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Impact of e-wallet fertilizer subsidy on productivity of maize-based farmers in Ogbomoso ADP zone, Oyo state, Nigeria

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Abstract: In the quest for solving the problems of agricultural inputs faced by smallholder farmers, the Federal Government of Nigeria in 2011 implemented E-wallet fertilizer subsidy programme to boost agricultural productivity. This study therefore evaluates the impact of e-wallet fertilizer subsidy programme on the productivity of maize-based smallholder farmers in Ogbomoso Agricultural zone of Oyo State. The study specifically describes the socioeconomic characteristics of the maize farmers and examines the impact of the fertilizer subsidy programme on the maize productivity in the study area. Primary data on input-output as well as demographic characteristics were collected with the aid of well-structured questionnaire. Multistage sampling technique was employed for the selection of 326 respondents which was stratified into treatment groups and control groups. Data were analysed with the used of descriptive statistics and regression discontinuity (RD) using Calonico, Catteneo and Titiunik (CCT) and Imbems and Kalyanaraman (IK) methods. The results showed that the treatment group recorded more profit than the control group. The results of RD revealed that the productivity level of the treatment group increased by 35.2% compared with control group under IK methods which had a significant value ($p \leq 0.05$), but it was insignificant under CCT method. The study concluded that the programme had positive impact on productivity of maize-based smallholder farmers. Efficient and timely distribution of fertilizer will enhance maize production. Also, stakeholders should consider nearness of the redemption centre to farm.
Keywords: Fertilizer, E-Wallet, Productivity, Smallholder, Subsidy

INTRODUCTION

Maize is the main staple crop grown in various agro-ecological zones and agricultural systems. According to Macauley and Ramadjita (2015) it is consumed by people with different food preferences and socioeconomic backgrounds in Sub-Saharan Africa (SSA). The well-known problems hindering high maize productivity are low percentage of nutrient in the soil and continuous cultivation of the same areas of land without planning how the land would regain its nutrient or fertility back (Wanyama *et al.,* 2009). A reasonable step must be taken to promote agricultural productivity in the sub-Sahara part of the nation "Nigeria" on time. One of the confirmed ways of promoting agricultural productivities to a higher level is through introduction of effective use of improved agricultural technology. Smil (2002) shows that proper use of fertilizer (inorganic) in the past 50 years had added 40 percent increase to the production of food crops in some local and regional areas. Consumption of fertilizer in Africa stood at an average of 16.24 kg/ha is about 1/6th of world consumption of 98.20 kg/ha (FAOSTAT 2010). Increased productivity of smallholder farmers through bridging the performance gaps and provision of appropriate inputs and improved technologies such as in developing stress resilient, high-yielding varieties and enablement of farmers to better climate risks management will represent a major step towards transforming agriculture in Africa (Macauley and Ramadjita, 2015). Evbuomwan (2003) discovered that low yield of food crops is caused by inadequate of application of fertilizer, stating the fact that sometimes the organic fertilizer in the land may not be enough to sustain the crops. She expressed further that despite all efforts put in by the nation to improve crop production, Nigeria's agricultural sector is still characterized by low yield of food crops. Thompson (2004) discovered the reason why government policy and regulated reforms on the fertilizer sections should be established and encouraged. Adesina (2012) commented on the method used in the past by the government to supply inputs to the farmers as method, which was not strong enough, not well-organized, it was a fraudulent system, hence a lot of the farmer did not benefit from the programme. The points were stressed that the inputs meant for boosting agricultural productivity and promote economic standard of the nation were diverted by insincere and corrupt political elites to other countries to boost their own personal businesses and gain. The e-wallet approach is designed to solve some of the problems facing smallholder farmers. The farmers to participate in the e-wallet approach were expected to be above 18 years of age, must have given the details of his personal information to the authorized government agent and must have a functioning registered cell phone. The farmers that have all these requirements mentioned would have full assurance of benefiting from e-wallet approach. The e-wallet voucher would be opened for such a farmer. The voucher would be a channel to get fertilizers, improved seeds, agrochemicals and other agricultural input from agro-dealer at half of the cost (Signal, 2014).

Measuring the impact of fertilizer subsidy on maize productivity is essentially a problem of missing data, because one cannot observe the outcomes of program participants if they had not been beneficiaries. Without information on the counterfactual, the next best alternative is to compare outcomes of treated individuals or households with those of a comparison group that has not been treated. In doing so, one attempts to pick a comparison group that is very similar to the treated group, such that those who received treatment would have had outcomes similar to those in the comparison group in absence of treatment.

