A Review of Zambia's Agricultural Input Subsidy Programs: Targeting, Impacts, and the Way Forward

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EXECUTIVE SUMMARY

Nearly three decades after the initiation of agricultural market reforms in Sub-Saharan Africa (SSA), subsidies for fertilizer and seed are once again the cornerstone of many SSA governments' agricultural development and poverty reduction strategies. Zambia is a prime example. In the last decade, the Government of Republic of Zambia (GRZ) has devoted a considerable share of its agricultural budget to input subsidies. Between 2004 and 2011, spending on the Farmer Input Support Programme (FISP) accounted for an average of 30% of total GRZ agricultural sector spending, and 47% of GRZ agricultural sector Poverty Reduction Programme spending. Through FISP, GRZ provides beneficiary farmers with subsidized fertilizer and hybrid maize seed.

This paper reviews the design and implementation of FISP and GRZ's other input subsidy programs since structural adjustment, synthesizes the empirical evidence to date on the targeting and effects of the programs, and presents new empirical evidence on heretofore unexplored dimensions of the programs. The article highlights the remaining knowledge gaps with respect to input subsidy targeting and effects in Zambia. It concludes with a discussion of the policy implications of the findings, including how FISP could be redesigned to increase its effectiveness as a poverty reduction tool.

The empirical evidence presented in the paper is drawn mainly from analyses of two nationally representative surveys of smallholder farm households in Zambia. The first is the Supplemental Survey (SS), a three-wave panel covering the 1999/2000, 2002/03, and 2006/07 agricultural years. The second is the 2012 Rural Agricultural Livelihoods Survey (RALS), which covers the 2010/11 agricultural year.

On *targeting,* the study finds significant political economy dimensions to FISP fertilizer targeting. Holding other factors constant, households in constituencies won by the ruling party in the last presidential election receive significantly more subsidized fertilizer than those in areas lost by the ruling party. Other statistically significant determinants of the quantity of subsidized fertilizer acquired by smallholder households are: landholding size (positive effect), livestock holdings (positive effect), and distances from towns and/or roads (negative effects). In general, as of 2010/11, FISP is being disproportionately allocated to better-off households above the $1.25/day poverty line.

Regarding the *impacts* of the subsidy programs*,* results suggest that the FISP program exhibits a significant degree of crowding out of commercial purchases of hybrid maize seed and fertilizer. This is mainly because subsidized inputs are generally targeted to relatively better off households who could afford the inputs at commercial prices. The crowding out effect is generally lower among female-headed households and in areas where the private sector is less active in agro-input retailing. A second set of impacts examined are those on smallholder crop production. Results show that an increase in the quantity of subsidized fertilizer acquired by a smallholder household raises its maize area planted, yields, and output; has no effect on its area planted to other crops but positive spillover effects on its yields and production of other crops; and a negative effect on its area under fallow. However, these effects are generally small in magnitude.

These and other results highlighted in the paper point to a number of changes that could be made to FISP to improve its poverty reduction impacts and to better achieve its other objectives, including raising agricultural productivity and increasing private sector participation in input markets. For example, rural poverty is concentrated among smallholders that cultivate less than 2 ha of land. Targeting FISP to these households has the potential to greatly increase the poverty reduction impact of the program without jeopardizing national food security, since empirical evidence for Zambia suggests that these households use fertilizer just as efficiently as households that cultivate larger areas. Equally, targeting FISP toward poorer households as well as to female-headed households and households in areas where the private sector is less active in agro-input retailing would also reduce crowding out of commercial fertilizer and hybrid seed purchases, and increase the impact of the program on total input use. Implementing FISP through an electronic voucher redeemable at private agro-dealers and input suppliers could further increase the impact of FISP on total input use and crowd in the private sector.

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ACRONYMS

ACF	Agricultural Consultative Forum
APE	average partial effect
BCR	benefit-cost ratio
CFS	Crop Forecast Survey
CRE	correlated random effects
CSO	Central Statistical Office
DACs	District Agriculture Committees
DOI	digital object identifier
FAO	Food and Agriculture Organization
FIQI	Fisher-Ideal Quantity Index
FISP	Farmer Input Support Programme
FRA	Food Reserve Agency
FSRP	Food Security Research Project
GRZ	Government of the Republic of Zambia
ha	hectare
IAPRI	Indaba Agricultural Policy Research Institute
IMF	International Monetary Fund
kg	kilogram
km	kilometer
MACO	Ministry of Agriculture and Cooperatives
MAL	Ministry of Agriculture and Livestock
MCDSS	Ministry of Community Development and Social Services
MFNP	Ministry of Finance and National Planning
MMD	Movement for Multi-Party Democracy
MT	metric ton
NAMBOARD	National Agricultural Marketing Board
PAM	Programme Against Malnutrition
PHS	Post-Harvest Survey
PRP	Poverty Reduction Programme
RALS	Rural Agricultural Livelihoods Survey
SAP	Structural Adjustment Program
SS	Supplemental Survey
SSA	Sub-Saharan Africa
ZMK	Zambian Kwacha

1. INTRODUCTION

Nearly three decades after the initiation of agricultural market reforms in Sub-Saharan Africa (SSA), subsidies for fertilizer and seed are once again the cornerstone of many SSA governments' agricultural development and poverty reduction strategies. Zambia is a prime example. Although the subsidies were scaled back during the 1990s, the last decade has been a renaissance period for input subsidies in Zambia. Like many other countries in SSA and in contrast to the universal subsidies in place prior to structural adjustment, the current wave of input subsidies in Zambia is targeted at certain intended beneficiaries.

The Government of the Republic of Zambia (GRZ) devotes a considerable share of its resources to input subsidies. For example, in 2011, GRZ spent approximately US$184 million, equivalent to 0.8% of gross domestic product, to provide nearly 182,500 metric tons (MT) of fertilizer and 9,000 MT of hybrid maize seed to participating farmers at subsidized prices through its Farmer Input Support Programme (FISP) (IMF 2012; MFNP 2012). Moreover, between 2004 and 2011, FISP accounted for an average of 30% of total GRZ agricultural sector spending, and 47% of GRZ agricultural sector Poverty Reduction Programme (PRP) spending (Table 1).[1] Spending on the maize marketing activities of the Food Reserve Agency (FRA), the other major GRZ agricultural sector initiative, accounted for most of the remaining agricultural sector and PRP expenditures.

Given the high level of spending on the program, FISP has received substantial attention from researchers, donors, and civil society groups both within and outside of Zambia. While much has been learned about the impacts of the program, considerable knowledge gaps remain. In this article, we review the design and implementation of FISP and GRZ's other

Table 1. GRZ Spending on Input Subsidy Programs (FISP and Food Security Pack Programme), 2002-2013 Budget Years

Budget year	FISP (billion ZMK)	FISP spending as % of total agricultural sector spending	FISP spending as % of total agricultural sector PRP spending	Food Security Pack spending (billion ZMK)	Food Security Pack spending as % of total agricultural sector spending	FISP as % of total agricultural input subsidy spending (FISP + Food Security Pack)
2002	17.79	10.4%	--	25.97	15.2%	40.7%
2003	50.00	17.2%	--	4.01	1.4%	92.6%
2004	98.05	26.8%	--	30.07	8.2%	76.5%
2005	139.99	26.9%	--	20.84	4.0%	87.0%
2006	184.05	25.5%	55.0%	16.20	2.2%	91.9%
2007	204.54	18.0%	46.4%	10.65	0.9%	95.1%
2008	492.08	37.6%	--	*10.00	*0.9%	98.0%
2009	565.12	42.5%	69.0%	10.00	0.8%	98.3%
2010	589.01	29.9%	32.6%	*10.00	*0.7%	98.3%
2011	895.39	30.1%	34.3%	*15.00	*1.1%	98.4%
2012*	500.00	27.9%	60.8%	25.00	1.4%	95.2%
2013*	499.97	22.8%	58.1%	--	--	--

Source: MFNP (various years).
Notes: *Based on budgeted amount for Food Security Pack; information on actual spending not available. -- Information not available. ZMK are nominal.

[1] The program was called the Fertilizer Support Programme from 2002/03 to 2008/09. For simplicity throughout the rest of the paper and unless otherwise noted, we use FISP to refer to the Fertilizer Support Programme and its successor program, the Farmer Input Support Programme.

input subsidy programs since structural adjustment, synthesize the empirical evidence to date on the effects of the programs, and present new empirical evidence on heretofore unexplored dimensions of the programs' impacts. This is done within the broader context of the country's rural development challenges, especially increasing land constraints among smallholder farmers and rural poverty rates that remain mired at nearly 80% despite a decade of massive public expenditures on input and output subsidies for maize.[2] In doing so, we examine the apparent contradictory rationale of FISP: the program is officially supposed to target *vulnerable but viable* smallholder farmers and, along with the FRA, is GRZ's main agricultural sector PRP. Yet Zambian Ministry of Agriculture and Livestock (MAL) officials indicate and empirical evidence shows that FISP inputs go disproportionately to the larger and more surplus-producing farmers, most of which are above the poverty line. Perhaps this indicates that GRZ is trying to reduce poverty by increasing the aggregate food supply in hopes of putting downward pressure on food prices, a topic examined by Ricker Gilbert et al. (2013).

More specifically, this article has six objectives. The first is to review the objectives, design, and implementation of input subsidy programs in Zambia in the post-structural adjustment period. The second objective is to examine who is targeted by FISP and other GRZ input subsidy programs, and to explore the implications of the findings for the programs' ability to meet poverty-reduction and other objectives. Actual targeting outcomes are compared to official targeting criteria and to the targeting outcomes of input subsidy programs in other SSA countries. The third objective is to review existing and present new empirical evidence on smallholder farmers' behavioral responses to input subsidies in Zambia. These range from the effects of the subsidies on commercial purchases of fertilizer and improved maize seed (i.e., crowding out of commercial purchases), to the effects on fertilizer application rates, production of maize and other crops (area, yields, and output), and area under fallow. The fourth objective is to compare the benefits and costs of FISP. The fifth objective is to identify the remaining knowledge gaps with respect to input subsidy targeting and effects in Zambia. And the sixth and final objective is to discuss the policy implications of the findings, including how FISP could be redesigned to increase its effectiveness as a poverty reduction and wealth creation tool.

In the next section, we briefly describe the data used in the major empirical studies to date on input subsidy targeting and impacts in Zambia, and also describe the data used in the new analysis for this article. Subsequent sections address each of the paper's six objectives in turn.

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[2] According to the Zambian Central Statistical Office, the rural poverty rate was 82% in 1996, 83% in 1998, 78% in 2004, 80% in 2006, and 78% in 2010 (CSO 2009, 2011).

2. DATA

Unlike many countries in SSA, a number of nationally representative smallholder farm household survey datasets are available for Zambia.[3] Every year, MAL and the Central Statistical Office (CSO) jointly implement two such surveys of smallholder farm households: (i) the Crop Forecast Survey (CFS), which is conducted after planting but before harvest and collects information on area planted and input use as well as expected crop production and sales; and (ii) the Post-Harvest Survey (PHS), which is conducted after harvest and collects similar information but on realized levels of production and sales. Since 2006/07, the sample size for both the CFS and PHS has been approximately 13,500 households.

While the CFS and PHS provide a wealth of information on crop production and input use, the surveys collect only minimal information on demographics, off-farm activities, other sources of income, and assets. To complement these GRZ surveys and to paint a more comprehensive picture of rural households' activities and income sources, since 2001 the Indaba Agricultural Policy Research Institute (IAPRI), formerly the Food Security Research Project, FSRP) has partnered with MAL and CSO to conduct nationally representative, longitudinal rural household livelihood surveys every three to four years. There have been four such surveys to date. The first three are the CSO/MACO/FSRP Supplemental Surveys (SS), which were conducted in mid-2001, 2004, and 2008 to capture information on the 1999/2000, 2002/03, and 2006/07 agricultural years and subsequent crop marketing years.[4]

A total of 6,922 households were interviewed for the 2001 SS. Of those, 5,358 were re-interviewed for the 2004 SS, and of those, 4,286 were re-interviewed for the 2008 SS.[5] See Megill (2005) for details on the sampling design of the CFSs, PHSs, and SS. The fourth survey, the Rural Agricultural Livelihoods Survey (RALS), was conducted by IAPRI in June 2012 in partnership with CSO and MAL. This was the first wave of what is to be a new panel survey. A total of 8,839 households were interviewed for RALS, which covered the 2010/11 agricultural year and the 2011/12 crop marketing year. See IAPRI (2012) for details on the RALS sampling frame. Most of the past econometric analyses of the targeting and impacts of GRZ's input subsidy programs have used the SS data. In this paper, we review the findings of these analyses and also present new results based on the 2012 RALS data. In addition to these nationally-representative household survey datasets, past studies and the current study also draw on administrative data from MAL on the volumes of GRZ-subsidized inputs allocated to each district in the country.

