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IMPACT OF THE GROWTH ENHANCEMENT SUPPORT SCHEME (GESS) ON MAIZE FARMERS IN DUTSINMA LOCAL GOVERNMENT AREA OF KATSINA STATE, NIGERIA

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ABSTRACT
The study examined the impact of the Growth Enhancement Support Scheme (GESS) on maize farmers in Dutsin ma, Katsina state, Nigeria. Simple Random sampling was used to select 100 beneficiaries while purposive sampling was used to select100 non-beneficiaries of the scheme. Data were analyzed using descriptive and inferential statistics as well the Propensity Score Matching technique. The likelihood that a household selected at random will participate in the scheme was 66.7%. The likelihood of participation in the GESS increases with household size ($p<0.05$), educational level ($p<0.10$), association member ($p<0.01$) and extension contact ($p<0.10$), while, the number of maize plots ($p<0.05$) and dependency ratio ($p<0.05$) reduces the likelihood of participating in the GESS. The Average Treatment Effect on the treated (ATT) for TFP shows that Maize productivity for the beneficiaries of the scheme increased by a factor of 2.25. The Average Treatment Effect on (ATE) shows that the scheme increased maize productivity by a factor of 0.855, while the Average Treatment Effect on the untreated (ATU) shows that maize productivity for the non-beneficiaries could have increased by a factor of 0.73 if they had benefited from the scheme. The Average Treatment Effect on the treated (ATT) for Gross Margin shows that maize income for the beneficiaries of the scheme increased by ₦58614 per hectare of area cropped with Maize. On the other hand, the Average Effect of the Treatment (ATE) shows that the scheme increased maize income by ₦15854, while the average treatment on the untreated {ATU} shows that maize income for the non-beneficiaries could have increased by ₦32804 if they had benefited from the scheme. The study concluded that the Growth Enhancement Support Scheme (GESS) or Electronic wallet had impacted positive among its intended beneficiaries in Dutsinma, Katsina state in terms of enhancing productivity and income among small holder Maize farmers.

Keywords: *Impact, growth enhancement support scheme, maize farmers*

INTRODUCTION

The Growth Enhancement Support Scheme (GESS) is one of the many critical components of the Federal Government Agricultural Transformation Agenda and was launched in July 16, 2012; this is a response by the government to reduce food insecurity. The broad objective of the scheme is to remove the usual complexities associated with fertilizer distribution, encourage critical actors in the fertilizer value chain to work together to improve productivity, enhance farmer's income and promote food security and shift provision of subsidized fertilizer away from the general public to genuine small-scale farmers.(Ahmed, et al; 2016). Under this Scheme, an accredited farmer will receive subsidized agro inputs allocation through an e-wallet that hosts unique voucher numbers sent to his or her phone, and goes to an accredited agro dealer to redeem his inputs. The back bone of any agricultural revolution is access of farmers to modern agricultural inputs. These agricultural inputs range from improved seeds, fertilizers and crop protection chemicals to machinery, irrigation and knowledge. Seeds are critical to successful crop production and inevitably, farm productivity and profitability (Nwaobiala and Ubor, 2015). However, a major policy stance underpinning the implementation of the GES was the withdrawal of the Federal government from the procurement and distribution of fertilizers and improved seeds in 2011. This is in a bid to decontaminate the input distribution system and promote effective service delivery. The agricultural transformation agenda (ATA) introduced in 2011 seeks to tackle the inefficiencies in the distribution of key inputs making them more readily available and affordable. In this regard the private sector agro-input business enterprises (agro-dealers) are assigned a critical role especially in the implementation of the Growth Enhancement Support (GES) Scheme (Akinwumi, 2012). They are involved in the procurement, distribution and delivery of inputs (fertilizers, improved seeds and agro-chemicals) to small-scale farmers. Under the scheme, farmers are to benefit directly from an innovative electronic system of delivering subsidized inputs in which the subsidy payments are delivered directly to the beneficiaries through mobile phones. However, the thrust of the scheme is to enhance the capacity of the farmers who could not afford a bag of fertilizer and seedlings (Tiri *et al*., 2014). According to (Tiri, et al. 2014); the expectation that GES scheme will bring out the best from both the small and large scale farmers all over the country, with full commitment of all the three tiers of government to agriculture. He further stated that the scheme will be more functional, efficient, generate employment, enhance farmer's income and reduce poverty and at the end make food security a dream come true. Maize crop was introduced into Africa in the 1500s and has since become one of Africa's dominant food crops. Like many other regions, Maize is a cereal crop that is grown widely throughout the world in a range of agro ecological environments. The Fertilizer procurement and distribution system in Nigeria over the years has been characterized by inefficiencies. Furthermore, subsidized fertilizer meant for farmers have either been diverted or resold to intermediaries before reaching the intended beneficiaries. Consequently, the resulting effect is the perennial scarcity and high cost of fertilizer and serious circumvent this situation; the federal Government of Nigeria introduced the Growth Enhancement Support Scheme (GESS) in 2012 under the Agricultural Transformation Agenda (ATA) for the provision of subsidized inputs to farmers in Nigeria. (Akinwumi, 2011).

