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# Growth Enhancement Support Scheme (GESS) and Farmers' Fertilizer Use in Rural Nigeria[1]

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## Abstract

Fertilizer use in Nigeria is estimated at 13 kg/ha, which is far below the 200 kg/ha recommended by the Food and Agricultural Organization (FAO). The objective of this investigation was to identify the determinant factors of farmers' participation in the Nigeria's growth enhancement support scheme (GESS). In addition, we determined the impact of the GESS on fertilizer use in rural areas. One thousand, two hundred rural farmers were sampled across the six geopolitical zones of Nigeria. Results from the use of recursive bivariate probit model indicated that GESS significantly impacted on the access and usage of fertilizer among the rural farmers; and that contact with extension agents, ownership of mobile phones, power for charging phone batteries, value output, mobile network coverage, ability to read and write were positive determinants of rural farmers participation in the GESS; whereas increased distance to registration and collection centers, and cultural constraints to married women reduced farmers' tendency to participate in the GESS. The findings suggest that farmers' participation in the GESS is a critical factor for raising fertilizer use in Nigeria. This implies that food security in sub-Saharan Africa can be achieved by increasing the participation of rural farmers in the growth enhancement support scheme.

*Keywords*: Growth Enhancement Support Scheme, Fertilizer Use, Rural Farmers, Recursive Bivariate Probit Model, Nigeria.
*JEL Classification*: O13, Q1, N27

## 1. Introduction

Fertilizer has immense possibility of assisting sub-Saharan African countries to attain food security. In 2012, the Federal Government of Nigeria (FGN) liberalized fertilizer distribution by launching the Growth Enhancement Support Scheme (GESS) to transform the delivery of input subsidy as part of its Agricultural Transformation Agenda (ATA). Under the GESS, the government's role shifted from direct procurement and distribution of fertilizer to facilitation of procurement, regulation of fertilizer quality, and promotion of the private-sector fertilizer value chain (Adesina, 2012; Uduji *et al,* 2018a; Uduji et al., 2019a). In this process, the FGN and state governments each contribute 25 percent of the fertilizer cost resulting to 50 percent subsidy offered directly to smallholder farmers in the country (IFDC, 2013). The states and local governments were responsible for registering the farmers, with 3.91 million farmers in 2012; 9.5 million farmers in 2013 and 10.47 million farmers in 2014 (Olomola, 2015). Compared to the prior subsidy programme, GESS appeared to be more efficient and transparent in subsidy delivery to smallholder farmers in the country. For example, FGN spent ₦30 billion ($180 million) in 2011 to reach 800, 000 smallholders with inputs; whereas it spent N5 billion ($30 million) in 2012 to reach 1.2 million smallholders (Grossman and Tarazi, 2014; Uduji and Okolo-Obasi, 2018b, 2019).

However, the extent to which the GESS initiative had contributed to farmers' agricultural production in rural Nigeria remain contested (Tiri *et al.,* 2014; Nwalieji *et al.,* 2015). Yet, Adenegan *et al* (2018) recently added some nuance to the debate as they suggested that the GESS initiative impacted on the farm income of cassava and maize farmers in Oyo State, Nigeria; indicating that productivity-enhancing agricultural innovations can contribute to raising the income of farming households, improve poverty alleviation and food security in developing countries. Uduji and Okolo-Obasi (2018a) introduced gender perspective to the debate, suggesting that participation of young rural women would intensify the use of modern agricultural inputs in Nigeria. The preceding deliberations portray the complexity of GESS in rural Nigeria. Meanwhile, fertilizer application in Nigeria is estimated at 13kg/ha by the Federal Ministry of Agriculture and Rural Development (FMARD); which is far below the 200 kg/ha recommended by the Unites Nations Food and Agriculture Organization (World Bank, 2014). This translates to about 6kg/ha of nutrients and is also well below the Abuja Food Summit recommendation of at least 50 kg/ha nutrients in line with the declaration of the African Union Heads of States and Government on food security and hunger reduction in the continent (Benin and Yu, 2013, Asongu *et al,* 2019a, 2019b, 2019c, Anyanwu, 2014a,

2014b). As low fertilizer use has been identify as a major challenge that must be overcome in order to increase Nigeria's agricultural productivity (FGN, 2017), we hypothesize that GESS does not impact on farmers' fertilizer use in rural Nigeria. Thus, this investigation, which is in line with the agricultural transformation agenda (ATA) contributes to agricultural and rural development debate by assessing the empirical evidence in two areas that have received much attention in the literature:

- What are the factors that determine rural farmers' participation in the GESS in Nigeria?
- Does GESS impact on farmers' fertilizer use in rural Nigeria?

The rest of the paper is structured as follows: Section 2 describes the methodology. Section 3 presents the main findings and their implications. Finally, Section 4 concludes with policy recommendation.

## 2. Methodology

In this study, we adopted a quantitative method, given the scarcity of quantitative works on the intricacies of production, allocation and extensive use of fertilizer in the region (Uduji and Okolo-Obasi, 2018a, 2018b, Uduji *et al,* 2019d, 2019e). This study made use of a survey research technique targeted at obtaining information from a representative sample of farmers. It is, for all intents and purposes, cross-sectional, which revealed the data that are currently in existence.

