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Improving the effectiveness, efficiency and sustainability of fertilizer use in Sub-Saharan Africa

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Fertilizer has enormous potential to help Sub-Saharan Africa achieve food security. But its farmers use less fertilizer than anywhere in the world. So far it has proved too expensive for many smallholders, and in some cases its misuse has actually led to the deterioration of soil fertility. As this briefing explains, to reverse this trend and to encourage the optimum use of fertilizer, lessons must be learned from past experience.

A man squats on a field looking over failed crops in the Kobo region, Ethiopia. Sub-Saharan Africa has yet to realize the potential of fertilizer for improving yields.
FREDERIC COURBET | PANOS PICTURES

Key messages

- Fertilizer use in Sub-Saharan Africa is low because of poor inherent soil fertility, poor extension services, constraints to fertilizer availability and limited availability of complementary inputs.
- The profitability of fertilizer use in the region is lower than elsewhere in the developing world, reflecting low crop response to fertilizer, the region's poorly developed marketing systems, its difficult production environment (transport, distance to markets) and the unstable prices of outputs.
- Policy formulation in the region has not always been based on critical agronomic and economic analyses of the advantages and disadvantages as well as opportunities and challenges facing Sub-Saharan African farmers. Agricultural policymakers in the region must move away from the 'one-size-fits-all' philosophy and each country must implement policies that consider the diversity of its agricultural production system.
- Fertilizer use can be improved by increasing farmers' knowledge and skills, by developing fertilizer distribution systems through the private sector and nurturing current fertilizer subsidy programs in Sub-Saharan African countries to maturity.

This briefing paper is one of the 10-part Global Development Network (GDN) Agriculture Policy Series for its project, 'Supporting Policy Research to Inform Agricultural Policy in Sub-Saharan Africa and South Asia'. It is based on a longer synthesis paper, ***Improving the effectiveness, efficiency and sustainability of fertilizer use in Sub-Saharan Africa***, which draws on extensive published and unpublished research. The full paper can be downloaded at: **www.agripolicyoutreach.org**

It will be of value to policymakers, experts and civil society working to improve agriculture in Sub-Saharan Africa.

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Mazire Odadi stores sacks of fertilizer at her home in Dickson village, Malawi. Smallholder farmers like Mazire have benefited from subsidized fertilizer.
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Fertilizer is part of the technological trinity (improved seed, irrigation and fertilizer) which created the Green Revolution in Latin America and Asia. Its adequate and efficient use is one of the main ingredients in achieving food security in the region, yet the average fertilizer use intensity in Sub-Saharan Africa is by far the lowest in the world. Insufficient use of fertilizer has hindered growth in agricultural productivity and to some extent jeopardized the quality of soil and its continued fertility in a number of Sub-Saharan African countries.

Over the years, government fertilizer policies have followed a general trend: state interventions and subsidies in the 1960s and 1970s, the introduction of liberalized markets and the removal of subsidies in the 1980s and 1990s, and a return to a policy of moderate state intervention in recent years.

Response to fertilizer policies has varied widely, ranging from Kenya's largely successful market reform policies in the mid-1980s and early 1990s to Malawi's debatable 'successful' state intervention and subsidy policies (see case study on pp4–5).

Fertilizer subsidy has been seen as an effective way to kick-start innovation, stimulate rapid market development, both at farm level and industry level, and counteract soil fertility depletion. Yet in practice the outcomes of the fertilizer subsidies have generally not been satisfactory.

With rising food security concerns, fertilizer subsidies have re-emerged in recent years, with innovative approaches introduced to address pitfalls from the past. Yet current subsidy programs still face problems.

The paper suggests that the contribution of fertilizer programs to reducing poverty and hunger would be higher if they could be designed and implemented so as to target poor households, and areas where fertilizer will give positive net economic benefits, and to promote rather than undercut the development of a commercial fertilizer distribution system.

Methods

This briefing analyzes the agronomic response (effectiveness), profitability (efficiency) and sustainability of fertilizer use and presents fertilizer-related agricultural policy experiences of Sub-Saharan African countries, as well as lessons learnt.

It is based on a literature review and analysis of leading journals, reports of institutions such as the World Bank, the International Food Policy Research Institute (IFPRI) and the Food and Agriculture Organization (FAO), agricultural/fertilizer policy documents, published and unpublished research materials from local sources such as ministries, research institutions, universities and non-governmental organizations (NGOs), and through discussions with farmers, researchers, policymakers and politicians in several African countries.

