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Research Article

Chemical Fertilizer Subsidy and Maize Production in Ashanti Region

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Abstract: This study examined the effects of fertilizer subsidy on maize production in the Ejisu-Juaben and Ejura Districts. Primary and secondary data were collected for the study from 300 randomly sampled maize farmers. Descriptive and inferential statistics were used to analyse the data. The study revealed that there was a considerable positive effect of the subsidy on maize production, as there had been an increase in the quantity of fertilizer applied after the subsidy when compared to those applied before the subsidy with the average total quantity of fertilizer applied increasing from 23.42kg per acre before the subsidy to 68.338kg per acre after the subsidy was implemented. Consequently, there had been an increase in maize yield from 309kg per acre to 498kg per acre after the subsidy and farm sizes increased averagely from 3.26 acres to 3.91 acres after the subsidy. There had been a significant reduction of the price of a 50kg bag of fertilizer from an average of ¢49 to ¢26. Challenges faced by the farmers included the high cost of other inputs; late arrival of the subsidized fertilizer; low prices for produce; and access to credit from formal financial institutions. For sustained maize production, the fertilizer subsidy should be continued, but on the condition that it reaches the farmers on time. In addition the farmers should be assisted with credit to enable them buy the subsidized fertilizer.

Keywords: Chemical fertilizer, Subsidy, Maize, Ejura, Ejisu-Juaben Municipality, Ghana.

INTRODUCTION

Agriculture is a key economic sector to many African countries as it employs most of the rural population and contributes significantly to household income, gross domestic product (GDP), foreign exchange earnings, food and nutritional security. Food production in Africa suffers from numerous constraints, including diminishing arable land due to urbanization and land degradation, a weak land tenure system, declining soil fertility, limited irrigation facilities and dwindling water resources, climate variability, unimproved planting materials, low access to credit, poor marketing and distribution system and, above all, the high cost of agricultural inputs, particularly fertilizer (Croppenstedt *et al.*,, 2003; Alfsen *et al.*,, 1997). The higher rate of soil fertility decline and consistent lower crop yields necessitate increased use of inorganic fertilizer in Africa (Alfsen *et al.*,, 1997; Xu *et al.*,, 2009; Larson, 1993). However, the high cost of inorganic fertilizer and inadequate or lack of credit prevents farmers, particularly small-holder farmers who are resource-poor and predominantly within the low income bracket, from using the required levels of fertilizer to boost crop production to a satisfactory level (Awunyo-Vitor & Al-Hassan, 2014). In 2006, the average use of inorganic fertilizer in Africa was 8 kg/ha compared to 73 kg/ha in Latin America and 135 kg/ha in Asia (MOFA, 2008).

In Ghana, fertilizer is primarily used on cash crops like cotton, palm oil and cocoa. Maize accounts for about 40 percent of non cash-crop fertilizer use (FAO, 2005). During the 1970s and early 1980s, fertilizer consumption in Ghana rose rapidly with various agricultural support programs including fertilizer subsidies (FAO, 2005). However, between the late 1980s and the 1990s, there was a substantial decrease in fertilizer consumption, likely due to the withdrawal of subsidies beginning in 1987, economic hardship, and the depreciation of the cedi. Fertilizer consumption began to increase again in the late 1990s as the national economic situation improved but fell again due to depreciation of the cedi. It began to recover once more with improvement in the national economy and by 2002 fertilizer consumption was raised again. Nonetheless, present per hectare application rates in Ghana are at half the level of Sub-Saharan Africa and at a quarter of the level of Africa as a whole (FAO, 2005).

The constraints of agriculture production collectively undermine the sustainability of food security in particular and agricultural productivity in general. Food production in Africa is predominantly undertaken by small-holder farmers, with farm sizes barely larger than two hectares. This situation, in combination with other factors, has resulted in food production consistently lagging behind population growth. The deficit in food supply is balanced by imports. However, the reliance on food imports to balance expected food supply deficits by the year 2020 may not be economically sustainable (Heisey & Mwangi, 1996; Mwangi, 1995). This raises the imperative for increased domestic food production and justifies the call for a green revolution in Africa. High input of inorganic fertilizer has been a key component of Green Revolutions around the world (Kelly *et al.,*, 2003; Tomich *et al.,*, 1995; Kherallah*et al.,*, 2002; Viyas, 1983; Reuler & Prins, 1993). Even though fertilizers are purchased at a subsidized price, it is however noticed that even upon the application, our maize farmers do not obtain optimum yields for the fertilizer applied and thus, the need for this research. Under traditional production methods and rain fed conditions, yields are well below their attainable levels – maize yields in Ghana average approximately 1.5 metric tonnes per hectare. However, yields as high as 5.0-5.5 metric tonnes per hectare have been realized by farmers using improved seeds, fertilizer, mechanization and irrigation (MIDA, 2011). The primary objective of this study was to assess the effect of chemical fertilizer subsidy on maize production in the Ejura and Ejisu-Juaben districts.

