Evaluating the Determinants of Access to Ghana Fertilizer Subsidy Program

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Authors' contributions

This work was carried out in collaboration between all authors. Author SM lead the data collection, wrote the introduction and the methodology. Author IAA estimated and wrote the descriptive statistics, both qualitative and quantitative analyses. Author YU did the econometric estimations and the analyses. All three authors have read through and are jointly responsible for the content of this paper.

Original Research Article

ABSTRACT

In line with economic conditions in 2008 and the need to boost agricultural productivity and stabilize agricultural commodity prices, the government of Ghana instituted a nationwide fertilizer subsidy program. This study analyzes the determinants of access to the Ghana Fertilizer Subsidy Program (GFSP). The paper uses cross-sectional data collected from 352 farmers in four districts in Ghana. To achieve the main objective of the study, probit and tobit models are used. This study reveals that access to the GFSP is still low (42.6%) despite the government's increasing budgetary allocation into subsidy provision over the years. The results of the probit and the tobit models indicate that access to the GFSP is largely determined by farmers' gender and political influence. It also reveals that the subsidy program does not crowd out private fertilizer retailers as farmers who buy more quantities from the commercial market are less likely to be allocated subsidy passbooks. It is therefore recommended that discrimination against women should be minimized to encourage

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their participation in agriculture and empower them to bring to the fore their potentials. Also, the government must encourage more private fertilizer retailers to establish sales points at vantage places to improve access to fertilizer.

ACRONYMS

GFSP   : Ghana Fertilizer Subsidy Program
ISP   : Input Subsidy Program
Kg   : Kilograms
MOFA : Ministry of Food and Agriculture
MT   : Metric Tons
NDC   : National Democratic Congress
NPK   : Nitrogen-Phosphorous-Potassium
SOAS : School of Oriental and African Studies
SSA   : Sub-Saharan Africa
US   : United States of America

1. INTRODUCTION

Agricultural statistics in 2013 provide evidence that it is still the mainstay of Ghana's economy, employing about 50% of the country's labor force and contributing 22% to its GDP [1]. Agricultural productivity is a major determinant of a country's development and performs a significant role in a country's development process. Increasing agricultural productivity in Ghana is critical if the country is to mitigate the increasing demand for food resulting from the high rates of population growth. However, productivity growth is continuously challenged by the high costs of inputs like fertilizers [2-4]. The Ghana government in an effort to boost agricultural productivity and reduce uncontrollable inflation and hardships associated with agricultural commodity prices, instituted the Ghana Fertilizer Subsidy Program (GFSP) in 2008. The program was necessitated by the 2008 staple food price hikes and the global price hikes in agricultural inputs including fertilizer [5].

Budgetary allocation to the fertilizer subsidy has increased over the years. Comparing the cost of the fertilizer subsidy and public agricultural expenditure in Ghana shows worrying results as available data show that government's expenditure on subsidies has grown consistently over the years. From its inception in 2008, the share of input subsidies as a percentage of public agricultural spending has increased from 19.1% in 2009 to 29.9% in 2011 as in Table 1.

Though the program may have typically stated goals as above, the GFSP may also have explicit and/or implicit political economic objectives as studies in other African countries (Zambia, Malawi) revealed the use of subsidy as a tool for perpetuating political dominance [6-8].

Inefficiencies in fertilizer distributions undercut the essence of the GFSP as an effective targeting tool for achieving the stated goals of the program and at the same time renders the targeting of subsidy benefits less effective whilst tax payers' money may be inefficiently utilized. [9] contend that when subsidy benefits are effectively targeted then the following are achieved: (i) promotion of economic efficiency; (ii) pro-poor and equity promotion; and (iii) development of the private sector. Therefore, an ineffective targeting scheme will fall short of these important benchmarks and waste scarce government resources.

When inputs are targeted at poorer households, the crowding out of the private sector is minimized than when subsidy benefits are targeted at large scale farmers with high income and ability to purchase fertilizers at commercial rates [10].