It is expected that the scheme will boost food production, the income of farmers as well as the value accorded to locally produce agricultural products (Tiri *et al*., 2014). The broad objective of this study is to assess the impact of growth enhancement support scheme on maize production in Dutsinma, Katsina State, while the specific objectives are to: describe the socio-economic characteristics of Maize farmers; identify the main determinants of participation in the GESS; determine the impact of the GESS on maize productivity (total factor productivity) and maize income (gross margin). This study will contribute to existing literature on the scheme as well as serve as evidence for policy formulation especially on the continuation of the scheme in Nigeria.

Empirical studies on the E-Wallet scheme in Nigeria

The extent to which the GESS impacted on agriculture and livelihood have been previously studied in Nigeria. A very recent study by Oluwafemi et al (2016) revealed that the GESS had led to an increase in the profitability level and standard of living on the Ofada Rice producers' in Obafemi Owode Local Government Area, Ogun State. An earlier study by Nwaobiala et al (2015), shows that the scheme led to an increase in crop yield, farm size, farm income and farm output of beneficiaries. However, late SMS messages, insufficient inputs at the redemption centers and the considerable time spent at the redemption center before redeeming inputs were the major challenges faced by the beneficiaries of the scheme in Imo State, Nigeria.

In addition, Tibi (2015) also observed that the GESS has led to increase in productivity and partially improved quality of life of beneficiaries in Delta State, Nigeria. Okorie (2016) however noted that the GESS, could help reduce poverty among farmers and also increase the production efficiency of farmers in Federal Capital Territory of Nigeria. Adebayo and Olagunju (2015) established that farming households participating in the scheme had better livelihood and productivity outcomes than the non-participating households. Some authors that studied the challenges of the scheme observed as follows. Nwalieji et al (2015) observed that the scheme had very low performance indices in redemption of inputs in 2012 and 2013 respectively, due to poverty, illiteracy, poor awareness and poor mobile phone possession in Anambra state, Nigeria. On the other hand, Ahmed et al (2016), pointed out that insufficient seed, fertilizer, poor communication and poor GSM network for proper operation of E-wallet, insecurity and distance from redemption centers were the major challenges of the scheme in Adamawa state. Furthermore, Oyediran et al (2015) submitted that, telecommunication problems, low coverage and late arrival of the inputs constituted major impediments to GESS programme in Ogun State, Nigeria. However, Fadairo et al (2015) are of the opinion that the non-commitment of the ADP personnel and long distance to redemption centers are the major constraints farmers participating in the scheme face. They further stressed that the constraints made farmers to have a negative attitude towards the scheme in Oke-Ogun area of Oyo state. Tiri et al (2014) observed that Growth Enhancement Support Scheme is an innovative approach to fertilizer subsidy and other input administration through electronic system that ensures that only registered farmers benefit through engagement of the private sector in the delivery and distribution of fertilizer and other input directly to the farmers. Ama (2016) reported that there was room for maize farmers to increase their production efficiency to attain the frontier optimum. Also, maize production was profitable and could help reduce poverty among farmers during his study on Analysis of Production Efficiency and Poverty Status of Growth Enhancement Support Scheme of Maize Farmers in Federal Capital Territory, Nigeria.

