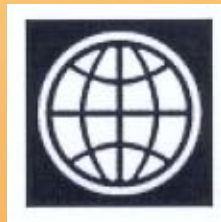




Nourish the soil, feed the continent.

Background Papers



World Bank Papers





The World Bank

Increasing Fertilizer Use in Africa: What Have We Learned?



Agriculture & Rural Development Department
World Bank
1818 H Street, NW
Washington, DC 20433
<http://www.worldbank.org/rural>

Colin Poulton
Jonathan Kydd
Andrew Dorward



The World Bank

Agriculture and Rural Development
Discussion Paper 25

Increasing Fertilizer Use in Africa: What Have We Learned?



*Colin Poulton
Jonathan Kydd
Andrew Dorward*

© 2006 The International Bank for Reconstruction and Development / The World Bank
1818 H Street, NW
Washington, DC 20433
Telephone 202-473-1000
Internet www.worldbank.org/rural
E-mail ard@worldbank.org

All rights reserved.

The findings, interpretations, and conclusions expressed herein are those of the author(s) and do not necessarily reflect the views of the Board of Executive Directors of the World Bank or the governments they represent.

The World Bank does not guarantee the accuracy of the data included in this work. The boundaries, colors, denominations, and other information shown on any map in this work do not imply any judgment on the part of the World Bank concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

Rights and Permissions

The material in this work is copyrighted. Copying and/or transmitting portions or all of this work without permission may be a violation of applicable law. The World Bank encourages dissemination of its work and will normally grant permission promptly.

For permission to photocopy or reprint any part of this work, please send a request with complete information to the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers, MA 01923, USA, telephone 978-750-8400, fax 978-750-4470, www.copyright.com.

All other queries on rights and licenses, including subsidiary rights, should be addressed to the Office of the Publisher, World Bank, 1818 H Street NW, Washington, DC 20433, USA, fax 202-522-2422, e-mail pubrights@worldbank.org.

About the Authors

The authors are with the Centre for Environmental Policy, Imperial College London.

Contents

Preface	v
1. Introduction.....	1
2. Supply-Side Constraints: Increasing Private Investment in Fertilizer Supply	3
Fertilizer Manufacture, Distribution, and Retail.....	4
Fertilizer Manufacture	4
Importation and Distribution.....	5
Fertilizer Retail—the Role of Rural Stockists	7
What Can We Learn from the Kenya Case?.....	8
3. The Demand Side: The Need for a Proactive Public Role.....	10
Increasing the Efficiency of Fertilizer Use	10
How Poor Are African Soils?	10
Local Level Variability	12
4. Soil Health and Soil Organic Matter.....	13
Promoting Improved Crop Varieties That Make More Effective Use of Fertilizer	15
Improving Cultural Practices Associated With Fertilizer Application.....	15
Varying Fertilizer Application According to Rainfall	15
Seasonal Weather Forecasting	15
Improving Water Control.....	16
Improving Access to Output Markets	16
Enhancing the Affordability of Fertilizer Use	17
Seasonal Credit	17
Small Packs.....	18
Subsidies	18
5. Kick Starting Markets	19
Subsidies and Vouchers	19
Subsidies	20
Vouchers	21
Public Investments in Generic Soil Fertility Enhancement Technologies	23
Locally Tailored Fertilizer Recommendations	23

Implications for Extension.....	24
Soil Testing Services.....	26
Coordinated Service Provision (including output markets).....	26
6. Interventions Discussed by E-Forum Participants.....	28
The Work of FIPS in Kenya (combination of approaches 3 and 4):	28
The CASE Approach (combines approaches 2 and 4).....	29
Results.....	29
Combining Fertilizer Promotion and Inventory Credit in Togo (combines approaches 2 and 4)	31
Combining Fertilizer Promotion and Inventory Credit in USAID “Target Project on Fertilizer Micro-Dosing for Small Farmer Prosperity in the Sahel” (combines approaches 2 and 4)	32
Coordinated Service Provision in Western Kenya (approach 4)	33
Starter Packs in Malawi (predominantly approach 1, but fertilizer combined with carefully selected seed varieties).....	34
Conservation Farming in Zambia	35
African Cotton Systems (approach 4).....	35
Fertilizer Subsidies in Zambia (approach 1).....	35
Fertilizer Vouchers (approach 1)	36
7. Key Points.....	37
Appendix. Terms of Reference for Moderating an E-Forum on “Increasing Fertilizer Use in Africa: What Have We Learned?”	40
References.....	42
Endnotes.....	43

Preface

Concerned by the low use of fertilizer in sub-Saharan Africa compared to other developing regions, in 2004 the World Bank and the UK Department for International Development (DFID) jointly undertook an Africa Fertilizer Strategy Assessment, the objectives of which included:

- Identifying factors that have undermined demand for fertilizer in sub-Saharan Africa;
- Identifying factors that have restricted the supply of fertilizer in sub-Saharan Africa;
- Assessing lessons learned from past attempts to promote increased use of fertilizer in sub-Saharan Africa; and
- Identifying entry points for supporting successful uptake of fertilizer by African farmers, particularly smallholders.

The Assessment generated a number of outputs. In addition to the “Africa Fertilizer Policy Toolkit ,” a CD-based resource designed for use by policy makers and development agency staff, these included four ARD Discussion Papers—three that address specific fertilizer-related themes and one that summarizes the contributions made by participants in an e-forum about increasing fertilizer use in Africa that was conducted as part of the Assessment. The four ARD Discussion Papers include:

1. *Alternative Approaches for Promoting Fertilizer Use in Africa*
Eric W. Crawford, T. S. Jayne, and Valerie A. Kelly

This paper examines a number of financial, economic, social, and political arguments that have been made in favor of promoting increased fertilizer use in Africa. The cases for and against fertilizer subsidies are discussed in some detail.

2. *Factors Affecting Demand for Fertilizer in Sub-Saharan Africa*
Valerie A. Kelly

This paper provides a comprehensive overview of the current state of knowledge about the factors affecting farm-level demand for fertilizer in sub-Saharan Africa. Technical, economic, and policy options for strengthening demand are reviewed.

3. *Factors Affecting Supply of Fertilizer in Sub-Saharan Africa*
D. I. Gregory and B. L. Bumb

This paper evaluates different strategies to make significant improvements in fertilizer supply to smallholder farmers in sub-Saharan Africa. Use of supply

chain analysis is advocated as a means of identifying entry points where targeted interventions can shift the fertilizer supply curve to the right.

4. Increasing Fertilizer Use in Africa: What Have We Learned?
Colin Poulton, Jonathan Kydd, and Andrew Dorward

This paper summarizes the proceedings of an e-forum organized by Imperial College London and NR International on behalf of The World Bank and DFID as part of a wider Africa Fertilizer Strategy Assessment Exercise. The e-forum took place from February 15th to March 8th 2005.

Acknowledgments

The Africa Fertilizer Strategy Assessment was carried out by a team that included Michael Morris, Ron Kopicki, Derek Byerlee, Jeanette Sutherland, Neil MacPherson, and Karen Brooks McConnell (all of the World Bank), as well as Valerie A. Kelly (Michigan State University). Helpful comments and suggestions were received also from John McIntire and Jock Anderson (both of the World Bank).

Funding for the Assessment was provided by the World Bank and DFID, in part through the Agriculture and Rural Development (ARD)-DFID Partnership Program.

Many people at the World Bank, DFID, Michigan State University (MSU), the International Fertilizer Development Center (IFDC), Imperial College London, and other organizations contributed to the content and quality of the ARD Discussion Papers. While it is not possible to acknowledge all those who contributed, the authors would like to recognize a number of individuals who made particularly noteworthy contributions.

Alternative Approaches for Promoting Fertilizer Use in Africa—Research support was provided by Andrew Kizito, Megan McGlinchy, and Jones Govereh. Helpful comments were received from Duncan Boughton, other colleagues at MSU, and several anonymous reviewers.

Factors Affecting Demand for Fertilizer in Sub-Saharan Africa—Research support was provided by Andrew Kizito and Megan McGlinchy. Helpful comments were received from Eric Crawford, John Staatz, Sieglinde Snapp, Cynthia Donovan, Duncan Boughton, Guy Evers, Michael Morris, Derek Byerlee, and two anonymous reviewers.

Factors Affecting Supply of Fertilizer in Sub-Saharan Africa—Helpful comments were provided by informal reviewers from The World Bank and IFDC. Suggestions made by an anonymous referee also helped to improve the focus and contents of the paper. The paper was edited and prepared for publication by Marie Thompson (IFDC).

Increasing Fertilizer Use in Africa: What Have We Learned?—Bert Janssen contributed valuable comments on technical and economic issues relating to the soil science aspects of the paper.

The first two papers by MSU authors drew heavily on the findings of research carried out under the Food Security III Cooperative Agreement (GDG-A-00-000021-00) between MSU and USAID through the Bureau for Economic Growth, Agriculture, and Trade's Office of Agriculture and Food Security, with

supplemental funding from the Africa Bureau's Office of Sustainable Development.

The third paper by IFDC authors drew heavily on both the Strategic Framework for African Agricultural Input Supply System Development (IFDC Technical Bulletin IFDC-T-63, 2000) funded by the United States Agency for International Development (USAID), the Government of the Netherlands, the International Fertilizer Industry Association (IFA) and support from the Economic Commission for Africa (ECA, and IFDC country assessments funded by USAID Africa Bureau).

Early drafts of the ARD Discussion Papers were reviewed by members of the World Bank team, as well as by Riika Rajalati (World Bank), Kees van der Meer (World Bank), Jean-Christophe Carret (World Bank), Jan Poulissse (FAO), Guy Evers (FAO), and Mike Wales (FAO).

The papers were edited by Shari Schlesinger. The publication process was managed by Melissa Williams (World Bank), with assistance from Marisa Baldwin (World Bank).

1. Introduction

The e-forum was organized by Imperial College London and NR International on behalf of the World Bank and DFID, as part of a wider Africa Fertilizer Strategy Assessment Exercise. The purpose of the e-Forum, was to elicit from experienced and knowledgeable practitioners lessons learned about:

- Features of the enabling environment needed to support successful uptake of fertilizer in Africa, and
- Specific interventions that have attempted to promote efficient and sustainable use of fertilizer by African farmers, particularly smallholders.

The terms of reference for the e-forum moderators are included as Appendix A of this report.

The forum ran from February 15th to March 8th 2005. A total of 257 people registered for the forum. Of these, 62 contributed to the forum discussions. A total of 213 postings were received from participants, distributed across the three themes as follows:

- Theme 1 (Creating an Enabling Environment)—54 postings
- Theme 2 (Public and Private Roles)—4 postings
- Theme 3 (Interventions to Promote Fertilizer Use)—155 postings.

In addition to a Moderators' Introduction setting out the scope and objectives of the e-forum, the moderators produced three summaries of discussions-in-progress for each of Themes 1 and 3, one summary for Theme 2, plus three "Global Newsletters" (sent out to all registered e-forum participants, irrespective of whether or not they were registered to individual themes).

The debate in the forum tended more towards general lessons learned from efforts to promote fertilizer use in Africa, rather than focused, critical discussion of specific interventions or cases. However, there was lively debate in a number of areas among both soil scientists and socio-economists, and some clear lessons emerged for policy. It is probably fair to say that no country in Africa currently applies all or even most of these lessons as part of its agricultural development strategy. Therefore, considerably increased fertilizer use could result if national governments and the donor community take note of the outcomes of the e-forum.

First, however, it is worth reiterating that increased fertilizer use should not be seen as a goal in isolation. The broader goal is healthier soils for increased agricultural productivity and food security. Increased inorganic fertilizer use is one component of this, but is unlikely to be achieved without complementary

investments in other aspects of soil health. Moreover, while ultimately we expect increased inorganic fertilizer use to be supported most efficiently by a strong commercial fertilizer industry, a viable commercial industry may itself not emerge until the fertilizer market has attained a certain level of development. There is, therefore, a key public role in creating the conditions under which a strong commercial fertilizer industry can develop.