Successful impact evaluations are hinged on getting a good comparison group. There are two broad approaches that researchers resort to in order to mimic the counterfactual of a treated group: (a) create a comparator group through a statistical design, or (b) modify the targeting strategy of the program itself to wipe out differences that would have existed between the treated and non-treated groups before comparing outcomes across the two groups. Equation 1 presents the basic evaluation problem comparing outcomes Y across treated and non-treated individuals i:

$$Y_i = \alpha X_i + \beta T_i + \varepsilon_i \; \ldots.. \quad (1)$$

Here, T is a dummy equal to 1 for those who participate and 0 otherwise. X is set of other observed characteristics of the individual and perhaps of his or her household and local environment. Finally, ε is an error term reflecting unobserved characteristics that also affect Y. Equation 1 reflects an approach commonly used in impact fertilizer subsidy, which is to measure the direct effect of the program T on outcome Y. Indirect effects of the program (that is, those did not use fertilizer) may also be of interest, such as changes in prices within program areas.

The problem with estimating equation 1 is that treatment assignment is not often random because of the following factors: (a) purposive program placement and (b) self-selection into the program. That is, programs are placed according to the need of the communities and individuals, who in turn are self-select given program design and placement. Self-selection could be based on observed or unobserved characteristics, or both. In the case of unobserved factors, the error term in the estimating equation will contain variables that are also correlated with the treatment dummy T. one cannot measure and therefore account for these unobserved characteristics in equation 1 which leads to unobserved selection bias. The correlation between T and ε naturally bias the other estimates in the equation, including the estimate of the program effect β. The average effect of the fertilizer subsidy might be represented as follows:

$$D = E(Y(1)|T=1) - E(Y(0)|T=0) \; \ldots.. \; (2)$$

The problem is that the beneficiaries and non-beneficiaries' groups may not be the same prior to the intervention, so the expected difference between those groups may not be due entirely to program intervention. If, in equation 2, one then adds and subtracts the expected outcome for non-participants had they participated in the program $E(Y_i(0) / T_i = 1)$. Another way to specify the counterfactual one is;

$$D = E(Y_i(1) \mid T_i = 1) - E(Y_i(0) \mid T_i = 0) + [E(Y_i(0) \mid T_i = 1) - E(Y_i(0) \mid T_i = 1)] \quad (3)$$

$$D = ATE + [E(Y_i(0) \mid T_i = 1) - E(Y_i(0) \mid T_i = 0)] \quad (4)$$

In these equations, ATE is the average treatment effect $[E(Y_i(1) \mid T_i= 1) - E(Y_i(0) \mid T_i = 1)]$, namely, the average gain in outcomes of participants relative to non-participants, as if nonparticipating households were also treated. The ATE corresponds to a situation in which a randomly chosen household from the population is assigned to participate in the program, so participating and nonparticipating households have an equal probability of receiving the treatment T [Rosenbaum and Rubin, (1983); Lechner (1999)].

Problem of contamination in agricultural intervention programme

Contamination occurs when members of treatment and comparison groups have access to another intervention which also affects the outcome of interest (White and Barbu 2006). Contamination comes from two possible sources. The first is own contamination from the intervention itself as a result of spillover effects. To ensure similarity of treatment and comparison groups, a common approach is to draw these groups from the same geographical area as the project. Indeed, neighbouring communities, or at least sub-districts, are often used. But the closer the comparison group to the project area the more likely it is to be indirectly affected in some way by the intervention. An agricultural intervention can increase labour demand beyond the confines of the immediate community. There is thus a tension between the desire to be geographically close ensuring similarity of characteristics and the need to be distant enough to avoid spillover effects. Where spillover effects are clearly identifiable, they should be included as a project benefit or cost. But distance will not reduce the possibility of external contamination by other interventions. The desired counterfactual is usually a comparison between the intervention and no intervention.

The first step to tackle the problem of external contamination is to ensure that the survey design collects data on interventions in the comparison group, a detail which is frequently overlooked, thus providing an unknown bias in impact estimates. The second step is to utilize a theory-based approach, the former being better able to incorporate different types and levels of intervention. This study used regression discontinuity design to tackle the problem.

Regression discontinuity (RD)

Regression discontinuity uses the propensity score in another way. The outcome variable is regressed upon the score including a program dummy. The fitted values are calculated using the mean score for the treated and both D=0 and D=1. The difference between these two fitted values is the program impact. The regression-discontinuity (RD) design has recently become a standard evaluation framework for solving causal issues with non-experimental data. The intrinsic feature of this approach is that there is jump in an increase in the probability of treatment when an observed covariate crosses a known threshold (Trochim 1984). This design allows one to identify the program's causal effect without imposing exclusion restrictions, index assumptions on the selection process, functional forms, or distributional assumptions on errors.