[3] Smallholder farm households are those that cultivate less than 20 hectares.

[4] The Ministry of Agriculture and Cooperatives (MACO) was renamed the Ministry of Agriculture and Livestock (MAL) in 2011. The agricultural year in Zambia is from October through September, and the crop marketing year is from May through April.

[5] All studies using the SS data test for attrition bias using the regression-based test described in Wooldridge (2010, p. 837) but in all cases fail to reject the null hypothesis of no attrition bias ($p>0.10$).

3. ZAMBIA'S INPUT SUBSIDY PROGRAMS: OBJECTIVES, DESIGN, AND IMPLEMENTATION

In this section, we begin by describing the historical context of input subsidies in Zambia. We then describe the objectives, design, and implementation of GRZ's four major input subsidy programs since structural adjustment: the Fertilizer Credit Programme (1997/98-2001/02), the Fertilizer Support Programme (2002/03-2008/09), FISP (2009/10-present), and the Food Security Pack Programme (2000/01-present).

3.1. Historical Context

Since independence, maize and input subsidies to support its production have been central to the social contract between GRZ and the Zambian people (Jayne 2008). Under this social contract, a core role of government is to keep maize prices low for urban consumers while maintaining remunerative prices for maize producers. Prior to structural adjustment, GRZ sought to uphold the social contract through consumer maize price subsidies and an integrated system of government support to maize production and marketing through the parastatal National Agricultural Marketing Board (NAMBOARD). Via NAMBOARD, GRZ provided farmers with subsidized fertilizer and seed on credit. The loans were to be recuperated when farmers sold their maize to NAMBOARD, which purchased the grain at a pan-territorial and pan-seasonal price (Smale and Jayne 2003). However, the massive government expenditures on these programs were not fiscally sustainable, and GRZ embarked on a structural adjustment program (SAP) in the early 1990s. Under SAP, NAMBOARD was abolished, direct input price subsidies were eliminated, the parastatal seed company Zamseed was privatized, and seed, fertilizer, and maize markets were liberalized (Howard and Mungoma 1996; Smale and Jayne 2003; De Groote et al. 2012).

Despite these reforms, the entrenched ethos of the social contract made it difficult for GRZ to fully abandon efforts to subsidize inputs. Moreover, the advent of multiparty democracy in Zambia in 1991 made it even more difficult for leaders to wholly eliminate input subsidies, as doing so would have opened them up to attacks from the opposition (Jayne 2008). After all, such subsidies are a highly visible way for politicians to demonstrate that they are 'doing something' for the rural populace (ibid). Thus, despite some attempts to move away from direct input subsidies during President Frederick Chiluba's first term (1991-1996), after his re-election for a second term, Chiluba was quick to establish the Fertilizer Credit Programme in 1997.

3.2. The Fertilizer Credit Programme

Under the Fertilizer Credit Programme, which was in place during the 1997/98 to 2001/02 agricultural years, fertilizer was not subsidized *per se*, nor was the coverage of the program universal. Beneficiary farmers could obtain 200 to 800 kilograms (kg) of fertilizer, and were to pay roughly 10% of the full market price of the fertilizer at planting time with the remaining 90% in cash or in maize at harvest time. However, loan repayment rates were low (e.g., 35% in 1999/2000), and beneficiary farmers that defaulted on the loan received the fertilizer at an effective subsidy rate of 90% (having paid only the 10% down payment) (MACO, ACF, and FSRP 2002). An average of 30,000 MT of fertilizer were distributed through the program each year (Table 2).

Table 2. Fertilizer Subsidy Program Beneficiaries and Quantities Distributed According to Official Ministry of Agriculture and Livestock (MAL) Records vs. Nationally-Representative Household Surveys, 1997/98-2012/13 Agricultural Years

		Based on MAL records		Estimated from household survey data	
Agricultural year	Fertilizer subsidy rate (hybrid maize seed subsidy rate in parentheses)	MT of Fertilizer Credit Programme/ FISP fertilizer delivered to districts	Number of intended beneficiaries	MT of Fertilizer Credit Programme/ FISP fertilizer received by smallholder households (as % of col. B in paren.)	Number of beneficiary smallholder households (as % of col. C in paren.)
	(A)	(B)	(C)	(D)	(E)
1997/1998	Loan	15,495	--	--	--
1998/1999	Loan	50,001	--	--	--
1999/2000	Loan	34,999	--	21,038 (60%)	64,493 (--)
2000/2001	Loan	23,227	--	11,266 (49%)	30,103 (--)
2001/2002	Loan	28,985	--	8,365 (29%)	26,763 (--)
2002/2003	50% (50%)	48,000	120,000	31,722 (66%)	102,113 (85%)
2003/2004	50% (50%)	60,000	150,000	33,372 (56%)	101,139 (67%)
2004/2005	50% (50%)	46,000	115,000	16,792 (37%)	64,854 (56%)
2005/2006	50% (50%)	50,000	125,000	23,595 (47%)	74,040 (59%)
2006/2007	60% (60%)	84,000	210,000	58,404 (70%)	164,229 (78%)
2007/2008	60% (60%)	50,000	125,000	43,596 (87%)	140,612 (112%)
2008/2009	75% (50%)	80,000	200,000	55,114 (69%)	192,860 (96%)
2009/2010	75% (50%)	100,000	500,000[a]	69,103 (69%)	292,685 (59%)
2010/2011	76% (50%)	178,000	891,500[a]	116,116 (65%)	430,141 (48%)
2011/2012	79% (53%)	182,454	914,670[a]	108,275 (59%)	422,393 (46%)
2012/2013	--	183,634[b]	900,000[b]	--	--

Sources: Mason and Jayne (2013); CSO/MAL 2011/12 Crop Forecast Survey; MAL (2012).
Notes: -- Information not available. [a] Pack size reduced from eight 50 kg bags to four 50 kg bags. [b] Planned distribution and number of intended beneficiaries (2012/2013 agricultural year not yet complete at time of writing). Total fertilizer and intended beneficiaries are for all crops included in the programs. Values in the table are for the Fertilizer Credit Programme for 2000/01-2001/02, the Fertilizer Support Program for 2002/03-2008/09, and the Farmer Input Support Program for 2009/10-2012/2013.

The Fertilizer Credit Programme was implemented through farmer cooperatives. The official eligibility criteria required beneficiaries to: (i) be bona fide farmers cultivating a maximum of 2 hectare (ha) of land; (ii) be members of a cooperative; (iii) be able to pay back the loan; and (iv) not be defaulters on Fertilizer Credit Programme loans in previous seasons. The program was intended as a stopgap measure until more formal public and/or private sector input credit programs could be established. As such, it did not have specific stated objectives other than to provide inputs on credit to small-scale farmers (FRA Agro Support Department 1999; MACO 2008).

3.3. The Fertilizer Support Programme

The 2002/03 agricultural year marked the return of large-scale input subsidies in Zambia. Since then, the volumes of subsidized inputs distributed through GRZ's programs have increased dramatically over time (Table 2). The resurrection of large-scale input subsidies has been facilitated by Zambia's participation in the Heavily Indebted Poor Countries initiative and donors' shift from aid conditionality to direct budget support, as well as by increased government tax revenues thanks to recent price booms for copper and other commodities (Jayne 2008).

The establishment of the cash-based Fertilizer Support Programme in 2002/03 was prompted by low loan recovery rates under the (loan-based) Fertilizer Credit Programme and severe droughts in the 2000/01 and 2001/02 agricultural years. The Fertilizer Support Programme was in place from 2002/03 through 2008/09 and an average 60,000 MT of fertilizer were distributed through it each year (double the volumes distributed under its predecessor program) (Table 2). While subsidies were implicit through default under the Fertilizer Credit Programme, Fertilizer Support Programme inputs were explicitly subsidized, initially at a rate of 50% but then at higher rates in later years of the program (Table 2). Rising subsidy rates over time and the continuation of the program beyond 2004/05 conflict with the program's original plans, which were that it would last for only three years with the subsidy rate reduced to 25% in the second year and eliminated in the third (MACO 2002). Although the subsidy may have been considered a 'smart subsidy' to some extent when it was initially conceived, its track record underscores the staying power of input subsidy programs and the political near-impossibility of scaling them back once they are established (Ricker-Gilbert, Jayne, and Shively 2013).[6]

The overall goals of the Fertilizer Support Programme were "improving household and national food security, incomes, [and] accessibility to agricultural inputs by small-scale farmers through a subsidy and building the capacity of the private sector to participate in the supply of agricultural inputs" (MACO 2008). Poverty reduction was an implicit goal of the program, as it was funded through and accounted for as much as 55% of GRZ's annual expenditures on agricultural sector Poverty Reduction Programmes (PRPs) (Table 1). The seven objectives corresponding to these goals were: "(i) to increase private sector participation in the supply of agricultural inputs to smallholder farmers thereby reducing government involvement; (ii) to ensure timely, effective and adequate supply of agricultural inputs in the country; (iii) to improve access of smallholder farmers to agricultural inputs (fertilizer and hybrid maize seed); (iv) to ensure competitiveness and transparency in the distribution of inputs, thereby breaking monopolies; (v) to serve as a risk-sharing mechanism for smallholder farmers to cover part of the costs for improving agricultural productivity; (vi) to expand markets for private sector input suppliers and increase their involvement in the distribution of agricultural inputs in rural areas, thereby reducing [the] direct role of government; and (vii) to facilitate the process of farmer organization, dissemination of knowledge and creation of other rural institutions that will contribute to the development of the agricultural sector" (MACO 2004).

Like the Fertilizer Credit Programme, the Fertilizer Support Programme was implemented through cooperatives and other farmer groups. Such groups were 'pre-selected' by District Agriculture Committees (DACs) and only farmers belonging to pre-selected groups were eligible to participate. Moreover, participating farmers were required to: (i) be active small-scale farmers in the cooperative coverage area; (ii) have the capacity to grow 1-5 ha of maize; (iii) be able to pay the farmer share of the input costs (e.g., 50% in 2002/03); (iv) not be concurrently benefiting from the Food Security Pack Programme (discussed further below);

[6] See Morris et al. (2007) for a full definition of 'smart subsidies'. Having an exit strategy is one hallmark thereof.

and (v) not be defaulters under the Fertilizer Credit Programme (MACO 2004). Note that there were no requirements related to inability to afford inputs at commercial prices, nor were there explicit aims to target female-headed households.

Beneficiary farmers were selected by cooperative boards in conjunction with the local Ministry of Agriculture and Cooperatives (MACO) extension officer. Selected beneficiaries were to receive an input pack consisting of 400 kg of fertilizer (200 kg each of basal and top dressing) and 20 kg of hybrid maize seed, sufficient to plant 1 ha of maize.[7] In practice, the volumes received varied widely across participants and it was not uncommon for input packs to be broken up. (See Mason and Ricker-Gilbert (2013), and Mason and Jayne (2013) for details.)

Fertilizer for the program was imported and transported to main depots in each participating district by suppliers selected through a national tender. This was to be a competitive process; however, the same two input suppliers (Omnia Fertilizer Zambia Limited and Nyiombo Investments Limited) have been awarded the contract every year to date. After arrival at the main depots, the inputs were delivered to satellite depots by contracted local transporters, and then distributed to beneficiaries (MACO 2004). In essence, the distribution system for the Fertilizer Support Programme (and now FISP) operated parallel to private agro-dealers rather than through them. These features call into question the extent to which the programs have accomplished their objectives of increasing competition and private sector participation in agricultural inputs supply in Zambia.