### *2.1 Study Area*

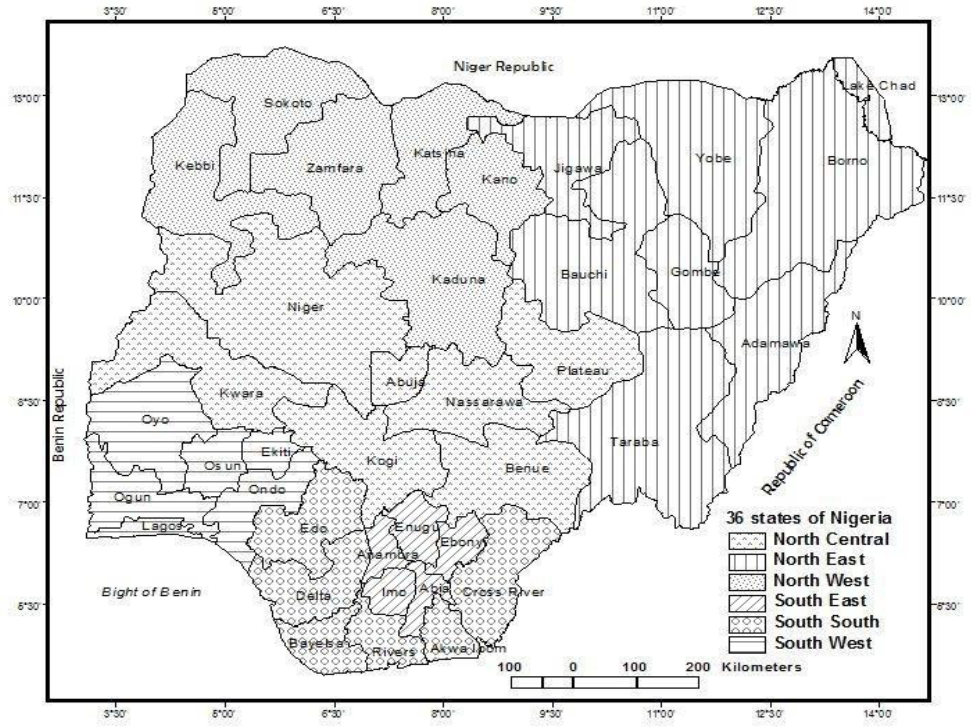

**Figure 3:** Constituent Sampled States of the Six Geo-Political Zones, Nigeria
**Sources:** Authors' Window Shade

**Figure 1:** Constituent Sampled States of the Six Geo-Political Zones in Nigeria
**Source:** FGN, 2017.

Nigeria comprises six geopolitical zones, with three zones each making up the north and south, as shown in Figure 1. The study was carried out in six states in Nigeria selected on purpose, as shown in Table 1.

**Table 1: Population of the selected states**

| States/Geopolitical Zones | Male | Female | Total |
|---|---|---|---|
| Adamawa (North-East) | 1,607,270 | 1,571,680 | 3,178,950 |
| Benue (North-Central) | 2,114,043 | 2,109,598 | 4,223,641 |
| Cross River (South-South) | 1,471,967 | 1,421,021 | 2,892,988 |
| Ebonyi (South-East) | 1,064,156 | 1,112,791 | 2,176,947 |
| Ekiti (South-West) | 1,215,487 | 1,183,470 | 2,398,957 |
| Kano (North-West) | 4,947,952 | 4,453,336 | 9,401,288 |
| Total | 12,420,875 | 11,851,896 | 24,272,771 |

**Source:** Population Commission, 2007

### *2.2 Sample Size*

The sample size (n) in this study was determined for finite population according to Taro Yamane (1964) as shown in Equation 1 below:

$$n = \frac{\mathrm{N}}{1+\mathrm{N}(\mathrm{e}*\mathrm{e})} \qquad \text{Equation 1}$$

Where n = the sample size

N = total of the study area

e = level of significance (limit of tolerable error)

1 = unity (constant)

Therefore, the sample size for the study was determined thus:

$$\mathrm{n} = \frac{24{,}272{,}771}{1 + 24{,}272{,}771(.05 * .05)}$$

$$n = \frac{24{,}272{,}771}{60{,}681.93} = 400$$

This was multiplied by 3 to ensure that adequate sample was selected for the study.Hence,the total sample size determined is 1,200.

**Table 2**: Sample Distribution Table

| States/Geopolitical zone | Male | Female | Total | % | Reg. Farmers | Non Reg Farmers | Total |
|---|---|---|---|---|---|---|---|
| Adamawa (North-East) | 1,607,270 | 1,571,680 | 3,178,950 | 13 | 78 | 78 | 156 |
| Benue (North-Central) | 2,114,043 | 2,109,598 | 4,223,641 | 17 | 102 | 102 | 204 |
| Cross River (South-South) | 1,471,967 | 1,421,021 | 2,892,988 | 12 | 72 | 72 | 144 |
| Ebonyi (South-East) | 1,064,156 | 1,112,791 | 2,176,947 | 9 | 54 | 54 | 108 |
| Ekiti (South-West) | 1,215,487 | 1,183,470 | 2,398,957 | 10 | 60 | 60 | 120 |
| Kano (North-West) | 4,947,952 | 4,453,336 | 9,401,288 | 39 | 234 | 234 | 468 |
| Total | 12,420,875 | 11,851,896 | 24,272,771 | 100 | 600 | 600 | 1,200 |

Sources: FMARD, 2010/Authors' Computation

### *2.3 Data Collection*

Data for this study were collected from both primary and secondary sources. However, primary source was the main source of data. Participatory rural appraisal (PRA) technique, namely semi-structured interview (SSI) questionnaire, was employed in the primary data collection. The use of participatory research technique in collecting e-wallet impact data especially as it concerns rural poor farmers is based on the fact that it involves the people being studied, and their views on all the issues are paramount. The semi structure interview questionnaire was the major tool the study used for the household survey. It was directly administered by the researcher with the help of a few local research assistants. 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.

### *2.4 Analytical Frameworks*

Data collected from respondents in the field were subjected to a series of treatments. Both descriptive and inferential statistics were used to analyze the data to achieve the objectives of the study. In modeling the impact of GESS (e-wallet) on rural farmers' access and usage of fertilizer, we used the bivariate probit model to test the hypothesis of the study, i.e., there is no significant correlation between the error terms of rural farmers participating in the e-wallet

program and access/usage of fertilizers. Also both descriptive and inferential statistics were used to achieve the objectives of the study which are as follows:

- Ascertain the determinants of rural farmers' participating in the GESS in Nigeria
- Examine the impact of GESS on rural farmers' access to and usage of fertilizer in Nigeria.

In modeling the impact of GESS on access and usage of fertilizer, so many statistical models like tobit, logit, and probit models, could be applied. As good as these specifications may be, this study noted that two major decisions - to participate in the government GESS program and to use the program to access fertilizer are involved and the decisions are interdependent. Using a single independent model specifications, e.g., logit, tobit or probit might result in ineffective parameter estimation, as single independent model may fail to capture the correlations between the two major decisions (Kefyalew *et al.*, 2016; Tura *et al.* ,2010). In modeling two interdependent decisions like we have in hand, a model like the bivariate probit according to Greene (2012) is very essential. The bivariate probit model is a natural extension of the probitmodel; it appears in both the decisions to participate in the government GESS and that of using the model to access fertilizer as farm inputs. In this case, the first leg of the model is decision to participate. This has participation in GESS as the dependent variable; the other leg is the decision to use the participation to access fertilizer having participation in GESS as one of the explanatory variable. Therefore, we adapted, with modification, the recursive bivariate models developed and used by Kassouf and Hoffmann (2006) to suit our data analysis. We used STATA 13 software to analyze the data generated.

