Promoting Fertilizer Use in Africa:

Current Issues and Empirical Evidence from Malawi, Zambia, and Kenya

Isaac Minde, T.S. Jayne, Eric Crawford, Joshua Ariga, and Jones Govereh

November 24, 2008

This study was funded jointly by the Regional Strategic Agricultural Knowledge Support System (Re-SAKSS) for Southern Africa, based at International Water Management Institute, Pretoria, South Africa, and by the United States Agency for International Development's Africa Bureau. Much of the data and analysis reported in this study was carried out under the Tegemeo Agricultural Monitoring and Policy Analysis Project, funded by USAID/Kenya; the Food Security Research Project/Markets, Trade and Enabling Environment (MATEP) Program, funded by USAID/Zambia and the Swedish International Development Agency; and by the DFID and USAID offices in Lilongwe, Malawi.

Promoting Fertilizer Use in Africa:
Current Issues and Empirical Evidence from Malawi, Zambia, and Kenya

Isaac Minde, T.S. Jayne, Eric Crawford, Joshua Ariga, and Jones Govereh

Background and objectives of the report

It is generally agreed that increasing agricultural productivity is critical to stimulating the rate of economic growth in Africa. There are many important and often complementary determinants of agricultural productivity. In this paper, we focus on fertilizer, without intending to imply that it is the only or most significant productivity determinants. Other key factors are seed technology, adequate water availability, labor, agronomic and other farmer management practices, and choice of crops to grow.

Promoting the use of fertilizer and improved seed involves addressing the supply and demand constraints that keep usage rates low, especially among smallholder farmers. Such inputs must be available, affordable, and profitable—for suppliers and farmers alike—without creating untenable financial risks. Agricultural research, input market development, and direct promotion of input use through provision of credit and subsidized distribution are used to improve access to improved inputs and the incentive to use them.

Recently, the role of input subsidies in stimulating growth and addressing food security and poverty alleviation objectives has re-emerged as an important agricultural policy debate. Sharp increases in world food and fertilizer prices in 2007 and 2008 have created a sense of urgency in meeting productivity and social welfare goals, and have put fertilizer promotion programs and fertilizer subsidies high on the list of options for government and donor responses to the crisis.

The purpose of this paper is to synthesize experiences with recent fertilizer promotion approaches in Malawi, Zambia, and Kenya, involving both subsidized distribution and development of private sector input markets. The aim is to contribute empirically based insights about when to invest in fertilizer promotion programs, including those with a significant subsidy element, and about how best to design and implement them. As background before synthesizing experiences across the three countries, the report draws briefly from the extensive recent debate about the case for and against fertilizer subsidies and how to make them more effective.[1] We focus on four salient questions:

- What are the guiding principles of a "smart" fertilizer subsidy program, and what determines its costs and benefits?
- What has been the experience of Malawi and Zambia with fertilizer subsidy programs—their achievements and limitations—and what lessons can be drawn for the design of future subsidy programs that would contribute most effectively to national food security and smallholder productivity?
- What can be learned from Kenya's experience of rapid smallholder adoption of fertilizer without subsidies?
- How do the sharply higher world food and fertilizer prices affect the justification for fertilizer subsidies in the region?

[1] For example, see Crawford, Jayne, and Kelly (2006); World Bank (2007a), especially pp. 150-53 on developing efficient input markets, including Box 6.7, "Is there a rationale for fertilizer subsidies?"; World Bank (2007b); Morris et al. (2007); Minde and Ndlovu (2007a and b); and Salzburg (2008).

"Smart" fertilizer subsidies

What are "smart" fertilizer subsidy programs?

Input subsidy programs may have various objectives, including to increase agricultural productivity, improve food security, or provide income support for poor farmers. National and household food security objectives may be especially urgent in times of crisis, such as the current environment of rapid and major increases in fertilizer and food grain prices. Regardless of their objectives, the design and implementation of input subsidies should be "smart" in the sense that (a) their benefits in terms of agricultural productivity and food security exceed what could be achieved by investing the resources in other areas;[2] and (b) they encourage farmers' purchases of fertilizer on commercial terms, or at least do not impede it, which could result if government input subsidy programs crowd out commercial transactions or undermine investment in fertilizer distribution by suppliers and agro-dealers.

Minde and Ndlovu (2007b) describe "smart" subsidies as those involving (**S**)pecific targeting to farmers who would not otherwise use purchased inputs (or to areas where added fertilizer can contribute most to yield improvement), (**M**)easurable impacts, (**A**)chievable goals, a (**R**)esults orientation, and a (**T**)imely duration of implementation, i.e., being time-bound or having a feasible exit strategy. Morris et al. (2007, 103-105) identify ten guiding principles for subsidies to be "market smart":

- Promote the factor or product as part of a wider strategy that includes complementary inputs and strengthening of markets
- Favor market-based solutions that do not undermine incentives for private investment
- Promote competition and cost reductions by reducing barriers to entry
- Recognize that effective demand from farmers is critical for long-run sustainability
- Insist on economic efficiency as the basis for fertilizer promotion efforts
- Empower farmers to make the decisions about soil fertility management
- Devise an exit strategy to limit the time period of public interventions
- Pursue regional integration in order to benefit from the economies of market size
- Emphasize sustainability as a goal when designing interventions, and,
- Promote pro-poor growth, in recognition of the importance of equity considerations.

While the concept of "smart" fertilizer subsidies is very appealing, they can be difficult to design. Also, unanticipated implementation problems can cause even well-designed programs to fall short of being "smart" in practice. To illustrate these points, and to identify lessons for future programs, we review below the experience with input subsidy programs in Malawi and Zambia.

What factors determine the costs and benefits of fertilizer subsidies?

The main cost factors are:

1. *The cost of acquiring the fertilizer.* World fertilizer prices have more than doubled over the past year and ocean freight and transport costs have also increased, reducing the potential returns to fertilizer subsidy programs. The subsidies needed to bring farm-gate

[2] A corollary of (a) is that the public funds devoted to input subsidies should not be so great as to leave insufficient resources for public investments such as agricultural research and development, farmer training and extension, and physical infrastructure, which have been shown by Fan, Gulati, and Thorat (2007) to have relatively high direct payoffs for smallholder farmers and as well as increasing the payoffs to input subsidies (Jayne and Myers, 2007).

fertilizer prices down to levels considered affordable to low-income farmers will require greater outlays from national budgets than in prior years.

2. *The full economic cost of implementing the fertilizer subsidy program*. These costs include not only the economic costs of distributing and applying the fertilizer but also the opportunity costs of the resources used in the program, e.g., the flow of benefits that otherwise could have been achieved with the resources used for the subsidy program.[3]

The main benefit factors are:

3. *The price of output.* World food grain prices have increased dramatically in the recent past. To the extent that these increases are transmitted to domestic prices, they will boost the potential returns to fertilizer subsidy programs. In an extreme case where needed grain could not be obtained from regional or world markets, the benefits of additional domestic food production generated from a subsidy program would include saved lives and malnutrition averted.

4. *Agronomic response rates.* The payoffs to fertilizer subsidy programs could be enhanced by improving the aggregate crop yield response rates to fertilizer application. This requires making complementary investments in training for farmers on agronomic practices, soil fertility and water management and efficient use of fertilizer, and investing in crop science to generate more fertilizer-responsive seeds.[4] Survey data commonly indicate that the contribution of fertilizer to food grain yields varies tremendously across farms even within the same villages. Simply bringing fertilizer response rates among the bottom half of the distribution up to the mean would contribute substantially to household and national food security (Nyoro et al., 2004).

5. *The degree to which subsidized fertilizer adds to total fertilizer use, rather than crowding out or displacing commercial fertilizer sales.* This concept may be best understood in a "with/without" framework. Assume, for example, that in the absence of a subsidy program a given farm would purchase 2 bags of fertilizer. If this farmer is allocated 4 bags of subsidized fertilizer, then she may no longer purchase the 2 bags from the trader. In this case, the additional fertilizer use as a result of the program would be only 2 bags instead of 4, i.e., 50% not 100% of the amount supplied. The two bags that she would have purchased from the trader now remain in the trader's inventory. This displacement of commercial sales will be low or zero if subsidized fertilizer is sold to households who otherwise would not have access to fertilizer or could not afford to buy it. Findings from Malawi and Zambia indicate that an additional kg of fertilizer distributed under the subsidy program adds only 0.5 to 0.8 kg to the amount of fertilizer used by farmers (implying a displacement rate of 20-50%), and that crowding out is lower when the subsidy is targeted to relatively poor households than when targeted to non-poor farmers (Dorward et al., 2008; Ricker-Gilbert and Jayne, 2008; Weber, 2008).

   The displacement of commercial fertilizer sales remains important even under a targeted input voucher program involving the private sector. It is possible that commercial fertilizer imports and sales to farmers may fall to near zero at the same time that private stockists are given fertilizer by the government to provide to farmers under the subsidy program. Stockists' financial situation can be "made whole" through such a program, but the overall contribution of the subsidy program to increased fertilizer use would still

[3] This would include, for example, benefits lost by redirecting Ministry of Agriculture extension staff to manage the distribution of subsidized fertilizer rather than to work with farmers to improve crop cultivation practices.
[4] Research indicates that the highest crop yield response is obtained when improved seed, fertilizer and good agronomic practices are combined (Heinrich, 2004). In some areas, improved management practices may have greater impact on yields than fertilizer alone (Haggblade and Tembo, 2003).

remain a major issue. The point highlighted here concerns the extent to which a fertilizer subsidy program displaces commercial sales (and therefore the extent to which it adds to total fertilizer use), not whether the fertilizer subsidy program allows private traders to be compensated for the loss of commercial sales by becoming agents of the subsidy program.

6. *Timely arrival and utilization of the fertilizer by farmers.* Crop yields may fall if fertilizer is applied significantly later than the optimal time in the crop growth cycle. Yet late arrival of fertilizer is a common feature of fertilizer promotion programs. For example, a recent study of fertilizer transport subsidies in Tanzania (MOAFC, 2007) reported that fertilizer arrived late in almost all regions visited. Late arrival and application of fertilizer were noted in the 2006/07 input subsidy program in Malawi (described below and reported in Dorward et al., 2008), and described for Zambia in Xu (2008, p. 68).

The benefits and costs of fertilizer promotion activities are influenced, potentially greatly, by these factors listed above. Difficulties in controlling for these factors pose methodological challenges for impact evaluations of fertilizer promotion programs. However, many unobservable household and village characteristics can be controlled for using household panel survey data to derive important lessons from past experience with fertilizer subsidy programs. The remainder of this report summarizes insights from these and other studies.[5]

Experience with fertilizer subsidies in Malawi

Malawian smallholder agriculture is characterized by large numbers of very poor farmers heavily dependent on low-input maize production on small land holdings that are very short of nitrogen. Maize production by these farmers is not normally sufficient to meet annual consumption needs, and they depend upon casual laboring and other income-earning opportunities to finance the purchase of the balance of their needs. Although Malawi is one of the poorest countries in the world, the nationally representative Integrated Household Survey 2 (IHS-2) conducted by the National Statistical Office (Dorward et al., 2008) indicates that 45% and 36% of smallholder farmers still purchased an average of 65 kg of fertilizer per household in 2002/3 and 2003/4. In those seasons, the Targeted Inputs Program distributed small packages of free fertilizer (a total of 35,000 metric tons (mt) and 22,000 mt, respectively compared to 179,000 mt distributed in the 2006/07 program[6]). Households purchasing commercial fertilizer tended to be relatively better off. Poorer households were less likely to purchase commercial fertilizer, though to date there remains little analysis to show whether unaffordability, lack of access, lack of profitability, or some combination, is the main constraint.

Food insecurity problems facing Malawian farmers have remained severe in recent years with national food shortages due to poor production seasons and late and expensive government-funded imports leading to large increases in the local market price of maize (Tschirley and Jayne, 2008). In this context, the government started implementing the Agricultural Input Support Programme (AISP) in the 2005/06 season with the stated objectives of improving smallholder productivity and food and cash crop production and reducing vulnerability to food insecurity and hunger. Other objectives were to promote food self sufficiency, development of private sector input markets (emphasized by donor agencies), and wider growth and development.

