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FERTILIZER DEMAND IN SUB-SAHARAN AFRICA: REALIZING THE POTENTIAL*

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Policy Messages: Many Sub-Saharan African countries have identified increased fertilizer use as an important component of their overall development strategy for meeting agricultural growth, poverty reduction, and environmental objectives. Simply increasing use, however, will not be enough—successfully using fertilizer to stimulate rural development will require policies and programs that ensure economically sound and technically efficient fertilizer use.

- Improved demand incentives require (1) better agronomic response, promoted by investments in the physical environment, technology research, and farmer training; (2) less volatile and higher (relative to input costs) output prices, promoted by public and private investment in market information, transportation, storage, and processing; and (3) lower fertilizer costs, promoted through improved transportation infrastructure and less policy uncertainty, which should encourage private investment and increased competition that will further reduce costs.
- Enhanced farmer capacity to use fertilizer requires major improvements in research and extension to equip farmers with the information and skills they need to evaluate, adopt, and adapt appropriate products and practices from a large pool of options.
- Clearer thinking about how fertilizer policy fits into a country's overall development strategy is needed given multiple objectives being addressed through fertilizer programs; limited funds will force choices about which farmers and which crop sectors are given priority.

BACKGROUND AND OBJECTIVES: The growing contrast between the very limited use of fertilizer in Sub-Saharan Africa (only 9 kg of nutrients per hectare) and the role played by fertilizer in other regions of the world (100-135 kg/ha in Asia, where 50% of yield growth is attributed to fertilizer) has stimulated debate about the role of fertilizer in Africa and what types of policies and programs are needed to realize its potential benefits. The objective of this paper is to provide a comprehensive overview of the current state of knowledge and the key debates concerning fertilizer demand in Sub-Saharan Africa (SSA). Technical, economic, and policy issues are addressed. The underlying assumption is that SSA needs to increase fertilizer consumption to meet agricultural growth, poverty reduction, and environmental objectives. This will require policies and programs that encourage economically sound and technically efficient fertilizer use, not simply increased use.

DETERMINANTS OF FERTILIZER DEMAND INCLUDE:

- Crop prices
- Fertilizer prices
- Prices of substitutes and complements
- Crop response to fertilizer

In a world of perfect information and well-functioning markets, a farmer would demand the amount of fertilizer that maximizes financial returns. This occurs when the marginal cost of the last unit of fertilizer applied is equal to the value of the marginal returns. However, African farmers face

significant information, liquidity, and risk constraints that limit effective demand; technical constraints that make it difficult to use recommended crop management practices; and institutional constraints that limit both human capital development and market performance. Farmers generally ask two questions before purchasing fertilizer:

- Will fertilizer be profitable (absolutely and relative to alternative expenditures)?
- Can I acquire it and use it efficiently?

The first question relates to *incentives* and the second question to *capacity*.

WEAK INCENTIVES CONSTRAIN FERTILIZER DEMAND:

- Poor fertilizer response (output/nutrient ratios < 10 for cereals)
- Unfavorable price relationships (input/output price ratios > 2)
- Low net returns (value/cost ratios < 2)

Studies on fertilizer incentives reveal that:

- Maize and irrigated rice enjoy the strongest combination of incentives;
- Sorghum faces poor incentives compared to maize, but shows some potential;
- Millet incentives are generally poor;
- Tea incentives are generally good;
- Cotton has relatively poor yield response and mediocre profitability.

Profitability could be boosted by reducing SSA's input/output price ratios, which are among the most unfavorable in the world.

EFFORTS TO IMPROVE INCENTIVES SHOULD AIM TO:

- Strengthen agronomic response
- Stabilize and/or increase output prices
- Reduce fertilizer costs

Agronomic response will improve with increased investments in:

- The physical environment
- Research and technology development
- Farmers' management skills

Irrigation, conservation farming, and soil and water conservation investments can all improve the physical environment. To date governments have favored direct investment in irrigation infrastructure and shunned direct investment to expand adoption of conservation farming and soil/water conservation technologies, despite the latter's potential to improve productivity and reduce poverty for a much wider range of beneficiaries.