### *2.5 Model Specification*

In specifying the model, we consider the equations,

$z^* = \alpha' w + \mu_1$ $\quad z{=}1 \; if \; a^* {>} 0 \; otherwise \;\; z{=}0$ Eqn. 1

$y^* = \beta' x + \delta z + \mu_2$ $\quad y{=}1 \; if \; y^* {>} 0 \; otherwise \;\; y{=}0$ Eqn. 2

In the above equations, 'x' and 'w' are column vectors of explanatory variables which acknowledged that;

$$\sum[\mu_1 \mid w, x] \quad = \quad \sum[\mu_2 \mid w, x] = 0,$$

$$Var[\mu_1 \mid w, x] \quad = \quad Var[\mu_2 \mid w, x] = 1,$$

$$Cov[\mu_1, \mu_2 \mid w, x] \quad = \quad \rho$$

We equally acknowledged that $\mu_1$ $and$ $\mu_2$ have bivariate normal distribution which is thus stated:

$$\int_{-\infty}^{x_2}.\int_{-\infty}^{x_1}\emptyset_2(z_1,z_2,\rho)\delta_{z_1}\delta_{z_2}\ where\ \emptyset_2(z_1,z_2,\rho) = \frac{\exp(-(\frac{1}{2})(x_{2+}^1 x_2^2 - 2\rho_{x_1 x_2}\quad)/(1-\rho^2)}{2\pi(1-\rho^2)^{1/2}} \quad \text{Eqn. 3}$$

This according to Greene (2003) is a specific case of recursive bivariate probit model of simultaneous equations. It is recursive in the sense that the variable (z) appears on both equations 1 and 2. The variable is the dependent variable in equation 1 and an explanatory variable in equation 2. On the other hand, the endogenous variable (y) does not appear on the right-hand side of any equation.

Applying this to our study, z = 1 represents when rural farmers decide to participate in the GESS programme, otherwise, z = 0. Also, y = 1 represent when farmers access and use fertilizer, otherwise, y = 0.

In this work, we used B# to represent equation 3 which indicates the distribution function of the bivariate standard normal distribution with correlation $\rho$. Hence, four basic probabilities are obtainable in this recursive bivariate probit model and are represented as thus:

$$prob[y = 1, z = 1] = B\#(\alpha' w, \beta' x + \delta, \rho) \quad \text{Eqn. 4}$$

$$prob[y = 1, z = 0] = B\#(-\alpha' w, \beta' x - \rho) \quad \text{Eqn. 5}$$

$$prob[y = 0, z = 1] = B\#(\alpha' w, -\beta' x - \delta - \rho) \quad \text{Eqn. 6}$$

$$prob[y = 0, z = 0] = B\#(-\alpha' w, -\beta' x - \rho) \quad \text{Eqn. 7}$$

Therefore, when 'x' and 'w' are known, the expected value for y is represented as follows:

$\sum$ (y|w, x) = Prob [z = 1]$\sum$ [y|z = 1,w, x] + Prob [z = 0]$\sum$ [y|z = 0,w, x]

= Prob [z = 1]Prob [y = 1|z = 1,w, x]

+ Prob [z = 0]Prob [y = 1|z = 0,w, x]

= Prob [y = 1, z = 1] + Prob [y = 1, z = 0]

$= B\#(\alpha' w, \beta' x + \delta, \rho) + B\#(-\alpha' w, \beta' x, -\rho)$ Eqn. 8

### *2.6Estimating the Marginal Effects*

Having $\phi(.)$ as the distribution function of the standard normal distribution, we obtained the probability of z = 1 from the marginal distribution using:

$$Prob(z = 1) = \phi(\alpha' w)$$

This is the probability of participating in GESS.

We evaluated the effect of participating in GESS by measuring the difference between the conditional probabilities of accessing fertilizer as a GESS farmer or not. The effect is measured with the function below:

$$G(z) = Prob(y = 1|\mathrm{w}, \mathrm{x}, \mathrm{z} = 1) - Prob(y = 1|\mathrm{w}, \mathrm{x}, \mathrm{z} = 0)$$

$$= \frac{B\#(\alpha'w, \beta'x + \delta, \rho)}{\phi(\alpha'w)} - \frac{B\#(-\alpha'w, \beta'x - \rho)}{1 - \phi(\alpha'w)} \quad \text{Eqn. 9}$$

The effect of participating in GESS on access to and usage of fertilizer can also be obtained by calculating its effect on the probability of the marginal distribution. This marginal distribution is represented thus:

$$M(z) = \phi(\beta'x + \delta) - \phi(\beta'x) \quad \text{Eqn. 10}$$

We obtained the probability in the bivariate distribution when $\rho = 0$, by the product of the marginal probabilities as stated below:

$$B\#(\alpha'w, \beta'x + \delta) = \phi(\alpha'w)\phi(\beta'x + \delta)$$

Hence, it becomes possible for us to verify that at the level $\rho = 0$, the difference between conditional probabilities is equal to the effect of participating in the GESS programme on access and usage of fertilizer i.e., G(z) = M(z).

In line with this, we analyzed the marginal effect of an explanatory variable $x_i$ on the probability of a farmer accessing and using fertilizer and this is denoted by $H(x_i)$. We first established how to calculate the effect of a binary explanatory variable $x_i$ that belongs to the vectors 'w' and/or 'x'. Assuming $w_0$ and $x_0$ are vectors with binary variable of value 0 and $w_1$and $x_1$ take the value 1, and the other variables having their mean value. In the context of this our study, the binary variable is given by

$$H(x_i) = \sum(y|w_1x_1) - \sum(y|w_0x_0)$$
$$= B\#(\alpha'w, \beta'x_1 + \delta, \rho) + B\#(-\alpha'w, \beta'x_1, -\rho)$$
$$-B\#(\alpha'w_0, \beta'x_0 + \delta, \rho) - B\#(-\alpha'w_0, \beta'x_0, -\rho) \quad \text{Eqn. 11}$$

Splitting this effect into two parts, we have:

$$H(x_i) = H_i(x_i) + H - 2(x_i) \quad \text{Eqn. 12}$$

with

$$H_i(x_i) = B\#(\propto' w_1, \beta'x_1 + \delta, \rho) - B\#(\alpha'w_0, \beta'x_0 + \delta, \rho) \quad \text{Eqn. 13}$$

and

$$H_2(x_i) = B\#(-\alpha'w_1, \beta'x_1 - \rho) - B\#(-\alpha'w_0, \beta'x_0 - \rho) \quad \text{Eqn. 14}$$

The first part corresponds to the effect of the binary variable $x_i$ on the probability of participating in the GESS whereas the second part is the effect on the probability of accessing and using fertilizer for farmers not participating in the GESS.

Another indicator that can be used to analyze the effects of a binary explanatory variable is the ratio between the probabilities of participating in GESS when this variable is equal to 1 and when it is equal to 0:

$$\theta = \frac{B\#(\alpha' w_1, \beta' x_1 + \delta, \rho) + B\#(\alpha' w_1 - \beta' x_1 - \delta - \rho)}{B\#(\alpha' w_0, \beta' x_0 + \delta, \rho) + B\#(\alpha' w_0 - \beta' x_0 - \delta - \rho)} \text{Eqn. 15}$$

We also analyzed the effect of a continuous variable $x_h$, such as per capita family income, which belongs to the vectors w and/or x. In this case, the effect is the partial derivative of $\sum(y|w, x)$ in relation to $x_h$. It is interesting to distinguish between the two different parts of this effect, which are the derivatives of each of the two terms on the right-hand side of equation 8.