LITERATURE REVIEW

Effects of Fertilizer Subsidy

Agricultural input subsidies have long been used to promote smallholder farmers' use of inputs, increase wages, reduce food prices, and promote economic growth (Crawford *et al.,*, 2003). Agricultural subsidies basically deal with all subsidies in the agriculture sector that is meant to reduce the cost or indirectly increase the profits of the agricultural sector.

Most often agricultural subsidies are controlled by the government, which in turn put private input dealers out of business as most farmers would prefer the subsidized inputs (Kydd & Dorward, 2004). This lowers the activities and performance of private dealers in the input industry. Governments in both developed and developing countries however intervene in agriculture with a view to achieving a wide range of economic and social objectives. Some of the most cited reasons for intervention are self-sufficiency, employment creation, support small-scale producers for adopting modern technologies and inputs, reduce price instability and improve the income of farm households (Vivay & Thaker, 2009).

This intervention can take a number of forms such as import policies, export policies and domestic policies like price support programmes, direct payments, and input subsidies to influence the cost and availability of farm inputs, like credit, fertilizers, seeds, irrigation water and labour. Of all domestic support instruments in agriculture, input subsidies and product price support are the most common. Various benefits are cited in justifying input subsidies: economic, environmental and social (World Bank, 2008).

Recent years have seen the re-emergence of fertilizer subsidies in the agricultural strategies of countries in Sub-Saharan Africa (SSA). The Malawian government pioneered the return to large-scale subsidies in 1998 when it started distributing free fertilizer after having discontinued similar programs in the early 1990s. The Nigerian government, which had halted its decades-long involvement in fertilizer subsidization, procurement, and distribution in 1997, resumed its major role in the fertilizer sector in 1999. In 2000, the Zambian government instituted the Food Security Pack program, in which it distributed seeds and fertilizer to households. The Tanzanian state returned to subsidizing fertilizer in 2003 and since 2008 has employed a voucher-based scheme. In 2006, Kenya, which has been touted for successfully developing private agricultural input markets through effective implementation of liberalization policies, also launched a fertilizer subsidy program. In 2008, the government of Ghana instituted a national voucher-based fertilizer subsidy after having been absent from active participation in the sector since liberalization in 1991 (Banful, 2010).

The global food crisis of 2007/2008 was a source of major concern all over the world and politically destabilized a number of governments. Governments responded to the crisis in many different ways. In Ghana, the government implemented a fertilizer subsidy programme in 2008 to promote the domestic production of agricultural output. The subsidy programme involves a number of innovations in programme implementation in order to achieve its objectives (Banful, 2009). The objectives of input promotion strategies have typically been articulated in the following terms:

First, to boost agricultural productivity by reducing the cost and/or increasing the supply of inputs and optimizing input used by the farmers. The above could be achieved via the use of farm inputs in the right quantity at the right time (Awunyo-Vitor *et al.,*, 2014; Ellis, 1992). Furthermore it was to avoid wrong choices concerning fertilizer types, use rates, or combinations based on trial-and-error decision-making by farmers (although an improved understanding of farmer circumstances might show that the choices are not necessarily wrong). Of course, determining economic prices is not always straight forward (Crawford *et al.,*, 2003).

The importance of fertilizers to agricultural production has made promotion of fertilizer use an important aspect of national policy in India. Almost all developing countries (including India) have, at various times and to different degrees, subsidized fertilizers. Subsidies have been widely used to stimulate increased fertilizer use and thereby bring about increased production and yields (Viyas, 1983). The effect of fertilizer subsidy would be under the following sub-headings: quantity of fertilizer applied; farm sizes; the cost; and yields.