Regression Discontinuity (RD) designs were first introduced by Thistlethwaite and Campbell (1960) as a way of estimating treatment effects in a non-experimental setting where treatment is determined by whether an observed "assignment" variable (also referred to in the literature as the "forcing" variable or the "running" variable) exceeds a known cutoff point. In their initial application of RD designs, Thistlethwaite and Campbell (1960) analysed the impact of merit awards on future academic outcomes, using the fact that the allocation of these awards was based on an observed test score. The main idea behind the research design was that individuals with scores just below the cutoff (those who did not receive the award) were good comparisons to those just above the cutoff (who did receive the award). Although this evaluation strategy has been around for almost fifty years, it did not attract much attention in economics until relatively recently.

The research work Cook *et al.,* (2008) has argued that a variety of non-experimental methods can provide causal estimates that are comparable to those obtained from experiments. One such non-experimental approach that has been of widespread interest in recent years is regression discontinuity (RD). RD analysis applies to situations in which candidates are selected for treatment based on whether their value for a numeric rating (often called the rating variable) falls above or below a certain threshold or cut point. The regression-based approach models the determinants of outcomes and possibly also models the determinants themselves. The approach has the advantage of flexibility – it does not lump different activities under the single heading of the intervention and automatically incorporates differing intensities of participation. It is only when the treatment is a simple, homogenous activity that dummy and mean comparison approaches are appropriate. However, the adoption of the regression-based approach does not mean that problems of selection bias are removed. They are not and must be addressed. Where selection is based on observables then this is readily done.

METHODOLOGY

This study was carried out in Ogbomoso Agricultural zone. Yams, cassava, maize, and tobacco are some of the notable agricultural products from the region. Data were collected with the use of well-structured questionnaire from both literate and non-literate farmers in the study area. Multistage sampling technique was used to sample 326 farmers who access e-wallet fertilizer subsidy. E-wallet program is a government program under the Agricultural Transformation Agenda (ATA) which enables farmers to access subsidized fertilizer for production.

Model Specification

Regression discontinuity (RD)

A different non-experimental method is the regression discontinuity (RD) approach. In the RD approach, programs are often assigned on the basis of a score (for example, a poverty score or a credit score), and there is a cutoff point above which units (individuals, households, localities and so forth) are eligible for the program and below which they are not. Intuitively, units that are just above this cutoff would not differ greatly from units that are just below the cutoff, with the only difference being eligibility for the program. An RD approach exploits the non-testable assumption that confoundedness holds in a small enough neighbourhood of the cutoff point. That is, in this neighbourhood treatment assignment is not systematically related to subjects' characteristics (Chay *et al.,* 2010).

In most cases, type of targeting implies that poorer or needier areas are included in the program. Typically, characteristics related to the relevant targeting objectives are used to compute a score, which is then employed to rank the areas. A cutoff point is then chosen and only areas with a score below (or above) this cutoff will be included in the program. RD can be employed to estimate both the ATE and the ITE. Only areas that are just above and just below the cutoff point was only used, assuming that these areas have both comparable characteristics and that the only relevant difference between them is that those just above the cutoff (T=1) receive the program and those just below (T=0) do not. We can write:

ATE ("just above cutoff") = E $(Y_1 - Y_0 | T=1, E=1,$ "just above cutoff") =
E(Y | E=1,"just above cutoff")- E(Y |"just below cutoff") (6)

and ITE("just above cutoff") = E$(Y_1 - Y_0 | T=1, E=0,$"just above cutoff") =
E(Y | E=0,"just above cutoff")- E(Y |"just below cutoff") (7)

The adoption of RD for this analysis emanated due to the problem of contamination. This problem occurs when members of treatment and comparison groups have access to another intervention which also affects the outcome of interest (White and Barbu (2006).

RESULTS DISCUSSION

Results on age distribution of respondents as found in Table 1 indicate that less than half of the respondents for both treatment and control group were between the age range of 41-50 years. The mean age of the respondents was 49.3. Findings further reveals that 79.1% of the respondents were male while only 20.9% were female. It was also revealed that marital status of the farmers in the study area shows that majority (84.4%) of the respondents were married. About 40.2% of the respondents had no formal education, 27.6% had primary education and 26.4% went through secondary school level while only 5.8% went through tertiary school. Findings further revealed that the mean household size were 7.1 and 7.2 for treatment group and control group respectively. The distribution based on farming experience among the respondents were (23.2years) for treatment group and (24.5years) for control group. This indicates that majority of the respondents were highly experienced in farming operations.

