Impacts of Farmer Inputs Support Program on Beneficiaries in Gwembe District of Zambia

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ABSTRACT

Since 2002, the Government of Zambia has been funding a farmer input subsidy program that consumes a very large part of the resources allocated to the Ministry of Agriculture and Livestock. This survey examines if the program is producing commensurate impacts on maize production by the farmers who benefit from the program. Data for the study was collected through a structured questionnaire administered to a sample of 600 farmers in Gwembe District. Though 600 copies of questionnaire were administered, 570 copies were recovered for analysis. Analysis was done using quantile regression at the 5th, 10th, 50th and 90th percentiles of the maize production distribution in two phases - with and without control for endogeneity. The analysis reveals that the largest production impact is on the farmers at the 50th percentile. There is also significant dependence on the subsidies by households at the 5th and 10th percentiles. These results cast doubt on the efficacy of the program to reduce poverty and improve household food security. The Zambian Government should target the program more selectively at the more responsive households in the median percentile.

Keywords: *input subsidy, maize production, quantile regression*

INTRODUCTION

In 2002, the Government of Zambia introduced a program aimed at subsidizing inputs to the small-scale farmers (Republic of Zambia, 2010). Initially known as the Fertilizer Support Program, it is today known as the Farmer Input Support Program (FISP) (Mbozi and Shawa, 2009). The Zambian Government over a period of ten years from 2002/2003 agricultural season to 2011/2012 agricultural season has been funding and running the fertilizer and seed subsidies to support maize production among the small scale farmers (Ministry of Agriculture and Livestock, 2012). The allocation of the budgetary support to the Farmer Input Support Program from the central treasury has been steadily increasing from the inception of the Program in 2002/2003 season through to 2011/2012 season (Fig 1). A Paper on Agriculture Case Study-Evaluation of Budget Support in Zambia (2010) compares the budgetary support to FISP and funding to the Ministry of Agriculture's core functions which are research and extension service delivery (Figure 2). It has been observed that in the four year period from 2001 to 2004, the Department of Agriculture expenditure increased at an average annual rate of 26.5% in nominal terms. However, over the same period, the annual rate of increase in the funds budgeted and spent on input subsidy program (FISP) increased much faster than the funds allocated to the Ministry's core functions which are research and extension service delivery (55.4%, compared with only 26.5% for the latter). This shows clearly that the Government of the Republic of Zambia placed greater importance on the implementation of the FISP, than on the other programs and general operations of the Ministry of Agriculture and Livestock (MAL). Between 2005 and 2010, an average of 95.6% of MAL expenditure was on the FISP while only 4.4% of the total expenditure in the same period was on the Ministry's core functions. However, the proportions fluctuated significantly, building up from a low base in the two early years of the program, 2001 and 2002 (Figure 2). Such pattern of expenditure which focused on the provision of subsidies was at variance with the National Agricultural Policy in place during the same period. It may be pointed out here that Zambia is not alone in making such allocations. In recent years, numerous other countries in Sub Saharan Africa including Ghana, Kenya, Malawi, Mali, Senegal and Tanzania have also implemented such programs at substantial cost to government and donor budgets (Baltzer, 2012, Dorward, 2009). For example, in 2008 Malawi spent roughly 70% of the Ministry of Agriculture's budget or just over 16% of the government's total budget subsidizing fertilizer and seed. In Zambia between 2004 and 2011, an average of 40% of the government's agricultural sector budget was devoted to fertilizer and maize seed subsidies each year (Nicole and Ricker-Gilbert, 2012). Meanwhile, the genetic advances that Government viewed as the major factors affecting maize production growth in earlier decades through research and provision of effective and regular extension services to the smallholder farmers have gradually declined and faded away as the core function of the Ministry, that is, research and extension service delivery by government has declined as shown in figure 2.

As a result of poorly funded research and extension service, maize production stagnated and in certain cases reduced significantly despite continuous and increased support to these small scale farmers in terms of subsidized inputs. The introduction of subsidies was premised on economic benefits to both producers and consumers. The important question, therefore, is whether these subsidies have any significant impacts on the benefiting farmers. This study intends to address this question. The specific objectives of the study are:

i To find out the impact of input subsidies on maize output of the beneficiary households after controlling for the size of the households, the sex of the heads of the households, the age of the heads of the households, the education level of the heads of the households;

ii To find out the effect of the input subsidies on households' dependence on subsidies in maize production; and

iii To draw policy implications on the need to continue or to discontinue with input subsidies from the empirical findings.

