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MAIZE FARMERS IN GHANA RESPOND TO FERTILIZER SUBSIDY POLICY: WHAT NEXT TO ENSURE SUSTAINABILITY?

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Abstract

Soil fertility loss issues in Ghana are crucial owing to the fact that Africa's soils are known to be the poorest in the world and fertilizer use is low. In 2007, a re-thinking of the fertilizer subsidy policy of the 1970s to 1990s targeted poorer farmers' inclusivity. The new Fertilizer Subsidy Programme (FSP) that was implemented in 2008 was designed as a public-private partnership agreement that allowed the private sector to supply fertilizer to farmers at half price. The aim was to increase use rate, crop yields and household food supply especially by small holder food crop farmers. In 2012, a subsidy on improved seeds was introduced as part of the FSP to support production of locally produced improved seed (germplasm) and use by farmers.

This study used the Nerlove regression model to establish the positive effect of fertilizer policy on output of maize, a leading staple crop grown in all five agro-ecological zones in Ghana. The roles of good rainfall amounts, high product price and area expansion were also identified. By 2015, the use rate of fertilizer had increased from 8kg/Ha to 20kg/Ha and maize yield from 1.5 Mt/Ha to 1.9 Mt/Ha. However, the initial subsidy rate of 50 percent on mineral fertilizer reduced to an average of 20 percent by the end of 2015. In 2014, the government did not pay subsidy on any of the fertilizers, raising sustainability concerns by various stakeholders: 1) Adequacy of funding sources of Government and financing for input dealers, 2) When the crowding out effect on the private sector will cease, 3) Effectiveness of the electronic monitoring of fertilizer retailers by local Agricultural officers with limited ICT training and 4) The quality of road infrastructure to facilitate distribution of fertilizer to remote areas. To sustain the gains made and ensure continued increased application of fertilizers by farmers, the study recommends that: 1) The FSP should be re-designed to include a government exit plan, which involves two key paths: i) the poorer farmers should be linked to social protection projects to support the subsidy portion of the scheme and ii) non-poor farmer entrepreneurs should be linked to financial institutions in a contract farming scheme. Government exit at the appropriate time will assure competition in the market and lead to sustainable interest and participation by the private sector. 2) Integrated soil health management should be promoted among farmers since that ensures the practice of combined use of mineral and organic fertilizer with improved germplasm and local adaptation. 3) Farm income be improved through output support programmes that assures market access and adequate pricing.

Key words: Fertilizer subsidy, Infrastructure, Smallholder, Maize farmers, Public-private partnership

1. Introduction

Ghana attained lower middle income status in 2006 when its Gross Domestic Product (GDP) per capita was estimated at US$1,820.00 (GSS, 2013). Agriculture is the economic foundation of Ghana's economy, employing about 44.3 percent of the work force and contributing 20.2 percent GDP (GSS, 2015). The goal of modernizing agriculture in order to improve income and food security of farmers has been pursued for a long time. One of the key crops that have received attention in research and development as well as investment in infrastructure is maize. Maize farming is a dominant land use system in that it is grown by more than fifty percent of rural households in all but one region in Ghana (GSS, 2013). Every household uses maize for one or more dishes (porridges, paste, grits and beer) in a week (FAO, 2008). For many years, maize production, just like the production of most other crops, did not depend much on mineral fertilizers which are perceived as productivity-enhancing. This is because soil fertility was considered good and the average yield of 2 metric tonnes per hectare fed the population adequately. From the 1950s to the 1980s unimproved seeds (local germplasm) were largely used and the climatic factors in both forest and savannah zones were not so erratic; the amount of rainfall was good and rainfall days were more predictable. Hence, from the 1970s to1992 a subsidy on mineral fertilizers which was instituted for all farmers, benefited rice and cash crop farmers the most.

By the mid-1990s and early 2000s, researchers had established that food production in Ghana suffers from numerous constraints, including low yields, declining soil fertility, diminishing arable land due to urbanization and land degradation, weak land tenure system, limited irrigation facilities and dwindling water resources, climate variability, unimproved planting materials, low access to credit, poor marketing and distribution, and, above all, high cost of agricultural inputs, particularly fertilizer (Croppenstedt et al., 2003 & Alfsen et al., 1997). The middle of the year 2000s witnessed global food crises and in Ghana limited food security was anticipated. Therefore, a call for increased use of fertilizers (mineral and organic) to boost productivity of maize and other grains was made. The crucial nature of managing soil fertility loss issues in Ghana was further linked with the fact that Africa's soil is perceived to be the poorest in the world and Ghana is one of the least users of fertilizer (8kg/ha as at 2008) in Africa.