Assuming $\emptyset(\cdot)$ as the value of the density function of the standard normal distribution, the effect of $x_h$ is

$$H(x_h) = \frac{\partial \sum(y|w,x)}{\partial x_h} = H_1(x_h) + H_2(x_h) \quad \text{Eqn. 16}$$

with

$$H_1(x_h) = \emptyset(\alpha' w)\phi(\beta' x + \delta - \frac{\rho \alpha' w}{\sqrt{1-\rho^2}})\alpha_h + = \emptyset(\beta' x + \delta)\phi[\alpha' w - \frac{\rho(\beta' x + \delta)}{\sqrt{1-\rho^2}}]\beta_h \quad \text{Eqn. 17}$$

and

$$H_2(x_h) = \emptyset(\alpha' w)\phi(\beta' x - \frac{\rho \alpha' w}{\sqrt{1-\rho^2}})\alpha_h + = \emptyset(\beta' x)\phi[-\alpha' w + \frac{\rho(\beta' x)}{\sqrt{1-\rho^2}}]\beta_h \text{ Eqn. 18}$$

## 3. Main Findings and their Implications

### *3.1 Descriptive Characteristics*

**Table 3:** Socio-Economic Characteristics of the Respondents

| Variables | Registered Farmers | | | Non-Registered Farmer | | |
|---|---|---|---|---|---|---|
| | **Freq** | **%** | **Cum** | **Freq** | **%** | **Cum** |
| Males | 467 | 78 | 78 | 250 | 42 | 42 |
| Females | 133 | 22 | 100 | 350 | 58 | 100 |
| | **600** | **100** | | **600** | **100** | |
| **Years of Experience** | | | | | | |
| 0- 10 Years | 281 | 47 | 47 | 45 | 8 | 8 |
| 11- 20 Years | 229 | 38 | 85 | 56 | 9 | 17 |
| 21 - 30Years | 61 | 10 | 95 | 221 | 37 | 54 |
| 31 - 40 Years | 22 | 4 | 99 | 152 | 25 | 79 |
| Above 40 Years | 7 | 1 | 100 | 126 | 21 | 100 |
| | **600** | **100** | | **600** | **100** | |
| **Age of Respondents** | | | | | | |
| Less than 20years | 138 | 23 | 23 | 54 | 9 | 9 |
| 21-35 years | 352 | 59 | 82 | 97 | 16 | 25 |
| 36-50 years | 86 | 14 | 96 | 330 | 55 | 80 |
| 51 years and above | 24 | 4 | 100 | 119 | 20 | 100 |
| | **600** | **100** | | **600** | **100** | |
| **Level of Education** | | | | | | |
| None | 106 | 18 | 18 | 377 | 63 | 63 |
| FSLC | 222 | 37 | 55 | 128 | 21 | 84 |
| WAEC/WASSCE | 153 | 26 | 80 | 65 | 11 | 95 |
| B.Sc. and Equivalent | 48 | 8 | 88 | 11 | 2 | 97 |
| Post Graduate Degrees | 26 | 4 | 93 | 4 | 1 | 98 |
| Others | 45 | 8 | 100 | 15 | 3 | 100 |
| | **600** | **100** | | **600** | **100** | |
| **Ownership of Mobile phone** | | | | | | |
| Have a set | 392 | 65 | 65 | 35 | 6 | 6 |
| Uses a neighbor's set | 172 | 29 | 94 | 102 | 17 | 23 |
| Have no set | 36 | 6 | 100 | 463 | 77 | 100 |
| | **600** | **100** | | **600** | **100** | |
| **Mobile Network coverage** | | | | | | |
| Network is good | 270 | 45 | 45 | 145 | 24 | 24 |
| Poor | 148 | 25 | 70 | 225 | 38 | 62 |
| Very poor | 148 | 25 | 94 | 72 | 12 | 74 |
| No network at all | 34 | 6 | 100 | 158 | 26 | 100 |
| | **600** | **100** | | **600** | 100 | |
| **Access to Credit** | | | | | | |
| Yes | 104 | 17 | 17 | 82 | 14 | 14 |
| No | 496 | 83 | 100 | 518 | 86 | 100 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **600** | **100** | | **600** | **100** | |
| **Land Ownership Type** | | | | | | |
| Inherited | 281 | 47 | 47 | 153 | 26 | 26 |
| Purchased | 205 | 34 | 81 | 196 | 33 | 58 |
| Leased | 114 | 19 | 100 | 251 | 42 | 100 |
| | **600** | **100** | | **600** | 100 | |
| **Contact with Extension Agent** | | | | | | |
| Yes | 543 | 90 | 90 | 49 | 8 | 8 |
| No | 57 | 10 | 100 | 551 | 92 | 100 |
| | **600** | 100 | | **600** | **100** | |
| **Distance to selling point** | | | | | | |
| Close | 375 | 62 | 62 | 393 | 66 | 66 |
| Far | 225 | 38 | 100 | 207 | 35 | 100 |
| | **600** | 100 | | **600** | 100 | |
| **Annual Income Level** | | | | | | |
| 0 - 50,000 | 34 | 6 | 6 | 76 | 13 | 13 |
| 51,000 - 100,000 | 53 | 9 | 15 | 134 | 22 | 35 |
| 101,000 - 150,000 | 72 | 12 | 27 | 146 | 24 | 59 |
| 151,000 - 200,000 | 102 | 17 | 44 | 86 | 14 | 74 |
| 201,000 - 250,000 | 118 | 20 | 63 | 58 | 10 | 83 |
| 251,000 - 300,000 | 72 | 12 | 75 | 38 | 6 | 90 |
| 301,000 - 350,000 | 56 | 9 | 85 | 26 | 4 | 94 |
| 351,000 - 400,000 | 45 | 8 | 92 | 24 | 4 | 98 |
| Above 400,000 | 48 | 8 | 100 | 12 | 2 | 100 |
| **Total** | **600** | **100** | | **600** | **100** | |

**Source:** Computed from the Field Data

We showed in Table 3 that a total of 1200 (600 each for registered and non-registered) farmers were sampled. The result shows that 78% of the registered farmers are men, while 42% of the non-registered farmers are also men. On the other hand, women constitute 22% of the registered farmer and 68% of the non –registered farmers.This gap in registration tends to agree with Uduji and Okolo-Obasi (2018) in that cultural constraints mandate woman to farm under their husbands. Further analysis revealed that about 76% of the registered women farmer are widowed, separated or divorced, suggesting that this group were not compelled to farm under any husband or man. The average age of registered farmers was 30 years; with average16years of experience (Table 3).The average age of the non-registered farmer was 42 years, with 31 years of experience. The registered farmers were more educated, with only 1 percent illiteracy level, whereas the literacy level among the non-registered farmers was low, with about 61% not able to read or write. About 66% of the registered farmers have their

own mobile phone, whereas 33% used the phones of their neighbours' children or relatives; and only 1% had no access to mobile phone use. Among the registered farmers, 48% had network coverage and only 13% had no network coverage in their villages. On the other hand, only 12% of non-registered farmer had access to mobile phones; whereas 88% had no access to mobile phones. This finding tend to concur with Grossman and Tarazi (2014) in that farmers not having mobile phone is a major challenge to GESS communications with the rural farmers in Nigeria.

