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Analysis of Farmers' Food Price Volatility and Nigeria's Growth Enhancement Support Scheme

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Analysis of Farmers' Food Price Volatility and Nigeria's Growth Enhancement Support Scheme

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Abstract

Food prices in Nigeria have become significantly higher and more volatile since 2012. The purpose of this research was to find out what affects farmers' participation in the growth enhancement support scheme (GESS) in the country. We determined the effect of the GESS on the ease of access to market information and agricultural inputs that influence price volatility at farm gate level. A total of 2100 rural farmers were sampled across Nigeria's six geopolitical zones. Result from the use of recursive bivariate probit model showed that farmers depended on the GESS for the resolution of food price volatility by providing food market information and agricultural inputs that bring down the incidence and amount of anxiety-impelled price rise in Nigeria. The results advocated for the need to improve the GESS in line with the agricultural transformation agenda (ATA) by cutting down the deterrents mostly linked with the use of mobile phones, and the distance of registration and assemblage centers. In extension and contribution, the findings suggest that smallholder farmers can be part of the volatility solution when they are provided with rural roads and transportation to get their product to the market, and technology to receive and share the latest market information on prices.

Keywords

Agricultural transformation agenda, recursive bivariate probit model, food price volatility, growth enhancement support scheme, rural farmers, Nigeria.

Introduction

Price volatility describes the magnitude of price functions or the risk of large, unexpected price changes. The menace of extreme price dealings can intensify and enlarge wider social risks related to human progress, adequate food provision and political control (Torero, 2016). The existing price volatility in international markets is a threat to the security of food all over the world. For the world's destitute who depend on small farming to survive, existence has become more distressing (FAO, 2018). The terrible upsurge in the prices of food for quite some years now has given rise to serious concerns about the state of food and nutrition of the impoverished in emerging nations (Minot, 2014). The upsurge in price affects impoverished households' expenditure on a collection of important goods and services as well as cutting down the calories they guzzle (World Bank, 2012). The surge in prices of consumables upsets the nutrition of the impoverished by forcing them to go for less exorbitant, low value, and less micronutrient-dense foods (Anriquez *et al,* 2013). Food price volatility in markets is having an adverse effect on the likelihood of African countries achieving economic growth and cutting down on living in paucity (Adam & Paice, 2017).Food price volatility in markets is among the most pressing food and economic problems before policy makers in Africa (Gilbert *et al,* 2017; Uduji *et al*, 2019i, 2019j). It has created anxiety and caused real hitches in the nations in sub-Saharan Africa (Alper *et al,* 2016). Though, with workable plan of action, investments, and advancement packages in place, smallholder farmers could really upturn food production, which will advance their lives and serve as a plus to the security of food for all (FAO, 2015).

Sub-Saharan Africa nations have a greater amount of net programmes connected to food security which are raised to react to growing prices in the region (Smith & Abraham, 2016). To serve as an example, the Federal Government of Nigeria (FGN) launched the Growth Enhancement Support Scheme (GESS) in 2012, to better the delivery of agricultural inputs, improve on yields, stimulate food security, and enhance progress in the rural part of the nation (Adesina, 2012). Under the GESS, the role of the government moved from direct procurement and conveyance of fertilizer to hastening of procurement, giving directives on the quality of fertilizer, and improvement on the private-sector agricultural inputs value chain (Adesina, 2013). A comparison of the scheme with the former subsidy programme reveals that the GESS has been more active and transparent. The FGN spent ₦ 30 billion (US$180 million) in 2011 to back inputs of which 90 percent never got to the intended smallholder

farmers; then, in 2012, the FGN spent ₦ 5 billion (US$30 million) to reach 1.2 million smallholders. Also in 2013, ₦12 billion (US$96 million) was spent by FGN to reach 4.3 million smallholder farmers (Grossman & Tarazi, 2014; Uduji *et al*, 2019e, 2019f).

Although the GESS appears to be more active in reaching more smallholder farmers than the previous schemes, it has been attacked over its usefulness and practical applications. For example, scholars such as Ahmed *et al* (2016), Oluwafemi, *et al* (2016), Trini *et al* (2014), Fadairo *et al* (2015), Nwaobiala & Ubor (2015), Nwalieji *et al* (2015), Oyedira *et al* (2015) and others have argued that the GESS process in Nigeria is not really widespread. Consequently, the scheme has not been believed to have reached many in rural areas (Ibrahim *et al*, 2018). In a different view, Uduji & Okolo-Obasi (2018a, 2018b),Olomola (2015), Grossman & Tarazi (2014), Uduji *et al* (2018b) and Adenegan *et al* (2018)support the GESS, stating that the scheme is effective in the area of supply of modern agricultural input to Nigeria's smallholder farmers. In further elucidation, Wossen *et al* (2017) noted that while there is positive outcome in average productivity of the GESS input subsidy programme in bettering food security, enhancing the distributional outcome of the programme by focusing on the most deprived groups would greatly impact on the programme's input towards food security and lessen impoverishment.

Meanwhile, prices of food in Nigeria have become much higher and more unstable since 2012; prices are surging up and instability (volatility) is still high; periods of inconsistency in prices are not new and price unpredictability is key to the very existence of food markets (Nwoko *et al*, 2016; Ojogho *et al*, 2015, Uduji & Okolo-Obasi, 2018a, 2018d, 2019a, 2019b). Consequently, the nation's agriculture sector will face remarkable problems in the coming years as population growth will keep increasing food demand; while change in climate and dreadful conditions of natural resources will make supply difficult, both with regard to the average production and volatility of farmers (Uduji & Okolo-Obasi, 2017, Uduji *et al*, 2019c, 2019d, 2019h, 2019i, 2019j).On this basis, we posit that the GESS programme of the federal government has not meaningfully impacted on Nigerian farmers' food price volatility. Hence, this paper drew greatly on works that have been published which add to the discussion in line with individual segments of the wallet technology (electronical in nature) in Growth enhancement support scheme (Uduji & Okolo-Obasi, 2018a, 2018b; Uduji, Okolo-Obasi & Asongu, 2019f, 2019i, 2019k, 2019b, 2019e, 2019j), and is a plus to the agriculture and rural

development debate by assessing the empirical evidence in three areas of great interest in the literature:

- To ascertain factors that serve as incentives to the decision of (local rice/ yam) farmers to partake in the GESS programme.
- To examine the degree of the impact of the federal government's GESS programme on the ease of access to market information by the (local rice/ yam) farmers in influencing the farm gate prices.
- To determine how the GESS giving out of agricultural inputs to (local rice/ yam) farmers' impact on farm gate level's price volatility.

In continuation, the remaining parts of the paper are presented thus: section 2—reviews on why food price volatility is a major concern in Africa; section 3—a look at the operation of Nigeria's GESS; section 4—the theoretical underpinnings; section 5—description of the methodology; section6—presentation of the empirical results and discussions, and section 7—concluding of the work with policy implications, caveats and directions to future research.

Why food price volatility is a major concern in Africa

Volatility actually refers to the idea of prices being unstable around a rather steady long-term price or price trend (IFPRI, 2008). These short-term fluctuations may concern day to day, weekly, or monthly prices. Periods of very high or low commodity prices are often connected to crises as they are a difficulty to policy makers, producers and consumers (IFAD, 2011). For that reason, the concept of volatility grips the idea of fluctuations in price in two dissimilar ways: in a historical perspective and in a forward-looking viewpoint (Haile & Kalkuhl, 2016). Price disparity is not astonishing if it bears a historical trend, as well as recurrent and popular typical variations; however, volatility in high degree gives rise to the governments, NGOs, businesses and consumers paying attention to food security. According to Gouel *et al* (2013), food security has an unswerving link with the problem of food price volatility due to increased price of food deterring access to food by the consumers from middle to lower income groups particularly in emerging and indigent nations.

