



**Measuring the Impacts
of Agricultural Input
Subsidies in Sub-
Saharan Africa:
Evidence from Malawi's
Farm Input Subsidy
Program**

GERALD SHIVELY

JACOB RICKER-GILBERT

Department of Agricultural Economics
College of Agriculture
Purdue University

PURDUE
UNIVERSITY

Global Policy Research Institute

1341 Northwestern Avenue

West Lafayette, IN 47906

Phone: (765) 496-6788

Fax: (765) 463-1837

www.purdue.edu/globalpolicy

Abstract

Malawi, a small, land-locked country in south Eastern Africa has been at the forefront of the recent push to reestablish subsidies as a way of boosting agricultural production and improving food security, especially among the poor. Its programs have been widely observed, scrutinized, and emulated. This policy brief examines Malawi's Farm Input Subsidy Program (FISP) and distills a set of key research findings drawn from research conducted recently at Purdue University.

Introduction: Agricultural Subsidies in Sub-Saharan Africa

Agricultural subsidies are used in many countries to support farmers and promote specific agricultural practices. They tend to be costly, and for this reason they justify close scrutiny, especially in developing countries, where there are numerous competing demands for scarce public resources. Agricultural input subsidies were a major component of agricultural development strategies in sub-Saharan Africa (SSA) in the 1970s and 1980s. They were then largely phased out in response to World Bank and IMF imposed structural adjustment programs in the 1990s. In recent years, large-scale input subsidy programs have re-emerged across the continent, and their reintroduction gained particular momentum following the first African Fertilizer Summit, which was held in Nigeria in 2006. Today, seven African governments alone spend roughly US\$2.0 billion on fertilizer promotion programs each year. These subsidies constitute a substantial share of public spending on agriculture in these countries. One justification for the re-introduction of large input subsidy programs has been the belief that past mistakes in administering these programs have been identified and can be corrected. The approaches taken in the 1970s and 1980s tended to rely on universal coverage, which was costly and spread benefits beyond target groups. In contrast, current efforts have been rebranded as "smart subsidies" because they are said to rely on new institutions and improved implementation strategies that can encourage private sector development and more accurately target intended beneficiaries. Arguments over the relative merits of fertilizer subsidy programs constitute one of the most contentious policy debates currently taking place in Africa. Much is at stake,

including smallholder livelihoods and government budgets.

Agricultural Subsidies in Malawi

The use of input subsidies in Malawi dates to the early seventies. Not only was the use of agricultural subsidies perceived as successful in stimulating food crop production, subsidies enabled the country to achieve a high degree of self-reliance in maize, Malawi's main staple. The use of subsidies was eliminated in the early 1990's as part of a Structural Adjustment Program (SAP) that was adopted to deregulate Malawi's markets. Agricultural subsidies were reintroduced in 1998 under a program called the Starter Pack Scheme (SPS). The SPS provided small quantities of seed and fertilizer to nearly all farmers in the country. The SPS eventually evolved into a Targeted Inputs Program (TIP). Under the program, all households were entitled to a package containing sufficient fertilizer and seed to plant about 0.1 hectare of maize. Although this was not a large subsidy, for food insecure households it was a substantial intervention.

Bad weather in the 2004/05 agricultural season led to very low national production and a severe food crisis in 2005. In response, government reorientated its food security program and scaled down the TIP. The ongoing food crisis prompted the government to re-introduce large scale input subsidies for maize and tobacco under a program called the Farm Input Subsidy Program (FISP). The program was implemented with the objective to increase smallholder farmers' access to improved agricultural inputs as a way of achieving food self-sufficiency and increasing farm incomes. The program transfers paper vouchers to selected households, which enables them to purchase fertilizer, hybrid seed and/or pesticides at greatly reduced prices.