3.4. The Farmer Input Support Programme

In the first full agricultural year after his election in 2008, President Rupiah Banda renamed the Fertilizer Support Programme the Farmer Input Support Programme, and FISP has run from 2009/10 to the present day. Although the objectives of the program remained the same as its predecessor's, some substantive changes accompanied the name change. Most notably, the input pack size was cut in half to 200 kg of fertilizer and 10 kg of hybrid maize seed. In principle, this doubled the number of beneficiaries per MT of subsidized inputs (Table 2).

The second innovation under FISP was the involvement of local leaders in the selection of beneficiaries. While Fertilizer Support Programme beneficiaries were selected by cooperative boards and the local extension officer only, representatives from the traditional authorities (e.g., the chief or headman), community-based organizations, youth farmer organizations, and public offices other than MAL are also involved in the selection of FISP beneficiaries (MACO 2009).

The third change under FISP was to expand the range of crops included in the program. Rice was added in 2010/11, and sorghum, cotton, and groundnuts were added in 2012/13 as part of President Michael Sata's push for crop diversification. The eligibility requirements for FISP are the same as those under the Fertilizer Support Programme except that the area cultivated requirement has been reduced from 1 ha of maize to 0.5 ha in line with the reduction in the input pack size. An average of 180,000 MT of fertilizer were distributed through FISP each

[7] The types of fertilizers distributed and the recommended application rates were uniform countrywide. We come back to this point later in the paper.

year between 2010/11 and 2012/13 (triple the volumes distributed under its predecessor program) (Table 2).

3.5. The Food Security Pack Programme

The last major GRZ input subsidy program since structural adjustment is the Food Security Pack Programme. In place since 2000/01, the Food Security Pack is a 100% grant (as opposed to a loan or cost-sharing program). The program is targeted toward *vulnerable but viable* farmers that cultivate less than 1 ha and are not in gainful employment. In addition, beneficiary households must be female-, elderly-, or child-headed, keeping orphans or abandoned children, headed by terminally ill individuals, and/or unemployed youth (PAM 2005).[8] The objective of the Food Security Pack Programme is "to empower the targeted vulnerable but viable households to be self sustaining through improved productivity and household food security and thereby contribute to poverty reduction" (ibid). Whereas FISP is implemented through MAL, the Food Security Pack falls under the Ministry of Community Development and Social Services. Beneficiaries are selected by local Community Welfare Assistance Committees or Area Food Security Committees.

Food Security Pack beneficiaries all receive 100 kg of fertilizer, 10 kg of hybrid or improved open-pollinated varieties of maize seed, seed to plant 0.125 ha of beans, soybeans, groundnuts, or cowpeas, and 312 cassava cuttings. Where agro-ecologically appropriate, program participants also receive seed and/or fertilizer for 0.5 ha of rice or 0.25 ha of sorghum or millet. In areas with acidic soils, 100 kg of lime is also included. The Food Security Pack Programme promotes conservation farming practices, with the recommendations tailored by agro-ecological region.

Currently, the Food Security Pack Programme is dwarfed by FISP. In almost every year since 2002, more than 90% of GRZ's spending on input subsidies has been on FISP (Table 1). The small scale of the Food Security Pack Programme relative to FISP is also evident in Table 3, which shows the numbers of intended beneficiaries of the two programs. That said, some of the elements of the Food Security Pack might be beneficial if incorporated into FISP, e.g., targeting households that are unlikely to be able to afford inputs at commercial prices, promoting conservation farming and liming, and tailoring the input packs and extension recommendations to local agro-ecological conditions.

[8] MAL has since co-opted the phrase *vulnerable but viable* for FISP, though it is not clear how MAL defines the phrase.

Table 3. Food Security Pack Programme and FISP Numbers of Intended Beneficiaries, 2000/01-2012/13 Agricultural Years

	# of intended beneficiaries		
Agricultural year	Food Security Pack	FISP	Food Security Pack beneficiaries as % of total input subsidy beneficiaries [b]
2000/2001	60,000	N/A	-- [c]
2001/2002	143,902	N/A	-- [c]
2002/2003	154,043	120,000	56.2%
2003/2004	160,000	150,000	51.6%
2004/2005	39,867	115,000	25.7%
2005/2006	34,942	125,000	21.8%
2006/2007	31,000	210,000	12.9%
2007/2008	[a]18,792	125,000	13.1%
2008/2009	11,070	200,000	5.2%
2009/2010	25,018	500,000	4.8%
2010/2011	15,400	891,500	1.7%
2011/2012	15,400	914,670	1.7%
2012/2013	27,400	900,000	3.0%

Sources: Programme Against Malnutrition (PAM) (various years); Ministry of Community Development and Social Services (MCDSS) (various years); MAL (2012).

Notes: [a] Number of intended beneficiaries for only six of nine provinces in Zambia. Information not available on numbers of beneficiaries in the other three provinces. [b] Total input subsidy beneficiaries refers to Food Security Pack + FISP. [c] The Fertilizer Credit Programme was in place in these years but did not have an explicit number of intended beneficiaries as program participants could apply for different quantities of inputs.

4. TARGETING

In this section, we review the targeting outcomes of FISP and other GRZ input subsidy programs. We begin with descriptive results and then turn to econometric results.

4.1. Descriptive Results

As discussed in the introduction and section 3, FISP is one of GRZ's two flagship Poverty Reduction Programmes, and it accounted for more than 50% of agricultural sector PRP spending in most years over the last decade (Table 1). At the same time, increasing household and national food security are also core FISP goals. As we will demonstrate, targeting FISP to poor households and increasing national maize production and food security need not be conflicting objectives. However, based on the actual targeting of FISP fertilizer, GRZ appears to expect that the program's stated objectives (and/or their political economy objectives) would be best achieved by allocating the inputs to better off households. For example, consider the results in Table 4, which show the distribution of smallholder farm households by hectares (ha) cultivated category during the 2010/11 agricultural year, along with poverty rates, FISP participation, and maize sales for each category.

There are several key things to note in this table.[9] First, 73% of Zambian smallholder household cultivate less than 2 hectares of land (column B). This may come as a surprise to those who consider Zambia a 'land-abundant' nation but nationally-representative household surveys repeatedly confirm this result. Second, the US$1.25/capita/day poverty rate is roughly 80% among households cultivating less than 2 ha – considerably higher than the rate among households cultivating more land (column C). Moreover, poverty is highly concentrated in the under 2 ha category: 78% of all smallholder households that fall below the US$1.25/capita/day poverty line cultivate less than 2 ha (column D). There is thus a strong negative correlation between area cultivated and the poverty rate.

Third, households that cultivate larger areas (and are more likely to be above the poverty line) are much more likely to receive FISP fertilizer. For example, roughly 50% of households that cultivated 2+ ha of land received FISP fertilizer in 2010/11, whereas only 23% and 32% of households in the 0.5-0.99 ha and 1-1.99 ha categories received FISP, respectively (column E).[10] The allocations are even more skewed in favor of households cultivating larger areas when we consider the *quantities* of FISP fertilizer received. The average kg of FISP fertilizer received by beneficiary households in the 5+ ha cultivated categories is more than double that received by those cultivating less than 2 ha (column F), and far above the 200 kg official FISP pack size. Furthermore, households cultivating 2+ ha received a disproportionate share of FISP fertilizer: despite being only 27% of smallholder households, they received 55% of the FISP fertilizer (column G). And although households cultivating more than 5 ha are not eligible for FISP according to official program guidelines, over 50% of such households received it, garnering 14% of all FISP fertilizer (MAL 2012). The results in Table 4 therefore suggest that FISP fertilizer is targeted disproportionately to households that cultivate larger areas, many of whom are above the poverty line. If FISP is intended to reduce poverty by *directly* targeting subsidized fertilizer to poor households, it has largely failed at doing so.

[9] This section draws on and builds upon Jayne et al. (2011) and Mofya-Mukuka et al. (2013).
[10] Households in the under 0.5 ha category may be largely excluded from FISP because they are not considered *viable* by MAL, and FISP guidelines stipulate that beneficiary households should have the capacity to grow at least 0.5 ha of maize.

Table 4. Distribution of Smallholder Households, Poverty Rates, and Receipt of FISP Fertilizer by Crop Area Cultivated Category, 2010/11 Agricultural Year

Total area cultivated (maize + all other crops)	# of HHs	% of total HHs	Poverty rate*	% of total small-holders below the poverty line*	% of HHs in category that received FISP fertilizer	Mean kg of FISP fertilizer received per beneficiary HH	% of total FISP fertilizer acquired	% of HHs in category that sold maize	Mean kg of maize sold per selling HH	% of total maize sold	Average product of fertilizer (kg maize per kg fertilizer)†
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)
0-0.49 ha	241,289	17.0	78.4	17.7	7.2	161	2.5	12.1	440	0.9	3.73
0.5-0.99 ha	334,200	23.6	83.2	26.0	22.5	190	13.0	29.8	763	5.2	
1-1.99 ha	452,364	31.9	80.6	34.1	32.1	225	29.7	48.2	1,203	18.0	3.48
2-4.99 ha	333,910	23.5	65.8	20.5	47.2	286	41.0	66.3	2,620	39.7	3.52
5-9.99 ha	47,076	3.3	37.9	1.7	54.5	458	10.7	83.6	7,975	21.5	3.68
10-20 ha	9,153	0.6	14.8	0.1	50.0	766	3.2	98.2	23,937	14.7	3.46
Total	1,417,992	100	75.5	100	30.0	259	100	43.5	2,368	100	--

Sources: Mofya-Mukuka et al. (2013); Author's calculations using CSO/MAL/IAPRI 2012 Rural Agricultural Livelihoods Survey Data; Burke, Jayne, and Sitko (2012) – column K.
Notes: *Based on US$1.25/capita/day poverty line, calculated using household income during the 2011/12 maize marketing year and the 2005 PPP exchange rate (inflated to the 2011/12 marketing year). † These results from Burke, Jayne, and Sitko. (2012) are for farm size categories (cultivated + fallow ha) and for the 2006/07 agricultural year, whereas all other columns are for ha cultivated categories and for the 2010/11 agricultural year. Columns B, D, G, and J each sum to 100 +/- 0.1 due to rounding.

Part of GRZ's rationale for targeting FISP fertilizer to better off households may be that it wants to raise the output and sales of surplus producers in order to put downward pressure on maize market prices, to the benefit of rural net buyers and urban consumers. Indeed, as shown in Table 4 (columns H through J), households in the 2+ ha cultivated categories are much more likely to sell maize, they sell more per household, and they account for a much larger share of the total maize sold by smallholders than households in the under 2 ha categories. More specifically, households in the 2+ ha categories account for 76% of total maize sales despite being only 27% of the smallholder household population. Unfortunately, empirical evidence presented in Ricker-Gilbert et al. (2013) suggests that the strategy of targeting larger farmers has failed to substantively reduce retail maize prices in Zambia. Using price data and FISP allocations for 50 districts over the 2000/01 through 2011/12 marketing years, Ricker-Gilbert et al. (ibid) find that *doubling* the mean volume of FISP fertilizer allocated to each district reduces retail maize prices by only 1.8% to 2.4%, *ceteris paribus*. Though statistically significant ($p<0.10$), this effect is very small in magnitude.

Underlying GRZ's strategy of targeting FISP fertilizer to households that cultivate larger areas is the implicit assumption that such households use the fertilizer more efficiently than households that cultivate smaller areas. This assumption, however, is not consistent with empirical evidence. Rather, as demonstrated in Burke, Jayne, and Sitko (2012), whose results are reproduced in Table 4, column K, average maize fertilizer response rates on small farms in Zambia are similar to, if not higher than, response rates on larger farms. For example, the average response rate on farms under 1 ha is 3.73 kg of maize per kg of fertilizer, which is slightly higher than the response rates on larger farms. These results suggest that an additional MT of FISP fertilizer distributed to a small farm would add as much if not more maize to national production than if that FISP fertilizer were allocated to a larger farm (Burke, Jayne, and Sitko 2012). Burke, Jayne, and Sitko conclude, "fertilizer subsidies could better accomplish poverty reduction by being more directly targeted to poorer households. By so doing, the government could more directly improve the livelihoods of poorer households without jeopardizing national food production objectives" (2012).