MATERIALS AND METHODS

Study Area

The study was conducted in Dutsinma Local Government Area of Katsina State. The area is bounded by Safana and Dan-Musa local governments to the west, Kurfi and Charanchi local governments to the north, Kankia to the east, Matazu and Dan-Musa local governments in the south. In absolute terms, Dutsin-ma town is found within Longitude 07°29,56"E and 07°30,04"E and Latitude 12°27,10"N and 12°27,16"N of the equator. It is also found in the basement complex area of Katsina State (Oguntoyimbo, 1983) as cited in (Tukur *et al*.,, 2013).The LGA has an area of 527 km² and a population of 169,671 ((NPC, 2006). The Local Government is located in the Sudan savanna zone of the central part of Katsina state with two distinct seasons, the tropical wet and dry seasons and endowed with vast fertile land suitable for the cultivation of cereal crops and tree crops. Rainfall is between May and September with a peak in August and the average annual rainfall is about 700 mm. Maximum day temperature reaches about 38°C in the month of March, April and May and minimum temperature is about 22°C in December and January. (Udoh 1970), as cited in (Tukur *et al.*, 2013).

Sampling Procedure

Dutsinma Local Government area was purposively sampled for the study due to its proximity to the base of the researchers and the ease of obtaining a sampling frame for the study. The list of GESS beneficiaries was obtained from officials at the redemption Centre. Simple Random sampling was used to select 100 Maize farmers as respondents for the study while purposive sampling technique was used to get 100 maize farmers that are non-beneficiaries of the scheme. A total of 200 respondents were used for the study. A structured questionnaire was used to collect information on respondents' socioeconomic characteristics, quantity of inputs and output for Maize production as well as prices.

Analytical Techniques

Descriptive statistics such as percentages and the mean as well as a Logit regression model were used to analyse the data. The Logit regression model was used to identify the determinants of participation in the GESS. The dependent variable is binary "0" and "1", and represents non-participation and participation in the GESS respectively

The explanatory/independent variables are:

X_1 = Age of Household Head (Years)
X_2 = Education Level of Household Head (Years)
X_3 = Household Size (Number)
X_4 = Total Farm Size (Ha)
X_5 = Extension contact (Number of visit)
X_6 = Membership of Farmers Association (Years of membership)
X_7 = Maize plot (Number)
X_8 = Occupation (Number of livelihood activities)
X_9 = Dependency ratio (Number)

The Heckman's single differencing approach was used to determine the impact of the GESS on maize productivity (Total Factor Productivity) and Maize income (Gross Margin). The method establishes a valid counterfactual by comparing the beneficiaries and non-beneficiaries who have comparable characteristics which affect project participation

and outcomes (Heckmann et al., 1997). The method nets out the effect of observable time-invariant drivers of project outcomes.

The difference of the outcome between the treatment and control group with and without the intervention – is the impact of the intervention (Smith and Todd, 2001). The model is specified as:

$DID = Y_t - Y_c$…… (1)

Where:

Y_t =outcome y for the beneficiaries group;

Y_c =outcome y for the control group

The Average treatment effect (ATE), Average treatment on the treated (ATT) and Average treatment effect untreated (ATU) will be computed to estimate the impact of the GESS scheme.

The average treatment effect (ATE) is the average response to treatment for a random sample from the population.it is a measure used to compare treatments (or interventions) the difference in mean (average) outcomes between units assigned to the treatment and units in randomized experiments, evaluation of policy interventions, and medical trials. The ATE measures assigned to the control. In a randomized trial (i.e., an experimental study), the Average Treatment Effect can be estimated from a sample using a comparison in mean outcomes for treated and untreated units. Average Treatment on the Treated (ATT) is the average response to treatment for a sample of individuals that chose (or were assigned) treatment. Average Treatment Effect Untreated (ATU) is the average response to treatment for a sample of individuals that chose (or were assigned) no treatment.