Africa is predominantly affected by the impact of high prices and price volatility generally (Arezki *et al,* 2016). With the discrepancy between volatility and high prices in mind, countries in African were among the worst hit by the rapid increment of prices in 2007-2008 (FAO, 2010). In 2010, as much as a quarter of human beings in the world underwent

malnutrition, with 30 % of the total number coming from Africa (SAHEL/OECD, 2011). The continent's population is growing so quickly that bringing down the rates of malnutrition to half by 2030 would not hinder the number of Africans affected by hunger to significantly rise (Adams & Paice, 2017). In addition, about60% of humans in sub-Saharan Africa live on agriculture, and not up to 20% of them are outside smallholder farmers with less than two hectares of land (Alper *et al*, 2016). Food is behind three-quarters of household expenses (IFAD, 2009). Increment in such food prices wanes most susceptible livelihoods, drops the financial resources of farmers and, due to that, heightens the possibility of small farmers becoming impoverished (Mason & Myers, 2013, Uduji & Okolo-Obasi, 2018c, 2019a, 2019b). In urban settings, the ability to access food is the key interest of food security (Minot, 2014). Mutinies over food prices in 2007-2008 have drawn international reaction to this problem (Asongu, 2013, 2014; Jatta, 2016). The social hitches that followed pushed African governments and African regional organizations to back the most susceptible populations and to begin structural policies aimed at improving food production. Sizable public investments have taken place to sustain the initiatives (FAO, 2011; Asongu *et al*, 2019a, 2019b, 2019c, 2019d). The worth of these African government initiatives, in response to the specific needs of their countries, must be looked into to find out the weight on food price volatility in the continent.

Operations of the GESS

Nigeria progressed on agricultural input distribution by inaugurating the Growth Enhancement Support Scheme (GESS) in 2012, to provide sufficient subsidized agricultural inputs to local farmers. The GESS, which is a distinguished agricultural scheme of the federal government, is targeted at providing subsidized farm inputs to farmers and making progress from subsistence to commercial farming realizable. It was planned to be a part of the Agriculture Transformation Agenda (ATA) of the government of Nigeria, in line with the Comprehensive African Agricultural Development Program (CAADP), which is the core background for fast-moving agricultural development in the continent. The ATA is the response of the federal government towards realizing food security and raising household income for small-scale farmers (IFDC, 2013). With the GESS, the government fights indirect seed purchase and circulation, betters the voucher system, and boosts direct circulation of inputs via mobile technology. Farmers who enrolled in the scheme are able to get a share of seeds via the mobile phone and physically collect them from an official agro-dealer. Through

this, an e-wallet can be stated to be a rich and effective electronic device system that uses the mobile phone for distributing agricultural inputs to smallholder farmers in rural Nigeria (Adesina, 2012, Uduji & Okolo-Obasi, 2018a, 2018b, Asongu *et al*, 2020a, 2020b, 2020c, 2020d).

The technology, innovation and science used in actualizing the GESS in the country are the e-wallet. It is the development process that guarantees that a smallholder farmer in Nigeria accesses a farm input subsidy without stress from the government through an approved agro-dealer in the local community. The conditions which empowers a farmer to be involved include: the farmer's age> 18; the farmer having taken part in a survey ran by the government to capture farmer's discrete broad information, and the farmer having a cell phone with a registered SIM card as well as not less than sixty Naira (0.16 USD) credit being on the cell phone. With these basic requirements met, an identification number is issued to the farmer that authorized the farmer to collect seeds, fertilizer and other needed agricultural inputs from agro-merchants at lower price which is actually half the open market cost (Akinboro, 2014).

Looking at how the GESS operates, it is the duty of state and local governments to register qualified smallholder farmers (who should have < 5 hectares of farmlands). Farmers complete a machine-readable form manually; then, data are worked upon before being sent to the national database (Grossman & Tarazi, 2014; Uduji *et al*, 2019i, 2019j). Farmers, who are properly registered via mobile phones, receive allocation of their subsidized seed using such phones, whereas farmers not registered can use a registered neighbor's phone to participate from the scheme (Adesina, 2013; Ugwuanyi, 2020). The GESS makes available a certain sum of subsidy credit to all farmers; such credits are connected to the farmers' GESS ID numbers, and if valid, to the mobile phone numbers of the farmers too. In either case, no farmer directly gets funds (Akinboro, 2014, Uduji *et al*, 2018a). On the other hand, participating farmers who have no phones are made aware of the time for redemption of subsidies by the registered ones with phones in the same community when such get alerted through the SMS information. Those who regrettably fail to get the information would probably miss gaining their subsidized input or, at best, get it late (Uduji *et al*, 2019a, 2019b, 2019c). At the collection center for the subsidized inputs, the farmers concerned make payment of the 50 percent balance and collect the subsidies by making a demand on the center platform via an SMS for approval of subsidy redemption (Trini *et al.*, 2014; Uduji *et al*, 2019g). If the deal is

through, both the farmer and the agro-merchant receive confirmatory alerts (text messages) about endorsement of the subsidy redemption.

Theoretical underpinnings

Agricultural development theories are attempts towards defining the forces in society and the economy that give rise to agricultural change. In the literature, there are about four strategic theories of agricultural development: the conservative model, the urban impact model (location model), the diffusion model and the high-pay off input model. Nevertheless, this paper evaluates the quantitative outcome of the analysis via the lens of the high-pay off input model (the Schultz theory). The problem Schultz (1964) is out to resolve is how traditional agriculture could be transformed into a very productive type of farming. Schultz considers this problem as an intervention one; however, solving it will not just be achieved by injection of capital into the agricultural sector, but by pre-determining the forms agricultural intervention should take. Schultz projects the notion that the traditional agricultural sector will not only grow with the support of the traditional production factors, but also grow at a very high charge. According to Lundahl (1987), Schultz high-pay off input model is classified into three core categories: the ability of both public and private sector research institutions to generate new technical knowledge; the capacity of the industrial sector to improve, create and sell fresh technical inputs, and the capacity of farmers to acquire new knowledge and use new inputs brilliantly.

Ayoola (1997) noted that the eagerness with which the high-pay off input model has been acknowledged and integrated into economic doctrine has been by part due to the spread of studies reporting high rates of yields to public intervention in agricultural research, as it relates to efforts towards developing fresh and high productivity grain varieties suitable for the tropic. For instance, Mexico were able to develop new high-yielding wheat varieties in the 1950s while new high-yielding rice varieties were developed in Philippines in the 1960s (Ruttan, 1977). These varieties were very much amenable to industrial inputs such as fertilizer and other agronomic chemicals, and effective soil and water management. The high yields linked to the adoption of new varieties and the technical input and management practices connected to it led to the rapid spreading of the new varieties among farmers in most emerging economies/countries (Dercon & Gollin, 2014). However, those not in support reason that the high-pay off input model is deficient as a theory of agricultural development

as a result of the following reasons: learning and research are public goods not discharged through the market place; the means by which resources are allotted among education, research and other alternative public and private sector economic undertakings are not fully incorporated into the model; the model does not deal with intervention in research as the basis of new high-pay off techniques; it does not clarify how economic state of affairs prompt the enhancement and taking on of an efficient set of technologies for a specific society; and it does not specify the process by which factor and product price relationship boost intervention in research towards a particular direction (Udemezue & Osegbue, 2018). All the same, this theoretical groundwork is reliable with the structure of this study in the angle that, the GESS is an intervention programme that provides the necessary agricultural inputs for farmers operating at smallholder's level to raise their produce and lower the food price volatility in the sub-Saharan region of Africa.

