by high transport cost; the rural unpaved roads are in particularly poor condition; their condition worsens during the rainy season, which also is the land preparation and planting season (Kassali *et al,* 2012; Uduji & Okolo-Obasi, 2018d, 2019). Informal moneylenders, who generally provide easy access to credit but at higher cost,

charging poor borrowers nominal monthly effective interest rates that typically range from about 10 percent to more than 100 percent, serve many of the rural farmers. As the enabling environment (in terms of access to credit and rural farm transport) has been identified as a major challenge that must be overcome to increase agricultural productivity (FAO, 2013), we hypothesize that the GESS, which is in line with the Nigeria's Agricultural Transformation Agenda (ATA) does not impact on the enabling environment of smallholder farmers in the rural areas. Thus, this investigation contributes to the agricultural and rural development debate by assessing the empirical evidence in three areas that have received much attention in the literature:

- Does the GESS impact on smallholder farmers' access to credit in rural Nigeria?
- To what extent does the GESS impact on smallholders' farm cost of transport in rural Nigeria?
- What are the consequences of an enabling environment for smallholder farmers in rural Nigeria?

2. Rural finance in Nigeria

Agriculture has enormous potential to help reduce poverty, raise incomes and improve food security for 80 percent of the world's poor, who live in rural areas and work mainly in farming (FAO, 2013). It is the predominant sector in Africa employing about 55 percent of the population, mostly in rural areas and making significant contributions to the gross domestic product (GDP) and foreign exchange earnings in the region (Gregory & Bumb, 2006). In spite of its major role in sub-Saharan Africa, agricultural productivity remains low and the people depending on farming are generally poor (Uduji & Okolo-Obasi, 2017, 2018a). With agriculture accounting for about 65 percent of the region's employment and 75 percent of its domestic trade, significant progress in reducing hunger and poverty across the region depends on the development and transformation of the agriculture sector (AU-NEPAD, 2003). Transforming agriculture from a largely subsistence enterprise to a profitable commercial venture is both a prerequisite and a driving force for accelerated development and sustainable economic growth in sub-Saharan Africa (Benin and Yu, 2013; Uduji *et al* 2018b).

Globally, small farms in developing countries, especially those in Africa face a number of hurdles including low productivity, limited access to market their products, lack of adequate

risk management for produce and services, and limited access to finance (IFAD, 2010; Tchamyou & Asongu, 2017; Tchamyou, 2019a, 2019b; Asongu *et al,* 2019a, 2019b). While agriculture remains a key economic activity in Africa, only approximately 1 percent of the bank credit goes to the agricultural sector. However, about 47 percent of adults in rural areas have access to loans from informal financial institutions (IFC, 2014; Uduji *et al,* 2019a). Although access to financial services to small farms is not a means, it is a critical factor to providing funds for the farm investments in productivity, improving post-harvest practices, smoothening household cash flows, enabling better access to markets, and promoting better farm management risks (IFAD, 2007). It also plays an important role in climate adaptation and increases the resilience of farming to climate change; thus contributing to food security plans among the vast majority of farmers in sub-Saharan Africa (IFAD, 2003; Uduji *et al,* 2019b).

3. Rural transport in Nigeria

Sub-Saharan Africa is compared unfavourably with other regions of the world on rural transport infrastructure, intermediate means of transport and transport services, the efficiency of farm transport and marketing, and on costs of transport (Hine, 2014). Poor accessibility in the rural areas of the region perpetuates the deprivation trap by denying communities access to their most basic needs (Donnges, 2003). In sub-Saharan Africa, most rural transport is conducted on an informal path and track network, which links villages, farms and sources of water and firewood (Airey, 2014). Traditionally, women incur most of the burden, particularly with regard to the collection of water and firewood (Uduji *et al,* 2019c). Poor accessibility limits access to several vital services in the region, such as markets, schools and health facilities, thereby limiting people's productive potential (Porter, 2013). The inefficient and unsafe transport system in the region is a key adverse knock-on-effect on livelihoods, the delivery of health and education, social interaction and the development of agriculture and the service sector (Starkey, 2007). The problems of rural transport are largely the manifestation of a wider vicious circle of rural poverty in sub-Saharan Africa (Raballand *et al,* 2010).

Transport infrastructure is an important factor in enabling farmers to operate, particularly in rural areas of developing countries (Ellis, 1997). In Nigeria, this consists mainly of road transport; but while the country has an extensive network of roads, most of its roads are in despair (Uduji *et al,* 2018b). Its rural transport indicators is compared undesirable with those

of its sub-Saharan Africa neighbours, both in terms of quality and service coverage (Banjo *et al,* 2012). The price of food is impaired by high transport costs, limited rail services, poor road conditions, frequent bottlenecks, and informal checkpoints; these have been identified among the causes of inefficiency and contributing factors that have slowed the pace of agricultural productivity in Nigeria (Kassali *et al,* 2012; Asongu *et al,* 2019a, 2019b). Lack of adequate funding by local governments, which is largely responsible for maintaining rural roads, is a challenge; the local government road networks that provide access for transporting farm produce from farmlands to first points of sale is described as highly dilapidated with more than 70 percent impassable (World Bank, 2014; Uduji & Okolo-Obasi, 2018d, 2019). The poor state of rural roads increases travel time, post-harvest losses, and cost of transport. Against this backdrop, this research also aims to assess the GESS impact on rural farm cost of transport in Nigeria.

4. Growth enhancement support scheme in Nigeria

In Nigeria, agriculture is the economic mainstay of the majority of households, and is a significant sector in the overall macro economy. It is a major source of employment for the large and growing population and contributes about 40 percent on the average GDP (World Bank, 2014). It is a major source of raw materials for the agro-based industries and with the exception of the oil sector; the agricultural sector generates most foreign exchange revenue (FGN, 2017). Nigeria's diverse range of agro-ecological zone makes possible the production of a wide variety of agricultural products. Yet despite its rich endowment of agricultural resources, the sector has been growing at a very low rate; and less than 50 percent of the country's arable land is under cultivation, mostly by smallholders and traditional farmers using rudimentary production techniques that are associated with low yields (FMARD, 2010). To increase yields and promote food security and rural development, FGN sought to subsidize agricultural inputs for smallholder farmers in the country.

Under the GESS, the federal government and state government contribute 25 percent of the input costs each, resulting in a 50 percent subsidy provided directly to smallholder farmers. The states and local governments are responsible for registering farmers (Grossman & Tarazi, 2014). Farmers manually fill out a machine-readable form; data are processed and captures in a national database; and farmers receive a unique GESS ID number (IFDC, 2013). If farmers have access to a mobile phone, their phones numbers are recorded during the registration process, and the system sends periodic messages confirming their registration, and notifying

them when and where to redeem their subsidy allocations. Registered farmers with mobile phones redeem subsidies using their phones; whereas those without phones can use available phones to redeem theirs (Akinboro, 2014). Registered farmers with phones receive a short message service (SMS) notification and proceed to the redemption center for collection. Registered farmers without phones would observe or hear that it is time to redeem input subsidies when the registered farmers in their communities begin to receive SMS'. At the redemption center, farmers pay 50 percent input cost and collect the allocation; whereas farmers who did not register with a phone number can use neighbors' phones to supply their GESS ID number. If the transaction is successful, both the farmer and the agrodealer receive confirmation messages authorizing input redemption. Compared with the prior subsidy scheme, the GESS has proven to be much more efficient and transparent; with improved transparency and accountability regarding the administration of the subsidy allocation and collection; as it has become easier to track and monitor deliveries to farmers (Uduji & Okolo-Obasi, 2018).

5. Theoretical perspectives

The term 'enabling environment' is increasingly used by a number of institutions in reference to an array of factors external to an enterprise (FAO, 2007). For instance, the Organization for Economic Co-operation and Development (OECD) refers to an enabling environment as one of the main incentives for foreign direct investment (OECD, 2003). FAO (2013) defines enabling business environments as sets of policies, institutions, support services and other conditions that collectively improve or create a general business setting where enterprises and business activities can start, develop and strive. According to Kuyvenhove (2004), the environment shapes the costs and risks of doing business, hence the competitiveness of an enterprise and its value creation abilities. The concept of an enabling environment can thus be associated with a situation in which entrepreneurs can operate and grow as a result of the presence, interaction and capacity of different institutions, policies and services (Abdula, 2008). Such an environment boosts the competitiveness of a business within its market. According to the World Bank (2004), an enabling environment where enterprises can thrive is an essential prerequisite for economic development. Therefore, creating an enabling environment is a key driver in attracting foreign and domestic investments, while the state of investments is also vital in reinforcing the enabling environments.

Focusing on agribusiness and agro-industries, Christy *et al* (2009) called the elements of an enabling environment the 'enabling needs'. The nine enablers identified by these authors were derived from the proceeding of FAO's regional workshops on enabling environments for agribusiness and agro-industries development (FAO, 2007). At the base of the hierarchy of the enabling needs for agro-industrial competitiveness, the government must provide 'essential enablers' that make possible the functioning of markets and enterprise. The 'important enablers' are second-order activities that government can and often does provide, such as finance, transportation and information. The 'useful enablers' are the third-order and are defined as sufficient but not necessary conditions, including grades and standards, linking small farmers to formal markets and business development services. The World Bank (2004) mentioned that investment brings structural changes to enabling environments, helps agribusinesses and agro-industries meet international market demands more effectively, and enhance enabling environments, transformed into competitive market. FAO (2013) and Asongu and Odhiambo (2019) suggested than an enabling environment generally refers to creating conditions that attract investments, create opportunities and incentives for businesses to thrive. However, following Christy *et al* (2009) on hierarchy of enabling needs, this study focused on 'essential enablers' environment in terms of access to credit and transport costs of small farms in rural Nigeria.