Boosting Africa's agricultural productivity

In order to examine the **effectiveness** of fertilizer use, it is necessary to question whether fertilizer is achieving its full agronomic purpose. In examining **efficiency** the review looked at whether the returns on fertilizer use are significantly greater than the cost of fertilizer itself. This analysis discusses crop response rates, the price ratios of fertilizers to crop outputs, the production risk (availability of transport, distribution) and the availability of credit to the small farmer. **Sustainability** measures the extent to which fertilizer use will ensure that agricultural production and productivity can improve and at the same time sustain soil quality for future generations.

'We are not adopting the improved maize varieties because without adequate fertilizer you will get nothing and we have very limited access to fertilizer.'

Farmer in Zanlerigu

Upper East Region, Ghana
interviewed by research team

Fertilizer use in other regions	
Asia	222 kg/ha
Oceania	160 kg/ha
South America	138 kg/ha

Source: Hernandez and Torreo (2011)

Increase in crop yields: 1962–2008	
South Asia	1 to 2.6 t/ha
East Asia	1.5 to 5.4 t/ha
Sub-Saharan Africa	0.8 to 1.5 t/ha (due to low and inefficient use of fertilizer)

Source: Hunt (2011)

The three criteria for a fertilizer evaluation

Effectiveness: is the fertilizer achieving its full agronomic purpose?

Efficiency: are the crop improvement returns significantly greater than the cost of fertilizer?

Sustainability: will the fertilizer ensure improvement of the soil and its sustainability?

Africa's fertilizer use: the lowest in the world

Numerous studies show that substantial gains in agricultural productivity in Sub-Saharan Africa can be achieved by increasing the use of fertilizer and improving its efficiency. Experiences outside Africa also highlight the key role of fertilizer in boosting agricultural productivity. Despite this growing evidence, farmers in Sub-Saharan Africa still have the lowest average fertilizer use at around 10 kg/ha.

The profitability of fertilizer use to farmers in Sub-Saharan Africa is also lower than elsewhere in the developing world, reflecting the low crop response to fertilizer, the region's poorly developed marketing systems and its difficult production environment (transport, storage). Studies using value–cost ratio (VCR), i.e. the ratio of the technical crop response to fertilizer use and the nutrient/output price, are clear indicators of Africa's low profitability of fertilizer use.

The contrast between the limited use of fertilizer in Sub-Saharan Africa and its use in other developing regions has stimulated a considerable number of policy initiatives. During the Africa Fertilizer Summit in 2006, African leaders made a unanimous commitment to take immediate action to solve Africa's fertilizer crisis.

Subsidies: a checkered history

Fertilizer subsidy has always been central to the fertilizer policy of countries in Sub-Saharan Africa. All countries in the region have implemented fertilizer subsidy schemes at some point, with the level of subsidy varying from quite modest (20 per cent or less) to as high as 90 per cent. In practice the outcomes of fertilizer subsidies have generally not been satisfactory. Empirical studies on their cost effectiveness suggest that their high costs exceeded their benefits.

However, recent food security concerns have sparked renewed interest in fertilizer subsidies. Innovative approaches – including input vouchers, demonstration packs, matching grants, credit guarantees and weather insurance – have been piloted to stimulate fertilizer use. Subsidies should now address not only demand and supply constraints but also function in a transparent and cost-effective manner. However, despite the innovations, existing fertilizer subsidy programs are not immune to problems that beset them in the past, such as the unsustainable burden on government budgets, crowding out the private sector and late delivery.

Kenya, Lake Naivasha. Grow trays with combinations of compost and fertilizer at Oserian Farm, the biggest of its type in Africa.
STEVE FORREST | PANOS PICTURES

Kenya: a successful transition

Kenya is one of the few countries that has successfully implemented fertilizer market reform policy and substantially increased its total fertilizer consumption. From the mid-1980s the government encouraged private firms to enter the market while initially maintaining tight controls.

In 1993 the government completely withdrew from the fertilizer market and abandoned price controls, ushering in successful market reform. Several factors played a role in Kenya's success. First, prior to the market reform period, state-led fertilizer policies were successful in increasing fertilizer use among smallholders. A great number of farmers learned about high-yielding varieties of crops and inorganic fertilizers. Second, Kenya had a strong cash crop sector which maintained a high and stable demand for fertilizer. Fertilizer importers and distributors were, therefore, willing to make the initial investments in facilities to import and store large amounts of fertilizer, thus reducing its retail price. Third, farmers received fertilizer credits from cooperatives and processing firms to apply fertilizer on their cash crops. This combined to help Kenya make a smooth transition from the state-led fertilizer system to a market-oriented fertilizer system that ultimately led to higher fertilizer consumption.

