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CAN THE FISP MORE EFFECTIVELY ACHIEVE FOOD PRODUCTION AND POVERTY REDUCTION GOALS?

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Key Points

- Despite being framed as a key component of the nation's poverty reduction strategy, evidence suggests that inputs distributed under Zambia's Farmer Input Support Programme (FISP) tend to be targeted to the least poor rural households.
- This seeming contradiction is the outgrowth of FISP's other major policy objective: to substantially increase total maize production in Zambia. Implicit in this targeting approach is the assumption that larger, wealthier farms are more capable of utilizing subsidized inputs to substantially raise total maize productivity in Zambia.
- Analysis of Central Statistical Office farm survey data indicates that maize yield response to fertilizer use may actually be higher on smaller farms. This is likely because small farms tend to be more intensively cultivated.
- Reallocating a greater proportion of FISP subsidies to relatively small farms would more effectively reduce rural poverty. This could reduce net maize purchasing households' dependence on the market for food and conserve more maize supplies for urban consumers without adversely affecting total national production.

INTRODUCTION: Since 2002, Zambia's Farmer Input Support Programme (FISP) has provided fertilizer and seed at heavily subsidized prices to farmers. Each year FISP has consumed the vast majority of the Government of Zambia's agricultural budget allocation to poverty reduction. In 2011, for example, 73% of the poverty reduction budget was allocated to FISP. Evidence suggests, however that prioritizing FISP as a cornerstone of the government's poverty reduction strategy has had little or no measurable impact on rural poverty. Headcount rural poverty rates have actually increased marginally from 77.3% in 2004 to 77.9% in 2010 despite a major scaling-up of expenditures on the FISP program. As will be described in the next section, one reason FISP has not succeeded in reducing rural poverty in Zambia is that the upfront costs and explicit targeting and land access requirements to be a FISP beneficiary tend to exclude poorer rural households. Farm survey data collected by the Central Statistical Office (CSO) consistently shows that FISP fertilizer and maize seed has been allocated disproportionately to households with relatively large farms and greater asset wealth (see Jayne et al. (2011) and more evidence in this report).

Government officials are cognizant of the apparent paradox of spending a massive share of the government's poverty reduction budget on relatively large and better off farm households. To redress this, the Government designed the Food Security Pack to explicitly target poorer rural households. However, the budget allocation to the Food Security Packs was just 5% of the value of the allocation to FISP.

Why would government spend so little of its budget for agriculture on its poorest farmers, while spending over 70% of the agricultural poverty reduction budget on a program that tends to be captured by larger, better-off farmers? In all likelihood, this spending pattern results from another important agricultural sector goal: to utilize government resources to increase total national maize production and maximize the marketed surpluses available for urban consumption. Larger farms are certainly more likely to produce a marketable surplus than smaller farms. In an increasingly urbanized country like Zambia, a seemingly straight-forward policy approach to meeting the food needs of urban consumers would be to provide subsidies to those that are better able to produce a surplus. However, this approach will do little to address issues of rural poverty, especially if it comes at the cost of lowered funding for other poverty reduction strategies that are targeted directly to the rural poor.

Moreover, the approach of targeting better off, surplus producers under-appreciates the fact that poorer rural farmers are also net buyers of maize (Tembo et al. 2009). Therefore, supporting food production in poorer rural households might be a viable alternative approach. That is, increasing production on poorer (smaller) farms would increase the supply of food for urban consumers by decreasing rural demand, while also more effectively reducing poverty.

This approach will only succeed if deficit production farmers could get the same yield response from fertilizer as larger farms. Under that condition, a kilogram of subsidized fertilizer targeted to a smaller farm would promote national food security just as effectively as a kilogram targeted to a larger farm.

Whether or not smaller farms achieve yield responses to fertilizer applications that are similar to larger farms has never been properly examined using Zambian yield data. Thus, the objective of this policy synthesis is to determine the relative productivity of fertilizer applications on farms of various sizes.

Our results show no significant evidence that larger farms use fertilizer more effectively. This implies that reallocating a greater proportion of FISP subsidies to relatively small farms would more effectively address rural poverty problems while not adversely affecting national production and food security.

BACKGROUND: Targeting Less Poor Households. There are a number of ways in which the poorest households are excluded from direct FISP benefits. For example, the FISP implementation manual states that the program should be targeted towards “viable” farmers with cooperative membership and “the capacity to grow at least 0.5 hectares of maize” (MACO 2011). Depending on how capacity is defined, this policy excludes 15-20% of the households with the least access to land. In rural Zambia, as in much of Africa, the link between low access to land and poverty is well established (e.g., Jayne et al. 2008). Differences in farm size also tend to reflect a host of more fundamental differences in resource control and political power across households (Berry 1993). This targeting requirement therefore minimizes the extent to which FISP inputs are allocated to the poorest rural households.