Generally, among the registered and non-registered farmers, access to credits was low, as only 19% of the registered farmer had access to credit, whereas 81% had no access to farm credit. Also, 86% of the non-registered farmers had no access to credit. Also, the findings revealed that 81% of the registered farmers either inherited or purchased their lands; whereas 42% of the non-registered farmers leased their farmlands. This suggests that the registered farmers were more certain of the availability of land than the non-registered farmers. About 90% of the farmers registered because they had contact with the extension agents, whereas 92% of the farmers did not register as they did have contact with the extension agents. Surprisingly, 62% the registered farmers complained that the distance to the registration and redemption point was far; whereas only 35% of the non-registered farmers complained of the distance. Also, result showed that average annual income of the registered farmer was N210, 000 ($583), whereasthe average annual income of the non-registered farmer was NGN80, 000 ($222).

### *3.2 Participation in the E-Wallet Program*

**Table 4**: Estimated Rate of Farmers' Participation in the GESS

| States (Geopolitical Zones) | Estimated Total Population | Estimated Farming Population | No of Registered Farmers | Percentage |
|---|---|---|---|---|
| Adamawa | 3,178,950 | 2,384,213 | 476,843 | 20 |
| Benue | 4,223,641 | 3,167,731 | 823,610 | 26 |
| Cross River | 2,892,988 | 2,169,741 | 455,646 | 21 |
| Ebonyi | 2,176,947 | 1,632,710 | 310,215 | 19 |
| Ekiti | 2,398,957 | 1,799,218 | 449,805 | 25 |
| Kano (North-West) | 9,401,288 | 7,050,966 | 2,326,819 | 33 |
| **Total** | **24,272,771** | **18,204,578** | **4,369,099** | **24** |

***Source:***FMARD, 2010/Authors' Computation

Participation in the GESS starts with registration of farmers, and our analysis in Table 4 show that only 24% of the farmers in the study area were registered. Despite the similarities in the socio-economic and demographic characteristics of the farmers, there were different reasons why many of them did not participate in the GESS (Table 5).Following the socio- economic analysis which shows that the output of registered farmers was twice more than that of the non-registered farmers, we assent with Morris *et al.* (2007) in that to explore grassroots mobilization involved persuading the rural farmers to actually take the first step of registration in the GESS.

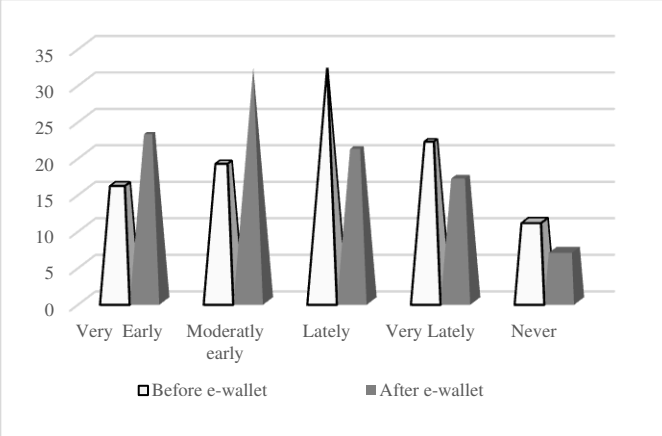


**Figure 2:** Timeliness of Getting FertilizerBefore and After GESS (E-Wallet) Introduction.
**Source:** Authors Computation from the Field Data.

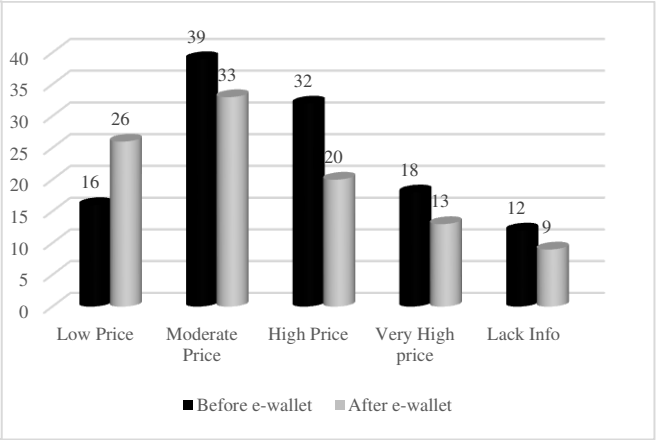


**Figure 3:**Constraints Faced in Accessing Fertilizer in Rural Areas Before and After GESS (E-Wallet) Introduction.
**Source:** Authors Computation from the Field Data.

The analysis of Figure 2 and Figure 3 showed that GESS had significantly impacted on the access and usage of fertilizer in rural Nigeria. For example, before the introduction of GESS, only 16% of the rural farmers gets fertilizer at low price and on time; about 39% gets fertilizer at moderate price; and 50% gets fertilizer at either high rate or very high rate. But after the introduction of GESS, 26% now gets fertilizer at low price; whereas 23% gets it on time. Also 33% and 32% gets the fertilizer at moderate price, and moderately early for the planting season. The percentage of the rural farmers that gets fertilizer at high or very high price had reduced to 33%. Further analysis of Figure 3 shows that before the introduction of GESS, 12% lacked information on accessing fertilizer in rural areas; 11% did not access fertilizer. However, after the introduction of GESS, only 9% still lack information, 7% did not access fertilizer. This findings support Olomola (2015) in that GESS is on the path of continuous improvement, as it is yielding some desired results of the federal government of Nigeria.

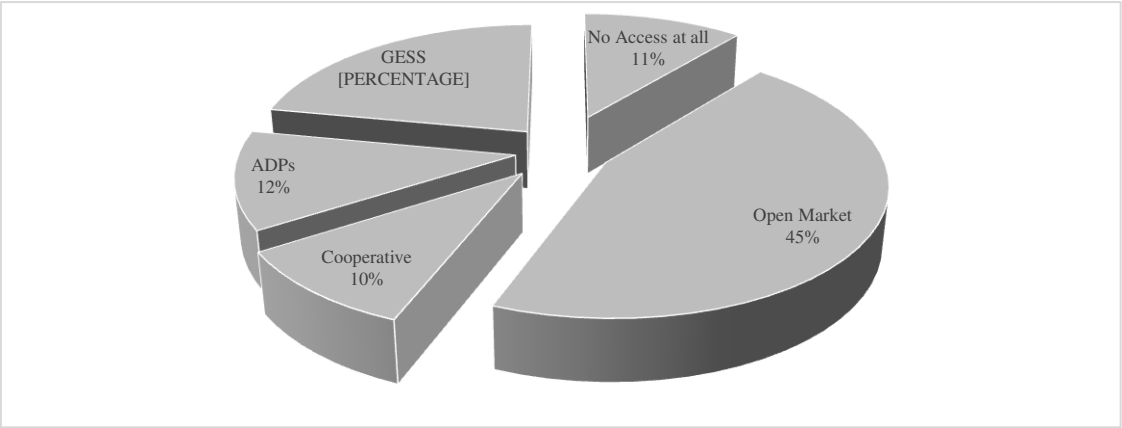


**Figure 4:**Rural farmers Sources of Fertilizer.

**Source:** Authors' Computation from the Field Data.

We observed in figure 4 that only 22% of the farmers access fertilizer through the GESS; 45% access fertilizer through the open market; whereas 12% access fertilizer through Agricultural development Programs (ADPs); 10% accesses fertilizer through cooperative societies; whereas 11% do not have direct access to fertilizer as farm input.