Deliberate efforts to steer subsidized fertilizer toward larger farms are not the only reason for lower FISP participation by poorer households that cultivate less land. FISP eligibility requirements also create barriers to entry for poor households (Burke, Jayne, and Sitko 2012). First, the requirement that beneficiary households have the capacity to cultivate at least 0.5 ha of maize immediately excludes 17% of smallholder households (Table 4, column B), although 7% of households that cultivate less than 0.5 ha did manage to obtain FISP fertilizer in 2010/11. Second, the requirement that beneficiary households be members of a cooperative or other farmer group equates to substantial cash outlays for membership fees and cooperative shares. Third, FISP requires that farmers pay a percentage of the input costs (e.g., 21% of the market price of fertilizer and 47% of the market price of hybrid maize seed in 2011/12 – Table 2, column A). Burke, Jayne, and Sitko (2012) estimate that these upfront costs (cooperative membership, one cooperative share, and the farmer's contribution for inputs) are equivalent to 20% of gross annual income for at least 60% of smallholder households. Indeed, 50% of the households that did not receive FISP fertilizer in the 2006/07 agricultural year reported that they did not receive it because they were not a cooperative member or because they could not afford the FISP farmer contribution (ibid).

So far, we have seen that FISP is disproportionately targeted to households that cultivate more land and are more likely to be above the poverty line. How do the socioeconomic characteristics of FISP beneficiaries compare to those of households that receive subsidized fertilizer from the Food Security Pack Programme, that buy fertilizer from commercial retailers, or that do not obtain fertilizer from any source? Results based on the 2001, 2004, and 2008 SSs and the 2012 RALS are summarized in Table 5. Before examining the characteristics of these various groups of households in detail, note the changes over time in the scale of FISP and the Food Security Pack Programme. While 9-11% of households acquired FISP in 2002/03 and 2006/07, this percentage was up to 30% in 2010/11 (column B). In contrast, the coverage of the Food Security Pack plummeted from 4.5% of households in 2002/03 to just 0.2% in 2010/11 (column B). On a positive note, the share of households purchasing fertilizer from commercial retailers increased from 15.4% in 1999/2000 to 24.4% in 2010/11, and nearly 50% of Zambian smallholders acquired fertilizer from some source in 2010/11 (Table 5). As expected based on program guidelines, the mean and median kg of fertilizer acquired through FISP was considerably higher than that acquired through the Food Security Pack Programme, and FISP quantities received were lower in 2010/11 than in earlier years as a result of the halving of the input pack.

As shown in Table 5 and consistent with the programs' objectives, the Food Security Pack Programme has generally targeted households with smaller landholdings and fewer assets (farm equipment and livestock), as well as proportionately more female-headed households compared to FISP. In general, the socioeconomic characteristics of Food Security Pack recipients are similar to those of households that did not acquire fertilizer from any source. On the other hand, in the early years of FISP, beneficiary households tended to be better off in terms of land and assets than households that purchased fertilizer commercially (Table 5). As of 2010/11, though, FISP recipients had landholdings that were similar to but fewer assets than households that purchased commercial fertilizer. The percentage of female-headed FISP recipient households was also significantly higher in 2010/11 than in earlier years of the program. The broadening of FISP's coverage may have reduced the extent of elite capture, something that has been observed in Tanzania, and may have lessened the crowding out effects of the program on commercial input purchases (Pan and Christiaensen 2012).

A final thing to note in Table 5 is the differences in the distance variables across households by source of fertilizer. Based on distances measured in 2000, households that received subsidized inputs or that purchased commercial fertilizer lived at least 4.8 kilometer (km) closer, on average, to the nearest district town or tarred road than did households that did not acquire fertilizer. Similar patterns hold as of 2010/11 (Table 5). However, households that purchased fertilizer from commercial retailers in 2010/11 lived at least 4 km closer, on average, to the nearest tarred road, private fertilizer retailer, or agro-dealer than did households that received FISP fertilizer. This may suggest that in recent years, FISP implementers have tried to focus on more remote areas where the private sector is less active. Per Mason and Jayne (2013), doing so has the potential to reduce crowding out effects.

4.2. Econometric Results

The descriptive results discussed in the previous section are useful but cannot tell us the *ceteris paribus* effects of the various socioeconomic characteristics on a household's receipt of subsidized inputs. In this section we review econometric findings related to targeting, most of which are based on Tobit regressions. Tobit models of the kg of subsidized fertilizer or seed received are used instead of probit models for binary receipt of subsidized inputs because many households receive no subsidized inputs and beneficiary households receive varying quantities thereof. With the exception of the Fertilizer Credit Programme, which offered a range of quantities (200-800 kg of fertilizer), GRZ subsidy programs have an official pack size (e.g., 200 kg of fertilizer and 10 kg of maize seed for FISP since 2009/10).

Table 5. Socioeconomic Characteristics of Households by Source of Fertilizer

		Source of fertilizer:						
Descriptive result	Agricultural year	Fertilizer Credit Programme (A)	FISP (B)	Food Security Pack (C)[a]	Government programs (A, B or C)	Commercial retailers	Both government & commercial sources	Did not acquire fertilizer
Share of households	1999/2000	6.5%	--	--	6.5%	15.4%	0.7%	78.8%
	2002/2003	--	8.8%	4.5%	13.2%	16.4%	0.7%	71.1%
	2006/2007	--	11.2%	1.1%	12.4%	18.2%	1.6%	71.1%
	2010/2011	--	30.0%	0.2%	30.2%	24.4%	6.6%	51.1%
							Gov't Comm.	
Mean kg fertilizer from source	1999/2000	338	--	--	338	243	144 139	0
	2002/2003	--	300	131	244	245	325 229	0
	2006/2007	--	356	131	336	336	471 645	0
	2010/2011	--	259	--	--	310	289 434	0
Median kg fertilizer from source	1999/2000	200	--	--	200	150	100 100	0
	2002/2003	--	200	100	100	150	180 200	0
	2006/2007	--	300	100	200	200	400 300	0
	2010/2011	--	200	--	--	200	200 200	0
Mean landholding size	1999/2000	3.12	--	--	3.12	2.84	2.76	2.02
(ha, cultivated + fallow)	2002/2003	--	3.13	2.14	2.79	2.84	4.21	1.86
	2006/2007	--	3.13	1.80	3.01	2.84	5.39	1.71
	2010/2011	--	2.68	--	--	2.71	4.03	1.56
Mean value of farm equipment[b]	1999/2000	6.32	--	--	6.32	4.06	2.69	1.12
(Real 100,000 ZMK,	2002/2003	--	5.63	2.52	4.54	4.74	9.54	1.53
2007/08=100)	2006/2007	--	4.85	0.74	4.48	4.56	10.81	1.22
	2010/2011	--	2.88	--	--	3.47	6.12	0.88
Mean value of livestock[c]	1999/2000	29.99	--	--	29.99	20.56	18.31	7.68
(Real 100,000 ZMK,	2002/2003	--	42.70	16.62	33.97	30.88	61.05	16.72
2007/08=100)	2006/2007	--	48.46	11.99	45.18	41.41	109.28	13.92
	2010/2011	--	27.01	--	--	30.51	50.42	9.88
% female-headed	1999/2000	8.7%	--	--	8.7%	14.2%	4.8%	21.8%
	2002/2003	--	15.7%	24.6%	18.9%	14.3%	9.4%	23.9%
	2006/2007	--	14.3%	28.9%	15.6%	17.9%	11.1%	26.7%
	2010/2011	--	19.5%	--	--	15.8%	12.6%	28.8%
Median education of HH head	1999/2000	7	--	--	7	7	7	5
(highest grade completed)	2002/2003	--	7	6	7	7	6	4
	2006/2007	--	7	5	7	7	7	5
	2010/2011	--	7	--	--	7	7	6
Mean km to nearest:								
District town/boma	As of 2000	27.8	29.5	31.3	29.5	27.1	24.6	36.4
	2010/2011	--	39.1	--	--	37.5	36.1	48.3
Tarred road	As of 2000	21.2	20.9	20.9	21.0	22.8	16.3	27.6
	2010/2011	--	31.5	--	--	23.5	22.0	40.9
Feeder road	As of 2000	2.3	2.6	2.8	2.6	2.6	2.2	3.5
	2010/2011	--	1.3	--	--	1.5	1.6	3.0
Private fertilizer retailer	2010/2011	--	35.2	--	--	30.7	31.3	43.2
Agro-dealer	2010/2011	--	33.8	--	--	29.8	29.8	40.2

Sources: Mason and Jayne (2013); Author's calculations based on the CSO/MAL/IAPRI 2012 Rural Agricultural Livelihoods Survey.

Notes: [a]N=19 in 2010/11, so socio-economic characteristics not reported for this group of households. [b]Farm equipment includes plows, harrows, and ox-carts. [c]Livestock includes cattle, sheep, goats, and pigs. “As of 2000” distance results are based on GIS estimates from the center of the enumeration area to the nearest district town/boma, tarred road and feeder road. Distances for 2010/11 are based on individual households’ responses.

However, survey data suggest that many households receive less than the official pack size, while others receive more. Packs are often broken up so that more households can benefit from the program, and some households receive multiple packs by signing up multiple household and/or non-household members for the program (Sitko 2010). Treating *participation* as a binary variable would therefore be misleading, since not all beneficiary households receive the same quantities of inputs. (See Mason and Ricker-Gilbert (2013); Mason and Jayne (2013); and Ricker-Gilbert, Jayne, and Shively (2013) for further details and discussion.)

Using the SS panel data, Mason and Ricker-Gilbert (2013) and Mason, Jayne, and van de Walle (2013) estimate correlated random effects (CRE) Tobit models of the factors affecting GRZ's targeting of subsidized fertilizer and/or seed.[11] They find that past election outcomes were major determinants of the spatial allocation of subsidized fertilizer under the Movement for Multi-party Democracy (MMD) governments that ruled Zambia from 1991 to 2011. Other factors constant, households in constituencies won by the MMD in the last presidential election received 23.2 kg more subsidized fertilizer, on average, than households in constituencies lost by the MMD (Mason, Jayne, and van de Walle 2013). Moreover, the quantity of subsidized fertilizer increased by an average of 0.5 kg for each percentage point increase in the MMD's margin of victory. These results suggest that Zambia's MMD governments used subsidized fertilizer to reward its supporters.[12] Mason and Ricker-Gilbert (2013) report similar findings for Malawi; however, Banful (2011) reports that in Ghana, the ruling party targeted fertilizer vouchers to areas it *lost* in the last election, and more so the larger its margin of loss.

In this article, we re-estimate the models in Mason, Jayne, and van de Walle (2013) for FISP fertilizer targeting using the 2012 RALS data.[13] Because these data are cross-sectional, we are not able to use the CRE approach to control for unobserved heterogeneity. Nonetheless, as shown in Table 6, the Tobit results based on the RALS data are largely consistent with Mason, Jayne, and van de Walle's results. Three model specifications are reported in Table 6. The covariates are the same in the three models except for the variables related to ethnicity. These variables capture the ethnicity of the household head, the dominant ethnic group in the household's district, and the percentage of smallholder households in the district that belong to each ethnic group in models (A), (B), and (C), respectively. The variables are included because GRZ might partially base its targeting on ethnicity.[14] Moreover, since we cannot use CRE to control for unobserved heterogeneity, it is important to control for as many observed household-, village-, and regional-level characteristics as possible. In specifications (A) and (C), we find that households in constituencies won by the MMD in the last presidential election receive significantly more (22.8 to 37.2 kg) FISP fertilizer on average than households in areas lost by the MMD.

[11] The CRE approach is used to control for time invariant unobserved heterogeneity that may be correlated with the observed covariates. See the papers and Wooldridge (2010) for details on CRE Tobit.

[12] See Mason, Jayne, and van de Walle (2013) for a more detailed discussion of the political economy implications of these findings.