Policy should also take a pragmatic view of the relative merits of organic and inorganic nutrient sources. This is well-expressed by the following excerpt from a posting to the e-forum by Christopher Dowswell: "The operating principle on organic versus inorganic sources should be the lowest-cost option of delivering essential nutrients to a farm. Where improved fallows through agro-forestry or green manure/cover crops are the lowest cost alternative, they should be actively promoted. Where inorganic sources, in combination with organic matter management, are the lower cost alternative, these should be promoted. In many cases, especially for farmers who have the best-bet chance to produce surpluses for the market place, inorganic/organic combinations will be the most likely alternatives. For more subsistence production, organic/inorganic combinations, with limited purchased inputs, are the most likely alternatives."

This report proceeds as follows. First, it examines what contributions to the e-forum had to say about the relative importance of supply and demand constraints on increased fertilizer use in Africa, and also about what should be done about these. This includes discussion of different views on the condition of African soils (How poor are they? What is the "problem"?). The report then considers four broad approaches proposed to "kick start" fertilizer markets in Africa. It then examines specific interventions to increase fertilizer use that were discussed in the e-forum, and classifies them according to the four approaches outlined previously. It concludes with thoughts on the way forward.

2. Supply-Side Constraints: Increasing Private Investment in Fertilizer Supply

Ultimately, we expect increased inorganic fertilizer use to be supported most efficiently by a strong commercial fertilizer industry. However, such industries have yet to emerge in most of Africa. To what extent is this due to the lack of an enabling policy environment for private investment, and to what extent is it due to demand constraints?

Many contributors to the e-forum recognized that there are important constraints to increased fertilizer use on both the supply and demand side. However, within the e-forum, Balu Bumb was a lone voice stressing the need for improving fertilizer supply by shifting the supply curve to the right. Bumb distinguished four constraints on increased fertilizer use in Africa: (a) supply, (b) knowledge, (c) agro-ecological / biophysical and (d) economic (output market). “Of these four constraints, the supply constraint is the most binding and easily removable.” He suggests that the middling 30% of farmers are likely to be the most responsive to lower fertilizer prices.¹ This group, is in general, not currently using fertilizer, but might adopt at achievable lower prices. The question then arises: If the supply of fertilizer strengthens, encouraged by a more conducive investment environment, to what extent will heightened private marketing activity also begin to shift the demand curve for fertilizer (i.e., going beyond the initial move down the demand curve as costs of fertilizer fall)? Hardwick Tchale argues that stronger private supply will eventually start to impact demand—but with a lag. This requires patience from policy makers and a commitment to maintain the enabling environment for private investment. In the meantime, he also argues for public investment in roads, research (R&D), and extension.

The majority of contributions within the e-forum focused on demand-side constraints and how these can be overcome. An early contribution by Patrick Heffer argued that there won't be a large-scale private investment response sufficient to drive a dynamic fertilizer industry until steps are taken (principally through public action) to raise demand from its current low levels: “Most national markets for agricultural inputs in Africa are limited in size. The main markets for fertilizers are Egypt (1.35 Mt nutrients), South Africa (0.72 Mt) and Morocco (0.37 Mt). The three countries together represent approximately 60% of the regional fertilizer market, estimated at 4.08 Mt nutrients for all-Africa. Markets in most other countries are small and little attractive [sic] for international actors producing and trading fertilizers and other agricultural inputs. This is particularly true when considering the other constraints to access such small markets.”

This argument for a proactive public role to stimulate fertilizer markets is consistent with IFDC “stages of fertilizer market development” analysis. The basic argument in Africa is that low market density (a combination of low population density and small marketed surpluses) plus high internal transport costs, plus economies of scale in fertilizer manufacture and/or importation, render the immature market unattractive for large-scale private investors. Moreover, early promotional activity regarding fertilizer use has a high public good element. The private sector is reluctant to lead this activity because of the problem of free-riding by (current or potential future) competitors. Bumb, however, stressed public efforts to stimulate fertilizer markets should be understood in the context of public-private-partnerships. Setting policy and ensuring adequate regulation are essentially government roles, while human capital development (See section on stockists below), provision of finance, market information, and technology transfer are most appropriately shared between public and private sectors.

Fertilizer Manufacture, Distribution, and Retail

These debates can be considered in more detail if supply activities are broken into three categories: (a) manufacture, (b) importation and distribution, and (c) retail. All three categories were discussed during the e-forum.

Fertilizer Manufacture

A clear desire was expressed, particularly by African participants, to see Africa manufacture more of its own fertilizers. Figures presented by Patrick Heffer showed that Africa produces enough nitrogen and phosphate fertilizers for its current needs, but that the majority of these are exported and additional supplies imported. Underlying this pattern of trade, however, are the high costs of within-continent transport and distribution, making export markets more attractive for the few African producers.

Participants wishing to see Africa manufacture more of its own fertilizers focused particularly on the possibility of developing local production of phosphate fertilizers using available deposits of rock phosphate. There are two major challenges here. The first is the solubility of rock phosphate for the manufacturing process. A discussion thread within the e-forum discussed this issue (which has been recognized as a research challenge for a long time). It is not clear that there is yet a cost-effective solution for this problem. An alternative proposed by the UN Millennium Project Hunger Task Force is that “in some areas of Africa, where phosphate rock is abundant and of the right quality, there is scope for developing local rock phosphate industries.” However, rock phosphate has a lower phosphorus concentration than competing products (e.g., TSP), which, therefore, leads to the second problem: the high internal transport costs within Africa. For rock phosphate this means that the transport cost per nutrient is higher than for products such as TSP. Therefore, at the farm gate the cost per kg of nutrients may be no lower for rock phosphate (despite low production costs) than it is for competing (generally imported) products. An

additional point made by skeptical participants is that, even if regionally coordinated transport development takes place, allowing economies of scale in production to be realized, one has only achieved local production of one type of fertilizer. While there were debates within the e-forum about how pervasive the problem of phosphorus deficiency is within African soils (see below), the consensus of participants was that African farmers need to be offered a range of fertilizer products, given the heterogeneity of soil conditions across areas and even within farms.

A final twist to this tale, however, comes from the recent investment by Athi River Mining Company in Kenya in a new fertilizer blending facility capable of producing 100 tons of fertilizer per day (10% of the current fertilizer market in Kenya). This facility is producing two new blends of fertilizer (a basal dressing and a top dressing) marketed under the brand name Mavuno. These combine imported macro nutrients (N, P) with locally granulated minerals (gypsum and dolomitic limestone), muriate of potash, and micronutrients (B, Zn, Mn, Mo and Cu). Due to their secondary and micronutrient content, the Mavuno blends outperform existing fertilizers, particularly where K and S are limiting and also where acidification of soils is increasing. In addition, the use of local minerals makes Mavuno blends cheaper than the established fertilizer types (DAP and Urea) on which they are based. In some cases Mavuno retails for up to 15% less than more established fertilizer types. The potential for adding value to Minjingu rock phosphate in Tanzania is currently being explored following the success of Mavuno.

To summarize, the case for Africa being more self-sufficient in its supply of phosphate fertilizers founders on the continent's high internal transport costs, taken in conjunction with the economies of scale involved in fertilizer manufacture. Public investment would, therefore, be better targeted at road and infrastructure improvement than at investment in fertilizer manufacturing plants. However, there may be further scope for judicious blending of locally granulated minerals with imported macronutrients to produce fertilizers that are both slightly cheaper than imported products and contain additional micronutrients. There may be a case for publicly-funded technical assistance to assist local entrepreneurs develop such products for market.

Importation and Distribution

As with local fertilizer manufacture, there are economies of scale in fertilizer importation (albeit not as severe). Again these interact negatively with high local transport costs, not necessarily to completely discourage investment, but to raise the costs of fertilizers that are imported. Clearly, investments in infrastructure and transport (e.g., roads, ports, also customs procedures) are an essential part of the long-term solution to increasing fertilizer use in Africa. However, it was argued that these investments could take decades to complete (so that most rural households in Africa see benefits), even if aid rises significantly. We return below to the issue of how to allocate scarce funds across infrastructure development and other, short-term investments.

Meanwhile, a contribution by Bumb broke supply constraints down into five areas: (a) policy, (b) human capital, (c) finance, (d) market information, and (e) regulation. Of these, policy and finance attracted most comment from e-forum participants in relation to importation and (wholesale) distribution activities.

Key aspects of an enabling policy environment mentioned by e-forum participants included:

- Maintenance of macroeconomic stability, including a stable exchange rate and moderate interest rates. Several contributors (Lubanga for DR Congo, Kormawa for non-UEMOA West Africa, and Bumb) stressed the importance of a stable exchange rate, without which importers cannot maintain stable enough price for fertilizer users, as output prices for non-tradable crops follow domestic inflation not real exchange rate fluctuations. Similarly, both Kormawa and Tchale emphasized the importance of moderate interest rates. With reference to the Malawi case, it was noted that high interest rates can impede credit linkages between wholesalers and stockists, as well as the viability of seasonal credit supply from stockists to producers.
- Avoiding free distribution of inputs or food aid, except in cases of extreme emergency. Various contributors (Bumb, Heffer, Malcolm Blackie) highlighted the damage that free distribution of inputs (directly) or food aid (indirectly) can do to fertilizer businesses, at both the importation/distribution and stockist levels.
- Maintenance of a predictable policy stance towards the fertilizer industry. Participants noted that some governments, despite having officially liberalized fertilizer markets, have still resorted to occasional subsidized fertilizer importation and distribution through parastatal agencies—to challenge allegedly excessive market prices. Such populist actions, however, are highly damaging to the confidence that private investors have to invest in fertilizer supply. Kormawa noted that, “in Nigeria, an assessment of the agri-input market conducted by IFDC/IITA/WARDA in 2000 showed that uncertainty about if, how, and when the federal and state governments will change policies and rules that directly affect agri-inputs was a major concern among private-sector investors investor in the fertilizer industry.”

With regard to finance, lack of collateral frequently limits access to capital and the volumes of fertilizer that importers can handle. With economies of scale in shipping, this raises fertilizer costs. Dowswell noted: “7,000 to 10,000 tons need to be procured and imported per shipment. This implies costs of up to \$2 million per shipment. Cannot government assist with access to international foreign exchange, approval to use inventories as partial collateral, and possibly even some forms of loan guarantee and hedges against devaluations?”

Where national markets are particularly small, regional cooperation in importation may also be required to bring down per unit shipping costs. Again, quoting Dowswell: “Many African countries are landlocked and in need of a coordinated approach to procurement and distribution. Here national policies

need to be harmonized, such that the entire fertilizer supply system works in a coordinated way. Mali and Burkina Faso, coordinated with Abidjan or ports in Ghana, Togo or Benin (or Dakar). Uganda and the lake countries, coordinated with Mombasa. Malawi with Mozambique. Progress in such regional coordination has occurred, but it could go farther. Regional economic integration on inputs, such as fertilizer and seed, and on output marketing, will lead to increased private sector investment (viz, the new Yara plan to forward stock Tanzania through their Kenyan operation)."

Meanwhile, Tchale explained the now-defunct Smallholder Farmers Fertilizer Revolving Fund (SFFRFM) in Malawi, which acted as a buffer stock for inorganic fertilizer to avoid supply failures (and hence price fluctuations) in a poor landlocked country—the input equivalent of a maize price stabilization scheme?

Although both market information and regulation were mentioned in passing by participants, less specific information or experience was volunteered on either of these issues. Useful market information includes information on fertilizer demand, stocks (by type) and prices. No examples were given of where and how such information is currently provided to players in the fertilizer industry. Similarly, while the importance of fertilizer quality control and anti-collusion laws was mentioned on a few occasions, it appears that these are rarely in place and/or enforced. Indeed, the capacity for such regulation (i.e., competition policy and consumer protection) is generally weak in Africa, not just in relation to the fertilizer industry.

