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

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Abstract

The prices of food in Nigeria have become considerably higher and more volatile since 2012. The aim of this research was to ascertain factors affecting farmers' involvement in the growth enhancement support programme (GESS) in the country. We ascertained the effect of the GESS on the handiness of market information and agricultural inputs that impact on price volatility at farm gate level. In number, 600 rural farmers were sampled across the six geopolitical zones of Nigeria. Results obtained from the use of a bivariate probit model show that farmers relied on the GESS for resolving food price volatility by making available the food market information and agricultural inputs that cut down the incidence and degree of panic-compelled price increment in Nigeria. The findings suggested the need to enhance the GESS in line with the agricultural transformation agenda (ATA) by reducing the hindrances mostly connected to the use of mobile phones, and how far the registration and collection centers are.

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

JEL Classification: O13, Q10; N27

Introduction

Price volatility defines the degree of price functions or the risk of huge, unanticipated price changes. The danger of extreme price events can heighten and add to wider social risks in terms of human development, food security and political stability (Torero, 2016). The current price volatility in international markets is threatening global food security. For the poor in the world whose lives revolve around small farms, life has become more disturbing (FAO, 2018). The serious increase in the prices of food over the past couple of years has raised grave concerns regarding the condition of food and nutrition of the poor in developing countries (Minot, 2014). The increases in price are cutting into poor households' spending on an array of vital goods and services and dropping the calories they consume (World Bank, 2012). The prices of food being high is upsetting the poor's nutrition by pushing them to shift to less costly, lower quality, and reduced amount of micronutrient-dense foods (Anriquez *et al,* 2013). The extent of price volatility in food markets is negatively impacting on the chances of African countries towards attaining economic growth and reduction of poverty (Adam & Paice, 2017).This price volatility in food markets is among the most critical economic and food challenges facing policy makers in Africa (Gilbert *et al,* 2017). It has generated some anxiety and resulted in real problems in the countries in sub-Saharan Africa (Alper *et al,* 2016). However, with the right plan of action, investments, and development programmes in place, smallholder farmers could greatly increase food production, which will improve their lives and contribute to better food security for all (FAO, 2015).

The countries of Sub-Saharan Africa have a higher amount of food-based safety net programs which are being scaled up to react to increasing prices in the region (Smith & Abraham, 2016). For instance, the federal government of Nigeria (FGN) launched the Growth Enhancement Support Scheme (GESS) in 2012, to improve on the delivery of agricultural inputs; better yields, promote food security, and heighten rural development in the country (Adesina, 2012). Under the GESS, the government's duty moved from direct procurement and delivery of fertilizer to acceleration of procurement, regulation of fertilizer quality, and advancement of the private-sector agricultural inputs value chain (Adesina, 2013). In doing a comparison of the scheme with the former subsidy programme, the GESS has demonstrated to be more effective and transparent. The FGN spent ₦ 30 billion (US$180 million) in 2011 to support inputs of which 90 percent did not get to the envisioned smallholder farmers; also in 2012, the FGN spent ₦ 5 billion (US$30 million) to reach 1.2 million smallholders; and in

2013, the FGN spent ₦12 billion (US$96 million) to reach 4.3 million smallholder farmers (Grossman &Tarazi, 2014; Uduji *et al,* 2019e, 2019f).

Although the GESS seems more effective in reaching more smallholder farmers than the previous schemes, it has been criticized over its efficacy and practical applications. For example, scholars such as Ahmed *et al* (2016), Fadairo *et al* (2015), Nwaobiala & Ubor (2015), Nwalieji *et al* (2015), Oyedira *et al* (2015), Oluwafemi, *et al* (2016), Trini *et al* (2014) and others have disputed that the GESS process in Nigeria is not really extensive. As a result, the scheme has been questioned as not being deeply embedded in rural areas (Ibrahim *et al,* 2018). In a contrary view, Uduji & Okolo-Obasi (2018a, 2018b), Adenegan *et al* (2018), Olomola (2015), Grossman & Tarazi (2014), and Uduji *et al* (2018b) support the GESS, disputing that the scheme is making headway in the area of modern agricultural input delivery to Nigeria's smallholder farmers. In further clarification, Wossen *et al* (2017) argued that while improvement in the average productivity of the GESS input subsidy programme is good for enhancing food security, bettering the distributional outcome of the programme by aiming at the most disadvantaged groups would make the most of the programme's contribution to food security and lessening of poverty.

In the meantime, prices of food in Nigeria have become considerably higher and more volatile since 2012; prices are hiking and volatility remains high; periods of fluctuating prices are not new; price variability is at the centre of the very existence of food markets (Nwoko *et al,* 2016; Ojogho *et al,* 2015, Uduji & Okolo-Obasi, 2018a, 2018d, 2019). As a result, the agriculture sector of the country will face notable challenges in the coming years as population growth will persist in driving-up food demand; while climate change and degradation of natural resources will create difficulties on the supply side, both with regard to farmers' average production and volatility (Uduji & Okolo-Obasi, 2017, Uduji *et al,* 2019c, 2019d).Based on this background, we posit that the federal government's GESS programme has not made a meaningful impact on farmers' food price volatility in Nigeria. Therefore, this paper adds to the agriculture and rural development debate by evaluating the empirical evidence in three areas of great focus in the literature:

- What are the factors that encourage the decision of (local rice) farmers to get involved in the GESS programme?

- What is the extent of impact of the federal government's GESS programme on the accessibility of market information by the (local rice) farmers to influence the farm gate prices?
- How does the GESS circulation of agricultural inputs to (local rice) farmers impact on price volatility at the farm gate level?

Then, for the remaining parts of the paper, section 2 reviews the context of food price volatility in Africa; section 3 looks at the technology application of Nigeria's GESS; section 4 makes available the theoretical perspectives; section 5 describes the methodology; section 6 presents the results and discussions, while section 7 concludes the work with policy implications and future research directions.