Quantity of Fertilizer Used

Chibwana *et al.,* (2010), after conducting the study, "Land allocation effects of agricultural input subsidies in Malawi" in Central and Southern Malawi in which households were given coupons for subsidized fertilizer and improved seeds, found that households that did not receive any coupons used less fertilizer, as did those that received seed only. In addition, receipt of a complete packet of coupons (100 kg fertilizer and seed) is correlated with 46kg greater use of fertilizer on average than those that did not receive any. Unsurprisingly, households that received a seed coupon and more than two fertilizer coupons used more fertilizer. Overall, the results suggest that the Fertilizer Input Subsidy Programme increased fertilizer use among benefiting households, which is consistent with the findings of Ricker-Gilbert and Jayne (2008) in "The impact of fertilizer subsidies on national fertilizer use: an example from Malawi" that the Fertilizer Input Subsidy Programme led to an increase in fertilizer use.

The effect of fertilizer subsidy on farm sizes is mixed. In some studies it has led to an increase in farm size while in other studies it has led to a reduction in farm size. Kaliba*et al.,* (2010) in the study, "Factors affecting adoption of improved maize seeds and use of inorganic fertilizer for maize production in the intermediate and lowland zones of Tanzania" found that the relationship between farm size and fertilizer use intensity is negatively related, implying that the more fertilizer a farmer uses the smaller the farm size he will cultivate or the larger the farm size, the less quantity of fertilizer used. This means that the effect of the subsidy will be negatively related to farm size as it makes fertilizer available at a cheaper cost, leading to an increase in quantity of fertilizer applied. As the quantity of fertilizer applied increases, their yield per farm size correspondingly increase causing them to reduce their acreage as they get more yields per the same farm size.

While Chibwana *et al.,* (2010) found that farmers with a complete set of subsidy coupons (fertilizer and seed inclusive) increased the area allocated to maize during the 2008/9 agricultural season by 16%. The subsidy reduced the price of fertilizer meaning that farmers could take advantage of the saving to cultivate more acreage.

Fertilizer application by farmers

Generally the application of fertilizer is less than the recommended rate of 250kg/ha of NPK and 125kg/ha of sulphate of ammonia fertilizer for maize production in Ghana (Aikins*et al.,*, 2010). Without the use of fertilizer, yields are usually less than one tons per hectare and with the application of the recommended rate of fertilizer, maize yields in Ghana average approximately 1.5-3.0 metric tonnes per hectare. However, yields as high as 5.0-5.5 metric tonnes per hectare have been realized by farmers using improved seeds, fertilizer, mechanization and irrigation (MIDA, 2011).

There are usually problems associated with the distribution and access to subsidized fertilizer by small-holder farmers in fertilizer subsidy programmes that have been implemented in many countries (Yawson *et al.,*, 2010). Findings from the study on "Ghana's Fertilizer Subsidy Policy: Early Field Lessons From Farmers" carried out in the Central Region of Ghana indicated that, even with the subsidy, the price of fertilizer still means in is unaffordable to the majority of farmers. This clearly shows that cost is still a major constraint for farmers accessing the subsidized fertilizer.

Late arrival of subsidized fertilizer was found to be another constraint as a good number of farmers complained of not getting the coupons on time coupled, with difficulties with the availability of coupons and fertilizers. According to Croppenstedt *et al.,* (2003), the chaotic and untimely fertilizer supply is one of the most important reasons for non-adoption of fertilizer subsidy programs by farmers and this is definitely prejudicial to the sustainability of the program. Moreover, the availability of coupons and the delivery of the fertilizers are not synchronized to allow effective access to the program. Consequently, the delays in fertilizer availability lowered the effectiveness of the fertilizer due to late application and the decline in the farmers' motivation to use the subsidized fertilizer.

Banful (2010) stated that the distribution of Ghana's subsidized fertilizer in 2008 through the coupon system was politically biased. As she found out, politics played a significant role in the allocation of vouchers. Higher numbers of vouchers were targeted to districts that the ruling party had lost in the previous presidential elections. She therefore cautions that, despite innovations in implementing fertilizer subsidies, politically motivated allocation of subsidy benefits remains a major potential source of inefficiency.

According to Buffie and Atolia (2009), some of the constraints faced by the fertilizer subsidy program are as a result of administrative inefficiencies. Almost all fertilizer subsidies normally target the small scale farmers but most often, a large fraction of fertilizer subsidies miss the target group and end up with medium and large-scale farmers who are better positioned to purchase fertilizer.