6. Methodology

The study adopts a survey research technique, aimed at gathering information from a representative sample of the population, as it is essentially cross-sectional that describes and interprets what exist at present. The study was carried out in six states in Nigeria, selected on purpose of the geopolitical zones as shown in Table 1.

6.1. Sample size

The sample size in this study was determined using Taro Yamane (1964) for finite population as in shown equation 1.Figure 1 identifies the constituent states of the geopolitical zones in Nigeria.

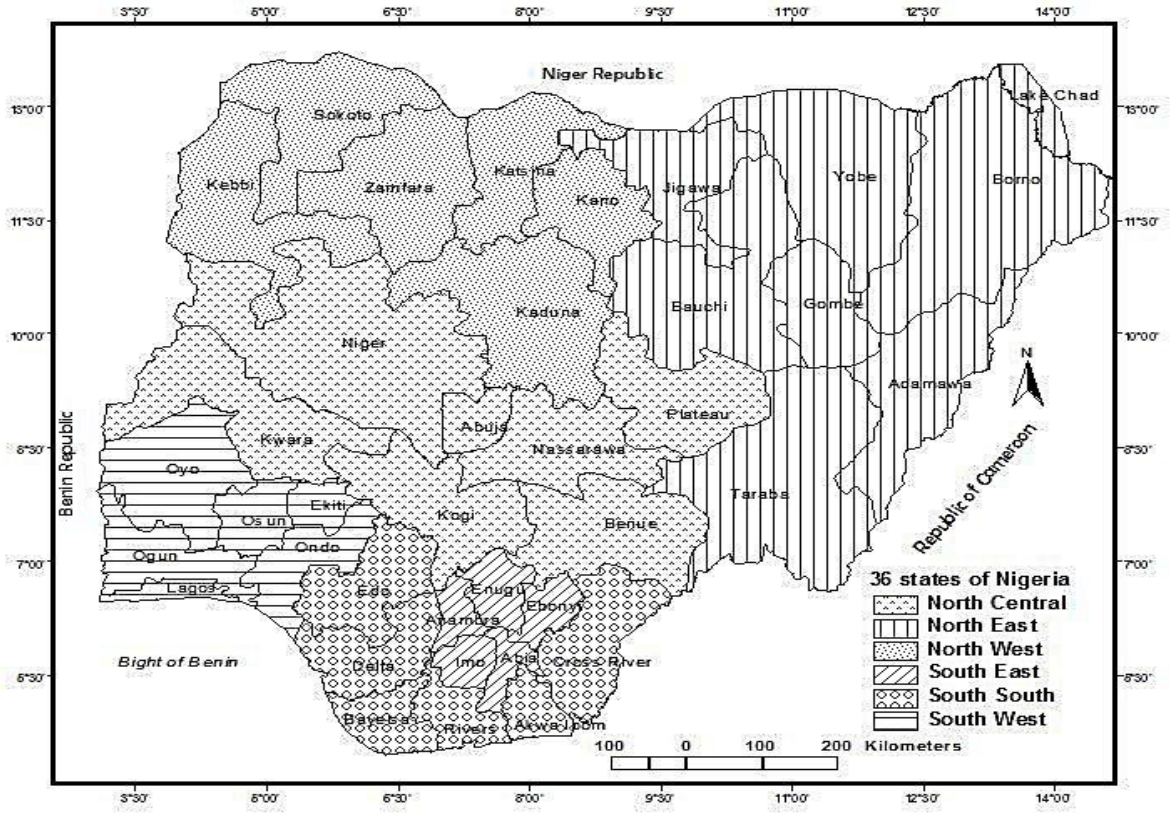

Figure1. Constituent states of the geo-political zones in Nigeria.

$$n = \frac{N}{1+N(e\times e)}$$ Equation 1

Where n = the sample size

N = total or finite population of the study area

e = level of significance (Limit of tolerable error)

1 = unity (constant)

The estimated total population of farmers in the study area is shown in table 1, hence

N = 18,204,578

And the level of significance of the study is 5%, which is a 95 percent confidence level, indicating that:

e = 0.05 percent

Thus:

$$\frac{18{,}204{,}578}{1 + 18{,}204{,}578(.05 \times .05)} = 400$$

This was multiplied by 3 as we are looking at three streams of farmers (i.e. those registered desired and access credit, those registered desired but could not access credit, as well as those

who did not register at all), to ensure that an adequate sample was selected for the study. Hence, the total sample size determined is 1,200 as shown in the population of selected states in Table 1.

Table 1 Sample size distribution

States (Geopolitical Zones)	Total Population	Farming Population	Sample per state	Sample per Community Regd. Farmers	Sample per Community Non Regd. Farmers
Adamawa(North-East)	3,178,950	2,384,213	156	17	9
Benue(North-Central)	4,223,641	3,167,731	210	23	11
Cross River(South-South)	2,892,988	2,169,741	138	16	8
Ebonyi(South-East)	2,176,947	1,632,710	114	12	6
Ekiti(South-West)	2,398,957	1,799,218	120	14	6
Kano(North-West)	9,401,288	7,050,966	465	52	26
	24,272,771	**18,204,578**	**1200**	**134**	**66**

Source*:* FMARD, 2010/authors' computation

6.2. Sampling procedure

To make for good responses in the study, multi-stage probability samplings was used to select the respondent farmers for the study. In the first stage, to ensure that the population is adequately represented, the states were clustered according to the six geopolitical zones of North-East, North-Central, North-West, South-East, South-South and South-West. In stage two, a purposive sampling was used to select one state from each of the six clusters (geopolitical zones) based on the intensity of agricultural practices (i.e the number of rural farmers in the state compare to the other states in the zone) in the states as follows: Benue State (North-Central), Adamawa State (North-East), Kano State (North-West), Ebonyi State (South-East), Cross Rivers State (South-South), and Ekiti State (South-West). In stage three, all the local government areas (LGAs) in each of the selected states were listed and using purposive sampling, two LGAs were selected from each state based on the intensity of agricultural practices (i.e the number of rural farmers in the LGA compare to the other LGAs in the state) in the LGAs. On this note, a total of twelve (12) LGAs were selected for the study. In the fourth stage, to ensure proper representation, the main communities in the selected LGAs were listed, and three communities were randomly selected from each LGA, giving a total of thirty-six rural farming communities. In the last stage, out of the thirty six communities selected, with the help of the community gate keepers, 600 registered farmers and 600 non-registered farmers were selected using purposive random sampling. About 800

registered farmers were selected from the list of registered farmers with the community gate keepers. Only the first 600 that agreed to respond to us were used as registered farmers. We also administered the questionnaire to the first 600 non-registered farmers that agreed to respond to us. The number of non-registered farmers that declined response was not taken into consideration. This was how a total of 1,200 respondents were generated as shown in Table 1.

6.3.Data collection

Data for this study were collected mainly from primary sources. A participatory rural appraisal (PRA) technique was used in the primary data collection. The semi-structure interview questionnaire was the major tool the study used for the household survey. The researchers with the help of a few local research assistants directly administered it. The use of local research assistants was because of the inability of the researchers to speak the different languages and dialects of the sampled rural communities.

6.4. Estimation issues

The objectives of the study are to:

- Ascertain the impact of participating in the federal government's GESS programme on smallholder farmers' access to credit in rural Nigeria.
- Assess the impact of participating in the federal government's GESS programme on smallholder farmers' cost of rural transport in rural Nigeria.
- Determine the consequences of an enabling environment for smallholder farmers in rural Nigeria.

Previous studies, such as Olomola (2015), Grossman and Tarazi (2014), Uduji and Okolo-Obasi (2018b)and Adenegan *et al* (2018) suggest positive impacts of the GESS on agricultural input distribution and farmers' income. However, it remains unclear whether these findings translate to improvement in the whole agricultural business indicators in the rural Nigeria, including the enabling environment. Hence, the main hypothesis of this study is that the federal government's GESS has not made a significant impact on farmers' enabling environment, in terms of access to credit and reduction in the cost of transport in rural Nigeria. In modeling the impact of the GESS and access to enabling environment, models like logit, probit and tobit would have appeal, but because two major decisions (to participate

in the government GESS programme and to access the enabling environment) are involved and the decisions are interdependent; the result of using the single model specifications is ineffective. Kefyalew *et al* (2016) and Tura *et al,* (2010) substantiated that using a single model may fail to capture the correlations between the two major decisions. Greene (2012) on his part opined that a model like the bivariate probit, double hurdle is more appropriate. The bivariate probit or double hurdle model is a natural extension of the probit model that will capture both the decisions to participate in the government's GESS programme, and also the decision to use the GESS to access credit (objective 1) and lessen cost of rural transportation (objective 2). It is on this note that the work applied a modified model of Uduji & Okolo-Obasi (2018a) to analysis the decisions. Analytical software - econometric view (E-view) and STATA were used in analysis. Results generated by both software were compared and the output of STATA was adopted. This is because STATA is particularly suitable to deal with both hurdles involved in the two models to properly access the enabling environment.