It is asserted that the decision to adopt fertilizer is determined by the interaction between agronomic response and the nutrient-grain price ratio as well as cost of operating capital for the cropping season, information and learning cost and effects of risk aversion (Abdoulae & Sanders, 2005 & CIMMYT, 1988). A demonstration of a higher marginal agronomic response than the nutrient-grain price ratio may not be incentive enough for poor farmers. The general thinking is that poorer farmers' inclusivity in the productivity drive should involve institution of an input subsidy policy (Yawson et al., 2010 & Banful, 2008). This was because poorer farmers cultivate food crops on small fields of 2 hectares or less, usually apply local and unimproved varieties of seed and limited amounts of organic matter, depend on rainfall and use simple tools and machinery.

In theory an input subsidy is instituted to reduce the cost of production for the poor and facilitate the adoption of other productivity-enhancing inputs to boost crop yield (Mason et al., 2013). Directly targeting farm households with input subsidy has the intention of improving their performance and well-being (Jayne and Rashid, 2013). In 2008, the Government of Ghana through public-private partnership agreements rolled out a Fertilizer Subsidy Programme (FSP) aimed at increasing use rate, crop yields and household food supply. The country-wide subsidy was on four types of mineral fertilizers, namely, NPK-15:15:15, NPK-23:10:05, urea, and sulfate of ammonia. Government spent a total of about GHS 900,000 million on subsidies from 2008 to 2015. In 2012, a seed subsidy policy was introduced to increase use of improved germplasm and boost crop yields further. The indication is that maize framers are responding to government interventions and yield increases have been recorded. What concerns most stakeholders is whether the increasing trends in output and yields will continue and whether the fertilizer subsidy will improve and be sustained. This is because there was no end-year specified for the fertilizer and seed subsidy programmes and in 2014 there was no government subsidy on fertilizer prices. An early evaluation of the effectiveness of the program by Banful (2008) and Yawson et al. (2010) revealed poor distribution of vouchers (authority note exchanged for fertilizer), thus limiting access to fertilizers.

The major objective of the study is to determine the extent to which the Fertilizer Subsidy Programme has improved maize output and assess the sustainability concerns of various stakeholders. Specifically, the study modelled the supply response of maize output to policy changes, described the

yield increases experienced by farmers and the benefits to fertilizer importing companies and retailer. Finally, the challenges of implementation are identified and the policy actions necessary for sustaining the support of government and response of farmers are suggested.

2. Methodology

A time series analysis was carried out. The assumption is that, subsidisation of synthetic agrochemicals and high-yield varieties of seed leads to the adoption of green revolution-related technologies (Sunding & Zilberman, 2001).To analyze the effect of fertilizer subsidy program on food crop production in Ghana, the Nerlove supply response model for agricultural commodities was used (Nerlove 1972). This choice was made due to the ability of the Nerlove model to show how a farmer intends to react to movements in the price of the crop that is produced or how a farmer will react to a policy which affect his factors of production.

According to Nerlove (1972), a farmer desired output can be expressed as a function of expected price and exogenous factors which affect his production:

$$Q_t^* = a + bP_t^* + cZ_t \quad (1)$$

Where Q_t^* is the desired output, P_t^* the expected price and Z_t the exogenous factors such as weather condition, technology change and policy environment, among others. Actual observed output may differ from the desired ones because of the adjustment lags of variable factors. Therefore, it is assumed that actual output would only be a fraction δ of the desired output.

$$Q_t - Q_{t-1} = \delta(Q_t^* - Q_{t-1}) \quad (2)$$

Where Q_t is the output obtained in period t, Q_{t-1} is the output obtained in period t-1 and δ the adjustment coefficient. The values of δ lies between 0 and 1. For the farmer expected price P_t^*, it is assumed that farmers maintain in their memory the magnitude of the mistake they made in the previous period and learn by adjusting the difference between actual and expected price in t-1 by a fraction λ. To be able to apply this model to estimate the effect of fertilizer subsidy programme, some other factors of production have been included. Hence,

$$Q_t = \alpha_0 + \alpha_1 P_{t-1} + \alpha_2 Q_{t-1} + \alpha_3 R_t + \alpha_4 F_t + \alpha_5 A_t + \mu_t \quad (3)$$