Materials and methods

We drew from earlier studies and publication made in the area of the debate on e-wallet technology in Growth Enhancement Support Scheme of agriculture and rural development programme of Nigeria. (Uduji & Okolo-Obasi, 2018a, 2018b; Uduji *et al*, 2019k, 2019b, 2019e, 2019f, 2019i, 2019j). It is a further analysis and improvement of a working paper (Uduji *et al*, 2019i, 2019j). This work also adopted quantitative method owing to the insufficiency of previous method on the intricacies of food price volatility in sub Saharan African, (Uduji & Okolo-Obasi, 2018b). Adopting a survey research technique, we sampled farmers at the farm gate level and elicited a cross sectional information that describes and interprets present condition of the farmers and food price.

Sample size

A key factor in determining the size of sampling error is the sample size relative to the entire population. This, in turn, is determined by the main variable's estimated prevalence, the tolerable error margin and anticipated confidence level (Uduji *et al,* 2019e, 2019f, 2019i, 2019j, and 2019k). Factoring in these, the sample size in this study was determined using Topman's formular for an infinite population. The degree of freedom and error tolerance are 95% and 5%, respectively. The sample size is calculated thus:

$$Ss = \frac{Z^2PQ}{e^2}$$

Where Ss = Sample size

Z = Confidence level (1.96) Constant

P = Proportion of positive response

Q = Proportion of negative response

e = Error margin

Hence, $Ss = \frac{1.96^2(0.65*0.35)}{0.5^2}$ this implies that, $Ss = \frac{3.8416*0.65*0.35}{.0025}$ = 349.59, we rounded the approximation 350 respondents. However, as determined by applying the formula, 350 as a sample is good, but because six geopolitical zones of the country are involved in the study, we chose to multiple the size by 6 to ensure that errors are reduced to the barest minimum. To this, our final sample size used for the study was 350 X 6 = 2100 respondent households.

Sampling procedure

We used multi-stage sampling techniques which included cluster, quota and sampling of simple random nature to select the respondents. The first stage of the sampling clustered the states according to the six geo-political zones of Nigeria. Hence we had six clusters of, South-East, North-East, South-West, North-West, South-South and North-Central, as shown in Figure 1.

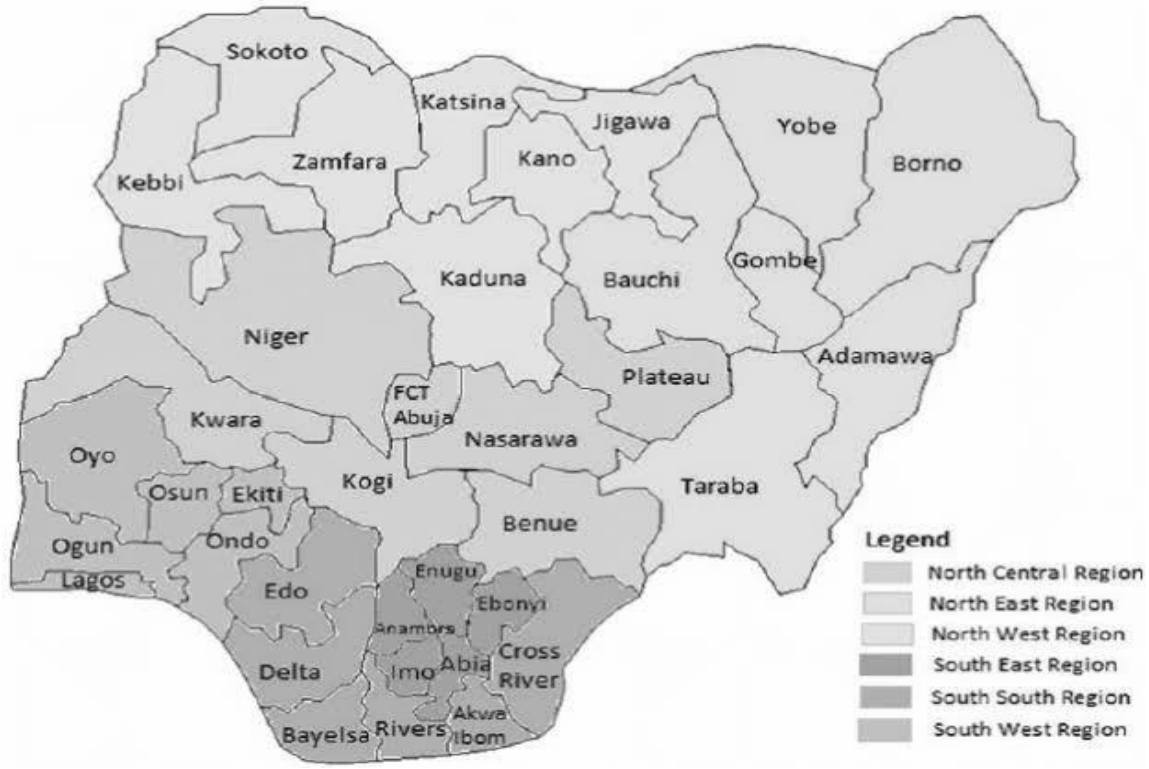

Figure 1. Constituent states of the geo-political zones in Nigeria.

Source: FGN, 2017

Table 1. Sample distribution

Zones	Total Population	Farmers Population	Sample Per State	Sample per community	
				Regd	Non-Regd
Taraba	2,294,800	1,560,464	112	56	56
Yobe	2,321,339	1,578,511	114	57	57
Kwara	2,365,353	1,608,440	116	58	58
Benue	4,223,641	2,872,076	207	103	103
Cross River	2,892,988	1,967,232	142	71	71
Delta	4,112,445	2,796,463	201	101	101
Ebonyi	2,176,947	1,480,324	107	53	53
Enugu	3,267,837	2,222,129	160	80	80
Ogun	3,751,140	2,550,775	184	92	92
Ekiti	2,398,957	1,631,291	117	59	59
Kano	9,401,288	6,392,876	460	230	230
Sokoto	3,702,676	2,517,820	181	91	91
	42,909,411	**29,178,401**	**2,100**	**1,050**	**1,050**

Source: National population commission, 2007/ FMARD (2010)/Authors' computation

The second stage involved sampling on purpose, so we used purposive sampling to select two states from each of the cluster defined in stage one. Hence two states were selected from each geo-political zones based on the degree at which farming activities are operated in the states as apparent in the National Bureau of statistics (NBS)in farming of both rice and yam which are the main staple crops in Nigeria (FGN, 2017). The selected states based on the cluster are thus: Kwara and Benue States in the North-Central region, Taraba and Yobe States in the North-East region, Kano and Sokoto States in the North-West region, Ebonyi and Enugu States in the South-East region, Cross Rivers and Delta State in the South-South region and, Ogun and Ekiti States in the South-West region. In stage three, we listed all the Local Governments Areas (LGAs) in the selected states and also purposively selected two LGAs based on the farming strength of the LGAs in the area of rice and yam farming. This gave us

a total 12 LGAs. In the next stage, from these 12 LGAs; we selected randomly the core communities in the LGAs, 2 communities each to make up 48 rural farming communities for the study. The last stage saw us using simple random sampling with the help of the community gate keepers to select 1050 registered and 1050 non-registered farmers. This gave us a total of 2100 respondents used for the study chosen unsystematically as shown in Table 1.

