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EFFECT OF FERTILIZER SUBSIDY ON MAIZE PRODUCTIVITY OF PEASANT FARMERS IN NORTHERN GHANA

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ABSTRACT

This study examined how fertilizer subsidy improves maize productivity in northern Ghana. The study, which involved 486 farmers, used an endogenous treatment effect model to measure the effect of subsidy participation on agricultural productivity. The results indicated that fertilizer subsidy increased the productivity of maize by 230.4 kg/acre. Farmers' age, sex, access to extension services, farm size and farm income were the determinants of subsidy participation, while productivity was influenced by age, sex, household size, soil fertility status and farm income. The study calls for adopting pro-poor measures such as input subsidization, especially for smallholder farmers, to boost fertilizer use and farm productivity in low-income countries. The government of Ghana should, therefore, expand the subsidy programme to reach farmers who did not receive the subsidy. The study further recommends that farmers' access to extension services should be enhanced since agricultural extension workers are pivotal to the implementation and success of the fertilizer subsidy programme. Also, subsidized fertilizer should be supplied to farmers on time to ensure effective utilization of the subsidy to increase productivity.

Keywords: Fertilizer subsidy, productivity, endogenous treatment effect, Ghana

I. INTRODUCTION

The productivity of smallholder farmers in sub-Saharan Africa is low due to several factors including low use of productivity-enhancing inputs such as chemical fertilizers and high-yielding seeds (Fan and Rue, 2020). Most smallholder farmers are not able to apply the recommended quantities of inorganic fertilizers to attain optimal crop yield and this has been ascribed to factors including high cost of inputs and low returns from farming. This is against the backdrop that most soils in Africa are declining in fertility due to poor management practices and depletion of soil nutrients. Fertilizer input subsidies are therefore regarded as an essential mechanism to improve fertilizer intensification which is necessary to enhance agricultural productivity.

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Thus, for most African countries, the drive towards increased use of chemical fertilizer is imperative to restore and sustain soil fertility levels to ensure higher productivity (Minot and Benson, 2009).

The Abuja Declaration on Fertilizer for African Green Revolution signed in 2006 stipulated an upsurge in fertilizer use in Africa to 50 kg per hectare (Bationo *et al*. 2013). Despite the declaration, fertilizer application rates have remained abysmally low, resulting in low productivity. The government of Ghana responded to the low fertilizer application rates in Ghana by reintroducing fertilizer subsidies in 2008 based on a voucher system. The fertilizer input subsidy programme has gone through some modifications and has currently evolved into the Planting for Food and Jobs (PFJs) initiative. Under the PFJ programme, farmers can access chemical fertilizer and improved seeds at a subsidized price. The aim is to enhance fertilizer intensification and uptake of improved seeds to increase productivity of smallholder farmers. In essence, PFJ was intended to make fertilizer affordable thus improving its use to increase productivity and attainment of national food self-sufficiency goals.

Under a voucher-based system, farmers purchased subsidized fertilizers from accredited licensed distribution companies with outlets in the production centers. The fertilizer distribution companies sell the fertilizer to farmers at the government approved subsidized price and are reimbursed the full cost of the fertilizer and its distribution by the government after distribution to farmers. Four types of fertilizers were included in the programme, which are NPK-15:15:15, NPK-23:10:05, urea, and sulphate of ammonia. Fertilizer quotas were given to each of the administrative regions of the country based on the crop production potential and needs.

There were operational challenges with the fertilizer input subsidy programme as many farmers complained of not receiving the subsidy. The fertilizer subsidy programme was rebranded as a new government flagship programme and renamed the Planting for Food and Jobs (PFJ) initiative when the current government took over the administration of the country in 2017. The aim was to encourage the production of the country's main staple food crops to create jobs. Thus, the fertilizer subsidy programme was intended to go beyond increasing farm production and productivity, but to serve as an avenue to create jobs especially along the agricultural value chain. The subsidized fertilizer was repackaged in newly designed bags. Administrative measures were put in place to ensure that the fertilizers could be tracked as they were being transported to ensure that they get to their destinations without being sold elsewhere.

Notwithstanding the rebranding of the fertilizer subsidy programme, there remains concerns from farmers that the distribution of fertilizer is still fraught with challenges. Many farmers complain of inability to access the subsidized fertilizer while others complain that the price is still high. Late and untimely supply of the input remains a challenge. Fertilizer distribution companies also complain of not being paid by the government after distributing fertilizer to farmers across the country. The Covid-19 pandemic has also disrupted the fertilizer marketing system in recent times and made the supply of the input very challenging, particularly from a global supply perspective.