[5] For more detailed household-level analysis, the reader is referred to Ariga et al. (2008); Dorward et al. (2008); Xu et al. (forthcoming); and Ricker-Gilbert and Jayne (2008).
[6] Approximately 175,000 mt distributed through the AISP and 4,000 mt through the Assets for Inputs program.

Malawi has recently received popular acclaim for its success in turning the country into a food surplus maize exporter (New York Times, 2007).[7] In 2005/06, the government re-introduced a large-scale fertilizer subsidy program (see Dorward et al., 2008 for a detailed assessment). Erratic rainfall in 2005/06 and the exclusion of the private input distribution system in this first year of implementation impeded the impact of the program in this first year.

In the second year of the program (2006/7), there was an explicit attempt to involve the private sector in the fertilizer voucher program. Roughly 2 million seed and 3 million fertilizer coupons for distribution to targeted households were initially allocated to districts and areas within districts in proportion to maize and (for "tobacco fertilizers") tobacco areas.[8] Government issued tenders to private firms to import and distribute the subsidized fertilizer. Import tenders were issued to selected firms that supplied government (ADMARC and SFFRFM) warehouses and/or private sector distributors authorized to sell subsidized fertilizer. Contracts allowing private sector firms to redeem coupons at the retail level were awarded initially to four firms, and later expanded to six firms. The criteria for participation in the coupon redemption process were evidence of a well-established retail network and access to supplies. These criteria excluded participation by independent agro-dealers operating small shops as well as a number of major importers who did not have their own distribution networks. Coupons, each good for one 50-kg bag of fertilizer, were supposed to be allocated to targeted households (able farmers who would otherwise be unable to purchase inputs) by Village Development Committees at the rate of one NPK (23:21:0) and one urea coupon per household, and one D compound and one CAN coupon per recipient tobacco farmer. Seed coupons were also distributed, one per household, sufficient to cover the cost of 2 kg of hybrid seed or 3 kg of open-pollinated variety (OPV) seed. The program was not designed to reach the poorest farm households, since it was felt that the 100 kg of fertilizer distributed per household was too much to be used effectively on the small land holdings typical of such households. In practice, allocation procedures varied widely between different areas, with some local authorities deciding to give only one coupon per household to a larger number of households. There were reports of substantial diversion of coupons in some areas, but few large-scale confirmed cases. Farmers were required to redeem fertilizer vouchers and pay MK950 (U.S. $6.50) per 50-kg bag, representing roughly 28% of the full cost, with government paying for the remaining 72% of the cost. A total of just under 175,000 metric tons (mt) of fertilizer and 4,500 mt of improved maize seed were distributed at a cost to government and donors of about US$91 million (Dorward et al., 2008).

In this second year of the program, the combination of favorable weather and the distribution of improved maize seed and fertilizer through the subsidy program produced what was considered to be a record maize harvest in 2007. The government issued an official maize production estimate of 3.4 million tons. Domestic consumption requirements were believed to be in the range of 2.0 million tons, indicating a surplus of well over a million tons.

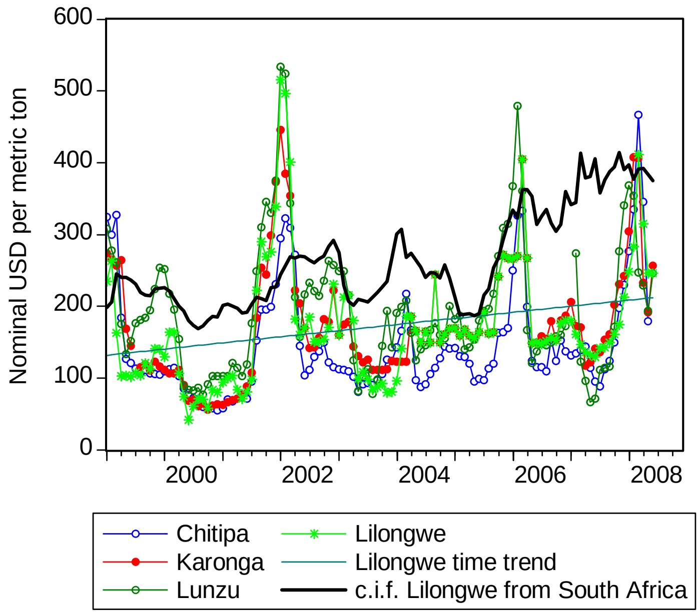
In response to the reported surplus, the government issued tenders to private traders to supply 450,000 tons for export to other countries in the region. However, the private sector reported difficulties in sourcing this quantity of maize, and by late 2007 Malawi had only exported 283,000 tons. The government then suspended further exports due to a rapid escalation in

[7] President Bingu Wa Mutharika was recently awarded a United Nations (UN) Global Creative Leadership Award and also received the first Food, Agriculture and Natural Resources Policy Network (FANRPAN) food security policy leadership award for reviving the country's fertilizer subsidy program. He also was honored at the 2008 African Green Revolution Conference in August 2008 for the country's success in promoting food security.

[8] These 3 million fertilizer coupons were distributed over a total number of 2.48 million smallholder farm households according to the 2000 Census adjusted for population growth rates between 2000 and 2006. The Ministry of Agriculture, however, estimates the number of farm households at 3.2 million.

domestic market prices. Within several months after the harvest, maize prices reached near record highs, exceeded only in the major crisis year of 2001/2 and the drought year of 2005/06 (Figure 1). By late 2007/early 2008, maize prices in Malawian markets were $100 to $150 per ton higher than in other regional markets. The 2007/08 season was also characterized by reports of localized maize shortages, rationing of maize by the marketing board ADMARC, and net maize imports of over 50,000 tons from neighboring countries, primarily Mozambique and Tanzania (Reuters, 2008; FEWSNet, 2008). These outcomes are difficult to reconcile with the official estimates of a record maize harvest of 3.4 million tons in 2007, which is now widely believed to be an overestimate.

Figure 1. Retail prices of maize in Malawian markets, January 1999 to May 2008, in nominal USD per metric ton.



Sources: SAFEX, Malawi Food Security Updates, FEWSNet. Kwacha/USD exchange rates from National Statistical Office bulletins.

Dorward et al. (2008, 72-77) conducted an economic benefit-cost analysis of the AISP, taking into account a range of assumptions about grain-fertilizer response rates in the 2006/07 production year (a year of abundant rainfall), displacement of commercial sales of fertilizer, contribution of improved maize seed to aggregate output, and maize price. The estimated benefit-cost ratios ranged from 0.76 to 1.36, and tended to be greater than 1.0 when the key variables were set at intermediate or more favorable levels. These results do not include the potential long-run growth impacts from higher 2006/07 incomes.

The AISP did not seem to have had adverse impacts on government budget allocations to nonagricultural sectors such as infrastructure, education and health. However, the sizeable government budgetary cost of the AISP (roughly $80 million) did seem to have adversely affected delivery of other services by the Ministry of Agriculture and Food Security, as evidenced by declining budget shares for research and extension (Dorward et al., 2008, 93).

The AISP evaluation identified a number of areas in which changes in program design or implementation would improve impacts:[9] (a) establish more comprehensive and consistent program objectives, e.g., to reconcile social protection versus productivity goals; (b) target subsidized inputs to the poorest 50% of small farmers, to reduce displacement of commercial sales and hence improve the aggregate impact of the program on maize production; (c) improve the monitoring of program impacts through strengthening the capacity of the national statistical agency to collect and analyze farm household survey data; (d) more effectively involve rural private retailers in the distribution of subsidized inputs (the small independent agro-dealers were largely excluded from the 2005/06 and 2006/07 programs and many of them had stopped selling fertilizer after the introduction of AISP, although the remaining dealers were incorporated into the 2007/08 program to a greater extent); (e) clearer and more timely procedures for AISP planning and implementation; and (f) better coordination of the AISP with other social safety net programs and policies, and with complementary agricultural development investments, such as research, extension, and roads. A number of these issues have been addressed through changes in the design of the 2007/08 program.

Experience with fertilizer subsidies in Zambia

Insights from Zambia are based on various analyses carried out by the Food Security Research Project and collaborating partners, using information from nationally representative surveys of smallholder farms conducted annually by the government's Central Statistical Office.

Five Phases of Fertilizer Subsidies

In the early 1990s, as part of economy-wide structural adjustment programs, the Zambian government initiated a process of fertilizer market reform that has evolved in five distinct phases. In the first phase, from 1991-93, the government appointed several state-affiliated banks and credit unions to distribute fertilizer on credit. Repayment rates were less than 5% during this period (Govereh et al., 2002). In the second phase, from 1994-96, the government appointed a few large private firms as Credit Managers (most importantly, Cavmont Merchant Bank Ltd. and SGS Ltd.) to import and deliver fertilizer on loan to "credit coordinators," who were private retailers tasked with forwarding the fertilizer on credit to farmers. Cavmont and SGS did not take ownership of the fertilizer; rather they received management fees for their role of distributing fertilizer to designated credit coordinators on behalf of government. The designation of both credit managers and credit coordinators was made by government. The volume of fertilizer supplied through this system was determined by availability of donated fertilizer from donors and local production. In 1994/95 and 1995/96, credit coordinators repaid Cavmont and SGS between 20-30% of the total loan value during this period, with evaluations concluding that many credit coordinators sold the fertilizer illegally instead of forwarding it to designated farmers on loan (Republic of Zambia, 1996; Pletcher, 2000). Pletcher (2000) argues that because this government distribution system provided selected private agents with the potential for major financial gains and a protected market, they became co-opted into the government system and did not lobby for a more transparent open market system. Cavmont and SGS exited the market only when government insisted that they sign performance contracts requiring them to absorb some of the repayment losses being incurred by the system.

The government responded by designating the state-run Food Reserve Agency to carry out the tasks of importing and distributing fertilizer to the agents. During this third phase, which lasted from 1996 until 1999, the FRA appointed private sector "agents" to distribute fertilizer

[9] For more details, see Dorward et al. (2008, iv-vi).

to farmers and cooperatives on behalf of FRA. Ostensibly, the criteria for designating agents were related to past repayment history and collateral, but in practice the system was again vulnerable to political interference. Evaluations of the program again concluded that a large proportion of the in-kind credit, designed to help farmers afford fertilizer, was diverted before reaching them (Govereh et al., 2002).

The fourth phase started in the 1999/00 crop season. Under pressure from donors to curtail the state's distribution of fertilizer on credit, the government contracted several large private firms to import and distribute roughly 45,000 tons of fertilizer (approximately three-quarters of all fertilizer delivered to the smallholder sector) to designated cooperatives on credit. The private firms operated on a commission basis on behalf of FRA. In 2000, there were four main fertilizer importers and wholesalers in Zambia: Omnia, Sasol, Norsk Hydro, and Farmer's Friend, with 85% of the volume concentrated in the hands of the two firms that the government chose to distribute fertilizer to selected cooperatives under its credit program. As with the private agents and credit coordinators before them, the selection of cooperatives to receive the fertilizer on credit lacked transparency and allegedly involved interference from state officials.[10] Evaluations indicated once again that a large proportion of fertilizer acquired on loan from FRA (through Omnia and Farmer's Friend) was sold by implementing agents before it got to farmers (Govereh et al., 2002). Overall repayment rates rose to 43%. During the decade of the 1990s, encompassing these first four phases of relatively limited fertilizer subsidy programs in Zambia, national fertilizer use and maize production actually declined.

