Effect of Subsidize Fertilizer on Smallholder Farmers Agricultural Productivity in Kano State, Nigeria

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Abstract

The study analysed the effect of subsidize fertilizer and factors affecting smallholder farmer's agricultural productivity in Kano state, Nigeria. The study adopts cross sectional survey design and employs descriptive statistic and OLS regression model to analyzed data using multiple regression. The data was collected from a sample of 555 randomly selected smallholder farmers from Kura, Bunkure and Danbatta LGAs. The result reveals that the mean ages of the respondents were 36 years and majority of them were males. The multiple regressions show that farming experience is statistically significant at 1% significant level, age is statistically significant at 5% level of significant, improved seeds has 1% level of significant, farm size is statistically significant at 1% level of significant and subsidized fertilizer is also highly significant at 1% level of significant. Finding of the study shows that access to subsidize fertilizer has not been sufficient for various reasons as shown in the study. Hence the study recommends that government should device better means of distributing fertilizers so as to reach the smallholder farmers and monitoring of the distribution of subsidize fertilizer to farmers.

Keywords: Agricultural Productivity, Factors, Kano, Nigeria, Smallholder Farmers, Subsidized Fertilizer.

Introduction

The role of the Nigerian Agricultural sector includes provision of food for the growing population, foreign exchange earnings, provision of income for the farming household and employment of labour force. It is obvious that agricultural productivity gains can help reduce rural poverty by raising real income from farming and keeping food prices from increasing excessively by improving the availability of food. The economic importance of improving agricultural productivity is even more evident in Nigeria where agriculture becomes the key sector to the government strategy; it can also lead to an increase in Growth Domestic Product (GDP) and provides employment opportunity.

In Nigeria, human population is growing rapidly which can lead to increase in the demand for food and agricultural products. According to Pender, Doya and Npats (2010), food security depends on improved agricultural productivity. Increases in agricultural productivity are central to economic growth (Okpachu, Okpacha & Obijesi, 2014). Agricultural productivity remains largely traditional and is concentrated in the hands of small holder farmers. It was also noted by Pender *et al* (2010) that small scale farmers dominated the agricultural sector in Nigeria, because 90% of the farmers belong to the category of small holder farmers. These farmers face many problems which include low productivity, inefficient resource inputs, and marketing challenges. As such small holder farmers are exploited by vicious circle of poverty because they have low income which leads to weak investment in their farming activities.

The Nigerian government began to reform the agricultural sector (World Bank, 2016). Agricultural Transformation Agenda (ATA) was initiated by President Goodluck Johnathan in 2011 to restructure the agricultural sector. The focus was on rebuilding the sector whose relevance had shrunk dramatically. There was lack of lending to farmers by the financial system and the levels of food imports from across the world (Adesina, 2016; World Bank, 2016). The Buhari administration observed that additional work is required in order to meet the objectives of ATA, especially because Nigeria still imports a significant amount of food and also is not earning significant foreign exchange from Agriculture (Federal Ministry of Agriculture and Rural Development, 2016).

In addition, FMARD also reports that Nigeria is facing two key gaps in agriculture; that is in ability to meet domestic food requirements which is caused by the problem of productivity driven by an input system and farming model that is largely inefficient. The second gap was the in-ability to export at quality levels required for international market success. As a result, an aging population of farmers does not have enough seeds, fertilizers, irrigation facilities, crop protection and related support to be successful. This shows that ATA did not deliver on all the targets identified.

To solve these two gaps and to position the Nigerian agriculture sector on a path to growth, the Buhari administration came up with new policy on Agricultural Promotion (APP) in 2016 so as to revamp the agricultural sector (FMARD, 2016).

Agricultural Performance Survey (APS) however states that availability of fertilizer to farmers is the most critical element for sustainable agricultural growth in Nigeria. According to (FMARD, 2016) access to input such as fertilizer remains a challenge for achieving optimal productivity of agricultural output. In addition, the previous administration implemented subsidy programme, for example, Growth Enhancement Scheme (GES) which was characterized by late or non-delivery of inputs. Previous studies on resource utilization and productivity (Bunde *et al*, 2010; Abula & Muhammad, 2013) showed that there are wide variations in the various levels of productivity and which is far away from optimum. Therefore, this study examines smallholder agricultural productivity in Kano state, with the main objective of determining the factors that affect their output in the study area. The specific objectives are: to examine the socio-economic characteristics of small holder farmers' in Kano state, assess the effect of subsidize fertilizer on agricultural productivity in the study area.