Data collection

We collected both primary and secondary information for the purpose of the study. We employed the technique based on participatory rural appraisal (PRA). We used the PRA in data gathering for this GESS study because Uduji *et.al*, (2020a, 2020b, 2020c, 2020d) suggested that using such appears to be the best as it relates directly to the rural households whose life and environment is being studied. Hence the inputs (view and opinion) of the rural household are of paramount importance

In using the key informant interview (KII), we generated detailed, group and gate keepers' information from key informants in the concerned communities. Their view on the effect of the GESS on the farm gate price volatility of local rice and yam produced in their communities and what it will take to better the involvement of the whole population in the GESS and the e-wallet technology were obtained.

We also reviewed past publication, government and some village head documentations to generate secondary data relating to consumer price index. The documents of the National Bureau of Statistics, Federal and States Ministries of Agriculture and Rural Development and the States Ministries of Commerce and Industries were on hand to provide supportive information.

Analysis technique

The data generated from the field study were treated with the employment of descriptive as well as inferential statistics in order to address the research questions and corresponding testable hypotheses. Following the findings in the previous study, (Uduji *et al*, 2019i, 2019j), we introduced recursive bivariate probit model to model the effect of the GESS on participation of rural farmers in the GESS, as well as on the price volatility. We took note that two decisions are involved; registration to participate is both a dependent variable as well as an explanatory variable determining the price volatility. Testing the marginal incidence of

the independent variable on the outcome variable, we made attempted to answer the following questions:

- What factors motivates to the decision of (local rice/ yam) farmers to participate in the Nigeria's Growth Enhancement Support Scheme of the Federal government?
- What is the degree of the impact of the Growth Enhancement Support Scheme of the Nigeria's Federal government on the ease of access to market information by the (local rice/yam) farmers in influencing the farm gate prices?
- How does the Growth Enhancement Support Scheme of the Nigeria's Federal government giving out of agricultural inputs to (local rice/ yam) farmers impact on farm gate level's price volatility?

We also used the recursive bivariate probit model to test the hypothesis of the study. The hypothesis of the study is that there is no significant correlation between the random terms of taking part in the Nigeria's Growth Enhancement Support Scheme model of the Federal government and the changes in price of the local rice and yam farmers.

To model the two interdependent decisions of participating in the Growth Enhancement Support Scheme of the Federal government and using the participation to fully access all the provision made by the government in the GESS programme, we thought of recursive bivariate probit model as very vital. Greene (2012) noted that the recursive bivariate probit model naturally extends the probit model suitable for such a further analysis like this one. This is as a result of the fact that two legs of decision are involved in the model. The first hurdle is to register and participate in the programme as a dependent variable, while the second hurdle is using the participation to access the provisions of the GESS is among the independent variables. The recursive bivariate model was therefore adapted with some modifications, following Uduji *et.al* (2019f) and the STATA 13 software was employed to analyze the data.

Model specification

In modelling the decisions we specify the model considering the equations below:

$K^* = \alpha' w + \varepsilon_1$ $\quad K{=}1 \; if \; a^* {>} 0 \; otherwise \;\; K{=}0$ Equation 1

$L^* = \beta' x + \delta K + \varepsilon_2$ $\quad L{=}1 \; if \; y^* {>} 0 \; otherwise \;\; L{=}0$ Equation 2

In equations 1 & 2, both 'x' and 'w' are column vectors representing independent variables. These variables definitely acknowledged that;

$$\sum[\varepsilon_1 \mid w, x] \quad = \quad \sum[\varepsilon_2 \mid w, x] = 0,$$

$$Var[\varepsilon_1 \mid w, x] \quad = \quad Var[\varepsilon_2 \mid w, x] = 1,$$
$$Cov[\varepsilon_1, \varepsilon_2 \mid w, x] \quad = \quad \rho$$

It is on this note that the model likewise recognized that ε_1 and ε_2 have bivariate normal distribution thus stated:

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

This model is recursive because the variable (K) is represented in equations 1&2 as the outcome indicator equation 1 and in equation 2, an explanatory variable. The other endogenous variable (L) on the other hand does not appear as explanatory variable on any of the equation. We apply this to our study and where K = 1 signifies the decision of the rural farmers to participate in the Growth Enhancement Support Scheme of the Federal government programme, otherwise, K = 0. Also, L = 1 signifies the decision of the registered farmers to access and use the provision of the GESS programme, otherwise, L = 0. The study therefore decided to use E3 to reflect equation 3 above (the function of a distribution corresponding to the bivariate standard normal distribution with a correlationρ). To this the obtainable basic likelihoods in the recursive bivariate probit model are:

$prob[L = 1, K = 1] = E3(\alpha' w, \beta' x + \delta, \rho)$ Equation 4

$prob[L = 1, K = 0] = E3(-\alpha' w, \beta' x - \rho)$ Equation 5

$prob[L = 0, K = 1] = E3(\alpha' w, -\beta' x - \delta - \rho)$ Equation 6

$prob[L = 0, K = 0] = E3(-\alpha' w, -\beta' x - \rho)$ Equation 7

This is to say that, if 'x' and 'w' are known, the value expected of L will be expressed as

$= E3(\alpha' w, \beta' x + \delta, \rho) + B\#(-\alpha' w, \beta' x, -\rho)$ Equation 8

The variable to be fitted into the model is represented as follows:

Age = Age of a farmer measured in range of number of years

Sex = Gender of the respondent (dummy – Males = 1 Females = 0)

Edu = Highest level of educational qualification obtained by respondents

Ms = Status of marriage respondent (dummy – Married =1 otherwise =0)

PrioC Primary occupation Full farming = 1 Otherwise = 0

Hhz = Household size of farmer, number of people in the household

Cred = Access to farm credit by farmers (1=accessed and 0 otherwise)

Famz = Size of farm cultivated by farmers (hectare)

Moby = Ownership of mobile phones (1= owned, 0 = otherwise)

Mkinf = Sources of market information/Input (1= GESS and 0= otherwise)

Expf = Farming experience measured in range of (years)

OfY = Off-farm income (other income generated from sources other than farm)

HhMY = Per capita income of other family members (NGN)

Outp = Value of farmers' output quantified in Nigeria Naira (NGN)

Mnc = Mobile network coverage (1= covered and 0 = otherwise)

Lot = Land ownership type (1= inheritance, 0 otherwise)

Ext = Contact with extension agent (number of times of visiting or visited by agent(s))

Dist = Distance to input redemption point (1 = far, 0 = otherwise)

Coop = Membership of cooperative organization

Polaff = Political afflation of the respondent (member of ruling party =1 otherwise =0)

Loctn = Residence of the respondents (Living in the rural communities fully =1, otherwise =0)

ε = Stochastic error term.