The fifth and current phase of Zambia's experience with fertilizer subsidies since liberalization in 1990 is marked by the Fertilizer Support Programme (FSP), which started in the 2002/03 season. The remainder of this section focuses on Zambia's experience in promoting fertilizer use under the FSP. The volume of subsidies delivered under the FSP has been somewhat larger than during the first 4 phases, averaging 66,345 mt of fertilizer per year compared to 42,505 mt per year in the previous 8 years. Two factors have relieved the government's budget constraints and made it easier for them to reinstate and self-finance their fertilizer promotion programs: the transition of the World Bank and other donors from conditionality agreements to direct budget support, and debt forgiveness under the HIPC program. Both of these recent developments have provided additional discretionary funds to scale-up the former fertilizer programs.

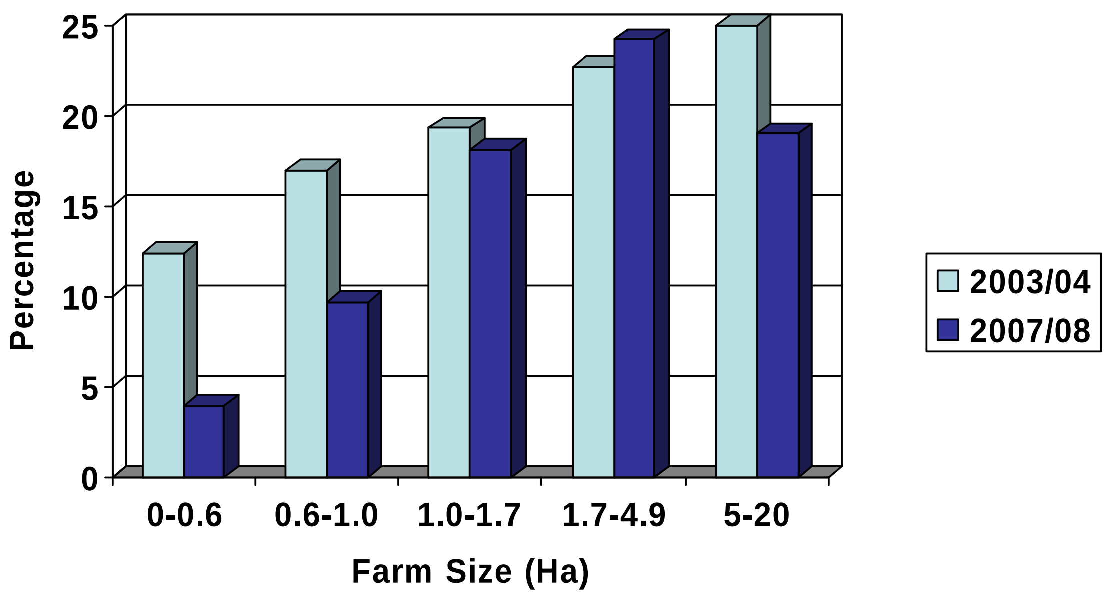
Starting in 2002/03 under the FSP, the government has awarded tenders annually to private companies to import and deliver fertilizer to registered cooperatives and other delivery points, where it is subsequently allocated by the coops and agricultural extension workers to farmers. The intent of the program has changed over time, first being conceived as a way to support smallholders in remote areas where markets were believed not to function. Later, the program's objectives evolved toward increasing maize production and marketed supplies. The FSP Program Manual establishes criteria for targeting farmers, one of them being possession of or access to at least 1-5 hectares of land and the capacity to produce maize on that area. Given that roughly 40 percent of the farms nationwide have less than one hectare of land, this criterion effectively excludes the poorest farmers from receiving subsidized fertilizer under the FSP (Weber, 2008).

[10]Politicians' financial interest in the FRA fertilizer distribution surfaced publicly in a front page article in the country's main newspaper, the Zambia Times ("Members of Parliament 'Shrink' Over FRA Debts Debate," November 11, 2000).

Impacts of Subsidies

In Zambia, for farmers in the small-scale category (0-20 ha of land), those with larger farms received more subsidized FSP fertilizer than those with smaller farms (Figure 2). Also, as found in Malawi (Dorward et al., 2008, p. 61), households that received subsidized fertilizer in Zambia tended on average to be larger in terms of land holdings and wealthier than households who did not receive subsidized fertilizer (Table 1). The government's stated rationale for targeting the more capitalized farmers was that they would use fertilizer more efficiently than smaller farms and contribute more to national maize supplies.

Figure 2. Percentage of small farmers who use fertilizer and who acquired subsidized fertilizer from the Zambian Fertilizer Support Programme, by farm size group, 2002/03 and 2007/08.



Source: Zambia Crop Forecast Surveys, 2002/03 and 2007/08.

Table 1. Characteristics of households obtaining fertilizer from government subsidy programs vs. non-recipients, Zambia, 2003.

	Households receiving fertilizer from government program	Households not receiving fertilizer from government
Share of total national sample (%)	13.9	86.1
Total household income ('000 kwacha per capita)	804	266
Value of farm assets ('000 kwacha per capita)	425	173
Landholding size (hectares per capita)	0.23	0.15
Distance from farm to district towns (km)	29.8	35.2

Source: Govereh et al. (2006) based on farm survey data from the Second Supplemental Survey, Government of Zambia, Central Statistical Office, 2004.

However, providing subsidized inputs to relatively well-off farmers may be inconsistent with national policy objectives related to productivity as well as to poverty alleviation. For example, the study by MACO/CSO/FSRP (2008), based on CSO survey data for 2007/08, indicates that mean maize yield increases per ton of fertilizer applied are lowest for the largest farm size category (3.32 metric tons/hectare for farms between 5-20 hectares). The highest yield increase per ton of fertilizer was 5.33 mt/ha for farmers in the 1.7-5.0 hectare category, while farms under one hectare averaged 4.55 mt/ha. Based on this information alone (but see the footnote to Table 2 below), one might conclude that targeting fertilizer to farms in the range of 1.7 – 5.0 hectares would provide the greatest amount of additional maize per unit of subsidized fertilizer.

Table 2. Fertilizer use and maize yields by farm size category, 2007/08 Crop Forecast Survey Data, Zambia.

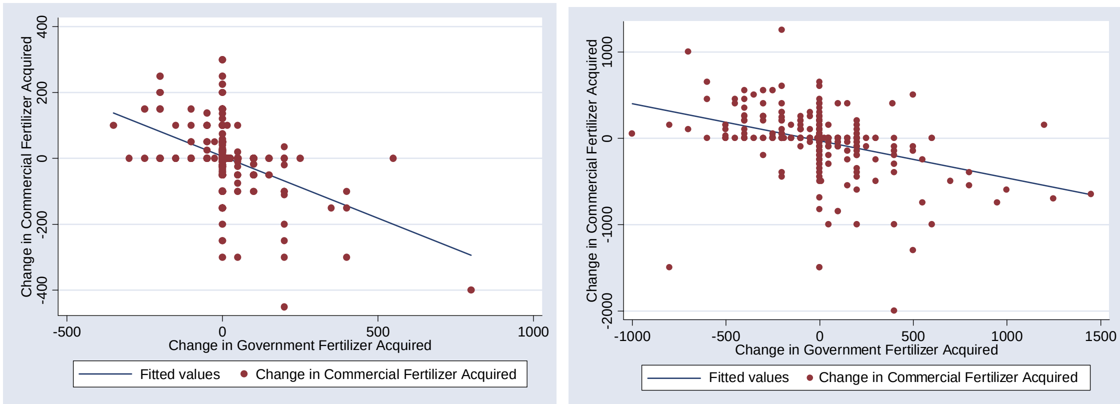
	Farm size category (hectares)				
	0 - 0.60	0.61 - 1.01	1.02 – 1.75	1.76 – 4.98	5.00 – 19.94
Maize yield, unfertilized fields (mt/ha)	1.86	1.52	1.62	1.49	2.00
Maize yield, fertilized fields (mt/ha)	3.18	2.66	2.63	2.61	2.63
Difference in yield (fertilized vs. unfertilized fields) (mt/ha) a/	1.32	1.14	1.01	1.12	0.63
Fertilizer used on maize field (mt/ha)	0.29	0.25	0.24	0.21	0.19
Additional maize output per ton of fertilizer applied a/	4.55	4.56	4.21	5.33	3.32

Source: Central Statistical Office Crop Forecast Surveys, 2007/08 season, Zambia.
a/ These estimates do not control for variables other than fertilizer, such as labor inputs or land quality, that may affect the difference in yield on fertilized vs. unfertilized fields. These average response rates are based on maize area harvested, not planted. In 2007/08, over 25% of the maize fields planted nationwide were not harvested, mainly due to floods and lodging.

Survey evidence also indicates that the crowding out of commercial fertilizer purchases by subsidized fertilizer is somewhat higher for large farms compared to small farms (Figure 3). Each dot in the graphs of Figure 3 represents a farm household surveyed by the CSO in both 1999/00 and 2002/03. The slope of the line measures the change in a household's commercial purchases of fertilizer per additional unit of fertilizer acquired from the government. In the case of the poorest tercile of farm households surveyed, the slope of the line is -0.34 while for the wealthiest tercile it was found to be -0.44. This means that each additional ton of subsidized fertilizer distributed to poor households contributes +0.66 tons of additional fertilizer use on their fields, while the incremental fertilizer use is only +0.56 tons among farms in the wealthiest tercile. Incremental fertilizer use observed for small farms is higher because they are generally poorer and less able to purchase fertilizer commercially. More than 80% of small farmers make no commercial purchases of fertilizer. For them, there is nothing to displace; all of the subsidized fertilizer they receive adds to their total fertilizer use. Similar findings were obtained for Malawi using nationwide survey data from 3 production seasons; mean incremental fertilizer use per unit of subsidized fertilizer acquired among the asset poor was +0.72 vs. +0.15 for the non-poor (Ricker-Gilbert and Jayne, 2008). This means that a fertilizer subsidy program will contribute more to national fertilizer use when a voucher is targeted to an asset-poor household than to a relatively non-poor household.

Figure 3. Changes in household acquisition of government-subsidized fertilizer compared to changes in purchases of commercial fertilizer, 2002/03 vs. 1999/00 production years, Zambia.

Poorest tercile of households ranked by assets | Wealthiest tercile of households ranked by assets



Slope of line (-0.34) | Slope of line (-0.44)

Note: These slope coefficients are accurate. The diagram for the wealthiest tercile (right side of Figure 3) has a much bigger Y-axis scale that has been collapsed to the same height as in the diagram for the poorest tercile. This makes the slope for the wealthiest tercile appear to be shallower than it actually is.

After taking account of differences in maize yields per ton of fertilizer used, and the effect of displacement rates on incremental fertilizer use, the incremental maize output per ton of fertilizer used is the product of two terms: (i) the maize-fertilizer response rate for farmer recipient i; and (ii) the extent to which an additional bag of fertilizer targeted to recipient i contributes to overall fertilizer use after accounting for potential crowding out.[11] This can be computed numerically as:

(1) $\Delta Qmz_i = (\Delta Qmz_i / \Delta total\ fertilizer\ use_i) * (\Delta Total\ fertilizer\ use_i / \Delta 1bag\ subsidized\ fertilizer_i)$

Both of the right-hand side terms in (1) are likely to differ for farmer groups ranked by landholding size and/or wealth. On-going research from both Zambia and Malawi suggests that the first term is greatest among relatively small and poorer farms, because the second term (incremental fertilizer use from an increase in subsidized fertilizer distribution) is appreciably higher for the poor (Ricker-Gilbert and Jayne, 2008; Xu et al., 2008). These findings suggest that targeting relatively poor farm households seems to increase rather than decrease the contribution of fertilizer subsidies to national maize production.

In addition to the objective of increasing national maize supplies, governments in the region are also concerned with ensuring household food security, achieving basic minimum nutritional standards, and improving equity. These objectives are also supported by targeting resources to the poorest rural households, since they run the greatest risk of being priced out of the market if they do not produce enough food for themselves. Well-targeted fertilizer subsidies therefore have the potential to help the rural poor feed themselves, rely less on markets for food, avert malnutrition, and promote equity in incomes in addition to increasing national grain production.