Theoretical Framework

This study is anchored on production economic theory. The theory is part of the microeconomic theory that deals with production of goods using a set of inputs (Doll & Orazem, 1984**).** A production is a model used to formalize this relationship. Below is a specification of a production function

$$Q = F \{L, S, F\ldots..\}$$

Where Q represent a firm output, L may represent the amount of labour, S represent quantity of seeds used in production of Q while f represents the amount of fertilizers applied. The objective of the producer is to maximize profit either by increasing the quantity of Q. The production function shows the maximum amount of the good that can be produced using alternative combinations of labour L, seed (S) and fertilizer (F). Q is also referred to as the total physical

product (TPP). This production relationship can be expressed in several forms such as: linear functional forms, polynomial functional forms and Cob Douglas functional form.

In his view, Kassa (2014) average productivities are calculated by driving the output of a given farm (or average output of a group of farms) by input used. In their theory (Ajah & Job, 2012) observes that calculation of marginal productivities requires the estimation of a production function. A production function is a model that relates output to a set of inputs and other factors: it is output explained by use of variable inputs (labour, land and capital) and other factors such as erosion or distance from farm. Therefore output = f (land, labour, capital).

Agricultural productivity is estimated using parametric and non-parametric approach. The parametric approach estimated the coefficient of production function using econometric approach whereas the non-parametric approach used in efficiency analysis (Widya, Teruaki & Yosuke, 2015).

Revisiting Doll and Orazem, the Cob-Douglas production function found to be theoretically and empirically appropriate, since it is easy to estimate and mathematically manipulate.

Therefore, following the model build by (Abrha, 2015), the Cob-Douglas production function can be specified as

$Y = F(x, \mathcal{E})$

Where: Y = yield response

X = a vector of technological inputs like fertilizer and others

$\mathcal{E}$ = vector of physical inputs such as sex, education, farm size and others

Therefore, the Cob-Douglas production function can be express as

$Yi = (X_{ij}{}^{\beta i} \mathcal{E}_{ij}{}^{\delta i}) e^{a+\mathcal{E}t}$

Where: Yi = yield response of the ith Area of land

X_{ij} = the use of the ith Area of the jth technological input

$\mathcal{E}_{ij}$ = the use of the ith physical input.

For all the above production functions, Y is the output produced and X's are the inputs used in production process.

This study has it theoretical backing from the work of Abrha (2015) who argues that agricultural sector is characterized by productivity growth. In (Abrha, 2015) theory, he did not include access to subsidize fertilizer, as such; the present study employed the variable to determine total production. The rationale behind employing the input (fertilizer) is due to the constraint the farmers faced in accessing the subsidize fertilizer. Supported evidence from the work of (Obasi *et al,* 2013) farmers are highly efficient in the use of planting material but inefficient in the use of chemical fertilizer. Therefore, further investigation is needed.

In the absence of subsidize fertilizer, as in Abrha model, the output may not be recursive because the productivity will not increase. Smith and Siciliano (2015) observes that China uses more fertilizer than any other country and increased use of chemical fertilizers and other inputs contributed to increase grain productivity since 1978. To be successful, there has to be close

relation between agricultural output and input. Kano state must identify factors that are critical to agricultural production in the form of increase in output. This study seeks to investigate why smallholder crop farmers are unable to produce more than marginal surplus.

Literature Review

Bunde *et al* (2010) investigates the effects of farm input subsidy on maize production. The study found that, quantity of fertilizers, use of certified seeds, land ownership by small holder farmers had positive relation to maize production. This is consistent with findings by Abula and Muhammad (2013) who investigated the impact of fertilizer subsidy on cassava production in Nigeria (1986 – 2010). In the study, a multiple regression was applied. Abula and Muhammad also observed a positive effect between fertilizer subsidy and hectare of land on cassava output, but adopted a different methodology in which they used secondary data to measure productivity. In addition, the study refused to make use of primary data as applied by most studies including Bunde *et al* (2010). Abula and Muhd (2013) in support of this, asserted that fertilizer application brings about an increase in crop yield per unit of area. Subsidies can benefit in terms of increase in agricultural output and therefore solve the problems associated with food production.

