BASIS BRIEF
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Impact of Subsidies on Fertilizer Use, Land Allocation and Forest Pressure: Evidence from Malawi

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A history of subsidies

Use of input subsidies in Malawi dates to the early 1970s. Not only were these early experiments with agricultural subsidies successful in stimulating food crop production, they enabled the country to achieve a high degree of self reliance in maize, Malawi's main staple. Eliminated for a time in the 1990s through a structural adjustment program adopted to deregulate markets, agricultural subsidies were reintroduced in 1998 through a scheme that evolved into the Targeted Inputs Program. Under this program, all households were entitled to a package containing sufficient fertilizer and seed to plant about 0.1 hectare of maize.

As a consequence of the government's reorientation of its food security program, the Targeted Inputs Program was scaled down. Combined with poor weather during the 2004-05 agriculture season, this led to a severe food crisis in 2005. The crisis prompted the government to re-introduce a program of large scale input subsidies for maize and tobacco. Called the Farm Input Subsidy Program (FISP), the objective was to increase smallholder farmers' access to and use of improved agricultural inputs as a way of achieving food self-sufficiency and increasing the incomes of resource-poor farmers. This brief synthesizes findings from studies on the impacts of the 2009 FISP on smallholders' behavior, decisions and outcomes.

Eligibility and implementation

Under FISP, selected households received a voucher/coupon that enabled purchase of fertilizer, hybrid or open pollinated maize seed, and/or pesticides at a reduced price. Priority was given to vulnerable households, especially those headed by a child or woman. For the 2008-09 growing season, the program included post-harvest pesticides for grain, and vouchers were made more secure against fraud, a common problem during previous seasons.

For the 2009 program, the focus of this brief, each eligible household was entitled to 100kg of maize fertilizer at a subsidized price, and 2kg of free hybrid maize seed or 4kg of open pollinated maize. Some households were also entitled to coupons for tobacco fertilizer, allowing access to 50kg of chemical fertilizer.

Using cross-sectional data from farm households in Kasungu and Machinga districts, we studied the impacts of the program on use of fertilizer, maize yields, land allocation, and forest clearing. Data were drawn from 35 villages in communities around the Chimaliro Forest Reserve in the Kasungu district, and the Liwonde Forest Reserve in the Machinga district. In June and July 2009, 380 households were interviewed, of which 211 were from Kasungu and the remainder from Machinga.

Beneficiaries

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

Study results suggest that older households were more likely to receive a complete input subsidy packet than younger households, as the former are most likely to be established as full-time farmers. Contrary to program criteria, female-headed households were *less* likely than male-headed households to receive a complete package of coupons. Being educated increased the likelihood of receiving more coupons than the recommended amount; it is likely that being educated enhanced bargaining power with the chiefs who played a significant role in identifying beneficiary households. Poor households were likely to receive nothing, owing to the fact that they have less land and are mostly female-headed.

Social factors played an important role in a household's probability of receiving a coupon and the amount of inputs they received. Household heads that had lived in their villages for longer periods had an increased probability of receiving coupons for more than the recommended amount. Length of residency is influential in forging ties with village heads and members of the village development committee, all of whom were responsible for identifying subsidy beneficiaries at the village level. The results also suggest important district-level differences in program implementation.

Fertilizer use and impacts

An important objective of the coupon/voucher system, albeit temporary, is to stimulate use of improved maize seed and fertilizer among poor farmers. The hope is that this will empower them to purchase their own inputs for subsequent growing seasons. Results suggest that smallholder farmers used fertilizer more intensively than was seen on large farms. Households that owned more land used more fertilizer for maize production than did those with less land. Female-headed households used 14kg less fertilizer for maize than did their male counterparts. Chemical fertilizer use was also affected by a household's asset status. Asset-poor households used less fertilizer on their plots. Such households generally tend to have low levels of income, yet, as we have seen, are less likely to be a beneficiary of the farm input subsidy since they own less land.