Another constraint that is far beyond human control is poor rainfall. Success of the fertilizer subsidy program in Africa largely depends on adequate amount of rainfall. Therefore, several studies on fertilizer subsidy in Malawi revealed that success of the programme in 2007 farming season was partly due to the good rains. It stands to reason that, even when all inputs are applied in the optimum quantity, without rain it will not yield any result (Chinsinga, 2007).

METHODOLOGY

Multistage sampling was conducted to select two (2) municipalities, 10 communities and 300 maize farmers for the study. Selection of the districts and communities were done using official statistics from Ministry of Food and Agriculture (MoFA) (2009). The districts whose maize production output in 2008 exceeded 20,000 metric tonnes were selected for the study. A third stage sampling involved identifying and listing maize farmers in the operational area. Selection of respondents was guided by their involvement in maize production. A total of 1200 maize farmers were sampled for the study. A questionnaire was administered to the sampled farmers. The survey questionnaire contained detailed sections on demographic and socioeconomic characteristics of the farmers, household characteristics, maize cultivation activities, and use of fertilizer before and after the subsidy.

The number of respondents was estimated using the estimation method given by Yamane (1967) as:

$$n = \frac{N}{1 + N(e)^2}$$

Where n is the sample size; e = error level; e = 1 – confidence level and N is the sample frame. Assuming a 95% confidence level, e = 0.05 the sample size of 300 was calculated based on the sample frame of 1200 maize farmers for the two assemblies. The sample was proportionally distributed among the two municipalities.

Analytical Framework

Descriptive statistics such as frequency tables and percentages were used to display the demographic characteristics, fertilizer application levels, yields, the cost of farm size and the constraints of the respondent farmers before and after the subsidy. The differences in fertilizer application levels yields farm size of the respondent farmers before and after the subsidy were statistically tested using the paired t-test.

Furthermore, Kendall's Coefficient of Concordance (W) was used to rank the key issues that the respondents deemed to be constraints to maize production in the study area. This measure ranges between 0 and 1 and it can be derived by determining the sum of rank for each constraint being ranked and was represented by T. The variance of the sum of ranks was measured by:

$$Var_T = \frac{\sum T^2 - {(\sum T)^2}/{n}}{n} \qquad [2]$$

Where Var denotes variance and n denotes the number of the constraints being ranked by the farmers. The maximum variance of T is specified as:

$$m^2\,{(n^2 - 1)}/{12} \qquad [3]$$

Where m is the sample size. The formula for Kendall's coefficient of concordance (W) is given by:

$$W = \frac{\left(\sum T - {(\sum T)^2}/{n}\right)/n}{m^2 * {(n^2-1)}/{12}} \qquad [4]$$

By simplifying equation 4 above result in the computational formula for Was:

$$W = \frac{12[\sum T^2 - (\sum T)^2/n]}{mn^2(n^2-1)} \qquad [5]$$

SPSS statistical package was used to analyze the data collected from the field.

RESULTS AND DISCUSSION

Demographic Characteristics of Respondents

Table 1 presents demographic characteristics of the respondents. From the table, the majority of the respondents were males (59%) with females making up 41%. This implies that there is gender inequality in agriculture and this is the reason why most governments and the Bill and Melinda Gates foundation have put in place strategies to increase female involvement in the agricultural sector (World Bank, 2008). About 47% of the respondents were within the age range of 31-40 years, 29% of the respondents were within the age range of 41-50 years, 19% of the respondents were within the age range of 51-60 years, 4% of the respondents were within the age range of 61-70 years and 1% of the respondents were within the age range of 21-30 years. The mean age of 43.28 years shows that most of the respondents were within their working years, which is consistent with the working age group of the Ejisu-Juaben Municipality, namely 15-64 years (Ejisu-Juaben, 2012).

Table 1: Socio-Economic Characteristics of the Respondents

Gender		**Frequency**	**Percentage (%)**
	Male	177	59
	Female	123	41
Total		300	100
Age in years		Frequency	Percentage (%)
	21-30	3	1
	31-40	141	47
	41-50	87	29
	51-60	57	19
	61-70	12	4
Total		300	100
Mean		43.28	
Educational Level		Frequency	Percentage (%)
	No formal education	189	63
	Basic education	84	28
	Senior high school	24	8
	Tertiary	3	1
Total		300	100

In all, 63% of the farmers who were interviewed had no formal education, 28% of them had basic school education, 8% had senior secondary/high school education and 1% of the farmers interviewed had tertiary level formal education from Kwadaso Agricultural College. This shows that most of the farmers in the Municipality are not formally educated. Research has shown that the more educated you are, the more you use fertilizer, as fertilizer usage is positively correlated with education (Bayite-Kasule, 2011).