Another issue is how much subsidized fertilizer is actually received by intended beneficiaries. Evidence from Zambia indicates that only 29% of the fertilizer intended for distribution under the Fertilizer Support Programme in 2007/08 was received directly by the intended

[11] This specification assumes no interaction between fertilizer and other inputs as well as no differences in the use of other inputs between groups of farmers who received fertilizer and those who did not.

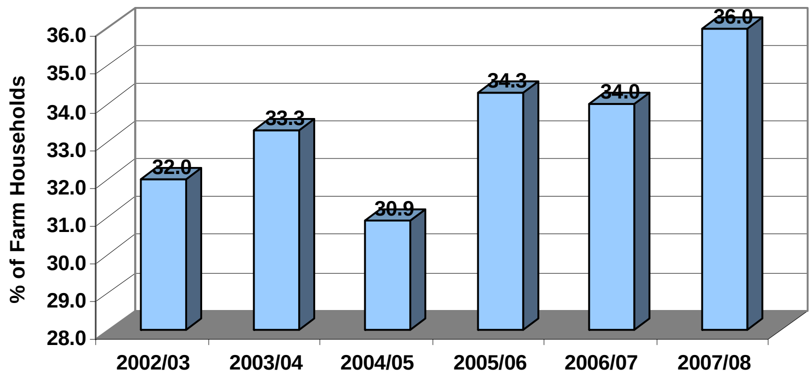
farmer beneficiaries. Official Ministry of Agriculture figures indicate that 50,000 tons of fertilizer were intended to be distributed under the Fertilizer Support Programme to 125,000 smallholder farmers in the 2007/08 season. Yet results from the nationally representative 2007/2008 CSO/MACO Crop Forecast Survey are much lower: only 14,706 tons of FSP-subsidized fertilizer received by an estimated 56,271 farmers reporting FSP to be the principal source of fertilizer they used. This finding is consistent with widespread anecdotal reports, newspaper reports of statements by GRZ officials, and a Chipata District Farmer Association study (CDFA, 2008), indicating that a substantial amount of FSP fertilizer was sold illegally to traders who subsequently sold it at market prices to farmers. As an indication of the potential magnitude of this diversion of FSP fertilizer, the 2008 Crop Forecast Survey indicates that 259,717 smallholders (about 25% of the national total) received 59,366 tons of fertilizer from commercial sources (MACO/ACF/FSRP, 2008). These survey findings, when juxtaposed with official FSP distribution figures, suggest that a substantial portion of this "commercial" fertilizer purchased by farmers in 2007/08 was recycled FSP fertilizer.[12] If this is the case, then the primary beneficiaries of the subsidy were likely to have been those in charge of allocating the fertilizer. These observations illustrate the potential for wide differences between fertilizer subsidy programs in theory and in practice, and indicate that implementation procedures and the ability to control them are critical determinants of their actual impact.

To the extent that the FSP fertilizer is nevertheless used on farmers' fields, it still contributes to national maize production. This is an extremely important benefit especially at a time such as 2008 when the cost of maize importation is very high. Over the six years since the introduction of the FSP program in 2002/03, fertilizer use by smallholder farmers has increased by 12.5% (Figure 4). Smallholder maize yields have also risen from 2.19 tons per hectare in 2002/03 to 2.51 tons/hectare in 2007/08 (MACO/CSO/FSRP, 2008), although abundant and relatively well-distributed rainfall in the 2005/06, 2006/07 and 2007/08 seasons may also be an important factor in these trends.

In summary, keeping food prices at tolerable levels through expanding local supply has important economic, social and political benefits. However, the experience of Zambia indicates that improvements in the pass-through of subsidized fertilizer to smallholder farmers and changes in targeting criteria and effectiveness would greatly increase the benefits of the FSP relative to its costs.

[12] However, since the national survey does not include urban districts, we were not able to estimate the amount of FSP fertilizer received by urban farmers, even though FSP distribution plans indicate that they did distribute a portion of their supplies to urban cooperatives.

Figure 4. Percentage of smallholder farm households using fertilizer, 2000/01 to 2007/08, Zambia.



Source: Central Statistical Office, Crop Forecast Surveys, Zambia.

The case of Kenya: fertilizer adoption without subsidies

Findings from Kenya are drawn from an Egerton Unversity/Tegemeo Institute report on trends and patterns in fertilizer use since the initiation of input market liberalization in 1990 (Ariga, Jayne, Nyoro, 2007; Ariga, Jayne, Nyoro, 2008). This study tracks trends in fertilizer use for a nationwide sample of 1,260 small-scale farm households in 22 districts surveyed by Egerton University's Tegemeo Institute in 1997, 2000, 2004 and 2007.[13]

Kenya liberalized its fertilizer market and phased out all fertilizer subsidy programs in the early 1990s. Total fertilizer consumption has risen from a mean of roughly 180,000 tons per year during the 1980s, to 250,000 tons per year during the early 1990s, to 325,000 tons in the 2000-2003 period, to over 400,000 tons in the 2004/05 and 2005/06 seasons. In the most recent year for which data is available, 2007, Kenyan farmers consumed 451,219 metric tons of fertilizer. Anecdotal reports indicate that at most 300,000 tons of fertilizer has been consumed so far in 2008 due to both civil disruption and the escalating cost of fertilizer in world markets.

The nationwide study of 1,260 smallholder households surveyed four times between 1995/96 and 2006/07 by Egerton University's Tegemeo Institute shows that fertilizer use per cropped hectare has risen by 39% over this 11-year period. The evidence suggests that growth in fertilizer consumption is occurring on smallholder farms; it is not driven by large-scale or estate-sector agriculture. The proportion of small farmers using fertilizer has increased steadily from 56% in 1995/96 to 70% in 2006/07 (Table 3). These rates vary considerably throughout the country, ranging from less than 10% of households surveyed in the drier lowland areas to over 90% of small farmers in Central Province and the maize surplus areas of Western Kenya. Interestingly, mean fertilizer use per hectare is virtually constant across farm size (hectares cropped), suggesting that even small and poor farmers are gaining access to fertilizer, and additional maize output per ton of fertilizer applied is higher for farms with under 2 ha cultivated than for those in the 2-40 ha range (Table 4; see footnote a/). When stratifying the nationwide sample according to wealth, the proportion of the poorest 25% of the farm households using fertilizer in high-potential areas increased from 67% in 1995/96 to 90% in 2006/07. Among the poorest 25% of farm households in semi-arid areas, the

[13] The Tegemeo survey is not strictly nationally representative but was designed to be proportionately representative within the main agricultural zones in Kenya. See Ariga et al. (2008) for details.

proportion using fertilizer increased from 3% to 17%. Fertilizer use remains limited in the drier regions because of low profitability.

These finding underscore the inferences made by Duflo, Kremer and Robinson (2007) in their randomized evaluation of fertilizer usage in Busia District of Western Kenya, and by Marenya and Barrett (2008), both of which indicate that the fertilizer use recommendations of the Government's extension service are unprofitable for most farmers in many areas of the country.

Table 3: Percent of Farm Households Using Fertilizer on Maize

Agro-regional zone	1996	1997	2000	2004	2007
	% of households using fertilizer on maize				
Coastal Lowlands	0	0	3	4	14
Eastern Lowlands	21	27	25	47	43
Western Lowlands	2	1	5	5	13
Western Transitional	39	41	70	71	81
High Potential Maize Zone	85	84	90	87	91
Western Highlands	81	75	91	91	95
Central Highlands	88	90	90	91	93
Marginal Rain Shadow	6	6	12	11	16
Total Sample	**56**	**58**	**64**	**66**	**70**

Source: Ariga et al. (2008), based on Tegemeo Institute/Egerton University household surveys, 1997, 2000, 2004, and 2007.

7.

Table 4. Fertilizer use and maize yields by farm size (hectares cropped) category, Kenya.

	(hectares cropped, average of four seasons)				
	0.16-0.81	0.85-1.30	1.30-1.78	1.78-2.51	2.55-39.11
Maize yield, unfertilized fields (mt/ha)	0.66	0.73	0.67	0.79	0.71
Maize yield, fertilized fields (mt/ha)	1.18	1.10	1.12	1.07	1.15
Difference in yield (fertilized vs. unfertilized fields) (mt/ha) a/	0.52	0.37	0.44	0.28	0.44
Fertilizer used on maize field (mt/ha)	0.12	0.12	0.12	0.14	0.15
Additional maize output per ton of fertilizer applied a/	4.23	3.15	3.60	2.00	2.97

Source: Tegemeo Institute / MSU Household Panel Surveys for the 1996/97, 1999/00, 2003/04, and 2006/07 cropping seasons.
a/ These estimates do not control for variables other than fertilizer, such as labor inputs or land quality, that may affect the difference in yield on fertilized vs. unfertilized fields.

Fertilizer consumption in Kenya grew both for food crops (mainly maize and domestic horticulture) and for export crops such as tea, sugarcane, and coffee. Fertilizer use per hectare of maize cultivated has increased dramatically in all but the semi-arid parts of the country. About 87% of small-scale farmers in the high-potential maize zones of Western Kenya now use fertilizer on maize, with dose rates of roughly 163 kg per hectare, higher than mean levels obtained in South and East Asia.

Three main factors account for the expanded use of fertilizer by small farmers in Kenya. First, the Government of Kenya has pursued a relatively stable fertilizer marketing policy since 1990. After the elimination of retail price controls, import licensing quotas, foreign exchange controls, and the phase-out of external fertilizer donation programs that disrupted commercial operations, Kenya has witnessed rapid investment in private fertilizer distribution networks, with over 10 importers, 500 wholesalers and 7,000 retailers now operating in the country.

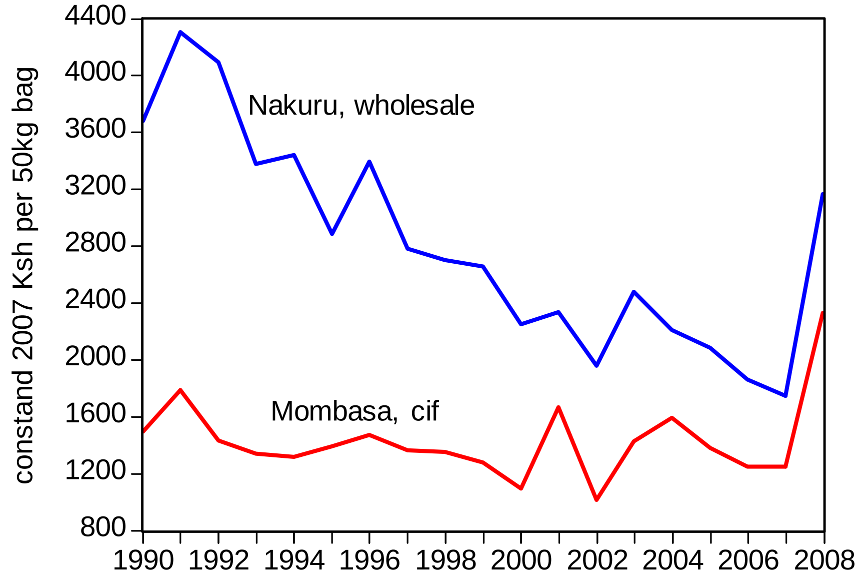
Secondly, because of the increasingly dense network of fertilizer retailers operating in rural areas, the mean distance of small farmers to the nearest fertilizer retailer declined progressively from 8.4 km to 3.9 km between 1997 and 2007. This has greatly expanded small farmers' access to fertilizer, reduced transport and transaction costs, and increased the profitability of using fertilizer.

The third factor is intense competition in importing and wholesaling, creating pressure to cut costs and innovate in logistics. As a result, over the past 10 years fertilizer transport and marketing costs from Mombasa to Western Kenya have declined by nearly 45%, from $245 to $140 per ton, allowing farm-gate fertilizer prices to remain roughly constant despite rising world prices (Figure 5).