Estimating the impact (Average Treatment Effect on the Treated)

The matched sample was used to compute the Average Treatment Effect for the treated (impact). It is estimated as follows:

$$ATT = E(\Delta \mid D=1, X) = E(Y_1 - Y_0 \mid D = 1, X) \ldots (1)$$

$$= E(Y_1 \mid D = 1, X) - E(Y_0 \mid D = 1, X) \ldots\ldots\ldots\ldots\ldots (2)$$

Where D = 1 denotes program participation (treatment) and X is a set of conditioning variables on which the subjects were matched. Equation 9 would have been easy to estimate except for the equation $E(Y_0 \mid D = 1, X)$. This is the mean of the counterfactual and denotes what the outcome would have been among participants had they not participated in the program. PSM provides a way of estimating this equation.

A unique advantage of PSM is that instead of matching subjects on a vector of characteristics, we only need to match on a single item, the propensity score that measures the probability of participating in the program. Given that the Conditional Independence Assumption and the common support assumption holds, then we estimate the mean effect of the treatment through the mean difference in the outcomes of the matched pairs:

$$ATT = E[Y_1 \mid D = 1, P(X)] = E[Y_0 \mid D = 0, P(X)] \ldots\ldots\ldots (3)$$

Equation 3 is applicable to single treatment programs where the treatment variable is a categorical variable that has only two mutually exclusive categories. However, the equation is easily generalized to multiple treatment programs (Imbens, 2000; Lechner, 1999, 2001) cited in Adebayo and Olagunju (2015).

The ATE, i.e. the average effect of the treatment for an individual drawn at random

From the overall population at random is

$$ATE = N_i/N \times ATT + N_o/N \times ATU \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where N_i is the number of treatment group and N_0 is the number of control group. The above illustration shows the relationship between ATT (average treatment on the treated), ATE (average treatment effect on an individual) and ATU (average treatment on the untreated). Maize income was determined using the Gross Margin Analysis.

Total Factor Productivity

The total factor productivity indices was estimated using Total Factor Productivity Index Program (TFPIP Version 1.0) developed by Mcbride (2003). Fakayode et al. (2008) also used this technique for estimating total factor productivity . The variable inputs used for this research include: cost of fertilizer (organic or inorganic) (kg/ha), seeds (kg/ha), labor (man-day/hours), Land (ha) and herbicide (litre/ha). The output for maize was in kilogram.

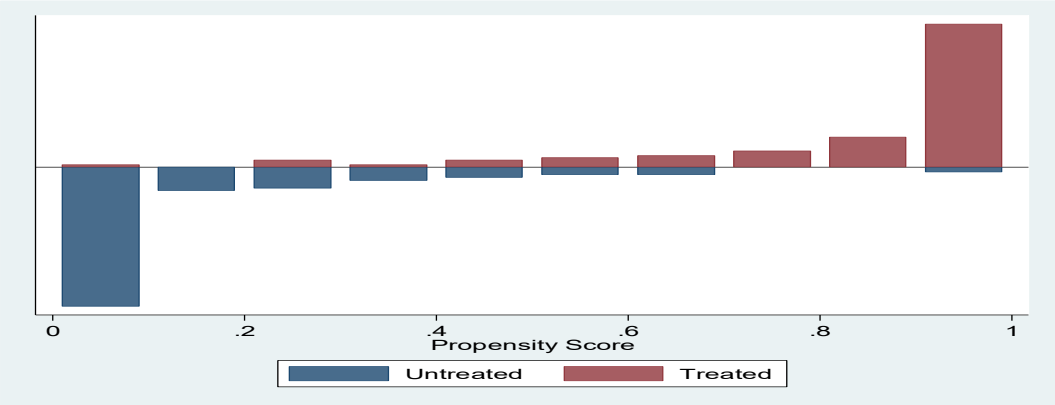

Fig 1: *Common support graph*

RESULTS AND DISCUSSION

Socio-economic Characteristics of Respondent

The result of the comparison of socio economic characteristics of the respondents is presented in Table 1. The result shows that significant differences exist between the beneficiaries and non-beneficiaries of GESS in terms of their socio-economic characteristics. This implies that significant selection bias exist between the respondent used for the studies. To account for the selection bias the Propensity Score Matching (PSM) approach was used in this study.