To estimate the marginal effect of the variable on the dependent variables, we got the likelihood of K = 1(likelihood of registering and participating in GESS) from the marginal distribution as $\phi(\alpha' w)$. Therefore, estimated the effect with the difference between the conditional likelihoods accessing the inputs provided under the Growth Enhancement Support Scheme of the Federal government or otherwise. This effect was measured by the function G(k) which is stated thus:

$$G(k) = \frac{E3(\alpha' w, \beta' x + \delta, \rho)}{\phi(\alpha' w)} - \frac{E3(-\alpha' w, \beta' x - \rho)}{1 - \phi(\alpha' w)} \quad \text{Equation 9}$$

We also calculated effect of participating in GESS on the probability of the marginal distribution to also determine its effect on access to and usage of inputs provider under the Growth Enhancement Support Scheme of the Federal government, and it is expressed as follows: $M(k) = \phi(\beta' x + \delta) - \phi(\beta' x)$ Equation 10

Thereafter we got the likelihood in the bivariate distribution if ρ = 0, by multiplying the marginal likelihoods thus:

$$E3(\alpha' w, \beta' x + \delta) = \phi(\alpha' w)\phi(\beta' x + \delta)$$

At this point, verifying that at the level ρ = 0 becomes possible. Hence, the difference between conditional likelihoods is the same thing with the effect of participating in the

programme of the Growth Enhancement Support Scheme of the Federal government on access and usage of inputs provided.

Therefore G(k) = M(k) Equation 11

Empirical results and discussion

Our analysis and discussion in this section drew significantly from the previously published works which add to discrete segments of the electronic wallet technology debate in Growth enhancement support scheme of Nigeria's agriculture and rural development programme (Uduji & Okolo-Obasi, 2019k, 2018b; Uduji, Okolo-Obasi & Asongu, 2019k, 2019b, 2019e, 2019f, 2019i, 2019j).

The socio-economic characteristics of the farmers

The analysis of demographic (age, marital status, household size), social (education, gender) and economic (occupation, income, farm size, ownership of mobile phone, power source and access to electricity) characteristics of the local rice/ yam farmers make available essential understanding of the socio-economic status of the rural farmers and evident factors that influence their taking part in the GESS (Table 2).

Table 2. Socio-economic characteristics of the respondents

	Registered Rural Farmers			**Non- registered Rural Farmers**		
Variables	**Freq**	**%**	**Cum**	**Freq**	**%**	**Cum**
Sex						
Males	788	75	75	735	70	70
Females	263	25	100	315	30	100
	1050	**100**		**1050**	**100**	
Primary Occupation						
Farming	485	46	46	727	69	69
Trading	160	15	61	170	16	85
Palm tapping	34	3	65	55	5	90
Government paid employment	286	27	92	23	2	93
Hunting	85	8	100	75	7	100
	1050	**100**		**1050**	**100**	
Years of experience						
0- 5 Years	315	30	30	32	3	3
6 - 10 Years	368	35	65	221	21	24
11 -20 Years	189	18	83	378	36	60
21-30 Years	95	9	92	231	22	82
31- 40Years	53	5	97	137	13	95

41 Years and Above	32	3	100	53	5	100
	1050	**100**		**1050**	**100**	
Age of respondents						
Less than 20 Years	158	15	15	42	4	4
21-30 Years	452	43	58	116	11	15
31- 40 Years	179	17	75	210	20	35
41-50 Year	126	12	87	578	55	90
51-60 Year	105	10	97	63	6	96
61 Years and Above	32	3	100	42	4	100
	1050	**100**		**1050**	**100**	
Level of Education						
None	137	13	13	502	51	51
FSLC	494	47	60	336	35	86
WAEC/WASSCE	294	28	88	147	14	100
B.Sc and Equivalent	95	9	97	56	0	100
Post graduate degrees	32	3	100	9	0	100
	1050	**100**		**1050**	**100**	
Marital Status						
Single	231	22	22	126	12	12
Married	609	58	80	640	62	73
Widowed	84	8	88	147	14	87
Divorced	53	5	93	63	6	93
Separated	74	7	100	74	7	100
	1050	**100**		**1050**	**100**	
Household size						
1-4 Person	777	74	74	347	33	33
5-9 Person	189	18	92	431	41	74
Above 9 persons	84	8	100	273	26	100
	1050	**100**		**1050**	**100**	
Farm Size						
Less than 1 Hectare	189	18	18	462	44	44
Between 1-2 Hectares	420	40	58	473	45	89
Between 3-4 Hectares	178.5	17	75	84	8	97
Between 4-5 Hectares	157.5	15	90	32	3	100
5 and above Hectares	105	10	100	0	0	100
	1050	**100**		**1050**	**100**	
Ownership Mobile phone						
Have a set	830	79	79	336	32	32
Uses a neighbor's set	221	21	100	158	15	47
Have no access to phone set	0	0	100	557	53	100
	1050	**100**		**1050**	**100**	
Monthly Income Level						
0 - 50,000	53	5	5	368	35	35
51,000 - 100,000	389	37	42	420	40	75

101,000 - 150,000	294	28	70	147	14	90
151,000 - 200,000	179	17	87	63	6	95
201,000 - 250,000	84	8	95	32	3	98
Above 250,000	53	5	100	21	2	100
	1050	**100**		**1050**	**100**	
Access to Electric Power Source						
Connected to PHCN	242	23	23	305	29	29
Uses Small Generator	441	42	65	252	24	53
Uses Solar energy source	63	6	71	105	10	63
Uses public charger	168	16	87	63	6	69
No access to power at all	137	13	100	326	31	100
	1050	**100**		**1050**	**100**	

Source: Computed from the field data by authors

Analysis (Table 2) shows that 75% of the registered farmers are male farmers while only 70% of the non-registered farmers are males. The women fill up the remaining 25% of the registered and 30% of non-registered farmers. This gap in registration according to Uduji & Okolo-Obasi, (2018a) seems to be a function of cultural practices. Some of the cultural practices in the country compel women to function under their husbands especially in the farming business. The Analysis also discloses that 75% of the registered female farmers are either widowed, separated or divorced. The average age of a registered respondent farmer as seen in the analysis is 36 years, and the average years of experience is 19 years old. For the non-registered farmers, the averages are 41 and 23 years respectively. Analysis (Table 2) also revealed the importance of education in the decision to register and participate in GESS. It shows that, about 13% of the registered farmers do not have formal education, while on the other hand,51% of the non-registered farmers are not exposed to any form of formal education. Out of the 1050 registered farmers, 89% have a personal mobile phone, while 11% depend on others phones. None of the registered respondents could be said to have no access to mobile phones. On the part of the non-registered farmers, only 32% have direct access to mobile phone, while about 53% have no access at all. This finding equally reveals that internet penetration have reasonably improved in Nigeria as compared to the findings of Grossman & Tarazi (2014) who opined earlier that only about half of the farmers owned personal phones.

Table 3: The Rate of Participation of Farmers in the Growth Enhancement Support Scheme.

Zones	Total Population	Farmers Population	No of Registered Farmers	Average Percentage
Taraba	2,294,800	1,560,464	343,302	22
Yobe	2,321,339	1,578,511	457,768	29
Kwara	2,365,353	1,608,440	337,772	21
Benue	4,223,641	2,872,076	746,740	26
Cross River	2,892,988	1,967,232	413,119	21
Delta	4,112,445	2,796,463	671,151	24
Ebonyi	2,176,947	1,480,324	281,262	19
Enugu	3,267,837	2,222,129	377,762	17
Ogun	3,751,140	2,550,775	586,678	23
Ekiti	2,398,957	1,631,291	407,823	25
Kano	9,401,288	6,392,876	2,109,649	33
Sokoto	3,702,676	2,517,820	679,811	27
	42,909,411	**29,178,401**	**7,412,837**	**24%**

Source: FMARD, 2010/Authors' Computation

To participate in the GESS starts with registration of farmers, and analysis (Table 3) shows an average registration and participation of farmers to be 24%. It shows that in the North - West the average rate of registration is 25.5%, North-East 30%, North Central23.5%, South-West 24%, South- South 22.1% and South-East18%.This shows that participation was higher in the North than the South, Nigeria. Irrespective of the similarities in the demographic and socio-economic characteristics of the respondent farmers, different reasons were adduced to why many farmers are still not registered to participate in the GESS. However, in line with the outcome of socio-economic analysis (Table 2)measured by monthly income that shows income of registered farmers to be significantly above that of the non-registered farmers, concur with the findings of Olomola (2015) which revealed that exploring the grassroots mobilization influence the rural farmers to pass the first hurdle by actually registering in the GESS.