As a ball-park figure, Dowswell estimated that greater supply chain efficiencies and greater use efficiency (discussed below) could lower input costs² by 25%, and raise yields by 25%. However, would even this be enough to stimulate fertilizer use to a level that triggered a major private investment response and set Africa on a positive growth path for fertilizer use?

Fertilizer Retail—the Role of Rural Stockists

Several participants (including Kopicki, Heffer) highlighted the importance of rural fertilizer stockists at the interface between supply and demand; as well as making products available close to producers--critical, as some producers have to walk 30–40km to obtain fertilizer where no stockist network exists. Stockists can play an important role in stimulating demand through the provision of information and advice to producers. They may also become a source of input credit to producers whom they know-- only a small number and mainly from within the top third of rural households? -- if they can access more finance themselves. However, one should not expect them to be the primary "drivers" of increased fertilizer use in Africa. Their limited capital bases do not permit them to proactively promote fertilizer use far beyond the threshold of their premises, nor to experimentally stock new fertilizer products for which there is not already clearly established demand among local producers. Rather, they should be important partners in efforts (principally from public research³, extension agencies, and NGOs?) to stimulate demand for fertilizer and important conduits

for the supply response (principally from private importers, manufacturers, and wholesalers).

Participants also acknowledged the weaknesses of many existing stockist businesses and suggested the following measures to encourage their development:

- Training in both marketing/business and technical skills. Some stockists have a background in research or extension and have moved into business because they have an entrepreneurial streak. Nevertheless, they lack a grounding in business and marketing. Others are general traders who have moved into selling agricultural inputs and lack the technical knowledge to provide informed advice to customers.
- Assisting stockists to build linkages within the supply chain, so as to qualify for supplier's credit. The training mentioned above is often a pre-requisite for this, while third party guarantees (as employed in Zimbabwe and now in Kenya and Malawi) may be required while the relationship with a supplier is being built.

These are proven approaches, which deserve wider replication.

What Can We Learn from the Kenya Case?

Final insights on the respective importance of supply and demand constraints come from discussions of fertilizer industry development in Kenya. Kenya was singled-out in background papers to the e-forum as the one sub-Saharan African country that has a moderate level of fertilizer use, and has seen national fertilizer consumption grow appreciably in the past decade or so. What explains this performance? The conclusion from e-forum contributions was that inherent characteristics of Kenya's agro-ecology plus favorable output market policies have been as important as either direct policy towards the fertilizer sector or innovative promotion of fertilizer use:

- Comments on the policy stance with respect to private fertilizer investment were, in fact, mainly negative. Joshua Ariga (among others) criticized the periodic practice of the Kenyan government since fertilizer liberalization in 1993 of importing fertilizer itself in an attempt to lower prices prevailing in the market. He also noted the disincentive effects of high port charges and inefficiencies in port clearance, plus the imposition of VAT on road transport.
- By contrast, a number of features of Kenya's agro-ecology and the structure of its agricultural sector are favorable to fertilizer use. The country's commercial farming sector and fertilizer-intensive industries (e.g., sugar), provide basic demand within the market, while fairly reliable rainfall (in a bi-modal pattern in the high potential areas) reduces the risks of application. High population densities and difficulties in fallowing land also naturally tend to push producers to acquire fertilizers (Bert Meertens).

- The bi-modal rainfall pattern also has another important, but often neglected, consequence: it allows stockists to turn over their capital twice per year and reduces the loss when stocks are held over after planting. When an alternative business could be as an agent for Coca Cola or the national brewery (in which case capital can probably be turned over every month), this is an important consideration.
- While the environment for private investment in fertilizer has been, at best, moderately “enabling,” national policy on maize pricing—keeping the maize price high through tariff protection—has made fertilizer use attractive particularly for surplus producers in high potential zones (Kibieno).
- Finally, Kenya has been home to some of the most innovative work in promoting fertilizer among poor, often food deficit households (first SCODP and now FIPS). However, while this has had very important livelihood benefits for many very poor households, SCODP’s fertilizer sales of c.500t p.a. make only a tiny contribution to growth in national fertilizer use from 230,000t p.a. in the early 1990s to 340,000t p.a. in 1996–2003.

Overall, this assessment of the Kenyan experience brings out the importance of demand factors. However, in the Kenya case, the factors contributing to fertilizer demand have been as much fortuitous as the result of careful policy and planning. On the other hand, the strong message coming through from e-forum participants was that, if fertilizer use is to be increased in Africa more generally, a much more proactive public role is required in stimulating fertilizer demand. It is to this that we now turn.

3. The Demand Side: The Need for a Pro-Active Public Role

E-forum participants discussed a number of issues affecting the demand for fertilizer in Africa. These can be grouped under the following headings:

- Increasing the efficiency of fertilizer use. In turn this can be subdivided into:
 - Tackling the inherently low quality of African soils
 - Identifying more appropriate fertilizers for local soils
 - Promoting improved crop varieties that make more effective use of fertilizer
 - Improving cultural practices associated with fertilizer application
 - Varying fertilizer application according to rainfall
 - Reducing the risk associated with fertilizer application through seasonal weather forecasting
 - Improving water control
 - Improving access to output markets (thereby raising the profitability of fertilizer use)
- Enhancing the affordability of fertilizer use. In turn this can be subdivided into:
 - Credit
 - Small packs
 - Subsidies
- Increasing the incentives for fertilizer use. A posting by Amadou Hamadoun Babana suggested that land leasing and/or sharecropping arrangements discourage use of fertilizer, as the landlord is likely to reclaim land where fertilizer has been applied, believing it to be of enhanced fertility.

Increasing the Efficiency of Fertilizer Use

Considerable attention was paid to this topic by e-forum participants, with vigorous debates about the status and condition of African soils underlying some of the discussion. We first, therefore, summarize some of these debates.

How Poor Are African Soils?

The poor quality of African soils, *vis-à-vis* those in African continents, was accepted in Background Paper #2. Within the e-forum, the main proponent of this view was Henk Breman, who argued that, “taking continents as a whole and classifying their soils in relation to their agricultural potential, only one other

continent has a weighted mean soil quality as bad as Africa, Australia.” However, Australia’s population is concentrated in the south–east of the continent, the one part with good soils. Although Africa has high population densities in areas with good soils (e.g., Rwanda, Burundi), it also has significant populations in areas with poor soils, especially West Africa. Other participants made corroborating statements to the effect, for example, that phosphorus deficiency is a widespread problem in African soils.

The main challenge to this view came from Roelf Voortman, who challenged the notions that African soils are (in comparison with soils elsewhere in the world) uniformly old, poor, acid or phosphorus deficient. Rather, he argued that they exhibit considerable heterogeneity, with micronutrient deficiencies and nutrient imbalances (including excesses) being common. Consistent with Voortman’s basic contention, Bert Meertens argued that, although there are densely populated parts of Africa (the places where efforts to promote fertilizer use should be concentrated), there are still large parts where fallowing is possible and where soil fertility is not one of farmers’ top priorities. Meanwhile, the FIPS/Mavuno experience (reported by Jonathan Anderson and Paul Seward) also highlights the importance of tackling micronutrient deficiencies, while sulphur deficiency is part of the story of Drastically Lowered Fertilizer Purchase and Use, recounted by John-Rupert Barnes with regard to TransNzoia District of Kenya.

As shown below, these contrasting views of the status and condition of African soils suggest quite different policy responses. A balanced assessment is, therefore, important. Final postings in this debate moved towards more of a “consensus” position, recognizing that micronutrient deficiencies are important in some locations, but that phosphorus and nitrogen deficiencies (and imbalances) remain a widespread problem; and that locally tailored variants of fairly generic soil enhancement interventions could have a useful role to play in improving the status of African soils.

There are two major causes for poor quality of African soils. The first cause of poor quality is the geologic origin of the parent material in which the soils have developed. Most highlands in eastern Africa are of volcanic origin and rich in nutrient-bearing minerals, whereas the lowlands of West Africa consist of old and weathered materials, which probably have never contained many nutrient-bearing minerals. The second cause of low fertility is nutrient depletion and degradation. This plays everywhere but perhaps more in East Africa than in West Africa. Areas with high depletion have rich soils (i.e., highlands with erosion of fertile soils), and areas with low depletion have poor soils that simply do not have much to lose. Without complementary soil enhancement interventions, use of fertilizers is likely to be more profitable on the inherently rich soils of East Africa. One reason is that usually only P or P and N should be added, while in West Africa all nutrients have to be applied because soil nutrient supplies of all nutrients are too low to get yields of say 3 or 4 t/ha.

Local Level Variability

A number of soil types can be found in quite small areas of Africa, unlike in, for example, the heartlands of the Green Revolution in Asia. (This is a point made by Voortman). However, two other types of soil variability were also mentioned by e-forum participants:

- Within-field variability (highlighted by Joost Brouwer)
- Within-farm variability is often associated with different management practices being adopted by a given farmer across his/her different plots (e.g., those closer to the homestead and those farther away).

The significance of the first of these is still being debated. Ongoing research is showing the importance of the second, with differences in soil fertility within individual farms sometimes greater than mean differences across districts. This has potentially profound effects for extension recommendations, a topic returned to below.

4. Soil Health and Soil Organic Matter

Participants were reminded that sustainable agriculture relies on good soil health, not (just) adequate fertilizer use. Soil health comprises acidity, structure, and biodiversity and, “The key to most problems of soil health is the soil organic matter content” (Anderson). The importance of conserving and/or raising the organic matter content of African soils—as a key to soil health and as a way to enhance the efficiency of fertilizer use—was widely acknowledged by participants.

Some participants argued that there are synergies between organic and inorganic nutrient sources, with the following quotes representative:

- “The availability of phosphorus fertilizer can be improved by combining its application with that of organic matter” (Goulding).
- “Combining inorganic and organic sources encourages more phosphorus to remain in more labile forms particularly as microbial phosphorus. This pool through mineralization can provide a steady supply of phosphorus to the plants leading to better responses to applied phosphates and less ‘disappearance of the fertilizer’” (Gichangi).

While the existence and significance of such synergies are, apparently, still being debated, on the socio-economic side, different combinations of organic and inorganic nutrient sources allow households to use different combinations of natural capital, labor, and financial capital (according to their means), with different risk profiles (according to their capacity to bear risk), to improve the fertility of their soil.

Conservation tillage (discussed and recommended by various participants) can *conserve* soil organic matter, but is not always associated with higher yields (Ken Giller). However, identifying what can be done to *raise* soil organic matter over time is more difficult. Sources of organic matter include:

- *Plant roots.* Where crop yields have been built up to a medium-high level and conservation tillage is practiced, root production may be sufficient to maintain soil organic matter at optimal levels (Anderson). This was identified as an area where further research work is needed. However, at lower yields (i.e., those currently achieved by most poor smallholders), this is not the case.
- *Crop residues.* However, production of residues is limited in drier parts of Africa by water availability and elsewhere by lack of phosphorus. Indeed, application of inorganic fertilizer may at times be needed to increase availability of residues-- Voortman, Bumb). Moreover, farm households face competing demands for crop residues, which, as a result, are not always

returned to the soil. Indeed, feeding crop residues to cattle, then collecting the dung for application on fields, may be a more effective use of residues than incorporating them directly into the soil. For, while the organic material present in fodder is partly digested in the animal and the organic matter in animal manure is only part of the organic matter originally present in the fodder, the loss of organic matter by digestion is more or less compensated by the higher humification coefficient of manure, than of fodder. This means that a greater proportion of the added organic sources are still present in the soil at one year after application.

- *Green manures*. These require land that could otherwise be planted to crops. They also decompose very rapidly after application, so are not efficient in building up soil organic matter over time;⁴
- *Composting*. Only likely to be sufficient for tiny areas;
- *Animal manure*. Fine where population densities are low enough to leave communal grazing land or other off-farm sources of vegetation for the livestock to eat. Otherwise, livestock keepers have to depend at least in part on purchased feeds, which are beyond the means of many poor households.