For more information on this case study, see pp10–11 of the synthesis report, *Improving the effectiveness, efficiency and sustainability of fertilizer use in Sub-Saharan Africa*, available at: www.agripolicyoutreach.org

Women working on farmland in Mutumba, Burundi, belonging to the Twitezimbere Abakenyezi Association. Women in the association learn about the production of seeds, how to produce manure, and how to prevent soil erosion.
DIETER TELEMANS | PANOS PICTURES

> 'Fertilizer and drought are not friends. If we suspect that there will be drought (after planting) it is not wise to use fertilizers.'
>
> **Burkinabe farmer**
> Burkina Faso

Malawi's voucher program – can it be sustained?

Malawi eliminated universal fertilizer subsidies for smallholders in the mid-1990s, but reintroduced limited subsidies in 1998 through the Starter Pack program, which gave all farmers 10 to 15 kg of fertilizer and enough improved seeds to plant 0.1 of a hectare. In 2000 the program was converted into the Targeted Input Program (TIP), which distributed the packs to a targeted group of farmers. In 2005 the program was again redesigned as the Agricultural Inputs Subsidy Program (AISP), a voucher-based universal subsidy program that allowed farmers to buy 100 kg of fertilizer at about one fifth of the market price, thus dramatically increasing both the quantity of fertilizer being subsidized and the fiscal cost of the subsidy. The program led to significant increases in maize production and productivity, and resulted in some economic growth and poverty reduction. The main driving force for the modest success story was the relatively good targeting of the program. However, the program resulted in a very heavy burden on Malawi's national budget. More than 60 per cent of the national budget was devoted to agriculture, mainly because of the subsidy. That alone is enough reason to question the sustainability and long-term impact of the program on smallholder welfare and the nation.

For more information on this case study, see pp12–13 of the synthesis report, *Improving the effectiveness, efficiency and sustainability of fertilizer use in Sub-Saharan Africa*, available at: www.agripolicyoutreach.org

Boosting domestic productivity of fertilizer

Sub-Saharan Africa also produces the lowest levels of fertilizer in the world. Due to limited availability of raw materials and inadequate infrastructure, production of nutrients in the region has been concentrated in just four countries: Zimbabwe, Senegal, Nigeria and Mauritius. The amount of nutrients consumed in the region is approximately 10 times the amount produced and therefore many Sub-Saharan African countries rely heavily on imports. To improve fertilizer use Sub-Saharan African countries must also expand their domestic production capacity.

Taking soil quality into account

Another factor in the failure to achieve the full potential of fertilizers is poor soil fertility. This is often a result of mismanagement of fertilizer at the farm level and the failure of extension services to inform farmers about appropriate technology, as well as poor availability of fertilizer and a lack of complementary inputs such as improved seeds and irrigation.

African soils also pose particular challenges for agriculture in terms of their fertility, acidity and drainage. Land use practices and harsh climatic conditions over the years have further degraded the soil through nutrient mining by crops, leaching and inadequate erosion control.

Countries grouped by average levels of losses of nitrogen, phosphorus and potassium (kg/ha per year), 2002–04 cropping seasons

Moderate/low Less than 30 kg/ha	kg/ha
Egypt	9
Mauritius	15
South Africa	23
Zambia	25
Morocco	27
Algeria	28
Medium **30 kg/ha–60 kg/ha**	**kg/ha**
Libya	33
Swaziland	37
Senegal	41
Tunisia	42
Burkina Faso	43
Benin	44
Cameroon	44
Sierra Leone	46
Botswana	47
Sudan	47
Togo	47
Côte D'Ivoire	48
Ethiopia	49
Mali	49
Djibuti	50
Mozambique	51
Zimbabwe	53
Niger	56
Chad	57
Nigeria	57
Eritrea	58
Ghana	58
High **Greater than 60 kg/ha**	**kg/ha**
Tanzania	61
Mauritania	63
Congo Republic	64
Guinea	64
Lesotho	65
Madagascar	65
Liberia	66
Uganda	66
Democratic Republic of Congo	68
Kenya	68
Central Africa Republic	69
Gabon	69
Angola	70
Gambia	71
Malawi	72
Guinea Bissau	73
Namibia	73
Burundi	77
Rwanda	77
Equitorial Guinea	83
Somalia	88

Source:
Henao and Baanante, 2006

Value-cost ratio with 35 kg N/ha application in some East African countries

Country	Market access High	Medium	Low	Average
Burundi	2.5	2.0	2.0	2.25
Kenya	2.75	2.25	1.5	2.25
Rwanda	2.0	1.5	1.5	1.75
Tanzania	3.25	2.75	1.25	2.5
Uganda	3.0	2.0	1.75	2.0
Total	2.75	2.25	1.5	2.25

Source:
Guo, Koo and Wood, 2009

The continuing diminishment of plant nutrients through leaching, erosion and nutrient mining can lead to irreversible soil degradation and soil infertility unless concerted and committed efforts are made by actors from a variety of sectors. Both private and public sectors, scientific and policy organizations, and industrialized and developing countries can help to intensify future agricultural production through the trilogy of seeds, fertilizer and irrigation. This will help to conserve the natural resource base and prevent the further degradation that has characterized African soil for generations.