Food price volatility in Africa

In description, volatility concerns the idea of prices fluctuating around a rather stable long-term price or price trend (IFPRI, 2008). These short-term fluctuations may refer to day to day, weekly, or monthly prices. Periods of extremely high or low commodity prices are often related to crises as they are a problem to producers, consumers, and policy makers (IFAD, 2011). Therefore, the concept of volatility grasps the idea of price fluctuations in two diverse ways: in a historical viewpoint and in a forward-looking standpoint (Haile & Kalkuhl, 2016). Price variation is not startling if it sustains a historical trend, as well as seasonal and well-known typical variations; however, a high degree of volatility results in paying attention to food security by the governments, businesses, NGOs and consumers. According to Gouel *et al* (2013), food security has a direct relationship with the problem of food price volatility because increased price of food deters the access to food by the consumers from middle to lower income groups especially in developing and in poor nations.

Africa is principally affected by the impact of price volatility and high prices (Arezki *et al,* 2016). With the distinction between volatility and high prices in mind, African countries were among the worst hit by the hikes of prices in 2007-2008 (FAO, 2010). In 2010, a quarter of the humanity in the world population suffered from malnutrition, with 30 % of the affected coming from Africa (SAHEL/OECD, 2011). The population of the continent is increasing so rapidly that cutting malnutrition rates in half by 2030 would not stop the number of Africans affected by hunger to rise considerably (Adams & Paice, 2017). Furthermore, close to 60% of humans in sub-Saharan Africa rely on agriculture, and not less than 80% of them are

smallholder farmers with not up to two hectares of land (Alper *et al,* 2016). Food is responsible for up to three-quarters of household expenses (IFAD, 2009). Increment in food prices weakens most susceptible livelihoods, brings down the financial resources of farmers and, as a result, increases the danger of small farmers to fall into penury (Mason & Myers, 2013; Uduji & Okolo-Obasi, 2018c). In urban settings, access to food is the main interest of food security (Minot, 2014). Riots over food prices in 2007-2008 have drawn international attention to this problem (Asongu, 2013, 2014; Jatta, 2016). The social problems that followed pushed African governments and African regional organizations to support the most vulnerable populations and to begin structural policies targeted at enhancing food production. Substantial public investments have been made to put up with the initiatives (FAO, 2011). The value of these African government initiatives, in response to the particular needs of their countries, must be examined to determine the effect on food price volatility in the continent.

The technology application of Nigeria's GESS

Nigeria eased up input distribution and brought into being the Growth Enhancement Support Scheme (GESS) in 2012 to provide subsidized inputs to farmers. The GESS, which is an exceptional agricultural scheme of the federal government, is targeted at the delivery of subsidized farm inputs to farmers and making it possible for them to move from subsistence to commercial farming. It was designed 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 main background for speeding up agricultural development in the continent. The ATA is the reaction of the federal government towards actualizing food security and bringing up household income for farmers at the micro level (IFDC, 2013). With the GESS, the government fights against indirect seed purchase and circulation, improves on the voucher system, and encourages direct distribution of inputs via mobile technology. Farmers registered in the scheme, obtain allocation of seeds through the mobile phone and collect them from an official agro-dealer. In this way, an e-wallet can be stated to be a clear and well-organized electronic device system that makes use of the mobile phone for distributing agricultural inputs to farmers in Nigeria (Adesina, 2012, Uduji & Okolo-Obasi, 2018a, 2018b, Asongu *et al,* 2019a, 2019b, 2019c, 2019d).

The technology utilized in achieving the GESS in the country is the e-wallet. It is the technology that assures that a Nigerian smallholder farmer easily accesses a farm input

subsidy from the government from an approved agro-dealer in the local community. The conditions for a farmer to partake include: the farmer's age> 18; the farmer must have participated in a survey handled by the government to capture farmer's distinct broad information; and the farmer must have a cell phone with a registered SIM card and the cell phone must have not less than sixty Naira (0.16 USD) credit. If these conditions are met, an identification number is issued to the farmer, which the farmer uses to collect fertilizer, seeds and other essential agricultural inputs from agro-merchants at half the actual cost (Akinboro, 2014).

In the operation of the GESS, it is the job of state and local governments to register qualified smallholder farmers (who should have < 5 hectares of farmlands). Farmers manually fill out a machine-readable form; then, data are treated before being sent to the national database (Grossman & Tarazi, 2014). Farmers, who have successfully registered using mobile phones claim their subsidized seed using such phones, whereas farmers who are not registered can use a registered neighbor's phone to make such claims (Adesina, 2013). The GESS gives a definite sum of subsidy credit to all farmers; such credits are linked to the farmer's GESS ID number, and if valid, to the farmer's mobile phone number too. In either case, no farmer is directly given funds (Akinboro, 2014, Uduji *et al*, 2018a). On the other hand, registered farmers who have no phones would know the time for redemption of subsidies when the registered ones with phones in the same community with them get alerted via the SMS information. Those who are unfortunate in getting the information would likely miss the redemption of their subsidized input or, at best, get it late (Uduji *et al*, 2019a, 2019b, 2019c). At the center where the subsidy is to be redeemed, the concerned farmers make payment of the 50 percent balance and collect the subsidies by requesting on the center platform through an SMS for authorization of subsidy redemption (Trini *et al.*, 2014; Uduji *et al,* 2019g). If the deal is successful, both the farmer and the agro-merchant receive confirmatory alerts (text messages) about authorization of the subsidy redemption.

Theoretical perspective

Agricultural development theories are efforts towards describing the forces in society and the economy that cause agricultural change. In the literature, there are about four key theories of agricultural development: the conservative model; the urban impact model (location model); the diffusion model, and the high-pay off input model. However, this paper

assesses the quantitative outcome of the analysis through the lens of the high – pay off input model (the Schultz theory). The problem Schultz (1964) sets out to solve is how traditional agriculture could be changed into a very productive type of farming. Schultz regards this problem as an intervention problem; however, resolving it does not lie just in injection of capital into the agricultural sector, but the forms agricultural intervention should take being pre-determined. Schultz projects the idea that the traditional agricultural sector cannot only grow with the assistance of the traditional production factors, but also at a very high charge. According to Lundahl (1987), Schultz high-pay off input model is classified into three main categories: the ability of both public and private sector research institutions to create new technical knowledge; the capacity of the industrial sector to advance, produce and market fresh technical inputs, and the capacity of farmers to obtain new knowledge and use new inputs excellently.