FISP Eligibility and Implementation

The FISP was first implemented in 2005. During the first two years of the program, guidelines for identifying beneficiaries were not clear. Targeting was decentralized, and village leaders and village distribution committees had wide latitude in deciding who was eligible to receive the voucher. At the start of the 2007/08 agricultural season, clearer guidelines and criteria

were established both for eligibility and selection. Priority was placed on emphasizing vulnerable households as program beneficiaries. Additional changes were made for the 2008/09 growing season. Pesticides for postharvest grain storage were introduced and vouchers were made more secure to prevent fraud, and voucher resale, two commonly recognized and ongoing problems during previous seasons. For the 2009 subsidy program each targeted household was entitled to 100kg of maize fertilizer at nearly a 90% subsidized price and either 2kg of free hybrid maize seed or 4kg of open pollinated maize. Some households were also entitled coupons for tobacco fertilizer allowing access to 50kg of chemical fertilizer and some subsidies were also provided for cotton growers. The following official criteria were clearly stated as those to be used to select beneficiaries in the 2007/08 and 2008/09 agricultural seasons:

- (1) Recipients had to be Malawians who owned a piece of land that was being cultivated;
- (2) Recipients had to be farmers that were bona fide residents of their villages;
- (3) Only one recipient was eligible per household; and
- (4) Priority was to be given to vulnerable groups, especially households that were either child- or female-headed.

Understanding the Impacts of the 2009 FISP

How well did the FISP perform and for whom? To answer this question we engaged in extensive and complementary fieldwork in Malawi in 2009 using several stages of data collection and analysis to study smallholder farmers' behaviors, their decisions and outcomes on their farms.

In one study, we conducted detailed interviews with 380 farm households in 35 villages in Kasungu and Machinga districts. As part of the study design we explicitly included in our survey households that had been part of prior studies conducted in 2002 and 2006 to understand how conditions and behaviors had changed in response to the program. Our collaborators included researchers at Bunda College at the University of Malawi. The districts studied possess diverse demographic, climatic and socioeconomic

conditions, but agriculture is the main occupation at both locations. Data were collected on a wide range of household and village characteristics such as crop production and input use, incomes and expenditures, and participation in the input subsidy program. The goal of data collection was to study: (i) receipt of subsidies; (ii) use of fertilizer; (iii) maize production; and (iv) patterns of agricultural land use.

The second study relied on a nationally representative sample of farm households in 13 districts across Malawi. Data were collected as part of a collaboration between Michigan State University, University of London School of Oriental and Asian Studies, and University of Malawi Chancellor College. The data set built on earlier rounds of data collected in 2003 and 2007. In total 1,375 households were interviewed. The goal of this research was to study: (i) receipt of subsidies; (ii) the extent to which the subsidy program affected private fertilizer markets; and (iii) maize production.

Participation In and Fertilizer Use Impacts of the FISP

Who actually received the coupons?

The initial design of the subsidy program was to have each deserving household receive two fertilizer coupons (one each for 50 kg of basal fertilizer and 50 kg of side dressing fertilizer) and a coupon for maize seed (2 kg hybrid or 4 kg Open Pollinated Varieties). However, program limitations, regional differences and local idiosyncrasies resulted in households receiving different packet sizes sometimes ranging from nothing to more than twice the recommended amount.

Overall, both studies found that even though targeting was decentralized and conducted at a local level, it was not very precise, and did not align well with official program goals. Study results suggest that older households were more likely to have received a complete input subsidy packet than younger households. Contrary to program requirements, female headed households were less likely than male headed households to have received a complete package of coupons. Being educated increased the likelihood of receiving more coupons than the recommended amount. It is likely that being educated possibly enhanced

bargaining power with those who played a role in identifying beneficiary households. Despite targeting criteria to the contrary, poor households were most likely to have received nothing.

Social factors played an important role in determining a household's probability of receiving a subsidy voucher. Household heads that had lived in their villages for longer periods had an increased probability of receiving coupons for 100 kg of fertilizer (the recommended amount) or more. The length of residency was influential in creating ties with the village head and members of the Village Development Committee, all of whom were responsible for selecting subsidy beneficiaries. Results also indicated important district-level differences in program implementation.

How did coupon receipt affect fertilizer use?

Having identified who actually received the coupons, the question of interest was to assess the effect of coupon receipt on chemical fertilizer use. In particular, what were the effects on the quantities of fertilizer applied to hybrid and traditional varieties? An important objective of the coupon/voucher system, albeit temporary, was to stimulate the use of improved maize seed and fertilizer among poor farmers and consequently empower them to purchase their own inputs for subsequent growing seasons. Our analysis took into account the fertilizer-maize price ratio, household socio demographic and economic characteristics, farmers' participation in the fertilizer subsidy program, economic shocks (shocks resulting in labor, financial and physical crop loss) encountered before and/or during the 2008/09 agricultural season, market access and whether or not a household used improved maize seed.