Table 1: Socio-economic characteristics of the respondents (n=326)

Variables	Treatment group		Control group		Pooled	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Age						
≤30	10	5.2	8	5.9	18	5.5
31 - 40	41	21.4	25	18.7	66	20.3
41-50	66	34.4	38	28.4	104	31.9
51-60	46	23.9	40	29.8	86	26.4
> 60	29	15.1	23	17.2	52	15.9
Mean	48.8		49.9		49.3	
Sex						
Male	142	74.0	116	86.6	258	79.1
Female	50	26.0	18	13.4	68	20.9
Marital Status						
Single	17	8.9	7	5.2	24	7.3
Married	158	82.2	117	87.4	275	84.4
Divorced	9	4.7	3	2.2	12	3.7
Widow	8	4.2	7	5.2	15	4.6
Educational level						
No formal	79	41.1	52	38.8	131	40.2
Primary	52	27.1	38	28.4	90	27.6
Secondary	49	25.5	37	27.6	86	26.4
Tertiary	12	6.3	7	5.2	19	5.8
Household size						
≤5	66	34.4	40	29.9	106	32.5
6-10	106	55.2	78	58.2	184	56.4
>10	20	10.4	16	11.9	36	11.0
Mean =	7.1		7.2		7.1	
Years of farming experience						
≤5	13	6.8	6	4.6	19	5.9
6 – 15	55	28.7	36	27.3	91	28.1
16 – 25	48	25.0	30	22.7	78	24.1
26 – 35	40	20.8	32	24.2	72	22.2
Above 35	36	18.8	28	21.2	64	19.8

Source: Authors computation, 2022

Constraints faced by the beneficiaries of the program in redeeming input(s)

Results in Table 2 revealed the problem faced by treatment group of e-wallet fertilizer subsidy program in the study area. It was discovered that distance to redemption centre was the major problem faced among the beneficiaries (34.4%). More than 31% of the beneficiaries agreed that delay in procurement of the subsidy was also a problem to the scheme while about 22% believe that bureaucracy affect the distribution of the e-wallet fertilizer subsidy in the study area.

Table 2: Constraints faced by the beneficiaries in redeeming the input(s)

Constraints	Frequency	Percentage
Long distance	66	34.4
Delay	60	31.3
Bureaucracy	43	22.4
No problem	21	11.9
Total	192	100.0

Source: Authors computation, 2022

Productivity level of the respondents

Table 3 reveals that the mean productivity level of the treatment group was 2.1 while that of control group was 1.9. This shows that treatment group had more maize yield than control group. The dataset in Table 4 contains two variables: productivity and farm size recentred at the mean threshold. The variable farm size recentred at the mean threshold ranges fr0m -4.2 ha to 10.55 ha with a mean of 0.003 ha which is defined as individual farm size minus the mean farm size. The variable productivity ranges from 0.171 to 6.921 with a mean of 2.019.

Table 3: Productivity levels of the respondents

Item	Treatment group	Control group
Mean	2.15	1.99
Standard deviation	1.0	0.8
Minimum	0.2	0.2
Maximum	6.9	5.5

Source: Authors computation, 2022

Regression discontinuity design

Figure 1 (local-linear) shows that the productivity level of maize-based cropping system of the treatment group increases by 0.9. And in figure 2 (local-quadratic) the productivity level of the treatment group increased by 0.6, while figure 3 which is the Local-cubic shows that it was increased by 0.7 and lastly figure 4 (4^{th} degree of polynomial), reveals that the level of discontinuity on maize-based cropping system productivity of the treatment group rises by 0.4.

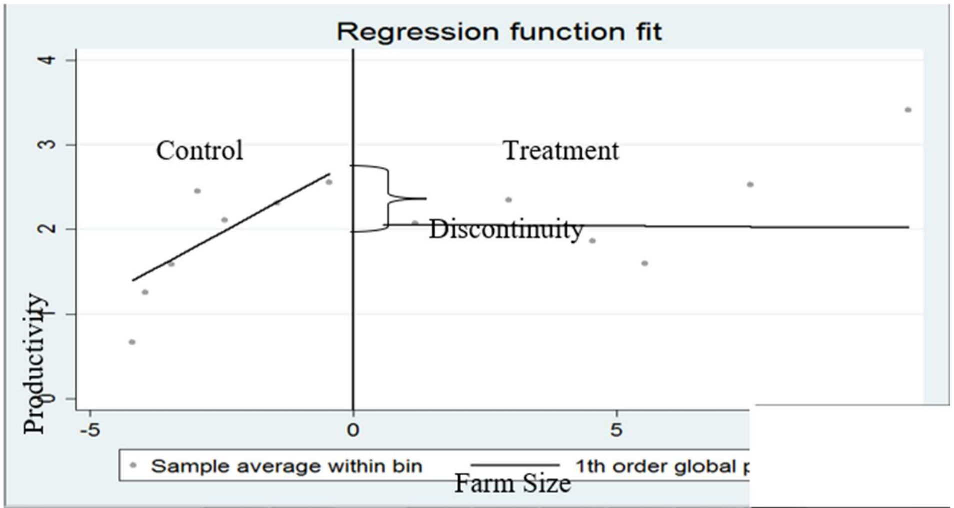
Table 4: Data set of the respondents.