Ayoola (1997) noted that the fervor with which the high-pay off input model has been acknowledged and interpreted into economic doctrine has been by part as a result of the spread of studies reporting high rates of returns to public intervention in agricultural research, as it concerns efforts to develop fresh and high productivity grain varieties appropriate for the tropic. For instance, new high-yielding wheat varieties were developed in Mexico in the 1950s while in Philippines, new high-yielding rice varieties were developed in the 1960s (Ruttan, 1977). These varieties were highly receptive to industrial inputs such as fertilizer and other agronomic chemicals, and effective soil and water management. The high returns connected to the adoption of new varieties and the technical input and management practices associated with it led to the quick dispersal of the new varieties among farmers in most developing countries (Dercon & Gollin, 2014). However, critics reason that the high – pay off input model remains inadequate as a theory of agricultural development due to the following reasons: education and research are public goods not transacted through the market place; the means by which resources are apportioned among education, research and other alternative public and private sector economic activities are not fully integrated into the model; the model does not deal with intervention in research as the source of new high-pay off techniques; it does not explain how economic conditions prompt the improvement and adoption of an efficient set of technologies for a precise society; and it does not stipulate the process by which factor and product price relationship encourage intervention in research towards a specific direction (Udemezue & Osegbue, 2018). All the same, this theoretical groundwork is consistent with the structure of this study in the angle that, the GESS is an

intervention programme that makes available the needed agricultural inputs to smallholder farmers to raise their yields and lessen the food price volatility in the sub-Saharan African region.

Methods and materials

We embraced a quantitative method in this study, given the shortage of quantitative data on the complexities of food price volatility in the region (Uduji & Okolo-Obasi, 2018b). We made use of a survey research technique aimed at getting information from a representative sample of farmers at the farm gate level. It is fundamentally cross-sectional that defines and interprets what exists at present.

Sample size

The z-score sampling technique postulated by Smith (2013) was used to acquire a sample size of 600 farmers in the rural farming communities of Nigeria as shown below.

$$\text{Sample size} = (z)^2 x std(1-std)/(mr)^2 \qquad \text{Eq. (1)}$$

Where z = z-score = confidence level

Std = standard deviation

mr = margin of error = confidence interval

1 = constant

We therefore selected a confidence level of 90%, margin of error of 5% and a standard deviation of 0.5. Substituting the values in our equation, we have

z-score @ 90% confidence level = 1.645 (z-score table) and thus

$$\text{sample size} = (1.645)^2 x0.5(1-0.5)/(0.05)^2$$

$$= 0.6765/(0.05)^2$$

$$= 0.6765/0.0025$$

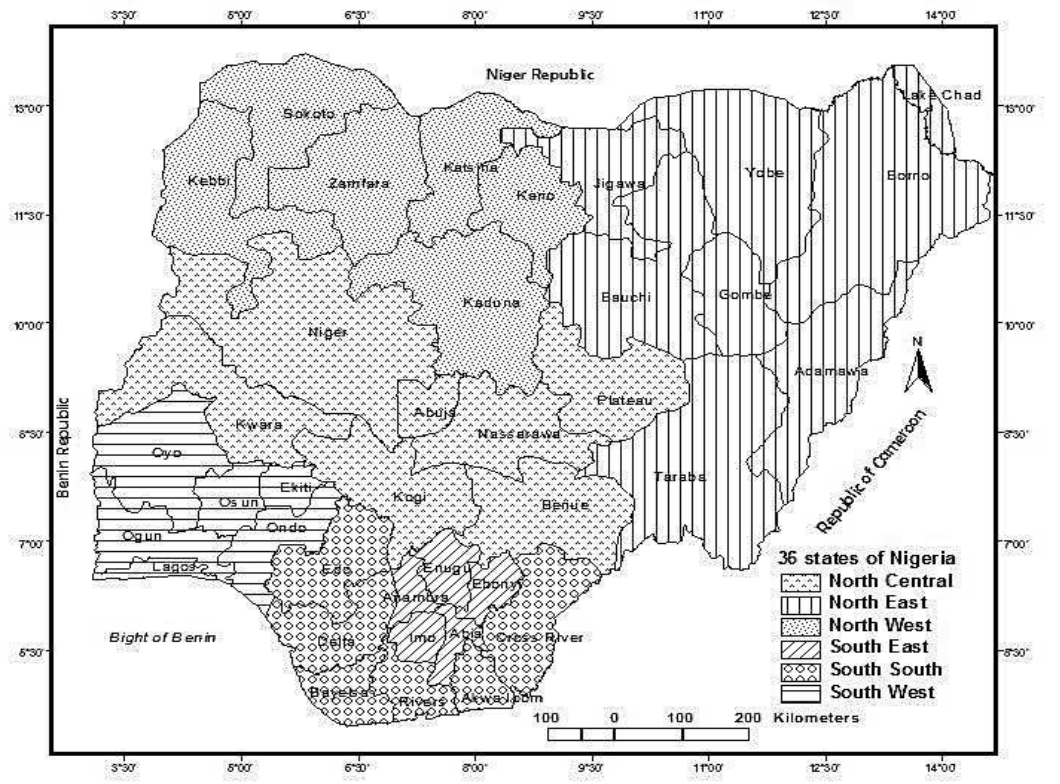
$$= 270.60$$

This was approximated to 300 and doubled to further minimize the possible errors in the sample selection. Therefore, the total sample unit chosen was 600 respondents.

Sampling procedure

Multi-stage probability including both cluster and simple random samplings were used in picking the respondents. The first stage was done to make sure that the population is amply

represented by clustering the states according to the six geo-political zones of Nigeria: North-East, North-Central, North-West, South-East, South-South and South-West (Figure 1).



six clusters as follows: st), Ebonyi). In stage listed and strength of ted for the study. In the fourth stage, to guarantee proper representation, the main communities in the selected LGAs were listed and two communities were arbitrarily picked from each LGA, giving a total of twenty-four (24) rural farming communities for the study. In the last stage, out of the twenty-four communities chosen, with the help of the traditional and community leaders, 300 registered farmers and 300 non-registered farmers were picked, giving a total of 600 respondents randomly selected as shown in Table 1.