Distribution of Respondents by Farming Experience

Table 2 presents maize cultivation experiences of the respondent in years, revealing that 46% of the respondents had 11-20 years farming experience, 26% of the respondents had 1-10 years farming experience, 21% of the respondents had 21-30 years farming experience, 6% of the respondents had 31-40 years of experience and 1% of the respondents had above 40 years of experience.

Table 2: Distribution of Respondents by Farming Experience

Years of experience	**Frequency**	**Percentage (%)**
1-10	78	26
11-20	138	46
21-30	63	21
31-40	18	6
Greater than 40	3	1
Total	300	100
Mean	17.44	

The mean years of farming experience for the respondents was 17.44 years, which falls within 11-20 years of experience. Given this result, it would be expected that the farmers have acquired enough experience to enable them to succeed in farming because experience has shown that the longer one stays in an occupation the higher the skills derived (Udoh, 2011). Bayite-Kasule *et al.*, (2011) in the study “Fertilizer use among smallholder farmers in Uganda” found that fertilizer use is negatively related to years of farming experience, implying that the more experienced the farmer, the less fertilizer will be used due to the lack of information on fertilizer use on the part of farmers. This led to the inefficient use of fertilizer resulting in low yields, which led farmers to resort to increasing their yields through increasing acreages instead of an increase in fertilizer use.

Access to Extension Services by Respondents

Table 3 shows that 69% of respondent farmers do not have access to extension services with the remaining 31% having access to extension services.

Table 3: Access to Extension Services by Respondents

Access To Extension Service	**Frequency**	**Percentage (%)**
YES	93	31
NO	207	69
TOTAL	300	100

This means that most of the respondents do not have access to extension services and therefore do not use it, which is similar to the results of the survey conducted in 2009 in the municipality where it was found that 26.8% of farmers in the municipality used extension services while 73.2% did not use any extension services (Ejisu-Juaben, 2012). This implies that the transfer of new and improved technology from researchers to farmers is not effective as many of them do not have access to extension services and this would result in low productivity (Morris *et al.*,, 1999).

Rate of Fertilizer Application before and After Introduction of Subsidy

Table 4 presents the rate of Sulphate of Amonia application before and after the introduction of the fertilizer subsidy; specifically that before the subsidy 71% of the respondent farmers applied between 1kg and 25kg of sulphate of ammonia fertilizer per acre while 28% did not apply sulphate of ammonia at all. Eleven percent of the respondents also applied between 26kg and 50kg of sulphate of ammonia fertilizer per acre. After the subsidy, 68% of the respondents applied between 1kg and 25kg of sulphate of ammonia fertilizer per acre while 23% of them applied between 26kg and 50kg per acre and 11% of the respondents applied no sulphate of ammonia fertilizer at all after the subsidy.

The mean quantity of sulphate of ammonia applied before the subsidy was 9.92kg/acre and 23.13kg/acre after the subsidy, which is statistically significant at 1% level of significance. . This figure is still below the recommended quantity of 50kg/acre of ammonia sulphate for maize production in Ghana (Aikins *et al.*,, 2010) and therefore respondents' yield will be low.

Table 4: Rate of Sulphate of Ammonia Application before and After Introduction of Subsidy

Rate of sulphate of ammonia kg/acre	Before subsidy frequency (%)	After subsidy frequency (%)
0.0	28	9
1.0-25.0	71	68
26.0-50.0	11	23
Total	100	100
Mean	9.92	23.13
T-test value	10.500**	

** means P is less than or equal to 0.01

Rate of Nitrogen Phosphorus Potassium (NPK) Fertilizer Application Before and After Subsidy Introduction

Table 5 presents the rate of NPK application before and after the introduction of the fertilizer subsidy. Table 5 shows that before the subsidy 89% of the respondent farmers applied between 1kg and 25kg of NPK fertilizer per acre, 10% of them applying between 26kg and 50kg of NPK fertilizer per acre and 1% applied no NPK fertilizer at all. After the subsidy, 75% of the respondent farmers applied between 26kg and 50kg of NPK fertilizer per acre, 22% of the respondent farmers applying between 1kg and 25kg of NPK fertilizer per acre, and 2% and 1% of respondents applied between 51-75kg and 76-100kg of NPK fertilizer per acre respectively. The mean quantity of NPK applied before the subsidy was 14.60kg/acre while the mean quantity of NPK applied after the subsidy was 46.26kg/acre.