Variable	Observation	Mean	Std. Dev.	Minimum	Maximum
Productivity	326	2.019	0.0889	0.171	6.921
Farm size recentred	326	0.003	0.003	4.2	10.55

Source: Authors computation, 2022

Degree of polynomial

To further explore the available data, RD plot was used to construct an automatic plot of regression discontinuity (RD) design. Table 5 and figure 1 to 4 were constructed using the local-linear, local-quadratic, local-cubic and polynomial of degree 4 options in the command rd plot, which produce an RD plot that has evenly spaced bins that mimic the underlying variability of the data and is implemented using spacing estimators. From the table, the number of optimal bins for control and treatment units is 6 and 26 respectively, implying bin lengths of 1.667 and 0.144 percentage points, respectively. The output table also reports the IMSE-optimal number of bins and the multiplicative factor (scale) associated with the selected number of bins. This is shown in the last row of the first panel. Finally, the bottom panel includes the IMSE-weights that correspond to the selected choice of the number of bins. This is to capture the variability of the underlying raw data and the natural approach is to under smooth the binned sample means estimators (that is, select a larger number of bins for control and treatment). This can be accomplished by radius off the variance and bias differently (Calonico et al., 2014a).



* Sample average within bin ----------- 1th order global polynomial

Figure 1: showing 1th order global polynomial.