6.5. Why double-hurdle model?

In modelling the behavior of human being, especially when it comes to adoption and usage of innovations, Gebremedhin and Swinton (2003) argue that the two decisions of adopting and using of a new innovation by any "would be" adopters (say, young rural women in the case at hand) could be made jointly or separately. In the studies of innovation adoption and usage, there is always a probability of recording zero participation. For this reason, the Tobit model, which is an extension of probit model, has always been used to analyze adoption with the assumption that the two decisions are affected by the same set of factors (Tobin, 1958; Ajide et al., 2019). This has been described as an approach to deal with the problem of censored data (Johnson and Dinardo, 1997). However, scholars, such as Garcia (2013), Beshir*et al* (2012), and Eakins (2014) argue that Tobit model is very restrictive in its parameterization because of the assumption that the two decisions are affected by the same factors. Also, Arabmazar and Schmid (1982) argue that empirical results obtained with Tobit model often are not robust across distribution assumptions. The specification of an appropriate model could depend on the phenomenon that is assumed to give rise to the zeros. Therefore in the case of taking decision to participate in the e-wallet programme and the subsequent usage intensity of modern Agricultural inputs, the Tobit model assumes that zero participation are

observed when desired participation is not positive, hence truncating the dependent variable at zero.

However, Cragg (1971) provided another explanation to this by accepting that one may desire a positive participation but some other factors may effectively hinder the participation. Cragg argued that different factors may influence each of the two processes contrary to the assumption of the Tobit model. To this, Cragg proposed the "double hurdle" model which is more flexible parameterization than the Tobit model. The double-hurdle model is a parametric generalization of the Tobit model, in which two separate stochastic processes determine the decision to adopt and the level of adoption technology. In so many empirical studies, such as Akinbode and Dipeolu (2012), Rossini *et al,* (2015), a double-hurdle model has been used to achieve robust results. In this study, the double-hurdle model is based on the assumption that, participation in the GESS and using it to access the enabling environment, especially credit are two distinct or independent decisions to make. The model assumes that rural farmers make two subsequent decisions with regard to participating in the GESS, and adoption and accessing the enabling environment (in terms of rural credit and rural transport). The two-stage decision nature implies that participation and adoption of the innovation should be modeled jointly to partly gain estimation efficiency. The advantage of the double-hurdle model compared with the standard univariatetobit model for this study is that it provides a more flexible framework to model the observed rural farmers' behavior as a joint choice of the two decisions instead of a single decision.

6.6.Model specification

In line with Cragg model, there is a need to cross two hurdles in order to access the enabling environment. In the first objective, (access farm credit), the first hurdle to cross is participation in the government GESS as a registered farmer. The second hurdle is using the participation in accessing farm credit as an enabling environment. While the second hurdle in objective 2 is using the participation in government GESS to reduce transportation cost. However, other current circumstances of the farmer then indicate whether or not the farmer actually accesses the enabling environment. Hence, the two equations of the double hurdle model are written as:

$p_i^* = z_i\alpha + u_i$ Equation 2

$y_i^* = x_i\beta + v_i$ Equation 3

$$y_i = \begin{cases} x_i\beta + v_i & \text{if } y_i^* > 0 \\ 0 & \text{if } y_i^* \leq 0 \end{cases}$$ Equation 4

Also

$$t_i = \begin{cases} z_i\alpha + u_i & \text{if } t_i^* > 0 \\ 0 & \text{if } t_i^* \leq 0 \end{cases}$$ Equation 5

Hence $y_1 = x_i\beta + v_i$ if $pi^* > 0$ and $pi^* > 0$ and 0 otherwise Equation 6

Where p_i^* is a latent endogenous variable representing a rural farmers decision to participate in the e-wallet model; y_i^* is a latent endogenous variable representing the farmer's decision to access the enabling environment using the GESS model, $Y_I$is the observed dependent variable (accessing credit, and rural transport using GESS), z_i i s a set of individual characteristics explaining the decision to participate in the GESS; while, x_i represents variables explaining the decision of the farmer using the GESS and u_i and v_i are independent, homoscedastic, normally distributed error terms.

The double hurdle model is estimated using maximum likelihood techniques with the loglikelihood given as follows:

$$LL = \sum_{\cdot}^{\cdot} Log\left(1 - \emptyset(Z_i\,\alpha)\emptyset\left(\frac{Xi\beta}{\sigma}\right)\right) + \sum Log\left(\emptyset(Z_i\alpha)\frac{1}{\sigma_i}\emptyset\left(\frac{Y_i - X_i\beta}{\sigma_i}\right)\right)$$ equation 7

Therefore, the empirical model used to estimate the probit and the truncated model of the GESS participation, accessing of farm credit is given as follows:

$AFC=\beta_0 +Age\beta_1 +HEQ\beta_2+Gen\beta_3+MS\beta_4+HHsize\beta_5+ PGESS\beta_6+ Fsize\beta_7+ OPhone\beta_8+FExp\beta_9OFI\ \beta_{10}+ Oput\beta_{11}+MoNC\beta_{12}+ Rg\beta_{13} +LOT\ \beta_{14}+ Ext\ \beta_{15} + Dis\ \beta_{16} +\varepsilon$ - Eqn 8

While for objective 2 the empirical model is

$RTC=\beta_0+Age\beta_1+HEQ\beta_2+Gen\beta_3+MS\beta_4+HHsize\beta_5+PGESS\beta_6+Fsize\beta_7+OPhone\beta_8+FExp\beta_9 OFI\ \beta_{10}+ Oput\beta_{11}+MoNC\beta_{12}+ Rg\beta_{13} +LOT\ \beta_{14}+ Ext\ \beta_{15} + Dis\ \beta_{16} +\varepsilon$ Eqn 9

AFC: Access to rural farm credit by respondent rural farmers.

Other variables used in the estimation are:

Age = Age of a farmer (years)
HEQ = Highest level of educational qualification (years)
Gender = Sex of the respondent (Male = 1 Female = 0)
MS = Marital status of respondents (married = 1, unmarried = 0)
HHsize = Household size of a farmer (numbers)

PGESS = Participation in the GESS model (participant = 1, non-participant =0
Fsize = Size of farm cultivated by farmers (hectares)
Ophone = Ownership of mobile phones (1= owned, 0 = otherwise)
Fexp = Farming experience (years)
OFI = Off-farm income
Oput = Value of farm output in naira (₦) (Farm income)
MoNC = Mobile network coverage (1= covered and 0 = otherwise)
Rg Region of the respondent (North = 1, South = 0)
LOT = Land ownership type (1= inheritance, 0 = otherwise)
Ext = Contact with extension agent (Yes =1 and No =0)
Dis = Distance to fertilizer selling point (More than 10Km = far = 1,Less than 10Km =0)
ε_i = stochastic error term.

6.7. Explanatory variables

In modeling the double hurdle model of participation in the GESS and accessing an enabling environment (access to credit and rural transport), some important covariates were included so as to maintain reasonable degrees of freedom in the estimates (Deaton, 1997; Poirer, 1980; Men & Schmidt, 1985). Previous studies have suggested that adoption of new technology by farmers is an important determinant of the prosperity or otherwise of the farmers (Onyenweaku *et al,* 2010; Imoru & Ayamga, 2015). The decisions to participate in the GESS and the usage of the model to access an enabling environment are outcomes of interdependent decisions; hence the variable that determines the process of the decisions are overlapping. Such overlapping variables, which maybe household characteristics, farm and institutional characteristics used to estimate the hurdle model, are as follows: Human capital endowments - family size and composition, and education are main factors that generally influence adoption decisions of households (Tura *et al* 2010). While family size and its composition influence the decision from both the demand and supply sides of labour, education, which include skills and training affect the profitability of modern technology. According to Carletto*et al* (1999), such human capital assets reflect unobservable productive characteristics of the decision maker. Wozniak (1997) argues that education increases the ability of farmers to obtain, process, and use information relevant to the technologies. Also included is off-farm income of the respondent specified as total income less farm income and expressed in Nigeria naira. Income from the farming activities was excluded from the measure of income of the respondent and included as a separate covariate. Another important covariate included is value of farm output (farm income) of farmers measured in Nigerian naira; the measure of the

difference between the GESS participants and non-participants will go a long way in determining adoption and usage of the government GESS model.

Access to farm credit by farmers was included as a separate covariant. Also, of high importance is the age bracket of the respondent, which was included as it plays a major role in accepting or rejecting changes. A gender dummy was used to account for the differential effects of gender of the respondent on resource availability and decision-making. Though women are known to be more concerned about household welfare and development, they are often disadvantaged in terms of social status and economic opportunities (Uduji & Okolo-Obasi, 2018b; Asongu & Odhiambo, 2018; Efobi et al. 2018). Marital status of respondent was included to buttress the issue of household decision-making. Other variables used are the education of respondents measured in number of years spent in formal school; this is important as the GESS model requires that at least a member of the farming household should be able to read and respond to phone text message and or e-mail. The size of farm cultivated by farmers measured in hectares was included as the World Bank (2014) argued that the larger the sizes, the more the farmers are involved in farming. Also, a type of farming dummy was used to account for the effect of the farming type on the decision of the respondent to participate in the GESS. The experience of the farmer measured in total number of years spent in active farming will definitely play a role in participating in the GESS. Other variables included are land ownership type, with a dummy for inheritance = 1 otherwise =0.Contactwith extension agent with also a dummy for yes = 1 and no = 0; this is very important as the complexity of the model may require constant explanations by the extension agents. A distance dummy used to account for the impact of distance to farmers registration center. Where the distance is up to 10 kilometer from the house of the farmer it is judged far, and not far otherwise.