Interviews of key informants in Kenya's fertilizer sector identified four factors responsible for the declining fertilizer marketing costs observed in Kenya: (i) exploiting the potential for cheaper backhaul transportation, taking greater advantage of trucks transporting cargo from Rwanda and Congo to the port of Mombasa; (ii) private importers are increasingly using international connections to source credit at lower interest and financing costs than are available in the domestic economy; (iii) mergers between local and international firms in which knowledge and economies of scale enable cost savings in local distribution; and (iv) increased competition among local importers and wholesalers given the expansion in the number of firms engaged in fertilizer marketing since the early 1990s.

Regarding credit, many Kenyan farmers have been able to finance fertilizer through the credit offered in the integrated input-output chains for crops such as tea, sugar, and coffee. These integrated marketing arrangements have also provided the means for farmers to obtain fertilizer for their food crops, since the companies can recoup their loans for other crops as well when the farmers sell their cash crop back to the company. But in areas where fertilizer use on a particular crop is profitable, such as maize in Western Kenya and horticulture throughout the country, most farmers have achieved reasonable levels of fertilizer use without credit.

Figure 5. Price of DAP (Di-Ammonium Phosphate) in Mombasa and Nakuru (constant 2007 Shillings per 50kg bag)



Note: Nakuru is a maize-producing area in the Rift Valley of Kenya, 400 miles (645 km) by road west of the port of Mombasa. Source: Ministry of Agriculture. FMB weekly fertilizer reports for CIF Mombasa.

The experience of Kenya shows how a stable policy environment can foster an impressive private sector response that supports smallholder agricultural productivity and poverty alleviation. These goals remain elusive in countries lacking a sustained commitment to the development of viable commercial input delivery systems. Output price stability has also facilitated the impressive growth in fertilizer use in Kenya. The operations of the National Cereals and Produce Board since the early 1990s, and the elimination of regional trade barriers since the inception of the East African Commission Custom Union in January 2005, have both promoted maize price stability (Jayne, Myers, Nyoro, 2008; Chapoto and Jayne, 2007). Complementary programs to support small farmer productivity, such as the Farm Input Promotions (FIPS) program, the CNFA agro-dealer training and credit program, and the organization of farmers into groups to facilitate their access to extension and credit services under the Kenya Market Development Programme, have also been important factors in raising fertilizer use in Kenya.

Because mean household incomes are higher in Kenya compared with many other African countries, the impressive market-led growth in smallholder fertilizer use in Kenya may not be easily transferable to areas where effective demand is highly constrained. And the Kenya success story is fragile. Sustaining its momentum will depend on commitment to supportive public investment and policy choices. Governance problems and civil disruption would jeopardize the sustainability of the commercially driven input distribution system and rural development more generally. Continued access to input credit for small farmers in many parts of the country will require government commitment to limit the potential for politicization and interference in the management of the interlinked crop marketing systems for sugarcane, tea, and coffee, which have provided a means for farmers to acquire additional fertilizer on credit for use on food crops. Also, new investment is needed in Kenya's eroded rail, road, and port infrastructure to maintain Kenya's competitiveness. Lastly, effective systems to improve smallholders' crop husbandry and management practices are needed to provide incentives for continued expansion of fertilizer use and productivity growth in areas where fertilizer is only marginally profitable at present.

Implications of sharply higher maize, fertilizer, and fuel prices

Since the beginning of 2007, world prices of maize and fertilizer have increased dramatically. According to data from the World Bank (2008a), increases in quarterly average prices from January–March 2007 to July-September 2008 are $74 for maize (from $171 to $245), $810/ton for DAP (from $344 to $1,154), $447 for urea (from $298 to $745), and $59 for crude oil ($57 to $116.[14]

A recent IMF study has examined the macroeconomic impact of higher food and fuel prices (IMF, 2008). Results indicate sizeable negative balance of payments impacts, primarily from the fuel price increases (since fuel imports by low- and middle-income countries are at least twice as large as food imports). Price increases have also contributed to inflation and poverty (especially for the urban poor), but here food prices have a bigger impact than fuel prices.

At the farm and national level, the presumption is that these price changes will have negative effects on the profitability and affordability of fertilizer use: they may lead to lower fertilizer application rates and hence yields; they may make fertilizer unaffordable for many farmers who previously bought fertilizer commercially and produced a marketed surplus; they may lead some farmers to switch land out of maize and into other crops; and they may further discourage fertilizer non-users from adopting fertilizer. The fear is that without support for maintaining fertilizer use levels, domestic maize output will decline, perhaps requiring governments to meet domestic consumption needs through very expensive imports. If sufficient maize imports cannot be mobilized, widespread hunger may result, with negative social and political consequences at the national (and international) level, particularly if hunger turns into famine.

How have these recent world price increases affected prices in Eastern and Southern Africa, and what are their implications for incentives to use fertilizer?[15] For producers, rising maize and fertilizer prices have positive and negative effects on profitability, respectively. The net effect on profitability depends on location and other specific circumstances, and is unclear a priori. For export-oriented crops, fuel price increases raise the costs of imported inputs and transport to the border, thereby reducing profitability. For import substitutes, the net effect on profitability depends on the location of production relative to the market to which output is delivered. Rising maize and fuel costs will increase the import parity prices at major internal markets. For production zones close to these markets, the rise in import parity price may offset the increased cost of transport from the production zone to those markets. This may not be true for more distant production zones.

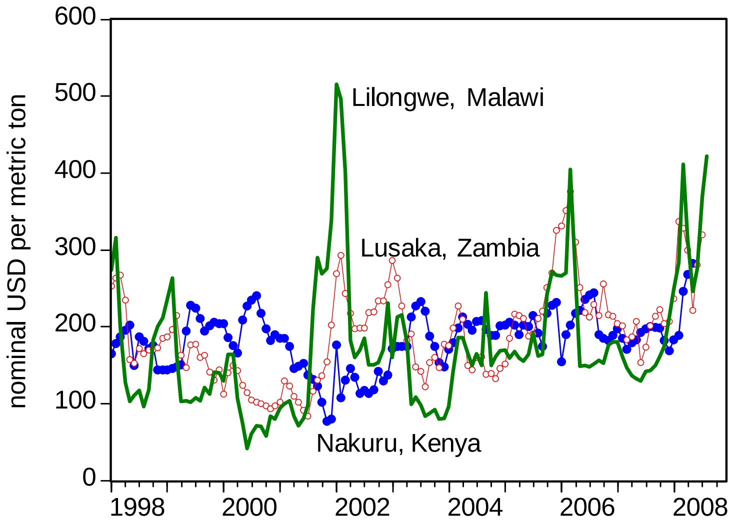
Figure 6 presents trends in maize prices in regional markets in Eastern and Southern Africa, in nominal USD per ton. The 2001/02 and 2005/06 years were drought years exacerbated by poor coordination between the private and public sectors in mobilizing needed imports in some countries (Tschirley and Jayne, 2008). The high food prices in 2007/08, by contrast, are not due to major production shortfalls, although maize production in South Africa was relatively low in both 2005/06 and 2006/07. The continued turmoil in Zimbabwe may also be contributing to rising prices.

---

[14] These world prices have fallen significantly as of October 2008, to $183 for maize, $970 for DAP, $406 for urea, and $73 for crude oil (World Bank, 2008a), but local prices within the Eastern and Southern Africa region remain high. World Bank price forecasts in nominal terms for 2009 are higher for maize ($210) and lower for DAP and urea ($500 and $350, respectively) (World Bank, 2008b).

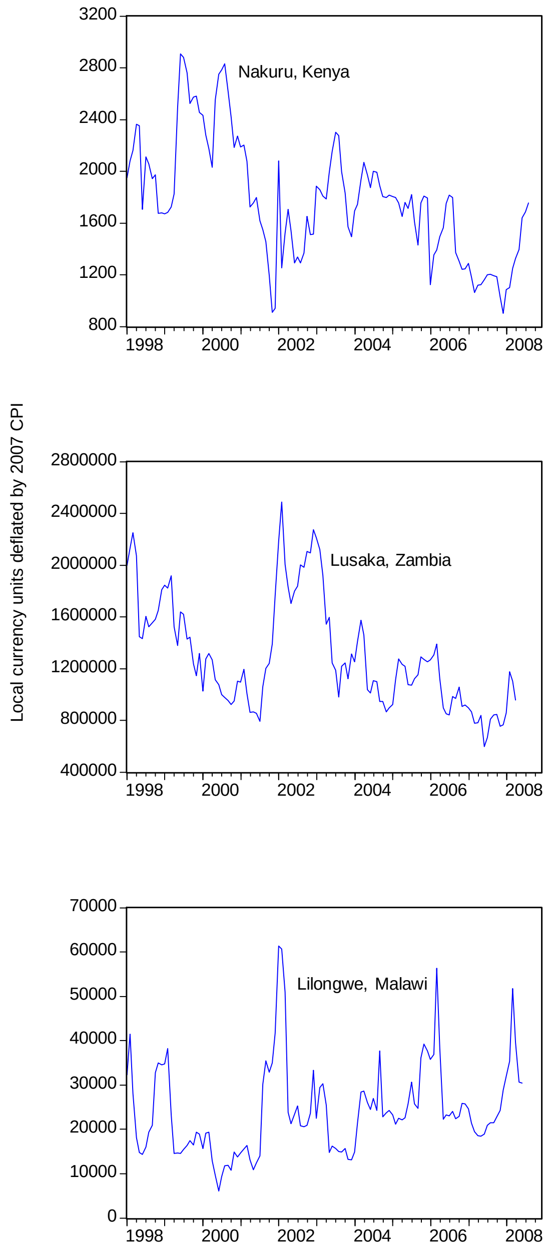
[15] Implications for consumers and government budgets are also important, but are not the focus here.

Figure 6. Retail prices of maize in Southern African markets, January 1999 to May 2008, in nominal USD per metric ton.



The trend in prices changes somewhat when examining regional maize price trends in inflation-adjusted local currency units (Figure 7). Maize prices are rising in some countries in the region (Malawi), and falling in others (Zambia and Kenya). Real prices in Zambia and Kenya are falling mainly because of currency appreciation against the US dollar in recent years. Rising food prices denominated in USD are offset to a large extent when converted into local currency units and further offset when adjusted by the ratio of US GDP price index to local inflation rates. Note, however, that declining real maize prices do not necessarily imply improved affordability for consumers, since the decline is occurring in part because other commodity prices are rising more rapidly, which affects consumers' real incomes and purchasing power. If incomes have not risen as fast as food prices, consumers' purchasing power has declined. To examine this it would be necessary to track food price trends against wage rates and nonfarm business income for both urban and rural households, yet even annual data on wage rates in the countries examined has proven difficult to obtain.

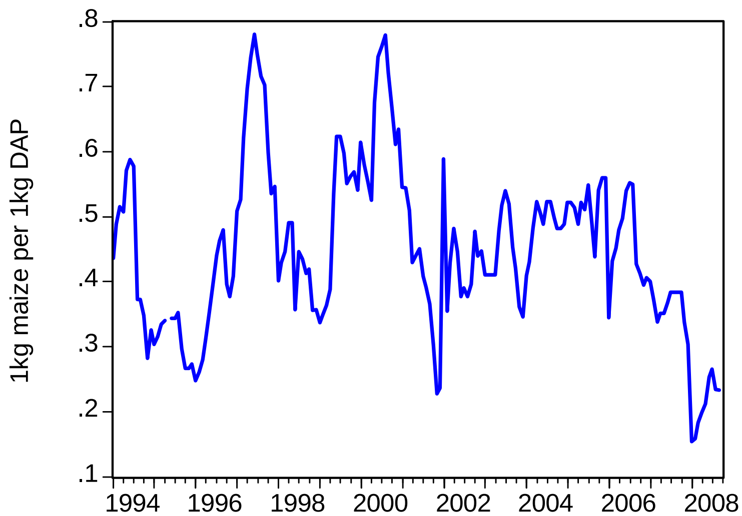
Figure 7. Maize prices in various markets of Eastern and Southern Africa, in local currency units per ton.