On the other hand, Baloch and Gopal (2016) employed a linear regression model on the effect of agricultural extension services on date farmers in Pakistan. The study found that on average date farmers operate at 15% below potential output. However, contrary to a study by Olujenyo (2011), further analysis revealed that there was no evidence of influence of extension on crop production. Baloch and Gopal's findings reveal a weakness especially in terms of extension service since it is expected that the more extension contacts, the more benefit from increased knowledge on better farming methods, hence increase agricultural production.

Similar to the findings, Mustapha and Salisu (2015) applied stochastic frontier with 140 samples to examine the determinants of technical efficiency of maize/cowpea intercropping among women farmers in Gombe. The study found that improved seed, farm size and fertilizer determine technical efficiency. Further analysis revealed that farm experience, education, access to extension services, family labour and off-farm income were the major determinants of technical efficiency. The present study supports findings by Mustapha and Salisu (2015) due to the fact that use of fertilizer, improved seeds and farm size determine technical efficiency.

In his own contribution Olujenyo (2011), applied OLS with sample of 100 respondents to examine the determinants of agricultural productivity and profitability among maize farmers in Ondo state, Nigeria. The findings of the study show that age, education, labour, cost of non-labour inputs was positively related to output while farm size and years of experience had negative relation with maize output. This is because the use of more labour will enhance productivity due increase number of workers. The author also argued that farmers who were educated tend to have more knowledge on new and improved farming practices, hence become more productive. Consistent with (Baloch & Gopal, 2016; Okpachu, Okpacha & Obijesi, 2014), Olujenyo (2011) also argued that educated farmers are able to gather, understand and use information from research and extension services more easily than those who are illiterate. In their study Okpachu *et al* (2014) applied regression analysis with 120 respondents to determine the impact of adult education on the agricultural production of small-scale maize farmers. Further analysis reveals that age, farming experience and extension contact significantly influence output of maize. The study concludes that there was statistical difference between the income and output of participant and non-participant

of the programme. The present study supports findings by Okpachu *et al* (2014) due to the fact that educated farmers acquire more skills and knowledge on how to improve their farming activities.

Furthermore, Abrha (2015) applied multiple regressions with 400 respondents to assess the major factors affecting agricultural production and farm income of household in Ethiopia. The result revealed that landholding size, possession of oxen, improved seeds, irrigation, soil quality, average distance of plots from homestead and crop rotation were the determinants of agricultural production. Abrha (2015) observes that age and distance to the market negatively affect production. The approach is acceptable and has been applied by many others using multiple regression. Contrary to the above findings, Yakubu (2016) applied multiple regressions with 179 respondents to examine productivity among maize farmers in Kano, Nigeria. Similar to the approach by Abrha (2015), the result of the findings shows that age, education and farming experience are the key determinants of maize output.

Material and Methods

Description of Study Area

The study was carried out in Kano state, Nigeria. The state lies in Northern part of Nigeria between latitude 10□ 33N to 12□ 37N, and longitude 7□ 34 to 9□ 25 E. the study area covers approximately 20,760sq km or 2.2% of Nigeria's land mass. It is bordered by four states: Jigawa, Kaduna, Bauchi and Katsina within the North West geo-political zone (Kano State Development Plan II, 2016). Kano state is also one of the major/key agricultural zones in Northern part of Nigeria. It possesses the largest markets for agricultural produce in West Africa, for example, the famous Dawanau market. Kano is one of the biggest terminals where all agricultural produce is bought and channelled to all major cities of the country and West Africa. This includes neighbouring countries of Niger Republic, Republics of Mali, and Mauritania. In terms of arable land, Kano has about 18,684 square km out of the total land area of 20,760 square km (Sani, 2005 cited in Idris 2009).