Since the inception of the PFJ, there have been a number of studies examining farmers' participation rates and the impact of the programme. For instance, Tanko *et al.* (2019) examined the PFJ programme and productivity of rice cultivation in northern Ghana and observed a positive impact of the PFJ programme on rice yield and household welfare. Lambongang *et al*. (2019) also found that the PFJ programme's participants outperformed non-participants by around 4 bags per acre in terms of yield. Abdallah *et al*. (2021) also observed that PFJ participation and maize yield positively influenced maize commercialization in Savelugu municipality of Ghana. In an earlier study to assess farmers satisfaction with the fertilizer input subsidy programme in Ghana, Yawson *et al*. (2010) reported that farmers are dissatisfied with the availability, accessibility and pricing of the subsidized fertilizer. Lambongang *et al*. (2019) also reported limited access to fertilizer as a constraint faced by farmers in northern Ghana.

Despite the existence of some studies on the PFJ programme, not much is known about the extent to which fertilizer subsidy improves maize productivity in the northern savanna ecological zone where soil infertility is a major concern. There is still a research gap in terms of how much fertilizer subsidy contributes to maize productivity because of the absence of studies that quantify the direct impact of fertilizer subsidy on farm performance such as maize productivity. This study fills the gap by estimating the direct effect of Ghana's fertilizer subsidy programme on maize productivity in the northern savanna ecological zone. The question that the study addresses is: To what extend does the fertilizer subsidy programme in Ghana improve maize productivity of smallholder farmers? The study is relevant because it provides a direct measure of the productivity effect of the input subsidy programme and thus a measure of the performance of the subsidy programme. The specific objectives of the study are (1) to assess the determinants of smallholder maize farmers' access to fertilizer subsidy in northern Ghana, and (2) to estimate the effect of access to fertilizer subsidy on maize productivity in northern Ghana.

II. MATERIALS AND METHODS

The research was carried out in northern Ghana which has a savanna vegetation and is regarded as the bread basket of the country due to the dominance of agriculture as the foremost economic activity. The area is noted for high annual temperatures and a single rainfall regime. Most food crops cultivated in the country are produced in the study area and these include maize, rice, yam, and other key staples.

The research employed a multistage sampling approach to choose the respondents. First, northern Ghana was purposively selected for the research since the study sought to examine the influence of subsidy on rural farmers in northern Ghana where smallholder farmers predominate. After this, five of the districts/municipalities known for maize cultivation in northern Ghana were randomly selected, namely Tolon district, Yendi municipal, East Gonja district, West Mamprusi district, and Bawku municipal. The subsequent stage involved selecting four communities at random from each district, after which 25 farmers were randomly selected from each community resulting in a total

sample of 500 respondents. Because of incomplete information, data on 486 respondents were included in the analysis. Respondents who received fertilizer subsidy during the cropping season were defined as participants, while those who did not receive the subsidy were defined as non-participants. Farmers were interviewed using a pre-tested questionnaire containing questions on all facets of maize farming in the study area and was administered in the respondents' native language by trained enumerators. Prior to the interviews, each respondent was briefed on the purpose and nature of the study and their consent to participate was sought. All the farmers indicated their readiness to take part in the interviews. The study's data pertained to the 2019/2020 cropping season and was collected between February and April 2020.

Analytical and Empirical Models

Endogenous Treatment -Regression Model (ETRM)