Table 1. Sample distribution

Zones	Male	Female	Total Population	Farmers Population	Sample per state	Sample per community	
						Regd	Non-Regd
Taraba	1,171,931	1,122,869	2,294,800	1,560,464	60	30	30
Kwara	1,193,783	1,171,570	2,365,353	1,608,440	60	30	30
Cross River	1,471,967	1,421,021	2,892,988	1,967,232	78	39	39
Ebonyi	1,064,156	1,112,791	2,176,947	1,480,324	60	30	30
Ogun	1,864,907	1,886,233	3,751,140	2,550,775	96	48	48
Kano	4,947,952	4,453,336	9,401,288	6,392,876	246	123	123
	12,420,875	**11,851,896**	**24,272,771**	**15,560,111**	**600**	**300**	**300**

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

Data collection

Data for this study were gathered from both primary and secondary sources. Primary data were collected using the participatory rural appraisal (PRA) technique which involves the use of semi-structured interview (SSI) questionnaire and in-depth interview of key informants. The use of a participatory research technique in collecting GESS data especially as it relates to the rural households in Nigeria is based on the fact that it consists of the people being studied, and their views on all the issues are relevant.

Also an in-depth interview of the key informants (KII) was done in all the concerned communities to get a group view of the separate groups on the impact of the GESS on the farm gate price volatility of local rice in the states and what it will take to enhance the GESS participation of the entire population.

Secondary data were gathered from the National Bureau of Statistics, Federal Ministry of Agriculture and rural development, and the consumer price index. Other pertinent literatures including the existing records of the community leaders and gate keepers were reviewed.

Analysis technique

Data collected from respondents in the field were exposed to a series of treatments. Both descriptive and inferential statistics were used to analyse the data, so as to realize the goals of the study. In modeling the impact of the GESS on rural farmers' participation in the GESS, and its impact on price volatility, we used the bivariate probit model to test the hypothesis of the study which states that there is no substantial correlation between the random terms of participating in the GESS model and the changes in price of the local rice farmers. The modelling exercise is, thus, geared towards achieving the following objectives:

- To find out the factors that influence the decision of local rice farmers to take part in the GESS programme;
- To examine the effect of the federal government's GESS programme on availability of market information to the local rice farmer to influence farm gate prices;
- To determine how the GESS dispersal of agricultural inputs to local rice farmers impact on price volatility at the farm gate level.

Model specification

To specify the model, we took note that the latent Y* from the decision to register and be involved in the GESS depends on a vector of explanatory variables 'X' so that the binary outcome Y= 1 arises when the latent variable Y*> 0. Also Y2 is a pointer to the

interdependency of the decision which is, using the GESS to access rice market information and inputs, this is only observed if Y1 (participation in the GESS) =1. The outcome of the decision represented by the first probit equation is fully observed. However, there is a censored sample in the second equation which stands for using the GESS to access local rice market information and inputs. According to Tura *et al* (2010), this censoring of observations means that it is important to take into account self-selection at the registration and participation decision making stages to ensure proper estimation of model parameters. Having the knowledge that there are two latent variables: Y1*and Y2* and that each observed variable takes on the value 1 if and only if its underlying continuous latent variable takes on a positive value according to the assumption of Green (2012), the bivariate model is thus:

$$Y1=\begin{cases}1, \text{if } Y1 *> 0\\ 0, \text{otherwise}\end{cases} \quad \text{Eq. (2)}$$

$$Y2=\begin{cases}1, \text{if } Y2 *> 0\\ 0, \text{otherwise}\end{cases} \quad \text{Eq. (3)}$$

With

$$\begin{cases}\gamma 1 *, X1\beta 1 + \varepsilon 1\\ \gamma 2 *, X2\beta 2 + \varepsilon 2\end{cases} \quad \text{Eq. (4)}$$

and

$$\binom{\varepsilon 1}{\varepsilon 2} \backslash X \sim \mu\binom{0}{0}, \binom{1P}{P1} \quad \text{Eq. (5)}$$

Note

Y1*and **Y2*** are underlying latent variables

Y1 = 1(if sampled rural farmers register in the government GESS; 0 if otherwise i.e. Never registered in the government GESS at the time of survey).

Y2= 1(if sampled rural farmers participate in the GESS to access modern agricultural inputs; 0 if otherwise).

$\boldsymbol{\beta 1}$and $\boldsymbol{\beta 2}$ are vectors of estimation parameters to be computed.

X1and **X2** are list of explanatory variables entered into the estimation model.

$\boldsymbol{\varepsilon 1}$and $\boldsymbol{\varepsilon 2}$ are normally distributed error terms.

From the above we maximize the likelihood of the bivariate model by estimating the values of $\beta 1$, and ρ to properly fit the model. Hence the likelihood is as.

$L(\beta 1, \beta 2) = (\pi\rho(Y1=1, Y2=1/ \beta 1, \beta 2)Y1Y2\ \rho(Y1=0, Y2=1/ \beta 1, \beta 2)(1-Y1)Y2\ \rho(Y1=1, Y2=0/ \beta 1, \beta 2)Y1(1-Y2)\ \rho(Y1=0, Y2=0/ \beta 1, \beta 2)(1-Y1)(1-Y2)$ Eq. (6)

Substituting the latent variables Y1*and Y2* in the probability functions and taking logs gives:

$\sum Y1Y2\ln\rho(\varepsilon 1>-X1\beta 1,\varepsilon 2>-X2\beta 2)+(1-Y1)Y2ln\rho(\varepsilon 1<-X1\beta 1,\varepsilon 2)>-X2\beta 2)+(1-Y1)(1-Y2)ln\rho(\varepsilon 1<-X1\beta 1,\varepsilon 2<-X2\beta 2)$ Eq. (7)

And the equation simplified by re-writing so that the log-likelihood function appears thus:

$\sum Y1Y2\ln\Phi\ (X1\beta 1,X2\beta 2,\rho)+(1-Y1)Y2ln\Phi(-X1\beta 1,-\rho)+(1-Y1)(1-Y2)ln\Phi(-X1\beta 1,-X2\beta 2,\rho)$ Eq. (8)

From the last equation, Φ is the cumulative distribution function of the bivariate normal distribution. Similarly, Y1 and Y2 in the log-likelihood function above are observed variables which are equal to one or zero depending on the rural youth farmer's decision as it concerns registering in the e-wallet model and using the model to access modern agricultural input. From the above, there are three probable different observations obtainable from each respondent of local rice farmer and is summarized thus:

$Y2 = 0$: $prob(Y2 = 0) = 1 - \Phi(X2\beta 2)$ Eq. (9)

$Y1 = 0, Y2 = 1$: $prob(Y1 = 0, Y2 = 1) = \Phi_2(-X1\beta 1x, X2\beta 2, -\rho)$ Eq. (10)

$Y1 = 1, Y2 = 1$: $prob(Y1 = 1, Y2 = 1) = \Phi_2(-X1\beta 1x, X2\beta 2, \rho)$ Eq. (11)

Representing the variable to be fitted into the model from X_1-------X_n is seen below:

- X_1 = Age of a farmer (years)
- X_2 = Highest level of educational qualification (years)
- X_3 = Marital status of respondent framer
- X_4 = Household size of farmer (number)
- X_5 = Access to farm credit by farmers (1=accessed and 0 otherwise)
- X_6 = Size of farm cultivated by farmers (hectare)
- X_7 = Ownership of mobile phones (1= owned, 0 = otherwise)
- X_8 = Sources of market information/Input (1= GESS and 0= otherwise)
- X_9 = Farming experience (years)
- X_{10} = Off-farm income
- X_{11} = Value of farm output of farmers in Nigeria Naira (N)
- X_{12} = Mobile network coverage (1= covered and 0 = otherwise)
- X_{13} = Land ownership type (1= inheritance, 0 otherwise)
- X_{14} = Contact with extension agent (number of times)

X_{15} = Distance to improved seed selling point (1 = far, 0 = otherwise)
X_{16} = Membership of cooperative organization
= Stochastic error term.

Results and discussion

The socio-economic characteristics of the farmers

The analysis of social (education, gender), economic (income, farm size, occupation, ownership of mobile phone, power source and access to electricity) and demographic (age, marital status, size of household), characteristics of the local rice farmers provide a vital understanding of the socio-economic status of the rural farmers and prominent factors that determine their involvement 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	225	75	75	211	70	70
Females	75	25	100	89	30	100
	300	**100**		**300**	**100**	
Primary Occupation						
Farming	138	46	46	208	69	69
Trading	46	15	61	48	16	85
Palm tapping	10	3	65	15	5	90
Government paid employment	82	27	92	7	2	93
Hunting	24	8	100	22	7	100
	300	**100**		**300**	**100**	
Years of experience						
0- 5 Years	89	30	30	8	3	3
6 - 10 Years	106	35	65	64	21	24
11 -20 Years	55	18	83	108	36	60
21-30 Years	26	9	92	66	22	82
31- 40Years	15	5	97	38	13	95
41 Years and Above	9	3	100	16	5	100
	300	**100**		**300**	**100**	
Age of respondents						

Less than 20 Years	46	15	15	12	4	4
21-30 Years	128	43	58	33	11	15
31- 40 Years	52	17	75	60	20	35
41-50 Year	36	12	87	165	55	90
51-60 Year	29	10	97	19	6	96
61 Years and Above	9	3	100	11	4	100
	300	**100**		**300**	**100**	
Level of Education						
None	39	13	13	152	51	51
FSLC	141	47	60	106	35	86
WAEC/WASSCE	84	28	88	42	14	100
B.Sc and Equivalent	28	9	97	0	0	100
Post graduate degrees	8	3	100	0	0	100
	300	**100**		**300**	**100**	
Marital Status						
Single	65	22	22	35	12	12
Married	175	58	80	185	62	73
Widowed	24	8	88	41	14	87
Divorced	15	5	93	18	6	93
Separated	21	7	100	21	7	100
	300	**100**		**300**	**100**	
Household size						
1-4 Person	221	74	74	98	33	33
5-9 Person	55	18	92	124	41	74
Above 9 persons	24	8	100	78	26	100
	300	**100**		**300**	**100**	
Farm Size						
Less than 1 Hectare	53	18	18	133	44	44
Between 1-2 Hectares	120	40	58	135	45	89
Between 3-4 Hectares	53	18	75	24	8	97
Between 4-5 Hectares	45	15	90	8	3	100
5 and above Hectares	29	10	100	0	0	100
	300	**100**		**300**	**100**	
Ownership Mobile phone						
Have a set	266	89	89	95	32	32
Uses a neighbor's set	34	11	100	45	15	47
Have no access to phone set	0	0	100	160	53	100
	300	**100**		**300**	**100**	

Monthly Income Level						
0 - 50,000	16	5	5	105	35	35
51,000 - 100,000	110	37	42	121	40	75
101,000 - 150,000	83	28	70	43	14	90
151,000 - 200,000	51	17	87	17	6	95
201,000 - 250,000	25	8	95	9	3	98
Above 250,000	15	5	100	5	2	100
	300	**100**		**300**	**100**	
Access to Electric Power Source						
Connected to PHCN	70	23	23	88	29	29
Uses Small Generator	126	42	65	71	24	53
Uses Solar energy source	18	6	71	31	10	63
Uses public charger	48	16	87	18	6	69
No access to power at all	38	13	100	92	31	100
	300	**100**		**300**	**100**	

Source: Computed from the field data by authors

Out of the 600 farmers sampled, 300 of them are registered, while the other 300 are non-registered farmers. The statistics reveal that men make up 75% of the registered farmers and 70% of the non-registered, while women constitute the remaining 25% of the registered and 30% of none registered farmers. This gap in registration seems to be due to the cultural practices that mandate women to farm under their husbands (Uduji & Okolo-Obasi, 2018a). Further analysis reveals that 75% of the registered farmers are widowed, separated or divorced.

Moreover, the analysis showed that the average age of a registered rice farmer was 36 years with an average of 19 years' experience, while the average age of the non-registered farmer was 41 years with an average of 23 years' experience. The analysis also shows that education plays a very significant role in the decision to register, as only 13% of the registered farmers are illiterates, while 51% of the non-registered farmers are illiterates. About 89% of the registered rural farmers have a personal mobile phone, whereas 11% used phones belonging to their neighbours' children or relatives; and none indicated not having access to mobile phone use. This finding shows an improvement in access to SIM and/ or handset when compared with Grossman & Tarazi (2014) who had earlier observed that while most Nigerians own their SIMs and handsets, only about half of the farmers have personal phones. Farmers who do share a SIM were not able to use the mobile phone number as a unique identifier, while those who share a handset had not received messages sent to them on a regular basis.