Proponents of the case for investment in raising the organic matter content of African soils (e.g., Breman) apparently viewed increased support for livestock keeping, animal traction and transport as the best entry point to achieve this. Guy Evers suggested that public funds that others were advocating should be spent on fertilizer subsidies might, in fact, be better directed to “subsidizing investments (e.g., reduced tillage mechanization) and farmers’ empowerment.”

A possible criticism of this view is that, if livestock is in practice equated with cattle (which references to traction and transport would suggest), then the benefits are likely to be captured principally by the top third-half of smallholder households, who are already likely to be amongst the most effective soil fertility managers. Nevertheless, enabling these households to further enhance the fertility of their soils and achieve higher returns to the use of inorganic fertilizers could be a catalyst to agricultural transformation that would eventually bring benefits to many poorer households, both rural and urban (Crawford et. al. Background Paper #1).

On the other hand, as argued by Jonathan Anderson, although strategies for poorer households to restore soil organic matter are available in theory, in practice it is difficult for poor farmers on degraded soils and with alternative uses for crop residues to invest in these strategies—much as it is difficult for them to invest in inorganic fertilizer. In Anderson’s view, the e-forum did not shed much light on ways forward for poorer households. This is, however, an issue that should be returned to during the production of the toolkit.

Promoting Improved Crop Varieties That Make More Effective Use of Fertilizer

This was a critical feature of the Malawian starter pack scheme, as initially conceived. Unfortunately, it was subsequently abandoned when alternative donor priorities took precedence. In Kenya, FIPS have worked with seed companies to promote improved seed varieties during their promotion of the new Mavuno fertilizers. Getting improved germplasm into farmers' hands and fields is also one dimension of the work of SCOBICS in western Kenya (reported by Poulton).

Improving Cultural Practices Associated with Fertilizer Application

This is another dimension to the work of FIPS in Kenya. In particular, they have focused on improving fertilizer application practice. They have found that farmers can double or even treble their yields by placing fertilizer 5 cm below and to the side of the seed at planting—rather than applying DAP fertilizer directly on top of the seed in a furrow or the seed directly on top of fertilizer, resulting in poor establishment—and by covering topdressing fertilizer with soil, rather than leaving them on the soil surface; thereby exposing them to losses through run-off and volatilization. Similarly, work on conservation tillage in Zambia (reported by Briton Walker) has also paid considerable attention to ensuring that farmers plant and weed on time.

Varying Fertilizer Application According to Rainfall

Blanket fertilizer recommendations were heavily criticized within the e-forum, and one of the many reasons for this is that they take no account of available rainfall. However, adjusting fertilizer recommendations to respond to rainfall is a surprisingly under-researched area. One notable exception that was summarized for the e-forum by Malcolm Blackie was the work of (Piha 1993) in Zimbabwe. Piha developed and tested with farmers fertilizer recommendations for maize that were based on common applications of P, K, and S (in a compound fertilizer broadcast at the start of the season), with N applications (from ammonium nitrate fertilizer) varying according to the unfolding rainfall pattern. Over a five-year period, Piha's recommendations gave 25–42% more yield and 21–41% more profit than existing fertilizer application recommendations. Moreover, he realized that lower applications of P, K, and S could have yielded similar results with lower risk in drier areas.

Developing and testing similar recommendations, starting with staple crops that are grown by almost all households (Piha worked with maize), should be a priority in other countries as well.

Seasonal Weather Forecasting

Piha's work was based on the assumption that farmers could not accurately anticipate weather patterns. Therefore, they should be equipped to respond to

them as they unfolded. A related discussion considered the possibility of harnessing long-range weather forecasts to allow producers to make more informed decisions on how much fertilizer to apply to their crops. The outcome of this discussion, however, was that long-range weather forecasts are not sufficiently accurate (nor will they be for the foreseeable future?) to inform detailed decisions on fertilizer application at local level. However, they may be useful for fertilizer distributors who need to know how much fertilizer to have in stock in different regions ready for a particular season (T.N.Rao) and possibly for farmers if they are prepared (and equipped) to make decisions on which crops to plant on the basis of expected weather patterns (Gichangi). (One imagines that only the more commercially oriented, with the best connections to markets, might be prepared to do this). Meanwhile, for detailed decisions on fertilizer application at local level farmers will want short-term forecasts or, failing that, should be equipped to respond to rainfall patterns as they unfold (as per the work of Piha).

Improving Water Control

Improving water control tackles the same problem as the previous two subsections were addressing, but from yet another angle. Claims were made during the e-forum (with supporting reference supplied) that “By identifying growth limiting factors [such as water supply] on a specific site, the yield per unit soil could increase more than 10 folds” (Uzi Kafkazi). An illustration of this point was provided in the form of conservation farming in Zambia. By concentrating fertiliser applications in basins (“potholes”), along with liming and emphasis on timely planting and weeding, the maize yield of farmers practicing conservation farming has been raised from one ton per hectare to six or more. Walker argues that this is one reason why crop production has risen in Zambia despite a dramatic decline in fertilizer use since 1991 (although he does not say what has happened to fertilizer use among farmers practicing conservation farming once they have adopted the practice).

Improving Access to Output Markets

Improving access to output markets is another means of raising the profitability of fertilizer use. The importance of improving the prices that farmers receive for their crops was raised by numerous participants and challenged by none. In addition, several of the specific examples of interventions to increase fertilizer use cited by participants (see below) included improved access to output markets as one component of the intervention. However, beyond improving road infrastructure, empowering farmers’ organizations, possibly improving national systems of market information provision and seeking to stabilize prices of key food crops, interventions to improve access to output markets are, almost by definition, local context specific. Efforts to scale-up such interventions, therefore, need to focus more on *processes* for identifying and responding to local market constraints than on specific interventions to enhance market access. Perhaps of even greater relevance for the e-forum, an implication of the emphasis on output

markets is that one cannot really consider fertilizer market in isolation. Efforts to increase fertilizer use need to be embedded within wider strategies for smallholder agricultural development. They should be an integral part of such strategies, not just at national level, but also within their local-level outworking (e.g., district level agricultural or rural development plans). However, efforts to “go it alone” on fertilizer use are likely to meet with only limited success.

Enhancing the Affordability of Fertilizer Use

Efforts to raise the efficiency of fertilizer use and improve access to output markets both see *profitability* of fertilizer use as the key issue. An emphasis on *affordability*, by contrast, highlights poor farmers’ lack of cash (Michael Kibiego) to purchase fertilizers that are both available and potentially profitable to use. In a contribution that challenged the assumption underlying the majority of forum contributions (i.e., relative prices or profitability of fertilizer use were the critical issues); Paul Heisey observed that in Malawi the real price of nutrients (i.e., nitrogen) in terms of maize has been falling over time, yet fertilizer use has not risen. Reviewing the relative price trends during the 1990s across Africa more widely, he reported mixed results, with a generally declining trend, but step rises where subsidies had been removed. In the case of Malawi, Heisey’s conclusion was that fertilizer “use seems to be determined far more by the ebb and flow of public programs to encourage this use than anything else.” He, therefore, suggested that, “in Malawi, at least, there must be institutional as well as technical factors that are quite important in affecting the level of fertilizer consumption.”

Here we review three tools (all of which just about qualify for the designation “institutional” innovation) that are designed to enhance the affordability of fertilizer use:

Seasonal Credit

Seasonal credit was a feature of most (abortive) “green revolution” experiences in Africa, as well as the real thing in Asia. Its importance was recognized by several participants, but there was little discussion of how to get seasonal credit going among poor smallholder households. One practical example that was provided, however, was the SCOBICS credit scheme that has been running in western Kenya since 2001; providing input credit in kind (e.g., improved seeds, inorganic fertilizers) to several hundred semi-subsistence households. In 2004 it returned a 92% credit repayment rate on very small loans (average size just over US\$30) to just under 300 clients and it has taken on additional borrowers for 2005 (Poulton). Scaling the scheme up remains a challenge (one that is currently being worked on).

Some examples of inventory credit being combined with fertilizer promotion were also provided (see below). Here, however, it is less clear whether the inventory credit assists with the affordability of fertilizer or rather enhances the profitability of fertilizer use by improving returns to output marketing for storable crops (generally maize). If such schemes do contribute to the

affordability of fertilizer, it is through their “savings” function, allowing maize stocks to be cashed in later than would otherwise be the case, thereby providing households with access to cash when they need to obtain fertilizer.

Small packs

These have been a feature first of SCODP and now of FIPS in Kenya (Seward, Anderson), and have also been used successfully in Zimbabwe (for both improved seed and fertilizer?). Discussion of small packs in the e-forum suggests that they perform at least two functions: (a) enhancing affordability of fertilizer for very poor households (Seward suggests that a small pack is likely to be more effective in this regard than a subsidy on a 50kg bag) and (b) reducing the risks for poor households of experimenting with (new types of) fertilizer. In the SCODP case, it is clear that many poor producers began using fertilizer through experimentation with small packs. In the FIPS/Mavuno case, it remains to be shown what proportion of buyers are commencing fertilizer use as a result of buying small packs of Mavuno and what proportion are switching from other types. The “theory of change” underlying small packs must then be that poor producers gradually expand their capacity to acquire fertilizer as yields rise. As with starter packs in Malawi, benefits are likely to be seen first in terms of enhanced household food security and later (how much later?) in terms of income generation through production of food/agricultural surplus.

Subsidies

We reserve full discussion of subsidies for a later section. Here we simply make the point that the lower price of fertilizer may increase its affordability for cash-constrained farmers (aside from its impact on profitability). In other words, subsidies may have a demand-side impact, even though they are essentially a supply-side intervention. However, as noted above, a subsidized 50kg bag of fertilizer may still be less affordable to many poor producers than (unsubsidized) 1kg or 5kg packs.

5. Kick Starting Markets

Having examined what contributors to the e-forum had to say about the relative importance of supply and demand constraints on increased fertilizer use in Africa, we now consider four broad approaches proposed to “kick start” fertilizer markets in Africa. The phrase “kick starting” fertilizer markets appeared within the e-forum in the following contribution from Paul Mapfumo; although the concept of “kick starting” rural markets in Africa more generally has recently been promoted by Dorward, Kydd et al. 2004: “Over the past four decades there has been a tremendous build up in scientific knowledge of the biophysical processes that govern soil fertility and the complex socio-economic environment that surrounds African farmers, as one can obviously tell from the foregoing debate. Unfortunately all this knowledge is yet to translate into efficient production systems (from plot-level efficiency of nutrient use to the farming system scale). It is all about shouldering the costs of kick-starting the production process—both from the perspective of soils with inherently low nutrient stocks to poor capacity by farmers to utilize the little ‘or nothing’ resources available and most importantly to adopt the new—that will effectively bring about change.”

A more concise summary of the same concept was provided by Jonathan Anderson, who described the work of FIPS in Kenya as “priming both demand and supply for farm inputs to the point where production and demand engage the private sector.”

Here we consider four broad approaches to “kick starting” fertiliser markets in Africa that arise from the e-forum discussions. The four approaches are not mutually exclusive, as we will see when (in the following section) we consider specific interventions presented by e-forum participants to increase fertilizer use in different parts of the continent.

Subsidies and Vouchers

We consider these together, although the first is essentially a supply-side measure and the latter a demand-side one. Also, as we shall see, there was a very different balance of opinion on them among e-forum participants. Both respond directly to the concern that, at current prices, many African households do not or cannot use fertilizer; hence, soils are being depleted of nutrients, making efforts to stimulate poverty-reducing smallholder agricultural growth ever more difficult as time goes by. Both can be seen as a holding measure or safety net—preventing the food security situation of poor households from deteriorating further (See Joost Brouwer on subsidies and Dowswell and others on voucher

schemes). However, both can also be seen as ways of stimulating demand for fertilizer to levels that make large-scale, commercial supply more attractive.