SSA research spending per scientist has declined by 50% since the 1970s; there is a need to reverse the trend. However, more cost-effective research methods that better link researchers to relevant stakeholders (farmers, extension, government, input suppliers, agricultural exporters and processors, NGOs) are needed given that fertilizer recommendations are increasingly site-specific and aimed at "best bet" solutions, which take into account a variety of socio-cultural, economic, and risk factors faced by both farmers and other actors.

Fertilizer's agronomic potential is often unrealized because of poor husbandry practices—often the result of a failure to transmit research results about fertilizer use efficiency (crop rotation interactions, use of micro-doses) to farmers. Many "poor" management practices (late application or inadequate doses) often stem from efforts to reduce risk. Response farming and simulation models show promise for better risk management; but researchers need to transfer these lessons to many more farmers.

Low and volatile output prices can be addressed using price supports and subsidies; but these policy instruments are expensive, difficult to manage and to sustain. Investments in transportation and communication generally reduce price levels and volatility more slowly, but more sustainably than price interventions. Other promising options are cooperative action by farmers to strengthen negotiating power, cereal banks and warehouse receipt systems allowing better timing of sales, and market information systems that help both farmers and traders to make more informed marketing decisions. Developing new products (animal feed, enriched baby foods) and output processing industries can increase demand for coarse grains—products which experience sharp price declines when production is good.

High fertilizer costs can be reduced by investments in transportation infrastructure, consistent input policies that reduce risk and uncertainty, and capacity building to create strong farmer organizations that can manage bulk purchases. Local production of fertilizer is not a viable economic option for most countries because demand is too low for economies of scale to be realized. A move toward regional markets could capture greater economies of scale, but this requires political will and collaboration. Reducing farmers' risks can lower costs and increase demand. Options range from simply selling inputs in smaller quantities to introducing weather insurance schemes.

FARMERS' CAPACITY TO PURCHASE FERTILIZER is constrained by low farm incomes, poor access to credit, and lack of market power. The latter can be enhanced by building strong farmer organizations for political advocacy and cooperative marketing. Efforts to resolve the income problem include diversification into higher-valued export crops and import substitutes (e.g., horticultural products). Both credit and market power constraints can be addressed through the development of farmer associations; the most successful experiences include sizeable and sustained investments in farmer capacity building.

In the past, interlinked markets successfully resolved credit problems for key cropping systems (e.g., cotton in West Africa, coffee in Tanzania, sugar in Kenya). Recent efforts to liberalize these markets have weakened the output market links that ensured high rates of credit repayment. New approaches to reduce defaults are being developed. Some banks have created borrower data bases (to reduce the risk of multiple loans to the same borrowers) and others have participated in warehouse receipt programs to collateralize crop output—both efforts increase lender costs but also have the potential to significantly reduce borrower defaults.

IMPROVING CAPACITY TO USE FERTILIZER: *Potential* demand can be increased through agricultural research but increases in *effective* demand require transmission of knowledge and skills to farmers. The challenge facing extension services is to develop a strategy to (1) inform farmers about available technologies, and (2) increase farmers' capacity to evaluate, adopt, and adapt the most appropriate technologies for their situation from a pool of available ones. This approach contrasts sharply with SSA's fertilizer extension tradition of "one size fits all." Moreover, the problem goes far beyond poor performance on the part of extension services. Other factors include:

- Inability of technical and social scientists to effectively communicate consistent, financially sound recommendations to extension agents;
- Poor (or no) strategy for targeting research recommendations and extension messages to specific agroecological and socio-economic situations;
- Limited effort to disseminate information beyond farmers participating in research trials or extension demonstrations;
- Poor (or no) monitoring and evaluation of the diffusion process, which limits our understanding of adoption and adaptation processes and farm-level impacts;
- Inconsistency in agricultural policies (credit, price, subsidy), which makes it difficult for farmers to assess benefits and sustain fertilizer adoption.