Timeliness of receiving market information

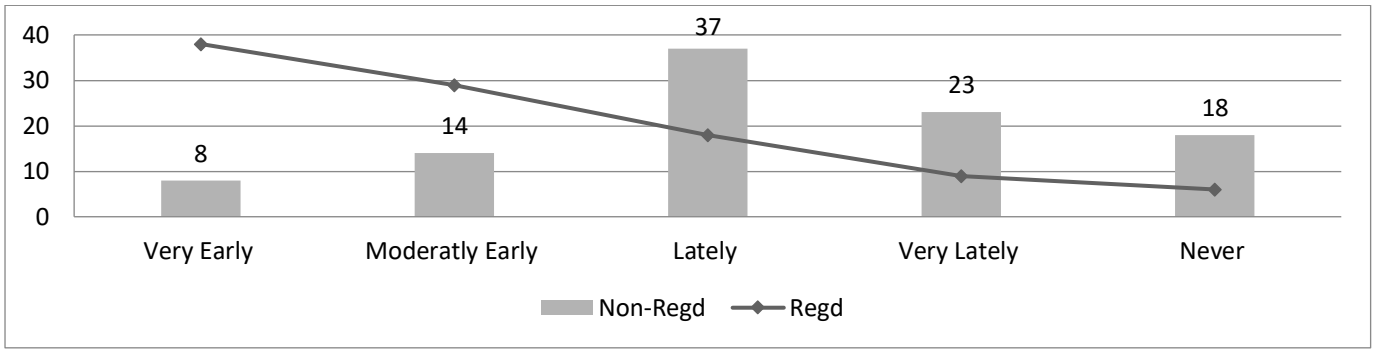

Figure 2. Distribution of respondents by timeliness of getting market information.

Source: Computed from the field data by authors.

Analysis (Figure 2) demonstrated that registration and participation in GESS enhances the timeliness and access to market information by the farmers. The analysis shows that about 38% of the registered farmers get timely access to market information after the GESS was introduced. Also similar experience was recorded by only just 8% of the non-registered farmers. While 6% of the registered farmer still lacks absolute information, about 18%of the non-registered farmers totally lack information. This confirms that finding of Haile *et.al* (2016) in the part innovation plays in rural farming by supporting that the application of ICTs for value chain development is necessary in any agricultural transformation programme. Those who were registered but still without sufficient market information were largely the ones that have limited access to phone and/ or were not academically exposed to reading test messages (SMS).

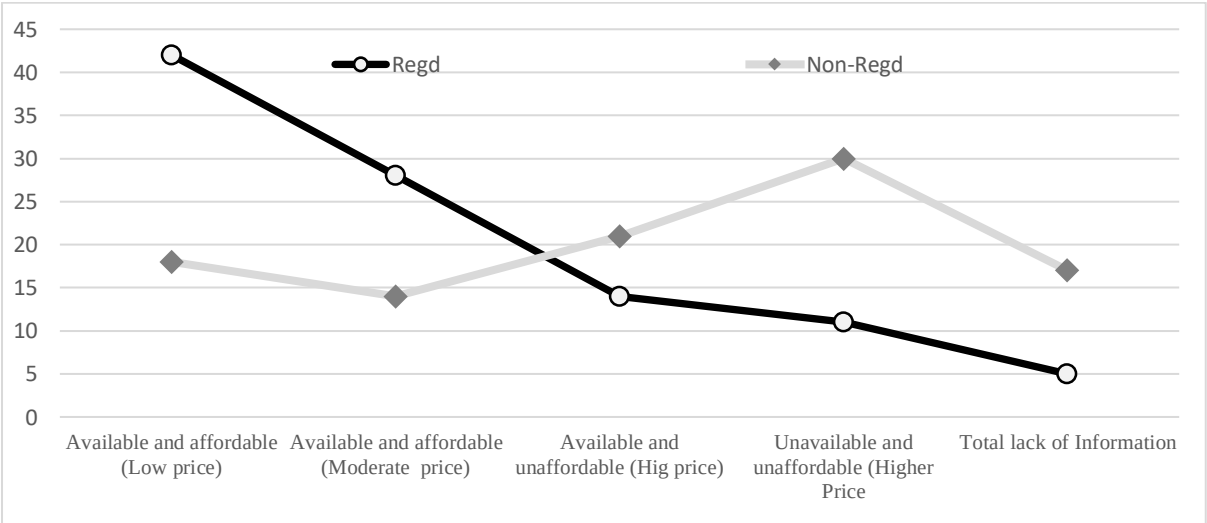

Figure 3. Distribution of respondents by constraints faced in accessing market Information/Input.

Source: Computed from the field data by authors.

Analysis (Figure 3) shows that availability and affordability of modern agricultural inputs has been improved with the introduction of the GESS. Hence, about 70% of the registered farmers who participate in the GESS programme have access to modern agricultural inputs as provided under GESS, at least at moderate prices. Only about 3% of the registered farmers are still not having the complete food market information. Among the non-registered farmers, only 18% have access to modern agricultural inputs, while about 43% do not have access to market information at all. This is an indication that the change agents (extension officers) diffusing GESS information appropriately would enhance a quicker and better access to high-quality agricultural inputs. This would eventually spread and affect the food price. This finding is not far from the conclusion of IFPRI (2008) which posited that the handiness of new technologies can aid in alleviating the rising food prices, particularly in emerging economies/countries. The major challenge to this, especially in the sub-Saharan African countries is the lack of extension services. This lack, according to Ibrahim *et al.* (2018) has denied rural farmers the opportunity to access new technologies and innovations.