Where R_t is rainfall, F_t represents the fertilizer subsidy policy and A_t area cultivated for maize. Equation (3) was estimated for maize from 1985 to 2013. It is assumed that the total output of maize in one period represents the supply of the commodity during this period. The producer price in US dollars per ton is preferred to the producer price in local currency to avoid the fluctuation of the later. A dummy variable which takes 1 when the fertilizer policy was applied (2008 to 2013) and 0 otherwise was used due to the lack of information on the type and the quantities of fertilizer applied on maize each year by farmers.

Results of Dickey-Fuller and Eagle/Granger co-integration tests supported the use of error correction model (ECM) estimation to obtain consistent coefficients for interpretation. Robust estimation was used to estimate and correct for heteroscedasticity.

3. Results and Discussion

3.1. Effect of Fertilizer Policy on Maize Production: A Regression Analysis

The results of the error corrected model (ECM) are presented in Table 1. The coefficient of the variable residue lies between -1 and 0 and is significant. This result shows that the ECM estimated is valid and the coefficients obtained may be a good estimation of the real value.

Table 1. Results of Nerlove Supply Estimation Using Error Correction Model (ECM)

Variable	Coefficient	P-value
Constant	0.179	0.575
Log(lag production)	-0.281**	0.041
Log(area cultivated)	1.052***	0.001
Log(lag output price)	0.057*	0.05
Log(rainfall)	0.105*	0.096
Fertilizer Policy	0.071**	0.015
Lag Residues	-0.045	0.005
Goodness of fit measures:		
Number of Obs	28	
R-squared	0.714	
Prob>F	0.0003	

Source: Authors' estimation from Stata
Note: ***, ** and * represent 1%, 5% and 10% significance respectively

It also shows that the production system of maize will overcome any exogenous shocks during a certain period of time. It appears from the result that area cultivated is the main factor affecting the supply of food crop commodities in Ghana. A 1% change in area cultivated for maize results in an increase of production by 1.1%, ceteris paribus. Though not strongly significant, rainfall amount is also important in food production. These results are consistent with the case of Ghana where food crop production is mainly done by small farmers who practice subsistence agriculture with low capital input and are dependent on rainfall and area expansion. The result is also consistent with work done in Zambia by Mason et al. (2013). As stated by Morris et al. (2007) input subsidy cannot constitute, in and by themselves, a comprehensive response to multiple rural development issues.

The results further showed that the production of maize is also driven by an output-price incentive, confirming the assertion of Druilhe & Barreiro-Hurlé (2012) that input price might not be the only bottleneck preventing widespread input use. The increase of producer price by 1% in the previous year resulted in the increase of production in the current year by 0.1%, others being constant. This result show that the production of maize in Ghana is market oriented. Any output price policies may increase the production of maize.

Since the fertilizer subsidy program is captured as a dummy variable in the model, direct interpretation of the coefficients estimated as percentage change of the dependent variable may lead to some error. Wooldridge (2006) proposed the following formula to compute the exact change:

$$\%\Delta production = 100[\exp(\hat{\alpha}) - 1] \quad (4)$$

Where $\hat{\alpha}$ is the coefficient estimated for the fertilizer policy variable, from the Nerlove supply response model. From the calculation, the percentage change in the production of maize due to fertilizer subsidy program is 7.35. This result shows that other factors being constant the production of maize increased by approximately 7% when the fertilizer subsidy was applied compared to the period when the programme was not applied. This indicates that the fertilizer subsidy program has a positive effect on maize production in Ghana. Recent studies in rice, another key crop staple in Ghana also showed that rice-producing households who participate in the fertilizer subsidy program obtained about 29Kg more rice per hectare cultivated (Wiredu et al. 2015). In Malawi, Lunduka et al. (2013) found that there was a positive but modest impact of an input subsidy program on food crop farms.