This study, therefore, intends to investigate the impact of the FISP on the benefiting households in terms of maize output and subsidy dependence by the benefiting households.

METHOD

The study adopted the survey research design. Data was collected by means of a questionnaire administered to 600 small scale farmers in randomly sampled 8 agricultural camps in Gwembe district. Cluster sampling method was used as the population is dispersed over a wide geographical area of the district. Also, a square root sample allocation method was adopted. Because of the missing responses to some items, the final sample dropped to 570 farmers, giving a participation of 95%. The questionnaire included questions about socio-economic variables such as the farmer's age, education of the head of household, household size, whether the head of the household was once employed or not and gender of the head of the household. All data relating to rainfall were obtained from the Meteorological Department in the district which was collected over the past four seasons (Meteorological Department, Gwembe 2012). The data thus collected include: the average cumulative annual rainfall over the past four growing seasons from 2008/2009 season to 2011/2012 season to model farmers' expectation; the standard deviation of rainfall over the past four years to give an estimate of rainfall variability; and cumulative rainfall over the growing season to account for rainfall's impact on production. We assume the maize yield for farmer (*i*) on field (*j*) at time (*t*) is a function of the following factors.

$$Y_{ijt} = f\left(F_{ijt}, S_{ijt}, O_i, L_{ijt}, |C_i\right) \qquad \text{..................................1}$$

Where

F_{ijt} = a vector of subsidized quantities of seed and fertilizer in kilograms used in field *j* in time t by farmer *i*.

S_{ijt} = a vector of agronomic conditions on the field that vary over time. These include rainfall. O_i indicates agronomic conditions on the field such as soil type, and nutrient content that stay roughly constant over time.

Lijt = the labor that farmer *i* used on field *j* in time *t*. This labour was used on various practices that include weeding and pest and disease management.

All of the factors that influence yield are represented in C_i, which represent factors like the farmer's management ability and risk aversion. Ability is a function of factors like experience and education while risk aversion may cause a farmer to under-apply an input like seed and/or fertilizer if he/she feels that it will not be profitable in a bad season. When other factors like soil type, farm size, rainfall, and management ability have been controlled for, farmers should all be on the same production function. Consider the following empirical specification for the factors affecting maize production for household (i) in district (j) at time (t):

$$Y_{ijt} = \beta_0 + \beta_1 S_{ijt} + \beta_2 X_{ijt} + \beta_3 T_t + C_i + \mu_{ijt} \qquad \text{.................................2}$$

where Y represents maize production estimated via supply response. The quantity of subsidized inputs that a household receives in time t is represented by *S*. Subsidized seed and fertilizer enter into the equation as quantity acquired by household i at time t in kilograms. Other factors that affect maize production, such as household demographics, assets and rainfall are denoted by the vector *X*. Shocks that are observable to the researcher such as rainfall are also included in *X*. Level of education for the household head is also included in *X*, in order to partially proxy for management ability. Soil quality is also partially controlled in *X* by including dummy variables for whether or not the household had a plot with sandy, clay or mixed soil, and dummy variables for whether or not the household had plots that were flat or sloped that were used to grow maize from subsidized inputs. Year dummies are denoted by T_t. The error term in the equation has two components. First, C_i represents the time-constant unobserved factors that affect maize production. Any factors affecting management ability not captured by the level of schooling variable and any soil quality factors not captured in the soil composition and field slope dummies end up in C_i. Second, μ_{ijt} represents the time-varying shocks that for the purposes of this research are assumed to be *i.i.d* normal.

Quantile regression which was first developed by Koenker and Bassett (1978) was used. Quantile regression uses a Least Absolute Deviation (LAD) estimator that minimizes the sum of absolute residuals rather than the sum of squared residuals as in Ordinary Least Squares (OLS) regression. As such quantile regression is less susceptible to extreme values in the sample than is OLS (Wooldridge 2011). This research estimates the equation for maize production as a linear model via quantile regression and compares those results with conditional mean estimates from OLS. Quantile regression allows seeing how subsidized inputs affect maize production. This helps in addressing the question of whether or not input subsidy programs can significantly boost maize production for those
μ at the bottom of the maize production distribution.