[13] See Table A1 in the appendix for summary statistics. Estimating similar models for Food Security Pack Program targeting is not possible due to the very small number of households that received it in 2010/11 (see Table 5).

[14] Mason, Jayne, and van de Walle (2013) find no statistically significant ethnicity-related effects in GRZ subsidized fertilizer targeting after using CRE to control for time constant unobserved heterogeneity.

Table 6. Factors Affecting the Kilograms of FISP Fertilizer Allocated to a Smallholder Household, 2010/11 Agricultural Year (Tobit Estimation Results)

	(A)			(B)			(C)		
Explanatory variables	**APE**	**Sig.**	**p-val.**	**APE**	**Sig.**	**p-val.**	**APE**	**Sig.**	**p-val.**
MMD won the HH's constituency in the last presidential election (=1)	22.781	**	0.022	10.151		0.439	37.184	***	0.006
Pct. point spread b/w MMD & lead opposition in constituency	0.010		0.949	0.148		0.420	0.213		0.234
Interaction effect: MMD won constituency (=1) × pct. point spread	1.025	***	0.002	1.025	***	0.003	1.372	***	0.000
Median district maize producer price (ZMK/kg, t-1)	0.021		0.646	0.006		0.898	0.039		0.417
Farmgate price of basal fertilizer (ZMK/kg)	-0.004		0.605	-0.003		0.704	-0.002		0.829
Farmgate price of top dressing fertilizer (ZMK/kg)	-0.001		0.927	-0.001		0.895	0.003		0.701
Landholding size (cultivated+fallow, ha)	19.096	***	0.000	18.994	***	0.000	19.329	***	0.000
Value of farm equipment ('00,000 ZMK)	0.721	**	0.011	0.776	***	0.006	0.771	***	0.006
Value of livestock ('00,000 ZMK)	0.073	**	0.038	0.080	**	0.022	0.076	**	0.031
Number of children age 4 and under	1.161		0.581	1.266		0.549	1.037		0.620
Number of children age 5 to 14	5.319	***	0.000	5.144	***	0.000	5.235	***	0.000
Number of prime age (PA) adults (age 15 to 59)	8.480	***	0.000	8.394	***	0.000	8.543	***	0.000
Number of adults age 60 and above	9.578	**	0.034	9.147	**	0.042	9.174	**	0.041
Age of the HH head	0.490	***	0.009	0.478	***	0.010	0.469	**	0.012
Highest level of education completed by the HH head (no formal education is base):									
Lower primary (grades 1-4) (=1)	-1.381		0.828	-2.986		0.636	-2.061		0.742
Upper primary (grades 5-7) (=1)	25.887	***	0.000	24.055	***	0.000	25.684	***	0.000
Secondary (grades 8-12) (=1)	56.348	***	0.000	54.728	***	0.000	56.366	***	0.000
Post-secondary education (=1)	106.549	***	0.000	104.243	***	0.000	110.755	***	0.000
Sex and residence status of HH head (resident male head is base):									
Female-headed with non-resident husband (=1)	10.166		0.275	9.162		0.324	9.479		0.308
Female-headed with no husband (=1)	13.205	**	0.016	13.922	**	0.011	14.013	***	0.010
Head/spouse PA death in last 4 years (=1)	-6.330		0.632	-8.104		0.537	-6.504		0.609
Other HH member PA death in last 4 years (=1)	0.703		0.932	0.812		0.921	1.773		0.829
HH head is related to the village headman (=1)	1.230		0.770	0.954		0.821	0.761		0.856
HH head is related to the chief (=1)	-6.170		0.297	-6.630		0.251	-6.787		0.252
HH member is a civil servant (=1)	22.617		0.121	21.922		0.124	20.683		0.133
Number of years since the HH head settled in the village	0.010		0.933	0.028		0.807	0.027		0.818
Ethnicity of HH head (column A) or dominant ethnic group among smallholders in the district (column B) (Bemba is base):									
Tonga	-3.864		0.716	-28.424	**	0.043	--	--	--
North Western	6.885		0.575	-55.011	*	0.095	--	--	--
Barotse	-3.516		0.826	-42.580		0.280	--	--	--
Nyanja	-7.069		0.422	-14.460		0.530	--	--	--
Mambwe	10.479		0.368	39.372		0.126	--	--	--
Tumbuka	-1.815		0.872	12.089		0.663	--	--	--
Other[a]	-10.011		0.499	--	--	--	--	--	--

Table 6 (cont'd)

Explanatory variables	(A) APE	Sig.	p-val.	(B) APE	Sig.	p-val.	(C) APE	Sig.	p-val.
% of smallholder households in the district in each major ethnic group (column C):									
Bemba	--	--	--	--	--	--	2.719	***	0.004
Tonga	--	--	--	--	--	--	2.481	**	0.032
North Western	--	--	--	--	--	--	3.670	***	0.000
Barotse	--	--	--	--	--	--	2.099	*	0.074
Nyanja	--	--	--	--	--	--	2.534	***	0.006
Mambwe	--	--	--	--	--	--	2.878	***	0.003
Tumbuka	--	--	--	--	--	--	2.752	***	0.003
Expected growing season rainfall (100 mm, average of past 9 years)	2.666		0.206	3.989	*	0.063	4.173	*	0.054
Expected moisture stress (# of 20-day periods with <40mm rain, average of past 9 years)	-25.537	**	0.017	-23.184	**	0.042	-13.025		0.306
Km from the homestead to the nearest:									
District town/boma	-0.304	**	0.013	-0.332	***	0.008	-0.249	**	0.031
Tarred road	-0.106		0.222	-0.072		0.480	-0.145		0.163
Feeder road	-0.768	*	0.057	-0.797	**	0.044	-0.715	*	0.061
Private fertilizer retailer	0.027		0.800	0.029		0.777	0.005		0.961
Agro-dealer	0.084		0.301	0.092		0.255	0.083		0.307
Province (Central Province is base):									
Copperbelt	-31.264	*	0.100	-49.277	**	0.014	-43.172		0.101
Eastern	-13.286		0.402	-30.533		0.292	-40.099		0.237
Luapula	-55.819	***	0.002	-75.350	***	0.000	-65.581	***	0.005
Lusaka	27.289		0.326	44.414		0.200	13.835		0.680
Muchinga	36.783	*	0.073	-6.398		0.796	34.020		0.310
Northern	-17.929		0.375	-48.699	**	0.032	-24.420		0.359
North Western	-42.651	**	0.034	27.975		0.753	-94.573	***	0.003
Southern	13.285		0.576	9.512		0.739	14.190		0.746
Western	-71.174	***	0.000	-49.776		0.367	-93.150	***	0.008
Number of observations	8,804			8,808			8,808		
Uncensored (non-zero) observations	3,338			3,338			3,338		
F-test: joint significance of ethnicity variables	0.46		0.865	1.98	*	0.067	33.63	***	0.000
F-test: joint significance of all regressors	10.14	***	0.000	10.20	***	0.000	10.53	***	0.000
R-squared	0.177			0.180			0.183		

Source: Own calculations.

Notes: ***p < 0.01, **p < 0.05, *p <0.10. APE = average partial effect. Farm equipment is plows, harrows, and ox-carts. Livestock are cattle, sheep, goats, and pigs. Resident males are defined as those that were at home for at least six of the 12 months. APEs include the effects of squared terms for landholding size, value of farm equipment, and value of livestock. [a]Other ethnic group is -- for column B because it is not the dominant ethnic group in any district.

Also similar to Mason, Jayne, and van de Walle (2013), all three models suggest that the quantity of FISP fertilizer is increasing in the MMD's margin of victory (by 1.0 to 1.4 kg per percentage point increase). Thus, even in more recent years (e.g., 2010/11), the MMD continued to target its supporters.

Politics is not the only factor driving GRZ's targeting of subsidized inputs. Tobit regression results in Table 6 as well as in Mason and Ricker-Gilbert (2013) and Mason, Jayne, and van de Walle (2013) suggest that households with larger landholdings get significantly more subsidized inputs. For example, in 2010/11, households received an average of 19 kg more FISP fertilizer for each ha increase in their landholding size (Table 6). These results are consistent with but substantially larger in magnitude than previous estimates (perhaps as a result of our inability to control for unobserved heterogeneity with the cross-sectional RALS data). For subsidized seed, households received an average of 0.2 kg more per ha increase in landholdings (Mason and Ricker-Gilbert 2013). In contrast, in Malawi, a one-hectare increase in landholding size increased households' receipt of subsidized fertilizer by 11.3 kg on average but did not significantly affect receipt of subsidized seed (ibid).

In Zambia, subsidized fertilizer is also targeted to households with more (non-land) assets. For example, in 2010/11, households received about 0.8 kg more subsidized fertilizer, on average, for each 100,000 Zambian Kwacha (ZMK) increase in value of farm equipment, and 0.1 kg more subsidized fertilizer on average for an equivalent increase in livestock holdings (Table 6).[15] Previous estimation results using the SS panel data (and controlling for unobserved heterogeneity) suggest that increases in livestock wealth but not farm equipment wealth raise households' receipt of subsidized fertilizer (Mason, Jayne, and van de Walle 2013).

Other results of interest are that female-headed households did not receive significantly more FISP fertilizer in the early years of the program (ibid) but in 2010/11, female-headed households (particularly those with no husband) received an average of 13 to 14 kg more subsidized fertilizer than male-headed households, *ceteris paribus* (Table 6). This may signal improvements in the targeting of FISP to households that could not afford the inputs at commercial prices, which should reduce crowding out. Indeed, Mason and Jayne (2013) show that crowding out is substantially lower among female-headed households. Other factors constant, distance from key infrastructure also influences FISP targeting. Estimation results based on the SS and RALS data both suggest that households living farther away from district towns and tarred and/or feeder roads receive significantly less subsidized fertilizer on average (Table 6; Mason and Ricker-Gilbert 2013; Mason, Jayne, and van de Walle 2013).

Overall, comparing the *ceteris paribus* targeting outcomes of FISP in the early years (through 2006/07) to 2010/11, there appear to have been increased efforts over time to target female-headed households. However, FISP continues to go disproportionately to wealthier households that have more land, livestock, and/or farm equipment, and to households that live closer to district towns or feeder roads. The program was also highly politicized by the MMD through 2010/11. Given MMD's loss in the 2011 presidential election, it will be interesting to see if and how FISP targeting changes under the new Patriotic Front government.

[15] When these asset values were measured, 100,000 ZMK was equivalent to US$21.

5. SMALLHOLDER BEHAVIORAL RESPONSES TO INPUT SUBSIDIES

In this section, we review previous findings and present new empirical evidence on how input subsidies affect smallholder behavior in Zambia. We begin by briefly discussing the crowding out effects of GRZ's input subsidy programs. We then discuss fertilizer subsidy impacts on smallholder fertilizer application rates, crop production, and area under fallow, as well as seed subsidy impacts on maize production, incomes, poverty, and income inequality.

5.1. Crowding Out

As discussed in detail in Jayne et al. (2013), which draws on the findings of Xu et al. (2009a), Mason and Jayne (2013), and Mason and Ricker-Gilbert (2013), input subsidies in Zambia have statistically and economically significant crowding out effects on smallholders' purchases of fertilizer and hybrid maize seed from commercial retailers. Recall from Table 4 that in 2010/11 (as in earlier years), the majority (55%) of FISP fertilizer was allocated to households cultivating 2 ha of land or more. This group tends to have higher incomes, more farm and non-farm assets, and more land than the 73% of smallholder households that cultivates smaller areas. They are therefore much more likely to be able to afford inputs at commercial prices – hence the crowding out effects. The incremental effects of fertilizer subsidies on total fertilizer use are further undermined by the leakage and resale on commercial markets of a substantial proportion of the fertilizer intended for the subsidy programs (see Table 2, columns B and D, Mason and Jayne (2013), and Holden and Lunduka (2013)). In the concluding section of this article, we offer recommendations on how FISP could be redesigned to reduce crowding out and leakage.