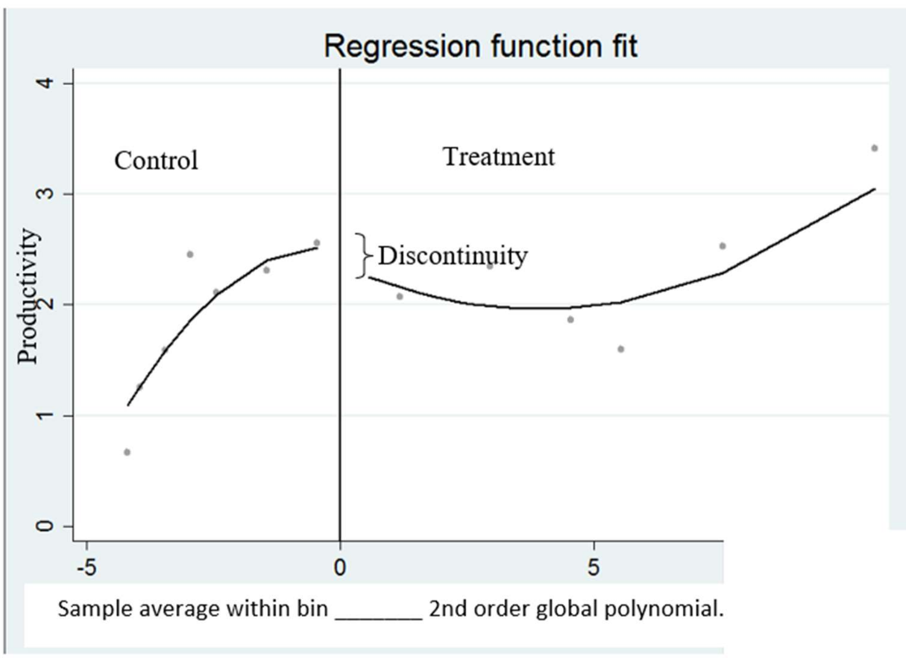


Figure 2: showing 2ndorder global polynomial

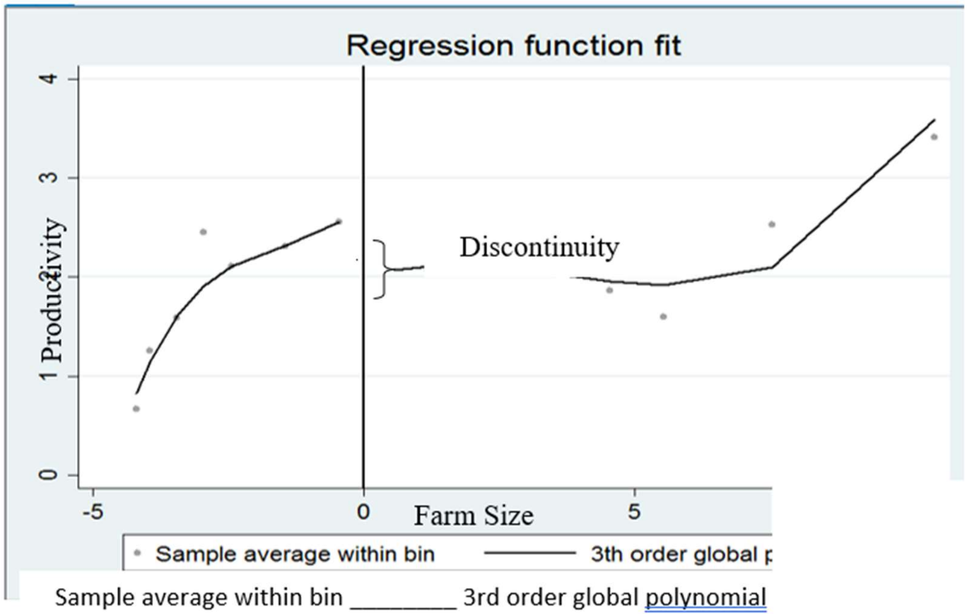


Figure 3: showing 3rd order global polynomial

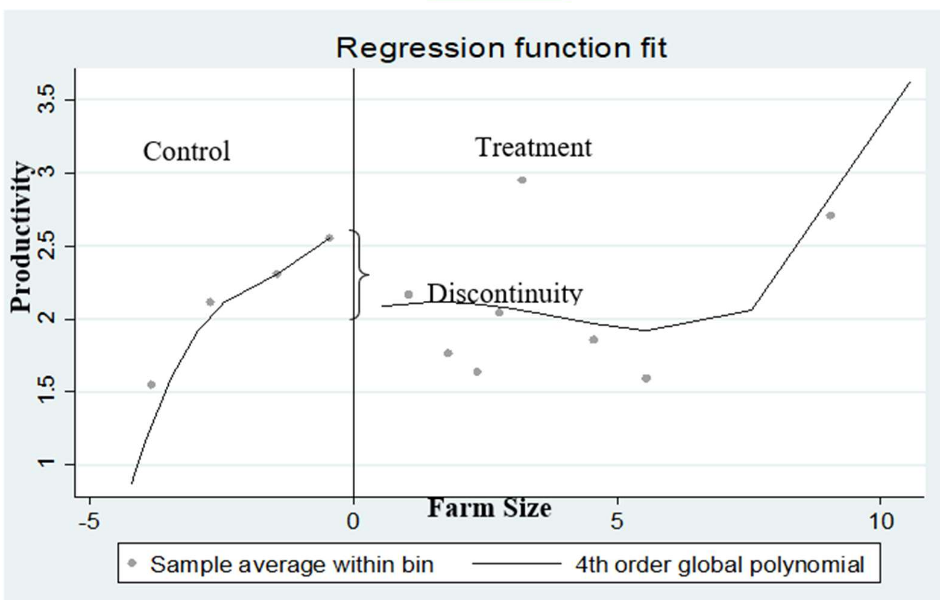


Figure 4: showing 4thorder global polynomial

Imbens and Kalyanaraman (IK) and Calonico, Catteneo and Titiunik (CCT) method

From Table 6, productivity of e-wallet fertilizer subsidy of treatment group increases by 35.2% compared with control group under IK methods and significant at 5% level of significance while it is not significant under CCT. The F statistics is not statistically significant which means that the data from each of the bins are not adding any additional information to the model, Calonico *et al.,* 2014b). This indicates that the model being tested is not underspecified and therefore not over smoothing the data.

Table 5: Degree of polynomial of regression discontinuity design

Cutoff c = 0	Local-linear		Local-quadratic		Local-cubic		4th polynomial degree	
	Left of c	Right of c	Left of c	Right of c	Left of c	Right of c	Left of c	Right of c
Number of observations	192	134	192	134	192	134	192	134
Polynomial order	1	1	2	2	3	3	4	4
Chosen scale	1	1	1	1	1	1	1	1
Selected bins	26	6	26	6	26	6	26	6
Bin length	0.144	1.667	0.144	1.667	0.144	1.667	0.144	1.667
IMSE-optimal bins	7	1	8	3	9	3	9	3
Mimicking Variance bins	26	6	26	6	26	6	26	6
Relative to IMSE-optimal:								
Implied scale	3.714	6.000	3.250	2.000	2.889	2.000	2.889	2.000
WIMSE variance weight	0.019	0.005	0.028	0.111	0.040	0.111	0.040	0.111
WIMSE bias weight	0.981	0.995	0.972	0.889	0.960	0.889	0.960	0.889

Table 6: Imbens and Kalyanaraman (IK) and Calonico, Catteneo and Titiunik (CCT) method