Table 2. Summary of statistics of the variables (mean and average)

Coding	Variables	Type of Variables	Summary Statistics
AC	Access to farm credit	Binary	21%
TCR	Reduction in cost of transportation	Binary	14%
Age	Age of respondent	Categorical	41 Years
HEQ	Highest educational qualification	Categorical	6 Year
Gender	Sex of the respondent	Binary	63% Male
MS	Marital status	Binary	65% Married
HHsize	Household size	Categorical	7 Persons
PGESS	Participation in GESS	Binary	50Yes
Fsize	Size of the Farm of respondent	Categorical	1.7 Hectres
OPhone	Ownership of Mobile phone	Binary	56% Yes
FExp	Farming Experience of the respondent	Categorical	19 Years
OFI	Off farm Income	Categorical	NGN147,000
Oput	Output of the farmer (Farm income)	Categorical	NGN123,000
MoNC	Mobile network coverage	Binary	45% Coverage
Rg	Region of residence of the Respondent	Binary	69 North
LOT	Land ownership Type	Binary	42 Inherited
Ext	Contact with extension Agents	Binary	54% Yes
Dis	Distance from GESS point	Binary	41% Far

Source*:* Authors' Compilation

7. Results

We begin the analysis of farmers' participation in the GESS with a description of some of their social (gender, education), demographic (age, marital status, household size) characteristics. These characteristics are important in undertaking the differences in the socio-economic status of the farmers who are participating in the GESS compared with their non-participating counterparts.

7.1. Socio-economic characteristics

Table 3. Socio – economic characteristics of the respondents

Sex	Freq	%	Cum
Males	745	63	63
Females	455	37	100
	1200	100	
Years of experience	**Freq**	**%**	**Cum**
0- 5 Years	69	6	6
6 - 10 Years	168	14	20
11 - 15 Years	182	15	35
16 - 20 Years	200	17	52
21 - 25 Years	296	25	76
26- 30 Years	210	18	94
Above 30 Years	75	6	100
	1200	100	
Age of respondents	**Freq**	**%**	**Cum**
Less than 20years	46	4	4
21-30 years	159	13	17
31-40 years	408	34	51
41-50 years	364	30	81
51years and above	223	19	100
	1200	100	
Household size	**Freq**	**%**	**Cum**
1-4 Persons	541	45	45
5-9 Persons	405	34	79
10-14 Persons	182	15	94
15 Persons and above	72	6	100
	1200	100	

Level of Education	Freq	%	Cum
None	397	33	33
FSLC	450	37.5	70.5
WAEC/WASSCE[2]	219	18.3	88.8
B.Sc and Equivalent	60	5	93.8
Post graduate degrees	31	2.6	96.4
Others	43	3.6	100
	1200	100	
Annual Income	**Freq**	**%**	**Cum**
0 - 50,000	293	24	24
51,000 - 100,000	330	28	52
101,000 - 150,000	298	25	77
151,000 - 200,000	120	10	87
201,000 - 250,000	74	6	93
251,000 - 300,000	38	3	96
301,000 - 350,000	22	2	98
351,000 - 400,000	17	1	99
Above 400,000	8	1	100
	1200	100	

Source*:* Authors' Computation

The analysis of Table 3 shows that 63% of the farmers are males, whereas 37% are females; the average farming experience is 19 years, this falls within the category of 16 – 20 years whereas for the level of education, the average age is 6 years; about 33% of the respondents are illiterates, whereas 67% have at least a first school leaving certificate (FSLC). The analysis also shows that the average household size in the study area is 7 persons which fall within the category of 5-9 persons.

[2]FSLC = First School Leaving Certificate (Basic primary education certificate = 6 years)
WAEC/WASSCE = West African Secondary School Certificate (Secondary Education = 12 years)
B.Sc = Bachelors Degree (University Degree and its equivalent = 15 years and above

7.2. The empirical estimations

In the econometric analysis of Table 4 and Table 5, we show that the GESS model is a critical component of the federal government's agriculture transformation agenda that provides avenue for direct access to credit for rural farmers in Nigeria; the research focused on the relationship between participation in the GESS model and access to an enabling environment (farm credit and Rural transportation) by rural farmers in Nigeria using an independent double hurdle model. This model assumes that the two error terms from the two hurdles are normally distributed and uncorrelated. In order to answer the research questions correctly, the investigation focused on the relationship between the error terms in both hurdles; the result reveals that the error terms were uncorrelated. This simply means that factors that influence the decision of the respondent to participate in the GESS model were not particularly associated with variables in the second hurdle involving enabling environment (access to farm credit in objective one or reduction in transportation cost in objective two). This result confirmed the imperativeness of the double hurdle model used in this study the maximum likelihood estimates of the double-hurdle model is presented in both Tables4 and 5. The Akaike Information Criteria (AIC) and the Log-Likelihood ratio (LR) attest to the reliability of the model. For both double hurdles, the probit result shows almost the same thing. It shows that only marital status, output of the respondent, and land ownership types are the variables that have no impact on the decision to participate or use the GESS progamme for accessing the enabling environment. Other variables have some level of significance.

Table 4. Maximum likelihood estimates of double-hurdle models for participating in GESS and access to farm credit in rural Nigeria.

		Double Hurdle Models		
Variables	**Probit**	**1st hurdle**	**2nd Hurdle**	**Marginal effect in probit**
Constant	-.251 (2.3020)	- 0. 513(0. 32)[3]	-.419 (1.27)**	-
Age	- 1.224 (3.128)**	-0.014(1.31)**	-18.3 (0. 016)	.-001340
HEQ	5.319 (1.43)***	0.742(0.416)**	1.23(1.25)**	0.032
Gender	-3.153 (4.031)	-0.066 (0.27)*	-13.764(2.30)**	0.00531
MS	0.266 (1.121)	-0.148 (0.28)	2.106 (0.931)*	-0.0321
HHsize	0.4251(0.102) **	-0.0914(0.21)**	-2.145(0.156)**	-0.0412
PGESS	8.621 (4.127) *	-	4.65 (4.001)***	0.0317
Fsize	1.302 (0.517)***	.094 (2.76)	-0. 413(0.001)	-0.0021
OPhone	4. 213(0. 304) ***	11.14(1.25)***	0.215(0.402)**	0.03403
FExp	-3.136 (0. 702) *	-.331(-4.73)*	-8.10 (2.821)*	-0.000181
OFI	0. 812 (0.109)**	-0.094(2.36)**	-2.612(1.26)**	-0.003142
Oput	1. 198 (0. 703)	1.83(1.32)**	1.125(0.33)**	0.0334
MoNC	2.53 (0. 152)**	.241 (0.132)*	0.241 (3.131)**	0.02403
Rg	1.215 (3,146)	-.0247 (5.2138)	1.76 2(0.189)	0000381
LOT	1.061(1.051)	1.127(2.73)*	0.021(1.53)**	0.000112
Ext	0. 691 (0. 072)	1.311(.012)***	-5.211(2.412)**	-0.1007
Dis	-0.323(0.106)**	-.328(1.31)**	10.022(1.91)***	0.0456
Number of observations	1200	1200	480	
Log likelihood	-421.186	-722.128	-823.126	
Prob> chi^2	0.0342	32.31	15.421	
Akaike Info criterion		311.18	526.612	_

Computed from the field data * = significant at 10% level, ** = significant at 5% level, *** = significant at 1% level. Standard errors are in parentheses.

Source: Authors' computation from the field data.

The coefficients in the first hurdle indicate how a given decision variable affects the likelihood (probability) to participate in the GESS; whereas those in the second hurdle indicate how decision variables influence access to farm credit. This implies that a rural farmer can fully participate in the GESS but the access to farm credit will be seriously hindered by some other socio-economic factors. The first hurdle agreed with Olomola (2015) in that age, gender, education, household size, size of farm, farming experience, off-farm income, value of output, ownership of mobile phone, mobile network coverage and contact with extension agents are decision variables that were statistically significant in influencing the probability of participation in the GESS. Also the marginal effect of the first hurdle show

[3] Numbers in parenthesis () represent the standard error.

changes in the probability of participation in the GESS for any additional unit increase made in the decision variables. The analysis indicates that, the likelihood to participate in the model drop by 0.13% for every unit increase on the category of age of the farmer. The analysis of the second hurdle shows that, except for the age of the respondent, region of the respondent and surprisingly size of the farm, all other variables are significant at various levels in determining the access to farm credit. The levels of education, participation in GESS programme, ownership of a mobile phone, and value of output, mobile network coverage, and contact with extension agents are positive determinants of the decision to accessing farm credit by rural farmers. Also marital status, farming experience, and distance to farmers' registration center are negative determinants of accessing farm credit among the rural farmers. Three variables that are important that caught the attention of the investigation are land ownership type, which is a determinant factor in both hurdle, and, gender, which is also vital in both decision and marital status, which has no impact in the first hurdle but is significant at 5% level in the second hurdle. These two variables suggest obstacles with cultural and societal values of the rural communities in Nigeria.

Table 5. Maximum likelihood estimates of double-hurdle models for participating in GESS and reduction transportation in rural Nigeria.