### *3.3 Econometric Estimations for Participating in the GESS and Usage of Fertilizer*

The results of the recursive bivariate probit model estimation are presented in the table below The first column contains the variables included in the analysis. The type of variable (binary or continuous) is described in the second column, and the means of the variables are presented in the third column. The fourth column shows the coefficients and the tests for participating in the GESS, whereas the fifth column presents the coefficients and tests for the "Access and usage of fertilizer" equation. The estimated value of correlation $\rho$ between the errors of both analyzed equations was 0.421, with p value equal to 0.0314 on Wald's test. The more important aspect of the output there is that GESS Participation which is a dependent variable in the fourth row of the table is also an explanatory variable in the fifth row and shows that at a 1% significance level, it has an impact on access to and usage of fertilizer by the rural farmers.

We identified in Table 5 that within the explanatory variables, ownership of a mobile phone, mobile network coverage, and contact with the extension agents are significant at a 1% significance level to both participating in the GESS and accessing fertilizer. Also the value of output (farm income of the respondents) is significant at 5% for participating in the GESS whereas for accessing and usage of fertilizer, it is significant at 1%. At the same 1%

significance level, GESS Participation, as an exogenous variable is significant for accessing and using fertilizer.

**Table 5: Means and coefficients of the recursive bivariate probit model whose dependent variables are "Participating in GESS" and "Access & Usage of Fertilizer" among rural farmers.**

| Variables | Type | Mean | Bivariate probit model | |
|---|---|---|---|---|
| | | | Participating in GESS | Access and Use Fertilizer |
| GESS Participation | | 0.215 | - | .6521 |
| | | | | 2.832*** |
| Full time Farming | Binary | 0.865 | 0.1421 | . 0713 |
| | | | 0.379** | 1.136* |
| Male Gender | Binary | 2.114 | -0.521 | -0.019 |
| | | | 0.175 | -2.167** |
| Education | Binary | 3.236 | 0.218 | 0.1426 |
| | | | 1.312** | 2.142*** |
| Marital Status | Binary | 1.063 | -0.0241 | -0.631 |
| | | | -1.051** | -2.106** |
| Household Size | Continuous | 1.007 | -0.215 | -0.112 |
| | | | 0.001 | 0.003 |
| Access to other Credit source | Binary | 0.0316 | -0.371 | 0.094 |
| | | | -0.041 | -0.0031 |
| Size of Farm | Continuous | 0.254 | 0.864 | 1.5307 |
| | | | 1.086** | .903** |
| Mobile Phone ownership | Binary | 0.915 | 0.925 | 1.215 |
| | | | 1.407*** | 2.682*** |
| Farming Experience (years) | Binary | 0.971 | -0.037 | -0.7956 |
| | | | -0.094* | -1.019* |
| Off Farm Income (NGN) | Continuous | 1.083 | - 0.1421 | - 1.4663 |
| | | | -1.023** | 0.002 |
| Value of Output (NGN) | Continuous | 1.105 | 1.521 | 0.126 |
| | | | 0.845** | 2.025*** |
| Per capita family (NGN) | Continuous | 0.063 | -0.018 | 0.3191 |
| | | | 0.021 | 0.034 |
| Mobile Network Coverage | Binary | 0.221 | 1.013 | 0.0713 |
| | | | 2.001*** | 3.112*** |
| Land Ownership Type | Binary | 0.013 | -0.218 | 0.019 |
| | | | 0.011 | 0.004 |
| Age (years) | Continuous | 2.321 | -0.725 | -0.1426 |
| | | | -0.241** | -0.128** |
| Extension Contact | Binary | 1.007 | 1.243 | 2.162 |
| | | | 2.131*** | 3.381*** |
| Distance to Registration | Binary | 0.254 | -0.121 | -0.5612 |
| | | | 1.231** | 0.827** |
| Access to Power Source | Binary | 0.532 | 0.017 | 0.102 |
| | | | 0.104** | 0.285** |
| Constant | | | -4.142 | -1.671 |

| | | |
|---|---|---|
| | -7.819*** | -5.685*** |

* = significant at 10% level;
**= significant at 5% level; and
*** = significant at 1% level

**Source:** Authors' Computation from the Field Data.

Meanwhile, size of farm, access to power source, farming type and education are positively significant at the 5% level for both participation and access. This simply implies that whatsoever that causes any of these variables to increase or improve, will definitely create more probability to participate in the GESS and to access and use fertilizer. Age respondent, off farm income and marital status are all negatively significant at the 5% significance level. This implies that as the variables increase, the tendency to access and use fertilizer decreases. Only farming experience is significant at 10% level.

The findings are consistent with Zinnbauer *et al* (2018) in that the liberalization and deregulation of the fertilizer distribution policy may have encouraged the private sector in the fertilizer market, but many factors still constrain the smallholders from participating and realizing their full potential.

### *3.4 Influence of the GESS on Fertilizer Use*

As stated in equation 9 of the model, we evaluated the effect of participating in the GESS by measuring the difference between the conditional probabilities of accessing fertilizer as a GESS farmer or not.

Table 6**: Probabilities (in %) of access to fertilizer while participating or not participating in GESS in the estimated bivariate probit model**

| **Access and Usage of fertilizer on time** | **Participation in the GESS Model** | | **Total** |
|---|---|---|---|
| | Yes | No | |
| Yes | 61.2 | 6.7 | 67.9 |
| No | 4.4 | 28.7 | 33.1 |
| Total | 65.6 | 35.4 | 100 |
| Conditional Prob | 8.84 | 3.32 | - |

Table 6 above shows that a positive association exists between the participation in GESS and fertilizer access and usage variables. The conditional probability of such usage increases from 3.12% when farmers are not participating in GESS to 8.84% when some started participating. This shows that the marginal effect H(z), as outlined in equation 9 above is positive as follows

G(z) = 8.84%− 3.12% = 5.57%.