Controlling for endogeneity with quantile regression: The challenge of obtaining consistent parameter estimates in this research is that the observed covariates such as S_{it} may be correlated with the unobserved heterogeneity C_i in the maize production model. It is important to note that subsidized inputs are not distributed randomly. For example, it is possible that Co-operative Leaders may target the subsidy towards people who are better managers, or worse managers. In addition perhaps households with better soil quality, or worse soil quality could have been targeted to receive the subsidy. If management ability and/or soil quality affect maize production and at the same time these factors are correlated with receiving subsidized inputs, then the coefficient estimate on in equation 2 above will be biased. The first difference and fixed effects regression techniques control for correlation between covariates and unobserved heterogeneity in OLS estimation. Unfortunately, these estimation techniques have the problem of incidental parameters when using the quantile regression, so they cannot be used in this application (Wooldridge 2011). Hence in this case we use the Correlated Random Effects (CRE) estimators to deal with C_i in the context of non-linear estimators (Mundlak 1978; Chamberlain 1996). Recently, several studies have used a CRE related framework to control for unobserved heterogeneity using Quantile regression in a panel context. Abrevaya and Dahl (2008) used a framework related to CRE to estimate the effects of smoking and prenatal care on birth weights in the United States. Gamper-Rabindran, Khan and Timmins (2010) used a similar framework to estimate the effects of piped water on infant mortality in Brazil.

In this research, we implement the CRE framework to control for C_i by including a vector of variables containing the means for household *i* of all time-varying covariates in equation 2 above. These variables denoted as have the same value for each household in every year but vary across households. We estimate equation 2 with $\overline{x}_t$ included via quantile regression using the STATA software.

RESULTS AND DISCUSSION

Table 1 displays the descriptive statistics for the variables used in this analysis. The table shows that the mean maize production increased from 57Kg per household in 2008/2009 farming season to 112Kg per household in 2011/2012 farming season. Table 2 displays the results for factors affecting household-level maize production without controlling for correlation between covariates and unobserved heterogeneity. The column to the left of table 2 shows conditional mean estimates using Pooled OLS (POLS), and the columns to the right display the coefficient estimates at different points in the maize production distribution using Pooled Quantile Regression. Bearing in mind that the Pooled OLS and Pooled Quantile estimates assume that all covariates are uncorrelated with unobserved heterogeneity, C_i in equation 2, the conditional mean estimate of subsidized seed and fertilizer is positive and statistically significant at the 1% level, indicating that an additional kilogram of subsidized seed and fertilizer increases maize production by 3.77Kg on average. The mean effect of subsidized seed and fertilizer is much higher than the median effect of 2.87Kg, and is close to the marginal product estimate of 3.91Kg at the 90th percentile of the distribution. This result indicates that there is a wide variation in the response to subsidized seed and fertilizer across the maize production distribution. Households at the 5th percentile of the distribution only gain a 0.87kg marginal production of maize, per Kg of subsidized inputs, while households at the 90th percentile gain a marginal product of 3.91Kg per Kg of subsidized seed and fertilizer acquired.

The results on table 2 also show a negative coefficient for the age of the head of the household. This implies that an increase in age of the head of the household by one year reduces the maize yield by 4.94Kg. This could probably be that as the household head advances in age, the less the economic importance he/she attaches to profitable farming, particularly maize production. However, household head's education, household size and whether the household head was once in formal employment all have a positive relationship to maize production. The results show that an additional year of schooling by the household head increases maize yield by 22Kg and this is statistically significant at 1% level. The results also indicate that there is a wide variation in the response to various demographic variables across the maize production distribution. Households at the 5th percentile only gain a 5.58Kg for each additional year of schooling by the head of the household, 2.61Kg for male-headed household, 6.32Kg for additional larger households and 3.21Kg for households whose household head was once in formal employment and loses only 0.47Kg marginal production of maize for each additional year to the age of the head of the household respectively. However, households at the 90th percentile gain a marginal product of 69.65Kg from an additional year of schooling by the head of the household. Similarly, households at the 10th and 50th percentiles gain by 9.24Kg and 29.78Kg respectively for each additional year of schooling by the head of the household and both are statistically significant at 1% level. Households with more land also produce more maize, as an additional hectare of land boosts maize production by 133.2Kg on average and by 112Kg at the median, *ceteris paribus*. Table 3 also displays the results for factors affecting household maize production, but now controlling for correlation between covariates and unobserved heterogeneity using First Difference (FD) in conditional mean estimation, and Correlated Random Effects (CRE) in quantile estimation. Two interesting findings come out when comparing results for the marginal product of subsidized seed and fertilizer on table 3 where unobserved heterogeneity is controlled for and on table 2 where it is not controlled for. Once unobserved heterogeneity is controlled for, the impact of subsidized seed and fertilizer on maize production is much lower than when it is not controlled for. Conditional mean estimates using FD demonstrates that on average each additional kilogram of subsidized seed and fertilizer boosts maize production by 2.24Kg. This is significantly lower than the 3.77Kg on average on table 2. The quantile regression results on table 3 are also significantly lower across the maize production distribution than they are for the pooled quantile regression results on table 2.