Results suggest that while larger farms used more fertilizer for maize production overall, small farms were more intensive in their use of fertilizer than large farms, providing greater returns to each unit of fertilizer applied. Female-headed households used less fertilizer for maize than did their male counterparts. Chemical fertilizer use was also correlated with the overall level of wealth of a household: poor households used less fertilizer on their plots. Such households generally tended to have low levels of income and were also less likely to have received subsidies.

Farmers that planted improved varieties of maize used approximately 50 kg more fertilizer than those that did not. This is probably indicative of patterns in adoption behavior where farmers adopt improved maize production technologies as a package. Households that were classified as net buyers of maize used less fertilizer suggesting competition for cash between immediate consumption and purchase of fertilizer.

The various forms of vouchers received led to mixed outcomes with regard to fertilizer use. Households that received two coupons (for 100 kg of fertilizer) used 178 kg more fertilizer on average than those that did not receive a coupon. Uncertainty surrounding the future of the program led some households to save fertilizer for future use. In general the FISP increased fertilizer use among beneficiaries, but by an amount somewhat less than the total quantity of fertilizer subsidized.

Did the program “crowd-out” the private sector?

The FISP’s effectiveness in targeting recipient farmers who met certain criteria had a direct effect on how the program impacted demand for commercial fertilizer. In principle, if subsidized fertilizer was allocated to farmers who would not have otherwise purchased fertilizer commercially, then a one ton increase in total fertilizer use would be observed for each ton of fertilizer distributed under the program. With other factors constant, such a pattern would maximize the contribution of a subsidy program to farm income and national food production. In contrast, if some of the fertilizer received in subsidized form would have been purchased even in the absence of the FISP, but was not, then the program can be said to have “crowded-out” the private sector. Measuring the degree to which fertilizer subsidies crowd out commercial sales is essential for understanding the contribution of the fertilizer subsidy program to total fertilizer use and, ultimately, the overall net impact on food production and farm incomes.

We estimate that the rate of crowding-out was 22%. This means that, on average, each kilogram of subsidized fertilizer crowded-out 0.22 kilograms of commercial fertilizer. Another way to look at this finding is that 100 kilograms of subsidized fertilizer added only 78 new kilograms to total fertilizer use, because 22 of those kilograms represent

commercial purchases that were displaced. We also found, not surprisingly, that relatively better-off farmers were more likely than poor farmers to crowd-out their commercial purchases. For example, we found that the crowding out rate for the poorest fifth of our sample was 18%, compared with a crowding-out rate of 30% for the wealthiest fifth of the sample. This result is logical because wealthier households were more likely to have had the resources to purchase fertilizer on the commercial market. To reduce crowding out and thereby maximize increases in total fertilizer use, it makes sense therefore to target households that are not participating in the commercial fertilizer market.

How did fertilizer use affect maize yields?

The subsidy program appears to have increased total fertilizer use for maize but what were its impacts on maize yields? To answer this question we measured the statistical relationship between fertilizer inputs and maize yields. The results indicate a significant and positive correlation between the amount of fertilizer used and yield. At higher rates of fertilizer use, however, the relationship between the amount of fertilizer used and the total yield exhibits declining returns to fertilizer use. Plots planted with improved maize on average produced higher yields (approximately 1400 kg/hectare) compared to those planted with traditional maize (approximately 1050 kg/hectare). Figure 1 shows the graphical relationship between fertilizer application and maize yield in Malawi, and can be used to understand how the subsidy program affected production on smallholder farms. The figure was generated using data collected on the 380 farms in our 2009 survey and represent “average” patterns observed in the data. The horizontal axis in the figure measures the fertilization rate on a farm (in kg/acre) and the vertical axis measures the amount of maize produced (in kg/acre). Two lines are plotted in the figure. The solid line represents the average physical relationship between fertilizer input and maize output when a traditional variety of maize was planted. The dashed line represents the average relationship between fertilizer and output when an improved (hybrid or open-pollinated) variety of maize was planted. The difference between these curves can be interpreted as the gain in output associated with using improved seeds, at any given level of fertilizer application.