Table 1. Fertilizer subsidy and public agricultural expenditure in Ghana, 2009, 2010 and 2011

Year	Program Cost (million US$)	Cost per MT of program fertilizer distributed (US$ per MT)	Public Expenditure on agriculture (million US$)	GFSP as % share of public agricultural spending
2009	52.5	719	275	19.1
2010	55.5	631	279	19.9
2011	111.7	634	374	29.9

Source: Extraction from Jayne and Rashid, 2013

Several studies have been carried out in most African countries including Ghana. A study by [11] and that by [12] focuses on how implementation of the fertilizer subsidies crowds out sales in the private fertilizer market sector. [13] revealed that a timely offer of fertilizer quantities during the harvest season, whilst farmers have cash will significantly increase fertilizer use the next season.

Chirwa et al. [14] used both the probit and tobit models in determining factors of access to the fertilizer input subsidy in Malawi using data from rural households drawn from 14 districts. Their study found that fertilizer subsidy coupons were given to wealthier households whilst relegating the fertilizer needs of the poor and vulnerable in society. Their study further revealed that the numbers of subsidy coupons received per household is positively related to farm size and welfare as well as food security whilst relating negatively to the proportion of female-headed households. [15] also found that the most vulnerable and female-headed households were not likely to get vouchers, whereas residents who stayed longer in the villages were more likely to be selected.

In determining the relationship between fertilizer subsidies and voting patterns in Zambia, [7] used the tobit model with quantity of subsidized fertilizer received as the dependent variable. Their study found the quantities of subsidized fertilizer to be allocated to more households in constituencies that the ruling government won in the last election, and more so the larger its margin of victory.

The GFSP is universal and as such all farmers are eligible to receive subsidy coupons. Though a lot of studies have been carried out in countries that have invested so much in that sector, research in Ghana on the fertilizer subsidy is limited in scope. [16] and [17] in their assessment of the GFSP program used mainly qualitative analyses. [16] concluded that few farmers actually benefited from the program. [17] in a study concluded that the outcome of the GFSP is uncertain, and that any effect is likely to be temporary. The study also observed that the poorest households were not targeted by the program. [6] used quantitative analyses to reveal that politics played significant role in coupon allocation and that high number of vouchers were targeted at districts that the ruling party lost in the last elections. This study, however, used district level data and modeled the quantity of vouchers received as dependent on political and economic district characteristics.

As far as Ghana's implementation of the subsidy program is concerned, the discussions of the literature above shows that the studies used mainly qualitative analysis and in the case of [6] in which econometric estimations are used, the study does not give an indication as to how individual smallholder farmers access the GFSP at the micro level.

A number of research questions which this study seeks to answer are: What are the characteristics of farmers who benefit from the GFSP? What are the determinants of access to the GFSP at the micro level? Does the fertilizer subsidy crowd out private fertilizer retailers? What role does political influence play in determining farmers' access to the GFSP? This study provides answers to the above questions using empirical evidence from four selected districts from the Transitional and the Guinea savannah zones of Ghana.

2. THE GHANA FERTILIZER SUBSIDY PROGRAM (GFSP)

In an effort to increase productivity and modernize agriculture, the government of Ghana following the 2008 food price crises instituted a countrywide subsidy of fertilizers. The subsidy was also in response to the unexpected food, energy and fertilizer inflations which affected access to fertilizers by smallholder farmers [6]. Maize prices in Accra (the capital city) and Tamale (considered food basket of Ghana) for example, rose by an average of 77% between May 2007 and May 2008. The global food price hikes also led to increases in the prices of other staples such as rice and wheat as well as general energy costs. Similarly, the price of fertilizers in Ghana increased tremendously during the same period. For example, between June 2007 and March 2008, the price of NPK 15:15:15, the most common food crop fertilizer in Ghana increased from GH¢ 26 to GH¢ 35 per 50 kilograms (kg) bag [18]. Although the fertilizer subsidy program was instituted temporarily in response to the 2008 global food crises, it has become the main agricultural policy tool by succeeding governments and has since been expanded.