5.2. Fertilizer Subsidy Effects on Fertilizer Application Rates, Crop Production, and Area under Fallow

In their econometric analysis of the effects of the Food Reserve Agency on smallholder behavior in Zambia, Mason, Jayne, and Myers (2012) also control for the effects of GRZ fertilizer subsidies. As a result, they obtain estimates of (but do not discuss in detail) the *ceteris paribus* effects of subsidized fertilizer on various dimensions of smallholder behavior. These results are summarized in Table 7. Three estimates are presented for each outcome variable: the average partial effect (APE) of a one-kg increase in subsidized fertilizer received by the household (column A); the elasticity of the outcome variable with respect to subsidized fertilizer averaged across *all* households in the sample (column B); and this elasticity averaged across households that received subsidized fertilizer (column C).

The results suggest that an increase in the quantity of subsidized fertilizer received by a household has positive, statistically significant effects on its fertilizer application rate on maize as well as its maize area planted, yields, and output ($p<0.05$). Subsidized fertilizer has no statistically significant effect on the area planted to other crops ($p>0.10$) but the additional area planted to maize appears to come mainly from area that was previously under fallow. The results suggest positive subsidized fertilizer spillover effects on the yields and output of other crops, although the effect on the output of other crops is less than half the size of the impact on maize output (columns B and C).

This empirical evidence is contrary to the conventional wisdom in Zambia, which posits that the increase in maize production in recent years has come at the expense of other crops.

Table 7. Estimated Effects of Subsidized Fertilizer on Smallholder Fertilizer Application Rates, Crop Output Supply, and Area under Fallow

	Average partial effect of a 1-kg increase in subsidized fertilizer on the outcome variable			Average elasticity of the outcome variable with respect to subsidized fertilizer	
	(A)			(B)	(C)
Outcome variable	APE	Sig.	p-value	All HHs	Subsidized fertilizer recipients
Fertilizer application rate (kg fertilizer/ha maize)	0.0995	***	0.000	0.112	0.296
Maize area planted (ha)	6.62E-04	***	0.000	0.0288	0.223
Maize yield (kg/ha)	0.743	***	0.000	0.0185	0.141
Maize output (kg)	1.884	***	0.000	0.0476	0.365
Area planted to other crops (ha)	3.30E-05		0.723	1.89E-03	0.0175
Yield of other crops (FIQI/ha)	7.62E-03	**	0.025	0.0181	0.165
Output of other crops (FIQI)	7.51E-03	**	0.025	0.0181	0.165
Area under fallow (ha)	-5.23E-04	***	0.000	-0.0194	-0.216

Sources: Mason, Jayne, and Myers (2012) and own calculations.
Notes: ***p < 0.01, **p < 0.05, *p <0.10. p-values based on 500 bootstrap replications. FIQI = Fisher-Ideal Quantity Index.
All models include control function residuals to control for the endogeneity of subsidized fertilizer.

Rather, the results suggest that the maize area expansion has come mainly through a reduction in area under fallow. This begs the question of how much further maize area can expand before it begins to encroach on the area planted to other crops. Reduced fallows could also adversely affect soil fertility.

The estimated effects of subsidized fertilizer in Table 7 are fairly small in magnitude as the elasticities averaged across all households range from 0.02 to 0.11 in absolute value, while average elasticities among households that received subsidized fertilizer range from 0.14 to 0.37 in absolute value. In quantity terms, a one-kg increase in subsidized fertilizer raises household maize output by 1.88 kg on average, other factors constant. The increase in maize production comes through both intensification and extension (Table 7).

How do these results compare to previous findings for Zambia and the results from other countries in the region? The finding of a positive fertilizer subsidy effect on maize yields is consistent with the production function estimates in Xu et al. (2009b), which are the only previous estimates of fertilizer subsidy effects on crop production in Zambia. The findings in Table 7 are also largely consistent with evidence from Malawi. For example, although we do not directly estimate the effect of subsidized fertilizer on the *share* of total area planted to maize, the findings that subsidized fertilizer induces an increase in maize area planted but no change in the area planted to other crops implies that subsidized fertilizer raises the share of total area that is planted to maize.[16] This is consistent with the results of Chibwana, Fisher, and Shively (2012), who find that in Malawi input subsidies have resulted in an increase in the share of area planted to maize and tobacco (the two crops promoted by the Malawi program). Moreover, our findings that subsidized fertilizer raises the output of both maize and other crops (and hence total crop output) are consistent with the findings of Ricker-Gilbert and Jayne (2011) for Malawi, which indicate that subsidized fertilizer has positive effects on maize and tobacco output and on the net value of rainy season crop production among smallholders.

Although subsidized fertilizer has a positive impact on maize output in Zambia, at just 1.88 kg of maize per kg of subsidized fertilizer on average, the effect is quite small. The magnitude of this effect is similar to Malawi, where the contemporaneous effect is 1.65 kg of maize per kg of subsidized fertilizer (Ricker-Gilbert and Jayne 2011). Why is the subsidized fertilizer response rate for maize so low in Zambia? First, as a result of crowding out, an additional kg of subsidized fertilizer only raises households' total fertilizer use by an average of 0.87 kg (Mason and Jayne 2013). Second, results in Burke, Jayne, and Black (2012) suggest that high levels of soil acidity on the majority of maize fields in Zambia significantly reduce fertilizer response rates to basal dressing fertilizers. Third, late delivery further undermines the maize yield-boosting potential of subsidized fertilizer.

Consider first the soil acidity effect. Burke, Jayne, and Black (2012) show that 98% of Zambian smallholders' maize fields are on soils with a pH of less than 5.5. At such high levels of soil acidity, maize plants' ability to take up and use phosphorous is severely compromised. In fact, Burke, Jayne, and Black (2012) find average response rates of just 2.1 to 3.7 kg of maize per kg of basal fertilizer on soils with a pH under 5.5, but an average response rate of 7.6 kg/kg on soils with a pH of 5.5 or above. Applying lime is the most direct

[16] Therefore, although the results suggest that the increase in maize area stimulated by FISP does not come at the expense of other crops in *absolute* terms (i.e., ha planted to other crops does not decline, *ceteris paribus*), it does come at the expense of other crops in *share* of total area terms.

way to solve the soil acidity problem. Yet, despite the fact that nearly all maize fields in Zambia are on highly acidic soils, based on the RALS data only 0.4% of smallholder households applied lime during the 2010/11 agricultural season. In the concluding section of the article, we make recommendations related to FISP and lime, and offer other suggestions on how to promote liming to reduce soil acidity and improve maize-fertilizer response rates.

In addition to soil acidity, late delivery of FISP inputs is a perennial problem in Zambia. For example, during the 2010/11 agricultural year, 21% of households reported that FISP basal and/or top dressing fertilizer were delivered late (RALS 2012).[17] Xu et al. (2009b) find that timely delivery and application roughly doubles the average and marginal products of nitrogen fertilizer. These findings suggest that efforts to ensure timely distribution of FISP fertilizer could greatly enhance the maize yield impacts of the program.

Overall, FISP fertilizer has had small, positive impacts on fertilizer applications rates and the production of maize and other crops in Zambia. However, the program has also incentivized a reduction in fallows, which could negatively affect soil fertility in the medium and long term. Reducing soil acidity through the promotion of liming and improving the timeliness of FISP fertilizer delivery could increase the maize production boost brought about by the program.

5.3. Seed Subsidy Effects on Maize Production, Incomes, Poverty, and Income Inequality

The discussion in the previous section focused on the effects of the *fertilizer* component of FISP but recall that a standard FISP pack includes both fertilizer *and* hybrid maize seed. Smale and Mason (2013) find that subsidized seed raises maize production and incomes and reduces the poverty gap and relative deprivation (income equality) among Zambian smallholder maize farmers. However, as with subsidized fertilizer, the effects are small in magnitude, and subsidized seed has no statistically significant effect ($p>0.10$) on a household's probability of falling below the poverty line. See Smale and Mason (2013) for details.

[17] This is down from 30% in 2002/03 (Xu et al. 2009b).

6. THE BENEFITS AND COSTS OF FISP

FISP faces many challenges as outlined above, among them: (i) late delivery of FISP fertilizer, which reduces maize-fertilizer response rates; (ii) high soil acidity throughout Zambia, which limits the uptake of basal dressing fertilizers by plants; and (iii) poor targeting and crowding out/leakage of FISP fertilizer, which reduces the impact of the program on total fertilizer use. As a result of these challenges, the total social costs of FISP greatly exceed the benefits of the program in terms of increased fertilizer use and increased maize production.[18] According to Mason and Jayne (2013), who use FISP cost data from the Zambian Ministry of Finance and National Planning and MAL, and estimates of incremental maize production based on their estimates of crowding out/leakage and maize-fertilizer response rates from Burke (2012), benefit-cost ratios (BCRs) for FISP are well below one for both the 2006/07 and 2010/11 agricultural years. Similar results are likely to hold in *all* years of the program. Even using the most favorable maize price to value the additional maize produced as a result of FISP, the BCR was at most 0.76. In the worst-case scenario, the BCR was 0.37. Program losses (i.e., costs minus benefits) were substantial, and for the 2010/11 FISP were approximately US$39.8 million to US$71.0 million (equivalent to 7% to 13% of total public expenditures in the agricultural sector) (Mason and Jayne 2013).

We repeated these calculations using the estimate in Table 7 that each additional kg of subsidized fertilizer raises maize production by 1.88 kg on average, and noting per Table 2 (column D) that smallholders received 58,404 MT and 116,116 MT of FISP fertilizer in 2006/07 and 2010/11, respectively. This approach gives even more unfavorable BCRs than those reported in Mason and Jayne (0.25 to 0.51 in 2006/07, and 0.29 to 0.44 in 2010/11). Therefore, FISP is far from profitable under a wide range of plausible assumptions.

It is important to note that these calculations do not incorporate the positive/negative spillover effects of the program (e.g., on the production of other crops); however, per Table 7, these spillovers have been modest and their inclusion is unlikely to raise the BCR of FISP above one. The calculations also ignore potential general equilibrium effects of FISP on prices, particularly the price of maize (Ricker-Gilbert, Jayne, and Shively 2013). However, as highlighted in Ricker-Gilbert et al. (2013), FISP has had no economically meaningful effect on maize prices in Zambia.

[18] The total social costs are those borne by government plus those borne by FISP beneficiaries.

7. REMAINING KNOWLEDGE GAPS

As evidenced above, there has been a substantial amount of research on the targeting and effects of input subsidy programs in Zambia. However, many important knowledge gaps remain. These fall into eight broad categories.[19]

- First are the effects of FISP on other aspects of smallholder behavior, e.g., crop diversification, commercialization and crop sales, livestock production and sales, and adoption of conservation farming and other management practices and technologies that can increase fertilizer response rates.
- Second, little is known about FISP's contribution to climate change adaptation and mitigation.
- The third broad category is FISP *fertilizer* effects on smallholder income levels (farm, non-farm, and total, gross and net), poverty rates and the poverty gap, as well as income inequality.[20]
- Fourth are effects on health and nutrition.
- Fifth is the relative targeting effectiveness of the current FISP system compared to an electronic voucher (e-voucher) system. Planning is currently underway for a FISP e-voucher pilot program in 10 districts in 2013/14.
- Sixth are the supply-side effects of FISP. To date, empirical estimates of FISP's crowding out effects are based on changes in farmers' demand for commercial fertilizer; however, FISP has likely also negatively affected the availability of inputs from commercial retailers because they have been sidelined from participation in and crowded out by FISP.
- Seventh are the general equilibrium effects of FISP on input prices and agricultural wage rates, as well as agricultural labor supply and demand.
- And eighth are analyses of the Zambia-specific rates of return to FISP compared to other agricultural sector programs and investments. Researchers often advocate for shifting some public expenditure away from FISP (and FRA) toward investments in agricultural research and development, rural roads and electrification, irrigation, market information systems, etc. Policy makers may be more amenable to such changes if they were presented Zambia-specific empirical evidence on the relative rates of return to the various programs and investments.

[19] Some of these knowledge gaps are highlighted in Ricker-Gilbert, Jayne, and Shively (2013).
[20] Work is underway at IAPRI to examine these issues. Smale and Mason (2013) estimate the *seed* subsidy effects on these outcomes.