Four key representative points are marked in the figure. These are labeled t_0 , t_1 , h_0 and h_1 . Points t_0 (traditional maize) and h_0 (hybrid maize) represent yields at average fertilization rates observed for farmers who did not receive subsidized fertilizer. Points t_1 (traditional) and h_1 (hybrid) represent maize yields at mean fertilization rates for farmers who used subsidized fertilizer. The points illustrate how the input subsidy program moved traditional maize producers from a point like t_0 on the production function (low inputs with traditional seeds) to a point like t_1 (higher inputs with the same traditional seeds). Similarly, on average farmers using improved maize seeds who received subsidized fertilizer moved from a point like h_0 to a point like h_1 (higher inputs with improved seeds). The total effect of access to a complete packet of coupons (consisting of both improved seed *and* fertilizer) was to shift production from a point like t_0 (low inputs with traditional seeds) to a point like h_1 (higher inputs with improved seeds). Our results indicate that, of the average gain in maize yield associated with this movement, about 40% of the gain came from accessing fertilizer and about 60% of the gain came from accessing improved seed. Including improved maize seed in the FISP boosted benefits of the program because yields from improved maize are higher at each level of fertilization than yields from traditional maize. Providing improved seed was therefore a key component in the subsidy program.

Land Use Effects of the FISP

Given enhanced incentives to produce maize, did farmers alter their planting decisions? Increasing maize production was one of the subsidy's program goals. An important outcome of the FISP has been an increase in maize production through higher yields. But we also observe that maize output increased due to an increase in the amount of land planted to maize. The subsidy program affected land use by increasing the allocation of land to maize in households that received a complete packet of coupons compared to those households that did not. Overall, we found that each complete set of subsidy coupons received by farmers was associated with a 16% increase in the area that farmers allocated to maize during the 2008/09 agricultural season. Combining this finding with results from the production analysis indicates that the total direct

impact of receiving a full seed and fertilizer subsidy consisted of two parts: an increase in area planted and an increase in yield on that area. The average amount of land planted to maize in our sample was 0.88 hectares. The average farm-level impact on maize production, accounting for both yield and area changes, was approximately 500 kg for each complete set of coupons (seed and fertilizer). We note, however, that output from other crops declined as a result of a shift toward maize. Farmers who received vouchers for seed and fertilizer allocated less land to other crops than those who did not receive vouchers. Valuing this reduced crop area based on average areas and yields for the most closely-competing crop (cassava), and using the prevailing farm gate price of cassava and retail price of maize, we calculate that the maize-equivalent value of offset production was roughly 250 kg of maize, on average, or about half of the observed gain. This means that the overall net effect of the subsidy program was to increase maize output by about 250 kg per beneficiary household per year.

Effects of the FISP on Forest Clearing

One additional objective of our research was to assess whether the subsidy program, which was targeted at maize and tobacco farmers, had any effect on farmers' decisions to clear forests for agricultural expansion, which has been a problem in Malawi, as elsewhere. We found that maize subsidies reduced agricultural expansion modestly. The FISP probably helped to lessen pressure on forests through intensification of maize production.

Conclusions

Input subsidies are currently receiving a great deal of attention as a potentially sustainable strategy for boosting productivity and increasing food security for small farmers in Africa. Malawi's Farm Input Support Program (FISP), which targets a subset of farm households, is seen by many as "proof of concept" for broader implementation across Africa. This policy brief has summarized research conducted at Purdue that estimates the impacts of Malawi's FISP.

The main findings are as follows:

- 1) Malawi's decentralized targeting system had trouble reaching resource-poor farmers.

- Contrary to program requirements, female-headed households were less likely than male-headed households to have received a complete package of coupons.
 - Being educated increased the likelihood of receiving more coupons than the recommended amount.
 - Social connections mattered: households whose heads had resided in the village for longer periods had higher probabilities of receiving subsidized fertilizer.
- 2) The subsidy program increased fertilizer use intensity in terms of kilograms of fertilizer applied per hectare.
 - Small farms had higher fertilizer use intensities, on average.
 - Female-headed households had lower fertilizer use intensities, on average.
 - 3) The subsidy program reduced household demand for fertilizer purchased on the commercial market (the “crowding out” effect).
 - On average, 100 kg of subsidized fertilizer crowded out 22 kg of fertilizer purchased on the commercial market.
 - The crowding out rate was smallest (18%) for the poorest fifth of households, and largest (30%) for the wealthiest fifth of households.
 - 4) Although costly, Malawi’s subsidy program produced some modest gains in maize yields.
 - Acquiring subsidized seed and fertilizer increased average yields by about 500 kg/ha.
 - Improved seeds were an essential component of the program. Programs should not overlook the value of providing farmers with improved seeds.
 - 5) While the subsidy produced some yield gains, it also altered farmer’s planting decisions and lead to increases in area planted to maize at the expense of other crops.
 - The maize-equivalent value of offset production was roughly 250 kg of maize, on average, roughly equivalent to half of the observed gain in maize output.
 - Such changes could have implications for household nutrition, for example if

displaced crops (such as legumes and tubers) are nutritionally superior to maize.