Table 5: Rate of NPK Application before and After the Subsidy by Respondents

Rate of NPK kg/acre	Before subsidy frequency (%)	After subsidy frequency (%)
0.0	1	0
1.0-25.0	89	22
26.0-50.0	10	75
51.0-75.0	0	2
76.0-100.0	0	1
Mean	14.60	46.26
T-test value	18.150**	

** means P is less than or equal to 0.01

The average quantities of NPK applied before and after subsidy was introduced are 14.60kg/acre and 46.26kg/acre respectively and the difference between them is statistically significant at 1% level of significance. The mean quantity of NPK applied after the subsidy (42.26kg/acre) was still below the recommended quantity of 100kg/acre of NPK for maize production in Ghana (Aikins *et al.*,, 2010). This will therefore result in respondents getting lower yields.

Rate of Total Fertilizer Application before and After the Subsidy by the Respondents

The rate of total fertilizer application before and after the introduction of the subsidy by the respondents is presented in Table 6. Table 6 shows that, before the subsidy, 72% of the respondent farmers applied in total (i.e. both sulphate of ammonia and NPK) between 1kg and 25kg of fertilizer per acre, 20% of the respondent farmers applied between 26kg and 50kg of fertilizer in total per acre, 5% of them applied between 76kg and 100kg of fertilizer in total per acre and 2% and 1% of the respondent farmers applied between 51-75kg and 0.00 kg of fertilizer in total per acre, respectively, before the subsidy.

Table 6: Rate of Total Fertilizer Application Before and After the Subsidy by the Respondents

Rate of total fertilizer kg/acre	Before subsidy frequency (%)	After subsidy frequency (%)
0.0	1	0
1.0-25.0	72	4
26.0-50.0	20	23
51.0-75.0	2	49
76.0-100.0	5	21
101.0-125.0	0	2
126.0-150.0	0	1
Mean	23.42	68.34
T-test value	13.917**	

** means P is less than or equal to 0.01

After the subsidy, 49% of the respondent farmers applied between 51kg and 75kg of fertilizer in total per acre, 23% of the respondent farmers applied between 26kg and 50kg of fertilizer in total per acre, 21% of the respondent farmers applied between 76kg and 100kg of fertilizer in total per acre and 4%,2% and 1% of the respondent farmers applied between 1-25kg, 101-125kg and 126-150kg of fertilizer in total per acre, respectively, after the subsidy.

The mean total quantity of 23.42kg/acre before the subsidy and 68.34kg/acre after the subsidy was significant at 1%. This indicates that there has been a significant increase in the quantity of fertilizer applied after the subsidy. This was consistent with the findings of Ricker-Gilbert and Jayne (2008) and Chibwana *et al.*, (2010) that fertilizer subsidy leads to an overall increase in fertilizer use among benefiting households. However, the mean total quantity of fertilizer applied after the subsidy was still below the recommended quantity of 100kg/acre of NPK and 50kg/acre of ammonia sulphate for maize production in Ghana (Aikins *et al.*,, 2010). This implies that respondents will get low yields from their production.

Maize Output of the Respondents before and After the Introduction of the Fertilizer Subsidy: Yields of Respondents

Maize yield of the respondents before and after the introduction of the subsidy is presented in Table 7. Table 7 shows that, before the subsidy, 66% of respondents had yields between 101kg and 300kg per acre, 33% getting yields between 301kg and 500kg per acre and just 1% of the respondents getting yields between 501kg and 700kg per acre before the subsidy.

Table 7: Yield of Respondents Before and After the Subsidy

Yield in kg/acre	Before subsidy frequency (%)	After subsidy frequency (%)
101-300	66	0
301-500	33	73
501-700	1	25
701-900	0	2
Mean	309	498
T-test	30.938**	

** means P is less than or equal to 0.01

After the subsidy, 73% of the respondents had yields between 301kg and 501kg per acre, 25% of the responding farmers had their yields between 502kg and 702kg per acre and 2% of them getting yields between 703kg and 903kg per acre after the subsidy. The mean yield of 309kg/acre before the subsidy and 498kg/acre after the subsidy was significant at 1%. This is similar to the result in Malawi (Chinsinga, 2007) where fertilizer subsidy resulted in an increase in yield. However, the increased yields were still below the expected yield of 1.5-3.0 tonnes per hectare (MIDA, 2011) due to the low rates of application and poor rains as reported by most of the farmers.