The impact of the GESS on farm gate price

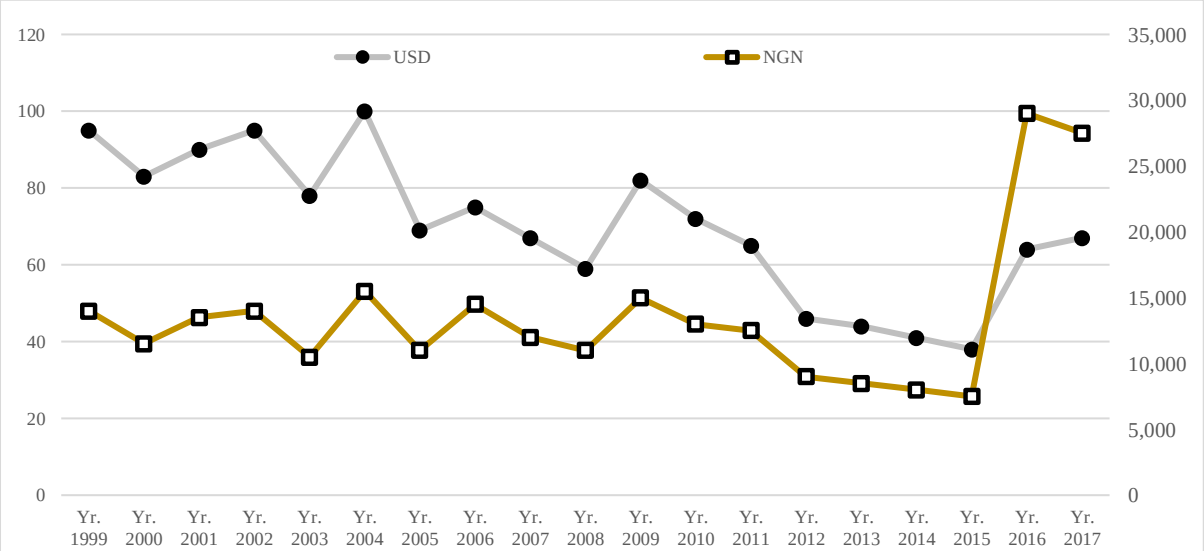

Figure 4: Farm gate price of rice and yam from 1999-2017

Source: Authors' computation from secondary data FMARD (2010) /FAO (2018)

Analysis (Figure 4) reveals that before GESS and even GESS farm gate prices starting from the year 1999 to the year 2010was seriously influenced by the political instability in Nigeria. This is because the food price volatility was high with the Nigeria naira (₦). Nevertheless, a

comparative analysis of this in US dollars ($) shows that even with the high cost of 50kg of rice, and a sizeable tuber of yam, the produce was still cheaper in 2016 – 2017 when compared to 1999 – 2015. This means that dissimilarity in the local currency (₦) was due to much fluctuation in the value of the Nigerian naira. This discovery implies that the introduction of the Growth Enhancement Support Scheme of the Federal government fixed the market price of yam and local rice to a significant level. This is judging from the fact that from 2012- 2015, the price was increasingly going down, until when the GESS was temporally put off by a new government in power, resulting in the cost of input and deficiency of market information, making the price to go high again. This finding presents another dimension dissimilar to Bellemare (2011) on rising food prices, food price volatility and political conflict.

The econometric estimation results

Table 4 is the results of the recursive bivariate probit model estimation with the column one containing the variables of the analysis both dependent and independent. Column two contains the means of the variables while the third and fourth are showing the coefficients and test for GESS participation; column five and six present the coefficients and tests for the Access to market information and usage of inputs provided under the GESS. Correlation ρ between the errors of both analyzed equations was estimated to be 0.512, and the Wald's test p value is 0.0413. To be noted as vital in the result output is that Participation in GESS (a dependent variable in the third column of the table is also an independent variable in the fourth row and is showing a significant on access to market information and usage of input provided under GESS at 1% significant level. Other explanatory variable in the analysis (Table 5) that were significant at 1% significant level to both participating in GESS and accessing market information and usage of inputs for rice and yam production are; ownership of mobile Phone, mobile network coverage, contact with the extension agents and sources of market information. The farm income of the respondents represented as output as well as their educational level show significance at 1% for participating in GESS, and at 5% for access to market information and usage of input. For primary occupation, of the respondents, that is respondent who are fully into farming of rice and yams, it is significant at 5% for participating and 10% for access to market information and usage of input.

Table 4: The recursive bivariate probit model of GESS participation and access to market information and usage of modern inputs

		Bivariate probit model			
		Participating in GESS		Access market information	
	Mean	**Coefficient**	**Test**	**Coefficient**	**Test**
Participating in GESS	0.215	-	-	2.621***	2.832
Age	1.821	-0.215**	0.041	-0.126**	0.028
Sex (male)	1.214	-0.521	0.175	-0.019	2.167
Edu	3.236	0.218***	0.312	0.1426**	2.142
Ms	1.063	-0.041	0.051	-0.631**	0.106
PrioC (Farming)	0.865	0.141**	0.379	. 0713*	1.136
Hhz	1.007	-0.215	0.101	-0.112	0.003
Cred	0.016	0.371	0.041	0.094	0.0031
Famz	0.971	0.037 **	0.094	0.7956**	0.019
Moby	1.915	1.253***	1.407	1.215***	1.682
SMkinf	1.107	1.043 ***	0.731	1.162***	0.381
Expf	1.105	-0.518**	0.845	0.126 *	0.025
OfY	0.063	0.018	0.021	0.391	0.0341
HhMY	0.254	0.864 **	1.086	0.507	0.903
Outp	0.013	1.218***	0.011	0.904**	0.019
Mnc	1.221	1.013***	2.001	1.013***	0.112
Lot	0.254	0.021**	0.031	0.061**	0.082
Ext	1.120	0.243***	0.131	1.112***	0.381
Dist	0.102	0.285	0. 014	0.532**	0.072
Coop	1.083	0.126**	0.023	0.023	0.002
Polaff	0.207	-0.042*	0.041	-0.041*	0.008
Loctn	0.181	-1.243**	0.011	-1.002*	0.053
Constant		-6.412***	7.819	-4.671***	2.685

* = significant at 10% level;

**= significant at 5% level; and

*** = significant at 1% level

Source: Authors' Computation from the Field Data.

On the other hand, land ownership type, size of farm, and membership of cooperatives are all significant at 5% for participating in GESS, out of these variables, only membership of cooperative is not significant for access to market information and usage of input. Other variables like age of the respondents, marital status, household size and experience in farming are all negatively affecting participation in GESS, and access to market information as they are significant at 5% significant level for both measurements. This simply implies that as the variables increase, the tendency to participate in GESS and access market information decreases. This agrees with World Bank (2012) in that liberalization and deregulation of farming input distribution policy may have encouraged the private sector in the input market, but many factors still constrain the smallholders from participating and realizing its full

potential. Table 5 reveals that political affiliation of the respondent is negative at 10% for both participation and access. This is because as long as a farmer believes he or she is not in the ruling party, there is every tendency to believe that government programmes will ever favour them. Also in participating and the access, we took note of the fact that location (i.e. whether the farmer is resident in the village or in the urban) has a negative effect as it is significant at 5% for participation and at 10% significant level for access. This explains that fact that most time, progamme targeted at the rural people are often hijacked by the urban dweller that have some little business interest in the rural farms. This maybe because they are often more educated and closer to the government offices.

The Effects of the GESS on Usage of modern Inputs

In line with equation 9 of the model specified, the effect of participating in GESS was evaluated as we measured the difference between the conditional likelihoods of accessing market information as either a GESS farmer or non-GESS farmer.

Table 5: Likelihood of access to inputs due to GESS participation decision in the estimated bivariate probit model

Timely access to market information and Usage of modern input	**GESS Model Participation**		**Total**
	Yes	No	
Yes	63.4	7.2	70.6
No	5.5	23.9	29.4
Total	68.9	31.1	100
Conditional Likelihood	9.28	2.63	-

Source: Authors' compilation from the field data.

Analysis (Table 5) points out that correlation between GESS participation and access to market information and usage of modern inputs is positive. The increase in the conditional probability is from 2.62% when the farmers are not participating to 9.28% as some farmers participated. This is a positive indication of the marginal effect G(k), as determined in equation 9 . Hence the outcome is expressed thus:

$G(k) = 9.28\% - 2.62\% = 6.66\%.$

To compare G(k) and M(k), we equally applied equation 10 to calculate the M(k). We then obtained the effect of participating in GESS on access to market information and usage of

modern input thus: M(k) = 3.21% - 8.82% = − 5.61% . This outcome simply substantiated the fact that there is a positive correlation between participating in GESS and access to market information and usage of modern input provided under GESS. It shows that GESS participation would have reduced the probability of having access to market information and usage of modern input by 5.61% if there was no positive correlation. We evaluated and presents the marginal effects H_1 (x_i), and H (x_i) on the probability of accessing market information and using modern agricultural input as provided under GESS for all the independent variables. The marginal effects were all calculated using STATA 13.0.