8. CONCLUSIONS AND POLICY IMPLICATIONS

Since the signing of the Maputo Declaration on Agriculture and Food Security in 2003, and even more so since the endorsement of the Abuja Declaration on Fertilizer for an African Green Revolution in 2006, many African governments have increased public spending on agriculture, with much of it devoted to input subsidies. Zambia is a key example. GRZ public spending on agriculture has exceeded the 10% Maputo Declaration target in recent years, with approximately 30% of those funds going to the Farmer Input Support Programme (FISP). Yet despite FISP's also accounting for approximately one third of GRZ spending on agricultural sector Poverty Reduction Programmes (PRPs), the rural poverty rate in 2010 (78%) is unchanged from 2004 levels (CSO 2009; CSO 2011). This article synthesizes existing and presents new empirical evidence on the targeting and effects of input subsidies in Zambia. While the analyses do not directly estimate the effects of FISP fertilizer on poverty, the findings do reveal a number of plausible reasons why rural poverty rates remain high despite massive spending on FISP. These insights point to ways that FISP and other input subsidy programs in Zambia could be redesigned to increase their poverty reduction impacts and to better achieve other program objectives.

A critical point highlighted in the paper is the fact that the majority of FISP fertilizer is not allocated to the poorest households. Rather, it is allocated to households that cultivate more land (2+ ha), who are more likely to fall above the poverty line. The majority (73%) of Zambian smallholder households cultivate less than 2 ha of land, and 78% of the smallholders below the poverty line fall into this category (Table 4). Targeting FISP to households that cultivate 0.5 to 2 ha of land has the potential to greatly increase the poverty reduction impact of the program without jeopardizing national food security, since these households use fertilizer just as efficiently as households that cultivate larger areas (Burke, Jayne, and Sitko 2012; Mofya-Mukuka et al. 2013).

What about the households that cultivate less than 0.5 ha? In the early 2000s, the Food Security Pack Programme, a GRZ initiative that offers free agricultural inputs to the poorest of the poor, was fairly well funded. But as FISP has been scaled up, the Food Security Pack Programme has been starved for funds and at present, spending on it is 5% that of FISP (Table 1). Recapitalizing the Food Security Pack Programme and targeting it toward households cultivating less than 0.5 ha would complement FISP and could further reduce rural poverty.

Targeting FISP toward poorer households as well as to female-headed households and households in areas where the private sector is less active in agro-input retailing would also reduce crowding out and increase the amount of additional fertilizer that ends up on farmers' fields as a result of the program (Ricker-Gilbert, Jayne, and Chirwa 2011; Mason and Jayne 2013). Reducing leakage by improving the monitoring and evaluation of FISP and crowding in private sector involvement by implementing the program through an e-voucher redeemable at private agro-dealers and input suppliers could further increase the impact of FISP on total input use and potentially create jobs in the process (Sitko et al. 2012; Mason and Jayne 2013).[21]

Under an e-voucher system, FISP beneficiaries would receive a coupon worth a certain Kwacha amount. They would then redeem the coupon at private traders' shops for the inputs of their

[21] Recall that FISP is currently distributed through a system that works parallel to rather than through private sector distribution networks.

choice. If well designed and implemented, the e-voucher could facilitate more rigorous monitoring and auditing (Sitko et al. 2012). Moreover, while the recent expansion of FISP to include crops other than maize is a welcome development, implementing the program through an e-voucher that farmers can redeem for the crop, livestock, and/or fish-farming inputs and equipment *of their choice* would enable beneficiaries to purchase the materials that are best-suited to agro-ecological and economic conditions in their area, and to their comparative advantage. This could further enhance the wealth creation impact of the program.

At present, the poverty reduction potential of FISP is further hampered by low maize-fertilizer response rates. On average, each kg of FISP fertilizer only raises maize production by 1.88 kg, *ceteris paribus*. Three main causes are one-size-fits-all recommendations, high soil acidity levels on 98% of smallholders' maize fields, and late delivery of FISP fertilizer. Currently, the same types and quantities of fertilizer are given to *all* FISP recipients. Maize-fertilizer response rates and the profitability of fertilizer use could be improved if the types of fertilizers and application rates recommended by government were better tailored to local agro-ecological and economic conditions (MACO, ACF, and FSRP 2002; Sheahan, Black, and Jayne 2013). Moreover, results suggest that reducing soil acidity, e.g., through liming, could double or even triple the maize yield boost from basal fertilizers (Burke, Jayne, and Black 2012). Lime could be included in the FISP pack (as is already done for the Food Security Pack) or as an eligible input for the FISP e-voucher (ibid). Government and private sector extension to raise awareness about the problem of soil acidity in Zambia and campaigns to encourage and train farmers to use lime are sorely needed. Extension efforts could also promote other complementary inputs and management practices, including conservation farming, to raise maize-fertilizer response rates. This could help reduce pressure on fallow land, as results suggest that FISP has incentivized a reduction in area under fallow.

Late delivery of FISP and resultant late application of fertilizer roughly halves maize-fertilizer response rates (Xu et al. 2009b). Implementing FISP through an e-voucher system may help to address the problem of late delivery. Distributing FISP e-voucher coupons to farmers early (e.g., in May/June when they are most likely to have cash from crop sales) would raise the purchasing power for agricultural inputs in the rural areas and encourage the private traders to make the inputs readily available well before planting time. By encouraging agro-dealers to stock inputs early and set up shop in the rural areas, implementing FISP through an e-voucher could help to ensure that inputs are available in a timely fashion for FISP beneficiaries *and* non-beneficiaries, because both could purchase inputs at the agro-dealers' shops.

While implementing FISP through an e-voucher is by no means a panacea, a well-designed and executed e-voucher system could ameliorate many of the problems that currently plague FISP (Sitko et al. 2012; Mofya-Mukuka et al. 2013). Furthermore, many of the aforementioned recommendations apply to both traditional and e-voucher FISP distribution systems. Research to fill the knowledge gaps highlighted in the previous section could illuminate additional ways to refine FISP to maximize its wealth creation impacts, to crowd in the private sector, and to achieve its other objectives. At present, FISP's costs far outweigh its benefits, but with the appropriate adjustments, the tables could be turned.

A final point is that while politicians may fear a backlash come election time if changes were made to FISP, empirical evidence indicates that FISP had no significant effect on voting behavior in the 2006 and 2011 presidential elections (Mason, Jayne, and van de Walle 2013). In contrast, voters rewarded the incumbent handsomely for reducing poverty, income inequality, and unemployment. Therefore, reforming FISP to increase its poverty-, inequality-, and unemployment-reduction impacts is not just good development practice, it is also good politics.

APPENDIX

Table A1. Summary Statistics for Variables Included in Table 6 (Factors Affecting the Kilograms of FISP Fertilizer Allocated to a Smallholder Household in 2010/11)

				Percentiles				
	N	Mean	Std. dev.	10th	25th	50th	75th	90th
Dependent variable: kg of FISP fertilizer acquired by the HH	8839	77.667	168.336	0	0	0	100	200
Explanatory variables:								
MMD won the HH's constituency in the last presidential election (=1)	8839	0.586						
Pct. point spread b/w MMD & lead opposition in constituency	8839	44.851	20.628	12.084	31.134	48.383	61.133	69.195
Median district maize producer price (ZMK/kg, t-1)	8839	1086.645	100.490	956.522	1111.111	1130.435	1130.435	1130.435
Farmgate price of basal fertilizer (ZMK/kg)	8839	3882.664	486.304	3240	3500	4000	4100	4300
Farmgate price of top dressing fertilizer (ZMK/kg)	8839	3781.630	474.167	3200	3460	3800	4020	4200
Landholding size (cultivated+fallow, ha)	8839	2.010	2.309	0.375	0.75	1.418	2.5	4.025
Value of farm equipment ('00,000 ZMK, 2007/08=100)	8839	2.494	10.073	0	0	0	0	6
Value of livestock ('00,000 ZMK, 2007/08=100)	8839	24.565	104.410	0	0	0	10.5	61.6
Number of children age 4 and under	8839	0.790	0.791	0	0	1	1	2
Number of children age 5 to 14	8839	1.671	1.445	0	0	1.833	3	4
Number of prime age adults (age 15 to 59)	8839	2.537	1.479	1	2	2	3	4.75
Number of adults age 60 and above	8839	0.275	0.572	0	0	0	0	1
Age of the HH head	8839	44.548	15.521	27	32	41	54	68
Highest level of education completed by the HH head:								
No formal education (=1)	8839	0.125						
Lower primary (grades 1-4) (=1)	8839	0.216						
Upper primary (grades 5-7) (=1)	8839	0.378						
Secondary (grades 8-12) (=1)	8839	0.245						
Post-secondary education (=1)	8839	0.036						
Sex and residence status of HH head:								
Resident male-headed (=1)	8839	0.761						
Female-headed with non-resident husband (=1)	8839	0.054						
Female-headed with no husband (=1)	8839	0.185						
Head/spouse PA death in last 4 years (=1)	8839	0.017						
Other HH member PA death in last 4 years (=1)	8839	0.043						
HH head is related to the village headman (=1)	8839	0.479						
HH head is related to the chief (=1)	8839	0.114						
HH member is a civil servant (=1)	8839	0.037						
Number of years since the HH head settled in the village	8811	26.078	18.893	4	10	24	38	52
Ethnicity of the HH head:								
Bemba	8831	0.305						
Tonga	8831	0.183						
North Western	8831	0.115						
Barotse	8831	0.074						
Nyanja	8831	0.173						
Mambwe	8831	0.060						
Tumbuka	8839	0.066						
Other	8839	0.024						

Table A1 (cont'd)

	N	Mean	Std. dev.	Percentiles				
				10th	25th	50th	75th	90th
Explanatory variables (cont'd):								
Dominant ethnic group among smallholders in the district:								
Bemba	8839	0.326						
Tonga	8839	0.236						
North Western	8839	0.102						
Barotse	8839	0.075						
Nyanja	8839	0.148						
Mambwe	8839	0.102						
Tumbuka	8839	0.075						
Other	8839	0.148						
% of smallholder households in the district in each major ethnic group:								
Bemba	8839	30.530	39.712	0	0.236	4.596	80.306	97.784
Tonga	8839	18.341	33.189	0	0	0.397	10.176	95.345
North Western	8839	11.489	24.995	0	0	0.163	3.727	49.735
Barotse	8839	7.420	19.325	0	0	0.697	1.796	43.379
Nyanja	8839	17.302	32.426	0	0.106	1.548	14.282	90.552
Mambwe	8839	5.955	18.919	0	0	0.147	2.803	7.312
Tumbuka	8839	6.568	18.931	0	0	0.235	4.065	6.186
Other	8839	2.395	4.596	0	0	0.124	2.150	7.559
Expected growing season rainfall (100 mm, average of past 9 years)	8839	10.028	2.063	7.284	8.933	9.591	11.685	12.003
Expected moisture stress (# of 20-day periods with <40mm rain, avg. of past 9 years)	8839	1.537	0.930	0.444	0.556	1.444	2.222	2.556
Km from the homestead to the nearest:								
District town/boma	8839	43.638	35.576	7	18	35	60	87
Tarred road	8839	34.868	42.645	0	5	20	50	90
Feeder road	8839	2.195	7.437	0	0	0	1	5
Private fertilizer retailer	8839	38.396	37.449	4	11	27	55	84
Agro-dealer	8839	36.324	37.090	3	10	25	51	85
Province:								
Central	8839	0.113						
Copperbelt	8839	0.056						
Eastern	8839	0.187						
Luapula	8839	0.106						
Lusaka	8839	0.031						
Muchinga	8839	0.082						
Northern	8839	0.122						
North Western	8839	0.071						
Southern	8839	0.131						
Western	8839	0.102						

Source: Author's calculations.

REFERENCES

Banful, A.B. 2011. Old Problems in the New Solutions? Politically Motivated Allocation of Program Benefits and the "New" Fertilizer Subsidies. *World Development* 39.1: 1166-76.