Subsidies

Several e-forum participants called for the reintroduction of fertilizer subsidies, but, in some cases, it appeared, this was in part at least a cry of desperation (what else can be done to enable poor producers to access fertilizers?). Subsidies, it was suggested, could compensate producers in remote areas for the high transport costs entailed in supplying them with inputs and purchasing their outputs, or could rebalance the playing field when producers in developed countries enjoyed high levels of support for their activities. However, no specific proposals were put forward for how subsidies might best be administered (e.g., paid to private importers or wholesalers, applied within a state-controlled input marketing chain?) or how the leakages and distortions from such a system might be minimized.

At a detailed level, there was much more negative comment against subsidies than positive support. Balu Bumb described them as “neither fiscally sustainable nor administratively feasible,” arguing that they would distort markets and any gains in fertilizer use would likely be reversed once subsidies were removed. Furthermore, he suggested that, even while in force, they would only achieve what alternative measures to enhance supply side efficiency could achieve (in terms of reducing the cost of fertilizer supply), yet these alternative measures would be much more enduring.

Christopher Dowswell summarized the views of Elliot Berg (elaborated at a 1991 Sasakawa conference in Arusha, Tanzania) on fertilizer subsidies. Although several arguments can be advanced for subsidies, few of these really stand-up to close scrutiny. Poor farmers are generally held to be risk averse, but evidence suggests that they will invest in fertilizer when the benefits are clear. (T.N.Rao presented data from semi-arid areas of India showing that small farmers apply fertilizer more intensively than large farmers under rain-fed conditions). As discussed above, subsidies can enhance the affordability of fertilizer, but small packs or investments in seasonal credit supply may be better approaches here. Although poor farmers currently rarely access fertilizers, many of the benefits of subsidies (being supply-side instruments) are captured by those who already have the most effective demand for fertilizers. This effect is magnified if subsidies lead to rationing of cheap fertilizer, such that “connections” somehow become important to one’s ability to access them.

Berg’s contention that there are now few places in Africa where farmers are unfamiliar with the benefits of fertilizers was supported by Paul Mapfumo. However, while Berg used this observation to argue that subsidies are not needed to encourage experimentation with fertilizer, Mapfumo argued that, as farmers are much more aware of fertilizer benefits now than when subsidies were in place in the past, the impact of subsidies on fertilizer use would be much bigger now than it was before. (This was in response to a point from Paul Heisey

that past subsidies did not lead to the consumption levels of fertilizers that today's advocates of subsidies are calling for). On this point of awareness, we should also note the experience of SCODP in western Kenya, where the ability to access small quantities of fertilizer, apparently for experimental purposes, did lead to the growth of a (still modest) fertilizer market over a number of years. The arguments about awareness are, therefore, inconclusive. However, the argument that subsidies are second-best investments to small packs (for experimental purposes), or investments in seasonal credit supply (for affordability) still apply.

A couple of additional arguments from e-forum participants are worth noting. Consistent with his views of African soils summarised earlier, Roelf Voortman argued that, "... increasing fertilizer use per se is not what should be pursued. What really matters is the right type of fertilizer, at the right dose, at the right time, at the right place. *Subsidizing current fertilizer recommendations often would amount to subsidizing inefficient practices* [moderators' emphasis], which are maintained as long as the subsidies are there and quite rightfully abandoned when the subsidies are withdrawn (as the past has also shown). What matters is to develop fertilizer technologies that work and have the expected effects. When fertilizer is effective there is no need to have subsidies. The funds involved in subsidy schemes are better invested in research aiming at the design of effective fertilizer technologies."

Along complementary lines, Guy Evers questioned whether, "the attractiveness of rapid impact [from subsidies] may constitute a disincentive for farmers, policy makers, politicians and development partners to address long term soil and land health problems (such as lack of soil organic matter, soil compaction, poor biological processes, high water run-off and soil erosion, etc.)." As noted above, he argued that the money that would otherwise be spent on subsidies would be better invested elsewhere, not just in research (as suggested by Voortman) or roads (as suggested by others), but in subsidizing animal traction or reduced tillage mechanisation, or in promoting farmer groups.

Vouchers

The language of the UN Millennium Project Hunger Task Force in calling for "targeted subsidy programs ... designed to supply both mineral and organic fertilizer to highly food-insecure farmers" is perhaps confusing. What the report calls in relations to inorganic fertilizers, is the widespread but targeted (at food insecure households in "hunger hotspots") distribution of vouchers or fertilizer entitlements on smart cards, so as to enable poor households to access fertilizer while simultaneously boosting the market for fertilizer stockists. Countering Guy Evers' objection above, this should also be combined with promotion of green manures and cover crops, nitrogen fixing fallow trees, application of crop residues (although see the earlier discussion of this), and soil and water conservation measures (e.g., conservation tillage, bunds planted with grasses, trees, or Mexican sunflower).

Indeed, among e-forum participants, there was quite broad support for the use of fertilizer vouchers to both assist food insecure households access fertilizer and stimulate private fertilizer markets. Where most of the other contributions in favor of vouchers differed from the proposals of the Hunger Task Force, however, was in linking distribution of vouchers to participation in public works programs. (This may be seen, inter alia, as a targeting measure. It is unclear how the distribution of vouchers proposed by the Hunger Task Force would be organized and how targeting of genuinely food insecure households would be ensured). Thus:

- Christopher Dowswell was the most ambitious advocate of voucher schemes linked to public works programs. He argued for schemes with a combined value of US\$7.5 billion, employing up to 50 million people in different countries of Africa during the off-season on infrastructure and eco-rehabilitation projects. This would not necessarily have to be fertilizer for work, however; food or cash for work would create extra demand for food in deficit areas and would, therefore, support the market for surplus producers elsewhere, hence raising their demand for fertilizer.
- From a fertilizer industry perspective, Patrick Heffer supported fertilizers for work, arguing that they represented a good combination of short-run and long-run objectives (see below). Hardwick Tchale also advocated fertilizers for work for the specific case of Malawi.
- Balu Bumb advocated the distribution of fertilizer vouchers to the (stylized) bottom 40% of the population, essentially as “market-friendly safety nets,” as this considerable group would still be unlikely to be able to participate actively in fertilizer markets even if the supply-side measures that he proposed (see earlier section) brought the price of fertilizer down by 30% or more. Bumb noted that IFDC has already implemented such schemes in Malawi and Afghanistan, (although it was not clear whether these were linked to work or not), as has SG2000 among poor women in Uganda. Photo IDs or smart cards can be used to minimise diversion of the entitlements.

Few, if any, detailed arguments were raised against the operation of such schemes by e-forum participants. However, the following two points are worth considering:

- First, why should fertilizer vouchers, and not cash, be given out by public works programs? In his contribution, Dowswell suggests that either of these (or food vouchers) would be adequate to achieve both welfare and market creation objectives. Should participants in such schemes be given a choice, as some may not wish to be constrained to use fertilizer, while others may appreciate the “forced saving” element of fertilizer vouchers, knowing how difficult it is to retain cash until the time comes to buy fertilizer?
- Second, a point was raised by several participants that voucher schemes (just like subsidies) have a significant opportunity cost. What balance should be struck between expenditure on (short-term) welfare on the one hand and

investment in (long-term) enhancement of fertilizer (and other) market efficiency through, most obviously, investment in road, rail, communications, and port infrastructure? This trade-off is less acute with vouchers than with direct fertilizer subsidies (an important argument for vouchers, as noted by Heffer). As argued by Dowswell, investments in human health (through higher incomes, food production and consumption) and environmental improvement (through public works) are long-term. Nevertheless, a trade-off does still exist. It is perhaps beyond the scope of an e-forum to resolve this (and no modelling evidence was presented to shed light on it), but it is an issue that politicians and policy makers in individual African countries will have to grapple with.

Public Investments in Generic Soil Fertility Enhancement Technologies

As already noted, the UN Millennium Project Hunger Task Force calls for its targeted fertilizer voucher programs to be combined with promotion of green manures and cover crops, nitrogen fixing fallow trees, application of crop residues, and soil and water conservation measures. Apparently taking a different view on the optimal balance between short- and long-term approaches, Henk Breman proposed that the main focus of public expenditure should be on promotion of some fairly generic technologies to enhance the status of African soils, thereby creating conditions under which farmers could make profitable use of fertilizer from commercial suppliers. His basic menu of activities (the balance of which could vary from place to place—Bumb) would aim to replenish phosphorus in African soils, encourage use of lime and raise organic matter levels. Precisely how these objectives might be achieved was not spelled out within the e-forum, although the challenge of raising organic matter levels has already been discussed; and one option to replenish phosphorus would apparently be subsidies!

Breman's claim is that such programs would be lower cost than irrigation investment (currently returning to the agricultural investment agenda) to achieve the same increase in agricultural production and food security.

Locally Tailored Fertilizer Recommendations

If public investments in generic soil fertility enhancement technologies are the policy corollary of the view of African soils as being of widespread poor quality (i.e., lacking in P, often acidic), then the corollary of the view that the challenge of African soils is their heterogeneity, nutrient imbalances and micronutrient deficiencies might be described as locally tailored fertilizer recommendations. Essentially, the argument here is that, if the limiting nutrient in a given soil can be identified, crop yields can be enhanced at low cost by often quite modest applications of that nutrient. This view promises enhanced agricultural productivity through "smarter" (and, therefore, highly profitable) fertilizer use for relatively little investment outlay (especially when compared to expenditure on vouchers or on widespread promotion of generic soil fertility enhancement

technologies). However, while the way forward according to this approach is not particularly capital intensive, it is extremely knowledge intensive.

The main investments required by this approach are in research and extension systems. The challenge is to provide systems that can identify nutrient imbalances and micronutrient deficiencies in a myriad of local settings and communicate these to producers, preferably also equipping them to perform their own diagnosis of the more common deficiencies in their soils. We also note that local heterogeneity of soils poses significant challenges for input suppliers, both wholesalers (who may have to stock a wide range of products and be able to advise stockists of what conditions different products are tailored to) and stockists (who will need considerable knowledge of local conditions if they are to offer useful advice to their customers on which products are most appropriate for their fields).

As noted earlier when discussing the soil science debates behind approaches 2 and 3, the prevalence of the “problems” highlighted by each is ultimately an empirical issue. However, even if micronutrient deficiencies are only limiting in a minority of cases, the wider debates within the e-forum have fairly major implications for the functioning of African extension systems. We, therefore, address these briefly now.

Implications for Extension

As noted above, some (though not all contributors) were of the view that the majority of African farmers are now aware of the benefits of fertilizer application. The challenge is, therefore, to advise them as to the most appropriate (effective and profitable) fertilizer products for their circumstances.

Blanket fertilizer recommendations—the stock message of too many extension systems—were roundly condemned by e-forum participants. Even if suitable for a minority of circumstances (i.e., biophysical and socio-economic), they will almost inevitably be inappropriate for many others. Typical “sins” are that recommendations are: too high, and too risky, for the majority of smallholder households; not targeted by area/soil type or status, and tend to ignore micronutrient issues. Many farmers simply do not follow them, but, if they do, this can lead to inefficient or unprofitable use of the wrong fertilizers. Christopher Dowsell was the only contributor to offer a partial defense of stock recommendations. His argument was based on the impracticality of mobilizing the skills to identify the local-level soil fertility constraints across the whole of Africa, and of offering appropriate technical advice to dispersed, poor producers. The challenge, however, is to identify “recommendation domains” that are big enough to provide some economies of scale in recommendation development, but not too large (across space and household type) as to become irrelevant to most producers within the domain or to encourage grossly inefficient or unprofitable use.

The growing recognition of the importance of within-farm gradients means that, within any given geographic area, advice may have to be tailored to two or more

field types (well- managed fields close to homesteads and more depleted fields typically further away). This is before the varying socio-economic status of different farm households is taken into account.