The fertilizer market in Ghana is considered one of the most liberalized in Sub-Saharan Africa (SSA) prior to 2008 with virtually no government

intervention. The removal of subsidies during the 1980s and 90s "coincided" with a significant drop in fertilizer use intensity from 22 kg/ha in 1978 to 8 kg/ha in 2006 [16]. The global price hikes in 2007 through 2008 led to increased fertilizer prices substantially raising government's fear that fertilizer use intensity could even drop further by an estimated 70% with a possible decline in agricultural productivity and food production by an estimated 20%, which may necessitate imports of food crops, the prices of which also reached an all-time high during this period [19].

In 2008 and 2009 the subsidy was implemented via the voucher system and then via the way-bill system starting in 2010. In essence, the voucher system targeted small-scale farmers as conceived; while the subsidy under the way-bill system provided universal subsidy for all types of farms and farmers that can afford the subsidized price [5].

From its inception in 2008, the fertilizer subsidy program was estimated to cost the government GH¢164 million (approximately US$82 million) over a four year period (2008 to 2011) [20]. Thus, the expenditure of government on the GFSP has more than tripled since its inception in 2008. From an initial US$10 million in 2008 to US$35 million in 2011 [21] and in 2012 alone, the government announced its intention to subsidize 176,000 tons of inorganic fertilizer at a cost of GHS120.3 million (approximately $60 million). The total cost of the fertilizer subsidy at the end of the 2012 crop season however, stood alarmingly at GH¢124.1 million ($66.4 million) [20]. In 2013, the subsidy program cost stood at $64 million [20]. The government continues to spend more and more of the agricultural sector budgetary allocations on the subsidy program as it has become the preferred policy of the government in trying to stimulate increased food crop production and score potential political points.

The essential aim of the fertilizer subsidy program is to address the fertilizer price hikes associated with the commercial fertilizer market, which affects fertilizer demand and utilization, which in turn leads to low yield and low income to farmers. The underlying assumption of the need for the subsidy program is that if farmers will be induced by the lower prices to use more of fertilizer and other subsidized inputs which will eventually lead to increased yields and income to farmers [22]. Under the way-bill system, the government absorbs among other things the port

handling charges, loading and transport costs as well as agents' commission and margins to the fertilizer companies. This is to arrive at prices that are affordable to the small-scale farmers.

3. METHODOLOGY

3.1 Data and Study Areas

Data was collected from 352 farmers in four districts selected from 57 districts in the Guinea savanna and the Transition zones of Ghana. The Guinea savanna zone and the Transition zone, which are considered the food baskets of Ghana, were selected for this study. The simple random sampling technique was used in selecting the districts as well as farmers from each ecological zone.

3.2 Data Analysis

The study employed both descriptive and econometric techniques. Descriptive analyses of both the beneficiaries and the non-beneficiaries are accomplished using the t-test for continuous variables and χ^2 test for categorical variables. The probit and the logit models were both used in examining the determinants of access to the GFSP.

Following [23], our econometric models of the determinants of access to subsidized fertilizers are specified using two definitions of access. The first is access to the subsidized fertilizers – farmers that actually used their subsidy passbooks to purchase fertilizers. The second definition measures access as the quantities of subsidized fertilizers (in kilograms) acquired by the farmer. These two definitions of access are tested using the empirical model below.

$$AS_{ij} = \alpha_0 + a_j \sum_{k=1}^{3} X_i + e_{ij} \qquad (1)$$

where $i = 1,2,.....352$ and $X = X_1 + X_2 + X_3$

From the function, X_1 represents farmer-specific characteristics: age, household headship, sex, educational status, household size and livestock value. X_2 represents farm-specific characteristics such as farm size and quantity of fertilizer acquired at the commercial rate. X_3 represents institutional and geographical factors such as access to credit, access to extension services, distance to the nearest fertilizer retailer, political factors and ecological zones.