- 6) There is also some evidence to suggest that the input subsidy program may have relieved pressure on forests by intensifying maize production.

We conclude with the following policy recommendations for improving the delivery and effectiveness of input subsidy programs.

- I) Governments need to establish clear targeting guidelines and stronger monitoring and evaluation procedures for subsidy programs. This will help resource poor farmers obtain greater access to subsidized inputs. Our results suggest that when resource poor farmers acquire subsidized fertilizer, they increase fertilizer use intensity. In addition, the overall rate of commercial crowding out can be reduced when poorer households are targeted, which maximizes the subsidy’s contribution to total fertilizer use.
- II) Subsidies can increase maize yields, but the programs are costly and, in purely value terms, provide a relatively low return to public expenditure. Providing improved seeds is an essential component of the policy mix. Providing farmers with improved seeds may be a more cost-effective way to boost yields than simply boosting fertilizer use. To some degree, increases in maize output occur at the expense of other important crops such as legumes and tubers. Subsidizing legume seed would be a way to prevent maize from completely dominating agricultural response. Planting legumes provides nutritional benefits to households. Legumes also return nitrogen to the soil, which can lessen the need for chemical inputs and further reduce the need to subsidize fertilizer.

For Further Reading

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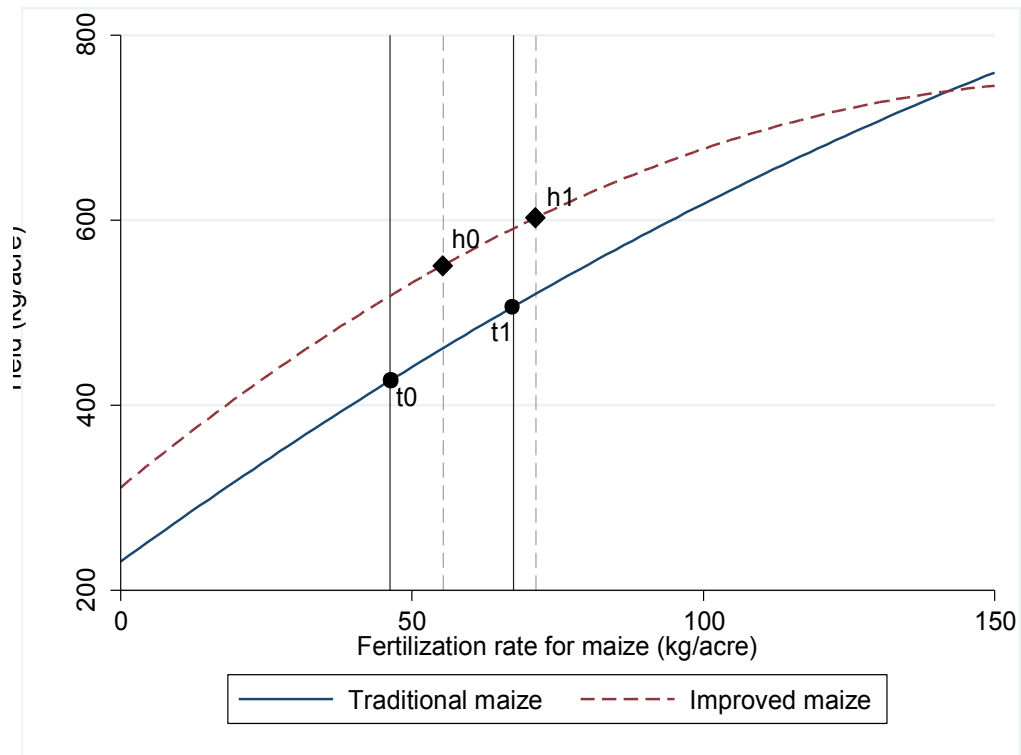


Figure 1: Maize yield response to fertilizer in Malawi