3.2. Socio-economic Benefits of FSP to Maize Farmers

Small holder farmers cultivating maize, rice, sorghum and millet who were targeted registered as individuals or under recognized nucleus farmers and companies. The FSP has increased farmers' access

to fertilizers and improved seed, reduced their cost of production in relation to fertilizer input and enabled farmers to apply the right quantities of fertilizer. In 2007, the national fertilizer use rate by maize farmers was 8kg/Ha and the yield level was estimated at 1.5 Mt/Ha. By 2015, the use rate had increased to 20 Kg/Ha and yield to 1.9 Mt/Ha. A research conducted by Peasant Farmers' Association of Ghana (PFAG) in 2010 on the impact of fertilizer subsidies revealed that the livelihoods of small scale farmers, especially those of the women among them, had improved and that these farmers were experiencing a reduction in poverty and an increase in their income, albeit at a slower rate (personal communication with Executive, 2016). The estimated nutrient/output ratio is 2.6, implying that farmers in Ghana have good incentives to use fertilizer despite higher input prices.

The non-poor farmers who participate in out-grower and other contract farming schemes managed by the private sector, non-governmental agencies and governmental projects benefited more than individual farmers who do not partner any one. Examples of private sector farmers associations are: the Masara N'Aziki Farmers Association (MAFA); farmers belonging to the Presbyterian Agricultural Station (PAS) groups; farmers benefiting from ACDI-VOCA's Agricultural Development and Value Chain Enhancement (ADVANCE) project; and farmers belonging to government projects such as Northern Rural Growth (NRG) and Savanna Accelerated Development Authority (SADA). Farmers in such organisations received information on soil health management, criterion for obtaining access (eg. 15 bags per farmer in 2015, targeting small holder farmers) and organized pool transport for obtaining the product in time and at cheaper cost. The observation that FBO membership is a strong institutional factor in technology adoption is further supported by Mwangi & Kariuki (2015).

3.3. Benefits to the Fertilizer Distributors / Agents / Dealers

There has been an expansion of private sector distribution networks in that several fertilizer importing companies (eg. Yara, Dizenghoff, AMG, Chemico, Afcott, ETC, Golden Stork and LDC) have successfully participated in the Fertilizer Subsidy Program since its inception in 2008. Private companies import fertilizer for the program in response to government tenders and distribute the product via their wholesale/retail network. There is anecdotal evidence that the subsidy program has boosted the sales of fertilizers due to the active involvement of the private sector. This evidence provides further justification for having adopted a public-private-partnership (PPP) model for the subsidy programme. The benefits have extended to the fertilizer distributors and agents/dealers in the districts and local communities. By 2015, the volume of fertilizer imported had increased by 128 percent. Accredited distributors can be found in all 10 regions of Ghana and key retailers in all 216 district capitals. The general observation is that farmers were able to purchase more fertilizer as a result of the subsidy; therefore, fertilizer retailers and agents also sold more and, by extension, earned more. Although no official statistics have been provided to ascertain the profit margins obtained as a result of increased volume of sales, personal communication with retailers in selected districts confirmed the assertion. This is a typical case of an institutional setting contributing to improve the returns of some technologies for farmers, by addressing some constraints among them, and then encourage the adoption of these technologies. The institutional strengthening of the private sector is a key factor in the sustainability of the FSP.

3.4. Implementation Challenges of the FSP

The key implementation challenges that have been widely discussed at official fora and documented by the researchers in rapid appraisal surveys were related to:

i. Ineffective supervision of the distribution system and delays in payment of private companies involved in the partnership. Due to poor monitoring reports of smuggling fertilizers to neighbouring countries were rife. This meant that the target group, the poor small holder farmers were not receiving the fertilizers for use. There was little wonder that by 2013, the yield target of 50kg/ha had not been achieved. The effectiveness of the electronic monitoring system introduced later was initially challenged by the low capacity of local level extension agents placed in charge of the monitoring.

ii. Yearly delays in paying the subsidy margin to participating firms. Government could not pay the 2013 debt by mid-2014, hence, no subsidized fertilizer distribution was effected in 2014. Farmers had no option but to consider buying fertilizer at the going market price of GHS100.00 (US$25.00) instead of the expected GHS80.00 (US$20.00) or less. A rapid appraisal survey of farm households in Northern Ghana by SEND Ghana, a development NGO, indicated that government's inability to fully finance the fertiliser subsidy programme in 2014 contributed to the failure in meeting yield targets for maize and rice in nearly all the six districts covered (SEND, 2016). In 2015, one of the largest distributing companies (Yara Ltd.) opted out of the partnership, delaying the supply process and causing farmers in the Southern regions to consider the commercial prices Yara Ltd. offered. Farmers in Northern Ghana (Savannah zone) were able to benefit from the subsidy program because their major farming season starts in July, in contrast with Southern farmers who start their farming in April. In 2016, there was improvement in the process of bidding and announcing the subsidy package but the quota system announced with the 20% subsidy rate was received with little applause. Farmers were allowed to purchase only 750kg of compound and urea fertilizers at the subsidized price. The amount could be used for only 1 hectare of food crops such as maize, rice and soya beans.