One other important observation we can make from table 3 is that households at the lower end of the maize production distribution obtain a significantly lower response to subsidized inputs than do households at the top end of the distribution. The mean response of 2.24Kg of maize per Kg of subsidized seed and fertilizer is lower than the median response of 3.11Kg. Households at the 5th percentile of the maize production distribution obtain a marginal product of just 0.69Kg of maize per Kg of subsidized seed and fertilizer, compared to a response of 2.58Kg for households at the 90th percentile. It is also important to note that households at the 50th percentile of the maize production distribution obtain a higher response (3.11Kg) than households at the 90th percentile which gets 2.58Kg per additional Kg of subsidized seed and fertilizer. This could probably be because households at the top of the maize production distribution (90th percentile) are most likely engaged in production of cash crops like cotton and other crops such as sorghum and cowpeas and also they may be involved in other income generating activities other than crop production. Therefore these households may not be interested in the management effort required to obtain the high marginal return to subsidized inputs.

Table 4 displays the results obtained from the administered questionnaire on the percentile groups of interviewed households in relation to the households' dependence on the program. The table indicates that at the 5th percentile, 36.2% of the interviewed households may not be able to continue with their maize production at their current level without the support from FISP. However, at the 90th percentile, only 4.3% of the respondents indicated that they may not be able to continue with maize production without the help of the program while at the 10th and 50th percentiles, 29.1% and 16.7% of the respondents respectively indicated they would not be able to continue to produce maize without the help from the program. This indicates the levels of dependence the program has created among the various percentile groups.

Table 1: Distribution of Variables Used in the Analysis

	2008/2009					2009/2010					2010/2011					2011/2012				
	5th	10th	50th	90th	mean	5th	10th	50th	90th	mean	5th	10th	50th	90th	mean	5th	10th	50th	90th	mean
Maize qty produced by hh (in Kg)	20	35	44	61	57	22	48	64	99	83	44	57	82	91	90	56	98	119	122	112
Kg subsidized seed & fertilizer acquired by hh	420	420	420	420	0.965	210	420	420	420	0.5	210	210	210	210	0.5	210	210	210	210	0.5
total land cultivated for maize in ha	0.25	0.75	1.5	2	1.58	0.5	1.5	1.75	2.5	2.14	1.0	1.75	2.0	2.5	2.5	0.75	1.0	2.0	2.5	1.5
Average Age of hh head in each year	58	51	41	38	44.9	67	49	44	39	45.2	43	36	48	52	45.3	61	51	45	37	46.012
=1 if household head attended school	0	0	1	1	0.5	0	0	1	1	0.7	0	1	1	1	0.9	0	0	1	1	0.6
=1 if household is male headed	1	0	0	1	0.28	0	1	1	1	0.36	1	0	1	1	0.41	0	1	1	1	0.9
=1 if hh head was once employed	0	0	1	1	0.21	0	0	1	1	0.22	0	0	1	1	0.23	0	0	1	1	0.26
Average annual rainfall over past 4 growing seasons in ml	1,110.2	1,110.2	1,110.2	1,110.2	1,110.2	890.9	890.9	890.9	890.9	890.9	731.9	731.9	731.9	731.9	731.9	1,081.9	1,081.9	1,081.9	1,081.9	1,081.9

Note: Variable distribution weighted by inverse probability weights*population weights

Source: Meteorological Department, Gwembe District, and authors' analysis

Table 2: Pooled Quantile Regression Results for Maize Production (in Kg)