In equation 1 above, the dependent variable, AS_{ij}, is operationalized in two ways, as having redeemed the subsidized fertilizer using the passbook and also as the quantity of subsidized fertilizer received by the farmer. The probit model is used in estimating the determinants of access to the fertilizer passbook whilst the tobit model is used in estimating the quantity of subsidized fertilizer received by a farmer.

Therefore, access to subsidized fertilizer passbook is first specified as a dichotomous variable $(AS_{ij} = 0,1)$ and therefore estimated using the probit model where AS_{ij} is 1 if the farmer received a fertilizer passbook and 0 if otherwise. For empirical purposes, the expected utility of access AS_{ij} can be construed from a farmer's observed binary choice of access to or non-access to subsidized fertilizer, which implies a probit model specified as [24]:

$$Y = F(\omega + \alpha X_i) = F(z_i), \tag{2}$$

where *Y* is the discrete adoption choice variable, *F* is a cumulative probability distribution function, α is a vector of unknown parameters, X is a vector of explanatory variables as in (1) and *z* is the *Z*-score of the aX area under the normal curve. The predictable value of the discrete dependent variable in equation 2 is conditional on the explanatory variables, and also given as:

$$E[Y / X] = 0[1 - F(\alpha'X)] + [F(\alpha'X)] = F9\alpha'X) \tag{3}$$

and the marginal effect of each explanatory variable on the probability of adoption is given by

$$\frac{\partial E[Y / X]}{\partial X} = \phi(a'X)a \tag{4}$$

Where $\phi(.)$ is the standard normal density function [24].

Alternatively, equation (1) has been estimated using the quantity of subsidized fertilizers acquired by farmers using a tobit model. The explanatory variable X is the same as explained above in equation (1).

3.3 Definitions of Variables

The variables in the models, their measurements and expected signs are indicated in Table 2.

The dependent variables in the model are access to the fertilizer subsidy (in the probit model) and quantity of subsidized fertilizers acquired by the farmer (in the tobit model). Access to fertilizer subsidy is a dummy variable equal to 1 if a farmer received at least one bag of subsidized fertilizer in the 2013/2014 agricultural season. The dependent variable in the tobit model (quantity of subsidized fertilizers) is the total amount of fertilizers in kilograms the farmer received in the 2013/2014 agricultural season.

The explanatory variables are grouped into three based on literature and community dynamics since there are no specific targeting criteria for the distribution of subsidized fertilizer. The first group represents farmer-specific characteristics such as age, household headship, sex, education status, household size and livestock value. The second group is farm-specific characteristics which captures farm size and quantity of fertilizer acquired at the commercial rate. Then the third group is institutional and geographical factors such as access to credit, access to extension services, distance to the nearest fertilizer retailer, political factors and ecological zones.

Age is measured in years and is expected that the age of the farmer would have a positive effect on access to fertilizer subsidy. This is the case because in terms of access to fertilizer subsidy coupons or passbooks, elderly farmers are more connected to the government agencies and are more likely to access the program [23].

Sex variable measures the effect of gender on access to fertilizer subsidy. It is a dummy indicating 1 if the farmer is male and 0 otherwise. Male farmers are heads of households and in control of resources. Given the general perception of discrimination against women, male farmers are expected to have more access to the GFSP.

Household headship is a dummy variable with the value of 1 if the farmer is a household head and 0 if otherwise. Household heads constitute leaders in the community and control family lands; they are therefore expected to have a high probability of access to the GFSP.

Education variable is a dummy variable with the value of 1 if a farmer had formal education and 0 if otherwise. Educated farmers have access to extra sources of information such as the social media. They can get timely and accurate

information on the availability and point of access of the GFSP.