Table 6: The Marginal effects and probability ratio based on the recursive bivariate probit model.

Variables	Marginal Effect			
	Participants in GESS $H_1(x_i)$	Non-Participants in GESS H_2 (x_i)	Total $H(x_i)$	Ratio of Probability of GESS Participation Ø
Age	0.325	0.139	-0.186	
Sex (male)	0.033	-0.298	-0.265	0.868
Edu	0.0416	0.013	0.0546	-
Ms	-0.019	-0.091	-0.11	1.103
PrioC (Farming)	1.05	-1.044	0.006	0.032
Hhz	0.376	-0.096	0.28	-
Cred	1.018	0.913	1.931	0.063
Famz	-0.201	0.028	-0.173	-
Moby	1.215	1.892	3.107	2.065
Mkinf	1.662	1.633	3.295	0.987
Expf	-0.4025	-0.056	-0.4585	-
OfY	1.143	0.013	1.156	-
HhMY	-0.2835	0.034	-0.2495	1.132
Outp	1.0362	1.402	2.4382	-
Mnc	2.1645	-0.402	1.7625	0.093
Lot	1.105	-1.163	-0.058	0.038
Ext	1.845	1.108	2.953	1.432
Dist	-0.376	-0.896	-1.272	1.005
Coop	0.441	0.008	0.449	0.245
Polaff	0.481	-0.241	0.24	0.026
Loctn	-0.0215	-0.172	-0.1935	0.321

Source: Authors' Computation from the Field Data.

Analysis (Table 6) presents the marginal effect of participating in GESS on access to market information. It shows that while contact with extension agents, output (income of registered farmers), ownership of mobile telephone has up to 5% effects showing positive significance

at 5% significant level; others variables such as Age of the respondents, Sex (if female), farming experience, distance to registration and redemption point and political affiliation (if not a member of the ruling party) show negative significance. This finding implies that to a significant extent, participating in the federal government's GESS is a key to accessing market information and on time. It definitely will enhance agricultural productivity of the rural farmers and thereby ensure food security which is what the federal government is targeting to end hunger and achieve sustainable development goal [SDGs 1&2]. And if a large number of farmers would register and participate in the federal government GESS that would translate to increased access to market information as well as improve agricultural production input in Nigeria. Also, this study pointed out the significant of contact with extension agents demonstrating that if the number of such trained change agents would increase, GESS awareness would be improved and that will in turn boost access to and usage of modern agro inputs.

The finding supports the high-pay off input theory (Schultz, 1964) in that transforming the traditional agriculture into an extremely productive type of farming would cut the constant food price movements and the difficulties of the days to come in Africa. Therefore, the niche of this paper is that, if the federal government of Nigeria is to face food price volatility at the farmers' initial point of sales (farm gate), inhibitions mostly connected to the use of mobile phones, distance to registration and centers for collection will be reduced. It is our specific request that the federal ministry of agriculture and rural development has the solution for upholding food security in the country's higher and volatile food markets. Hence, resolving the problem of network connectivity (primarily in rural areas), distance to registration and centers of collection, cultural barricades and rural electrification for better participation of rural farmers in the GESS programme, will make available sufficient market information for domestic evening out of food price volatility in Nigeria and thus realizing extensive food security in sub-Saharan Africa. Farmers of smallholder scale can be part of the way out when they are made to enjoy good rural roads and transportation to get their product to the market. This will be in addition to provision of effective technology to get and share the latest market information on prices. This paper is different from the working paper of Uduji *et al* (2019i, 2019j) in that in an attempt to extend the analysis of the working paper Uduji *et al* (2019i, 2019j): First, we changed the methodology from bivariate probit model to use recursive bivariate which not only used the coefficients, but estimated the marginal effect of the explanatory variables on access to market information and usage of modern agricultural

production input. Second, knowing that recursive bivariate recognizes participation in the GEES programme as both dependent and independent variable, we extended the analysis of the working paper version (Uduji *et al*, 2019i, 2019j). Third, we increased the number of areas covered by extending the study sample from 600 to 2100 respondents, comprising 1050 registered farmers and 1050 non-registered farmers. Fourth, the working paper (Uduji *et al*, 2019i, 2019j) covered the production of rice only, while this further analysis version extended the study to include yam producing farmers. Fifth, in this further analysis version, we expanded the explanatory viable to include the residential location of the farmers, their political affiliation and per capital income of other household members.

Concluding implications, caveats and future research directions

We examined how the growth enhancement support scheme (GESS) impacts on farmers' food price volatility in Nigeria. Results from the use of a recursive bivariate probit model showed that the likelihood of the rural farmers' taking part in the GESS, having access to food market information and adopting fresh farming technologies is positive, given that the difficulties to address in both decisions are the same; and that farmers' level of education, ownership of a mobile phone, value of output, network connectivity, power for charging phone batteries and contact with extension agents were positive defining factors for taking part in the GESS. Cultural impediments to married women, grower's age, and increased remoteness to registration and collection centers negatively affected farmers' aspiration to be involved. The result also revealed that farmers hinged on the GESS for dealing with food price volatility by making available food market information that reduced the incidence and amount of panic-driven price hike in Nigeria. The results put forward the need for a value-added GESS in line with the agricultural transformation agenda (ATA) by easing the deterrents mostly linked to the use of mobile phones and remoteness to the registration and collection centers. Farmers of smallholder scale can be part of the way out when they are provided with rural roads and transportation (to move their product to the market), and empowered with technology (to receive and share the most recent market information on prices). This finding enhances the literature on agriculture and rural development by identifying the key challenges to the GESS. We also put forward policy proposals that would support government to efficaciously tackle the crises of food price volatility in sub-Saharan Africa. In an attempt to extend the analysis of the working paper Uduji *et al* (2019i, 2019j):First, we changed the methodology from bivariate probit model to use recursive

bivariate which not only used the coefficients, but estimated the marginal effect of the explanatory variables on access to market information and usage of modern agricultural production input. Second, knowing that recursive bivariate recognizes participation in the GEES programme as both dependent and independent variable, we extended the analysis of the working paper version (Uduji *et al*, 2019i, 2019j). Third, we increased the number of areas covered by extending the study sample from 600 to 2100 respondents, comprising 1050 registered farmers and 1050 non-registered farmers. Fourth, the working paper (Uduji *et al*, 2019i, 2019j) covered the production of rice only, while this further analysis version extended the study to include yam producing farmers. Fifth, in this further analysis version, we expanded the explanatory viable to include the residential location of the farmers, their political affiliation and per capital income of other household members. The key caveat of the study is that it is restricted to the scope of Nigeria's rural areas. Hence, the discoveries cannot be directly useful to other African countries with the same policy challenges. Based on this shortcoming, it is advisable to reproduce the analysis in other countries in order to ascertain if the established nexuses withstand empirical scrutiny in diverse rural contexts of Africa.

Acknowledgement

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Declaration of conflict of interests

The authors declared no potential conflict of interest as it concerns the research, authorship and/or publication of this article.

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