The study's first objective is to estimate the factors influencing smallholder maize farmers' access to fertilizer subsidy. Typically, such an objective is analysed using a probit or logit model since the dependent variable is dichotomous. The study's second objective sought to evaluate the effect of fertilizer subsidy on maize productivity. However, participation in fertilizer subsidy programme is potentially endogenous, which means that participation in subsidy could correlate with the unexplained residual of the outcome (i.e., productivity). In other words, unexplained factors which affect productivity may correlate with the predictor (participation in subsidy), making the variable endogenous. Ignoring the potential endogeneity of the subsidy participation variable could result in biased estimates of the effect of the treatment on the outcome of interest. The study addressed endogeneity of the participation variable using an endogenous treatment-regression model (ETRM). The ETRM is a two-step approach with the first part being the selection equation (participation in subsidy) which uses a probit model, and the second part being the outcome equation (maize productivity), which uses linear regression. The ETRM evaluates the average treatment effect on the treatment, that is, the effect of subsidy participation on the outcome of interest (productivity) of participants in the programme, and accounts for selection bias arising from both observed and unobserved factors. Selection bias occurs when respondents are not randomly assigned to participant and non-participant groups. It arises when certain factors exclude non-participants from participating in the subsidy programme, while due to some favourable factors, participants become better placed to access subsidy. Thus, farmers may self-select into participant and non-participant groups, resulting in a non-random sample which presents a challenge in econometric modelling and must be addressed. Without accounting for this bias, estimation of the effect of subsidy participation on productivity is likely to be biased, resulting in estimates that are not reliable. The ETRM model accounts for selection bias emanating from both observed and unobserved factors and therefore provides consistent estimate of the impact of the treatment on the outcome of interest.

The following are the steps to estimate the ETRM. We specify an outcome equation followed by a treatment equation for subsidy participation. Suppose we denote the outcome variable by Y_i and the participation variable by L_i. Then the ETRM may be denoted by the following equations:

$$Y_i = w_i\pi + \varphi L_i + v_i \quad (4)$$

$$L_i^* = w_i\gamma + u_i \quad (5)$$

$$where\ L_i = \begin{cases} 1, & if\ \ L_i^* > 0 \\ 0, & otherwise \end{cases} \quad (6)$$

where w_i is a vector of explanatory variables, L_i is the observed adoption variable (the treatment or indicator variable) while L_i^* measures the probability of participation. β and γ are vectors of unknown parameters, while u_i and v_i are random errors. Because of self-selection, the parameter φ does not capture the pure effect of subsidy participation on the outcome variable (Y_i). Joint estimation of equations (4) and (5) using the ETRM provides consistent parameter estimate of the effect of subsidy participation on productivity. The error terms v_i and u_i are bivariate normal and have mean 0 and a covariance matrix given by

$$\begin{bmatrix} \delta^2 & \rho\sigma \\ \rho\sigma & 1 \end{bmatrix} \quad (7)$$

Empirically, the model to evaluate the effect of subsidy participation on productivity is presented as follows.

$$Y_i = \pi_0 + \sum_{j=1}^{10} \pi_j\, w_{ji} + \varphi L_i + v_i \quad (8)$$

$$L_i^* = \gamma_0 + \sum_{j=1}^{10} \gamma_j\, w_{ji} + u_i \quad (9)$$

where Y_i denotes the outcome variable (productivity) and L_i is the participation dummy. The two equations are jointly estimated to obtain consistent parameter estimates of φ, π and γ.

Variable Description

The variables included in the model are described in Table 1. Mean fertilizer use intensity is 45 kg/acre with a mean yield of 344 kg/acre. The mean fertilizer intensity of 45 kg/acre with relatively high standard deviation (28.1 kg) suggests that most farmers within the PFJ programme were able to meet the 50 kg/ha (approximately 20 kg/acre) requirement of the Abuja declaration (Klutse *et al*., 2018), even though this falls behind the rate of 150 kg/ha (approximately 60 kg/acre) in Asia. The average age of a farmer was about 41 years, suggesting an active age for farming. Also, majority of the farmers were males while about 88% were married. The average years of schooling was about 4 years, indicating low level of education among the respondents, while the average household size was about 10 members. Furthermore, most of the respondents were experienced farmers with about 19 years of farming experience.

Table 1: **Characteristics of the sample**

Variable description	Mean	Std. Dev.	Min.	Max.
Productivity (maize output in kg/acre)	344.2	195.8	50	1167
Participation in subsidy	0.671	0.470	0	1
Age (years)	41.13	13.79	17	85
Sex (1 = male; 0 otherwise)	0.759	0.428	0	1
Marital status (1 = married; 0 otherwise)	0.879	0.327	0	1
Education (years)	3.724	5.378	0	19
Household size	9.932	5.926	1	35
Farm income (Ghana cedi) [†]	1325	1261	48	8640
Farm credit (1 = access; 0 otherwise)	0.325	0.469	0	1
Access to extension (1 = access; 0 otherwise)	0.459	0.499	0	1
Soil fertility dummy (1 = fertile; 0 otherwise)	0.379	0.486	0	1
Farm size (acres)	3.678	2.098	0.5	12
Fertilizer use (kg)	149.1	109.7	0	500
Fertilizer intensity (kg/acre)	45.25	28.11	0	116.7

[†]1.0 Ghana cedi (GH¢) equals US$ 0.17.