Table 1: Socio-economic characteristics of beneficiaries and non-beneficiaries of the GESS

Variable	Beneficiaries of GESS	Non Beneficiaries of GSS	T-value
	Mean	Mean	
Quantity of seed	27.42	15.49	4.4*
Quantity of organic fertilizer	4.55	19.45	-6.81
Quantity of inorganic fertilizer	171.21	93	5.41*
Age	45	40	4.33*
Farm size	2.3	1.3	6.2*
Household size	12.0	7.0	5.51*
Dependency ratio	3.3	1.0	-3.01
Farming experience	17.3	13.8	2.09
Maize plot	1.3	1.6	2.55
Extension contact	2.0	1.6	3.6
Frequency of extension contact	0.2	0.6	-2.3

, **, * = 10%, 5% and 1% respectively*

Determinants of participation in the GESS

The result for the determinants of participation in the GESS scheme is presented in Table 2, the result shows that the estimated Logit model of GESS participation was a good predictor of participation as demonstrated by the results of two alternative tests of goodness of model fit (The Hosmer-Lemeshow (H-L) static and the Chi Square test). As the rule of thumb for accepting a Logit model is that The H-L static must be greater than 0.05 and should show non-significances. The H-L goodness of fit test statistic for the study was 12.225 and it was non-significant (p=0.141), depicting that the model is a good fit. Secondly, the model has a Chi-square static of 127.872, which is statistically significant at ($p<0.05$) implying that all the predicators that have been included in the model are capable of jointly predicting participation in the GESS programme. The results further shows that the likelihood of participation in the GESS increases with household size ($p<0.05$), educational level ($p<0.10$), association member ($p<0.01$) and extension contact ($p<0.10$). On the other hand, the number of maize plots ($p<0.05$) and dependency ratio ($p<0.05$) reduces the likelihood of participating in the GESS. A recent study by Adebayo and Olagunju (2015) also noted that household size and educational level had a positive influence on GESS participation while occupation will reduce the likelihood of participation in the scheme. The Household size variable enhanced the likelihood of participation in the scheme because any household member above 18 years is eligible to register and participate in the scheme. As more members of a household register for the scheme, the quantity of inputs that the household can redeem via the scheme will also increase. Education on the other hand positively influences decision making by farmers. This is especially true in the case of decisions involving new technologies or programs. Literate individuals are very ambitious to get and use new technologies. Maize farmers with other occupation or livelihood activities have the tendency not to want to participate in the scheme due to the time required to register and also redeem inputs.

Table 2: Result of the Logistic Regression Model for participation in the GESS

Variables	B	S.E	Sig	Exp(B)
Household size	.129	.059	.027**	1.138
Farming experience	.006	.033	.856	1.006
Educational level	. 681	.189	.000*	1.975
Association member	.947	.527	.072***	2.578
Extension contact	.831	.229	.000*	2.295
Other occupation	-.019	.106	.854	.981
Number maize plot	-.662	.330	.045**	.516
Dependency ratio	-1.205	.515	.019**	.300
Age	.061	.045	.171	1.063
Constant	-7.701	2.212	.000*	.000

Propensity Score and Balancing test

The propensity score is the predicted probability of participation in the GESS and it was estimated from a Logistic regression of GESS participation status on the predictor variables. The average probability for all households was 0.66.7 (Table 3) which means that the probability that a particular households selected at random to participate in the scheme is 66.7% with respect to the outcome variable (Total Factor Productivity and Gross Margin /ha).