Farm Sizes of Respondents Before and After the Introduction of Fertilizer Subsidy

A farm size of the respondents prior to the introduction of the fertilizer subsidy and after the subsidy is presented in Table 8. The result indicated that, before the subsidy, 53% of the respondents had farm sizes between 0.5-2.5 acres, 29% of the respondents had farm sizes between 2.6-4.6 acres, 9% of the respondents had their farm sizes between 4.7-6.7 acres and 3%, 2% and 1% of the respondents had their farm sizes between 19.4-21.4 acres, 6.8-8.8 acres and 8.9-10.9 acres of land, respectively, before the subsidy (Table 8).

After the subsidy, 44% of the respondents had farm sizes between 0.5-2.5 acres, 32% of the respondents had farm sizes between 2.6-4.6 acres, 14% of the respondents had their farm sizes between 4.7-6.7 acres and 4%, 3%, 2% and 1% of the respondents had their farm sizes between 8.9-10.9 acres, 6.8-8.8 acres, 19.4-21.4 acres and 29.9-31.9 acres of land, respectively, after the subsidy.

Table 8: Farm Sizes of Respondents Before and After the Introduction of the Fertilizer Subsidy

Farm sizes in acres	Before subsidy frequency (%)	After subsidy frequency (%)
0.5-2.5	53	44
2.6-4.6	29	32
4.7-6.7	11	14
6.8-8.8	2	3
8.9-10.9	1	4
19.4-21.4	3	2
29.9-31.9	0	1
Mean	3.36	3.96
T-test value	4.286**	

** means P is less than or equal to 0.01

The mean farm size of 3.36 acres before the subsidy and 3.96 acres after the subsidy was significant at 1%. This is similar to the findings of Chibwana *et al.*, (2010) in their study 'Land allocation effects of agricultural input subsidies in Malawi' conducted in central and southern Malawi, where they found that farmers with a complete set of the subsidy coupon (fertilizer and seed inclusive) was associated with a 16% increase in the area that farmers allocated to maize during the 2008/9 agricultural season. This implies that farmers increase their farm sizes to increase their yields.

Constraints Farmers Face in Accessing the Subsidized Fertilizer

Table 9 presents the constraints faced by the farmers in accessing the subsidized fertilizer. The table revealed that 63% of the responding farmers said cost was their constraint, 23% had no constraint and 14% of the respondents had the time of arrival as their constraint. This was not different from the study of Yawson *et al.*, (2010) who found that, even with the subsidy, the price of fertilizer was still not affordable to the majority of the farmers.

Table 9: Constraints Farmers Face in Accessing the Fertilizer Subsidy

Constraint	Frequency (%)	Rank
Cost of fertilizer	63	2
Time of arrival	14	1
No constraints	23	3
Kendell's Coefficient of Concordance	0.687(68%)	

The result clearly shows that cost is still a major constraint to farmers accessing the subsidized fertilizer. The late arrival of subsidized fertilizer was another constraint that a good number of farmers complained of. The implication of this chaotic and untimely subsidized fertilizer supply is the non-adoption of this programme by farmers (Croppenstedt *et al.*,, 2003). However all respondents stated that their main constraint was rainfall as they could apply the recommended quantity and still get low yields due to poor rainfall.

CONCLUSION AND POLICY IMPLICATIONS

Based on the findings of the study, there has been a significant increase in the quantity of fertilizer applied by respondents after the subsidy; but application rates are still below the recommended rates. The subsidy has led to a significant increase in the respondents' yields but it was still below what was expected. Furthermore, there was a significant increase in the farm sizes of respondents, which can be attributed to the introduction of the fertilizer subsidy. Despite the subsidy some farmers still perceive the price of fertilizer as too high for them to afford. Subsidized fertilizer is normally released to the market late and this has affected the programmed adversely.

From the study the following recommendations were made. The fertilizer subsidy should be maintained but the government should release funds and place orders for fertilizer from the fertilizer manufacturers to ensure the early arrival of the subsidized fertilizer. Farmers should be assisted with farm credit to enable them to purchase more of the subsidized fertilizer to apply the recommended quantity so that they could get a better yield, which will enable them to pay for the credit received. Farmers should also form cooperatives groups and associations to easily access subsidized farm inputs as well as get free training and extension services from the government.

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