Sources: Ministry of Agriculture market information systems in Malawi, Zambia, and Kenya, National Statistical Offices for CPI data.

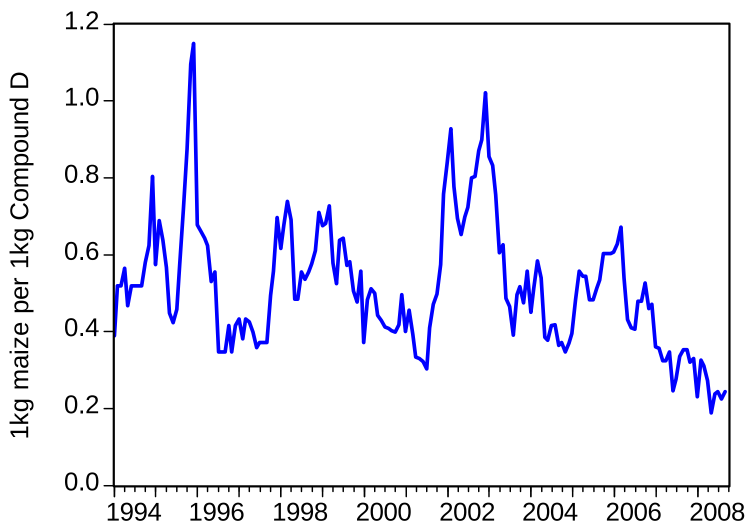
Trends in the local maize-fertilizer price ratio are a third important indicator to examine in evaluating how recent grain and fertilizer price rises will affect the incentives to use fertilizer. There has been a dramatic rise in fertilizer prices since 2007, and this rise in fertilizer prices has been proportionately higher than the rise in food prices. Figures 8, 9 and 10 present trends in maize-fertilizer price ratios over the 1994-2008 period for Kenya, Zambia and Malawi. Maize-fertilizer price ratios in 2008 are at all-time lows in Kenya and Zambia. In Malawi, the relatively high price of maize in 2008 has partially offset the impact of rising fertilizer prices, and the anticipated expansion of the fertilizer subsidy program for 2008/09 is also likely to stabilize fertilizer use in Malawi.

Figure 8. Maize / Fertilizer Price Ratios, Kenya, 1994-2008.



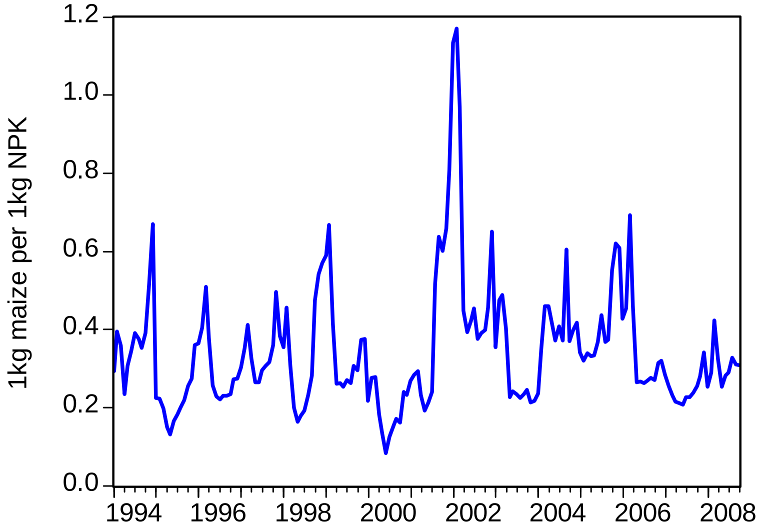
Notes: Price ratio defined as wholesale market price per metric ton, Nakuru, divided by DAP, c.i.f. Nakuru per metric ton, in nominal shillings.
Sources: Ministry of Agriculture Market Information Bureau, Nairobi.

Figure 9. Maize / Fertilizer Price Ratios, Zambia, 1995-2008.



Notes: Price ratio defined as retail market price per metric ton, Lusaka, divided by Compound D, c.i.f. average of provincial centers per metric ton.
Sources: Omnia data files and Ministry of Agriculture and Cooperatives files for Compound D; CSO retail price data for maize prices.

Figure 10. Maize / Fertilizer Price Ratios, Malawi, 1990-2008.



Notes: Price ratio defined as retail maize market price per kg, Lilongwe, divided by NPK (23:21:0 4s) c.i.f. Lilongwe per kg, in nominal kwacha.
Sources: FEWSNet reports for maize prices; Ministry of Agriculture for fertilizer prices, Lilongwe.

Relatively low maize-fertilizer price ratios in most of the rest of the region are likely to produce several unwelcome outcomes: (a) less fertilizer used on maize and other crops in the coming cropping season; (b) lower maize yields and production, other factors constant; (c) continued upward pressure on maize prices, even in countries that so far have not experienced major price increases; and (d) a possible shift in area out of crops that require heavy fertilization for profitability and into crops that are profitable even at low or no fertilizer use (e.g., a partial shift into roots and tubers at the expense of maize in the mixed cassava/maize zones, and a shift out of fertilizer-intensive cash crops such as tobacco and tea).

The impact of lower fertilizer use on maize production and marketed supplies will be most discernable in countries that make relatively intensive use of fertilizer such as Kenya and least discernable in countries where fertilizer use is negligible, such as Mozambique.[16] However, high fertilizer prices will limit expansion of production through technology adoption. For that reason, the Mozambican government is considering a fertilizer subsidy program similar to Malawi's starter pack program. Countries gearing up for large-scale fertilizer subsidy programs in 2008, such as Malawi, may also not be greatly affected in the short run. However, the impact of Malawi's subsidy program and the current ADMARC and NFRA operations associated with maize price stabilization are anticipated to impose massive fiscal costs on the treasury with potentially serious macroeconomic consequences that could indirectly affect livelihoods and food insecurity in 2009 and beyond.

As important as fertilizer use is in increasing food production over time, many other factors are crucial as well. Over the medium and longer run, smallholder productivity and food security outcomes in the region will also depend on investments in seed research and other forms of crop science; extension programs to improve farmer knowledge and management practices; initiatives to organize farmers into viable groups for accessing seasonal loans to finance crop input purchase, obtain support services (e.g., crop husbandry knowledge, conservation farming techniques and other viable agronomic practices, soil testing for fine-tuning efficient fertilizer use recommendations), and achieve scale economies in crop

[16] In 2007, 70 percent of smallholder farmers in Kenya used fertilizer while only 4 percent of farmers in Mozambique did.

marketing; and investments in physical infrastructure, e.g., roads, electrification, port development, etc. For empirical estimates of how infrastructure investments affect agricultural productivity, see Antle, (1983) and Binswanger, H., S. Khandker, M. Rosenzweig (1993).

It is also important to stress that incentives to use fertilizer depend not only on the maize-fertilizer price ratio but also on fertilizer application rates and the maize yield response to fertilizer. Without pretending to any definitive results that would support specific policy recommendations, several rough calculations can be used to illustrate this point, given the maize and fertilizer price increases cited at the beginning of this section.[17]

First, consider a farmer who currently applies fertilizer. Using a simple partial budget that assumes a fertilizer application rate of 100 kg/ha each for DAP and urea, a yield of 2 tons/ha, a maize price increase of $75/ton, and an average fertilizer price increase of $630/ton,[18] the change in value of output is 2 x $75 = $150 and the change in cost is 200/1000 x $630 = $126, for a net gain of $24. With these assumptions, the net gain is negative only if more than 115 kg/ha each of DAP and urea are used, or if the fertilizer dose remains at 100 kg/ha each of DAP and urea and the yield falls to about 1.7 tons/ha. This illustrates the importance of the maize yield response to fertilizer, other things equal.

Second, consider a farmer who does not currently apply fertilizer. Heisey (cited in Byerlee and Eicher, 1997) indicates that in Malawi 55 kg of nutrient per ha applied to local (unimproved) maize gives a 750 kg/ha increase in yield over unfertilized local maize. Valuing maize and fertilizer at the July-September 2008 quarterly average prices cited by the World Bank (2008a), the gain in value of maize is roughly $184 minus the cost of fertilizer applied of $163,[19] for a net gain of $21 per ha. As in the first illustration, this result depends heavily on the maize-fertilizer response rate. Also, note that while the net gain in this simple example is positive, it is substantially lower than the net gain ($74) that would be obtained at the prices prevailing in the January-March quarter of 2007. Moreover, the net gain of $21 per ha implies a value-cost ratio (VCR) of $184/163 = 1.13, which is well below the value of 2.0 commonly used as a threshold for acceptability to farmers.

Third, the benefit-cost analysis reported in Dorward et al. (2008) for the 2006/07 Malawi input subsidy program provides another way of estimating the impact of recent maize and fertilizer price increases. Increasing the maize price from $147.5/ton to $245/ton, raising the average cost of fertilizer by $630/ton, and holding constant other assumptions from Dorward et al., the benefit-cost ratios for the Malawi program decline only slightly, ranging from 0.72 to 1.18, instead of from 0.76 to 1.25 (the range reported in Dorward et al. for the base maize price of $147.5).[20] Other noteworthy impacts of the fertilizer price increase in this example are that the cost of procuring the aggregate amount of subsidized fertilizer distributed (approximately 175,000 tons) would rise by $630/ton, increasing the budgetary outlay by $110.25 million. Also, if farmers were expected to make the same 28% co-payment, they

---

[17] These examples do not include the effect of fuel price increases on within-country prices of maize and fertilizer. Also, using the October 2008 prices given in World Bank (2008a) would result in net losses rather than net gains in the first two illustrations discussed in the text. On the other hand, at the forecast nominal 2009 prices (higher for maize, lower for fertilizer) cited in footnote 14 (World Bank, 2008b), the net gains in these two illustrations would be much higher.

[18] Average of $810 increase for DAP and $447 increase for urea, rounded up to $630.

[19] Using an average of DAP and urea prices ($1,154 + $745)/2 = $950 and a nitrogen nutrient content of fertilizer of 32% (average of 18% and 46%).

[20] This result is explained by (a) the positive effect of the maize price increase tending to offset the negative effect of fertilizer price increase, and (b) the fact that fertilizer costs make up only part of the total cost in the BCR denominator (54-56% of total costs given 2006/07 prices, and 70-74% given the World Bank's 2008 prices).

would need to pay 2,094 MK per bag rather than 950 MK per bag.[21] This illustrates the farm- and national-level financial costs associated with large fertilizer price increases.

Lastly, even if fertilizer use on maize remains profitable, it may become less profitable than other crops for some farmers, inducing them to switch out of maize. For example, anecdotal reports from Zambia indicate that because of the major run-up in soybean prices, many commercial farmers are expecting to find it more profitable to apply fertilizer on that crop in the upcoming growing season. Maize producers may also apply less fertilizer than in previous years if supplies are rationed or otherwise constrained.

While maize-fertilizer price ratios may not be abnormally low relative to long-run mean levels, this is not cause for complacency. Major gains can be achieved from efforts to reduce costs in the fertilizer distribution system to push down the cost to farmers. There is also a need for innovative farmer extension programs to assist farmers to use fertilizer more efficiently so that each kg used produces more output. Also, at least some smallholder farmers who have been buying fertilizer at commercial prices may cut back on the amount of fertilizer used per hectare rather than eliminating fertilizer use entirely. If this is true, the potential effect of high prices may not be a great as some predict. A lot depends on whether timely fertilizer stocks are available for sale. Also if a smallholder has access to cash to buy fertilizer, and has a very small area on which to plant maize, the cheapest way to get maize to eat may still be to pay even higher prices for fertilizer to avoid having to buy even more expensive maize from the market. Hence, potentially the most important consideration is to ensure that adequate fertilizer supplies are imported into each country in the region in a timely and efficient way, as well as ensuring their distribution to the sites where they are needed.