Productivity	IK method			CCT method		
	Coef.	Std. Err.	Z	Coef.	Std. Err.	Z
t	0.3523	0.1677	2.10**	0.3050	0.3252	0.94
Farm size recentred	0.1149	0.3679	0.31	-	-	-
Interaction	0.3606	0.4457	0.81	-	-	-
Constant	2.3111	0.4899	4.72	2.2478	0.2828	7.95
F-value	0.88			0.89		

Source: Authors computation, 2022

T-test of on socio-economic characteristics of the treatment group and control group

Table 7 shows the summary statistics of e-wallet fertilizer subsidy program of treatment group and control group. Sex and farm size of the respondents were significant at 1%. This implies that there is significant difference between the socio-economic characteristics of the treatment group and control group. Likewise, the table shows that there exists difference between the productivity level of both the beneficiaries and non-beneficiaries of e-wallet fertilizer subsidy in the study area.

Table 7: Comparison of treatment group and control group using t-test

Variables	Control group		Treatment group		Difference		t-value	Decision
	Mean	Std.Err	Mean	Std.Err				
Productivity	1.998	0.061	2.057	0.082	0.048	0.100	0.4809	Accept H_0
Age	48.8	0.824	49.9	1.018	1.144	1.302	0.8791	Accept H_0
Sex	0 .73	0.032	0.866	0.029	0.126	0.045	2.7810	Reject H_0
Household size	7.06	0.225	7.22	0.272	0.161	0.353	0.4572	Accept H_0
Farming experience	23.23	0.931	24.47	1.114	1.235	1.452	0.8507	Accept H_0
Farm size	5.45	0.076	2.40	0.151	5.864	0.157	37.429	Reject H_0

Source: Authors computation, 2022

RESULTS DISCUSSION

The result presented in Table 1 revealed that the mean age of the respondents was 49.3 which implies that majority of the respondents are in the active age, intellectually incline to make accurate decision for improved agricultural production. Fanifosi *et al.,* (2021) argued that maize farmers are able bodied who could translate their energy to better agricultural production provided they have favourable operating condition. More male farmers were the beneficiary of the e-wallet fertilizer subsidy as reported by the result. The result was obtained due to the increased number of male farmers in the study area than the female farmers. Women are mostly denied of major productive assets such as land. And this plays importantly on the involvement of the same in agricultural production. As a matter of fact, most women energy is channel into processing and marketing of agricultural produce. Furthermore, the significance of education in modern agriculture cannot be overlooked. The findings showed that most of the smallholder farmers in the study area were still constrained by education; this development may hinder considerably adoption of agricultural innovations on the long run. Agricultural labour in Nigeria is obtained through two major sources: the family and hired labour. Large number of the farm family uses the family members on the farm due to subsistence nature of their major sources of livelihood activity (Ogunniyi *et al.,* 2018). The result in this study indicated that most of the farming household has a quite large size which can be used for farm activities. And more so, most of the farmers in the study area had good farming experience. That is, they had the basic indigenous knowledge of farming.

The results further revealed some of the difficulties that the beneficiaries of e-wallet fertilizer subsidy encountered in redeeming their benefits. This study discovered that distance to redemption centre was the major problem faced among the beneficiaries which is aligned with the claim of the Fertilizers Suppliers Association of Nigeria (2012)'s monitoring report on GES scheme. They claimed that distance of farmer's house to redemption centre is one of the constraints hindering the accessibility of input as well as network issue/problem. Also, delay in procurement of the subsidy was another problem to the scheme and that bureaucracy affect the distribution of the e-wallet fertilizer subsidy in the study area.

The productivity level of the treated group was higher than that of the control group – indicating e-wallet subsidy programme has a significant impact on the productivity of the maize farmers in the study area. The result was presented in a pictorial order. RD design requires a break in outcome at the threshold point and the four figures presented were in line with this decision. However, the discontinuity differs in each of the figure. The size of the discontinuity at the cutoff is the size of the effect. The discontinuity between the regression lines at the cutoff of each figure showed that there is an impact of e-wallet fertilizer subsidy on productivity of maize-based cropping system in the study area.

CONCLUSION

The study used Regression discontinuity design (RDD) to assess the impact of e-wallet fertilizer subsidy on productivity of maize-based smallholder farmers in Ogbomoso agricultural zone. From the result, the study concluded that e-wallet fertilizer subsidy program has a positive impact on the productivity of maize-based smallholder farmers in the study area. The study suggested efficient and timely fertilizer distribution to enhance maize production. Also, nearness of the redemption center to farm should be given priority. This study also concluded that there is significant difference between the socio-economic characteristics of the treatment group and control group. The cut off chosen to classify the group into two was the size of the farmland cultivated. The uniqueness of RD come to play as the farmers cultivating not more than 5 hectares of land while the productivity of both the respondents differs from each other.