Simple random sampling was used to select three LGA's of Kano state. The Local Governments areas were selected from 3 Senatorial zones, Kano South, Kano North and Kano Central. Three local government areas were randomly selected from the 3 Senatorial Zones of Kano State using the secret ballot system. The Local Government areas selected were Bunkure, (Kano South); Dambatta, (Kano North) and Kura (Kano Central). The sample include 162 small holder farmers from Kura, 164 small holder farmers from Bunkure, 164 small holder farmers from Danbatta LGA, making a total of 490 small holder farmers for the study.

Primary data were collected from the smallholder farmers with the aid of questionnaire which was administered after the harvest season. The data collected include information on age, education, farming experience, family size, farm size, and contact with extension workers and fertilizer subsidy. The model parameters were estimated using STATA software version 14.

Descriptive statistics such as mean and frequency tables were used to describe the socio-economic characteristics of the respondents. To analyze the effect of subsidized fertilizer on agricultural productivity, ordinary least square (OLS) regression model was employed. The rationale for the application of OLS was due to the continuous nature of the data of the dependent variable. Besides,

different studies such as Ajah and Job (2012), Obasi *et al* (2013), and Abrha (2015), used multiple regression models in addressing similar issues. The linear model is specified below:

$Y= \beta_o +\beta_i x_i +\beta_2 x_2 +\beta_3 x_3 \ldots\ldots\ldots\ldots +\beta_n x_n + \varepsilon$ ---------- (1)

Where Y = the dependent variable (production)

X_i = a vector of explanatory variables

β_i = a vector of estimated coefficient of the explanatory variables (parameters)

ε = disturbance term that is assumed to satisfy all OLS assumption error terms.

The explanation of the dependent and independent variables are as follows:

$Y = \beta_o +\beta_i$age $+\beta_2$education $+\beta_3$farming experience $+\beta_4$family size $+\beta_5$extension contact $+\beta_6$improved seed $+\beta_7$fertilizer access + $\beta_8$farm size. ---------- (2)

Where: total production = continuous dependent variable indicating farm yield in bags

$\text{Ln } Y = \beta_o +\beta_i \text{ Ln } x_i +\beta_2 \text{ Ln} x_2 +\beta_3 \text{ Ln } x_3 \ldots\ldots\ldots\ldots +\beta_n x_n + \varepsilon$ ---------- (3)

$\text{Ln } Y = \beta_o +\beta_i \text{ Lnage} +\beta_2 \text{ Lneduc} +\beta_3 \text{ Lnfexp} +\beta_4 \text{ Lnfszeh} +\beta_5 \text{ Lnfmse} +\beta_6$imseed $+\beta_7$faccess + β_8 extn---------- (4)

Diagnostics tests were employed using a simple regression matrix of the variables. Multicolinearity was tested using Variance Inflation Factor (VIF) command to calculate for the independent variables in the linear model (Gujarati, 2008), if this problem happens to occur. To overcome this constraint, is to drop the variable with higher p-value and run the model again.

Heteroscedasticity affects the distribution of βs increasing the variance of the distribution and also makes the OLS estimator to be inefficient (Bloggers, 2016; Hossain, 2011).

Result of the Findings

The socio-economic characteristics of smallholder farmers as in Table 1 shows the distribution of smallholder farmers according to age. The mean age of the respondent was found to be 36 years, which shows that majority of the farming population were youth and in the active age group. The finding is in line with that of Yakubu (2016), who reported that age factor in smallholder farming significantly influences productivity. The Table 1 also shows that the mean years of education were found to be 7.83. Education influences farmer's decision making, awareness and adoption of innovations that can bring increase in productivity (Masunga, 2014). The mean of farming experience was found to be 16 years, implying that majority of the smallholder farmers have some level of experience in farming activity, similar to the finding of Ajah and Job (2012), who opined that majority of the farmers (51%) have been producing crops for more than 15 years. The mean size of family was found to be 6.83 with 3.45 as the female dependent and 3.74 as the male dependent. This means that family labour will be available, implying that smallholder farmers have enough family labour (Wongana, 2013). Mean farm size was 2.52 hectares, implying that majority of the small holder farmers cultivate on small scale which is less than 3.0 hectares of land.