52-year-old Jane Chisi stands in her maize field in the community of Ekwaiweni, Northern Malawi. Farmers' profits can be improved by selecting the most appropriate fertilizer.
FREDERIC COURBET | PANOS PICTURES

Increasing profitability

The profitability of fertilizer, as measured by its value-cost ratio (VCR), i.e. the ratio of the technical crop response to fertilizer use and the nutrient/output price, depends on the crop price, fertilizer price and the response of the crop to fertilizer application. Profitability can be increased by:

- Selecting the most appropriate type of fertilizer (percentages and types of nutrients).
- Using the most efficient application method (type, number and timing of applications).
- Improved water control (e.g. smallholder irrigation).
- Better management of the fertilized crop (timely weeding, adequate pest control, timely harvest and proper post-harvest techniques).

Fertilizer prices in Sub-Saharan Africa are generally high because of the low volumes of production, poor infrastructure for its storage and transport, low population densities, and inadequate and costly financial services to allow small farmers to borrow for fertilizer on a future crop.

Even if fertilizer achieves VCRs above the minimum required (3–4), there is still no guarantee that a farmer will use it. Highly volatile output prices from one season to another and production risk make it very difficult for farmers to assess the eventual benefit of fertilizer use.

Studies using VCR are clear indicators of the low profitability of fertilizer use throughout the region.

Recommendations

The following recommendations indicate several areas where more focused policies are required to increase the effectiveness, efficiency and sustainability of fertilizer use.

- **Adapting to Africa's diversity**

  The current 'same fertilizer for all soils' practice is a major contributor to both low fertilizer use by farmers and ineffectiveness in the region. The nutrient-supplying capacity of soils must be taken into consideration and appropriate mechanisms should be developed to assess the location and crop-specific fertilizer requirements based on soil types and agro-ecological zones. This information, along with crop-specific recommendations, should be disseminated to farmers through extension services.

- **Information is crucial**

  Extension services must be strengthened to improve their responsiveness to the needs of farmers.

  - Existing extension service system must be well equipped and adequately staffed to cover the large number of small famers.
  - Extension agents should receive regular training so that they can transfer appropriate location and crop-specific knowledge to farmers.
  - Extension agents, both public and private, should use participatory methods involving feedback from farmers. Relationships should be established to exchange information and disseminate technologies which address current and longer-term farmer needs.

- **Fertilizer cannot do the job alone**

  Fertilizer use requires complementary inputs such as investment in soil and water conservation for efficient and optimal nutrient uptake. The public and private sector should consider a partnership to improve complementary inputs, such as irrigation, soil conservation and erosion control.

- **Stepping up production of fertilizer**

  Fertilizer-producing countries in Sub-Saharan Africa should build production plants at locations close to major consumption areas or input supply centers based on sound feasibility studies. Such expansion should also be supported by better storage, handling and transport facilities.

- **Distributing fertilizer efficiently**

  Fertilizer distribution through the private sector should be developed to ensure an efficient supply chain. Government investment in transportation and market infrastructure will reduce input costs and secure improved producer prices. Development of market information systems, institutions for contract enforcement, and telecommunications will attract new investments by commodity marketing firms.

- **Better targeted subsidy programs**

  The contribution of fertilizer subsidy programs would be higher if they:

  - Target households with little ability to afford fertilizer.
  - Target areas where applying fertilizer can actually give positive net economic benefits.
  - Promote rather than undercut the development of a commercial fertilizer distribution system.
  - Function in a transparent and cost-effective manner, and follow an exit strategy
  - Declare well in advance the allocation of fertilizer subsidies.
  - Are run in conjunction with other long-term agriculture development strategies, such as investment in agricultural extension and research service and infrastructure.
  - Are nurtured to maturity, thus becoming unnecessary in the shortest possible time.

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The full paper ***Improving the effectiveness, efficiency and sustainability of fertilizer use in Sub-Saharan Africa*** is available for download at **www.agripolicyoutreach.org**

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Further information

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