Esther Gikonyo argued, from experience in Kenya of two different projects designed to develop fertilizer recommendations, that if farmers are not involved in developing fertilizer recommendations, they may ignore them. (Is the real point here one about participation per se or about the unrealistic nature of recommendations developed without farmer participation?). Roelf Voortman argued that, "Since farmers are risk averse they will want to experiment on their own field. Therefore, it is very much desirable that such improved technologies are divisible (i.e., they can be practised on part of the farm or [at] below-recommended fertilizer doses...The technologies should also be presented as such to farmers and not as a take it or leave it complete package involving high and risky input levels. Cash constrained farmers can only conduct their own experimentation if fertilizer is available in small sized bags...Because farmers' objectives are so diverse, it is very much desirable that researchers develop a portfolio of small improvements that deviate not too much from current practices, from which the farmers can select what in their particular situation suits them best. However, current practice is that usually only one technology is on offer."

Even more fundamentally, it was argued that farmers should be taught the principles of soil fertility management, rather than simply being told what fertilizers might be appropriate for their field conditions. According to Dowswell: "Whether publicly funded research and extension is conducted by public institutions or outsourced to private agricultural service providers, much benefit can come from dynamic soil fertility programs, where farmers are taught principles and offered a range of choices. There is much need for this sort of publicly funded interventions." Unfortunately, most public investments to date in soil fertility programs of this nature have been "relatively small, and interventions more of a boutique nature."

Teaching farmers how to recognize nutrient deficiencies through the dissemination and use of leaf color charts is an approach that is used by IFDC with farmer field schools near Lome, and also by SCODP and others in western Kenya. Instead of suggesting that a certain quantity of a particular fertilizer(s) should be applied to a particular crop, this teaches farmers to modify their fertilizer application as the plant's condition requires. Another way of identifying soil type and deficiencies—one that builds on indigenous knowledge—is to look for "indicators" in the vegetation types found around the edges of fields. A possible advantage of this approach is that it does not depend on waiting until crops exhibit signs of stress before suggesting nutrients that should be applied.

However, if extension staff are to provide farmers with "responsive" and tailored advice on soil fertility management, many will need retraining in agro-ecological and socio-economic aspects of soil fertility management—not just agronomy! There are potentially large investments required here, but these will only bear fruit if the management of extension organizations—and the integration of

extension services into wider agricultural development strategies and processes⁵—also receives attention.

Soil Testing Services

The role for—and possible need for subsidy of—soil testing services was also discussed by e-forum participants. This is particularly relevant if the heterogeneity of African soils is emphasised. At least three different views were advanced on this issue:

- Laboratories for soil testing should be subsidized, such that all farmers can obtain test results for their fields. However, in reality only a tiny minority of more commercial farmers would be likely to seek such tests.⁶ There is also the question of how reliable the test results are (a function of the investment in human capital and physical equipment in the labs?);
- Farmers should be taught to rely on plant appearance to detect basic macronutrient deficiencies. As noted above, there is plenty of merit in this approach. However, it was also pointed out that such visual inspections cannot handle more complex scenarios (e.g., some micronutrient deficiencies?) and that they often require plants to become stressed before remedial action can be identified. Laboratory back-up may be desirable in some cases, therefore;
- Laboratories are most useful in supporting the development of area-based extension recommendations. One posting noted the development (by Keith Shepherd and colleagues at ICRAF, Nairobi) of near infra-red spectrometry for quick and cheap diagnosis of large quantities of soil samples—suitable for gaining an overview of the status of soils within a district or region. Capitalizing on this advance will require investment in both equipment and staff training, but the benefits in terms of better targeted extension recommendations could be enormous.

Coordinated Service Provision (including output markets)

This approach incorporates insights from contributions on the importance of output markets and credit services, as well as the key insight that it may be necessary to “prim[e] both demand and supply for farm inputs to the point where production and demand engage the private sector.” The fundamental argument is that, to get out of poverty traps, poor producers may need simultaneous access to improved seed varieties, fertilizers, extension advice and credit, plus attractive output market opportunities. However, the return to investment in any one of these services (on the part of the service provider) is contingent upon there being complementary investments in the other services, due to the complementary nature of the services from the producer’s perspective. The challenge then is how to coordinate service provision for producers in a given location (FARM-Africa, Harvest Help et al. 2004).

Within the e-forum, Patrick Heffer provided an excellent statement of this approach: “Extension services are quite inefficient in many countries. Therefore,

farmers do not receive the necessary information on the benefits of using agricultural inputs, and on best management practices to fully benefit from the use of these inputs. Weak partnerships between National Agricultural Research Systems (NARS) and local entrepreneurs constitute another constraint that limits the transfer to the farmers of locally adapted inputs, technologies, and practices. To improve agricultural production, all necessary inputs should be available to the farmers, in particular fertilizers, seeds and crop protection products. *If any of these inputs is missing, it will limit agricultural production. As a consequence, increasing the consumption of manufactured fertilizers in Africa can hardly be achieved without improving the delivery of seed and crop protection products, and vice-versa* [moderators' emphasis]. This requires joint distribution of technology packages. In order to be successful, the different agricultural inputs should also be available in appropriate quantity and quality at the right time and at affordable prices. Lastly, in order for fertilizer consumption to increase, profitability of its use must be improved. This means reducing fertilizer prices through better supply systems, and increasing crop output prices."

The success of African cotton sectors in encouraging fertilizer use was noted within the e-forum. These have been successful, because they provide all of the services required by producers to intensify their production. Individual agricultural development projects (see examples below) may also provide all these services at localised level, even for food crops. However, the challenge is how to scale such coordinated service provision up.

Michael Kibiego (and others) emphasised the importance of promoting farmers' organizations if farmers are to access the range of services that they require for production intensification. Farmers' organizations can (potentially) assist in access to knowledge and information, purchased inputs (both seeds and fertilizer), finance and output markets. However, farmers' organizations would have to grow very strong before they could act as a magnet for providers of all these services into its area of operations. In the meantime, some form of multi-stakeholder, area-based agricultural development planning is likely to be necessary to encourage coordinated action by the range of players (public and private) required.

Again, Patrick Heffer expresses it well, stressing the importance of "the organization of the agri-food chain in Africa and good governance. ... It is urgent to organize farmers, the agri-input sector and the output markets at the national and, possibly, at the regional levels,⁷ (e.g., through the establishment of national and regional associations representing farmers, input dealers... This would allow coordination of the efforts of all the stakeholders, a better communication among them as well as with the local and regional authorities. Such associations would be the counterparts of policy makers and would advise governments on the right reforms to be taken. Such associations exist in some countries, but need to be expanded to all the African countries. Regional and/or sub-regional associations should also be encouraged to liaise with the African Union, NEPAD, SADC, ECOWAS..."

6. Interventions Discussed by E-Forum Participants

In this penultimate section we summarize specific experiences of interventions to promote fertilizer use in Africa that were presented (and sometimes discussed) by participants. Some of this will go over ground already covered in previous sections. However, we also locate the examples discussed within four “big approaches” outlined above.

The Work of FIPS in Kenya (combination of approaches 3 and 4):

FIPS works with local companies (and local subsidiaries of international seed companies) to:

- Formulate improved fertilizers using locally-available minerals to incorporate nutrients which are limiting productivity;
- Package into 1 kg bags, as well as the conventionally-available 10, 25, and 50 kg bags;
- Provide fertilizers and improved seed varieties for demonstrations and promotions;
- Distribute fertilizers to rural areas.

In return, donors (USAID, DfID, the Rockefeller Foundation) are providing support to FIPS to promote these improved fertilizers among small farmers and at the same time to promote the use of sound agronomic principles (i.e., correct fertilizer placement, soil management, and effective weed and disease/pest control). This is done through demonstrations, and promotions through rural stockists in close cooperation with the Ministry of Agriculture’s extension services.

Following contact with FIPS, “Athi River Mining agreed to manufacture two fertilizers tailored to local needs in Kenya:

- *Mavuno*: 10-26-10+2S which is a blend of imported DAP, and its own locally-made granule comprising dolomitic limestone (Ca, Mg), gypsum (Ca, S), MOP (K), and micronutrients (B, Zn, Mn, Mo, and Cu).
- *Mavuno-Top*: 30 + 5S which is a blend of imported urea (N) and locally-available granulated gypsum (Ca, S).

Both fertilizers catered for increasing incidences of K, and S deficiency, and increasing trend of soil acidification on small farmers’ fields. The Mavuno and Mavuno-Top fertilizers retail at lower prices (up to 15% lower) than DAP and

Urea. The fertilizers, which are packaged into 1 kg bags to facilitate farmer experimentation, have been tried out widely by farmers on different crops throughout Kenya. They are proving to be as good as if not better than DAP and urea, and especially effective on crops such as potatoes, vegetables, fruits, and French beans. Farmers are getting up to 50% yield increases on vegetables with Mavuno fertilizers compared to conventionally-used DAP and Urea.

The Company started to manufacture the fertilizers on a pilot basis (10T/day). Demand quickly outstripped supply. As a result, after only 18 months, Athi River Mining started to import DAP, and has increased its capacity to produce its own blends to 100 T/day.” (Paul Seward)

The CASE Approach (combines approaches 2 and 4)

“The acronym CASE stands for Competitive Agricultural Systems and Enterprises. It emphasizes the importance attached to competitiveness, both related to the agricultural production systems within the target region; and to the rural and urban enterprises that are directly linked to the agricultural production systems, by providing inputs and market outlets. The CASE approach is not a technology—but a demand-driven approach, which fosters production chain development, by strengthening the innovative capacities of the various stakeholders—including the service providers (e.g., research, extension organizations, NGOs)—involved. Farmers and local entrepreneurs identify agricultural production and business opportunities and invest in their own future. Some activities focus on different aspects and depend on the bottlenecks identified by the major stakeholders themselves for improved competitiveness. They can be grouped in three categories:

- Improving the accessibility, both geographically and financially, of “external” inputs, for example, by stimulating the development of infrastructure (e.g., warehouses, local shops); through investments in private-sector capacity development, networking with savings and credit systems, and development of lobbying capacity to enforce effective regulations promoting competitiveness and “fair” trade.
- Development of market outlets for agricultural produce, for instance, by stimulating the development of agriculturally-linked enterprises, the diversification of agricultural production, and improved coordination between consumers and producers.
- Fine-tuning of technological options: to improve the efficiency of “external” input use, including optimal strategies of fertilization according to climatic zone, soil type, and crops cultivated, and complementary measures of soil fertility management and of water harvesting—mainly through investments in participatory, as much as possible farmer-led, research and extension.

Results

IFDC and partners have facilitated work on improved and sustainable land management through a number of projects since 1998 in seven West African

countries (Benin, Burkina Faso, Ghana, Mali, Niger, Nigeria, and Togo). The projects are sited in 16 target regions that have a potential for agricultural intensification, (i.e., with, among other factors, reasonably well-functioning factor and output markets. The projects involve over 30 governmental and non-governmental organizations as “facilitating institutions.” Extensive training has been given to staff from the partner organizations (field personnel and supervisors/ managers) to strengthen their capacities in participatory approaches, organizational strengthening and facilitation of social learning processes, and institutional change. About 3,000 farmers actively participate in “learning” activities, and have formed farmer learning groups to develop, validate, and disseminate alternative high-value crops and more efficient technologies; and develop and lobby for alternative organizational and institutional arrangements that may spur agricultural intensification through improved access to factor- and output-markets. Major results to date are:

- Adoption of alternative more intensive technological options: An estimated total of 60,000 farmers have adopted new technologies on a significant part of their farm. Value—Cost Ratios of the options adopted are well above 2, and returns to (family) labor are 2 to 6 times higher than the average salary in the area. Farm-level incomes of participating farmers have increased with 20 to 50%. Fertilizer consumption on these farms has increased by approximately 100 kg per ha and is still increasing.
- Farmer “learning groups” established in 300 pilot villages, taking the lead in the development and validation of intensive technological options for a focused set of marketable products, and experimenting alternative institutional arrangements to improve access to factor (including information) and product markets.
- Organizational capacities of farmer groups in the pilot areas improved. Farmer groups at village- and regional-level have taken up new roles, (e.g., input provisioning, diffusion of information, linkages to credit & savings systems, and local and regional traders (including retailers and fertilizer companies).
- About 250 local entrepreneurs—input dealers, traders, managers of warehouses and processing units have been trained, participated in round table meetings, and work with farmer groups.
- Gender awareness increased, in the pilot-villages and within the “facilitating institutions.” Women play an important role in the project activities and related decision-making; they are, on average, equally represented in the farmer groups and have often leading roles.
- Land tenure security improved for participating farmers, including female farmers. In some cases, contracts between landowners and farmers for a sequence of years were established.