Timeliness of receiving market information

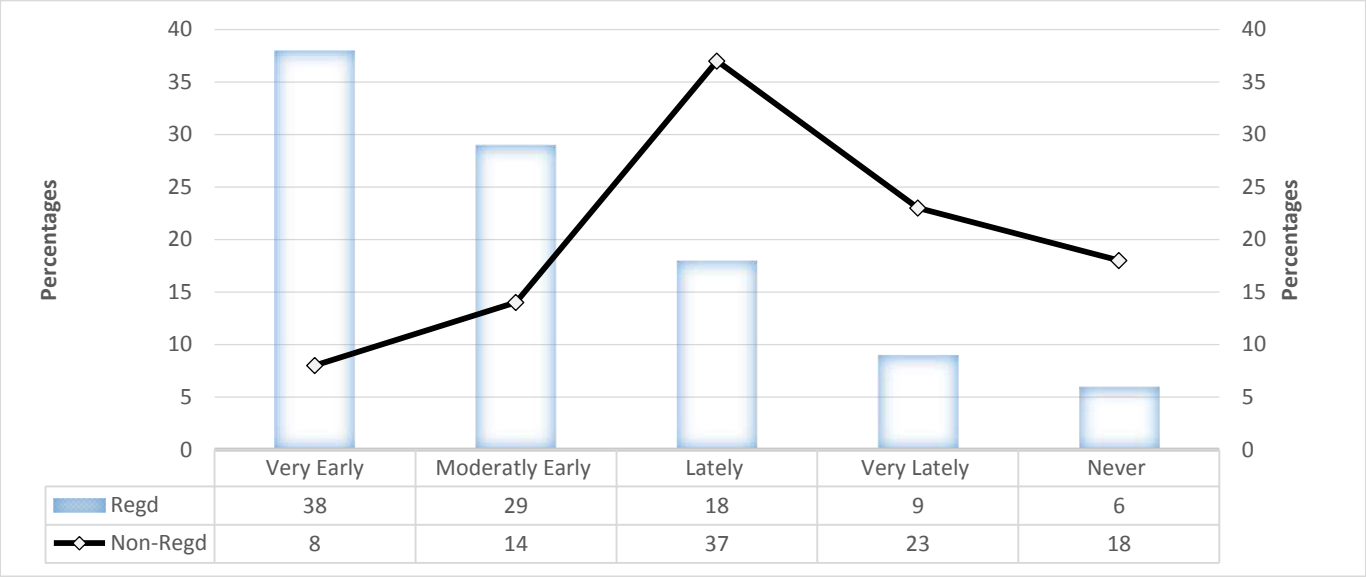


Figure 2. Distribution of respondents by timeliness of getting market information.

Source: Computed from the field data by authors

From Figure 2, we noted that the usage of the GESS by registered farmers has enhanced the timeliness and access to market information. After the introduction of the GESS, 38% of the registered farmers get timely access to market information, whereas only 8% of the non-registered farmers have timely access to such information. Those who moderately access food market information on time have also increased by 15%, whereas only 6% of registered farmers were still out of the picture. This discovery is consistent with Haile *et al* (2016) in that the role of innovation in rural farming by promoting the application of ICTs for value chain development is vital. Those who were registered but still without adequate market information were mainly the ones that have limited access to phone and/ or were not intellectually exposed to reading test messages (SMS).

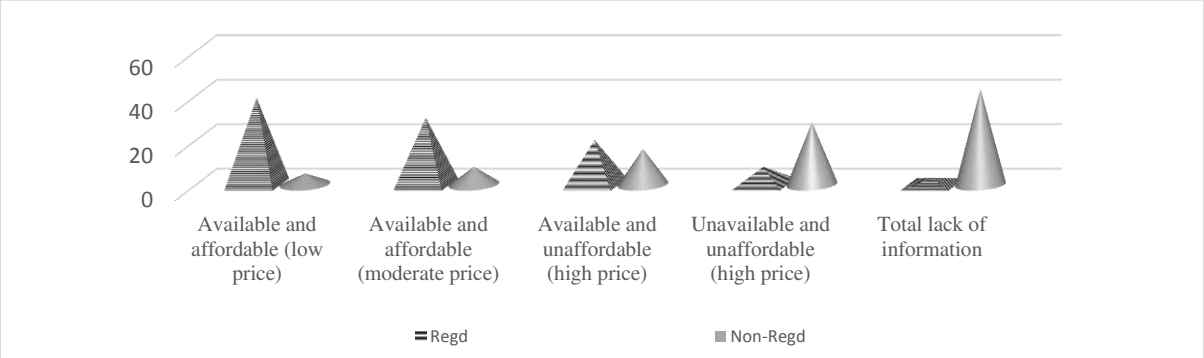


Figure 3. Distribution of respondents by constraints faced in accessing market Information/Input.

Source: Computed from the field data by authors.

From Figure 3, we observed that the introduction of the GESS has added to the handiness and affordability of modern agricultural inputs to the registered rural farmers. About 69 percent of the registered farmers have access to modern agricultural inputs, at least at moderate prices, and just 3 percent of the registered rural farmers do not have complete food market information. On the other hand, only 18% of the non-registered rural youth farmers have access to modern agricultural inputs, at least, at moderate cost while about 43% do not have access to market information at all. This reveals that if the information about the GESS is properly diffused by the extension agents, access to improved agricultural inputs through the GESS will spread and even out the food price. This finding is consistent with IFPRI (2008) in that the availability of new technologies can aid in mitigating the rising food prices, especially in developing countries. However, lack of extension services has meant that these farmers could not access these new innovations (Ibrahim *et al,* 2018).