Households that planted improved varieties of maize used 51kg more fertilizer than those that planted traditional seeds. This is probably indicative of farmers' adopting improved maize production technologies as a package. Households classified as net buyers of maize used less fertilizer, suggesting competition for cash between immediate consumption and purchase of fertilizer.

The various forms of coupon receipt produced mixed results with regards to fertilizer use. Households that received two coupons for 100kg of fertilizer used 178kg more fertilizer on average than those that did not receive a coupon. Recipients of a complete packet of coupons (100kg fertilizer and seed) used 46kg more fertilizer, on average, than those that did not. The uncertainty surrounding the future of the program meant that some households saved some of their fertilizer for later growing seasons. In general, FISP increased fertilizer use among beneficiary households, albeit by an amount less than the total quantity of subsidized fertilizer that was introduced.

Given that the subsidy program appears to have increased the total amount of fertilizer used for maize, what were its impacts on yields? Our analysis indicates a significant positive correlation between the amount of fertilizer used and maize yield. However, as seen in Figure 1 (opposite page), there were declining returns for higher rates of use. We observed a similar pattern in effect for use of seed, though these results were not statistically significant.

Figure 1 shows the relationship between fertilizer and maize yield. Not surprisingly, households producing improved maize (shown by the dashed line) have higher yields compared to those producing traditional maize. Yet, looking deeper, we can see the effect of subsidies. Points t_0 (traditional maize) and h_0 (hybrid maize) represent yield at average fertilization rates for farmers who did not access subsidized fertilizer. Points t_1 (traditional) and h_1 (hybrid) represent maize yield at mean fertilization rates for farmers who used subsidized fertilizer.

Access to fertilizer through the subsidy program moves traditional maize producers from point t_0 on the production function to t_1. Producers of improved

maize who accessed subsidized fertilizer move from h_0 to h_1. Access to a complete packet of coupons (seed and fertilizer) shifts production from t_0 to h_1. Plots planted with improved maize on average produced higher yields (536kg/acre) compared to those planted with traditional maize (484kg/acre). However, where intercropped, maize plots produced 18% lower yields compared to plots that were mono-cropped.

Results indicate that the gain in maize yield from having access to subsidized improved maize seed and fertilizer was approximately 178kg per acre. The gain in maize yield from accessing only subsidized fertilizer, but not improved maize seed, equaled 99kg per acre. Including improved maize seed in the FISP resulted in the highest net benefits, as yields from improved maize were higher at each level of fertilization than the yields from traditional maize.

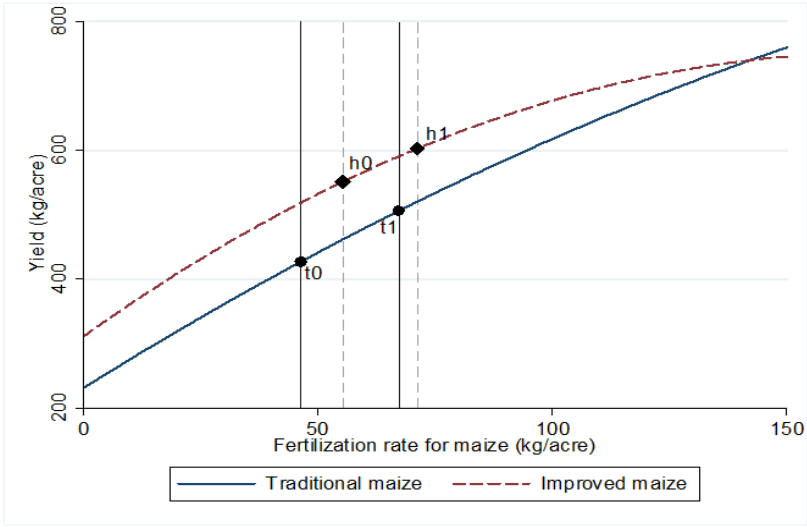
Land use effects

An important outcome of the FISP has been an increase in maize production through an increase in the area planted to maize and per acre harvest yield. The subsidy program affected land use by increasing the allocation of land to maize by 20% in households that received a complete packet of coupons compared to those households that did not. However, this was achieved at the expense of other crops (legumes, cassava and sweet potato), which were allocated 24% less land, on average.