REFERENCES

Adesina, A. (2012). Unlocking the Potential of Agriculture in Sub-Saharan Africa: Nigeria's

Transformation Agenda for Agriculture. A Paper Presented by the Honorable Minister of Agriculture and Rural Development at the Symposium on Growing Food: New Places, New Technologies', At the Johns Hopkins University School of Advanced International Studies April 17th 2012.

Calonico, S., Cattaneo, M.D., and Titiunik, R. (2014a). Optimal Data-Driven Regression Discontinuity Plots. Working Paper, University of Michigan. Http://www-Personal.Umich.Edu/~Cattaneo/Papers/RD-Rdplot.Pdf

Calonico, S., Cattaneo, M.D., and Titiunik, R. (2014b). Robust Data-Driven Inference in the Regression-Discontinuity Design. *The Stata Journal,* 14(4): 9o9-946.

Chay, K., Ibarraran, P., and Villa, J. (2010). Regression Discontinuity and Impact Evaluation.

Forthcoming in the Inter-American Development Bank-SPD Impact Evaluation Guidelines Series. Washington DC, United States: IDB.

Cook, T., Shadish, W., and Wong, V. (2008). Three Conditions under which experiments and

observational studies produce comparable causal estimates: New findings from within-study comparisons. *Journal of Policy Analysis and Management,* 27 (4): 724-750.

Evbuomwan, G.O. (2003). Agricultural Development: Issues of Sustainability Central Bank of

Nigeria: Contemporary Economic Policy Issues in Nigeria. Central Bank of Nigeria Publication.

Fanifosi, G.E., Ogunniyi, L.T., Aregbesola, O.V., Olaoye, T.A., Oladiran, J.O., and Ajao, O.A (2021): Evaluating Poverty and Risk Attitude of Maize Farmers in Surulere Local Government Area of Oyo State, Nigeria: A safety-first analysis approach, *International Journal of Scientific Research in Multidisciplinary Studies*, 7(6), pp.86-90.

FAOSTAT (2010). http://Faostat.fao.org

Fertilizers Suppliers Association of Nigeria (2012). The Growth Enhancement Support Scheme:

Monitoring. Report A Report Submitted to the Federal Minister of Agriculture and Rural Development, Pp8-12

Lechner, M. (1999). Earnings and Employment Effects of Continuous off-the-Job Training in East Germany after Unification. *Journal of Business Economic Statistics*, *17* (1): 74–90.

Macauley, H and Ramadjita, T. (2015). Cereal Crops: Rice, Maize, Millet, Sorghum, Wheat. Background Paper for Feeding Africa 21 – 23 October 2015

Ogunniyi, L.T., Fanifosi, G.E., Ajao, O.A and Dlamini, D.V (2018); Impact of Agricultural Extension Services on Crop Farmers' Productivity in Oyo State, Nigeria. *App. Sci. Report*. 23 (3), 97-101

Rosenbaum, P., and Rubin, D. (1983). The Central Role of the Propensity Score in observational Studies for Causal Effect. *Biometrika*, 70(1):41-55.

Signal, A. (2014). ERP for the Agriculture Sector in Nigeria. Transforming Big Date into Big Value in Agriculture industry. Retrieved From Http://Www.Slideshare.Net/Signalalliance/Erp-For-The-Agriculture-In-Nigeria. Accessed on April 23, 2014

Smil, V. (2002). Nitrogen and Food Production: Proteins for Human Diets. *Ambio*, 31,126-131.

Thompson, T. K., Vander, M., Alex, G., and Kane, S. (2004). Agricultural Investment Source Book Promoting Private Sector Fertilizer Distribution System. Module 6. World Bank Group. http://www.worldbank.org/egsourcebookIFDC

Thistlethwaite, D., and Campbell, D. (1960). Regression-Discontinuity Analysis: An Alternative to the Ex Post Facto

Experiment. *Journal of Educational Psychology,* 51 (1):309-317

Trochim, W. (1984). *Research Design for Program Evaluation*: *The Regression-Discontinuity Approach.* Sage Publications, Beverly Hills.

Wanyama, J.M., Moses, L.O., Rono, S.C., Masinde, A.A., and Serem, A. (2009). Determinants of Fertilizer Use and Soil Conservation Practices in Maize Based Cropping System in Transnzoia District, Kenya. A Publication of Kenya Agricultural Research Institute, Kitale

White, H and Barbu, A (2006). Impact Evaluation: The Experience of the Independent Evaluation Group of the World Bank, (English) Washington, D.C: World Bank pp3