iii. Inadequate finance for input dealers to procure and stock adequate volumes of fertilizer. This makes access to credit and market conditions issues not only for farmers, but also for entrepreneurs supporting agricultural sector activities. Mwangi & Kariuki (2015 and Latruffe & Nauges (2014) have pushed strongly for credit as a key institutional factor.

iv. Poor condition of road infrastructure for distribution and supply closer to poorer farmers. Most of the poorer farmers are located in remote villages (more than 100 kilometres from the city/ capital town) that are connected by feeder roads which are not well maintained. During the raining season such roads become immotorable and suppliers are not able to carry the fertilizers to sell to farmers. Lack of vehicles during this period restricts farmers further to their villages resulting in low patronage of subsidized fertilizer.

v. In recent times, concerns for the negative environmental impact of mineral fertilizer have been revisited by several agencies including civil society. Until 2016, only mineral fertilizers were subsidized and efforts by individuals and companies to promote organic fertilizers (including compost) were not recognized by farmers. The promotion of organic fertilizer in crop farming is important for soil amendment and long-term enrichment of farm land. The FAO (2012) intimated that subsidy programmes must be coupled with the promotion of agronomic best practices. “If local organic materials do not exist, the cropping system has to be diversified so as to include soil-improving crops. Only such a parallel approach has a chance of sustainable use of fertilizers, once the subsidy programme has stopped – provided the agronomic effect of using mineral fertilizers turned out to be positive” (FAO, 2012).

4. Conclusions and Recommendations

4.1. Conclusion

The purpose of this study was to understand how input subsidy programmes should be best designed to promote sustainable fertilizer use. Using Ghana’s case the following key lessons have been shown: That: 1) With enough funds Government can bear over 25 percent of the unit price of fertilizer yearly. In 2008 Ghana paid as high as 50% of fertilizer expenditure as subsidy to farmers. 2) The Fertilizer Subsidy Programme has had a positive effect on crop output; in Ghana each year of subsidy resulted in a 7.4 percent increase in maize production. 3) Although subsidy on fertilizer and other inputs may be important, they are not sufficient; sufficiency lies with good rainfall amounts, high product price and farm area expansion. 4) Farmers who participate in out-grower and other contract farming schemes are likely to benefit more from subsidy programmes 5) Concerns with assured Government sources of funding, adequate finance for input dealers, monitoring of fertilizer retailers, conditions of road infrastructure and adequacy of price incentives, pose questions about the sustainability of fertilizer subsidy programmes.

4.2. Recommendations

In order to ensure the sustained supply and continuous increased use of fertilizer by the target group (including poorer farmers), the subsidy programme should be redesigned to include an exit plan for Government and there should be institutional strengthening for the private sector participants. 1) In the Government exit plan, two strategies should be designed: i) Strategy one should effectively link poorer farmers to other social protection projects (SPP). This will allow the SPPs to take over from government in the medium term. ii) Strategy two should identify non-poor entrepreneurial farmers and effectively link them to financial institutions in a manner that allows them to farm on contract basis. Contract farming assures ready market and income for re-purchasing fertilizer and other inputs. Government exit at the appropriate time will assure competition in the market and lead to sustainable interest and participation by the private sector, further strengthening its institutional structure. 2) Integrated soil health management should be promoted among farmers since that ensures the practice of combined use of mineral and organic fertilizer with improved germplasm and local adaptation. The practice will sustain improved fertilizer use and reduce the negative environmental impacts of mineral fertilizer. 3) Farm income should be improved through output support programmes that assure market access and adequate pricing. Market access improvement should include improvement in the surface condition of feeder roads to enhance on one hand mobility of farmers to urban markets to buy inputs and sell produce, and on the other hand, mobility of input suppliers and produce traders to supply inputs and buy produce at the farm gate.

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