Other factors that were positively associated with the amount of land planted with maize included a household's annual subsistence requirement and the proportion of households in the farmers' village reporting off-farm income. Educated household heads allocated less land to maize and more land to high-value tobacco. Households classified as net buyers of maize planted less tobacco but more of other crops, suggesting potential allocation of incomes derived from selling these other crops to meet their maize subsistence requirements. Gender played an important role in the choice between traditional and improved varieties. Female-headed households allocated more land to traditional maize than did their male counterparts. Lack of working capital for purchase of improved maize seed can be attributed to this difference in allocation. Results also show that older household heads allocated more land to traditional maize. Farmers who received either a coupon for seed, a coupon for fertilizer, or both, allocated more land to improved maize than those who did not.

Another important objective of the study was to assess whether FISP, which was targeted at maize and tobacco farmers, had effects on smallholder farmers' decision to clear forests for agricultural expansion. Results show that FISP helped lessen pressure on forests through intensification of maize and tobacco production in the two study areas. In the study year, households that participated in the program cleared 1.5 acres less forest land per household for agricultural expansion.

Figure 1. Maize yield response to fertilizer



Policy implications

The maize subsidy program was intended to benefit both the most vulnerable farm households and those having sufficient land to make use of the subsidized seed and fertilizer. However, our results, which are consistent with other research regarding FISP, suggest that the most vulnerable people in the communities were not the main recipients of the coupons. Female heads were targeted, yet findings indicate they were less likely to benefit from the program compared to male-headed households. In addition, asset-poor households were less likely to participate in the FISP compared to non-poor households. These results raise questions about the targeting effectiveness of the program.

Could the program have been more effective at increasing fertilizer use had the poor been better

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targeted? Results show that asset-poor households and households that were net buyers of maize used less fertilizer for maize production during the study year. To achieve FISP's goal of stimulating use of improved maize technologies among resource-poor smallholder farmers, the poor and vulnerable need to be the primary targets for the input vouchers. A revision of the system for distributing the coupons to households could help achieve this.

Nevertheless, the results suggest that the subsidy program for maize may have helped increase fertilizer use among benefiting households. This finding is consistent with previous research about the effects of FISP on fertilizer use. Fertilizer use intensity is negatively correlated with farm size, and positively correlated with the planting of improved maize. Asset-poor households used less fertilizer, which was compounded by their low levels of participation in the subsidy program.

Results show that the average increase in maize yields from accessing a standard FISP package of maize seed and fertilizer was 178kg/acre, about twice the yield gain from receiving coupons for fertilizer only. The program design may place too much emphasis on fertilizer for maize. Farmers were able to choose 2kg of hybrid maize seed or 4kg of open pollinated seed, in addition to 100kg of fertilizer. Given the yield differentials between the two varieties, shifting emphasis to promoting the use of hybrid seed in the subsidy program would most likely help generate greater returns. In the long run, ensuring food security may rest on policies that seek to improve the delivery of improved seed to farming communities.

Results show that the FISP increased the amount of land planted with maize, while reducing the share of other crops in total land cultivated. If agricultural input subsidies do encourage farmers to concentrate on a smaller number of crops, and if this is viewed as detrimental, government policies might have to be redesigned to avoid this unintended effect. From one perspective, crop diversification is an important strategy for resourceful households. By growing a mixture of crops, farmers can reduce potentially negative impacts of labor shortages, seasonal production needs, and uncertain climate conditions. In this sense, the movement toward a more simplified cropping system, dominated by maize, might make farm households particularly vulnerable to climate variability and change. Furthermore, the increase in maize acreage at the expense of relatively drought-tolerant crops, notably cassava and sweet potato, could exacerbate the impact of drought on food security.

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Related reading

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