- Capacities of “facilitating institutions” strengthened. The quality of services provided to farmers and local entrepreneurs has improved considerably.

The Fertilizer and Sustainable Agricultural Development project implemented by IFDC and partners is a low-budget project, with emphasis on partnership, capacity-building, and investments in key activities that otherwise would not have been carried out. Partner organizations leverage resources, combine activities from different projects and/or programs to obtain synergy; and are encouraged to work as much as possible together with other organizations able to contribute to the dynamics of intensification, whether directly or indirectly (e.g., alphabetization, advice on nutrition, awareness raising). Inter-institutional collaboration has taken an enormous flight during the last few years of the project. It is increasingly recognized that no single organization can embrace all activities that are needed to facilitate agricultural intensification. Although collaboration between national research and national extension services was not so difficult to establish, open and frank collaboration between National Agricultural Research and Extension Services (NARES) and NGOs was much more difficult. However, the results from the last two years clearly demonstrate that NGOs—the good ones—have competences, in particular related to capacity-building, organizational strengthening, institutional developments, and private-sector support, that the NARES normally do not have.” (M. Konlambigue)

An additional observation on this experience is the importance of strategic site selection—making the investments where the basic cropping potential will permit fertilizer uptake.

Combining Fertilizer Promotion and Inventory Credit in Togo (combines approaches 2 and 4)

“In order to improve credits accessibility to many farmers for fertilizer purchase, PODV in collaboration with IFDC has facilitated some institutional arrangements between organization, credit institutions, and input suppliers. The project had set up a system (related to the inventory credit system) where loans were given to farmers (in group) based on the quantity and quality of maize or any crop stocked in warehouse. At harvest, farmers who need credit have to stock part of their production at an amount commensurable to the loan they are hoping to receive. The warehouse is locked by three padlocks, and every institution holder has the key to one padlock. The financial system immediately releases half of the loan in cash to allow the farmers to develop small business during the off season or to meet the financial needs of his family. The rest of the credit is given directly to an input dealer who in turn will provide to the farmer the fertilizer he owes. The store is opened by the three stakeholders when the market price of the crop is high and sold to pay back the loan. As the loan was given on the basis of the value of crop at harvest, farmers often get back money after paying the loan and the interest. The construction of the warehouses was supported by an investment project (PODV) with the participation of FBOs. The prerequisite to success is the provision of training to the FBO on loan management, on post harvest operations, and marketing of agricultural products.

This system has resolved two problems: (a) the access to credit for small-scale farmers to buy input and (b) the selling-off of crop products at a fairly good price. It was a great success because farmers involved in this process were able to access fertilizer and boost their crop yield. Nowadays, most of them are facing the problem of dropping food crop prices in markets. Prices at farm gate are very low as the results of increase productivity in the villages, making it difficult to get profit. This calls for other types of intervention that should include market information systems and support to food crop dealers and processors if the fertilizer use is to be sustained in the regions.

In conclusion, the promotion of the use of fertilizer needs coordination mechanisms that will permit farmers to learn about best Integrated Soil Fertility Management practices and improve access to credit. But “change agents” have to facilitate the integration of farmers into commodities chains that can allow them to have access to market.” (M. Konlambigue)

The link between this initiative and fertilizer use is that, simultaneously, “IFDC has initiated in partnership with some NGO’s, rural development projects and some farmer based organization in the coastal zone of southern Togo a learning process that aimed at improving the understanding of farmers on the nature and management of fertilizer and to develop fertilizer recommendation rates tailored to their local settings. ... Scientists among the facilitation team while facilitating the learning process collected data on soil and plants that are being used to develop “à la carte” site-specific fertilizer recommendation rates using decision support models that account for target yield, native soil fertility and the purchasing power of the farmers. These rates are again tested by the learning groups in the subsequent year and provide an array of efficient options to invest in fertilizer, options, that are tailored to farmer’s purchasing power and soil conditions. ... These activities have raised awareness among the rural community on the potential role of fertilizer and the benefits obtained from combined application of fertilizer and organic input. Furthermore the development of “à la carte” fertilizer recommendation rates boosted the number of farmers that can use fertilizers with economic added benefit.” (A.Mando)

Combining Fertilizer Promotion and Inventory Credit in USAID “Target Project on Fertilizer Micro-Dosing for Small Farmer Prosperity in the Sahel” (combines approaches 2 and 4)

“The main objectives of this Project are to increase and stabilize production, farm households’ incomes, and food security and to help farmers better manage the natural resource base through the uptake of fertilizer micro-dosing technology; and better farmer-based cooperatives in the Sudano-Sahelian zones of Burkina Faso, Mali, and Niger. The fertilizer micro-dose technology consists in the application of small quantities of inorganic fertilizers in the planting/seed hole to increase yields while minimizing input cost.

Recognizing that liquidity constraints often prevent farmers from intensifying their production system, the project also initiated, with the help of Projet Intrants

FAO, the warrantage credit system to remove barriers to the adoption of soil fertility restoration. This credit system aims to assist villagers set up farmers' organizations, fertilizer shops, and storage facilities, and to grant them access to cash credit. This enables farmers to purchase external inputs such as fertilizers and store crops to get higher prices during periods when the market supply begins to decline.

The promotion of the fertilizer micro-dosing technology is closely tied to the availability, accessibility of fertilizers, and especially to the financial resources available to the producers for their purchases. Therefore, farmer-based cooperatives or producer associations were established and village savings-credits associations promoted in order to provide farmers access to micro-credit. The inventory credit scheme or warrantage system allows farmers (or producer organizations) to mortgage their cereals at harvest time to secure a loan in order to carry out their income generating activities during the off-season, without selling their grains at a lower price. These cereal grains and grains of other crops are kept in a clean store with a double lock. Buying inputs in a consolidated order from all the farmers' groups enables cooperative members to purchase inputs at a lower price and of good quality at the beginning of the production cycle. The establishment of an inventory credit scheme also allows households to smoothen their consumption patterns, thus reducing consumption risk. The warrantage credit system was popularized in the targeted areas (Niger, Mali, and Burkina Faso) with the assistance of farmers' organizations, commercial banks, NGOs, and donors." (Ousmane Hassane)

Coordinated Service Provision in Western Kenya (approach 4)

"An action research project funded by the UK Department for International Development's Natural Resource Systems (Research) Program has been working ... in selected districts of western Kenya since 2001. Based on agro-climatic conditions, these districts should be a food surplus area. Instead, they are dependent on food "imports." At the root of the problem is high population density and, therefore, small land holdings (ranging between 0.5 and 2.0 ha per household). Due to continuous cropping and little investment in soil fertility replenishment, the soil has become severely depleted. Neither phosphorus nor nitrogen levels are sufficient for even moderate agricultural performance. Many households are, therefore, caught in a "maize-focused poverty trap:" their first agricultural priority is to provide themselves with maize for home consumption, yet yields are low and incomes/returns are insufficient to support the necessary investment in either organic soil fertility enhancement technologies or inorganic fertilizers. Thus, despite the fact that they put a large share of their land under maize during both cropping seasons, they are still unable to feed themselves for several months of the year.

The project's analysis of the situation suggests that, to invest in soils, most households (unless they have a reliable source of non-farm income) need to diversify into higher value crops than maize. However, the combination of small land holdings and existing maize deficits mean that they will only plant other

crops if they can simultaneously raise their maize yields. They will only be able to do this if they can access a number of important support services. Firstly, households must have sufficient information about markets to be able to identify higher value cropping opportunities. Currently, many producers are only familiar with local markets (where opportunities are limited). They must also be able to market their crops once they have grown them. As they will only initially be able to offer small quantities of produce, which reduces their attractiveness to potential buyers, they may also need some facilitation to undertake marketing activities on a group basis. Secondly, they need technical knowledge, on best cultural practices for the new crops and, critically, on how to manage their natural resource base, so as to increase their yields both of maize and of the new crops. Thirdly, they need to be able to access good quality seeds of crop varieties that are both suited to their local production conditions and are demanded in the market-place. Finally, many also need access to credit, so as to be able to acquire inputs for more intensive maize production. This credit can then be repaid out of the sale of the additional crops later in the year.

Critically, all these services need to be in place within their local area before poor households can hope to shift from a maize-only production system to one that delivers enhanced food and cash, whilst simultaneously enhancing the soil fertility on which future production depends.

The project has had some success in providing the range of services noted above. Perhaps most notably, the SCOBICS credit scheme that it runs is continuing to grow. In 2004 it returned a 92% credit repayment rate on several hundred very small loans (average size just over US\$30) and has taken on additional borrowers for 2005." (Colin Poulton)

An impact survey of the project's activities will be conducted in May 2005.

Starter Packs in Malawi (predominantly approach 1, but fertilizer combined with carefully selected seed varieties)

"In 1998, Malawi began a program of distributing small packs of improved seed and fertilizers with illustrated planting information to all smallholder farmers (2.8 million). With recommendations based upon extensive research station and farmer field testing, the concept was to tailor the packages of practices to the Best Bet for each region. Undertaken in the midst of a food crisis on an emergency basis, the program helped Malawi produce two back-to-back bumper crops, 22% above the previous record harvest and 62% above the twenty year average. The program was then scaled back and re-conceptualized as a targeted safety net with open-pollinated maize replacing the Best Bet hybrid maize and a lower dose of fertilizer. Another food crisis prompted a wider distribution of this safety net pack. While not approaching the original Starter Pack levels, production recovered and the packs proved a cost-effective way to avoid the need for large food aid programs." (Charles Mann)

Mann acknowledges that, "The program remains highly controversial." However, his main point is that it "has changed substantially from its original conception as the centerpiece of a national productivity improvement program." In this original conception the program aimed at "getting the fruits of science-based agriculture (i.e., new varieties combined with appropriate fertilizer dosages) to very poor farmers" in the expectation that some would be able to continue using this technology once the external support through the starter packs stopped.

Conservation Farming in Zambia

"In Zambia the conservation farming system, which uses permanent basins, normally increases small farmer maize outputs from about 1 ton /ha to about 3 in the first year. Refinement of the technique has pushed yields to 6–8 tons. Reasons for this are correct date of planting, more effective use of fertilizer (only in basins), and liming and weeding... This system allows the very small farmer to produce as much as the most efficient commercial farmers, with less labor and less inputs than normal." (Briton Walker)

Conservation farming has been promoted by Ministry of Agriculture, NGOs, and the country's biggest cotton company, which gives the practice some credit for supporting cotton production levels even during the 2001/02 drought. From the limited information supplied within the e-forum, it is not clear how important reliable output market access has been to the spread of the practice (present in cotton, not necessarily for maize).

African Cotton Systems (approach 4)

The success of cotton systems in Africa in encouraging fertilizer use is widely acknowledged (Naseem and Kelly 1999). This is despite the fact that cotton does not necessarily provide the best returns available to farmers in the relevant areas (See contribution by Mamadou Doumbia for the case of Mali). Tjark Struif Bontkes attributes their success in West Africa to "an efficient market structure and stable prices." However, access to credit and other support services is also a feature of cotton systems, and these almost certainly contribute to the willingness of producers to use fertilizer.