Conclusions and implications for policy

The existence of acute poverty and hunger, exacerbated by soaring food and fertilizer prices, cries out for an immediate response. “Smart” fertilizer subsidy programs in Africa are attractive to many because they offer the potential to increase the food grain harvest and thus reduce hunger in the short run. Income gains transferred to farmers through the subsidy are expected to result in greater savings and investment in productive assets, contributing to longer-run growth. In addition, income transfers to farmers address the social and political objectives of poverty alleviation and improved equity.

However, achieving these benefits depends greatly on how the programs are implemented. The contribution of fertilizer subsidy programs to reducing poverty and hunger would be higher if they could be designed and implemented so as to (a) target households with little ability to afford fertilizer; (b) target areas where applying fertilizer can actually increase total output; and (c) promote rather than undercutting the development of a commercial fertilizer distribution system.

---

[21] In fact, the co-payment was not increased in the 2007/08 Malawi program.

Several caveats should be considered before implementing fertilizer subsidies:

1. Fertilizer subsidies may not be the best option for addressing the current crisis of high food and fertilizer prices. Significant increases in demand for fertilizer are likely to drive up prices further (Salzburg, 2008). Also, the supply response to increased fertilizer use is not assured, given weather and other maize production risks prevalent in most of eastern and southern Africa. Thus, implementing large-scale fertilizer subsidy programs will not guarantee an adequate harvest. Lastly, subsidies targeted to particular crops such as maize may reduce output of other food crops such as cassava (Zulu et al., 2001), reducing the net food supply response.

2. Fertilizer subsidies may not be the best option for addressing the current crisis of high food and fertilizer prices. Significant increases in demand for fertilizer are likely to drive up prices further (Salzburg, 2008). Also, the supply response to increased fertilizer use is not assured, given weather and other maize production risks prevalent in most of eastern and southern Africa. Thus, implementing large-scale fertilizer subsidy programs will not guarantee an adequate harvest. Lastly, subsidies targeted to particular crops such as maize may reduce output of other food crops such as cassava (Zulu et al., 2001), reducing the net food supply response.

3. As a tool for increasing overall agricultural productivity, especially for small, poor farmers, fertilizer subsidies have a questionable record. Long experience with input subsidy programs in Africa is not encouraging on several points:[22] (a) there is very little evidence from Africa that fertilizer subsidies have been a sustainable or cost-effective way to achieve agricultural productivity gains compared to other investments, (b) there are no examples of subsidy programs where the benefits were not disproportionately captured by larger and relatively better-off farmers, even when efforts were made to target subsidies to the poor,[23] and (c) there is little evidence that subsidies or other intensive fertilizer promotion programs have "kick-started" productivity growth among poor farmers in Africa enough to sustain high levels of input use once the programs end.[24]

[22] Morris et al. (2007, 103) summarize by saying: "the weight of empirical evidence now show(s) that fertilizer subsidies are likely to be inefficient, costly, and fiscally unsustainable."

[23] The logical response is to call for better targeting of future input subsidy programs. However, Dorward et al. (2008, section 7.2.3) includes an illuminating discussion of the practical difficulties involved in targeting subsidized fertilizers to poor households, including lack of information on who the poor households are, and unwillingness of some communities to exclude any households from receiving subsidized fertilizer. The daunting variety of difficulties described here makes it hard to be optimistic about the prospects for significantly improved targeting.

[24] For example, Malawi and Zambia have had almost continuous fertilizer subsidy programs each year for the past several decades even during the so-called liberalization process (e.g., see Dorward et al., 2008; Jayne et al., 2002).

4. As a tool for increasing overall agricultural productivity, especially for small, poor farmers, fertilizer subsidies have a questionable record. Long experience with input subsidy programs in Africa is not encouraging on several points:[25] (a) there is very little evidence from Africa that fertilizer subsidies have been a sustainable or cost-effective way to achieve agricultural productivity gains compared to other investments, (b) there are no examples of subsidy programs where the benefits were not disproportionately captured by larger and relatively better-off farmers, even when efforts were made to target subsidies to the poor,[26] and (c) there is little evidence that subsidies or other intensive fertilizer promotion programs have "kick-started" productivity growth among poor farmers in Africa enough to sustain high levels of input use once the programs end.[27]

5. In the high potential areas of Kenya, Zambia, and Malawi, many if not most households use fertilizer regularly. In less stable production zones, low or no fertilizer use by many smallholders is explained not just by credit constraints that limit acquisition, but also by the risk of crop failure, with resulting financial losses and consumption shortfalls. The lack of insurance causes inefficiency in production choices (Dercon and Christiaensen, 2007). Recent trials of weather-indexed insurance are a promising potential solution for the risk problem (World Bank, 2007a, p. 149).

6. Hence, a balance is needed between interventions to address short-term supply shortages and avoid widespread hunger vs. investments and policies to drive growth and lift poor households out of the poverty trap in which they are caught. Currently, the governments of Malawi and Zambia devote at least 60% of their agricultural budgets to input and crop marketing subsidies, leaving relatively little for the long-term investments required for sustainable reductions in poverty and hunger.

If the decision is made to implement input subsidies, the experiences of Zambia and Malawi provide several practical guidelines for how to maximize their effectiveness in meeting important national objectives other than economic growth, such as improved national food security, alleviation of poverty and hunger:

1. ***Use input vouchers that can be redeemed at local retail stores rather than direct distribution*** in order to maintain or improve the capacity of the private sector input delivery system.

---

[25] Morris et al. (2007, 103) summarize by saying: "the weight of empirical evidence now show(s) that fertilizer subsidies are likely to be inefficient, costly, and fiscally unsustainable."

[26] The logical response is to call for better targeting of future input subsidy programs. However, Dorward et al. (2008, section 7.2.3) includes an illuminating discussion of the practical difficulties involved in targeting subsidized fertilizers to poor households, including lack of information on who the poor households are, and unwillingness of some communities to exclude any households from receiving subsidized fertilizer. The daunting variety of difficulties described here makes it hard to be optimistic about the prospects for significantly improved targeting.

[27] For example, Malawi and Zambia have had almost continuous fertilizer subsidy programs each year for the past several decades even during the so-called liberalization process (e.g., see Dorward et al., 2008; Jayne et al., 2002).

2. ***Involve a wide range of fertilizer importers, wholesalers, and retailers in the input voucher scheme,*** even if it entails additional logistical costs. Providing tenders to only 2-3 firms to import fertilizer can entrench their position in the market, cause other firms to cease making investments in the system or drop out altogether, leading to a more concentrated input marketing system and restricted competition when the input subsidy program comes to an end. A system that allows farmers to redeem coupons at the full range of existing independent agro-dealer retail stores will promote additional investment in remote rural areas where it is most needed. By contrast, failure to involve the small rural retailers may lead many of them to stop carrying fertilizer, as was the case in Malawi after the 2005/06 season, leading to erosion rather than development of a private retailing system.

3. ***Before deciding to target the input vouchers***, carefully consider the objectives of the targeting and the practical feasibility and costs of implementing a targeted program, including personnel costs, time requirements and potential delays, leakage, and displacement of commercial sales by subsidized inputs.

    a. If the objective is to increase total output, then the inputs need to reach farmers who can use them efficiently and on a large enough area to generate significant gains in total output. Evidence indicates that a high proportion of non-poor farmers are able to acquire fertilizer through markets so spending scarce government resources to provide them with discounted fertilizer will largely substitute subsidized fertilizer for commercial fertilizer, adding relatively little to overall fertilizer use or crop output. In some cases, small farmers may also use fertilizer more efficiently than larger farmers.

    b. If the objective is to alleviate poverty, or to overcome liquidity constraints for poor farmers who would otherwise be unable to purchase fertilizer, then it must be possible to identify poor farmers, and socially acceptable to channel vouchers to them, at a reasonable cost including leakage. Assisting low-income households to acquire fertilizer especially in a high food price environment may make the difference between their ability to eat and going hungry. Providing crop production support to relatively asset-poor households also contributes importantly to equity and social protection objectives,

    c. If effective targeting does not seem feasible or achievable at an acceptable cost, then a small universal voucher program would be worth considering. For example, a program designed to provide all farmers with inputs for 0.2 ha would primarily benefit small farmers while at the same time limiting the displacement of commercial purchases by larger higher-income farmers, some degree of which might occur anyway under a program that fails to target small farmers successfully.[28]

4. ***Address infrastructure and input supply constraints as well as improving procurement efficiency*** (joint procurement arrangements and regional procurement hubs). This will help achieve the goal of enhancing farm-level fertilizer supplies at a lower price. Facilitating the movement of fertilizers across borders (removing customs duties and export taxes) will also contribute to overall improvements in supply efficiency.

---

[28] The option of a small universal subsidy program is discussed in Imperial College et al. (2007). See also Chinsinga (2005) for a discussion of the earlier experience in Malawi with universal and targeted input subsidy programs.

5. ***Facilitate private sector partnerships with farmers***, such as through contract farming where conditions are suitable, would go a long way toward reducing the financial burden on government.

6. ***Strengthen farmers' effective demand for fertilizer*** by making fertilizer use profitable and by building durable input markets and output markets that can absorb the increased output without gluts that depress producer prices. This involves two major commitments from government:

   a. To increase farmers' demand for fertilizer, governments should invest in rural infrastructure, efficient port facilities and standards of commerce to reduce the costs of distribution; fund agricultural research to produce seeds that respond to fertilizer; determine and disseminate fertilizer use recommendations that are appropriate for different areas (as opposed to one blanket recommendation for an entire country); and nurture the development of rural financial systems, market information systems, institutions for contract enforcement, and telecommunications to attract new investments by commodity marketing firms. These "public goods" investments, often considered outside the scope of fertilizer marketing policy, nevertheless strongly affect the demand for fertilizer and hence whether sustainable markets for fertilizer can arise.

   b. To build durable input and output markets, governments should establish a supportive policy environment that attracts local and foreign direct investment. The case of Kenya shows how a stable policy environment has induced an impressive private sector response that has helped to make fertilizer accessible to most small farmers. Importantly, this has involved reforms to the financial market (elimination of foreign exchange controls) as well as to fertilizer and crop markets. In other countries, the implementation of large subsidy programs has inhibited the type of private investment response seen in Kenya, due to the risk of huge losses that subsidy programs inflict on commercial input dealers.

7. ***Increase fertilizer use efficiency*** by promoting farmers' use of improved crop management practices such as crop rotation with legumes, changes in density and spacing patterns of seeds and placement of fertilizer and seeds at planting (FIPS Africa, 2008), improved soil organic matter, early planting, timely weeding, applying fertilizer in response to rainfall (Snapp, Blackie, and Donovan, 2003; Blackie et al. 2006), water harvesting, and other conservation farming methods (Haggblade and Tembo, 2003).

References

Antle, John M. 1983. Infrastructure and Aggregate Agricultural Productivity: International Evidence. *Economic Development and Cultural Change* 31(3):609-19.

Ariga, J., T.S. Jayne, and J. Nyoro. 2006. Factors Driving the Growth in Fertilizer Consumption in Kenya, 1990-2005:Sustaining the Momentum in Kenya and Lessons for Broader Replicability in Sub-Saharan Africa. Working Paper 24. Egerton University, Tegemeo Institute, Nairobi.

Ariga, J., T. Jayne, B. Kibaara, and J. Nyoro. 2008. Trends and Patterns in Fertilizer Use in Kenya, 1997-2007. Working Paper, Egerton University, Tegemeo Institute, Nairobi.

Binswanger, Hans P., Shahidur R. Khandker, and Mark R. Rosenzweig. 1993. How Infrastructure and Financial Institutions Affect Agricultural Output and Investment in India. *Journal of Development Economics* 41(2):337-66.

Blackie, Malcolm, Paul Thangata, Valerie Kelly and Wilkson Makumba. 2006. Agricultural Sustainability in Malawi: Transforming Fertilizer Subsidies from a Short-run Fix for Food Insecurity to an Instrument of Agricultural Development. Paper presented at the International Association of Agricultural Economists Conference, Gold Coast, Australia, August 12-18.