The result also shows that obtaining the effect of participating in GESS on access to fertilizer by calculating its effect on the probability of the marginal distribution is negative when we applied equation 10 above.

$$M(z) = 2.72\% - 7.48\% = -4.76\%$$

This estimated model buttress also that if there is not positive correlation between participating in GESS and usage of fertilizer, the effect of participating in GESS would reduce the probability of using fertilizer by 4.76%.

Table 7 below presents the marginal effects $H_1(x_i)$, and $H(x_i)$ on the probability of accessing and using fertilizer for all explanatory variables. However the continuous variables and their marginal effects were obtained based on last three equations of the model equations 16 – 18. The ratio of probability of GESS participation $\theta$ for the binary explanatory variables is presented for the relationship between the probabilities of participating in GESS in the presence and absence of the characteristic associated with the explanatory variable. Marginal effects were all calculated using STATA 13.0

**Table 7:** Marginal effects and likelihood ratio based on the equations for the recursive bivariate probit model for rural farmers

| **Variables** | Marginal Effect | | | |
|---|---|---|---|---|
| | GESS Participants $H_1(x_i)$ | GESS Non-Participants $H_2(x_i)$ | Total $H(x_i)$ | Ratio of Probability of GESS Participation $\theta$ |
| Full time Farming | 0.325 | 0.186 | 0.511 | 1.113 |
| Male Gender | 0.453 | 0.298 | 0.751 | 0.886 |
| Education | -0.0546 | -0.1003 | -0.155 | - |
| Household Size | -2.219 | 0.91 | -1.307 | - |
| Access to other Credit source | -1.05 | -1.404 | -2.454 | 0.063 |
| Size of Farm | 0.376 | 0.896 | 1.272 | 0.032 |
| Mobile Phone ownership | 3.441 | 1.008 | 5.449 | 2.065 |
| Farming Experience (years) | -0.481 | 0.288 | -0.193 | - |
| Off Farm Income (NGN) | -0.0215 | -0.172 | -0.151 | - |
| Value of Output (NGN) | 1.662 | 1.033 | 2.695 | - |
| Per capita family (NGN) | -0.4025 | 0.056 | -0.346 | - |
| Mobile Network Coverage | 1.143 | 0.083 | 1.226 | 0.987 |
| Land Ownership Type | -0.2835 | 0.004 | -0.279 | 1.132 |
| Age (years) | -0.00624 | 0.020 | 0.014 | - |
| Extension Contact | 3.1645 | 2.002 | 5.167 | 0.093 |
| Distance to Registration | -1.105 | -1.163 | -2.058 | 0.321 |
| Access to Power Source | 0.8455 | 0.308 | 1.154 | 1.432 |

**Source:** Authors' Computation from the Field Data.

The analysis of Table 7 shows that measuring the marginal effect of GESS participation on access to fertilizer, only mobile phone ownership and contact with extension agents have up to 5% effects showing significance at 5%. Others that are significant at 10% are mobile network coverage, access to power source, value of output, size of farm, which are positively significant while access to other credit sources, distance to registration and household size are negatively significant.

This suggests that participation in the GESS to access fertilizer is a critical factor that enhances agricultural productivity of the rural farmers; and that increased participation in the GESS will increase access to fertilizer in rural Nigeria. Increased in the number of farmers who register and participate in the GESS will definitely increase access to fertilizer, as well as improve agricultural production in Nigeria. Also noted was that increased in the number of extension agents also raises the GESS awareness, which in turn boost access to fertilizer. On the other hand, cultural constraint of the married women (marital status), age of the farmer, distance to registration and redemption centers, and farming experience were negatively significant at a 5% probability level. The issue of marital status agreed with Uduji and Okolo-Obasi (2018) in that the young rural married women face cultural challenges and cannot take the decision to participate in the GESS or adopt any technology independently of their husbands, who are the custodians of the land. This is, because such decision must be taken with the husband who is the custodian of the land. At the 10% significance level, access to credit, off farm income, as well as the educational level of the respondent farmer, were positively significant. This result is consistent with Shamgo (2011) in that an increase in these factors would increase the tendency of the farmer to access and use fertilizer.

## 4. Conclusion and Policy Recommendation

Fertilizer use in Nigeria is estimated at 13 kg/ha, which is far below the 200 kg/ha recommended by the Food and Agricultural Organization (FAO). The objective of this investigation was to identify the determinant factors of farmers' participation in the Nigeria's growth enhancement support scheme (GESS). In addition, we determined the impact of the GESS on fertilizer use in rural areas. This paper contributes to agricultural and rural development debate by assessing the empirical evidence in three areas that have received much attention in the literature:

- What are the factors that determine rural farmers' participation in the GESS in Nigeria?
- Does GESS impact on farmers' fertilizer use in rural Nigeria?

One thousand, two hundred rural farmers were sampled across the six geopolitical zones of Nigeria. Results from the use of recursive bivariate probit model indicated that GESS significantly impacted on the access and usage of fertilizer among the rural farmers; and that contact with extension agents, ownership of mobile phones, power for charging phone batteries, value output, mobile network coverage, ability to read and write were positive determinants of rural farmers participation in the GESS; whereas increased distance to registration and collection centers, and cultural constraints to married women reduced farmers' tendency to participate in the GESS. The findings suggest that farmers' participation in the GESS is a critical factor for raising fertilizer use in Nigeria. This implies that food security in sub-Saharan Africa can be achieved by increasing the participation of rural farmers in the growth enhancement support scheme.

The policy implications in terms of practice, policy and research are discussed in what follows. From the perspective of practice, it is obvious from the results that the productivity of rural famers in Nigeria can be improved through the government's GESS programme. Therefore, a great proportion of rural farmers need to make use of the programme in order to leverage on the associated benefits which consist of among others: some guarantee that the farmer receives subsidy in farm inputs from government via the ago-dealers that are accredited; allocation of important agro-information; participation in schemes linked to micro-lending and the presence of a system of agricultural extension. The relevance of the study is premised on the importance of how information technology can be leveraged by policy makers in order to provide an interface of agricultural enhancement between the government of Nigeria and farmers based in rural communities. The underlying consolidation can be made through the design and implementation of information technologies that are focused on improving, *inter alia*: affordability, efficiency, adoption, interaction, reach and access.

With respect to the implications of the findings to research, whereas the study has shown that mobile phones have a crucial role to play in terms of bridging the gap of information with the ultimate aim of boosting rural agricultural, it is also relevant to extend this study with a research that clarifies if mobile phones can be substituted for interactions among farmers that are face-to-face or whether the employment of mobile phones can be

used to enhance complementary sources of information in rural communities. The principal caveat of this research is its restricted scope to rural communities in Nigeria. Therefore, the results of the study cannot be generalized to other African nations which are confronted with similar policy issues. Hence, replicating this study in the context of other rural communities in Africa in particular and the rest of the world in general is worthwhile for future research.

**Disclosure statement**

No potential conflict of interest was reported by the authors.