Covariates	Pooled OLS Conditional Mean Estimation		Pooled Quantiled Regression 5%		10%		50%		90%	
	Coeff.	P-Value	Coeff.	P-Value	Coeff.	P-Value	Coeff.	P-Value	Coeff.	P-Value
Kg subsidized Inputs acquired by hh	3.77***	(0.00)	0.87	(0.00)	1.78***	(0.00)	2.87***	(0.00)	3.91***	(0.00)
total land cultivated for maize in ha	133.2***	(0.00)	29***	(0.00)	48***	(0.01)	112***	(0.00)	437***	(0.00)
log of Age of hh head in each year	-4.94	(0.78)	-0.47	(0.89)	-0.71	(0.93)	-0.92	(0.96)	-0.63	(0.98)
=1 if household head attended school	22***	(0.00)	5.58	(0.19)	9.24***	(0.00)	29.78***	(0.00)	69.65***	(0.00)
=1 if household is male headed	62***	(0.00)	2.61	(0.28)	7.36	(0.39)	8.60	(0.49)	37.13***	(0.00)
Household Size	26.14	(0.71)	6.32	(0.67)	9.49	(0.86)	15.18	(0.51)	21.38	(0.89)
=1 if hh head was once employed	16.2**	(0.03)	3.21	(0.16)	4.78	(0.21)	9.29	(0.74)	11.27**	(0.02)
Average annual rainfall over past 4 growing seasons in ml	0.61***	(0.00)	0.10***	(0.01)	0.29***	(0.00)	0.17**	0.02)	-0.36	(0.18)
cumulative rainfall over the current growing season in ml	0.04	(0.81)	0.03	(0.36)	0.01	(0.73)	0.00	(0.80)	1.02	(0.44)
Std deviation of the average long run rainfall	-0.06	(0.74)	0.06	(0.49)	0.08	(0.17)	0.12	(0.15)	-0.19	(0.58)
Intercept	-1.93***	(0.00)	-114***	(0.00)	-214***	(0.00)	-692***	(0.00)	-1362***	(0.00)
Soil quality dummy variables included	Yes		Yes		Yes		Yes		Yes	
Num of Observations	570		570		570		570		570	
R^2	0.41		0.06		0.18		0.26		0.31	

Note: **, *** indicates that the corresponding coefficients are significant at 5% and 1% level. Figures in the parentheses are estimated standard errors

Source: Authors' econometric analysis using STATA software of data obtained from administered questionnaire

Table 3: Correlated Random Effects (CRE) Quantile Regression Results for Maize Production (in Kg)

Covariates	First Difference, Conditional Mean Estimation		Correlated Random Effects Quantile Regression 5%		10%		50%		90%	
	Coeff.	P-value	Coeff.	P-value	Coeff.	P-value	Coeff.	P-value	Coeff.	P-value
Kg subsidized Inputs acquired by hh	2.24***	(0.00)	0.69***	(0.00)	1.10***	(0.00)	3.11***	(0.00)	2.58**	(0.02)
total land cultivated for maize in ha	241***	(0.00)	35***	(0.00)	55***	(0.00)	98***	(0.00)	337***	(0.00)
log Age of hh head in each year	NA	NA	-1.41	(0.88)	1.56	(0.83)	4.69	(0.61)	-2.63	(0.94)
=1 if household head attended school	NA	NA	10.08	(0.24)	24***	(0.00)	31.40***	(0.00)	49.27*	(0.08)
=1 if household is male headed	51	(0.45)	18	(0.49)	-15	(0.50)	-18	(0.58)	-56.10	(0.63)
Average annual rainfall over past 4 growing seasons in ml	-0.54***	(0.00)	-0.09***	(0.00)	-0.12**	(0.05)	-0.16***	(0.01)	-0.34	(0.11)
Household Size	18.11***	(0.00)	4.38	(0.29)	7.45	(0.49)	10.61	(0.82)	12.19	(0.14)
=1 if hh head was once employed	11.36*	(0.01)	-1.89*	(0.01)	3.46	(0.51)	5.26*	(0.03)	9.18	(0.21)
cumulative rainfall over the current growing season in ml	-0.02	(0.63)	0.06**	(0.03)	0.05**	(0.02)	0.04	(0.27)	0.13	(0.31)
Std deviation of the average long run rainfall	-0.22	(0.23)	0.03	(0.25)	0.05	(0.41)	0.07	(0.58)	-0.16	(0.13)
Intercept	-8.79	(0.96)	-23	(0.80)	-44	(0.76)	385	(0.34)	-1,004	(0.52)
Soil quality dummy variables included	Yes	Yes	Yes	Yes	Yes					
Num of Observations	228	570	570	570	570					
R2	0.21	0.09	0.17	0.28	0.36					