Burke, W.J. 2012. Maize Production in Zambia and Regional Marketing: Input Productivity and Output Price Transmission. Doctoral dissertation, Michigan State University. Accessed March 2013, available at http://www.aec.msu.edu/theses/fulltext/burke_phd.pdf

Burke, W.J., T.S. Jayne, and N.J. Sitko. 2012. *Can the FISP More Effectively Achieve Food Production and Poverty Reduction Goals?* Food Security Research Project Policy Synthesis No. 51. Accessed March 2013, available at http://fsg.afre.msu.edu/zambia/ps_51.pdf

Burke, W.J., T.S. Jayne, and R. Black. 2012. *Getting More 'Bang for the Buck': Diversifying Subsidies Beyond Fertilizer and Policy Beyond Subsidies.* Food Security Research Project Policy Synthesis No. 52. Accessed March 2013, available at http://fsg.afre.msu.edu/zambia/ps_52.pdf

Central Statistical Office (CSO). 2009. *Living Conditions Monitoring Survey 2006 Draft Report – Chapter 12, Poverty*. Lusaka, Zambia: CSO.

CSO. 2011. *Living Conditions Monitoring Survey Report, 2006 and 2010*. Lusaka, Zambia: CSO.

CSO/MAL. 2012. 2011/12 Crop Forecast Survey Data. Lusaka: CSO.

CSO/MAL/IAPRI. 2012. 2012 Rural Agricultural Livelihoods Survey Data. Lusaka: IAPRI.

Chibwana, C., M. Fisher, and G. Shively. 2012. Cropland Allocation Effects of Agricultural Input Subsidies in Malawi. *World Development* 40.1: 124-33.

De Groote, H., Z. Gitonga, M. Smale, D. Asare-Marfo, E. Kasuta, E. Birol, and K. Sonder. 2012. *Adoption and Diversification of Modern Maize Varieties in Zambia in 2011: A Baseline Report Prepared for HarvestPlus*. Accessed March 2013, available at ftp://ftp.cgiar.org/ifpri/Ekin/Gene%20Kahn/Zambia-maize/HPlus-Modern%20maize%20in%20Zambia_final.pdf

Food Reserve Agency (FRA) Agro Support Department. 1999. *Implementation Manual on Modalities for the Distribution of the 1999/2000 Agricultural Season Inputs*. Lusaka, Zambia: FRA.

Holden, S. and Lunduka, R. 2013. Who Benefits from Malawi's Targeted Farm Input Subsidy Program? *Forum for Development Studies* 40.1: 1-25.

Howard, J. and C. Mungoma. 1996. *Zambia's Stop-and-Go Revolution: The Impact of Policies and Organizations on the Development and Spread of Maize Technology.* Michigan State University International Development Working Paper No. 61. Accessed March 2013, available at http://fsg.afre.msu.edu/papers/idwp61.pdf

Indaba Agricultural Policy Research Institute (IAPRI). 2012. *The 2012 Rural Agricultural Livelihoods Survey: Interviewer's Instruction Manual*. Lusaka, Zambia: IAPRI.

International Monetary Fund (IMF). 2012. *Zambia 2012 Article IV Consultation.* IMF Country Report No. 12/200. Accessed March 2013, available at http://www.imf.org/external/pubs/ft/scr/2012/cr12200.pdf

Jayne, T.S. 2008. Forces of Change Affecting African Food Markets: Implications for Public Policy, in *The Transformation of Agri-Food Systems: Globalization, Supply Chains, and Smallholder Farmers,* ed. E.B. McCullough, P.L. Pingali, and K.G. Stamoulis. Rome: Food and Agriculture Organization.

Jayne, T.S., N.M. Mason, W.J. Burke, A. Shipekesa, A. Chapoto, and C. Kabaghe. 2011. *Mountains of Maize, Persistent Poverty.* Food Security Research Project Policy Synthesis No. 48. Accessed March 2013, available at http://fsg.afre.msu.edu/zambia/ps_48.pdf

Jayne, T.S., D. Mather, N.M. Mason, and J. Ricker-Gilbert. 2013. *How Do Fertilizer Subsidy Programs Affect Total Fertilizer Use?* Presentation at MSU/IFPRI Policy Workshop on Input Subsidy Programs in Sub-Saharan Africa, 16-17 April. Washington, D.C.

MACO. 2002. *Implementation Manual for the 2002/2003 Agricultural Inputs Support Programme*. Lusaka, Zambia: MACO.

MACO. 2004. *Implementation Manual for the 2004/2005 Agricultural Season Fertilizer Support Programme*. Lusaka, Zambia: MACO.

MACO. 2008. *Fertilizer Support Programme Internal Evaluation*. Lusaka, Zambia: MACO. Accessed March 2013, available at http://www.aec.msu.edu/fs2/zambia/tour/FSP_Internal_Evauation_2008.pdf

MACO. 2009. *Farmer Input Support Programme Implementation Manual, 2009/2010 Agricultural Season*. MACO, Lusaka, Zambia.

MACO, ACF, and FSRP. 2002. *Developments in Fertilizer Marketing in Zambia: Commercial Trading, Government Programs, and the Smallholder Farmer.* Food Security Research Project Working Paper No. 4. Accessed March 2013, available at http://aec.msu.edu/fs2/zambia/wp4zambia.pdf

Mason, N.M., and T.S. Jayne. 2013. Fertilizer Subsidies and Smallholder Commercial Fertilizer Purchases: Crowding out, Leakage, and Policy Implications for Zambia. *Journal of Agricultural Economics* 64.3: 558–82. Can be accessed at: http://onlinelibrary.wiley.com/doi/10.1111/1477-9552.12025/abstract;jsessionid=2969E1D0CF9E7338519BA2596E582479.d04t01

Mason, N.M., T.S. Jayne, and R.J. Myers. 2012. *Smallholder Behavioral Responses to Marketing Board Activities in a Dual Channel Marketing System: The Case of Maize in Zambia.* Selected paper prepared for presentation at the International Association of Agricultural Economics Triennial Conference, 18-24 August. Foz do Iguaçu, Brazil. Accessed March 2013, available at http://ageconsearch.umn.edu/bitstream/126927/2/MasonEtAl.pdf

Mason, N.M., T.S. Jayne, and N. van de Walle. 2013. *Fertilizer Subsidies and Voting Behavior: Political Economy Dimensions of Input Subsidy Programs.* Selected paper prepared for presentation at the Agricultural and Applied Economics Association's 2013 AAEA and CAES Joint Annual Meeting, 4-6 August. Washington, D.C. Accessed June 2013, available at http://ageconsearch.umn.edu/bitstream/149580/2/Fertilizer_subsidies_%26_election_outcomes-AAEA_V1.pdf

Mason, N.M. and J. Ricker-Gilbert. 2013. Disrupting Demand for Commercial Seed: Input Subsidies in Malawi and Zambia. *World Development* 45: 75-91.

Megill, D.J. 2005. *Recommendations for Adjusting Weights for Zambia Post-Harvest Survey Data and Improving Estimation Methodology for Future Surveys.* Food Security Research Project Working Paper No. 13. Accessed March 2013, available at http://www.aec.msu.edu/fs2/zambia/wp13_zambia.pdf

MAL. 2012. *Farmer Input Support Programme Implementation manual, 2012/2013 Agricultural Season*. Lusaka, Zambia: MAL.

MAL/MACO. Various years. *Crop Forecast Survey Interviewer's Instruction Manual*. Lusaka, Zambia: MAL/MACO.

Ministry of Community Development and Social Services (MCDSS), various years. *The Targeted Food Security Pack for Vulnerable but Viable Farmers: Programme Implementation Guidelines*. Lusaka, Zambia: MCDSS.

MFNP. 2012. *Estimates of Revenue and Expenditure: Activity Based Budget, 2011.* Lusaka, Zambia: Government Printer.

MFNP. Various years. *Estimates of Revenue and Expenditure: Activity Based Budget.* Lusaka, Zambia: Government Printer.

Mofya-Mukuka, R., S. Kabwe, A. Kuteya, and N.M. Mason. 2013. *How Can the Zambian Government Improve the Targeting of the Farmer Input Support Programme?* Indaba Agricultural Policy Research Institute Policy Brief No. 59. Accessed March 2013, available at http://fsg.afre.msu.edu/zambia/ps_59.pdf

Morris, M., V.A. Kelly, R.J. Kopicki, and D. Byerlee. 2007. *Fertilizer Use in African Agriculture: Lessons Learned and Good Practice Guidelines*. Washington, D.C.: World Bank.

Pan, L. and L. Christiaensen. 2012. Who Is Vouching for the Input Voucher? Decentralized Targeting and Elite Capture in Tanzania. *World Development* 40.8: 1619-33.

PAM (Programme Against Malnutrition). 2005. *The Targeted Food Security Pack for Vulnerable but Viable Farmers: Programme Implementation Guidelines for the 2005/06 Agricultural Season*. Lusaka, Zambia: PAM.

PAM. Various years. *The Targeted Food Security Pack for Vulnerable but Viable Farmers: Programme Implementation Guidelines*. Lusaka, Zambia: PAM.

Ricker-Gilbert, J. and T.S. Jayne. 2011. *What Are the Enduring Effects of Fertilizer Subsidy Programs on Recipient Farm Households? Evidence from Malawi.* Michigan State University Staff Paper No. 2011-09. Accessed March 2013, available at http://ageconsearch.umn.edu/bitstream/109593/2/StaffPaperRickerGilbert2011-09A.pdf

Ricker-Gilbert, J., T.S. Jayne, and E. Chirwa. 2011. Subsidies and Crowding Out: A Double-Hurdle Model of Fertilizer Demand in Malawi. *American Journal of Agricultural Economics.* 93.1: 26-42.

Ricker-Gilbert, J., T.S. Jayne, and G. Shively. 2013. Addressing the "Wicked Problem" of Input Subsidy Programs in Africa. *Applied Economic Perspectives and Policy* 35.2: 322-40.

Ricker-Gilbert, J., N.M. Mason, T.S. Jayne, F. Darko, and S. Tembo. 2013. *What are the Effects of Input Subsidy Programs on Maize Prices? Evidence from Malawi and Zambia.* Indaba Agricultural Policy Research Institute Working Paper No. 75. Accessed August 2013, available at http://fsg.afre.msu.edu/zambia/wp75.pdf.

Sheahan, M., R. Black, and T.S. Jayne. 2013. Are Kenyan Farmers Under-utilizing Fertilizer? Implications for Intensification Strategies and Research. *Food Policy* 41: 39-52.

Sitko, N.J. 2010. *The Fractured Politics of Food Security: Maize, Power, and Hunger on a Zambian Frontier*. Ph.D. dissertation. University of Colorado at Boulder.

Sitko, N.J., R. Bwalya, J. Kamwanga, and M. Wamulume. 2012. *Assessing the Feasibility of Implementing the Farmer Input Support Programme (FISP) through an Electronic Voucher System in Zambia.* Indaba Agricultural Policy Research Institute Policy Brief No. 53. Accessed March 2013, available at http://fsg.afre.msu.edu/zambia/ps_53.pdf

Smale, M. and T. S. Jayne. 2003. *Maize in Eastern and Southern Africa: "Seeds" of Success in Retrospect.* IFPRI Environment and Production Technology Division Discussion Paper No. 97. Accessed March 2013, available at http://www.ifpri.org/sites/default/files/publications/eptdp97.pdf

Smale, M. and N.M. Mason. 2013. *Impacts of Seed Subsidies on Poverty and Inequality Among Smallholder Maize Growers in Zambia*. Mimeo.

Wooldridge, J.M. 2010. *Econometric Analysis of Cross Section and Panel Data, 2nd Edition*. Cambridge, MA: MIT Press.

Xu, Z., W.J. Burke, T.S. Jayne, and J. Govereh. 2009a. Do Input Subsidy Programs "Crowd In" or "Crowd Out" Commercial Market Development? Modeling Fertilizer Demand in a Two-Channel Marketing System. *Agricultural Economics* 40.1: 79-94.

Xu, Z., G. Guan, T.S. Jayne, and R. Black. 2009b. Factors Influencing the Profitability of Fertilizer Use on Maize in Zambia. *Agricultural Economics* 40.4: 437-46.