The respondents had a mean farm income of GH¢ 1325 and cultivated about 3.7 acres (i.e., 1.48 hectares) of maize. A similar study by Asravor (2018) observed that the mean farm size of farming household in northern Ghana was 1 hectare (i.e., 2.5 acres) while Danso-Abbeam *et al*. (2020) reported the mean farm size to be 1.25 hectares (i.e., 3.12 acres). About 32.5% and 45.9% had access to farm credit and extension services respectively. Anang *et al*. (2022) reported that 65% of farmers had access to credit while Danso-Abbeam *et al*. (2020) reported that 52% of farmers had access to extension services in their studies in northern Ghana. About 28% of the farmers took part in off-farm activities as an additional income source while 30.7% were found to belong to a farmer group. Dagunga *et al*. (2020) noted that 35% of farmers in Ghana's Upper East region belonged to a farmer group. Those who reported that their soils were relatively fertile were about 37.9% while about 52.7% of the farmers use improved maize seeds.

III. RESULTS AND DISCUSSION

Characteristics of the respondents according to subsidy participation status

The characteristics of the respondents according to subsidy participation status is presented in Table 2. Farm income, productivity and fertilizer intensity levels for participants in the PFJ programme were higher compared to nonparticipants. With regards to fertilizer use, participants used about 96 kg more fertilizer than non-participants and recorded fertilizer use intensity of 54.6 kg/acre compared to 26 kg/acre for non-participants. This suggests that PFJ participation is expected to enhance farmers' welfare outcomes. There was no significant difference in the mean ages of PFJ participants and non-participants. Furthermore, participants obtained about 77 kg more maize output per acre than non-participants which corroborates the finding of Lambongang *et al*. (2019) about the PFJ in northern Ghana. Also, access to agricultural extension and years of formal

education were higher for subsidy participants compared to nonparticipants. While 53.7% of participants had access to agricultural extension services, only about 30% of nonparticipants had access.

Participants in the PFJ programme also had fewer household members and less access to farm credit. Non-participants were also found to use more improved variety than participants. One would have expected that, since the PFJ programme included the supply of improved seeds to farmers, participants would have recorded higher use of improved seeds, but the results suggest otherwise.

Table 2: Characteristics of the respondents according to subsidy participation status

Variable	Participants (n=326)	Non-participants (n=160)	Mean difference	*t*-value
	Mean	Mean		
Farm income	1496.4	974.5	521.9***	4.365
Age	41.29	40.79	0.500	0.376
Sex	0.779	0.719	0.060	1.464
Marital status	0.899	0.838	0.061*	1.947
Education	4.450	2.244	2.207***	4.329
Household size	8.856	12.13	- 3.269***	-5.911
Farm credit	0.267	0.444	-0.177***	-3.967
Access to extension	0.537	0.300	0.237***	5.041
Soil fertility	0.307	0.525	-0.218***	-4.760
Farm size	3.626	3.784	-0.158	-0.783
Productivity	369.5	292.7	76.79***	4.131
Fertilizer use (kg)	180.8	84.38	96.45***	9.996
Fertilizer intensity (kg/acre)	54.60	26.21	28.39***	11.88

***, ** and * means significance at 1%, 5% and 10% respectively.

The data further shows that only 31% of PFJ participants perceived their soils to be fertile, compared to 53% of nonparticipants. Farmers' perception of their soil fertility status thus seems to have a relation with participation in the subsidy programme, and therefore likely to affect maize productivity. Farmers' perception of the fertility status of their farms influences their choice of variety, with traditional varieties more likely to be planted on soils with lower fertility. This could explain the behaviour of the farmers in this study. Also, farmers in most areas of northern Ghana cultivate a wide variety of crops including roots and tubers which are not given priority by the PFJ programme. Since these crops require less fertilizer to produce, nonparticipants could thus cultivate more of their improved variety on their perceived fertile lands for optimal yield.