Household Size measures the number of people who eat from the farmer's pot. It is expected that large households may not have excess income to enable them purchase fertilizer at the commercial rates, hence larger households rely on the GFSP for their fertilizer needs.

Extension visits variable indicates the number of visits received by a farmer during the farming season. Extension agents are responsible for teaching farmers new and improved methods of farming. Farmers who receive visits from extension service officers learn more about the government programs. Extension is therefore expected to be positively related to access to subsidy.

Farm size is the area of land in hectares of maize cultivated. It is expected that farmers with small farm sizes will receive a greater quantity of fertilizer relative to farmers with larger farm sizes if the GFSP is targeted at smallholder farmers.

Livestock value represents the resource base and the main form of storing wealth by smallholder farmers, hence the wealth of the farmer. Since this indicates affordability, our expectation is that wealthier farmers are likely to redeem their fertilizer passbooks, and are likely to be given priority on account of likely utilization of the subsidy. For a pro-poor fertilizer subsidy program, however, farmers with low values of assets are more likely to be allocated subsidy and we therefore expect a negative relationship between livestock value and access to subsidized fertilizers.

Commercial fertilizer quantity measures farmers' ability to purchase fertilizers at prevailing market prices. Farmers who can afford to purchase commercial fertilizer are unlikely to access subsidized fertilizers. To capture this, we include the quantity of commercial fertilizers acquired by the farmer in kilograms. The higher the quantity of commercial fertilizer purchased by the farmer, the less resource constrained the farmer and the more probable to be excluded in the allocation of the subsidy passbooks.

Credit Access is a binary variable used to capture the effect of credit on access to subsidy. This variable is measured as a dummy, 1 if farmer had access to credit, 0 otherwise during the season. A farmer having access to credit in cash will enable her/him to purchase fertilizer inputs in a timely manner.

Table 2. Measurement of variables in the estimations

No.	Variable	Measurement	Expected sign
1	Age	Actual age of farmer	**+**
2	Sex	Dummy (Male=1)	**+**
3	Household headship	Whether farmer is the head of the household (head=1)	**+**
4	Educational status (Educated=1)	Whether respondent has formal education or not)	**+**
5	Household size	Size of farmer's household	_
6	Extension visits	Number of extension visits	**+**
7	Farm size	Size of farm (ha)	_
8	Livestock	Value of livestock of a farmer(GH¢)	_
9	Commercial Fertilizer	Quantity of commercial fertilizer used by a farmer (kg)	_
10	Credit	Farmer's access to credit(received credit=1)	**+**
11	NDC	Dummy (where NDC won=1) at the farmer's polling station	**+**
12	Ecological zone	Ecological zone of farmer(Guinea savannah zone=1)	**+**
13	Marketing of maize	Whether farmer sold some of his/her output(Sold output=1)	**+**
14	Time to retailer	Time taken (minutes) to the nearest fertilizer retailer	_

NDC won represents the influence of politics in the targeting of subsidy benefits in Ghana. Farmers were unwilling to disclose the political parties they support and since the National Democratic Congress (NDC) has been the ruling party in Ghana since 2009, NDC won is a dummy variable with 1 if NDC won at the farmer's polling station and 0 if otherwise. Ruling governments are reported as using the subsidy programs to either reward their loyal supports or to lure voters in opposition constituencies.

Eco-zone represents the role of farmer's geographical location on access to fertilizer subsidy. It is a dummy variable with 1 if the farmer is in the Guinea-Savanna zone and 0 if otherwise. [6] reported that farmers in the Northern part had more subsidy coupons, therefore this variable is expected to be positive if farmers in the Guinea savanna zone have more access to the GFSP.

Marketing of maize by the farmer is captured by a dummy equal to 1 if the farmer sold some maize. Farmers that sell maize are potentially net maize sellers and therefore food secure [14].

4. RESULTS AND DISCUSSION

4.1 Descriptive Statistics

Tables 3 and 4 are the descriptive statistics of the variables used in the econometric analyses. Table 3 shows a comparison of means between farmers who have access and those who do not have. Table 4 shows categorical variables used in the econometric models.