	Probit	**1st hurdle**	**2nd Hurdle**	**Marginal effect in probit**
Constant	-.251 (2.3020)	- 0. 513(0. 32)[4]	-816.734(1.62)***	–
Age	- 1.224 (3.128)**	-0.014(1.31)**	29.347(3.35)***	-0.0004
Gender	5.319 (1.43)***	0.742(0.416)**	-157.448(2.83)***	-0.0295
HEQ	3.153 (4.031)*	0.066 (0.27)**	4.179(0.28)	0.001
MS	0.266 (1.121)	-0.148 (0.28)	0.473(0.61)	.00041
HHsize	0.4251(0.102) **	-0.0914(0.21)**	-3.025(0.46)	-0.0122
PGESS	0.621 (4.127) *	-	0.452(0.01)	-0.0052
Fsize	1.302 (0.517)	.094 (2.76)**	-11.964(1.92)*	-0.01323
OPhone	4. 213(0. 304) ***	11.14(1.25)*	-140.983(3.31)***	0.0173
OFI	-3.136 (0. 702) *	-.331(-4.73)***	-7.268(6.52)***	0.2442
FExp	0. 812 (0.109)**	-0.094(2.36)**	0.799(0.41)	-0.0039
Oput	1. 198 (0. 703)	1.83(1.32)**	-0.001(1.79)*	0004.95
Ext	2.53 (0. 152)**	.241 (0.132)**	-21.513(0.55)*	-0.0174
MoNC	1.215 (3,146)*	-.0247 (5.2138)*	-10.451(1.80)	0.000137
Rg	1.061(1.051)*	1.127(2.73)	-7.772(.103)*	-0.00460
LOT	0. 691 (0. 072)	1.311(.012)*	16.746(0.42)	-0.0010
Dis	-0.323(0.106)**	-.28(1.31)*	-1.320(-2.60)***	0.0234
Number of observations	1200	1200	480	
Log likelihood	-421.186	-722.128	-692.254	
Prob> chi^2	0.0342	32.31	9.642	
Akaike Info criterion		311.18	361.423	

Computed from the field data * = significant at 10% level, ** = significant at 5% level, *** = significant at 1% level.
Standard errors are in parentheses.

Source: Authors computation from the field data

[4]Numbers in parenthesis () represent the standard error.

The coefficients in the first hurdle indicate how a given decision variable affects the likelihood (probability) to participate in the GESS; whereas those in the second hurdle indicate how decision variables influence the level of reduction in rural farm transportation. This implies that a rural farmer can fully participate in the GESS but the cost of transportation will still not be reduced due to some other socio-economic factors. In the first hurdle, except for the region of respondent and marital status, other decision variables were statistically significant in influencing the probability of participation in the GESS. Also the marginal effect of the first hurdle shows changes in the probability of participation in the GESS for any additional unit increase made in the decision variables. The analysis of the second hurdle shows that, age, farm size, mobile phone ownership, off farm income, output (farm income), region of the respondents, distance, contact with extension agents and surprisingly gender are all significant factors that show positive impact on the cost reduction as they show a negative relationship with the cost. Unfortunately participating in GESS, levels of education, marital status, household size, farming experience, and land ownership type have no significant impact on the cost reduction.

7.3.Access to rural credit

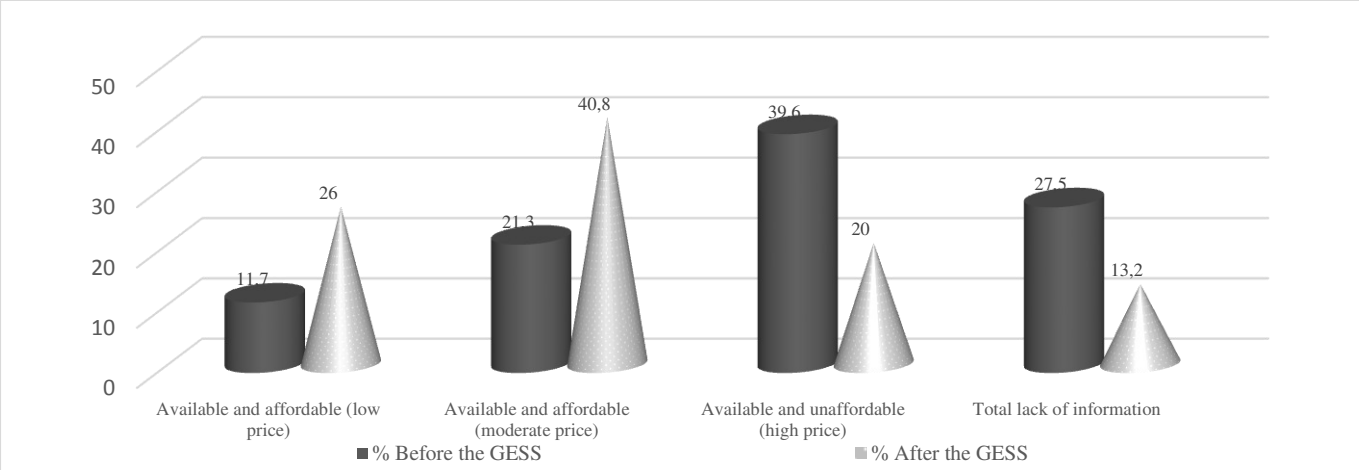

Figure 2. Distribution of respondents by constraints faced in accessing rural farm credit

Source: Authors' computation from the field data.

From the analysis of Figure 2, we noticed that the actual cost of agricultural credit is a major reason why many respondents are not keen to have access to it. Before the introduction and participation in the GESS by some farmers, about 40% of the farmers agreed that the cost and conditions (including the collateral requirements) are unaffordable, whereas 27% have no information about the source of rural credit at all. After the introduction of the GESS, the

number reduced to 20% and 13%, respectively; which suggest that the GESS has made a significant impact in access to rural farm credit. This finding agreed with IFC (2014), in that a lack of collateral among farmers is a major hindrance to smallholders accessing credit from formal financial institution in developing countries.

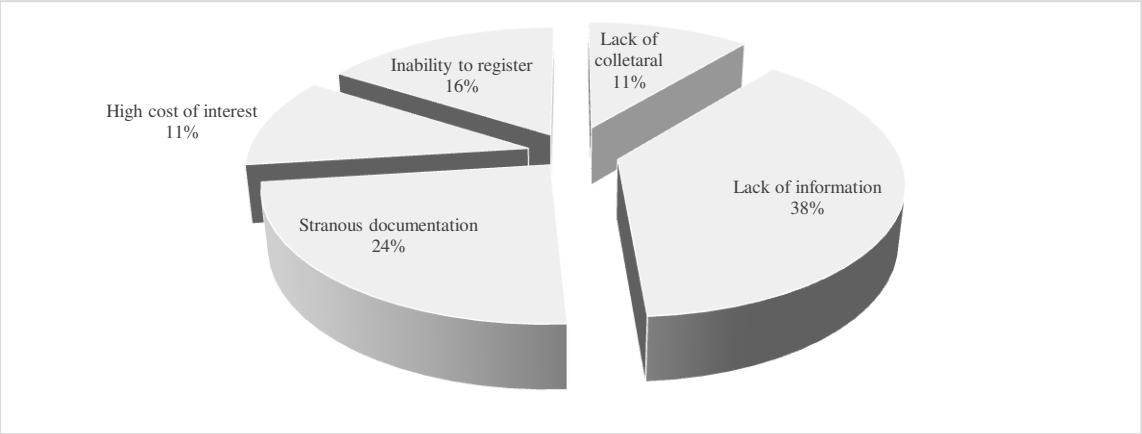

Figure 3. Distribution of respondent by reason for not accessing credit
Source: Authors' computation from field data

The analysis of Figure 3 shows that lack of information on the availability and source of funds accounted for about 38% of the reasons why access to credit was hindered in the rural communities, also to those who know the links, strenuous documentation involved in the process hindered them the access to the farm credit; inability to register accounted for 16%, whereas both high cost of interest and lack of collateral accounted for 11% each. This finding suggests that effective contact with extension agent and the GESS personnel will enhance access to rural farm credit in the country. This result agreed with Christen *et al* (2013) in that increasing access to agricultural finance for unbanked smallholder farmers, women and youths requires addressing the role of extension agents in both supply- and demand-side constraints in rural areas.

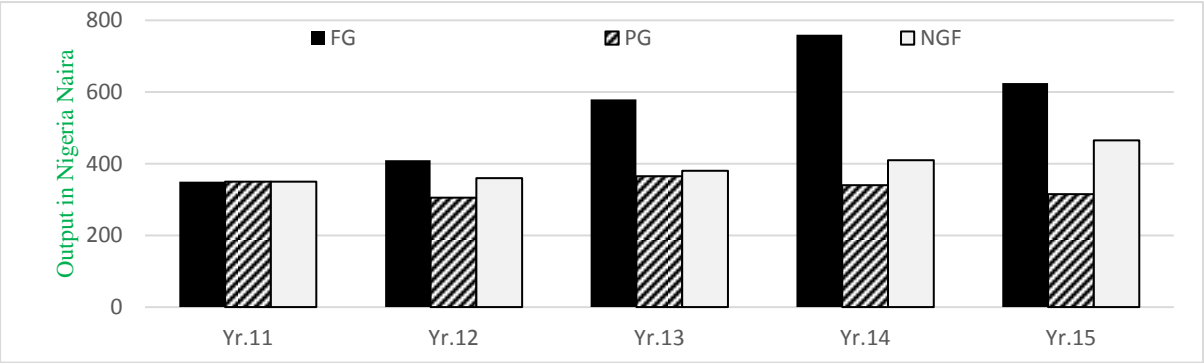

Figure 4. Trends of output among the three streams of farmers[5].

Source: Authors' computation from field data

Note:

The analysis of Figure 4 shows that access to credit increased the output of farmer continuously until 2015, when a new government that took over administration in the country temporally suspended the program; not having much information about GESS and registration hindered many of the farmers to gain access to rural farm finance. This finding is in harmony with World Bank (2014) and Tchamyou et al. (2019), in that the provision of financial services to commercial agriculture is widely recognized as a critical factor in enabling the private investors to participate in the agricultural sector.