Fertilizer use among the respondents

Fertilizer use among the respondents is presented in Table 3. The results show that about 29% of non-participants did not use fertilizer in farming, suggesting that access to fertilizer subsidy is critical to adoption of fertilizer in farming. The result is expected because many smallholder farmers lack the financial wherewithal to purchase critical farm inputs such as fertilizer. This

situation is made worse because farmers in the study area find it difficult to borrow for agricultural purposes as indicated by the low level of credit access (27%) among the farmers. The results further reveal that while about 42% of non-participants used up to 100 kg of fertilizer, 36% of participants used that amount of fertilizer. Conversely, while about 36% of participants used between 101 and 200 kg of fertilizer, only 24% of non-participants used this level of fertilizer in production. Again, close to 29% of participants used more than 200 kg of fertilizer, while only 5.6% of non-participants used this amount of fertilizer in production. Participation in the fertilizer subsidy programme is therefore associated with higher fertilizer use according to the results of this study.

Table 3: Fertilizer use intensity among the respondents

Fertilizer use (kg)	Participants		Non-participants	
	Frequency	Percent	Frequency	Percent
0	-	-	46	28.75
1 – 100	117	35.89	67	41.88
101 – 200	116	35.58	38	23.75
201 – 300	42	12.88	8	5.000
301 – 400	42	12.88	1	0.625
401 – 500	9	2.761	0	0
Total	326	100	160	100

Results of the endogenous treatment-regression model

The results of the endogenous treatment-regression model used to estimate the impact of fertilizer subsidy on maize productivity is presented in Table 4. The model has two parts, which comprise the selection equation (subsidy participation) and the outcome equation (maize productivity). The subsidy participation equation (which is a probit equation) is presented in the second column of Table 4 while the productivity equation (a linear regression) is presented in the third column. We discuss the subsidy participation model in this section and proceed with discussion of the productivity model in the next section.

Table 4: Results of the endogenous treatment-regression model

Variable	Subsidy participation		Productivity	
	Coefficient	Std. Err.	Coefficient	Std. Err.
Age	0.051*	0.027	-5.697*	3.393
Age squared	0.001	0.001	0.053	0.036
Sex	0.265*	0.141	-63.33***	17.69
Marital status	0.201	0.208	-36.53	26.34
Education in years	0.011	0.013	0.397	1.603
Household size	-0.016	0.010	2.587*	1.336
Farm size	-0.340***	0.028		
Farm income	0.001***	0.001	0.102***	0.006
Farm credit	-0.179	0.128	26.06	16.19
Access to extension	0.329***	0.128	-19.27	16.09
Soil fertility dummy			20.82*	11.39
Participation in subsidy			230.4***	15.64
Constant	-0.707	0.586	234.0***	73.44
/athrho	-1.509***	0.106		
/lnsigma	5.084***	0.039		
rho	-0.907***	0.019		
sigma	161.4***	6.330		
lambda	-146.3***	7.889		
Wald test of indep. eqns. (rho = 0): chi2(1)	200.7***			

***, ** and * means significant at 1%, 5% and 10% respectively.

Determinants of farmer participation in fertilizer subsidy programme

Of the variables considered in the PFJ participation model (Table 4), the findings indicate that the age of the farmer, sex, farm income and access to extension services had positive influence on the probability of participation in PFJ. With regards to the age of the farmer, the results contradict that of Martey *et al*. (2019) who reported a negative relationship between age of the household head and the probability of fertilizer adoption. Their study however was not based on an input subsidy regime as is the case for this study. This could thus mean that, fertilizer subsidy offers older farmers the opportunity to purchase fertilizer for optimal yield, and agrees with the result for the fertilizer intensification model discussed earlier. The reasons adduced for higher fertilizer intensification among older farmers may account for the effect of age on access to fertilizer subsidy. The results agree with Lambongang *et al*. (2019) who found a positive association between farmer's age and participation in the PFJ programme in northern Ghana.

In line with expectation, male farmers had higher participation in the PFJ programme. Because of the patriarchal nature of the social setting, men typically have more influence over resources and decision-making, and therefore more likely to be beneficiaries of agricultural projects and programmes. Men typically have higher social standing in rural communities where social ties and status play a role in access to services and programmes. Thus, apart from programmes that

specifically target women participants, male dominance in programme participation is expected which is partly the result of socio-cultural factors.

Farm size had a negative effect on the likelihood of participation in PFJ. The negative association between farm size and PFJ participation could be ascribed to difficulty to access adequate coupons for large farms. Lambongang *et al*. (2019) observed that farmers' main challenge with the PFJ was limited access to fertilizers. Abdallah *et al*. (2021) however found a positive association between farm size and participation in the PFJ programme.