To test for balancing i.e. quality of match, the common support graph was drawn. This test is effective because it shows visual presentation of overlap of propensity scores between the participants and non partcipants in the GESS. A substantial or large proportion of overlap in the density distribution of the estimated propensity scores of both beneficiaries and non-beneficiaries implies a good match of treated and control cases; thus, satisfying the common support condition Dehejia and Wahba (2002) as cited in Adebayo and Olagunju (2015). From the graph, a considerable overlap of propensity scores between the participants and non partcipants groups exist. This implies that the match is good and balanced. Based on this result, the PSM technique can be used to attribute an increase in maize income and Maize productivity to participation in the GESS. This is because any selection bias due to observed vocariates have been eliminated or acccounted for.

Table 3: Propensity score Estimate for Maize farmers

Variable	Observation	Mean	Min	Max
Propensity score	299	0.6695	.364	.981

Impact of GESS on Maize productivity

The result on the impact of GESS participation on Maize productivity using TFP index as a proxy for Maize productivity shows that GESS intervention had a positive and significant effect on Total Factor Productivity of Maize farmers in the study area. Average Treatment Effect on the treated (ATT) on the entire population of participants was 2.2519030 (Table 4). This implies that participation in the GESS will enhance Maize productivity by a factor of 2.25 for all Maize farmers that participate in the scheme. On the other hand, the average effect of the treatment (ATE) for a household drawn from the overall population at random is somewhat smaller with a value of 0.855 compared to the treated category. The ATU was estimated by matching a similar treated household to each non-treated household. Thus, average treatment effect on the untreated (ATU) had a significant positive impact on Total factor productivity, this is the counter factual outcome of the treated had it been they were not treated. The findings above clearly show that the GESS scheme increased the productivity of Maize farmers in the study area.

Table 4: Average Impact Estimates of GESS on Total Factor Productivity

TFP	Sample	Treated	Control	Difference	S.E	t-stat	
Maize farmers	Unmatched	3.23344043	1.36001517	1.87342526	0.775187634	2.42*	
	ATT	3.23344043	0.981537403	2.25190303	0.751579187	3.00*	
	ATU	1.36001517	0.626266669	0.733748504	-	-	
	ATE	-	-	0.855388603	-	-	

* Significant at 10 % level, ** Significant at 5 % level, *** Significant at 1 % level

Impact of GESS on Income from Maize (Gross Margin)

The impact of GESS participation on Maize income was also estimated through the propensity score matching. Results presented in Table 4 show that GESS intervention had a positive but not significant effect on Gross Margin /ha for Maize farmers considered in the study. The Average Treatment Effect on the treated (ATT) of the entire population of participants in the study area was ₦58614.GM/ha (Table 5). This implies that the income from Maize for the GESS participants increased by ₦58614 per hectare of area cropped with Maize. The average effect of the treatment (ATE) on the entire population in the study area i.e. picking any Maize farmer at random was ₦ 15854. This implies that both participants and non-participants in the scheme were considered, Maize income due to participation in the scheme will increase by about ₦ 15854.1954GM/ha. For the, effect on the untreated category, the average treatment on the untreated (ATU) had a positive impact but not significant effect on Gross Margin /ha. Maize income will increase by 32804 for this category of respondents assuming they were treated. Most importantly, Participation in GESS will lead to an increase in Maize income as measured by the Gross Margin per hectare.

Table 5: Average Impact of GESS Gross Margin /ha

GM/HA	Sample	Treated	Control	Difference	S.E	t-stat	
Maize farmers	Unmatched	99781.352	86996.9117	12784.4403	18295.9023	0.70	
	ATT	99781.352	41166.7819	58614.5701	44536.6767	1.32	
	ATU	86996.9117	54192.7496	32804.1621	-	-	
	ATE	-	-	15854.1954	-	-	

CONCLUSION

The Growth Enhancement Support Scheme (GESS) or Electronic wallet had impacted positive among its intended beneficiaries in Dutsinma, Katsina state in terms of enhancing productivity and income among small holder Maize farmers. The scheme obviously has enormous potentials and is also very promising for agricultural input procurement and distribution in Nigeria. The GESS approach should be used for future agricultural development initiatives in Nigeria and more rigorous impact assessment using a mixed method approach is required to provide more concrete evidence of the impact of the scheme.

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