Table1: Socio-economic characteristics of respondents

Variables	Obs	Mean	Std.Dev
Age	490	36	9.180089
Education (in years)	490	7.83	5.49
Farm Experience	490	16.07	9.29
Family Size	452	6.83	4.41
Number of Female Dependents	420	3.45	2.64
Number of Male Dependents	438	3.74	2.46
Farm Size	490	2.52	1.39

Source: Fieldwork, 2018.

Table 2 shows the result of the multiple regression analysis on the factors affecting agricultural productivity of smallholder farmers in Kano state, Nigeria. Based on the magnitude of the coefficients of multiple factors of R^2 0.29, implying that 29% of the variation in agricultural productivity in the study area is explained by the joint action of the independent variables. Among all inputs, only faming experience and farm size make a significant positive contribution to output. A negative relationship was discovered between age and crop production, which shows some level of significance at 5%. This implies that older farmers tend to be less productive, which is consistent with the findings of (Abrha, 2015) in Ethiopia. The study finding reveals that 1% increase in the farming experience results in 17% increase in crop production and this was statistically significant at 1% significant level. This implies that the more farmers had experience in farming the more productive they become in the farming activity. 1% increase in the use of improved seed results in 86% reduction in crop production and this was statistically significant at 1% level. This occurs as a result of ignorance in the use of improved seed in the farming. 1% increase in farm size result to 29% increase in crop production and was statistically significant at 1% significant level. This is in line with the findings of Mustapha and Salihu (2015) in Gombe, that large farm size influences farmer decision to increase crop production. 1% increase in farmers access to subsidized fertilizer results to 27% reduction in crop production and was also statistically significant at 1% significant level. This is to say that, the farmers were not able to buy fertilizers at subsidized rate which lead low level of production. The farmers state that the government introduce a system of receiving alert through cell phone before getting the subsidize fertilizer, if they receive the alert and show it to the agents, they will say that their name is not in the list. The results revealed that crop production was significantly influenced by farming experience, age, improved seed, farm size and subsidized fertilizer.

Table 2: Factors Affecting Agricultural Productivity among Smallholder Farmers

Variable	Unit	Expected Sign	Coefficient	Standard Error	t-value
EDUCATION	Continuous	+	-.0088908	.0073688	0.228
FARMING EXPERIENCE	Dummy	+	.0175759***	.0061582	0.005
FAMILY SIZE	Continuous	+/-	.0039069	.0646578	0.051
AGE	Continuous	-	-.1265328**	.012708	0.760
IMSEED	Dummy	+	-.8630958***	.0862305	0.000
CONTACT WITH EXTENSION	Dummy	+	-.0544714	.0815598	0.505
FARM SIZE	Continuous	+	.2874574***	.0768066	0.000
SUBSIDIZE FERTILIZER	Dummy	+	-.2720804***	.0834083	0.001
CONS			5.676704	.2898772	0.000

Source: Field Survey Result, 2018 ***, significant at 1%; **, significant at 5% and *, 10% confidence level.

Conclusion

The study has examined the effect of subsidize fertilizer and factors affecting smallholder farmer's agricultural productivity in Kano state, Nigeria. The findings of the study indicate that the independent variables can play important role in improving crop production. The findings of the study reveals that subsidize fertilizer in Kano state has not been particularly effective for various reasons which include: inability to access the fertilizer sell at subsidized rate, even with the introduction of alert receiving through the cell phone by the government agents before acquiring the fertilizer, the farmers do not access the fertilizer. The farmers lament that if they received the alert and show it to the distributors of the fertilizer, they will say that their name is not in the list.

Recommendations

Based on the findings of the study the following recommended are made;

i. The government should create database that would serve as a means of identifying beneficiaries based on the size of their farms and what they produce, because both farm size and plantings can vary greatly as time passes.
ii. The government should give more priority or increase pressure for transparency and monitoring in the distribution of subsidized fertilizer to farmers.
iii. The government should establish a mini market for selling of fertilizer at a subsidized rate at the various LGA's, so that smallholder farmers can buy fertilizer at a subsidized price.

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