Table 3 shows that access to fertilizer subsidy is low (42.6%). The data show significant average differences between farmers who have access and those who do not in terms of age, household

size and quantity of commercial fertilizer. The t-test results, suggest for both groups an ageing farmer population, thus, the much youthful generation is moving to more lucrative and higher paying ventures in the non-farm sectors. The results further show that those who have access to the GFSP have an average of about 2 years of than those who do not have access. However, farmers who have access to the GFSP have an average of about 2 household sizes and bought 124 kg of commercial fertilizer, less than those who do not have access to the GFSP. The significant difference in household size shows that those who have access have small family size. The results further show a negative difference of GH¢ 3, 229.5 between those who have access to the GFSP and those who do not. This indicates that, the subsidy is accessed largely by poorer households who have few assets or livestock. The negative difference in quantity of commercial fertilizer implies that those who do not have access to the GFSP access fertilizer at the commercial rates.

Table 4 presents a chi-square test of the categorical variables in the econometric models. The results show significant differences in sex, household headship and political power (NDC won) between those who have access to the program compared to those who do not. More males are reported to have accessed the program than females. This reflects the fact that the distributions of the subsidy passbooks favor men, who are household heads and participate in decision making. Also, household heads are more likely to get the subsidy passbooks and likewise those who voted at polling stations where the ruling party (NDC) won. Household heads participate in decision making in communities and have privileged information on the existence of subsidies and how to access the

Table 3. Comparison of means between farmers who have access and farmers who do not

Variable	Access (N=150 0r 42.6%)	No access (N=202 or 57.4%)	Difference (Access-no access)	T-test
Age	41.82 (12.475)	39.52 (13.648)	2.3*	1.621
Household size	13.82 (5.847)	15.63 (5.055)	-1.81***	-3.106
Extension visits	0.85 (0.946)	0.83 (0.811)	0.02	0.213
Farm size	1.93 (0.893)	1.92 (0.911)	0.01	0.103
Time to retailer	55.45 (19.356)	56.47 (16.859)	-1.02	-0.527
Livestock value (GH¢)	2183.00 (361.599)	5412.51 (115.956)	-3229.51***	-34.127
Commercial fertilizer (kg)	165 (197.701)	288.61 (257.125)	-123.61***	-4.908

Numbers in parentheses are standard deviations.
*, ** and *** represent significance at 10%, 5% and 1% respectively

Table 4. Chi-square tests of categorical variables in the models

Variable	Categories	Access	No access	X^2
Sex	0=Female	53 (35.3)	114 (56.4)	15.37***
	1=Male	97 (64.7)	88 (43.6)	
Household headship	0=No	51 (34.0)	117 (57.9)	19.74***
	1=Yes	99 (66.0)	85 (42.1)	
Education (Formal)	0=No	130 (86.7)	171 (84.7)	0.28
	1=Yes	20 (13.3)	31 (15.3)	
Credit Access	0=No	130 (86.7)	171 (84.7)	0.28
	1=Yes	20 (13.3)	31 (15.3)	
NDC won	0=No	36 (24.0)	163 (80.7)	112.59***
	1=Yes	114 (76.0)	39 (19.3)	
Eco-zone	0=Transition	55 (36.7)	75 (37.1)	0.01
	1=Guinea-Savanna	95 (63.3)	127 (62.9)	
Maize marketing	0=No	39 (26.0)	41 (20.3)	1.59
	1=Yes	111 (74.0)	161 (79.7)	

Numbers in parentheses are column percentages.
*, ** and *** represent significance at 10%, 5% and 1% respectively.

passbooks. Also, farmers in the communities where the ruling government won will benefit from subsidies if the government uses the subsidy as a reward to its loyalists.

4.2 Econometric Results

Table 5 presents the probit and the tobit regression estimates of factors that determine access to the GFSP. The marginal effects (dy/dx) of the determinants of receiving a fertilizer subsidy passbook are reported for the probit model.