7.4 Rural transportation costs

The analysis of Figure 5 suggests that rural transport cost steadily increased. Unfortunately, this is the most important factor for farmers to get their produce to the primary market or the aggregator as fast as possible to limit spoilage and attract premium price. Porter (2013) agreed that one reason why the food transport system was very expensive in rural sub-Saharan Africa was because of the poor condition of the roads. Raballand *et al* (2010) concur that there were also very few transporters along the farm route; sometimes with only one person who monopolized the market and charged exorbitant prices. From the analysis shown in the table four above, the factors that reduce cost of transportation only have meager marginal effect. Hence it takes a large accumulation of such effect to notice any change in cost of transportation among the participants and non-participants. General cost of rural transportation remains almost same for all.

- [5] FG Full GESS farmers: = Farmers that participated and used GESS to access the enabling environment.
- PG- Partial GESS farmers: = Farmers that participated but could not use GESS to access the enabling environment.
- NFG - Non GESS Farmers: = Farmers who do not participate in the GESS programme at all

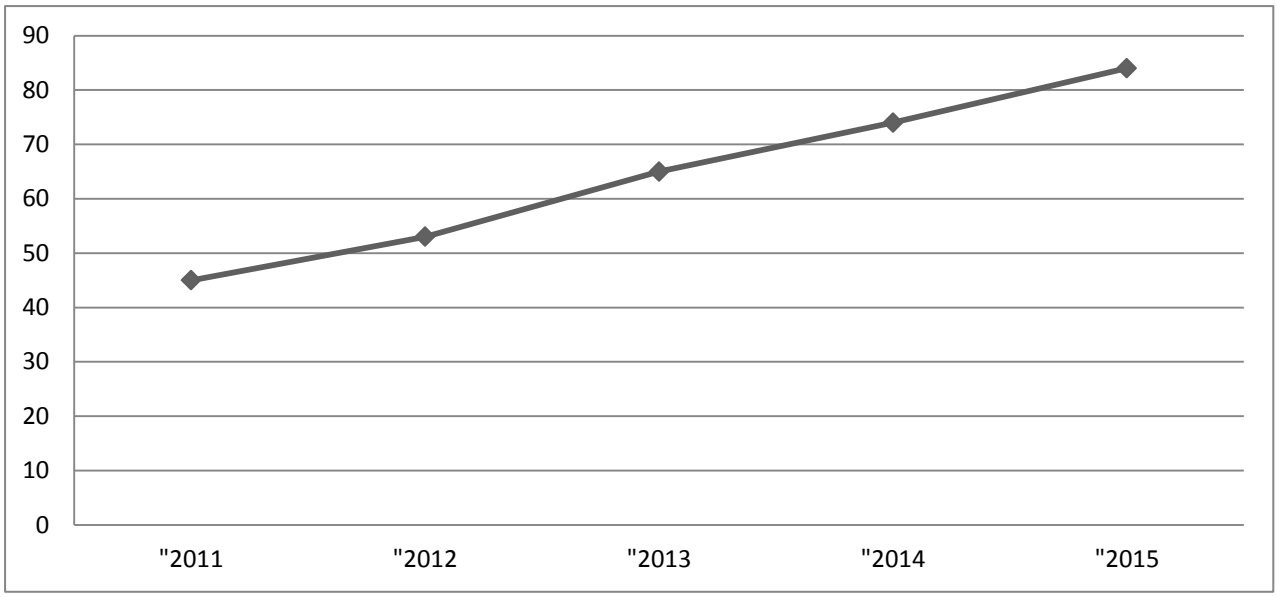

Figure 5. Average rural transportation costs

Source: Authors' computation from field data

The analysis of Figure 5 implies that rural accessibility remains a serious problem in Nigeria, with major repercussions for agricultural and rural development. The World Bank (2014) confirmed that about 47% of rural inhabitants in Nigeria live within 2 kilometers of an all-season road; which is well above the average of around 34% for sub-Saharan Africa, but still falls short of the 67% average found in other developing countries. Foster and Pushak (2011) acknowledged that only about 20% of rural Nigerians have access to an all-season road, a figure somewhat below the average for the peer group; be it as it may, it is clear that Nigeria's rural road network falls well short of what is needed to service the agricultural transformation agenda in the rural economy.

8. Discussion

This paper has followed the assumption that enabling environment in terms of access to rural finance and rural farm transport would provide opportunities for smallholder farmers to invest more in agricultural production. The analysis of Figure 6 suggests that the GESS positively impacts on the gross profit of the participant farmers when compared with the non-participant farmers. However, the high price of food at farm gate is substantially attributable to high transportation costs (Figure 5). A realistic extension of rural access will require strategic alignment of rural roads and the country's agricultural transformation agenda. The World Bank (2014) argued that Nigeria's classified road network amount to 85,000km; and to provide all-season road coverage to 75% of the rural population would require the

classified network to be extended by a further 20,000km; an uphill task given the huge amount of resources needed.

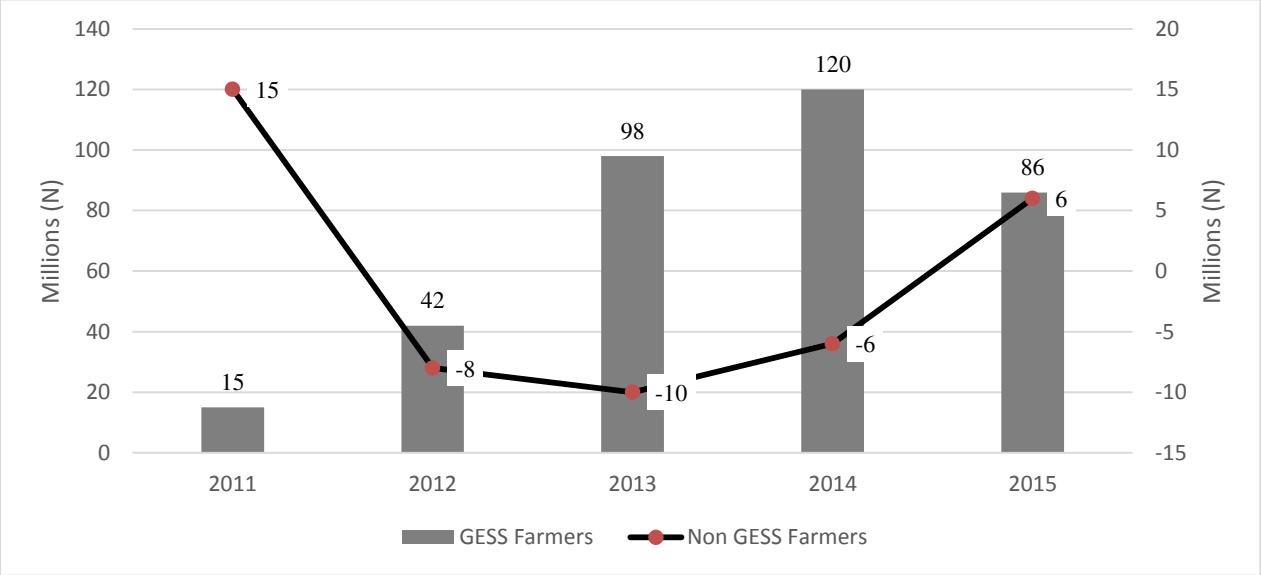

Figure 6. Average output-variable cost of both the GESS and the Non-GESS farmers
Source: Authors' computation from the field data

Following the results of this analysis, it is therefore shown that the GESS somewhat impacts on an enabling environment of smallholder farmers in rural Nigeria. However, if the federal government of Nigeria is to work towards an ideal agricultural transformation agenda that impacts on agricultural development and subsequent food security, we would argue that rural farm transport be closely aligned with the GESS priorities; to provide connectivity to rural areas in the country that produce most of the value of the country's agricultural output. Just like Christy *et al* (2009) called for tackling the 'enabling needs' for agribusiness and agro-industry development, the federal government of Nigeria must strive to provide the 'important enablers' of rural farmers transport and information for linking small farmers to formal markets and agricultural development. Investing in rural farm transport would bring changes to agricultural production, help smallholder farmers meet market demand more effectively and transform rural farms into competitive markets. It is therefore our contention in this paper that the federal ministry of agriculture and rural development holds the key to improvement of the GESS networks. Hence, embracing rural finance and transportation infrastructure should form the foundation of its agricultural transformation agenda, which in turn will provide the enabling environment for more widespread rural economy in sub-Saharan Africa.

9. Conclusion and policy recommendations

Thus far, we critically assessed the impact of the federal government's growth enhancement support scheme on the enabling environment (in terms of access to credit and transportation) of farmers in rural Nigeria. A total of one thousand, two hundred rural farmers were sampled across the six geo-political zones of Nigeria. Results from the use of double-hurdle model, indicate that the GESS significantly impacts on farmers' access to credit, but does not impact on their transportation cost. This suggests that to work towards an ideal agricultural transformation agenda (ATA), farm transport should be closely aligned with the GESS priorities to provide connectivity to rural areas that produce most of the country's agricultural outputs; embracing rural finance and transportation infrastructure should form the foundation of ATA to provide the enabling environment for widespread rural economy in sub-Saharan Africa.