Chapoto, A. and T. Jayne. 2007. Price Instability, Trade Policy, and the Demand for Food Staples: An Application of the ARCH Model in Eastern and Southern Africa. Antony Chapoto and T.S. Jayne, December 10-11, 2007, paper presented at the FAO workshop on "Appropriate Trade Policies for Agricultural Development in a Globalizing World", FAO Headquarters, Rome, Italy, December 10-11, 2007.

CDFA (Chipata District Farmers Association). 2008. The 2007-8 Fertilizer Support Programme. Prepared by Chipata District Farmers Association, Chipata, Zambia.

Chinsinga, Blessings. 2005. Practical and Policy Dilemmas of Targeting Free Inputs. In Sarah Levy (Ed.), *Starter Packs: A Strategy to Fight Hunger in Developing Countries?* Wallingford, UK: CABI Publishing.

Crawford, E. W., T. S. Jayne, and V. A. Kelly. 2006. Alternative Approaches for Promoting Fertilizer Use in Africa. Agriculture and Rural Development Discussion Paper 22. Washington, D.C.: World Bank.

Denning, Glenn, and Jeffrey Sachs. 2008. Subsidising agriculture not enough. *The Sunday Times*, Features, February 24. Malawi: BNL.

Dercon, S. and L. Christiaensen. 2007. Consumption risk, technology adoption and poverty traps: evidence from Ethiopia. Policy Research Working Paper 4257, the World Bank, Washington, D.C.

Dorward, A., E. Chirwa, V. Kelly, T. Jayne, R. Slater, and D. Boughton, 2008. Evaluation of the 2006/7 Agricultural Input Supply Programme, Malawi. Final report, School of Oriental and African Studies (SOAS), Wadonda Consult, Michigan State University, and Overseas Development Institute (ODI), undertaken for the Ministry of Agriculture and Food Security, Government of Malawi. March.

Duflo, E., M. Kremer, and J. Robinson. 2008. How High Are Rates of Return to Fertilizer? Evidence from Field Experiments in Kenya. *American Economic Review:* Papers and Proceedings 2008, 98(2): 482-488.

Dugger, C.M. 2007. Ending Famine, Simply by Ignoring the Experts. *New York Times*, December 2, 2007.

Fan, Shenggen, Ashok Gulati, and Sukhadeo Thorat. 2007. Investment, Subsidies, and Pro-Poor Growth in Rural India. IFPRI Discussion Paper 00716, September. Washington, D.C.: IFPRI.

FEWSNet. 2008. Informal Cross Border Food Trade in Southern Africa. Famine Early Warning Systems Network, and World Food Program. May 2008.

FIPS Africa, 2008. Success Story: Small farmers in Kisii District greatly increase their yields of maize through management practices. Farm Input Promotions, Africa. Accessed on Sept. 13 from: http://fipsafrica.org/downloads/kisiifarmerssuccess.pdf

Gough. A. E., Christina H. Gladwin, and P. E. Hildebrand. Vouchers Versus Grants of Inputs: Evidence From Malawi's Starter Pack Program. *African Studies Quarterly* 6, no.1: [online] URL: http://web.africa.ufl.edu/asq/v6/v6i1a8.htm

Govereh, J., T. Jayne, J. Nijhoff, H. Haantuba, E. Ngulube, A, Belemu, J. Shawa, A. Banda, C. Donovan, and B. Zulu. 2002. Developments in Fertilizer Marketing in Zambia: Commercial Trading, Government Programmes, and the Smallholder Farmer. Working Paper 4. Lusaka, Zambia: Food Security Research Project.

Govereh, J., J. Shawa, E. Malawo, and T.S. Jayne. 2006. Raising the Productivity of Public Investments in Zambia's Agricultural Sector. Working Paper No. 20, Food Security Research Project, Lusaka, Zambia.

Gregory, I. 2006. The role of input vouchers in pro poor growth. IFDC Background Paper, Africa Fertilizer Summit, 9-13 June 2006. Abuja, Nigeria.

Haggblade, Steven, and Gelson Tembo. 2003. Development, Diffusion and Impact of Conservation Farming in Zambia. Food Security Research Project Working Paper No. 8. Lusaka, Zambia, November.

Harrigan, J. 2005. Food Insecurity, Poverty and the Malawian Starter Pack: Fresh Start or False Start? Institute for Development Policy and Management. University of Manchester, 2005.

IFDC. 2003. Input Subsidies and Agricultural Development: Issues and Options for Developing and Transitional Economies. Paper Series P-29. International Fertilizer Development Center, Muscle Shoals, AL.

Imperial College London, Wadonda Consult, Michigan State University, and Overseas Development Institute. 2007. Evaluation of the 2006/7 Agricultural Input Supply Programme, Malawi Interim Report Undertaken for the Ministry of Agriculture and Food Security. Revised, May.

International Monetary Fund. 2008. Commodity Price Surge Boosting Inflation, Hitting Budgets. *IMF Survey Magazine: Policy*. Accessed September 7 online at: http://www.imf.org/external/pubs/ft/survey/so/2008/POL070108B.htm

Jayne, T.S., J. Govereh, A. Mwanaumo, J. Nyoro, and A. Chapoto. 2002. False Promise or False Premise: The Experience of Food and Input Market Reform in Eastern and Southern Africa. *World Development*, Vol 30 (11): 1967-1986.

Jayne, T. and R. Myers. 2007. Improving the Performance of Output Markets to Exploit the Potential of Improved Seed. In Minot, Nicholas, Melinda Smale, Carl Eicher, Thomas Jayne, Jennifer Kling, Daniela Horna, and Robert Myers (Eds). *Seed development programs in sub-Saharan Africa: A review of experiences*, Discussion Paper, International Food Policy Research Institute, Washington, D.C.

Jayne, T.S., R.J. Myers, and J. Nyoro. The Effects of Government Maize Marketing Policies on Maize Prices in Kenya. *Agricultural Economics,* 38(2008): 313–325.

Kherallah, Mylène, Christopher Delgado, Eleni Gabre-Madhin, Nicholas Minot, and Michael Johnson. 2002. *Reforming Agricultural Markets in Africa*. Baltimore, MD: IFPRI/Johns Hopkins University Press.

Levy, S., and C. Barahona. 2002. Findings of the starter pack and TIP M&E programmes: Implications for policy in 2002-03 and beyond. London: Department for International Development (UK).

MACO/CSO/FSRP. 2008. Patterns of Maize Farming Behavior and Performance Among Small- and Medium-Scale Smallholders in Zambia. A Review of Statistical Data from the CSO/MACO Crop Forecast Survey - 2000/2001 to 2007/2008 Production Seasons. Ministry of Agriculture and Cooperatives, Central Statistical Office, and Food Security Research Project, Lusaka, Zambia. Draft, June 19 , 2008.

Marenya, P. and C. Barrett. 2008. Soil quality and fertilizer use rates among smallholder farmers in western Kenya. Draft working paper, Cornell University, Ithaca.

Minde, I. J., and P. Ndlovu. 2007a. Agricultural Subsidies: A Carrot and Stick? Paper Prepared for Contribution to the Ministerial Seminar, Maputo, Mozambique, 8 June 2007. Regional Strategic Analysis and Knowledge Support System for Southern Africa (ReSAKSS-SA). Mimeo.

Minde, I. J., and P. Ndlovu. 2007b. How to make agricultural subsidies smart. Paper Prepared for Contribution to the Ministerial Seminar, Maputo, Mozambique, 8 June 2007, Regional Strategic Analysis and Knowledge Support System for Southern Africa (ReSAKSS-SA). Mimeo.

Minde I., J. Tinga, and P. Ndlovu. 2007. Agricultural Strategy Development in Mozambique: Agricultural Intensification and the Role of Subsidies. Ministerial Seminar presentation. Maputo, 8 June.

Ministry of Agriculture, Food Security and Cooperatives, Tanzania (MOAFC). 2007. Report on the Effectiveness of Fertilizer Transport Subsidies in Agricultural Production. Consultancy Report by Unique Cosultancy Services Ltd, Dar es Salaam.

Morris, M., V. A. Kelly, R. Kopicki, and D. Byerlee. 2007. *Promoting increased fertilizer use in Africa: Lessons learned and good practice guidelines*. Washington, D.C.: World Bank.

Nyoro, J. L. Kirimi, and T.S. Jayne. 2004. Competitiveness of Kenyan and Ugandan Maize Production: Challenges for the Future. Working Paper 10, Egerton University, Tegemeo Institute, Nairobi, Kenya.

Pletcher, J. 2000. The Politics of Liberalizing Zambia's Maize Markets. *World Development,* 28(1): 129-142.

Republic of Zambia. 1996. Review of the Agricultural Credit Management Program in Zambia. Market Liberalization Impact Studies No. 16, Lusaka: Ministry of Agriculture, Food, and Fisheries.

Reuters, 2008. Malawi Starts Rationing Maize as Stocks Fall. Reuters News Agency on-line, Feb. 5, 2008. http://africa.reuters.com/business/news/usnBAN554003.html

Ricker-Gilbert, J. and T.S. Jayne. 2008. The Impact of Fertilizer Subsidies on National Fertilizer Use: The Case of Malawi. Paper prepared for the 2008 summer meetings of the American Agricultural Economics Association, Long Beach, California, July 26, 2008.

Salzburg. 2008. “Fertilizer Subsidies Convening Synthesis.” Fertilizer Subsidy Meeting, Salzburg, Austria, April 29-30. Mimeo.

Silva, H., and R. K. Tuladhar. 2006. Smart subsidies: getting the conditions right. The experience of expanding rural telecoms in Nepal. The World Dialogue on Regulation for Network Economies (WDR).

Snapp, S. S., M. J. Blackie, and C. Donovan. 2003. Realigning research and extension to focus on farmers’ constraints and opportunities. *Food Policy* 28(4):277-419.

Tschirley, D. and T.S. Jayne. 2007. Food Crises and Food Markets: What has been Learned in Southern Africa over the Past Decade? Paper prepared for: “Vulnerability to and Early Warning for Food Emergencies: Conceptual Issues and Practical Implementation.” A Workshop organized by the FAO Global Information and Early Warning System (GIEWS) on Food and Agriculture, Trade and Markets Division, FAO Headquarters, Rome (Italy), 6-7 December 2007.

Weber, M. 2008. Empirical Information on Smallholder Maize Production and Fertilizer Use in Zambia. Presentation at Fertilizer Support Programme Evaluation Kick-Off Workshop, Protea Safari Lodge, June 25-26, 2008.

World Bank. 2007a. *World Development Report 2008: Agriculture for Development.* Washington, D.C.: World Bank.

World Bank. 2007b. *New Approaches to Input Subsidies.* World Development Report 2008: Agriculture for Development, Policy Brief 41390. Accessed from permanent URL = http://go.worldbank.org/43D8YAOXA0

World Bank. 2008a. Commodity Price Data (Pink Sheet) for October 2008. Accessed on Nov. 22 from permanent URL = http://go.worldbank.org/2O4NGVQC00

World Bank. 2008b. Prospects for the Global Economy: Commodity Forecasts (Nominal Prices). Accessed on Nov. 22 from permanent URL = http://go.worldbank.org/9VQJ4ACJZ0

Xu, Z. 2008. Profitability of Applying Fertilizer on Maize for Smallholder Farmers in Zambia. Essay 2 of Ph.D. dissertation, Department of Agricultural, Food, and Resource Economics, Michigan State University, East Lansing.

Xu, Z., W. Burke, T. Jayne, and J. Govereh. forthcoming. Do Input Subsidy Programs “Crowd In” or “Crowd Out” Commercial Market Development? Modeling Fertilizer Demand in a Two-Channel Marketing System. Forthcoming in *Agricultural Economics, (40)1*.

Zulu, Ballard, J. J. Nijhoff, T. S. Jayne, and Asfaw Negassa. 2001. Is the Glass Half-Empty or Half-Full? An Analysis of Agricultural Production Trends in Zambia. *Food Security Research Project Policy Synthesis* No. 2, Lusaka, January.