FISP guidelines also stipulate that subsidy eligibility requires membership in a local cooperative. According to ethnographic research with four cooperatives in Kalomo district, cooperative membership entails a one-off 50,000 ZMK non-refundable member fee along with 200,000 ZMK for every cooperative share the farmer wishes to purchase (Sitko 2010). A farmer must acquire a minimum of one share to become a cooperative member. Once a farmer has become eligible to receive FISP through the cooperative, he/she must provide 280,000 ZMK per FISP input pack.[1] Based on nationally representative household survey data collected by the Central Statistical Office in 2008, this 530,000 ZMK in upfront costs represents more than 20% of a household's gross annual income for at least 60% of rural households. Results from the same survey show that 50% of the agricultural households who did not receive the FISP subsidy claim the primary reason was either they were not a cooperative member, or that the FISP packet was too expensive. In addition to the explicit targeting of larger farms, this further explains why poorer households often fail to acquire inputs through FISP. Instead, our informal interviews suggest many sell their claim on subsidized inputs to larger farmers.

Together, these factors lead to a highly skewed distribution of FISP fertilizer towards better off farmers. In 2011, for example, nearly 32% of rural farm households had access to less than 1 hectare (ha) of land, but they received less than 10% of the FISP fertilizer distributed (Table 1). Households with access to 2-5 ha received 44% of FISP distribution, but this group represented just 30% of rural farming households. Combined, all those with more than 2 ha constituted 37% of all rural households, but they received 64% of the FISP fertilizer distributed.

FISP has clearly contributed to national food production objectives in Zambia. Mason et al. (2011) estimate that 15% of the increased maize production in 2011 over levels in the mid-2000s was due to increased fertilizer use. However, the apparent assumption that relatively small farms are less efficient users of fertilizer and the effect this assumption has had on FISP targeting have severely limited the potential of FISP to reduce poverty.

Table 1. Distribution of Smallholder Farm Households and FISP Fertilizer (2011)

Farm size (ha)	Percent of households	Percent of FISP kgs distributed
Less than 1	31.6	9.8
1 - 2	31.7	25.9
2 - 5	30.0	43.9
5 - 10	5.6	16.2
More than 10	1.1	4.2

Source: Author, based on data from MACO/CSO Crop Forecast Survey 2011. Farm size is total area cultivated and fallow.

DATA AND METHODS: We use panel household data from two surveys carried out in 2004 and 2008 that were conducted by the Food Security Research Project and the Central Statistical Office. The determinants of maize yield are estimated at the field level using observations from 7,127 maize fields on farms of various sizes (3,448 from 2004 and 3,679 from 2008). The data used for this analysis are described in greater detail in Burke (2012).

We use an extension of the model presented in Burke (2012), where the effectiveness of fertilizer application is estimated as a function of agronomic conditions and farming practices. For this study, the model also allows land and fertilizer productivity to fundamentally differ across farm size categories in ways not related to farm management (e.g., general differences in soil quality or overall asset endowment). Specifically, the model estimates land and fertilizer productivity separately for 5 groups: i) households with less than 1 ha, ii) households with 1-2 ha, iii) households with 2-5 ha, iv) households with 5-10 ha, and v) households with more than 10 ha.

[1] This is 50,000 ZMK per bag of fertilizer and 80,000 ZMK for seed. All packs are sold as one unit with two bags of top dressing and two bags of basal fertilizer.

Table 2. Maize Producers' Average Fertilizer Productivity in Zambia by Farm Size

	Average product of fertilizer (kg/kg, where applied)			Actual yield (kg/ha)		
	Basal	Top dress	Both	Unfertilized	Fertilized	Difference (within group)
Farm Size (ha)	Mean					
Less than 1	2.83	4.62	3.73	1257	2181	924
1 - 2	2.61	4.35	3.48	1247	1957	710
2 - 5	2.70	4.33	3.52	1429	2180	751
5 - 10	3.08	4.27	3.68	1560	2372	812
More than 10	3.13	3.78	3.46	1725	2511	786

Source: FSRP/CSO Supplemental Surveys 2004 and 2008 and author's calculations. Farm size is total area cultivated and fallow. This is based on 2008 observations (the only data available) and treated as time-constant.

KEY FINDINGS: Table 2 presents the mean average product (AP) estimations for fertilizer users in various farm size categories.[2] The AP measures the additional kg/ha of maize per kg/ha of fertilizer applied. The first column in Table 2 shows estimated APs for basal fertilizer (also called Compound D), the second shows APs for top dressing (also called Urea), the third shows the mean AP for *fertilizer*, or the AP if basal and top dressing are applied in equal proportions. This table also shows the actual yields on fertilized and unfertilized fields and the difference between them within each farm size category in the three far right columns.