The impact of the GESS on farm gate price

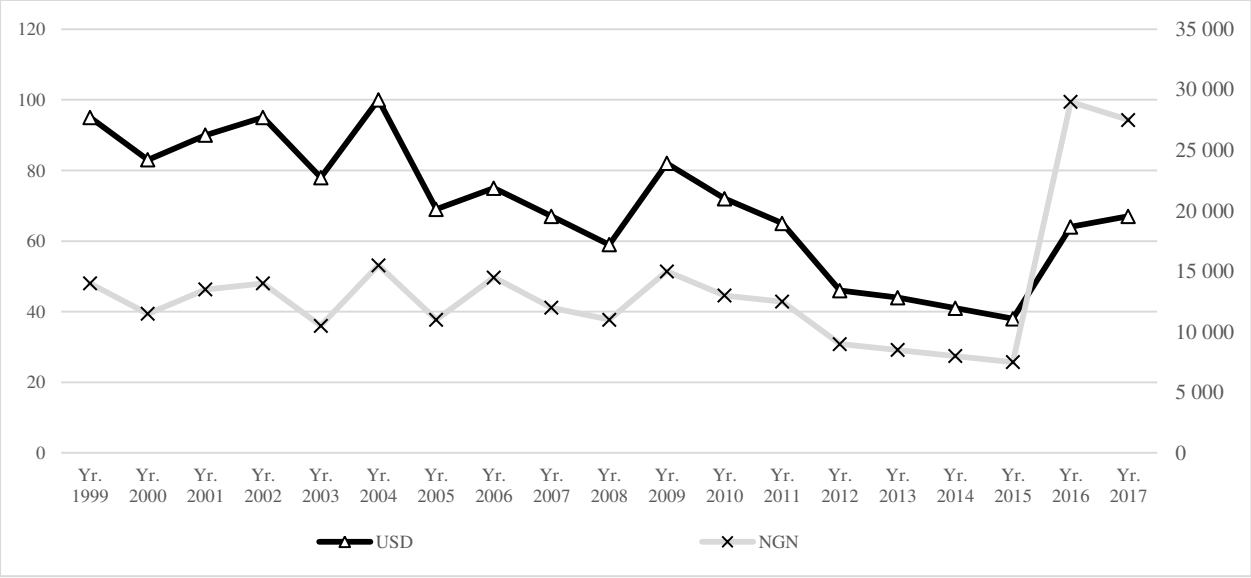


Figure 4. Farm gate price of rice from 1999 to 2017.
Source: FMARD, 2010/FAO, 2018/Authors' computation.

From Figure 4, we observed in the pre-GESS and during GESS farm gate prices (1999 – 2010) that the price of rice was influenced by the political instability in Nigeria, as the food price volatility was high with the naira (₦). However, when measured in US dollars ($), results indicated that even with the high cost of 50kg of rice, it was still cheaper in 2016 –

2017 when compared to 1999 – 2015. This means that variation in the local currency (₦) was as a result much fluctuation in the value of the Nigerian naira. This finding shows that the introduction of the GESS steadied the market price of local rice to a significant level; judging that from 2012- 2015, the price was progressively going down, until when the GESS was temporally suspended by a new government in power, resulting in the cost of input and lack of market information, making the price to surge again. This finding presents another dimension different from Bellemare (2011) on rising food prices, food price volatility and political conflict.

The econometric estimation results

The bivariate probit model put to use in this study was tested against other models with the result revealing that it was valid and fit for the estimation. Also, multicollinearity was measured using the variance inflation factor (VIF). This VIF evaluates how much the variance of the estimated regression coefficient increases if the predictors are correlated. In the study, we noted that the VIF values of the independent variables were constantly below 3. Therefore, the bivariate probit regression coefficients are properly assessed. The bivariate probit model used in the study was found to be effective. This is because, the likelihood ratio test carried on independent equations reveals that, random terms of registration and participating in the GESS in addition to accessing market information and usage of modern agricultural inputs, are strongly correlated. The importance of the LR test ($\rho=0$) is an implication that the decision to register as a rural farmer and to use market information plus modern agricultural inputs were influenced by almost the same set of unobservable heterogeneities; signifying that the two decisions are to a large extent jointly made. This is the reason the study concludes that evaluating a univariate equation will result in inefficient parameterization. Hence, the choice of a bivariate probit model.

Table 3. Econometric estimates of bivariate probit models for the GESS registration by rural youth farmers in Nigeria

Variables	Coefficients	Standard errors	|P| z > z|
Constant	-.5134	.4120	.5151
Age (years)	- 225	.118	0.42**
Education (years)	0.103	513	0.125**
Marital status	-0.216	.839	1.173*
Household Size	- 0.341	1.41	1.231
Access to credit	0.253	0.242	0.152***
Size of farm	1.612	0.217	1.221
Mobile phone	2. 131	0.164	0.145*
Farming experience (years)	-4.160	0.127	1.27**
Off farm income	0.321	0.109	0.021***
Value of output (₦)	2.041	0.131	1.51**
Mobile network coverage	2.158	0.071	0.021**
Land ownership type	1.004	1.41	.154*
Extension contact	0.516	0.178	0.321*
Access to power supply	1.725	0.420	0.138*
Distance	-.071	0.104	0.282**
Number of observations	600	600	600
	χ 2 (1)		
LR test (ρ=0)	=1654.16**		
Pseudo R^2	0.41		

Computed from the field data * = significant at 10% level; ** = significant at 5% level; *** = significant at 1% level

Source: Computed from the field data by authors

From Table 3, we found out that, at the 1% significance level, possession of mobile phones, access to power source for charging phones, type of land ownership and contact with extension (change) agents were important. This shows that farmers who have mobile phones (which is the main source of communicating the GESS information) have a higher likelihood to register in the programme. Also availability of power for charging the mobile phone is as vital as ownership. This two combined with satisfactory land ownership and access to change

(extension) agents will certainly promote registration. On the other hand, marital status is undesirably affecting farmers' registration with the GESS, which is in agreement with Uduji & Okolo-Obasi (2017) in that rural women rarely get involved in the development intervention programmes as they mainly face cultural related impediments.