The result of the probit model explains about 38% of the factors that determine access to the GFSP as indicated by the Pseudo R^2. The Wald X^2 statistics of 183.92 and 208.52 in Table 5 show that we reject at the 1% significance level, the null hypothesis that the marginal effects of the probit model and the coefficients of the tobit model respectively, are equal to zero.

The results show that male-headed households, household heads, extension visits, marketing of maize and political influence increase the probability of access to the GFSP by 41%, 18%, 11%, 14% and 58% respectively.

Thus, female farmers have less probability of access to the program and receive fewer quantities of subsidized fertilizers than their male counterparts. Being a male farmer increases farmers' probability of access to the GFSP by 41% and being a male farmer increases the quantities of the fertilizers the farmers receive by as much as 184 kilograms as indicated by the tobit results. These findings reveal discrimination against women who constitute the majority of

Ghana's population and also undermine efforts towards empowering women to improve agricultural productivity. The finding is consistent with the study by [14] which revealed that male headed households have positive probability of access to subsidy.

Generally, awareness of the subsidy program increases probability of access to the subsidy. Extension officers usually disseminate information on modalities for accessing the GFSP. Therefore, it is not surprising that farmers who had more contact with extension officers had a higher probability of accessing subsidized fertilizer. The results show that number of extension visits has the a priori positive sign and thus, an additional extension visit increases farmer's probability of accessing the GFSP by 11%. The tobit model also shows a positive relationship between the quantity of subsidized fertilizer and extension visits. The results show that increasing extension visit by one will increase farmers' access to the subsidized fertilizer by 33 kilograms.

The effect of politics on the targeting of subsidy programs in Africa and Ghana cannot be underestimated. The results show that political influence increases farmer's probability of access to subsidized fertilizer by as much as 58%. The tobit results indicate that farmers who voted at the polling station where the government in power (NDC) won have as much as 220 kilograms (equivalent to of about 5 bags of the subsidized fertilizer) more than those who voted at polling stations where the government lost. These findings are consistent with the findings of [7] that places where the ruling government won in their last election had received more

Table 5. Econometric results of determinants of access to the GFSP

Variable	Probit model			Tobit model		
	dy/dx	Std. Err.	P>|z|	Coef.	Std. Err.	P>t
Constant	-0.481	0.49	0.327	-214.8648**	70.218	0.002
Age	0.001	0.003	0.663	1.076	1.044	0.304
Sex	0.411***	0.08	0.000	189.021***	33.123	0.000
Household headship	0.18**	0.074	0.015	4.265	27.184	0.875
Education	-0.366***	0.059	0.000	-13.362***	3.646	0.000
Household size	-0.018***	0.007	0.010	-4.885**	2.348	0.038
Extension visits	0.114**	0.05	0.023	32.933**	15.074	0.030
Farm size	0.084	0.064	0.193	84.041***	17.402	0.000
Time to retailer	-0.008***	0.003	0.001	-3.424***	0.706	0.000
Log Livestock value	-0.008	0.01	0.427	4.631	3.532	0.191
Commercial Fertilizer Quantity (kg)	-0.001***	0.0002	0.001	-0.398***	0.07	0.000
Credit Access	-0.007	0.107	0.946	-5.407	39.106	0.890
NDC won	0.578***	0.054	0.000	219.888***	26.341	0.000
Eco-zone	0.078	0.069	0.259	25.973	25.339	0.306
Marketing of maize	0.139*	0.079	0.077	99.29***	30.758	0.001
Number of observations	**352**			**352**		
Pseudo R-Square	**0.38**			**0.09**		
LR Chi-square (14)	**183.92***			**208.52***		
Sigma				**171.83**	**10.71**	

*, ** and *** represents significance at 10%, 5% and 1% respectively

fertilizer subsidy coupons in Zambia than places where the government lost and contradicts earlier study by [6] that government supplied more fertilizer to opposition strong holds in effort to win more votes.