An added challenge is the high rate of illiteracy, which significantly increases the costs of delivering extension messages.

The solutions to these problems of knowledge diffusion are not self-evident and they will often be location- and crop-specific. In addition, messages and methods may need to differ by gender, prevalence of HIV/AIDS, and access to markets and infrastructure. Given budget constraints, more cost-effective collaboration between all the stakeholders in the agricultural transformation process (researchers, extension specialists, NGOs, farmers, input suppliers, banks, exporters and processors) will be needed. Increased funding for extension appears justified given recent declining trends, but more cost-effective programming of any additional funding is also needed.

There are many examples of "promising" approaches to improve knowledge transfer: participatory technology development, use of simulation models to fine-tune recommendations, outreach to the commercial sector to stimulate supply at an early stage in the adoption/diffusion process are but a few. Unfortunately, most of these "promises" remain just that, with little evidence of widespread application and impact on effective demand. In situations where lack of effective demand (not poor supply) is the binding constraint, much more emphasis needs to be given to identifying successful approaches for diffusion of knowledge and skills.

FERTILIZER'S ROLE IN NATIONAL DEVELOPMENT STRATEGIES: There is a need for clearer thinking about how fertilizer policy fits into a country's overall development strategy. Fertilizer's traditional role as a productivity-enhancing input is being expanded as donors and governments seek to use it as an instrument for achieving diverse goals (GDP growth, poverty alleviation, soil fertility replenishment, soil conservation, food security, general safety net). While fertilizer combined with improved land husbandry practices has the potential to contribute to these different goals, the types of programs and policies one might implement to achieve them have important implications for the spatial distribution and sequencing of fertilizer promotion efforts. Consider the different needs and outcomes that might be realized by programs to stimulate fertilizer demand for each of the following crop categories:

- High value or export crops with reliable markets (horticulture, cotton, tea);
- Fertilizer-responsive crops (hybrid maize or irrigated rice), often characterized by weak or risky output markets;
- Crops with relatively poor fertilizer response and low output prices (millet, sorghum, and legumes), generally grown in more difficult environments where integrated soil fertility management may be more appropriate than less complex seed/fertilizer technologies.

Production systems that include the first two types of crops will need less intensive extension on the technical aspects of farming but more attention to input acquisition and output marketing skills (topics that current extension services rarely address). Farmers producing crops of the third type will need to improve their technical farming skills and ability to identify and apply the management practices of relevance to their individual situation. Promoting fertilizer among poor farmers in difficult agroclimates may have positive environmental consequences (reduced soil mining) and poverty alleviation implications (better food security), but it may not contribute as much to GDP or to the development of fertilizer supply networks as would a program to expand fertilizer use in irrigated agriculture. Limited funds will force governments to make choices about which farmers and which crop sectors are given priority. This should be done in the context of a country's overall development strategy.

Suggested reading:

Kelly, V. Farmers' Demand for Fertilizer in Sub-Saharan Africa. Forthcoming 2005. World Bank, Agriculture and Rural Development Discussion Paper.

Crawford, E., T. Jayne, and V. Kelly. Forthcoming 2005. Alternative Approaches for Promoting Fertilizer Use in Africa, with Particular Reference to the Role of Fertilizer Subsidies. World Bank, Agriculture and Rural Development Discussion Paper.

*This *Policy Synthesis* is condensed from a longer paper by the same name, forthcoming as a World Bank Agriculture and Rural Development Discussion Paper. A draft version of this paper may be downloaded from: http://www.aec.msu.edu/agecon/fs2/inputs/documents/WB_demand_paper_August_18_2005_Final_full.pdf

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