The study also showed that farm income and PFJ participation were positively correlated which is in line with expectation. This is because farmers with higher income levels are expected to have higher likelihood of participation in PFJ, all things being equal. Furthermore, access to extension services correlated positively with participation in the PFJ programme. The finding meets our expectation because extension agents link farmers to input sources and therefore play a crucial role in their participation in programmes such as the PFJ. The result is further supported by the finding of Anang and Kudadze (2019) which indicated that access to fertilizer subsidy in northern Ghana increased with farmers' access to extension services.

Effect of subsidy participation on land productivity

The land productivity model in Table 4 (third column) shows that participation in the fertilizer subsidy programme significantly improves land productivity of maize farmers in northern Ghana. The result indicates that smallholder farmers who participated in the subsidy programme increased their productivity by 230.4 kg per acre. This finding is in consonance with the study's *a priori* expectation and provides justification for public investment in fertilizer subsidies in developing countries like Ghana, particularly for smallholder farmers. Maize is a heavy feeder when it comes to inorganic fertilizer hence the need to promote fertilizer intensification to increase productivity. The PFJ programme is thus useful in this direction and has been shown to serve its purpose in enhancing productivity especially among smallholder farmers. The finding is in congruence with related studies like Lambongang *et al*. (2019) and Abdallah *et al*. (2021) who found that participation in the PFJ had a positive and significant influence on yield and maize commercialization, respectively, in northern Ghana.

Other variables that significantly influenced land productivity include age, sex, household size, farm income and farmers' perception of their soil fertility status. The result shows that, as the farmers grow older, their level of productivity decreases. This is because as farmers get older, they become less energetic, which coupled with financial obligations and social responsibilities, may reduce their level of productivity. Also, female farmers in the study area were more productive than their male colleagues suggesting that female farmers have the potential to be more productive and should therefore be supported with inputs and other services to enhance their productivity. Addai and Temoso (2021) also found similar results in the Upper East Region of Ghana where female rice farmers produced about 18% more rice output than their male counterparts.

Furthermore, household size correlated positively with land productivity which implies that households with more members are more productive. For a labor-intensive production system as prevails in northern Ghana, this result is expected. This is because large households are less likely to be labour-constrained hence, may be able to carry out farm activities such as weeding, planting and harvesting timeously compared to a labour-constrained household.

Farm income and perceived soil fertility status on the other hand had positive and significant effects on land productivity. Since farm income increases the total household income, it helps farmers to invest in farming to further increase productivity. Farm income promotes fertilizer intensification resulting in higher productivity. Also, farmers with fertile soils are expected to have higher land productivity, all things being equal. The findings are therefore in line with *a priori* expectations.

IV. CONCLUSION

The study was carried out to assess the effect of fertilizer subsidy on maize productivity using a sample of maize farmers in northern Ghana. An endogenous treatment-regression model was used to analyze the data. The results indicated that the PFJ programme increased the productivity of maize farmers by 230.4 kg/acre. The study underpins the critical role that input subsidies particularly chemical fertilizer play in enhancing input intensification and crop yield especially among smallholder farmers.

The study concludes that investing in fertilizer input subsidy has immense benefits to smallholder farmers. This is because peasant farmers who produce the bulk of the nations' food needs are typically resource-poor and can become more productive when key inputs like fertilizer and seeds are subsidized. Maize farmers in Ghana are currently producing below the attainable yield levels which calls for measures to improve the level of productivity, and the fertilizer subsidy programme is key to achieving this objective. The study therefore calls for adoption of pro-poor measures such as input subsidization especially for smallholder farmers to boost fertilizer use and farm productivity in Ghana and other low-income countries. Increasing maize output by 230kg/acre is a huge jump in productivity of peasant farmers, hence the input subsidy programme should be supported and made functional to achieve its objective of improving farm productivity. The government of Ghana should therefore prioritize expansion of the subsidy programme to reach farmers who could not access the subsidized fertilizer to boost their level of output.

The study further recommends that access to extension services should be enhanced because of the pivotal role that agricultural extension workers play in the implementation and success of the fertilizer subsidy programme. Extension workers should be involved in the distribution of fertilizer to enhance access by smallholder farmers in remote areas of the country. A common challenge with the fertilizer subsidy programme in Ghana is untimely supply of fertilizer to farmers. Hence, efforts should be made to ensure timeous supply of fertilizer to enable farmers to make the best use of the input to derive maximum output.

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