Similarly, farmers that engage in maize marketing are more likely to access fertilizer and increase their probability of receiving the fertilizer subsidy by 14%. This implies that subsidized fertilizers are likely to be received by smallholder farmers who engage in maize production for both cash and subsistence. The results of the tobit model also indicate that engaging in maize marketing increases the quantity of subsidized fertilizers by 99 kilograms. These findings are also consistent with the literature on a subsidy of fertilizer [14].

Contrary to our expectation, educated farmers are less likely to have access to the program. Farmers with formal education have 37% less likelihood of access to the program. Also, those who have formal education receive 13 kilograms of fertilizers less than farmers without formal education. This could be as a result of the lack of interest by elites in farming in their pursuit of white-collar job.

Moreover, this study reveals that large households are less likely to receive subsidized

fertilizer. The probit results show that the probability of a household receiving subsidized fertilizer reduces by 2% as household size increases by one person while the tobit results show that as households increase by one person, the quantity of subsidized fertilizer received by farmers reduces by 5 kilograms.

Consistent with the findings of [14] who found that households that bought fertilizer at the commercial rate in the past season had a less probability of access to subsidy coupons marginally by 0.02%, this study finds that buying fertilizer at the commercial rate reduces the probability of a farmer's access to fertilizer subsidy marginally by 0.1%. In the tobit results, increasing the quantity of commercial quantity by one kilogram decreases the quantity of subsidized fertilizer by 0.4 kilograms. This implies that the subsidy is targeted at farmers who cannot buy fertilizer at the commercial rate. This result may then imply that the implementation of the GFSP does not crowd out private fertilizer suppliers.

The distance to the source of input is hypothesized to have an inverse relationship with the ability to acquire such inputs. Time taken to the nearest fertilizer subsidy retailer as expected has a negative sign. The result implies that as the distance to the nearest fertilizer retailer

increases, the probability of accessing subsidized fertilizer decreases by 0.8%. The results of the tobit model indicate that a minute increase in distance to the nearest fertilizer retailer will decrease the quantity of subsidized fertilizer the farmer receives by 3 kilograms. This confirms the assertions of [25] that the level of concentration of the fertilizer retailers affects access to the subsidy program.

5. CONCLUSIONS AND RECOMMENDA-TIONS

This paper sets out to evaluate the determinants of access to the Ghana Fertilizer Subsidy Program. The government is continuously pumping in more of agricultural sector budgetary allocations into subsidies as it has become the main tool of government in its effort to improve fertilizer use, farm-level productivity, levels of food security and poverty rates amongst others. It is also used as a political tool to reward citizens who vote for the ruling party or wow potential and swung voters. Unlike other countries that run this program, Ghana has no clear targeting criteria and hence the need for the determination of these factors. Existing studies have raised doubts over the program's ability to achieve the stated objectives.

This study revealed several findings with implications for the targeting of fertilizer subsidy program. Despite government's continuous investment in subsidy policy, this study finds that access to the program is low. Also, women are discriminated against in the targeting of subsidy benefits in the midst of high political influence in access to the GFSP. Moreover, distance to the nearest fertilizer retailer, which measures the proximity of farmers to the source of subsidized fertilizer reduces access to the subsidy program.

We therefore recommend that deliberate efforts must be made to increase access of women small holder farmers to the program. Women constitute 50.3% of Ghana's population and said to be vulnerable. If they receive a fair share of the subsidy benefit, they will be empowered economically to improve agricultural productivity and reduce poverty rates among smallholder farmers. This will automatically empower them politically and socially since research has shown that economically empowered women do take part in decision making. Also, private fertilizer retailers must be incentivized by government to establish retail points close to smallholder farmers. This will reduce the distance to the

fertilizer sales point and hence improve farmers' access to fertilizer.

ACKNOWLEDGEMENTS

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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