Fertilizer Subsidies in Zambia (approach 1)

The negative aspects of the history of fertilizer subsidies were highlighted by Cynthia Donovan: access to subsidized fertilizer was tied to maize production at (inefficient?) pan-territorial prices; standard use recommendations were promulgated; fertilizer use then fell when maize prices did (although, as Briton Walker pointed out, agricultural production has risen); farmers gained no experience with fertilizing other crops.

Fertilizer Vouchers (approach 1)

It was noted that IFDC has implemented these in Malawi and Afghanistan and SG2000 among poor women in Uganda, although insufficient information was provided to make any evaluation.

7. Key Points

Increased fertilizer use should not be seen as a goal in isolation. The broader goal is healthier soils for increased agricultural productivity and food security. Increased inorganic fertilizer use is one component of this, but is unlikely to be achieved without complementary investments in other aspects of soil health. Policy should take a pragmatic view of the relative merits of organic and inorganic nutrient sources.

Although we expect increased inorganic fertilizer use to be supported most efficiently by a strong commercial fertilizer industry, a viable commercial industry may not emerge until the fertilizer market has attained a certain level of development. There is a key public role in creating the conditions under which a strong commercial fertilizer industry can develop.

The case for Africa being more self-sufficient in its supply of phosphate fertilizers founders on the continent's high internal transport costs, taken in conjunction with the economies of scale involved in fertilizer manufacture. However, there may be scope for judicious blending of locally granulated minerals with imported macronutrients to produce fertilizers that are both slightly cheaper than imported products and contain additional micronutrients. There may be a case for publicly-funded technical assistance to assist local entrepreneurs develop such products for market.

Key aspects of an enabling policy environment for private sector fertilizer supply include: maintenance of macroeconomic stability; avoiding free distribution of inputs or food aid, except in cases of extreme emergency; maintenance of a predictable policy stance towards the fertilizer industry. There is also a key role for government in upgrading infrastructure (i.e., roads, ports) and there may also be a role in assisting importers gain access to finance so as to benefit from economies of scale in importation.

Stockists play an important role in bringing fertilizer products close to producers and in stimulating demand through the provision of information and advice on fertilizer use. They may also become a source of input credit to producers whom they know—if they can access more finance themselves. However, one should not expect them to be the primary “drivers” of increased fertilizer use in Africa. Their limited capital bases do not permit them to proactively promote fertilizer use far beyond the threshold of their premises, nor to experimentally stock new fertilizer products for which there is not already clearly established demand among local producers. Rather, they should be important partners in efforts (principally from public research and extension agencies and NGOs?) to stimulate demand for fertilizer and important conduits for the supply response (principally from private importers, manufacturers, and wholesalers).

Programs that train stockists in both marketing/business and technical skills, and assist them to build linkages within the supply chain so as to qualify for supplier's credit, are valuable.

Although there are some fairly widespread "deficiencies" in African soils (e.g., low P levels, low soil organic matter), African soils are also extremely heterogeneous, and nutrient imbalances and micronutrient deficiencies are locally important. Interventions to promote fertilizer use need to be based on a clear understanding of the relevant soil fertility constraints.

Increased support for livestock keeping, animal traction and transport, may be the best entry point for raising the organic matter content of African soils. However, the benefits are likely to be captured principally by the top third-half of smallholder households. Although strategies for poorer households to restore soil organic matter are available in theory, in practice, it is difficult for poor farmers on degraded soils and with alternative uses for crop residues to invest in these strategies—just as it is difficult for them to invest in inorganic fertilizer. This is an issue that should be returned to during the production of the toolkit.

Adjusting fertilizer recommendations to respond to rainfall is a surprisingly under-researched area. Developing and testing rainfall-dependent recommendations, similar to those produced by Melvin Piha in Zimbabwe, should be a priority in other countries too—starting with staple crops that are grown by almost all households.

Improving water control is likely to go hand-in-hand with increasing fertilizer use.

Fertilizer use is assisted where producers also gain access to complementary services, (e.g., technical advice, access to improved seed varieties, credit, attractive output marketing opportunities). Efforts to increase fertilizer use need to be embedded within wider strategies for smallholder agricultural development. They should be an integral part of such strategies, not just at national level, but also within their local-level outworking (e.g., district level agricultural or rural development plans).

Promoting farmers' organizations is important if farmers are to access the range of goods and services (including fertilizer) that they require for production intensification.

Enhancing affordability of fertilizer for cash-constrained households may be important even where fertilizer use is profitable. Small packs are likely to be more effective in this regard than a subsidy on a 50kg bag. They also reduce the risks for poor households of experimenting with (new types of) fertilizer. Seasonal credit was a feature of most (abortive) "green revolution" experiences in Africa, as well as the real thing in Asia. There has been insufficient progress made in developing viable seasonal credit models for poor smallholder households.

On the balance of debate within the e-forum, fertilizer subsidies are not a recommended policy option. The majority of the benefits are likely to be captured by those who already have the most effective demand for fertilizers. By subsidizing current fertilizer recommendations, they would often end up subsidizing inefficient practices. They distort markets and, hence, any gains in fertilizer use would likely be reversed once subsidies were removed. Furthermore, even while in force, they may only achieve what alternative measures to enhance supply side efficiency could achieve (in terms of reducing the cost of fertilizer supply).

By contrast, among e-forum participants, there was quite broad support for the use of fertilizer vouchers to both assist food insecure households access fertilizer and stimulate private fertilizer markets. Targeting of vouchers could be achieved through linking their distribution to participation in public works programs. However, the question has to be answered as to why vouchers should be provided instead of cash. Moreover, policy makers have to decide what balance should be struck between expenditure on (short-term) welfare on the one hand, and investment in (long-term) enhancement of fertilizer (and other) market efficiency through, most obviously, investment in road, rail, communications, and port infrastructure on the other.

Proposals to increase fertilizer use have fairly major implications for the functioning of African extension systems. Blanket fertilizer recommendations—the stock message of too many extension systems—were roundly condemned by e-forum participants. Even if suitable for a minority of circumstances (i.e., biophysical and socio-economic), they will almost inevitably be inappropriate for many others. Moreover, the growing recognition of the importance of within-farm gradients means that, within any given geographic area, advice may have to be tailored to two or more field types. Even more fundamentally, it was argued that farmers should be taught the principles of soil fertility management, rather than simply being told what fertilizers might be appropriate for their field conditions. However, if extension staff provides farmers with “responsive” and tailored advice on soil fertility management, many will need retraining in agro-ecological and socio-economic aspects of soil fertility management—not just agronomy! There are potentially large investments required here, but these will only bear fruit if the management of extension organizations—and the integration of extension services into wider agricultural development strategies and processes—also receives attention.

Appendix

Terms of reference for Moderating an e-Forum on “Increasing Fertilizer Use in Africa: What Have We Learned?”

This e-forum is being commissioned for a project whose primary purpose is to provide guidance to development practitioners confronting the challenge of increasing fertilizer use in African smallholder farming systems. It is expected that the findings and recommendations also will be of more general interest.

The purpose of the e-forum titled: *Increasing Fertilizer Use in Africa: What Have We Learned?*, is to elicit from experienced and knowledgeable practitioners lessons learned about (a) features of the enabling environment needed to support successful uptake of fertilizer in Africa, and (b) specific interventions that have attempted to promote efficient and sustainable use of fertilizer by African farmers, particularly smallholders. Participants in the e-forum will be sent several background papers that will provide a common set of baseline information and analysis.

1. The e-forum will include three discussion threads:

- What type of enabling environment is needed to support the emergence of efficient and dynamic fertilizer systems in Africa?
- What roles and responsibilities can best be assigned to the public sector and to the private sector in planning and executing fertilizer distribution programs, in developing efficient fertilizer distribution chains, in importing fertilizer, in distributing fertilizer at the wholesale and retail levels, and in promoting efficient use at the farm level?
- What lessons have been learned from specific interventions that have attempted to promote efficient and sustainable use of fertilizer by African farmers?

2. Assignment objectives

The findings of the e-forum will be used to develop a policy maker’s toolkit that provides guidance to World Bank staff and others on how to increase fertilizer use in situations where increased fertilizer use is financially, economically, socially, or politically justifiable. The objective of this assignment is to identify, enlist in the dialogue and then tap the views, arguments, and experiences of the 150 best qualified experts in the world on African fertilizer system development. The overriding objectives of this assignment are to organize all aspects of the e-forum, to effectively tap the expertise of the participants and to fully and faithfully record their views and arguments.

3. Suggested activities

- Develop a list of 150–200 potential participants
- Acquire, test, and implement e-forum software
- Develop background materials for participants
- Issue invitations to participants
- Initiate e-forum and manage discussion threads
- Prepare weekly summary reports which will be used to refocus the discussion
- Prepare a final synthesis report which summarizes main findings

4. Reference processes

It is anticipated that the e-forum will follow the same processes and procedures as the recently completed e-forum dealing with “Re-regulating Markets.”

5. Timing and resources

The e-forum is scheduled to take place from February 15 to March 15. The time line for these activities therefore will be as follows:

January 1	Delivery of an inception report. This report should clarify the Forum manager’s implementation plan
January 31	Development of a complete e-mailing list of potential participants
February 7	Solicitation of potential participants and distribution of e-forum invitations
February 15–March 15	Production of e-forum over a three-week period, during this period which agreed with the task manager
March 21	Delivery of a summary of e-forum Findings, Recommendations, and Conclusions

Management of the e-forum will be contracted out to a qualified consultant (individual or organization), to be selected based on familiarity with the theme of the e-forum, as well as experience managing similar activities.

A lump sum amount of up to £18,325 will be available for managing the e-forum and producing the synthesis report. A team approach is welcomed as a means to enrich quality and expedite delivery. We expect to pay 25% upon submission of a list of e-forum participants, 50% upon completion of the e-forum, and 25% upon submission of the final synthesis paper.

The coordinators for the e-forum will be Ron Kopicki (AFTPS) and Michael Morris (AFTS3).

References

- Dorward, A. R., J. G. Kydd et al. 2004. "A Policy Agenda for Pro-Poor Agricultural Growth." *World Development* 32(1): 73–89.
- FARM-Africa, Harvest Help et al. 2004. *Reaching the Poor: A Call to Action (Investment in Smallholder Agriculture in Sub-Saharan Africa)*. London, FARM-Africa.
- Naseem, A. and V. Kelly 1999. *Macro Trends and Determinants of Fertilizer Use in Sub-Saharan Africa*. 36. East Lansing, Michigan State University.
- Piha, M. 1993. "Optimizing Fertilizer Use and Practical Rainfall Capture in a Semi-arid Environment with Variable Rainfall." *Experimental Agriculture* 29: 405–415.

Endnotes

1. According to Bumb's stylized typology, the top 25–30% of households already use some fertilizer, either for cash crop production or, through investment of non-farm income, on food crops. Meanwhile the bottom 40% are unlikely to be able to afford fertilizers even if prices are lowered by plausible increases in the efficiency of supply
2. Greater input use efficiency should reduce input costs (on per hectare or per ton of output basis), so it is not clear how much of this 25% fall might be expected to derive from greater supply chain efficiency
3. The importance of strengthening linkages between agricultural research programs and stockists (who can then function as extension agents for the key fertilizer-related research findings) was emphasized by both Heffer and Bumb.
4. It is worth noting here that, apart from one discussion thread on the merits and drawbacks (from a farmer's perspective) of *Faidherbia albida* and the advocacy of agro-forestry promotion in the excerpt submitted from the UN Millennium Project Hunger Task Force, there was almost no mention within the e-forum of agro-forestry technologies.
5. Too often, extension reform or capacity building is conducted as a stand-alone project, rather than forming part of a coordinated agricultural development strategy.
6. From a farmer's perspective, the (cash and transaction) costs of a soil test should be less than the (discounted future?) benefits generated through more appropriate fertilizer application.
7. The authors of this report would also stress local level planning processes—coordination needs to happen at point of service delivery.