Note: *, **, *** indicates that the corresponding coefficients are significant at 10%, 5% and 1%

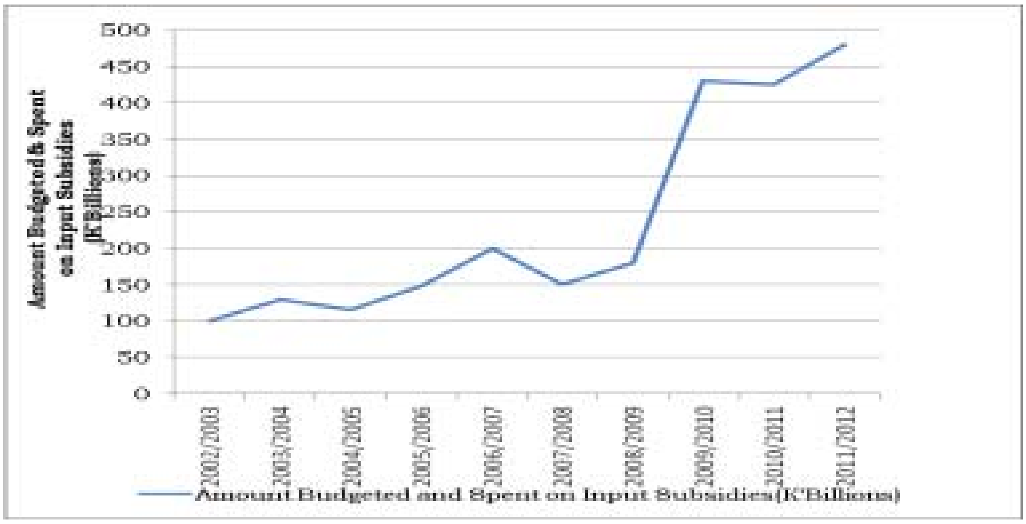
Source: Authors' econometric analysis using STATA software of data obtained from administered questionnaire

Table 4: Levels of dependence on FISP by various percentile groups

	Percentile Groups 5th	10th	50th	90th
Level of Dependence on FISP	36.2%	29.1%	16.7%	4.3%

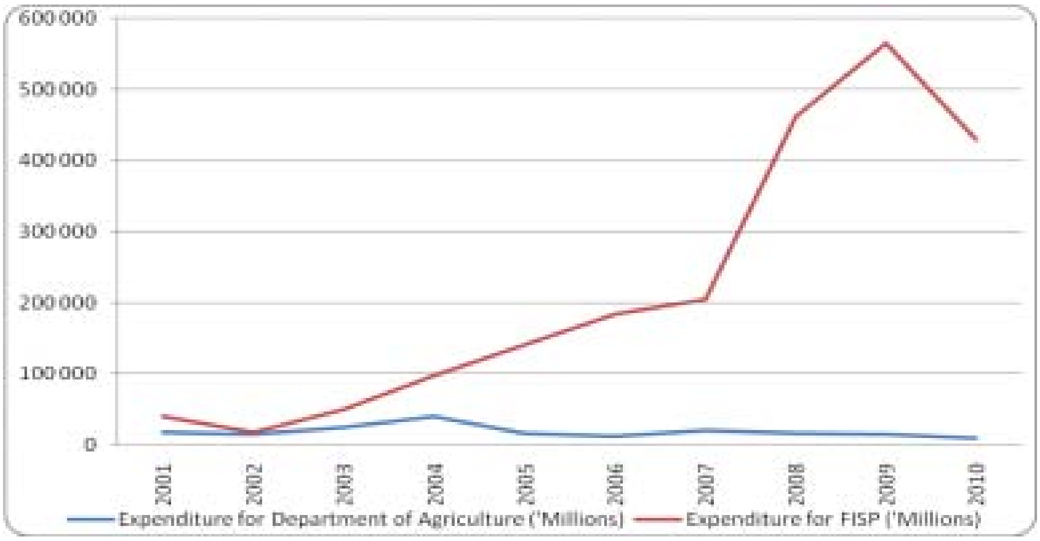
Source: Authors' Analysis

Figure 1: Input Subsidies Budgetary Allocations (K'Billion) 2002/2003 - 2011/2012



Source: MAL - Implementation Manual 2012/2013 Agricultural season

Figure 2: Proportion of MAL Expenditure on FISP Compared to Department of Agriculture (2001 to 2010) Zambia