This paper extends and contributes to the literature on agricultural and rural development in five notable ways. Firstly, we identify the factors that hinder or enhance rural farmers' participation in a growth enhancement support scheme. Secondly, the research provides insights into the usefulness of mobile phone-based technologies in the distribution of agricultural inputs in rural areas. Thirdly, unlike previous studies, the investigation makes use of a quantitative methodology, keeping in mind that quantitative works on farmers' enabling environment in the region is lacking. Fourthly, the paper seeks to explore the nature of the elements of enabling need in the context of rural sub-Saharan Africa. Fifthly, we put forward policy suggestions, which in turn will provide the enabling environment for widespread rural economy in sub-Saharan Africa region. To our knowledge, this is the first study that surveys the relevance of the growth enhancement support scheme in embracing rural finance and transportation infrastructure in Africa.

Disclosure statement

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References

Abdula, D., 2008. Mozambique country paper. In *Enabling environments for agribusiness and agro-industry development in Africa:* Proceedings of an FAO workshop, 106-117. Rome: FAO.

Adebo,G.M.,2014. Effectiveness of e-wallet practice in grassroots agricultural services Deliveryin Nigeria: a case study of Kwara State growth enhancement support scheme.*Journal of Experimental Biology and Agricultural Sciences,*2(4),411-418.

Adenegan, K.O., Fagbemi F.,Osanyinlusi O.I.,Omotayo A.O.,2018.Impact of the growth enhancement support scheme (GESS) on farmers' income in Oyo State, Nigeria.*The Journal of Developing Area.*52 (1), 15-28.

Adesina,A.,2012.*AgriculturalTransformation Agenda: Repositioning Agriculture to Drive Nigeria's Economy*.Federal Ministry of Agriculture and Rural Development:Abuja.

Adesina, A.,2013.Agricultural *Transformation Agenda: Mid-Term Report May 29, 2011-May 29, 2013 Score Card*. Federal Ministry of Agriculture and Rural Development:Abuja.

Airey, A., 2014.*Good Policies and Practices on Rural Transport in Africa: Monitoring & Evaluation.* SSATP Africa Transport Policy Program, Working Paper No. 99: World Bank Group: Washington DC.

Ajide, K. B., Raheem, I. D., Asongu, S. A., 2019. Dollarization and the "Unbundling" of Globalization in sub-Saharan Africa.*Research in International Business and Finance*, 47(January), 398-409.

Akinbode, S.O.,Dipeolu, A.O.,2012.Double-hurdle model of fresh fish consumption among urban households in South-West Nigeria.*Current Research Journal of Social Sciences.*4(6), 431-439.

Akinboro, B., 2014.The concept of GESS and technology components. Paper presented at theinauguration of ATA economic policy working group. Transcorp Hilton Hotel, Abuja. September 15.

Arabmazar, A.,Schmidst P., 1982.An investigation of the robustness of the Tobit estimator to non-normality.*Econometrics* 50, 1055-1063.

Asongu, S. A., Odhiambo, N. M., 2018. ICT, Financial Access and Gender Inclusion in the Formal Economic Sector: Evidence from Africa.*African Finance Journal*, 20(2), 46-66.

Asongu, S. A., Odhiambo, N. M., 2019.Challenges of Doing Business in Africa: A Systematic Review; *Journal of African Business*. DOI: 10.1080/15228916.2019.1582294

Asongu, S.A., Uduji, J.I. and Okolo-Obasi, E.N. 2019a. Tourism and insecurity in the world. *International Review of Economics,* http://doi:10.1007/s12232-019-00330-z

Asongu, S.A, Uduji, J.I. and Okolo-Obasi, E.N. 2019b. Transfer pricing and corporate social responsibility: Arguments, views and agenda. *Mineral Economics,* http://doi:10.1007/s13563-019-00195-2

AU-NEPAD,2003.*Comprehensive Africa Agriculture Development Programme.*African Union-New Partnership for Africa's Development:Midrand, South Africa.

Bagazonzya, H.,Marx, H., 2005.Rural financial institutions and services. In *Getting Agriculture Going in Nigeria: Framework for a National Growth Strategy.* Washington, DC: IBRD.

Bagazonzya, H., Safder, Z.,Sen, S.2011. Broadening smallholders' access to financial services through ICT. *ICT in Agriculture: Connecting smallholders to Knowledge, Networks, and Institution.*The World Bank: Washington DC.

Banjo, G., Gordon, H., Riverton, J., 2012.*Rural Transport-Improving its Contribution to Growth and Poverty Reduction in Sub-Saharan Africa.*SSATP Working Paper No.93, The World Bank: Washington DC.

Bashir, H., Emana, B., Kassa, V.,Haji, J.,2012.Determinant of chemical fertilizer technology adoption in North Eastern highlands of Ethiopia: The double-hurdle approach. *Journal of Research in Economics and International Finance.*1(2), 39-49.

Benin, S., Yu, B., 2013.*Complying With the Maputo Declaration Target: Trends in Public Agricultural Expenditures and Implications for Pursuit of Optimal Allocation of Public Agricultural Spending.*ReSAKSS Annual Trends and Outlook Report 2012, International Food Policy Research Institute (IFPRI): Washington DC.

Carletto, C., Savastano, S.,Zezza, A.,2013.Fact or artifact: the impact of measurement errors on the farm size – productivity relationship.*Journal of Development Economics.*103, 254 -261.

Carrol, T., Stern, A., Zook, D., Funes, R.,Rastegar, A.,Lien, Y.,2012.*Catalyzing Smallholder Agricultural Finance.* Dalberg Global Development Advisors.

Christen, R.P.,Anderson J., 2013.*Segmenting of smallholder household: meeting the range of financial needs in agricultural families.* No.85 of Focus Note: CGAP.

Christy,R., Mbaya, E.,Wilson, N.,Mutambaststere, E.,Mhlanga, N., 2009. Enabling environments for competitive agro-industries. In *Agro-industries for development,* eds. C. da Silva, D. Baker A.W. Shepherd, C. Jenane and S. Miranda da Cruz, 136-185, Wallingford, UK: CABI/FAO/UNIDO.

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

Deaton, A.,1997.*The Analysis of Household Survey: A micro econometric Approach to Development Policy.* The World Bank: Washington DC.

Donnges, C., 2003.*Improving Access in Rural Areas: Guidelines for Rural Accessibility Planning*. ILO: Geneva.

Eakins, J.,2014.*A Supplication of the Double-Hurdle Model to Petrol and Diesel Household Expenditure in Ireland*.Surrey Energy Economics Discussion Paper series 145. School of Economics: University of Surrey.

Efobi, U. R., Tanaken, B. V., Asongu, S. A., 2018. Female Economic Participation with Information and Communication Technology Advancement: Evidence from Sub-Saharan Africa. *South African Journal of Economics*, 86(2),231-246.

Ellis, S.D.,1997.*Key Issues in Rural Transport in Developing Countries*.Transport Research Laboratory Report 260: Berkshire.

Fadairo, O.S., Olutegbe N.S.,Tijani A.M., 2015.Attitude of crop farmers towards e-wallet platform of growth enhancement support scheme for input delivery in Oke-Ogunarea of Oyo State.*Journal of Agricultural Informatics,*6(2),62-71.

FAO, 2007.*Enabling environment for agribusiness and agro-industry development in Eastern Europe and Central Asia.*Proceedings of an FAO Workshop, Rome: FAO.

FAO, 2013.*Enabling environment for agribusiness and agro-industries development-regional and country perspectives*. Food and Agriculture Organization: Rome.

FGN,2017.*Economic Recovery and Growth Plan: 2017-2020.*Federal Government of Nigeria.Ministry of Budget and National Planning: Abuja.

FMARD,2010. ECOWAP*/CAADP Process of National Agricultural Investment Plan (NAIP) 2010-2013*. Federal Ministry of Agriculture and Rural Development: Abuja.

Foster, V.,Pushak N., 2011.*Nigeria's Infrastructure: A Continental Perspective.* The International Bank for Reconstruction and Development, World Bank: Washington DC.

Garcia, B., 2013.Implementation of a double-hurdle model.*The Stata Journal,*13(4), 776-794.

Gebremedhin, B.,Swinton, S.M.,2003. Investment in soil conservation in Northern Ethiopia: The role of land tenuresecurity and public programmes.*Agricultural Economics* 29(1), 69-84.

Green, W.H., 2012.*Econometrics Analysis*. Pearson: Harlow, England.

Gregory, D.I.,Bumb, B.L., 2006.*Factors Affecting Supply of Fertilizer in sub-Saharan Africa.*Agriculture and Rural Development Discussion Paper Series. No. 24. World Bank: Washington DC.

Grossman, J.,Tarazi, M.,2014.*Serving Smallholder Farmers: Recent Development in Digital Finance*.CGAP Focus Note, No. 94,World Bank Group: Washington DC.

Hine, J.,2014.*Good Policies and Practices on Rural Transport in Africa: Planning & Services*. SSATP Africa Transport Policy Program, Working Paper No. 100. World Bank Group: Washington DC.

IFAD, 2003.*Agricultural marketing companies as sources of smallholder credit in East and Southern Africa: experiences, insights and potential donor role.* IFAD: Rome.

IFAD,2007. Strategies for enhancing the sustainability of the agricultural credit guarantee. Presentation for the CBN Repositioning the Agricultural Credit Guarantee Scheme as a Vehicle for Economic Growth and Development Summit. IFAD: Rome

IFAD,2010. IFAD *Decision Tools for Rural Finance*. International Fund for Agricultural Development: Rome.

IFC,2014.*Access to Finance for Smallholder Farmers.*International Finance Corporation: Washington DC.

IFDC,2013.*Proceduresof the Nigeria's Growth Enhancement Support Scheme.* IFDC Report Describing the GESS 2013 Experiences and Challenges, International Fertilizer Development Corporation (IFDC): Abuja.