The first two columns suggest that the average product for basal fertilizer is higher on larger farms, but top dressing is more productive on smaller farms. These trends can be explained by a combination of farm management and soil acidity. Top dressing is more vulnerable to leaching, or having the nutrients washed away before crops have time to consume them. Our regression results indicate this is somewhat more of a risk on plowed fields, where more soil is disturbed during tillage. The fields of top dressing users on larger farms are much more likely to be plowed (Table 3), which partially explains why top dressing is estimated to be more effective on smaller farms.

Small farms may also be likely to use their land more intensively over time. Given that land is a more limited resource on smaller farms, there is greater incentive to sow seeds closer together and less opportunity to rotate crops or allow fields to fallow. This depletes the nutrients in the soil that fertilizers replenish, which may result in higher yield responses on smaller farms. This is consistent with our regression results, and partially explains why the estimated AP of top dressing is higher on smaller farms.

That said, Zambian soils tend to be naturally acidic and, unless measures are taken, top dressing fertilization increases acidity over time. For reasons discussed in Griffith (2010), this considerably reduces the effectiveness of basal fertilizer. Smaller farms tend to apply fertilizers at a higher rate (Table 3). The combination of basal fertilizer's low effectiveness (on acidic fields of any size) and higher application rates on smaller farms partially explains why the kg per kg average yield response is lower on small farms. Altogether, whether fertilizer is used more or less efficiently on smaller farms seems to be dependent on the type of fertilizer being applied. The relative efficiency of smaller farms more generally is addressed in column 3 of Table 2. When fertilizers are applied in equal proportion, these results indicate that farms in the smallest category will get the highest return.

[2] These estimations are based on regression results from a larger econometric model for yields. Full results are available upon request. In addition to farm size, factors controlled for are seed type and application rate, soil acidity and type, tillage method and timing, crop mix, manure application, weeding, weather and other unobserved household fixed effects.

Table 3. Plow Tillage and Fertilizer Application Rates (among Users) by Farm Size

	Plowed fields	Top Dress	Basal
Farm size	--------Percent--------	----------------------Mean (kg/ha)----------------------	
Less than 1	28	167	170
1 - 2	28	144	147
2 - 5	42	136	132
5 - 10	67	137	140
More than 10	83	137	140

Source: FSRP/CSO Supplemental Surveys 2004, 2008. Farm size is total area cultivated and fallow. This is based on 2008 observations (the only data available) and treated as time-constant.

For example, farms that are less than one hectare produce 3.73 kg of maize per kg of fertilizer applied, which is 0.27 more kg/kg than farms larger than 10 ha. It should be noted that the difference in yield response to fertilizers is not statistically significant across farm sizes, all else equal.

Although yields overall tend to be higher on larger farms, the difference between average yields on fertilized and unfertilized fields within each farm size category is greatest for the smallest fields (924 kg/ha, compared to 786 kg/ha on the largest farms). This is again suggests that fertilizer is more effective on smaller farms and is consistent with the notion that yield response would be higher on smaller farms with depleted soils.

These results suggest that subsidies targeted at the smallest (poorest) farms would not only be more likely to impact poverty, but could also potentially have an even greater impact on improving national food security.

CONCLUSION: The objective of this analysis was to demonstrate the relative productivity of fertilizer application on farms of various sizes in Zambia. Fertilizer subsidies are a key poverty reduction strategy in the country, but have systematically been targeted to larger, wealthier farms within the small- and medium-scale farming sector. This targeting approach suggests that increasing national surplus production has been a higher priority than direct poverty reduction and by the apparent assumption that smaller farmers would use fertilizer less effectively.

The empirical evidence in this analysis does not support this assumption. We find the response to fertilizer applications (basal and top dressing combined) on Zambian farms smaller than 1 ha is statistically no different from the response to fertilizer application on large farms. In fact, we find that an additional tonne of fertilizer distributed to farms smaller than one hectare would contribute as much maize to national output as it would if the fertilizer were distributed to farms in any other farm size category.

These findings imply that 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.

One way this could be achieved may be by providing funding to the Food Security Pack at levels that reflect the scale of rural poverty. For example, since nearly two out of three rural households have access to less than 2 hectares of land, this would suggest allocating over 65% of the poverty reduction budget to production enhancing programs that are specifically designed to reach these smaller farms.

While not the focus of this analysis, it is important to note that there are several other ways in which FISP modifications could more effectively achieve Zambia's food security and poverty reduction goals. For example, more appropriate technologies could be contained in the subsidized package of inputs, such as lime and fertilizer types more appropriate to the varied soils found in Zambia. The new government might also consider productivity enhancing investments other than input subsidies, such as increased public investment in crop science, agronomic improvements, tsetse fly control, veterinary support, enhanced livestock breed stock and farmer extension support.

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