Source: Paper on Agriculture Case Study - Evaluation of Budget Support in Zambia - 2010

CONCLUSION AND RECOMMENDATIONS

Fertilizer and seed subsidies are gaining support as a policy tool to foster improved agriculture production as a pro-poor policy approach, particularly for ensuring household food security in most African countries (Druilhe and Barrero-Hurle, 2012; Liverpool, Saweda and Salau 2013). The reported goals of agricultural input subsidy programs are often to reduce poverty and boost staple crop production among smallholder farmers

(Kelly, Crawford and Ricker-Gilbert 2011; Crawford, Kelly, Jayne and Howard, 2003). This research used panel data collected from the smallholder farmers in Gwembe district in the four seasons to estimate how an additional Kg of subsidized fertilizer and seed affects maize production across the distribution of these smallholder farmer households. The results from this study demonstrate that it may in fact be difficult for subsidy programs to achieve the joint goal of reducing poverty and boosting staple crop production. Using Quantile regression with a Correlated Random Effects estimator to deal with endogeneity, we find that households at the 5th percentile of the maize production distribution obtain a response of just 0.69Kg of maize per Kg of subsidized seed and fertilizer acquired.

Since the goal of the subsidy program is to boost staple crop production and increase household food security, then it may be plausible to target people at the median of the maize production distribution with a response of 3.11Kg of maize yield per Kg of subsidized seed and fertilizer other than the lower end and the upper end of the maize production distribution with a response of 0.69Kg and 2.58Kg respectively which is lower than the median response. Results from this study indicate that an additional kilogram of subsidized fertilizer and seed boosts maize production by 3.11Kg at the 50th percentile of the maize production distribution and by 2.58Kg at the 90th percentile of the maize production distribution. Therefore, it seems to be reasonable for Government to target more productive farmers in order to boost maize production (at the 50th percentile). Evidence from this study seem to suggest however, that farmers at the 90th percentile who may produce the most maize do not get as high a marginal response to subsidized seed and fertilizer as do households at the 50th percentile. This could be because households at the 90th percentile are able to grow other crops instead of concentrating on maize production.

In addition, these households may decide to use part of, if not all the subsidized fertilizer on other crops such as yellow maize meant necessarily for livestock feed other than on the seed for which it was meant, hence obtaining a lower marginal product of subsidized seed and fertilizer compared with farmers at the 50th percentile. If more productive households are targeted to receive the subsidy, government should be aware that when wealthy, more productive households receive subsidized fertilizer they are likely to use it in place of some of their commercial fertilizer purchases (Ricker-Gilbert, Jayne, and Chirwa 2011; Mason 2011). From the data collected using the questionnaire that was administered on the 8 sampled agricultural camps in the district (Gwembe), it was also observed that at the 5th percentile, 36.2% of the interviewed respondents depend on the subsidy for them to produce maize crop as they will not be able to produce the crop once the subsidy is withdrawn, while at the 10th and 50th percentile, 29.1% and 16.7% also depend on the program for their maize production. However, at the 90th percentile, only 4.3% depend on the program. It is evident from the above analysis of the interviewed households that somehow the Program seems to have created a dependence syndrome among the subsidy receiving households especially those households at the 5th and the 10th percentiles. Ultimately if the Zambian government wants to increase household food security and reduce poverty among its rural population, targeting fertilizer and seed subsidies to resource-limited farmers, especially farmers at the 5th percentile who produce small quantities of maize and are less responsive to subsidized seed and fertilizer is likely less effective. Perhaps social cash transfer to such households may be more effective. This is because returns that resource-limited households obtain from subsidized inputs is small, most likely due to poor soil quality of their fields, low management ability, and other factors. Similarly, targeting farmers at the 90th percentile of the maize production distribution may be less effective as this group is not as responsive as it should have been as they may divert these subsidized inputs to other alternative uses other than what they were intended for.

Therefore, if the Zambian government wants to use agricultural inputs subsidies to increase maize crop production, then it would be advisable to selectively target households at the 50th percentile in the maize production distribution who can obtain a positive higher return from these subsidized inputs, but will be less likely to use the subsidized inputs in other ventures of crop production or sell them. Such households may be those smallholders who have between 1 and 2 hectares, have enough family labour to be able to utilize the subsidized inputs. There is also value in extending this study to other districts in the country before arriving at a national policy on agricultural input subsidies.

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