**References**


Adenegan, K.O., F. Fagbemi, O.I. Osanyinlusi and A.O. Omotayo (2018), 'Impact of the Growth Enhancement Support Scheme (GESS) on Farmers' Income in Oyo State, Nigeria', *The Journal of Developing Area,* Vol.52, No.1, pp.15-28.

Adesina, A. (2012), *Agricultural Transformation 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.

Anyanwu, J.C. (2014a), 'Factors Affecting Economic Growth in Africa: Are There any Lessons from the Soaring Dragon (China)?',*African Development Review,* 26(3): 468-93.

Anyanwu, J.C. (2014b), 'Oil Wealth, Ethno-Religious-Linguistic Fractionalization and Civil Wars in Africa: Cross-Country Evidence', *African Development Review,* 26(2):209-36.

Anyanwu, J.C. and A.E.O. Erhijakpor (2010), ' Do International Remittances Affect Poverty in Africa?', *African Development Review,* 22(1): 51-91.

Anyanwu, J.C., E.O. Andrew and E. Obi (2016), 'Empirical Analysis of the Key Drivers of Income Inequality in West Africa', *African Development Review,* Vol.28, No.1, pp.18-38.

Asongu, S.A, J.I. Uduji and E.N. Okolo-Obasi (2019a), 'Tourism and Insecurity in the World', *International Review of Economics,* https://doi:10.1007/s12232-019-00330-z

Asongu, S.A, J.I. Uduji and E.N.Okolo-Obasi (2019b), 'Transfer Pricing and Corporate Social Responsibility: Arguments, Views and Agenda', *Mineral Economics* https://doi:10.007/s13563-019-00195-2

Asongu, S.A, J.I. Uduji and E.N.Okolo-Obasi (2019c), 'Thresholds of External Flows for Inclusive Human Development in sub-Saharan Africa', *International Journal of Community Well-Being* https://doi:10.1007/s42413-019-00037-7

Benin, S. and B. Yu (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.

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

FMARD (2011), *Fertilizer Use and Management Practices of Crops in Nigeria,* Bobma Publishers, Ibadan.

Green, W.H. (2012), 'Econometrics Analysis' Pearson: Harlow, England.

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

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

Kassouf, A. L. and R. Hoffman (2006), 'Work-Related Injuries Involving Children and Adolescents: Application of a Recursive Bivariate Probit Model', *Brazilian Review of Econometrics,* Vol. 26, No.1, pp. 105-126.

Kefyalew, G., A. Bedilu, M. Ahmed and W. Mena (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),* Vol.4, No.9, pp. 1369-1376.

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

Morris, M., V.A. Kelly, R.J. Kopicki and D. Byerlee (2007).*Fertilizer Use in African Agriculture,* The World Bank, Washington, DC.

Ncube, M., J.C. Anyanwu and K. Hausken (2014), 'Inequality, Economic Growth and Poverty in the Middle East and North Africa (MENA)', *African Development Review,* 26(3): 435-53.

Nwalieji, H.U., C.O. Uzoegbunam, M.N. Okeke (2015), 'Assessment of Growth Enhancement Support Scheme among Rice Farmers in Anambra State, Nigeria', *Journal of Agricultural Extension,* Vol. 19, No.2, pp. 71-81.

Olomola, A.S. (2015), *Driving Agricultural Transformation with the Power of Information and Communication Technology: The performance of Nigeria's Growth Enhancement Support Scheme,* NSSP Working Paper 30, International Food Policy Research Institute (IFPRI), Washington, DC.

Shamrao, T.S. (2011), 'A Study of Fertilizer Policy in India', *International Journal of Agriculture Sciences,* Vol. 3, No.3, pp. 145-149.

Tiri, G.D., E.A. Ojoko, A. Aruwayo (2014), 'Growth Enhancement Support Scheme (GESS) and the Challenges of Food Security in Nigeria: A Review', *ARPN Journal of Agricultural and Biological Science,* Vol.9, No.7, pp. 226-232.

Uduji, J.I.and E.N.Okolo-Obasi (2017), 'Multinational oil firms' CSR initiatives in Nigeria: The need of rural farmers in host communities', *Journal of International Development,* Vol.29, No.3,pp. 308-329, http://doi.org/10.1002/jid.3243

Uduji, J.I. and E.N.Okolo-Obasi (2018a), 'Young rural women's participation in the e-wallet programme and usage intensity of modern agricultural inputs in Nigeria'*Gender, Technology and Development*Vol. 22, No.1, pp. 59-81, http://doi.org/10.1080/09718524.2018.1445894

Uduji, J.I. andE.N. Okolo-Obasi (2018b),'Adoption of improved crop varieties by involving farmers in the e-wallet programme in Nigeria',*Journal of Crop Improvement,*Vol. 32, No.5, pp.717-737, http://doi.org/10.108/1547528.2018.1496216

Uduji, J.I.andE.N.Okolo-Obasi (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.IandE.N.Okolo-Obasi (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. and E.N. Okolo-Obasi (2019), Corporate Social Responsibility in Nigeria and Youths in Sustainable Traditional Industries Livelihood in Oil Producing Communities', *Journal of International Development,* https://doi:10.1002/jid.3432

Uduji, J.I.,E.N. Okolo-Obasi, andS.A. Asongu(2018a), 'The Impact of E-Wallet on Informal Farm Entrepreneurship Development in Rural Nigeria', *The Electronic Journal of Information Systems in Developing Countries,*85(3):1-21,https://doi//10.1002/isd2.12066

Uduji, J.I, E.N. Okolo-Obasi,andS.A. Asongu (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., E.N. Okolo-Obasi, S.A. Asongu (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., E.N. Okolo-Obasi, S.A. Asongu(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,* 27(4): 692-703https://doi.org/10.1002/sd.1933

Uduji, J.I., E.N. Okolo-Obasi, S.A. Asongu (2019c),'Multinational Oil Companies and Corporate Social Responsibility in the HIV/AIDS Response in Host Communities',*Local Environment* ,24(5):393-416https://doi.org/10.1080/13549839.2019.1585770

Uduji, J.I., E.N. Okolo-Obasi and S.A. Asongu (2019d), 'Sustainable Cultural Tourism through Higher Female Participation in Nigeria: The Role of Corporate Social Responsibility in Oil Host Communities', *International Journal of Tourism Research,* https://doi.org/10.1002/jtr.2323

Uduji, J.I., E.N. Okolo-Obasi and S.A. Asongu (2019e), 'Electronic Wallet Technology and the Enabling Environment of Smallholder Farmers in Nigeria', *Agricultural Finance Review,* https://doi:10.1108/AFR-2018-0103

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

Zinnbauer, M., J. Mockshell and M. Zeller (2018), *Effects of Fertilizer Subsidies in Zambia: A Literature Review,* Munich Personal RePEC Archive (MPRA), Paper No. 84125, University of Hohenheim.