At the 5% significance level, educational level, worth of participants' output and mobile network coverage were positively noteworthy. This proposes that an upsurge in any of these factors positively impacts registration in the federal government of Nigeria's GESS programme. Increased education enhances the aptitude to read and write which are requirements in the running of e-wallet technology text messages; whereas access to mobile network coverage guarantees that phones are active and massages sent are received and utilized. An increase in the output of users is a natural incentive to non-users. Also at the 5 % significance level, the age of farmers and their farming experiences were of negative significance. This reveals that as the age of the farmer increases with the experience in farming, the propensity to register in GESS programme drops. At the level of 1%, access to off-farm income and credit were positively significant; suggesting that increased access to credit and off-farm income makes available to farmers the funds to redeem the assigned agricultural inputs.

Access to market information and usage of modern inputs to stabilize price.

From Table 4, we observed that four factors negatively impact on the decision to partake in the GESS programme by using it to gain access to market information and make available modern agricultural inputs to rural farmers in Nigeria. While the marital condition of the farmer, remoteness to input redemption centres and farming experience are negatively significant at the 10% probability level, the age of the respondent is important at the 5% level. This could be described by the cultural difficulties faced by majority of the married rural female farmers as they would not make decisions without involving their husbands. Besides, as the farmer's age increases, it is anticipated that access to land could be assured through having male children. The discoveries equally point out that the more the distance to the input center, the further rural people ignore being involved in the GESS even when they have registered. Therefore, in deciding on the use of the modern agriculture inputs, farmers take into account the source and distance from their villages. This shows why many farmers are not accessing food market information to reduce the price volatility at farmers' first point of sale.

Table 4. Econometric estimates of bivariate probit models for using the GESS in Accessing market information by farmers in Nigeria.

Variables	Coefficient	Std. errors	|P| z > z|
Constant	14.423	8.217	4.1425
Age of a farmer (years)	- 0.4121	0.719	0.423**
Highest level of educational qualification (years)	1.421	.571	0.213**
Marital status of respondent farmer	0.141	0.415	2.612*
Household size of farmer	- 1.103	0.1321	.803
Access to farm credit by farmers	0.513	0.213	0.251**
Size of farm cultivated by farmers (hectare)	2.621	2.423	1.65
Ownership of mobile phone	1.817	1.629	0.231**
Farming experience (years)	-0.231	0.163	4.413*
Membership of cooperative body	0.621	0.235	0.151***
Sources of improved seed	1.142	0.291	3.523**
Off Farm Income	3.127	1.451	0.093**
Value of farm output of farmers in naira (N)	1.215	1.134	.831*
Mobile Network coverage	0.521	0.65	.123***
Land ownership type	0.371	0.251	0.523*
Access to power source	0.641	0.442	1.432
Contact with extension agent	2.842	1.117	0.923*
Distance to improved seed/selling point	-0.317	0.934	0.409*
n = 600			
LR test (ρ=0)	χ 2 (1) =194.54**		
Pseudo R^2	0.28		

*** = significant at 1% probability level

** = significant at 5% probability level

* = significant at 10% probability level

Source: Authors' computation

On the other hand, output of the participant, the type of land ownership and contact with the extension agents were positively significant at the 10% level. Sources of getting inputs, off

farm income, household size, access to credit and educational level of the respondent were significant at the 5% level, while only membership in a cooperative body was positively significant at 1%. The size of household is positive because through the provision of household labour, it affects the decision to adopt even when it may be more labour intensive. Education helps the farmers with sufficient information and at the right time. Thus, upturns in these factors definitely will better the tendency to get involved in the GESS thus using it to access market information, enjoy modern agricultural inputs and consequently affect the food price volatility in the region.

In contrast, our findings demonstrated food security approach suitable for sub-Saharan African countries which differs from Saina & Gulati (2016) in the India's food security policies discovered in the wave of global food volatility. More so, our findings suggest differing opinion from Yang *et al* (2008) in the China's response to solving global food volatility that could be most appropriate for developing countries in Asia. More specifically, this study suggested that rural farmers' involvement in the GESS, accessing market information and embracing new farming technologies will positively impact on farmers' food price volatility in Nigeria. The discovery supports the high – pay off input theory (Schultz, 1964) in that converting the traditional agriculture into a highly productive type of farming would cut the constant food price movements and the problems of the days to come in Africa. Hence, if the federal government of Nigeria is to confront food price volatility at the farmers' initial point of sales (farm gate), impediments mostly related to the use of mobile phones, distance to registration and collection centers will be cut down. It is our argument that the federal ministry of agriculture and rural development has the answer for maintaining food security in the country's higher and volatile food markets. Hence, confronting the challenges of network connectivity, predominantly in rural areas, distance to registration and collection centers, cultural barriers and rural electrification for increased involvement of rural farmers in the GESS programme, will make available adequate market information for domestic stabilization of food price volatility in Nigeria and consequently achieving widespread food security in sub-Saharan Africa.

Conclusion, caveats and future research directions

We looked at the effect of the growth enhancement support scheme (GESS) on farmers' food price volatility in Nigeria. Results from the use of a bivariate probit model showed that the

probability of the rural farmers' involvement in the GESS, accessing food market information and adopting fresh farming technologies is positive, given that the problems to address in both decisions are the same; and that farmers' literacy, ownership of a mobile phone, network connectivity, value of output, power for charging phone batteries and contact with extension agents were positive determining factors for participating in the GESS. Cultural obstacles to married women, grower's age, and increased remoteness to registration and collection centers negatively affected farmers' desire to be involved. The result also revealed that farmers depended on the GESS for dealing with food price volatility by providing the food market information that reduced the occurrence and degree of panic-driven price surge in Nigeria. The results put forward the need for an improved GESS in line with the agricultural transformation agenda (ATA) by assuaging the hindrances mostly related to the use of mobile phones and remoteness to the registration and collection centers.

This research adds to the literature on agriculture and rural development by pinpointing the key challenges to the GESS. We also put forward policy suggestions that would support sub-Saharan African countries to successfully tackle the crises of food price volatility in the region. Much as we know, this is the foremost study that surveys the significance of the growth enhancement support scheme in handling food price instability in Africa. The key caveat of the study is that it is limited to the scope of rural areas in Nigeria. Hence, the discoveries cannot be applied to other African countries with the same policy challenges. Based on this shortcoming, replicating the analysis in other countries is advisable in order to find out if the established nexuses withstand empirical scrutiny in dissimilar rural contexts of Africa.

Disclosure statement

No potential conflict of interest was reported by the authors.

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