Imoru, J.A.,Ayamga, M., 2015.Fertilizer subsidy effects on fertilizer use in Northern region of Ghana.*African Journal of Agricultural Research* 10(53), 4926-4936.

Johnson, J., Dinardo, J.,1997.*Econometric methods.* McGraw-Hill, New York.

Kassali, R., Ayanwale, A.B.,Idowu, E.O.,Williams, S.B.,2012.Effect of rural transportation system on agricultural productivity in Oyo State, Nigeria, 113(1), 13-19.

Kefyalew, G.,Bedilu, A., Ahmed, M., Mena, W., 2016.Analysis of smallholder farmers' adoption and continued application of teff row planting technique in Wolaita Zone, Southern Ethiopia.*International Journal of Advance Research (IJAR)*4(9), 1369-1376.

Kuyvenhove,A.,2004.Creating an enabling environment: policy conditions for less-favoured areas.*Food Policy,*29(4), 407-429.

Labonne, J.,Chase, R.S.,2009.*The Power of Information: The Impact of Mobile Phones on Farmers' Welfare in the Philippines.* The World Bank: Washington, DC.

Landes, M., 2008.*The environment for agricultural and agribusiness investment in India.*Economic Information Bulletin, No.37. USDA: Washington DC.

Mahajan, V.,Vasumathi K.,2010. Combing extension services with agricultural credit: the experience of BASIX. Focus 18, Brief 13 of *Innovations in Rural and Agricultural Finance,* eds R. Kloeppinger-Todd and M. Sharma. International Food Policy Research Institute:Washington DC:

Masuki, K.F., Kamugisha, G., Mowo, J.G., Tanuri, J.,Tukahirwa, J.,Mogoi, J.,Adera,E.O.,2010.*Role of Mobile Phones in Improving Communication and Information Delivery for Agricultural Development: Lesson from South-Western Uganda.* Working Paper Series No.50 Presented. Center for Development Informatics, Manchester, UK.

Men, C.,Schmidst, P.,1985.On the cost of partial observability in bivariate probit models'.*International Economic Review,*26(1), 75-86.

Meye, R., 2012.*Microcredit and agriculture: challenges, success and prospects.* Antwerp, INCOFIN: Belgium.

Miller, C.,2013.Agricultural finance.In *the New Microfinance Handbook.*ed. J. Ledgerwood. World Bank: Washington DC.

Mittal, S.,Mehar, M.,2012.How mobile phones contribute to the growth of small farmers? Evidencefrom India.*Quarterly Journal of International Agriculture* 51(3),227-224.

Nwalieji, H.U., Uzoegbunam, C.O.,Okeke, M.N., 2015.Assessment of growth enhancement support scheme among rice farmers in Anambra State, Nigeria. *Journal of Agricultural Extension,*19(2), 71-81.

OECD, 2003.*Checklist for Foreign Direct Investment Incentive Policies.* Organization for Economic Co-operation and Development: Paris.

Olomola, A.S.,2015.*Driving agricultural transformation with the power of information andcommunication technology: the performance of Nigeria's growth enhancement support scheme*.NSSP Working Paper 30. International Food Policy Research Institute (IFPRI): Washington, DC.

Onyenweaku, C.E., Okoye, B.C.,Okorie, K.C.,2010.Determinants of fertilizer adoption by rice farmers in Bende local government area of Abia State, Nigeria.*Nigeria Agricultural Journal.*41(2), 1-6.

Poirier, D., 1980.Partial observability in bivariate probit models.*Journal of Econometrics*12, 209-217.

Porter, G.,2013.*Transport Services and their Impact on Poverty and Growth in Rural Sub-Saharan Africa.* Africa Community Access Programme: University of Durham.

Raballand, G.,Macchi, D.,Petracco, C.(2010).*Rural Road Investment Efficiency: Lessons from Burkina-Faso, Cameroun, and Uganda.* World Bank: Washington, D.C.

Rossini, G., Vicentim, J.,Depetris, E.,2015.*Household cheese consumption in Argentina: A double-hurdle model estimation.* Paper prepared for presentation at the EAAE-AA EA joint seminar consumer Behaviour in a changing World. Food, cultureand society: Naples, Italy.

Starky, P.,2007.*Rural Transport Services in Africa: Lessons from Rapid appraisal Surveys in Burkina Faso, Cameroun, Tanzania and Zambia.*SSATP Working Paper No.87B The World Bank: Washington DC.

Tchamyou, V. S., 2019a. Education, Lifelong learning, Inequality and Financial access:evidence from African countries.*Contemporary Social Science*.DOI: 10.1080/21582041.2018.1433314.

Tchamyou, V. S., (2019b). The Role of Information Sharing in Modulating the Effect of Financial Access on Inequality.*Journal of African Business*.DOI: 10.1080/15228916.2019.1584262.

Tchamyou, V. S., Asongu, S. A., (2017). Information Sharing and Financial Sector Development in Africa.*Journal of African Business*, 18(7), 24-49.

Tchamyou, V.S., Erreygers, G., Cassimon, D., (2019). Inequality, ICT and Financial Access in Africa. *Technological Forecasting and Social Change*,139(February), 169-184.

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

Tiri, G.D.,Ojoko, E.A.,Aruwayo, A.,2014.Growth enhancement support scheme (GESS) and the challenges of food security in Nigeria: a review.*ARPN Journal Journal of Agricultural and Biological Science,* 9(7),226-232.

Tura, M., Aredo, D., Tsegaye W., La Rovere, R., Tesahun, G., Mwangi, W.,Mwabu, G. 2010. Adoption and continued use of imported maize seeds: case study of Central Ethiopia.*African Journal of Agricultural Research.*5(17), 2350-2358.

Uduji, J.I., Okolo-Obasi, E.N. 2017. Multinational oil firms' CSR initiatives in Nigeria: The need of rural farmers in host communities. *Journal of International Development,* 29(3): 308-329, http://doi.org/10.1002/jid.3243

Uduji, J.I.,Okolo-Obasi, E.N. 2018a. Young rural women's participation in the e-wallet programme and usage intensity of modern agricultural inputs in Nigeria. *Gender, Technology and Development,* 22(1): 59-81, http://doi.org/10.1080/09718524.2018.1445894

Uduji, J.I., Okolo-Obasi, E.N. 2018b. Adoption of improved crop varieties by involving farmers in the e-wallet programme in Nigeria. *Journal of Crop Improvement*, 32(5): 717-737, http://doi.org/10.108/1547528.2018.1496216

Uduji, J.I., Okolo-Obasi, E.N. 2018c. Does corporate social responsibility (CSR) impact on development of women in small-scale fisheries of sub-Saharan Africa? Evidence from coastal communities of Niger Delta in Nigeria. *Marine Policy,* https://doi.org/10.1016/j.mapol.2018.10.036

Uduji, J.I., Okolo-Obasi, E.N. 2018d. Corporate social responsibility initiatives in Nigeria and rural women livestock keepers in oil host communities. *Social Responsibility Journal,* https://doi/10.1108//SRJ-01-2018-0025

Uduji J.I.,Okolo-Obasi, E.N. 2019. Corporate social responsibility in Nigeria and rural youths in sustainable traditional industries livelihood in oil producing communities. *Journal of International Development,* https://doi.10.1002/jid.3432

Uduji, J.I., Okolo-Obasi, E.N., Asongu, S.A. 2018a. The impact of e-wallet on informal farm entrepreneurship development in rural Nigeria. *The Electronic Journal of Information Systems in Developing Countries,* https://doi//10.1002/isd2.12066

Uduji, J.I., Okolo-Obasi, E.N., Asongu, S.A. 2018b. Does CSR contribute to the development of rural young people in cultural tourism of sub-Saharan Africa? Evidence from the Niger Delta in Nigeria. *Journal of Tourism and Cultural Change,* https://doi.org/10.1080/1476682.2018.1502777

Uduji, J.I., Okolo-Obasi, E.N., Asongu, S.A. 2019a. Responsible use of crop protection products and Nigeria's growth enhancement support scheme. *Development in Practice,* https://doi/10.1080/09614524.2019.1572713

Uduji, J.I., Okolo-Obasi, E.N., Asongu, S.A. 2019b. Corporate social responsibility and the role of women in sustainable agricultural development in sub-Saharan Africa: Evidence from the Niger Delta in Nigeria. *Sustainable Development,* https://doi.org/10.1002/sd.1933

Uduji, J.I., Okolo-Obasi, E.N., Asongu, S. A. 2019c. Multinational oil companies and corporate social responsibility in the HIV/AIDS response in host communities. *Local Environment,* 24(5): 393-416,https://doi.org/10.1080/13549839.2019.1585770

Weber, R. , Musshoff, O. 2012. Is agricultural microcredit more risky? Evidence from Tanzania.*Agricultural Finance Review.*

Willoughby, R.,Forsythe, L.2011.*Farming for impact: A case study of smallholder Agriculture in Rwanda.*Concern Worldwide and the Natural Resources Institute: University of Greenwich.

World Bank, 2004.*World Development Report 2005: A Better Investment Climate for Everyone.* World Bank: Washington, D.C.

World Bank, 2008.*Rural Finance in Nigeria: integrating new approaches.* World Bank: Washington, DC.

World Bank,2014.*Nigeria-Agribusiness Indicators*.World Bank Group: Washington DC.

Wozniak, G.D.,1997.Human capital, information, and the early adoption of new technology.*Journal of Human Resources,*22(1), 101-112.